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AN ANALYSIS OF THE IMPLEMENTATION OF RECOMMENDATIONS MADE BY THE GROUP OF EXPERTS ON BIODIVERSITY AND CLIMATE CHANGE (2006-2011)

- FINAL

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The opinions expressed in this work are the responsibility of the author and do not necessarily reflect the official policy of the Council of Europe

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SUMMARY

A review is presented of reports submitted to the Expert Group by various parties to the Bern Convention describing the actions that they had taken in response to the series of Recommendations made by the group, especially its Recommendations Nos. 135 (2008) and 143 (2009). Eight of the reports reviewed were submitted in 2012 and had been elicited specifically for the purposes of this review. In order to provide a wider view and context for those reports, however, reports submitted to the group in 2011 by a further 13 countries were also included in the review.

The review was required to "*focus on adaptation, highlighting the main gaps and challenges encountered, the lessons learned and the examples of good practices*", and to "*propose priorities for action and/or specific recommendations*".

In order to undertake the review, the Recommendations made by the Expert Group are themselves first reviewed and the many individual actions listed in their Appendices are summarised. Ten 'composite actions' are identified that synthesise the numerous actions listed by the Expert Group's various Recommendations. The reports from parties are then reviewed and the actions reported therein summarised and related to the ten composite actions. Examples of good practice are identified and, in a minority of cases, criticisms are made of reports that are considered to be seriously deficient or to fail to report any relevant activities.

A synthesis and analysis is then presented of the extent to which the reports from parties indicate that they have undertaken recommended activities, and thus have addressed the Expert Group's Recommendations. Each of the ten composite actions is considered in turn and evidence evaluated of the extent to which it has been addressed by the actions reported by the parties.

On the basis of this analysis, a series of fourteen specific conclusions is presented. An over-arching conclusion is reached that there is a very real danger that too little will be done too late by many of the parties: This depressing conclusion emphasises the need to press all parties to respond actively and swiftly to the Recommendations made by the Expert Group, where they have not already done so.

Finally, a series of sixteen specific recommendations is made, along with three general recommendations related to addressing the overall conclusion.

INTRODUCTION

Since its establishment the Group of Experts on Climate Change and Biodiversity of the Bern Convention has commissioned a number of reports from consultants and, in the light of these and the group's own discussions of these, has made a number of recommendations. Parties to the Bern Convention are expected to take steps to implement these recommendations, where relevant, and are from time to time requested to report to the Group of Experts on the nature of the steps that have been taken. The present report has been commissioned by the Group of Experts in order to provide an analysis of the steps that various parties have to-date reported to have been implemented. In particular, the report was required to "*focus on adaptation, highlighting the main gaps and challenges encountered, the lessons learned and the examples of good practices*", and to "*propose priorities for action and/or specific recommendations*".

In order to address these goals, the text that follows first summarises the relevant recommendations, focusing as requested upon those of key importance, namely those contained in Recommendations 135 (2008) and 143 (2009). The various reports submitted by parties to the convention and made available to the consultant are then reviewed, identifying the key steps taken and their relevance to the Group's recommendations. An overall synthesis then summarises and analyses the nature of the steps taken that are of relevance to the Group's recommendations. Finally, a number of conclusions are presented, addressing the key issues identified by the Group when commissioning the present report.

I. REVIEW OF RECOMMENDATIONS MADE BY THE GROUP OF EXPERTS

As of the date of the present report, the Group of Experts on Climate Change and Biodiversity of the Bern Convention lists eight documents making recommendations relating to biodiversity and climate change on its web page (http://www.coe.int/t/dg4/cultureheritage/nature/bern/climatechange/default_EN.asp):

- Recommendation No. 122 (2006) on the conservation of biological diversity in the context of climate change
- Recommendation No. 135 (2008) on addressing the impacts of climate change on biodiversity
- Recommendation No. 142 (2009) on interpreting the CBD definition of invasive alien species to take into account climate change
- Recommendation No. 143 (2009) on further guidance for Parties on biodiversity and climate change
- Recommendation No. 145 (2010) on guidance for Parties on biodiversity and climate change in mountain regions
- Recommendation No. 146 (2010) on guidance for Parties on biodiversity and climate change in European islands
- Recommendation No. 147 (2010) on guidance for Parties on wildland fires, biodiversity and climate change
- Recommendation No. 152 (2011) on Marine Biodiversity and Climate Change

Recommendation No. 122 (2006)

The first of these recommendations, No. 122 (2006), was made by the Standing Committee on the conservation of biological diversity in the context of climate change, on the basis of a report commissioned from Prof. M. Usher, and concerned the establishment of the present Group of Experts, its recommendation being as follows:

Recommends that Contracting Parties to the Convention:

1. *Set up a Group of Experts on Biodiversity and Climate Change, in accordance with the terms of reference annexed to this recommendation, to provide information and guidance to Parties on understanding climate change impacts and threats, and provide Parties with tools and support in developing appropriate adaptation measures in national policies regarding the species and habitats protected under the Bern Convention.*
2. *Engage in this work and give it adequate priority and resources for its timely completion.*

Recommendation No. 135 (2008)

Following its establishment, the Group of Experts commissioned a series of further reports from various consultants, on the basis of which the Standing Committee then made its recommendation, No. 135 (2008), in which a series of measures was identified in the extensive Appendix to the recommendation. The recommendation was as follows:

Recommends Contracting Parties to the Convention and invites Observer States to:

1. *Address and communicate, as a matter of urgency, the impacts of climate change on biological diversity and its conservation;*
2. *Raise awareness of the link between biodiversity and climate and emphasis the large potential for synergies when addressing biodiversity loss and climate change in an integrated manner; including socio-economic effects;*

3. *Encourage the elaboration of climate change adaptation activities for biodiversity, taking account of the suggested measures listed in the guidance set out in the Appendix to the present Recommendation; and*

4. *Continue to engage in the development of further guidance to implement the Convention.*

The Appendix to this recommendation is included as Appendix 1 of the present document. This Appendix lists a large number of specific recommended actions, mostly derived from the following commissioned reports addressing climatic change impacts upon various aspects of European biodiversity: "*Conserving European Biodiversity in the Context of Climate Change*" by M.Usher [document CO-DBP (2005) 3 rev]; "*Climatic change and the conservation of European biodiversity: Towards the development of adaptation strategies*" by B. Huntley [document T-PVS/Inf (2007) 3]; "*Climate change and the vulnerability of Bern Convention species and habitats*", by P.Berry [document T-PVS/Inf (2008) 6 rev]; "*Climatic change and the conservation of migratory birds in Europe: Identifying effects and conservation priorities*" by M.Ferrer, I.Newton and K.Bildstein [document T-PVS/Inf (2008) 1 rev]; "*A perspective on climate change and invasive alien species*" by L.Capdevila-Argüelles and B.Zilletti [document T-PVS/Inf (2008) 5 rev]; "*Climate Change Impacts on European Amphibians and Reptiles*" by K. Henle *et al.* [document T-PVS/Inf (2008) 11 rev]; and "*Review of existing international and national guidance on adaptation to climate change with a focus on biodiversity issues*" by M. Harley and N. Hodgson [document T-PVS/Inf (2008) 12 rev].

Recommendation No. 142 (2009)

In recommendation No. 142 (2009) the Group of Experts specifically responded to an issue raised in the present author's earlier report (Huntley, 2007), namely that of the need to distinguish, when formulating conservation policies and measures, between alien species and species that naturally extend their range, as a result of climatic change, into areas where they were not previously native. The recommendation was:

Recommends Contracting Parties to the Convention and invites Observer States to:

1. *interpret the term "alien species" for the purpose of the implementation of the European Strategy on Invasive Alien Species as not including native species naturally extending their range in response to climate change.*

Notwithstanding this recommendation, the status of species not previously 'native' to Europe but colonising the continent from adjacent areas, e.g. northern Africa, remains unclear and thus of continuing concern.

Recommendation No. 143 (2009)

Having commissioned and received several further reports from consultants, this recommendation complemented No. 135, once again including as an Appendix a series of detailed recommendations and guidance for appropriate actions. The recommendation was:

Recommends Contracting Parties to the Convention and invites Observer States to:

1. *Increase efforts to improve understanding of the linkages between biodiversity and climate change (according to Recommendation 135 (2008)).*

2. *Make full use of the large potential for synergies and co-benefits between biodiversity conservation and climate change mitigation and adaptation, including ecosystem-based approaches .*

3. *Ensure that biodiversity considerations, including potential negative impacts, are taken fully into account in climate change adaptation and mitigation policies and measures.*

4. *Develop climate change adaptation activities for biodiversity, taking due account of the proposed guidance set out in the Appendix to the present Recommendation; and*

5. *Continue to engage in the development and application of further guidance to implement the Convention.*

The Appendix to this recommendation is included as Appendix 2 of the present document; it lists a number of specific recommended actions, mostly derived from the commissioned reports dealing with climatic change impacts upon invertebrates, plants and protected areas: "*Impacts of climate change on European invertebrates*, by R. Wilson [doc.T-PVS/Inf (2009) 8 rev]; "*The impacts of climate change on plant species in Europe"* by V. Heywood [doc.T-PVS/Inf (2009) 9 rev]; and "*Protected areas and climate change in Europe*" by M. B. Araújo [doc.T-PVS/Inf (2009) 10 rev].

Recommendation No. 145 (2010)

This recommendation specifically addressed the potential impacts of climatic change in mountain regions and once again included an Appendix listing specific recommended actions and guidance. The recommendation was as follows:

Recommends Contracting Parties to the Convention and invites Observer States to:

1. *Address and communicate the impacts of climate change on mountain biological diversity and its conservation,*
2. *Carry out specific national and European research or, as appropriate, reinforce existing research on the mountain areas habitat types and species that will be most affected by climate change, monitoring their change and co-operating as appropriate with neighboring states in shared mountain ranges; Promote sharing of information on research carried out in different countain ranges of Europe,*
3. *Develop specific climate change adaptation policies and action for mountain biodiversity, taking due account of the proposed guidance set out in the Appendix to the present recommendation;*
4. *Where appropriate, implement the proposed actions of the guidance in appendix to this recommendation*

Further recommends Contracting Parties of the Convention on the Protection of the Alps and Convention on the Protection and Sustainable Management of the Carpathians and invites their observer States to help implement this recommendation in their respective frameworks.

The Appendix to this recommendation is included as Appendix 3 of the present document. The specific actions that it recommends are based principally upon the relevant commissioned report: "*Impacts of climate change on Mountain Biodiversity in* Europe' by Ms Eva Spehn [doc. T-PVS/Inf (2010) 8].

Recommendation No. 146 (2010)

The focus of this recommendation was upon the potential impacts of climatic change on the biodiversity associated with European islands; once again the recommendation had an associated Appendix offering guidance and specific recommendations upon actions to be taken. The recommendation was as follows:

Recommends relevant Contracting Parties to the Convention and invites relevant Observer States to:

1. *Address and communicate the impacts of climate change on island biological diversity and its conservation including coastal and marine biodiversity in the waters surrounding islands;*
2. *Carry out inventories and specific national and European research on island biodiversity that will be most affected by climate change, monitoring their change, identifying in particular species that may go extinct in the next decades, and propose solutions for the conservation of their genetic diversity;*

3. *Carry out a special effort to create more reserves in and around islands, in particular coastal and marine reserves, ensuring their functionality and better integrating biodiversity concerns in development, water and tourism policies;*

4. *Develop specific climate change adaptation policies and action for island biodiversity, taking due account of the proposed guidance set out in the Appendix to the present recommendation.*

5. *Where appropriate, implement the proposed actions of the guidance in appendix to this recommendation.*

The Appendix to this recommendation is included as Appendix 4 of the present document. The actions recommended therein are derived mainly from the commissioned report: "*Climate change and the biodiversity of European islands*' by Ms Cordula Epple [*document T-PVS/Inf (2010) 9*].

Recommendation No. 147 (2010)

This recommendation focused upon the links between wildfire, climatic change and biodiversity and once again included an Appendix detailing specific recommended actions. The recommendation was as follows:

Recommends Contracting Parties to the Convention and invites Observer States to:

1. *Assess how fire may affect biological diversity in a context of climate change, particularly in fire-prone areas; identity which areas may increase their risk of fire in different climate change scenarios and take precautionary measures; identify, in particular, areas that may be at risk of desertification in Europe by a combination of higher temperatures, repetitive fire and erosion;*

2. *Assess the changes required in land use and land management policies, including forestry, to make forests and other ecosystems more resilient to fires in a context of climate change;*

3. *Consider the role of fire in the implementation of Bern Convention guidance on biodiversity and climate change.*

4. *Where appropriate, implement the proposed actions of the guidance in appendix to this recommendation.*

Appendix 5 of the present document presents the Appendix to this recommendation, the specific actions recommended therein being based principally upon the commissioned report: "*Climate change, wildland fires and biodiversity*" by Mr Jose Manuel Moreno [doc T-PVS/Inf (2010) 10].

Recommendation No. 152 (2011)

The most recent recommendation explores the potential impacts of climatic change on marine biodiversity, drawing upon a report that examines this specific topic ("Impact of Climate Change on Marine and Coastal Biodiversity: current state of Knowledge", by UNEP-MAP-RAC/SPA), as well as upon several of the reports commissioned by the Group of Experts: "*Conserving European biodiversity in the context of climate change*", by Mr. Michael B. Usher [doc. T-PVS (2005) 21]; "*Climatic change and the conservation of European biodiversity: towards the development of adaptation strategies*" by Mr. Brian Huntley [doc. T-PVS/Inf(2007)03]; "*Protected areas and climate change in Europe*" by M. B. Araújo [doc. T-PVS/Inf (2009) 10 rev]; and "*Climate change and the biodiversity of European islands*" by Ms Cordula Epple and Mr Yves de Soye [doc. T-PVS/Inf (2010)09E]. The recommendation was as follows:

Recommends Contracting Parties to the Convention and invites Observer States to:

1. *Increase efforts to develop robust ecological models pertaining not only to species but specifically also to the biotic/abiotic mechanisms and processes regulating marine ecosystems so as to evaluate their resilience to climate change, bearing in mind that uncertainties surrounding the precise nature of future climate change and its impacts on biodiversity should not delay practical conservation action;*

2. *Develop cross-cutting and sectoral adaptation and mitigation policies and measures to take account of the different climate change scenarios, particularly focussing on mitigating current and potential impacts on already vulnerable marine and coastal areas;*

3. *Improve the status of marine biodiversity by stepping-up the designation of marine and coastal protected areas, including under the Emerald and the Natura 2000 networks, and ensure that they are managed in a sustainable way;*

4. *Improve the knowledge-base of effects of climate change on marine and coastal biodiversity, including improved understanding of mitigation and adaptation measures to effectively inform the conservation of marine and coastal biodiversity, and ecosystem services. Ensure mechanisms are in place, to facilitate sharing of data and information at national, regional and international levels, making full use, where possible, of already-established mechanisms, including the Global Biodiversity Information Facility;*

5. *Examine how marine invasive alien species may affect the biodiversity and, in particular, how Lessepsian species may affect native Mediterranean biodiversity;*

6. *Continue to engage in the development and application of further guidance to implement the Convention in this regard; and*

7. *Keep the Standing Committee informed of measures taken to implement this recommendation.*

Summary of Recommendations

Although recommendations Nos. 135 and 143 are the most extensive and far-reaching in scope, each of the recommendations, aside from No.122, provides specific guidance on actions to be taken by parties to the convention, and is thus of importance. Whilst clearly those recommendations that focus upon mountainous areas (No. 145) and upon islands (No. 146) have more limited geographical relevance, mountainous areas and islands are of disproportionate importance from a biodiversity perspective, and also at generally enhanced risk from negative impacts of climatic change. Much of the endemism in European biota is concentrated in mountainous regions and upon islands. Changing climates, coupled to the geometry of mountains, leads to reduced areas, or even disappearance of suitable climatic space, for higher altitude species as climate warms. Island biota too face reductions in extent, or disappearance from their island homes, of areas of suitable climatic space. Given that some of our most biodiverse islands, with high concentrations of endemic species, are also mountainous, many species are faced with the combined implications of occupying mountain-top habitats and isolated islands, resulting in a very high risk of negative impacts of climatic change.

