

Climate change adaptation indicators for biodiversity



ETC/ACM Technical Paper 2011/14
December 2011

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The European Topic Centre on Air Pollution and Climate Change Mitigation (ETC/ACM)
is a consortium of European institutes under contract of the European Environment Agency
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Climate change adaptation indicators for biodiversity

European Topic Centre on Air Pollution and Climate Change Mitigation – Technical Paper 2011/14



Report for European Environment Agency

AEA/R/ED56728
Issue Number 1
Date 25/01/2012



Customer:

European Environment Agency

Customer reference:

ETC 2011 Task 2.1.2

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AEA reference:

Ref: ED56728- Issue Number 1

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Executive summary

This project builds on the preceding phases of work on climate change adaptation indicators undertaken by AEA and the Netherlands Environmental Assessment Agency (PBL) for the European Environment Agency (EEA). It uses the 'high-level' adaptation indicator categories proposed for biodiversity (Harley & van Minnen, 2010) as a starting point to prepare the ground for embedding, within related policy areas, an agreed set of indicators for monitoring and evaluating the implementation and effectiveness of adaptation policies, measures and actions in reducing the vulnerability of biodiversity to climate change.

The high-level biodiversity adaptation indicator (BAI) categories were used as the basis for securing input from stakeholders within the biodiversity, agriculture, forestry and water policy areas in the European Commission (EC) and Member States (MSs). The project's objectives were to identify:

- How to build common understanding, ownership and commitment to the development of BAIs that can be used by stakeholders to monitor their performance and the effectiveness of their processes and outcomes
- The support required by stakeholders to implement the use of BAIs across Europe
- Those high-level categories of indicators perceived as relevant by stakeholders at EC, MS, regional and local levels
- Potential data issues relating to the high-level categories of indicators selected by stakeholders.

Over 100 relevant stakeholders were identified and provisionally classified according to four key policy areas (biodiversity, agriculture, forestry and water), European Union (EU) regional representation, and the level at which their organisations were believed to be involved in policy development. The stakeholders represented all four policy areas and were spread across Europe, with a degree of emphasis on those countries most actively engaged in biodiversity adaptation (UK, Netherlands and Germany). Their organisations were thought to be predominantly involved in national policy.

Two phases of engagement were used to capture the information needed to address the project's objectives. A self-guided questionnaire was sent by email to all stakeholders. All respondents were then invited to participate in one-to-one telephone interviews to gather further information and clarify their responses.

Responses to the questionnaire highlight a potential lack of understanding about the impacts and dependencies of policy areas on biodiversity. Certain questions proved too onerous, including those that sought to identify which existing climate change adaptation indicators within each policy area have greatest relevance to the high-level BAI categories, which of these categories are most relevant to each policy area, and what relevant data is available. Four respondents, from Belgium, the Netherlands, Norway and the UK, gave specific examples of existing suites of climate change adaptation indicators for their policy area (biodiversity or forestry) at a national or regional level. Other respondents stated that indicators have been developed in tandem with their organisation's adaptation strategies, with one set mentioned as still being in development. MSs that do not have an existing suite of national adaptation indicators were reported to be either implementing adaptation at a more local level or to have mechanisms in place to monitor adaptation strategies more generally.

The adaptation principle 'Maintain and increase ecosystem resilience' was associated with the highest numbers of examples of relevant existing indicators and data. The greatest discrepancy between the numbers of examples of actual indicators and relevant data identified was for the principle 'Develop knowledge/evidence base and plan strategically'.

Interestingly, respondents were able to suggest potentially relevant data for use with indicators that have yet to be developed.

All factors identified in the questionnaire that might motivate people to adopt adaptation indicators in relation to biodiversity and climate change were regarded as being of similar importance. These were opportunities to: understand/quantify links between biodiversity and ecosystem services relevant to policy areas; establish requirements for monitoring performance of EU/MS /regional/local government; inform development of policy and practice; and review effectiveness of EU/MS /regional/local government policies and outcomes in building resilience.

Respondents placed a particular emphasis on the need to involve national organisations in the development of BAIs within their policy areas in order to build common understanding, ownership and commitment. A majority also identified the need to involve regional organisations, but less than half suggested that local, trans-national or EU organisations should be engaged. Respondents' views may reflect a genuine need or may be prejudiced by the fact that their organisations are predominantly involved in national policy development and delivery. Data and funding were the main types of support that respondents identified as being needed to develop and implement BAIs in their policy areas.

A range of common points, contradictory points and exceptional points arose from the interviews.

A total of 16 questionnaire responses were received (a 15% response rate). Whilst this is reasonable, the sample of stakeholders is too small to draw robust conclusions.

Respondents cannot be regarded as representative of stakeholders within their policy areas, within their MSs, or within the levels at which they engage with policy development and delivery. Stakeholders who responded were predominantly from the biodiversity policy area and no-one from the agricultural policy area contributed. The six respondents who chose to take part in one-to-one telephone interviews were also those who are already actively engaged in biodiversity adaptation. This is unfortunate as, although the views of stakeholders within the biodiversity policy area may be informative, it is the attitudes of stakeholders within other policy areas that have an impact on biodiversity and ecosystem services, or that are dependent on them, which will be defining of the way ahead.

The Bern Convention adaptation principles (Harley & Hodgson, 2008) recognise that, in addition to direct impacts, climate change will bring indirect impacts to biodiversity through changes in socio-economic drivers, working practices, cultural values, policies and use of land and other resources. Due to the scale, scope and speed of indirect impacts, many could be more damaging than direct impacts. Consequently, there is a need for an integrated approach to BAI development. A range of views expressed by interviewees, therefore, point to the need to link with and build upon current indicator initiatives at an EU level that may provide opportunities to embed BAIs across policy areas. This thinking was reinforced by representatives of EEA, EC (DG ENV) and European Topic Centres for Biodiversity and Climate Changes Adaptation when they met to discuss the project's initial findings. It is also reflected by the FP7 RESPONSES project (Meller *et al.*, 2011), which aims to assemble a set of indicators to evaluate both direct and indirect impacts of climate change through policy changes in sectors responding to mitigation and adaptation needs.

This report provides brief summaries of relevant on-going policy initiatives at an EU level that may have a direct bearing on the development and synthesis of BAIs. The summaries highlight the degree to which consideration of biodiversity adaptation is, or should be, integrated into other policy processes. As many of these initiatives are developing in parallel, opportunities to influence them may not be straightforward. In order to make headway, there is an urgent need to undertake an in-depth review of the complete spectrum of EU indicators in relation to the high-level BAI categories (and *vice versa*) to identify those that are relevant by policy area and associated data issues, and where existing indicators need to be modified or new indicators developed.

The review would clarify for stakeholders across all policy areas, including those who work on the development and implementation of biodiversity policy, that BAIs do not only focus inwards on biodiversity, but also outwards to embrace the impacts and dependencies of all policy areas on biodiversity. It would highlight potential synergies and opportunities to avoid duplication of data collection and analyses. In doing so, it might then enable fruitful engagement with relevant policy initiatives. Such an approach might also be furthered through case studies in relation to MSs' national indicators. A twin-pronged approach to identifying BAIs at EU and MS levels would help highlight potential issues relating to the need for adaptation to link seamlessly across policy areas and between levels (EU, MS, regional and local).

Potential ways to fund such a project should be given due consideration by EEA, DG CLIMA, DG ENV, and DG RTD, as well as EEA member countries. It is noted that the EC has proposed that 20% of the EU budget should address climate change in the next multi-annual financial framework of the EU (2014–2020). Identification of BAIs across all policy areas that impact or are dependent on biodiversity should be a priority for future funding, given the recognition of the importance of such links in various key EU policy documents. These include the White Paper on adapting to climate change (EC, 2009), which states that it is important for the EU and MSs *“To promote strategies which increase the resilience to climate change of health, property and the productive functions of land, inter alia, by improving the management of water resources and ecosystems”*. Furthermore, the EU biodiversity strategy to 2020 (EC, 2011) states that *“Ecosystem-based approaches to climate change mitigation and adaptation can offer cost-effective alternatives to technological solutions, while delivering multiple benefits beyond biodiversity conservation”*.

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1 Background

1.1 Introduction

The European Commission's (EC) White Paper on adapting to climate change (EC, 2009) presents a framework for adaptation policies and measures to reduce the vulnerability of the European Union (EU) to climate change. It recognises the significance of climate change for biodiversity loss and the increasing pressures on habitats and ecosystems. The White Paper highlights that it is important for the EU and Member States (MSs) *"To promote strategies which increase the resilience to climate change of health, property and the productive functions of land, inter alia, by improving the management of water resources and ecosystems"*. The new EU biodiversity strategy to 2020 (EC, 2011) goes on to state that *"Ecosystem-based approaches to climate change mitigation and adaptation can offer cost-effective alternatives to technological solutions, while delivering multiple benefits beyond biodiversity conservation"*.

The adaptation White Paper (EC, 2009) makes a policy commitment to publish an EU strategy on adaptation to climate change by 2013. Adaptation indicators will be needed at an EU level to monitor the implementation and effectiveness of the strategy, but are only currently being furthered at a national level in some MSs. Adaptation indicators will also help to:

- Mainstream adaptation within and between policy areas
- Communicate adaptation to policy and decision-makers and other stakeholders
- Justify, target and monitor funding for adaptation
- Compare adaptation achievements across policy areas, regions and countries
- Inform international climate change negotiations.

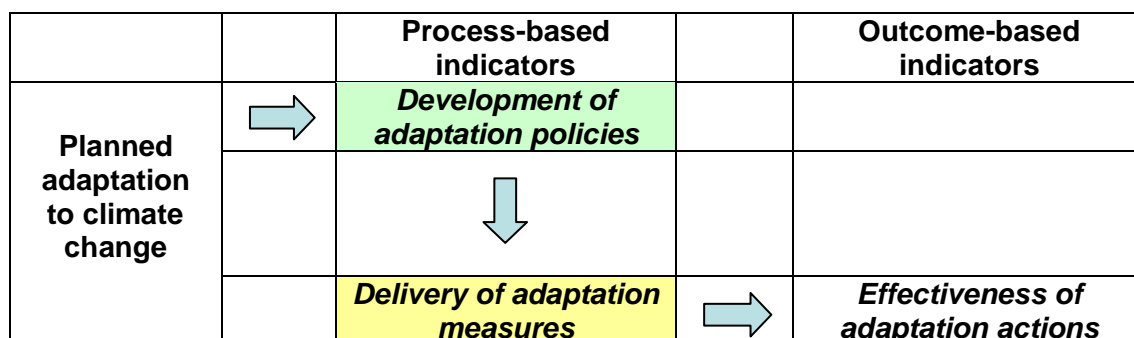
AEA and the Netherlands Environmental Assessment Agency (PBL) have been undertaking work on climate change adaptation indicators for the European Environment Agency (EEA) since 2008, including for biodiversity (Harley & van Minnen, 2010).

Building on preceding phases of this work, this project makes recommendations on a way forward for developing Biodiversity Adaptation Indicators (BAIs) across the EU and MSs. It does not, however, go as far as attempting to establish an agreed suite of specific indicators. This would require extensive stakeholder engagement, and a detailed review of existing biodiversity indicators and of data availability in relation to entirely new potential indicators.

1.2 Preceding EEA work on adaptation indicators

The fundamental concepts surrounding the identification and development of adaptation indicators were rehearsed at an *Expert meeting on climate change vulnerability and adaptation indicators*, convened by EEA in Szentendre, Hungary in September 2008 (Harley *et al.*, 2008). The meeting also established a conceptual framework for the development of adaptation indicators (Figure 1). This shows the relationship between adaptation indicators that are process-based (i.e. indicators for monitoring the development and implementation of adaptation policies and measures) and those that are outcome-based (i.e. indicators for measuring the effectiveness of adaptation actions, which are themselves determined by policies and measures).

Figure 1: Conceptual framework for adaptation indicators



A second *Adaptation indicators expert meeting*, held at EEA, Copenhagen in July 2009, considered the conceptual framework in more detail and developed it further for wider application (Harley & van Minnen, 2009). The meeting focused on two case studies, one of which showed how the Bern Convention's seven adaptation principles (Harley & Hodgson, 2008) might be used in the development of BAIs. These principles were derived from an extensive and systematic review of published international, EU and MS guidance on adaptation to climate change, with a focus on biodiversity and its conservation, and were agreed by the Bern Convention's 'Group of Experts on Biodiversity and Climate Change' in September 2008.

A third *Expert workshop on possible adaptation indicators for biodiversity* was held at EEA, Copenhagen in October 2010 (Harley & van Minnen, 2010). Building on the outputs of the 2009 meeting, the purpose of the workshop was to develop specific BAIs for use in related policy areas.

Experts attending the workshop agreed to the use of the Bern Convention's adaptation principles as the basis for a set of BAIs. These are:

- Take action now
- Maintain and increase ecosystem resilience
- Accommodate impacts of climate change
- Facilitate knowledge transfer and action between partners, sectors and countries
- Develop knowledge/evidence base and plan strategically
- Use adaptive conservation management
- Monitoring and indicators.

Each of the adaptation measures associated with the principles was assessed in terms of their suitability for the development of individual process-based and outcome-based indicators. Following the workshop, and in liaison with key experts, the level of relevance (high, medium, low) of each of the principles and measures to the biodiversity policy area and six associated policy areas was established. This enabled high-level categories of indicators to be identified and prioritised. These included process-based categories of indicators for adaptation policy and adaptation measures, and outcome-based categories of indicators for adaptation actions.

2 Aims and objectives

This project's aim was to prepare the ground for embedding an agreed set of adaptation indicators as a tool for monitoring and evaluating the implementation and effectiveness of adaptation policies, measures and actions for biodiversity within related policy areas.

The project used the high-level BAI categories proposed by Harley & van Minnen (2010), as a starting point for discussions with stakeholders from the EC and MSs in the biodiversity, agriculture, forestry and water policy areas. The project's objectives were to identify:

- How to build common understanding, ownership and commitment to the development of BAIs that can be used by stakeholders to monitor their performance and the effectiveness of their processes and outcomes
- The support required by stakeholders to implement the use of BAIs across Europe
- Those high-level categories of BAIs perceived as relevant by stakeholders at EC, MS, regional and local levels
- Potential data issues relating to the high-level categories of BAIs selected by stakeholders.

A self-guided questionnaire and in-depth telephone interviews were used to gather information from stakeholders relevant to the project's objectives.

3 Methodology for stakeholder engagement

3.1 Stakeholders

A list of 102 relevant stakeholders was compiled comprising:

1. National Reference Centres (NRCs) on climate change impacts, vulnerability and adaptation. These stakeholders are EEA's official contacts on climate change in MSs. They have previously taken part in five EIONET workshops on climate change impacts, vulnerability and adaptation in recent years (most recently in June /July 2011).
2. Members of the European Environmental Protection Agencies (EPA) and European Nature Conservation Agencies (ENCA) networks. These stakeholders represent a range of policy areas; many were already aware of AEA's and PBL's work on climate change adaptation indicators and had considered its relevance. It was hoped that their engagement would aid rapid exploration of pertinent issues within the short timescale of the project.
3. Policy officers within the EC and EEA staff. The EC White Paper on adapting to climate change (EC, 2009) and the EU biodiversity strategy to 2020 (EC, 2011) both require the use of indicators as a means of tracking adaptation to climate change in Europe. It was hoped that engaging with relevant EC policy officers and EEA staff would raise awareness of the project and secure EC-level input to its outcomes.
4. The Working Group Knowledge Base (WGKB) for the Adaptation Clearinghouse Europe. This group comprises stakeholders that are representative of adaptation across MSs. It was anticipated that engagement with relevant members would help ensure that key policy areas were comprehensively covered within the project.
5. Suggestions from EEA project managers and the project team's own contacts in relevant policy areas.

The stakeholders identified were provisionally classified according to the four policy areas (biodiversity, agriculture, forestry and water; Figure 2), EU regional representation (northern, southern, eastern and western, as per the UN Composition¹; Figure 3), and the level at which their organisations were believed to be involved in policy development (Figure 4).

