MACIS

Minimisation of and Adaptation to Climate change Impacts on biodiverSity

Deliverable 4.1: Policy Analysis for Biodiversity under climate change

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Jake Piper

Elizabeth Wilson

and MACIS Co-ordination Team

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MACIS

Minimisation of and adaptation to climate impacts on biodiversity

WP4 Policy options to prevent/minimise negative impacts on biodiversity

Deliverable 4.1:

POLICY ANALYSIS FOR BIODIVERSITY UNDER CLIMATE CHANGE

April, 2008

"Review paper of relevant policy and policy trends (A&M, sectoral), current policy-related research and future scenarios across selection of MSs and at EU level and development of assessment frameworks and policy-linkage framework"
(MACIS DoW p 23)

OXFORD BROOKES UNIVERSITY

Dr Jake Piper
Elizabeth Wilson
School of the Built Environment

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Introduction

Biodiversity protection policy in the EU and its Member States is based upon an assessment of the value and rarity of habitats and species. The most valued are given designations which determine the degree of protection they have from disturbance and loss as a result of human actions, particularly development. Climate change is an additional factor now affecting wildlife and ecosystems, and further measures to protect biodiversity are now being developed within and beyond the EU. Additional pressures are also acting upon biodiversity notably population growth and over-exploitation.

Section 2

EU and Member States' national policies on climate change and biodiversity have been reviewed and analysed. This review shows policy development cross the EU is uneven, but that there is some evidence of nations learning from each other and collaborating on research and policy development. This is a rather new field of policy, one that has emerged following climate change impact assessment, sometimes at regional level, and research into the potential of mitigation and adaptation measures. Awareness of impacts of climate change upon natural ecosystems is growing, as is awareness of the value and importance of protecting biodiversity as a route to moderating climate change.

National strategic adaptation plans from three countries (Finland, Spain and France) have been analysed in more detail and evaluated to see how closely they align with the recommendations of the EU Green Paper *Adapting to climate change* – the aim here was to see in what ways they might be upgraded. A non-EU example of a strategic adaptation plan exclusively for biodiversity adaptation in Australia is also reviewed.

Strategies to address impacts upon biodiversity and to propose adaptation measures are coming forward, but other topics - such as health and agriculture - generally take precedence in climate change policy development, ahead of biodiversity. The likely effectiveness of such strategies is taken to be dependent upon:

- Knowledge and understanding of systems, resources and effects and their interactions
- Knowledge and mastery of policies and measures which will bring the desired results
- Authority/power to carry out the necessary actions, backed by legislation
- Resources – the skills, funds, access to land, and time needed to instigate (or control) actions
- Institutions, strategies and plans to monitor change and progress towards desired aims.

Not surprisingly, some countries are further advanced in this than others. Late starters may be expected to make rapid progress in view of the material and models of approach now available from other countries as well as increasing research work across the EU - this provides opportunities for awareness raising, evaluation of approaches, etc. Cooperative transboundary activities on biodiversity conservation also provide a platform for sharing practice and for learning.

Section 3

Interactions between biodiversity and many other policy fields - perhaps especially agriculture, built environment and transport - are very complex, as are the interactions between the respective policy communities. That biodiversity and natural ecosystems provide services for other sectors (services such as pollination, flood mitigation and maintaining water quality) is acknowledged, and the consequences of losing biodiversity are beginning to be recognised.

Nevertheless, what is apparent from the strategies and other documents examined is that there is still a form of "silo" thinking: whilst biodiversity is beginning to be perceived as being subject to climate change in combination with impacts from other sectors, this is not a two-way process.

To develop biodiversity adaptation policy which is directed at only the biodiversity sector would be to overlook interactions with other sectors and the important contribution that other sectors can make. Review of recent policy development across a wide array of policy areas has confirmed that the majority of these still make little reference to climate change, and less to biodiversity, even where those sectors are important in affecting/disturbing biodiversity as well as relying upon ecosystem services. A consultation exercise amongst the MACIS team and other experts working in this field on these policies identified suggestions for the amendment of policy to incorporate measure which would help protect biodiversity. These suggestions fall into the areas of policy, planning, implementation and research. The range of policy areas covered here includes not only those which make direct use of natural resources, but also social and economic policies such as trade policy.

That policy integration is needed is a central thesis of reports such as the EU Green Paper of 2007, and of others commissioned by the EU (e.g. ICON et al, 2001) and is expected in the 2008 EU White Paper on adaptation. Policy integration would mean integrating the objectives and implementation of sectoral programmes, integrating strategic programmes of support at EU level for substantive sectors, and of horizontal, cross-cutting policies such as the Lisbon Agenda, competitiveness and cohesion policies. Whilst this emphasis on policy integration is to be welcomed, it is clear from the review work in MACIS Work packages 2, 4.1 and 4.3 of the EU's relatively new policies for biodiversity (i.e. to halt the loss of biodiversity by 2010) and for mitigation of and adaptation to climate change, that there are potential conflicts and potential but unexplored synergies. The ideal of policy integration is still difficult to achieve.

The review has shown the complexity of these interactions, operating at and across multiple scales of policy intervention. It is important not just that there is policy integration of climate change adaptation with other sectors (as in the EU Green Paper), but that, as each sector responds to climate change, adaptation and mitigation actions are also consistent. This is important for the achievement of the EU's biodiversity policies under conditions of climate change. There is therefore a clear need for measures at institutional (policy), operational (plan) and technical (implementation) scales to ensure consistency and avoid conflicts.

Section 4

Recognising the impacts upon biodiversity and natural systems of each of the major economic sectors, which may act cumulatively with climate change impacts, a range of measures that may be taken within each of six sectors are identified. The sectors are Agriculture, Built Environment, Centralized energy generation, Industry, Tourism and informal recreation, and Transport. The measures outlined are means of protecting biodiversity and strengthening the resilience of four types of natural systems: ecosystems and biodiversity, water, rivers and wetlands; coastal areas; and soils.

Policies and measures which can help in this include full impact assessment procedures, principles such as "no net loss" or "net gain" in natural resources, the introduction of compensatory measures to counter impacts and restore system quality, and research. A pre-emptive and proactive style of engagement on impacts, acknowledging the value of the natural systems to the sectors, would help to prevent losses and may well cut long-term costs.

Section 5

The development and use of socio-economic scenarios (in addition to the baseline climate scenarios) in planning for climate change is explored. Future scenarios[1] have played a

[1] Coherent, internally consistent, and plausible descriptions of future states of the world, used to inform future trends, potential decisions or consequences (UKCIP, 2001 p. 4)

significant and fundamental role in the way in which climate change has been presented to policy-makers as an issue requiring immediate and urgent attention and action.

There is a raft of research projects including those developing and engaging with scenarios, of direct and indirect relevance to the impacts of climate change on ecosystems, and to the implementation of mitigation and adaptation policies to respond to climate change. Review of this work has suggested that climate change mitigation and adaptation are still being considered separately, and their interactions are not being adequately considered. This is particularly important for biodiversity. It is also evident that, despite the high public profile of some of these studies there needs to be more concerted effort to communicate outputs to policy-makers and stakeholders at multiple levels, and to enhance opportunities for sharing learning. The EEA has indicated[2] that it is important to support policy processes that handle uncertainties in a systematic way. The current study shares this belief and would extend this work to focus on the need to integrate climate change policy responses with current commitments to halting biodiversity loss:

- designing futures studies around issues on the current policy agenda: this would include specifically studies which integrate climate change mitigation and adaptation;
- including more forward-looking perspectives in national environmental reporting: this would include suitable forward-looking indicators, drawn from scenario studies of ecosystems under conditions of climate change;
- a systematic audit of the usefulness of climate change and socio-economic scenarios and futures studies with the EU is also recommended.
- the active involvement of regional and national institutions in futures studies; and
- increasing institutional capacity (expertise and resources), especially in the integration of mitigation and adaptation.

A process for exploring a particular "shock scenario" is presented: the case of a future Europe in which a pandemic impacts upon a society already affected by climate change, examining responses in geographical zones and in terms of wealth levels upon different sectors. Major EU research programmes and their use of scenarios are also examined, identifying policy implications.

Section 6

The need for an assessment framework for policy and plans is proposed to provide policy integration and to "climate proof" policy - i.e. to take into account potential impacts associated with climate change, extreme weather and sea level rise, and where possible to introduce measures which increase resilience to climate change. The proposed framework is based on the approach taken in spatial planning in order to integrate and harmonize land use and other decisions. After reviewing issues associated with biodiversity and climate change adaptation through spatial planning, the assessment framework used in plan and programme assessment, Strategic Environmental Assessment (SEA), is introduced and an approach to risk assessment is summarized briefly A process and some techniques to assist in this assessment work are proposed to aid exploration of policy as well as negotiation on policy and measures with respect to impact mitigation and climate change adaptation.

A comprehensive assessment of proposed policies and plans for their impact upon and interaction with climate change would include the following elements in order to develop mitigation and adaptation policies and to harmonize and integrate cross-sectoral policy:

- scenarios for both climate change and socio-economic changes
- risk assessment
- knowledge of the current baseline in the area or topic under study, and relevant additional information
- a set of principles for mitigation and adaptation

Nevertheless, where information is lacking or is inadequate, it may be necessary to make progress on the basis of assumptions and broad-brush assessments. The assessment framework and analysis tools described are intended to help the policy and plan assessment

[2] EEA 2007a

and integration process become systematic and transparent and are proposed as a basis for uncovering relationships and negotiating responses.

Section 7

This report has outlined an array of measures - from high-level strategic policy to implementation measures - that can help to protect aspects of, and resources for, biodiversity and ecosystems in different circumstances. We have emphasized that all policy areas (and not only those which directly influence the physical environment) need to be reviewed and assessed for impacts - both beneficial and adverse, as well as direct, indirect and cumulative. We have indicated what policy and planning measures may be used by a number of policy areas and economic sectors, including socio-economic scenarios as a measure for policy development, and further research.

EU strategic policy for the protection of biodiversity at present focuses on “halting loss” and, where specially valued (Natura 2000) sites are involved, on securing compensation for loss or harm. European biodiversity continues to decline as a consequence of the multiple pressures upon species, habitats and systems. We conclude that current policy needs to be strengthened if biodiversity, and the ecosystem services on which we rely, are to be maintained. Policies such as “halting decline” and “no net loss” are insufficient to protect biodiversity in a rapidly changing environment of multiple interacting pressures. “Net gain” of biodiversity or resources for biodiversity (indicating a replacement rate of more than 1:1) is a precautionary and necessary response to planned changes and developments.

In addition to this, also needed is a policy of incorporating greater resilience - flexibility, “slack” or a redundancy of provision in terms of sites, forms of protection and enhancement implementation measures. All EU directorates (both sectoral programmes and cross-cutting policies) should have responsibility for biodiversity – not just to mitigate the impacts of their policies or projects, but to enhance and restore biodiversity in order to redress past losses and to enable resilient and robust adaptation to future climate change. A valuable objective to achieve this could be to establish sound and improving ecosystem functioning through robust and resilient ecosystems.

Clear strategic planning towards an achievable objective is needed at EU level, to include funding, targets, implementation measures and monitoring; allocating responsibilities and setting a schedule for expected progress towards aims. Objectives of this work would be to:

- research & address transboundary effects
- integrate biodiversity and climate change concerns across other sectors (e.g. transport, energy).
- promote a sense of urgency identify necessary changes,
- seek consensus on a set of essential goals (in line with the strategic aim of the Water Framework Directive, “all water bodies will be restored towards good quality”).
- bring about harmonisation of vision and action across the community.
- offer incentives via funding, and seek to balance impacts of this new policy on different countries.
- maintain a strong and continuing commitment to the Natura 2000 network - but seeking to extend the network with additional areas.

ABBREVIATIONS

Bd	Biodiversity
BRANCH	Biodiversity Requires Adaptation in NW Europe under a Changing Climate*
CAP	Common Agricultural Policy
CBD	Convention on Biological Diversity
CC	Climate change
CEC	Commission of the European Communities
COCONUT	Understanding effects of land use changes on ecosystems to halt loss of biodiversity due to habitat destruction, fragmentation *
EC	European Commission
EIA	Environmental Impact Assessment (of individual projects)
ESPACE	European Spatial Planning - Adapting to Climate Events *
EU	European Union
FAO	Food and Agriculture Organisation (of the UN)
HNVF	High Nature Value Farmland
ICZM	Integrated coastal zone management
MACIS	Minimisation of and adaptation to climate impacts on biodiversity *
MPA	Marine Protected Areas
MS	Member State
MSD	Marine Strategy Directive
RDP	Rural Development Programme
SEA	Strategic Environmental Assessment (of plans, programmes, policies)
SPA	Special Protected Area
SWOT	Strengths, Weaknesses, Opportunities and Threats analysis
UKCIP	UK Climate Impacts Programme
UHI	Urban Heat Island
UNFCCC	United Nations Framework Convention on Climate Change
WFD	Water Framework Directive

* EC-funded biodiversity research programmes

POLICY ANALYSIS FOR BIODIVERSITY UNDER CLIMATE CHANGE

1 INTRODUCTION

1.1 Biodiversity protection policy in the EU

The EC's 2006 Communication on biodiversity (CEC, 2006) acknowledged the on-going decline in "both the variety and extent of natural systems", or biodiversity highlighting the role of biodiversity in supporting ecosystem services, in addition to not only the intrinsic value of nature but also the link between biodiversity and sustainable development, and therefore economic aims of the community, including growth and employment. This decline had been in evidence even since the global signing of the Convention on Biological Diversity (1993) the Millennium Ecosystem Assessment on biodiversity (World Resources Institute, 2005) and the 2004 Message from Malahide and Action Plan to 2010 of 2004.

With the Communication, the EC set out to open a debate on safeguarding nature, but emphasized that the decline in biodiversity could only be halted with substantial changes in policy and practice. Ill-considered land use and development and the increasing impact of climate change on biodiversity are identified in the Communication on biodiversity as being significant threats. To counter these, the Communication provided an agenda for action to halt the loss of biodiversity by 2010 and a set of proposals for:

- priority objectives addressing most important habitats and species;
- actions in the wider countryside and marine environment;
- making regional development more compatible with nature;
- reducing impacts of invasive alien species;
- effective international governance;
- support to biodiversity in international development;
- reducing negative impacts of international trade;
- adaptation to climate change; and
- strengthening the knowledge base.

The Communication moreover highlights the need for measures relating to

- adequate financing,
- strengthening EU decision-making,
- building partnerships and
- promoting public education, awareness and participation.

The purpose of the MACIS project is to summarise what is already know about the impacts of climate change on biodiversity and develop methods to assess the potential impacts in the future, not only of climate change but also of mitigation and adaptation measures introduced to address climate change. Working with policy makers and stakeholders, MACIS is intended to prepare a comprehensive assessment of the observed and the potential impacts of climate change on biodiversity and the impacts of adaptation and mitigation measures on biodiversity**;** Workpackage 4 of MACIS is designed to analyse and explore the available policy options to prevent and minimise negative impacts for EU 25 up to the year 2050. The present report, WP4 deliverable 4.1, is a review paper of relevant policy and policy trends (adaptation and mitigation policy, sectoral policy) and current policy-related research and future scenarios, across a selection of Member States and at EU level. Also, it explores the development of assessment frameworks and a policy-linkage framework.

1.2 Policy review and options for biodiversity under climate change

MACIS Workpackage 1 has reviewed the impacts of climate change on biodiversity. This report deals with policy options which prevent or minimize impacts on biodiversity caused by climate change, including those resulting from mitigation policies on the one hand and adaptation policies on the other. These areas of policy development may occasionally be in conflict with regards to biodiversity, or may act positively in synergy. The report attempts to

capture this range of both policies and consequences; some of the following sections focus on mitigation, others on adaptation. The report comprises five main sections.

Section 2 reviews the current status of policy and planning relating to climate change and biodiversity across the EU. It highlights two types of Member State high-level policy documents: those that relate to climate change mitigation and adaptation and those which also concern biodiversity. In sub-section 2.2 three EU national strategies for adaptation are compared: those for Spain, Finland and France. Australia's action plan for biodiversity and climate change - essentially concerned with adaptation - is introduced in 2.3 as an example of such a plan. Annexes to this section list the national policies reviewed.

Section 3 presents the result of a review of other policy sectors (sustainable development, agriculture, transport, etc.) where policy development is needed to take into account the potential impacts of climate change mitigation and adaptation upon biodiversity, in those sectors. Policy options and implementation measures - collated following consultation with a sample of expert stakeholders - are outlined. Topics for future research are also indicated.

Section 4 highlights the cumulative nature of impacts upon four natural resource systems (water and wetlands, coastal areas, biodiversity, soils) which result from the combination of climate change impacts and construction and operation impacts across six economic sectors, identified on the basis of their likely impacts (resulting from land occupancy, emissions, etc.). It considers how each activity sector might act proactively to address cumulative impacts and protect and enhance vital natural systems and, consequently, species and habitats.

Section 5 presents information on research which has relevance to policy development for biodiversity under climate change - that is, research that will for example produce models to guide future planning for biodiversity, or assesses impacts and risks affecting biodiversity. This section also includes an assessment of the current and potential future use of scenarios in planning for biodiversity under climate change and describes a "thought experiment" to develop the use of scenarios for further impacts upon biodiversity resulting from an additional "shock" to socio-economic systems.

Section 6 brings together mitigation and adaptation policies in a policy compliance matrix introducing means of identifying linkages, conflicts and synergies between policies either within a sector or between sectors. It applies this to the case of the built environment (building on work for Deliverable 2.2) as an example of the approach. The section goes on to present a potential assessment framework for measures and policies which promote either mitigation or adaptation to climate change (or both approaches together).

An appendix presents the WP4 team response to the consultation on the EC's Green Paper of June 2007 - ***Adapting to climate change.***

2 CLIMATE CHANGE AND BIODIVERSITY - POLICY TRENDS

2.1 Development of national policy on climate change and biodiversity (European Union Member States and others)

2.1.1 Introduction

As part of a background policy familiarisation review for Workpackage 4 of the EC MACIS Programme (Minimisation of and Adaptation to Climate Impacts on biodiverSity), the WP4 team has examined strategy and policy documents relating to climate change and biodiversity from a number of sources: the European Commission, Member States, and other countries.

Whilst an attempt was made to investigate the status of policy development across the EU, the focus has been on countries showing evidence of more advanced policy development in this area in the form of published policy documents. The issues of climate change and biodiversity are multi-scalar, but this section is concerned principally with national level plans and strategies on climate change mitigation and adaptation, and the extent to which these deal with measures to protect biodiversity. Climate change is currently an important topic for policy action: new statements and strategies are being published regularly. For this reason a tabular presentation and a deadline date have been used. The information reviewed is that which has become publicly available in the period up to February 2008. Whilst the selection is not comprehensive, it does represent the array of publicly available strategies and plans.

The majority of EU nations have prepared and are implementing National Sustainable Development Strategies (strategies are still awaited in some Accession States), and there is a degree of overlap between these and climate change strategies. National sustainable development strategies are not covered here - although some do make reference to climate change, generally they do not focus on climate change adaptation as they were largely prepared before the 2002 Johannesburg Summit on Sustainable Development, and consequently before the surge in awareness of climate change of the past two - three years. Instead, the review focuses on climate change strategies.

Under the UN Framework Convention on Climate Change (UNFCCC) governments of the economically-developed nations submit National *Communications* on progress on adaptation to climate change. Gagnon-Lebrun and Agarwal (2006) have reviewed these *Communications* and have characterized the work of 39 developed countries as falling into three groups:

1. Early stages of impact assessment (seven countries)
2. Advanced impact assessment but slow development of policy responses (27)
3. Moving towards implementing adaptation (five countries: Netherlands, United States, New Zealand, Australia, and United Kingdom)

The findings of Gagnon-Lebrun and Agarwal (2007) are compared, below, with those of the current review.

2.1.2 Methodology

In addition to policy documents already known to the team, further documents have been identified: via contacts at national government institutions, via contacts within the MACIS team either directly to documents or to individuals (in government, NGOs, etc.) who might be able to suggest relevant policy documents, and directly from the Internet using keyword searches. In some cases the contacts made (either within the MACIS team or at the identified institutions) were also able to comment on the nature and content of national policy, although no systematic survey of stakeholders was carried out.

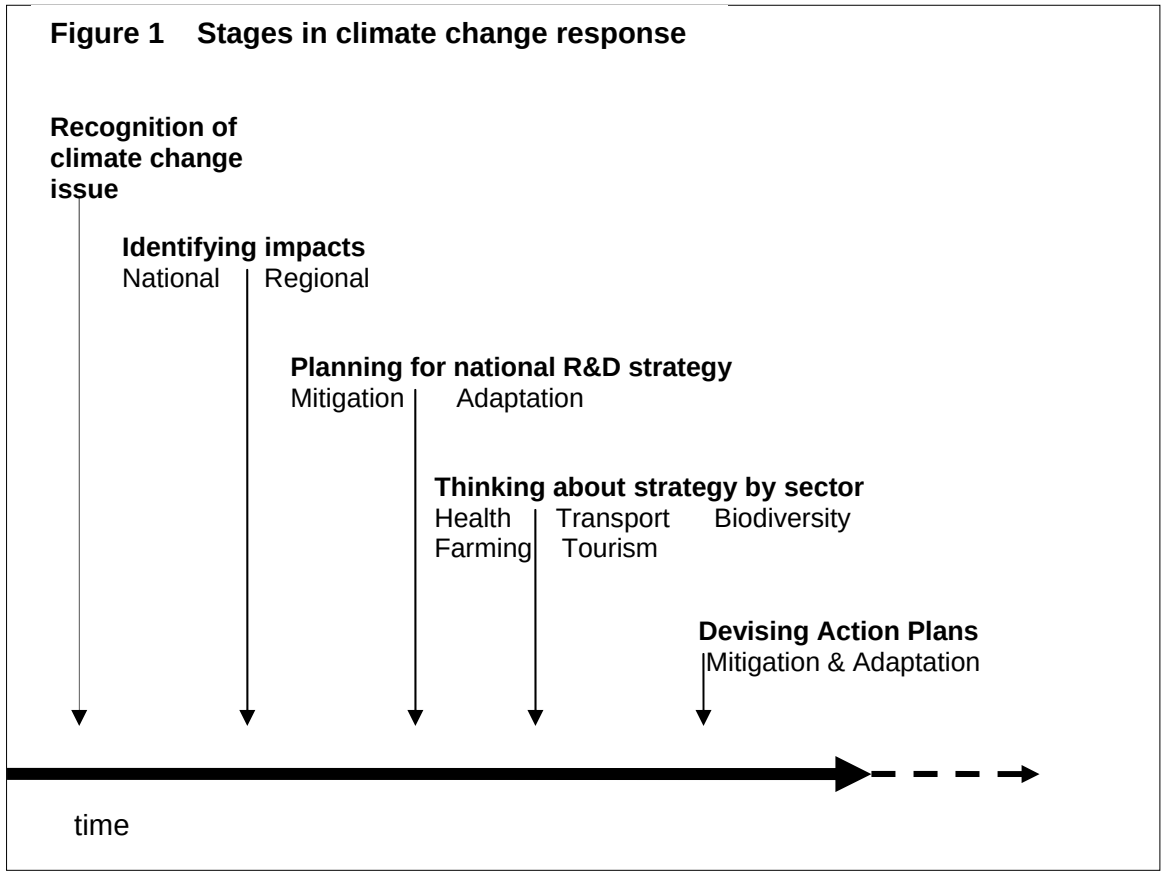
The array of published policy documents outlining national-level plans and strategies on climate change and on biodiversity were reviewed for their content, specifically:

- recognition of importance of climate change
- identification of impacts and in particular, impacts on biodiversity
- identification of measures to address impacts , including:

- o policy measures (strategies, policies, monitoring, indicators and targets, planning horizons)
- o implementation measures (for biodiversity protection, this might include corridors, patches, buffer zones, Suds and partnerships)
- o research recommendations
- o funding plans

Comparing policy development in the array of countries, a "standard" model has been identified in broad terms, though not all countries will necessarily follow this path. This five stage process is represented in Figure 1, showing development from "Recognition" to "Action". Within each stage, certain activities or sectors have frequently been addressed first, e.g. mitigation before adaptation, health before biodiversity.

Figure 1 Stages in climate change response



Annex 1 summarizes information collected for twelve EU countries for which information is available: *Selection of Member State policy documents on climate change and biodiversity.* Work in four countries outside the EU (Australia, Canada, Norway and the USA) is also noted (Annex 2). Document dates and links are also shown in the annexes.

The various policy documents are classified in Annex 1 according to their level of development. The content was assessed firstly regarding climate change impacts and then regarding biodiversity. Six possible "stages" of response on climate change are distinguished, thus:

- A an initial statement of concern on climate change
- B a review of impacts at international national or regional level
- C a plan for research to be undertaken

Then the review examined, with specific respect to biodiversity, which further measures were included; plans which included these were classified as follows:

D a set of policies to address climate change impacts on biodiversity

E a strategy with objectives and targets regarding biodiversity

F an Action Plan with specific implementation measures for biodiversity, with locations and timelines

2.1.3 Findings

Review of the available documents has shown that the twelve EU Member States covered here have reached different stages with regards to addressing the impacts of climate change via mitigation and adaptation. Policy documents for some countries remain at the stage of discussing mitigation strategies (i.e. reducing emissions or capturing carbon), whilst in others progress is being made towards considering needs and adaptation strategies, and evaluating and recommending implementation measures.

With regards to biodiversity, some countries have prepared strategies with objectives and targets on biodiversity in the light of climate change, whilst others had not yet published information on this (at February, 2008). Whilst it is recognised that this is a rapidly moving field, it is clear that at the time of the survey, most countries had yet to show published evidence of significant headway with adaptation measures for biodiversity under climate change.

Apart from political agreements on climate change such as the Kyoto Protocol (adopted 1997, in force 2005) and the Baltic Pact (June 2007)[3], there has been some collaboration between nations, especially within the EU, with regards to research and to devising adaptation programmes and measures, in particular:

- EU-funded research programmes on climate change adaptation, e.g. BRANCH, MONARCH, ALARM, MACIS, etc. – see section 4.1 below.
- Similarities in approach, analysis and proposals of Finnish and Spanish adaptation strategies.

Particular progress has been made by countries such as the Finland, Netherlands, and the UK, and more information on these countries is presented in section 2.2 and 2.3 below. (This is in line with the findings of Gagnon-Lebrun and Agarwal (2006), see section 2.1.1 above). Beyond Europe, there has also been collaboration between Australia and New Zealand, working with the Bilateral Climate Change Partnership.

Many EU countries have been affected by “extreme weather events” over the past decade, and whilst these cannot be attributed directly to climate change, it is likely that they have spurred policy-makers towards action. In the case of countries which may have made most progress, the “triggers” may have been the widespread flooding in the Netherlands and UK, “excess” heatwave-related deaths (France in 2003) and extended drought (UK in 2005-6). Similarly, Australia is currently affected by a very serious drought.

2.1.4 Measures included in national adaptation strategies

Table 2.1 introduces some of the elements of four national adaptation strategies which pay more attention to biodiversity as an important issue.

[3] International agreement signed at Heiligendamm to reduce greenhouse gas emissions, to lead to a reduction of 50% by 2050.

Table 2.1: Biodiversity-related elements in four MSs' national strategies

Finland: National Adaptation Strategy (MAF, 2005)	The strategy was published in 2005 and its time horizon is 2080. • Biodiversity is addressed under sector -specific measures: **"Biological diversity** • Incorporation of the assessment and monitoring of the impacts of climate change into projects and programmes concerning the protection and management of biological diversity • Evaluation of the coverage of the nature protection in changing climate conditions" • Recreational use of "nature" is also discussed under tourism. • Little reference to funding of measures
France: National Adaptation Strategy (ONERC, 2006).	• Addresses biodiversity as one of four cross-cutting themes. Does not specify locations, timelines or specific targets. • Recommends that all measures for preserving or restoring ecosystem resilience to climate change to be studied and put into action (including ecological corridors) (Rec. 28) • Also, recommends that linkage be established between the national biodiversity strategy and the recommendations on adaptation to climate change be undertaken (Rec. 29)
Netherlands: National Adaptation programme 2006	• Spatial planning and climate change (Adaptie Ruimte en Klimaat - ARK) intended to lead via three phases to an adaptation strategy. • Array of measures under other policies (e.g. Room for the River) which contribute to planning for adaptation to climate change and biodiversity, including National Ecological Network. • Also cross-boundary working, e.g. with Germany, upstream (Meuse) and along coast, with neighbouring countries: Wadden Sea area
UK: Climate Impacts Programme (from 2000)	UK Climate Impacts Programme (since 1997) commissioning research across a wide field, including adaptation research. First UK Climate Change Programme commenced in 2000. • UK Climate Change Programme, 2006; objectives include understanding impacts on biodiversity, developing adaptation options, implementing monitoring systems. o Series of MONARCH studies on biodiversity includes modelling. (MONARCH Partnership, 2007) o Plans for work with the UK Biodiversity Partnership to publish practical guidance for nature conservation managers and planners, see www.ukbap.org.uk/ o and for revised guidance statement on the role of spatial planning in adapting to climate change • Adaptation Policy Framework: an integrating framework for the role of Government action on adaptation. • England Biodiversity Strategy: towards adaptation to climate change - (Mitchell et al., 2007). Research review. (Also, November 2007: Climate Change Bill, proposing action on targets, an expert Committee, a Carbon Reduction Commitment, action on the Renewable Transport Fuel Obligation, and on waste.)

