Impacts of climate change and selected renewable energy infrastructures on EU biodiversity and the Natura 2000 network

Tasks 2b & 3b - Impacts of climate change on EU biodiversity policy, and recommendations for policies and measures to maintain and restore biodiversity in the EU in the face of climate change

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1 Introduction

The principal aim of this part of the study is to provide recommendations that "identify what steps could be taken to protect the integrity of the Natura 2000 network and to mitigate the negative effects on habitats and species". The focus is on providing practical recommendations for EU institutions, especially with respect to existing nature conservation instruments, and other sectoral policies, that may help to achieve the nature conservation objectives of the Natura 2000 network.

The recommendations that are provided are firstly based on a review of the principals of supporting biodiversity adaptation to climate change and existing recommendations (especially those relating to Europe and protected areas), followed by an assessment of existing policy instruments that can be used to implement practical adaptation measures. The effectiveness of the existing biodiversity conservation policy framework is briefly assessed and key biodiversity pressures identified; these will exacerbate climate change impacts – and will therefore need to be addressed. Opportunities for linking biodiversity adaptation measures to other sectoral actions for climate change mitigation and/or adaptation are also briefly reviewed and taken into account as actions that provide co-benefits are more likely to receive political support.

2 Principles and recommendations for biodiversity adaptation

2.1 Existing biodiversity adaptation recommendations

A relatively large number of guidance documents have been developed on measures to support the adaptation of biodiversity to climate change by multilateral environmental agreements (e.g. CBD, Ramsar, Bern Convention and Convention on Migratory Species), non-governmental biodiversity conservation organisations, governmental environmental agencies and academics. These include:

- Climate change and wetlands: impacts, adaptation and mitigation (Ramsar Bureau, 2002).
- Climate change and nature: adapting to the future (IUCN, 2003).
- A user's manual for building resistance and resilience to climate change in natural ecosystems (WWF, 2003).
- Global action for nature in a changing climate (IUCN, 2004).
- Biodiversity conservation and adaptation to the impacts of climate change (EEAC, 2005).
- Conserving European biodiversity in the context of climate change (Usher, 2005).
- Adaptation Policy Framework (DEFRA, 2006).
- Biodiversity sites and climate change (Eurosite, 2006).
- Climate Change 2007: Impacts, adaptation and vulnerability IPCC (2007).
- Conserving biodiversity in a changing climate: guidance on building capacity to adapt (Hopkins et al., 2007).
- England Biodiversity Strategy - towards adaptation to climate change (Mitchell et al., 2007).
- Climatic change and the conservation of European biodiversity: towards the development of adaptation strategies (Huntley, 2007).
- Climate change: wildlife and adaptation; 20 tough questions, 20 rough answers (RSPB, 2007).
- Preliminary review of adaptation options for climate-sensitive ecosystems and resources (CCSP, 2008).

- Review of existing international and national guidance on adaptation to climate change: with a focus on biodiversity issues (Harley, 2008).
- Meta-analysis of adaptation and mitigation measures across the EU25 and their impacts and recommendations how negative impacts can be avoided (Berry et al., 2008).
- Report on improved method for reserve selection (Cabeza et al., 2008).
- Policy analysis for biodiversity under climate change (Piper & Wilson, 2008).
- England Biodiversity Strategy. Climate change adaptation principles (Smithers et al., 2008).
- Draft findings of the Ad Hoc Technical Expert Group on Biodiversity and Climate Change (CBD AHTEG, 2009).
- Towards a strategy on climate change, ecosystem services and biodiversity (AHEWG, European Commission, 2009).

It is therefore not within the scope of this study, nor necessary, to develop new biodiversity adaptation strategies or generic recommendations by reviewing ecological principles and the nature of climate change impacts on biodiversity (as reviewed in Task 1). Furthermore, many of these guidelines include reviews of previous recommendations, most notably for the Council of Europe, which resulted in a set of adaptation principles that are of particular relevance to this study (Harley 2008). These principles are presented in Table 2.1 and are used as a basis for the identification of practical adaptation policy recommendations for the Natura 2000 network outlined in Section 7. More specific recommendations were also produced for the Council of Europe (Huntley 2007), which are also of particular relevance, and therefore presented in Table 2.2.

Table 2.1. Adaptation principles for biodiversity in a changing climate
(adapted from Harley, 2008; actions have been numbered to facilitate cross-referencing)

PRINCIPLE 1. TAKE ACTION NOW
Uncertainties surrounding the precise nature of future climate change and its impacts on biodiversity should not delay practical conservation action.
Action should be taken now to:
1.1 Reduce other sources of stress and harm not directly linked to climate change.
1.2 Maintain existing conservation activities in protected areas and intervening habitats.
1.3 Deliver current biodiversity policy and legislative commitments and agreements.
PRINCIPLE 2. MAINTAIN AND INCREASE ECOSYSTEM RESILIENCE
The ability of ecosystems to absorb and recover from change whilst maintaining and increasing biodiversity should be enhanced.
This includes measures to:
2.1 Maintain and restore ecosystem function and, where appropriate and cost effective, relocate and create new habitats.
2.2 Conserve the range and variability of species, habitats and ecosystems.
2.3 Establish buffer zones with ecologically sensitive management regimes around conservation areas.
2.4 Control and limit the succession of invasive species.
PRINCIPLE 3. ACCOMMODATE THE IMPACTS OF CLIMATE CHANGE
Both gradual change and extreme weather events will be experienced.
There is a need to:
3.1 Increase understanding of climate change and acceptance that it is unavoidable.
3.2 Work with ecological succession and not against it.
3.3 Adopt the principle of 'potential native' species.
3.4 Establish networks of interconnected protected areas (terrestrial, freshwater and marine) and intervening habitat mosaics to increase permeability and aid gene flow.

3.5 Plan future conservation areas to ensure that vulnerable species groups and habitats types are protected.

3.6 Allow for the changing configuration of coasts and rivers by avoiding development in these areas.

3.7 Consider the role of species translocation and ex-situ conservation, especially for threatened species.

PRINCIPLE 4. FACILITATE KNOWLEDGE TRANSFER AND ACTION BETWEEN PARTNERS, SECTORS AND COUNTRIES

Successful adaptation requires that biodiversity conservation is integrated with other land and water management activities.

Action is required to:

4.1 Strengthen existing relationships and build new partnerships.

4.2 Ensure that policy and practice are integrated across sectors and borders.

4.3 Coordinate adaptation and mitigation measures to avoid mal-adaptation within and across sectors.

4.4 Increase awareness of the benefits that biodiversity provides to society and its role in adaptation strategies across all sectors.

4.5 Communicate best practice and exchange information on successful adaptation.

PRINCIPLE 5. DEVELOP THE KNOWLEDGE/EVIDENCE BASE AND PLAN STRATEGICALLY

To effectively plan for an uncertain future, it is essential that the best available evidence is used to develop techniques that allow biodiversity to adapt.

It is therefore necessary to:

5.1 Continually review the evidence base and identify knowledge gaps and research opportunities.

5.2 Undertake vulnerability assessments of biodiversity and associated ecosystems.

5.3 Undertake scenario assessments and identify ‘no regrets’ actions.

5.4 Pilot new approaches through demonstration projects.

5.5 Develop ‘win-win’ adaptation measures and use them to build resilience and accommodate change.

PRINCIPLE 6. USE ADAPTIVE CONSERVATION MANAGEMENT

Effective conservation in a changing climate will require a flexible approach.

This approach should compromise:

6.1 Continual monitoring and re-assessment of adaptation actions as new information and research becomes available.

6.2 Amendments to biodiversity policy, legislation and agreements to ensure that conservation objectives reflect the challenges presented by climate change.

PRINCIPLE 7. MONITORING AND INDICATORS

Monitoring is a key contributor to the evidence base and, as such, existing schemes must be strengthened and new requirements incorporated.

Programmes should be set up to:

7.1 Identify indicators to monitor the impacts of climate change on biodiversity and to assess vulnerability and adaptation.

7.2 Continue to monitor the observed impacts of climate change on biodiversity and establish procedures to validate projections.

7.3 Monitor the occurrence and dispersal of ‘potential native’ species.

7.4 Monitor the effectiveness of adaptation measures and adaptive conservation management in maintaining and increasing ecosystem resilience and accommodating change.

Table 2.2. Recommendations made to the Standing Committee of the Convention on the Conservation of European Wildlife and Natural Habitats (Huntley 2007)

1: Adaptation strategies must recognise the dynamism of species' geographical ranges. This will require a re-evaluation of the management goals of protected areas, as well as of the basis for maintaining the protection of areas that in future may no longer support one or more of the species whose local conservation was a primary reason for the initial recognition of the protected area. A re-evaluation of the use of the concept of 'native' species in setting conservation priorities also will be required, both at the level of individual countries and at the European scale. In addition, strategies will be required that aim to facilitate the achievement by species of the potential future range changes required as they adjust to the projected climatic changes.

2: Adaptation strategies must recognise the need to facilitate, rather than to hinder, gene flow through species' populations if they are to adapt to projected climatic changes. In addition, such strategies must include mechanisms designed to ensure that intra-specific genetic diversity loss is minimised, especially that component of the genetic diversity of many European species that is concentrated near the 'trailing edge' of their distribution, and thus is most vulnerable to the negative impacts of climatic change upon these 'trailing edge' populations.

3: Adaptation strategies must have amongst their goals that of facilitating community and ecosystem changes resulting from climatic changes, as well as of permitting and in some cases facilitating the ecosystem dynamic processes upon which the realisation of such changes often depends. These changes are an essential component of adaptation by the biosphere to climatic change.

4: Adaptation strategies must aim to ensure the continued protection and appropriate management of existing protected areas. A coarse filter type approach should be implemented at a European scale to identify gaps in this network of existing protected areas, and the network then should be augmented in order to maximise the representation of the full range of environmental conditions and physical habitats. The network also should be augmented where necessary to ensure that there are no excessively large spatial gaps in the network of protected areas. Appropriate management of the wider landscape, and the development of a suitable landscape structure, will be essential to complement the protected area network; without such management of the wider landscape, many species will be unable to achieve the responses to climatic change that are essential to their long-term
survival.

5: Adaptation strategies ought to exploit buffer zones as a valuable tool for enhancing the effectiveness of protected areas, but should not consider them generally as contributing directly to adaptation to climatic change.

6: Adaptation strategies should not focus upon the provision of corridors as a necessary part of achieving landscape structures that are favourable for the dynamic range adjustments of species in response to climatic change. Furthermore, in most of Europe corridors of the necessary scale to be truly valuable will not be a viable option. Nonetheless, where the provision of such large-scale conservation corridors (cf. Rouget et al., 2006) is a viable option, this option ought to be pursued as part of the overall adaptation strategy.

7: Adaptation strategies should aim to develop permeable landscapes that provide functional networks of habitat 'stepping stones' of various sizes and separations linking protected areas that will form the principal nodes in these functional networks. In general, the smallest habitat stepping stones should be separated by the shortest distances and should provide the links between more widely separated but larger stepping stones along a continuum of sizes and separation distances extending up to those characteristic of the protected areas of the region. Size and separation, as well as the number of patches, also will relate to the size, separation and frequency typical of the habitat(s) represented within any particular stepping stone – thus habitat types that are naturally represented by patches that are relatively small in extent, widely separated and/or infrequent can be represented by fewer, smaller and more remote stepping stone patches than can habitats that naturally are extensive, continuous or near-continuous and dominant in the landscape.

8: Adaptation strategies also should aim to ensure that these 'stepping stones' are embedded in a landscape matrix that is managed less intensively than is typical of much modern commercial agriculture and forestry practice, as well as in ways that promote relatively fine-grained

heterogeneity.

9: Adaptation strategies should exploit and, where possible, enhance, existing incentive schemes that aim to promote lower intensity land management and the development of greater landscape heterogeneity. Such schemes can help provide stepping stone habitat patches where these do not already exist, as well as a more favourably managed landscape matrix.

10: Management strategies must combine and balance the need to facilitate species' responses to climatic change and the need to maximise populations of rare and threatened species. Achieving this balance will perhaps be one of the primary challenges facing managers of protected areas. Furthermore, success in achieving this balance in a given protected area will principally be reflected not just by successful transformation of the ecosystems of that area, but by the successful dispersal to other protected areas, and establishment therein, of rare or threatened species that may ultimately be unable to persist under the new climatic conditions of the given area.

11: The framework for the provision of legal protection for designated protected areas also must be rendered dynamic. Such protection for any individual area must no longer be dependent upon the successful conservation therein of particular target rare or threatened species, or the maintenance therein of a particular community or ecosystem viewed as characteristic of the region.

12: The concept of a 'native' species, especially where that is embedded in legislation relating to biodiversity conservation, requires re-evaluation.

13: Accommodating such contrasting management strategies will in general require that, wherever possible, the extent of protected areas be increased.

14: Increases in the size of existing protected areas should be targeted to provide the greatest flexibility and ability to 'buffer' against the effects of climatic change.

15: In addition to increasing the size of existing protected areas wherever this is feasible, additional protected areas will be required in many regions to ensure that a functional network of sites is attained.

16: Especially in the extensively and heavily altered landscapes of much of western Europe, an effort should be made to retain as many as possible of the remaining patches of semi-natural habitats because replacing them, if they are allowed to be destroyed, is much more difficult, as well as both more expensive and only possible on relatively long time scales in many cases.

18: In addition to including these various components, any adaptation strategy for biodiversity conservation in a world of climatic change also must be international, and preferably sub-continental or continental, in scope if it is to be effective, because this is the spatial scale at which climatic change will impact upon the distributions of species and the composition and structure of communities and ecosystems.

19: Such adaptation strategies also must include provision for the translocation of genotypes, species or even such poorly understood parts of ecosystems as the soil invertebrate and microbe communities, and also for the use of captive breeding programs where this is feasible.

Although many of the proposed adaptation strategies include a wide range of measures and in a variety of conceptual frameworks there are a lot of similarities amongst them. Furthermore, most of the principal recommendations contribute to one of the following three strategic actions for biodiversity adaptation identified by IUCN in 2004; namely:

1. Assess the vulnerability of species, habitats, and ecosystems to climate change.

2. Develop strategies and practical measures that increase the resilience of ecosystems, habitats and their associated species populations to climate change, thereby improving their adaptive capacity.

3. Develop strategies and practical measures that accommodate changes by facilitating the movement of species (and habitats) to new areas with suitable climatic conditions.

The first component aims to assess vulnerability in order to help establish priorities, e.g. with respect to which regions, habitats, sites and species require actions to increase resilience or support accommodation to changes etc. These issues have been covered by Tasks 2a and 3a of this study and are therefore discussed further in their respective reports. The rationale for and key principles associated with increasing resilience and the movements of species and habitats is, however, of considerable relevance to the development of practical policy measures. These concepts are therefore further described below.

2.2 The need for measures to increase resilience and facilitate movements

Adaptation strategies aim to increase resilience and, where necessary, to facilitate movements in order to support autonomous adaptation by species to climate change. In general a species' potential adaptation responses to climate change are:

- Stay and adapt through:
  - withstanding declines in survival and productivity;
  - behavioural change (e.g. switch to new prey types);
  - natural selection of existing genotypes (i.e. individuals in a population that are better suited to the new conditions are at a selective advantage and therefore their genotypes spread in the population); and
  - macro-evolution (i.e. creation of new genetic forms that are better adapted to the new conditions; but this process is normally too slow to significantly aid adaptation).
- Move to new locations with suitable climatic conditions, through:
  - small-scale movements, e.g. within existing Natura 2000 sites (altitude, depth, aspect); and
  - dispersal and colonisation of new sites.

It is firstly important to bear in mind that thriving species populations and habitats (e.g. those in Favourable Conservation Status according to the Habitats Directive terminology) may be able to exist for a long-time outside their apparent current climate envelopes. This is because it is likely that many ecological changes will not result from the direct effects of climate change, but indirectly, e.g. as a result of competition from other species that become better adapted to the new climatic conditions. But if competitors are absent (e.g. because conditions were unsuitable for them and their dispersal rates are slow) then the less adapted species may continue to survive, perhaps indefinitely if competitors remain absent. Some species may be vulnerable to sudden climate impacts e.g. as a result of major disturbances, such as fire or extreme weather events. But these are chance events, and species populations might remain until such events occur, which may be a long-time, if ever.

The ability to withstand climate change impacts might also be increased by behaviour changes, genetic selection (Huntley, 2007) or by small changes in distribution (e.g. which might just be small altitudinal movements, or from one side of a hill to another). It is therefore important to maintain genetic variation within populations (as this is the raw material on which selection acts) and structural heterogeneity and overall biodiversity within sites (to provide opportunities for species to adjust distributions and behaviours etc.).

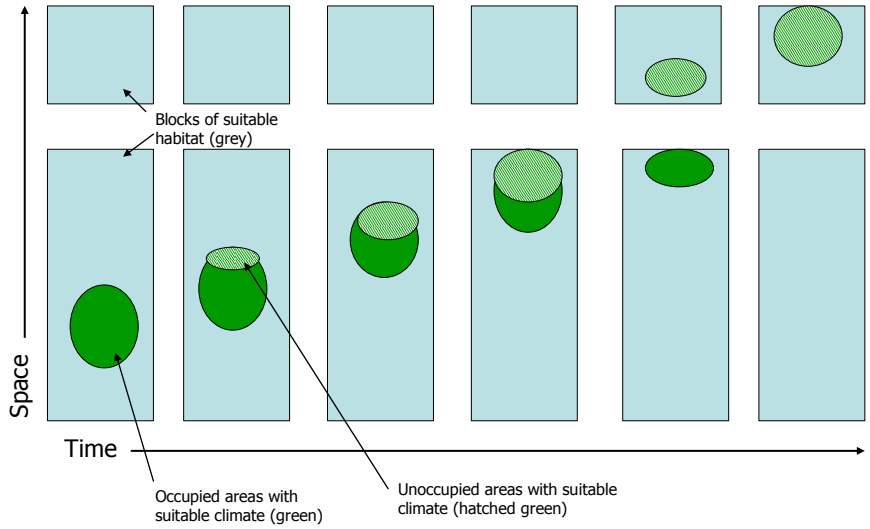
There is also evidence (reviewed in Task 1) that many species are showing movement responses to climate change and, according to Huntley (2007) these are approximately equal to the rate of movement needed (up to now) to track recent climate changes. However, there is also evidence, e.g. with respect to butterflies (Hill et al., 2001; Hill et al., 2002), that many

species are not able to move or otherwise adapt successfully to climate change as a result of a number of natural and human caused constraints, including:

- populations / habitats already being in poor condition;
- restricted ranges and small population sizes;
- restricted movements;
- biological constraints on dispersal & colonisation;
- bounded distributions (e.g. islands, mountain tops, high latitudes);
- blocked dispersal routes (e.g. by mountains, fragmented habitat); and
- dependence on specific habitats or prey, etc.

Biodiversity adaptation measures need to address these constraints, but as illustrated in the hypothetical examples below (Figure 2.1-2.3), the key constraints will vary according to species and circumstances. In Figure 2.1 the species is a habitat generalist (both blocks have entirely suitable habitats) and is able to move and track its suitable climate space, though with a lag at the leading edge. However, the climate space reaches the edge of the extent of suitable habitat. Although new suitable climate space appears in the new habitat the species cannot cross the gap between the habitat blocks, e.g. due to sea, lowland between mountains (or vice versa), unsuitable soils or hydrology etc. The species then goes extinct as the climate space in its existing habitat block dwindles.

Figure 2.1 A hypothetical example of a species' redistribution and eventual extinction due to movement in the area of its suitable climate space and habitat isolation. Key: Suitable blocks of habitat in grey. Suitable climate space in green. Occupied climate space in solid green. Unoccupied climate space hatched green. As climate change occurs, the suitable climate space moves.



In the Figure 2.2 example, the suitable climate space for the species contracts and moves as climate change occurs. Although the species moves with the climate space, it contracts to a size that is so small that the species population size becomes non-viable and in time extinction occurs as a result of chance events. Although the climate space increases with further time the species population is extinct.

Figure 2.3 illustrates the potential impacts of a time lag in habitat establishment for a species with more specialist habitat needs. The species is able to move and cross the gap in habitat. But the rate of habitat advance is less than that of the species and its climate envelope. And the rate of habitat loss at the trailing edge of its climate envelope is greater than the rate of development of new areas of habitat at the advancing edge, which leads to a reduction in suitable habitat area. Eventually there are no areas of suitable climate within the area of suitable habitat, so the species goes extinct.

Figure 2.2 A hypothetical example of a species' redistribution and eventual extinction due to a decline in its suitable climate space. Key: Suitable blocks of habitat in grey. Suitable climate space in green. Occupied climate space in solid green. Unoccupied climate space hatched green. As climate change occurs, the suitable climate space moves.

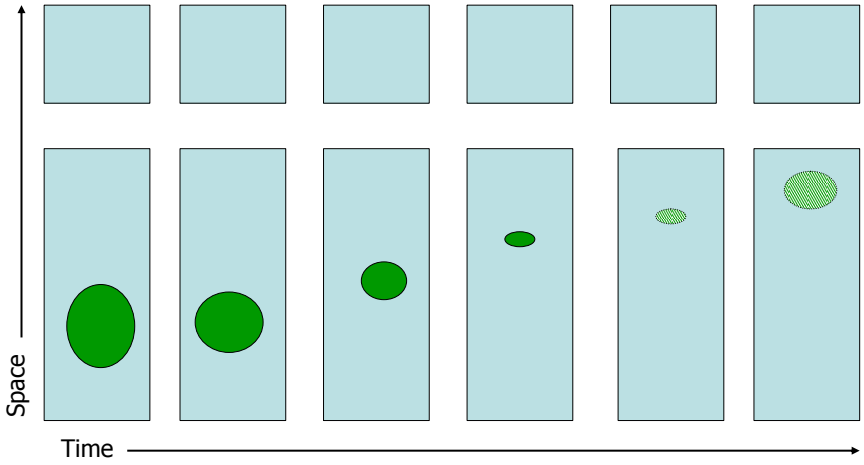
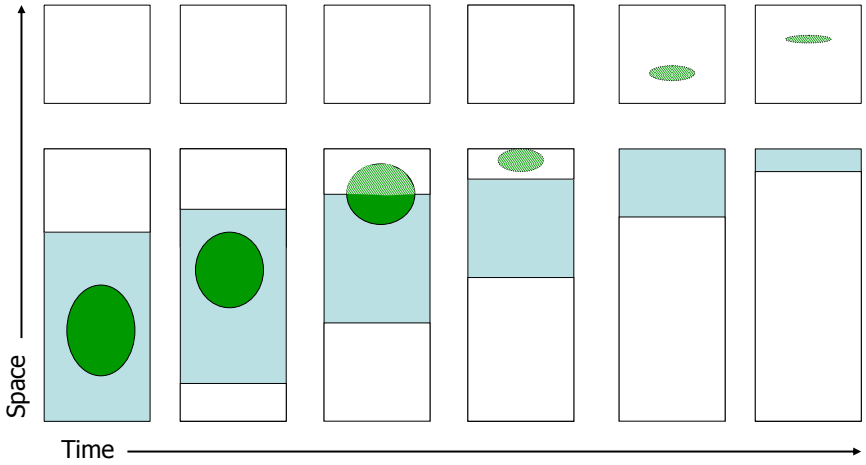


Figure 2.3 A hypothetical example of a species' redistribution and eventual extinction due to a decline in its suitable climate space. Key: Suitable blocks of habitat in grey. Suitable climate space in green. Occupied climate space in solid green. Unoccupied climate space hatched green. As climate change occurs, the suitable climate space moves.



These few hypothetical examples, show that the optimal strategic balance of resilience and movement facilitation measures will be species-specific and will especially depend on the impacts of climate change on the species, its dependence on specific habitats (and the impacts of climate change on them) and the dispersal and colonisation abilities of the species and its habitat. For many the priority will be to increase resilience to buy time for habitat development in new areas of suitable climate space. Therefore generic strategies that aim to increase the resilience of species populations and facilitate the redistribution of species are unlikely to be efficient. In fact they might even be counterproductive. For example, increasing connectivity may be damaging for species that cannot move and that

need to be isolated from competitors that may be better suited to the changing climatic conditions.

Table 2.3 therefore outlines the appropriate responses for species according to the generic types of adaptation constraint. Most importantly, buying time to enable habitats to develop will probably be a common need as many species will be able to move faster than their habitats can establish in new areas of suitable climate. Indeed this may be the only option for some species that rely on specific habitat types that will take a long time to develop, even with proactive habitat creation interventions. The establishment of ecologically functional forests for example takes hundreds of years; blanket bogs thousands of years (Morris & Barham, 2007).

Table 2.3. Appropriate adaptation measures for different types of adaptation constraint

Adaptation constraint	Response
Temporal gaps in existence of suitable climate space	Increase resilience of existing populations to buy time
Inability to move to new areas of suitable climate and habitat	Increase dispersal capabilities (or translocate)
Absence of suitable habitat in new areas of suitable climate	Increase resilience of existing populations (to buy time) and aid habitat development (e.g. disturb, plant, translocate)
Permanent loss of areas with suitable climate space that coincide with potential habitat	Increase resilience of existing population and hope for the best, or give up and invest resources elsewhere

It is however, **important to base adaptation strategies on reliable information**. Current model projections of species responses to climate change are unlikely to be sufficiently robust (especially at local levels) to reliably indicate appropriate adaptation strategies for individual species. Models also need to factor in the species dispersal abilities and the current and potential dynamic availability of habitat before they can provide useful guidance on appropriate adaptation measures (see Section 7.8). For the moment adaptation measures should therefore focus on well tested no-regret conservation actions that concentrate on increasing the resilience of populations. More risky or ambitious measures, especially relating to decisions on which species might be “abandoned” to climate change should be based on robust and comprehensive assessments of all the key factors affecting the species prospects with adequate supporting evidence of impacts. In other words, **important and irreversible decisions on adaptation should not be based on models alone**.

2.3 Practical measures to increase resilience and to facilitate movements

In the first instance, the principal actions for increasing the resilience of existing populations of species and habitats, should be those that reduce existing threats and constraints on the ecological condition of the population or habitat, including:

- habitats change;
- habitat fragmentation (to create areas of habitat with viable populations, and/or link metapopulations);
- pollution;
- disturbance;
- predation (over-exploitation); and
- alien species and pathogens.

Where measures are necessary to facilitate the movement of species, these may need to include:

- increasing productivity and emigration rates (i.e. improve the condition of the population);
- improving the condition of individuals (to increase the likelihood of survival and colonisation during dispersal);
- reducing habitat fragmentation (to facilitate long-distance dispersal); and
- removing barriers to dispersal.

It is apparent from these brief lists that many of the measures that will help to increases the resilience of existing populations will also facilitate the movement of species. This is because, for example, measures that increase habitat quality are likely to increase breeding productivity and therefore the recruitment of emigrants and their individual condition. Increasing emigration rates and the survival rates of emigrants will increase the probability of successful dispersal and colonisation. Similarly, actions that increase connectivity by reducing habitat fragmentation may help to increase the resilience of existing populations, e.g. by establishing larger and more robust meta-populations (Hanski, 1999; Opdam et al., 2002; Opdam & Wascher, 2004; Vos et al., 2008). In practice therefore, many practical measures for biodiversity adaptation will provide multiple resilience and functional connectivity benefits.

It is also apparent that in practice adaptation measures need to focus on existing conservation actions, such as:

- maintaining and increasing the area of core habitats (Natura 2000 sites and other protected areas);
- reducing external impacts, e.g. by establishing buffer zones and controlling pollutant emissions;
- managing / enhancing the ecological quality of habitats, especially in protected areas;
- managing species populations (e.g. controlling exploitation, impacts of IAS); and
- increasing / restoring connectivity through landscape scale conservation measures, e.g. through restoration of stepping stones patches of habitat (or where well justified the creation of habitat corridors – see Section 7 for discussion) or enhancing the wider habitat matrix.

Most of these measures are already obligations under Directives, and/or included in the existing EU Biodiversity Action Plan. In essence, therefore, **biodiversity adaptation requires the redoubling and speeding up of current conservation efforts to protect and manage habitats and species populations**, etc. Existing measures are therefore outlined in the next section and recommendations to increase their effectiveness and efficiency are given in Section 8.

3 The EU biodiversity conservation policy framework

The EU has developed a framework for biodiversity conservation with relatively comprehensive and effective legislation, wide-ranging environmental policies and potentially high levels of funding. The key sectoral instruments that may help to facilitate the adaptation of biodiversity to climate change, and in particular the establishment and conservation of the Natura 2000 network are outlined in Table 3.1 and the most significant are described further below. Adaptation measures for these sectors are further described in Section 4.

3.1 The Habitats and Birds Directives and Natura 2000 network

These Directives are described in some detail as they are of central importance to this study.

Aims

The Habitats Directive[1] and the Birds Directive[2] form the main legal framework for the protection of nature and biodiversity in the EU.

The principal aim of the **Birds Directive** (Article 2) is to ensure that *Member States shall take the requisite measures to maintain the population of the species referred to in Article 1*[3] *at a level which corresponds in particular to ecological, scientific and cultural requirements, while taking account of economic and recreational requirements, or to adapt the population of these species to that level.*

The **Habitats Directive** includes a number of requirements for Member States to implement conservation measures for habitats and species of Community interest[4]. The general purpose of such measures should be to achieve the overall aim of the Directive, which as stated in Article 2(1) "*shall be to contribute towards ensuring bio-diversity through the conservation of natural habitats and of wild fauna and flora in the European territory of the Member States to which the Treaty applies*."

Article 2(2) then states that "*Measures taken pursuant to this Directive shall be designed to maintain or restore, at favourable conservation status, natural habitats and species of wild fauna and flora of Community interest*." The general principles and criteria that define Favourable Conservation Status (FCS) are outlined in Article 1. In layman's terms, 'FCS can be described as a situation where a habitat type or species is prospering (in both quality and extent/population) and with good prospects to do so in future as well'[5].

Key measures

Both Directives require two main types of action. Firstly, the protection and conservation management of sites that are particularly important for EU biodiversity. These include protection measures for sites of Community Importance (SCIs), which must be designated as Special Areas of Conservation (SACs) by Member States under Article 4 of the Habitats Directive (for habitats and species of Community interest), and Special Protection Areas

[1] Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora, OJ L 206, 22.07.1992.
[2] Council Directive 79/409/EEC of 2 April 1979 on the conservation of wild birds, OJ L 103, 25.04.1979.
[3] All species of naturally occurring birds in the wild state in the European territory of the Member States to which the Treaty applies.
[4] These are habitats and species that are listed in Annex I and II of the Directive respectively.
[5] Assessment, monitoring and reporting of conservation status – Preparing the 2001-2007 report under Article 17 of the Habitats Directive (DocHab-04-03/03 rev 3).

(SPAs) designated under Article 4 of the Birds Directive (for birds listed in Annex I of the Directive and for migratory species). These SACs and SPAs are combined under Article 3 of the Habitats Directive with the intention of forming 'a coherent ecological network' referred to as the Natura 2000 network. The reference to 'a coherent ecological network' here is important because it implies that the spatial distribution and connectivity amongst sites is important as well as the amount of habitat protected. It also implies that measures may be required in the wider environment to maintain ecological connectivity between some Natura 2000 sites.

The second type of action (under Article 12) within both Directives is the strict protection of listed species as well as their breeding sites and resting places, wherever they occur.