¹ UN Composition of macro geographical (continental) regions, geographical sub-regions, and selected economic and other groupings
<http://millenniumindicators.un.org/unsd/methods/m49/m49regin.htm#europe>

Figure 2: Provisional assessment of policy areas represented by stakeholders selected

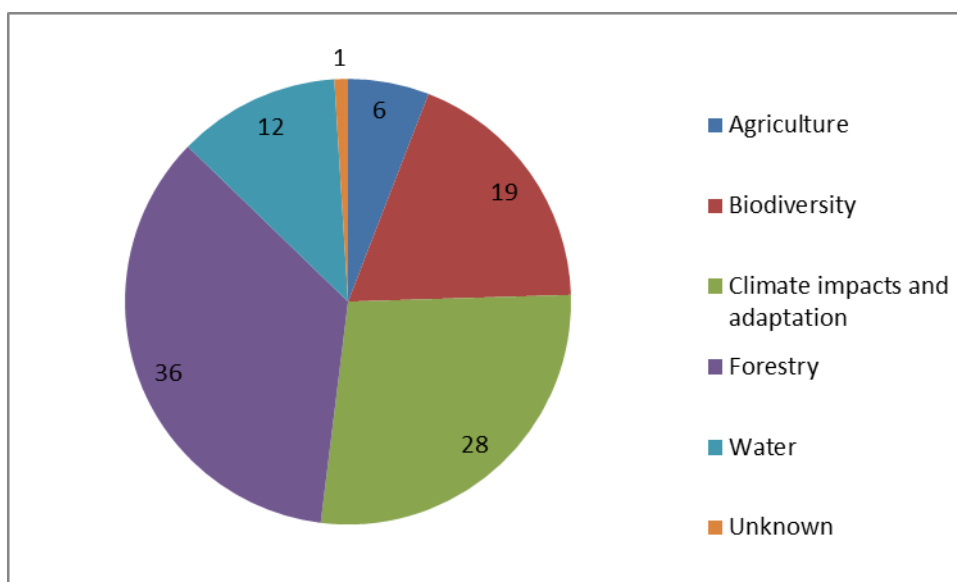


Figure 3: Countries represented by stakeholders selected

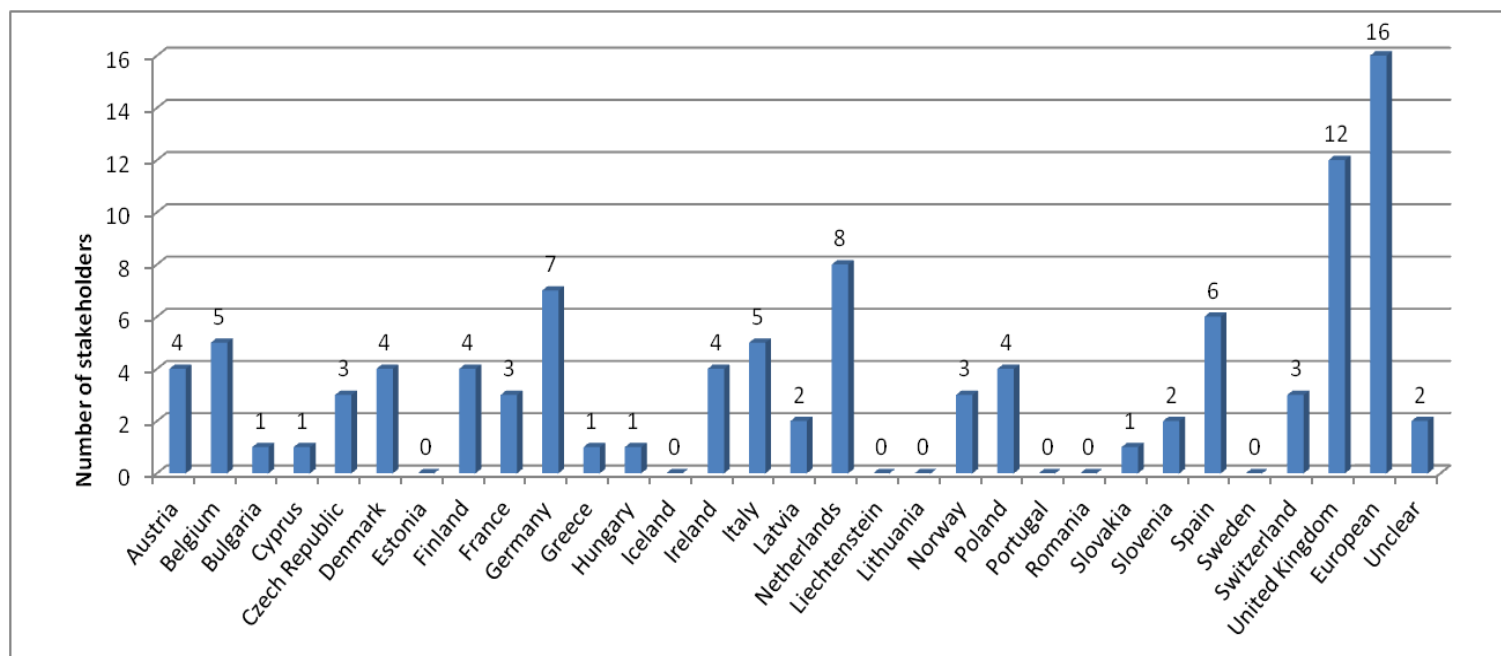
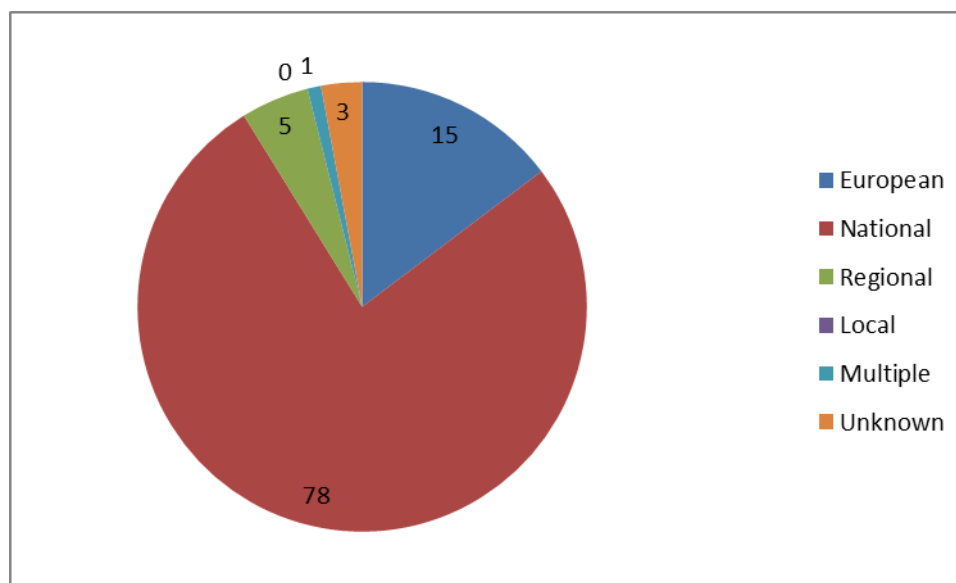


Figure 4: Provisional assessment of level at which the selected stakeholders' organisations are involved in policy development



3.2 Methods of engagement

Two phases of engagement were employed to capture information relevant to the project's objectives:

- Phase 1 involved the use of a self-guided questionnaire, which was sent to all stakeholders selected
- Phase 2 involved in-depth telephone interviews, which explored the stakeholder's responses to questionnaire in more detail. The interviews focused on gaining perspectives relating to themes, incentives and barriers in more depth.

Phase 1: self-guided questionnaire

The self-guided questionnaire (Appendix 1) was drafted by the project team and agreed with EEA. The questionnaire introduced the project to stakeholders and then asked a series of short, high-level questions designed to gather views from a wide range of stakeholders across all levels of governance in Europe. It included a set of introductory questions, followed by specific questions that addressed issues requiring more detailed exploration. The questionnaire was divided into the following sections:

- Section 1: General
- Section 2: Impacts and dependencies on biodiversity and ecosystem services
- Section 3: Biodiversity Adaptation Indicators
- Section 4: Ownership and commitment
- Section 5: You and your work

A mix of multiple-choice and free-text questions was used to ensure that both quantitative and qualitative information could be provided. The questionnaire was designed for participants to complete electronically or in paper format and without assistance (although this was offered to stakeholders).

Phase 2: stakeholder interviews

All respondents to the Phase 1 questionnaire were invited to participate in one-to-one telephone interviews, which were intended to provide an opportunity to gather further information and clarification on their responses.

In preparing for the stakeholder interviews, the study team agreed a set of common questions through which to explore issues with interviewees. The questions were based on initial, high-level analysis of the questionnaire responses. Scripts were drafted to ensure consistency in the interview methodology (Appendix 2).

The interviews explored issues common to all policy areas or specific to individual ones; for example, reasons for the specified levels of understanding amongst policy-makers, and links between biodiversity, ecosystem services and the interviewee's policy area. Other topics of discussion included: specific examples of impacts and dependencies; observed changes in environmental baselines; and ideas about the use of BAIs specific to policy areas. Participants were also asked about potential data, spatial resolution and support needs.

Detailed interview notes were compiled by the researcher before being sent to the interviewee for their comments and approval.

3.3 Meeting of the EPA's Interest Group on Adaptation

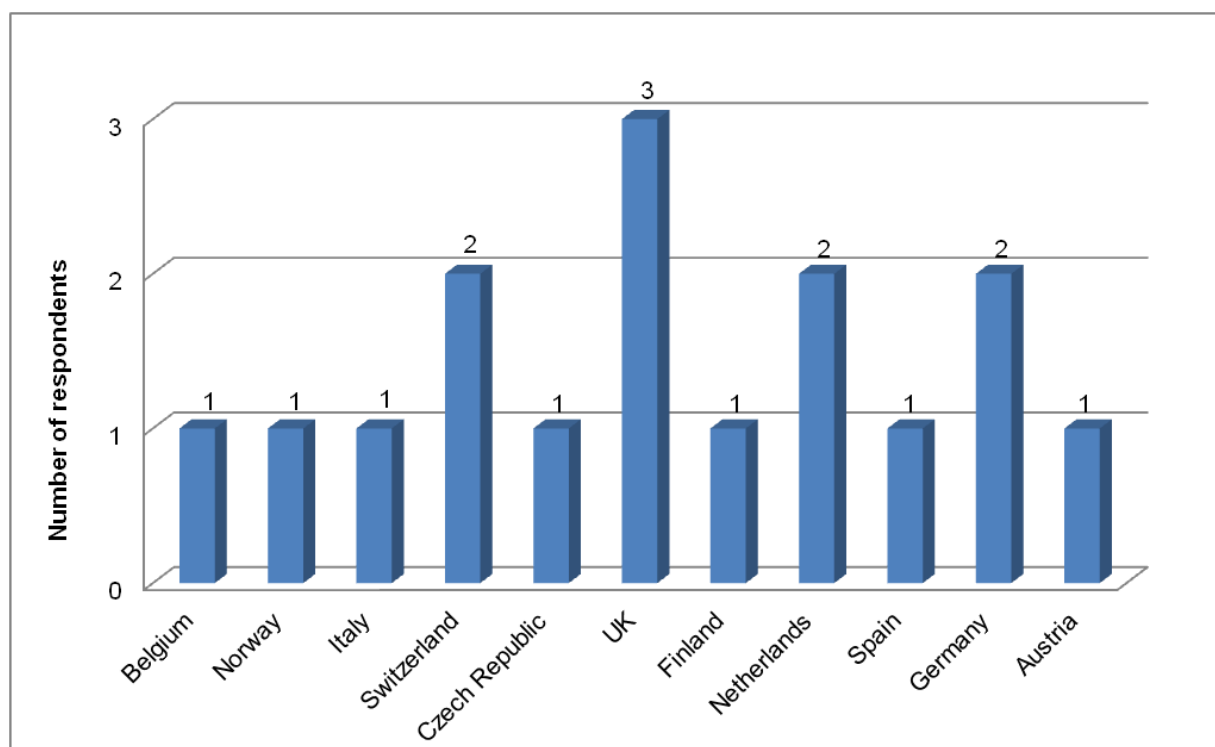
In addition to the Phase 1 and Phase 2 engagement, the study team was represented at the annual meeting of the EPA's Interest Group on Adaptation, held in Edinburgh in September 2011. An update on the project was presented. It raised a number of questions and helped to generate discussion amongst participants of the purposes and challenges of developing and implementing indicators at the EU level. The presentations were followed by a breakout session on development of BAIs. Participation in this meeting raised awareness of BAIs amongst the various stakeholder groups targeted during the engagement phase.

4 Results

4.1 Questionnaire results

This section presents the findings from the questionnaire responses. A total of 16 responses were received from stakeholders across a range of countries (Figure 5). Please refer to Appendix 3 for a list of respondents.

Figure 5: Geographical coverage of questionnaire responses



The respondents covered three main policy areas: biodiversity (56%), forestry (12%), and water (13%). Responses were also received from 'Other' policy areas (19%). Others included respondents with a background in climate change impacts and adaptation (Figure 6). Although 6% of invitees were stakeholders working in the agricultural policy area, none of them responded (Figure 2).

Respondents were asked to rank in order of importance the levels at which their organisations are involved in policy development and policy delivery, from an EU to a local scale. In order to gain an appropriate overview of responses, it was necessary to account for some respondents' organisations only working at one level and others being involved at all levels. Responses were summed across all levels by ranks of importance to give a measure of the degree of focus on each level (Figures 7 and 8). This means that the scores inevitably total more than the number of respondents. The analysis highlights that the majority of respondents' organisations are focused primarily on policy development and delivery at the

national level, but then on EU policy development, as compared to regional policy delivery (Figures 7 and 8).

Figure 6: Policy background of questionnaire respondents

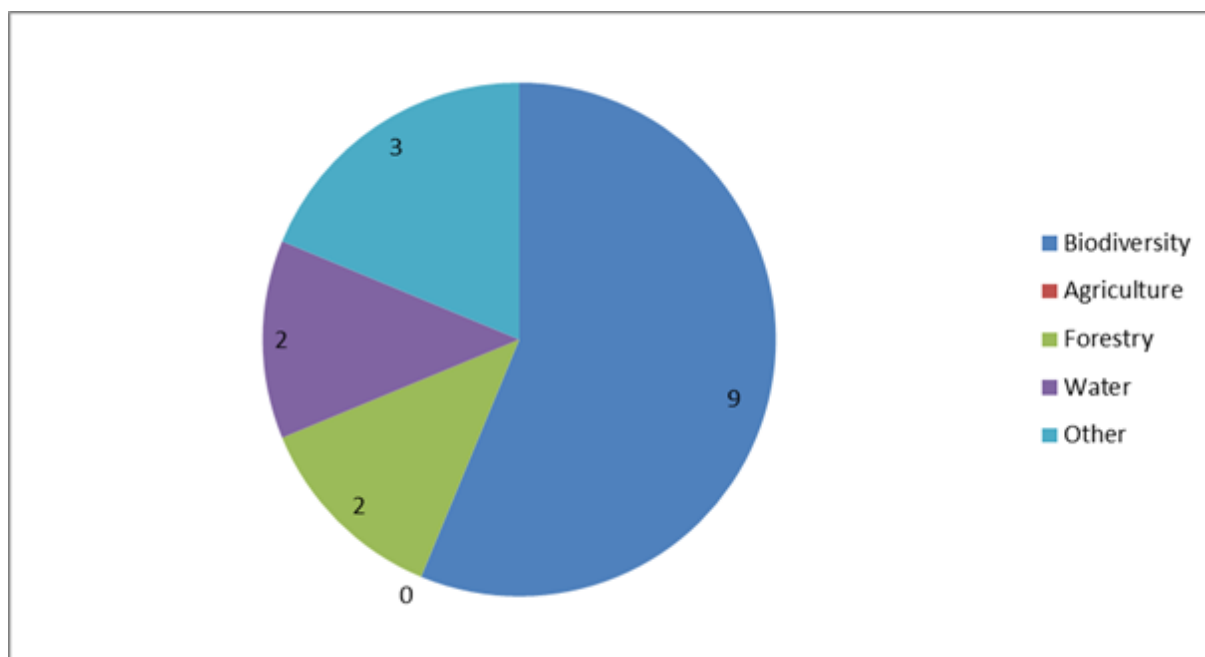


Figure 7: Levels at which respondents' organisations are involved in policy development