The potential for climatic change, as well as for changes in land use, to alter the frequency, intensity and extent of wildfire, addressed in recommendation No. 147, is clearly of greatest immediate concern in the semi-arid and fire-prone regions surrounding the Mediterranean. However, it should not be overlooked that fire is a natural agent of regeneration also in both Boreal forests and steppe grasslands, albeit that the natural return periods for fires in these systems are longer and shorter, respectively, than those in typical Mediterranean maquis or garrigue ecosystems. Furthermore, as the Appendix to the recommendation makes clear, climatic change may alter the likelihood of fire in areas and ecosystems that have not historically been associated with fire as an agent of regeneration. Palaeoecological evidence, for example, has been interpreted as showing that, as earlier hypothesised by Huntley (1993), a change in fire frequency, resulting from a shift in climatic conditions, enabled the early Holocene expansion of *Corylus avellana* (Hazel) into areas around the Alps where forests dominated by deciduous *Quercus* spp. (Oak) previously had become established (Finsinger *et al.*, 2006). Although fire is not generally today associated with such ecosystems dominated by deciduous broadleaved trees, the palaeoecological evidence makes clear that climatic change may render such ecosystems fire prone. Thus, not only those parties to the convention that host Mediterranean ecosystems, and those in Boreal and steppic areas, but also others where wildfire has historically been infrequent, must take the potential for changes in fire regime into account.

The recommendation (No. 142) relating to how species should be classified that are naturally shifting their range in response to climatic change and colonising areas outside their historical area of native distribution is welcome and important, although as noted above it does not explicitly address the potential for species to colonise Europe from adjacent geographical regions as a result of climatic change. The final recommendation (No. 152), relating to marine biodiversity, whilst obviously important, adds little that has not been covered, implicitly if not explicitly, by previous recommendations.

Between them even the Appendices to just the two principal recommendations (Nos. 135 and 143; Appendices 1 and 2) recommend and describe a total of 55 actions, many of them with several subsidiary parts; the Appendix to recommendation No. 135 in addition describes seven underlying principles for adaptation strategies. Whilst there is some obvious duplication of the underlying principles between actions that have been included as a result of their recommendation by reports commissioned to address, for example, different taxonomic groups, it is nonetheless apparent that a large number of actions has been recommended for adoption by parties to the convention, even when only those associated with the two principal recommendations are considered. When all of the recommendations made to-date are considered, the number of recommended actions becomes very large and is likely to be more than a little bewildering to many of those being asked to consider and implement these recommendations. With this in mind it is strongly recommended that the Group of Experts commission a detailed review of the recommendations for actions made to date with the aim of producing a simplified synthesis of these recommended actions that will facilitate both implementation and reporting by parties to the convention.

As a first step in this direction, and for the purposes of the present report, the numerous recommended actions have been synthesised into a list of 10 'composite actions' (Table 1). The activities listed in the national progress reports have then been assessed in relation to which of these actions they address.

TABLE 1: SYNTHESIS OF RECOMMENDED ACTIONS

1. **Target as a priority the most vulnerable regions/ecosystems** – the Arctic (sea-ice, tundra and boreal forest), mountains, coastal zones, islands, wetlands in areas of increasing drought. Improve knowledge of potential losses of such vulnerable habitats from the combined effects of climatic change and changing land use. Take steps to minimise other pressures on these habitats and regions that are most vulnerable to climatic change.
2. **Enhance the adaptive capacity of vulnerable species** (rare/endemic/threatened). Take steps to increase their populations; identify and urgently address threats, other than climatic change, to these species; develop climatic change adaptation/mitigation plans, especially for those species identified as most vulnerable to climatic change.
3. **Improve knowledge of species and habitats of special concern** (including Bern Convention species/habitats, endemics, sea-turtles, amphibians and reptiles), especially of their vulnerability to climatic change. Simulate potential impacts using species' distribution models, enabling a focus upon those identified as most vulnerable to climatic change. Update or develop conservation statements and, where necessary, recovery plans for all threatened species, incorporating climatic change impacts. Incorporate climatic change vulnerability into the assessment of threatened status when compiling 'Red Books/Lists'.
4. **Improve knowledge and understanding of the role of wildfire** in ecosystem dynamics. Assess the vulnerability of ecosystems to changes in wildfire frequency as a result of climatic change, land-use changes and human settlement patterns. Include the role of fire in all assessments of the vulnerability of species, ecosystems and habitats. Assess the vulnerability of protected area networks to wildfire and take this into account when developing strategies for their management and/or enhancement.

5. **Improve knowledge of introduced alien species**, especially those widely cultivated as horticultural subjects. Assess how their populations are likely to respond to climatic change and hence which of them are potentially invasive. Monitor, assess and control intentional new introductions of alien species not already present, taking into account potential impacts of climatic change and/or enhanced atmospheric CO_2 concentrations upon their potential to become invasive.
6. **Implement monitoring** of *inter alia* species' population trends, species behaviour, including phenology, and climatic change impacts upon protected areas. Select focal species as targets for monitoring on the basis that they are highly sensitive potential indicators of climatic change impacts, or else that they respond to critical biologically-relevant variables that themselves are difficult to monitor. Target monitoring to critical areas (e.g. southern Europe is important for many migratory birds).
7. **Maintain or restore intact ecosystems**. Ensure existing protected areas are managed appropriately so as to maximize their health and resilience; increase the extent of protected areas, implement buffer zones and increase connectivity by developing permeable landscapes that provide functional networks of habitat 'stepping stones' of various sizes and separations linking protected areas, thus facilitating both local adaptation and range shifts. Retain as many as possible of remaining fragments of unaltered or semi-natural habitats; create new patches of habitat where past land management has led to their absence from the present landscape; maintain and, where appropriate, increase habitat heterogeneity; take steps to increase ecosystem resilience, not only to progressive climatic change but also to extreme weather events; use a variety of mechanisms, including easements, set-aside, incentive-based schemes, local conservation strategies and public and private collaboration for conservation, to achieve these goals.
8. **Implement adaptive management practices and strategies**. Use monitoring results to inform adaptive management; improve understanding and knowledge of the practical application and effectiveness of alternative management practices; take a long-term view (20 – 50 years) when developing protected area management plans. **Act now** – do not allow uncertainties about the precise nature of future climatic changes to be an excuse for delays in taking practical conservation actions.
9. **Adopt holistic approaches to adaptation and mitigation**. Development of species' and/or habitat conservation and/or recovery plans should take an holistic view, not only across different taxonomic groups and ecosystems, but also trans-nationally and across sectors other than the biodiversity conservation sector. Adaptation strategies should aim to reduce species losses whilst mitigation measures should contribute to reducing species and/or habitat vulnerability. Steps should be taken to facilitate knowledge transfer between partners, stakeholders, including the general public, and sectors.
10. **Consider assisted colonisation and/or *ex situ* conservation** for species unlikely to achieve necessary range shifts. Evaluate potential risks and benefits, considering both target species and potential 'receiving' sites/ecosystems. Assess coverage and quality of existing *ex situ* conservation measures (e.g. seed banks, botanical garden collections); take steps to enhance these where necessary, ensuring propagules are preserved of Bern Convention and other threatened plant species.

II. REVIEW OF REPORTS RECEIVED FROM PARTIES TO THE CONVENTION

Eight parties submitted the requested reports for 2012, whilst reports for 2011 were made available from a further 13 parties. Table 2 lists those parties from which reports were received, indicating for which period(s) reports were available. Where reports were available for both periods the analysis was based only upon the report submitted for 2012.

TABLE 2: REPORTS RECEIVED

Party reporting	2012 report	2011 report
Albania / Albanie		✓
Armenia / Arménie	✓	✓
Azerbaijan / Azerbaïdjan	✓	
Belgium / Belgique		✓
Bosnia and Herzegovina / Bosnie-Herzégovine		✓
Bulgaria / Bulgarie	✓	✓
Croatia / Croatie		✓
Cyprus / Chypre		✓
Estonia / Estonie		✓
European Commission / Commission européenne	✓	✓
Georgia / Géorgie		✓
Germany / Allemagne		✓
Latvia / Lettonie		✓
Malta / Malte	✓	
Norway / Norvège	✓	✓
Poland / Pologne		✓
Serbia / Serbie		✓
Spain / Espagne	✓	✓
Switzerland / Suisse		✓
Ukraine / Ukraine		✓
United Kingdom / Royaume-Uni	✓	✓

Reports were reviewed for evidence of actions relevant to each of the ten composite actions summarised above. This evidence is summarised for each reporting party in the sections that follow, firstly for those parties who submitted a report this year in time for inclusion in this review, and then for those other parties who submitted a report in 2011. Italicised numbers in parentheses in these summaries indicate which of the 10 composite actions various measures are considered to address.

Armenia / Arménie (2012)

The forest ecosystems that cover *ca.* 11% of the country, and that form part of the Caucasus-Anatolian-Hyrcanian Temperate Forest Ecoregion, have been identified as vulnerable to climatic change and the need to enhance their resilience has been recognised. New protected areas have been established, including some forest-covered areas. The impacts of increasing aridity on forest ecosystems, including mountain forests, is being addressed through adaptation plans designed to enhance their resilience and enable ecosystem-based adaptation of rural communities; 75,000 ha of forests identified as most vulnerable to climatic change are being initially targeted for adaptation measures. (*1, 3, 7, 9*).

Forest rehabilitation and regeneration options are being piloted at four sites, making use of local genotypes of endemic species, including wild fruit and nut trees and/or local drought-tolerant tree and shrub species not generally used in forestry. The use of mixed plantings is designed to enhance resilience of the forests to climatic change, as well as to increased frequency of pests and of wildfire. The sites are monitored and adaptive management strategies are used. Knowledge gained from these pilot sites will be disseminated to inform adaptation options nationally. (*2, 4, 6, 7, 8, 9*)

Strategies are being developed to improve wildfire management nationally in both the short- and medium-term. Steps have been taken to reduce potential for ignition resulting from agricultural waste burning, and to improve the provisions made for fire suppression. Engagement with the tourism sector aims to mainstream climatic change adaptation and mitigation, as well as biodiversity conservation, in this sector. (*4, 9*)

Bio-indicators have been identified for forest health monitoring and steps taken to identify and monitor forest pests that may benefit from changing climatic conditions, including invasive species. Efforts are being made to mainstream climatic change risk considerations into management plans both for managed forests and for protected areas. (*5, 6, 9*)

Summary: The report indicates a high level of awareness of the potential impacts of climatic change upon biodiversity, and describes a series of projects and measures that are already being undertaken that are designed to address these impacts. These activities target, to a greater or lesser extent, all but the last of the composite actions identified above.

Azerbaijan / Azerbaïdjan (2012)

Protected areas have been established, forest cover restored to reduce soil erosion, and drainage systems developed to reduce soil salinization problems. Protected areas now cover 10·3% of the country. Ongoing research aims to increase knowledge of endangered species. Legal instruments have been enacted that aim to ensure the protection of genetic resources and of biodiversity generally, and the sustainable use of natural resources. An extensive programme of re-afforestation has been undertaken. Forest seed orchards have been established, providing the plant materials for these re-afforestation projects. Whilst a wider need for *ex situ* conservation measures is recognised, no coherent steps have as yet been taken to implement this, although legislation provides protection of threatened species from unlicensed collection. Some captive breeding of native species is undertaken at the Baku City Zoological Park. (*7, 10*)

As part of a suite of adaptation measures aimed to reduce the negative impacts of climatic warming on human health, an acceleration of 'greening' in cities, along with planting of vegetation in large areas around cities, is planned. These measures, if appropriately implemented, offer opportunities also to achieve biodiversity conservation targets. (*7*)

Assessment of the vulnerability of Bern Convention species and habitats is planned to be completed over the coming 2 – 3 years. (*3*)

A biodiversity monitoring network has been developed, linked to a national environmental monitoring system. (*6*)

Summary: Although the report shows clear evidence of awareness of issues relating to climatic change and its potential impacts upon biodiversity, this awareness appears as yet to have resulted in few if any specific conservation actions designed to target issues arising from climatic change. Nonetheless, some activities already in place will help ensure the general health and conservation of the country's undeniably high level of biodiversity and will provide monitoring of climatic change impacts. Other relevant activities are planned for the short-term future. Activities already underway, planned or available as future opportunities will address at least in part four of the ten composite actions identified earlier.

Bulgaria / Bulgarie (2012)

Work has been undertaken to identify those species or species groups potentially most vulnerable to negative effects of climatic change. These include in particular: marine species, including endemics, of the Black Sea for which the opportunities to move to cooler waters are limited; and glacial relict plant species limited to areas of severe (i.e. cold) abiotic conditions in the mountains. Further work is being undertaken to identify the species and ecosystems potentially most vulnerable to climatic change; alpine forests, wetlands and the lower montane zone up to 800 m altitude, and migratory birds, amphibians and reptiles, invertebrates and plants, have been initially identified as likely to be amongst the most vulnerable. (*1, 3*)

Areas identified as forming part of the Natura 2000 network account for 34·4% of the country's land area, whilst protected areas represent *ca.* 5·3% of the country. A network of marine protected areas is being developed in the Black Sea. (*7*)

Specific measures for biodiversity conservation are to be included in the Third National Action Plan on Climate Change, Strategy on adaptation to climate change (2013–20), although no details are provided as to what these measures may be.

Monitoring schemes are in place for various taxonomic groups of plants and animals. Although most of the schemes have not yet been running long enough to have provided unequivocal evidence of the impacts of climatic change, they have this potential. (*6*)

Ongoing work is addressing potential links between climatic change and the incidence of invasive species. (*5*)

The forestry sector has adopted policy priorities relating to climatic change adaptation and mitigation, prevention of and protection of forests from wildfires, and requiring development of multifunctional and sustainable forest management practices. They are also committed to monitoring of forest pests and diseases. Forest areas vulnerable either directly to climatic change or to associated natural hazards (fires, pests and diseases) have been identified. The genetic variability of the principal tree species has been assessed and the results used to inform the development of *in situ* conservation units and *ex situ* conservation collections in arboretums and seedbanks. (*4, 6, 10*)

Development of renewable energy resources as part of measures to mitigate climatic change is seen as a potential threat to some larger-bodied endangered bird species (e.g. Red-breasted Goose (*Branta ruficollis*), Imperial Eagle (*Aquila heliaca*), Egyptian Vulture (*Neophron percnopterus*), Dalmatian Pelican (*Pelecanus crispus*) and Saker Falcon (*Falco cherrug*)).

Summary: There is clear awareness of the problems posed by climatic change and of the need to incorporate the issue when developing policy and conservation strategies. Steps have been taken or are underway to identify species and ecosystems most vulnerable to climatic change. Although measures have been taken that will enhance the status of ecosystems and monitor the effects of climatic change, apparently only in the forestry sector have adaptation measures been adopted that are relevant to biodiversity conservation. Concerns are expressed about the potential negative impacts upon biodiversity of mitigation measures proposed in the energy sector, but no practical suggestions are made as to how these might be addressed. The actions reported relate to seven of the ten composite actions, but in no case do they go very far towards addressing these actions.

European Commission / Commission européenne (2012)

A study has been undertaken to assess current knowledge of risk from climate change to species and habitats of EU conservation concern protected by the Natura 2000 network and to elaborate approaches to reduce, mitigate and adapt to such impacts, both within individual sites and at broader network level. (*3*)

The Commission plans to adopt a Green Paper on a Strategy on Green Infrastructure in the autumn of 2012; it sees green infrastructure as an essential means of integrating biodiversity and climate change adaptation. Development of Green Infrastructure, using ecosystem-based approaches, is embedded in target 2 *"by 2020, ecosystems and their services are maintained and enhanced by establishing green infrastructure and restoring at least 15 % of degraded ecosystems*" of the EU Biodiversity Strategy to 2020. (*7*)

The Commission is committed to the development and application of ecosystem-based approaches to climatic change adaptation and mitigation and has made funds available for projects addressing this goal. (*7*)

A legislative instrument addressing the problem of invasive species is in preparation, although it is not apparent that this includes any explicit consideration of the potential impacts of climatic change on either invasiveness of introduced species or the invasibility of ecosystems. (*5*)

Summary: Although the measures reported only clearly address three of the ten composite actions, the Commission nonetheless is clearly taking the problem of climatic change very seriously, and embedding this throughout its activities. The commitments to green infrastructure and to ecosystem-based approaches to adaptation and mitigation have the potential to generate important win–win outcomes of benefit to biodiversity conservation. The assessment of the climatic change risk to species and habitats of EU conservation concern is an important first step towards developing adaptation policies that will limit the potential negative impacts of climatic change on European biodiversity.

Malta / Malte (2012)

The Climate Change Adaptation Strategy' adopted in May 2012 includes a number of proposed or planned actions that will address *inter alia* strengthening of protected sites, including extension to the marine realm, development of green infrastructure, habitat restoration, threats from alien and invasive species, and the maintenance of traditional agro-ecosystems. The 'National Biodiversity Strategy and Action Plan' (2012) proposes actions related to these proposals as well as further related measures, including conservation of genetic resources, development of ecological networks of protected areas, and monitoring of biodiversity. The 'National Environment Policy' (2012) includes relevant commitments, including the designation of additional marine protected areas and strengthened management of protected areas generally, ensuring an adequate knowledge base about national biodiversity and ecosystems is available by 2015, the preparation of management plans for terrestrial Natura 2000 sites by 2013, and actions related to invasive species control, restoration of damaged ecosystems and the incorporation of biodiversity issues into the policy frameworks for the agricultural and fisheries sectors. Management plans being developed for terrestrial protected areas will take into account climatic change and adaptation issues. (*3, 5, 6, 7, 9*)

An overall assessment of vulnerability of species and habitats has been made on the basis of data where these are available but principally using expert judgement; *Posidonia oceanica* meadows and littoral and sub-littoral species generally are identified as particularly vulnerable. There is some evidence that plant species from northern Africa have become established on the island in recent years. (*3*)

Challenges identified include principally knowledge limitations that limit the extent to which objective assessments of vulnerability can be made, lack of long-term monitoring data on biodiversity, lack of knowledge of native and even of endemic species. The report also draws attention to the general

problem of the extent to which climate change projections made at global, or even at regional, scales are able to make adequately resolved projections for smaller oceanic islands.