Table 3.1. Policy instruments that can significantly support biodiversity adaptation to climate change by increasing resilience of populations and/or their ability to move to new areas of suitable climate.

Key: HD = Habitats Directive; BD = Birds Directive; CFP = Common Fisheries Policy; ELD Environmental Liability Directive; EIA = Environmental Impact Assessment Directive; HNV High Nature Value (farmland); GAEC Good Agricultural and Environmental Condition (under cross compliance); ICZM = Integrated Coastal Zone Management; IPPC; Integrated Pollution, Prevention and Control; NECD = National Emissions Ceilings Directive; MSFD = Marine Strategy Framework Directive; SEA = Strategic Environmental Assessment Directive; SMR Statutory Management Requirements (under cross compliance regulation) RDP = Rural Development Programme; WFD Water Framework Directive.

Protection of areas: including core areas, buffers and linear corridors and/ or habitat patches (stepping stones). Habitat Management: e.g. grazing, burning, farming and forestry operations and hydrology. Species management: e.g. protection from hunting, persecution, over-exploitation and control of invasive alien species and other species that have significant impacts as a result of disease, predation or competition. External pressures: e.g. air and water pollution, and disturbance). Habitat creation / restoration, e.g. to increase habitat area, amalgamate fragmented habitats or create new habitat patches.

Policy area	Protection of areas	Habitat management	Habitat restoration/ creation	Species management	Reduction of external pressures	Other / notes
Wildlife and countryside	HD & BD: Natura 2000 sites	HD Art 6.1 management measures. Management Plans objectives should take into account future climate change	Implied under the objectives of HD for Favourable Conservation Status. Compensation measures under Art 6.4 Potential compensation for damage to Natura sites under ELD	HD Art 12 measures for strictly protected species	HD Art 6.3 Appropriate Assessments of plans and projects affecting Natura sites ELD control of impacts on (Natura sites)	HD Article 10 re conservation of landscape features
Agriculture & forestry	Cross compliance[*1] – GAEC – retention of features	RDP Axis 2 (Agri-env & Natura payments) Cross compliance[*1] GAEC measures (e.g. retention of landscape features) LFA support in certain situations Use of funds under Art 68 (e.g. for environmentally beneficial farming)	RDP Axis 2 (Agri-env & Natura payments, afforestation measures*[2]) Cross-compliance[*1] - habitat creation option & buffer strips		Cross-compliance[*1] (SMR & GAEC measures – inc buffer strips)	*1 Reg 73/2009 *2 but depends how applied

Policy area	Protection of areas	Habitat management	Habitat restoration/ creation	Species management	Reduction of external pressures	Other / notes
Fisheries Common Fisheries Policy (CFP)	CFP – Seasonal closed areas Designation of 'protected areas' under CFP, but outside Habitats & Birds Directives when fishing activities are involved (e.g. coral reefs)	CFP – Member States' emergency measures Commission emergency measures CFP – Technical measures: gear restrictions Article 9 Regulation 2371/02		CFP – recovery plans and long term management plans Designation of 'protected areas' under CFP, but outside Habitats & Birds Directives when fishing activities are involved (non-fish species)	Integrated Maritime Policy	Enhance application of ecosystem approach since mid-2008. (impact assessments will take into account effects on broader ecosystem)
Energy	Protection of high carbon areas including HNVA from bioenergy production Protecting habitats and species of Community interest from maladapted renewable energy developments (hydropower, tidal barrages, wind etc.)	Bioenergy/biomass targets* - management of forests for sustainable biomass production	Bioenergy/mass targets - if planting appropriately located. Compensation for energy developments Maintaining or restoring environmental flows in hydropower infrastructure, decommission obsolete infrastructures	Avoiding risks of alien invasive species establishment from bioenergy crops	Avoid maladapted targets in renewable and conventional energy development (incl. biomass targets): potential benefits from low nutrient / pesticide inputs on short-rotation coppice	*No legal req, but potential benefits if National Action Plans implement appropriately
Water	WFD - Potential protection of areas to achieve good ecological status	WFD – some where necessary, e.g. removal of weeds	WFD - improvement of habitats that do not have good ecological status. Removal of polluted sediments	WFD - removal / control of invasive alien species & reintroduction of lost species. Active management for key spp (e.g. Salmon)	WFD & MSFD – any external pressure that affects ecological status (e.g. point discharges & diffuse pollution). Maintaining water levels for wetlands (e.g. control of abstractions)	WFD & MSFD Specific interventions are not prescribed, but to be developed by MS to achieve good ecological status. Ecological measures under WFD go beyond those of Nitrates Directive
Waste					Waste Framework Dir* and Landfill Directive*	Limited biodiversity adaptation benefits
Air					Air Framework Directive and National Emissions Ceilings Directive & IPPC*	* Reduce widescale impacts from SO2, NOx, Ozone and Ammonia

Policy area	Protection of areas	Habitat management	Habitat restoration/ creation	Species management	Reduction of external pressures	Other / notes
Harmful substances					REACH, Sustainable Use of Pesticides Dir, Authorisation of Plant Protection Products Reg.	Limited adaptation benefits for Natura sites
Impact assessment & planning	SEA & EIA		SEA (strategic planning of) & EIA - mitigation, offsets / compensation		SEA & EIA	
Other financial and economic instruments		LIFE+	LIFE+ Structural Funds: infrastructure actions under jobs and competiveness	LIFE+	LIFE+ Structural Funds: infrastructure actions under jobs and competiveness	Structural Funds convergence Art re env – promotion of biodiv & habitat protection in N2K.
Other		FP7	FP7	FP7	FP7 Intelligent Energy Europe	European Economic Recovery Plan – inc New Challenges for Rural Development, inc climate change

Progress with the establishment of the Natura network

The establishment of the Natura 2000 network has been generally slow but the network has been significantly extended in recent years and now comprises more than 26,000 sites, covering 17 per cent of the EU land territory (see Task 3 report). It is likely that the terrestrial part of the network will be complete by 2010, but additional efforts are needed to finalise the network for marine protected areas. Natura 2000 sites also have a relatively strong level of protection from potentially damaging developments through the Appropriate Assessment process and its enforcement in recent rulings of the European Court of Justice. Furthermore, there is evidence that measures taken for birds through the Birds Directive have had significant beneficial impacts on those species that receive special protection under the Directive, i.e. species listed in Annex 1 (Donald et al., 2007).

Now the key challenge is to ensure that habitats in Natura 2000 sites, and elsewhere, are appropriately managed such that habitats and species of Community interest are maintained in favourable conservation status.

Management requirements for Natura 2000 sites

The requirements for conservation management of habitats under the Birds Directive are rather general and vaguely defined. Article 3(3b) is of most relevance, but this merely states that the preservation, maintenance and re-establishment of biotopes and habitats shall include amongst other primary measures the '*upkeep and management in accordance with the ecological needs of habitats inside and outside the protected zones*'. Conservation management measures that must be taken by Member States in SACs are outlined in Article 6(1) of the Habitats Directive. Reference is again made to 'ecological requirements'; and the concept of preparing site management plans is suggested. Further clarification is provided in

a European Commission report on Natura 2000 site management[6], which notes that Member States (in accordance with the principles of subsidiarity) may decide upon which measures are appropriate.

Neither the Birds nor the Habitats Directives define the meaning of "ecological requirements", and their identification is the responsibility of Member States. However, the European Commission's guidance on Article 6 of the Habitats Directive (European Commission, 2000) notes that ecological requirements should include all the abiotic and biotic requirements needed to ensure FCS (e.g. air, water, soil and vegetation). Requirements need to be defined from scientific knowledge for each habitat and species according to the conditions at each site.

The preparation of management plans for SACs is not obligatory, but where they are considered necessary by the Member State, they must, according to the Directive, be "*appropriate and specifically designed for the sites*".

The choice between statutory, administrative or contractual site management measures is left to Member States, in accordance with the principle of subsidiarity. There is no hierarchy between the three categories and they can be implemented singly or jointly in any combination (with or without a site management plan). A variety of measures can be considered to be appropriate to meet the requirements of the Directive, and all suitable EU funds (for example, LIFE, rural development and regional funds) should be considered as a means for implementing conservation measures. For example, appropriately designed agri-environment schemes may be a suitable and sufficient contractual measure to manage (or even restore) habitats where these are necessary to promote FCS in agricultural areas.

Protection measures for Natura 2000 sites

In addition to the positive conservation measures described above, Member States are obliged to protect sites and their features from disturbance, deterioration and damaging developments. An important principle of these elements of the Habitats Directive is the introduction of the precautionary principle with respect to the control of potential threats.

Under Article 6(2) Member States are required to take preventive measures to avoid deterioration and disturbances connected with a predictable event. These measures apply only to the species and habitats of Community Interest for which the sites have been designated, and should also be implemented, if necessary, outside the sites (European Commission, 2000).

Articles 6(3) and 6(4) aim to assess and control projects on Natura 2000 sites that are not necessary for the management of the Natura 2000 features. Under these Articles, projects will normally only be permitted if it has been ascertained by an appropriate assessment that they will have no adverse effect on the integrity of the site. Further guidance on the application of these measures is included within the European Commission guidance document on Natura 2000 management and in more specific guidance on Appropriate Assessment[7]. These measures have generally been well implemented in Member States as a result of the Commission's guidance and a number of legal cases that have clarified and strengthened the legal basis of Natura 2000 site protection[8].

[6] European Commission 2000. Managing Natura 2000 sites: the provisions of Article 6 of the 'Habitats' Directive 92/43/EEC. Office for Official Publications of the European Communities, Luxembourg.

[7] Guidance document on the Assessment of Plans and Projects significantly affecting Natura 2000 sites (November 2001).
http://ec.europa.eu/environment/nature/natura2000/management/guidance_en.htm

[8] For example, see *Nature and Biodiversity cases ruling of the European Court of Justice 2006* http://ec.europa.eu/environment/nature/legislation/caselaw/index_en.htm.

Connectivity measures for Natura 2000 sites and Species and Habitats of Community importance

Connectivity measures are of particular relevance to facilitating climate adaptation (see Section 8.4 below), and these are required to maintain or restore the coherence of the Natura 2000 network, in accordance with Article 3, which states that Member States should:

'*Where they consider it necessary … endeavour to improve the ecological coherence of Natura 2000 by maintaining, and where appropriate developing, features of the landscape which are of major importance for wild fauna and flora*.' (Our emphasis)

In addition, Article 10 includes the following further provisions for Natura 2000 and more general connectivity provisions for flora and fauna:

'*Member States shall endeavour, where they consider it necessary, in their land-use planning and development policies and, in particular, with a view to improving the ecological coherence of the Natura 2000 network, to encourage the management of features of the landscape which are of major importance for wild fauna and flora. Such features are those which, by virtue of their linear and continuous structure (such as rivers with their banks or the traditional systems for marking field boundaries) or their function as stepping stones (such as ponds or small woods), are essential for the migration, dispersal and genetic exchange of wild species*.' (Our emphasis)

Member States can exercise discretion as to whether it is appropriate or not to maintain and develop landscape features to meet the objective of ecological coherence. It is not a compulsory requirement, although a study found that as of 2000 a number of the EU-15 Member States had taken steps to respond to Article 10 (see Table 3.2).

Table 3.2 Summary of Implementation of Article 10 of the Habitats Directive in the EU-15.

Member State	Implementation of Article 10
Austria	Three of the nine Länder stress the importance of voluntary nature conservation measures, to enhance the coherence and connectivity of the Natura 2000 network. Little information was included on the specific measures taken to encourage the management of features of the landscape.
Belgium	In the Brussels Region, Flanders and Wallonia, different network activities have been established to connect green spaces and watercourses. The Flemish ecological network covers most of the Natura 2000 network and includes inter-connecting zones such as small landscape elements. It is not clear how the networks of the different regions are interlinked to enhance Natura 2000.
Denmark	Most county councils have planned to encourage the linkage of ecological areas in open country through measures such as the creation of ecological corridors.
Germany	The concept of the 'Biotopverbund' (stepping stones and wildlife corridors) is transposed into federal law. In order to support a coherent system of habitat and species protection, a number of programmes (wildlife, water courses), plans (species and habitats recovery plans) and conservation measures have been established.
Greece	In accordance with Law 1650/86 a programme for the identification and recording of landscapes is under construction. The programme aims for the creation of a network of 'protected landscapes', including landscapes which could function as pathways.
Ireland	The National Biodiversity Plan and management programmes and policies for the coastal zone, rivers, lakes, wetlands and woodlands will support biodiversity conservation in general and serve to reinforce the Natura 2000 network.
Netherlands	The Structural Plan for the Rural Areas (SGR) stipulates that species which are subject to international agreements must be taken into account in district and land-use plans. Spatial planning and development activities have to consider the conservation and development of the habitats of such species. If disruption is unavoidable, compensation measures have to be taken (e.g. by minimising fragmentation and barrier effects). The SGR also provides for the implementation of the Main Ecological Structure (EHS), which aims to provide greater cohesion between spatially dispersed designated areas, under which 95% of the Dutch Natura 2000 network is being established. The EHS is evolving through the acquisition and development of farmland and management of nature areas.
Spain	The national law on nature conservation states that the public authorities should "promote the management

	of landscape elements that are of fundamental importance for wildlife, in particular those which, due to their linear and continuous structure (such as drovers' roads, rivers and their riparian vegetation, traditional field margins) or their function as stepping stones (ponds, patches of vegetation) are essential for the migration, geographic distribution and genetic interchange of wild species".
UK	The development of networks of statutory and non-statutory sites, and the landscape features which provide links from one habitat to another, is transposed into the Conservation Regulations. All Planning Authorities have to make such provisions in local and structure plans.

Source: For all countries except Spain - Composite Report from the Commission the implementation of the Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora, Part II – Summaries and EU Member State Reports, 2003. (Period is 1994-2000. No reporting on Article 10 implementation took place in Finland, France, Italy, Luxembourg, Portugal, Spain and Sweden). Spain source is Beaufoy (2008).

A more recent study by IEEP (Kettunen *et al.*, 2007) found that both the Community and national legal/policy frameworks provide opportunities to address ecological coherence and connectivity within the EU. In addition, a number of practical national and regional measures are in place. These included, for example, supporting the maintenance of connectivity as a part of the national legal framework for nature conservation, measures related to establishment of national/regional ecological networks, integrated approaches to land-use planning and management, enhancing connectivity within the agricultural landscapes (for example, through agri-environment schemes) and mitigation of fragmentation impacts (for example, from transport infrastructures). However, actual implementation of such measures is patchy and inconsistent. For example, progress has been particularly slow with regard to practical implementation of ecological networks in most countries, primarily as a result of limited legal powers and the costs of large-scale land purchase and long-term management (see for example, Bennett and Mulongoy, 2006).

Furthermore, there was little evidence that new policies or measures are being implemented to address Article 10 requirements. The study therefore concluded that further efforts are needed to secure the maintenance of ecological connectivity amongst Natura 2000 sites and the wider European landscape.

A current study by the Institute for European Environmental Policy and Alterra for DG Environment[9] is examining the implementation of ecological networks in more detail. This includes a review of lessons learnt from ecological network and biodiversity corridor initiatives so far; a key aim being to identify issues that have hindered their practical establishment and actions that have been particularly useful. Initial results from this study suggest that these initiatives differ considerably in the manner in which they have been initiated, their organisational form and the manner in which they interact with spatial planning. To a large extent, most initiatives have been successful in designing and identifying the network on paper, generally consisting of a series of core areas linked by a series of interconnecting habitat corridors and buffer zones. In many cases, these networks are afforded strict legal protection (such as in the Flanders region of Belgium), are implemented through agri-environment measures or, occasionally, are implemented through land purchase.

Implementation on the ground, resulting in protection and restoration of the sites, has proved more difficult. The networks have yet to be fully incorporated into local planning schemes. Often they have suffered from lack of consultation with landowners, local authority officials and interest groups during the design phase, resulting in a lack of trust and consequently slower progress in implementation. The lack of consultation can also result in over-ambitious plans that do not reflect the resources available in the country and therefore may be difficult to implement on the ground. Projects also suffer from continuing pressures of fragmentation through the continuing loss of habitat as a result of development. Successful projects, on the other hand, have cited good local delivery partnerships with landowners and strong support at a national level, as key factors.

[9] Reflecting environmental land use needs into EU policy: preserving and enhancing the environmental benefits of "land services": soil sealing, biodiversity corridors, intensification / marginalisation of land use and the permanent grassland. Reference: ENV.B.1/ETU/2008/0030

3.2 Environmental Liability Directive

The Environmental Liability Directive (2004/35/EC) establishes a framework of environmental liability rules based on the polluter pays principle, with the aim of preventing and remedying environmental damage. It imposes a strict liability obligation on the operator of a list of activities regulated under existing Community environmental laws to remedy or prevent damage to the environment, including: damage to protected species and natural habitats, damage to water and damage to land. It imposes fault-based liability on all other occupational activities for damage to species and habitats. These liabilities are imposed by means of public administrative law, rather than private civil law, meaning that enforcement is confined to actions brought by public authorities, with private individuals and groups limited to requesting action from those authorities.

The Directive links directly to conservation legislation by defining 'Protected species and natural habitats' as those covered in Annexes of the Habitats and Birds Directives (Annexes I, II and IV and Annexes I and IV respectively). In addition, Member States can designate other habitat or species not listed in the Annexes, for equivalent purposes to those in the two Directives. 'Waters' are defined as all waters covered by the Water Framework Directive (see below) while there is no definition for land. Annex III lists the activities that are liable for remedial and preventative action, such as those that require Integrated Pollution and Prevention Certificates, discharges to surface water and groundwater and the use and storage of dangerous substances. The Directive obliges operators of activities that pose an imminent threat of damage to take necessary steps without delay. Where damage has occurred, operators must identify potential remedial options and submit them to the competent authority for approval.

3.3 Agricultural policy

The Common Agricultural Policy (CAP) has a profound impact on the management of farmland and therefore many Natura 2000 sites in the EU. Although it has undoubtedly been partly responsible for many of the impacts of agricultural intensification on biodiversity, it has undergone many reforms and now includes some important measures that can help to protect and appropriately manage Natura 2000 sites.

Of particular importance to the management of habitats in Natura sites are the Axis 2 measures of the European Agricultural Fund for Rural Development (EAFRD) under Council Regulation 1698/2005. The EAFRD provides a strategic framework consisting of social, economic and environmental objectives, within which Member States have considerable flexibility to use its 46 measures in ways to suit their local needs and priorities through the development of Rural Development Programmes (RDPs), including an overarching strategy document, at the national or regional level. Axis 2 measures are of particular importance to biodiversity conservation because they aim to improve the environment and countryside by supporting land management. Member States are required to allocate at least 25% of the EAFRD budget to Axis 2 measures.

Agri-environment measures are the main means of supporting habitat management and sit as one of 13 measures within Axis 2, and remain the only compulsory measure within the EAFRD. Over the years a wide range of different agri-environment schemes has been developed, not just in response to varying environmental priorities and pressures, but also reflecting societal preferences, institutional arrangements and financial and political pressures. They tend to differ in three key ways: the level of expenditure dedicated to the measure; the environmental objectives of the schemes, and the nature of the ways in which they are targeted (e.g. whether they are geographically delimited or open to all farmers across the territory); and the degree to which they are focused on maintenance, enhancement, restoration or creation of new habitats. Besides the agri-environment

measure, other measures within Axis 2 which are most likely to benefit farmland biodiversity include the natural handicap measures (which largely continue to be referred to as the Less Favoured Area (LFA) measure) and a measure which allows land managers to be compensated for a portion of the costs associated with undertaking management of Natura 2000 sites.

The Axis 2 measures now provide by far the largest source of funding for the management of terrestrial Natura 2000 sites, and other areas of biodiversity importance. In total, about €68 billion of public money is allocated for 2007-2013 across all Axis 2 measures (including agri-environment measures and Natura 2000 payments). This accounts for approximately 46% of all public expenditure under the EAFRD, but still only represents 16% of the total CAP budget for 2007-2013 (calculations based on official sources as used in IEEP 2009). The extent to which Natura 2000 sites are covered by agri-environment schemes and Natura 2000 measures is unknown, but it is clearly currently incomplete.

Another constraint on the effectiveness of the measures is that the biodiversity benefits of agri-environment schemes are variable and very much depend on the objectives of each Member State's RDP, as some give higher priorities to resource protection than directly to biodiversity (Farmer et al., 2008). There is also infrequent or weak targeting towards Natura 2000 sites and HNV habitats and the practical effectiveness of biodiversity measures is variable (Boccaccio et al., 2009). Whittingham (2007) noted that the performance of agri-environment schemes is limited by their small-scale, inappropriate placement (e.g. where target species are absent) and the application of generalised national habitat management prescriptions. Another problem has been that they are voluntary schemes and landowners are usually able to choose from a suite of options. As a result there has often been low participation in the more demanding options, which are often those that produce the greatest biodiversity benefits.

Nevertheless, it appears that agri-environment schemes can provide substantial biodiversity benefits, especially when they are appropriately designed, targeted and implemented (Wilson et al., 2009). It also seems that 'narrow and deep' approaches with more targeted, possibly higher maintenance and management options provide more certain benefits than 'broad and shallow' measures that offer relatively simple, low-cost management options over very wide areas.

As noted above, current CAP funding is not sufficient to manage the entire farmed landscape under agri-environment schemes. Therefore cross compliance is the principal policy instrument for maintaining basic environmental standards. Cross compliance allows deductions to be made to the CAP payments farmers receive, or for payments to be withdrawn completely, if the farmer is found not to be compliant with a number of standards. This system was introduced in 2005 under Regulation 1782/2003 and consists of Statutory Management Requirements (SMRs) based on selected articles for 19 pieces of EU legislation (including the Birds and Habitats Directives), and conditions relating to the maintenance of land in Good Agricultural and Environmental Condition (GAEC)[10].

The GAEC framework requires Member States to introduce standards to address soil erosion, soil structure, soil organic matter and the minimum maintenance of habitats. There are four main types of GAEC minimum maintenance measures that may provide biodiversity benefits: minimum livestock stocking rates and/or appropriate regimes, protection of permanent pasture, and retention of landscape features. It is important to note that these measures only provide baseline protection, rather than the management or enhancement of habitats (which is addressed by agri-environment measures). Member States are given a considerable amount of discretion in terms of which GAEC measures they adopt and how they apply them.

[10] listed in Annex III of Council Regulation 73/2009 (previously Annex IV of Council Regulation 1782/2003)

A recent study (Alliance Environment, 2007), and most notably the recent European Court of Auditors report (ECA, 2008) have identified weaknesses within the system, which severely undermine its ability to act as an effective environmental baseline for the management of agricultural land across the EU. Nevertheless, cross compliance has been an extremely significant addition to the CAP as it introduced, for the first time, a link between direct payments to farmers and basic environmental standards.

3.4 Forestry policy

The EU does not have competency in forestry policy (because the Treaty establishing the European Community makes no provision for a specific common forestry policy). The responsibility for forest policy therefore lies with the EU Member States. Nevertheless, there are many EU policies (such as the CAP, structural funds, Birds and Habitat Directives and various directives controlling pollution) that directly or indirectly affect forestry and forests, typically through national implementation measures. Pursuant to the principle of subsidiarity and the concept of shared responsibility, the European Community also intentionally contributes to the implementation of sustainable forest management and to the multifunctional role of forests (e.g. wood production, protection of biodiversity, protective functions of forest soils and water, socio-economic services) by the means of:

- Non-binding policy frameworks, like EU Forest Strategy and EU Forest Action Plan (FAP).
- Binding directives, regulations and decisions, like the Birds Directive and Habitats Directive, the Rural Development Regulation (see above) or the (2006 expired) Forest Focus Regulation[11] for which financial support is provided by various funds and financial instruments (see below).

Cooperation and support for sustainable forestry is a key principle within the EU Forestry Strategy and the EU FAP. The strategy focuses on the essential ecological, economic and social role of forests and covers such measures as investments to improve their economic, ecological or social value, and to restore the potential of forestry production following damage by natural disasters and fire.

The principles of the Forestry Strategy have been further developed into a dynamic process consisting of a set of key actions in the EU FAP. The plan is an expression of common intentions by EU Member States in trying to achieve a sustainable and competitive forestry sector, whilst balancing these needs with the broader multiple functions of forests. The EU FAP has four objectives and identifies 18 Key Actions which it is envisaged will be jointly implemented by the Commission and the Member States between 2007 and 2011. The following actions relate to the objective “To maintain and appropriately enhance biodiversity, carbon sequestration, integrity, health and resilience of forest ecosystems at multiple geographical scales” and are therefore of particular relevance to biodiversity:

- promote the use of forest biomass for energy generation;
- foster the cooperation between forest owners and enhance education and training in forestry;
- facilitate EU compliance with the obligations on climate change mitigation of the UNFCCC and its Kyoto Protocol and encourage adaptation to the effects of climate change;
- contribute towards achieving the revised Community biodiversity objectives for 2010 and beyond;
- work towards a European Forest Monitoring System; and
- enhance the protection of EU forests

[11] Council Regulation (EC) No 2152/2003

The main mechanisms for implementing the EU Forest Strategy and EU FAP are the Rural Development Regulation (EC No 1698/2005), the financial instrument LIFE+ (EC No 614/2007) and the 7th Research Framework Programme (Council Decision, 18 December 2006). Between 2003 and 2006 the Forest Focus Regulation (EC No 2152/2003) was of particular importance for supporting forest condition monitoring in the EU.

The Forestry Strategy and FAP have resulted in an important increase in the role of forestry measures in the rural development Pillar of the CAP. At present, the relevant rural development measures mainly focus on afforestation and improving the competitiveness of the forestry sector. Rather less emphasis is placed on supporting the environmental role of forests, which is catered for by two measures (the forest-environment payment and the Natura 2000 payment for forests). However, there has been rather low uptake of these measures amongst Member States.

The concept of High Nature Value (HNV) forestry has also been developed and may help to target strategic priorities for rural development as well as for monitoring the impact of rural development measures. But HNV forestry is difficult to define and needs to be made more coherent with other concepts that exist in the forestry arena.

A general constraint on sustainable forest management measures is that agriculture and forestry continue to be compartmentalised in EU policy terms. In order to address (some) forest protection issues, further progress in integrating forest and agriculture in policy terms may be desirable.

The European Community and its Member States have made international commitments relating to the maintenance and protection of forests. At the global level, the debate on the conservation and sustainable management of all types of forests takes place in various multilateral processes and initiatives, which are jointly called “the international forest regime”. This includes global processes, like the UN Forum on Forests (UNFF), and regional processes, like the Ministerial Conference on the Protection of Forests in Europe (MCPFE).

Besides regulative instruments, market-based initiatives support the implementation of strategies regarding different forest functions. Certifications of sustainable forest management help to achieve goals for protecting biodiversity, combating illegal logging and, possibly in the future, monitoring and certifying carbon sequestration (EEA, 2008). Two of the most important certification schemes in Europe are the Forest Stewardship Council (FSC) and the Pan-European Forest Certification (PEFC).

3.5 The Common Fisheries Policy

Marine fisheries policy is an exclusive competence of the European Community (EC). This means that all decisions are taken at an EU level. Member States cannot intervene in fisheries management unless they are explicitly delegated the powers to do so. At present the main area for which Member States have such powers relates to inshore fisheries (with a maximum of 12 nautical miles (nm) from the shore). The Common Fisheries Policy (CFP) thus provides the framework for European and national fisheries management activities. It therefore also has an major influence of biodiversity conservation in the EU, as a result of impacts on biodiversity and through some measures which aim to support implementation of Community nature conservation legislation.

The CFP was formerly established in 1983 and primarily focused on the management of fish stocks in accordance with the founding agricultural policy objectives of Article 37 the EC Treaty. The greening of the CFP, began in the early 1990s, with a significant development being the 2002 reform. The main objective of the CFP, as set out Article 2(1) of the new basic Regulation (Regulation 2371/2002) states that “*The Common Fisheries Policy shall*

ensure exploitation of living aquatic resources that provides sustainable economic, environmental and social conditions."

Furthermore, Article 2(1) goes on to add further context to the objective: "*For this purpose, the Community shall apply the precautionary approach in taking measures designed to protect and conserve living aquatic resources, to provide for their sustainable exploitation and to minimise the impact of fishing activities on marine eco-systems. It shall aim at a progressive implementation of an eco-system-based approach to fisheries management. It shall aim to contribute to efficient fishing activities within an economically viable and competitive fisheries and aquaculture industry, providing a fair standard of living for those who depend on fishing activities and taking into account the interests of consumers*."

Importantly a conservation policy strand was introduced under the reform – governing the direct exploitation of Community fish resources with the aim of conserving and managing living marine aquatic resources, and providing for their exploitation on a sustainable basis. The CFP now also includes several measures to limit the environmental impact of fishing. Among them is the protection of non target species such as marine mammals, birds and turtles, juvenile fish and vulnerable fish stocks, and the protection of sensitive habitats. Of particular relevance to the achievements of the aims of the birds and habitats directives (including climate change adaptation) are:

- measures regarding the structure of fishing gear, the number and size of fishing gear on board, their methods of use and the composition of catches that may be retained on board when fishing with such gear.
- zones and/or periods in which fishing activities are prohibited or restricted including for the protection of spawning and nursery areas.
- specific measures to reduce the impact of fishing activities on marine eco-systems and non target species.

Since 2002, the Commission has proposed and adopted a number of implementing regulations in order to meet the objectives of the reformed CFP. These include recovery plans, emergency measures and revised technical measures for the Baltic and the North East Atlantic. Regulations relating to the adjustment of fishing capacity have also been added as well as recent new proposals to improve the EU control regime. However, according to a review by Lutchman et al (2008), further action is required, both at Commission and Member State levels, to ensure that the CFP Regulation achieves its objectives.

In April 2009, the European Commission launched a Green Paper (CEC, 2009) which marked the beginning of the next official reform process of the CFP. This will last until 2012, when it is expected that the Council will adopt a new regulation. This review is expected to be the most radical review since the CFP adoption in 1983. This is because the Commission recognizes that whilst there has been some progress towards better management of European fisheries, there is still more to be done. Fishing fleets are still too large, and most European fish stocks are still overfished.

The Green Paper sets out an ambitious vision for European fisheries by 2020, but highlights that this vision can only become a reality by addressing the pitfalls of the current CFP (Lutchman et al., 2009). The Green Paper identifies five structural failings of the CFP – notably that the current CFP includes imprecise policy objectives resulting in 'insufficient guidance for decisions and implementation'. The Green Paper calls for clarity of the objectives and a refocusing of the objectives to ensure environmental sustainability and a shift away from short term economic and social objectives. Ecological sustainability is described as a basic premise for the economic and social future of European fisheries. The Green Paper also highlights the role of the Marine Strategy Framework Directive (see below), as the environmental pillar of the Integrated Maritime Policy and the need for the

CFP to take more concrete actions to achieve an integrated approach to marine management.

3.6 Marine Framework Strategy Directive

The Marine Framework Strategy Directive (2008/56/EC) establishes a framework within which Member States are required to take necessary measures to achieve or maintain good environmental status in the marine environment, to be achieved by the year 2020 at the latest. The Directive applies to all marine waters over which Member States have sovereignty and/or exercise jurisdictional rights. Marine Strategies have to be developed and implemented in order to protect and preserve the marine environment, prevent its deterioration or, where practicable, restore marine ecosystems. These strategies are to apply an ecosystem-based approach to the management of human activities and ensure that there are no significant impacts on or risks to marine biodiversity, marine ecosystems, human health or legitimate uses of the sea.