2.1.5 The next steps

Hannah, Midgeley *et al.* (2002) have proposed climate change-integrated conservation strategies to take work further work to develop policy to assist with climate change adaptation for biodiversity - see Box 2.1.

Box 2.1: Biodiversity Conservation Responses

"Conservation of biodiversity in a changing climate requires both limits on change and conservation strategies responsive to changes that are inevitable. Conservation strategies at a scale and with objectives that explicitly address the potential effects of climate change are required. We call these *climate change–integrated conservation strategies* (CCS). Although these strategies must be tailored to individual regions, to be successful each CCS needs to include five key elements:

(1) regional modelling of biodiversity response to climate change;

(2) systematic selection of protected areas with climate change as an integral selection factor;

(3) management of biodiversity across regional landscapes, including core protected areas and their surrounding matrix, with climate change as an explicit management parameter;

(4) mechanisms to support regional coordination of management, both across international borders and across the interface between park and non-park conservation areas; and

(5) provision of resources, from countries with the greatest resources and greatest role in generating climate change to countries in which climate-change effects and biodiversity are highest. To adequately respond to the uncertainties posed by climate change, the provision of resources will be required on a much larger scale than has occurred to present."

L Hannah, G. F Midgley, T Lovejoy, W. J Bond, M Bush, J. C Lovett, D Scott, F. I Woodward (2002) Conservation of Biodiversity in a Changing Climate *Conservation Biology* 16 (1), 264–268.

Some EU countries have made progress towards the "ideal" for biodiversity conservation responses suggested by Hannah, Midgeley et al, 2006 by proposing appropriate adaptation measures in certain circumstances (e.g. river floodplains, coastal areas); the Netherlands, for example, has made good progress. However, across the EU, and within individual countries, the position remains rather patchy and there is some way to go before the necessary policy, mechanisms and resources are in place.

2.1.6 Conclusions

There is a good deal of ongoing research work on adaptation to climate change, and some collaborative work between nations (see section 2.2.6). Awareness of impacts of climate change upon natural ecosystems is growing, as is awareness of the value and importance of protecting biodiversity as a route to moderating climate change. Strategies to address impacts upon biodiversity and to propose adaptation measures are coming forward, but other topics - such as health and agriculture - generally take precedence in climate change policy development, ahead of biodiversity.

Not surprisingly, some countries are further advanced than others. Late starters may be expected to make rapid progress in view of the material and models of approach now available from other countries (e.g. see section 2.2.5 and links between Spanish and Finnish plans) as well as because of increasing research and involvement of their national researchers in research studies of many kinds (see section 4.1). This provides opportunities for awareness raising, evaluation of approaches, etc. Cooperative transboundary activities on biodiversity conservation, such as work with respect to the Wadden Sea (Denmark, Germany, Netherlands) also provides a platform for sharing practice and for learning (CWSS, 2007).

Interactions between biodiversity and many other policy fields - perhaps especially agriculture, built environment and transport - are very complex, as are the interactions between the respective policy communities. That biodiversity and natural ecosystems provide services for other sectors (services such as pollination, flood mitigation and water quality enhancement) is recently emerging as a consideration for policy-makers working on climate change. On-going policy development in several countries (UK, Netherlands, France, etc.) should help to redress the balance between policy areas.

Much more work remains to be done to recognise the role of biodiversity, to incorporate this in government policy-making (i.e. identifying actions, timelines, funding and responsible bodies), in order to achieve biodiversity protection at the level of conservation strategies proposed by Hannah, Midgley *et al.* (2002).

Section 2.2 below compares the national adaptation strategies of three EU member states (Spain, Finland and France) in greater detail. The non-EU case of Australia is also outlined in section 2.3 as that country has published a more developed *National Biodiversity and Climate Change Action Plan* which details objectives, strategies and actions for specific locations and environments, with some indication of timing in early years.

Annex 1 Selection of Member State policy documents on climate change and biodiversity (Update of policy documents - Feb 26 2008

Note that the table identifies not all climate change strategies in each country, but those strategy/policies which appear **most focussed on biodiversity**

Member State	date	Policy documents	Class. A-F	Comment
Austria	2002	Climate Strategy 2008-12 klima:activ (MITIGATION) Key ministry: Federal Ministry of Agriculture, Forestry, Environment and Water Management www.lebensministerium.at	A	http://www.accc.gv.at/ = Austrian Climate Portal **Feb 08: klima:aktiv news newletter, plus klim:activ climate protection programme.**
		Regional policies and measures	A	
Bulgaria	2004	Second National Action Plan on Climate Change 2005-8	A	http://www.moew.government.bg/home_e.php?action=fullnews&id=44 Covers activities/policies for all economic sectors, and indication of funding
Denmark	2003	Ministry of Environment http://www.mim.dk/ and Danish EPA "Miljoestyrelsen" www.mst.dk Proposal for a Climate strategy for Denmark From 2005: Work on preparing adaptation policy and catalogue of impacts. Strategy under preparation (planned for 2007)	A	Concerns CO_2 emissions, and mitigation
	2007?	Summary of the Danish Government's Strategy for Climate Adaptation http://glwww.mst.dk/homepage/default.asp?Sub=http://glwww.mst.dk/transportuk/01000000.htm		see update by country. Refers to nature and nature management. Mentions corridors, EIA, activities to improve resilience of nature and environment plus risk analysis and risk management. Also, maybe, "safeguarding" land for future biodiversity use? mentions "reservations in planning"
Finland	2005	National Strategy for Adaptation to Climate Change. (to 2080) (see section 2.2 for more details)	D/E	Addresses biodiversity: principles and objectives and timelines, but no locations or targets http://www.ymparisto.fi/
France	2006	National adaptation strategy for the consequences of climate change ONERC	C/D	Addresses biodiversity (cross-cutting theme) Objectives and strategies (in general terms) across sectors. No locations, timelines or targets.
	2006-7	Territorial Climate Plans (regional and local level)	B/C	Some mention of general adaptation (for heatwaves, drought, flooding) but not biodiversity.

Germany	start: 2007	German National Strategy on Adaptation to Climate Change	C/D	Work on this started 2007. The first stage will be a compilation and evaluation of existing knowledge on climate impacts across all relevant sectors and on possible adaptation measures for consultation in 2008. Nature conservation will be one of the sectors considered.
		Lander level: Some states (e.g. Baden-Württemberg, Hessen, Thüringen, Sachsen, Bayern) have completed studies on the regional impacts of climate change, including conservation concerns. In some states, adaptation strategies are also currently under development, none have been completed yet.	B	Two examples for studies carried out: "Impacts of climate change on water-related ecosystems", an R+D-project in Sachsen (peatland areas) which identified expected impacts and possible measures Brandenburg: research on ways to prevent impacts of increasing drought on its large-scale protected areas, especially the Spreewald Bio-sphere Reserve (br-spreewald@lua.brandenburg.de).
Greece		Ministry of Environment http://www.minenv.gr/4/41/e4100.html		National report on climate change "coming soon" on website (Feb 08)
Italy		Ministry of the Environment and care for biodiversity www.minambiente.it http://www.conferenzacambiamenticlimatici2007.it/site/it-IT/ lists "hotspots" for biodiversity impacts in forests Climate conference held in Rome in September 2007, by Envt Min. Conference "manifesto" makes some ref to biodiversity		Documents only on environmental sustainability, little reference to climate change (06/07) Italy's Third National Response to the Framework Convention on Climate Change (2003) deals with emissions and mitigation nothing else on website: Feb., 2008
Netherlands	2004	Nota Ruimte (5th National Policy Document on Spatial Planning)	A/B/C	Identifies impacts, proposes mitigation
	2006	Regional example: Noord-Holland Water Management Plan 2006-2010		Recognition of CC impacts on water (availability, flooding)
	2006	Climate strategy: between ambition and reality (Scientific council for Government Policy http://www.wrr.nl/content.jsp?objectid=3638		(English summary seen) emphasis on flooding issues

Portugal		ICN: Instituto da conservacao da natureza http://portal.icn.pt/ICNPortal/vPT/ Comissão para as Alterações Climáticas - essentially mitigation. Plan for Energy Efficiency (2007) National Strategy for Conservation of Nature and Biodiversity (2001)	B/C	Research example: SIAM project: Scenarios, impacts and adaptation measures - Project report: http://www.siam.fc.ul.pt/SIAMExecutiveSummary.pdf
Spain		National Adaptation Strategy on CC and Action Plan www.mma.es/portal/secciones/cambio_climatico/areas_tematicas/impactos_cc/pdf/pna_v3.pdf	C/D	Essentially an Action Plan for R&D, includes biodiversity
		Climate Action Plan for Andalucia 2007-2012	B/C	Mitigation programme with R&D and mention of adaptation
		Estrategia Española De Cambio Climático Y Energía Limpia Horizonte 2007- 2012 -2020		Spanish Strategy for Climate change and Clean Energy. Mitigation and adaptation measures, plus clean energy. Update to UNFCCC indicates some funding for adaptation measures.
Sweden	2002	Swedish climate policy (bill)	A-C	
UK		UKCIP (UK Climate Impacts Programme, sponsored by DEFRA) National and regional strategies for adaptation, making some reference to biodiversity. Research programme preparing technical reports . www.ukcip.org.uk Adaptation policy framework under preparation to structure roles and activities of relevant organisations - government, etc. Regional impact studies	A/B/C	Example of research under UKCIP: Monarch (Modelling Natural Resource Responses to Climate Change): a synthesis for biodiversity conservation Wamsley, et al. 2007 Example of regional impact assessment studies: REGIS: Regional Climate Change Impact Response Studies in East Anglia and North West England.
		A Government agency - Natural England - with responsibilities for biodiversity is preparing a campaign for a "National spatial vision" which will include spatial planning for adaptation to climate change		Managed realignment of coasts✶
	2007	England Biodiversity Strategy Review for CC – available from Defra website: http://www.defra.gov.uk/wildlife-countryside/resprog/findings/ebs-climate-change.pdf	D	

Annex 2 Selection of non-EU policy documents on climate change and biodiversity

Country	date	Policy documents	Clas sfn. A-F	Comment
Australia see section (2.3 for more details)	2004-7	National Biodiversity and Climate Change Action Plan http://www.environment.gov.au/biodiversity/publications/nbccap-brochure/pubs/actionplan-brochure.pdf In April 2007, the National Climate Change Adaptation Framework highlighting priority actions for a range of vulnerable sectors, including biodiversity, was endorsed by the Council of Australian Governments.	E/F	Action Plan details objectives, strategies and actions, at specific locations and location-types (or environments); also actions by cross-cutting themes; working group to oversee implementation. The Adaptation framework refers to Government is investment of $126 million over five years in climate change adaptation policies, programs and research. A further $44 million is being invested in a CSIRO Climate Adaptation Flagship
Canada	2004	Provincial example: British Columbia: Weather, climate and the future: B.C.'s Plan http://www.env.gov.bc.ca/air/climate/cc_plan/pdfs/bc_climatechange_plan.pdf	A/B	Sets out multiple actions (by sector), chiefly for mitigation, 5 on adaptation. Biodiversity mentioned mainly under forests and water sectors.
Norway	1998 2007	Norwegian Climate Change Policy White paper on climate change policy: http://www.regjeringen.no/en/dep/md/Documents-and-publications/Government-propositions-and-reports-/Reports-to-the-Storting-white-papers-2/2006-2007/Stmeld-nr-34-2006-2007-.html?id=473411	A ?	A translation to English of the White paper is currently being finalized. Message from Philip Mortensen , adviser, Department for Pollution Control, Ministry of the Environment. Also: recent work on integrated management of the Barents Sea (holistic, long-term) emphasises biodiversity and climate change and need to protect for long term value
USA	2007?	United States Environmental Protection Agency US Climate Change Science Program *Preliminary review of adaptation options for climate-sensitive ecosystems and resources.* Draft July 2007, planned publication: May 2008		Adaptation measures listed on under "ecosystems and wildlife" on EPA website include migration corridors, appropriate management practices and promoting ecosystem resilience via management practices.

2.2 Comparison of three Member States' national strategies for climate change adaptation and the salience of biodiversity

2.2.1 Introduction

This section of the report presents a detailed analysis of three national strategies aimed at adaptation to climate change[4]. The analysis evaluates the three strategies in terms of their "fit" with the four pillars of the EC Green Paper *Adapting to Climate Change (2007)* in order to identify whether these approaches ("pillars") are already being recommended. It also examines the structure and content of the adaptation plans, focusing in particular on biodiversity. Biodiversity-related measures within the plans are categorized.

2.2.2 Methodology

EU Member States' published strategies for adaptation to climate change were identified either via contact with relevant ministries or researchers, or via the Internet. Various types of strategies, plans and action plans exist or are in preparation for many countries - some are focussed on climate change and relate to either or both mitigation or adaptation measures such as the UK's Climate Change Programme, and others are more broadly based national spatial planning strategies which also include planning for climate change e.g. the Dutch Nota Ruimte (2004) which also touches on climate change as a major pressure influencing planning and land use.

Selection criteria: Five regions and environments are identified in the CEC Green Paper on adaptation (CEC, 2007) as being particularly vulnerable to climate change effects. They are: mountain areas, especially the Alps; Mediterranean/southern Europe; and Scandinavia/Arctic regions, as well as coastal areas across the Community and densely populated floodplains. The three plans selected for analysis have been chosen as they refer (at least in part) to examples of these environments. These three strategies are shown in Table 2.2.

Table 2.2 - The three adaptation strategies compared

Country	Author / date / title	Includes environments in:
Finland	Ministry of Agriculture and Forestry (MAF, 2005) *Finland's National Adaptation Strategy (An integral part of the National Energy and climate change Strategy)*	Scandinavia/ Arctic regions
Spain	Ministry of Environment, Spanish Office for Climate Change OECC (2006) *Plan nacional de adaptación al cambio climático (National Plan for Adaptation to Climate Change)*	Mediterranean regions
France	ONERC (Observatoire nationale sur les effets du changement climatique) (MAF, 2007) *Stratégie nationale d'adaptation au changement climatique* (*National strategy for adaptation to climate change)*	Mountain regions/Alps

Evaluation criteria: Criteria for the evaluation of these strategies have been developed on the basis of recommendations in the EU Green Paper *Adapting to Climate Change* (CEC, 2007). The Green Paper sets out four principal "priority options" for addressing climate change - these are referred to as the "four pillars" of the Green Paper, and are summarized in Box 2.2.

[4] A version of this section (2.2) has been submitted for publication to the journal *European Planning Studies.*

Box 2.2 Four pillars of EU Green Paper *Adapting to climate change*

Pillar 1: Early action in the EU
- Integrate adaptation when implementing existing and upcoming legislation and policies
- Integrate adaptation into existing Community funding programmes
- Develop new policy responses

Pillar 2: Integrating adaptation into EU external actions

Pillar 3: Reducing uncertainty by expanding the knowledge base through integrated climate research

***Pillar 4*:** Involving European society, business and public sector in the preparation of coordinated and comprehensive adaptation strategies

The climate change strategies compared here (Finland, Spain and France) were devised by national government institutions which form part of the epistemic policy development community surrounding climate change and environmental protection, so it is to be expected that, although published before the Green Paper on adaptation, they might share many of the recommendations of that Green Paper.

The three national strategies are not strictly similar: they have been prepared at different dates and so represent different stages in the development of understanding of climate change and adaptation. Table 2.3 compares their structure, then Table 2.4 uses a classification or scoring system to indicate compliance with the four pillars or approaches. These scores (0 – 3) indicate for each "pillar" (e.g. integration into external actions)

0 no mention
1 brief reference
2 moderate reference
3 well-integrated references

Next, the plans were examined for the use of specific planning tools (such as objectives, deadlines and indicators) to assess how well they may be implemented and monitored. All these plans provided a detailed analysis of impacts and effects of climate change, and make reference to international scenarios of climate change and to the use of risk assessment. The further components and tools, presented in Table 2.5 and discussed in section 2.2.4, include:

- the structure of the plan
- its objectives and goals (the future state to be attained)
- identification of time horizon used and any deadlines for action
- plans for research, use of maps and any system of indicators for monitoring progress towards achievement of the plan
- other aspects: composition, scenarios, responsibilities

With regards to the discussion of alternatives, which would also normally be a core element of strategic planning, this is restricted within the three strategies to alternative measures and some mention of alternative scenarios of climate change.

Finally, the measures for the protection of flora and fauna and ecosystems proposed in the three adaptation strategies are discussed in section 2.2.5 below.

2.2.3 Findings: alignment with Green Paper proposals

Although each of the three strategies antedates the EU Green Paper on adaptation, they have been analysed with respect to its four pillars, in order to identify the ways in which they may need to be updated. Table 2.4 presents the analysis of the strategy documents using

these criteria - darker shading in each cell indicates a higher score (2 or 3),using the scoring system described in 2.2.2 above.

Pillar 1: Initial actions
The EU Green Paper has identified three types of initial action on adaptation, relating to policy, legislation and funding. The three strategies explored respond well here, particularly with respect to new or improved policy responses. The French strategy includes references to a review of legislation throughout; there is a lower perception of this need in the Finnish strategy and no mention of it in the Spanish document. Both the French and Finnish strategies show evidence of analysis of funding issues, though the Spanish strategy makes little reference to sources of funding.

Pillar 2: Integrate adaptation into national external actions
External relations and their consequences for adaptation to climate change do not feature in the Spanish strategy.

Perhaps because of France's overseas territories, there is good evidence in the French strategy of an awareness of the consequences of national external actions, with frequent references to interactions between France and other countries. Similarly the Finnish strategy contains references to the impacts of trade and linkages across international borders (e.g. on insurance).

Pillar 3: Conduct integrated climate research
Both the French and the Finnish strategies make widespread references to future and on-going national and international research programmes, with the Finnish strategy outlining plans for a specific research programme. This is less in evidence in the Spanish document which makes little reference to national climate research although it includes knowledge creation as a strategy objective; international research is acknowledged.

Pillar 4: Involve partners across society and public sector
It is Spain which makes most frequent reference to participation (between institutions, the public, etc.) as a tool in an adaptation strategy, and the preparation of a database of stakeholders is proposed. There is some reference to this approach in the Finnish strategy, but less in the French strategy.

Although all three of the strategies analysed here were published before the Green Paper, so are not responding to it, nevertheless this examination shows that generally speaking many of the approaches now proposed in the Green Paper have already been considered in each of the countries. Most importantly, all three are recommending strongly the development or improvement of policy responses to climate change. The importance of funding to strategy achievement is not stressed in any of the three cases, which may be a weakness, and similarly a review of legislation might be expected to achieve greater prominence than it is given.

Partnership approaches constitute a pillar of the EU proposals, and these feature strongly in the Spanish strategy - a database of actors/stakeholders is to be developed - though less so in the other two. Using partnerships to implement strategy may be a style of action not uniformly used across Europe, but given the extent of climate change impacts it is very likely to be an important approach not to be overlooked.

2.2.4 Discussion of three strategies with respect to structure and content

Table 2.5 analyses the three strategies with respect to their structure, their treatment of positive and adverse effects and five elements common to planning strategies: objectives; time horizon; research plan, mapping, and monitoring; composition (distinguishing biodiversity content); use of scenarios; and allocation of responsibilities Implementation measures (to aid biodiversity adaptation) are analysed in section 2.2.5 below.

Positive and adverse effects We know that climate change may bring both opportunities and adverse impacts, and these may be spread unequally across societies and members of societies. The three adaptation strategies studied deal principally with adverse consequences. A few advantages of climate change are mentioned in the Spanish plan and there is a sprinkling of perceived potential "advantages" in the French plan. A more systematic treatment of opportunities and impacts (referred to as advantages and disadvantages) is given in the Finnish document, though this strategy strongly emphasizes that the comparative significance of advantages and disadvantages cannot be assessed adequately at present. A European Environment Agency report (EEA 2007) has more recently attempted to assess the costs of inaction, and has concluded hat there are still considerable methodological as well as substantive difficulties in providing such a set of costs and benefits.

Plan objectives: Although the three strategies are intended for the same purpose, there is some difference between their objectives, identifying many different aspects of the challenge of climate change. France - which experienced major loss of life during the 2003 "*canicule*" (heatwave) - prioritizes security and public health and risk reduction (ONERC, 2007). The preservation of the natural heritage is a further headlining French objective. For Finland, the national strategy is focussed on strengthening and increasing the country's adaptive capacity, a much broader approach. Three sub-objectives are given (see Table 2.5) which relate to the formation of the strategy rather than to the objectives of the strategy itself; these sub-objectives cover description, assessment and presentation. The Spanish objectives include strengthening capacity, but also identify other broad objectives, including "meeting international obligations", knowledge creation, and the promotion of participation.

Time horizon: No time horizon is specified for the French plan, whereas the Finnish plan refers to a 75 year horizon and the Spanish plan to "10-100 years". Despite its title the French *National Plan for Adaptation to Climate Change* (prepared by ONERC, the National Observatory on the effects of global warming) is recognised to be a preliminary document, and it calls, on p. 83, for the coordination of its recommendations within the framework of an "authentic" national adaptation plan.[5] No deadlines are set.

Research plans, mapping and monitoring: Whilst the Finnish document refers to a forthcoming research plan, the Spanish and French documents merely refer to "needs" and to ongoing research. The need for detailed mapping is barely mentioned in the French and Spanish plans, but is in evidence in the Finnish plan. References to monitoring work occupy a small proportion (approximately 4%) of each strategy.

Composition: Not surprisingly, the three national strategies have quite different structures to achieve their aims though many of the same fields of information are included. The following Table 2.3 summarizes the approximate proportion of the main text given over to sections on background/context, climate change impacts, objectives and action - different sections are combined in individual cases. Table 2.3 indicates that 20-30% of each of these strategies presents the context and background to the strategy.

Biodiversity content: As an indicator of the perceived importance of biodiversity, the right-hand column of Table 2.3 indicates approximately how much of the main text is given over to the discussion of baseline information, impacts upon and adaptation strategies or measures in connection with biodiversity. Again there are major differences here – that a greater proportion of the Spanish text is devoted to biodiversity may be a reflection of the fact that Spain, amongst EU countries, has the largest proportion of its area designated for biodiversity importance as Natura 2000 sites (19.1%, vs. 7.5% and 7.7% for Finland and France, respectively) (EEA, 2007).

[5] ("Il est souhaitable que la mise en oeuvre de ces recommandations soit coordonnée dans le cadre d'un véritable plan national d'adaptation..")

Table 2.3 Structural composition of the three strategies

	Background	Objectives	Impacts	Action	Biodiversity-related text[1]
Finland	21%		43%	35%	5%
France	19%	5%	5%	70%	2.5%
Spain	31%	4%	60%		7.5%

Note 1: the biodiversity text is spread across the four main sections, Background – Action.

Scenarios: In each of the three cases the IPCC international climate change scenarios are presented, with some detail at national level (these are included in Table 2.3 under "Background". These scenarios include socio-economic changes in an array of political circumstances, but it may be that these do not accurately represent the full consequences of interactions between climate and non-climate impacts. Non-climate changes such as population growth and economic growth outside national and EU boundaries (such as in India and China) are not analysed in any of these strategies although their interactions with climate change may exacerbate impacts.

Responsibilities: The Spanish strategy gives greater detail than the other two on which institutions and government agencies might have responsibility for specific actions or areas, and provides a coordination plan, as well as a separate section on communication, training and awareness. The Finnish strategy is particularly detailed with respect to impacts and background. All make reference to an array of economic sectors and environments and to cross-cutting issues, though these are more sketchily represented in the Spanish plan.

Table 2.4 National strategies evaluated by "four pillars" of EU Green Paper *Adapting to Climate Change* (see text for details of scoring system, 0-3; darker colour cells indicate closer compliance)

	CEC Green Paper	Finland (MAF, 2004)	Spain (OECC, 2006)	France (ONERC, 2007)
1	Initial action			
1.1	Integrate adaptation into policy and legislation	**1 / 2** Some reference to need for legislation review	**0 / 3** No mention of legislation review; BUT many references to adaptation policy development	**3** Widespread reference to review of legislation
1.2	Integrate adaptation in funding programmes	**2** Moderate analysis of current funding and possibilities for change	**1** Very brief mention of sources of funding	**2** Discussion of international and some national sources; recommendation made for study of potential funding sources.
1.3	Develop new policy responses	**3** Widespread reference to new policy responses	**3** Frequent reference to improved adaptation policies	**2** Several non-specific references to need for "enhancement of adaptation policies"
2	Integrate adaptation into national external actions	**3** Widespread reference to impacts of trade and role of international insurance	**0**	**3** Widespread references to interactions between other countries and France, and developed-developing countries
3	Conduct integrated climate research	**3** Outline of plans for research programme	**1** Some reference to international research; less to national climate research	**3** Widespread references to international and national research programmes
4	Involve partners across society and public sector	**1 /2** Some references to partnerships across society	**3** Widespread reference to participation between institutions, public, etc.	**1** Little reference to collaborations, partnerships or participation across national society. Some reference to international collaborations

Table 2.5 - Planning devices used in the three strategies

	Finland: Finland's National Strategy for Adaptation to Climate Change (MAF, 2005) 281 pp.	**Spain**: National Plan for Adaptation to Climate change (OECC, 2006) 59 pp	**France:** National Strategy for Adaptation to Climate Change (ONERC, 2007) 97 pp
Structure	Background and Objectives; Future Scenarios; CC Impacts; CC Adaptation (sector-specific adaptation, to change elsewhere, cross-sectoral issues); Impacts and follow-up.	Background; Objectives; Technical characteristics (approaches, CC scenarios); Modelling impacts (by 15 sectors - economic and environments); Plan coordination and management; Institutions; Plan development; Participation; Communication, training and awareness; Monitoring and evaluation.	Introduction/ background; Context (change, risks, susdev); Objectives; Nine strategic axes (develop, consolidate, inform, use, etc.); Cross cutting approaches (water, risk, health, biodiversity); Sectoral highlights (agriculture, transport, insurance, etc.); Environment types (urban, coastal, mountain, forest); Implementation.
Objectives set for strategy	"to strengthen and increase Finland's adaptive capacity"; to be achieved by: - describing CC and its impacts; assessing sensitivity of sectors. - assessing current adaptive capacity, vulnerability and opportunities associated with CC; - presenting actions that should be taken immediately and policies for future actions.	-Integrate CC adaptation into planning and management -Knowledge creation and strengthening of capacity. -Help administrations and organisations evaluate CC impacts. -Promote participation for definition of better CC adaptation options. -Meet international obligations.	-Act for security and public health -Reduce inequalities of risk. -Limit costs, take advantage of benefits. -Preserve natural heritage.
Time horizon / deadlines	< 2080 (=75 years)	"10-100 year strategy" no deadlines set (less applicable in strategic plan)	not specified
Research plan	Five year research plan from 2006 to be proposed.	Reference to ongoing coastal research; no specific research plan.	References to needs
Mapping	Global impacts map & forest vegetation zones map; flood maps mentioned.	No reference to mapping.	Two small maps of climate risk and one of soil movement included.
Monitoring and indicators	Reference to monitoring systems; no indicators specified.	Sparse reference to monitoring; a few indicators mentioned.	Monitoring system and indicators.

2.2.5 Biodiversity protection implementation measures proposed

Investigating ways of enabling biodiversity to adapt to climate change is an objective of MACIS so the profile/salience of biodiversity within adaptation plans has been examined - a broad estimate of the proportion of plan text devoted to biodiversity is given above in section 2.2.4 and in Table 2.3.

A number of measures are proposed in each of the plans, and these may be broadly categorized as policy measures, technical measures (research, assessment) and implementation measures, though some are difficult to categorize. Examples of these measures, selected from the three strategic plans, are given in Table 2.6 below. All the measures represented here relate to biodiversity though the documents cover a wider array of measures.

The examples of measures proposed are given to indicate the range of measures, but also to demonstrate the differences between the plans in the level of detail, e.g. on location or approach. Thus, compare the very broad character of the French recommendations with the much more detailed Finnish measures - see in particular the technical measure relating to the protected area network, which specifies locations. The Spanish strategy largely follows the structure of the Finnish strategy, listing recommended measures by natural resource (water, forests, soil, etc.) and by economic sector. The Finnish strategy, however, also distinguishes between anticipatory and reactive measures, and public and private measures.

The prominence of biodiversity-related measures varies sharply between the three strategies: only 7% of the French "recommendations" relate directly to biodiversity, compared with 10% of the Finnish "indicative adaptation measures" and 15% of the Spanish "courses of action".

The strategies propose an array of measures to protect biodiversity and ecosystems, although these tend to concentrate on aspects of the sector as it currently exists, rather than upon sectoral responses such as how, for example, transport planning might be upgraded to strengthen biodiversity (the agriculture sector is the exception here).