Summary: Strategies and action plans adopted this year include many relevant and important proposals and commitments, with planned actions that address at least in part five of the ten composite actions. However, to-date actions have apparently been implemented in relation to only one of these composite actions, a vulnerability assessment of species and habitats having been made. Even here, however, data deficiency meant that this assessment was based principally upon expert judgements.

Norway / Norvège (2012)

A number of ecosystems and species has been identified as likely to be especially vulnerable to negative impacts of climatic change, notably high alpine and Arctic species (e.g. Polar Bear – *Ursus maritimus*, Arctic Fox – *Alopex lagopus*) and cold-water fish (e.g. Arctic Char – *Salvelinus alpinus*). The combined effects of higher ocean temperatures and acidification are expected to lead to impacts upon marine organisms. Climatic change vulnerability assessments have been made for a number of different species and ecosystems (marine benthic fauna, seashores, Atlantic salmon, vegetation, alien species, northern Norway and Svalbard – including an assessment of the carbon sequestration capacity of the terrestrial ecosystems of these regions, mountain summer farming landscapes). In other cases climatic change vulnerability has been included in more general assessments of vulnerability to a range of pressures (seabirds, various marine area management plans). Climatic vulnerability has been assessed for a number of Bern Convention species (*Anser erythropus, Emberiza hortulana* and *Limosa limosa* (birds); *Margaritifera margaritifera, Osmoderma eremita* and *Parnassius mnemosyne* (invertebrates); *Dracocephalum ruyschiana* and *Najas flexilis* (plants); *Alopex lagopus* (mammal)). (*1, 2, 3*)

Long-term monitoring data for migratory birds document dates of arrival, breeding and autumn migration. Monitoring programmes have also been established for terrestrial ecosystems, palsa mires and mountain vegetation, all of which focus upon linkages between climatic change and biodiversity. Monitoring is also carried out of freshwater and marine ecosystems, the results from which provide insight into climatic change effects. (*6*)

An enhanced threat is expected from invasive species, many of which are expected to benefit from the shift towards milder climatic conditions, especially in winter. (*5*)

Climatic change adaptation measures are integrated into existing management structures for protected areas. (*7*)

Norwegian climate policy (2012) adopts the ecosystem approach and makes a commitment to "*prioritise measures that have positive effects for both reducing greenhouse gases and for securing biodiversity and other important environmental values*". The legislative framework requires that issues of climatic change, and environmental considerations such as biodiversity, be included in sectoral policies, and various measures are in place to promote cross-sectoral development of adaptation policies. (*9*)

Potential conflicts with biodiversity are identified arising from the development of renewable energy resources (wind power, water power, bioenergy crop production).

Seminars for teachers and pupils at secondary schools have presented scientific knowledge about man-made changes in nature, with an emphasis on knowledge about climatic change and biodiversity loss. (*9*)

Summary: Many important steps have already been taken, including a series of valuable assessments of the vulnerability of species and ecosystems to climatic change. A legislative and policy framework has been developed that embeds the needs for ecosystem-based approaches to adaptation and for biodiversity conservation to be taken into account across all sectors. A series of important monitoring schemes is in place providing valuable data about the responses of various species and ecosystems to climatic change. Overall, progress has been made with respect to at least seven of the ten composite actions, the progress in some cases being substantial.

Spain / Espagne (2012)

A 'Strategic Plan for Natural Heritage and Biodiversity' has been adopted (September 2011) that identifies a series of lines of action relating to biodiversity and adaptation to climatic change. In particular, it proposes the following actions; mapping the vulnerability of Spanish biodiversity; consolidation of ecological monitoring networks; development of a system of biological indicators for impact assessment; assessment of the protected areas – including the Natura 2000 Network – under different climatic change scenarios; evaluation of the potential of *ex-situ* conservation measures; and assessment of the impacts on ecosystems goods and services. (*3, 6, 7, 10*)

Studies have been undertaken to assess the potential impacts of climatic change on the flora and fauna of Spain. Species' distribution models and climatic change projections have been used to simulate species' potential future distributions. The results have been used to assess species' vulnerability to climatic change, to propose adaptation measures and to assess the implications for biodiversity conservation. (*3*)

A global change monitoring network has been established in the National Parks; this is a joint venture between the National Park Autonomous Organization, the Spanish Meteorological Agency, the Biodiversity Foundation and the Spanish Climate Change Office. The nature of the biodiversity-relevant monitoring being undertaken, however, is unclear. (*6*)

Summary: Potentially valuable studies have been undertaken to assess the potential impacts of climatic change on flora and fauna. A series of important targets for future work has been identified and a monitoring programme has been implemented for National Parks. Whilst all of these are important and laudable, and together they represent some progress in relation to four of the ten composite actions, it is nonetheless unclear that any practical steps have yet been taken to embed climatic change issues into the development of biodiversity conservation strategies, nor into the management plans for individual protected areas or for the network as a whole.

United Kingdom / Royaume-Uni (2012)

A 'UK Climate Change Risk Assessment' has been published (January 2012); this includes 'Biodiversity and Ecosystem Services' as one of eleven themes. Biodiversity impacts are also described under several of the other themes, notably agriculture, forestry, water and marine. There is a commitment to repeat this assessment regularly on a five-year cycle. Many other initiatives are underway, of which the following summary is illustrative rather than exhaustive. Scotland's 'Climate Change Adaptation Framework' (2009) includes a sector action plan addressing 'Biodiversity and Ecosystem Resilience'. Scotland is also committed to adopting an ecosystem approach to land-use decisions in the light of climatic change, and to build ecological networks. Mitigation opportunities related to woodlands and peatlands are identified in the 'Climate Change Strategy for Wales'. The Forestry Commission in Wales has published guidelines on species diversification to support climatic change adaptation both in timber production and in native woodlands. The 'Climate Change Risk Assessment' for Northern Ireland has identified a number of biodiversity risks that are to be addressed in a forthcoming 'Northern Ireland Adaptation Programme'. In England, a new biodiversity strategy has set out a major shift in emphasis of conservation effort towards a much extensive, more innovative and more integrated approach to biodiversity conservation. Exemplified by the Nature Improvement Areas initiative, this approach is intended to render ecological networks more coherent and resilient, and thus more able to respond to the challenges of climatic change and other pressures. Twelve Nature Improvement Areas have been established with the aims of creating more and better-connected habitats, enhancing benefits that nature provides to people and uniting local stakeholders in a shared vision for a better future for both people and wildlife. A 'National Adaptation Programme' is under development that will set out joint actions to be undertaken by a range of stakeholders. In England, a Green Infrastructure Partnership has been established by the government with the aim of planning and delivering more green infrastructure at local, city-wide and landscape levels. (*3, 7, 9*)

Projects are underway to enable assessments of the biodiversity impacts of planned renewable energy developments, and to produce 'report cards' recording observed and projected impacts of climatic change on terrestrial and freshwater species, habitats and ecosystems of the UK, and of marine climatic change on fish, fisheries and aquaculture. A further phase of the Bicconet project is planned to screen UK species' data for signals of response to climatic change. Potential impacts of climatic change on the birds of SPAs across the UK have been assessed. An assessment has been performed of the potential impacts of climatic change on plant communities, enabling an evaluation of the potential for changes in priority habitats; the results suggest that many priority habitats are already in a process of change in composition as a result of climatic change. A report has been published assessing the risks to habitats within protected areas around the UK coastline; large areas are already at risk and the risks increase throughout the present century as sea-level is projected to rise. (*1, 3, 6*)

In Scotland an assessment has been undertaken of the vulnerability to climatic change of priority habitats; adaptation priorities are being identified and integrated into relevant action plans. (*3*)

Long-term monitoring of the environment and of biodiversity is performed by the Environmental Change Network at a series of sites across the UK. In Scotland Scottish Natural Heritage has published 'Trend Notes' on changes in biodiversity resulting from climatic change as well as a climate indicator on the timing of seasonal events. (*6*)

Risk assessment procedures for introductions of non-native species have been modified to include explicit assessment of the risk that climatic change may lead to a species becoming invasive. (*5*)

Scottish Natural Heritage has commissioned a review of the use of translocations as a conservation tool and is undertaking a trial translocation of a montane lichen species. (*10*)

The Forestry Commission has undertaken or commissioned a large number of relevant projects and has developed guidelines for the creation and management of forests and woodlands taking into account projected climatic change. (*7*)

Summary: A large number of initiatives is reported, and many valuable background research projects have been undertaken or are underway. Seven of the ten composite actions are addressed at least to some extent. Notwithstanding the many positive steps taken, especially in terms of the legislative framework and various national assessments, there is a disappointing lack of evidence of 'carry through' to management practices on the ground. However, the establishment of an initial set of twelve Nature Improvement Areas in England offers hope that this will be remedied in the very near future. It is apparent from the report that biodiversity conservation efforts are sometimes disparate and, as a result, also potentially less effective, in the four components of the UK. This situation, which resulted initially from the breaking up of the former Nature Conservancy Council, has apparently been exacerbated since the devolution of powers to the Scottish Parliament, Welsh Assembly and Northern Ireland Assembly. At a time when holistic and trans-national approaches to biodiversity are of greater importance than ever before, this situation is especially to be regretted. It is to be hoped that a more holistic approach to the problem can be adopted with the various 'national' agencies working in partnership.

Albania / Albanie (2011)

A vulnerability assessment of the entire coastal zone has been performed. The Drini and Mati River Deltas region has been identified as having critical vulnerability as well as harbouring considerable biodiversity; a project underway is identifying and implementing adaptation response measures. The aim is to build adaptive capacities and achieve resilience both of ecosystems and local livelihoods. The 'National Biodiversity and Action Plan' (2000) is being updated during 2012. (*1, 3, 9*)

Summary: Key steps have been taken to identify vulnerable systems and to identify and implement adaptation measures in one of the most vulnerable systems.

Belgium / Belgique (2011)

A 'National Climate Change Adaptation Strategy' was adopted in 2010, including proposals for adaptation actions for biodiversity and ecosystems; this will form the basis for development of a national adaptation plan. Actions are being implemented that aim to enhance the resilience of marine ecosystems to climatic change. The 'Federal Plan' (2009–13) integrates biodiversity into four key sectors (economics, development cooperation, science and transportation) and makes a commitment to REDD+, including contributing to pilot projects. The 'Science for a Sustainable Policy' programme (2006–11) has supported a number of research projects that aim to improve knowledge of the processes relating climatic change adaptation and mitigation measures to biodiversity. (*3, 7, 9*)

An assessment of the climatic change vulnerability of biodiversity has been carried out in the Walloon Region and an action plan for biodiversity protection and ecosystem resilience produced. Restoration of the ecological network to facilitate migration was identified as an action in the Walloon 'Action Plan for Air and Climate' (2007). The Walloon 'Rain Plan' includes actions to conserve and restore wetlands, including restoration of flood plains, that will have positive benefits for biodiversity. Recommendations have been developed on forest management in the Walloon Region in the context of climatic change. The Flemish 'Climate Policy Plan' largely omits biodiversity issues aside from some forestry issues identified as of priority concern. Biodiversity is a key theme in the 'Flemish Adaptation Plan', preparation of which was underway in 2011. The Brussels Region has made commitments to green infrastructures and to a blue network that aims to improve the ecological status of rivers, lakes and wetlands through a series of restoration projects. A new strategy for the management of the Sonian Forest is being prepared that will take into account the potential impacts of climatic change on dominant tree species. Regional Nature Action Plans or Nature Plans are under development; these will include actions favourable to the adaptation of biodiversity to climatic change. (*3, 7*)

Monitoring activities have indicated northward range shifts of southern species of dragnonfly, seven species of which have become established in the Walloon Region over the past two decades; southern European species have also been recorded more frequently in Flanders, and some of these have established permanent populations. In the Flemish Region eight of twenty-six species of dragonfly examined appeared earlier in spring between 1984 and 2006 ad the flying season for dragonflies has extended by two weeks on average. Some southern butterfly species have shown northward range expansions into the Walloon Region, although others that use habitats that are rare in the region have failed to expand. The arrival dates for migratory birds have advanced over the past twenty years, by an average of 0·45 d yr^{-1} for 15 species monitored in the Flemish Region. (*6*)

Summary: Steps have been taken to improve knowledge and to embed biodiversity conservation concerns into the process of strategy development in other sectors. Various legislative measures and plans have been implemented or are being prepared. Although monitoring has shown clear evidence of species responding to climatic change, few relevant actions have yet been implemented and only four of the composite actions are in part addressed by what is reported.

Bosnia and Herzegovina / Bosnie-Herzégovine (2011)

The country has an exceptionally high diversity both of habitats and of species, including many endemics. The ecosystems assessed as most vulnerable to climatic change are those of highlands and mountains, especially the higher mountains, those of karst areas, those of the sub-Mediterranean region of forests and woodlands, and those of the margins of the Pannonian Basin that extends to the north-east of the country. Whereas higher temperatures are the principal threat to the upland ecosystems, including the *Abies* (Fir) forests of the montane zone, more frequent and extensive floods are identified as the principal threat to the Pannonian ecosystems. (*3*)

A programme has been established to monitor the effects of climatic change on biodiversity, both in terms of species diversity and ecosystem diversity. (*6*)

Although the country favours adoption of ecosystem-based approaches to adaptation, a number of constraints is identified, including incoherency between sectoral plans, limited public awareness of the importance of biodiversity conservation and especially of its potential contributions to climatic change adaptation and mitigation measures, limited human and institutional capacities, and limited financial resources to undertake the necessary underpinning scientific research.

Hydro-power projects, promoted as a key component of strategies for mitigation through the development of renewable energy sources, are one of the main causes of habitat conversion or loss int eh country.

Summary: Initial steps have been taken to identify the most vulnerable ecosystems and a monitoring programme has been established. However, a lack of coherency between sectors, resource limitations, and proposals for mitigation measures that do not take into account their negative consequences for biodiversity, all give cause for concern about the extent to which the recommended actions are being adopted. Only two of the composite actions are identified as being addressed, and these are only being addressed to a very limited extent. Given the high diversity of the country, the general lack of progress must be viewed as a serious issue.

Croatia / Croatie (2011)

The country is one of high biodiversity; it has established protected areas that now extend over 11·26% of the land area and 1·56% of the territorial sea area. In addition, a National Ecological Network covers 47% of the land and 39% of the territorial sea area. A Red List has been compiled in which 2235 taxa from six groups (vertebrates, butterflies, dragonflies, cave fauna, vascular plants and fungi) are listed as threatened; all of these have strict legal protection. Work is underway to identify sites for the Natura 2000 network. (*3, 7*)

The 'Strategy and Action Plan for The Protection of Biological and Landscape Diversity of the Republic of Croatia' includes a number of actions relevant to the impacts of climatic change on biodiversity. It calls for the development of a monitoring programme that will monitor climatic change impacts on biodiversity and for monitoring of invasive species that are indicators of climatic change. To-date, however, only a single project is reported that can be seen as potentially contributing directly to this programme; this project is investigating how climatic change is affecting the timing of migration and nesting in migratory birds. No activities related to the identification and development of possible adaptation or mitigation measures have yet commenced. (*5, 6*)

Although experts have predicted the vulnerability of the country's biodiversity to climatic change, this has not yet been recognised as important at the national policy level. Karstic coastal regions are identified as potentially one of the most vulnerable systems, especially to the effects of sea-level rise associated with climatic change. Research has shown evidence already that more southern species of marine fish have expanded northwards in the Adriatic. (*3*)

Summary: For a country that hosts such a wide range of biodiverse habitats, the lack of progress reported is a cause for serious concern. Viewed generously, the actions reported can be considered to address in part four of the ten composite actions, although when examined closely only the proposal to develop monitoring relates directly to the issue of climatic change, and this appears not to have progressed beyond a call for their development. The reported lack of recognition at the national policy level of the challenges and opportunities that will result from the responses of species and ecosystems to climatic change is distressing.