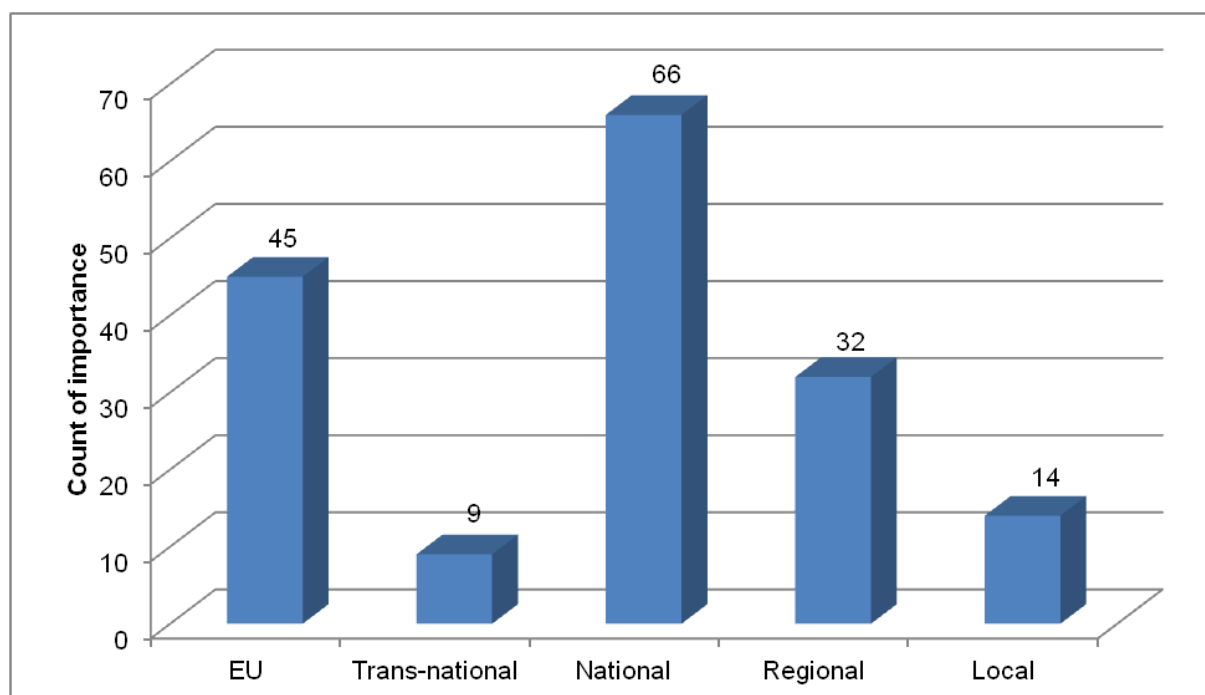
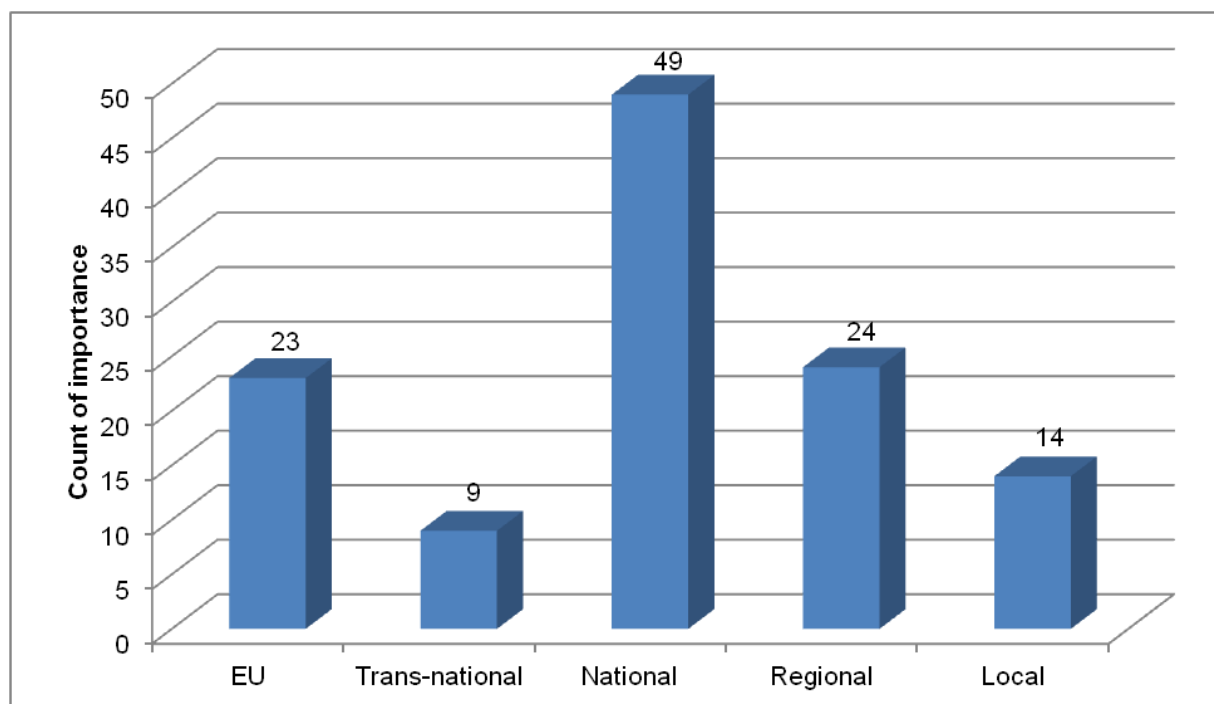


Figure 8: Levels at which respondents' organisations are involved in policy delivery

Only one respondent believed that the level of understanding amongst policy-makers of the links between biodiversity, ecosystems services and their policy area was excellent; most thought it was adequate (Figure 9).

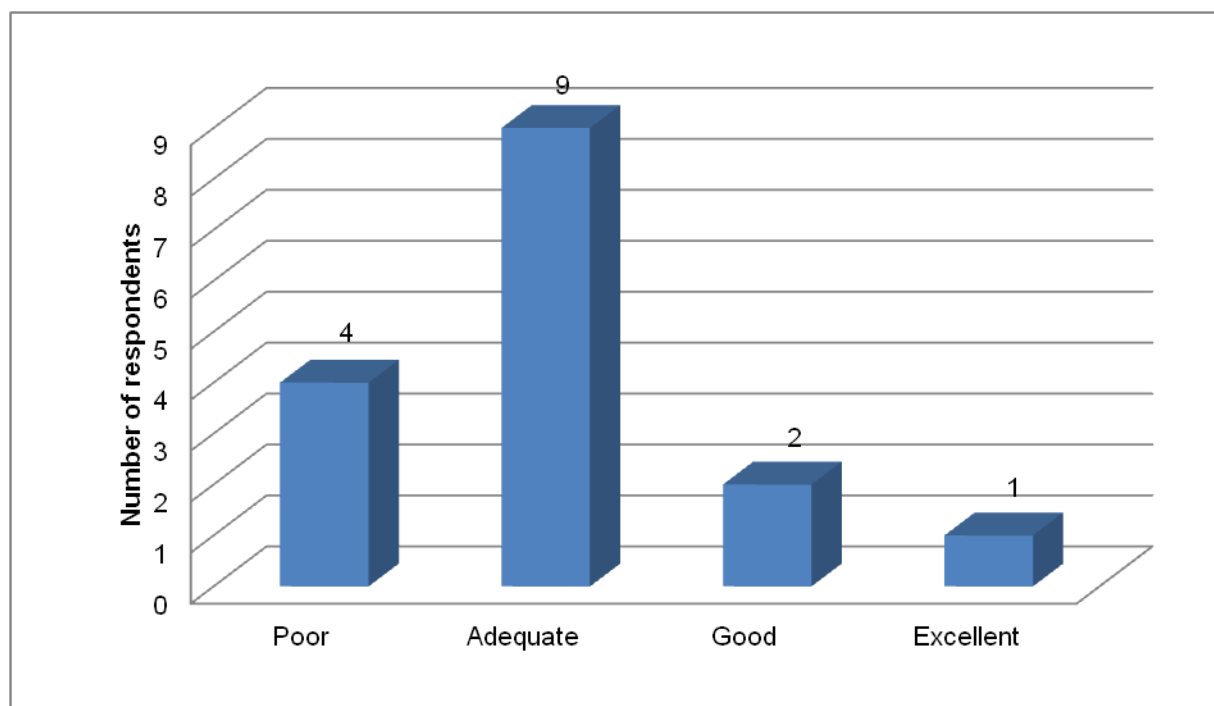
Figure 9: Level of understanding

Table 1 summarises the impacts and dependencies on biodiversity and ecosystem services identified by stakeholders in relation to their policy area. Although biodiversity policies would be expected to have a positive impact on biodiversity and ecosystem services, all respondents focused on the positive rather than negative impacts of their policy areas. Some respondents identified examples of ways in which policy areas other than biodiversity were dependent on biodiversity and ecosystem services, but most misinterpreted the question. Those from the biodiversity policy area did not confine identification of impacts and dependencies to their policy area and, as a result, a number of the examples listed under the biodiversity policy area appear to relate to other policy areas.

Table 1: Impacts and dependencies identified by stakeholders in relation to their policy area

Policy area: biodiversity Examples of impacts and dependencies identified by respondents (Question 5)	
Examples of impacts:	Examples of dependencies:
Positive impact on biodiversity and ecosystem services. For example, conservation and sustainable use of biodiversity, hindering introduced species, freshwater management etc.	Outdoor recreation, including hunting and fishing, represents an ecosystem service offered by biodiversity.
Some negative impacts from associated management (e.g. outdoor recreation and deer management) on biodiversity and/or ecosystem services may occur locally.	Sustainable use of natural resources, such as wildlife and fish species, depends on well-managed ecosystems maintaining biodiversity.
Regulating use and pollution of the water environment through implementation of the Water Framework Directive. The regulation is essential to ensure continued delivery of many water and wetland-derived ecosystem services.	As the policy area is biodiversity, the dependence is total.
Increasing the extent of forests means promoting conifer monoculture plantations.	Terrestrial planning and linear infrastructures are developed in other government departments.
Water courses are physically managed to avoid flooding, resulting in very artificial basins.	Biodiversity is not a priority for regional and local governments, as budget is always much lower than that of climate change or waste management.
National biodiversity strategy lists impacts.	Other policy areas (e.g. agriculture, territorial management) are at least as important for biodiversity and ecosystem services.
Nature conservation aims to improve the conservation status of species and habitats and protect ecosystem services too.	Establishment of protected areas, maintenance of extensively used areas (e.g. meadows).
Policy area: forestry Examples of impacts and dependencies identified by respondents (Question 5)	
Examples of impacts:	Examples of dependencies:
Implementation of sustainable forest management practices protects and enhances biodiversity.	Nature conservation vs commercial forestry interests.
Current woodland creation agenda provides new habitat and delivers ecosystem services, protecting the freshwater environment.	Landscape conservation vs ecosystem services provided by woodland expansion.
Landscape-scale contributes more generally to adaptation of biodiversity.	European protected species legislation and sustainable forest management.

Policy area: water	
Examples of impacts and dependencies identified by respondents (Question 5)	
Examples of impacts:	Examples of dependencies:
River flows critical for biodiversity - Environmental Flow Indicators are used as the primary metric under WFD.	Catchments provide ecosystems services in terms of moderating the hydrograph, helping to manage water resources, water quality, and flood risk.
Chemical water quality, sediments, hydromorphology, etc. also critical and primarily managed through WFD and daughter directives. Both point and diffuse sources of pollution are a challenge.	Currently over 100 catchment initiatives under way to enhance ecosystems services for water management.
Climate change will have impact on movements of species and ecosystems. Spatial planning and water management need to accommodate these moves (e.g. by providing ecological connections).	Road development and urban sprawl hampers free movement of species.
Policy area: other	
Examples of impacts and dependencies identified by respondents (Question 5)	
Examples of impacts:	Examples of dependencies:
The German EPA designs indicators for the German Strategy for Adaptation to Climate Change. This covers 15 action fields and cross-national fields (e.g. human health, buildings, water, soil, agriculture, forestry, fisheries, energy, finance, transport, trade and industry, tourism, spatial planning, population). The biodiversity action field is the responsibility of BfN (German Federal Nature Conservation Agency).	Measures to support adaptation of biodiversity to climate change are good for biodiversity in general, and vice-versa.
The national adaptation strategy includes adaptation goals for the biodiversity sector and for other sectors that impact biodiversity. The former are in line with efforts to halt biodiversity loss (e.g. to connect habitats). The latter may cause additional stress to biodiversity (e.g. use of artificial snow).	Climate policies, especially those focusing on increased use of renewable energy, depend on ecosystem services such as wood production and the hydrological cycle. Such policies may affect these services over time.
Potential reduction of biodiversity dependent on dead wood in forests, and changes in habitats in agriculture and forestry.	

The risks and opportunities arising from climate change that relate to these impacts and dependencies on biodiversity and ecosystem services, identified by stakeholders in relation to their policy area, are summarised in Table 2.

Table 2: Risks and opportunities identified by stakeholders in relation to their policy area

Policy area: biodiversity The risks and opportunities arising from climate change for your policy area that relate to these impacts and dependencies (Question 6)	
Examples of risks:	Examples of opportunities:
Changes in hydrology (dry summers, high peaks of rain fall in winter), changes in humidity, temperature, wind and changes in the related aspects of biodiversity.	Solving (human) problems of flooding (changes in water storage capacity, changes in land use) can create opportunities for marshland development and related biodiversity. More attention to policy for green infrastructure can have the same effect.
Loss of species and/or habitats (especially arctic and alpine species/habitats).	Movement of species to new areas/environments and following management challenges.
Movement of species to new areas, and enhanced vulnerability to fragmentation.	New species for hunting and fishing.
New species from more southern areas (e.g. parasites).	Management of new species coming from more southern areas.
Better conditions (increased survival) for introduced species.	Increased productivity.
Reduced reindeer winter food supply due to freezing-thawing of grazing areas.	
Modification of physiology, phenology, range and interactions of species, which can lead to biodiversity loss.	Likely to be few opportunities (e.g. broader vegetative period for forests, resulting in a higher yield).
	Providing background information for drafting and developing a national climate change adaptation strategy, implementing ecosystem-based approach and combining it with standard technological measures.
Isolated nature reserves do not allow for species migration.	Southern species appear in the Netherlands.
Species and ecosystems depending on more 'northern' climatic conditions decrease or disappear.	Reptiles do well.
Weather extremes may cause local extinctions of species; where nature reserves are isolated, recolonisation may be difficult/slow.	Stream restoration increases the amount of water that can be stored in the water bed during excess periods
Weather extremes cause problems for society as well, both in extreme rainfall and prolonged dry periods.	
Moving environmental baselines (e.g. river flow changes as a result of changing climate) will put at risk the protection of biodiversity where we use environmental standards based on those baselines.	The need to allow for biodiversity adaptation to changing climatic conditions has provided a strong driver for improving policy on integrated habitat networks, a key policy response for biodiversity climate change adaptation.
Only focus on managing and financing climate change and forgetting other type of measures related for example to biodiversity.	The commitment and involvement of policy-makers to develop innovative responses. Important involvement and participation in international networks
Climate change increases - in some cases - the existing risks for biodiversity and nature conservation.	Climate change underlines the importance of existing efforts in biodiversity and nature conservation.

Threat and extinction of species and change of habitats, number of alien species and range can increase.	
Policy area: forestry The risks and opportunities arising from climate change for your policy area that relate to these impacts and dependencies (Question 6)	
Examples of risks:	Examples of opportunities:
For the time being, have to measure CO ₂ (and other gases) concentration for the whole country. After that we should talk about risks.	
Pest and disease outbreaks; over-exploitation of forestry resource to meet renewable energy requirements; inappropriate woodland expansion to meet renewable energy and carbon targets; declining productivity and species suitability in some regions; inability to maintain some habitats and populations of priority species.	Rising timber prices enhancing economic resilience of the forestry sector; economic viability of woodland management bringing undermanaged woodlands into management and improving habitat quality; driver for woodland expansion (for both landscape adaptation and carbon sequestration); increasing timber production in some regions; ability to plant a wider range of species for commercial forestry.
Policy area: water The risks and opportunities arising from climate change for your policy area that relate to these impacts and dependencies (Question 6)	
Please provide examples of risks:	Please provide examples of opportunities:
Both direct and indirect risks exist. Direct risks include temperature and river flow related changes to aquatic biodiversity and resource availability and quality. Indirect risks include land use policy changes to respond to climate change (e.g. significant expansion in growing bioenergy crops, or tree planting to manage flood risk (with negative impacts on water resource availability).	Opportunities exist in terms of use of ecosystem services generally providing lower carbon (than traditional engineering) options to provide solutions to water management. In addition, most ecosystem services provide multiple benefits for water management. Solutions include tree planting which has benefits for carbon mitigation and biodiversity. Uplands management is another solution – there has been significant removal of peat for grazing pastures. Oxidation occurs and releases carbon into the water. The peatland has reduced absorption and there is greater run-off and less control of flow. Flooding risk is increased. Benefits for water management include reducing run-off of soil and nutrients; reducing rate of run off; steady flow in rivers. This helps manage water quality and flow, as well as quality of farmlands and habitats.
Climate change strengthens the need for timely adjustments in water management and spatial planning.	Room for the river, primarily as a security measure, creates opportunities to also give species room to move along these blue/green connections.
Policy area: other The risks and opportunities arising from climate change for your policy area that relate to these impacts and dependencies (Question 6)	
Please provide examples of risks:	Please provide examples of opportunities:
There are lots of impacts, dependencies, risks and opportunities for biodiversity and ecosystem services; see: http://www.uba.de/uba-info-medien/4031.html	Another goal of the national adaptation strategy is to seize the opportunities provided by climate change. Adaptation itself may lead to a more dynamic understanding of biodiversity. Some ecosystem services may also profit from climate change (e.g. carbon sequestration).