Table 2.6 Examples of biodiversity-related measures proposed in plans

France	The French strategy proposes 43 recommendations (of which 3 relate directly to biodiversity)
Policy measure	Recommendation 48 -Follow a precautionary policy with regards to strengthening the adaptation capacity of forests...
Technical/research measure	Recommendation 28 - Research into all measures to improve ecosystem resilience
Implementation measure	Recommendation 28 - Implementation of ecological corridors (following research)
Finland	Total of 210 "indicative adaptation measures" of which 121 relate to natural resources (of which 21 concern biodiversity) and agriculture, whilst 89 relate to economic sectors.
Policy/institutional measures	•Reducing human-induced stress on nature by controlling land use •Changes in policy regarding the management and use of protected areas, when necessary •Conservation of valuable traditional farmland biotopes with the help of the agri-environmental support scheme
Technical/research measures	• Evaluation of the integrity and connections of Finland's network of protected areas in the core areas of boreal species near the Finnish-Russian border, as well as in the watershed Suomenselkä and a number of places elsewhere in Southern and Central Finland. Discovering the possibilities to reduce the pressures for change in the ecosystems of mountain areas. • Studying the preconditions for the protection and management of water systems and their catchment areas so that deterioration in the quality of water can be prevented and the living conditions and opportunities for certain cold water species can be improved.

Implementation measures	• Reconstructing and restoring wetlands and mires to reduce the pressures for change in the water economy of catchment areas and to ensure that they function as naturally as possible, while studying the potential drawbacks caused by such measures. • The improvement of monitoring, planning and information systems regarding biodiversity for studying the overall impacts of climate change
Spain	A total of 59 "courses of action" are proposed relating to natural resources (inc. agriculture) and 24 relating to economic sectors (thus, 83 in all). Thirteen measures are listed under biodiversity.
Policy/institutional measures	• Promotion of greatest possible genetic variation in ecosystems as a basis for adaptive capacity in the light of climate change • Development of guidelines and handbooks for management of agricultural systems with a view to short term climate change, based on simple strategies for changing farming practices such as sowing dates. • Development of the most sensitive climate change indicators for use in implementing WFD. • Climate change to be incorporated as a variable to be considered in ecosystem restoration projects
Technical/research measures	• Monitoring soil degradation/desertification via erosion and soil carbon loss • Assessment of carbon balances for different Spanish ecosystems • Assessment of effects of climate change on alien spp in Spain
Implementation measures	• Consolidation of long term monitoring networks and integration of information to detect effects of climate change • Identification of biological indicators system for climate change, and devising of protocols to set up a vigilance system for early warning

2.2.6 Policy learning

As climate change is a problem shared across the EU and the world, and it must be expected that common approaches and measures will be applicable in many countries and regions, shared policy development and learning will help in the adaptation process[6].

It has been argued that successful policy integration requires attention to the ways in which problems are framed and reflection on the knowledge of policy options and instruments and, more significantly, knowledge of and reflection on the policy process itself. This form of policy learning entails both technical learning (such as knowledge of the effectiveness of various policy instruments), but also conceptual learning. Conceptual learning is the ability to adjust ways of framing the issue and developing solutions under conditions in which policy frames and collective goals are evolving (Nilsson and Eckerberg, 2007). This ability to work with changing perspectives and to re-frame objectives and strategies is deemed to be essential for achieving more integrated sustainable development. Such policy learning for sustainability is particularly needed for providing international, national and local responses to the problem of climate change**.**

To what extent do these strategies demonstrate policy learning? Using Nilsson and Eckerberg's distinction between technical learning and conceptual learning (2007), our review suggests that the plans show a varied reflection on the technical efficiency of the actions an instruments they contain, with some identification of knowledge gaps and hence areas for research, but little emphasis on the importance of monitoring the implementation or effectiveness of these actions.

For conceptual learning, the plans do recognise the challenges of the evolving scientific evidence for climate change, the need for pre-emptive and precautionary action, and the

[6] A further example of collaborative work between EU Member States is the Netherlands contribution to Bulgaria's Second National Action Plan on Climate Change. See http://www.evd.nl/zoeken/showbouwsteen.asp?bstnum=113571&location=&highlight=

implications this has for framing the problem and the notion of solutions. They also recognise that both mitigation and adaptation require not just top-down policy actions, but societal shifts in expectations and behaviour. They thereby illustrate a degree of policy learning and reflexive governance, building on the notion that circumstances change, that traditional modes of government action are insufficient, and that a shift in values is required. However, they do not consistently recognise the possible synergies or conflicts between the actions proposed - for instance, the possible conflicts in the contentious area of biofuels as a response to climate change mitigation that might inhibit the ability of biodiversity to adapt to climate change.

2.2.7 Conclusions

This section of the WP4 MACIS research set out to discover whether existing national strategies share with the EU Green Paper their identification of objectives, approaches and tools and consequently, what gaps exist and how the strategies might be reviewed and updated. In addition, the study has explored the structure and content of the strategies and the implementation measures recommended.

The analysis has identified a good deal of variation in structure, level of detail, use of standard planning elements/tools, time horizons and implementation measures. When compared with the four pillars of the EU Green Paper *Adapting to Climate Change*, we see that the strategies respond well on the need for policy review and enhancement though recognition of a need for legislation change is low. Awareness of impacts and linkages across the globe in connection with climate change and activities such as trade and insurance is good in the French and Finnish strategies, but less good in the Spanish strategy. The important role of research is recognised by all three countries, though not all propose detailed research plans. The value of participation and partnership is best recognised in the Spanish strategy, which also begins to allocate roles to specific institutions of government and amongst stakeholders.

The formulation of climate change mitigation and adaptation strategies is taking place internationally and nationally as well as at regional and local levels. There are now good opportunities to build on work in other locations and bio-geographical and economic regions. Where climate change adaptation strategies are being drafted by further countries, the following points might be considered.

- Careful objective setting, to provide responses to the complex and interacting impacts of climate change upon environments (including biodiversity), society and the economy, as well as upon governance.
- Determination of an appropriate time horizon for the strategy, in line with the rate of change, recognising that there is uncertainty over the rate and extent of future change.
- Assessment of policy coherence between climate change mitigation and adaptation measures
- The need for periodic review of legislation and policies affecting a wide array of sectors which interact with biodiversity and the environment, such as infrastructure sectors (transport, energy, housing, water) and other sectors (including tourism and health).
- A deepening of the analysis of impacts to respond to Pillar 3 of the Green Paper (reducing uncertainty), via the inclusion of interactions with other (non-climate) pressures such as demographic change and urbanisation.
- A thorough review of impacts, direct and indirect, of external actions involving both developing and developed countries.
- Designing plans for national research on adaptation to climate change, as well as cooperation with international research to include the development and implementation of monitoring systems and indicators of change
- The identification of sources of potential funding, both national and EU, to support adaptation measures
- The engagement and involvement of stakeholders and partners across society and the public sector - and measures to promote participation and partnership

The prominence of the biodiversity and ecosystems topic varies in the three strategies - but it neither dominates nor is overlooked in any of them. In the Spanish strategy, biodiversity is first on the list (non-alphabetical) of sectors discussed. There would appear to be reasonable acknowledgement of both impacts upon biodiversity and the multi-functional importance of biodiversity conservation and ecosystem services in the three strategies discussed here, though in future work there is a need for analysis of the interaction between sectors (e.g. transport, agriculture) and biodiversity, and how sectoral policies might change to improve the resilience of natural resources to climate change. These issues are discussed further in section 3.

2.3 Australia: Action Planning for Biodiversity and Climate Change

Source: ***National Biodiversity and Climate Change Action Plan 2004-2007 (2004)***
www.environment.gov.au/biodiversity/publications/nbccap/pubs/nbccap.pdf
published by: Natural Resource Management Ministerial Council (last accessed 28 03 08)

2.3.1 Introduction, composition and content

This section summarizes a non-EU example of an existing action plan for the protection of biodiversity in the face of climate change. The Plan is reviewed here as an example of a plan which incorporates many of the responses which Hannah et al. state are necessary to conserve biodiversity in a changing climate (see Box 2.1 above). The Action Plan derives from *The Review of the National Strategy for the Conservation of Australia's Biological Diversity* (ANZECC 2001) which identified the need to 'Plan to minimise the potential impacts of human-induced climate change on biological diversity'. Subsequently, in response to this, the *National Objectives and Targets for Biodiversity Conservation* specified a target to develop a National Biodiversity and Climate Change Action Plan, and this is the document reviewed here.

The following analysis covers the aspects already described above (section 2.2) for three EU member state national strategies for adaptation (though the above cases cover all sectors, not only biodiversity).

Positive and adverse effects a number of benefits associated with climate change are identified: costs and benefits of climate change impacts on biodiversity; benefits of adaptation; benefits from association with international research. Also: opportunities to improve stewardship of biodiversity

Plan objectives: list as stated below

Time horizon: the action plan is dated 2004-2007 and actions laid out are to be implemented over the "next three years" i.e. by 2007, though this is set in the context climate impacts occurring "over the next 100 years". The plan is described as a "national framework" with individual work plans to be developed by each State and government. The document also states: "This three-year plan is only the beginning. Programs will be reviewed in 2007 and a revised plan will be developed in light of new understanding and information." (The published report of this further review is not yet available.)

Research plans, mapping and monitoring: This is the principal content of Objective 1; priority areas for research and monitoring are identified, including the need for "gap-filling research" on understanding of impacts of climate change on biodiversity, in improving knowledge and communications.

Composition: Of the 38 page main text, all of which in concerned with biodiversity, 26% is concerned with background – predictions and impacts on biodiversity; a section on objectives, strategies and actions occupy 43% of the plan.

Scenarios: The IPCC international climate change scenarios are presented briefly; no socio-economic scenarios are used..

Responsibilities: Throughout the text actions are repeatedly allocated to "all jurisdictions", with some specific allocation of responsibilities to bodies such as National Heritage Trust and National Action Plan (e.g. salinity) regions.

2.3.2 Objectives of the Australian action plan

1 to improve our understanding of the impacts of climate change on biodiversity (identify gaps in knowledge, refine tools, improve ability to measure..

2 to increase awareness of climate change impacts on our capacity to respond (raise awareness in the community, develop information packages..)

3 to minimize the impacts of climate change on inland aquatic and semi-aquatic ecosystems (identify impacts, identify actions to be taken

4 to minimize the impacts of climate change on marine estuarine and coastal ecosystem (identify vulnerable species and ecosystems, consider ways to protect

5 to minimize the impacts of climate change on native terrestrial spp, communities and ecosystems (design protection programmes for vulnerable spp, re-establish natural vegetation as habitat for vulnerable species)

6 to minimise the impact of invasive organisms on biodiversity in future climates (work to improve understanding of IAS, prevent establishment of IAS

7 to factor the impacts of climate change on biodiversity into natural resource management and land-use planning (incorporate monitoring and evaluation of impacts of climate change on biodiversity into the natural resource management frameworks; work to ensure that suitable strategies to minimise adverse impacts of climate change are incorporated into regional plans and other biodiversity plans)

The Australian Action Plan recognises that species distribution is likely to change under climate change "communities may dissolve, while new ones may form" - timeframes for change "as short as decades" are considered likely, and "species that are currently "protected" in reserves may therefore not be adequately conserved in the future".

The Action Plan states that therefore, there is a need to:

1 ***Helg species adapt to climate change***

- create networks of protected areas or "ecological opportunities for movement"
- build resilience (of ecosystems) to climate change, i.e. ability to withstand and recover from environmental stresses

2 Protect species that are particularly vulnerable to climate change.

- create refuges
- create buffer zones (minimize stresses)
- find the best management techniques

2.3.3 Range of approaches proposed

The measures proposed include the following, which have similarities with the green Paper's "four pillars". There is, however, no mention of harmonising external actions with these adaptation aims.

- Integration climate change considerations into the management of all other threats to biodiversity by biodiversity managers. (There is no mention of wider review of legislation and policy in order to integrate biodiversity protection into other sectors).
- Reducing uncertainty via research
- Developing communication strategies to engage the support of key stakeholders for adaptation
- measures identified in the plan (stated to include: Landcare and other NRM-related community groups; land-holders; the tourism and mining industries and Indigenous communities).

Specific funding for the initiatives and actions were not determined in this Action Plan, but have been in the Adaptation framework - see below.

2.3.4 Subsequent development and funding

A series of catchment-based reports produced by CSIRO to raise awareness of local risks and adaptation potential have been produced, (e.g. the Murambidgee catchment), which recommend measures with potential to help biodiversity, including:

- Improving water-use efficiency;
- Providing migration corridors for vulnerable fauna and
- Reviewing flood management arrangements.

In March 2008, Australia's Department of Climate Change published: Implications of climate change for Australia's National Reserve System: a preliminary assessment (Dunlop and brown, 2008). Whilst this is not a strategy or plan, it does give a comprehensive assessment of both impacts upon biodiversity (nationally and in agro-climatic zones and at bioregional level and focuses specifically upon areas protected for their ecological value. This report refers to Australia's National Climate Change Adaptation Framework (April 2007) highlighting priority actions for a range of vulnerable sectors, including biodiversity, which has been endorsed by the Council of Australian Governments.
The Framework is divided into two main sections or "Strategies and actions". These are:

- **Building Understanding and Adaptive Capacity**
  - Australian centre for climate change adaptation
  - Regional climate change information
  - Integrated regional vulnerability assessments
  - Communication, information and tools
  - International connections and partnerships

- **Reducing Sectoral and Regional Vulnerability**
  - Water resources
  - Coastal regions
  - Biodiversity
  - Agriculture, fisheries and forestry
  - Human health
  - Tourism
  - Settlements, infrastructure and planning
  - Natural disaster management

Following this Framework the Australian Government is investing $126 million over five years in climate change adaptation policies, programs and research. A further $44 million is being invested in a CSIRO Climate Adaptation Flagship.

2.4 Conclusions

The three sections above trace the development of planning for biodiversity protection under changing climates in both EU and non-EU countries. From the early recognition of climate change, moving through the identification of how this might impact upon the array of physical, social and economic resources and systems, approaches have been developed suggesting ways of tackling change. Mitigation (emission reduction) was explored first, then adaptation (adapting to changes which are known to be inevitable). These concepts have come to be applied to the array of policy sectors (e.g. health, tourism, built environment, transport), then eventually to biodiversity. Increasingly the significance of natural systems (atmospheric, soil, water, habitats and their component species) has been better understood, and the protection of biodiversity is now seen more widely as an essential element in supporting other activities – notably agriculture and tourism - but also in supporting health and well-being and even economic activity.

Whilst biodiversity figured relatively faintly in early strategy-making on climate change it appears to be increasingly recognised that interactions, cumulative effects and synergies

exist which can and must be taken into account. Changes expected in climates (and extreme weather) will interact with activity in sectors such as transport or building and so, in addition to the direct impacts of climate change, other indirect effects arise, many of which have consequences for biodiversity. Integrating action to address both direct and indirect effects of climate change and other aspects of human activity is vital to biodiversity protection. Measures to do this are coming forward.

Three EU national strategies for adaptation to climate change have been examined to identify both the measures proposed and also the likely effectiveness of such strategies. Effectiveness is taken to be dependent upon:

- Knowledge and understanding of systems, resources and effects and their interactions
- Knowledge and mastery of policies and measures which will bring the desired results
- Authority/power to carry out the necessary actions, backed by legislation
- Resources – the skills, funds, access to land, and time needed to instigate (or control) actions
- Institutions, strategies and plans to monitor change and progress towards desired aims.

A non-EU example has also been examined. Australia has taken forward the process of planning for biodiversity protection in the face of climate change further (beyond the EU strategies) and into the action planning stage. This action plan goes some way to identifying locations for action and sources of funding. Other components which are also important, such as skills development, need to be incorporate into an overall national strategy – but may be outside the scope of a site-based action plan.

Nevertheless, what is apparent from the strategies and other documents explored is that there is still a form of “silo” thinking: whilst biodiversity is beginning to be perceived as being subject to climate change in combination with impacts from other sectors, this is not a two-way process. The extent to which other sectors may be impacted by indirect effects resulting from changes to biodiversity and its supporting systems, is still rather poorly identified, although loss of certain habitats and species may have very significant impacts. This topic is explored more closely in the next section (3) which investigates recent policy trends and the extent to which biodiversity has been incorporated in statements and aims. A further set of possibilities: how other sectors can be encouraged pre-emptively put in place practices and approaches which are beneficial to biodiversity whether or not those sectors are causing significant direct impacts upon biodiversity, is rarely considered, and such action is probably restricted to the agriculture sector.

3 EU POLICY AREAS, CLIMATE CHANGE AND BIODIVERSITY

3.1 Introduction

This section presents the result of a review of policy for biodiversity and for other policy sectors (sustainable development, agriculture, transport, etc.) where policy development is needed to take into account the potential impacts upon biodiversity which may result from climate change mitigation and adaptation policy and measures in those sectors. (MACIS Workpackage 2 reviews the impacts of activities in other sectors on biodiversity under climate change.) Policy options and implementation measures - collated following consultation with a sample of expert stakeholders - are outlined. Topics for future research are also indicated.

In the light of this review of policy areas we also draw attention in the summary and conclusions (section 3.6) to the EU's regulatory procedures and requirements for policy integration which offers opportunities for addressing impacts of climate change on biodiversity.

3.2 Biodiversity policy

Whilst early EU biodiversity policy was predominantly focused on sites and species, a wider understanding of biodiversity and its relationships and interactions with other systems and other impacts has emerged. The foundation for the protection of biodiversity is rests on the following Directives.

2001	Assessment of effects of plans and programmes (SEA) Directive 2001/42/EC	Requires assessment of significant impacts upon biodiversity, and mitigation resulting from sectoral and territorial plans
2000	Water Framework Directive Directive 2000/60/EC	Requires river basin management to be integrated with the requirements of the Birds and Habitats Directives,
1992	Habitats Directive 92/43/EEC	Natura 2000 network (inc. SPAs and SACs) process established; species protection. Article 10 highlights connectivity; Appropriate Assessment
1985, amended 1997, and transposed 1999	Environmental Impact Assessment Directive 85/337/EEC as amended by Directives 97/11/EC and 2003/35/EC.	Requires assessment of significant impacts upon biodiversity, and mitigation resulting from projects
1979	Birds Directive 79/409/EEC	Scheme for protection of all wild birds; SPA sites

Since the 1993 ratification of the UN Convention on Biological Diversity by the EU, key moments in the development of EU biodiversity policy have included:

2001: Biodiversity action plans to be prepared in the areas of conservation of natural resources, agriculture, fisheries, and development and economic co-operation, which had the aim of halting biodiversity loss ***in the EU*** by 2010 and to restore habitats and natural systems.

2004: Message from Malahide and Action Plan to 2010, which recognised the decline in ecosystem services and emphasized a global focus for biodiversity protection. Here the aim was to significantly reduce the rate of biodiversity loss ***globally*** by 2010; priority objectives and targets were set.

2006: Communication on Biodiversity, which set an agenda for action to halt the loss of biodiversity by 2010. The Communication includes provisions for:

- priority objectives addressing most important habitats and species;

- actions in the wider countryside and marine environment;
- making regional development more compatible with nature;
- reducing impacts of invasive alien species;
- effective international governance;
- support to biodiversity in international development;
- reducing negative impacts of international trade;
- adaptation to climate change; and
- strengthening the knowledge base.

The Communication highlights the need for measures relating to

- adequate financing,
- strengthening EU decision-making,
- building partnerships and
- promoting public education, awareness and participation.

Nevertheless, it is apparent that, despite the various Directives and the 2006 Communication, the loss of biodiversity has not yet been halted, and it is acknowledged that the 2010 deadline will not be achieved, despite the measures being taken. There are many reasons for the continuing loss of biodiversity, many of which relate to human and development pressures and therefore there is a strong case for better interpretation of the biodiversity commitment into other policy and sectoral decisions. For instance, to fulfil the measure "strengthening EU decision-making", the Impact Assessment Board (set up in 2006) has an important role in "ensuring evidence-based policy making inside the Commission through an integrated and balanced assessment of problems and alternative courses of action." This procedure clearly has potential value in the assessment of policies (including Directives) which may have impacts for biodiversity. See sections 3.1 and 3.6.3 for further comment.

At national level within the EU some policies on biodiversity exist which are more challenging than "halting decline" or "no net loss". A compulsory compensation system for development impacts upon biodiversity has been in place in Germany for over 20 years. Legislation backing this includes the Federal Planning Act of 2004 (updated 2007).[7] The legislation requires that all development proposals be accompanied by an undertaking to provide compensation (or "counterbalances[8]"). A further example is UK Planning Policy Statement 9 (PPS9) which states that regional plans should "include policies to conserve and ***enhance*** biodiversity at the regional and sub-regional levels" (ODPM 2005, p 4). This approach is also referred to in the associated Good Practice Guide as "net gain". Net gain is also an aim proposed for biodiversity action plans elsewhere than in the EU, such as in Australia (see box 3.7 below).

3.3 Consultation approach

A set of EU policy areas were selected - covering those areas more closely related with the physical environment, natural and built.(and therefore particularly relevant to biodiversity). Recent EU policy relating to each of these areas was reviewed and a set of amendments to policy, planning practice, action (implementation of planning) and research were proposed. The list of proposals was circulated (autumn, 2007) to a set of experts and expert institutions across the EU for comment, and responses were received from approximately half of these. The tables which follow (listed alphabetically) are based upon that consultation and the EU Green Paper: *Adapting to climate change* (EC, 2007).

The policy areas given below - and the proposals made for each in the tables which follow - represent a preliminary range of issues and approaches and are not to be considered as comprehensive.

[7] implemented under the local *Bebauungsplan* (Binding Land-use Plan) and at site-specific plan level; see http://www.iuscomp.org/gla/statutes/BauGB.htm, section 1a: *Consideration of environmental concerns*.

1 Agriculture and rural development
2 Biofuels
3 Energy
4 Fisheries
5 Flood Management (fluvial and coastal)
6 Soils and forests
7 Sustainable development
8 Transport
9 Water (quality and supply)

Each of these policy areas is analysed in a table which identifies the relevant policy document in the policy area, notes its objectives and the current level of reference to climate change and biodiversity, then indicates any implication for this policy area which is noted in the Green Paper. A set of possible amendments to policy and planning to incorporate policy for biodiversity under climate change are then listed. Subsequently (in section 3.3) a further set of nine tables present suggested implementation measures and research areas to bring together the policy area and biodiversity interests.

Comments were also sought on further policy fields, which also have potential impacts for biodiversity in circumstances of climate change - Competition; Regional policy; Trade, and International development. Fewer responses were received on these, but there is a brief commentary in section 3.4.

Further policy areas also need to be addressed - e.g. in addition to the topic of trade, Kok and Coninck (2007) discuss mainstreaming of climate policy for a further range of policy areas, not addressed here, namely: poverty alleviation; disaster management; air quality and health. However, biodiversity is not considered by these authors and these areas have not been addressed in the current exercise, though it is recognised that there may be interacting links, for example, between climate change, biodiversity and health.

3.4 EU policy areas - incorporating climate change and biodiversity in policy

Box 3.1 AGRICULTURE AND RURAL DEVELOPMENT POLICY[9]	
Policy document	Comment
Common Agricultural Policy Reference to CC and Bd: None Health Check of CAP reform (CEC 2007b: COM(2007) 722 final): Both CC and Bd will be considered.	"The aim of the common agricultural policy (CAP) is to provide farmers with a reasonable standard of living, consumers with quality food at fair prices and to preserve our rural heritage".
Community strategic guidelines on rural development , programming period 2007-2012 (Feb 2006) Reference to CC and Bd Resources allocated under axis 2 of CAP should contribute to CC - a priority area - combating CC Resources allocated under axis 2 of CAP should contribute to biodiversity - a priority area	Improving the environment and countryside is Community priority 2. Official summary of guidelines: With these strategic guidelines the Council identifies the European Union's priorities under the European Agricultural Fund for Rural Development (EAFRD). It establishes a link with the Göteborg and Lisbon objectives and translates them into rural development policy. The idea is to ensure the consistency of rural development with other Community policies, in particular in the field of cohesion and environment, and accompany the implementation of the new common agricultural policy (CAP) and the restructuring involved.
Council Regulation (EC) No 1698/2005 of 20 September 2005 on support for rural development by the European Agricultural Fund for Rural Development Reference to CC and Bd CC a "key issue" ; "specific methods of land management" needed to contribute to SusDev; also CC mitigation via afforestation Biodiversity a "key issue". Extend forest resources to protect biodiversity; forest-environment payments to enhance biodiversity	Rural Development is plays an important role in helping rural areas to meet their economic, social and environmental challenges. Rural areas make up 90 percent of the territory of the enlarged EU and the new legal framework is intended to boost growth and creating jobs in rural areas – in line with the Lisbon Strategy – as well as improving sustainability - in line with the Göteborg sustainability goals.
Forthcoming review	Further reforms of CAP and the 2008 Health Check could provide opportunities e.g. how far CAP promotes climate change compatible farming and pro-active environmental protection
Implication for policy or sector noted in EU Green Paper on Adaptation	The role of agriculture and forestry as providers of ecosystem services will gain importance e.g. water courses, flood management, multi-functional landscapes.

[9] Note: Agriculture and rural development are taken together here in view of their interlocking policies and impacts.

Possible amendment of policy, to protect biodiversity:

Policy

- Strengthen CC mitigation policy as it affects the agriculture and interactions with other sectors, e.g. transport, energy.
- Review policy/legislation and incorporate CC and Bd issues; integrate adaptation into funding programmes
- Consider subsuming agriculture policy into wider sustainable land use policy for Europe. This will assess the evolving goods and services needed from land as climate changes, make rational choices about competing land uses, and help farmers provide food and services e.g. flood areas, biodiversity, ecological connectivity, sustainable bioenergy.
- Integrate the dynamics of CC into farming policy at the European planning level - accepting new constraints (and some opportunities) and end anomalous practices e.g. widespread irrigation.
- Establish links with non-agricultural policies (e.g. recreation, water resources) so that beneficiaries can recognise/support the provision of services derived from agricultural land.
- Review EU external action on agriculture, rural development and interactions with CC implications for biodiversity globally.
- Reassess funding levels under CAP Single Payment scheme to better compensate the costs of implementing/maintaining environment-friendly farming options.
- Review conflicts between Community strategic guidelines on rural development, such as between aims like “improve competitiveness for farming and forestry” , “boost growth and create jobs in rural areas” and “improve quality of life and diversification of the rural economy” with the other main axis of “environment and countryside” .
- Review capacity of policy tools to guide possible responses of agriculture to climate change such that negative effects on biodiversity (e.g. of new crops, increased irrigation, crop breeding for drought or herbicide resistance, housing for stock – controlled environment) are controlled. Should policy be more pre-emptive and provide outline guidelines/legislation for possible outcomes? (a number of responses will be covered by existing law, e.g., water extraction licences).

Planning

- Provide for incorporation of measures to address climate change, assess impacts of rural development measures upon biodiversity and provide mitigation/compensation for them.
- Involve wide range of partners in developing coordinated and comprehensive adaptation strategies for agriculture, rural development and their interactions with biodiversity under changing climates

NB: See also: AEA et al. (2007) *Adaptation to Climate Change in the Agricultural Sector.*

Box 3.2 BIOFUELS POLICY

Policy document	Comment
Commission Communication An EU Strategy for Biofuels COM(2006) 34 final The European Union (EU) sets out seven strategic policy areas for the development of the production and use of biofuels by the Member States and developing countries. Reference to CC and Bd: Single reference: "..further policy development should take into account and reflect the differing CC benefits of different biofuel technologies and production processes" Brief reference (p 10) to "concerns" over use of set-aside land because of potential impacts on biodiversity and soil. Also, practices to avoid negative effects on biodiversity, water and soils.	Three aims: • to further promote biofuels in the EU and developing countries, ensure that their production and use is globally positive for the environment and that they contribute to the objectives of the Lisbon Strategy • to prepare for the large-scale use of biofuels by improving their cost-competitiveness • to explore the opportunities for developing countries – including those affected by the reform of the EU sugar regime – for the production of biofuel feedstocks and biofuels, and to set out the role the EU could play in supporting the development of sustainable biofuel production.
Forthcoming review	(most recent review started end of 2006)
Implication for policy or sector noted in EU Green Paper on Adaptation	Impact of biofuel energy production on global food supply should be assessed. Key question: What will be the consequences of climate change for Member States' potential energy mix and for European energy policy?

Possible amendment of policy, to protect biodiversity:

Policy

- Strengthen CC mitigation policy as it affects the energy sector and interactions with other sectors; only incentivise biofuels which are sustainable and produce lower/fewer impacts than the fuels they replace
- Policy/legislation review in order to incorporate CC and Bd issues; integrate adaptation into funding programmes
- Review EU external action in connection with biofuels and interactions with CC implications for Bd globally. Review impacts of timber and vegetable oil (e.g. palm) imports upon deforestation in exporting countries and determine sustainable policy.
- Determine policy on sustainable managed woodlands as source of biomass with potential beneficial biodiversity impacts.