Cyprus / Chypre (2011)

Whilst the need to address the issue of climatic change across all sectors of activity, including biodiversity conservation, has been recognised, the status reported is one in which a series of action plans and assessments are being prepared. Those most relevant here are the 'National Action Plan to Combat Desertification', the 'National Action Plan on Biodiversity' and the 'Impact Assessment of Climate

Change on the Forests of Cyprus'. Aside from the commitment to prepare these various documents, no actions are reported relating to climatic change, in particular to the conservation of biodiversity in the face of climatic change or to the implementation of adaptation or mitigation measures.

Summary: It appears that, whilst the problem has apparently been recognized, no substantive actions have yet been implemented. This is a very distressing state of affairs, especially for a country that has been a member of the EU since 2004.

Estonia / Estonie (2011)

An unusually diverse country for its latitude, in part because of the widespread occurrence of limestone along the Baltic coastline, almost 18% of its land area is in some form of protected area. Although no exhaustive national study has been made of the potential impacts of climatic change, the quite astonishing statement is made that these impacts are "*expected to be relatively small compared to the southern and northern regions of Europe*" and "*Therefore no significant consequences are expected for biodiversity*…". Furthermore, no national adaptation strategy or policy has yet been formulated, although the aim of adapting to climatic change has been included in some draft documents. Funding is being sought to enable the mapping of climatic change impacts, awareness raising and the development of measures, all of which are seen as leading towards the development of a national climate adaptation strategy; no timescale for this is specified, however. (*7*)

Estonian partners are involved in an international project BALTADAPT that aims to develop circum-Baltic adaptation strategies for the sea and coastal zone. Given that the project leadership includes the Federal Ministry for the Environment, Nature Conservation on and Nuclear Safety of Germany, and that the project home page refers clearly to the "*Baltic Sea Ecosystem*" and identifies climatic changes as likely to "*jeopardize the integrity of the ecosyste*m", it is surprising that there is no explicit mention of biodiversity issues in this context in the present report. (*3, 7, 9*)

Steps are being taken, through the Baltic Environmental Forum (BEF) BaltClim project to encourage and support relevant stakeholders to initiate climatic change adaptation programmes, although the information given makes no explicit reference to biodiversity and the BEF www page offers no further information that can clarify this. (*9*)

Summary: Viewed generously, the activities and status reported does represent some progress towards three of the ten composite actions. However, the statement that climatic change impacts are "*expected to be relatively small compared to the southern and northern regions of Europe*" and "*Therefore no significant consequences are expected for biodiversity*…" is not only astonishing, but quite at variance with the results from a series of published studies. Huntley *et al.* (2007) project a net loss of avian species richness in the country by the end of the present century, with a shift of the assemblage from predominantly that which they characterise as South Boreal – Montane to that which they characterise as Nemoral; they also project range changes by many species that will result in species being lost or gained by the country. This corresponds to the shift from Hemiboreal mixed forest to predominantly Temperate mixed broad-leaved forest simulated by Hickler *et al.* (2012), and to the change in vegetation type simulated by these authors for the majority of Natura 2000 sites in the country. Similarly, Settele *et al.* (2008) simulate potential range changes for butterflies in Europe, showing numerous species potentially being lost or gained by the country. Whilst the reported failure even to begin to formulate a national adaptation strategy or policy is deplorable, it is presumably related to the unfounded and inaccurate denial that the country and its biodiversity will suffer substantial climatic change impacts. Hopefully this is a state of affairs that will soon be remedied.

Georgia / Géorgie (2011)

The vulnerability of various ecosystems was assessed, adaptation projects developed and activities to raise public awareness were arranged during the process of preparing the country's second national notification to the UNFCCC (2006–9). Three regions of particular vulnerability were identified: the Black Sea coast; the Dedoplistskaro district; and Kvemo Svaneti; these regions have been evaluated

in terms of vulnerability and adaptation measures. Significant negative impacts are projected for protected areas along the Black Sea coast, principally as a result of sea-level rise. Increased salinity of Paliastomi Lake has already led to the replacement of endemic fish species by more widespread marine species; although climatic change adaptation measures are planned for this site no evidence is given as to what these might be. The Dedoplistskaro district is subject to desertification with evidence already of species typical of hotter and more arid areas to the south establishing in the region and other species formerly typical of the in decline. The district has a number of protected areas that together cover 12% of its area. A monitoring system is to be established with the aim of evaluating climatic change impacts on the endemic flora and fauna. In Kvemo Svaneti the principal issues that are believed to relate to climatic change are increases in the incidence of various forest pests and consequently of damaged trees, which is now 20%, increasing incidence of drought stress in the forests and the loss of area and volume of glaciers in the mountains. The principal adaptation measure of relevance identified to-date is one that aims to rehabilitate and improve the management of severely damaged forests. (*1, 3, 6, 7*)

Summary: Important and valuable first steps have been taken that address at least in part four of the ten composite actions. Although problems have been identified that already are evident and that are likely to be related to climatic change, there is no evidence of a systematic assessment of vulnerability to projected future climatic change. The adaptation measures being developed to address the current problems are reactive; there is no indication of longer-term planning or of the development of pro-active strategies for adaptation, mitigation and the conservation of biodiversity in the face of projected climatic changes.

Germany / Allemagne (2011)

The report from this country begins with a vision for the future that all countries ought to be ready to adopt. A primary aim is to achieve even greater reductions in greenhouse gas emissions than is agreed generally by the EU, with a commitment to limiting the increase in global mean temperature to 2°C above its pre-industrial value. A key aim relating to biodiversity conservation is then presented, namely that "*Sensitive species and biotic communities are able to respond to climate-induced changes by means of geographical migration within a network of spatially or functionally linked biotopes that will have been created by 2020*". This is complemented by a third aim to increase by 10%, by 2020, the natural storage capacity of land habitats for CO_2; this aim will be realised through measures that also will have biodiversity benefits (re-watering and re-naturation of peatlands; increase in semi-natural forests). (*7, 9*)

The report lists a series of aspirations that would contribute to the attainment of these aims; these are worthy of being reproduced here in full:

- *To achieve an international system of interlinked biotopes* (*7, 9*)
- *To continuously increase CO_2 sink capacity by creating new forest areas in suitable locations* (*7, 9*)
- *To promote natural development throughout all upland moors and peatland forests; to significantly reduce peat harvesting from 2015 coupled with an increase in the use of peat substitutes in horticulture; to rewet dehydrated sites* (*7, 9*)
- *To give increased consideration to the interactions between biodiversity and climate change throughout all areas of social action* (*9*)
- *To more widely integrate biodiversity protection into the German Government's climate protection programme* (*9*)
- *To promote greater cooperation between all national and international players in the updating and implementation of the Convention on Biological Diversity, the Framework Convention on Climate Change and the Kyoto Protocol, as well as the Convention to Combat Desertification.* (*9*)
- *To formulate a concept on "nature conservation and climate change" by July 2008* (*9*)

- *To formulate and establish a system of indicators for assessing the impacts of climate change on biological diversity by 2015.* (*6*)

Summary: This report is presented at a high level; as a result it could be criticised for lacking details of specific measures, and it only makes explicit reference to actions that can be identified as contributing to attainment of three of the ten composite actions. However, it is clear from the tone of the report that Germany is committed to taking the actions necessary to address the impacts of climatic change on biodiversity, to integrate biodiversity issues across sectors, and to develop adaptation and mitigation measures that also benefit biodiversity and hence represent win–win solutions.

Latvia / Lettonie (2011)

The 'National Environmental Policy Strategy' (2009) aims to minimise conflicts between biodiversity conservation and mitigation measures, although no indication is given in the report as to whether this goes further and seeks win–win measures of benefit in both sectors. The 'State Programme for Environment Monitoring' (2010) includes a commitment to a biodiversity monitoring programme. (*6, 9*)

The University of Latvia is a partner in the BaltAdapt project that aims to develop an adaptation strategy for the entire Baltic Sea Ecosystem. Latvia is also a partner in the FUTURE Forest project that aims *inter alia* to ensure that European forests are well adapted and resilient to the effects of climatic change and able to deliver multiple benefits. Principal emphasis, however, in this and other projects is given to the forestry sector and forest production, with no explicit mention of biodiversity. (*9*)

Summary: What is reported is very limited in relevance to biodiversity conservation and the impacts of climatic change on biodiversity; it only addresses, and then only in part, two of the ten composite actions. Whilst the policies being adopted are welcome and laudable, there is a lack of evidence of either specific relevant actions or of the vision and commitment needed to develop the necessary strategies.

Poland / Pologne (2011)

A cross-sectoral seminar (November 2010) addressed the topic "*Biodiversity and climate change – risks, prospects and trends of measures*"; this was seen as a first step towards developing an assessment of the potential impacts of climatic change on the country's biodiversity. Following the seminar, recommendations for administrative measures relating to nature conservation were included in 'Poland 2030'. A national sectoral adaptation policy is being prepared, due for completion by the end of 2012. The 'National Program of Increasing Forested Areas' aims to increase the extent of forested areas to 30% of the area of the country by 2030 and to 33% by 2050; it is not clear, however, whether this will be achieved principally or even solely by the development of areas of production forestry, as opposed to by the creation of areas of semi-natural woodland that would potentially provide important habitats and contribute to the development of a coherent network of habitats that would facilitate species' range shifts. (*9, 7*)

Summary: It is clear that Poland is at an early stage in the recognition of the problems faced by biodiversity as climate changes, and has yet to come to grips with the challenges and opportunities that will arise as strategies are developed for adaptation and mitigation. As yet it is unclear that any concrete and directly relevant actions have been undertaken, although what is reported can, if viewed generously, be seen as contributing towards two of the ten composite actions.

Serbia / Serbie (2011)

Habitats most vulnerable to climatic change have been identified; these include steppes, wetlands and forests. In the case of forests, the potential for climatic change to lead to increased frequency of pest outbreaks and to increased risk of wildfire is recognised. Mountain-top species, especially those that are endemic and that often also already have small populations, are identified as perhaps the most vulnerable group of species. However, no systematic monitoring of the effects of climatic change on biodiversity is taking place. (*1, 3, 4*)

The 'Strategy of Biological Diversity of the Republic of Serbia' (2011-2018) includes a 'National Action on Climate Change' that includes *inter alia* commitments to: develop and implement a 'National Biodiversity and Climate Change Action Plan'; develop climate change adaptation strategies for PAs based on the results of climate change vulnerability analysis; conduct a national climate change vulnerability assessment focused on protected areas and vulnerable, rare and threatened ecosystems; identify indicators, information and equipment requirements and priorities for the long-term monitoring of climate change impacts on biodiversity. The action plan also calls for steps to evaluate and refine adaptation strategies and to facilitate information exchange with resource and land managers, decision makers and the general public. (*3, 6, 7, 9*)

Projects underway aim to strengthen administrative capacities for protected areas, to identify and establish a series of sites to form the Natura 200 and EMERALD networks in the country, and to research the influence of climatic change, considering impacts, adaptation and mitigation. A planned future project will address the impact of climatic change on forest biodiversity. (*7*)

Summary: Important first steps have been taken, in terms of identifying ecosystems and species likely to be most vulnerable to climatic change. Commitments have been made that will address other important issues, but as yet the amount of concrete and directly relevant action appears limited. Thus, although some progress has been made in relation to addressing, at least in part, five of the ten composite actions, the amount of real progress is small.

Switzerland / Suisse (2011)

A preliminary version of a climatic change adaptation strategy, designed to address impacts and measures for adaptation to 2050, is reported to be under consultation. Amongst the objectives of this strategy, biodiversity is considered under a generic aim to increase the adaptive capacity of all resources where it is considered one of the nine sectors most affected by climatic change. The need for action at all levels from genes to ecosystems has been recognised and a series of specific actions/targets has been identified. These address the needs to identify biodiversity components most impacted by climatic change, to co-ordinate measures nationally and internationally, to take immediate action for habitats already being negatively influenced (wetlands, alpine habitats), to take measures to achieve early detection of invasive species, to develop an ecological infrastructure that will provide a wide range of potential pathways for species shifting their ranges and that is embedded internationally, and to ensure that adaptation measures adopted by other sectors take into account potential impacts upon global biodiversity and ecosystem services. (*1, 3, 5, 7, 8, 9*)

Monitoring of alpine peak vegetation and its changes over the past century is being undertaken and data from a wider national biodiversity monitoring programme have been analysed to investigate climatic change related changes in selected species groups. Research is being undertaken into methods for *ex-situ* conservation and assisted colonisation as a means to conserve threatened plant species. (*6, 10*)

Summary: Although what is reported includes actions that address, at least in part, eight out of the ten composite actions, there is nonetheless a lack of evidence of the implementation of concrete and directly relevant actions. A great deal is planned, proposed or underway, but the report lacks evidence of implementation. An excellent aspect of the approach being taken, however, is the recognition of the need to embed national actions within the international context; given that most European countries have at least some land borders, and that Switzerland is certainly not the only land-locked European country, there is an important lesson here for most other parties.

Ukraine / Ukraine (2011)

National policy documents make commitments to biodiversity conservation and the development of an ecological network. To-date 5·7% of the country's territory is within protected areas. The development of the ecological network is undertaken at the regional level (oblasts); to-date schemes have been approved in four oblasts (Crimea, Zhytomyr, Ternopil and Kyiv). International ecological corridors have been developed to facilitate migration of a number of large vertebrates (bison, brown bear,

lynx, wild boar) and other species between protected areas in Ukraine and Poland (Turkivsky eco-corridor, linking protected areas in Poland to the Skolivsky Beskidy National Park) and in Ukraine and Romania (Bukovinsky eco-corridor, linking Vanatori Neamt National Park" (Romania) to the Vizhnitsky National Park). Negotiations are well advanced with the governments of Poland and Belarus for the establishment of the Zakhidne Polissya trans-boundary biosphere reserve; work is in progress towards the development of three further trans-boundary reserves on the borders with Romania, Poland and Russia respectively. (*7, 9*)

An enumeration of invasive plant species has been undertaken. (*5*)

Summary: Although policy commitments have been made to biodiversity conservation and the development of ecological networks, there is little evidence in the report of the embedding of issues relating to the potential impacts of climatic change on biodiversity into either policies or actions. The actions reported only address, and then only in small part, three of the composite actions. The efforts to develop international ecological corridors and trans-boundary protected areas, however, are particularly important and valuable, and provide an example which other parties should be encouraged to emulate.

III. SYNTHESIS AND ANALYSIS OF IMPLEMENTATION OF RECOMMENDATIONS

The above review of the reports received from parties to the Bern Convention makes clear that the extent to which parties have to-date implemented the recommendations made by the Expert Group is both extremely variable and overall rather disappointing. Even at the level of the ten composite actions identified earlier, few parties appear to have taken actions that relate to more than about half of these, and even then most of the actions address the relevant composite action only to a limited extent. Table 3 presents a summary of the composite actions identified as having been addressed, at least in part, by the reporting parties.

TABLE 3: COMPOSITE ACTIONS IDENTIFIED AS ADDRESSED BY THE RELEVANT REPORTS

Party reporting	**Composite actions**										
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Σ**
Albania / Albanie (2011)	✓		✓						✓		3
Armenia / Arménie (2012)	✓	✓	✓	✓	✓	✓	✓	✓	✓		**9**
Azerbaijan / Azerbaïdjan (2012)			✓			✓	✓			✓	**4**
Belgium / Belgique (2011)			✓			✓	✓		✓		4
Bosnia and Herzegovina / Bosnie-Herzégovine (2011)			✓			✓					2
Bulgaria / Bulgarie (2012)	✓		✓	✓	✓	✓	✓			✓	**7**
Croatia / Croatie (2011)			✓		✓	✓	✓				4
Cyprus / Chypre (2011)											0
Estonia / Estonie (2011)			✓				✓		✓		3
European Commission / Commission européenne (2012)			✓		✓		✓				**3**
Georgia / Géorgie (2011)	✓		✓			✓	✓				4
Germany / Allemagne (2011)						✓	✓		✓		3
Latvia / Lettonie (2011)						✓			✓		2
Malta / Malte (2012)			✓		✓	✓	✓		✓		**5**
Norway / Norvège (2012)	✓	✓	✓		✓	✓	✓		✓		**7**
Poland / Pologne (2011)							✓		✓		2
Serbia / Serbie (2011)	✓		✓	✓		✓	✓		✓		6
Spain / Espagne (2012)			✓			✓	✓			✓	**4**
Switzerland / Suisse (2011)	✓		✓		✓	✓	✓	✓	✓	✓	8
Ukraine / Ukraine (2011)					✓		✓		✓		3
United Kingdom / Royaume-Uni (2012)	✓		✓		✓	✓	✓		✓	✓	**7**
Totals/Means – for all 21 parties	8	2	16	3	9	15	17	2	13	5	4·29
– for the 8 parties reporting in 2012	**4**	**2**	**8**	**2**	**6**	**7**	**8**	**1**	**4**	**4**	**5·75**
– for the 13 parties reporting only in 2011	4	0	8	1	3	8	9	1	9	1	3.39

Parties indicated in **boldface** are those for which a report for 2012 was available for this review. Values in the lower right of the Table are means of the number of composite actions identified as being addressed across all 21 reports examined, by the 8 reports for 2012 and by the 13 reports for 2011 that were reviewed.