One of the goals of the national adaptation strategy is to reduce risks caused by climate change (e.g. due to the growing number of invasive species or the loss of habitats and subsequent extinction of species).	Creation of new favourable habitats for certain species if bioenergy production changes agricultural production in such a way that conditions for greater biodiversity improve (e.g. through a switch to multiannual crops, use of crops that require less fertilizer input etc.).
Loss of biodiversity through, in particular, loss of habitats or overexploitation of ecosystem services.	

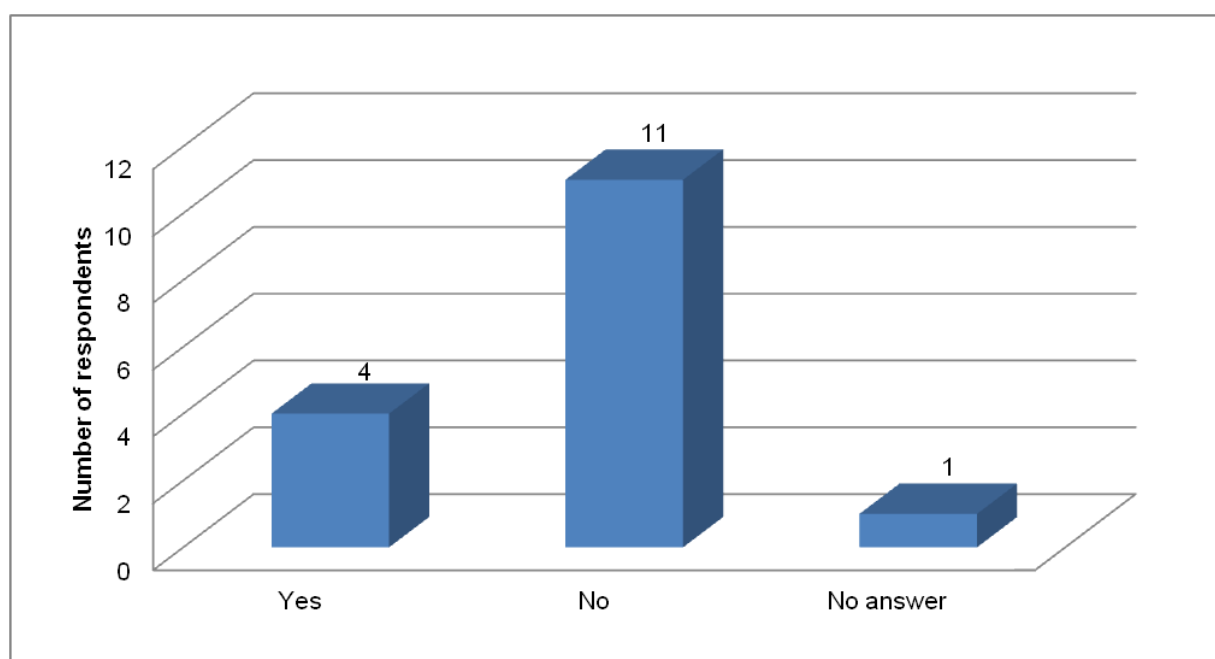
Four respondents gave specific examples of existing suites of climate change adaptation indicators for their policy area (Figure 10), although one of these focuses on impacts rather than on adaptation:

- A region of Flanders, Belgium has a set of indicators to assess the impact of climate change of biodiversity
- Indicators have been developed by the Norwegian Directorate of Nature Management with regard to their national adaptation strategy
- The Netherlands has developed indicators relating to national trend lines of species depending on more northern or southern climatic conditions compared with trend lines of species with central climatic demands
- A national set of indicators has been established in the UK as a measure of the adaptive capacity of woodland in relation to climate change.

Other respondents stated that indicators have been developed in tandem with their organisation's adaptation strategies, with one set mentioned as still being in development.

Those countries that do not have an existing suite of national adaptation indicators were reported to be either implementing adaptation at a more local level or to have mechanisms in place to monitor adaptation strategies more generally.

Figure 10: Existing climate change adaptation indicators



Questions 8-10 asked respondents to identify which existing indicators in their policy area have greatest relevance to the high-level BAI categories (Harley & van Minnen, 2010), which of these categories are most relevant to their policy area, and what relevant data is available. The responses have been grouped in relation to the Bern Convention adaptation principles (Harley & Hodgson, 2008), upon which the high-level BAI categories are based (Table 3). The principle 'Maintain and increase ecosystem resilience' was associated with the highest numbers of examples of relevant indicators and data. The greatest discrepancy between the numbers of examples of actual indicators and relevant data identified was for the principle 'Develop knowledge/evidence base and plan strategically'. Interestingly, respondents were able to suggest potentially relevant data for use in the development of new indicators.

Table 3: Numbers of examples of indicators and data sources identified relevant to the high-level BAI categories

Bern Convention adaptation principles	Examples of relevant indicators identified	Examples of relevant data identified
1. Take action now	7	11
2. Maintain and increase ecosystem resilience	12	12
3. Accommodate impacts of climate change	6	8
4. Facilitate knowledge transfer and action between partners, sectors and countries	5	9
5. Develop knowledge/evidence base and plan strategically	1	10
6. Use adaptive conservation management	0	4
7. Monitoring and indicators	3	4

Results for what would motivate people within policy areas to adopt adaptation indicators that relate to biodiversity and climate change show that all four reasons specified by the questionnaire were regarded as being of similar importance (Figure 11).

Respondents placed a particular emphasis on the need to involve national organisations in the development of BAIs within their policy area in order to build common understanding, ownership and commitment. A majority also identified the need to involve regional organisations, but less than half suggested that local, trans-national or EU organisations should be engaged (Figure 12).

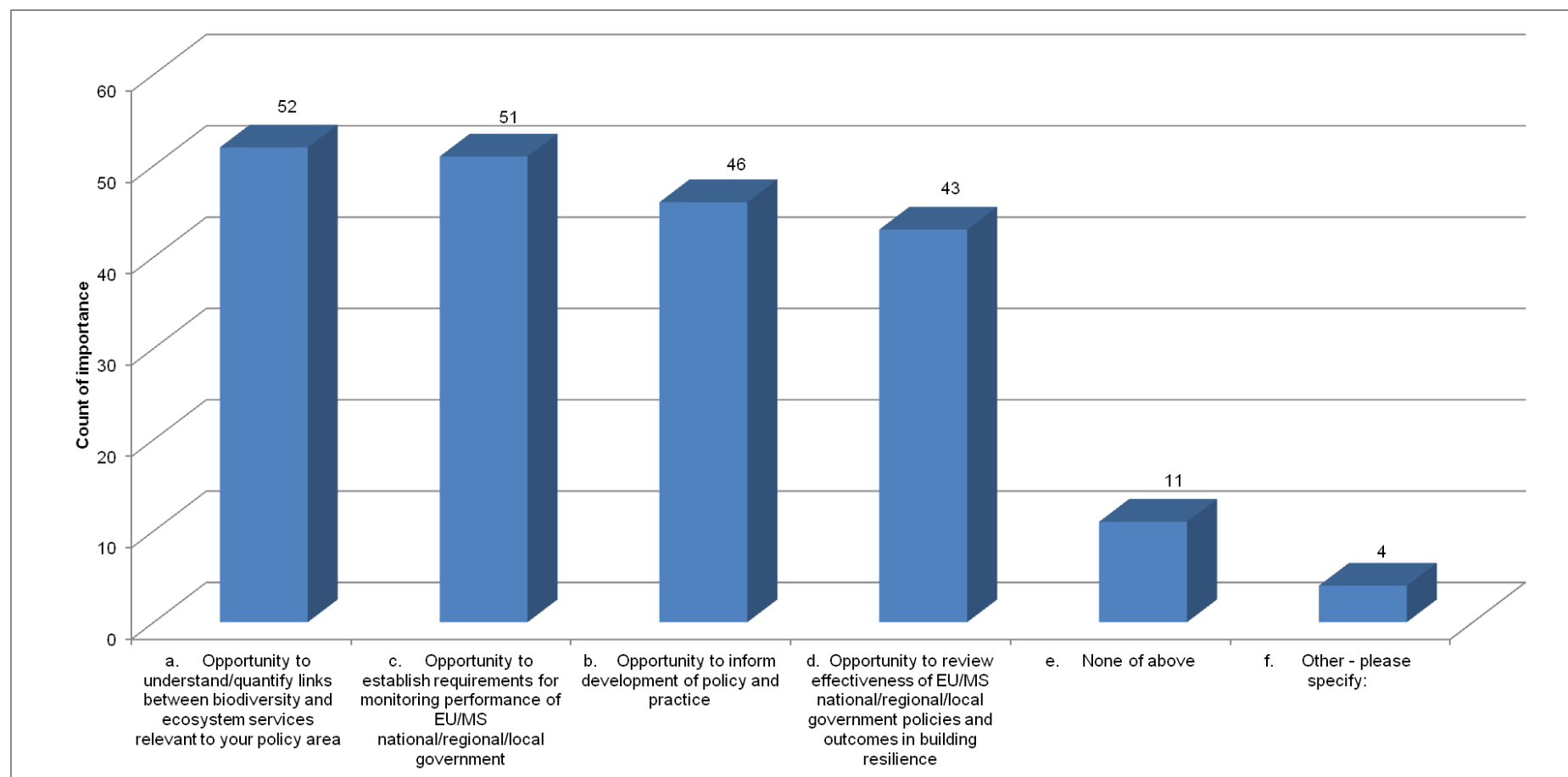
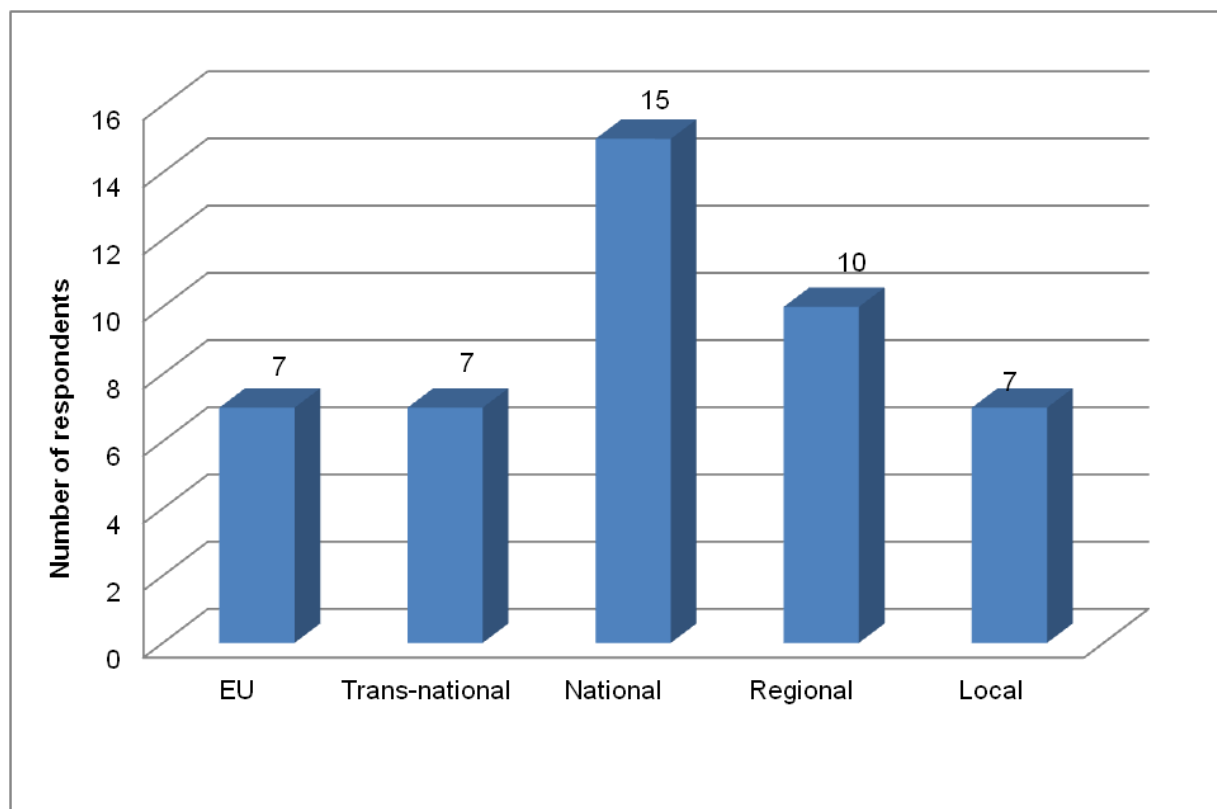
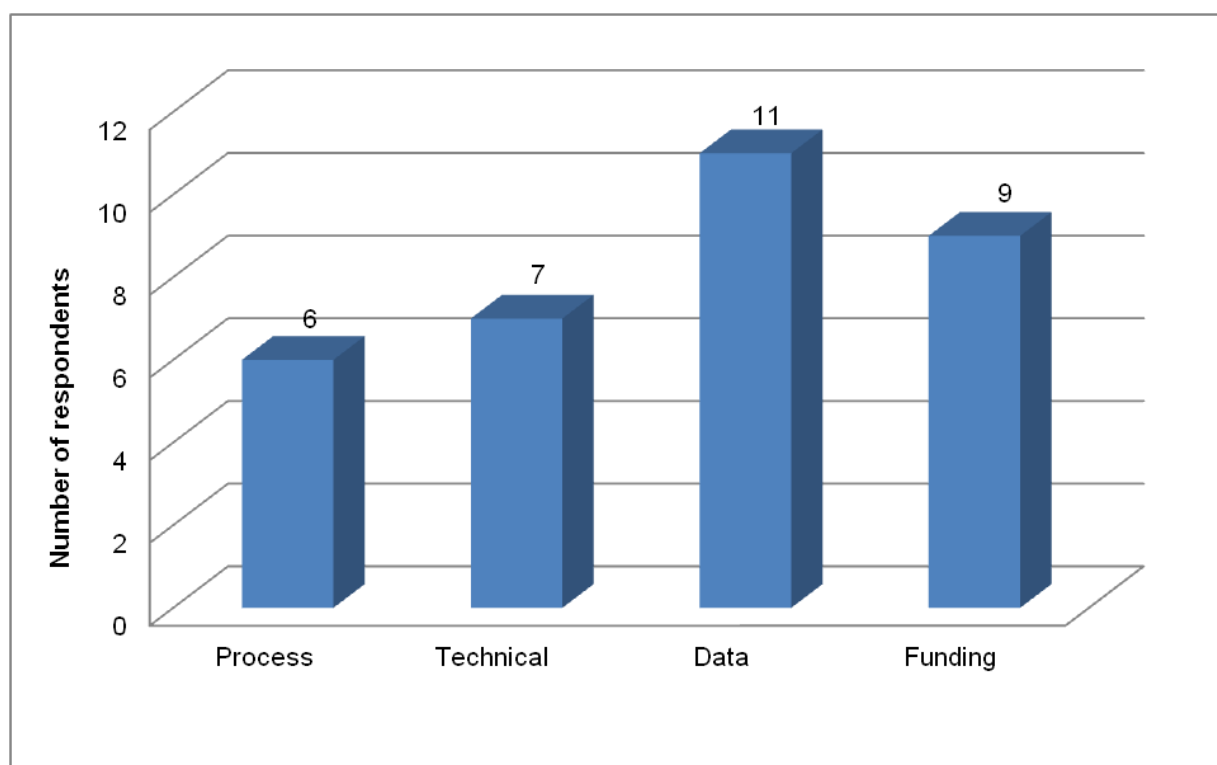
Figure 11: Motivations for adopting adaptation indicators

Figure 12: Levels of organisations that need to be involved in the development of BAIs to build common understanding, ownership and commitment



Data and funding were the main types of support that respondents identified as being needed to develop and implement BAIs in their policy areas (Figure 13).