Planning

- Involve wide range of partners in developing coordinated and comprehensive adaptation strategies

Box 3.3 ENERGY POLICY	
Policy document Reference to CC	Comment
Commission Communication An Energy Policy for Europe COM(2007) 1 final Reference to CC and Bd: CC listed as first of three major challenges to all EU members. Further references throughout communication. No reference to Bd	Factors contributing to energy policy: climate change strategy; strategy on sustainable development; integration of environment into community energy policy; forum on Energy and Transport and information on investments in energy generating sectors The policy compares different energy sources on grounds of price, CO_2 emissions, import dependence , efficiency and road transport, etc.
Commission Green Paper of 8 March 2006: "A European strategy for sustainable, competitive and secure energy" [**COM(2006) 105** final Reference to CC and Bd Frequent reference throughout and one of the core objectives is "actively to combat" climate change by promoting renewable energy sources and energy efficiency No reference to biodiversity (but biofuels seen as one of range of renewable technologies with potential to produce environmentally-friendly energy)	Official summary: "The Commission proposes a common European energy policy which will enable Europe to face the energy supply challenges of the future and the effects these will have on growth and the environment. [...]." Three core objectives: • sustainability (renewable energy sources and energy efficiency); • competitiveness (efficiency of the European energy grid, and competitive internal energy market) • security of supply and demand in an international context
Forthcoming review	Revision of Energy Performance of Buildings Directive is proposed. Strategic EU Energy review proposed in Energy Green Paper {SEC(2006) 317}
Implication for policy or sector noted in EU Green Paper on Adaptation	Opportunities e.g. for solar, but also risks e.g. cooling capacity of water; changed hydrological regimes for hydro-power; and higher demand for summer air-conditioning; and direct impact by storms and floods on energy infrastructure. Therefore need to diversify energy sources.

Possible amendment of policy, to protect biodiversity:

Policy

- Strengthen CC mitigation policy as it affects the energy sector and interactions with other sectors (including renewables, energy efficiency, distributed generation and low carbon sources, carbon capture and sequestration.)
- Review the regulatory framework - require assessment of impacts for biodiversity and provide mitigation /compensation for them.
- Policy/legislation review in order to incorporate CC and Bd issues; integrate measures for adapting energy policy to protect biodiversity into funding programmes (especially when building infrastructure)
- Review EU external action on energy use and interactions with CC implications for Bd globally
- Introduce policies to stimulate/incentivise markets (where appropriate) for energy sources that will restore biodiversity (e.g. coppicing/wood fuel)

Planning

- Incorporate sectoral responses, e.g. energy in built environment: greater resilience to climate extremes and improved energy performance (forthcoming revision of Directive). energy in water sector: incentivise efficiency to reduce energy use (pumping) and so

protect habitats

- Involve wide range of partners in developing coordinated and comprehensive adaptation strategies.

Box 3.4 FISHERIES POLICY

Policy document	Comment
Council Regulation (EC) No 2371/2002 of 20 December 2002 on the conservation and sustainable exploitation of fisheries resources under the Common Fisheries Policy *Reference to CC and Bd* **None**	Sets out proposals for multi-annual approach to fisheries management, involving multi-annual management plans for stocks at or within safe biological limits. For stocks outside safe biological limits, the adoption of multi-annual recovery plans is an absolute priority. Substantial reductions in fishing effort may be required for these stocks, in line with scientific advice.
Forthcoming review	
Implication for policy or sector noted in EU Green Paper on Adaptation	Fisheries: Important objective of CFP to ensure sustainable stocks: impacts of climate change on distribution & abundance of species and aquatic farming.

Possible amendment of policy, to protect biodiversity:

Policy

- Strengthen CC mitigation policy as it affects the fisheries sector and its interactions with other sectors e.g. transport, processing.
- Policy/legislation review in order to incorporate CC and Bd issues; integrate adaptation into funding programmes (inc. ports development)
- Review impact of policies relating to trade and fisheries upon international and national fisheries, to prevent over-fishing in conditions of climate change
- Further develop the links which have now been made between the CFP and the forthcoming EU Marine Strategy Directive (MSD) (a Framework for Community Action in the field of Marine Environmental Policy), such that the Directive protects marine Bd and promotes awareness of climate change impacts on marine Bd.

Planning

- Involve wide range of partners in developing coordinated and comprehensive adaptation strategies for fisheries and their interactions with biodiversity under changing climates

Box 3.5 FLOOD MANAGEMENT (fluvial and coastal) POLICY[10]	
Policy document	Comment
Directive on the assessment and management of flood risks 2007/60/EU Reference to CC and Bd Notes increased likelihood of floods resulting from CC. Assessment to include likely flood risk in light of CC. This Directive to complement the WFD with respect to CC and floods How about integrated coastal zone management policy: Reference made to damage to biodiversity caused by flooding/polluted water.	From official summary: "The purpose of this proposal is to manage and reduce the risk of floods, particularly along rivers and in coastal areas. It provides for assessment of the risk of flooding in river basins, the mapping of flood risks in all regions where there is a serious risk of flooding and the drawing up of flood risk management plans based on close cooperation between and the broad participation of Member States."
Communication from the Commission - Report to the European Parliament and the Council: an evaluation of Integrated Coastal Zone Management (ICZM) in Europe /* COM/2007/0308 final */ Reference to CC and Bd Extensive reference to CC, very little to Bd	
Forthcoming review	(Directive comes into force 26 11 07)
Implication for policy or sector noted in EU Green Paper on Adaptation	Proposed legislation on assessment & management of floods, including extreme events. Soft, non-structural measures should be prioritised i.e. using natural processes e.g. working with wetlands. But hard structural flood defences are important for the extremes.

Possible amendment of policy, to protect biodiversity:

Policy

- Strengthen CC mitigation policy as it affects flood management, and interactions with other sectors.
- Review policy/legislation incorporating CC and Bd issues; integrate adaptation into infrastructure and other funding programmes

Planning

- Incorporate measures to address climate change, assess impacts of flood management measures upon biodiversity and provide mitigation/compensation for them. Safeguard and plan to restore biodiversity and ecosystems.
- Involve wide range of partners in developing coordinated and comprehensive adaptation strategies
- Review targeting of expenditure: revise (upwards) priority of measures that encourage adaptation to climate change for funding.
- Provide opportunities for "soft engineering" approaches to flood management to maximise opportunities for Bd.

[10] Flood management policy may refer to flooding and drainage both in river floodplains and along the coasts, and concerns both rural and urban areas.

Box 3.6 SOILS AND FORESTS POLICIES[11]	
Policy document	Comment
Thematic strategy for soil protection [COM(2006) 231 final] Soils Framework Directive proposed Reference to CC and Bd Soil degradation has direct impact on [...] climate change Impacts of soil degradation include impacts upon biodiversity Research needed on soil biodiversity	This strategy explains why further action is needed to ensure a high level of soil protection; it sets the overall objective of the Strategy and explains what kind of measures must be taken. It establishes a ten-year work program for the European Commission.
EU Forest Action Plan [**COM(2006) 302** final Reference to CC and Bd Forests essential to combating climate change *Key action 6*: Facilitate EU Member States' compliance with UNFCCC and Kyoto Protocol and encourage adaptation to the effects of climate change. Forests essential to preserving biodiversity *Key action 7*: Contribute towards achieving the revised Community biodiversity objectives for 2010 and beyond	The overall objective of the EU Forest Action Plan is to support and enhance sustainable forest management and the multifunctional role of forests. It is based on the following principles: – national forest programmes as a suitable framework for implementing international forest-related commitments; – the increasing importance of global and cross-sectoral issues in forest policy, calling for improved coherence and coordination; – the need to enhance the competitiveness of the EU forest sector and good governance of EU forests; – respect for the principle of subsidiarity.
Forthcoming review	Forest Action Plan Mid-term review 2009
Implication for policy or sector noted in EU Green Paper on Adaptation	Climate change will have profound impacts on physical and biological components of ecosystems: water, soil, air and biodiversity. For each of these, EU legislation and policies are in place or in the pipeline. [See also agriculture, water, and biodiversity]

Possible policy amendment to protect biodiversity:

Policy

- Strengthen CC mitigation policy as it affects the forestry sector and its interactions with other sectors (e.g. transport, tourism) so controlling adverse impacts on Bd..
- Review policy on woodland creation for carbon sequestration, an approach to mitigation; balance against woodfuel supply from existing woodlands (could compromise adaptation and nature conservation objectives if the policy is not implemented sustainably or sensitively).
- Policy/legislation review in order to incorporate CC and Bd issues; integrate adaptation into funding programmes
- Review EU external action affecting soils and forests and interactions with CC implications for biodiversity globally. Promote ways of preventing deforestation and so reduce emissions
- Further explore and strengthen policy links between forestry and other sectors, specifically,
    - bioenergy - sustainable management of existing woodlands as a very

[11] Note: Soils and forests are taken together here in view of interlocking policies and impacts.

significant bioenergy resource;
    - WFD and water quality - watershed management and amelioration of diffuse pollution - woodland as a low input productive land use is also important;
    - flooding and catchment management - floodplain woodland delays and reduces peak flood flows; biodiversity generally benefits from “wetter” landscapes.
    - woodland creation programmes to increase habitat connectivity
    - riparian woodland to protect fisheries from thermal stress;
    - sustainable development - wood and wood products as renewable materials with low embedded energy/carbon emissions.
- Review contribution of Rural Development Programme (RDP) to forestry adaptation as part of mid-term review of RDP - particularly with respect to spatial planning.
- Institute as a policy objective the linking of forestry policy with other aspects of rural policy to achieve integrated spatial planning and the implementation of a more comprehensive 'landscape approach' to climate change adaptation.

Planning

- Involve wide range of partners in developing coordinated and comprehensive adaptation strategies for soils and forests and their interactions with biodiversity under changing climates.
- Work with partners to safeguard vulnerable soils

Box 3.7 SUSTAINABLE DEVELOPMENT POLICY	
Policy document	Comment
Communication from the Commission of 15 May 2001 "A Sustainable Europe for a Better World: A European Union Strategy for Sustainable Development" (Commission's proposal to the Gothenburg European Council) [COM(2001) 264 - not published in the Official Journal]. Communication from the Commission of 13 December 2005 on the review of the Sustainable Development Strategy - A platform for action (COM(2005) 658	" a long-term strategy to dovetail the policies for economically, socially and environmentally sustainable development, its goal being sustainable improvement of the well-being and standard of living of current and future generations."
Reference to CC and Bd CC is one of six "unsustainable trends". Limiting CC is first of the strategy's long term objectives. States need to halt the loss of biodiversity by 2010; EU must ensure effective protection of biodiversity	
Forthcoming review	Two yearly review, starting 2007.
Implication for policy or sector noted in EU Green Paper on Adaptation	There is a reference in the Green Paper to the sustainable development of agriculture - recent reforms are seen as a first step towards this. Also, recognition that sustainability of fishing stocks ay be affected by climate change.

Possible amendment of policy to protect biodiversity

Policy

- Review policy in order to incorporate CC and Bd issues; integrate adaptation and mitigation into funding programmes.
- Acknowledge need for a wider understanding of well-being and standard of living, which includes survival of biodiversity
- Review EU external action on sustainable development and interactions with CC implications for Bd globally
- Frame the EU's CC Adaptation White Paper to place biodiversity protection and ecosystem resilience / conservation as central underlying requirements for all sectoral adaptation: sustainable development is a key means towards achieving this; EC to co-ordinate development synergistic, cross-cutting sectoral adaptation policies, programmes and actions; national policies on SusDev to reflect this.
- Strengthen CC mitigation policy via sustainability objectives, addressing poverty issues in developing countries.

Planning

- Introduce concept of ecosystem services and acknowledge importance of healthy ecosystems which are more resilient to climate change.
- Aim to reduce "conventional" pressures that cause fragmentation, degradation and over-exploitation and pollution of ecosystems.
- Involve wide range of partners in developing coordinated and comprehensive adaptation strategies and in implementing mitigation policies
- Where nature conservation sites are under threat of over-use, designate new sites with capacity to "spread" visitor interest whilst maintaining awareness and revenues. Site selection to be informed by location, accessibility and quality, and potential contribution to a wider Green Infrastructure network.
- Strengthen policy on assessments for sustainability with assessment of cumulative

interactions/impacts on wildlife as a result of the direct and indirect impacts of CC

- Require impact mitigation to a standard of "no net loss of biodiversity value" at sites as in PPS 9 UK[12], possibly including biodiversity offset (USA) and habitat compensation NSW, Australia. "Net gain" is pursued in Victoria, Australia[13].

Box 3.8 TRANSPORT POLICY

Policy document	Comment
Keep Europe Moving - sustainable mobility for our continent (2006) (Mid term review of 2001 White Paper on Transport - see below) Reference to CC and Bd Reference to emissions causing CC	Objectives include: high level of mobility, environmental protection, innovation via efficiency and sustainability, and international connectivity. "..future policy will have to **optimise** each mode's own potential to meet the objectives of clean and efficient transport systems". Reference to measures to reduce emissions from air transport.
White Paper European Transport policy for 2010 - time to decide (2001) Reference to CC CC throughout, no ref. to Bd	Recommendation on a pricing structure for transport that reflects the costs to the community. Presents an estimate of average external costs 1995 (EU-17) by transport mode and type of cost: passenger and freight transport (without congestion costs). Climate change and air pollution are seen as two separate "costs"

Forthcoming review	
Implication for policy or sector noted in EU Green Paper on Adaptation	Impacts on (for example) canals & rivers. Spatial planning (for example, of ports) should take account of future climate

Possible amendment of policy, to protect biodiversity:

Policy

- Strengthen CC mitigation policy as it affects the transport sector and its interactions with other sectors.
- Policy/legislation review in order to incorporate CC and Bd issues; integrate CC adaptation and mitigation into funding programmes at EU and MS level (particularly important for infrastructure projects
- Review EU and MS external action on transport (including air, shipping) and interactions with CC implications for Bd globally
- Introduce overarching policies to reduce any habitat fragmentation or destruction as a result of development of new transport infrastructure. Use of "green links" to be inherent as part of design criteria
- Review EU policy: 'Keeping Europe on the move' to ensure goals are environmentally sustainable and achieved via approaches such as via mass transit, energy-efficient low-emissions transport
- Introduce policies which incentivise reduced travel and freight by road.

Planning

- Plan for integrated transport systems adapted to climate change. Assess impacts for biodiversity of new/amended "climate-proofed" infrastructure and provide mitigation /compensation for these impacts.
- Involve wide range of partners in developing coordinated and comprehensive mitigation and adaptation strategies for transport.
- Spatial planning (for example, of ports) should take account of future climate, including changing biodiversity requirements under climate change.

Box 3.9 WATER (QUALITY AND SUPPLY) POLICY	
Policy document	Comment
EC Directive 2000/60/EC Water Framework Directive Reference to CC and Bd Addressing CC is not a principal aim of the WFD Maintaining or raising the « ecological status » of water bodies is fundamental to the Directive	From official summary: The WFD "provides for the management of inland surface waters , groundwater , transitional waters and coastal waters in order to prevent and reduce pollution, promote sustainable water use, protect the aquatic environment, improve the status of aquatic ecosystems and mitigate the effects of floods and droughts"
Forthcoming review	Work in progress on CEC Communication on Water scarcity & droughts: sustainable demand management
Implication for policy or sector noted in EU Green Paper on Adaptation	1st WFD planning cycle for 2009 should incorporate climate change measures: especially economic instruments and user pays in households, transport, energy, agriculture & tourism to promote water conservation & efficiency.

Possible amendment of policy, to protect biodiversity:

Policy

- Strengthen CC mitigation policy as it affects the water sector and interactions with other sectors.
- Review policy and legislation review in order to incorporate CC and Bd issues; integrate adaptation into funding programmes (especially water infrastructure projects)

Planning

- Involve wide range of partners in developing coordinated and comprehensive adaptation strategies
- Formally embed climate change projections in River Basin Management Plans (actions to meet WFD objectives may either be excessive or insufficient as a result of future climate change).
- Develop holistic water use plans ensuring that water requirements of biodiversity and habitats are maintained.

3.5 Options for implementation measures and research, by policy area

A set of implementation measures and research topics have also been identified for the nine policy areas. These are summarized in the following tables.

Box 3.10 Agriculture and rural development

Implementation measures

- Review indirect impacts of regional variations in climate change for agriculture upon biodiversity, for example, changing balance between southern and northern Europe and possible intensification.
- Introduce measures for the safeguard and restoration of biodiversity and ecosystems and deliver landscape scale biodiversity conservation as per Birds (art 3) and Habitats (art 10) Directives.
- Introduce measures and mechanisms to improve “permeability” of farmed land to biodiversity, to facilitate species movements associated with shift in location of suitable climate conditions. This should encompass both large scale features, including the restoration of all semi-natural habitat, and smaller scale biodiversity features including ponds, copses, hedgerows and field margins.
- Recognise and integrate the role of high nature value farmland (HNVF) across the agricultural and nature protection policies. HNVF comprises a high proportion of Natura 2000 sites (15-25%) and integrated policies to support its management for Bd protection and CC mitigation are largely lacking. Find means to coordinate action at multiple spatial scales (watershed, member state and EU?) to maximise the future potential benefits derived from HNVF.
- Monitor effects of changes to CAP and abolition of set-aside, and take measures to ensure continued environment-friendly design under Single Payment Scheme.
- Consider the spatial targeting of agri-environmental scheme options as part of the CAP health check.. Coordination (as in Switzerland, with advisers) can lead to a 'grouped plan' where farmers in a watershed agree on a set on 'linked up' options and wider landscape structures (e.g. buffer zones and corridors) to enhance species dispersal and habitat resilience under CC.

Research

- Continue to support research into CC, agriculture/rural development and impacts for biodiversity. Research and assess potential for improving connectivity for wildlife across farmed landscapes; explores potential for biodiversity corridors and buffers around protected sites.
- Research and assess measures to identify and protect ecosystem services in agricultural landscapes.
- Research into wider impacts of changing crop types (including biofuel production) and management regimes.
- Further research into the role of ecosystem services generated on agricultural land but experienced elsewhere: carbon storage in biomass and soils, pollination; soil integrity, water quality etc. These support Bd and could be used to reduce the number and extent of negative pressures on Bd.

Box 3.11 Biofuels

Implementation measures

- Introduce measures to ensure more stringent control on where biofuels are planted, avoiding degraded land / species-rich set-aside)
- Stipulate strict environmental and sustainability code of practice / legislative requirement for all biofuel used in the EU, relevant to production both within and outside of the EU

Research

- Assess impacts of trade policy relating to biofuels and alternative/competing crops for their impacts on Bd under changing climates
- Continue to support research into CC, biofuels policy and implications for Bd research into management of biofuel and biomass plantations for habitat protection.
- Research impact of incorporation of biofuels into the Single Payment Scheme and consequences for global biofuel trade.
- Research to provide more rigorous understanding of the impacts of producing different types of biofuel
- Research into aspects of biofuel species ecology that may negatively affect the environment (e.g., species invasiveness, fire risk).
- Review food security issues with potential external effects on Bd.
- Research impacts on biodiversity as a result of changes in crop types and changes to predator/prey relationships and potential impacts as a result of new pathogens being introduced.
- Investigate potential contribution of biofuels and biomass for biodiversity survival (e.g. coppice species).
- Conduct full life cycle analysis to identify the real benefits of biofuels (and bioenergy) to address climate change.

Box 3.12 Energy

Implementation measures

- Assess impacts upon biodiversity and provide mitigation for them, in proposals for: diversification of sources, development of renewable energy, accelerated innovation of technologies; and improved demand-response management and distribution capacity which is responsive to greater fluctuation in demand and production
- Include measures to safeguard and restore biodiversity and ecosystems
- Ensure that all energy developments, including low-carbon ones have no impact on national and international obligations for nature conservation, and that they avoid / create no harm to all designated sites of nature conservation interest.
- Ensure that all bio-energy is produced to strict environmental and sustainability standards, to ensure that biodiversity is not lost as a result of a move to new energy sources.

Research

- Continue to support research into CC, energy options and implications for Bd

Box 3.13 Fisheries

Implementation measures

- Continue to identify and support safe limits for fish catches globally, in conditions of climate change, addressing impacts via marine food chains
- Create a coherent framework of measures on other activities and policies affecting fisheries (e.g. extractive and polluting activities).
- Review EU external action on fisheries with CC implications for biodiversity globally
- Provide financial incentives through the European Fisheries Fund (EFF), supporting resilience to CC. Review compensation for regions where significant economic impacts have occurred, to address poverty/vulnerability issues.
- Measures to increase resilience of fish populations: adopting measures to increase resilience of fish populations to environmental impacts, permitting sustainable exploitation of fish stocks.
- Establish representative networks of Marine Protected Areas (MPAs), in line with FAO recommendations, on a case by case basis, based on sound scientific knowledge, with clear objectives, regular assessment/review and efficient control.
- Provide incentives for transfer of aquaculture production sites to deeper and cooler water or to focus on new species; sites to use closed recirculation systems.
- Implement the EU Integrated Maritime Policy (the 'Blue Book'), and encompass all aspects of the oceans and seas in a holistic, integrated approach: tackling all economic and sustainable development aspects of the oceans and seas, including the marine environment, in an overarching fashion. (The strategy aims at a sustainable future for maritime activities and communities under CC.

Research

- Continue to support research into CC, fisheries and impacts for biodiversity
- Investigate impacts upon the location of fisheries and fishing fleets as a result of species migration caused by climate change
- Evaluation of the role of Marine Protected Areas to deliver resilience to climate change, Bd protection and fisheries benefits
- Continue to identify and support safe limits for fish catches globally, in conditions of climate change, particularly in respect of the EC aspiration to restore stocks to levels that produce Maximum Sustainable Yield by 2015, in keeping with the Johannesburg (2002) implementation plan.
- Continue to support research into CC, fisheries and impacts for biodiversity, including critically the need to study how large-scale changes in plankton affect the growth and survival of fish eggs, larvae and subsequent stages in the growth cycle

Box 3.14 Flood Management (fluvial and coastal)

Implementation measures

- Review EU external action on flood management and interactions with CC implications for Bd globally
- Safeguard and restore biodiversity and ecosystems with water holding flood protection properties e.g. wetlands, floodplains, soft coastal areas and defence s / managed realignment etc.
- Establish criteria to guide decisions on managed realignment of coasts, as this could lead to "competition" between habitat types e.g. coastal grazing marsh vs. saltmarsh.
- Implement integrated coastal zone management policy respecting and enhancing Bd opportunities
- Incorporate measures to address climate change, assess impacts of floods management measures upon biodiversity and provide mitigation/compensation for them.
- Implement WFD measures with respect to flooding, e.g. land management for flooding and natural flood retention and at the same time providing habitats for biodiversity.

Research

- Continue to support research into CC, flood management and impacts for Bd
- Research options for appropriate managed coastal realignment, taking Bd into account.
- Improve evidence base for soft engineering solutions to flood management, taking into account biodiversity benefits.

Box 3.15 Soils and forests

Implementation measures

- Pay particular attention to the conservation of peat soils, which are an important carbon store; end commercial extraction of peat and restore all degraded peatland habitat, to conserve peat soil.
- Links should be developed between adaptation policy and the Life+ instrument, which has a role to play in monitoring and fire prevention - both important aspects of an adaptation strategy.

Research

- Research into CC and impacts upon soils affecting soil fauna/flora and food chains.
- Continue to support research into CC, soils and forests and impacts for biodiversity. Research into CC and erosion affecting biodiversity.
- Research to understand long term interactions in changes in harvested timber and biodiversity changes as a result of changes to climate space.
- Further research required into the impacts of climate change on soil biodiversity and the potential impacts to the functions of soil.
- Develop research on fire prevention and soil erosion control particularly in southern Europe.

Box 3.16 Sustainable development

Implementation measures

- Promote EU and MS external action on sustainable development and interactions with CC implications for Bd globally; make sustainability core to all adaptation development with which the EU and MSs are involved
- Devise and implement measures for biodiversity protection, for example:
    - Set up buffer zones around sites of interest (such as Exclusion Zone (e.g. within 400 m of the linear distance of an SPA and Zone of influence (e.g. between 400 m and 5 km linear distance from the SPA
    - Institute “mitigation banks” to offset development impacts (generally, or by sector)

Research

- Continue to support research into CC and sustainable development
- Explore and better understand links to and conflicts with Lisbon and Gothenburg Agendas
- Develop concept of ecosystem services/functions and their contribution to EU and MS society and wealth; raise awareness of importance of healthy ecosystems which are more resilient to climate change

Box 3.17 Transport

Implementation measures

- Include measures to safeguard and restore biodiversity and ecosystems and ecosystem services.
- Include measures to avoid and repair fragmentation of habitats by transport infrastructure.
- Include measures to safeguard and restore biodiversity and ecosystems and ecosystem services; and to ensure that transport infrastructure facilitates, not hinders, biodiversity movement and habitat development and quality.
- Develop adaptation requirements and programmes alongside transport sector’s action to provide CC mitigation
- Raise awareness of personal sustainability / impacts of transport, to revise personal expectations of travel and hence influence travel patterns

Research

- Develop new methods to evaluate transport infrastructure projects in terms of CC and Bd and generally to introduce mechanisms for applying appropriate values of natural resources in assessments.
- Continue to support research into CC, transport development options and implications for Bd

Box 3.18 Water (quality and supply)

Implementation measures

- Incorporate measures to address climate change in policy, e.g. through economic instruments applied to all water-using sector, such as incentives for use reduction.
- Also, measures to address water scarcity and drought (forthcoming Communication) should assess impacts upon biodiversity and provide mitigation/compensation for them.
- Take measures to resolve potential conflicts between WFD and Habitats directive (e.g. maintaining favourable conservation status for species could lead to a failure to meet good ecological status under water quality standards)
- Implement habitat measures that benefit biodiversity to improve water quality and flood control, e.g. uplands drainage, flood plain management, lowland farm drainage and irrigation, etc
- Consideration of water management measures in urban development eg SuDS, compensatory water storage areas, green roofs, which also favour biodiversity
- Take measures to address water scarcity and drought (forthcoming Communication); these should assess impacts upon biodiversity and provide mitigation/compensation for them –
- Link agri-environment payments to WFD objectives.
- Ensure that WFD measures to address land cover/use change are used to meet objectives. Woodland (including appropriately located bioenergy plantations) is a low input productive land cover with significant biodiversity benefits so is a potential measure.

Research

- Research and assess measures for protecting ecosystem services relating to water supply and quality.
- Examine impacts of EU external action on water and flood and interactions with CC implications for Bd globally
- Continue to support research into CC and water quality/supply and flood risk.
- Investigate potential impacts of changing biomass production on water resources as more "thirsty" species are planted (e.g. *Eucalyptus* spp.), and consequent impacts upon terrestrial and aquatic biodiversity.
- Research further habitat measures that benefit biodiversity to improve water quality and flood control, e.g. uplands drainage, flood plain management, lowland farm drainage and irrigation, etc.

3.6 Wider policy areas

Four further policy areas with relevance to biodiversity protection under climate change have also been explored, though in less detail. These are: competition, regional policy/cohesion, trade and international development . All are policy areas for which economic growth is an important driver, giving rise to impacts upon natural resources and biodiversity in particular. Policy choices need to be made with these impacts in mind.

Some suggestions proposed during the consultation are given below.

Box 3.19 Competition

Policy

- Strengthen CC mitigation policy taking into account the impacts and interactions of competition policy across sectors and regions.
- Policy/legislation review in order to incorporate CC and Bd and sustainability issues; integrate adaptation into funding programmes
- Review EU external action on competition and interactions with CC implications for biodiversity globally
- Develop sustainable competition policies which recognise the role of ecosystems and ecosystems services in sustainable competitive economies.
- Introduce policies to stimulate new market opportunities which support more sustainable behaviour and practice.
- Support and refine the EU Emissions Trading System and on Renewables targets.

Planning

- Involve wide range of partners in developing coordinated and comprehensive adaptation strategies for competition policy and its interactions with biodiversity under changing climates

Research

- Review impacts of competition strategy on wildlife globally, under changing climates
- Support research into CC, competition policy and impacts for biodiversity and sustainability

Box 3.20 Regional Policy/Cohesion

Planning

- Involve wide range of partners in developing coordinated and comprehensive adaptation strategies for regional policy and its interactions with biodiversity under changing climates

Action

- Introduce actions to ensure that the importance of biodiversity to society is widely understood and appreciated.
- Amend the Community Strategic Guidelines on cohesion (which build on eligibility of investments in the regulations) so as to encourage Member States to allocate funds in ways that take into account and benefit biodiversity. The Guidelines already make reference to nature, species and natural resources in discussing infrastructure investment, improving the physical environment for business and undertaking risk prevention.

Research

- Research impacts of regional policy on Bd across EU and beyond, and interactions with CC impacts.
- Continue to support research into CC, regional policy and impacts for biodiversity

Assess impacts of Cohesion Policy (2007-13) and its priority: Regional Cooperation and impacts of funding of measures across Convergence regions.

Box 3.21 Trade

Policy

- Strengthen CC mitigation policy taking into account impacts of international and intra-European trade, and interactions with the range of sectors.
- Review impacts of EU trade upon Bd and sustainability globally, under changing climates. Integrate adaptation to CC into funding programmes

Planning

- Involve wide range of partners in developing coordinated and comprehensive adaptation strategies for trade and its interactions with biodiversity under changing climates

Action

- Develop measures for protecting global Bd from adverse impacts resulting from CC impacts upon trading relationships.
- Integrate adaptation into funding programmes.