Member States must develop indicators and targets as well as a monitoring programme followed by programmes of action (by 2013) to demonstrate how they intend to achieve good environmental status and meet environmental targets. The principle of sustainable development should be given 'due consideration' when drawing up the plans to include the social and economic impacts of the measures envisaged, as well as the environmental and ecological aspects. They shall include spatial protection measures, contributing to coherent and representative networks of marine protected areas, adequately covering the diversity of the constituent ecosystems, such as areas designated under the Habitats and Birds Directives and marine protected areas as agreed by the Community or Member States resulting from international or regional agreements.

The MFSD says little about climate change. The European Parliament had sought to introduce climate change as a factor which was outside the control of Member States in their ability to achieve good environmental status, but this was not included in the final text. Climate change is not a pressure included in the list of pressures to be assessed in the characterisation and assessment of marine regions.

A complication with policy measures in the marine environment is that Member States have transferred some of that competence to the Community, most notably in relation to fisheries (see above). Therefore, many of the goals of the MSFD will need to be taken forward under the CFP. Both policies are themselves, under the umbrella of the EU's Integrated Maritime Policy, which encourages policy integration across maritime policy issues. These complex issues are outside the scope of this study, but Lutchman and Farmer (2009) consider how the MSFD addresses fisheries issues and considers how it can be used to help push for changes to the CFP to improve the conservation of marine biodiversity.

3.7 Water policy

Water Framework Directive

The Water Framework Directive (WFD, 2000/60/EC) aims to establish a framework for the protection of fresh water, transitional waters (estuaries), coastal waters and groundwater in the Community. The overall objective is to achieve "good ecological status" of surface waters by 2015 (or within two subsequent six year periods). The WFD aims to protect and enhance the status of aquatic ecosystems, and promote sustainable water consumption based on long-term protection of available water resources. It requires that the objectives of water management are based on the overall ecology of these waters, taking account of biological, chemical and hydro-morphological (i.e. a combination of hydrology and physical structure) characteristics. Member States are required to undertake extensive analysis of these

characteristics to determine how far the ecology has been affected by human activity, and identify a programme of measures to rectify any problems within the context of a catchment-based River Basin Management Plan. These measures should include specifying a monitoring programme for a general assessment of water status and for specific threats to any water body where status is not 'good'.

The Directive brings together for the first time a wide range of EU legislation regarding water protection into one comprehensive law. It places the protection of aquatic ecosystems at the centre of its objectives, providing a powerful platform for biodiversity conservation. It has also set the ambitious goal of achieving good water status in all waters, except for particular circumstances (e.g. where natural conditions require additional time to meet the objectives or where heavily modified waters are designated). The aims are to be carried out by the establishment of river basin districts with integrated management, the identification of point and diffuse sources of pollution, meeting the requirements of protected areas, undertaking economic analyses of water use and developing a programme of measures to achieve objectives in each river basin district.

Directive on the Assessment and Management of Floods

Until recently, there was little EU law relating to flood management. The WFD requires that flood management issues are taken into account in overall river basin planning. However, little more is said in this regard. As a result in 2007 the EU adopted Directive 2007/60/EC on the Assessment and Management of Flood Risks and this entered into force on 26 November 2007. This Directive requires Member States to assess if all water courses and coast lines are at risk from flooding, to map the flood extent and assets and humans at risk in these areas and to take adequate and coordinated measures to reduce this flood risk.

Although this Directive does not directly address biodiversity, or Natura 2000 sites, it has a potentially important role in stimulating ecosystem-based adaptation measures that reduce flooding. It may therefore support measures that achieve favourable conservation status of habitats where these provoide flood control benefits by reducing run-off (flood attenuation) or increasing flood storage capacity.

Urban Waste Water Treatment Directive

The Urban Waste Water Treatment Directive (91/271/EEC) seeks to reduce the pollution of freshwater, estuarial and coastal waters by domestic sewage, industrial waste water and rainwater run-off (collectively known as 'urban waste water'). It sets minimum standards for the collection, treatment and discharge of urban waste water, with timetables for their achievement. The deadlines for the installation of secondary (biological) treatment systems vary with the size of the population served: all discharges from towns greater than 15,000 population equivalent had to be subject to secondary treatment by the end of 2000, while the deadline for most discharges from towns with populations between 2000 and 10,000 was not until 2005.

The Directive requires higher standards of treatment (or tertiary treatment) for discharges to particularly sensitive areas, including waters subject to eutrophication; surface waters with high nitrate levels intended for the abstraction of drinking water; and other waters where higher treatment standards are necessary to fulfil the requirements of other Community Directives. Waters sensitive to eutrophication in particular refer to those with pristine conditions with high levels of biodiversity (such as fish or invertebrate life). These were to be subject to more stringent treatment by the end of 1998. In many Member States, the impact of the Directive has been most marked in coastal areas, for example in the UK where some 253 sewage outfalls to coastal waters from towns with summer populations greater than 10,000 existed, of which only 43 per cent had secondary treatment.

Nitrates Directive

This Directive (91/676/EEC) seeks to reduce or prevent the pollution of water caused by the application and storage of inorganic fertilizer and manure on farmland. It is intended both to safeguard drinking water supplies and to prevent wider ecological damage in the form of the eutrophication of freshwater and marine waters generally. Member States are required to identify waters actually or potentially affected by pollution from nitrates including surface waters, ground waters, estuaries, coastal waters and marine waters which are or may become eutrophic and hence a danger to aquatic ecosystems. These become designated as 'nitrate vulnerable zones' (NVZs) thus requiring the development and implementation of specific action plans. Specific actions refer to the periods and quantities of fertilizer application permitted, limits on livestock manure application and codes of good agricultural practice.

A Commission report (COM(2007)120) on the implementation of the Nitrates Directive shows that agriculture accounts for approximately 62 per cent of the nitrogen load to surface water across the EU-15, ranging from 18 per cent in Portugal to 97 per cent in Denmark. The report shows that, with regard to nitrate levels in groundwater, the overall trend across 64 per cent of monitoring sites has been for nitrate levels to remain stable or improve, while the remaining 36 per cent has seen a deterioration in quality. The area of territory in the EU-15 designated as NVZs has increased from 35.5 per cent in 1999 to 44 per cent in 2003, with further designations thereafter. By 2003 seven Member States (Austria, Denmark, Finland, Germany, Luxembourg, the Netherlands and Ireland) had applied NVZ action programmes throughout their territories.

Specific articles of the Nitrates Directive have been included in cross compliance (see Section 3.3) in the EU-15 (plus Malta and Slovenia) as a Statutory Management Requirement (SMR) since 2005. As a result, if farmers who are located within an NVZ fail to comply with these requirements of the Nitrates Directive, then cross compliance sanctions, usually a deduction from their Single Payment, will be applied. These are in addition to possible legal sanctions.

3.8 Air pollution policy

The most important instrument controlling the impacts of air pollution on biodiversity is the National Emissions Ceilings Directive (2001/81/EC). The Directive aims to reduce the adverse effects of acidification (on water and soil), ground-level ozone (air) and eutrophication (water and soil) by setting national emission ceilings for sulphur dioxide (SO2), nitrogen oxides (NOX), volatile organic compounds (VOC) and ammonia (NH3). By 2010, Member States shall limit their annual national emissions of SO2, NOx, VOC and NH3 to those laid down in the Directive. These ceilings are intended to meet 'broadly' the interim environmental objectives for reduction of acidification and ground-level ozone to be achieved by 2010 (which include the need to reduce the areas where critical loads of acidification are exceeded by at least 50 per cent on 1990 levels and to reduce the ground-level ozone critical level related to crops and semi-natural vegetation by one-third in all grid cells compared with the 1990 situation and that the absolute load to not exceed 10ppm per hour).

Member States are required to draw up national programmes which must include information on adopted and envisaged policies and measures and the effect of these on emissions in 2010. The Directive covers all sources that arise from human activities except emissions from international maritime traffic, aircraft emissions beyond landing and take-off cycle and for specified overseas territories.

3.9 The Structural and Cohesion Funds

The aim of the EU regional policy is to promote coherent development within the EU and reduce gaps between the wellbeing of different regions within the Community area. Traditionally, the Community's regional policy has paid little attention to issues related to nature conservation and biodiversity. Furthermore, the initiatives supported by Structural and Cohesion Funds have frequently been criticised for having negative impacts on biodiversity (see for example WWF 2006). These negative effects include issues related to the fragmentation of landscapes, for example, as a consequence of the development of transport networks and construction of infrastructure for irrigation (e.g. dams and channels). For example, the development of roads, dams and railways supported by the EU Structural and Cohesion Funds has contributed to the loss and fragmentation of Iberian Lynx populations in Spain, by creating barriers between the different populations and obstructing the exchange of individuals among them. Similarly, in Greece the construction of the Egnatia Highway is predicted to lead to fragmentation of the Greek population of Brown Bears. Promoting sustainable development has, however, improved the inclusion of environmental issues, including biodiversity, into EU regional policy.

The EU regional policy is supported by three specific funding instruments: the European Regional Development Fund (ERDF), the European Social Fund (i.e. the Structural Funds) and the Cohesion Fund. Of these funds the ERDF and the Cohesion Fund are the most relevant in the context of this guidance document. The Community co-financing for managing Natura 2000 during the 2007-2013 period will come from a mixture of existing funds (COM/2004/431), including also the Structural and Cohesion Funds. This will increase possibilities for implementing measures that also support ecological coherence and connectivity in the context of regional development. These measures can be linked, for example, with risk prevention and the development of transport networks. In addition, support is also provided for transnational initiatives.

The programming of Structural and Cohesion Funds gives Member States a lot of freedom to develop policies and measures that suit their national and regional needs. Consequently, the actual level and types of funding in support of Natura 2000 and ecological connectivity in individual countries will depend on decisions taken at a national level. It is therefore important to ensure that these types of activities are or can be addressed in Member States' priorities for ERDF and Cohesion funding, i.e. in the national strategic plans and operational programmes for these funds.

It is worth noting that the four Outermost Regions of France (French Guiana, Guadeloupe, Martinique, Reunion) are fully eligible for regional policy funding streams, but that they are the only EU regions where no EU-regulated biodiversity safeguards exist such as those provided by the Birds and Habitats Directives whose application is limited to the EU mainland and the Outermost Regions of Spain (Canary Islands) and Portugal (Azores, Madeira).

3.10 Impact assessment and planning policy

The EU does not have competency over land use planning. However the following two directives are of particular relevance to the control of the environmental impacts of developments.

Strategic Environmental Assessment Directive

This Directive (2001/41/EC) requires authorities to undertake an environmental assessment of certain plans and programmes which are likely to give rise to significant effects on the environment. The process of assessing plans and programmes is generally referred to as 'strategic environmental assessment' (SEA), although nowhere is this term used in the

Directive. It sets out standard procedures for undertaking an environmental assessment, and complements Directive 85/337 on the assessment of projects ('EIA') by requiring assessments at an earlier stage in the planning process.

The Directive refers specifically to biodiversity by covering all plans and programmes which have been determined to require an assessment under the Habitats Directive (92/43) in view of their likely effect on Natura 2000 sites. An environmental report has to be produced that contains the likely significant effects on biodiversity, population, human health, fauna, flora, soil, water, air, climate, material assets, cultural heritage, and the inter-relationship between these factors. In addition, it should include proposed mitigation and compensation measures for any significant adverse impacts on the environment, reasons for selecting the options chosen and a description of proposed monitoring measures.

Environmental Impact Assessment Directive

The Environmental Impact Assessment (EIA) Directive (85/337) stipulates that before consent can be given for certain development projects, such as large-scale industrial or infrastructure projects, an assessment of the effects they may have on the environment has to be made so that the competent authority that grants consent is aware of the consequences. It acts as an embodiment of the preventative approach to environmental protection by ensuring the information regarding the potential impacts of the development are known before a decision is made. It requires the developer to supply information and to consult with the public and certain stakeholders. The Directive creates procedural rather than substantive obligations, and does not in itself require that Member States refuse to approve projects that are damaging to the environment. The study must cover the impact on specific factors including human beings, flora, fauna, soil, water, air, climate, the landscape, material assets and the cultural heritage as well as the interaction of all of these.

3.11 EU Biodiversity Action Plan

As a result of this strong environmental policy framework, the EU Heads of State and Government undertook in 2001 to halt the decline of biodiversity in the EU by 2010 and to restore habitats and natural systems. To achieve this aim, the European Commission adopted in May 2006 a Communication on "Halting the loss of Biodiversity by 2010 – and Beyond: Sustaining ecosystem services for human well-being"[12]. The Communication underlined the importance of biodiversity conservation and included a detailed EU Biodiversity Action Plan (BAP, COM 2006/216) to achieve its objectives.

A key aim of the BAP is that it attempts to reinforce the implementation of nature conservation legislation. It places a high priority on enhancing the coherence and connectivity of the protected areas network (e.g. both Natura and non-Natura areas) (Objective 1 of the Action Plan). In particular, it recognises that in addition to 'structural tools' (such as flyways, stepping stone and corridors), enhancing the coherence, connectivity and resilience of the Natura 2000 network requires actions that support biodiversity in the wider environmental matrix. In this context, in its endorsement of the Biodiversity Communication and Action Plan on 18 December 2006, the Council of the European Union particularly emphasised the importance of regional and local land-use planning, in particular the related responsibilities of the Member States, was stressed (Kettunen et al., 2007).

The BAP moreover encourages the integration of biodiversity conservation requirements into the policies of other sectors such as agriculture, fisheries, transport and energy

[12] http://ec.europa.eu/environment/nature/info/pubs/docs/brochures/bio_brochure_en.pdf

Finally, the BAP includes a specific set of actions “to support biodiversity adaptation to climate change” (Objective 9 of the Action Plan). The aim of these actions is to substantially reduce the damaging climate change impacts on biodiversity and to control for any negative impacts of climate change adaptation and mitigation measures. One of the listed actions specifically addresses the coherence, connectivity and resilience of the Natura 2000 network.

The full list of BAP objectives, targets and actions is shown in Table 6.1 in Section 6, in which the consequences of climate change for the EU Biodiversity Action Plan and its implementation are evaluated in depth.

4 Status of Habitats and Species of Community Interest and the impacts of climate change and other pressures

4.1 The status of EU Habitats and Species of Community Interest

In December 2008, the European Commission published its mid-term assessment of progress with the implementation of the BAP at both European Community and Member State levels (CEC, 2008). The assessment concluded that although many biodiversity conservation actions had been undertaken (notably the further extension of the Natura 2000 network of protected areas), further actions are urgently required, especially integration of biodiversity and ecosystem conservation measures into other sectoral policies: consequently the EU will fail to meet its target of halting the loss of biodiversity by 2010 unless there is significant additional effort over the next two years.

This assessment was based on an analysis of selected biodiversity indicators by the EEA (EEA, 2009), including Article 17 assessments of the status of habitats and species of Community Interest under the Habitats Directive (CEC, 2009a), which revealed that only 17 per cent of the 701 Annex I habitat assessments judged habitats to be in 'favourable' condition[13]. Of nine habitat groups broadly encompassing the habitat types in the Habitats Directive those in poorest condition were dunes; bogs, fens and mires; grasslands; and coastal habitats (Table 4.1). Dunes and coastal habitats were reported by Member States to be under severe pressure from tourism and coastal development and climate change. Bogs, fens and mires suffered from land conversion (e.g. drainage and afforestation) and climate change, and were particularly affected in the Atlantic and Continental regions.

Table 4.1: Conservation status of habitat types according to Article 17 reports (CEC, 2009)

Biogeographical region	% favourable	% unfavourable - inadequate	% unfavourable - bad	% unknown – but not favourable	% unknown	% not possible to assess
Dune habitats (62)	1	41	50	2	6	
Bogs, mires and fens (56)	7	30	55	6	2	
Grasslands (102)	6	22	51	5	15	1
Heath and scrub (36)	17	28	38		17	
Coastal habitats (84)	9	30	35	7	14	5
Freshwater habitats (84)	16	35	29	6	13	1
Forests (181)	21	27	35	6	11	
Sclerophyllous scrub (32)	22	35	9		34	
Rocky habitats (64)	55	19	9	2	15	

Note: figures in brackets indicate the number of assessments of habitats

[13] The Article 17 reports classify the habitats and species into 'favourable', 'unfavourable inadequate', 'unfavourable bad' and 'unknown' status according to a common framework agreed by the Habitats Committee. The national assessments are apportioned to (and subdivided where necessary) into seven land and four marine bio-geographical regions.

4.2 Key pressures on habitats and species of Community Interest

There is now growing evidence (as reviewed in Task 1) that climate change is already having a significant impact on many species and habitats in Europe. The Article 17 reports have also noted that climate change is having a negative impact on the conservation status of 42 habitats (19 %) and 144 species (12 %) of Community Interest (CEC, 2009a). This is despite the difficulties of detecting climate related effects, which are probably leading to widespread underestimation of the impacts on biodiversity. Wetland habitats such as bogs, mires and fens are apparently the most influenced by climate change, with dune habitats also negatively affected. Amphibians appear to be the most affected species group, probably because of their dependence on wetland habitats that are being affected by droughts etc. It is therefore apparent that practical measures already need to be in place in order to aid biodiversity adaptation by increasing resilience and facilitating redistributions of species and habitats

However, the Art 17 assessments and EEA review indicate that the most widespread pressures continue to result from the intensification of land use, especially in agricultural habitats. This has been prevalent since the 1970s in western Europe (Newton, 2004; O'Connor & Shrubb, 1986; Pain & Pienkowski, 1997; Tucker & Evans, 1997). Despite many reforms to the EU's Common Agricultural Policy (Tucker et al. in prep) intensification is continuing and spreading, especially to southern and eastern Europe. This results in farm and field amalgamation which involves loss of hedgerows, woodlands and other important ecological features. Farms also tend to specialise with a consequent decline in mixed farming. There are also marked switches in crop types and substantial declines in the area of unimproved habitats. Many remaining semi-natural grasslands are still subject to high stocking rates causing widespread damage to vegetation communities and their associated fauna. In contrast, agricultural abandonment is a significant problem in parts of Europe. Semi-natural grasslands of High Nature Value (Baldock et al., 1993) are particularly at risk, such as in some hill farming areas and in the Mediterranean region, but especially in Eastern Europe. In fact the current study for DG Environment on land services suggests that high rates of land abandonment can be expected (according to results from the CLUE land use model) over the next 25 years if current policies and trends continue (IEEP/Alterra unpublished results).

In contrast many forest habitats in the EU are less threatened and a relatively high proportion of forest and Mediterranean shrub lands have a Favourable Status. Over the past few decades, both the forest area and standing volumes of timber have increased (EEA 2008). Around 25% of forests are also protected from harvesting as a result of their importance for biodiversity and a higher proportion are allowed to grow into older development stages, thereby improving the biodiversity value. However, intensification of forestry is still an important issue in some areas (e.g. in parts of Eastern Europe, where formerly strictly protected state forests have now been privatised). Intensive commercial forest management results in the loss of old-growth semi-natural forests and their replacement with more uniform and denser forests with reduced species and structural diversity. Commercial forestry also results in high levels of disturbance, which is a major problem for many sensitive species. In contrast, in some parts of Europe, abandonment of forest management is evident, which is also having serious impacts on their ecological quality.

Large-scale wetland drainage has declined in many parts of Europe over recent decades (Stanners & Bourdeau, 1995), mainly because there is much less to drain. But drainage and wetland degradation remains a threat in some areas, especially in the Mediterranean regions of Europe. The 2001-2006 Article 17 assessments indicate that 60% of habitats of Community Interest are potentially threatened by human induced changes in wetlands and marine environments in at least one Member State in at least one biogeographical region.

Some species groups, such as amphibians are particularly at risk from threats to wetlands as they entirely depend on these habitats. As a result IUCN has recently noted that 23% of amphibians are threatened with extinction in Europe, of which many are endemic or concentrated in Europe and therefore globally threatened (Temple and Cox, 2009). The main threats are a result of the ongoing loss and fragmentation of small wetlands (e.g. temporary ponds) primarily as a result of agricultural intensification and infrastructure developments.

Infrastructure developments are in fact leading to significant impacts on many habitats and species groups. With increasing populations and economic prosperity over the EU over the last few decades there has been a considerable increase in infrastructure developments such as housing, businesses, industry, energy, water supplies and roads etc. Although the combined areas of these remain relatively small, they have significant local impacts, especially in some of the more developed regions of Europe and in favoured locations (e.g. coasts and valleys), and also lead to wider impacts (e.g. air and water pollution). Consequently, the Article 17 assessments indicate that between 70% and 80% of habitats of Community Interest are threatened by each of leisure and tourism, transportation and communication, and urbanisation, industrialisation and similar activities, in at least one Member State. Nearly 60% of habitats of Community Interest are threatened by mining and extraction of materials. Furthermore, it is expected that pressures from developments will grow with further economic development.

As a result of the combination of these changes in land use and other pressures, many habitats are now becoming increasingly fragmented into small patches that are often ecologically isolated from other areas of habitat and/or are too small to hold viable populations of important species of conservation importance (Fahrig, 2003; Opdam & Wiens, 2002). Small habitat patches also suffer from high levels of disturbance and pollution from, for example, nearby roads and industry, and visitors.

It is clear that the poor condition of many habitats and species populations in the EU as a result of long-established and ongoing pressures will greatly exacerbate likely climate change impacts on biodiversity. As described in Section 2 of this report, existing pressures will constrain the adaptive capacity of species to adapt to the effects of climate change by reducing their resilience and ability to disperse to, and colonise, suitable areas of habitat. Furthermore, the Task 2 analysis confirms that many these species of Community conservation importance will be highly vulnerable to climate change as a result of such constraints. Consequently, a high priority needs to be given to taking measures that address current pressures that also constrain biodiversity adaptation.

5 Mitigation and adaptation measures for non-environmental sectors and their potential impacts on biodiversity

As noted above, there is the potential for climate change mitigation and adaptation measures for non-environmental sectors to conflict with or support biodiversity objectives (Ad Hoc Technical Expert Group on Biodiversity and Climate Change, 2008a, b, c; AHEWG, 2009; Berry et al., 2008; Campbell et al., 2008; Paterson et al., 2008). Some of the likely principle mitigation and adaptation measures are therefore outlined below. Many of the adaptation principles are also reflected in the European Commission's Green Paper on 'Adapting to climate change in Europe – options for EU action' (CEC, 2007). This was followed by a White Paper in April 2009 entitled "Adapting to climate change: Towards a European framework for action" (CEC, 2009b), which is likely to stimulate the development and implementation of various adaptation policy instruments.

Further information on many of the more practical measures and their interrelationship with adaptation measures for biodiversity can be found at the MACIS study website http://www.macis-project.net/MACIS-Deliverable-2.2-2.3-Oct.2008.pdf

5.1 Agriculture

With regard to climate change mitigation measures in the agricultural sector, an increased shift towards the production of bio-energy crops may be expected given the EU's bioenergy targets set under the 2009 Renewable Energy Sources Directive. In Western Europe this is expected to primarily lead to an intensification of production on existing agricultural lands; in Eastern Europe, in contrast, it is expected to cause further conversion of natural lands into production areas.

Further potential climate change mitigation measures affecting agricultural production in the EU are linked to livestock management and the underlying production of animal feedstock. The management type if not the quantity of livestock produced will likely change to reduce methane emissions (e.g. through reduced grazing stocking densities, or a shift to indoor production). Such changes may have significant knock-on effects on some EU habitats of Community Interest dependent on human management, that are hard to predict both in general and locally.

Lastly, under a mitigation agenda low-till or no-till farming practices may become more widespread in order to reduce greenhouse gas emissions from agriculture linked to tillage. Although the direct and indirect effects on biodiversity are uncertain it is likely that they would be beneficial for soil organisms and freshwater ecosystems (through reductions in nutrient rich silty runoff).

The Commission recently produced a report on "Adapting to climate change: the challenge for European agriculture and rural areas" (CEC, 2009c). This summarises the main impacts of climate change on EU agriculture, examines adaptation needs, describes the implications for the CAP and explores possible orientations for future action. It complements the White Paper on adaptation and aims to further engage Member States and the farming community in the debate on agricultural adaptation needs.

It suggest that possible short to medium term farm-level adaptive measures may include:

- adjusting the timing of farm operations, such as planting or sowing dates and treatments;

- technical solutions, such as protecting orchards from frost damage or improving ventilation and cooling systems in animal shelters;
- choosing crops and varieties better adapted to the expected length of the growing season and water availability, and more resistant to new conditions of temperature and humidity;
- adapting crops with the help of existing genetic diversity and new possibilities offered by biotechnology;
- improving the effectiveness of pest and disease control through for instance better monitoring, diversified crop rotations, or integrated pest management methods; and
- using water more efficiently by reducing water losses, improving irrigation practices, and recycling or storing water.

As with mitigation measures, the likely impacts of such actions on biodiversity are difficult to predict. Although some measures may be beneficial, such as increase crop rotations and integrated pest management, other more technical solutions such as increases in irrigation or use of pesticides would be damaging. In fact, the recommendations above seem to emphasise technological rather than biodiversity focussed measures. But in the context of agriculture, biodiversity fulfils a number of adaptation functions. For example, improved soil management could contribute to adaptation to climate change, as they are less prone to drought, flooding and water-logging. Agricultural systems with a diversity of crops and surrounding natural habitat are likely to be more resistant to weather extremes, pest infestations and invasive species, and agro-biodiversity is crucial when developing climate change resistant crop and livestock varieties and genotypes. There may therefore be more opportunities for co-benefits from biodiversity conservation and agricultural adaptation than are apparent from the Commission's report.

5.2 Forestry

The EU Forest Action Plan refers to adaptation, but is not detailed enough to provide a more elaborate definition of what this means in the forestry context. It implies, rather obliquely, that adaptation of the forest sector is required in order to maintain productive capacity and suggests that this should involve improving the resilience of forest stands and maintaining biodiversity. The Action Plan places a requirement on the European Commission to undertake research on adaptation to climate change and invites Member States to promote 'activities' for adaptation.

The Forest Focus Regulation which expired in December 2006 implemented EU-scale forest monitoring, part of which included a focus on biodiversity and climate change. The monitoring activities will be provided for by LIFE+ over the 2007-2013 period, but will lose an explicit forest dimension and be integrated in other policy areas. It is not yet clear whether this will be more beneficial than a dedicated co-ordinated system of forest monitoring in understanding changing forestry dynamics as a basis for making proposals on the adaptive response for forest ecosystems.

Axis 2 of the EAFRD (see Section 3.3) includes two afforestation measures (one for agricultural land and one for non-agricultural land), the forest environment measure (akin to the agri-environment measure), a measure for forest areas designated as Natura 2000 sites and a measure to establish agro-forestry systems. If used in a sensitive and strategic way these measures may assist biodiversity adapt to climate change through, for example, the appropriate management of and creation of habitats to help maintain the resilience of different species populations both inside and outside of protected areas. Afforestation could also be incentivised where this will help flood alleviation and soil protection, which may also benefit the adaptation of biodiversity to climate change. But poorly located or planned afforestation measures could equally be damaging, especially if monocultures and/or non-

native species are planted. This underlines the importance of appropriate assessment of the consequences of afforestation on biodiversity.

Member States are required to develop national forest strategies, and it is within these that adaptation considerations are likely to be found. Whilst it is not possible in a study of this size to consider the content of national level policy documents, the adaptive response of the forestry sector is likely to involve developing fire management and fire suppression policies, and also in introducing non-native species into existing stands of native species (if not a full replacement of native with exotic stands). Systems of short rotation forestry may also become more widespread in order to meet domestic demand for timber and wood based products. More intensive management, such as more intensive thinning regimes in order to reduce vulnerability to windstorms, may also be required. These changes in management are all likely to have implications for biodiversity. In systems of continuous cover forestry, it would be desirable, for example, to allow natural regeneration to occur, thereby taking advantage of natural forest dynamics, and presenting better conditions for biodiversity whilst allowing wood production to continue.

Compounding the above, it can be expected that current EU climate change mitigation policies such as the Renewable Energy Sources Directive and the Biomass Directive (currently being developed) will lead to an increased pressure on forests to satisfy the growing demand for wood-based energy (pellets for heat generation; second-generation bioenergy fuels produced for instance in biorefineries; etc.). In some parts of Europe, this may help to improve the ecological conditions of woodlands that need some form of management. But in other areas detrimental changes have already been observed, where tree roots are processed and soil compacting increased, leading to potentially significant consequences for biodiversity.

5.3 Freshwater supply and management

Water quality issues are also likely to be affected by climate change. However, at this stage adaptation requirements and specific adaptation approaches are particularly difficult to predict. In some regions increasing abstraction and droughts will concentrate pollutants where previously dilution has reduced health and ecosystem impacts. Elsewhere, increased winter rainfall may have the reverse impact. High rates of runoff and soil erosion may increase eutrophication of water bodies. This may necessitate reductions in the cultivation of crops, use of minimum tillage practices and increased use of buffer strips to prevent or intercept soil loss. Other drivers of land use, particularly agriculture, will also affect the location and type of pollution in surface and ground waters.

As described in Section 3.8, the Water Framework Directive (along with a range of supporting EU legislation) sets the framework for addressing water quality issues. Although climate impacts are not expressly included, any changes in the pressures on water bodies will need to be assessed under the Directive and appropriate measures taken. Therefore, to this extent adaptation is implicit.

The EU Directive on the Assessment and Management of Flood Risks requires an ‘assessment of the potential adverse consequences of future floods for human health, the environment, cultural heritage and economic activity, taking into account as far as possible issues such as […] long-term developments including impacts of climate change on the occurrence of floods’. Thus the Directive requires future climate events to be taken into account in risk assessment and for this to be addressed in flood management planning. However, nothing more specific is required in relation to adaptation.

Clearly there is the potential for flood management policies to impact adversely on biodiversity in the construction of flood defenses on flood plains and on the coast.

Conversely creative flood defense (such as the maintenance or restoration of habitats that provide flood barriers, alleviation or storage) can provide opportunities for biodiversity (Berry et al., 2008).

5.4 Fisheries and aquaculture

Climate change mitigation measures under the Common Fisheries Policy (CFP) are unlikely to have any significant impact on biodiversity and Natura 2000 sites. However, proposed adaptation measures may be beneficial. Of the suggested European and national level measures, those that could affect marine ecosystems directly, and potentially have impacts on Natura 2000 sites, are:

- Support initiatives to reduce fishing effort in overexploited fisheries. Lightly-fished stocks are likely to be more resilient to climate change impacts than heavily-fished ones.
- Establish institutional mechanisms to enhance the capacity of fishing interests (fleets, processing capacity, quota ownership) to move within and across national boundaries to respond to changes in resource distribution. This implies developing bilateral and multilateral agreements. This can only be recommended in the context of functional trans-boundary fishery governance regimes and effective systems to control illegal, unreported and unregulated fishing.
- Link with disaster management and risk reduction planning, especially concerning planning coastal or flood defences; apply ‘soft engineering’ solutions where possible – conservation of natural storm barriers, floodplains, erodible shorelines to manage costs and damage impacts.