Figure 13: Support needed in to develop and implement BAIs



4.2 Interview results

Stakeholder interviews in the second phase of the engagement exercise were designed to provide an opportunity to gather further information or clarification of the responses provided by a sub-set of participants. These interviews explored detailed issues that were common to all policy areas or specific to individual ones, as highlighted in individual questionnaires. Six interviews were carried out in total. The list of stakeholders who took part is given in Appendix 4 and a detailed summary of individual interviews is provided in Appendix 5.

4.2.1 Common points

Impacts and dependences on biodiversity and ecosystem services

- Four interviewees thought that policy-makers' understanding of links between biodiversity and ecosystem services was adequate in their country.
- It is believed that the connections between biodiversity, ecosystem services and water are well understood by people in the biodiversity policy area, are increasingly recognised by those in the water management policy area, but are less appreciated by other policy-makers.
- Two interviewees identified indicators as being useful tools to improving policy-makers' understanding of impacts and dependencies on biodiversity and ecosystem services.
- All interviewees were able to list recent changes observed in environmental baselines relevant to their policy areas and were able to cite reports or evidence.

Biodiversity Adaptation Indicators

- Three interviewees explained that they have no national BAIs, one revealed that they contribute data to international indicators for the Convention on Biological Diversity (CBD), another has more generic adaptation indicators linked to a national adaptation strategy, as a way of monitoring progress in adapting to climate change, and another is expecting to be developing BAIs for their policy area based on upcoming policy.
- Interviewees agreed that there is a need to minimise and streamline the number of indicators already being used. They thought that there was quite a lot of overlap in current lists, that it would be better to have fewer meaningful indicators, that BAI's should link into existing monitoring and reporting, and that they should be flexible to take account of adaptation taking place locally/regionally rather than nationally.

Motivations and stakeholders (ownership and commitment)

- Interviewees believed that indicators motivate behavioural change and policy development, and are a way of engaging with relevant sectors. It was suggested that the development of indicators by academic institutions and their established use motivated people to adopt them.
- However, as adaptation is often carried out at a local level, it was thought that motivating local stakeholders will be more of a challenge when the main interest in BAIs will be at an EU level.

Data issues and spatial resolution needed and support needs

- Interviewees identified that development of BAIs required a statutory driver and guidance from a national or EU level, that would attract funding for relevant monitoring or improvements to existing monitoring and reporting.
- Three interviewees agreed that information from BAIs should be presented and disseminated at an EU level to enable comparisons between countries. Reports should be in an accessible format to help countries raise the awareness of stakeholders and the general public at a more regional/local level. A storyline or case studies could provide a basis for communicating lessons learnt.

4.2.2 Contradictory points

Biodiversity adaptation indicators

- One interviewee suggested climate change is just one factor and that it cannot be considered in isolation, adding that the full list of BAI categories seems unworkable.

Data issues and spatial resolution needed and support needs

- One interviewee did not know what data would be suitable and exists at a national level. Another thought that, as data is collected for other purposes and not specifically for BAIs, data gathering needs to be improved to enable its use for a range of purposes. The remaining two interviewees were aware of an abundance of suitable data, but thought the main issues were its accessibility and copyright.
- All interviewees suggested that the frequency of reporting should be aligned to current requirements relevant to their policy areas (3-6 years). For example, CBD reporting occurs on a 4-year cycle, the Water Framework Directive requires 6-yearly reports, and political changes happen approximately every three years.

4.2.3 Exceptional points

Impacts and dependences on biodiversity and ecosystem services

- One interviewee thought that understanding of links between biodiversity and ecosystem services were poor amongst policy-makers in their country.
- One interviewee highlighted that understanding of the links between biodiversity, ecosystem services and climate change is poor because people are sceptical about climate change due to it being over-dramatised.

Biodiversity adaptation indicators

- Recommendations to improve the BAI categories based on the Bern Convention adaptation principles included:
 - Using the DPSIR (Driving Forces-Pressures-State-Impacts-Responses) framework for indicator development
 - Considering process and outcome indicators separately, as process indicators should be only be required short-term
 - Establishing a baseline to assess trends in vulnerability
 - Presenting information from MSs using a case study approach rather than indicators
 - Combining CBD data to show how biodiversity has changed and will change in the future by taking a top-down approach from global to local; CBD indicators may provide a useful starting point for identifying what additional indicators are required
 - Map overlaps between the current BAI categories and existing measures
 - Developing indicators that relate to statutory drivers (e.g. Water Framework Directive and Habitats Directive).

Data issues and spatial resolution needed and support needs

- One interviewee suggested that reporting should be in line with the rate of change and the statistical processing required, and that setting a standard timescale was not appropriate.

4.3 Feedback from the EPA Interest Group on Adaptation

The presentation of the project raised a number of questions and helped to generate discussion amongst participants of the purpose and challenges of developing and implementing indicators at the EU level, these included:

- Should development of ecosystem-wide indicators be considered rather than just focusing on biodiversity? What is the suitability of the ecosystem for biodiversity? How should species and/or adaptation actions be prioritised?
- Are there conflicts of interest between adaptation actions and biodiversity conservation?
- Can existing datasets be used to detect trends?
- Are there regional differences in findings/views on BAIs?

4.4 Summary of results

- Responses to the questionnaire highlight a potential lack of understanding about the impacts and dependencies of policy areas on biodiversity and ecosystem services.
- A number of questions proved too onerous, those that sought to identify: which existing climate change adaptation indicators have greatest relevance to the high-level BAI categories, which of these categories are most relevant to each policy area, and what relevant data is available.
- Four respondents, from Belgium, the Netherlands, Norway and the UK, gave specific examples of existing suites of climate change adaptation indicators for their policy area (biodiversity or forestry) at a national or regional level. Other respondents stated that indicators have been developed in tandem with their organisation's adaptation strategies, with one set mentioned as still being in development.
- Countries that do not have an existing suite of national adaptation indicators are reported to be either implementing adaptation at a more local level or to have mechanisms in place to monitor adaptation strategies more generally.
- The adaptation principle 'Maintain and increase ecosystem resilience' was associated with the highest numbers of examples of relevant existing indicators and data. The greatest discrepancy between the numbers of examples of actual indicators and relevant data identified was for the principle 'Develop knowledge/evidence base and plan strategically'. Interestingly, respondents were able to suggest potentially relevant data for use with indicators that have yet to be developed.
- All factors identified in the questionnaire that might motivate people to adopt BAIs were regarded as being of similar importance. These were opportunities to: understand/quantify links between biodiversity and ecosystem services relevant to policy areas; establish requirements for monitoring performance of EU/MS/regional/local government; inform development of policy and practice; and review effectiveness of EU/MS/regional/local government policies and outcomes in building resilience.
- Respondents placed a particular emphasis on the need to involve national organisations in the development of BAIs within their policy area in order to build common understanding, ownership and commitment. A majority also identified the need to involve regional organisations, but less than half suggested local, trans-national or EU organisations should be engaged. Respondents' views may reflect a genuine need or may be prejudiced by the fact that their organisations are predominantly involved in national policy development and delivery.
- Data and funding were the main types of support that respondents identified as being needed to develop and implement BAIs in their policy areas.

5 Discussion

5.1 Representativeness of sample

Whilst a 15% response rate to the questionnaire is reasonable, in discussing the findings of this project, it is important to bear in mind that the sample of 16 stakeholders is too small to draw robust conclusions. The respondents cannot be regarded as representative of stakeholders within their policy areas, MSs, or levels at which their organisations engage with policy development and delivery. They were also predominantly from the biodiversity policy area and no-one from the agricultural policy area responded. The six respondents who chose to take part in one-to-one telephone interviews were also those who are already actively engaged in biodiversity adaptation. This is unfortunate as the project's aim was to prepare the ground for embedding an agreed set of adaptation indicators as a tool for monitoring and evaluating the implementation and effectiveness of adaptation policies, measures and actions for biodiversity within related policy areas. Whilst the views of stakeholders within the biodiversity policy area may be informative in this regard, it is the attitudes of stakeholders within other policy areas that have an impact on biodiversity and ecosystem services, or that are dependent on them, that will be defining of the way ahead.

5.2 The need to link with and build upon current indicator initiatives

The Bern Convention adaptation principles (Harley & Hodgson, 2008) recognise that, in addition to direct impacts, climate change will bring indirect impacts to biodiversity through changes in socio-economic drivers, working practices, cultural values, policies and use of land and other resources. Due to the scale, scope and speed of indirect impacts, many could be more damaging than direct impacts. Consequently, there is a need for an integrated approach to BAI development. A range of views expressed by interviewees, therefore, point to the need to link with and build upon current indicator initiatives at an EU level that may provide opportunities to embed BAIs across policy areas. These views notably include:

- Concern that climate change adaptation cannot be considered in isolation
- Desire to minimise the number of indicators
- Expectation of overlap between BAIs and existing indicators
- The need to link into existing monitoring and reporting
- The need for BAIs to relate to statutory drivers.

Such thinking was reinforced by representatives of EEA, EC (DG ENV) and European Topic Centres for Biodiversity and Climate Changes Adaptation when they met at EEA, Copenhagen on 22 November 2011 to discuss the project's initial findings. It is also reflected by the FP7 RESPONSES project (Meller *et al.*, 2011), which aims to assemble a set of indicators to evaluate both direct and indirect impacts of climate change through policy changes in sectors responding to mitigation and adaptation needs. The RESPONSES biodiversity indicators and climate change workshop, held at the Free University, Amsterdam in January 2011, noted that biodiversity indicators often fall short of providing feedback to policy-makers about the impacts of policy decisions and of predicting the consequences of planned actions, or informing the decision-making process of whether such actions are likely to deliver a desired outcome. It concluded that improvements are needed to enable the information required to understand relationships between impacts, pressures and responses to be provided and to project and evaluate responses under a range of climate change scenarios.

What follows are brief summaries of relevant on-going policy initiatives at an EU level that may have a direct bearing on the development/synthesis of BAIs. The summaries highlight the degree to which consideration of biodiversity adaptation is, or should be, integrated into other policy processes. As many of these initiatives are developing in parallel, opportunities to influence them may not be straightforward and the summaries seek to clarify differences in approaches and resultant conflicts, as well as synergies. A concluding overview of all the initiatives is provided in the form of a Gantt chart, which highlights processes and timescales over the next two years.

A simplified schematic illustrating some of the links between different policy areas and their indicators is given in Figure 14. The desired degree of integration between different suites of indicators will vary according to the perceptions and value-judgements of policy-makers within associated policy areas, and their recognition/acceptance of the need for greater policy integration (Figure 15). Whilst some BAIs are already integral to existing suites of indicators within specific policy areas, wider development will inevitably be required to ensure integration across all relevant policy areas.

Figure 14: A schematic illustrating some of the links between different policy areas and indicators

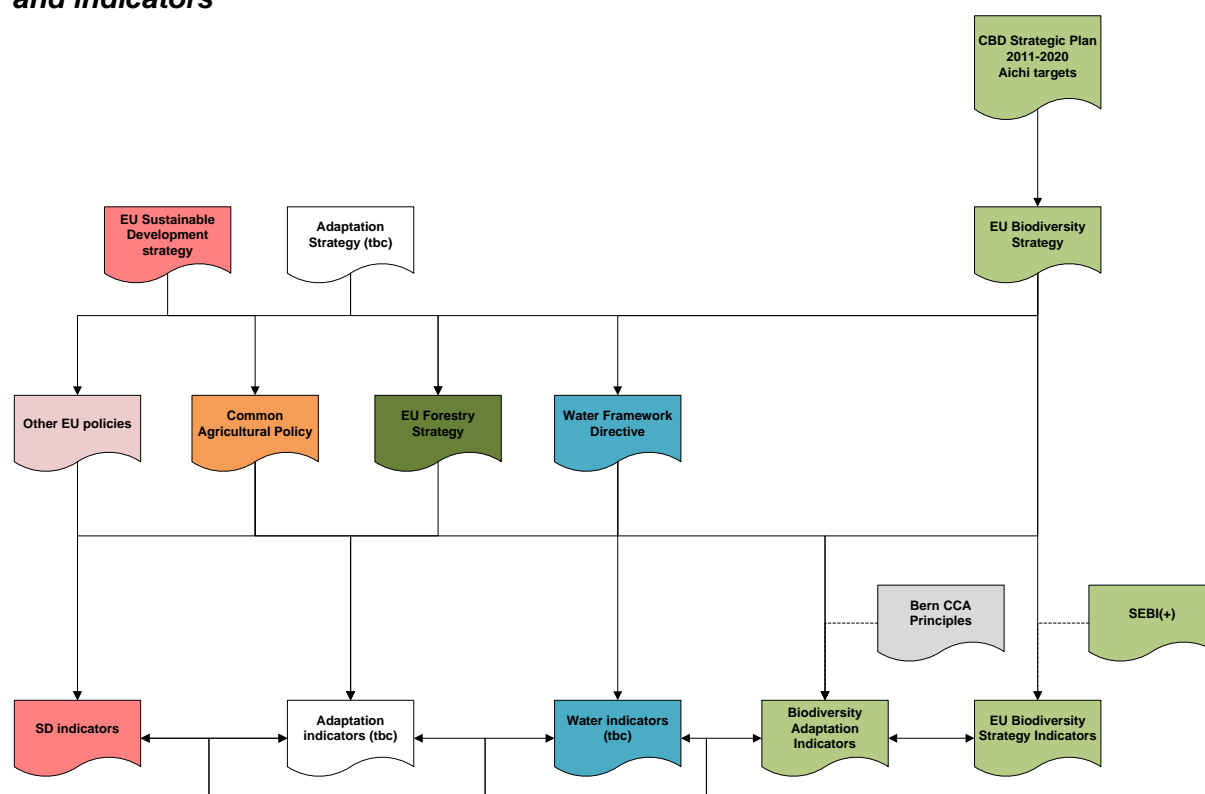
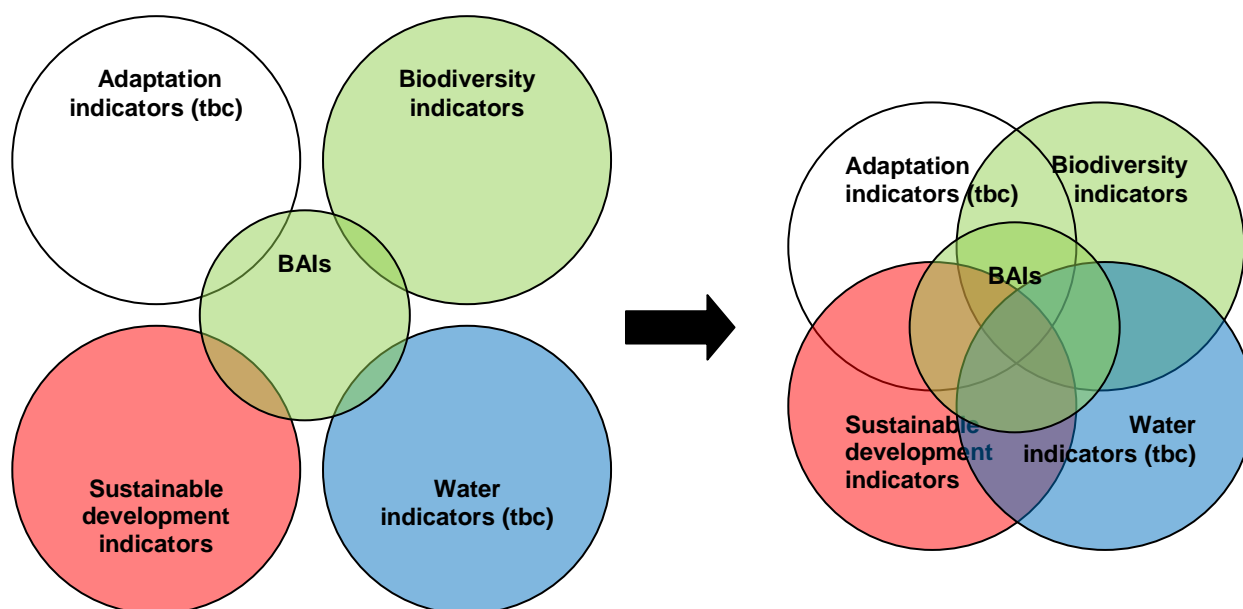


Figure 15: Desired degree of integration between different suites of indicators



5.3 Relevant on-going policy initiatives

5.3.1 Convention on Biological Diversity indicators

The CBD Strategic Plan for Biodiversity 2011-2020 was agreed at COP-10 in Nagoya in October 2010. The Plan's mission is to "Take effective and urgent action to halt the loss of biodiversity in order to ensure that by 2020 ecosystems are resilient and continue to provide essential services...". It includes 20 headline targets for 2015 or 2020 (the 'Aichi Biodiversity Targets'), organised under five strategic goals. The targets and goals provide a flexible framework for the establishment of national or regional targets

A meeting of CBD's AHTEG on indicators, held in the UK (High Wycombe) in June 2011, led to the collation of about 90 potential indicators relevant to the Aichi targets. These indicators are divided into three classes: A – ready for implementation (i.e. methodology defined and data available) at global, national and more local levels; B – recommended for development, but at various stages of development currently; C – examples and case studies only for use at a national or more local level.