As is evident from Table 3, those parties responding to the specific call to submit reports this year (2012), that would provide the principal basis for this analysis, have reported actions that on average address, at least in part, 70% more of the composite actions than do those reports submitted by other parties in 2011. Nonetheless, some general patterns emerge that can be seen in the reports submitted in both years. In particular, whereas four of the composite actions (*3, 6, 7, 9*) are addressed much more frequently than the remainder, three are rarely addressed (*2, 4, 8*). A brief analysis is presented below for each of the ten composite actions.

Target as a priority the most vulnerable regions/ecosystems

Four of the eight reports for 2012, and a further four of the 2011 reports, included evidence that this action had been addressed, at least in part. In general, however, only the first part of the action had been addressed: Those parties whose reports indicated relevant activity generally had done no more than identify relevant priority regions/ecosystems. The most frequently noted priorities were mountains, wetlands and the coastal zone, although Arctic regions and ecosystems were also noted where they were relevant to the reporting party.

There was very little evidence in any of the reports to suggest that the need to improve knowledge of potential losses of such vulnerable habitats is being addressed, nor that any assessment has yet been made of the combined impacts of climatic change and land-use changes. There also was little or no evidence of any activities being undertaken that would represent efforts to minimise other pressures on these most vulnerable priority habitats.

Enhance the adaptive capacity of vulnerable species

Only in two of the eight reports submitted in 2012 was evidence identified of activities relevant to this action. In the case of Armenia, forest rehabilitation efforts are making use of local genotypes of endemic species, thus increasing the populations of these vulnerable species that previously have not generally been used in forestry; this directly addresses the headline action for this composite action. In the case of Norway, assessments have been made of the vulnerability of seabirds and marine organisms to the combined effects of climatic change and of other pressures, including ocean acidification, thus addressing the need to identify threats other than climatic change when considering vulnerable species.

Although a number of the reports indicated that efforts had been made to improve knowledge of the vulnerability of species to climatic change (see the next composite action), no evidence was identified of the explicit development of climatic change *adaptation* plans targeting individual species, even for those species identified as most vulnerable, nor of efforts to address threats, other than climatic change, to vulnerable species. Whilst the first of these apparent gaps may well represent a real failure to take action, the latter is more likely to reflect the omission from the reports of specific reference to ongoing conservation efforts that target the vulnerable species. The Group of Experts may wish to address this latter omission by modifying the indicative content for the reports that they request in future.

Improve knowledge of species and habitats of special concern

This action was one of those that was most frequently identified as having been addressed, at least in part; all eight of the 2012 reports address this action, as do eight of the thirteen 2011 reports examined. The extent to which the action was being addressed varied considerably, however. In many cases climatic change vulnerability assessments had been made, although often only for a limited number of priority species. Only in a minority of cases was evidence presented indicating that species' distribution models had been developed for a wide range of species and used to simulate potential future distributions and hence to identify the most vulnerable species: The report from Spain, however, draws explicit

attention to two complementary projects that have performed such analyses for higher plants and for a range of vertebrates native to that country. Once again, however, the lack of evidence of such activity in the other reports may represent an omission from the reporting process rather than a failure to take action: In the United Kingdom, for example, although not mentioned in the report submitted, the MONARCH project (http://www.eci.ox.ac.uk/research/biodiversity/monarch.php, see also: Berry *et al.*, 2002) some years ago undertook species' distribution modelling of a large number of species from a range of taxonomic groups, the results being used to assess their vulnerability to climatic change.

Rather few of the reports indicated that assessments of species' vulnerability to climatic change had subsequently been used to update or develop conservation statements or recovery plans for these species. Although several reports made reference to the existence of national 'Red Lists/Books', none indicated that any efforts had been made, or were underway, to incorporate climatic change vulnerability into the assessments of threatened status. Given that the IUCN guidelines for the use of the 'Red List' categories and criteria (http://intranet.iucn.org/webfiles/doc/SSC/RedList/RedListGuidelines.pdf) now include explicit guidance on how threats from climatic change may be incorporated, however, revision of the threat status, at least for the most vulnerable species, is an action that parties ought to consider undertaking, although not at the expense of more concrete conservation actions that urgently are needed.

Improve knowledge and understanding of the role of wildfire

Only in two of the 2012 reports, those from Armenia and from Bulgaria, and in the 2011 report from Serbia, was evidence detected that explicit consideration was being given to the potential impacts of wildfire, and especially of the potential for climatic change to result in changes in the frequency, intensity and/or extent of wildfires. In the case of Armenia the focus is on reducing likelihood of ignition, improving provisions for fire suppression and increasing the resilience of forests through the use of mixed plantings. In Bulgaria the relevant actions all relate to the forestry sector, rather than the biodiversity sector, and include the identification of forest areas considered vulnerable to wildfires and measures to prevent and protect forests from wildfires. In the case of Serbia there is simply a recognition of the potential for climatic change to increase the risk of wildfire in forest areas.

None of the reports indicates that efforts are being made to address the headline action, nor is there evidence that the role of fire is being included generally in vulnerability assessments, nor in the development of strategies for the management of protected areas. This is especially of concern in Mediterranean countries, in those central and eastern European countries with extensive areas of steppe grasslands and in those northern European countries lying in the Boreal forest zone, although as discussed above the potential for climatic change to lead to the risk of wildfire in regions not generally considered fire prone makes this a factor that is relevant for all parties to consider.

Improve knowledge of introduced alien species

Invasive species issues are addressed in nine of the reports reviewed, including six of the eight 2012 reports. In most cases the focus is upon the headline issue of improving knowledge of such species, although the issue of the need for control of introductions is also frequently mentioned. Only very rarely is mention made explicitly of the need to include assessments of the potential impacts of climatic change on the invasion potential of proposed introductions, and no evidence was identified of attention being given to the potential for increasing atmospheric CO_2 concentrations to alter species' invasion potential.

None of the reports indicated that any extensive and systematic assessment was being made of how climatic change might alter the invasion potential of species already present and widely cultivated in horticulture, although this is likely to be the principal source of newly invasive species in most terrestrial ecosystems over the coming decades. Explicit consideration was given in some cases to invasive marine species, notably those introduced in the ballast water discharged by ships, although no evidence was identified of efforts to assess the extent to which climatic change may alter the invasion potential of species regularly introduced in this way but not at present invasive.

Implement monitoring

Implementation of new efforts to monitor biodiversity and/or the existence of established monitoring schemes was reported by seven of the eight 2012 reports and by eight of the 2011 reports reviewed. In most cases the monitoring reported was of species' distributions and/or of species' phenology. Monitoring of species' populations, however, was rarely mentioned. This is a surprising omission, given that many of the reporting parties are participants in the regular monitoring of populations of bird species carried out by the Pan-European Common Bird Monitoring Scheme (PECBMS) that provided the data for one of the first indicators of the impacts of climatic change upon wildlife (http://www.eea.europa.eu/data-and-maps/indicators/impact-of-climate-change-on/, see also: Gregory *et al.*, 2009).

Of concern is the general lack of evidence of monitoring of climatic change impacts upon protected areas, of targeting of monitoring to critical areas, or of identifying and targeting focal species likely to be particularly sensitive potential indicators of climatic change impacts. Although work at a European scale, such as that mentioned above, is to some extent addressing the last of these, with a focus upon birds and butterflies, and these groups also have been adopted as indicators by some national governments (see e.g. http://www.butterfly-conservation.org/article/9/20/butterflies_get_frisky_in_role_as_climate_indicators.html), it is disappointing that such efforts are not evident in the reports reviewed.

No evidence was identified of the targeting of monitoring to species that respond to critical biologically-relevant variables that themselves are difficult to monitor. This may reflect a failure to identify such biologically-relevant variables, and/or to appreciate the potential for such monitoring. An obvious example, however, would be the sensitivity of higher plants generally to soil moisture availability, but the generally sparse and disparate data available from monitoring of this variable directly. Monitoring of plant species targeted because of their particular sensitivity to soil moisture, however, could provide important evidence of changes in this important variable and of its ecological impacts.

Maintain or restore intact ecosystems

This was perhaps the easiest composite action for which to find evidence, and this is reflected by the fact that relevant activities were identified in most of the reports, including all eight submitted for 2012 and nine of those from 2011 that were reviewed. However, in a majority of cases the evidence was simply of the establishment and management of protected areas, with actions to increase the extent of protected areas identified in rather fewer reports, and actions relating to the need to increase connectivity and establish functional ecological networks being identified in only a minority of cases. Nonetheless, there were some excellent examples of good practice in relation to steps being taken to address this composite target. Amongst these, attention should be drawn, in particular, to measures and/or commitments reported by Germany, Switzerland, the United Kingdom and Ukraine.

The efforts to achieve international co-operation and co-ordination in addressing this target were particularly welcome, exemplified by the development of trans-boundary national parks and ecological corridors (Ukraine), and by the BaltAdapt project that addresses the Baltic Sea Ecosystem as a whole.

Implement adaptive management practices and strategies and Act now

It was extremely disappointing that this very important action was one of those for which evidence was most difficult to find; only in one of the 2012 reports (Armenia) was evidence identified that adaptive management practices were being implemented, i.e. that management would be informed by appropriate monitoring, the practices employed being modified if necessary in the light of this monitoring so as to ensure that the desired outcomes were achieved. Globally, however, whilst much is written about the desirability of adaptive management strategies, it has generally been slow to be adopted; it is perhaps, therefore not surprising to see little evidence of the application of this approach by the parties. What is surprising, however, is the lack of evidence of the recognition of the desirability of the approach, and hence of commitments to adopting the approach.

There was also little evidence of recognition of the need to take a suitably long-term view when developing protected area management plans, especially where forest ecosystems are concerned, but more generally where the organisms that dominate the ecosystem are relatively long-lived (e.g. re-sprouting woody species in Mediterranean ecosystems) and/or the ecological processes are slow (e.g. in Arctic tundra and high mountain ecosystems).

Recognition of the need for immediate *practical* action – to **Act now** – was identified in only one of the reports reviewed (Switzerland). A majority of the reports did, of course, report actions that had been taken or were being taken, but in most cases these related to the development of policies or legislative measures, the preparation of strategies, the launching of projects, the initiation of monitoring schemes, and the like. None of these was considered to address the need for immediate *practical* actions, because the actions that are needed immediately are principally conservation management actions that address such issues as: the need to minimise other pressures on the most vulnerable habitats and regions (composite action 1); the need to take steps to increase the populations of vulnerable species and urgently to address threats, other than climatic change, faced by these species (composite action 2); the need to increase knowledge of the vulnerability to climatic change of species that are already rare and/or threatened (composite action 3); and the need to incorporate an assessment of vulnerability to wildfire when preparing or revising protected area management plans (composite action 4).

Adopt holistic approaches to adaptation and mitigation

Half of the 2012 reports and nine of the 2011 reports reviewed included evidence that steps were being taken to address this composite action. The nature and extent of those steps was, however, extremely varied. Examples of good practice (e.g. Germany, Norway, United Kingdom) made clear that biodiversity conservation concerns were embedded in the development of strategies across most or all principal sectors, and that in developing adaptation and/or mitigation strategies, win–win measures were favoured and/or being adopted. In other cases, the good practice identified relates to recognition of the need to take a trans-national view when developing ecological networks (e.g. Switzerland, Ukraine) and protected areas (Ukraine). Several reports referred to a commitment to increase the extent or use of green infrastructure, and in one case reference was also made to the development of a blue network (Belgium). A commitment to an 'ecosystem-based' approach was frequently reported, although it was not always clear how this term was being interpreted.

Several of the reports included evidence that steps were being taken to facilitate knowledge transfer, including the presentation of seminars for representatives from other sectors and preparation of material targeting school teachers and pupils.

Consider assisted colonisation and/or ex situ conservation

Four of the 2012 reports and one of the 2011 reports reviewed included specific reference to the development or implementation of assisted colonisation or *ex situ* conservation measures. Assisted colonisation for a lichen was reported as being attempted in Scotland, although the development of seed banks for threatened plant species was the measure most frequently being implemented. *Ex situ* conservation measures for vertebrates, through captive breeding programmes, were mentioned only rarely, although a number of countries that did not mention this activity are known to have zoological gardens where such captive breeding programmes for threatened species are implemented (e.g. United Kingdom).

Despite discussion of the measures in five of the reports, no evidence was identified of efforts explicitly to evaluate the potential risks and benefits of either assisted colonisation proposals or of *ex situ* conservation programmes.

CONCLUSIONS

A number of conclusions can be drawn from the review and analysis presented above. Key amongst these are the following:

1. The majority of parties who submitted reports in 2012 or 2011 recognised the need to take action in relation to the conservation of biodiversity in the face of climatic change. It was extremely disappointing, however, that one party took the view that this was not a matter of concern for their country. It was also of concern that one other country, whilst apparently recognising the problem, had yet to initiate any relevant actions.
2. Although many of the parties reported actions relating to the development of policies, strategies or legislative measures designed to address specifically the issue of biodiversity conservation in the face of climatic change, only a small minority provided evidence of legislative or other measures adopted to ensure that the need to consider the issue of biodiversity conservation was embedded across other sectors.
3. Given the required focus upon adaptation, it was extremely disappointing that only a minority of parties made reference in their reports either to the development of strategies that would assist the adaptation of biodiversity to climatic change (e.g. development of ecological networks) or to the scope for win–win adaptation solutions for other sectors that also would benefit biodiversity (e.g. diversification of forestry plantings, using native species, to enhance resilience to climatic change).
4. Although several of the parties expressed concern in their reports about the potentially negative consequences for biodiversity of measures being proposed in their country for the use of renewable energy sources as a means to mitigate climatic change, there was a lack of evidence from most parties of proposals for the adoption of win–win solutions to achieve mitigation targets and also benefit biodiversity (e.g. re-wetting of wetlands and restoration of peatlands to enhance their carbon sink potential).
5. Some excellent examples of good practice were identified; these have been highlighted in the foregoing review and analysis of the reports from the parties. Of particular note are those parties where the embedding of consideration of biodiversity issues cross-sectorally has already been achieved, where win–win solutions are being adopted for adaptation and/or mitigation, where the development of ecological networks already is underway, where the need to embed national actions in their international context has been recognised, where systematic evaluations of species' vulnerability to climatic change have been made using species' distribution models, and where a national vision underpins a series of coherent actions aimed at addressing both the limitation of climatic change and its inevitable impacts.
6. The most worrying gaps in the actions reported related to those concrete and practical actions most directly related to minimising the negative effects of climatic change on biodiversity, and especially upon species and ecosystems already under threat from other pressures. There was also a worrying lack of evidence of an appreciation of the need to 'Act now'. The following key gaps need urgently to be addressed:

    - There was little or no evidence that parties had taken steps to minimise other pressures on habitats or regions most vulnerable to climatic change.
    - There was very limited evidence that parties had taken steps to increase the populations of threatened species nor to reduce their exposure to threats other than climatic change.
    - There was little or no evidence that parties had developed climatic change adaptation/mitigation plans for those species most vulnerable to climatic change.
    - Simulations of the potential climatic change impacts upon species, and their use to identify those most at risk of negative effects of climatic change, were reported by only one party.

(Note that to be meaningful such analyses need to be done at a supra-national or even continental level, because the magnitude of projected climatic changes means that species will in most cases be shifting their ranges at a scale beyond that of the individual country.)

- There was little or no evidence of the updating or development of species' conservation statements to incorporate climatic change impacts.
- There was no evidence of updating of Red Lists to take into account climatic change vulnerability.

7. Only a small minority of parties indicated that the potential for climatic change to increase the risk of wildfire was being addressed, and even then this was principally limited to concerns about wildfire impacts upon forestry.
8. There was little evidence of awareness of the potential for climatic change to alter the invasiveness of introduced plant species already widely established in horticulture, and of the need to assess this potential. Where the issue of invasive species was addressed the focus was principally upon potential future introductions of invasive species, although in only one case was there evidence that the need to consider how a proposed introduction might be affected by climatic change was taken into account.
9. Monitoring activities that were reported were patchy; many parties reported a commitment to implement monitoring of biodiversity, although usually without any indication of how this might be targeted to be most effective. In many cases parties that are known to contribute to extensive monitoring schemes did not report these activities although they are clearly of direct relevance.
10. Only a minority of parties reported actions that addressed the need to develop permeable landscapes and functional ecological networks, in order to facilitate species' range shifts in response to climatic change. Similarly, there were few references to identifying new protected areas, to increasing the extent of existing protected areas, or to the addition of buffer zones around protected areas.
11. There was only very limited evidence of a commitment to the implementation of adaptive management practices, and none of the need to take a long-term view when formulating management plans for protected areas.
12. Whilst there were examples of good practice with respect to the adoption of the necessary holistic approach, for example to the development of ecological networks, this was not evident from the reports with respect to the formulation of conservation or recovery plans for individual species.
13. Good practice was evident in a minority of cases with respect to knowledge transfer activities, but a majority of party's reports made no reference to this activity.
14. Only a minority of parties reported actions relating to assisted colonisation or *ex situ* conservation measures. Where these were reported there was no explicit evidence that the recommended risk assessments had been undertaken, nor that steps were being taken explicitly to enhance *ex situ* conservation measures (e.g. seed banks) targeting threatened species.