Research

- Continue to support research into CC, trade and impacts for biodiversity and to develop sustainable trade

Box 3.22 International Development

Policy

- Strengthen CC mitigation policy taking into account impacts of international development, and interactions with range of sectors.
- Review impacts of CC upon developing nations and assess strategies for development which protect wildlife and vulnerable economies under changing climates.
- Review EU external action on development and interactions with CC implications for biodiversity globally
- Policy/legislation review in order to ensure that protection of Bd and ongoing sustainability under CC are fundamental to all funding programmes; integrate adaptation into funding programmes aimed at developing nations.

Planning

- Involve wide range of partners in developing coordinated and comprehensive adaptation strategies for development and its interactions with biodiversity under changing climates and make these conditions of funding

Action

- Develop measures for protecting global Bd from adverse impacts resulting from CC impacts upon development programmes, e.g. for improving water supply

Research

- Continue to support research into CC, development and impacts for biodiversity

3.7 Summary, conclusions and recommendations

Summary

This section has reviewed a set of major policy areas which have impacts upon biodiversity and which interact with climate change - and interact with each other - to have further indirect impacts upon diversity. If EC policy on biodiversity loss is to be actively pursued then it is essential that all these sectors "mainstream" biodiversity issues into their policy development and assessments (see recommendations below). It is recognised that further policy areas also interact with biodiversity under circumstances of climate change, and so the review should also be extended to those areas, including competition, regional policy, health, etc.

A series of tables have attempted to present concisely some of the policy developments or modifications and some of the planning approaches which would be required to bring this into effect. Two other types of initiative - implementation measures and potential research areas - have also been noted.

Amongst the suggestions some themes are repeated, such as the need to incorporate climate change and biodiversity awareness into any related funding programme, the need for the review of interactions with other policy areas, reduction of conventional pressures, carry out assessments, and involve other stakeholders as partners. There will, of course, be some variation in appropriate policy development in different bio-geographical regions and cases, but the suggestions made in the above boxes are intended as an initial framework for policy development.

Conclusions

The publication of the Climate Change Adaptation Green Paper in 2007 and the expected publication in autumn 2008 of the White Paper show that the EU has lately recognised the great importance of climate change adaptation. A central thesis of these reports, and of others commissioned by the EU (e.g. ICON et al, 2001), is the need for policy integration – integrating the objectives and implementation of sectoral programmes, integrating strategic programmes of support at EU level for substantive sectors, and of horizontal, cross-cutting policies such as the Lisbon Agenda, competitiveness and cohesion policies.

This emphasis on policy integration is to be welcomed. However, it is clear from the review in WP2, WP4.1 and 4.3 of the EU's relatively new policies for biodiversity (of halting the loss of biodiversity by 2010) and for climate change (mitigation and adaptation) that there are potential conflicts, and potential but unexplored synergies, and that this ideal of policy integration is still difficult to achieve.

The review has shown the complexity of these interactions, operating at and across multiple scales of policy intervention. It is important not just that there is policy integration of climate change adaptation with other sectors (as in the EU Green Paper), but that, as each sector responds to climate change, adaptation and mitigation actions are also consistent. This is important for the achievement of the EU's biodiversity policies under conditions of climate change. The Stakeholders' meetings on the EU Adaptation Green Paper in 2007 confirm the support for this. There is therefore a clear need for measures at institutional (policy), operational (plan) and technical (implementation) scales to ensure consistency and avoid conflicts.

Recommendations

Substantive:

> All EU directorates (both sectoral programmes and cross-cutting policies) should have responsibility for biodiversity – not just to mitigate the impacts of their policies or projects, but to enhance and restore biodiversity in order to redress past losses and to enable resilient and robust adaptation to future climate change. A valuable objective to achieve this could be to establish sound and improving ecosystem functioning through robust and resilient ecosystems.

Procedural:

2.1 The Five-year Strategic Objectives, the Annual Policy Strategy, the Annual Work Programme and Road Map for the Commission's Strategic and Policy Initiatives require explicit consideration of climate change. While Climate Change and Sustainable Europe is a Priority Action in the Annual Policy Strategy for 2009 (CEC, 2008), we recommend that the other priorities are appraised against this commitment. (This would include, for instance, the Annual Progress Report on the Lisbon Strategy).

2.2 Another potential route for this, as mentioned in section 3.1, is the EU's commitment to undertaking Impact Assessment of its own new initiatives (IAB -Impact Assessment Board, 2008). Following strict reporting requirements, the impact assessments are intended to "ensure evidence-based policy-making throughout the Commission through an integrated and balanced assessment of problems and alternative courses of actions" (IAB, 2008).

We would recommend that the Impact Assessment Guidelines be adjusted to include impacts on biodiversity, and consistency with adaptation and mitigation. Possible ways of conceptualising and recording this are shown in Sections 6.5 and 6.7.

Impact Assessment:

A further opportunity for this cross-cutting integration of climate change and biodiversity lies in the EU's horizontal procedures such as SEA, EIA and Appropriate Assessment which apply to both EU initiatives and to those of Member States.

These recommendations are elaborated in the following Section 4 on potential responses by sectors to aid ecosystem functioning, in Section 5 which explores the role of futures scenarios in policy formulation and review, and in Section 6 which explores the potential of a policy compliance and assessment framework.

4 OPTIONS FOR SECTORAL RESPONSES TO CUMULATIVE EFFECTS: counteracting adverse impacts of major economic sectors upon physical and biological systems already affected by changing climate

4.1 Introduction

Each of the major economic sectors has impacts for biodiversity and natural systems and these may act cumulatively with climate change impacts. This section (building on section 3 above and also on MACIS Workpackage 2 with its review of the impacts of activities of other sectors on biodiversity under climate change) attempts systematically to identify a range of measures that may be taken within each of six sectors to protect biodiversity and to strengthen the resilience of four types of natural systems. The six sectors have been selected as they are major contributors to greenhouse gas emissions on the one hand (see EEA, 2006) and/or because they are also major forms of land occupancy or of recent land-take (EEA, 2005), with consequent impacts for biodiversity. The six sectors are:

Agriculture	Table	4.1
Built Environment		4.2
Energy, centralized generation		4.3
Industry		4.4
Tourism and informal recreation		4.5
Transport		4.6

In the tables the range of sectoral impacts which may act cumulatively with climate change impacts upon natural systems are summarized; often these sectoral impacts will include land-take, fragmentation, disturbance of drainage and habitats. It is important to remember that impacts may result from different phases in project or programme cycles: planning, construction, operation and, eventually, decommissioning. The four types of natural resource systems at risk from both climate change and sectoral impacts outlined here are:

- ecosystems and biodiversity
- water, rivers and wetlands
- coastal areas
- soils

These four systems are used here as they underpin biodiversity and represent the range of impacts that can occur, as discussed in MACIS Deliverable 1.1. Impacts upon these resource systems may be both direct and indirect, and have both direct and indirect consequences for biodiversity. For example, a development programme which leads to increases in hard surfacing is a direct impact (land-take) but, indirectly, may well result in less infiltration of rainfall, lower water tables and availability of groundwater, changing water relations further down a catchment , and leading to changed plant growth conditions which may further alter the available habitat for wildlife.

4.2 Potential responses by sector for natural systems

There is great complexity in the possible consequences of cumulative impacts upon natural systems, and this can only be indicated here: the tables which follow are not intended to be comprehensive, but rather to indicate the array of issues and consequences that need to be addressed and possible policy measures which can help in controlling impacts upon both the natural systems and biodiversity. These policy options and measures include, for example, the precautionary principle, licensing, consent and permit regimes, and assessment protocols.

The following abbreviations are used in the tables**:**

Bd	Biodiversity	SEA	Strategic environmental assessment (of plans, programmes, policies)
CC	Climate change,		
EIA	Environmental Impact assessment (of individual projects)	WFD	Water Framework Directive
ICZM	Integrated coastal zone management		

Table 4.1

Systems affected by climate change	**Sector: Agriculture**
Ecosystems and biodiversity	
Examples of potential further (non-CC) impacts	Fragmentation, contamination Disturbance
Policy options& measures to address CC and sectoral impacts	***WFD (countering diffuse pollution)*** ***Re-establish connections, increase opportunities*** ***Reduce impacts; ensure no net loss, or net gain*** ***Precautionary principle*** ***Provide land for compensatory measures*** ***Protect, enlarge and enhance semi-natural habitats***
Water & rivers, wetlands	
Examples of potential further (non-CC) impacts	Depletion of quantity and loss of natural functions of floodplain; Diversion of drainage; Pollution,
Policy options & measures to address CC and sectoral impacts	***WFD (countering diffuse pollution)*** ***Flood & drought assessments and strategies*** ***Efficient use of water in sustainable production*** ***Provision of land (under stewardship arrangements) for compensatory measures for other sectors, or payment for flood storage*** ***Protect, enlarge and enhance semi-natural habitats***
Coastal areas	
Examples of potential further (non-CC) impacts	Pollution; Natural processes interrupted behind flood defences
Policy options & measures to address CC and sectoral impacts	***WFD and EIA (of projects), SEA (of plans, etc.) to minimise impacts*** ***ICZM partnerships*** ***Sequential land use change as sea level rises*** ***Protect, enlarge and enhance semi-natural habitats***
Soils	
Examples of potential further (non-CC) impacts	Direct loss and damage caused by agriculture; Contamination; Compaction
Policy options & measures to address CC and sectoral impacts	***Soils protection strategy*** ***Sustainable production*** ***Precautionary principle and no net loss*** ***Protect, enlarge and enhance semi-natural habitats***

Table 4.2

Natural systems (affected by climate change)	**Sector: Built environment, construction, infrastructure**
Ecosystems and biodiversity	
Examples of potential further (non-CC) impacts	Fragmentation, disturbance
Policy options& measures to address CC and sectoral impacts	***EIA (of projects), SEA (of plans, etc.) to minimise impacts*** ***Compensatory measures, biodiversity offsets*** ***research on barrier removal*** ***Establish minima for natural space*** ***Precautionary principle and "no net loss/net gain"*** ***Ongoing review to propose impact reduction measures*** ***Research into urban habitats and change***
Water & rivers, wetlands	
Examples of potential further (non-CC) impacts	Pollution, reduces infiltration and speeds runoff (loss)
Policy options & measures to address CC and sectoral impacts	***WFD (countering diffuse pollution),*** ***Limit/reduce sealing of soils -incorporate measures to promote infiltration*** ***Precautionary principle and "no net loss/net gain"*** ***Ongoing review to propose impact reduction measures*** ***Research into water efficient devices and flood protection*** ***Water Opportunity Mapping (see WP4.1 section 5)***
Coastal areas	
Examples of potential further (non-CC) impacts	Occupies land, limits retreat /flood management, eutrophication of coastal waters
Policy options & measures to address CC and sectoral impacts	***Sequential land use strategy (as sea level rises)*** ***Green networks*** ***ICZM partnerships*** ***Precautionary principle and "no net loss/net gain"*** ***Ongoing review to propose impact reduction measures*** ***Research into coastal habitats and change***
Soils	
Examples of potential further (non-CC) impacts	Sealing, contamination
Policy options & measures to address CC and sectoral impacts	***Soils protection strategy*** ***Review permit conditions***

Table 4.3

Natural systems (affected by climate change)	**Sector: Energy, centralized generation**
Ecosystems and biodiversity	
Examples of potential further (non-CC) impacts	Fragmentation, creation of barriers Disturbance,
Policy options& measures to address CC and sectoral impacts	***EIA (of projects), SEA (of plans, etc.) to minimise impacts*** ***Compensatory measures; mitigation banking, biodiversity offsets*** ***Green grids*** ***Research on barrier removal*** ***Precautionary principle and no net loss/net gain*** ***Protect, enlarge and enhance semi-natural habitats***
Water & rivers, wetlands	
Examples of potential further (non-CC) impacts	Temperature change (with discharge of cooling water from power stations); Direct land-take (e.g. wetlands) Pollution, Barriers (barrages, windpower)
Policy options & measures to address CC and sectoral impacts	***EIA (of projects), SEA (of plans, etc.) to minimise impacts*** ***Review of abstraction and discharge licensing; monitoring and setting limits*** ***Precautionary principle and no net loss, or net gain*** ***Compensation (land, funding);*** ***Decoupling (greater efficiency of use)*** ***Infrastructure review to propose impact reduction measures*** ***Protect, enlarge and enhance semi-natural habitats***
Coastal areas	
Examples of potential further (non-CC) impacts	Direct and indirect effect on coastal defences which may disturb natural processes, and limit coastal retreat; Change of coastal regime
Policy options & measures to address CC and sectoral impacts	***EIA (of projects), SEA (of plans, etc.) to minimise impacts*** ***Compensatory measure, inc. mitigation banking*** ***Research on barrier removal*** ***ICZM partnerships*** ***Protect, enlarge and enhance semi-natural habitats***
Soils	
Examples of potential further (non-CC) impacts	Soil sealing, soil disturbance for energy projects. Direct removal.
Policy options & measures to address CC and sectoral impacts	***Ensure disturbance minimized via soils protection strategy*** ***Precautionary principle and no net loss*** ***Protect, enlarge and enhance semi-natural habitats***

Table 4.4

Natural systems (affected by climate change)	**Sector: Industry**
Ecosystems and biodiversity	
Examples of potential further (non-CC) impacts	Pollution, disturbance
Policy options& measures to address CC and sectoral impacts	***EIA (of projects), SEA (of plans, etc.) to minimise impacts*** ***Compensatory measures, biodiversity offsets*** ***Research on barrier removal*** ***Establish minima for natural space*** ***Precautionary principle and "no net loss/net gain"*** ***Ongoing review to propose impact reduction measures*** ***Promote awareness of biodiversity*** ***Incorporate Bd/CC measures into plans*** ***Sustainable production; decoupling***
Water & rivers, wetlands	
Examples of potential further (non-CC) impacts	Pollution, depletion, constraint of natural processes
Policy options & measures to address CC and sectoral impacts	***EIA (of projects), SEA (of plans, etc.) to minimise impacts*** ***Compensatory measures*** ***Precautionary principle and "no net loss/net gain"*** ***Ongoing review to propose impact reduction measures*** ***Sustainable production;*** ***Decouplingfor greater efficiency***
Coastal areas	
Examples of potential further (non-CC) impacts	Occupies land, limits retreat /flood management
Policy options & measures to address CC and sectoral impacts	***EIA (of projects), SEA (of plans, etc.) to minimise impacts*** ***Develop green networks*** ***Precautionary principle and "no net loss/net gain"*** ***Ongoing review to propose impact reduction measures*** ***Sustainable production;*** ***Decoupling for greater efficiency***
Soils	
Examples of potential further (non-CC) impacts	Loss, sealing
Policy options & measures to address CC and sectoral impacts	***Soils protection strategy*** ***Review permit conditions***

Table 4.5

Natural systems (affected by climate change)	**Sector: Tourism (including informal recreation)**
Ecosystems and biodiversity	
Examples of potential further (non-CC) impacts	Fragmentation, pollution, disturbance; Damage by casual walkers
Policy options& measures to address CC and sectoral impacts	***EIA (of projects), SEA (of plans, etc.) to minimise impacts*** ***Compensatory measures*** ***Research into barrier removal*** ***Establish minima for natural space*** ***Precautionary principle and "no net loss/net gain"*** ***Promote awareness of biodiversity*** ***Incorporate Bd/CC measures into plans, plus ongoing review to propose impact reduction measures***
Water & rivers, wetlands	
Examples of potential further (non-CC) impacts	Pollution, depletion, competition for water resources Diversion of watercourses
Policy options & measures to address CC and sectoral impacts	***EIA (of projects), SEA (of plans, etc.) to minimise impacts*** ***Compensatory measures*** ***Precautionary principle and "no net loss/net gain"*** ***Ongoing review to propose impact reduction measures***
Coastal areas	
Examples of potential further (non-CC) impacts	Facilities occupy land, limit retreat /flood management, may cause eutrophication of coastal waters. Indirect effects of disturbance.
Policy options & measures to address CC and sectoral impacts	***EIA (of projects), SEA (of plans, etc.) to minimise impacts*** ***Compensatory measures*** ***Precautionary principle and "no net loss/net gain"*** ***Ongoing review to propose impact reduction measures***
Soils	
Examples of potential further (non-CC) impacts	Contamination, sealing
Policy options & measures to address CC and sectoral impacts	***Soils protection strategy*** ***Review permit conditions***

Table 4.6

Natural systems (affected by climate change)	**Sector: Transport**
Ecosystems and biodiversity	
Examples of potential further (non-CC) impacts	Fragmentation, disturbance creation of barriers, impacts on water relations
Policy options& measures to address CC and sectoral impacts	***EIA (of projects), SEA (of plans, etc.) to minimise impacts*** ***Compensatory measures, biodiversity offsets*** ***Research on barrier removal*** ***Precautionary principle and no net loss***
Water & rivers, wetlands	
Examples of potential further (non-CC) impacts	Pollution Diversion of drainage patterns
Policy options & measures to address CC and sectoral impacts	***EIA (of projects), SEA (of plans, etc.) to minimise impacts*** ***Compensatory measures*** ***Precautionary principle and no net loss*** ***Infrastructure review to propose impact reduction measures***
Coastal areas	
Examples of potential further (non-CC) impacts	Defences for transport and transport infrastructure may limit retreat, soil sealing. SLR leads to occupation of land elsewhere. Diversion of drainage
Policy options & measures to address CC and sectoral impacts	***EIA (of projects), SEA (of plans, etc.) to minimise impacts*** ***Compensatory measures*** ***Research on barrier removal*** ***ICZM partnerships***
Soils	
Examples of potential further (non-CC) impacts	Erosion/loss, contamination
Policy options & measures to address CC and sectoral impacts	***Soils protection strategy*** ***Precautionary principle and no net loss***

4.3 Conclusions

Natural resource systems are affected by an accumulation of pressures - from development, demographic and policy change as well as by climate change. It is important to review this array of pressures when decisions are made either about planned changes or when attempting to put in place measures and policies which provide mitigation or adaptation for climate change. This section has sketched what types of response might be appropriate or necessary from six activity sectors.

Each of these sectors (and perhaps all other sectors of activity) relies on the natural environment for resources and ecosystem services. If these services and functions are to be maintained then the sectors must make provision for their protection and enhancement. Policies and measures which can help include full impact assessment procedures, principles such as “no net loss” or “net gain” in natural resources, the introduction of compensatory measures to counter impacts and restore system quality, and research. A pre-emptive and proactive style of engagement on impacts, acknowledging the value of the natural systems to the sectors, would help to prevent losses and may well cut long-term costs.

5 SCENARIOS, CLIMATE CHANGE AND BIODIVERSITY RESEARCH

5.1 Introduction

The previous sections have focused on existing policy responses to climate change and biodiversity and from this review we have generated a number of recommendations for greater policy integration, bringing the policy response to climate change together with sectoral policy, as well as greater emphasis on resilient ecosystem functioning. This section reviews another possible policy tool for climate change planning, that of further scenarios, as well as briefly reviewing other EU research underway on biodiversity and climate change policy. Note that MACIS Workpackage 3 is concerned with impacts of climate change on biodiversity under different scenarios.

The section explores the development and use of socio-economic scenarios (in addition to the baseline climate scenarios) in planning for climate change. Section 5.2.1 examines the development and use of existing uses of socio-economic scenarios generally in EU planning. Section 5.2.1 demonstrates a potential methodology for incorporating sudden change into on-going climate change - exploring a particular "shock scenario" developed as part of the COCONUT project (twinned with MACIS and also funded by the EC Sixth Framework). This exercise (thought experiment) explores a future Europe in which a pandemic impacts upon a society already affected by climate change, and does this by examining responses in geographical zones and in terms of wealth levels upon different sectors. The consequences of these responses for European biodiversity are sketched.

Section 5.3 presents a table showing the range of EU projects currently (and recently) in process which are concerned with impacts upon biodiversity. Where use is made of scenarios other than the IPCC-Hadley climate change scenarios, this is noted. A set of major on-going EU member states' research programmes are also listed.

Some conclusions for future research in this area are drawn in section 5.4.

5.2 Current use of scenarios in climate change planning

Future scenarios have played a significant and fundamental role in the way in which climate change has been presented to policy-makers as an issue requiring immediate and urgent attention and action. Scenarios are:

> Coherent, internally consistent, and plausible descriptions of future states of the world, used to inform future trends, potential decisions or consequences (UKCIP, 2001 p. 4)

Scenarios may be used for a variety of purposes: to allow the exploration of possible futures without policy or resource commitment; to be a springboard for more creative thinking, allowing us to step outside the conventions of current thinking and structures; or to offer the possibility for building consensus amongst interests or stakeholders. They can assist in accommodating the inherent uncertainties of the future, and be useful in testing the robustness of a policy, plan or strategy. They can help to think through the consequences of key policy choices, and help in identifying new issues and anticipating surprises or shocks.

The IPCC SRES and climate change scenarios have indeed been extremely useful in prompting action at international, national, regional and local levels amongst a range of decision-makers. The use of scenarios of course predates climate change applications. During the 1980s and 1990s, institutions such as military interests and multi-nationals undertook scenario analysis to identify trends and to scan for possible shocks. Many of those studies identified climate change as such a shock. Since the 1990s and the work of the IPCC, climate change itself has been the principal subject of sets of scenarios, but we can assume that future climates will not be experienced under current socio-economic conditions. There have therefore been many recent attempts to identify and understand the drivers of socio-

economic change, and to project possible socio-economic futures, but many fewer which integrate climate change and socio-economic scenarios.

EEA: Outlooks

The EEA Outlooks project, following the Fourth Assessment review of pan-European environmental challenges, has reviewed a wide range of forward-looking studies and scenarios at global (c. 60 studies), and pan-European scales (over 50 in West and Central Europe, and c.10 in South East Europe, and 20 in Eastern Europe, Caucasus and Central Asia) (EEA, 2007c). The approaches ranged from "model-based projections, through reference scenarios with alternative scenarios, to fully explorative scenario studies" (EEA, 2008a), often involving stakeholder participation. The review found that the majority focus on demographic, economy, energy and political futures, with only a few focusing on possible future environmental issues.[14] The review concludes that key global assessments which have been important in informing decision-making are the IPCC, MEA and UNEP scenarios. But it also argues that, besides the gaps of coverage of environmental concerns, and information, reliability and methodology, in general there is a lack of direct relevance to priority policy issues. The EEA suggests a number of reasons for this neglect of environmental issues: firstly, environmental issues have complex cause-effect relationships, and future changes are therefore particularly hard to determine, given the limits of our scientific understanding, the inherent unpredictability of large complex systems, and the extent of human intervention in natural processes. It argues that uncertainty for some environmental concerns – such as biodiversity – is even higher than for others (such as the ozone layer). Perhaps for these reasons, the EEA report concludes that very few of the forward-looking studies reviewed "assess plausible environmental futures in an integrated manner" (p. 36).

A separate review (EEA, 2008b) of the studies specifically for climate change adaptation was undertaken, and this too concluded that few explicitly addressed climate change adaptation, or were designed to be used in climate change impact assessments. The study examined 15 studies in detail, and found that most did not show the interaction between climate change determinants and adaptive capacity, or consider shocks or extreme events. Moreover, apart from the larger studies such as the IPCC's SRES scenarios, the UKCIP01 (socio-economic) and UKCIP02 (climate change) scenarios, there was little evidence of documented use in decision-making.

MACIS review

This section of the MACIS study does not therefore duplicate the review by the EEA. What it does is to identify those future scenario studies which do address the drivers for land use changes (rural and urban), and hence impacts on ecosystems and biodiversity, and attempts to draw out the policy implications of these studies, especially for biodiversity. It also addresses issues of the utility of scenarios in policy-making.

Broad outlines of the scenario work undertaken by these studies focusing on aspects of climate change, biodiversity and/or land use changes for EU25 is shown in Table 5.4, which very briefly summarises the justification for the study, its scope and time-horizons, the driving forces identified, and the key elements of the selected scenarios. It also draws out the implications for biodiversity explicitly identified in the studies, and the broader policy implications – some of them explicit, some implicit.

Three key points arise from this brief review, and are concerned with

- time horizons and uncertainty,
- implications for policy and decision-making and
- impacts for biodiversity.

[14] Exceptions are, within the EECCA region, the UNECE/UNESCAP 20004 study of water scenarios for central Asia, and, in SEE region, the Plan Bleu's Mediterranean Outlook for 2025

1. *Time horizons and uncertainty*

The time horizons of most of these scenario-exercises are quite short – in many cases not beyond 2035, although those which explicitly address climate change have a 2070 or 2100 end-date. The reasons given for this are often that the relationships between the drivers are extremely complex, and that coherent and consistent projections rely on quantification (especially of factors such as GDP, distribution of economic activity by sector and region, demography etc), and that models providing such quantification are only reliable or valid for the short-term at any useful spatial resolution. This seems to apply particularly to those projecting urban futures and spatial built development – a significant concern given that fragmentation by development is one of the key causes of biodiversity loss currently, and that in many global scenarios (such as the Millennium Ecosystem Assessment), land use changes are expected to have the largest impact on biodiversity.

A further reason may be that the socio-economic drivers identified in the scenarios - cultural and political values (such as internationalisation versus localisation, individualism versus community) - do not lend themselves to quantification in the same way as conventional socio-economic factors, and so inhibit more exploration amongst those who rely on quantitative indicators. There may be a disjuncture between the storylines and understanding amongst those elaborating the scenarios. Nevertheless, there are some studies which do undertake quantification at sub-national regional level for the medium term. For instance, one by the Policy Studies Institute (Dahlstrom and Salmons, 2005) provided quantification within coherent storylines up to 2050s at regional level within England for projects within the EPSRC and UKCIP's BKCC (Building knowledge for a changing climate) research programme, which focused on the built environment.

The EEA (2007c, p.37) distinguishes between projections and scenarios. It may be understandable that we rely on trends and find it difficult to envision the future, but scenarios do therefore have a role to play in overcoming that short-sightedness and handling uncertainty. They can broaden the scope of our foresight, removing mental filters which might restrict expectations.