5.3.2 EU biodiversity strategy

The EU biodiversity strategy to 2020 (EC, 2011) comprises six main targets and 20 actions to help Europe reach its headline target of *"Halting the loss of biodiversity and the degradation of ecosystem services in the EU by 2020, and restoring them in so far as feasible, while stepping up the EU contribution to averting global biodiversity loss"*. The strategy accords with the CBD Strategic Plan for Biodiversity 2011-2020. Whilst the strategy does not include specific climate change adaptation targets and actions or make demands for BAIs, it does have a strong focus on maintaining and enhancing ecosystem services and restoring degraded ecosystems by incorporating green infrastructure (GI) into spatial planning, which will make significant contributions to climate change adaptation and mitigation. Delivery of the biodiversity strategy and achieving the 2020 target will require implementation of other EU environmental legislation and actions associated with existing and planned policy initiatives that support biodiversity objectives.

The process of developing a set of indicators for the 2020 strategy is not yet complete. This involves the EC, EEA, the Streamlining European Biodiversity Indicators (SEBI) project and biodiversity representatives from MSs, and will continue in 2011/12. Six EU level targets and strong cross-sectoral implications mean the development of existing SEBI 2010 indicators and establishment of new ones is challenging. A Common Implementation Framework is being developed for MSs.

The SEBI project presented conclusions on using indicators to measure 'no biodiversity loss' at the CBD AHTEG above. These included:

- Given the complexity of biodiversity, there are no easy answers
- Individual indicators provide only very specific perspectives on ecosystems, species and genes
- Very few indicators are available with good Europe-wide coverage
- SEBI 2010 indicators were not devised to measure progress towards a biodiversity target
- Post-2010 targets are more specific and are linked to drivers, so conclusions based on a variety of indicators may be less difficult
- The SEBI process has focused on bridging global-regional-national indicator production, collating information within a regional hub
- Work has been undertaken to map EU Biodiversity Strategy 2011-2020 sub-targets to global targets and link with SEBI 2010 indicators
- There is now a need to integrate 2020 indicators:
 - Across different sectors (e.g. agriculture, fisheries, forestry, physical/land-use planning, etc.)
 - From SEBI 2010 and other indicators (e.g. EEA's core set of indicators and agri-environmental indicators), plus some additions
 - Beyond CBD, to include all biodiversity-related multilateral environmental agreements.

5.3.3 Green infrastructure initiatives

Target 2 of the new EU biodiversity strategy, *"By 2020, ecosystems and their services are maintained and enhanced by establishing green infrastructure and restoring at least 15 % of degraded ecosystems"*, aims to reduce land fragmentation, restore degraded ecosystems, and maintain and enhance ecosystem services by incorporating GI into spatial planning. Investing in GI is essential to the delivery of ecosystem-based approaches to climate change mitigation and adaptation within multi-functional landscapes. The EC will develop a strategy (or Green Paper) by 2012 to promote the deployment of GI in the EU. Some kind of quantitative and/or qualitative indicators will be needed.

Four papers have been produced by the EC's Working Group on a GI Strategy for the EU, which are intended to provide expert input and to collect stakeholders' views on different policy options. The papers explicitly address climate change adaptation in relation to: the scope and objectives of GI in the EU; how to put GI in place on the ground; how to fund GI; and the role of the EC in GI. The Working Group suggests that indicators corresponding to overall EU strategic goals for GI may be established by introducing minimum area or functional targets for GI across land-use policy areas, and setting quantitative limits to future landscape fragmentation and/or land sealing. Some countries (e.g. Germany and Switzerland) have already introduced such targets and limits, which might inform their development at an EU level. The Working Group notes that these could be integral to, or complement, the 15% restoration target in the CBD strategic plan and EU biodiversity strategy, and that they should be consistent with the resource efficiency indicators (section 5.3.9).

5.3.4 EU adaptation strategy

The White Paper on adapting to climate change (EC, 2009) recognises the significance of climate change for biodiversity loss and the increasing pressures on habitats and ecosystems. These are addressed, at least in part, through policy commitments to: limit atmospheric warming to a 2 degree maximum; publish an EU strategy on adaptation to climate change by 2013 (both of which are essential to averting further loss of biodiversity); and establish a European Climate Change Impacts, Vulnerability and Adaptation Clearinghouse (in which biodiversity is a key policy area). The Clearinghouse is due to be launched in March 2012. However, it is likely to require further development, particularly from a biodiversity perspective and in relation to the provision of case studies and the inclusion of further information on adaptation at the national level.

Adaptation indicators are only currently being furthered at a national level in some MSs. Development of the EU adaptation strategy by DG CLIMA may lead to a requirement for MSs to produce adaptation plans, which might give rise to reporting requirements and bring the issue of BAIs to the fore. The strategy could adopt a sectoral approach, with GI potentially having an important role.

5.3.5 Sustainable development indicators

The EU Sustainable Development Strategy (EU SDS) sets out the objective of promoting sustainable patterns of consumption and production. It identifies that addressing social and economic development within the carrying capacity of ecosystems and decoupling economic growth from environmental degradation is essential. The EU SDS's overall objective in relation to natural resources is to improve their management, avoid over-exploitation, and recognise the value of ecosystem services. The 2006 'renewed' EU SDS called for a comprehensive set of Sustainable Development Indicators (SDIs). In order to address this requirement, Eurostat developed a set of SDIs, helped by a group of national experts known as the Task Force on SDIs. A first set of indicators was adopted by the EC in 2005 and then updated in 2007. The development of this set of SDIs remains on-going. Eurostat reports on progress towards the objectives of the EU SDS every two years, drawing on the established set of 111 SDIs, which are presented in 10 themes, including sustainable consumption and production, and natural resources.

5.3.6 Agriculture

The Common Agricultural Policy (CAP) is due to be reformed by 2013. After a wide-ranging public debate, the EC published 'The CAP towards 2020' in November 2010. It outlined options for the future of the CAP and launched debate with stakeholders. In October 2011, the EC presented a set of legal proposals intended to ensure that the CAP delivers a more competitive, sustainable agriculture and vibrant rural areas.

Eurostat is responsible for the overall coordination and long-term development of agri-environment indicators and started to collect data on 28 agri-environment indicators in 2006. However, only six are well-defined and have data available at a regional level. For many of the indicators, regional data needs to be developed and work is on-going.

5.3.7 Water

The adoption of the Water Framework Directive (WFD) in 2000 led to development of an integrated approach to river basin management aimed at achieving good ecological/chemical status of all EU waters by 2015. In 2012, MSs will report on progress with measures to achieve good status, but will not report on status itself until 2015. Whilst the WFD provides standard definitions, there is also a need for standard aggregations of measures, which will lead on to agreement of indicators. At present, an over-abundance of information is causing analytical and reporting difficulties.

In 2009, as part of the actions included in the adaptation White Paper, MSs adopted a guidance document on 'River basin management in a changing climate' to integrate climate change adaptation into the implementation of EU water policy. Flood risk and water scarcity measures, in particular, need to be strengthened when taking climate change into account.

As a next step, a 'Blueprint to safeguard European waters' will be developed in 2012. It will review the Strategy for Water Scarcity and Droughts, the vulnerability of water resources, and adaptation measures at an EU level using a combination of quantitative modelling and stakeholder discussions. Particular attention will be given to the role of policies and measures to boost the capacity of ecosystems to store water. It will include recommendations for ensuring that climate change is taken into account in the implementation of the Floods Directive and will assess the need for further measures to enhance water efficiency in agriculture, households and buildings. The Blueprint is closely related to the Europe 2020 Strategy and, in particular, the Resource Efficiency Roadmap (section 5.3.9). It will develop options to improve the quality of the knowledge base for water policy-making, which may include enhancing the Water Information System for Europe (WISE), maintained by EEA, with policy-relevant indicators.

To support development of the Blueprint, EEA will publish a report on the 'State of Europe's Waters' in 2012. It will be based on information reported via River Basin Management Plans and the WFD in 2010, supplemented by other sources (e.g. WISE, water accounts), reporting on other EU water directives (Bathing Water Quality, Urban Waste Water Treatment, Nitrates, Drinking Water) and scientific literature. During 2012, EEA will also publish four thematic assessments on 'Water resources and resource efficiency and water economics', 'Hydromorphology, state and pressures', 'Water and vulnerability (water scarcity and droughts, floods)' and 'Freshwater status, biodiversity and related pressures'.

5.3.8 Forestry

An EU Forestry Strategy (EU FS) was established in 1998 to provide a framework for forest-related actions in support of sustainable forest management (SFM). The Strategy emphasises the importance of the multifunctional role of forests and of SFM for society. It identifies that responsibility for forest policy lies with MSs. It also emphasises international commitments and stresses the need to improve co-ordination across all relevant policy areas. A review of the EU FS was launched in 2011, with a new EU FS scheduled for adoption in autumn 2012. An EC workshop (April 2011) to establish stakeholders' expectations across MSs identified a need for a strategic vision, with targets and indicators to measure progress. .

5.3.9 Resource efficiency

The Europe 2020 Strategy sets objectives on employment, innovation, education, social inclusion and climate/energy to be reached by 2020. MSs have adopted national targets in each of these areas. Progress is currently measured by eight headline indicators. Together with its flagship initiative, 'A resource efficient Europe', the strategy sets the EU on a path to rewarding innovation and resource efficiency, creating economic opportunities and improved security of supply through product redesign, sustainable management of environmental resources, greater reuse, recycling and substitution of materials and resource savings. It identified the need for a roadmap "to define medium and long term objectives and means needed for achieving them". The vision of the EC's 'Roadmap to a resource efficient Europe', which is of considerable relevance to biodiversity adaptation, is that *"By 2050 the EU's economy has grown in a way that respects resource constraints and planetary boundaries, thus contributing to global economic transformation. Our economy is competitive, inclusive and provides a high standard of living with much lower environmental impacts. All resources are sustainably managed, from raw materials to energy, water, air, land and soil. Climate change milestones have been reached, while biodiversity and the ecosystem services it underpins have been protected, valued and substantially restored"*.

The Roadmap identifies that robust, easily understandable and widely accepted indicators will be required to measure improvements in resource efficiency. The EC proposes a process that will consider existing assessment frameworks, such as iGrowGreen (an indicator-based assessment framework tracking how structural reforms can contribute to a competitive, greener economy), and involve discussion and agreement with all key stakeholders by the end of 2013. Three levels of indicators are proposed:

1. A lead indicator in relation to the principal objective of improving economic performance while reducing pressure on natural resources. In recognition of the need to start measuring progress immediately, the EC proposes provisionally using 'resource productivity' as the indicator. However, the EC's intention is that a new lead indicator will be developed on natural capital and environmental impacts of resource use by the end of 2013.
2. A series of complementary indicators on key natural resources, such as water, land, materials and carbon, and indicators that measure environmental impacts and natural capital or ecosystems, as well as taking into account the global aspects of EU consumption.
3. Thematic indicators to monitor progress towards existing targets in other policy areas.

5.3.10 Ecosystem accounting

Ecosystem accounts are being developed as part of the System of Environmental-Economic Accounts, which aims to supplement the UN System of National Accounts (the basis for GDP) with information on the environment and natural capital. The purpose is to improve policy-makers' understanding of the interdependence of the economy and the environment. Ultimately, these ecosystem accounts will yield new indicators and aggregates expressed in physical and monetary units, which will help policy-makers assess the efficiency of natural resource use, the pattern of economic growth, nature's market and non-market uses, the short- and longer-term constraints of needing to maintain living and other renewable capital, and the related benefits and costs.

In 2009, EEA launched a 'fast-track' initiative to implement simplified ecosystem capital accounts for Europe, based on existing data and statistics. The project has led to development of an overall framework for ecosystem capital accounting, which highlights key indicators and aggregates that describe economy-ecosystem interactions for integration into national accounts. Some initial results on water accounts will become available in 2012.

5.3.11 EEA indicators

A desire to streamline Europe's environmental indicators has led EEA to reduce the number hosted on its website (<http://www.eea.europa.eu/data-and-maps/indicators>) by removing those that were redundant or duplicated. The remaining group of about 200 indicators, which includes a core set of 37 established in 2004, are being mapped in relation to their technical, conceptual and political context to help identify new demands for indicators, improve links with policy targets, and decide whether to change the core set. During 2012, on-going consideration of links between indicators and state of the environment reporting (SOER) needed in 2015, at EU and MS levels, will use this group of indicators (including the existing core set), and tools such as SENSE (a Shared European and National State of the Environment), as a basis for progress. EEA's 2012 indicator report will focus on the green economy. During 2012, EEA and Eurostat intend improving the coherence between their respective indicator initiatives through linking websites, common metadata templates and standards.

In support of the EC's development of an EU adaptation strategy by 2013, EEA will publish a report on climate change impacts, vulnerability and adaptation in Europe in autumn 2012. The report will use about 40 indicators to present the state of the climate system, impacts of climate change and associated social, economic, and ecological vulnerabilities arising from both observed and projected changes. Economic consideration will be given to the possible

future costs of damage and adaptation actions. Emergent national and sub-national adaptation actions across Europe will also be analysed and presented. The report will highlight data gaps and the need for enhanced monitoring and scenario planning at appropriate scales, as well as communication of uncertainties. It will update and extend a report on climate change impacts published jointly by EEA, the EC's Joint Research Centre and the World Health Organization in 2008. The report will not contain indicators on adaptation actions, as information currently available across countries is too diverse. For example, this is due to differences in understanding of adaptation, varying approaches to governance, no common methodologies, and lack of data collection specific to adaptation. Instead, a qualitative analysis of existing and potential adaptation actions will be included. The report will be published in autumn 2012 in two separate volumes, one on the indicators of impacts and vulnerabilities and the other on adaptation.

5.3.12 Summary of processes and timescales, 2012-13

Table 4 provides a concluding overview of all the above initiatives in the form of a Gantt chart.

Table 4: Processes and timescales relevant to indicator development, 2012-13

Initiative	Process	2012				2013			
		Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
EU biodiversity strategy	2020 indicator development								
Green Infrastructure (GI) initiatives	Development of GI strategy (or Green Paper) (and associated indicators?)								
EU adaptation strategy	Launch of Clearinghouse								
	Development of EU adaptation strategy (and associated indicators?)								
SD indicators	On-going development of SDIs								
Agriculture	CAP reform								
	Development of agri-environment indicators								
Water	MSs report on progress with measures to achieve good status								
	Development of Blueprint (and associated indicators?)								
Forestry	Development of new EU FS (and associated indicators?)								
Resource efficiency	Development of resource efficiency indicators								
EEA indicators	Identify new demands for indicators, improve links with policy targets, and establish renewed EEA								

Initiative	Process	2012				2013			
		Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
	group of indicators for use in thematic, sectoral and SOER assessments								
	2012 annual indicator report focused on green economy								
	Improving coherence with Eurostat indicators								
	2012 report on climate change impacts, vulnerabilities (indicators) and adaptation								
	2012 reports on water (and associated indicators)								

6 Conclusions

The current focus of climate change indicators in relation to biodiversity is on direct impacts and may lead to an expectation that BAIs can be considered in isolation from other indicators. However, the Bern Convention principles highlight that adaptation actions, and thus also BAIs, need to be integrated across all policy areas and that to a varying extent many existing indicators may be relevant.

The results of this project imply that, unsurprisingly, it may primarily be stakeholders within the biodiversity policy area who are already engaging with biodiversity adaptation. However, it is the attitudes and actions of stakeholders within other policy areas (e.g. agriculture, forestry, water) that have an impact on biodiversity and ecosystem services, or are dependent on them, that will have a large role in defining of the way ahead on BAIs. The results also suggest that, even amongst stakeholders within the biodiversity policy area, there may be a lack of understanding as to the potential extent of such impacts and dependencies. As a first step to achieving an agreed set of adaptation indicators as a tool for monitoring and evaluating the implementation and effectiveness of adaptation policies, measures and actions for biodiversity within other policy areas, there is a need to review:

- Which existing indicators within each key policy area are relevant to the high-level adaptation indicator categories proposed for biodiversity (Harley & van Minnen, 2010)
- Which high-level BAI categories are relevant to each policy area
- What relevant data is available and from where.