Overall, the conclusion reached is that there is a very real danger that too little will be done too late by many of the parties. This is a depressing conclusion to reach, but it reinforces the need to press all parties to respond actively and swiftly to the recommendations made by the Expert Group, where they have not already done so. Although four years have passed since the first set of recommendations were made by the group, this is clearly a relatively short time in the context of the 'political machine' and the need in many cases for parties to advocate, discuss, draft and ultimately enact the policies that are considered necessary before concrete actions can be taken. The Expert Group are encouraged to urge parties to recognise that many of the actions recommended, but as yet rarely implemented, can almost certainly be commenced under existing conservation legislation in their country; there is thus no justification in these cases for delay, except perhaps where there is a genuine lack of resource. Where lack of resource is the principal issue, as was mentioned in some of the reports, then the Bern Convention

can perhaps use its influence to encourage parties that suffer less from this problem to make the necessary resources available to more resource-deficient parties. Some excellent examples of good practice in this respect were already evident from the reports but more of such assistance is urgently needed by at least some parties.

RECOMMENDATIONS

On the basis of the conclusions presented above a number of specific key recommendations are made to the Expert Group:

1. Take steps to ensure that the importance of the issue of climatic change impacts upon biodiversity is recognised by all parties, and that all parties take action urgently to address this issue.
2. Urge all parties to adopt measures that ensure that biodiversity conservation is embedded across other sectors and taken into account when formulating policies or strategies for those sectors.
3. Use the forum of the Expert Group, and any other means available, to inform policy-makers in various sectors and across the parties about the opportunities for win–win solutions when developing strategies for adaptation to climatic change by their sector.
4. Use the forum of the Expert Group, and any other means available, to inform policy-makers in various sectors and across the parties about the opportunities for win–win solutions when developing strategies for mitigation measures.
5. Ensure that all parties are aware of the examples of good practice identified and urge the wider adoption by the parties of such practices.
6. Emphasise to all parties the need to act now, especially in respect of many of the concrete and practical conservation measures that have been recommended by the Expert Group. Encourage all parties to implement these measures as a matter of urgency.
7. Re-emphasise to all parties the importance of taking into account the potential increased risk of wildfires as a result of climatic change and of embedding consideration of this risk into protected area management plans. It is important that parties recognise that this is not a problem that is limited to the Mediterranean countries.
8. Encourage all parties to recognise, and to take steps to address, the need to assess the potential for introduced species already present to become invasive under future changed climatic conditions.
9. Urge all parties to adopt the good practice, identified in the case of the United Kingdom, of implementing control measures for the assessment of introductions that include assessment of the impacts of projected climatic changes on the species' invasion potential.
10. Ensure that those persons preparing reports from parties for the Expert Group are fully informed about relevant activities, for example monitoring activities, being undertaken in their country, thus avoiding spurious identification of gaps in the activities of that party or of priorities for new actions by the party.
11. Urge all parties to take urgent steps to develop ecological networks, to enhance the permeability of landscapes generally, and to enhance their protected area network by the addition of new protected areas, increases in the extent of existing protected areas and the designation of buffer zones around protected areas.
12. Re-emphasise the desirability and benefits of adopting adaptive management practices.
13. Re-emphasise the need to take an appropriately long-term view when formulating management plans and strategies for protected area management.
14. Urge all parties to adopt a more holistic approach when formulating strategies and plans for ecological networks or protected areas, and when developing conservation or recovery plans for individual species. In particular, encourage the general adoption of the examples of good practice reported, especially by Switzerland and Ukraine, with respect to taking into account their international context when planning ecological networks, and to developing networks and protected areas in partnership with their neighbours.

15. Encourage all parties to undertake knowledge transfer activities to ensure awareness by those in other sectors, stakeholders and the general public of the challenges posed and opportunities present by climatic change when considering biodiversity conservation, including its links to other sectors and the opportunities for win–win solutions.
16. Encourage all parties to ensure that appropriate risk assessments are made before the implementation of assisted colonisations or of *ex situ* conservation measures. Urge that these generally very expensive measures principally be targeted, where the risk is assessed as acceptable, to Bern Convention and other threatened species, and that they only be applied when it is apparent that other options will not suffice to ensure the species' survival.

In addition to these specific recommendations, the general recommendations made above in relation to the overall conclusion reached are worth re-iterating, namely:

- To urge all parties to recognise that many of the actions recommended, but as yet rarely implemented, can almost certainly be commenced under existing conservation legislation in their country;
- That in these cases the only reasonable excuse for delay in implementing appropriate activities is where there is a genuine lack of resource; and

That where genuine lack of resource is the principal issue preventing the commencement of urgent activities, the Bern Convention should consider using its influence to encourage parties that suffer less from this problem to make the necessary resources available to more resource-deficient parties.

Appendix 1: Guidelines for the 2012 reporting by Parties on the implementation of Recommendations No. 135 (2008) and 143 (2009)

REPORTING BY PARTIES

Parties are invited to provide a report in writing (electronic WORD format), informing on the measures/actions/strategies/policies implemented in accordance to the guidance appended to Recommendation 135 (2008) and Recommendation 143 (2009).

The report should include, as far as possible, information on:

- Main challenges posed by climate change in the country
- Integration of biodiversity in climate change mitigation and adaptation national strategies/policies/actions;
- Vulnerability assessment for Bern Convention species and habitats, with particular focus on:
  - Migratory Birds;
  - Amphibians and reptiles
  - Invertebrates
  - Plants
  - Protected areas
- Elaboration and implementation of adaptation strategies/actions, including ecosystem-based approaches to climate change adaptation
- Cross cutting issues
  - Invasive Alien Species
  - Protected areas and landscape scale conservation
- Mainstreaming of adaptation to climate change in sectoral policies

Where relevant, please provide additional information on:

- Research, monitoring and awareness raising
- Main challenges faced while elaborating/implementing adaptation activities/policies (from both a scientific and/or an administrative/legal point of view);
- Examples of good practices that your country can export:
- Lessons learned

SUMMARY OF SPECIFIC RECOMMENDATIONS

Through **Recommendation No. 135 (2008)** the Standing Committee to the Bern Convention recommends Contracting Parties to the Convention and invites Observer States to:

1. Address and communicate, as a matter of urgency, the impacts of climate change on biological diversity and its conservation;

2. Raise awareness of the link between biodiversity and climate and emphasis the large potential for synergies when addressing biodiversity loss and climate change in an integrated manner; including socio-economic effects;

3. Encourage the elaboration of climate change adaptation activities for biodiversity, taking account of the suggested measures listed in the guidance set out in the Appendix to the present Recommendation; and

4. Continue to engage in the development of further guidance to implement the Convention.

Through **Recommendation No. 143 (2009)** the Standing Committee to the Bern Convention recommends Contracting Parties to the Convention and invites Observer States to:

1. Increase efforts to improve understanding of the linkages between biodiversity and climate change (according to Recommendation 135 (2008)).

2. Make full use of the large potential for synergies and co-benefits between biodiversity conservation and climate change mitigation and adaptation, including ecosystem-based approaches.

3. Ensure that biodiversity considerations, including potential negative impacts, are taken fully into account in climate change adaptation and mitigation policies and measures.

4. Develop climate change adaptation activities for biodiversity, taking due account of the proposed guidance set out in the Appendix to the present Recommendation; and

5. Continue to engage in the development and application of further guidance to implement the Convention.

More information on: www.coe.int/bernconvention

Appendix 2: Appendix to Recommendation No. 135 (2008)

GUIDANCE

This guidance draws on the expert reports commissioned by the Council of Europe and discussed by the Group of Experts on Biodiversity and Climate Change at its meetings in 2007-2008. The conclusions and recommended actions provided stem from six separate expert reports and discussions by the Group of Experts, which should be completed and updated in the future, and including potential revision of the current recommendations as well as additional recommendations for other groups of species.

Measures that may be considered as appropriate for addressing the impacts of climate change on biodiversity, for the purposes of the application of the Convention, are listed for consideration by Contracting Parties. These measures are offered as examples of action that may be taken by authorities at all levels of governance to address this issue. Other complementary measures may be identified by governments as equally appropriate to their particular circumstances and concerns.

The effects of climate change on ecosystems are complex. The impacts of a changing climate on the species and habitats protected by the Bern Convention may differ widely, depending on the species and the interactions with other species and/or their habitats, as well as according to location. The effects that climate change adaptation measures in other sectors can have on species and habitats should also be considered in order to avoid further unforeseen impacts.

I. Vulnerability to climate change

Vulnerability, as defined by the Intergovernmental Panel on Climate Change (IPCC), incorporates the concepts of exposure, sensitivity and adaptation, and it is usually a combination of these that lead to vulnerability. Species are already vulnerable to decreases in their abundance and range but on a short-time scale (1-10 years), climate change will increasingly contribute to longer-term stresses and exacerbate the current drivers of bioiversity loss. Climate change is not an isolated factor, and an integrated approach is needed in order to understand how interacting factors contribute to vulnerability.

There is abundant evidence from observations and monitoring that climate change is already impacting species and habitats, and, for some, this is leading to increased vulnerability. There is little direct information on the attribution of sources of this vulnerability but the majority of the observed responses are consistent with those expected from climate change.

Most of the very limited evidence for the potential impacts of climate change on Bern Convention species and habitats is inferential and based on monitoring and observations of responses to current climate change, expert knowledge and modelled projections. A picture of species' vulnerability can begin to be drawn, but this information base needs to be further developed, as the nature of the threatened status of many species suggests that climate change will only compound the situation.

This section includes proposed actions and measures based on the work done so far under the Bern Convention (see reports "*Climate change and the vulnerability of Bern Convention species and habitats*", by P. Berry; "*Climatic change and the conservation of migratory birds in Europe: Identifying effects and conservation priorities*" by M. Ferrer, I. Newton and K. Bildstein, and "*Climate Change Impacts on European Amphibians and Reptiles*" by K. Henle *et al.*).

Proposed actions[1]:

1. There is a need for action in all sensitive areas in Europe, including South Eastern Europe, the Mediterranean and central European regions, but there is urgency to address the impacts of climate change on the species and habitats of those areas consistently projected as being most vulnerable in Europe: the

[1] These recommended actions are drawn from the report by P.Berry "Climate change and the vulnerability of Bern Convention species and habitats", document T-PVS/Inf (2008) 6 rev.

Arctic (including parts of Scandinavia and Greenland); mountain regions; coastal zones (including the Baltic and parts of the Mediterranean); and island habitats and wetlands in areas increasingly threatened by drought**.** The terrestrial ecosystems considered especially affected by climate change (and found in Europe) are: tundra, boreal forest, mountain and Mediterranean-type ecosystems, salt marshes and sea-ice biomes, and the Arctic region.

2. Given the threatened status of many species included in the Bern Convention, and their level of endemicity and rarity, take measures to build up population numbers.

3. Further develop and improve the information base on the vulnerability of Bern Convention species and habitats based on all the components of vulnerability (i.e. exposure, sensitivity and adaptive capacity).

4. As mitigation and adaptation are both aimed at reducing vulnerability to climate change, consider adaptation strategies to reduce species loss, and assess mitigation activities and measures in terms of their potential to contribute to or reduce vulnerability of species and habitats.

5. Take care that adaptation and mitigation measures conform with biological diversity conservation principles. Bear in mind that adaptation strategies may favour certain species or groups of species over others. Take an integrated, cross-sectoral approach to assess responses to climate change, as mitigation and adaptation activities in other sectors can have either positive or negative effects on biodiversity.

6. Focus attention on the potentially more vulnerable Bern Convention species regarding climate change (preliminary analysis based on available information from modelling)[*]. These lists are not comprehensive, but focus on some species already identified as potentially threatened by climate change in the report by P. Berry "*Climate change and the vulnerability of Bern Convention species and habitats*":

- Mammals: *Lynx pardina*, (Iberian lynx); *Microtus tatricus* (Tatra vole) and *Myomimus roachi* (Mouse-tailed dormouse); *M. roachii; Myotis dasycneme* (Pond bat); *Monachus monachus* (Mediterranean monk seal); Saimaa ringed seal *(Phoca hispida saimensi).*

- Birds: The greatest reduction in bird species richness is projected to occur in southern and central Europe. Most affected species: *Anthus berthelotii* (Berthelot's pipit); *Chersophilus duponti* (Dupont's lark) and *Bucanetes githagineus* (Trumpeter Finch) ; *Apus* caffer (white-rumped swift), *Phoenicopterus ruber* (greater flamingo) and *Calidris alba* (sanderling); *Acrocephalus paludicola* (aquatic warbler), pintail *(Anas acuta*) and meadow pipit (*Anthus pratensis*). Northern species are generally vulnerable and birds such as marsh warbler (*Acrocephalus palustris*) could be vulnerable in the southern and western parts of their range.

- Reptiles: *Lepidochelys kempii* (Kemp's Ridley Sea turtle), *Dermochelys coriacea* (Leatherback turtle) and *Eretmochelys imbricata* (Hawksbill turtle); *Gallotia simonyi (*Hierro lizard, Canary Islands endemic). For *Vipera ursinii* (Meadow viper), if it is able to disperse it could expand its range, but otherwise it could contract.

- Amphibians: Particularly vulnerable in the Iberian peninsula. Of the species modelled, both *Alytes obstetricans* (Midwife toad) and *Bufo calamita* (Natterjack toad) are vulnerable to climate change.

- Insects: It is thought that Southern European species may remain less affected as they are better adapted to very high temperatures as well as rapid changes in temperature.

- Fish: One of the most vulnerable species is the *Romanichthys valsanicola*; the European sturgeon (*Acipenser sturio*) has also been identified.

[*] Even though climate change has not been used as a criterion for the listing of species, if other threats are present then it is possible that the species will be vulnerable to climate change too, especially if it is in a vulnerable region or if there is other supporting evidence in the form of modelling results and/or additional components of vulnerability present.

- Vascular plants: No evidence of responses to current changes or sources of vulnerability have been found for Bern Convention vascular plants, but species such as *Pulsatilla patens* (Pasqueflower), *Apium repens* (Creeping marshwort) and *Cypripedium calceolus* (Lady's slipper) could be vulnerable in southern parts of their range in Europe. Particularly vulnerable species will be those with long life cycles and/or slow dispersal, as well as some isolated species (Arctic, alpine, island, coastal..).

7. Identify and address with urgency other non-climate threats to vulnerable species to enhance their adaptive capacity.

Migratory birds

Migratory birds can be influenced by a changing climate in three different geographic locations: their breeding grounds, their wintering areas, and their migration routes. We can expect that migrants will suffer greater storm-induced losses, which could cause noticeable reductions in populations regardless of other climate changes.

The breeding ranges of some European birds are already shifting north, as individuals withdraw from southern portions of their ranges, while others spread north at the northern limits of their ranges. A particular concern involving range shifts is the loss of mountain-top and high latitude breeders, which may disappear from much of their range, as global warming reduces the extent of specific high-mountain and high latitude habitats.

Proposed actions[2]:

8. Establish a functional network of watch sites or "watchtowers" to monitor changes in bird behaviour and assess bird-population trends in Europe.

9. Establish a set of focal species whose populations and behaviour should be monitored because of their relationships with more-difficult-to-follow but critical biological variables. In particular, seabirds, wetland birds, diurnal birds of prey or raptors, other soaring birds, and several widespread and long-term studied songbirds should be monitored.

10. Undertake studies in southern Europe, where many migratory birds over-winter, and where many others pass through while migrating between European breeding grounds and African wintering areas.

Amphibians and reptiles

There is mounting empirical evidence that climate change is already having various impacts on different aspects of the ecology of organisms, including amphibians and reptiles. Long-term studies on European amphibians and reptiles show already a tendency to earlier breeding in many species. Also, the decline of some species have been linked to changed climatic conditions.

Amphibians and reptiles critically depend on temperature and water. While reptiles have developed adaptations to cope with water scarcity, all European amphibians require moist habitats and, with few exceptions, open water for reproduction. Species will become threatened by climate change particularly in regions where water and humid habitats are already scarce and expected to become even drier. As wetland habitats disappear, aquatic and semi-aquatic species will suffer declines.