Table 5.4 Analysis of development and use of socio-economic scenarios

Scenario analy-sis/Scope & time-frame	Justification	Driving forces	Scenarios	Policy implications/**Use in policy**
EEA PRELUDE (Prospective environmental analysis of land use and development in Europe) EU25 plus Norway & Switzerland 2005-2035	Impacts of future development on EU landscape & biodiversity	environmental awareness solidarity & equity governance & intervention agricultural organisation technology & innovation	1. Great Escape (contrasts) 2. Evolved Society (harmony) 3. Clustered Networks (structure) 4. Lettuce SurpriseU (innovation) 5. Big Crisis (cohesion)	Use for alternatives assessment of multi-annual strategic programmes All EU policy development and reviews Abandonment of agriculture occurs in all scenarios – CAP does not stand test Demography and climate change have major impact Strict policies for rural development Regional disparities **Use in policy:** **Application in DG Agri under PRELUDE2 Action** **Forthcoming EU White Paper on Adaptation?**
PESETA (Projection of economic impacts of climate change in sectors of EU based on bottom-up analysis) 2011-40, 2071-2100	Multi-sectoral assessment of climate change impacts, and monetary valuation	Global emissions driven by: demographic change; economic development; technological change	2 global scenarios : IPCC A2 (national enterprise) and B2 (local stewardship)	Difficulties in inter-sectoral impacts and some market (eg forestry) and non-market (eg ecosystems) impacts **Use in policy:** **Early results on impacts for various sectors published in 2007 Green Paper Adapting to climate change in Europe – options for EU action**

ALARM Assessing large-scale risks for biodiversity with tested methods EU 25 2020/2050	Exploration of forces behind pressures to develop effective biodiversity protection and EU public policies	CAP Chemicals, energy, transport, trade & biotechnology policy structural funds ESDP Natura 2000 Climate change	1. BAMBU (business-as-usual) 2. GRAS - growth applied strategy 3. SEDG – sustainable European development goal	Interaction of climate change, pollution, invasive species and changes in land use. Possible identification of biodiversity indicator species for climate change. Need to develop scenarios which combine mitigation and adaptation
ACCELE-RATES Assessing climate change effects on land use and ecosystems: from regional analysis to European scale EU25 2050	Assess vulnerability of European agro-systems to environmental change (wrt CC convention and CBD)		2 climate scenarios; 2 emissions scenarios; four socio-economic scenarios (WM, RE, GS and LS)	Major land use changes at Europe periphery; few changes in central Europe. Increase in European production; Northward movement of arable farming in Europe; in southern Europe, abandonment and problems of water for irrigation Possible effects on landscape & environment, esp. soil erosion and changes ecological diversity and food resources for wildlife ; Variable changes in suitable climate space for species: northern European species will lose most space Choice of socio-economic scenarios significant **Use in policy:** **Focus on policy in support of climate change convention, CBD and CAP** **Decoupling of agricultural subsidies will remove barriers for autonomous adaptation to cc; but still need for regulation** **Conservation management & legislation will need strengthening ; EU conservation policy needs constant reviewing to protect vulnerable species**

ESPON EU 25 & Norway & Switzerland 2006-2030	Spatial scenarios in context of EU enlargement	Disparities in wealth at enlargement External factors: Globalisation, Energy price-rise, Climate change Immigration, Internal: Population change, EU policies	1. Trend scenario 2. Globally competitive Europe 3. Economic, social & territorial cohesion 4. Prescriptive scenario	Policy-makers to work with change Most territorial goals can only be achieved by investments in non-territorial policies Sectoral policies should take account of territorial impacts
SENSOR EU25 2005-2025	Impact assessment tools to support decision-making for multi-functional land-use	Oil price World demand Population growth Labour participation rates R&D efforts	1.Reference – trend 2. High growth 3. Low growth	Possible applications in bio-energy financial reform biodiversity forest management and transport
SCENAR 2020 EU27	Agricultural and rural economy	Rural demography Agricultural technology Agricultural markets Natural & social constraints on land use Exogenous and policy-related (e.g. EU enlargement, WTO, CAP)	Trend-based reference scenario Regionalisation Liberalisation	Rural areas not stable; agriculture diverse; world agric markets slow down; structural change continues whatever policy: EU Rural development support is small influence in comparison with demography, regional economic restructuring, and environmental considerations (sustainable management of env resources to direct impacts of CC) Increasing social competition for water supplies in Mediterranean leading to reduction in irrigation Increase in afforestation in several EU countries esp. Nordic Non-food demand for agricultural products competes with food demand leading to higher food prices and land expansion with implications for environment

EURURALIS EU27 2000-2030	Develop a tool to support long-term changes and policy challenges in rural areas of Europe	Continuation of globalisation Government intervention Agriculture Land use Rural development	1. Global economy 2. Global co-operation 3. Continental markets 4. Regional communities	Importance of autonomous forces e.g. demography Possibly for EU Cohesion policy, as regional differences (e.g. risk of abandonment) are large
EEA Urban Sprawl in Europe 2005-2100 City case studies 2020; 2025	Examine drivers for sprawl in context of EU policies of Internal market, competitiveness, sustainable development, Cohesion Structural funds	Macro-economic Micro-economic (e.g. price of land) Demography Housing preferences Transportation Regulatory framework (e.g. poor enforcement or co-ordination)	1. Business-as-usual 2. Compact development 3. Scattered development	Policy coherence (e.g. EU White Paper on European Governance) Responsiveness to local conditions & co-operation in policy development Local urban & regional management
Foresight Future Flooding UK 2002-2080	Scenario analysis to inform strategic choices to address future flood risk	Autonomy vs independence Community vs consumerism	1. World markets 2. Local stewardship 3. National enterprise 4. Global sustainability	Need for current and future flood defence policy and increased financial support Need to strengthen flood risk and spatial planning policy **Use in policy:** **Making space for water; Future Water (water white paper) revision of PPS25 (national spatial planning policy on development & flood-risk)**

2. *Implications for policy and decision-making*

Table 5.1 shows a considerable effort is going into scenario and futures studies. While some of these studies were not specifically undertaken in order to influence policy-making directly, some of them were – and even those without a specific remit tend to draw implications for policy. Many of the studies refer to particular EU policy areas and initiatives – such as CAP, Cohesion Policy, Governance Strategy, Lisbon Agenda, Rural Development Programme, or Natura 2000. Nevertheless, it proves harder to find examples where these studies have actually been used in policy-making. The studies tend to be one-off, and their final reports and web-sites do not themselves generally identify any ultimate end-use. This raises questions about the utility, design and auditing of these exercises. But first, drawing on the authors' knowledge, a comment is made on use at EU level and also a sub-national example.

The utility of IPCC, MEA and UNEP scenarios at the global scale has already been mentioned. Table 5.1 shows other examples where such scenario studies have been used at the EU level; these include the PESETA project (which fed directly into climate change adaptation thinking in the EU Green paper on Adaptation); and the EEA's PRELUDE2 action is currently being used in policy work DG Agri.

At a sub-national level, the UKCIP's various studies of the impacts of climate change on different regions under different socio-economic scenarios have prompted the regional planning bodies to take the issue seriously. UKCIP reports that their UKCIP02 scenarios have been the most widely used of the tools offered by the programme, providing a strong integrating mechanism amongst the sub-national studies, "ensuring a consistent approach allowing different results to be compared and so offering a means of achieving integration" (West and Gawith, 2005 p. 25). UKCIP also regards them as an important communication tool. One example of use is the role played by the climate change impact scoping report *London's Warming* (LCCP, 2002) in political awareness in London, and hence the preparation of the London Plan. London's Warming adapted the socio-economic scenarios published by UKCIP in 2001, and examined three scenarios: one to reflect the broad provisions and trends of the extant London Plan, one a more dynamic World Markets scenario (given London's role as a world city), and one to reflect more commitment to Regional Sustainability, through action at community level on air quality, biodiversity, water resources etc. The scenarios were used systematically to examine the impacts on particular groups, at significant risk, such as the elderly, the poor, and single-person households, for instance under the expected intensification of the Urban Heat Island effect. This has led to further alterations to the London Plan, currently at inquiry stage, and to further work on measures – including more green spaces and space for biodiversity such as green roofs - to ameliorate the UHI effect (Mayor of London, 2006).

Despite these examples, it is clear (for instance, from the stakeholder workshops in 2007 on the EU Green Paper on Adaptation) that for the most part existing policy review tools, such as the EU's Impact Assessment procedure, and EU-wide obligations on Member States such as EIA and SEA, are not systematically using these scenarios to assess the robustness or resilience of plans or projects to climate change under different socio-economic conditions.

Possible reasons include:

1. The mis-match between scenario developers and policy-makers (even if the former process has included extensive stakeholder involvement). This could be because of policy-makers' political and legislative short-termism, and their focus on specific measures, options and legislation. However, some of the scenario exercises reviewed have fairly short-term horizons.

2. There may also be more fundamental difficulties amongst decision-makers (professional as well as political) in envisioning radically different futures (such as a Europe without the CAP): this may be because policy is more normative (desired outcomes), and represents alternative political perspectives, especially in a pluralistic policy context (Parsons, 2006), whereas many scenarios are exploratory (imaginary). It may also be that for some professionals, such as land use planners, they associate alternative future visions with unhappy experiences of failed utopian experiments.

3. It may also be that the strong focus on sustainability in policy has emphasised the importance of achieving (balancing or trading off) economic, environmental and social objectives, and has therefore paid less attention to sustainability into the long term.

4. Similarly, climate change may still be seen as a long-term rather than immediate issue, and therefore the emphasis on future scenarios, despite their exploratory value, works against practical action.

5. Many of the futures and scenario studies reviewed have been undertaken by research teams without a specific decision-making audience, and have not been sufficiently designed or communicated for their use in decisions-making. The EEA's SWOT analysis of some selected studies (EEA, 2008b) makes some very pertinent comments in this respect about how easy (or not) it is to see whether the scenarios are internally consistent.

6. It may be that there is more use of the scenarios, but this is not well-documented. UKCIP is unusual in its stakeholder-led work and so its need to justify its continued support through auditing the use of its tools such as scenarios.

7. There is evidence from UKCIP that nevertheless some stakeholders involved in the preparation of regional scoping studies found scenarios difficult to use: the studies generally only used two of the four climate change scenarios, but even so some expressed a wish to see more prediction, especially in support of adaptation (West and Gawith, 2005, p. 26).

8. There may be particular difficulties in combining climate change scenarios with socio-economic scenarios, and there is evidence of some confusion as to their relationship and uses in testing policy options, and in isolating climate change impacts and hence identifying scope for adaptive action.

9. Some decision-makers, especially in the utilities, are looking in scenarios for explicit statements of probabilities and likelihoods: UKCIP08 will provide probabilistic scenarios, and it will be interesting to se if they are used more extensively.

10. Even for scenarios that are developed for policy, it is necessary to be clear about who the policy-makers are, what their roles are (for instance with respect to managers of climate change adaptation or energy resource managers (Parsons, 2006)), and at what stage they see opportunities for decisions to be taken. It may be worth scenarios defining specific dates that relate to policy evaluation opportunities.

3. *Impacts for biodiversity*

The review of scenarios in Table 5.1 shows that many of the scenario studies do identify serious impacts for biodiversity under many of their scenarios and shocks, with obvious implications for the achievement of the EU's commitment to halting biodiversity loss. For instance, in Urban Sprawl and PRELUDE Great Escape scenarios, protected areas are lost to development; or agriculture becomes more intensive (as in BAMBU food security crisis), or (as in BAMBU SEL) an energy crisis means heavy commitment to bio-fuels with consequent loss of biodiversity. The policy implications of these scenario exercises are therefore of some significance, both for substantive policy and for policy assessment and review procedures.

The PRELUDE study concludes that abandonment of agriculture occurs in all scenarios: south and east Europe could be especially affected by combined intensification of agriculture and rural land abandonment. These are the areas also most susceptible to social and environmental (such as climate) changes. Nevertheless, land abandonment might offer large-scale opportunities for large-scale nature development and for production of biomass.

PRELUDE concludes that this underlines the need for strict spatial priorities for rural development, and that integration of these issues might require improving spatial planning capacities at European level (not at present an EU competence). Strict intervention requires common agreement about long-term objectives, and better information (for instance, on the values of landscapes and the impacts of policy-spending in programmes such as EAFRD,

ERDF and LIFE+). Autonomous development of different policies which compete for land will be environmentally harmful, so better policy co-ordination is needed.

The EEA's Urban Sprawl study similarly concludes that there is an urgent need for policy coherence (an issue which could be picked up in the EU White Paper on European Governance); responsiveness to local conditions and cooperation in policy development; and stronger local urban and regional management, with appropriate enforcement.

The ALARM study concludes that there is an urgent need to develop scenarios which (unlike SRES) include both mitigation and adaptation policies and their interactions.

From all these studies, it is evident that scenarios can show the impacts of the interactions of urban and rural development on biodiversity under conditions of climate change. But these scenario exercises need to be followed up with changes to policy, that is: changes to biodiversity conservation policies to protect ecosystems under climate change, and changes to policies for other sectors which impact on biodiversity. These latter changes will reduce the impacts of these sectors or drivers on biodiversity and will maximise their potential for creating or enhancing ecosystem functions under a changing climate.

5.3 Using scenarios: climate change + "shock"

5.3.1 Introduction and methodology

A "thought experiment" was conducted in order to explore the value of this approach for foreseeing impacts, trends and changes upon different regions of the EU and different sectors/policy areas, as a result of climate change *in combination with* another severe pressure. A series of steps in a process were identified to guide those taking part, and in order to contain the range of hypotheses discussed. The process and its results are reported below as a possible approach to scoping further work into future-gazing on climate change impacts.

To conduct this "thought experiment", four members of the project team explored a "shock scenario" within the context of predicted levels of climate change. A framework of regions within Europe and two social divides within those regions was determined, then one "shock" from the three used in the COCONUT project was selected and its timing was decided, with respect to changes in technology and governance.

Contextual changes likely to result from the "shock" (together with climate change) were hypothesized. These changes were expected to include:

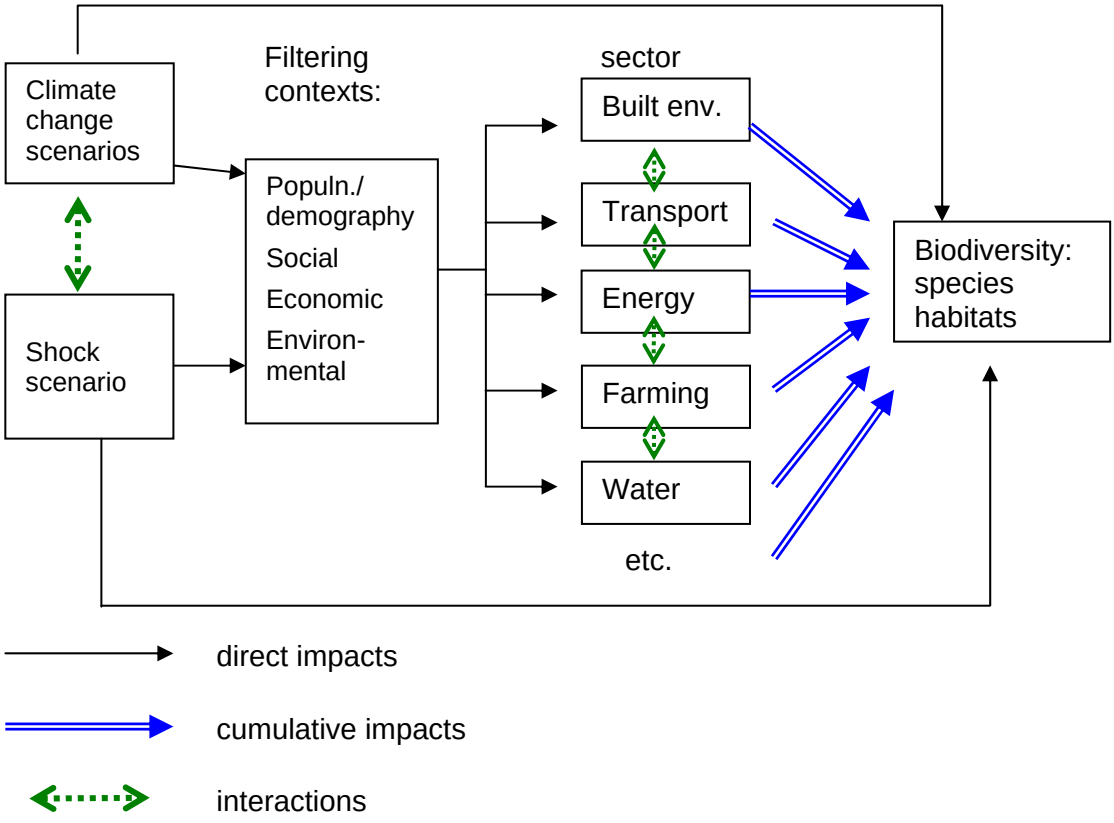
- *Population/development*
- *Social*
- *Economy*
- *Governance*

Five interacting policy and activity sectors were chosen, for which the thought experiment was run. The sectors are: energy, agriculture, transport, water, and biodiversity.

Likely changes within each of the policy sectors were discussed, first at a "contextual" level, also considering impacts upon groups with different levels of wealth. Next the consequences of the "shock" were considered for each of the activity sectors, first broad trends, then broken down by region and wealth. The concepts of urban-rural divide and rich-poor divide were to some extent taken, for the purpose of clarity, to be largely subsumed within the regional variation - in other words, North-North-West Europe was considered as a predominantly wealthy urban region, whilst central and southern Europe reflect lower population densities. Further work would need to focus more closely on different social groups within regions. Figure 5.1 represents the process.

During the discussions potential sources of information and approaches to modelling for greater precision were considered.

Figure 5.1: Scenario use in tracing cumulative and interacting impacts upon biodiversity



Regions:
Europe was classified into three bio-geographical regions:

- North plus North-West Europe,
- Central (to inc. Alps)
- South

Within these regions there was consideration and discussion of the rich-poor divide and the urban-rural divide.

Timing:
The shock happens "tomorrow" without change to current governance or technology.

Shocks:
The three "shocks" developed and used in the COCONUT and ALARM projects, and reproduced here, are:

1	Gulf Stream stops (Gras-cut)	Use as "extreme" case of climate change, concentrating on the extreme temperatures before the THC stops. An example of a `physical' change
2	Energy price shock (Bambu-sd)	An example of an `economic' change
3	Pandemic (Bambu-cane)	Again, explore extremes of change in behaviour and society via a "large enough" loss of population to cause this. An example of a `social' change

Amongst these, one “shock scenario” was selected - the occurrence of a pandemic, in the scenario BAMBU-CANE - for further investigation. The storyline of this shock scenario is as follows:

> A contagious global pandemic affecting people leads to the death of a significant proportion of human populations (sufficient to disrupt societies). It is effectively uniformly distributed across the countries of the world, though not necessarily distributed equally across rural-urban areas. The changes to be explored are changes in behaviour, socio-economic change and governance change.
>
> Climate change context: conditions of moderate climate change are assumed, but without a prior significant shift to renewables.

5.3.2 Findings: thought experiment process and results

Step A: Contextual change

Overall short-term autonomous changes are expected to include:

Population/ development	• population decline and shift, both autonomous and planned: • between countries (where possible) • urban to rural: flight from the cities to “safer”, less densely populated rural areas • eventual rebound in population and activity and use of land, but in a more dispersed pattern, hence long-term land use changes
Social	• different impacts for rich and poor (e.g. rich can be more mobile and buy land for food production) • suspicion of government • reduction in outdoor recreation?
Economy	• sharp decline of consumption of all kinds • decline in production • reduced long-distance mobility • more home-working?
Governance	• rise of national or regional barriers and decline of cross-national powers (EU) • containment of trade and activity within “fortress” regions/nations (for food security or immigration control) • more regionalised response • short-term capacity for policies to respond is limited (by loss of key personnel & disruption to systems) hence not effectively implemented • medium-term EU policies e.g. competition policy, CAP and CFP weakened

Step B: Scoping sectoral changes:

B.1 Energy sector

Overall trends

The Bambu scenario includes slow gradual ongoing shift to more renewables.

- Reduced transport availability (air - road)

- Falling demand for energy (for transport, food and commodity production, fewer people, so less energy required for heating?)
- Energy price falls
- Severity of climate change is delayed slightly
- Possible failure of infrastructure (maintenance failure or decision by exporters); increase power outages
- Trend to local energy generation, including renewables
- Over the medium-term, reduced or delayed severity of climate change because of reduction in energy demand.

Regional variations

N & NW Europe	greater dependence on energy - more vulnerable to supply failure; greater disruption of populations given current more urban distribution - more vulnerable
Central Europe	access to biomass and space for wind energy - less vulnerable; lower population densities, better access to rural land - less vulnerable
Southern Europe	capacity for solar energy, lower population density - less vulnerable; lower population densities, better access to rural land - less vulnerable
Rich	Greater dependence on energy - more vulnerable to supply failure?
Poor	Poor urban: little access to alternative energy sources Poor rural: possible access to alternative energy sources

B.2 Agriculture sector

Overall trends

- movement of goods becomes less common - inputs and outputs
- more local production, perhaps on small holdings
- self-sufficiency trend with “lifestyle blocks” of land
- less demand for land for livestock/crops - marginal land abandoned?
- Or: decline in availability of traditional imports (because of less transport, lower global production, and fortress economy) could increase demand for land
- independence from government pursued
- political response to incentivise production?
- reduced availability of fertilizer
- yields per ha. fall
- knock on effects on dependent economic sectors....
- disproportionate effect on certain regions, leading to poverty gap

Regional variations

N & NW Europe	Less knowledge of farming, access to land means adaptation by individuals more difficult; attempts to move to/ exploit land outside this densely populated zone?
Central Europe	“Closer to farming” so easier to adjust and move back to self sufficiency; attempts to block entry by people from NW Europe;
Southern Europe	Nations somewhat “closer to farming” so easier to adjust and move back to self sufficiency; subsequently, CC impacts make farming even more difficult - abandonment?
Rich	Able to obtain food supplies
Poor	Poor urban: greatest difficulty obtaining food supplies Poor rural: some possibility of securing food supplies

B.3 Transport sector

Overall trends

- reduced transport and mobility
- problems maintaining infrastructure (smaller taxation base)
- more home working

- shift from centralized production means reduced need for transport
- disruption of government: road tax not collected
- unplanned urbanisation as city-dwellers move out
-

(example of Leipzig as declining area - PLURAL project)

Regional variation

N & NW Europe	Greater dependence on infrastructure, so more dislocation;
Central Europe	Less dependence on infrastructure; Erection of barriers to control would-be immigrants;
Southern Europe	Less dependence on infrastructure;
Rich	Greater dependence on infrastructure, so more dislocation;
Poor	Poor urban: ? Poor rural: Great difficulties gaining access to services, markets, work

B.4 Water sector

Overall trends

- demand for water falls (domestic, agriculture, industrial)
- problems maintaining supply and treatment infrastructure (smaller taxation base)
- breakdown of water supply and treatment : secondary (i.e. in addition to pandemic) health impacts
- governance breakdown - national/regional policies replacing EU?
- regional conflicts on sources of fresh water (after collapse of treatment plants)
- no money for flood defences – increased risk of flooding, and contamination of water
- re-emergence of vigilantes?

Regional variation

N & NW Europe	Greater dependence on infrastructure, denser populations, so more dislocation
Central Europe	Dependence on infrastructure - ?
Southern Europe	Dependence on infrastructure - ? Shortage of water with increase in droughts exacerbating human migration
Rich	High dependence on supply and treatment infrastructure, so more dislocation
Poor	Poor urban: High dependence on supply and treatment infrastructure, so more dislocation Poor rural: Variable of access to clean water and sanitation

B.5 Biodiversity sector

Overall trends

- more people living in the landscape/rural areas increases pressure on biodiversity
- reduction in outdoor recreation reduces pressure on biodiversity
- some grassland for livestock abandoned - biodiversity impact variable
- marginal areas less able to support population
- more small-holding production - biodiversity impact variable
- failure of water treatment leads to impacts on aquatic biodiversity
- erosion of land resulting from use of marginal land
- reduced CC drivers on biodiversity as CC impacts are slightly delayed
- governance failure leading to loss of protection of biodiversity land
- additional pressures on biodiversity in rural areas, resulting from urban flight
- transport impacts on biodiversity decline
- indirect energy sector impacts on biodiversity decline

Regional variation

N & NW Europe	Biodiversity under most pressure from urban-rural movement? Designation more important in densely populated areas, so failure of protection significant Decline in transport impacts more significant
Central Europe	Biodiversity usually under less pressure (sparser populations) but urban flight increases pressure? Decline in transport impacts less significant
Southern Europe	Biodiversity usually under less pressure (sparser populations) but urban flight increases pressure? Decline in transport impacts less significant

5.3.3 Summary

This section has attempted to sketch a broad methodology for using scenarios to explore future impacts upon biodiversity which might result from a major sudden impact upon society (here, a pandemic), together with climate change.

The methodology suggested starts with contextual change (population/demography, social, economic and governance) then for each of a se of sectors explores possible regional variations and social (income) variants.

The approach used in this case serves to highlight issues such as the complexity of interactions, and the importance of the very many social and economic "contexts" within Europe and across the globe, within which the array of impacts - with or without any additional "shock", will play out. This suggests the need for further information and research. However it is also apparent that the exercise of "going through the process" raises awareness of the way in which factors, policies and activities interact. This greater awareness of complexity and consequently, perhaps, vulnerability, should be valuable in increasing preparedness to introduce measures that increase resilience to impacts, even where it is not immediately possible to assign a positive economic benefit to doing so.

5.3 European research projects on biodiversity and climate change

The tables which follow (Table 5.1, 5.2 and 5.3) review over 20 on-going or recent EU-sponsored research projects and major national projects which deal with many aspects of climate change and biodiversity. As well as indicating the research bodies involved, the project/programme timetable and a link for further details, these tables indicate the objectives of the projects and how it is hope they can assist policy makers. A number of these projects use not only the IPCC climate scenarios, but also socio-economic scenarios, in assessing future change.

These projects are listed here as their aim is to provide the information, models and analysis which will be important in guiding future planning for biodiversity, or to assess the impacts which must be addressed. The projects explore the likelihood and extent of changing baselines, and likely response by biodiversity.

Table 5.1 Examples of on-going European research projects relevant to biodiversity and climate change policy

Project & participants	Funding and link	Objectives and *Policy relevance*	Timing
ADAM project (Adaptation and Mitigation) 26 research institutes across Europe	EC (6th FP) www.adamproject.eu	To lead to a better understanding of the trade-offs and conflicts that exist between adaptation and mitigation policies *Supporting EU policy in post-Kyoto discussion and informing emergence of new adaptation strategies for Europe*	2006-2009 + Scenarios
ALARM **(=** A**ssesing** LA**rge-scale environmental** R**isks with tested** M**ethods,)**	EC Sixth Framework www.alarmproject.net/alarm/	To develop and test methods and protocols for the assessment of large-scale environmental risks in order to minimise negative direct and indirect human impacts. *Assisting in incorporating risk into policy development*	2004-2008 Soc-econ risk indicators
Alter-Net (=A Long-Term Biodiversity, Ecosystem and Awareness Research Network) 24 partner Institutes, etc. in 17 countries	EC Sixth Framework www.alter-net.info	To achieve lasting integration amongst its partners and others, all of whom are involved in biodiversity research, monitoring and/or communication. Aims to build lasting integration of biodiversity research, monitoring and communication capacity. *Providing networked evidence for policy.*	2004-2009
AMICA (Adaptation and Mitigation — an Integrated Climate Policy Approach) Germany, Austria Italy, France, the Netherlands	INTERREG IIIC — project-part financed by the EU www.amica-climate.net	To develop local and regional strategies which adopt a comprehensive approach to climate change To combine measures to promote climate change adaptation with preventive strategies to maintain and protect the global climate *Providing local and regional strategies for climate change (mix of short- and long-term preventive and reactive measures); responding to risks.*	2005-2007
ASTRA (Developing Policies & Adaptation Strategies to Climate Change in the Baltic Sea Region) Finland, Germany Latvia, Estonia, Lithuania, Poland	INTERREG IIIB — project-part financed by the EU www.astra-project.org	To assess regional impacts of climate change and develop strategies and policies for adaptation *Focusing on Baltic Sea Region (BSR) and on stressors such as extreme temperatures, droughts, forest fires, storm surges, winter storms, floods*	2005-2007
BIOASSESS **(**The biodiversity assessment tools project)	European Union Energy, Environment and Sustainable Development Programme www .nbu.ac.uk/bioassess/	**B**IOASSESS (The biodiversity assessment tools project) develops a tool box for assessing the impacts of policies on biodiversity in Europe and measures the impact of land use change on biodiversity across Europe's biogeographic regions. *Tools for policy assessment*	?

CIRCLE-ERA	EU Sixth Framework Programme www.circle-era.net/	To contribute to climate impact analysis and adaptation response by networking and aligning national research programmes in the 19 CIRCLE partner countries. Final goal: Implementation of a European Research Area (ERA) for climate change. *Building networks of research capacity to underpin policy*	2004-2009
COCONUT (Understanding effe**C**ts **O**f land use **C**hanges **ON** ecosystems to halt loss of biodiversity due to habitat destr**U**ction, fragmen**T**ation). 11 research institutes across Europe	EU Sixth Framework Programme STREP http://www.coconut-project.netT	ItO synthesize existing data ON land use change and habitat fragmentation and the effects on biodiversity. With this information COCONUT develops decision tools and policy option - jointly with MACIS – for stopping biodiversity loss. *Providing evidence for policy tools and approaches.*	2006-2008
COMCOAST (Combined functions in Coastal defence zones) The Netherlands, Germany, UK, Belgium, Denmark	INTERREG IIIB — project-part financed by the EU www.comcoast.org/	To explore coastal defence strategies in the North Sea, plus new methods to evaluate flood defence zones; to develop new flood defence solutions *Proposing best practice multifunctional flood management solutions*	2004-2007
EuMon (**EU** wide **Mon**itoring methods and systems of surveillance for species and habitats of Community interest,	EU Sixth Framework Programme http://eumon.ckff.si/	Will provide a European framework that standardizes, focuses and coordinates existing monitoring programs by comparing and integrating existing methods and monitoring schemes of species and habitats of community interests. *Informing the monitoring function within policy.*	2004-2008
MACIS (Minimisation of and Adaptation to Climate Impacts on Biodiversity)	EU Sixth Framework Programme STREP www.macis-project.net	Detailed assessment of on-going and potential impacts of CC upon biodiversity, including impacts of adaptation measures. developing advanced models and policy measures to prevent and minimise adverse impacts from CC. *Supporting policymakers and stakeholders with an overview of CC impacts, and how to deal with uncertainties.*	2006-2008
RUBICODE - Rationalising Biodiversity Conservation in Dynamic Ecosystems. Institutions in 25 countries, inc. EU, Australia, New Zealand and USA	EU www.rubicode.net	To define and evaluate those components of biodiversity which provide specific services to society, inc. food, fibre and fuel, regulation of air and water quality, flood protection, pollination, control of pests, recreation and ecotourism .	2006-200

Table 5.2 Recently Completed Research Programmes

DINAS-COAST (Dynamic and Interactive Assessment of National, Regional and Global Vulnerability of Coastal Zones to Climate Change and Sea Level Rise) Germany, UK, the Netherlands	EC (5th FP) www.dinascoast.net	To develop a CD based tool to produce information on a range of coastal vulnerability indicators, for climatic/socio-economic scenarios and adaptation policies, on national, regional and global scales, for all coastal nations *Practical tool for policymakers and other stakeholders*	2001-2004
ESPACE (European Spatial Planning: Adapting to climate Events) UK, Belgium, the Netherlands, Germany	INTERREG IIIB; North West Europe Prog.UK ODPM www.espace-project.org/index.htm	To develop a dynamic approach to CC adaptation for spatial planning; to recommend approach at European, national, regional and local levels *Directly linked to inform policy decision for spatial planning adaptation*	2004-2007
MICE: Modelling of the Impacts of Climate Extremes 8 Research institutes across Europe	EC www.cru.uea.ac.uk/cru/projects/mice/index.html	Identify and assess current and future changes in climate extremes and the impact of these changes *Providing information on the impacts of extremes*	2002-2005
PRUDENCE (Prediction of Regional scenarios and Uncertainties for Defining EuropeaN Climate change risks and Effects) 25 research institutes across Europe	EU Fifth Framework Programme http://prudence.dmi.dk/	To quantify confidence and uncertainties in predictions of future climate and impacts Will interpret these results in relation to European policies for adapting to or mitigating climate change. *Providing scenarios for policy testing.*	2001-2004
SEAREG (Sea Level Change Affecting The Spatial Development In Baltic Sea Region) Finland, Sweden, Germany	INTERREG IIIB — project-part financed by the EU www.gtk.fi/projects/searegdoc.html	Assess impacts of future sea level rise in several case study areas in the BSR *Developing information on impacts, plus the Decision Support approach to adaptation strategies*	2002-2005

Table 5.3 A selection of major national research programmes on adaptation to climate change

MS	Acronym/Name	Sponsoring Body	START
Austria	A tale of two valleys, within ProVision www.zamg.ac.at/a-tale-of-two-valleys	Central Institute for Meteorology and Geodynamics, Austria and Joanneum Research, Austria	2005
Bulgaria	Second National Action Plan on Climate Change www.moew.government.bg/home_e.php?action=fullnews&id=44	Ministry of Environment and Water	
Finland	ISTO - Climate change adaptation research programme www.mmm.fi/	Min of Envt., Min. of Agric. and Forestry	2006
Germany	Klimazwei www.klimazwei.de DEKLIM www.deklim.de/seiten/dek-frame-en.asp	Fed Min. Education & Research Fed Min. Education & Research	2007
Netherlands	ARK www.vrom.nl/pagina.html?id=30673&term=ARK	Min of Housing, Spatial Planning	2006
Norway	Norklima http://www.forskningsradet.no	Research Council of Norway	2004
Portugal	SIAM www.siam.fc.ul.pt/siam.html	Caloutse Gulbenkian Foundation, Fdn for Science and Technology	2001
Sweden	SWECIA http://www.mistra-swecia.se/	Mistra	2008
UK	Living with Environmental Change http://www.nerc.ac.uk/research/programmes/lwec/ Adaptation and Resilience to a Changing Climate (forthcoming)	Joint Research Councils EPSRC	2007 2008

5.4 Conclusions and recommendations

There is a raft of research projects, including those developing and engaging with scenarios, of direct and indirect relevance to the impacts of climate change on ecosystems, and to the implementation of policies to respond to climate change, both mitigation and adaptation, including the opportunities for promoting adaptive capacity within ecosystems. The EU itself has undertaken and commissioned work via the EEA and other studies.