Such a review should be undertaken in close collaboration with key relevant sectoral stakeholders. The results of this project support a desire to minimise the number of sectoral and other indicators, the need to increase synergies between potential BAIs and existing indicators, the need for BAIs to relate to sectoral drivers and pressures, and to link into existing monitoring and reporting at national and EU levels.

The project has also identified a wide range of on-going policy initiatives that may provide opportunities to embed BAIs. As many of these initiatives are developing in parallel, opportunities to influence them may not be straightforward. In order to make headway, there is an urgent need to undertake an in-depth review of the complete spectrum of EU indicators in relation to the high-level BAI categories (and *vice versa*) to determine those that are relevant by policy area and associated data issues, and where existing indicators need to be modified or new indicators developed.

This review would clarify for stakeholders across all policy areas, including those who work on the development and implementation of biodiversity policy, that BAIs do not only focus inwards on biodiversity, but also outwards to embrace the impacts and dependencies of all policy areas on biodiversity. It would highlight potential synergies and opportunities to avoid duplication of data collection and analyses. In doing so, it might then enable fruitful engagement with relevant policy initiatives, including those that this project has identified. Such an approach might also be furthered as case studies in relation to MSs' national indicators. A twin-pronged approach to identifying BAIs at EU and MS levels would help highlight potential issues relating to the need for adaptation to link seamlessly across policy areas and between levels (EU, MS, regional and local).

Potential ways to fund such a project should be given due consideration by EEA, DG CLIMA, DG ENV, and DG RTD, as well as EEA member countries. It is noted that the EC has proposed that 20% of the EU budget should address climate change in the next multi-annual financial framework of the EU (2014–2020). Identification of BAIs across all policy areas that impact or are dependent on biodiversity should be a priority for future funding, given the

recognition of the importance of such links in various key EU policy documents. These include the White Paper on adapting to climate change (EC, 2009), which states that it is important for the EU and MSs *“To promote strategies which increase the resilience to climate change of health, property and the productive functions of land, inter alia, by improving the management of water resources and ecosystems”*. Furthermore the EU biodiversity strategy to 2020 (EC, 2011) states that *“Ecosystem-based approaches to climate change mitigation and adaptation can offer cost-effective alternatives to technological solutions, while delivering multiple benefits beyond biodiversity conservation”*.

7 References

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8 Appendices

Appendix 1: Phase 1 self-guided questionnaire

European Biodiversity Adaptation Indicators: Stakeholder Questionnaire

Introduction to the project

AEA and the Netherlands Environmental Assessment Agency (PBL) are undertaking a project for the European Environment Agency (EEA) on climate change adaptation indicators for biodiversity. The project will build on preceding phases of this work and will use the high-level Biodiversity Adaptation Indicator categories proposed in ETC/ACC Technical Paper 2010/15 as a starting point for discussions with stakeholders in the EU and Member States. Feedback from these discussions will be used to determine the support required to implement the use of biodiversity adaptation indicators across Europe. In relation to biodiversity, agriculture, forestry and water policy areas, the project will seek to identify:

- How to build common understanding, ownership and commitment to the development of indicators that can be used by stakeholders to monitor their performance and the effectiveness of their processes and outcomes.
- Those high-level categories of indicators perceived as relevant by stakeholders at EU, Member State, regional and local levels.
- Potential data issues relating to the high-level categories of indicators selected.

The project's output will be a Technical Paper that addresses these questions and makes detailed recommendations for a process to implement Biodiversity Adaptation Indicators across the EU and Member States. It is, however, beyond the scope of the project to establish an agreed suite of specific indicators. This would require a detailed review of existing biodiversity indicators that might be used and of data availability in relation to entirely new potential indicators.

The project will make a significant contribution to the delivery of key EU policies in terms of climate change adaptation and biodiversity. The EU Adaptation White Paper (EC, 2009) highlights that it is important for the EU and Member States *"To promote strategies which increase the resilience to climate change of health, property and the productive functions of land, inter alia by improving the management of water resources and ecosystems"*. Similarly, the new EU biodiversity strategy to 2020 (EC, 2011) states that *"Ecosystem-based approaches to climate change mitigation and adaptation can offer cost-effective alternatives to technological solutions, while delivering multiple benefits beyond biodiversity conservation"*.

The EU strategy, which is aimed at halting the loss of biodiversity and ecosystem services in the EU by 2020, comprises six main targets and 20 actions to help Europe reach its goal. Indicators will be required to monitor progress and evaluate the effectiveness of policies and outcomes. This will necessitate the review of existing indicators (e.g. SEBI - Streamlining European Biodiversity Indicators) and the establishment of new ones where necessary.

More information

- For more information about the background to this project, see [European Topic Centre on Air and Climate Change Technical Paper 15 Adaptation Indicators for Biodiversity](#) (ETC/ACC Technical Paper 2010/15).
- For more information about the EU White Paper *Adapting to climate change: Towards a European framework for action*, see <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2009:0147:FIN:EN:PDF> (EC, 2009).
- For more information on the new EU biodiversity strategy, see [Our life insurance, our natural capital: an EU biodiversity strategy to 2020](#) (EC, 2011).

Purpose of questionnaire

The following questionnaire forms part of a two phase stakeholder engagement process, focussing on biodiversity, agriculture and water policy areas. In the first phase, a set of short high-level questions are designed to gather views from a wide range of stakeholders across all levels of governance in Europe. This will be followed in a second phase by targeted in-depth interviews, which will explore themes, incentives and barriers in more detail.

Completing this questionnaire

Your answers to the questions below should be based on your personal opinion and/or perception and your expert judgement as a professional in this field. Organisational/institutional views are not being sought. The information gathered will only be used for the purposes of this project. If you require assistance in completing the questionnaire or have any further questions about the process, please contact karen.miller@aeat.co.uk +44 870 190 5284 or nikki.hodgson@aeat.co.uk +44 870 190 3858.

Questions

Section 1: General questions

1. With what policy area are you involved?	Please select only one option: a. Biodiversity and nature b. Agriculture c. Forestry d. Water e. Other – please specify:	
2. At what level is your organisation involved in policy development?	Please rank in order:	Where 1 is the highest
	a. EU	
	b. Trans-national	
	c. National	
	d. Regional	
	e. Local	
	f. None	
3. At what level is your organisation involved in policy delivery?	Please rank in order:	Where 1 is the highest
	a. EU	
	b. Trans-national	
	c. National	
	d. Regional	
	e. Local	
	f. None	

Section 2: Impacts and dependencies on biodiversity and ecosystem services

4. What level of understanding exists amongst policy-makers of links between biodiversity, ecosystem services and your policy area:	Please select only one option: a. Poor b. Adequate c. Good d. Excellent	
5. What impacts and dependencies does your policy area have on biodiversity and ecosystem services?	Please provide examples of impacts:	
	Please provide examples of dependencies:	

6. What are the risks and opportunities arising from climate change for your policy area that relate to these impacts and dependencies?	Please provide examples of risks:	
	Please provide examples of opportunities:	
Section 3: Biodiversity Adaptation Indicators (BAIs)		
7. Do you have an existing suite of climate change adaptation indicators for your policy area?	a. Yes b. No If yes, please give details:	
8. Which existing indicators in your policy area have greatest relevance to the high-level BAI categories listed in Annex 1?	Please provide examples in Annex 1	
9. And, which of the high-level BAI categories are relevant to your policy area?	Please provide examples in Annex 1	
10. With reference to your answer to questions 8 and 9, what relevant data is available and from where?	Please provide examples in Annex 1	
Section 4. Ownership and commitment		
11. What would motivate people within your policy area to adopt adaptation indicators that relate to biodiversity and climate change?	Please rank options a. to d. in order of importance (1 – 4 where 1 is the highest): a. Opportunity to understand/quantify links between biodiversity and ecosystem services relevant to your policy area b. Opportunity to inform development of policy and practice c. Opportunity to establish requirements for monitoring performance of EU/MS national/regional/local government d. Opportunity to review effectiveness of EU/MS national/regional/local government policies and outcomes in building resilience e. None of above f. Other - please specify:	
12. Name the organisations that would need to be involved in the development of BAI within your policy area to build common understanding, ownership and commitment at each of the following levels?	EU	
	Trans-national	
	National	

	Regional	
	Local	
13. What support would be needed by your policy area to develop and implement BAIs?	a. Process b. Technical c. Data d. Funding e. Other – please specify:	
Section 5: You and your work		
Name:		
Email:		
Telephone:		
Organisation:		
Job role:		
Involvement in any networks:		
Phase 2: would you be interested in being interviewed by telephone to explore in detail issues that are common to all policy areas or specific to your area - as highlighted by respondents to this questionnaire?	a. Yes b. No	
Next steps		
<p>Thank you for taking the time to complete this questionnaire. Please return it to karen.miller@aeat.co.uk and nikki.hodgson@aeat.co.uk. If you have completed a paper version, please mail it to: Karen Miller, AEA, Glengarnock Technology Centre, Caledonian Road, Lochshore Business Park, Glengarnock, Ayrshire, KA14 3DD, UK.</p> <p>If you have agreed to take part in the second phase of this project, we may contact you in August to set up a telephone interview. We will also notify you when the final report is published (by January 2012).</p>		

Appendix 2: Interview questions

Stakeholder interviews in the second phase of the engagement exercise will provide an opportunity to gather further information or clarification of the responses provided by a subset of participants. These interviews will explore detailed issues that are common to all policy areas or specific to individual ones, as highlighted in individual questionnaires.

Impacts and dependences

Q4 – Can you explain why there is *[insert questionnaire response]* understanding amongst policy makers, of links between biodiversity and ecosystem services? Can you give examples that demonstrate this level of understanding, and suggest what is needed to improve understanding?

Q6 – Risks and opportunities. Have you witnessed any of these risks and opportunities manifesting themselves in recent times?

Biodiversity Adaptation Indicators

Q7 – Can you provide further detail of the indicators you refer to (e.g. how they are used; who submits data; who collates data; what the results are used for?) Can you send more information on these?

Can you identify any synergies between your indicators and the BAI categories proposed in this study? How transferable are they to other Member States?

Are there any lessons from these that could inform development of BAIs? How can we integrate BAIs with existing national indicator sets to minimise burden?

Do you have any sector-specific thoughts on the high-level categories of BAIs?

Ownership and commitment

Q11 – Can you explain why you attributed highest priority to the opportunity to understand/quantify links between biodiversity and ecosystems, and national/regional/local government policies and outcomes in building resilience?

Similarly, can you explain why you attributed low priority to the opportunity to compare MS performance?

Q12 – can you give examples of how the stakeholder you list would be involved in developing and implementing BAIs?

Data issues and spatial resolution needed and support needs

You identify data as a key requirement for implementing and developing BAIs. What data do you currently possess and what data challenges do you face with your current indicators (e.g. very local, poor quality, out of date)?

Do you have baseline data that could feed into the indicators? If so, what type of data?

How are existing indicators funded? Who would you expect to fund BAIs?

Reporting requirements

How frequently should data reporting be requested?

How should the information from the BAIs be used?

How should the information be presented/disseminated, and to whom?

Appendix 3: Respondents to Phase 1 self-guided questionnaire

Name	Organisation	Country
Julian Wright	Environment Agency	UK
Scot Mathieson	Scottish Environment Protection Agency	UK
Vincent van den Bergen	Ministry of Housing, Spatial Planning and the Environment	Netherlands
Ben ten Brink	Environmental Assessment Agency	Netherlands
Jan Plesnik	Agency for Nature Conservation and Landscape Protection	Czech Republic
Christian Schlatter	Federal Office for the Environment	Switzerland
Gian-Reto Walther	Federal Office for the Environment	Switzerland
Roland Hohmann	Federal Office for the Environment	Switzerland
Petra van Ruth	Umweltbundesamt (The Federal Environment Agency)	Germany
Luc De Bruyn	Research Institute for Nature and Forest	Belgium
Francesca Giordano	Institute for Environmental Protection and Research	Italy
Mikael Hilden	SYKE Finnish Environment Institute	Finland
Else Loberli	Directorate for Nature Management	Norway
Ainhize Butrón Mota	IHOBE - Basque Environmental Agency	Spain
Maria Tiefenbach	Environment Agency	Austria
Ioannis Meliadis	National Agricultural Research Foundation/ Forest Research Institute	Germany
Mark Broadmeadow	Forestry Commission England	UK

Appendix 4: Participants in Phase 2 telephone interviews

Name	Role	Organisation	Country
Julian Wright	Water Policy Advisor– Climate Change	Environment Agency	UK
Scot Mathieson	Principal Conservation Policy Officer	Scottish Environment Protection Agency	UK
Else Loberli	Senior Adviser	Directorate for Nature Management	Norway
Ben ten Brink	Leader of the International Biodiversity Program	Environmental Assessment Agency	Netherlands
Jan Plesnik	Adviser to Director	Agency for Nature Conservation and Landscape Protection	Czech Republic
Dave Thompson	Senior Analyst	Adaptation Sub Committee	UK

Appendix 5: Summary of individual interviews

<u>Impacts and dependences on biodiversity and ecosystem services</u> Understanding amongst policy-makers, of links between biodiversity and ecosystem services	
Interviewee 1	<p>Biodiversity and ecosystem services are one of the most researched topics since the Millennium Ecosystem Assessment (2001–2005).</p> <p>Indicators are the vehicle for quantifying and modelling how agriculture, forestry etc. impact on biodiversity, and will be key to improving this understanding amongst policy-makers.</p>
Interviewee 2	Topic not discussed.
Interviewee 3	<p>The water management sector is beginning to recognise the connections between biodiversity, ecosystem services and water.</p> <p>There has been a rapid expansion of the number of Catchment Management Plans over the last five years, with in excess of 100 schemes now in existence in England and Wales. Many of these investigate the types of ecosystem services provided.</p> <p>There is better understanding at the policy level (e.g. Natural Environment White Paper, National Ecosystem Assessment). The challenge is in translating this understanding into joined-up funding.</p>
Interviewee 4	<p>The understanding of links between biodiversity, ecosystem services and climate change are well understood amongst environmental policy-makers (good understanding). However, for general policy-makers, the level of understanding is adequate.</p> <p>It is partly my job to improve this understanding by getting people to see how biodiversity is linked to climate change adaptation. The media could be used to improve understanding more widely.</p>
Interviewee 5	<p>In the Czech Republic, the main problem is not that politicians and decisions-makers can't understand the process or background, it is their scepticism. They in effect are very much influenced by the opinion that while climate change exists, it is not as dramatic as it has happened in the past and has been overestimated by the rest of the world. This is the main problem - we need to provide as much scientific evidence as possible.</p> <p>Indicators could help provide data to overcome scepticism. Adaptation measures should be based on real processes in nature, as well as on technology. We can then communicate to stakeholders that adaptation solutions are based on nature and demonstrate we have the concrete evidence to back this up.</p>
Interviewee 6	<p>Ecosystems services are a new policy area. It is not something most people understand in terms of business (actually there is an inadequate understanding). Ecosystem services is such a new concept and very few areas of policy, including biodiversity policy, have come to terms with what they do and what a policy based on ecosystem services would do in contrast. Just because we protect biodiversity at the moment does not mean that ecosystem services would too. The understanding that exists is better than poor, but we do not understand the full links.</p>