6 Assessing the impacts of climate change on the EU Biodiversity Action Plan

The 2006 EU Biodiversity Communication and related Biodiversity Action Plan (BAP) were introduced in Section 3.12. In the following the impacts of climate change on the BAP will be assessed, by looking at the direct and indirect impacts on each of the listed actions covering both short term and long term aspects (Table 6.1.). This assessment is largely based on a combination of the results of the present study, the European Commission's mid-term assessment of the EU BAP (CEC, 2008b,c), other recent analyses and expert judgement.

The following brings together and summarises the most important conclusions from the impact assessment in Table 6.1. Recommendations to overcome detrimental impacts are described and integrated in Section 8.1.

1. *Direct* impacts of climate change on biodiversity and the EU BAP already exist and will become stronger. However, currently the effects of the *indirect* impacts of climate change, most notably the financial implications and those associated with mitigation measures and (mal-)adaptation in other sectors require more attention and response measures.

2. Funding for the conservation of biodiversity and ecosystem services, as well as for biodiversity adaption to climate change, is prone to reduction as decision-makers and stakeholders at all levels (e.g. WTO, EU, EU member states, ODA-recipient countries, regional and local authorities, businesses, land owners, farmers, fishermen) will need to allocate significant resources to climate change mitigation and adaptation across all sectors.

3. The EU Overseas Entities (Outermost Regions and Overseas Countries and Territories) harbour the EU's greatest biodiversity and will experience severe climate change impacts; they are especially vulnerable to reduced conservation funding, given that their economies are dependent on very few sectors (e.g. tourism).

4. The implementation of a wide range of actions may be delayed, weakened or impeded, as the direct and indirect impacts of climate change complicate scientific research and related policy procedures (e.g. the establishment of fisheries management plans where the evolution of fish stocks under climate change is uncertain).

5. Climate change is seen as an overriding environmental and political concern; there is a risk that the implementation and enforcement of existing biodiversity-friendly policies and measures may therefore be reduced, particularly where responsibility is devolved to national, regional or local authorities.

6. Various climate change adaptation and mitigation measures may have significant negative impacts on biodiversity and ecosystem services. The mandatory targets under the Renewable Energy Sources Directive are a particular concern, as they may lead to significant impacts through the production of bioenergy feedstock within and outside the EU, the installation of new small and large hydro power infrastructures along EU rivers, and the installation of other high impact renewable energy infrastructures (e.g. tidal barrages).
7. Despite this largely negative summary assessment, the rise of climate change to the top of the political agenda may provide an opportunity for biodiversity, if the critically important biodiversity-climate change interface is further exploited and recognised. Properly planned ecosystem-based adaptation and mitigation measures offer significant opportunities for biodiversity to benefit indirectly from climate change action and funding.

Table 6.1 Direct and indirect impacts of climate change on the actions in the 2006 EU Biodiversity Action Plan (COM 2006/216). Only activities under the 10 BAP Objectives and 4 BAP Supporting Measures are assessed, but not those belonging to Monitoring, Evaluation and Review.

BAP Objectives, Targets and Actions	Direct impacts of climate change	Indirect impacts of climate change (from mitigation and adaptation measures, others)
OBJECTIVE 1: TO SAFEGUARD THE EU's MOST IMPORTANT HABITATS AND SPECIES.		
HEADLINE TARGET: Biodiversity loss of most important habitats and species halted by 2010, these habitats and species showing substantial recovery by 2013.		
A 1.1 TARGET: Natura 2000 network established, safeguarded, designated and under effective conservation management by 2010, 2012 in marine.		
A1.1.1 **ACTION:** Accelerate efforts to **finalise the Natura 2000 network** including: complete terrestrial network of Special Protection Areas (SPA) [by 2006, 2008 for marine]; adopt lists of Sites of Community Importance (SCI) [by 2006, 2008 for marine]; designate Special Areas of Conservation (SAC) and establish management priorities and necessary conservation measures for SACs [by 2010, 2012 for marine]; establish similar management and conservation measures for SPAs [by 2010, 2012 for marine].	While the designation of the terrestrial Natura 2000 network is almost completed, delays could be incurred with the designation of sites, particularly in the marine biome where the network is still largely incomplete, on the basis of the fact that climate change will impact the distribution of habitats and species of Community Interest. Species and habitats particularly vulnerable to climate change could potentially be added to the criteria for designating sites, through an amendment of biodiversity legislation, thus further complicating or delaying designation.	None
A1.1.2 **ACTION**: Ensure **adequate financing provided to Natura 2000** implementation from Community sources (notably Rural Development funds, Cohesion and Structural Funds, Pre-Accession Instrument, Life-III, Life+) and MS sources, accessible to those who manage Natura 2000 sites, with focus on optimising long-term conservation benefits as well as priority awareness raising and networking initiatives [2006 onwards].	None	Increased funding needs for climate change action (mitigation and adaptation measures, related capacity building) might lead to a significant reduction in financial resources for environmental protection in EU MSs, thus also affecting the funding available for the establishment and management of the Natura 2000 network. On the positive side, where ecosystem-based adaptation and mitigation activities are promoted and implemented, opportunities may exist for specific habitats in Natura 2000 sites to significantly benefit from additional funding streams earmarked for climate change action. On the climate change mitigation side, funding for AFOLU (Agriculture, Forestry and Other Land Uses) measures are particularly relevant; any such measures providing biodiversity co-benefits should be given priority, where they affect Natura2000 sites.
A1.1.3 **ACTION**: Transpose fully [by 2006] **Articles 6(2), 6(3) and 6(4)** of the Habitats Directive into national legislation and planning policies and ensure subsequent timely implementation; where appropriate (i.e. where development proposals cannot avoid damage to Natura 2000 sites, but proceed for reasons of overriding public interest) ensure special effort for adequate design and implementation of **compensatory measures** [2006 onwards].	None	The criteria for defining "overriding public interest" could be reinterpreted in such a way that measures for climate change mitigation or adaptation that may impact negatively on species and habitats (e.g. bioenergy plantations; hydropower dams; new barriers to flooding and sea level rise; use of peat lands for energy purposes) in designated Natura 2000 sites are permitted. For instance the targets laid out in the Renewable Energy Sources Directive (2009/28/EC) are prone to drive such developments.

BAP Objectives, Targets and Actions	Direct impacts of climate change	Indirect impacts of climate change (from mitigation and adaptation measures, others)
A1.1.4 **ACTION**: Strengthen effectiveness of **Strategic Environmental Assessment (SEA) and Environmental Impact Assessment (EIA)** in informing decision-making (inter alia: take stock of effectiveness, produce guidance, tighten legal requirements as appropriate) so as to prevent, minimise and mitigate damages to Natura 2000 sites [2006 onwards]. (*cf Actions A4.1.4, A4.1.6 and A4.6.1 to A4.6.4*)	None	None, except that funding shortcuts resulting from perceived economic impacts of climate change could delay, weaken or impede implementation of this Action.
A1.1.5 **ACTION**: Ensure full and timely application of the **Environmental Liability Directive** (ELD) as it applies to protected species and natural habitats (as defined under the directive), including preventive measures and remedial actions, as appropriate [2006 onwards]	None	None, except that funding shortcuts resulting from perceived economic impacts of climate change could delay, weaken or impede implementation of this Action.
OBJECTIVE 2: TO CONSERVE AND RESTORE BIODIVERSITY AND ECOSYSTEM SERVICES IN THE WIDER EU COUNTRYSIDE.		
HEADLINE TARGET: In wider countryside (terrestrial, freshwater, brackish water outside Natura 2000 network), biodiversity loss halted by 2010 and showing substantial recovery by 2013.		
A2.1 TARGET: Member States have optimised use of opportunities under agricultural, rural development and forest policy to benefit biodiversity 2007-2013.		
A2.1.1 ACTION: Allocate, at MS initiative, within **each national/regional Rural Development (RD) Programme, adequate Community and MS cofinancing** to measures available under all three axes of the RD Regulation which are directly or indirectly supportive of nature and biodiversity [2006/07 and any subsequent revisions]. (*cf Action B.1.1.2*)	None	Funding shortcuts resulting from perceived economic impacts of climate change could delay, weaken or impede implementation of this Action. More specifically, funding may be required for adapting rural development and agricultural production to climate change, wherefore measures supporting nature and biodiversity may continue to receive inadequate attention under RD programming
A2.1.2 ACTION: Apply **Rural Development (RD) measures** in the next programming period [2007-2013] to optimise long-term benefits for biodiversity - in particular for Natura 2000 areas and for other 'high nature value' farm and forest areas.	None	Funding shortcuts resulting from perceived economic impacts of climate change could delay, weaken or impede implementation of this Action. AFOLU climate change mitigation measures that do not respect biodiversity (e.g. some plantation forests, bioenergy crops), inside or outside Natura 2000, may potentially out-compete biodiversity-friendly RD measures, particularly where such AFOLU measures are more adapted to rural cultures or where their opportunity costs are higher and more predictable. As a consequence, the adoption of RD measures could be delayed, weakened or impeded.
A2.1.3 ACTION: Define criteria and identify [2006-07] **high-nature-value farmland and forest areas** (including the Natura 2000 network) threatened with loss of biodiversity (with particular attention to extensive farming and forest/woodland systems at risk of intensification or abandonment, or already abandoned), and design and implement measures to maintain and/or restore conservation status [2007 onwards].	More areas of high-nature value farmland and forest areas have/will become threatened with biodiversity loss due to the direct impacts of climate change; and the criteria as well as the design of measures for maintaining or restoring areas need to be adapted such as to accommodate these impacts.	Some climate change mitigation or adaptation measures (e.g. bioenergy plantations, changes in agricultural crops and production methods) may add pressure on land use, and may thus directly or indirectly impact negatively on high-nature-value farmland and forest areas, inside and outside Natura 2000 sites. Opportunities exist for maintaining and/or restoring high-nature value forest areas under forest-based carbon storage and sequestration schemes (LULUCF, AFOLU)

BAP Objectives, Targets and Actions	Direct impacts of climate change	Indirect impacts of climate change (from mitigation and adaptation measures, others)
A2.1.4 ACTION: Ensure effective implementation of **cross-compliance** (which provides a baseline for most of the measures of Axis 2 of the Rural Development Regulation) in ways that benefit biodiversity [2007-2013].	None	Agricultural and other sectoral adaptation requirements (e.g. water resources) may strengthen the need for enforcement or widening of cross-compliance measures there are also beneficial for biodiversity.
A2.1.5 ACTION: Ensure that MS Rural Development Plans (RDPs) comply with environmental legislation and in particular with the nature directives so as to **prevent and minimise any potential damages to biodiversity** [2007-2013].	None	The need to adapt RD to climate change in order to avoid income losses to farmers and rural communities may override concerns about biodiversity in RD planning. So even if climate change may not necessarily impact on the compliance of RD Plans with environmental legislation, the risks of monitoring and enforcement loopholes remain. In particular because the expected cost of adapting RD and agricultural production to climate change may reduce funding available for monitoring and enforcement action in EU MS.
A2.1.6 ACTION: Broaden **extension services, farm advisory systems and training** actions to farmers, landowners and farm workers to strengthen biodiversity-related implementation in the next rural development programming [2007 onwards], including support from the LEADER axis.	None	Extension services, farm advisory system and training actions to farmers will have to additionally include elements on adapting agricultural production to climate change. On the one hand this will likely reduce the focus and resources for biodiversity-related outreach. On the other hand, if biodiversity-related measures were made an integral part of outreach on the climate-proofing of agriculture, the uptake by farmers may be enhanced given that production are prone to be their primary concern.
A2.1.7 ACTION: Ensure future **'less favoured area' (LFA) regime** [from 2010] under Axis 2 enhances its contribution to biodiversity and to 'high nature value' farm and forest areas.	LFA, defined as areas in which agricultural production or activity is more difficult because of natural handicaps, are prone to be particularly exposed to the effects of climate change. Any biodiversity in these areas is likely to face increasing direct pressure.	Where LFA become more vulnerable due to climate change, the abandonment of agricultural and forest lands is yet more likely; in addition more areas may become listed as LFA in result of climate change. Therefore, more resources will be required under the LFA payment scheme to counter both effects and stem land abandonment. Where LFA require additional adaptation actions and resources in order to maintain agricultural activities in the face of climate change, the uptake of biodiversity-friendly measures may become reduced. It is generally understood that land abandonment in the EU will harm specific biodiversity. This assumption should be controlled for, particularly in light of climatic changes; possibly under a changing climate abandonment of LFA may be more beneficial at least in some cases.
A2.1.8 ACTION: Implement the **common monitoring and evaluation framework and Strategic Environmental Assessment (SEA) Directive requirements** where applicable for rural development programmes, including the definition of indicators in a way that impact of measures on biodiversity is assessed [2006 onwards].	Indicators assessing the biodiversity impact of measures under this Action Point might have to be revisited and adjusted to integrate climate change considerations.	SEA processes and priorities will likely change over the coming years and decades, by integrating climate change mitigation and adaptation needs. In the context of rural development planning, *weak* implementation of the SEA Directive and the Common Monitoring and Evaluation Framework therefore pose a threat to biodiversity. At the same time, *enhanced* implementation of the SEA Directive and the Common Monitoring and Evaluation Framework would offer significant opportunities because ecosystem-based RD measures addressing both climate change and offering biodiversity co-benefits could be promoted.

BAP Objectives, Targets and Actions	Direct impacts of climate change	Indirect impacts of climate change (from mitigation and adaptation measures, others)
A.2.1.9 ACTION: Encourage that implementation of the **Common Agricultural Policy first pillar benefits biodiversity**, notably through mandatory cross-compliance, decoupling (single farm payments) and by encouraging take-up of modulation by the Member States.	None	The need to adapt agriculture to climate change in order to avoid income losses to farmers and rural communities may override concerns about biodiversity.
A2.1.10 ACTION: Consider, if appropriate, a **possible review of cross-compliance requirements related to the preservation of biodiversity** in the 2007 review of the cross-compliance system.	None	No impacts on the Action Point as such, but clearly cross-compliance measures and their effects on biodiversity should be reviewed with regard to their relevance, effectiveness, and efficiency, fully integrating new developments in climate change mitigation and adaptation science and policy (esp. on AFOLU mitigation schemes)
A2.1.11 ACTION: Strengthen measures to ensure conservation, and availability for use, of **genetic diversity** of crop varieties, livestock breeds and races, and of commercial tree species in the EU, and promote in particular their in situ conservation [2006 onwards].	Climate change may negatively impact on the conservation status of, or even eliminate, globally rare breeds (subspecies, races) of crops, livestock or trees in situ. Still, some breeds currently rare in the EU might become more established.	In some cases at least, genetically diverse varieties of crops, livestock and commercial trees will favour successful adaptation in the agricultural and forestry sectors. However ill-informed or overly simplistic adaptation schemes may lead to a more reduced and homogenised production portfolio, putting at risk the rarer varieties.
A2.1.12 ACTION: Exploit opportunities under the CAP [2007-2013] to implement all above actions in the **Outermost Regions**.	None	The Outermost Regions and their very high biodiversity are particularly vulnerable to climate change wherefore the needs and risks are greater.
A2.1.13 ACTION: Ensure that the forthcoming **EU Forest Action Plan** [due 2006] addresses forest biodiversity among the priorities, in line with the EU Forest Strategy and the 6th Environment Action Programme.	None, as the EU Forest Action Plan was published in June 2006	None, as the EU Forest Action Plan was published in June 2006. However: climate change adaptation and mitigation measures are significant new drivers in forest conservation and policy; they can be both a threat and an opportunity to biodiversity in EU forests. Under the mitigation agenda, the use of woody biomass for energy purposes (e.g. in the form of pellets or 2nd generation cellulose-based bioliquids) is strongly promoted by specific policy-makers and interest groups; the importance of biodiversity in the *implementation and future revisions of the EU Forest Action Plan* may therefore rather drop, and increased exploitation of forests can be expected with negative effects on forest biodiversity (particularly in northern and eastern Europe). Equally under the mitigation agenda there are opportunities to store and sequester carbon in forests. Some of these will benefit forest biodiversity where they use or restore natural forests. Plantation forests tend to have a neutral or negative impact on biodiversity, the latter especially where they replace natural forests or other high-nature-value lands. Under the adaptation agenda and funding streams, significant opportunities exist to use maintain and restore natural forests, most importantly to protect watersheds and halt land erosion, thus benefitting biodiversity.

BAP Objectives, Targets and Actions	Direct impacts of climate change	Indirect impacts of climate change (from mitigation and adaptation measures, others)
A2.1.14 ACTION: Implement **Vienna Ministerial Conference resolution on forest biodiversity** (2003) through forest policies of MS and EU Forest Action Plan with particular reference to the CBD Expanded Programme of Work on Forest Biological Diversity [2006 onwards].	None	See under Action Point A2.1.13
A2.1.15 ACTION: **Assess potential impact on biodiversity of plans, programmes and projects for afforestation** (or, should the case arise, deforestation); **adjust accordingly** in order to ensure no overall long-term negative impact on biodiversity [2006 onwards].	*Afforestation/reforestation* programmes may suffer in result of climate change if maladapted species were chosen, for instance because of unexpected weather phenomena. The resulting impacts on biodiversity are not linear. The medium to long-term biodiversity impacts from *deforestation* will be increased by climate change as the resulting degraded landscapes are even more vulnerable to weather events or the establishment of new invasive alien species (IAS).	See under Action Point A2.1.13 Under some ecosystem-based adaptation and mitigation (AFOLU/LULUCF, and REDD outside the EU) schemes, an increase of *afforestation/reforestation* programmes is likely; and given that climate change arguments (e.g. GHG emission reduction targets; flood protection) currently dominate discussions and decision-making, a prior assessment of the biodiversity impacts of such schemes is critically important to avoid counter-productive actions. Climate change may indirectly lead to additional *deforestation*, driven primarily by changes in practices and markets in the agricultural and forestry sectors; e.g. an expansion of agricultural lands to produce first generation bioenergy feedstock; or the increased use of woody biomass for energy purposes.
A2.2 TARGET: Risks to soil biodiversity in EU substantially reduced by 2013.		
A2.2.1 ACTION: **Identify geographical risk areas for factors affecting soil biodiversity** (soil sealing, loss of organic matter, soil erosion, etc.) [by 2009].	Although no observed climate change impacts on soil biodiversity are reported in this project's Task 1 literature review, it can be assumed that soil biodiversity *will* be affected, at least locally, in both natural and anthropogenic landscapes. Direct climate change impacts hence complicate the identification of geographical risk factors affecting soil biodiversity (species, community composition).	Specific climate change adaptation and mitigation measures in sectors relevant to land use, in particular agriculture and forestry, are prone to significantly affect soil biodiversity, such as through changes in crops, trees or farming practices (e.g. the introduction of GM crops adapted to new climatic conditions; the application of low tillage farming to reduce GHG emissions; increased soil compacting in forests where root extraction is practiced with heavy machinery to satisfy increased demand for biomass for energy purposes). Also indirect climate change impacts hence complicate the identification of geographical risk factors affecting soil biodiversity (species, community composition). Climate change considerations must therefore be integrated in the identification process to prevent maladaptive actions. New laboratory, field and modelling research in this area will be required.
A2.2.2 ACTION: **Minimise soil sealing, sustain soil organic matter and prevent soil erosion** through timely implementation of key measures identified in the forthcoming Thematic Strategy for Soil Protection [2010 onwards].	The present study has not looked at soil sealing, soil organic matter and soil erosion and is not in the position to comment on these with authority. However, it seems reasonable to assume that climate change will have very varied direct impacts in this regard, depending on the geographic location, soil type, prevailing land use and the type of local and regional climate change impacts.	See under Action Point A2.2.1 New research or analyses are necessary to adequately inform the forthcoming Thematic Strategy for Soil Protection, such that both the direct effects of climate change and the indirect effects resulting from land use changes can be fully incorporated in a preventive manner in order to avoid maladaptive measures.
A2.3 TARGET: Substantial progress made towards 'good ecological status' of freshwaters by 2010 and further substantial progress made by 2013.		

BAP Objectives, Targets and Actions	Direct impacts of climate change	Indirect impacts of climate change (from mitigation and adaptation measures, others)
A2.3.1 ACTION: Ensure implementation of **operational monitoring programmes** [by 2006] and publication of **River Basin Management Plans** and establishment of **River Basin District Programmes of Measures** [by 2009] and that these Plans and Programmes of Measures are fully operational [by 2012], in line with provisions of the Water Framework Directive.	Climate change will directly and significantly impact water flows in the EU, with regard to both total annual water flows in specific regions and their seasonal distribution. In addition to changes in precipitation patterns, the loss of snow cover and glaciers that are regulating annual water flows is a concern. Operational Monitoring Programmes, River Basin Management Plans and River Basin District Programmes of Measures must consider and address these impacts.	Mandatory climate change mitigation (and hence renewable energy) targets will likely - almost by default - lead to proposals asking for new hydropower infrastructures (both large and small scale) along EU rivers. Large-scale hydro will be promoted particularly in countries where few other renewable energy options exist and/or where the hydro power potential is not yet largely exploited (i.e. especially in the eastern and south-eastern EU MS). Small scale hydro is expected to be deployed in countries where few opportunities for additional large hydro dams remain. The deployment of large scale hydro is a severe concern for biodiversity both upstream and downstream, affecting freshwater, riverine and estuary species and habitats. Now, the present study concludes that hydro dams may emit sufficiently significant quantities of methane due to deep-water anaerobic processes to fundamentally question the value of large scale hydro power in climate change mitigation. Further research and analyses in this area are required. In contrast, ecosystem-based climate change adaptation measures in river basins (such as the restoration of natural flood plains, and enhancement of natural watershed forests) may significantly benefit biodiversity. All these aspects must be integrated in a proactive and rigorous manner in river basin planning.
A2.4 TARGET: Principal pollutant pressures on terrestrial and freshwater biodiversity substantially reduced by 2010, and again by 2013.		
A2.4.1 ACTION: Significantly **reduce point source pollutant pressures** on terrestrial and freshwater ecosystems through strengthening implementation of relevant Directives, notably on Integrated Pollution Prevention and Control, Large Combustion Plants, Waste Incineration, Urban Waste Water Treatment (*cf Action 3.2.1*) [2006 onwards].	None	Efforts to reduce airborne pollution should benefit from enhanced pollution/environmental monitoring programmes expected to result from future climate change legal frameworks; particularly where their scope can be expanded to include pollutants not directly related to climate change. Moreover, a gradual transition to low-carbon technologies over the coming decades should reduce emission of certain point source pollutants, e.g. from large combustion plants. However, comprehensive Life Cycle Analyses should be undertaken of new (low carbon) technologies and practices deployed under climate change adaptation and mitigation schemes, such as to control for pollutants harmful to the environment and biodiversity.

BAP Objectives, Targets and Actions	Direct impacts of climate change	Indirect impacts of climate change (from mitigation and adaptation measures, others)
A2.4.2 ACTION: Significantly **reduce airborne eutrophicating and acidifying pollution** of terrestrial and freshwater ecosystems in line with Thematic Strategy on Air Quality [2006 onwards]; revise National Emissions Ceiling Directive [by 2007]. (*cf Action 3.2.2*)	None	Efforts to reduce airborne pollution should benefit from enhanced pollution/environmental monitoring programmes expected to result from future climate change legal frameworks; particularly where their scope can be expanded to include pollutants not directly related to climate change. Moreover, a gradual transition to low-carbon technologies over the coming decades should reduce airborne eutrophicating pollution (esp. NO_x) and acidifying pollution (esp. SO_x, NO_x), such as from combustion plants, transport and shipping. Over the medium to long term, the introduction of AFOLU mitigation measures can be expected to reduce airborne eutrophicating pollution coming from the agricultural sector (NH_3). However such qualitative assumptions must be underpinned by quantitative analyses that look at the entire portfolio of mitigation and adaptation measures and their impact on airborne eutrophicating and acidifying pollution.
A2.4.3 ACTION: Significantly **reduce pollution of terrestrial and freshwater ecosystems from agricultural sources** (notably pesticides, nitrates) through measures in line with Thematic Strategy on the Sustainable Use of Pesticides, pesticides and biocides legislation, Nitrates Directive [2006 onwards]. (*cf Action 3.2.3*)	None	Climate change mitigation and adaptation measures may lead to either increases or decreases of pollution from agricultural sources. The relative quantitative proportions are hard to anticipate and put into perspective. One the one hand, increased pollution with nitrates and pesticides may be caused by intensification of agricultural practices, for instance to increase crop yields for bioenergy purposes responding to demands created by GHG emission reduction / renewable energy targets; or by the introduction of agricultural crops (maybe GM crops) that are more resistant to climatic events but require greater chemicals input. Also responses to disaster events in agriculture may result in unexpected additional use of chemicals; for instance massive outbreaks of pests arriving newly with climate change may trigger large-scale applications of pesticides, overriding biodiversity concerns. One the other hand, with the advent in the medium to long term of AFOLU climate change mitigation measures, the input of fertilizers responsible for nitrate and similar pollution may be significantly reduced to curb emissions of the potent GHG N_2O.
A2.4.4 ACTION: Significantly **reduce current exposure, and limit future exposure, of terrestrial and freshwater ecosystems to toxic chemicals** through measures in line with EU chemicals legislation including REACH [2006 onwards]. (cf action 3.2.4)	None	Given that this Action Point refers to any sector responsible for pollution with toxic chemicals, it is very hard to assess the indirect impacts of climate change. It would therefore be most appropriate if under the EU Chemicals Legislation including REACH, all potential sources of toxic chemicals relevant under mitigation and adaptation schemes were compiled and analysed, in a continuous process.

BAP Objectives, Targets and Actions	Direct impacts of climate change	Indirect impacts of climate change (from mitigation and adaptation measures, others)
A2.5 TARGET: Flood risk management plans in place and designed in such a way as to prevent and minimise biodiversity loss and optimise biodiversity gains, by 2015.		
A2.5.1 ACTION: As part of the preliminary flood risk assessment for each river basin, **assess the risks and benefits of flooding for biodiversity** [within 3 years of adoption of Directive].	Flooding risks and benefits may increase or decrease in result of climate change, depending on the water flow changes experienced in the river basin in question.	Depending on the factors integrated in the planning, adaptation measures aimed at reducing flood risks could either reduce or increase risks for biodiversity. Where soft ecosystem-based approaches in flood control are used (such as restoring natural flood reservoirs), biodiversity may benefit both from the adaptation measures and from the flood events (for instance where they nourish natural flood plains and river oxbows). If in contrast hard adaptation measures are adopted that protect primarily human infrastructures, flooding may be displaced to other river sectors and cause harm to species and habitats. Sound integrated and location-specific planning of climate adaptation measures is needed that fully considers potential negative side-effects on and co-benefits for biodiversity. In cases where (new) hydro dams control flooding (be it under a flood control adaptation or a renewable energy target agenda), immediate negative impacts of floods on biodiversity (and human infrastructure) may be reduced; these benefits are however easily offset by the more fundamental negative impacts of hydro dams on environmental flows and biodiversity
A2.5.2 ACTION: **Ensure Flood risk management plans for each river basin optimise benefits for biodiversity** through, in particular, allowing necessary freshwater input to wetland and floodplain habitats, and creating where possible and appropriate additional wetland and floodplain habitats which enhance capacity for flood water retention [by 2015].	See under Action Point A2.5.1	See under Action Point A2.5.1 Ecosystem-based climate change adaptation measures provide significant opportunities to optimise benefits for biodiversity.
OBJECTIVE 3: TO CONSERVE AND RESTORE BIODIVERSITY AND ECOSYSTEM SERVICES IN THE WIDER EU MARINE ENVIRONMENT.		
HEADLINE TARGET: In wider marine environment (outside Natura 2000 network), biodiversity loss halted by 2010 and showing substantial recovery by 2013.		
A3.1 TARGET 3.1: Substantial progress achieved by 2010 and again by 2013 towards 'good environmental status' of the marine environment.		
A3.1.1 ACTION: Make **initial assessments, determine 'good environmental status'**, and **establish environmental targets** for each Marine Region in line within the timetable specified in the proposed Marine Strategy Directive [2006 onwards].	The establishment of environmental targets becomes more complicated as these must integrate and address the anticipated direct impacts of climate change	The establishment of environmental targets becomes more complicated as these must integrate and address the potential impacts and opportunities resulting from climate change mitigation and adaptation measures.
A3.1.2 ACTION: Develop **programmes of measures** designed to achieve good environmental status in each Marine Region [by 2016 at latest, earlier where possible].	The development of programmes of measures becomes more complicated as these must integrate and address the anticipated direct impacts of climate change.	The development of programmes of measures becomes more complicated as these must integrate and address the potential impacts and opportunities resulting from climate change mitigation and adaptation measures.