Significant conclusions are that, while there is extensive work being undertaken, climate change mitigation and adaptation are still being considered separately, and their interactions are not being considered. This is particularly important for biodiversity. It is also evident that, despite the high public profile of some of these studies – for instance, the presentation at EU Green Week in 2007 of the EEA's PRELUDE scenarios, and the efforts of DGEnv and DG Research to pull together different studies and their outputs in preparation for the Adaptation White Paper in 2008 – there needs to be more concerted effort to communicate outputs to policy-makers and stakeholders at multiple levels, and to enhance opportunities for sharing learning.

These conclusions are consistent with those of the EEA 2007a report, and the EU's ADAM study. The EEA concludes that it is important to support policy processes that handle uncertainties in a systematic way, and makes a number of useful recommendations (p.38). The MACIS project concurs with these broad conclusions, and presents them here with a focus on the need to integrate climate change policy responses with current commitments to halting biodiversity loss:

- designing futures studies around issues on the current policy agenda: this would include specifically studies which integrate climate change mitigation and adaptation;
- including more forward-looking perspectives in national environmental reporting: this would include suitable forward-looking indicators, drawn from scenario studies of ecosystems under conditions of climate change;
- the active involvement of regional and national institutions in futures studies; and
- increasing institutional capacity (expertise and resources), especially in the integration of mitigation and adaptation.

In addition, we recommend that

- There be a systematic audit of the use and usefulness in policy decision-making and practice of climate change and socio-economic scenarios and futures studies within the EU. This could be modelled on the stakeholder-led UKCIP audits, and commence by contacting the stakeholders who have been involved in generating some of the scenarios used in the studies.

The EU's ADAM study, while it focuses specifically on adaptation, in its interim report (McEvoy and Lonsdale, 2008) offers some tentative explanations from a social learning perspective as to why adaptation action might be difficult. They adopt an actor-based approach to provide perspectives both on the determinants of adaptive capacity and the mechanisms necessary for delivering adaptation actions. They highlight the role of learning, and the importance of involving actors at multiple levels, who can draw on their experience and provide local or "vernacular" knowledge. They recommend giving active support to knowledge networks, peer-to-peer learning (and not just policy-makers to policy-makers), and suitable knowledge transfer platforms and sets of tools targeted to specific end-users.

Many of these should be considered when implementing the recommendations given above for making better use of scenarios and research studies in policy-making, through linking research, policy and stakeholder communities. (See also section 2.2.6 on Policy learning).

6 POLICY COMPLIANCE AND ASSESSMENT FRAMEWORK

6.1 Introduction

In this section we examine the options for including climate change impact assessment in policy and plan development, and some techniques available for assessing policy consistency and compliance with objectives.

First, the need for an assessment framework for policy in this context is discussed (section 6.2) to provide policy integration and to "climate proof" policy - i.e. to take into account potential impacts associated with climate change and extreme weather, and where possible to introduce measures which increase resilience to climate change. The proposed framework is based on the approach taken in spatial planning in order to integrate and harmonize land use and other decisions. After reviewing issues associated with biodiversity and climate change adaptation through spatial planning (section 6.3), the assessment framework used in plan and programme assessment, Strategic Environmental Assessment (SEA), is introduced in section 6.4 and an approach to risk assessment is summarized briefly (section 6.5). We go on to propose a process and some techniques to assist in this assessment work, to aid exploration of policy as well as negotiation on policy and measures with respect to impact mitigation and climate change adaptation (sections 6.6. and 6.7).

The assessment framework proposed is based on the procedures of Strategic Environmental assessment and Environmental Impact Assessment, which are required under EU Directives and already widely undertaken, though so far the inclusion of assessment of climate change impacts together with project or plan impacts is only gradually being introduced.

6.2 Policy assessment and integration and climate-proofing

Preceding sections 2, 3 and 4 have identified where policies at EU and national level interact with climate change and climate change policy. Policies across the field of governance - not only policies associated with mitigation of or adaptation to climate change - have implications for climate change and are affected by climate change; moreover they frequently interact to lead to indirect effects upon the environment. This report is principally concerned with biodiversity, and so it is the interaction of policies and climate change and impacts for biodiversity that are the focus of this section.

Previous work by several authors (e.g. Treweek, 2005; also Piper et al. 2006 in an output of the EU-funded BRANCH project) have pointed to the use of Strategic Environmental Assessment (SEA) as a framework for assessment that can incorporate climate change and its direct and indirect impacts upon biodiversity into decision-making. In this section we will propose the extension of SEA to policy assessment to work towards the integration of objectives relating to biodiversity, under conditions of climate change.

Policies (existing, new and updated) need to be tested against climate change scenarios and assessed for risk resulting from climate change and the interaction of climate change with other changes and policies. Where there are policy objectives for biodiversity, policy integration needs to be achieved both horizontally and vertically. It is also important for action to be taken at the appropriate scale. At the broadest scale, horizontal integration is needed across policy areas both within the remit of spatial planning, and interacting with it. This is to ensure the consideration of cross-sectoral measures, such as promoting water efficiency as a means to offset increased demand for water for existing populations, for new development areas, whilst remembering the needs of wildlife under conditions of climate change.

Vertical integration is also needed across the levels of the plan hierarchy to ensure national objectives for climate change adaptation are cascaded "down" to local decision-makers, and that local knowledge is conveyed "upwards" to policy makers.

The role of spatial planning in addressing climate change, and the role of SEA in spatial planning are reviewed in sections 6.3 and 6.4. Section 6.5 provides a brief overview of risk assessment, which is a further element of the assessment process.

6.3 Biodiversity and climate change adaptation through spatial planning

Spatial planning can provide a model for action on climate change in other policy areas. Work undertaken as part of the BRANCH project (reported in Piper et al., 2006), showed that spatial planning is still at a preliminary stage with respect to addressing dynamic biodiversity in circumstances of climate change, and with regard to recognising and valuing ecosystem functions. Spatial planning systems in the partner countries of the BRANCH study (UK, Netherlands, France) had only recently begun to integrate more dynamic conceptions of biodiversity, such as the need for biodiversity space, green infrastructure, ecological networks and the integration of biodiversity into development, and in many cases adopt only short-term plan-horizons.

Essential elements of spatial plans which drive adaptation to climate change will include clear adaptation objectives and objectives which support and enhance biodiversity - Piper et al. (2006) found that this was not yet the case in the array of plans they analysed. Many plans have short time-scales: although the Netherlands national spatial plan and some sectoral plans, such as for water and coastal areas, have longer term horizons. Piper et al. emphasized the need to extend the time-horizon of plans, to acknowledge the anticipated change in climate over the next 25, 50 and 100 years, noting that the built developments which are the outcome of many spatial plans have a design-life of 50-100 years, a period over which climate changes will become apparent (occurring rapidly or slowly over that period), whilst over such a period biodiversity may adapt in ways not yet foreseen.

Key findings from Piper et al. (2006) were that

- to turn policy into action on the ground there must be a strategy/vision for biodiversity response to climate change with agreed objectives and targets;
- appropriate powers (perhaps through partnerships) and enforceable measures are needed, and there must be access to funding for some actions;
- there is agreement that spatial planning approaches that enable natural processes to take place and enable biodiversity to thrive also lead to other socio-economic benefits; and
- research continues to be needed, but complete certainty is probably not achievable, so it will be necessary to proceed despite information shortfall on some issues; risk assessment will help to cope with this.

Consequently the BRANCH spatial planning report (Piper et al. 2006) recommended that spatial plans

- adopt a longer-term plan horizon to take account of climate change scenarios
- adopt an explicit spatial plan objective to adapt to climate change
- award higher priority to biodiversity objectives or considerations in all spatial planning policy arenas in fulfilment of EU legislation and national requirements under the Convention on Biodiversity.
- emphasise both biodiversity's intrinsic value and also the role that it can play in enabling adaptation in other sectors (multiple benefits such as flood-management, water, building design, and quality of life.

What is true of spatial planning, we argue, is equally important at the level of policy. Thus we proposed that policy impact assessment should include strategic evaluation of the impacts of climate change and related risks, within an SEA-derived framework.

6.4 Policy and plan appraisal: Strategic Environmental Assessment (SEA)

The European Commission's key message on the SEA Directive (2001/42/EC) is that it "stipulates that plans and programmes which are liable to have significant effects on the environment must be subject to an environmental assessment prior to their adoption". The BRANCH report on spatial planning and climate change has discussed the value of including climate change within environmental assessment procedures (EIA for projects, SEA of plans and Habitats Regulations Assessment or "Appropriate Assessment" at specially protected

sites). Climate change is not an impact considered in the formation of the respective establishing directives, but SEA, for example has been identified in international agreements relating to biodiversity (the Convention on Biological Diversity (CBD), the Ramsar Convention on Wetlands and the Convention on Migratory Species) and is seen as an important tool for ensuring that conservation and sustainable use of biodiversity are pursued as fundamental objectives of strategic decision-making and planning. The role of SEA in promoting the conservation and sustainable use of biodiversity has been discussed by Treweek and others (2005) who indicate that SEA provides opportunities to ensure that proposed plans are consistent with policies and priority actions for biodiversity conservation, protection and sustainable use. Obligations under global conventions as well as any national policies for biodiversity or environmental protection would be met in this way. Guidance is also available on SEA and climate change (Levett-Therivel, and others 2004).

For climate change impact assessment to become a standard element in a policy assessment process, the impact of a policy, plan or programme must be assessed against a changing climatic context, over time, taking into account any proposed mitigation (to reduce plan or policy impacts) as well as likely adaptation to climate change. The probable effectiveness of any compensatory measures should also be assessed in the light of climate change.

All Member States are required to undertake SEA to assess the environmental impacts of plans and programmes at national, provincial and local level. This procedure has considerable potential to assist with the integration of biodiversity and spatial planning under conditions of climate change. Actions to take include:

- using objectives to generate climate change adaptation criteria to assess development plans, including the interaction of the policy or proposal with biodiversity and climate change
- establishing the current baseline but also current and expected trends under conditions of climate change
- generating and evaluating alternative plans and options assessing impacts under conditions of climate change
- assessing the impacts of alternatives on biodiversity over the plan period and beyond, and the impacts of possible changes in biodiversity on the plans
- using the process to identify the scope for achieving multiple benefits for a range of objectives
- providing broad or more detailed costings of the economic value of biodiversity and ecosystem services.

In some circumstances Habitats Regulations Assessment (also known as Appropriate Assessment) is required under the Habitats Directive, and then the appraisal should consider the plan horizon and the possible climate changes over that period, direct and indirect effects, and the interaction with other plans, across administrative and national boundaries where appropriate. The scoping process for SEA should identify other relevant plans such as Natura 2000 management plans and the river basin management plans devised in accordance with the Water Framework Directive.

Piper et al. (2006) recommended that the wording of the SEA Directive be changed to make the direct and indirect consequences of climate change on the plan a “minimum information” requirement under Article 5(1) and Annex 1 of the Directive.

6.5 Risk assessment

Risk assessment is an additional procedure for spatial planning under climate change. Risk assessment examines the risk that products and activities cause to human health, safety and ecosystems. It involves identifying possible hazards, the exposure and vulnerability of receptors (for instance birds or the local economy), and identifying and analysing the likelihood and consequences of the resulting risks.

Risk assessment for climate change has been the subject of work by UKCIP and a detailed handbook, covering a variety of decision-making tools, has been prepared (UKCIP 2003). The elements of the UKCIP process are summarized in Figure 6.1.

Risk assessment can be used to compare options on the basis of the risk that they cause (or face) and can incorporate the precautionary principle. However risk assessment involves the use of assumptions and this will lead to varying levels of uncertainties in the result - the incorporation of cost-benefit analysis which adduces values to species and habitats will further affect levels of uncertainty. Sensitivity testing may be used to acknowledge uncertainties, and to assess options for decision against different climate change scenarios.

Figure 6.1 UKCIP Risk, uncertainty and decision-making framework

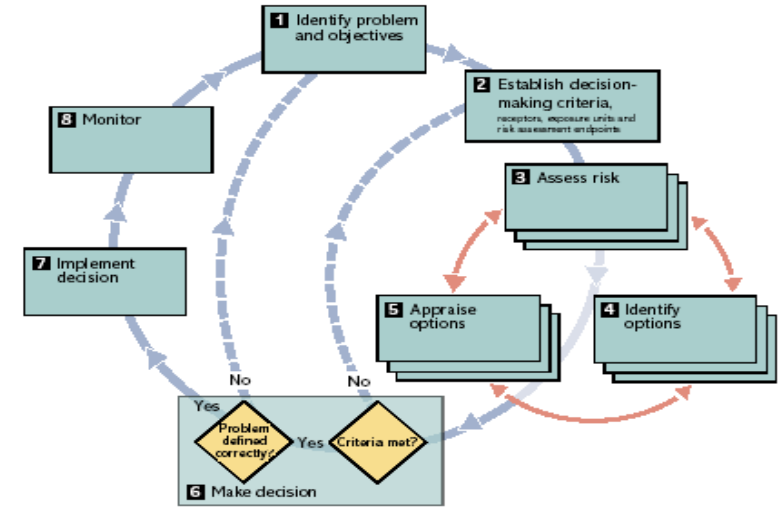


Figure 1: A framework to support good decision-making in the face of climate change risk

The six principal stages of the UKCIP process are summarized below. The sequence matches well with the SA and SEA tools being used during plan-formulation. Each stage requires a set of questions to be answered - a few of these are indicated.

Stage 1	Identify problem and objectives Why make the decision? For what objectives? Origin of need to decide? Timescale?
Stage 2a	Establish decision-making criteria Nature of criteria (e.g. risk)? Legislative context, constraints? Decision rules? Interaction with other policy?
Stage 2b	Establish exposure units, receptors and risk assessment endpoints Define receptors, exposure unit. Adequate resources and time available?
Stage 3	Preliminary climate change risk assessment Lifetime of decision? Likely significant variables? Level of uncertainty? Anything to screen out at this stage?
Stage 4	Initial options identification Type of options available? No regret, low regret, partial or full adaptation options available? What level of flexibility in options?
Stage 5	Initial options appraisal Rate options against criteria. Sensitivity analysis? Are more detailed assessments necessary?
Stage 6	Make decision Is there a clear preferred option? How would changing the criteria affect the decision?

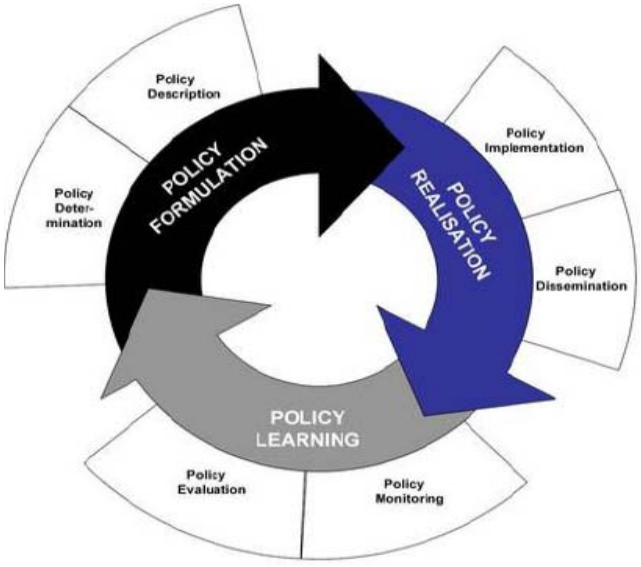
source: Summarized from UKCIP (2003) *Climate change: Risk, uncertainty and decision-making*

6.6 Policy development and assessment

EU and national government policies for the array of policy areas are designed to meet desired objectives, but conflicts may exist, for example as a result of interactions, competition for resources and indirect effects. When climate change is added to the "baseline environmental conditions" to be considered, there are further opportunities for obstacles and conflicts to develop. In order to identify such conflicts and maladaptations, we propose adapting existing tools for checking policy consistency.

Peltonen (2007), in an output of the ASTRA research programme, has described how policy development in this area must deal with conflicting goals. Peltonen sees policy development as a cycle from policy formulation through policy implementation to policy learning - see Figure 6.2. He argues that comprehensive methods are needed to address problems which will arise from "mainstreaming" climate change into the array of sector policies and recommends that cost-benefit analysis needs to be embedded in a broader debate, setting multiple criteria for sound adaptation measures. Peltonen moreover recognizes the needs for policy and plan development in line with principles of communicative and participatory planning. The assessment framework discussed in the following sections is intended as a measure in accordance with these requirements. Section 2.2.6 above has discussed evidence of policy learning across the EU and beyond.

Figure 6.2 Policy wheel: from policy formulation to learning



Source: Peltonen, 2007

Given the array of policies which interact to affect the environment, in addition to climate change impacts, an iterative approach would be needed, first comparing policies against each other, perhaps pair-wise, then bringing them together and attempting to harmonize objectives in the light of the effects identified. This iterative process is illustrated in Figure 6.3.

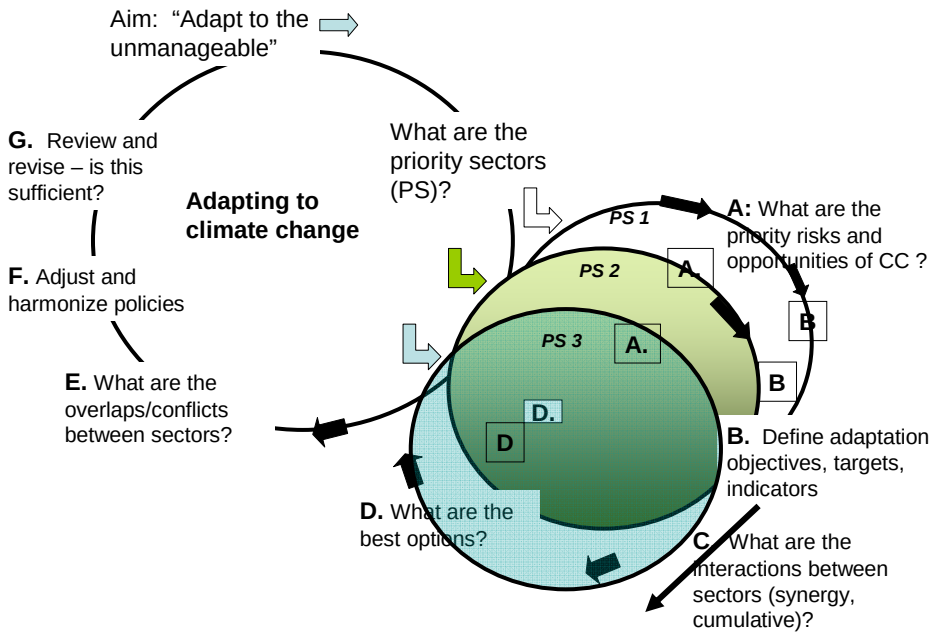
Figure 6.3 Assessment process stages

Within each priority sector (e.g. transport)

- **Step A:** What priority risks and opportunities?
- **Step B.** Define adaptation objectives, targets, indicators
- **Step C.** What are the interactions between policy sectors?
- **Step D.** What are the best options?

Across priority sectors (e.g. transport + housing)

- **Step E.** What are the overlaps/conflicts between policy sectors?
- **Step F.** Adjust and harmonize proposed policy changes
- **Step G.** Review and revise – is this sufficient?



After identifying priority risks and opportunities resulting from likely climate change (step A), perhaps using the UKCIP risk assessment framework shown in figure 6.1, and after defining objectives, targets and indicators for the policy/plan (step B), any interactions between policies and sectors need to be reviewed. First, the main planks of climate change policy (mitigation and adaptation) may be compared to assess their mutual consistency. This would be done initially for a single sector or policy area; for example, Figure 6.4 takes the case of policies and measures within the built environment sector and uses a policy consistency chart to compare policies (or objectives) identifying areas of agreement, conflict or synergy.

It is emphasized that these techniques, which are based on SEA models and procedures, are put forward as a basis for exploration of issues and effects and therefore as a means for negotiation and agreement on responses. Each of the figures presented below provides a systematic array of cells which may be used:

- first in a scoping exercise, with a symbol to indicate whether or not this combination of elements needs to be explored further.
- secondly, in an assessment process to summarize for example whether the interaction or combination of the elements is a significant effect and requires mitigation or other action. Thus, in a second stage an alternative version of Figure 6.4 could be used to identify and record the significance of any conflict, synergy, etc.

Figure 6.4 Assessing consistency of adaptation and mitigation measures, example of built environment sector

		MITIGATION POLICY/ MEASURES						
		Modal shift	Reduce urban sprawl	Energy effic. measrues	Switch from FF to Renew.s	C capture/seq.	Bldg mats. technology	Green roofs/walls
ADAPTATION POLICY / MEASURES	Adapt urban design	✓ ✓	✓		✓	✓		✓
	Adapt building design		✓			✓		
	Gardens/parks management							
	Increase resilience to extreme w'ther			✓				✓
	SuDs		✓					✓
	Changed urban management practices							
	Re-settlement (coastal realignment)							

Next, a similar tool could be useful to identify interactions and impacts between potential measures for adaptation (or mitigation) and the elements of biodiversity which they may affect. This tool could help with step D, assessing the best options, together with Figure 6.5, below. Again the symbols inserted in cells could be ticks and crosses (yes / no) to indicate inter-policy consistency or could indicate the likely degree of significance (S = significant). Text information could also be inserted in the cells, for example identifying a location (for a plan) or a refinement of policy.

Figure 6.5 Impact of adaptation measures upon biodiversity indicators or elements

		BIODIVERSITY "INDICATORS"/ELEMENTS						
		habitats	species	niches	corridors	patches	Protected Site - quality	Prot. Site - size
ADAPTATION MEASURES	Urban design	✓	✓	✓	✓	✓		
	Building design			✓				
	Gardens/parks management	✓	✓	✓	✓			
	Increasing resilience to extreme weather		-ve (urban trees)					
	SuDs	✓	✓	✓	✓- S	✓		
	Changed urban management practices.	✓ = S	✓	✓				
	Re-settlement (coastal realignment)	✓/-	✓		✓/-	✓/-	-	✓/-

To continue the assessment process to step E, a compatibility appraisal tool (Figure 6.6) could be used. This is a simple tool used in sustainability appraisal and SEA, which employs a matrix to examine the consequences of policies and objectives, and confirms that these are internally coherent within a plan and consistent with other strategic plans/actions in other plans. To assist with biodiversity adaptation to climate change, the comparison would be made between the array of policy objectives, adaptation to climate change objectives, and biodiversity enhancement objectives. Where incompatibility is found, it will be necessary to re-think the objective and/or policy. Compatibility appraisal can help to clarify trade-offs and is relatively simple to perform, though it is subjective and can be time consuming.

The purpose of the policy compatibility chart (Figure 6.6) is to prompt questions about impacts resulting from the interaction of two policy areas upon biodiversity, and then to prompt identification of measures to address those impacts.

Figure 6.6 Policy compatibility chart

Policy area	sust dev	agriculture/rural development	transport - mobility	energy	biofuels	water (qlty, supply	flood mgmt	Soils and forests	fisheries	competition	regional policy	trade	international development
Sust. develpmt.													
agric/rural dev	?												
transport-mobility	x												
energy		✓/X	X										
biofuels	x												
water (qlty/sply))													
flood m'gement						✓							
soils and forests						✓							
fisheries													
competition				X									
regional devlpmt.				X	?								
trade													
international development													

The choice of the symbol in each cell will depend on local/regional circumstances (environment and policy), but a few have been filled in for illustration. At a given location these might include:

Agric. development	x Energy	✓/X potential for adverse and positive interactions, e.g. intensification, transport issues, fertilizer and irrigation use
Biofuels	x Soils	X potential for adverse effects e.g. depletion of soil fertility or resilience to extreme weather
Flood mgmt	x Water supply	✓ potential for beneficial effects, e.g. infiltration zones enhancing groundwater reserves

6.7 Examining plans - potential lines of enquiry

As part of an SEA process to assess the likely impacts of proposed policy or plan (i.e. strategic plan, regional or sectoral plan) upon biodiversity, the policy or plan should be interrogated with questions such as those shown in the following Figure 6.7, which include matters relating to water, soil and risk assessment, but which are also of relevance to biodiversity.

Box 6.1 Lines of enquiry - biodiversity and climate change in policy and plans

Biodiversity

Does the policy or plan:

- help implement the objectives of relevant Biodiversity Strategies at each level?
    - local
    - regional
    - national
- help to halt the loss of biodiversity and continue to reverse previous losses through targeted action for species and habitats?
- increase awareness, understanding and enjoyment of biodiversity and engage many more people in conservation and enhancement?
- restore and enhance biodiversity in all urban environments it covers, through better planning, design and practice?
- provide opportunities to restore and enhance biodiversity in all rural environments it covers, through better planning, design and practice?
- develop an effective management framework that ensures that biodiversity is taken into account in all decision-making?
- ensure that the most accurate and up-to-date knowledge on biodiversity is available to all policy makers and practitioners in a convenient form?
- introduce or increase risks to existing habitats and species via impacts upon physical resources (soils, water, and slopes) or invasive species?

Water and Soil

Does the policy or plan

- contribute to sustainable soil management through appropriate land use planning and management?
- promote land and land use management which contributes positively to the sustainable management of the water environment and achievement of WFD objectives.

Energy

Does the policy or plan

- have impacts for the supply and/or uptake of opportunities for renewable energy?
- affect existing levels of carbon storage (rates and stocks). Does it offer potential for increasing capture and sequestration?