<u>Impacts and dependences on biodiversity and ecosystem services</u> <u>Observed changes in environmental baselines in recent years, and benefits of BAIs</u>	
Interviewee 1	<p>Refers to the four CBD indicators on biodiversity state (ecosystem extent, abundance of selected species, threatened species, and genetic variety).</p> <p>Mean Species Abundance (MSA) is a composite indicator derived from the CBD. At present, we have already lost 30% species population and around 2% of this is due to climate change. Agriculture is the greatest driver. Over the next 40 years, as climate change increases, around 5% could be lost due to climate.</p>
Interviewee 2	Topic not discussed.
Interviewee 3	<p>Tree planting for carbon mitigation and benefits for biodiversity.</p> <p>Uplands management – removal of peat for grazing pastures. Oxidation occurs and releases carbon into the water. The peatland has reduced absorption and there is greater run-off and less control of flow. Flooding risk is increased.</p> <p>Benefits include reducing run-off of soil and nutrients; reducing rate of rain water run-off and promoting a steady flow in rivers. This helps manage water quality and flow, as well as the quality of farmlands and habitats.</p>
Interviewee 4	Yes, the movement of species to new areas (marine ecosystems report). Some have moved very long distances.
Interviewee 5	Two years ago, the Ministry of the Environment of the Czech Republic developed climate change policy, and there is a special chapter on ecosystems and adaptation/mitigation. They felt this was not enough, so the Minister asked the ministry and agency to develop a specific document on adaptations based on nature and landscape processes. This has been drafted, but still under negotiation with other sectors. We propose to use scenarios, models and indicators. Just now there is no deadline for submission of the document, so there is still possibility that government will approve the use of indicators in our adaptation strategy. There are no indicators in the above mentioned national climate change policy hence we presented a proposal for use of indicators.
Interviewee 6	<p>There has been a 30% increase in water flowing in Scotland's rivers. We have good long-term data sets which show changes in baselines and these are used for setting standards. This increase in water flow has brought about an increased risk of flooding.</p> <p>We will continue to monitor environmental baselines – we don't necessarily need to do any new monitoring. The Water Framework Directive introduced new government policy on habitat network monitoring to provide a new perspective on biodiversity impacts (e.g. greater monitoring of fish and macrophytes). Previously, the emphasis was on monitoring macroinvertebrates. As a result, we will have a better idea of areas where biodiversity is under pressure from changing flows.</p>

Biodiversity adaptation indicators Further detail of the indicators you refer to – thoughts on high-level BAI categories	
Interviewee 1	<p>There are four CBD indicators (2010) for biodiversity:</p> <ul style="list-style-type: none"> • Area change • Change in species abundance (Mean Species Abundance is the aggregate indicator) • Red list (threat of extinction) • Change in genetics of species. <p>The monitoring of these four indicators is coordinated by the Biodiversity Indicator Partnership (based at UNEP-WCMC - see CBD Technical series No. 53)</p> <p>Combined, this data provides information on how biodiversity has probably been changed and will change in the future.</p>
Interviewee 2	<p>It would also be useful to consider how to assess trends in vulnerability to climate change so that we understand current vulnerability/have a baseline to measure progress against. For example, what is the trend in fragmentation? Is it increasing or decreasing?</p> <p>There should be greater emphasis on understanding the drivers and vulnerabilities to current climate as the starting point for assessing resilience to future climate.</p> <p>It is important that policy frameworks for biodiversity are flexible in order to take account of changes in climate (e.g. changing conservation targets).</p> <p>In terms of reporting/presenting information from Member States, it might be useful to do so using a case study approach or on a project by project basis.</p>
Interviewee 3	<p>Environment Agency adaptation indicators are likely to be process based. They will be based around ensuring we have delivered what we said we would under the Adaptation Reporting Power, which contains around 100 actions. Other indicators used include the number of catchments at unsustainable levels of abstraction.</p> <p>The Adaptation Sub Committee (ASC) is using existing metrics to develop indicators, linked to the Climate Change Risk Assessment. ASC will focus on direct climate variables (e.g. rainfall, temperature) and then intermediary impacts (e.g. indication of vulnerability of current level of habitat at risk, movement of species).</p>
Interviewee 4	<p>Indicators allow you to measure something with the same methods again and again and assess development. We have no direct indicators which are reported systematically yet; instead the Adaptation Strategy (in Norwegian) is a way to monitor our progress in adapting to climate change impacts. A report made in 2007 was used as a basis for the strategy on climate change and biodiversity management.</p>
Interviewee 5	<p>Topic not discussed.</p>
Interviewee 6	<p>I would recommend separating outcome and process indicators because process indicators should be temporary.</p>

Biodiversity adaptation indicators Further detail of the indicators you refer to – thoughts on high-level BAI categories	
	SEPA aren't planning for future conservation adaptation; instead we are looking at habitat networking.

Biodiversity adaptation indicators Sector-specific thoughts on the high-level categories of BAIs	
Interviewee 1	<p>There is a key requirement to minimise the number of indicators for several reasons (cost, organisational matters, limits of human perception).</p> <p>We must be careful which issues we choose to look at with the BAIs, because climate change is just one factor next to many others and we cannot look at this in isolation.</p> <p>Just adding another set of BAI to the entire set would make the whole framework unworkable.</p> <p>I would suggest looking at the existing CBD indicators and asking whether they can provide the answers we need in terms of adaptation. Take a top down approach, from global down to EU and national level. If we cannot answer our questions, what indicator(s) would be needed on top of what already exists? You need a very strong argument to add more indicators – will it entail excessive cost and burden? Besides, not all desired information requires (expensive) indicators.</p> <p>Biodiversity indicators are commonly categorized according to the DPSIR framework.</p>
Interviewee 2	Topic not discussed.
Interviewee 3	<p>BAIs should link into existing monitoring requirements (e.g. monitoring under the Water Framework Directive for the water policy area). Indicators should link management of existing pressures with increasing resilience and vulnerability. The headline indicator for water is “good ecological status” which falls into the BAI category ‘Sources of stress and harm are being reduced’.</p> <p>Other useful indicators for water include landscape habitat creation - % increase or decrease in land area of habitat (BAI = ecosystem function is being maintained and restored, and where appropriate and cost effective, habitats relocated and created). The overall outcome indicator would be the % habitat in good ecological status.</p> <p>Is there an indicator relating to the connectedness of habitats/landscapes?</p>
Interviewee 4	In general, it is a good thing to have indicators to compare progress at national level and to compare different countries' performance. It is difficult to identify good adaptation indicators on the list; better to have fewer, meaningful indicators. The challenge is finding and comparing adaptation indicators that are applicable across Member States, partly because climate change adaptation has to be done locally/regionally.
Interviewee 5	These are the multi-functional indicators. If BAIs are developed, they could be used for monitoring other strategies in the Czech Republic, including the State Nature Conservation and landscape Protection Programme or National

Biodiversity adaptation indicators Sector-specific thoughts on the high-level categories of BAIs	
	<p>Biodiversity Conservation Strategy, because they should deal <i>inter alia</i> with ecosystem resilience and resistance. We also need good, clear communication between scientists, practitioners and policy-makers, and BAIs could provide this common understanding of adaptation and biodiversity. The BAIs would allow us to convey information in a clear way, for example, allowing us to teach a farmer that he is able to contribute to biodiversity conservation and, at the same time, to climate change protection. This is much more practical (and likely) than a farmer reading reports by the IPCC. The BAI categories are clear and would be relevant to wide range of stakeholders.</p>
Interviewee 6	<p>The Bern adaptation principles are clear and sensible.</p> <p>However, there is quite a lot of overlap in the BAI categories; a lot of existing categories cover these already.</p> <p>A mapping exercise should be carried out to show the overlap as some indicators are served by a number of existing measures. The list is very long.</p> <p>Existing data held by SEPA feeds into a number of the BAIs.</p>

Motivations and stakeholders (ownership and commitment) Motivating people within your policy area to adopt adaptation indicators that relate to biodiversity and climate change	
Interviewee 1	<p>Information on benchmarking might be useful, but more important is tracking progress towards the CBD 2020 targets.</p> <p>It is not that we are able/unable to meet the targets rather it is to do with willingness.</p>
Interviewee 2	Topic not discussed.
Interviewee 3	<p>Indicators allow early detection of areas where you are heading in the wrong direction, providing a prompt to take remedial action. The reason to do it is to influence action.</p> <p>Performance comparison should be stimulated by existing Member State-level metrics which have a statutory driver. This should feed into the EEA/EU level (e.g. Water Framework Directive and Habitats Directive), rather than defining new indicators which don't have statutory drivers to feed into performance measurement at EU level.</p> <p>The greatest interest in BAIs will be at the EU level. The BAIs will help to identify whether or not the EC is delivering its policies effectively (e.g. Adaptation White Paper).</p>
Interviewee 4	<p>We must understand the links between biodiversity and ecosystem services. Understanding the links helps us to see the importance of indicators.</p> <p>International demands and national policy are very important for Norwegian policy-makers to gain funding for projects such as indicators. But it is not easy to differentiate between these options.</p>

Motivations and stakeholders (ownership and commitment) Motivating people within your policy area to adopt adaptation indicators that relate to biodiversity and climate change	
Interviewee 5	<p>The Czechoslovak ecological network concept called the Territorial System of Ecological Stability of the Landscape (TSES) was developed in late 1970s. In the Czech Republic, we have four levels of the network: international, national, sub-national and local. It is clear that, because processes in nature and landscape appear in various time and spatial scales, we need adaptation measures at various time scales and spatial scales. The approach which will be most favourable to stakeholders is to use multi-level measures that mean something can be done by the ministry, regional (provincial) government and municipalities. We need a common, conceptual framework on how to do adapt and protect biodiversity so that we don't waste time and money through uncoordinated processes.</p>
Interviewee 6	<p>The opportunity to understand/quantify links between biodiversity and ecosystem services must be the basis for further work on ecosystem services. The basic science is the basis for all the other steps.</p> <p>It is not important to us to monitor the performance of Member States – much more important to understand the performance of my agency, SEPA, so this is not directly relevant to us.</p>

Motivations and stakeholders (ownership and commitment) The organisations that would need to be involved in the development of BAI within your policy area to build common understanding, ownership and commitment at each of the following levels	
Interviewee 1	Topic not discussed.
Interviewee 2	Topic not discussed.
Interviewee 3	<p>For biodiversity in Norway, the DN (national level) is most authoritative and therefore the most important level of governance to engage with. The Norwegian Institute for Nature Research works closely with the DN on indicators, so this organisation will be a really important partner. Since different sectors (agriculture, fisheries etc.) have biodiversity responsibility in Norway, sector institutes should also be involved. At the local level, adaptation very often has to be done locally, so we must involve municipalities and regional county governors. It is important to involve local authorities as work on adaptation takes place on a local/regional level.</p>
Interviewee 4	Topic not discussed.
Interviewee 5	<p>We have already tried to use indicators related to other biodiversity issues, and so we would like to use indicators relating to adaptation too. For example, EEA are dealing with SEBI indicators and the agency has been involved in this process. The Ministry of Environment for the Czech Republic has produced a report assessing whether the country was able to meet the 2010 biodiversity target using 21 indicators. But we won't use the BAIs in isolation, we would use both.</p> <p>Because of the tradition of using indicators and developing them with academic institutions, people will be motivated to use the indicators. They recognise that good indicators can be used to measure and explain issues to the general public, thereby raising awareness.</p>

<u>Motivations and stakeholders (ownership and commitment)</u> The organisations that would need to be involved in the development of BAI within your policy area to build common understanding, ownership and commitment at each of the following levels	
Interviewee 6	<p>SEPA is least interested in the European scale - we can aggregate up to this scale. It is more important to monitor at the local, regional and national scales. We would want indicators that are useful (if you engage with a policy area in the development of the indicators, for example looking at existing data and find out that monitoring is already happening, this adds value to the development process). We would use indicators as a stick to motivate behaviour change; we are not getting things right yet and we need to do things differently, whether internally or within external government bodies.</p> <p>Greenspace Scotland is collecting spatial mapping data for a 'State of green space map', which will allow the construction of integrated habitat networks and maps.</p> <p>Scotland's Environment Web is a €550M project, which will bring environmental reporting data into a single system.</p>

<u>Data issues and spatial resolution needed and support needs</u> Additional data that needs to be collected and from whom, and the resources and support needed. The main barriers faced gathering this data	
Interviewee 1	Do not know the BAIs currently considered; do not know what data would be suitable and exists at national level.
Interviewee 2	Topic not discussed.
Interviewee 3	<p>The challenge will be in determining what degree of improvement is related to climate change or other pressures.</p> <p>Data is already abundant (e.g. River Basin Management Plans contain data on current status of water bodies and is updated every six years). Data is at catchment level, so granularity is not a problem.</p> <p>Catchment Abstraction Management Schemes (CAMs) ask whether there is enough water in the water body.</p> <p>The key will be use of a statutory driver and guidance from government (from Defra or via EC). If there is a statutory driver, it follows that funding will be made available to Member States to carry out monitoring and reporting.</p>
Interviewee 4	More data collection would be needed. The listed data sources are easy to obtain. Most of them are, however, developed for another purpose, and therefore might need manipulation before used in a climate change adaptation context. For example, the Nature Index is a large report, but it would need to be manipulated and maybe also supported with more data before use in a climate change adaptation context. The other data sources listed are relevant to BAIs and we have data to explain the link to BAIs, but this would need manipulation too.
Interviewee 5	We have existing sources, including a very specific database called the Nature Conservancy Information System which has had a range of GIS levels. For example, we have some data on the resilience of ecosystems and responses of nature to climate change at the wildlife and species level, and we have some

Data issues and spatial resolution needed and support needs Additional data that needs to be collected and from whom, and the resources and support needed. The main barriers faced gathering this data	
	<p>data on flooding. What we need is to pull them together because they are collected for reasons other than climate change adaptation. So if we can finish our adaptation strategy and agree indicators, we will need data to feed into these. But there is very little chance we will get additional funds to develop a new monitoring scheme from the government.</p> <p>The data we already have is good, although 15 years ago due to political history, there were some problems regarding the copyright of data. Data ownership was very new for us, as under the communist regime everything was owned by government. Now we use data collected by NGOs, etc., so we have overcome this problem. So today, if we gather data, we should do it in a way that allows us to use it for a variety of purposes. We have more than six million data on wild species of fauna and flora occurrence, but we need more pragmatic data on resilience of ecosystems at landscape level.</p> <p>In the Czech Republic, there has been a high quality system of monitoring wildlife species and natural habitat types in relation to EU legislation. We have various schemes and people in the field gathering data, but what is missing is the scheme which gets data on climate change adaptation at landscape levels, using landscape features instead of populations or habitats, and covering the whole country, not only N2K sites or species and habitats. But to do this, we need to select a few pragmatic features at landscape level to allow us to assess effectiveness of adaptation measures taken in the field. This requires some funding.</p>
Interviewee 6	Work to improve access to data is costing money. The data needed is often on paper and systems are incompatible. This exercise needs to be done by someone. Technical and funding support is part of the opportunity.

Data issues and spatial resolution needed and support needs Frequency of data reporting	
Interviewee 1	Same as CBD indicators - every four years.
Interviewee 2	Topic not discussed.
Interviewee 3	<p>It will be important to work with existing data reporting requirements. For the Water Framework Directive/ RBMPs, this is every six years.</p> <p>Perhaps reporting could reflect that used by EEA in the State of Environment report (annual?).</p>
Interviewee 4	It depends what is being measured. Five years is probably too long; perhaps one year is more realistic. But it must be an easy to use system to encourage people to report.
Interviewee 5	Not on an annual basis because of seasonality and the practicality of data management. For us, every three years would probably be realistic to allow us to assess what changes have happened and come up with predictions for future – this is very much in the mind of politicians (what will happen if...?).
Interviewee 6	Reporting – we don't need to report every year. SEPA reports annually for some things and less for others. One can't set a standard timescale. You need

<u>Data issues and spatial resolution needed and support needs</u>	
<u>Frequency of data reporting</u>	
	to ask what is the rate of change and what is the statistical power needed to measure change? Policy indicators are useful to keep track of progress.

<u>Data issues and spatial resolution needed and support needs</u>	
<u>Information audience, presentation and dissemination</u>	
Interviewee 1	<p>This is a key challenge. With as a few as possible indicators, a good and understandable story line, also on what it means for people's lives in the future.</p> <p>Visual measures that people can relate to, such as a film like 'An Inconvenient Truth', would be an interesting new pathway to follow.</p>
Interviewee 2	Topic not discussed.
Interviewee 3	This should be owned by DG CLIMA, and used to determine whether the Adaptation White Paper and other strategies/policies are working.
Interviewee 4	<p>There are different possibilities. On a bigger EU scale, the data could be used to compare countries' performances; at the local level BAIs could generate best practice. The challenge is to find relevant data from existing systems. BAIs are a very broad topic, so it is hard to answer this question. Generally, it is good to have indicators to monitor performance. Having indicators helps us to get funding from the ministry/government to do practical management work.</p>
Interviewee 5	<p>The information should be used to raise awareness, but also to provide examples (good and bad) and illustrate lessons learned. This can affect stakeholder thinking - there will be greater confidence in us if we can show we have learned from the past. The BAIs can also provide background/context to the challenges we are facing.</p>
Interviewee 6	<p>Technically – pulling together information and understanding of how ecosystem services and biodiversity relate is better done at EU level as an assessment of existing understanding.</p>



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