BAP Objectives, Targets and Actions	Direct impacts of climate change	Indirect impacts of climate change (from mitigation and adaptation measures, others)
A3.1.3 ACTION: Ensure key biodiversity and ecosystem provisions of the Thematic Strategy for the Marine Environment are assured in the forthcoming Green Paper on a Future **Maritime Policy** for the Union and any consequent policy.	Policies resulting from the 2006 Green Paper on a Future Maritime Policy must better integrate and address the direct and indirect impacts of climate change on biodiversity and ecosystems. Changes in shipping routes, marine and offshore energy infrastructures, rising seas levels and changing coast lines, to mention but a few consequences, are prone to ask for new tools and approaches to ensure the impacts on biodiversity are mitigated and opportunities utilised. However, a focus on climate change mitigation and adaptation priorities in the different sectors covered by EU Maritime Policy may lead to biodiversity and ecosystems receiving less attention.	
A3.1.4 ACTION: Ensure timely implementation of the **Water Framework Directive** as it applies to coastal areas [2006 onwards].	None	On the negative side, a new and greater focus on climate change mitigation and adaptation priorities may lead to reduced funding and to environmental considerations receiving less attention. This holds true also for WFD elements relevant to coastal waters; implementation may therefore be delayed or weakened. On the positive side, implementation may be strengthened where synergies exist between WFD requirements and adaptation as well as mitigation needs. See under Action Points A2.4.3 and A2.4.4 for potential indirect effects of climate change on pollution from agriculture and other land-based sources, as this is key to coastal water quality.
A3.1.5 ACTION: Ensure timely implementation and review of the EU **Integrated Coastal Zone Management Recommendation** [2006 onwards].	Given that the ICZM Recommendation was adopted back in 2002, future reviews and consequent policies should integrate and address direct climate change impacts to a stronger degree.	Reduced funding availability may delay or weaken implementation of the ICZM Recommendation. Climate change mitigation and adaptation needs and schemes may not be aligned with the ICZM Recommendation and/or specific ICZM projects/programmes; e.g. where rising sea levels require coastal protection measures these may affect ICZM zoning or management. But ultimately, indirect and direct effects of climate change ask precisely for ICZM to be applied in a comprehensive and rigorous manner, to afford each sector the necessary spaces in a strategic manner that respects environmental sustainability.
A3.2 TARGET: Principal pollutant pressures on marine biodiversity substantially reduced by 2010, and again by 2013.		
A3.2.1 ACTION: Significantly **reduce point source pollutant pressures on marine ecosystems** through strengthening implementation of relevant Directives, notably on Integrated Pollution Prevention and Control, Large Combustion Plants, Waste Incineration, Urban Waste Water Treatment [2006 onwards] (*cf Action 2.3.1*)	See under Action Point A2.4.1	See under Action Point A2.4.1
A3.2.2 ACTION: Significantly **reduce airborne eutrophicating and acidifying pollution of marine ecosystems** in line with Thematic Strategy on Air Quality [2006 onwards]; revise National Emissions Ceiling Directive [by 2007]. (*cf Action 2.3.2*)	See under Action Point A2.4.2	See under Action Point A2.4.2

BAP Objectives, Targets and Actions	Direct impacts of climate change	Indirect impacts of climate change (from mitigation and adaptation measures, others)
A3.2.3 ACTION: Significantly **reduce pollution of marine ecosystems from agricultural sources** (pesticides, nitrates) through measures in line with Thematic Strategy on the Sustainable Use of Pesticides, pesticides and biocides legislation, Nitrates Directive [2006 onwards]. (*cf Action 2.3.3*)	See under Action Point A2.4.3	See under Action Point A2.4.3
A3.2.4 ACTION: Significantly reduce current exposure, and limit future exposure, of marine ecosystems to **toxic chemicals** through measures in line with EU chemicals legislation [2006 onwards]. (*cf Action 2.3.4*)	See under Action Point A2.4.4	See under Action Point A2.4.4
A3.3 TARGET: Ecosystem approach to the protection of the seas in place and implying fisheries management measures no later than 2016.		
A3.3.1 ACTION: Introduce the **fisheries management measures** required in the Regional Marine Strategies adopted by Member States in line with the requirements of the Marine Strategy Directive [by 2017].	Fisheries will be substantially affected by the direct effects of climate change. While overall productivity in EU waters may increase, some stocks and their exploitation will be displaced, potentially jeopardising traditional artisanal and coastal fisheries. The consequences of climate change on fish stocks will need to be considered and integrated in fisheries management. However, in view of the uncertainty of these changes, the introduction of some fisheries management measures required under the RMS & MSD may be delayed or weakened; except where new research provides a solid foundation in order to avoid maladaptive measures. Changes in fish species distribution resulting from climate change may complicate the application of fisheries regulations, for instance if species occur in new areas where restrictions do not apply. The fishing industry is prone to exploit any such loopholes.	The inevitable adaptation of the fisheries sector to climate change (e.g. as regards boats, gear, techniques, targeted species, and fishing areas) is prone to require a substantial amount of public funding. Any resulting funding shortages, but also the uncertainty caused by changes in fish stock abundance and distribution, may lead authorities and fishermen to consider the introduction of fisheries management measures a low priority issue. New field research and modelling will be required to inform the planning of climate change adaptation measures in the fisheries sector, for them to be consistent with the management measures required to make fisheries more sustainable. Large-scale offshore wind energy developments may potentially create safe havens for fish stocks where they reduce fishing efforts, whether by legal regulation or incompatible use (e.g. dredging is not allowed near wind turbines to preclude damage to cables), thus inadvertently supporting the recovery of selected fish stocks and habitats.
A3.4 TARGET: Substantially enhanced funding provided to environmentally-friendly fisheries management from 2007 onwards.		
A3.4.1 ACTION: Apply new **European Fisheries Fund and Member State funds** for actions beneficial to marine biodiversity [2007 onwards]. (*cf Action B1.1.3*)	None	Increased funding needs for climate change action (mitigation and adaptation measures, related capacity building; including in the fisheries sector) might lead to a significant reduction in financial resources for direct biodiversity protection in EU MSs; resources available to actions benefiting marine biodiversity under new EU and MS fisheries funds may therefore be smaller than expected and necessary.
A3.5 TARGET: Stock levels maintained or restored to levels that can produce maximum sustainable yield, where possible no later than 2015.		

BAP Objectives, Targets and Actions	Direct impacts of climate change	Indirect impacts of climate change (from mitigation and adaptation measures, others)
A3.5.1 ACTION: Prepare **plan of action to attain maximum sustainable yield**, prepare and implement **stock recovery plans** as soon as needed for any stocks outside safe biological limits, and **management plans** to maintain other stocks at safe biological levels. [2006 onwards]	See also Action Point A3.3.1 Given that climate change will impact fish stocks in a not entirely predictable manner, it will be more difficult to determine MSY and prepare stock recovery or management plans, possibly causing delays and/or inaccurate if not maladaptive recommendations. In this context it is worth mentioning that marine resources management now asks for other tools, as MSY is not any longer considered the most suitable fisheries management goal to maintain sustainable fisheries and marine ecosystems.	Increased funding needs for climate change action (mitigation and adaptation measures, related capacity building; including in the fisheries sector) might lead to a significant reduction in financial means allocated to the management of natural resources in EU MSs. Any resulting funding shortages, but also the uncertainty caused by changes in fish stock abundance and distribution, may lead authorities and fishermen to consider the establishment of MSY and the implementation of stock recovery and management plans a low priority issue. Large-scale offshore wind energy developments may potentially create safe havens for fish stocks where they reduce fishing efforts, whether by legal regulation or incompatible use (e.g. dredging is not allowed near wind turbines to preclude damage to cables), thus inadvertently supporting the recovery of selected fish stocks and habitats. New field research and modelling will be required to inform the planning of climate change adaptation measures in the fisheries sector, for them to be consistent with the management measures required to make fisheries more sustainable.
A3.5.2 ACTION: Develop, adopt and implement **restoration programmes for diadromous species** (eg. trout, salmon, sturgeon). [2006 onwards]	Climate change is prone to directly impact diadromous species in various ways: it may lead to shifts in breeding rivers where climatic and aquatic conditions become unsuitable; seasonal shifts in upstream and downward migration. However, given that climate change impacts on these species will not be entirely predictable, it may in some cases be more difficult to determine restoration programmes, possibly causing delays and/or inaccurate if not maladaptive recommendations.	While the Water Framework Directive with its target to improve the environmental status of waters in the EU can be expected to significantly improve the outlook for the EU's diadromous species, the opposite may hold true for the Renewable Energy Sources Directive, most importantly where/if mandatory renewable energy targets will lead to an increase of hydro power infrastructures in the EU's rivers inhibiting the migration of diadromous species. And yet again, funding shortages may result from climate funding needs.
A3.5.3 ACTION: **Adjust fishing capacity** to improve balance between fishing capacity and available fish stocks. [2006 onwards]	See under Action Point A3.3.1	See under Action Point A3.3.1
A3.5.4 ACTION: Adopt and implement provisions under CFP for the wider establishment of **no-take zones**.	See under Action Point A3.3.1	See under Action Point A3.3.1
A3.5.5 ACTION: Take concerted EU action to **combat illegal, unreported and unregulated fishing**. [2006 onwards]	Changes in fish species distribution and populations resulting from climate change may potentially confound the boundaries between legal/reported/regulated and IUU fishing.	See under Action Point A3.3.1 New field research and modelling will be required to inform the regulation of fisheries into the future.
A3.6 TARGET: Impact of fisheries on non-target species and habitats progressively and substantially reduced from 2006 onwards.		

BAP Objectives, Targets and Actions	Direct impacts of climate change	Indirect impacts of climate change (from mitigation and adaptation measures, others)
A3.6.1 ACTION: Implement **technical measures** to help ensure favourable conservation status of marine species and habitats which are not commercially exploited, aimed at the reduction of unwanted by-catch and of damage to the benthos. [2006 onwards]	Unexploited benthic habitats may be affected by increasing sea-levels and changes of water parameters (tidal hub, temperature, salinity, density) which may require that technical measures aimed at improving their conservation status may need to be adapted. The regulation of by-catch may be impacted if changes in fish distribution resulting from climate change render currently envisaged technical measures avoiding by-catch unsuitable.	The inevitable adaptation of the fisheries sector to climate change (e.g. as regards boats, gear, techniques, targeted species, and fishing areas) may lead to new and unexpected by-catch challenges and benthic habitat impacts. New field research, modelling and monitoring will be required to inform these technical measures. Large-scale offshore wind energy developments may potentially create safe havens for fish stocks and benthic habitats where they reduce fishing efforts and other seascape use, whether by legal regulation or incompatible use (e.g. dredging is not allowed near wind turbines to preclude damage to cables), thus inadvertently supporting the recovery of selected fish stocks and habitats.
A3.6.2 ACTION: Adopt **Community Plans of Action for the conservation of sharks and seabirds** and implement progressively thereafter.	See under Action Point A3.3.1	See under Action Point A3.3.1
A3.6.3 ACTION: Identify, define, adopt and **enforce fisheries measures required for Natura 2000 sites** in the marine environment. [by date of designation]	See under Action Point A3.3.1	Increased funding needs for climate change action (mitigation and adaptation measures, related capacity building; including in the fisheries sector) might lead to a significant reduction in financial resources for environmental protection in EU MSs, thus also affecting the funding available for the identification, definition, adoption and enforcement of fisheries measures in the Natura 2000 network. Large-scale offshore wind energy developments may potentially create safe havens for fish stocks and benthic habitats where they reduce fishing efforts and other seascape use, whether by legal regulation or incompatible use (e.g. dredging is not allowed near wind turbines to preclude damage to cables), thus inadvertently supporting the recovery of selected fish stocks and habitats. It remains an open and valid question (that could not be resolved by an expert workshop on offshore wind energy & biodiversity at IUCN in October 2009) whether such large scale offshore energy developments could (at least in some cases) be combined and overlapped with marine Natura 2000 sites in order to create synergies and combine management effectiveness; or whether any such suggestions should be discouraged from the start. A study with a comprehensive SWOT analysis is recommended on this issue given the potentially significant opportunities provided by the large scale of the expected offshore wind energy developments.

BAP Objectives, Targets and Actions	Direct impacts of climate change	Indirect impacts of climate change (from mitigation and adaptation measures, others)
A3.6.4 ACTION: Ensure adequate treatment of biodiversity concerns in all cases where **environmental impact assessment or strategic environmental assessment** is required in relation to fisheries or aquaculture, and ensure authorisation process and subsequent implementation take due account of EIA and SEA findings in order to prevent negative impacts on biodiversity or, where prevention is not possible, minimise, mitigate and/or compensate for these negative impacts [2006 onwards].	Climate change will almost certainly affect the distribution of both fisheries and aquaculture (species, infrastructures) in the EU. Authorities overseeing related EIAs and SEAs in new areas will hence potentially not be familiar with and overlook the related impacts on biodiversity. Climate change impacts on biodiversity will require that established standard EIA & SEA procedures for fisheries and aquaculture be revised to accommodate expected changes. For instance, if a strictly protected species becomes newly established in an area used for a particular type of aquaculture, the biodiversity impacts may be increased; such concerns should be reflected in the adapted/revised EIA/SEA.	The inevitable adaptation of the fisheries and aquaculture sector to climate change (e.g. as regards boats, gear, techniques, targeted species and areas) is prone to require a substantial amount of public funding. Any resulting funding shortages, but also the uncertainty of climate change impacts, may lead authorities and fishermen to consider biodiversity a low priority issue.
A3.7 TARGET: Substantially improved information and reporting on environmental integration of the Common Fisheries Policy from 2008 onwards.		
A3.7.1 ACTION: Make **periodic assessments** [2006 onwards] of the progress of the Common Fisheries Policy in incorporating environmental protection requirements (with particular reference to biodiversity).	Delays may be incurred where climate change considerations must be integrated in environmental protection & biodiversity requirements under the CFP; and the periodic assessments may therefore also become more complicated.	Delays and complications may be incurred if the CFP pays great attention to adapting the EU's fisheries sector to climate change, and not so much on environmental protection. Also, the inevitable gradual adaptation of the fisheries sector to climate change (e.g. as regards boats, gear, techniques, targeted species, and fishing areas) will complicate the assessment of progress.
OBJECTIVE 4: TO REINFORCE COMPATABILITY OF REGIONAL AND TERRITORAL DEVELOPMENT WITH BIODIVERSITY IN THE EU.		
HEADLINE TARGET: Regional and territorial development benefiting biodiversity, and negative impacts on biodiversity prevented and minimised or, where unavoidable, adequately compensated for, from 2006 onwards.		
A4.1 TARGET: Cohesion and structural funds contributing to sustainable development and making (directly or indirectly) a positive contribution to biodiversity, and negative impacts on biodiversity prevented or minimised or, where unavoidable, adequately compensated for, from 2006 onwards.		
A4.1.1 ACTION: Allocate, at MS initiative, **cohesion and structural funds for projects directly or indirectly benefiting biodiversity** in appropriate operational programmes [2006 onwards]. (*cf Action B1.1.4*)	None. Such funding could and should also support measures helping biodiversity adapt to climate change.	Increased funding needs for climate change action (mitigation and adaptation measures, related capacity building) might lead to a significant reduction in financial resources for environmental protection in EU MSs; this is prone to apply also to biodiversity funding from structural and cohesion funds. On the positive side, where ecosystem-based adaptation and mitigation activities are promoted and funded through cohesion and structural funds, significant opportunities may exist for biodiversity to benefit indirectly from additional funding streams earmarked for climate change action. On the climate change mitigation side, funding for AFOLU (Agriculture, Forestry and Other Land Uses) measures are particularly relevant; any such measures providing biodiversity co-benefits should be given priority.

BAP Objectives, Targets and Actions	Direct impacts of climate change	Indirect impacts of climate change (from mitigation and adaptation measures, others)
A4.1.2 ACTION: **ESF contributing to biodiversity objectives** through awareness-raising, capacity building, employment of the young, long-term jobless and elderly, etc. [2007 onwards] (*cf Action B1.1.5*)	None	ESF measures may prioritise climate change issues (especially mitigation and adaptation) given that these are currently perceived as the key environmental threat. However if biodiversity were integrated in ESF measures as the 2nd priority issue, synergies could be created that elevate the consideration of biodiversity
A4.1.3 ACTION: Ensure **National Strategic Reference Frameworks (NRSFs) and Operational Programmes 2007-2013 fully respect environmental acquis** [2006 onwards]	None	NSRFs and Operational Programmes may prioritise climate change issues (especially mitigation and adaptation) given that these are currently perceived as the key environmental threat. However if biodiversity were integrated as the 2nd priority issue, synergies could be created that elevate the consideration of biodiversity
A4.1.4 ACTION: Ensure **strategic environmental assessment (SEA) of Operational Programmes** [2006 onwards] gives adequate treatment to biodiversity concerns and that the final programmes take full account of the SEA findings in order to prevent, minimise and mitigate impacts on biodiversity and provide where possible benefits to biodiversity. (*cf Action A1.1.4*)	SEAs of Operational Programmes (as well as the integration of biodiversity in such SEAs) may become more complicated as these must integrate and address the anticipated direct impacts of climate change; the definition of appropriate prevention, mitigation and compensation measures may also become more complicated. The reason for this may be both incomplete science and the lack of climate change capacity in SEA issuing agencies.	SEAs and Operational Programmes may prioritise climate change issues (especially mitigation and adaptation) given that these are currently perceived as the key environmental threat, such that biodiversity concerns may receive less attention.
A4.1.5 ACTION: Ensure **environmental impact assessment (EIA) of projects co-financed by Cohesion Fund and European Regional Development Fund (ERDF)**, where such EIA is required, gives adequate treatment to biodiversity concerns and that final projects take full account of EIA findings in order to prevent, minimise and mitigate impacts on biodiversity and provide where possible benefits to biodiversity [2006 onwards]. (*cf Action A1.1.4*)	EIAs of projects co-financed by Cohesion Fund and ERDF may become more complicated as these must integrate and address the anticipated direct impacts of climate change; the definition of appropriate prevention, mitigation and compensation measures may also become more complicated. The reason for this may be both incomplete science and the lack of climate change capacity in EIA issuing agencies.	Cohesion Fund and ERDF may prioritise climate change issues (especially mitigation and adaptation) given that these are currently perceived as the key environmental threat, such that biodiversity concerns may receive less attention.
A4.1.6 ACTION: Ensure full **participation of civil society** in development of NSRF and national Operational Programmes and in SEA/EIA and ensure biodiversity interests fully represented [2006 onwards].	Climate change should not lead to a reduced participation of civil society in the development of NSRF and national Operational Programmes and related EIAs/SEAs. However many civil society organisations, particularly of local nature, will not have the capacity to adequately follow and understand the implications of the direct and indirect impacts of climate change; these civil society organisations may therefore not always be in the position to identify and support the most appropriate actions in the case of biodiversity-relevant decisions (e.g. on bioenergy crops, wind power infrastructures, specific species recovery activities, etc.).	
A4.2 TARGET: Negative impacts of territorial plans (within each MS) on biodiversity prevented or minimised, and positive benefits optimised, from 2006 onwards.		

BAP Objectives, Targets and Actions	Direct impacts of climate change	Indirect impacts of climate change (from mitigation and adaptation measures, others)
A4.2.1 ACTION: Ensure that all **those territorial plans subject to strategic environmental assessment** (SEA) (where deemed applicable by Member States under the SEA Directive) do not cause significant negative impacts on biodiversity (direct, indirect, cumulative) [2006 onwards].	Territorial planning may become more complicated as they and the related SEAs must integrate and address the anticipated direct impacts of climate change.	Territorial plans and related SEAs may prioritise climate change issues (especially mitigation and adaptation) given that these are currently perceived as the key environmental threat, such that biodiversity concerns may receive less attention.
A4.2.2 ACTION: Implement policies and measures in line with Thematic Strategy for Urban Environment to **prevent urban sprawl** [2006 onwards].	Some human infrastructures and cities in the EU MS, particularly along coasts, rivers and near mountains, may require additional protection if not relocation because of exposure to rising sea levels and/or increased disaster risk. Urban development can therefore be expected to expand into new areas.	The adaptation of human settlements to climate change, especially where the current building standards are most outdated (dense agglomerations of buildings with little green spaces and air exchange, poor insulation, etc.), may potentially lead to new urban sprawl. Climate change considerations should therefore be integrated in the Thematic Strategy for Urban Environment, seeking solutions that limit impacts on the natural environment and biodiversity.
A4.3 TARGET: Ecological coherence and functioning strengthened through spatial planning from 2006 onwards.		
A4.3.1 ACTION: Develop and implement **spatial and programmatic plans** that support the coherence of the Natura 2000 network (in line with the requirements of the nature directives to ensure such coherence) and maintain and/or restore the ecological quality of wider landscape [2006 onwards] (*cf Action B2.5.1*)	This is a key Action Point as regards the adaptation of EU biodiversity to climate change. Spatial and programmatic planning supporting the Natura 2000 network and the ecological quality of the wider landscape (marine and terrestrial) must integrate climate change considerations, and should be appropriately informed (looking at ecological evidence, effectiveness, cost-benefit analyses, feasibility, etc.). This could lead to delays. The present study (especially this Task 2b&3b Report) and similar related work (see Task 1 Report, Section 1.2) provide some guidance in this regard.	Spatial and programmatic planning will be a key tool to ensure that climate mitigation and adaptation measures (across all sectors such as agriculture, transport, energy, health, forestry, water, fisheries, etc.) adequately consider other land use requirements and biodiversity. The fact that the EU institutions have no competence in spatial planning is a reason for concern, because all climate mitigation and adaptation measures should be assessed in an integrated manner in an international or inter-regional context; local or regional development interests and a lack of capacity on climate change and biodiversity may potentially undermine such integrated planning.
A4.4 TARGET: Significant increase in proportion of tourism which is ecologically sustainable by 2010 and again by 2013.		
A4.4.1 CBD Guidelines on Sustainable Tourism promoted, adopted and implemented as appropriate by key stakeholders [2006 onwards].	The direct and indirect effects of climate change will alter the seasonal and annual flow of tourists in the EU, with some regions loosing and others benefitting. The resulting pattern is complex and will in some regions support, and in others undermine, the adoption of sustainable tourism guidelines; moreover, the resulting secondary effects on biodiversity are complex and hard to predict. For instance, in the context of climate change mitigation measures, remoter destinations (especially the biodiversity-rich EU Overseas Entities) may suffer from an increased cost of long-distance flights. This will have knock-on effects: where tourism declines, increased competition may reduce opportunities to introduce sustainability considerations; and new resource exploitation pressures may arise with potentially negative impacts on biodiversity. The introduction of new tourism destinations or activities in various regions of Europe may offer opportunities to integrate sustainability and biodiversity considerations from the start. However, whether such opportunities are realised is hard to predict; an example from the Caribbean shows the contrary: with the U.S. tourists looking at destinations closer to their country, a housing boom has been taking place in several Caribbean islands that severely undermines environmental sustainability.	

BAP Objectives, Targets and Actions	Direct impacts of climate change	Indirect impacts of climate change (from mitigation and adaptation measures, others)
A4.5 TARGET: All above outcomes achieved also in Outermost Regions.		
A4.5.1 ACTION: All above actions applied, as appropriate, in **Outermost Regions** (French Guyana, Guadeloupe, Reunion, Matinique, Canaries, Azores, Madeira) [2006 onwards].	The 28 EU Overseas Entities including the 7 Outermost Regions (see IUCN, 2008, and www.reunion2008.eu/pages/en/en-conf-outre-mer.html), harbour the EU's most important biodiversity but are expected to be amongst the worst hit by climate change in the EU. Moreover, they are prone to suffer severely from reduced funding given that their economies are very vulnerable with their dependence on only few sectors such as tourism. However, the components of this biodiversity, the related ecology and the precise climate change impacts are even less studied or surveyed than in the EU mainland (but see IUCN, 2008, at www.reunion2008.eu/pages/en/en-publication.html). Therefore, appropriate specific funding for biodiversity research, biodiversity conservation, biodiversity adaptation and ecosystem-based adaptation and mitigation measures should be allocated to the EU Overseas Entities (Outermost Regions ORs and Overseas Countries and Territories OCTs), via the relevant EU & MS funding mechanisms. Several of the above BAP Action Points related to Natura 2000 cannot be fully implemented as long as no corresponding appropriate legal framework exists in the French ORs. The concerned EU MS and the EC are currently developing a voluntary Natura 2000-like scheme for these ORs (and for interested OCTs); this scheme should from the start integrate climate change considerations and provide funding to an appropriate height. See also under Action Point A7.2.5 in this context	
A4.6 TARGET: All Strategic Environmental Assessments and Environmental Impact Assessments have taken full account of biodiversity concerns (2006 onwards).		
A4.6.1 ACTION: Ensure effective treatment of biodiversity in all **Strategic Environmental Assessment (SEA) of programmes and plans, where such SEA is required**, including by promotion of best practice through the development of guidelines, recognition of good performance) – and ensure that full account is taken of the findings of the assessment (in terms of impacts on biodiversity) in the final programmes or plans [2006 onwards]. (*cf Action A1.1.4*)	The integration of biodiversity in SEAs of programmes and plans may become more complicated as these must integrate and address the anticipated direct impacts of climate change. The reason for this may be both incomplete science and the lack of climate change capacity in SEA issuing agencies.	SEAs and programmes and plans may prioritise climate change issues (especially mitigation and adaptation) given that these are currently perceived as the key environmental threat, such that biodiversity concerns may receive less attention.
A4.6.2 ACTION: Ensure effective treatment of biodiversity in all **Environmental Impact Assessment (EIA) of projects, where such EIA is required**, including by promotion of best practice through the development of guidelines, recognition of good performance) - and ensure that full account is taken of the findings of the assessment (in terms of impacts on biodiversity) in the authorisation procedure [2006 onwards]. (*cf Action A1.1.4*)	The integration of biodiversity in project EIAs may become more complicated as these may need to integrate and address the anticipated direct impacts of climate change. The reason for this may be both incomplete science and the lack of climate change capacity in EIA issuing agencies.	EIA and projects may prioritise climate change issues (especially mitigation and adaptation) given that these are currently perceived as the key environmental threat, such that biodiversity concerns may receive less attention.

BAP Objectives, Targets and Actions	Direct impacts of climate change	Indirect impacts of climate change (from mitigation and adaptation measures, others)
A4.6.3 ACTION: Ensure all new **Trans-European Networks** provide for environmental assessment and take full account of biodiversity impacts in the design and authorisation process in the framework of the existing EU legislation [2006 onwards]. (*cf Action A1.1.4*)	See under Action Point 4.6.3	TEN EIAs may prioritise climate change issues (especially mitigation and adaptation) given that these are currently perceived as the key environmental threat, such that biodiversity concerns may receive less attention. Under a climate change mitigation agenda there is a small opportunity that new transport systems evolve over the medium term that rely less on roads, which are responsible for much of the fragmentation and biodiversity impacts in the EU. If these are however replaced by river traffic requiring river modification and straightening the biodiversity impacts may be even greater, particularly given that freshwater habitats are the most threatened in the EU.
A4.6.4 ACTION: Take stock of effectiveness of EIA and SEA in preventing and minimising negative impacts and improving positive impacts of developments on biodiversity and consider necessary measures to improve EIA and SEA performance in this respect [by 2009]. (cf Action A1.1.4)	The integration of biodiversity in EIAs and SEAs may become more complicated as these must integrate and address the anticipated direct impacts of climate change.	Assessment of EIA/SEA effectiveness for biodiversity may be delayed, weakened or impeded if climate change mitigation and adaptation actions are given the priority over biodiversity.
OBJECTIVE 5: TO SUBSTANTIALLY REDUCE THE IMPACT ON EU BIODIVERSITY OF INVASIVE ALIEN SPECIES (IAS) & ALIEN GENOTYPES.		
HEADLINE TARGET: Negative impacts on EU biodiversity of IAS and alien genotypes prevented or minimised from 2010 onwards.		
A5.1 TARGET: Impact of IAS on biodiversity in the EU substantially reduced by 2010 and again by 2013.		
A5.1.1 ACTION: **Assess, at EU level, gaps in the current legal, policy and economic framework** to prevent, control and eradicate IAS and mitigate their impacts on biodiversity and **develop a community strategy to address IAS including, where necessary and appropriate, measures to fill gaps** [by 2007].	Delays may be incurred given that the overall concept of IAS needs to be revisited to accommodate climate change effects such as species adaptation. In addition to preventing, controlling and eradicating known IAS threats, intense monitoring will become necessary of already established species of fauna and flora that are not yet invasive but may become so under a changing climate (such as grass species common in gardening in the EU, Vernon Heywood, pers. comm. to Y. de Soye 2009)	Climate change adaptation and mitigation measures may be the source of new threats and opportunities for a legal, policy and economic framework for IAS; for instance, the introduction of new agricultural crops adapted to climate change, or the production of bioenergy feedstock using potentially invasive species.
A5.1.2 ACTION: Encourage Member States to develop **national strategies on invasive alien species** [by 2007] and to implement them fully [by 2010].	Delays may be incurred due to funding constraints and given that national IAS strategies need to accommodate the direct and indirect effects of climate change.	
A5.1.3 ACTION: Encourage ratification and implementation by Member States of the International Convention for the **Control and Management of Ship's Ballast Water and Sediments** under the International Maritime Organisation [2006 onwards].	The changes in climate and the increased IAS threat ask for a rapid ratification. However, the IMO Convention might need updating for it to consider climate change impacts.	None, except that the adaptation of shipping fleets, cargo and routes under a changing climate (e.g. via the soon ice-free Arctic Ocean) may need to be reflected in the said Convention, as it may possibly affect the ballast water carried by ships and the measures laid down in the Convention.

BAP Objectives, Targets and Actions	Direct impacts of climate change	Indirect impacts of climate change (from mitigation and adaptation measures, others)
A5.1.4 ACTION: **Establish early warning system** for the prompt exchange of information between neighbouring countries on the emergence of IAS and cooperation on control measures across national boundaries [by 2008].	None	None except for potential financial constraints resulting from increased funding needs for climate change action (mitigation and adaptation measures, related capacity building).
A5.2 TARGET: Impact of alien genotypes on biodiversity in the EU significantly reduced by 2010 and again by 2013.		
A5.2.1 ACTION: **Fully apply the Cartagena Protocol on Biosafety** to ensure an adequate level of protection of biodiversity (and human health) in the field of the safe handling, use and transfer of genetically modified organisms [2006 onwards].	None	Climate change adaptation measures in several sectors (especially agriculture; possibly forestry, health, and others) are prone to lead to requests for an increased use of GM organisms; adequate tests and biodiversity safeguards are required.
A5.2.2 ACTION: Ensure protection of biodiversity as part of measures to protect human health and environment in relation to the **deliberate release into the environment of Genetically Modified Organisms** (GMOs) [2006 onwards].	None	See under Action Point A.5.2.1
OBJECTIVE 6: TO SUBSTANTIALLY STRENGTHEN EFFECTIVENESS OF INTERNATIONAL GOVERNANCE FOR BIODIVERSITY AND ECOSYSTEM SERVICES.		
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A6.1 TARGET: International governance for biodiversity substantially more effective in delivering positive biodiversity outcomes by 2010.		
A6.1.1 ACTION: Press for **effective worldwide implementation of the Convention on Biological Diversity**, decisions of the Conference of the Parties including thematic and cross-cutting programmes of work, and other related international and regional biodiversity agreements (eg. Bonn, Berne, AEWA, Ramsar, UN Fish Stocks Agreement) and promote greater synergies between these [2006 onwards].	None	Implementation of this Action might be delayed or weakened, because (a) of potential financial constraints resulting from increased funding needs for climate change action (mitigation and adaptation measures, related capacity building); and (b) governments may prioritise climate change actions (especially mitigation and adaptation), such that biodiversity concerns may receive less attention.
A6.1.2 ACTION: Enhance **integration of biodiversity into global processes** with important impacts on biodiversity such as sustainable development and the Millenium Development Goals, trade and climate change [2006 onwards].	None	Implementation of this Action might be delayed, weakened or impeded, because governments may prioritise climate change actions (especially mitigation and adaptation), such that biodiversity concerns may receive less attention.
A6.1.3 ACTION: Promote **improved oceans governance** for conservation and recovery of marine biodiversity, ecosystem services and integration of key sectors, including in relation to areas beyond national jurisdiction; make progress towards mechanisms for establishment of Marine Protected Areas in the high seas, including by supporting the adoption of an Implementing Agreement to the UN Convention of the Law of the Sea, with the scientific support from the CBD, notably in developing criteria for identifying the areas to be protected. [2006 onwards]	The development of mechanisms and identification criteria for MPA establishment could be delayed as they need to accommodate and address direct climate change effects. Changes in sea levels and coastlines, as well as in ice cover (at least in the Arctic) may lead to conflicts regarding territorial sovereignty, which in turn may delay, weaken or impede the designation of MPAs and/or jeopardise specific agreements on oceans governance, in the areas of concern.	None

BAP Objectives, Targets and Actions	Direct impacts of climate change	Indirect impacts of climate change (from mitigation and adaptation measures, others)
OBJECTIVE 7: TO SUBSTANTIALLY STRENGTHEN SUPPORT FOR BIODIVERSITY AND ECOSYSTEM SERVICES IN EU EXTERNAL ASSISTANCE.		
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A7.1 TARGET: Financial resources flowing annually to projects directly benefiting biodiversity has substantially increased in real terms (for period 2006-2010 compared with period 2000-2005; and again for period 2011-2013).		
A7.1.1 ACTION: **Ensure adequate community funds earmarked for biodiversity** in development cooperation (in line with European Consensus on Development Cooperation) in EC Thematic Programme for Environment and Natural Resources and ensure the use of these funds is targeted at biodiversity priorities [2007-2013]; decide [in 2006] on an adequately funded EC Thematic Programme for Environment and Natural Resources (ENRTP) in the European Neighbourhood and Partnership Instrument (ENPI) and the Development Cooperation and Economic Cooperation Instrument (DCECI) and ensure that biodiversity priorities receive an appropriate share of the total ENRTP and DCECI resources [2007-2013].	None	Implementation of this Action might be weakened, because (a) of potential financial constraints resulting from increased funding needs for climate change action (mitigation and adaptation measures, related capacity building) both in the EU and paid to ODA-receiving countries; and (b) governments may prioritise climate change actions (especially mitigation and adaptation), such that biodiversity concerns may receive less attention.
A7.1.2 ACTION: Allocate adequate resources in **Country and Regional Strategy Programmes** wherever biodiversity identified as a key issue in country/regional environmental profiles [2006 onwards].	None	See under Action Point A7.1.1
A7.1.3 ACTION: **Enhance MS funds earmarked for biodiversity** (in line with European Consensus on Development Cooperation) in MS bilateral development cooperation programmes in support of implementation of the CBD, Millenium Development Goals and other programmes relevant for biodiversity in developing countries [2006 onwards].	None	See under Action Point A7.1.1
A7.1.4 ACTION: **Enhance the overall contribution of EU MS for biodiversity through a substantial 4th replenishment of the GEF** based on the agreed policy priorities [2006/07].	None	See under Action Point A7.1.1
A7.1.5 ACTION: Enhance funds for biodiversity related actions under the **national and regional components of the Instrument for Pre-Accession (IPA) and the European Neighbourhood and Partnership Instrument (ENPI).**	None	See under Action Point A7.1.1
A7.1.6 ACTION: Enhance economic and development assistance funds available for biodiversity-related actions in the MS' **Overseas Countries and Territories** [2006 onwards] .	None	See under Action Point A7.1.1
A7.2 TARGET: EU 'mainstream' external development assistance delivering enhanced biodiversity and related livelihoods benefits, and negative impacts on biodiversity prevented or minimised, from 2006 onwards.		