Risk Assessment

Does the policy or plan quantify and collate changes to risk levels affecting biodiversity directly, and changes to risks affecting biodiversity indirectly, via impacts upon:

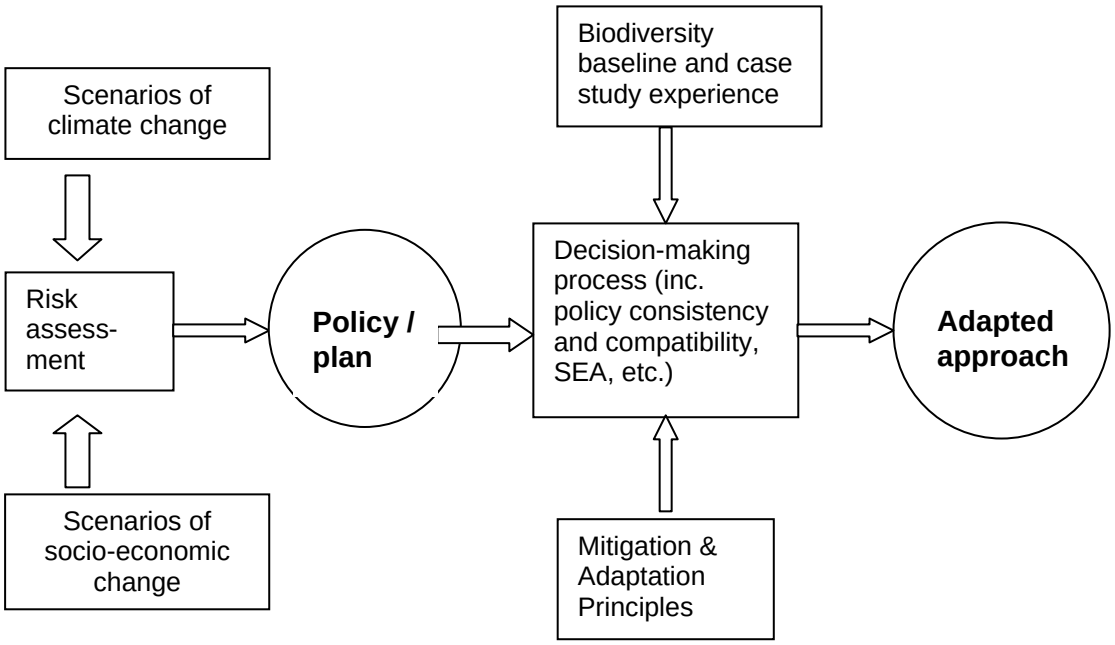
- soils
- water environment and flooding risk
- air quality
- slopes
- disturbance (by development or by human presence)

6.8 Conclusions

Figure 6.8 attempts to bring together the various elements of a process that assesses the impacts of policies and plans, together with those of climate change, upon biodiversity. A comprehensive assessment of proposed policies and plans for their impact upon and interaction with climate change valuable elements will include information on the following, in order to develop mitigation and adaptation policies and to harmonize and integrate cross-sectoral policy

- scenarios for both climate change and socio-economic changes
- risk assessment
- knowledge of the current baseline in the area or topic under study, and relevant additional information
- a set of principles for mitigation and adaptation

Figure 6.7 Elements in policy and plan assessment for climate change



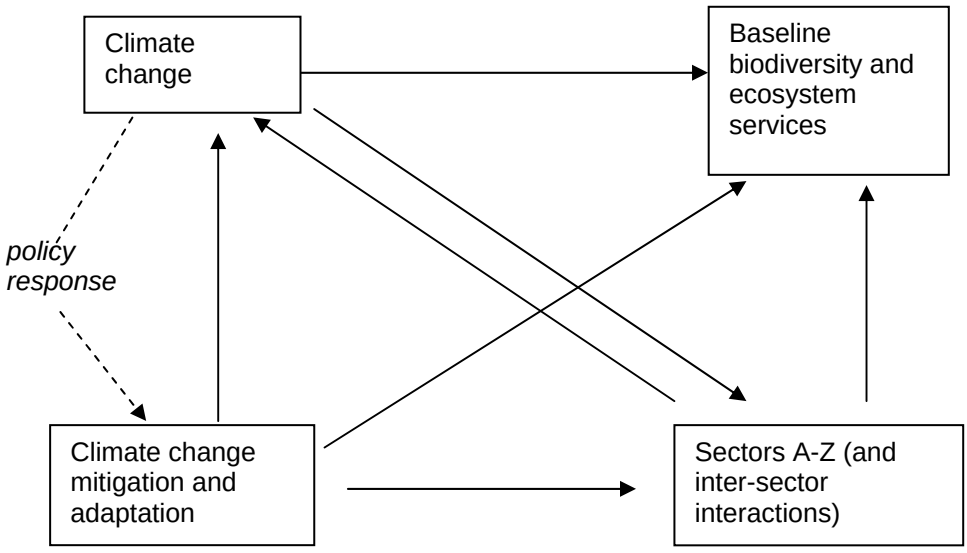
It is likely that not all of the desirable elements will be available - many of the components shown above are “data-hungry”, i.e. requiring very large quantities of information - for example, quantitative or modelled socio-economic scenarios. It may be necessary to make progress on the basis of assumptions and broad-brush assessments. The assessment framework and analysis tools described above are intended to help the policy and plan assessment and integration process become systematic and transparent and are proposed as a basis for uncovering relationships and negotiating responses, rather than as a means to a “black and white” policy recommendation.

7 POLICY ANALYSIS FOR BIODIVERSITY AND CLIMATE CHANGE: CONCLUSIONS

In this report we have reviewed and analysed policy at EU-level and in Member States which has relevance for biodiversity under changing climates. Evidence of impacts of climate change upon biodiversity, and of the range of policy areas and economic sectors which affect biodiversity, has been demonstrated in other deliverables of the MACIS project and this has been incorporated within the present report.

It is recognised that there are multiple interactions between human actions/activities and biodiversity, as outlined in the following diagram (Figure 7.1). Some interactions are positive, others adverse, but none of the linkages shown is always positive or always negative in all situations and locations (or, perhaps, not even permanently so at a given location).

Figure 7.1 Interactions between climate change, sectors, policies and biodiversity



Chapters 3 and 4 above have outlined an array of measures - from high-level strategic policy to implementation measures - that can help to protect aspects of, and resources for, biodiversity and ecosystems in different circumstances. We have emphasized that all policy areas (and not only those which directly influence the physical environment) need to be reviewed and assessed for impacts - both beneficial and adverse, both direct, indirect and cumulative. We have indicated what policy and planning measures may be used by a number of policy areas and economic sectors. Chapter 5 has explored the use of socio-economic scenarios as a measure for policy development, and has analysed on-going research programmes.

EU strategic policy for the protection of biodiversity at present focuses on “halting loss” and, where specially valued (Natura 2000) sites are involved, on securing compensation for loss or harm. Given the evidence of continuing biodiversity decline (see, for example: Temple and Terry, 2007; and Conrad et al., 2006), we conclude that such policies by themselves are insufficient to tackle the combined effects of planned impacts (resulting from policies, programmes and projects) together with the myriad “autonomous” decisions of individuals (which lead, for example, to smaller households) and other pressures, as well as those of individuals, companies, governments etc., in response to climate change.

Policies such as “halting decline” and “no net loss” are insufficient to protect biodiversity in a rapidly changing environment of multiple interacting pressures. “Net gain” (of biodiversity or

resources for biodiversity, and indicating a replacement rate of more than 1:1), is a proper and precautionary response to planned changes.

In addition to this, also needed is a policy of incorporating "resilience" - which is to say flexibility, "slack" or a redundancy of provision in terms of sites, forms of protection and enhancement implementation measures. Such a response to the impact of climate change, together with autonomous or unplanned changes occurring across regions and nations, would provide resilient resources for wildlife and ecosystems - and the importance of these for ecosystems and human welfare has been documented. Figure 2 attempts to illustrate the consequences of the different levels of policy aim to the various pressures, and suggests that only a combination of policy aims for resilience and net gain will lead to stability or enhancement of biodiversity.

Figure 7.2 Representation of likely consequences of different policy aims

Policy aim for biodiversity	Existing baseline situation	"Unplanned" change		Planned change		Result of cumulative effects: **1+2+3+4**
		1- CC and autono-mous responses to CC	**2** - demo-graphic change & other pressures	**3** - Planned change/ development by sectors	**4** - Planned response to CC	
No net loss	Change is unavoidable	Impacts not addressed	Impacts not addressed -	Anticipated impacts addressed under EIA/SEA	Anticipated impacts addressed under EIA/SEA	Decline
Net gain		Unmet impacts	Unmet impacts	Anticipated impacts addressed under EIA/SEA	Anticipated impacts addressed under EIA/SEA	Stability or decline?
Resilience (to type **1+2** impacts)		Impacts addressed	Impacts addressed			Stability or decline?
Resilience + net gain		Impacts addressed	Impacts addressed	Impacts addressed	Impacts met	Stability or Improvement

The evaluation of progress on the Communication on Biodiversity and Action Plan 2010 states that:

> "Important new initiatives identified in the Action Plan are under preparation including work towards development of an EU framework on invasive alien species, strengthening partnerships on business and biodiversity, communicating biodiversity and launching of a review of the economics of biodiversity loss. However, despite increased opportunities, it is at present difficult to demonstrate significant progress in the integration of biodiversity into other sectoral policies relating to the conservation and restoration of biodiversity and ecosystem services in the wider EU countryside and marine environments and in reinforcing the compatibility of regional and territorial development with biodiversity in the EU" (EC, 2008).

This report has identified some ways in which biodiversity concerns could be better integrated into sectoral policies. It suggests that the strategic aim with respect to biodiversity needs to be extended to include not only concepts of compensation and no net loss, but to address this via a formulation which encompasses both the need to strengthen resilience to cumulative impacts upon biodiversity (including climate change) via a call for a net gain in biodiversity and ecosystem resources and precautionary policies to provide resilience to changes which are more difficult to predict.

Moreover, and in order to improve the scoping of future changes, we recommend in section 5. that socio-economic scenario futures work be used more widely to enable broader understanding to be developed of where changes and interactions may come, and so to test response options.

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APPENDIX

MACIS WP4 - RESPONSE TO CONSULTATION ON GREEN PAPER - ADAPTING TO CLIMATE CHANGE

1) What will be the most severe impacts on Europe's natural environment, economy and society? (optional)

Direct impacts on biodiversity (Bd) plus indirect impacts:

- mitigation actions by other sectors, e.g. energy sector, such as biofuels development)
- "maladaptation" by other sectors (e.g. actions leading to higher demands for water in changed climates)
- other adaptation, eg migration.

Impacts for Bd result from habitat loss & fragmentation, alien species, changed water relations, etc. , leading to lost ecosystem services (nutrient cycling, carbon sequestration, pollination, cleansing of water bodies, flood abatement and flow regulation, "quality of life" services). Also: indirect consequences for human health & economic consequences (e.g. loss of pollinators). And

- greater unpredictability in food production/access,
- Invading pests diseases (livestock & human)
- Flooding, landslide, erosion.

2) Which of the adverse effects of climate change identified in the Green Paper and its Annex concern you most? (optional)

Impacts on biodiversity and ecosystems may have consequences upon both continuing survival of biodiversity (and perhaps humans also) and upon the quality of life lived in different locations.

3) Should further important impacts be added? (optional)

☐ **Yes** ☐ No

Impacts upon governance and stability of human societies as a result of cumulation of pressures.

4) Does the green paper place the right urgency and emphasis on the matter of adaptation in Europe? (optional)

☐ Yes ☐ **No**

More emphasis is needed on the need for action to be taken very quickly (e.g. review of infrastructure, policies etc. to check for need to act), rather than waiting for lengthy periodic cycles of review.

5) What should be the different roles of EU, national, regional, local authorities and the private sector? (optional)

With regards to biodiversity, the EU has a strategic objective - halting the loss of biodiversity by 2010 - but there is general acknowledgement that this will not be met. There is a need for clear strategic planning at EU level towards an achievable objective. This strategic plan would include funding, targets, implementation measures and monitoring. It would allocate responsibilities and set a schedule for expected progress in meeting aims.

The EU perspective also permits transboundary effects across Europe (and globally) to be researched and addressed. Also, the EU can play a role in integrating biodiversity and climate change concerns across other sectors (e.g. transport, energy).

It is also the role of EU to promote a sense of urgency, to identify necessary changes, to seek consensus on a set of essential goals (e.g. compare with Water Framework Directive, which insists that the status of all water bodies will be restored towards "good quality"). These goals would bring about harmonisation of vision and action across the community. The EC can offer incentives via funding, and seek to balance impacts of this new policy on different countries.

A strong and continuing EU commitment to the Natura 2000 network is important (for example, because these are likely to be the best such conservation areas available into the future, despite change, and partly because it would be very difficult and time-consuming to identify alternative areas), though additional areas might begin to be sought.

National level: national governments' role is to find a route to compliance with the EU goal, in the light of national circumstances, and to set a national roadmap for that in broad terms. Also, to find ways of ensuring implementation of the approaches (including impact assessment and SEA, to integrate action across sectors and perhaps between government departments; river basin planning; partnerships and participation).

Regional and local levels have the role of implementing these policies on the ground, in the light of local circumstances.

More detail on responsibilities at different levels of the hierarchy are given in the following report, published as part of the BRANCH project (EU-funded under Interreg III): *Spatial planning for biodiversity in our changing climate (Natural England Report R677)* http://naturalengland.twoten.com/NaturalEnglandShop/product.aspx?ProductID=2f3fc694-f835-451f-8bf3-27c73395acac

Clear strategic planning at EU level towards an achievable objective is needed, to include funding, targets, implementation measures and monitoring; allocating responsibilities and setting a schedule for expected progress towards aims.

- research & address transboundary effects
- integrate Bd & CC concerns across other sectors (e.g. transport, energy).
- promote a sense of urgency identify necessary changes,
- seek consensus on a set of essential goals (e.g. compare with Water Framework Directive, "all water bodies will be restored towards good quality").
- Bring about harmonisation of vision and action across the community.
- Offer incentives via funding, and seek to balance impacts of this new policy on different countries.
- Strong and continuing commitment to the N 2000 network - but seek additional areas.

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6) Which economic, social and environmental impacts of climate change should be addressed at EU level as a matter of priority? (optional)

- Risks to ecosystem services and biodiversity
- Migration of species and habitats - providing space for this to happen.
- Impacts of EU sectoral policies (especially transport, energy, trade and development, competition, regional development) upon the biodiversity sector under changing climates, identifying how to prevent/mitigate these impacts.
- Danger to life (coastal and fluvial flooding, heatwaves, landslip)
- Danger to food production/ food security

7) Apart from the main priority areas identified in the four-action approach, are there other areas that have been missed out? (optional)

☐ **Yes** ☐ No

We recommend that the issue of relevant strategies be examined: is there a need for separate climate change and sustainable development strategies? If they are to be kept separate, how are they (and how should they) be interpreted?

An alternative might be an additional pillar: a common EU commitment to protection of physical and biological systems in the face of climate change, perhaps along these lines: "All land management and development must aim to restore and improve ecosystem services provided by water, soils, the air, ecosystems and biodiversity."

It would be important that this commitment apply not only to cases where there is development but also to management of existing stocks of housing, industry, infrastructure etc.

The proposed White Paper on adaptation to impacts of climate change might usefully include generic recommendations applicable to many sectors, leading to the amendment/upgrade of aspects of relevant directives such as the Habitats Directive with respect to the assessment of impacts upon, and provision for, biodiversity.

8) Does section 5.1 correctly and comprehensively identify the needs and policy priorities for early adaptation actions that should either be taken or coordinated at the EU level? (optional)

☐ Yes ☐ **No**

Natural resources: Ecosystems and biodiversity, forests and soils come towards end of this section but are vital. They are said to be "at the heart" but they are discussed at the end - they should be priority issues, addressed at the beginning.

Energy section highlights buildings, but not the appliances within them. The EU has a role here in enforcing eco-labelling.

In section 2, CC impacts on physical and biological systems worldwide are outlined: (water, ecosystems and biodiversity, food, coasts, health - but atmospheric/air quality systems are not mentioned). The Green Paper then moves directly to sectors under the first pillar, and its recommendations for each sector are directed inwards, responding to questions such as: How can transport can be adapted? However, the reverse of this: how transport systems might support or enhance environments and ecosystems in circumstances of climate change is not asked.

It would be valuable to base a set of proposals on the physical and biological systems themselves, and on how they can be maintained/supported. These proposals would address how these systems should be / could be further protected and improved, despite climate change and other interacting pressures. To do this entails review of current sectoral policies at EU and national levels - this is being undertaken within the MACIS project.

9.a) How do policy priorities need to change for different sectors? (optional)

- Identification of weaknesses/vulnerability exacerbated by potential climate changes.
- Identification of adverse interactions between policies or exposure to further pressures.
- More emphasis on use of interpretative and assessment tools.

9.b) Which policy approaches should be taken at national, regional or local level? (optional)

More detail on policy approaches at different levels of the hierarchy are given in the following report, published as part of the BRANCH project (EU-funded under Interreg III): *Spatial planning for biodiversity in our changing climate (Natural England Report R677)*
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Specific examples include

1	**EIA and SEA Directives:**
	Review directives (assess objectives and process) in order to raise the profile of impacts of climate change upon biodiversity, and the priority given to adaptation measures. "Climate-proof" directives and amend.
	Strengthen assessment of climate change impacts within environmental assessment of plans and projects, covering mitigation, compensatory measures and monitoring. Climate change impact assessment should be a minimum requirement included in appropriate Articles of these directives.
	Also, determine possible appropriate conditions on planning consents to assist in adaptation to climate change.
2	**Birds and Habitats Directives:**
	Review these directives in the light of expected impacts of climate change, examining likely future status of Natura 2000 sites and need for flexibility.
	Develop policy on Natura 2000 network in the light of climate change impacts on biodiversity and processes.
	In line with Article 10 of the Habitats Directive, strengthen support programmes and measures to encourage and permit ecological interaction between areas of European importance for nature conservation
3	**Water Framework Directive:**
	Emphasize the potential role of climate change impacts and adaptation in River Basin Management Plans under the WFD to identify potential future locations for climate change adaptation measures.
	Also review integration of planning for biodiversity and water.
4	**Sustainability Appraisal:**
	Promote sustainability appraisal of plans, critically evaluating of the performance of a plan against pre-determined social, economic and environmental criteria.
5	**Potential legislative measures:**
	Assess the value of preparing a Climate Change Directive, and the nature of appropriate content as part of current EU Climate Change Programme Review Adaptation study.
	Ensure climate change impacts are included in forthcoming Soil Quality Directive.

	Integrate biodiversity planning into the proposed EU Floods Directive.
6	**Other measures**
	Introduce statutory management plans for Natura 2000 sites in all EU countries, and the plans should address the impact of climate change upon the area.
	Develop policy on non-native species (invading spp. and introduced exotics).
	Promote international coordination and collaboration in order to establish cross-border ecological corridors within the EU and between the EU and neighbouring states.

The following table (taken from the 2006 BRANCH project report (EU-funded under Interreg III): *Spatial planning for biodiversity in our changing climate (Natural England Report R677)* proposes measures at N - national, R - regional and L - local level.

Recommendations to policy-makers - spatial planning, climate change and biodiversity

1. Spatial policies and plans	**N**	**R**	**L**
Recognise that biodiversity will change as a result of climate change, and agree policy promoting flexibility, not only protecting sites and conservation objectives but bringing forward measures to ensure that the wider landscape is also suitable habitat for biodiversity.	✓	✓	
Seek consensus on a national vision for biodiversity (sites, species, role in wider landscape and contribution to environmental processes and services).	✓		
Promote policies which have “knock-on” benefits for wildlife: e.g. SuDS, green space, tree planting (“win-win” policies).		✓	✓
Strengthen policies for the protection of features likely to support and maintain biodiversity, e.g. undeveloped areas, ponds, unused brownfield sites, etc.		✓	✓
Enhance consideration of climate change impacts and adaptation potential in all plans and policies at national and regional level,	✓	✓	
Plan to avoid fragmentation of areas with habitat value/potential, and plan for de-fragmentation where possible.		✓	✓
2. Other policies			
Develop policies which avoid or reduce over-exploitation impacts, such as habitat loss e.g. as the result of tourism, as these will help taxa to adapt.	✓	✓	
Review plans and policies which might increase pressure on potential biodiversity sites (e.g. development schemes and incentives).	✓	✓	✓
3. Safeguarding for the future			
Introduce policies to safeguard land with biodiversity enhancement potential	✓	✓	✓
Make strategic provision for safeguarded sites for future dispersal of species and sites for new habitats.	✓	✓	
Build biodiversity enhancement sites into local and regional planning		✓	✓
4. Integrating plans			
Aim towards further integration of biodiversity-climate change adaptation in spatial plans using objectives, indicators and targets.	✓	✓	✓
Integrate plans for land and for water to assist spatial planning for biodiversity through WFD and other measures.	✓	✓	✓
Use sustainability appraisal as a measure to integrate sustainability aims into all aspects of development.	✓	✓	✓
5. Awareness and communication			
Recognise that biodiversity will change - the *status quo* will not be maintained - and develop communications strategies to raise awareness of climate change impacts on biodiversity.	✓	✓	✓
Strengthen the regard given to Article 10 of the Habitats Directive, and provide guidance on how to do so. Article 10 requires Member States to endeavour, where they consider it necessary, to encourage the management of features of the landscape which function as "stepping stones" and are essential for migration, dispersal and genetic exchange. These include rivers with their banks, traditional field boundary systems, ponds and small woods.	✓	✓	

9.c) Where is European action needed? (optional)

addressed elsewhere

10.a) How can EU agriculture and fisheries policy be adapted to help these sectors adjust to the impacts of climate change? (optional)

Adaptation of agricultural policy to maintain resilience of ecosystem services:

For example:

- Review policy/legislation and incorporate climate change and biodiversity issues; integrate adaptation into funding programmes
- Provide for incorporation of measures to address climate change, assess impacts of rural development measures upon biodiversity and provide mitigation/compensation for them.
- Introduce measures for safeguard and restoration of biodiversity and ecosystems under changing climates.
- Continue to support research into climate change, agriculture/rural development and impacts for biodiversity. Research and assess potential for improving connectivity for wildlife across farmed landscapes; explore potential for biodiversity corridors and buffers around protected sites, stepping stones, additional sites, etc.
- Research and assess measures to identify and protect ecosystem services in agricultural and other landscapes.
- Review EU external action on agriculture, rural development and interactions with climate change implications for biodiversity globally. also, external action relating to sourcing of inputs for agriculture (energy, fertilizers, livestock, meat, feed, etc.)
- Involve wide range of partners in developing coordinated and comprehensive adaptation strategies for agriculture, rural development and their interactions with biodiversity under changing climates.

10.b) What will be the likely consequences of climate change for trade in agricultural products? (optional)

Other pressures upon the agriculture sector include changes in commodity markets from emerging economy demand, and the biofuels issue. Climate change may be an exacerbating pressure, as it affects the ability of certain countries (e.g. China, Australia) to feed themselves or to provide exports, thus leading to greater uncertainty on world markets.

Easier migration of livestock disease (e.g. bluetongue) is a further potential consequence of climate change.

11) How should the EU express its solidarity with regions suffering most heavily from the consequences of climate change? (optional)

Assistance with research and development of measures to prepare for climate change impacts. Assistance with phytosanitary health and livestock health issues.

Coasts: Strengthening integrated coastal zone management (ICZM), funding research, developing risk-based decision-making in these areas.

River valleys: Strengthening catchment management planning (CMP) and funding research, developing risk-based decision-making in these areas (flood risk assessment).

Mountain areas: Strengthening protection given to mountain areas (slopes, biodiversity); research and funding into activities which do not expose vulnerable areas to human and agricultural pressures.

Water: Assisting with sustainable and lean/efficient water and wastewater systems.

12) How could a collective European response help coastal Europe to tackle the effects of rising sea levels? (optional)

A collective European research response.
Integrated coastal zone management and European funding for compensatory measures addressing loss of coastal ecosystems.
Loss of coastal areas will probably mean occupation of additional land further inland, perhaps putting extra pressures on biodiversity sites. A European response might research and respond to this.

13) How should EU policy on public health take the impact of climate change into account? (optional)

The contribution of ecosystems and biodiversity to public health should not be overlooked: reducing urban heat island, promoting infiltration of precipitation so abating floods and providing water resources, etc.

14) What will be the consequences of climate change for Member States' potential energy mix and for European energy policy? (optional)

While other pressures (such as geopolitical pressures and technological development) may exceed the impact of climate change, policy must shift towards energy-efficiency and alternative energy sources with lowest possible environmental impact.

Climate change may affect total energy demand in different seasons, and it may entail a need for more resilient supply networks. It will require more distributed systems and micro-generation, and less dependence on large capital investment and infrastructure/plant.

15) Please rank the listed options under each of the areas of the four-action approach for EU adaptation into the following three categories:
15.a) Which actions are most urgent and to be implemented by the Commission as a matter of priority? (optional)

- Agriculture: integrating climate change into funding support; appropriate land management in conditions of climate change. (Agri-environment schemes should reflect climate change impacts and improve support for biodiversity/ecosystem maintenance).
- Industry and services: location and resilience of infrastructure. Energy efficiency.
- Energy: Diversification and development of energy sources. Improving energy efficiency of existing buildings as well as new ones. Improving efficiency of energy use in transport and by households. Distributed energy networks Ensure energy policy both reduces climate change (mitigation measures) and permits adaptation to climate change.
- Transport: Climate proofing and upgrading of existing transport systems to increase resilience and reduce energy demand. Planned replacement where this is not feasible BUT consider impacts upon biodiversity
- Health: Continuing research on health threats to livestock.
- Water: ensuring timely implementation of Framework Directive.
- Ecosystems & biodiversity: Seek ways to achieve restoration and improvement of ecosystem services, especially as dependent on soils and water resources.

15.b) Which actions have a low priority for Commission implementation? (optional)

15.c) Which actions are irrelevant for Commission implementation? (optional)

16) What are the possible synergies between adaptation and mitigation measures? How can these synergies be strengthened? (optional)

Biodiversity: Within the built environment, reducing energy use by use of appropriate materials and public transport; also providing shading and green walls to reduce urban heat island effect whilst providing habitats for wildlife.
Transport: In rural and urban areas, improving both public transport and opportunities for walking/cycling. Walking/cycling routes to incorporate space for biodiversity.
Coasts: coastal realignment to include provision for the re-creation of coastal habitats further inland (also reduces any emissions associated with hard flood defences).
Energy: conversion to renewables, and taking opportunities for biodiversity associated with these - e.g. wildlife habitats at small hydro sites; restored habitats on windfarms.
Also: use of integrative assessment processes (EIA and SEA) to look for impact synergies.

17) In the context of EU policy, how can companies and citizens be encouraged to participate in adaptation actions? (optional)

Participation by companies and citizens requires: awareness, education, a range of ways to act and examples to follow (measures and models), active encouragement (including awards) and potential for penalty.
Consistency of action/policy also important: not visibly encouraging wasteful use of energy in one area whilst penalising it elsewhere.

18) How will climate change affect the policy priorities of the EU's external policies? (optional)

- Developing countries: It is likely that more disaster assistance will be required. Therefore try to help set up disaster prediction systems and act on their forecasts; also help to develop greater resilience of food supplies and water supply.
- Neighbouring countries: Promote awareness and adaptation/mitigation responses where these have yet to get started; work together for common action in research and policy response
- Industrialised countries: Seek to promote sustainable lifestyles; work together for common action in research and policy responses.

all:

- Find a fair way to apportion what emissions will have to be produced.

19) Which priorities should the EU set for its co-operation programmes in the different parts of the World with respect to adaptation to climate change? (optional)

Promote awareness of sustainable patterns of consumption and trade, i.e. local, energy efficient, low resource input - perhaps using recycled goods - and low waste.

20) Which are the main opportunities and obstacles for adaptation in different parts of the World? (optional)

21) What are the best options to make the EU's external action more resilient to climate change? (optional)

Try to develop trading communities that respond more rapidly than WTO trade rounds.

22) What could be the value added for EU action compared to other international initiatives including, for instance, the UNFCCC and multi-lateral funding instruments? (optional)

23) Do the listed research areas address the most important knowledge gaps? (optional)

☐ Yes ☐ **No**

Should also include:
Soils and soil ecosystems

- impacts of climate change
- thresholds for change/failure.

Biodiversity:

- map species distributions across whole European area;
- identify potential migration possibilities and necessary adaptation of corridors for biodiversity through the "wider landscape";
- further research on impacts of climate change on seasonal behaviour and their consequences.

24) Which are the five most important research areas that need to be addressed as a matter of priority? (optional)

- Seek a better understanding of the basic environmental systems upon which all human systems depend (ecosystem services).
- Attempt to cost their value to us (and what their loss might mean in different locations).
- Soils information (exposure/vulnerability, soil ecosystems, etc.
- Synergies between mitigation and adaptation approaches.

25) How should research results be communicated and made available to decision makers and a broader public at local, national, EU-level and internationally? (optional)

- Information should be made available in forms accessible to different audiences, as widely and in as many different media and fora as possible, to reinforce messages and ensure recognition.
- Use trusted and respected communicators.
- Listen and respond to reactions/intervention from stakeholders
- Frequency of synthesis reports: should be more frequent than 4-5 yearly, the field is developing fast: two yearly, maybe.

26) Does the Green Paper foresee sufficient participation of the different stakeholders in identifying and implementing EU adaptation actions? (optional)

☐ Yes ☐ No

27) Should stakeholders from the EU's neighbours and other regions be involved? (optional)

☐ **Yes** ☐ No

28) Would the establishment of a European Advisory Group on Adaptation be helpful in further exploring an EU response to the effects of climate change? (optional)

☐ **Yes** ☐ No

Probably this should be made up of "divisions" relevant to the five most vulnerable areas (mountains, floodplains, etc.), and also to other common types of environment across the community.