The main response of species to climate change is either a range shift or in-situ adaptation by evolutionary change. Apart from marine turtles, reptiles and amphibians have a too low dispersal capacity to follow the expected rapid changes, especially in the highly fragmented European landscapes. In-situ adaptation requires large populations – beyond the size of most amphibian and reptile populations in modern landscapes. Climate envelope modelling and the assessment of the climate sensitivity of amphibians and reptiles clearly show that climate change impacts will considerably differ among species

[2] These recommended actions are drawn from the report by M. Ferrer, I. Newton and K. Bildstein "Climatic change and the conservation of migratory birds in Europe: Identifying effects and conservation priorities", document T-PVS/Inf (2008) 1 rev.

and regions. Overall, amphibians are expected to suffer more than reptiles based on their adaptation to harsh environments.

Proposed actions[3]:

11. Take early action on the following species, expected to be most affected, including through species-specific climate change mitigation plans:

- Amphibians from dry Mediterranean regions (especially in Spain, Western France, and Italy), and amphibians requiring cool environments;
- For reptiles, projected losses are also highest in areas with high temperatures and major reductions in precipitation (Spain, Italy, the Balkans, and Greece);
- Island endemics, such as *Alytes muletensis* (Balearic Mid-wife Toad), the lizards *Algyroides fitzingeri* (Pygmy Algyroides), *Lacerta bedriagae* (Bedriaga's Rock Lizard), *Podarcis tiliguerta* (Tyrrhenian Wall Lizard), and *Gallotia simonyi* (El Hierro Giant Lizard), and the snake *Macrovipera schweizeri* (Cyclade Blunt-nosed Viper) are predicted to become the most affected species, together with *Phyllodactylus europaeus* (European Leaf-toed gecko);
- In Central and Northern Europe, early breeding amphibian, i.e., primarily brown frogs (*Rana arvalis, Rana dalmatina, Rana temporaria*) and the common toad (*Bufo bufo*) may be placed at increasing risk due to late frosts, less snow cover, and warmer winter temperatures.

12. Highly sensitive species should be monitored as indicators of climate change.

13. Facilitate in-situ adaptation and natural range shifts by redoubling efforts to maintain or restore large intact habitats and large-scale connectivity.

14. Countries with breeding populations of sea turtles and endemic island taxa potentially threatened by sea level rise should gather data and undertake studies to improve knowledge on climate change impacts on endemic island species.

15. Mediterranean countries should assess the reduction of permanent wetlands and rivers by the combined effects of land use and climate change to better understand impacts on amphibian species.

16. Further research should be undertaken on the potential impacts of climate change on amphibian and reptile species.

II. Adaptation strategies

Climate change is an important determinant of the distribution and functioning of natural systems, with species, habitats and ecosystems having been modified repeatedly throughout geological time. Today, changes in land use and management are resulting in the degradation of semi-natural habitats, declines in traditional agricultural and forest management on which many species depend, and now large-scale land abandonment. It is likely that these changes will be further exacerbated by climate change. Projections suggest that between one fifth and one third of European species will be at increased risk of extinction if global mean temperatures rise more than 2 to 3 ºC above pre-industrial levels. A combination of climate change and other drivers of change will reduce the adaptive capacity (and resilience) of many species and habitats, and will have potentially serious consequences for the delivery of ecosystem services that are the cornerstone of human existence and well-being. Robust mitigation and adaptation policies are clearly needed in order to address the impacts of climate change on biodiversity.

The following seven overarching adaptation principles for biodiversity and its conservation derived from pre-existing guidance, are linked with more detailed measures, and should be considered when developing adaptation strategies and actions to conserve species, habitats and ecosystems, and the services

[3] These recommended actions are drawn from the report by K. Henle et al "Climate Change Impacts on European Amphibians and Reptiles", document T-PVS/Inf (2008) 11 rev.

that they provide. The concepts underpinning these principles are also equally relevant to other sectors and could be further developed within and across sectors as a standard for universal application, and they should be considered when devising adaptation activities at all levels[4]:

1. Take action now: As uncertainties surrounding the precise nature of future climate change and its impacts on biodiversity should not delay practical conservation action.

Proposed actions:

a. Enhance existing biodiversity conservation activities in protected areas and intervening habitats.

b. Deliver on current biodiversity policy and legislative commitments and agreements.

c. Reduce other sources of stress and harm not directly linked to climate change.

d. Develop further biodiversity policy, legislation and agreements to ensure that conservation objectives reflect the challenges presented by climate change.

2. Maintain and increase ecosystem resilience: In order to improve the ability of ecosystems to mitigate the effects of climate change whilst maintaining and increasing biodiversity.

Proposed actions:

a. Maintain and restore ecosystem structure and function and, where appropriate and cost effective, relocate and create new habitats.

b. Conserve the range and variability of species, habitats and ecosystems.

c. Establish buffer zones with ecologically sensitive management regimes around conservation areas.

d. Prevent the introduction and control the spread of invasive species.

e. Develop actions to increase resilience and communicate those actions.

3. Accommodate the impacts of climate change: As both gradual change and extreme weather events will be experienced.

Proposed actions

a. Increase understanding of the specific effects of climate change on biodiversity, develop adaptive strategies based on sound ecological research and undertake risk management planning to take account of unpredictable effects.

b. Work with ecological principles when accommodating to climate change impacts.

c. Establish networks of interconnected protected areas (terrestrial, freshwater and marine) and intervening habitat mosaics to increase permeability and aid gene flow.

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

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

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

[4] These recommended actions are drawn from the report by M. Harley and N. Hodgson "Review of existing international and national guidance on adaptation to climate change with a focus on biodiversity issues", document T-PVS/Inf (2008) 12 rev.

4. Facilitate knowledge transfer and action between partners, sectors, the general public, and authorities at all levels, including Conventions: As successful adaptation requires biodiversity conservation to be integrated with other land and water management activities.

Proposed actions:

a. Strengthen existing relationships and build new partnerships, including across Conventions.

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

c. Co-ordinate adaptation and mitigation measures to avoid mal-adaptation for the environment and biodiversity within and across sectors.

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

e. Communicate best practice and exchange information on successful adaptation.

f. Communicate and engage the wider public to promote concerns on biodiversity and face the challenges of climate change.

5. Develop the knowledge/evidence base and plan strategically: It is essential that the best available evidence is used to develop techniques that allow biodiversity to adapt.

Proposed actions:

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

b. Develop research on biodiversity and climate change to enhance a comprehensive understanding of the impacts of climate change at the community/ecosystem level which will provide a better analysis of the consequences regarding species, and with a biogeographical vision, both at short and long time-scales.

c. Undertake vulnerability assessments of biodiversity and associated ecosystems.

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

e. Pilot new approaches through demonstration projects.

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

6. Monitor and use indicators: As monitoring is a key contributor to the evidence base and, as such, existing schemes must be strengthened and new requirements incorporated

Proposed actions:

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

b. Continue to monitor the observed impacts of climate change on biodiversity and establish procedures to validate projections to direct or develop conservation objectives, including where appropriate through the development of community-based monitoring programmes.

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

7. Use adaptive conservation management: As effective conservation in a changing climate will require a flexible approach based on learning from direct experiences**.**

Proposed actions:

a. Undertake continual monitoring and re-assessment of adaptation actions as new information and research becomes available.

b. Develop and communicate adaptive management actions to increase both ecosystem resilience and accommodation to the impacts of climate change.

III. Cross-cutting issues

Invasive species

Biological invasions are a problem likely to increase under climate change. The risk posed by invasive species under climate change conditions is, in general, underestimated because models and scenarios, mainly focused on native biodiversity, have poorly explored the issue. IAS and climate change are considered two of the five main threats to biodiversity, and therefore the two operating together could be expected to produce extreme outcomes. Current biotic changes caused by invasive species could further interact with climate change, increasing ecosystems' vulnerability and therefore the risk of new invasions.

While tools to fight invasive species already exist, countries' concern is still scarce and action is urgent. It is difficult to predict how climate change will affect invasive processes per se as well as in combination with other factors of global change (biotic changes, land use changes, etc.). Climate change could alter the structure and composition of native communities and, as a consequence, the way in which an ecosystem functions, increasing the risk of biological invasion: maintaining high biodiversity communities is expected to reduce susceptibility to invasives. Climate change is also likely to increase the potential distribution and abundance of invasive species, further enlarging areas at risk of invasion, and threatening the viability of current management strategies against invasive species.

Proposed actions[5]:

17. Improve information on the biology of invasive species and how their populations respond to climate change.

18. Condition any intentional introduction of alien species on exhaustive risk analysis processes which include considerations related to climate change. Also, risk analysis on pathway and vectors should take into account potential interactions with climate change to prevent unintentional introductions.

19. Consider the effects of altered climate and atmospheric chemistry when undertaking risk analysis for biotic invaders.

20. Step up research on biological invasions linked to climate changes, including on: (i) the influence of dispersal, propagule pressure and species interactions; (ii) the populations' ability to adapt, and the scales over which climate will change and living systems will respond; (iii) the synergistic effects between climate and other anthropogenic variables that are likely to exacerbate the abundance and impact of invasive species; and (iv) predictive models.

Protected areas and landscape scale conservation

Protected areas have long been one of the cornerstones of conservation policy, and they have a vital role in biodiversity adaptation strategies to climatic change. Protected areas are likely to become of even greater importance as they often harbour the best quality habitats for many species. It will therefore be necessary to take account of climate change in the planning and management of protected areas to achieve successful strategies for biodiversity conservation in the face of climatic change.

Networks of protected areas should be embedded within a high-quality landscape conservation approach to provide permeability and connectivity to assist species adjust their spatial distributions, through the provision of habitat 'stepping stones' and other tools. Protected areas alone will not be sufficient to ensure adequate protection of habitats and species. It will be critical to ensure the continued protection and appropriate management of existing protected areas which, to be effective, should need to be complemented by appropriate management and structure of the wider landscape, as otherwise many

[5] These recommended actions are drawn from the report by L. Capdevila-Argüelles and B. Zilletti "A perspective on climate change and invasive alien species", document T-PVS/Inf (2008) 5 rev.

species will be unable to achieve the responses to climatic change that are essential to their long-term survival.

Proposed actions:

21. Consider the extent and location of protected areas to provide flexibility and potential for species to adjust their distributions within the landscape in response to climatic change. Consider buffer zones as a valuable tool for enhancing the effectiveness of protected areas.

22. Develop permeable landscapes that provide functional networks of habitat 'stepping stones' of various sizes and separations linking protected areas, to help species' adaptation to climate change.

23. Take the necessary steps to retain as many as possible of the remaining fragments of unaltered or semi-natural habitat in the landscape in order that they may serve as 'stepping stones' and contribute to rendering the landscape permeable, and encourage the creation of habitat 'stepping stones' in landscapes where past land management practice has led to the absence of sufficient suitable patches of unaltered or semi-natural habitat that may be managed for this purpose.

Appendix 3: Appendix to Recommendation No. 143 (2009)

GUIDANCE

This guidance draws on the expert reports commissioned by the Council of Europe and discussed by the Group of Experts on Biodiversity and Climate Change at its meeting in 2009. The conclusions and recommended actions provided below stem from three separate expert reports and the discussions in the Group of Experts. This guidance complements the suggested actions endorsed by the Standing Committee in 2008 (Recommendation No. 135), which in turn should be further completed and updated in the future, including a potential revision of the proposed recommendations.

Measures that may be considered as appropriate for addressing the impacts of climate change on biodiversity, for the purposes of the application of the Convention, are listed for consideration by Contracting Parties. These measures are offered as examples of action that may be taken by authorities at all levels of governance to address this issue. Other complementary measures may be identified by governments as equally appropriate to their particular circumstances and concerns. Notwithstanding these adaptation measures, there is an urgent need for climate change mitigation actions at local, regional, country and global levels. Effective mitigation is crucial to contain climate change to levels within which we may have a reasonable chance of achieving effective adaptation. However, addressing mitigation lies outside the scope of these recommendations.

The effects of climate change on ecosystems and their biological communities are complex. The impacts of a changing climate on the species and habitats protected by the Bern Convention may differ widely, depending on the species and the interactions with other species and/or their habitats, as well as according to location. The effects that climate change mitigation and adaptation measures, taken in other sectors, can have on species and habitats should also be considered in order to avoid negative impacts.

I. Invertebrates and climate change

Changes to the life history, population dynamics, distributions and diversity of invertebrates have been observed in response to recent climate change. To minimise losses in invertebrate biodiversity resulting from these changes, there is a need for conservation policy and practice to increase the adaptive capacity of natural and managed systems.

Narrow range endemics are particularly vulnerable to climate change and may have little opportunity to shift their distributions naturally to track suitable climate space. Documenting and conserving the current distributions and habitats for these species is vital if they are to have any chance of surviving climate change. Regions which support populations of many narrow range endemic species and species which are unlikely to be able to shift their distributions naturally in response to climate change include Atlantic and Mediterranean islands, and southern and central European mountain ranges.

PROPOSED ACTIONS[6]:

Conserve, and where possible expand, heterogeneity

I.1. Maintain and, where possible and ecologically appropriate, add large areas and networks of heterogeneous habitat, in order to: (i) protect large invertebrate populations with low risk of local extinction; (ii) be prepared for changes to the habitat associations of species in a changing climate; and (iii) provide buffering capacity against the impacts of extreme climatic or climate-related events (e.g. fire).

[6] These recommended actions are based on the report by R. Wilson "Impacts of climate change on European invertebrates, documentT-PVS/Inf (2009) 8.

Conserve existing populations

I.2 Conserve existing populations of threatened invertebrate species in a range of habitats and locations across their geographic ranges. Focus efforts to conserve existing populations of species within existing high biodiversity areas and protected area networks, such as Emerald and Natura 2000 sites across Europe.

I.2 bis Develop understanding and practical application of the management of micro-habitat and micro-climate conditions for the conservation of invertebrates at current locations, in order to increase resilience against climate change.

Minimise threats to invertebrate biodiversity

I.3. Minimise threats which interact with climate change to threaten invertebrate biodiversity, including land-use intensification, abandonment of traditional farming and forestry, wetland drainage, urbanisation, pollution, and the spread of alien invasive species. As a priority, minimise these threats in systems which support the most vulnerable invertebrates, including:

- Mountains, natural and semi-natural grasslands, old growth forests, the Mediterranean biome, wetlands (including peatlands, freshwater lakes, ponds and rivers) and marine benthic systems.
- Atlantic and Mediterranean Islands, and southern and central European mountain ranges.

Facilitate range shifts

I.4. Establish or maintain landscape-scale networks of natural and semi-natural habitat in order to increase the chances that species can shift their distributions naturally, because many invertebrates will need to expand their distributions to higher latitudes or elevations in order to survive climate change.

I.5. Achieve landscape-scale ecological networks through measures including protection and active management of existing habitats, restoration of degraded habitats, and sustainable management of areas separating existing protected areas.

I.6. Consider assisted colonisation by planned conservation interventions for the conservation of species whose current distributions are unlikely to support them in the long term, and which are unlikely to reach identifiably suitable habitat and climatic conditions outside their current ranges, taking due account of potential impacts of translocation activities on species and habitats in the target area.

Monitor and research

I.7. Undertake increased monitoring and research into the responses of invertebrates and ecological systems to climate change, which is crucial to provide an evidence base for making decisions about policy and management, and include the following key areas:

- Document species distributions, habitat requirements, and climate associations for poorly known invertebrate species and regions as baseline data to predict likely responses to climate change and other environmental drivers, and to permit recommendations to be made regarding their conservation.
- Test the independent and interacting roles of climate change and other threats in driving observed changes to the population dynamics and distributions of invertebrate species, which will help to identify underlying causes, project future ecological responses, and prioritise systems and approaches for adaptive management.
- Monitor responses of invertebrates to climate change in order to detect changes to the relative vulnerability of different species, and to ensure that resources are focused towards priority species and systems.

II. Plants and climate change

All available evidence points to the high probability that plant diversity in Europe, both at the landscape and ecosystem level, and at the species and population level will be severely impacted by climate change over the course of this century, interacting with other forms of global change such as population growth and movement and changes in disturbance regimes.

The impacts will not be uniform. Some regions will experience moderate changes and turnover of species, while others may expect serious disruption of existing ecosystems and their replacement with novel assemblages of species and the loss of considerable numbers of currently rare and endangered species in specialised habitats, such as high mountains.

Many species that are not currently threatened or on national Red Lists may be put at risk by climate change or threatened with extinction through lack of suitable niches into which to migrate. While we have developed increasingly sophisticated tools and modelling procedures, very considerable uncertainty remains about species migrations and habitat change at the local scale. It is very likely that there will be a substantial rise in the number of invasive species with serious effects on particular habitats.

While recognising that the Bern Convention, the Habitats Directive and individual countries have made major progress in determining which species require priority action through habitat conservation and the creation of ecological networks, implementation is not yet complete, especially in terms of area management and species-level conservation.