BAP Objectives, Targets and Actions	Direct impacts of climate change	Indirect impacts of climate change (from mitigation and adaptation measures, others)
A7.2.1 ACTION: **Prepare country and regional environmental profiles** with specific attention to the maintenance of biodiversity and ecosystem services (in particular in relation to livelihood concerns), and take these needs fully into account in preparation of Country Strategy Papers (CSPs) and Regional Strategy Papers (RSPs) and in equivalent MS country and regional aid programming [2006 onwards].	CSPs and RSPs may prioritise climate change issues (especially mitigation and adaptation) given that these are currently perceived as the key environmental threat, such that biodiversity concerns may receive less attention. At the same time, properly planned ecosystem-based adaptation and mitigation measures may offer opportunities for biodiversity to benefit indirectly. However, the integration of biodiversity and ecosystem services in Country and Regional Profiles and in CSPs & RPS may become more complicated as these must integrate and address the anticipated direct and indirect impacts of climate change. Indeed, from conversations with the EC services it appears that the mainstreaming of climate change issues into CSPs & RSPs is still in its infancy, due to incomplete processes and partly inadequate technical capacity in the EC delegations and ODA receiving countries.	
A7.2.2 ACTION: Systematically carry out **ex-ante strategic environmental assessment (SEA) of relevant strategies and programmes and environmental impact assessment (EIA) of relevant projects** funded by EU in partner countries and ensure actions are identified and implemented to prevent and mitigate negative impacts on biodiversity in a timely manner [2006 onwards].	SEAs and EIAs may become more complicated as these must integrate and address the anticipated direct and indirect impacts of climate change; integrating biodiversity concerns in SEAs and EIAs may therefore become more complicated as well. This may be compounded by incomplete science and partly inadequate climate change capacity in SEA & EIA implementing authorities, including in the EU institutions, its delegations, in the EU MS and in EU partner countries.	
A7.2.3 ACTION: Substantially **strengthen capacities in recipient countries and in Commission and MS cooperation programming** for these purposes, including integrating implementation of the CBD into national development strategies including Poverty Reduction Strategies [2006 onwards].	Implementation of this Action might be delayed or weakened, because (a) capacity building for biodiversity will need to integrate the direct and indirect impacts of climate change as well as the risks and opportunities provided by adaptation and mitigation measures. (b) of potential financial constraints resulting from increased funding needs for climate change action (mitigation and adaptation measures, related capacity building) in the EU, EU MS and ODA-receiving countries; and (c) the EC, EU MS and ODA-receiving countries may prioritise climate change actions (especially mitigation and adaptation), such that biodiversity concerns may receive less attention.	
A7.2.4 ACTION: Ensure that **projects financed by EU under the Development Cooperation and Economic Cooperation Instrument (DCECI), European Development Fund (EDF), pre-accession, neighbourhood and partnership instruments** delivering enhanced biodiversity benefits, and negative impacts on biodiversity prevented or minimised [2006 onwards].	Implementation of this Action might be delayed or weakened, because (a) of potential financial constraints resulting from increased funding needs for climate change action (mitigation and adaptation measures, related capacity building) in the EU, EU MS and ODA-receiving countries; and (b) DCECI, EDF and the other financing mechanisms may prioritise climate change actions (especially mitigation and adaptation), such that biodiversity concerns may receive less attention.	
A7.2.5 ACTION: Ensure that projects financed by EU economic and development assistance do not cause significant negative impacts on biodiversity in the MS **Overseas Countries and Territories** [2006 onwards].	See under Action Point A7.2.4, as well as under A4.5.1	
OBJECTIVE 8: TO SUBSTANTIALLY REDUCE THE IMPACT OF INTERNATIONAL TRADE ON GLOBAL BIODIVERSITY AND ECOSYSTEM SERVICES.		
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8.1 TARGET 8.1: Impact on biodiversity of EU trade significantly reduced by 2010 and again by 2013.		

BAP Objectives, Targets and Actions	Direct impacts of climate change	Indirect impacts of climate change (from mitigation and adaptation measures, others)
A8.1.1 ACTION: **Identify major impacts of trade on third countries' and EU biodiversity and adopt measures to significantly reduce (in case of negative impacts) and/or enhance (in case of positive impacts) these impacts** [by 2010]. This will in particular be done in the context of the Commission's trade-related Sustainability Impact Assessment (SIA) Programme, that covers a number of sectoral studies (e.g. agriculture, forests and forest products as well as fisheries), in the context of multilateral (WTO, ongoing negotiations on the Doha Development Agenda) and/or regional/bilateral free trade agreements (e.g. EPAs with ACP countries).	Biodiversity-relevant aspects of the direct impacts of climate change on global trade include changed shipping routes, particularly due to a reduced ice cover in the Arctic Ocean. With regard to direct impacts on traded agricultural & forestry products and commodities: on the positive side, some temperate areas are predicted to become more productive, possibly reducing the demand for land and reducing pressures in more biodiverse tropical countries; on the negative side, one may anticipate that the loss of productivity resulting from climatic changes (e.g. by desertification in Africa and the Mediterranean, by the reduction of irrigation water resources in India and China) will cause increased conversion of natural lands for agriculture and plantation forestry.	Financial constraints potentially resulting from increased funding needs for global and national climate change action (mitigation and adaptation measures, related capacity building) may lead to biodiversity receiving less attention. A number of climate change mitigation and adaptation actions are prone to have significant impacts on global trade, with both negative and positive impacts on biodiversity. The resulting pattern is complex and difficult to predict in a quantitative manner, even more so if one considers knock-on effects. Ex ante qualitative and quantitative studies of the interface between trade, climate change and biodiversity would be highly desirable. For instance, an increase of global bioenergy feedstock production satisfying a new commodity market, will inevitably lead to direct and indirect land use changes with impacts on biodiversity (expected to be largely negative, e.g. in Indonesia). In the EU, the promotion of bioenergy crops already resulted in the loss of many set aside areas. It is worth noting in this context that WTO rules are not supportive of mandatory sustainability considerations, such as those requested under EU bioenergy legislation. REDD-based mitigation measures will benefit biodiversity in REDD countries but likely displace deforestation to other areas given that the demand for wood products is not expected to drop but to further increase over the coming decades; this may have positive impacts on global biodiversity if plantation forests are used and/or biodiversity-poorer areas are targeted (e.g. if deforestation shifts from the biodiversity-rich Colombia to the relatively biodiversity-poor Finland), but it may have negative impacts on global biodiversity if the reverse is the case (e.g. a shift from the Amazon to the Atlantic rainforest in Brazil). Moreover, even if the global balance for biodiversity is positive by such a displacement, locally important biodiversity may be negatively affected (in the above example, Finland). Also deliberate changes in the production of global agricultural and fisheries products & commodities resulting from climate change adaptation measures, will lead to biodiversity impacts, such as through an extended use of GM crops; a greater need for pest control to combat new invasive species; an expansion of the agricultural frontier; an intensified use on current arable lands; or the introduction of potentially invasive aquaculture species in new areas. Finally, under a climate change mitigation agenda, changes in livestock rearing could be required (in order to reduce methane emissions) that could in the extreme case (if large-scale open air ranching were prohibited) significantly modify global land use patterns.

BAP Objectives, Targets and Actions	Direct impacts of climate change	Indirect impacts of climate change (from mitigation and adaptation measures, others)
A8.1.2 ACTION: Foster links between the WTO agreements and biodiversity related international agreements, and ensure biodiversity taken into account as a Non-Trade Concern, in order to identify and **put in place key measures to reduce the ecological impact of globalisation** in line with the precautionary principle and with the commitment made in the context of the WTO's Doha Development Agenda to promote the objective of sustainable development (paragraph 6 of the Doha Declaration) and to enhance the mutual supportiveness of trade and environment (paragraph 31) [2006 onwards].	None	Implementation of this Action might be delayed or weakened, because (a) of potential financial constraints resulting from increased funding needs for climate change action (mitigation and adaptation measures, related capacity building); and (b) WTO parties and vested interests may consider that addressing climate change through mitigation and adaption measures is the topmost priority, even where these undermine biodiversity and sustainable development (which are still perceived as obstacles to trade and economic development, and hence, globalisation)
A8.1.3 ACTION: Promote **full implementation of the CBD Bonn Guidelines on Access to Genetic Resources and Fair and Equitable Sharing of Benefits (ABS)** arising out of their Utilisation, and other agreements relating to ABS such as the FAO International Treaty on Plant Genetic Resources for Food and Agriculture – and continue to contribute to negotiation of an international regime on ABS according to the mandate adopted at the 7th Conference of the Parties of the CBD [2006 onwards].	None	ABS, the use of genetic resources and related issues may become more important in the context of climate change adaptation measures, particularly in the agricultural sector; under the expected post-2012 climate deal (2007 Bali Action Plan) developed countries are expected to assist developing countries in their adaptation and mitigation actions including by the transfer of technology and knowledge. This additional pressure could hence bring countries to better implement ABS and FAO treaty regulations.
A8.1.4 ACTION: Maximise the proportion of EU **consumption of wood products deriving from sustainable sources** [by 2010].	Natural and plantation forests across the world, including such managed under sustainability schemes, will be impacted in various ways: On the positive side, in recent times many forests have been exhibiting improved growth, likely linked to increased CO2 concentrations and more suitable climatic conditions. However, in some if not many regions of the world this may reverse through increasing hydrological and temperature stresses, risk from fires, storms and IAS, etc.; Even if an increasing proportion of forests are managed under sustainability schemes, this may undermine the recruitment and replacement of forests and the overall sustainability of forest exploitation, at least in some regions.	REDD and LULUCF schemes may alter forest product supply chains given that many areas will be closed for exploitation, wherefore sustainability certification schemes may need to be redeployed, if not redesigned. Under a climate change mitigation agenda, appropriately designed REDD and LULUCF schemes should in particular protect natural forests; wherefore an increased planting and use of plantation forests could result, contributing to the overall sustainability of forest.

BAP Objectives, Targets and Actions	Direct impacts of climate change	Indirect impacts of climate change (from mitigation and adaptation measures, others)
A8.1.5 ACTION: In the context of action 8.1.1, **identify EU non-wood imports driving deforestation in third countries** (particularly in the context of trade related SIAs, notably on agricultural products) and adopt and implement measures to prevent, minimise and/or mitigate this deforestation [by 2010].	With regard to direct climate change impacts on EU non-wood imports driving deforestation (at the global level, these are primarily: soy, sugar cane, corn, rape seed, cattle ranching, palm oil, rubber, coffee, tea): changes in climatic patterns may lead to (a) new areas becoming suitable for cultivation leading to deforestation; (b) current cultivation areas becoming unsuitable leading to increased demand for arable land.	Yet again, importing bioenergy feedstock or finished bioliquids (from soy, sugar cane, palm oil, corn, rape seed) will inevitably lead to direct and indirect land use changes with impacts on biodiversity (the 2009 Renewable Energy Sources Directive with its sustainability criteria does not address these threats in a sufficient manner). Under a climate change mitigation agenda, changes in livestock rearing could be required (in order to reduce methane emissions) that could in the extreme case (if large-scale open air ranching were prohibited) significantly modify global land use patterns, by reducing the amounts of lands under pasture.
A8.1.6 ACTION: Put in place bilateral agreements between EU and major timber exporting countries with aim to support **forest law enforcement, governance and trade (FLEGT)** [2006 onwards].	None	FLEGT and REDD schemes are mutually supportive. Emerging REDD schemes can therefore build on successful FLEGT pilot projects, in particular when REDD schemes are fully rolled out under the expected post-2012 climate agreement; in turn FLEGT efforts will benefit from increased climate change financing to achieve better forest governance.
A8.1.7 ACTION: Ensure **Fisheries Partnership Agreements** compatible with maintenance and recovery of stocks at levels that can produce maximum sustainable yield, and with minimising impact on non-target species and habitats [2006 onwards].	Depending on the evolution of EU fish stocks under climate change [note the confounding effects of fisheries management measures cannot be considered here], increased or reduced pressure will be put on fishing grounds covered by FPAs. Where EU stocks move, decline, or collapse, fishing pressure will likely increase on areas covered by FPAs undermining sustainability considerations. The reverse will happen where EU fish stocks recover and increase due to climate change. In addition, determining MSY in areas covered by FPAs will be difficult, as climate change may also here affect fish stocks. In this context it is worth mentioning that marine resources management now asks for other tools, as MSY is not any longer considered the most suitable fisheries management goal to maintain sustainable fisheries and marine ecosystems.	Increased funding needs for climate change action (mitigation and adaptation measures, related capacity building; including in the fisheries sector) might lead to a significant reduction in financial means allocated to the management of natural resources in EU MSs. Any resulting funding shortages, but also the uncertainty caused by changes in fish stock abundance and distribution, may lead authorities and fishermen to consider the establishment of MSY and the implementation of stock recovery and management plans a low priority issue. New field research and modelling will be required to inform the planning of climate change adaptation measures in the fisheries sector, for them to be consistent with the management measures required to make fisheries more sustainable.

BAP Objectives, Targets and Actions	Direct impacts of climate change	Indirect impacts of climate change (from mitigation and adaptation measures, others)
A8.1.8 ACTION: Support capacity-building and implementation of CITES provisions to ensure that **trade in CITES species is effectively regulated and controlled** and not detrimental to the conservation of the species in range states [2006 onwards].	Climate change is prone to lead to changes in national inventories of fauna and flora, including in the population sizes of CITES species. National CITES authorities should be informed about and monitor these changes, which in the medium to long term may ask for an updating of the CITES annexes.	Implementation of this Action might be delayed or weakened because of potential financial constraints resulting from increased funding needs for climate change action (mitigation and adaptation measures, related capacity building)
A8.1.9 ACTION: Apply principle of **prior informed consent** when commercially using traditional knowledge relating to biodiversity and encourage the **equitable sharing of benefits** arising from the use of such knowledge [2006 onwards].	None	None
OBJECTIVE 9: TO SUPPORT BIODIVERSITY ADAPTATION TO CLIMATE CHANGE.		
HEADLINE TARGET: Potential for damaging impacts, related to climate change, on EU biodiversity substantially reduced by 2013.		
A9.1 TARGET: 8% reduction in greenhouse gas emissions achieved by 2010.		
A9.1.1 ACTION: **Commitments made under the Kyoto Protocol respected** [2006 onwards].	None. The EU is currently on track to meeting its Kyoto targets. However, the commitments allowed too many loopholes through carbon offsets including CDM schemes that have been criticised for not delivering the ultimately required GHG emissions reductions.	
A9.2 TARGET: Global annual mean surface temperature increase limited to not more than 2ºC above pre-industrial levels.		
A9.2.1 ACTION: **Further ambitious measures to limit temperature increase agreed** in line with the long-term Intergovernmental Panel on Climate Change (IPCC) assessments, and **action against climate change post-2012 extended to all the polluting countries** (with common but differentiated responsibilities) and sectors involved.	The commitment of the EU to reduce GHG emissions by 20 % by 2020 (and up to 30% if others step up to the challenge) is regrettably insufficient and according to more recent science also not consistent with its parallel commitment to limit global warming to +2°C. The IPCC's 4th Assessment Report (2007) concluded that to keep temperature increase to below +2°C, atmospheric GHG concentrations must stabilise at less than 450 ppm CO_2-equivalent, meaning at less than 350 ppm CO_2; more recent studies integrating positive climate feedbacks and ice sheet melting have asked for an even lower target of 350 ppm CO_2-equivalent. And yet, already now atmospheric GHG concentrations stand at 385 ppm CO_2 (http://co2now.org, October 2009) and more than 445 CO_2-equivalent (IPCC 2007, for the 6 Kyoto GHG). Realistically, therefore, limiting global average temperature increase to +2°C will require reversing atmospheric GHG concentrations through mitigation efforts far beyond all schemes currently envisaged. Policy makers must be fully aware that this is where the challenge ultimately lies.	
A9.3 TARGET: Climate change adaptation or mitigation measure from 2006 onwards delivering biodiversity benefits, and any negative impacts on biodiversity prevented or minimised, from 2006 onwards.		
A9.3.1 ACTION: All **climate change adaptation and mitigation measures assessed** to prevent negative impacts or, where prevention not possible, to minimise, mitigate and/or compensate for negative impacts and, wherever possible, provide positive benefits to biodiversity [2006 onwards].	A key Action Point, no comment or update needed	

BAP Objectives, Targets and Actions	Direct impacts of climate change	Indirect impacts of climate change (from mitigation and adaptation measures, others)
A9.3.2 ACTION: Ensure that implementation of **EU Biomass Action Plan** takes due account in assessments, where relevant, of impacts on biodiversity, in particularly on high-nature-value farmland and forests, in order to achieve ecological sustainability of biomass production [2006 onwards].	The Action Point is not fully satisfied because biodiversity impacts of EU Biomass production have been observed; for instance bioenergy crop production has been made responsible for the loss of agricultural set asides that were important for biodiversity and promoted for that very aim using EU subsidies; also increased wood use for pellet production has led to at least locally increased forest soil compacting and depletion. Negative impacts in the EU are prone to increase in light of the targets under the 2009 Renewable Energy Sources Directive.	
A9.4 TARGET: Resilience of EU biodiversity to climate change substantially strengthened by 2010.		
A9.4.1 ACTION: Develop a **comprehensive programme of priority actions to support biodiversity adaptation to climate change in the EU** [by 2008].	In development, through various studies, workshops and conferences (e.g. 2009: Green Infrastructure, Athens, Prague). While many theoretical concepts and proposals for action exist, including many that could be implemented immediately, some aspects are still poorly understood; in particular with regard to evidence showing which measures are most cost-efficient and ecologically effective. Clarifying the relationship between biodiversity conservation, biodiversity adaptation to climate change, and ecosystem-based mitigation and adaptation measures, has been useful to enhance awareness in the relevant communities and identify the risks and opportunities.	
A9.4.2 ACTION: Assess [by 2008], on the basis of available scientific evidence, and substantially strengthen [by 2010] **coherence, connectivity and resilience of the protected areas network** (Natura 2000 and non-Natura protected areas) **in order to maintain favourable conservation status of species and habitats in the face of climate change** by applying, as appropriate, tools which may include flyways, buffer zones, corridors and stepping stones (including as appropriate to neighbouring and third countries), as well as actions in support of biodiversity in the wider environment (*cf Action 1.2.3*).	While many theoretical concepts and proposals for action exist, including many that could be implemented immediately, some aspects are still poorly understood; in particular with regard to evidence showing which measures are most cost-efficient and ecologically effective, to allow the maintenance or restore FCS of species and habitats in the face of climate change.	Changes in land/sea use resulting from climate change adaptation and mitigation measures, most importantly in the agricultural, forestry and fisheries sector, may undermine efforts to enhance the permeability of the wider landscape and the coherence, connectivity and resilience of the N2000 network.
A9.4.3 ACTION: Make a **preliminary assessment of habitats and species in the EU most at risk from climate change** [by 2007], detailed assessment and **appropriate adaptation measures prepared** [by 2009], commence implementation [by 2010].	The present study provides a new vulnerability assessment framework, applied to a rather preliminary number of 212 *species* of Community Interest; it was not able to provide the same analysis for the remaining species and for *habitats* due to a lack of modelling data and appropriate methodology. More detailed information on the distribution and ecology of many species and habitats of Community Interest is required, particularly from eastern Europe. Possibly a study focusing specifically on these data-deficient species to complete the vulnerability assessment would be a good next step. Expand this assessment also to all the EU Outermost Regions and Overseas Countries and Territories.	
OBJECTIVE 10: TO SUBSTANTIALLY STRENGTHEN THE KNOWLEDGE BASE FOR CONSERVATION AND SUSTAINABLE USE OF BIODIVERSITY, IN THE EU AND GLOBALLY.		
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A10.1 TARGET: Research findings on biodiversity and ecosystem services has substantially advanced our ability to ensure conservation and sustainable use by 2010 and again by 2013.		
A10.1.1 ACTION: Subject to funding being found from existing financial resources, establish an **EU mechanism for independent, authoritative research based advice** to inform implementation and further policy development.	Implementation might be further delayed or weakened because of potential financial constraints resulting from increased funding needs for climate change action (mitigation and adaptation measures, related capacity building). Such an EU science-to-policy-to-implementation mechanism would be particularly useful in the context of the new, numerous and complex challenges arising from the direct and indirect impacts of climate change.	

BAP Objectives, Targets and Actions	Direct impacts of climate change	Indirect impacts of climate change (from mitigation and adaptation measures, others)
A10.1.2 ACTION: Identify ways and means to **strengthen independent scientific advice to global policy making**, inter alia by actively contributing to CBD consideration of the 2007 evaluation of the Millenium Ecosystem Assessment, and the ongoing consultations on the need for improved International Mechanisms on Scientific Expertise on Biodiversity.	None	Implementation might hence be further delayed or weakened because of potential financial constraints resulting from increased funding needs for climate change action (mitigation and adaptation measures, related capacity building).
A10.1.3 ACTION: Enhance research on **status, trends and distribution** of all habitats and species of community interest and of additional habitats and species of policy relevance [2006 onwards].	Direct climate change effects will complicate such research as the target will be moving. Moreover also well-studied species and habitats must be monitored to assess changes in status trends and distribution. Further research into ecological processes is required. An important Action Point for facilitating progress with regard to species and habitat specific vulnerability assessments and appropriate biodiversity adaptation measures.	None
A10.1.4 ACTION: Enhance research on most **significant pressures** on biodiversity, develop and test **prevention and mitigation options** [2006 onwards].	Direct and indirect climate change impacts must be integrated. This is closely related to Action Point A9.3.1	
A10.1.5 ACTION: Develop and apply tools to measure, anticipate and improve **effectiveness of most important policy instruments** for conservation and sustainable use of biodiversity [2006 onwards].	Critical to avoid maladaptive policies and measures. A substantive review of existing biodiversity-relevant policies is recommended such that they accommodate direct and indirect climate change impacts	
A10.1.6 ACTION: Allocate adequate **financial resources** to European and national biodiversity research and to dissemination of its results, including under the Seventh Framework Programme [2006 onwards].	None	Implementation might be weakened because of potential financial constraints resulting from increased funding needs for climate change action (mitigation and adaptation measures, related capacity building).
A10.1.7 ACTION: Establish effective and inclusive **European Research Area** for biodiversity and strengthen capacities (including infrastructures) in key disciplines, interdisciplinary and participatory science [2006 onwards].	None	Implementation might be weakened because of potential financial constraints resulting from increased funding needs for climate change action (mitigation and adaptation measures, related capacity building).
A10.1.8 ACTION: Put institutional arrangements in place to ensure **policy-relevant research** done (eg. in support of implementation of the nature directives, integration of biodiversity into sectoral policies) and **research outcomes are reflected where appropriate in policy development** [2006 onwards].	None. Ensure better coordination of research initiatives in the EU to reduce redundancy and maximise effectiveness. Implementation might be weakened because of potential financial constraints resulting from increased funding needs for climate change action (mitigation and adaptation measures, related capacity building).	

BAP Objectives, Targets and Actions	Direct impacts of climate change	Indirect impacts of climate change (from mitigation and adaptation measures, others)
A10.1.9 ACTION: Establish and promote [2006 onwards] **common data standards and quality assurance procedures to enable interoperability** of key european and national biodiversity databases and inventories [by 2008].	The development of standards could become more complicated or should be revised if direct and indirect climate change considerations must still be integrated.	None
SUPPORTING MEASURE 1: ENSURING ADEQUATE FINANCING FOR BIODIVERSITY.		
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B1.1 TARGET: Adequate funding provided for Natura 2000, biodiversity outside Natura 2000 in EU, biodiversity in external assistance and biodiversity research, inventory and monitoring 2007-2013.		
B1.1.1 ACTION: Ensure **adequate financing provided** [2007-2013] to Natura 2000 implementation through community (CAP Rural Development, Structural Funds, Life+) and MS co-financing, accessible to those who manage Natura 2000 sites, with focus on optimising long-term conservation status and benefits as well as priority awareness raising and networking initiatives. (*cf Action A1.1.2*)	See under Action Point A1.1.2	See under Action Point A1.1.2
B1.1.2 ACTION: Allocate, at MS initiative, within **each national/regional Rural Development (RD) Programme, adequate Community and MS cofinancing** to measures available under all three axes of the RD Regulation which are directly or indirectly supportive of nature and biodiversity [2006/07 and any subsequent revisions].	See under Action Point A2.1.1	See under Action Point A2.1.1
B1.1.3 ACTION: Apply new **European Fisheries Fund and Member State funds** for actions beneficial to marine biodiversity [2007-2013]. (*cf Action A3.4.1*)	See under Action Point A3.4.1.	See under Action Point A3.4.1.
B1.1.4 ACTION: Allocate, at MS initiative, **cohesion and structural funds** for projects directly or indirectly providing biodiversity benefits in all MS operational programmes [2006 onwards]. (*cf Action A4.1.1*)	See under Action Point A4.1.1	See under Action Point A4.1.1
B1.1.5 ACTION: **ESF contributing to biodiversity objectives** through awareness-raising, capacity building, employment of the young, long-term jobless and elderly, etc. [2007 onwards]. (cf Action A4.1.2)	See under Action Point A4.1.2	See under Action Point A4.1.2

BAP Objectives, Targets and Actions	Direct impacts of climate change	Indirect impacts of climate change (from mitigation and adaptation measures, others)
B1.1.6 ACTION: Ensure **adequate financing of other biodiversity measures outside Natura 2000 in the EU through other Community cofinancing** (e.g. Life+) and Member States' financing [2007-2013].	None	Increased funding needs for climate change action (mitigation and adaptation measures, related capacity building) might lead to a significant reduction in financial resources for environmental protection in EU MSs, thus also affecting the funding available for biodiversity measures outside the Natura 2000 network. On the positive side, where ecosystem-based adaptation and mitigation activities are promoted and implemented, opportunities may exist for biodiversity to significantly benefit from additional funding streams earmarked for climate change action. On the climate change mitigation side, funding for AFOLU (Agriculture, Forestry and Other Land Uses) measures are particularly relevant; any such measures providing biodiversity co-benefits should be given priority.
B1.1.7 ACTION: Increase in real terms international development assistance funds **flowing annually to projects directly benefiting biodiversity** [for period 2006-2010 compared with period 2000-2005; and again for period 2011-2013]. (*cf Actions A7.1.1 to A7.1.6*)	None	Implementation of this Action might be weakened, because (a) of potential financial constraints resulting from increased funding needs for climate change action (mitigation and adaptation measures, related capacity building) both in the EU and paid to ODA-receiving countries; and (b) governments may prioritise climate change actions (especially mitigation and adaptation), such that biodiversity concerns may receive less attention.
B1.1.8 ACTION: Allocate adequate financial resources to **European and national biodiversity research** and to dissemination of its results, including under the Seventh Framework Programme [2006 onwards]. (*cf Action A10.1.5*)	See under Action Point A10.1.6 (not A10.1.5, as indicated in B1.1.8!)	See under Action Point A10.1.6 (not A10.1.5, as indicated in B1.1.8!)
B1.1.9 ACTION: Allocate adequate funds for **supporting measures** including promoting joined-up planning, development of partnerships, monitoring, awareness raising and institutional capacity-building for biodiversity [2007-2013].	None	Implementation of this Action might be weakened, because (a) of potential financial constraints resulting from increased funding needs for climate change action (mitigation and adaptation measures, related capacity building) both in the EU and paid to ODA-receiving countries; and (b) governments may prioritise climate change actions (especially mitigation and adaptation), such that biodiversity concerns may receive less attention.
SUPPORTING MEASURE 2: STRENGTHENING EU DECISION-MAKING FOR BIODIVERSITY.		
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B2.1 TARGET: EU vision on biodiversity and ecosystem services agreed and providing policy framework by 2010.		
B2.1.1 ACTION: Launch, hold and conclude **EU debate** on this vision and policy framework [2007/08].	The BAP vision and policy should be revisited, to more clearly integrate the risks and opportunities provided by the direct and indirect impacts of climate change; most importantly with regard to new research needs, capacity building, screening of risks and opportunities under climate change measures, and to ring-fencing funding for biodiversity given that climate financing needs may reduce available funding streams.	

BAP Objectives, Targets and Actions	Direct impacts of climate change	Indirect impacts of climate change (from mitigation and adaptation measures, others)
B2.1.2 ACTION: Strengthen understanding and communication of the **values of natural capital and of ecosystem services**, and the taking into account of these values in the policy framework, expand incentives for people to safeguard biodiversity [2006 onwards].	Indeed, a key issue is how biodiversity, ecosystem services and ecosystem management can be more recognised (mainstreamed) in the sectors responsible for climate change adaptation and mitigation planning and implementation, such that negative impacts are mitigated and opportunities for biodiversity promoted. The Biodiversity community can draw lessons from the Climate Change community with regard to the IPCC-led efforts on compiling scientific evidence and raising awareness, for instance towards the building of the IPBES.	
B2.2 TARGET: New policies benefit biodiversity and ecosystem services, and their negative impact on biodiversity and ecosystem services prevented or minimised, from 2006 onwards.		
B2.2.1 ACTION: Integrate concerns for biodiversity and ecosystem services, given their economic important in terms of jobs and growth for some sectors such as tourism, into **Lisbon National Reform Programmes** and the development of policies and budgets under these NRPs [2006 onwards].	None	Implementation of this Action might be weakened, because (a) of potential financial constraints resulting from increased funding needs for climate change action (mitigation and adaptation measures, related capacity building) in the EU; and (b) governments may prioritise climate change actions (especially mitigation and adaptation), such that biodiversity concerns may receive less attention.
B2.2.2 ACTION: **Screen all new legislative and policy proposals at EU and MS levels for potential significant impacts on biodiversity** in general and on ecosystem goods and services in particular, and ensure effective treatment of biodiversity concerns in policy impact assessments, in particular to ensure the maintenance of ecosystem goods and services [2006 onwards].	Implementation of this critically important Action Point might be delayed or weakened, because (a) the identification of significant impacts on biodiversity may in some cases become more complicated due to the direct impacts of climate change; (b) of potential financial constraints resulting from increased funding needs for climate change action (mitigation and adaptation measures, related capacity building); and (c) EU institutions and governments may prioritise climate change actions (especially mitigation and adaptation), such that biodiversity concerns may receive less attention	
B2.3 TARGET: Biodiversity needs have been better integrated, as necessary, into post-2013 Financial Perspectives and any mid-term review of FP 2007-2013.		
B2.3.1 ACTION: Strengthen **alignment of the biodiversity policy cycle with the broader EU policy and budgeting cycle** to enable more effective integration [2006 onwards].	None	Implementation of this critically important Action Point might be delayed or weakened, because (a) of potential financial constraints resulting from increased funding needs for climate change action (mitigation and adaptation measures, related capacity building); and (b) EU institutions and governments may prioritise climate change actions (especially mitigation and adaptation), such that biodiversity concerns may receive less attention
B2.4 TARGET: Complementarity of EC and MS biodiversity strategies and action plans substantially enhanced by 2010.		

BAP Objectives, Targets and Actions	Direct impacts of climate change	Indirect impacts of climate change (from mitigation and adaptation measures, others)
B2.4.1 ACTION: **Re-align MS biodiversity strategies and action plans with this EU Action Plan** [by 2007] and strengthen mechanisms for ongoing alignment of EC and MS biodiversity strategies and action plans [2007 onwards].	Implementation of this Action Point might be delayed, weakened or impeded, because (a) the uncertainties attached to the direct and indirect climate change impacts, the partly inadequate capacity on the biodiversity/climate change interface in EU MS, and/or the new interest groups arising under climate change mitigation and adaptation agendas, may much rather lead to more heterogeneous (i.e. misaligned) biodiversity strategies; (b) potential financial constraints resulting from increased funding needs for climate change action (mitigation and adaptation measures, related capacity building); and (c) EU institutions and governments may prioritise climate change actions (especially mitigation and adaptation), such that biodiversity concerns may receive less attention	
B2.4.2 ACTION: **Strengthen the institutional arrangements in support of coherence and complementarity** in the implementation of EC and MS biodiversity strategies and action plans and in particular of this Action Plan [2006 onwards].	None	Implementation of this critically important Action Point might be delayed or weakened, because (a) of potential financial constraints resulting from increased funding needs for climate change action (mitigation and adaptation measures, related capacity building); and (b) EU institutions and governments may prioritise climate change actions (especially mitigation and adaptation), such that biodiversity concerns may receive less attention
B2.4.3 ACTION: **Strengthen mechanisms for delivery from MS level to local level** [2006 onwards].	See under Action Point B2.4.1	
B2.5 TARGET: Effective integration of Natura 2000, rural development, river basin management and other territorial plans and programmes in support of biodiversity achieved by 2010.		
B2.5.1 ACTION: Strengthen proactive **integration of available planning instruments** including Natura 2000, river basin management planning, programmes of measures for soils, rural development plans – towards application of a ecosystems approach in the terrestrial and freshwater environment [2006 onwards]. (*cf Action A4.3.1*)	See under Action Point A4.3.1	See under Action Point A4.3.1
B2.5.2 ACTION: Integrate biodiversity concerns into the **evaluation, monitoring and reporting mechanisms of Community-funded programmes** which have an impact on the conservation and recovery of biodiversity [2006 onwards].	See under Action Point B2.2.2	See under Action Point B2.2.2
B 2.6 TARGET: Substantial improvement in compliance with environmental regulations by 2010 and again by 2013		
B2.6.1 ACTION: Reinforce efforts to ensure compliance, control and enforcement at national, regional and local levels [2006 onwards].	None	Implementation of this critically important Action Point might be delayed or weakened, because (a) of potential financial constraints resulting from increased funding needs for climate change action (mitigation and adaptation measures, related capacity building); and (b) EU institutions and governments may prioritise climate change actions (especially mitigation and adaptation), such that biodiversity concerns may receive less attention

BAP Objectives, Targets and Actions	Direct impacts of climate change	Indirect impacts of climate change (from mitigation and adaptation measures, others)
SUPPORTING MEASURE 3: BUILDING PARTNERSHIPS FOR BIODIVERSITY.		
/		
B3.1 TARGET: Key stakeholder groups actively engaged in conservation of biodiversity from 2006 in each MS.		
B3.1.1 ACTION: Enhance **communication, cooperation and concerted action** between Commission, Member States, landowners, scientific and conservation communities in support of Natura 2000 (including implementation of 'El Teide' Declaration) [2006 onwards].	None	Implementation of this Action Point might be delayed, weakened or impeded, because (a) potential financial constraints resulting from increased funding needs for climate change action (mitigation and adaptation measures, related capacity building); and (b) EU institutions, EU MS and landowners may prioritise climate change actions (especially mitigation and adaptation), particularly those of promising economic profitability given new emerging markets (e.g. increased use of forest resources for bioenergy purposes), such that biodiversity concerns may receive less attention.
B3.1.2 ACTION: Develop **farming and biodiversity, forestry and biodiversity partnerships**, building on existing consultative processes under the Common Agricultural Policy and forest policy [2006 onwards].	None	Implementation of this Action Point might be delayed, weakened or impeded, because (a) potential financial constraints resulting from increased funding needs for climate change action (mitigation and adaptation measures, related capacity building); and (b) EU institutions, EU MS, farmers and foresters may prioritise climate change actions (especially mitigation and adaptation), particularly those of promising economic profitability given new emerging markets (e.g. increased use of forest resources for bioenergy purposes), such that biodiversity concerns may receive less attention. On the positive side, the agricultural sector may realise that biodiversity (genetic diversity) may be a useful pool to facilitate continuous climate change adaptation, especially where (bio-)technology solutions appear inadequate
B3.1.3 ACTION: Establish and adequately fund **Regional Advisory Councils for fisheries**, as provided for under the Common Fisheries Policy, and support their operations [2006 onwards].	None; however the scope and objectives of the fisheries management overseen by each RAC may be complicated in light of the direct impact of climate change on the distributions and populations of commercial species See also under Action Point A3.3.1	The inevitable adaptation of the fisheries sector to climate change (e.g. as regards boats, gear, techniques, targeted species, and fishing areas) is prone to require a substantial amount of public funding. Any resulting funding shortages, but also the uncertainty caused by changes in fish stock abundance and distribution, may lead authorities and fishermen to consider the introduction of fisheries management bodies (including RACs) a low priority issue.

BAP Objectives, Targets and Actions	Direct impacts of climate change	Indirect impacts of climate change (from mitigation and adaptation measures, others)
B3.1.4 ACTION: Establish a **Biodiversity and Climate Change Adaptation Task Force** at EU level [2007] to advise on measures to support biodiversity adaptation to climate change and the prevention of damaging impacts of climate change adaptation and mitigation measures on biodiversity [2007 onwards].	None	The establishment was successful, and the work of the Task Force (or, Ad Hoc Working Group) should lead to a new policy stream and better integration of the climate change / biodiversity interface. The AHWG should be made permanent and its advisory role increased; and the policy impact and the participation from EC services and EU MS, particularly from the respective climate change teams, should be enhanced.
B3.1.5 ACTION: Develop **biodiversity and planning partnership** [2007 onwards].	Implementation of this critically important Action Point might be delayed or weakened, because (a) planning will become significantly more complicated due to the direct and indirect impacts of climate change; in many cases regional and local planning authorities will not have adequate capacity to follow and understand the climate change/biodiversity interface in an appropriate manner; (b) of potential financial constraints resulting from increased funding needs for climate change action (mitigation and adaptation measures, related capacity building); and (c) EU institutions, EU MS and other stakeholders may prioritise climate change actions (especially mitigation and adaptation), such that biodiversity concerns may receive less attention	
B3.1.6 ACTION: Develop **business and biodiversity partnership** [2006 onwards].	Implementation of this Action Point might be delayed or weakened, because (a) of potential financial constraints resulting from increased funding needs for climate change action (mitigation and adaptation measures, related capacity building); and (b) the private sector and other relevant stakeholders such as the EU institutions and EU MS may prioritise climate change actions (especially mitigation and adaptation), such that biodiversity concerns may receive less attention Moreover, the direct and indirect impacts of climate change will complicate business planning in a number of sectors, with some becoming more vulnerable and others benefitting; the effect of this on the promotion of business & biodiversity partnerships is unpredictable.	
B3.1.7 ACTION: Develop **partnership between financing sector and biodiversity** [2006 onwards].	Implementation of this Action Point might be delayed or weakened, because the financing sector and other relevant stakeholders such as the EU institutions and EU MS may prioritise climate change actions (especially mitigation and adaptation), such that biodiversity concerns may receive less attention Moreover, the direct and indirect impacts of climate change will complicate business planning in a number of sectors, with some becoming more vulnerable and others benefitting; the effect of this on the promotion of business & biodiversity partnerships is unpredictable.	
B3.1.8 ACTION: Apply the CBD Akwe-Kwon Guidelines for **projects affecting terrestrial lands of indigenous and local communities** both within the EU MS and in Third countries [2006 onwards].	None	Specific climate change mitigation measures (especially AFOLU/LULUCF and REDD schemes) may negatively affect the land tenure or land access of indigenous and local communities, unless appropriate safeguards are put in place. If in contrast full local stakeholder involvement and recognition is secured, REDD schemes in particular could offer interesting opportunities for indigenous tribes to keep and manage their ancestral lands in a way that benefits biodiversity.
SUPPORTING MEASURE 4: BUILDING PUBLIC EDUCATION, AWARENESS AND PARTICIPATION FOR BIODIVERSITY.		
/		
B4.1 TARGET: 10 million Europeans actively engaged in biodiversity conservation by 2010, 15 million by 2013.		

BAP Objectives, Targets and Actions	Direct impacts of climate change	Indirect impacts of climate change (from mitigation and adaptation measures, others)
B4.1.1 ACTION: Develop [2006/07] and implement [2007 onwards] a **communications campaign** in support of full implementation of this Action Plan.	None	None
B4.1.2 ACTION: Strengthen and implement **IUCN Countdown 2010 initiative** [2006 onwards].	None	None
B4.1.3 ACTION: Ensure **public participation, related access to justice requirements of the Aarhus Convention** applied to projects, plans and programmes relating to or having an impact on biodiversity conservation [2006 onwards].	None	None

7 EU actions to support biodiversity adaptation to climate change

It can been seen from Chapters 5 and 6 that a range of policy instruments exist that can be used to implement a range of practical biodiversity adaptation measures and also to avoid impacts from climate change mitigation measures. But as evident from the mid-term assessment of the EU BAP (CEC, 2008b,c), even the general biodiversity conservation measures need to be more effective and better targeted and implemented by the Member States. Moreover, the challenge to increase actions for biodiversity is likely to be exacerbated by other sectoral mitigation and adaptation measures that may lead to further detrimental impacts on biodiversity.

Furthermore, very few practical measures have been taken to date to specifically aid biodiversity adaptation, beyond business as usual conservation actions. Although some Member States have developed adaptation strategies (Berry, 2008; EEA, 2005), these only outline broad objectives and measures. According to the BAP mid-term review no EU Member State has had prepared a biodiversity adaptation action plan detailing specific actions, responsibilities and time-scales (CEC, 2008b,c). One reason for this may be uncertainty over expected climate changes at the EU and Member State level, which undermines the reliability of modelled projections of the likely responses by species to climate change. Another major constraint on existing models is that they do not take the likely distribution of suitable habitat into account when producing projected maps of potential range under climate scenarios. A recent modelling study has attempted to do this (Vos et al., 2008), but this currently covers a small range of species in the Netherlands. It is also constrained by a lack of detailed spatial habitat data. The only currently available EU-wide spatial habitat data are CORINE land use cover data, and its habitat typology is probably not well correlated with the specific requirements of most species.

Another concern (outlined in the previous chapter) is that biodiversity conservation is suffering as a result of an increasing focus on other climate change issues, which are considered to be of greater importance – in particular measures to reduce the emissions of greenhouse gases. But this overlooks the potentially important role that biodiversity can play, through ecosystem-based adaptation, in terms of the wider climate change adaptation and mitigation agenda (AHEWG 2009). For example, the recent MACIS study has highlighted a range of potential multiple benefits from appropriate land use management (Berry et al., 2008; Paterson et al., 2008). Consequently, the mid-term assessment of the EU BAP calls for wider recognition of the critical role that healthy ecosystems play in mitigating climate change and adapting to its impacts.

The White Paper on adapting to climate change (CEC, 2009b) recognises the importance of biodiversity in providing ecosystem services, and that healthy ecosystems are an essential defence against some of the most extreme impacts of climate change. It therefore states “A comprehensive and integrated approach towards the maintenance and enhancement of ecosystems and the goods and services they provide is needed”. Amongst other things, it notes with regard to habitats that “the impact of climate change must also be factored into the management of Natura 2000 to ensure the diversity of and connectivity between natural areas and to allow for species migration and survival when climate conditions change. In future it may be necessary to consider establishing a permeable landscape in order to enhance the interconnectivity of natural areas.”

The White Paper then recommends the following actions for the EU and Member States to increase the resilience of biodiversity, ecosystems and water:

- Explore the possibilities to improve policies and develop measures which address biodiversity loss and climate change in an integrated manner to fully exploit co-benefits and avoid ecosystem feedbacks that accelerate global warming.
- Develop guidelines and a set of tools (guidance and exchange of best practices) by the end of 2009, to ensure that River Basin Management Plans (RBMP) are climate-proofed.
- Ensure that climate change is taken into account in the implementation of the Floods Directive.
- Assess the need for further measures to enhance water efficiency in agriculture, households and buildings.
- Explore the potential for policies and measures to boost ecosystem storage capacity for water in Europe.
- Draft guidelines by 2010 on dealing with the impact of climate change on the management of Natura 2000 sites.

Similar calls were also made at the high-level conference on EU post-2010 biodiversity policy (Athens, April 2009). The conference conclusions, presented in *The Message from Athens*[14], recommend that EU institutions and Member States should:

- Ensure that climate mitigation and adaptation measures are fully compatible with the objective of conserving biodiversity.
- Promote the implementation of "triple win" measures that conserve biodiversity while actively contributing to climate mitigation and adaptation.
- Develop and implement adaptation measures for nature conservation.

Some of the actions proposed in the White Paper and Message from Athens have subsequently been further promoted by the European Commission's establishment of an EU Ad Hoc Expert Working Group on Biodiversity and Climate Change, and its subsequent production of a discussion paper "Towards a strategy on climate change, ecosystem services and biodiversity" (AHEWG 2009). This notes that we need to:

- Use ecosystem-based approaches to address climate change and biodiversity loss and ecosystem service degradation in an integrated manner and develop strategies that achieve mutually supportive outcomes. This implies addressing the wider ecosystem challenges and potential in the climate change negotiations e.g. by establishing a REDD+ like mechanism, promoting a similar approach for other land use and ecosystems and, by including ecosystem-based approaches as an integral part in the UNFCCC Framework for Adaptation Action.
- Take immediate action to conserve and restore terrestrial and marine biodiversity and ecosystem services as these are the basis for cost-effective climate change adaptation and mitigation and can provide multiple economic, social and environmental benefits.
- Engage other sectors, for example agriculture, finance, transport, energy, regional planning, water management, fisheries, forestry, tourism, development policy, health, built environment to maintain and increase ecosystem resilience and to ensure that their activities do not further damage biodiversity and ecosystem services.
- Raise awareness of the linkages between climate change, biodiversity and ecosystem services through communication and education initiatives, make use of local knowledge and build institutional capacity and partnerships to facilitate integration.
- Strengthen the knowledge base on the climate change-biodiversity linkage through increased research efforts, long-term monitoring, and valuation.
- Appropriately address the issue of biodiversity, ecosystem services and climate change in upcoming financial reviews.

Of particular relevance to this study is the White Paper recommendation on drafting guidelines on the management of Natura 2000 sites. The next section of this report provides

[14] http://ec.europa.eu/environment/nature/biodiversity/conference/pdf/message_final.pdf

policy recommendations that specifically aim to support the adaptation of the Natura network to climate change, and it is assumed should therefore contribute to the development of the management guidelines.

8 EU policy recommendations

This chapter provides recommendations from this study that aim to avoid or reduce the negative impacts of climate change on biodiversity, and in particular the integrity of the Natura 2000 network. It therefore aims to support biodiversity adaptation to climate change and avoid or reduce the potential negative impacts of sectoral climate change mitigation and adaptation measures. The recommendations focus on EU policy development and implementation and are outlined in Table 8.1, with further descriptions given below of those that are considered to be most important. The sectoral recommendations are then followed by key cross-sectoral recommendations relating to research and monitoring, and communication issues. The recommendations have been developed on the basis of the results of the present project, the above consideration of biodiversity adaptation principles and existing authoritative recommendations, existing policy instruments, pressures on biodiversity and the adaptation policy agenda in the main sectors affecting biodiversity and Natura 2000 sites.

There are no priorities or timetables allocated to these recommendations (as this would probably be inappropriate without detailed consultations with the affected EU institutions and other stakeholders). However, in the short term, particular attention should be given to measures that focus on increasing the resilience of existing habitats and species populations, primarily by reducing existing threats (such as inappropriate habitat management, pollution, over-exploitation and habitat fragmentation) and controlling newly emerging threats (such as increasing pressures for forest exploitation and crops for bioenergy purposes). In the longer-term actions will be needed to further facilitate the redistribution of vulnerable habitats and species in response to changing climate conditions. Increasing the resilience of habitats and populations will also help in this respect (e.g. by increasing emigration and survival rates), but further measures to increase habitat connectivity, and proactively restore or even transpose habitats and species may become necessary. But much more research will be required on these topics before practical measures can be identified that will reliably provide robust and cost-effective long-term benefits.

Table 8.1. Recommended policy measures to support biodiversity adaptation to climate change, especially within the Natura 2000 network, by increasing resilience of populations and/or their ability to move to new areas of suitable climate

Key: HD = Habitats Directive; BD = Birds Directive; CFP = Common Fisheries Policy; ELD = Environmental Liability Directive; EIA = Environmental Impact Assessment Directive; HNV = High Nature Value (farmland); GAEC = Good Agricultural and Environmental Condition (under cross compliance); IAS = invasive alien species; ICZM = Integrated Coastal Zone Management; IPPC; Integrated Pollution, Prevention and Control; NECD = National Emissions Ceilings Directive; MSFD = Marine Strategy Framework Directive; SEA = Strategic Environmental Assessment Directive; SMR = Statutory Management Requirements (under cross compliance regulation); RDP = Rural Development Programme; UWWT = Urban Waste Water Treatment Directive; WFD = Water Framework Directive. See Table 3.1 for a description of the types of measures.

Policy area	Protection of areas	Habitat management	Habitat restoration/ creation	Species management	Reduction of external pressures	Other / notes
	HD & BD Natura sites: Urgently complete the designation of currently selected SCIs as SACs and complete the selection of other sites (esp marine sites), taking into account likely climate impacts. Update the lists of HD Habitats and Species of Community Interest and birds listed on BD Annex I: ensuring species that are vulnerable to climate change are included. Reassess the coherence of the Natura network (taking into account the revised species and habitat lists) and projected impacts (see research measures): expand network accordingly. In the longer term, guidance should be provided for MS on objective setting for and monitoring of habitats and species that may no longer be viable in SACs where they are designated features.	Further encourage MS to complete management plans for Natura sites, and provide guidance on addressing climate change adaptation needs in plans, including consideration of connectivity measures for species that are vulnerable to climate change that are in sites with small populations and/or are likely to need to move .	Develop guidance and EU procedures that can provide adaptation benefits from compensation measures under Art 6.4, e.g. by using and strategically locating habitat restoration based compensation to functionally connect (by corridors and stepping stones) or extend Natura sites.	Enforce implementation of HD Article 12 in MS, especially for species that are vulnerable to climate change; link to offsite compensation measures (e.g. habitat banking) where appropriate. Develop and implement a robust IAS strategy which includes measures to address IAS impacts on species and Natura sites that are vulnerable to climate change. Redefine the concept of IAS, to accommodate species' natural movements and colonisation in response to climate change.	Continue enforcement of HD Arts 6.3 & 6.4, and ensure that future impact assessments in Appropriate Assessments take into account the effects of climate change (e.g. of combined effects of project related and climate change related hydrological impacts).	Ensure objectives of BD, HD and EU BAP, and key biodiversity adaptation measures, are inadequately considered in other EU policies. Enforce implementation of HD Article 10 measures in MS, e.g. through development of national/regional strategies for maintenance / restoration of connectivity – focussing on species that are vulnerable to climate change and/or fragmentation impacts. Ensure funding of nature conservation is adequate. The primary source of funding under the integrated model is from the CAP and Regional Funds (see below) but the amount of funding actually directed to biodiversity remains inadequate. Ensure adequate funding of control and removal of IAS, especially in Natura sites where species that are vulnerable to climate change are also threatened by IAS.

Policy area	Protection of areas	Habitat management	Habitat restoration/ creation	Species management	Reduction of external pressures	Other / notes
Climate change		Link habitat management / restoration to ecosystem-based adaptation where this conserves biodiversity and supports other climate change mitigation and adaptation objectives.				
Agriculture & forestry	Strengthen the environmental conditions attached to forest improvement, infrastructure, restoration and prevention actions as well as afforestation in RDPs	Improve the design and monitoring of agri-environment measures; target schemes to Natura sites and other PAs and provide more training and advice. Ensure proper consideration of biodiversity requirements in all RDP measures, to avoid conflicting actions. Strengthen and enforce Cross Compliance[*1] – GAEC regulations to protect ecologically important landscape features and to maintain appropriate basic environmental conditions. Develop obligatory measures for recapturing the environmental benefits of the abolished set-aside scheme.	Target restoration measures in agri-environment schemes to priority areas (identified in management plans / HD Art 10 strategies) requiring buffers, additional habitat or functional connections amongst Natura sites for species that are vulnerable to climate change Promote the use of cross-compliance to create buffer strips where these can protect sensitive habitats (e.g. water bodies).		Strengthen and enforce Cross Compliance – GAEC regulations to reduce the impacts of agriculture on other habitats.	Increase funding allocations for Axis 2 measures, especially Natura measures (agriculture and forest) where these are not already adequately covered by established agri-environment measures. In the longer-term (2013 onwards) fundamental reform of the CAP is required, as most payments are not linked to any clear biodiversity objectives, or the provision of any other public goods. Further promote the implementation of the EU Forest Action Plan and implement the recommendations from the DG ENV contract on the need for an EU forest policy instrument.
Coastal	Promote the implementation of the ICZM Recommendation (2002) and development of regional and national ICZM plans, and provide guidance on the incorporation of biodiversity adaptation issues in ICZM plans.					

Policy area	Protection of areas	Habitat management	Habitat restoration/ creation	Species management	Reduction of external pressures	Other / notes
Fisheries / marine	Increase use and monitoring of marine protected areas for fisheries conservation purposes. Increase use of management tools, such as closed areas.			Develop and implement CFP stock recovery plans. Increase use of management tools, such as closed areas		Enforce existing legal requirement for MS to address overcapacity in fishing fleets, but MS have failed to fulfil these requirements Reform the legal framework of the CFP to better address biodiversity loss and impacts on non-target species and habitats, by improved implementation of the ecosystem approach and greater integration with the MSFD.
Energy	Ensure robust biofuel sustainability criteria are developed and enforced, that take into account indirect land use change, and possible impacts on Natura sites. Develop similar sustainability criteria for biomass energy crops.	Develop sustainability criteria for biomass energy crops that take into include appropriate management requirements	Provide guidance / incentives to target biomass planting to areas that may buffer, extend or provide functional connectivity to Natura sites			
Water	Ensure full and timely implementation of the WFD, and proper consideration of climate change issues and Natura conservation requirements in the development of River basin Management Plans.			Ensure implementation of the WFD includes the removal / control of IAS especially where these threaten species in Natura sites that are also vulnerable to climate change	Ensure that WFD set and maintain water levels for wetlands (e.g. by control of abstractions) that are appropriate in the context of climate change projections. Ensure all MS fully implement the Nitrates Directive and UWWT Directive.	

Policy area	Protection of areas	Habitat management	Habitat restoration/ creation	Species management	Reduction of external pressures	Other / notes
Air					Ensure all MS meet current NECD targets for a all pollutants. Revise NECD and reduce the emission thresholds to levels that will avoid significant habitat damage.	* Reduce widescale impacts from SO2, NOx, Ozone and Ammonia
Impact assessment & planning	Improve the quality and treatment of biodiversity in SEA and EIA especially in relation to cumulative impacts, functional connectivity requirements and the projected impacts of climate change. Provide further guidance, and if necessary, legislation to ensure planning / development decisions do not harm biodiversity in the wider environment (Natura sites are protected under HD Art 6(3)). Develop a policy for no net loss of biodiversity from all developments; supported by a policy framework for biodiversity compensation, e.g. offsets and habitat banking.		Provide guidance and encourage MS to use SEA as a means of identifying priority areas where habitat restoration (e.g. as compensation for residual impacts) may provide valuable functional connectivity or buffers for Natura sites that contain species that are vulnerable climate change		Improve the quality and treatment of biodiversity in SEA and EIA	
Other financial and economic instruments	Increase LIFE+ funding for the designation / management / restoration of habitats and/or management of species populations, where this increases the resilience of habitats / species that are vulnerable to climate change. Target trials / demonstration projects of new adaptation measures. Allow LIFE + funding to be used to create and maintain stepping stone / corridor habitats (without subsequent Natura designation) where there is an important need to increase functional connectivity amongst Natura sites.				Allow LIFE + funding to be used to create and maintain buffer habitats around Natura sites.	Increase total LIFE + budget
			Increase the use of Structural Funds for habitat restoration (e.g. to reduce habitat fragmentation) especially where this supports other mitigation and adaptation objectives.		Ensure proper scrutiny of the use of Structural Funds to avoid significant biodiversity impacts	

8.1 Implementation of the EU Biodiversity Action Plan

As discussed in Chapter 2, a key principle arising with respect to climate change adaptation is that actions must be taken to increase the resilience of ecosystems, habitats and species populations to climate change (e.g. Principle 2, Table 2.1; Harley 2008). Furthermore, actions need to be taken now as significant impacts are already clearly affecting habitats and species of Community Interest (Task 1; CEC 2009). Although there are uncertainties regarding the potential effectiveness of some adaptation measures, it is clear that measures to reduce existing sources of harm and to maintain existing conservation activities in Natura 2000 sites and elsewhere will provide adaptation benefits. They need to be carried out anyway, e.g. to deliver the EU 2010 biodiversity target and are therefore no-regret actions that should be implemented now (Principle 1, Table 2.1; Harley 2008).

However, the mid-term assessment of the EU BAP (CEC, 2008b,c) concluded that the 2010 biodiversity target will not be met without further urgent actions. A recent assessment for DG Environment by IEEP, UNEP-WCMC and MRAG (2009 draft) of the **key reasons for the failure to meet the target concluded that the main problems were not related to the current policy and legal framework**, because it is relatively comprehensive, and legislation that has been well designed and enforced does provide major biodiversity conservation benefits (e.g. most of the provisions in the Birds and Habitats Directives). The **key problems are mostly the result of ineffective or slow implementation**. These are often the result of inadequate funding for practical biodiversity measures (such as the appropriate management of Natura 2000 sites) and the limited capacities of government environmental agencies and other conservation organisations to support and monitor actions. Capacity issues appear to have been a particular common and significant problem because most Member States have limited institutional resources to tackle the highly demanding task of implementing existing biodiversity conservation measures. As noted in the analysis above (Chapter 7) resources for some biodiversity conservation measures may become further stretched as a result of an increasing focus on climate change mitigation and adaptation in other sectors.

Such funding problems are exacerbated by perverse subsidies that often provide stronger economic incentives for activities that damage biodiversity than for conserving it (e.g. the use of structural funds to support agricultural intensification or damaging infrastructure developments). Furthermore, land use and other policy decisions often overlook or underestimate the full socioeconomic value of biodiversity and ecosystem services and do not internalise the costs of their loss (TEEB, 2008). This failure to incorporate the full costs and benefits of biodiversity in economic systems has been a key driver of biodiversity loss and a constraint on the effective use of market measures to conserve it. Perhaps the most fundamental reason for the failure to meet the biodiversity target is that there has been limited progress on ensuring that economic development within the EU is sustainable in broader environmental terms.

It is therefore clear that these existing problems need to be addressed as a priority, rather than more ambitious biodiversity adaptation measures. Actions must firstly focus on redoubling existing efforts to deliver the existing EU Biodiversity Action Plan and subsequent plans and targets (e.g. as outlined in the Message from Athens). It is not within the scope of this study to provided detailed recommendations with respect to the implementation of all the relevant actions in the EU BAP (even if all individual actions were analysed and commented on in Table 6.1). But the most important actions are listed below and included in Table 8.1. Other key actions of particular relevance to Natura 2000 sites and climate change adaptation are described in detail in subsequent sections of this chapter.

- As highlighted in Chapter 6, funding for the conservation of biodiversity and ecosystem services, as well as for biodiversity adaptation to climate change, is prone to reduction as a result of an increasing focus by decision makers on other climate change mitigation and

adaptation issues. Therefore, explicitly ring-fenced funding for biodiversity conservation and adaptation is needed under all the funding mechanisms covered in the BAP (EU and EU Member State allocations, European Social Fund (ESF), cohesion/structural funds, CFP and CAP/RDPs, etc.), and this should receive proper attention in the imminent EC Budget Review.

- Appropriate specific funding for biodiversity conservation, biodiversity adaptation and ecosystem-based adaptation and mitigation measures should be allocated to the EU Overseas Entities (Outermost Regions and Overseas Countries and Territories), as they are highly vulnerable to reduced funding.

- Various sectoral climate change adaptation and mitigation measures (e.g. under the Renewable Energy Sources Directive) may have significant negative impacts on biodiversity and ecosystem services, and must should therefore undergo strict Environmental Impact and Strategic Environmental Assessments (see Section 8.8). These should fully integrate and respect biodiversity and ecosystem aspects, and be assessed in relation to their impact on the BAP and Natura 2000 and other EU biodiversity targets. Adaptation and mitigation measures should therefore also be closely and regularly monitored. Existing environmental legislation should be updated and strengthened, where necessary and appropriate, and implementation and enforcement should be enhanced.

- Properly planned ecosystem-based adaptation and mitigation measures offer significant opportunities for biodiversity to benefit indirectly from climate change action and funding. To maximise these opportunities, effective outreach to the sectors responsible for the planning and implementation of adaptation and mitigation measures is critical, in order to underline the biodiversity co-benefits and ensure that ecosystem-based measures are given priority.

- New modelling, field research, review studies and monitoring programmes as well as capacity-building on the complex climate change and biodiversity interface are urgently needed, to inform measures and policies, including policy reviews (see Section 8.8 for details). At the same time, no-regret measures that do not risk being maladaptive, such as conservation activities enhancing the resilience of existing species populations and habitats, should be fast-tracked in spite of knowledge gaps.

8.2 Development of climate change adaptation strategies and action plans

From information that is readily available (e.g. Member State reports to the CBD) there appears to be little evidence that significant biodiversity adaptation measures are being planned in most countries. Some Member States have developed adaptation strategies, such as in Finland, which produced a National Strategy for Adaptation to Climate Change at the end of 2004. However, the degree to which such strategies include biodiversity considerations is unclear from the information available to this review. No Member State seems to have developed a biodiversity adaptation action plan with defined actions, time tables and responsibilities (although some have stated they include actions within their national BAP). For example, the UK Biodiversity Partnership has produced guidance on building the capacity for biodiversity climate change adaptation – "Conserving biodiversity in a changing climate" (Defra, 2007). However, it does not contain a programme of actions and it is not clear whether it will be supported by the statutory adaptation programme that is being developed for England and Wales.

Furthermore most of the proposed measures to increase biodiversity resilience appear to be actions that are already being taken, or are planned, to meet existing conservation needs (e.g. the protection and management of sites). For example, the EU BAP and several Member States refer to connectivity measures (e.g. the establishment of ecological networks) as being important to increase resilience (by overcoming habitat fragmentation) and to help species to move in response to climate change. But, as noted previously, there is little evidence of substantial additional effort to increase connectivity in response to the growing threats from climate change.

It is therefore recommended that Member States should complete national strategies for biodiversity adaptation (where still required) and extend these with clear biodiversity adaptation action plans that set SMART objectives and identify responsibilities for implementation. Such action plans should be integrated with the requirements of the EU BAP and other sectoral strategies for climate change mitigation and adaptation, to take advantage of the potential co-benefits of combined actions with other sectors.

8.3 Designation of Natura 2000 sites and other protected areas

The merits of maintaining fixed protected areas where profound changes will inevitably occur in the distributions of habitats and species as a result of climate change may seem to be questionable. Indeed, the concepts of the Natura 2000 network, and most other protected areas were established to conserve species and ecosystems under the assumption of a stable climate, and therefore the selection of sites was based on particular components of biodiversity as they were distributed at the time of the initial assessment and planning (Hannah, 2008; Huntley, 2007). But as species ranges shift in response to climate change, and ecosystem composition changes as a result, existing protected areas may play a declining role in conserving the species that were original the focus of each site. This view is supported by a recent study using bioclimatic envelope models, which projects a decline in Natura 2000 sites of habitat suitable to support many of the species they currently protect (Vos et al., 2008).

Nevertheless, it is clear from this current study that the protection and management of a robust and coherent protected area network, as is the aim of the Natura 2000 network, is essential. Indeed, it should continue to form the cornerstone of habitat and species protection and management, because such areas are likely to be those that can most feasibly be protected and managed to increase ecosystem resilience, buy time and keep space for biodiversity. Such areas will maintain space for nature; even if some species and habitats that were present at the time of designation are lost, it can be expected that others will move in. Indeed, one recent study emphasising the importance of connectivity has suggested that expanding protected area networks could delay loss of species representation under climate change until the middle of the century (Hannah 2008).

It is, however, clear that the Natura 2000 network, even when fully established, will not be sufficient to protect biodiversity in Europe according to all reasonable projections of climate change. In most parts of Europe, protected areas are too small to accommodate changes, and the matrix around them is too modified and intensively used. New areas may therefore have to be added to the network in future. Considerable effort will need to be devoted to expanding and redesigning protected areas systems to ensure that they include sufficient area to accommodate management practices that both facilitate change and maintain large populations of species of concern (Huntley 2007). As noted by Campbell et al. (2009), additional criteria and approaches for consideration in re-designing protected areas systems suggest that they should:

- contain large enough core areas of ecosystems that will be relatively un-affected by climate change, which can serve as refugia from changing conditions;
- maximize representation of species of concern by including their projected distributions under a changed climate, similar to system planning exercises that are in use for current conditions;
- include the greatest possible degree of habitat diversity, including as far as feasible a full range of combinations of environmental conditions (Huntley 2007).

Systematic conservation planning has developed sophisticated algorithms to assess protected area networks and identify and prioritize requirements for new areas (Margules & Pressey, 2000). However, the inclusion of a climate change component in such tools is still in its infancy. But more importantly, it is clear that in the EU the options for redesigning and extending the protected areas network, including the Natura 2000 network, are limited by the availability of space and resources. Instead, it is likely to be more feasible to support the Natura 2000 network by improving functional connectivity (see below), establishing 'buffer zones' to increase the effective size of reserves (Huntley 2007; Mitchell et al 2007), linking habitats in new suitable climate zones with existing relatively 'climate-proof' refugia and including diverse protected area management strategies (CCSP, 2008; Vos et al., 2008; Williams et al., 2005). These considerations may be particularly important in western EU Member States where lands outside of protected areas are most intensively used; in some eastern EU member states, suitable areas for protected area network expansion may be more easily found.

Although there is a strong case for retaining the vast majority of existing Natura 2000 sites for the foreseeable future, there is also a case for re-examining their objectives with respect to their focus on specific species and habitats, i.e. their "designated features". It is therefore currently recommended that guidance should be provided for Member States on objective setting for, and monitoring of, habitats and species that are designated features that are being impacted by climate change. In the longer-term the objectives for the Natura 2000 network may need to be more flexible, to accommodate change whilst maximising the ecological value of each Natura 2000 site and the network as a whole.

8.4 Increasing connectivity through corridors and ecological networks

One of the most common approaches proposed for conservation adaptation is increasing functional connectivity amongst protected areas to support meta-populations and facilitate shifts in species distributions in response to climate change (Crooks & Sanjayan, 2006; Kettunen et al., 2007). There is little doubt that maintaining habitat linkages parallel to climatic gradients and minimizing new artificial barriers is a prudent strategy under any climate-change scenario. However, large-scale plans to increase connectivity should be carefully considered, as such measures are often difficult and very expensive to implement (IEEP/ Alterra: DG Environment Land Services study data). Furthermore, connectivity is species-specific and context specific, and therefore generic network measures may be ineffective for many species that are vulnerable to climate change (e.g. because they have specialist habitat requirements). There are also significant risks attached to increasing connectivity as well as benefits (Box 7.1).

It is therefore essential to assess connectivity requirements for biodiversity before embarking on potentially difficult and costly practical actions. In accordance with Articles 3 and 10 of the Habitats Directive, a high priority should be given to assessing the coherence of the Natura 2000 network with respect to species and habitats that are vulnerable to fragmentation. This should include the identification of current functional connectivity amongst the network for these species and habitats on the basis of empirical evidence where available.

Box 7.1. Potential advantages and disadvantages of the use of corridors as conservation tools to facilitate connectivity. Source: Crooks & Sanjayan (2006), modified from Noss and Soulé (1987), in Kettunen et al. (2007)

Potential advantages	Potential disadvantages
1. Increase immigration rate, which could: • Increase or maintain species diversity. • Provide a 'rescue effect' to small, isolated populations by augmenting population sizes and decreasing extinction probabilities. • Permit re-colonisation of extinct local populations, potentially enhancing persistence of meta-populations. • Prevent in-breeding depression (i.e. reduced fitness in a given population as a result of breeding of related individuals) and maintain genetic variation within populations.	1. Increase immigration rate, which could • Facilitate the spread of infectious diseases. • Facilitate the spread of alien species, e.g. exotic predators and competitors. • Facilitate the spread of weedy or pest species. • Decrease the level of genetic variation among sub-populations. • Cause 'out-breeding suppression'(i.e. situation where crosses between offspring of individuals from different populations have lower fitness than offspring from crosses between individuals from the same population) by disrupting local adaptations and co-adapted gene complexes
2. Permit daily or seasonal movements for foraging, breeding, migration, or other behaviours	2. Facilitate spread of wildfires and other catastrophic abiotic disturbances
3. Facilitate dispersal of animals from natal ranges to adult breeding ranges	3. Create a 'mortality sink' by increasing exposure of animals in corridors to humans, native and exotic predators and competitors, pollution, and other deleterious 'edge effects'
4. Accommodate natural range shifts due to global climate change	4. Riparian strips, often recommended as corridors might not enhance dispersal or survival of upland [i.e. non-wetland] species
5. Provide predator-escape cover for movement between patches	5. High economic cost to purchase, design, construct, restore, maintain and protect corridors
6. Provide wildlife habitat for transient or resident animals within corridors	6. Trade-off costs and conflicts with other conservation acquisitions, including conventional strategies for enlarging core areas and preserving endangered species habitat
7. Provide alternative refuges from large disturbances (a 'fire' escape)	7. Political costs from altering human land-use patterns
8. Continuance of ecological processes and ecosystem services such as succession, seed dispersal, and flow of water, nutrients, and energy	
9. Provide 'green belts' to limit urban sprawl, abate pollution, provide recreational opportunities, and enhance scenery and land values	

If functional connectivity models are used, these should take into account the properties of the intervening landscape and each species' ability to move through it, such as through 'least-cost' analysis (Adriaensen et al., 2003; Bunn et al., 2000). Such 'least-cost' approaches can use 'generic focal species' (sensu Lambeck, 1997) for each habitat type to represent typical movement costs across different habitat types - a method used to develop ecological networks in England (Catchpole, 2006). But these models and measures of connectivity need to be further tested. For example, in simulations Tischendorf and Fahrig (2000), found that some measures of connectivity increase in response to habitat fragmentation. They therefore conclude that the response of connectivity measures to habitat fragmentation should be understood before deriving conclusions for conservation management. Particular care should be taken in assessing the functional importance of landscape features that appear to be of high connectivity value. Many narrow habitat corridors and linear features, such as hedgerows, may provide valuable habitat but there is little empirical evidence that they have significant functional connectivity value (Davies & Pullin, 2007; Dawson, 1994; Donald, 2005; Donald & Evans, 2006; Hobbs, 1992; ITE, 1994; Spellerberg & Gaywood, 1993). Nevertheless the precautionary principle should be applied so that in cases of doubt such features should be retained.

The assessment of connectivity requirements should be completed with an evaluation of the adequacy of existing connectivity. Typically this may consider the species' demographic ecology, current conservation status and possible future threats from fragmentation. For example, the carrying capacity or actual population size within each identified functional network should be assessed in relation to recommended minimum habitat areas or minimum viable population sizes. Such assessments may often need to be carried out by expert evaluations. However, these should take account of all available empirical data and expert approaches should be complemented by modelling analysis where feasible and appropriate. The use of spatially explicit population models and stochastic patch occupancy models may be particularly useful in this regard (Carroll, 2006). However, in practice such models are often unsupported by empirical data. Furthermore, sensitivity analyses of spatial population models such as LARCH indicate that they are highly sensitive to small alterations in parameter values (Verboom & Pouwels, 2004). The outputs of such models, including those incorporating climate change and habitat availability (Vos et al., 2008) should therefore be treated cautiously and expert evaluations, and ideally some field validations, should be carried out before they are used as a basis for defining biodiversity corridors and ecological networks or other connectivity conservation decisions.

Once an assessment of functional connectivity requirements has been completed then options for maintaining and increasing connectivity, if it is inadequate, can be considered. Assessments of options for alleviating inadequate connectivity should take into account all factors that affect the conservation status of the species or habitat in question, and not just projected climate impacts, because connectivity measures need to be considered as part of a range of possible actions (Bennett, 2003). Increasing connectivity *per se* may not be the most appropriate solution. In particular, increasing connectivity should not be seen as a substitute for the conservation of large core areas of habitat (Noss & Daly, 2006). Instead connectivity features such as corridors should complement extinction-resistant core areas because these areas are likely to hold key populations that play a major role in maintaining meta-populations. A high priority should, therefore, be given to assessing the coherence of the Natura 2000 network for species that are considered to be at risk from fragmentation. Thus the relationship between Natura 2000 sites and their wider ecological networks (if present) should be established and their viability evaluated. The management of these sites should then take into account their wider ecological network, as for example suggested by Opdam et al. (2002).

As described above, the first conservation options that should be considered for any habitat patch relate to improving the quality of the existing habitat and the viability of their species' populations. This may alleviate requirements for increasing connectivity. In particular, increasing the area of small habitat patches may increase population sizes, thereby reducing the risk of chance extinction and other threats associated with small populations.

If connecting structures are needed to increase functional connectivity between core areas (such as Natura 2000 sites) and other habitat patches, then careful consideration needs to be given to the selection of options. The maintenance or creation of biodiversity corridors is often promoted as the principal means of increasing functional connectivity, although there is very limited evidence to show that corridors really improve functional connectivity (see Box 7.2). Most of the evidence comes from experimental settings rather than from natural populations (Beier and Noss, 1998). Moreover, as noted by many landscape ecologists, there are often many other options for increasing habitat connectivity (Opdam & Wiens, 2002). The effectiveness and efficiency of connecting structures will vary according to the habitats and species being targeted and the landscape configuration present (i.e. the spatial distribution and quality of habitat patches, the properties of the surrounding habitat matrix and the possible presence of barriers to movement).

Box 7.2. Evidence of the effectiveness of corridors and stepping stones as measures for increasing connectivity

The evidence that corridors provide benefits by increasing connectivity, rather than simply by providing additional habitat, are equivocal, largely because of the practical difficulty of distinguishing between these two effects and because of methodological shortcomings in previous research. From a review of the published literature up to 1994 it was found that many studies demonstrated that animals and plants prefer to move along corridors rather than cross the matrix habitat, but an approximately equal number found no detectable effects and few, if any, showed that re-colonisation would not have occurred without corridors (Dawson, 1994). Dawson could find no studies that conclusively demonstrated that corridors act as conduits that prevent extinctions in patches, possibly because few were sufficiently rigorous to demonstrate unambiguous advantages. Overall, Dawson concluded that corridors:

1. 'Sometimes allow individual animals to survive by allowing them access to sufficient habitat to meet their needs;
2. May maintain populations of some animal and plant species by replenishment; however, most species probably fail to use a corridor or can cross the gaps between patches of habitat adequately without its aid; and
3. Can serve the needs of some migratory animals in their seasonal movements'.

Others have come to similar conclusions (Davies & Pullin, 2007; Donald, 2005; Donald & Evans, 2006; Hobbs, 1992; Spellerberg & Gaywood, 1993). For example (Wiens, 1995) suggested that the 'evidence that species do depend on corridors for their movements or that corridors have clear conservation value … is limited and equivocal'. Little evidence was also found of the potential benefits of corridors in relation to movements required as a result of climate change (Davies & Pullin, 2007; ITE, 1994; Wiens, 1995).

Still, some studies have found some evidence of benefits from corridors. For example, Gonzalez et al. (1998), have demonstrated significant effects of corridors in preventing meta-population extinction by providing an immigration 'rescue effect', and Mech and Hallet (2001) used genetic methods to argue that corridors increase connectivity for specialist mammals. Beier and Noss (1998) found convincing connectivity benefits of corridors, but in only around half of all published studies, largely because too few studies have included all the necessary demographic parameters. More recently a review by Debinski and Holt (2000) suggested that although the predicted positive relationship between species richness and fragment size is rarely apparent in empirical data from patches of natural habitat in fragmented landscapes, there is a consistent agreement across many studies that increasing connectivity increases species richness, and that movement is related to connectivity.

Despite these studies, it still remains unclear whether increases in movements and species richness are the direct result of connectivity, or simply because corridors provide additional habitat area. Furthermore, Haddad and Tewksbury (Haddad & Tewksbury, 2006) note that the effects of corridors on population viability is little studied and the empirical understanding of the effects of corridors on community structure and diversity is still in its infancy. Although they find that support for corridor effects on population is growing, especially for smaller taxa with short generation times (because these are easier to study), there are many caveats.

Although there is little clear evidence that corridors directly provide clear population benefits, it might be prudent to assume that corridors should be maintained in accordance with the precautionary principle. This seems particularly prudent given the difficulties associated with demonstrating their impacts. Consequently Beier and Noss (1998), reviewing the complexity and intractability of this issue, suggest that 'those who would destroy the last remnants of natural connectivity should bear the burden of proving that corridor destruction will not harm target populations'. On the other hand, in the absence of conclusive evidence of the functional benefits of corridors, the costs of establishing them need to be compared critically against the costs and potential benefits of alternative conservation approaches (Simberloff et al., 1992).

Consequently, in a summary of management options for protected areas in the face of climate change, Halpin (1997) reiterates the need for firm ecological evidence upon which to base corridor design. In a more recent review on management options for forests in the face of climate change, Noss (2001) identifies similar priorities. In recommendations to the Bern Convention, Huntley (2007) states that adaptation strategies should not focus on the provision of corridors as a means of increasing functional connectivity, but instead he promotes measures that aim to develop permeable landscapes of stepping stones. Similarly the advantages of wider scale measures to increase the permeability of the habitat matrix are promoted by Donald et al. (2006), together with options for delivering such measures through agri-environment schemes.

Proposals for the creation of ecological corridors are often made as part of proposals for the development of ecological networks. The ecological network as a concept and a tool has been developed over the past 30 years with the broad aim of maintaining the integrity of environmental processes (Bennett & Mulongoy, 2006). Although such networks vary in concept, implementation and so forth, they share two generic goals, namely:

- maintaining the functioning of ecosystems as a means of facilitating the conservation of species and habitats; and
- promoting the sustainable use of natural resources in order to reduce the impacts of human activities on biodiversity and/or to increase the biodiversity value of managed landscapes (Bennett & Wit, 2001).

Over the last few decades there have been large numbers of ecological network initiatives. However, numerous reviews (e.g. Bennett & Mulongoy, 2006; Bennett & Wit, 2001; Hootsmans & Kampf, 2005) have noted that most ecological networks remain as plans and deliver little added value (IEEP/ Alterra: DG Environment Land Services study data). Although core areas and buffers may be protected by legislation and planning regulations, this often adds little value, and protection of existing corridors is typically weak. Moreover, the creation of new corridors and core habitat expansion is normally severely restricted by costs and landownership constraints.

However, with the increasing recognition of the value of ecosystem-based adaptation and mitigation options (e.g. arising from the MACIS study[15]), it may be possible for ecological network proposals to benefit from policy instruments outside the environment sector. For example, opportunities to link ecological networks to other climate change mitigation and adaptation measures might include:

- Upland catchments for water resources and flood attenuation
- Peatlands and natural forests for carbon storage and sequestration
- Flood plains for flood alleviation
- Coastal wetlands as coastal protection

Detailed recommendations on measures to reduce fragmentation impacts and facilitate climate change adaptation were developed under contract for DG Environment and are provided in Kettunen et al. (2007). In summary they recommended that measures to increase connectivity should:

- Assess the need for, and plan measures on the basis of functional (not structural) connectivity.
- Focus on species that are most at risk from fragmentation and climate change.
- Base network designs on ecological science and evidence.
- Protect existing connectivity - follow the precautionary principle when there is doubt over its value.
- Only increase connectivity where it is necessary and carefully consider the possible risks from such actions.
- Consider all options for increasing functional connectivity and take their cost-effectiveness into account.

8.5 Control of invasive alien species

There is now considerable evidence that invasive alien species (IAS) have led to significant biodiversity losses across a wide range of taxa and habitats, and impacts are likely to be

[15] http://www.macis-project.net/index.html

exacerbated by climate change (Kettunen *et al*., 2008, DAISIE 2009, Hulme *et al*., 2009, Vila *et al*., 2009). But the EU has been slow to recognise the threats posed by IAS and as a result there is no overarching EU strategy to deal with IAS. This is a clear policy gap with regard to the control of climate change-related impacts, and the conservation of biodiversity in general and the achievement of the 2010 target. The absence of an overarching EU strategy has lead to a general lack of co-ordination between EU institutions, Member States and regions on prevention and response measures. In addition, it has resulted in unhelpful ambiguity in terms of sectoral responsibilities and adoption of IAS measures (e.g. the possibility for Member States to adopt trade related measures).

The importance of policy measures for IAS is now widely recognised, not least because of the realisation of their socio-economic impacts (Kettunen *et al*., 2008, Shine *et al*., 2008, 2009). For example, the European Commission recently acknowledged that the lack of both EU and national IAS strategies are major policy gaps (CEC, 2008b). The Commission is currently addressing the gap at the Community level and developing an EU Strategy for IAS. In December 2008 the Commission adopted a Communication (CEC, 2008a) that outlined a number of policy options for EU action on IAS, thereby starting a discussion on the scope and content of the upcoming strategy. The EU IAS Strategy is likely to be finalised in early 2010 and it is likely that it will speed up the development of policies and adoption of measures on IAS at the national and regional level.

It is therefore essential that the EU does develop and implement (with effective enforcement) a strong and comprehensive IAS strategy, which aims to prevent the arrival of new IAS, control the spread and impacts of existing IAS, and where necessary eradicate existing IAS. The strategy should take into account the likely effects of climate change on the spread of IAS and the possible need for special and targeted measures for Natura 2000 sites as well as for species and habitats of Community Interest in general.

In the context of climate change, clarification will be necessary on distinguishing unwanted IAS from species that extend their natural ranges while adapting to climatic changes (which should therefore be considered benign immigrants).

8.6 Delivery of conservation management

As described in Section 3.3., the most important source of funding for the management of terrestrial Natura 2000 sites and other areas of biodiversity importance, such as HNV farmland and forests, is now the Axis 2 measures of Rural Development Programmes (RDPs) of the EAFRD. Such measures are undoubtedly providing significant conservation benefits, but there is considerable scope for further improvement (Boccaccio et al., 2009, Farmer et al., 2008, Wilson et al., 2009). Currently the biodiversity benefits of **agri-environment measures** are variable and very much depend on the objectives of each Member State's RDP, as some give higher priorities to resource protection than directly to biodiversity (Farmer *et al*., 2008). There is infrequent or weak targeting towards Natura 2000 sites and HNV habitats and the practical effectiveness of biodiversity measures is variable (Boccaccio *et al*., 2009). Whittingham (2007) noted that the performance of agri-environment schemes is limited by their small-scale, inappropriate placement (e.g. where target species are absent) and the application of generalised national habitat management prescriptions. Another problem has been that they are voluntary schemes and landowners are usually able to choose from a suite of options. As a result there has often been low participation in the more demanding options, which are often those that produce the greatest biodiversity benefits. This is probably often because management payments cannot be higher than income foregone (to comply with international trade rules), and therefore provide little incentive for farmers to risk making substantial changes to existing practices. In addition, more demanding options (such as whole field measures in arable systems), are also very

expensive, and therefore schemes may have to set limits on the amount of higher level options that they can fund.

With better targeting and design, agri-environment measures could play a major role in increasing resilience of habitats and species populations, especially in Natura 2000 sites, as well as increasing functional connectivity amongst them. To achieve this, funding for agri-environment and Natura 2000 measures in RDPs needs to be raised to increase their coverage of Natura 2000 sites and to increase opportunities for funding measures that provide the highest biodiversity benefits. RDPs should also favour bespoke and well targeted schemes as they seem to be more effective in delivering biodiversity benefits than generic horizontal measures (Evans et al., 2002; Kleijn et al., 2006; Whittingham, 2007; Wilson et al., 2009). It would also be advantageous to encourage greater use of Natura 2000 payments in RDPs to provide specific management measures for Natura 2000 sites that take into account climate change adaptation needs.

Although the Natura 2000-focused agri-environment schemes are of considerable importance, they are not able to address biodiversity conservation needs across the wider environment. Yet, evidence reviewed in Section 2 clearly shows that farmland habitats and their associated species are suffering considerably as a result of widespread ongoing intensification and abandonment in some areas. **Cross-compliance measures** are therefore seen as the principal policy instrument for the maintenance of the environmental baseline of agricultural land across the EU (by linking direct payments to most farmers to the achievement of environmental standards). However, a number of studies have identified weaknesses within the system (European Court of Auditors, 2008; Alliance Environment, 2007). Furthermore, such problems are being exacerbated by the recent loss of set-aside, which is likely to have serious consequences for farmland birds and other wildlife over much of Europe, unless effective large-scale counter-measures are implemented quickly (Hodge *et al*., 2006; Curry, 2008; Brunner *et al*., in prep.). Such counter-measures could be extended to provide potential compensation for the loss of set-aside, e.g. by requiring a certain percentage of land to be placed in some form of environmental scheme or left fallow.

The role of forest management in helping biodiversity adapt to climate change could be promoted through more explicit recognition of the adaptive function in the EU FAP. The potential to develop landscape-scale approaches to land use planning could be examined, in order to ensure that a sufficient diversity of habitats exists to help maintain the resilience of different species populations. Steps could be taken, perhaps through the European Network for Rural Development, to ensure that the afforestation, agro-forestry and forest-environment measures are implemented in a way that is conducive to meeting adaptation goals. Any measures that seek to bring farm woodland into management to supply bioenergy should be done in a way that is not detrimental to biodiversity and biodiversity adaptation.

8.7 Impact assessment and planning policy

An important area of policy weakness relates to the assessment and treatment of the potential impacts of commercial, housing and infrastructure developments etc. on biodiversity in the wider terrestrial and marine environment. This is partly because the EU has no competency over spatial planning and therefore development control standards and their implementation vary considerably between Member States. Although the EU has legal requirements for SEAs of plans and programmes and EIAs for significant development projects, the application of these is variable particularly with respect to their treatment of biodiversity. Most importantly, the legislation focuses on the impact assessment process rather than the appropriateness of decisions in the relation to potential impacts. Consequently the requirements for measures to avoid, minimise or compensate for impacts are often weak; and where such measures are required enforcement is often lacking. Natura 2000 sites are relatively well protected from developments by requirement to undertake

Appropriate Assessments in accordance with Article 6(3) of the Habitats Directive. But important implementation loopholes remain, and in addition the overall coherence of the Natura 2000 network is also affected by impacts on the wider environment.

An underlying cause of development impacts is that the EU does not require Member States to implement a general policy of ensuring no net loss of biodiversity. Compensation[16] measures are mandatory for residual impacts on designated habitats and species within Natura 2000 sites, in accordance with Article 6(4) of the Habitats Directive. But there has been no policy requiring or promoting compensation measures for residual biodiversity impacts in the wider environment.

There is therefore a need to better address biodiversity conservation needs in SEA and EIAs, both inside and outside Natura 2000 areas, and to ensure that they properly consider climate change related issues. SEAs may also be able to play an important role in identifying strategic opportunities for enhancing biodiversity resilience and allowing for biodiversity adaptation. The possible benefits of the introduction of a no-net-loss policy for biodiversity should also be considered. Such a policy would require practical measures to deliver, such as the promotion of offsets, e.g. through market-based habitat banking schemes. This could provide a useful mechanism for delivering habitat enhancement and restoration measures, which could help reverse habitat fragmentation (especially if located in priority areas identified in adaptation strategies and site management plans). But, as noted in a current study for DG Environment (The Use of Market-Based Instruments for Biodiversity Protection – The Case of Habitat Banking: ENV.G.1/ETU/2008/0043), the introduction of such compensation measures has some risks, such as potentially reducing acceptable thresholds for residual impacts whilst providing compensation with uncertain long-term additionality (Eftec and IEEP, 2009). Such a policy and compensatory framework would therefore have to be introduced carefully with appropriate regulatory safeguards.

8.8 Research and monitoring

This study has not undertaken a comprehensive review of scientific studies on the impacts of climate change on biodiversity or the effects of adaptation measures. However, it is clear that further research and monitoring urgently needs to be conducted in order to provide reliable species-specific, habitat-specific and site-specific guidance. Although, the information that is currently available can give an indication of the broad strategies that are likely to help with climate change adaptation, the actual delivery of effective long-term actions will require much more detailed ecological knowledge.

It is therefore recommended that the following biodiversity related climate change research actions be given a high priority.

- Carry out fundamental ecological research to improve our understanding of the effects of climate change on biodiversity and interactions with other environmental changes and pressures. A particularly high priority should be given to examining the factors that affect resilience (e.g. habitat condition, genetic variability and changes in competitive interactions) and the ability for species to move to and colonise new areas (e.g. habitat availability, connectivity, dispersal and emigration rates). The research should be combined with long-term monitoring of the impacts of climate and other abiotic factors on biodiversity at an appropriate range of spatial scales.

- Undertake necessary field surveys and analyses to map the full spatial distribution of EU species and habitats of Community Interest, especially those likely to be vulnerable to climate change, to provide the necessary baseline for studies on climate change

[16] Compensation must be in terms of biodiversity outcomes, rather than monetary compensation

vulnerability, on potential climate-related distributional changes, and on specific biodiversity adaptation measures.

- Extend climate envelope mapping to all taxa groups and habitat types (especially Habitats of Community Interest listed in Appendix 1 of the Habitats Directive) with suitable spatial distribution data. Link resulting climate envelope projection models to dispersal models and dynamic models of existing and potential habitat availability. The aim should be to quantitatively and objectively extend the analysis carried out in Task 2, and provide clearer and more reliable assessments of vulnerability (i.e. that consider adaptation constraints) and projected changes in distribution of species and habitats.

- Further develop the spatial analysis of the impacts of climate change on the Natura 2000 network (Task 3), by analysing the distribution of species of Community Interest that are vulnerable to the impacts of climate change (from Task 2) in relation to modelled projections of their suitable climate space. This analysis should be supported by the development of reliable spatial maps of the distribution of species and habitats of Community Interest and the completion of inventories of the presence and relative abundance of habitats and species of Community Interest in all Natura 2000 sites (drawing on the survey work described above). The studies should aim to identify Natura 2000 sites that are likely to lose species and habitats of Community Interest, and sites that might gain species and habitats of Community Interest, taking into account adaptation constraints (e.g. functional connectivity and presence of suitable habitat). An integrated assessment should then be carried out to assess the potential coherence of the overall Natura network (and its biogeographical regions) in relation to projected losses and gains of species (taking into account adaptation constraints) according to various climate scenarios and timelines. This should consider the adequacy of representation of species and habitats of Community Interest (in terms of maintenance of range, proportions protected and variability) and requirements for functional connectivity amongst sites (e.g. for migration and dispersal).

- Develop and test methods for assessing functional connectivity requirements for species that are vulnerable to climate change. These should aim to reliably establish existing functional networks (i.e. interconnected populations), assess their viability under various climate change scenarios, and identify needs for increasing connectivity to increase resilience and, where necessary, re-distribution to suitable habitats in areas projected to have suitable climate space.

- Carry out research and monitoring to improve our understanding of the potential impacts of extreme weather events on the viability of species populations and habitats, and how such events may drive changes in their distribution. Incorporate these findings into climate based models of species and habitat distribution.

- Conduct detailed monitoring of appropriate sample species and habitats that are considered to be vulnerable to climate change to validate and calibrate model based projections. Use the findings to identify indicators (species and otherwise) that will provide an early warning of climate change impacts in Natura 2000 sites.

- Carry out controlled experiments to assess the risks and benefits of assisted migration, learning from advances in invasives science.

- Monitor the impacts and cost-benefit relationships of biodiversity adaptation measures that aim to support species and habitats of Community Interest in Natura 2000 sites and the wider environment (e.g. the effectiveness of habitat management measures, increasing Natura 2000 site areas, buffer zones and connectivity measures).

- Conduct further research to identify practical, robust and cost-effective ecosystem management measures that can significantly support biodiversity conservation and/or climate change mitigation and/or climate change adaptation for other sectors. Develop policy instruments to support such ecosystem-based adaptation and mitigation measures, in particular where they offer multiple benefits.

- Model and monitor the impacts of land-use and biodiversity relevant climate change adaptation and mitigation measures, such as flood control infrastructures, new agricultural crops, renewable energy infrastructures (hydro, wind, marine, etc.), and most importantly the production of bioenergy feedstocks including forest resources.

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