Given that baseline data are still far from complete, it is difficult to determine appropriate targets for action. There is a need for a major expansion of monitoring systems to keep the effectiveness of the Emerald and Natura 2000 networks, and the threat status of listed species, under constant observation and review. The European Strategy for Plant Conservation (ESPC), as a comprehensive tool for plant conservation, constitutes a relevant framework to address the issue of plant conservation in the face of climate change.

PROPOSED ACTIONS[7]:

In situ species conservation

II.1. Undertake an urgent review of the *in situ* conservation needs of all threatened European species, not just those listed in the Bern Convention/ Habitats Directive.

II.1 bis Incorporate the likely impacts of climate change into the assessment of threatened status of species in national Red Books or Lists.

II.2. Prepare a conservation statement for all threatened species and take steps to accelerate the preparation and implementation of species action, management or recovery plans, as appropriate.

II.3. Review the state of country recovery planning for listed species and formulate management or recovery plans for those that are not so far covered.

II. 3 bisPut in place a supra-national monitoring scheme in order to follow the evolution of species chorology across borders.

II.4. Consider management interventions to facilitate species dispersal into suitable areas e.g. for species restricted to specific microhabitats such as cliff and rupicolous plants.

II.5. Assess the need, within the global context of conservation strategies, for population reinforcement, *inter situs* and human assisted translocation of species that are threatened with extinction and not likely to survive in their current distribution in the face of climate change, and prepare a list of candidate species after careful weighing of potential risks and benefits.

[7] These recommended actions are based on the report by V. Heywood "The impacts of climate change on plant species in Europe", document T-PVS/Inf (2009) 9.

II.6. Assess the effectiveness and sustainability of Plant Micro-reserves (PMR) over the medium to long term.

II.7. Explore conservation outside protected areas, notably in important areas for plant conservation as defined in the GSPC, and consider a significant expansion of off-site arrangements such as easements, set-aside, incentive-based schemes, local conservation strategies and public and private collaboration for conservation.

Ex situ species conservation

II.8. Assess the coverage and quality of existing seed banks and botanic garden collections so as to fit conservation purposes, take steps to strengthen and improve their networks, and ensure sufficient genetic diversity within available seed and plant collections.

II.9. Take urgent action to collect and store propagules of the majority of Bern Convention and most threatened European species that are not at present covered by such collections, either as living collections or as seed, and enhance the quality of sampling of those that already exist.

Predicting the impacts of climate change

II.10. Apply bioclimatic modelling at least to all Bern Convention listed species and countries, and consolidate the information obtained from published modelling studies so that the results can be easily searched on a species by species basis.

II.11. Supplement bioclimatic modelling by the application of other criteria for identifying taxa vulnerable to climate change

Invasive species

II.12. Make important efforts to prevent the introduction and establishment of new invasives, through understanding vectors and pathways responsible for invasive species establishment, risk assessment, risk analysis, horizon scanning for potential new invasives, early warning systems, codes of conduct and control strategies.

II.13 Encourage the wide adoption of the 2008 Bern Convention *Code of Conduct on Horticulture and Invasive Alien Species,* given that horticulture is identified as the main pathway for invasion.

III. Protected areas and climate change

European protected areas and European–wide networks of conservation areas are severely threatened by climate change. Up to 52%±12.1 of European vertebrates and plants are forecasted to lose suitable climate within existing protected areas by 2080.

Conventional views on protected-areas planning assume that successful conservation is achieved by safeguarding protected areas from the processes that threaten their existence. However, it is evident that conservation strategies, in order to be effective, need to mitigate impacts of climate change in addition to providing sustainable management of habitats and ecosystems.

Classification of Emerald and Natura 2000 networks is based on the presence of species and habitats of European concern. With climate change, species may move away from these areas but more fundamentally, changes in species priorities are expected. Both changes in the distribution of species and the changes in the identities of the species of European concern, require iterative, evidence-based and integrated approaches.

PROPOSED ACTIONS[8]:

III.1. Ensure that existing protected areas are adequately managed and monitored so that they are in as healthy a state as possible before climatic and other change intensifies.

III.2 Implement protected areas management to increase their resilience to climate change. This may include both on-site actions and management of the wider landscape to maintain ecosystem processes and functions.

III.3 Take a long-term view in protected-areas management plans, and include actions for climate change adaptation (for periods up to 20 to 50 years, depending on the speed with which ecosystem changes are expected). Use adaptive management strategies and prevent the maintenance of ill-adapted habitats.

III.4. Ensure the development of a sufficiently representative and connected network of protected areas so as to allow for species dispersal and settlement in new suitable sites as a consequence of climate change. In a context of great uncertainty, such a network would constitute an insurance policy to provide protection for most endangered species and habitats.

Improve protected area networks on the basis of further continuous research and monitoring to take account of climate-related changes in species distribution and habitat quality and consequential changes in community composition.

III.5. Connect protected areas into functional ecological networks to allow the movement of species between them. Techniques include, as appropriate, buffer zones, stepping stones, corridors, and measures to reduce habitat fragmentation.

III.6. Carry out integrated management of the wider countryside to alleviate the overall pressure on biodiversity and facilitate movement of species between conservation areas, as species dispersal is likely to be the most important mechanism of species adaptation to climate change.

III.7 Consider the following possible mechanisms for implementation of off-protected-areas management:

- regulatory prohibitions and requirements,
- direct incentives for conservation on private land,
- market creation and improvement, and
- information and education instruments.

III.8 Develop and implement effective monitoring of climate change impacts on protected areas, at both site and network levels. Research and monitoring should also be implemented to develop and assess effective adaptation action for the biological interest of protected areas and networks.

III.9. Follow closely the experience of countries, within and outside Europe, where specific adaptation measures for biodiversity are being taken.

[8] These recommended actions are based on the report by M. Araújo "Protected areas and climate change in Europe", document T-PVS/Inf (2009) 10, and on the report by V. Heywood "The impacts of climate change on plant species in Europe", document T-PVS/Inf (2009) 9.

Appendix 4: Appendix to Recommendation No. 145 (2010)

GUIDANCE

This guidance draws on the expert report commissioned by the Council of Europe and discussed by the Group of Experts on Biodiversity and Climate Change at its meeting in 2010.

Measures that may be considered as appropriate for addressing the impacts of climate change on biodiversity, for the purposes of the application of the Convention, are listed for consideration by Contracting Parties. These measures are offered as examples of action that may be taken by authorities at all levels of governance to address this issue. Other complementary measures may be identified by governments as equally appropriate to their particular circumstances and concerns. Notwithstanding these adaptation measures, there is an urgent need for climate change mitigation actions at local, regional, country and global levels. Effective mitigation is crucial to contain climate change to levels within which we may have a reasonable chance of achieving effective adaptation. Although these recommendation focus on the adaptation to climate change, it is important to bear in mind that, on the one hand, climate change mitigation activities may be harmful to biodiversity and, on the other hand, the conservation and restoration of certain ecosystem types in particular forests and wetlands have to play an important role in the overall mitigation effort.

The effects of climate change on mountain ecosystems and their biological communities are complex. The impacts of a changing climate on the species and habitats protected by the Bern Convention may differ widely, depending on the species and the interactions with other species and/or their habitats, as well as according to location. The effects that climate change mitigation and adaptation measures, taken in other sectors, can have on species and habitats should also be considered in order to avoid negative impacts.

Mountains and climate change

Changes in the environmental factors of European mountains caused by climate change are already visible. There is a decrease in mountain glacier area, an increased annual precipitation with changing seasonality in the Alps, less predictability of rainfall and temperatures in Mediterranean mountains and a marked migration of species “uphill” as mean temperatures rise.

Mountain forest plants have been found to climb between 25 and 93 meter per decade since the 1950’s and a number of other groups (carabids, fungi, birds, molluscs and spiders) have also shown a marked variation along an altitudinal gradient.

Mountain ecosystems are also naturally vulnerable because of their relatively smaller extension, the risk of erosion and the extreme conditions of many mountain habitats.

Mountains exhibit the most pronounced climatic gradients and, in evolutionary and biographical terms, they can be compared to islands, archipelagos of high elevation habitats, isolated by the lowlands. As such isolated ecosystems they host a very high proportion of endemic species that are at great risk of extinction because of the unprecedented speed of present climate change and the West-East orientation Europe’s mountain ranges, which hinders North-bound migration possible in other mountain ecosystems of the world (for instance in the Americas). Particularly threatened will be species confined to summits or the plains, late successional plant species, species with small restricted population and species with relative low mobility, as some amphibians. Other species (in mix-altitudinal ranges) are also likely to see their habitats reduced as they are displaced uphill, thus becoming more vulnerable to extinction.

PROPOSED ACTIONS

Improve Protected Areas in mountains: Re-evaluate management goals of protected areas, ensure continued protection and appropriate management of existing protected areas. Increase the effective size of the protected area where and when possible (e.g., enlarged core protection zone and buffer zone with

nature-friendly land use) and/or create new protected areas. Protect altitudinal gradients avoiding further fragmentation. Cooperate to develop common approaches with adjacent or nearby protected areas.

Connect: The safeguard of latitudinal and altitudinal ecological continuums will be a crucial element in adaptation to changing conditions for many species and populations, mainly in areas of actual or potential tree line and in urbanised areas in the Alps. However, improving ecological connectivity also facilitates the dispersal of disease and invasive alien species along corridors. More research is needed on how ecological connectivity improves biodiversity and ecological persistence.

Permeable landscapes: Enhance existing incentive schemes promoting lower intensity land management and the development of greater landscape heterogeneity. Retain as many patches of "semi-natural habitats", especially in urbanised or intensively used areas.

Reduce anthropogenic stresses: minimize localised human-cased disturbances (e.g. fragmentation, nitrogen addition or other pollution) that hinder the ability of species or ecosystems to withstand climatic events(Baron *et al.*, 2008). It can also mean to keep traditional land use in regions where this has been the predominant management, in order to preserve species diversity and sensitive ecosystems.

Protect key ecosystem features: manage to maintain structural characteristics, organisms or areas that support the overall system, such as keystone organisms. Protect variant forms of a species or ecosystem so that, as climate changes, there may be populations that survive and provide a source for recovery. Maintain or establish more than one example of each ecosystem or population within a management systems, such that if one area is affected by disturbance, replicates in another area may reduce risk of extinction and provide a source for recolonisation(Baron *et al.*, 2008). Sustain the slow variables (e.g., soil resources and the species' pool) that accumulate slowly and provide buffers. Sustain both ecological legacies (e.g., old forest growth, woody debris) and cultural legacies (e.g. people's connection to land).

Restoration: restore ecosystems that have been lost or degraded. Restore or facilitate recovery of missing keystone species (e.g., wolf, beaver).

Identify refugia: use areas that are less affected by climate change than other areas as sources for recovery or as destinations for climate sensitive migrants and maximise populations of rare and threatened species.

Relocation: relocate where appropriate and necessary organisms from one location to another in order to bypass a barrier (e.g. urban area). This may involve translocation of genotypes, species or soil invertebrates or microbes, if appropriate, captive breeding programs and ex-situ conservation programmes of the genetic diversity of threatened mountain plants.

Build communication and scientist-manager-public partnerships: Create interdisciplinary teams of economists, climatologists, land use experts and modellers with the mission to carry out integrative research combining conservation planning climate change, adaptive capacities, human livelihoods that may offer further guidance.

Appendix 5: Appendix to Recommendation No. 146 (2010)

GUIDANCE

This guidance draws on the expert report commissioned by the Council of Europe and discussed by the Group of Experts on Biodiversity and Climate Change at its meeting in 2010.

Measures that may be considered as appropriate for addressing the impacts of climate change on biodiversity, for the purposes of the application of the Convention, are listed for consideration by Contracting Parties. These measures are offered as examples of action that may be taken by authorities at all levels of governance to address this issue. Other complementary measures may be identified by governments as equally appropriate to their particular circumstances and concerns. Notwithstanding these adaptation measures, there is an urgent need for climate change mitigation actions at local, regional, country and global levels. Effective mitigation is crucial to contain climate change to levels within which we may have a reasonable chance of achieving effective adaptation. Although these recommendation focus on the adaptation to climate change, it is important to bear in mind that, on the one hand, climate change mitigation activities may be harmful to biodiversity and, on the other hand, the conservation and restoration of certain ecosystem types in particular forests and wetlands have to play an important role in the overall mitigation effort.

The effects of climate change on island biodiversity are complex. The impacts of a changing climate on the species and habitats protected by the Bern Convention may differ widely, depending on the species and the interactions with other species and/or their habitats, as well as according to location and, especially latitude. The effects that climate change mitigation and adaptation measures, taken in other sectors, can have on species and habitats should also be considered in order to avoid negative impacts.

Islands and climate change

Islands are more vulnerable than other territories as in many of them there has been an intensive human occupation and because some of them are small so that developments that would be environmentally feasible in the continent have greater impact on natural ecosystems. Pollution is often a problem in islands, linked with relatively high human density, and often not much water. Management of waste can be a challenge due to scarcity of land. The absence of long rivers in small islands has often lead in Mediterranean and Macaronesian islands to water scarcity, intensive use of ground water and sometimes saline intrusions. Invasive alien species have a strongest impact on island endemics than in flora and fauna elsewhere. This marked environmental fragility of island ecosystems is likely to be worsened by climate change.

European islands are home to many species and habitats of conservation concern, including endemic as well as threatened biodiversity. Endemism is largely concentrated on islands in the Mediterranean and Macaronesian region. There are significant knowledge gaps concerning current and potential future impacts of climate change on European island biodiversity. However, there is enough evidence to demonstrate that impacts already take place and are likely to increase in future. Processes related to climate change which are particularly relevant in the island context include sea level rise and the possibility of increasing incidence of invasive alien species. Available measures to support adaptation for biodiversity are similar to those recommended for other areas However, possibilities to enhance connectivity beyond the individual island are limited so that a greater attention has to be paid to island unique ecosystems and their conservation.

PROPOSED ACTIONS

1. Applying general policy on climate change adaptation to islands

Fully implement previous Bern Convention recommendations relevant to the conservation of island biodiversity under climate change which have already been approved by the Standing Committee and should be applied in the island context as a matter of urgency.

These include:

- Bern Convention Recommendation 135 (2008) on addressing the impacts of climate change on biodiversity, and in particular the points of guidance on taking an integrated approach to climate change response activities, addressing non-climatic threats to vulnerable species, taking early action on the protection of island-endemic amphibian and reptile species, maintaining and restoring large intact habitats as well as ecosystem structure and function, establishing networks of interconnected protected areas, increasing protected area coverage where necessary to ensure that vulnerable species groups and habitats are included, establishing buffer zones around conservation areas, avoiding development in coastal areas, considering the role of species translocation and ex situ conservation, ensuring policy integration, using adaptive management and addressing invasive species issues.
- Bern Convention Recommendation 143 (2009) on further guidance for Parties on biodiversity and climate change, and in particular the points of guidance on minimising threats to vulnerable invertebrates and plants, including in Atlantic and Mediterranean islands, implementing appropriate protected area management to increase resilience and considering mechanisms for implementation of off-protected areas management.
- Bern Convention Recommendation 91 (2002) on invasive species that threaten biological diversity on islands and evolutionary isolated ecosystem which ask for special mechanisms to prohibit intentional introduction of alien species and special precautionary measures to avoid their unintentional introduction.
- The European Strategy on Invasive Species endorsed in Recommendation No. 99 (2003) which requests Contracting Parties to draw up and implement national strategies on invasive alien species taking into account that guidance.

2. Islands of special concern

- When developing adaptation measures, special consideration should be given to islands of the Mediteranean and Macaronesian regions because of their high rates of endemism and expected serious changes in precipitation regimes, and within these regions particularly to those sites hosting vulnerable or threatened endemic taxa, or unique habitat types; mountain habitats in both regions are under a double threat of being small, be particularly isolated and often, contain unique ecosystems or species that can migrate nowhere (like the high Canarian mountain) .
- Identify islands in other regions may also contain highly sensitive biota which require attention, as exemplified by the observed drastic declines in seabird populations of the North East Atlantic region.

3. Ensuring preservation of species that may lose their climate space

Because many island species have no or little possibility to migrate or extend their geographical range to other territories, and taking into account the high level of endemism on certain islands, special consideration should be given to the question of ex situ conservation and translocation for those species which are threatened with extinction in their current habitat, and unlikely to be able to reach other suitable habitat by natural dispersal. Although both ex situ and translocation measures are very resource-intensive strategies and not always feasible in practice, and translocation also carries a significant amount of risk to biota in the target area, where such options exist they may be the only way to ensure the survival of certain taxa.

4. Developing special financial and regulatory mechanisms for island biodiversity

Because islands gather, together with mountains, a very high proportion of Europe's endemic flora and fauna (see for instance that Appendix I of the Bern Convention had to be split in two parts, the second exclusively with Macaronesian flora) a special and solidarity effort has to be carried out at the European level to provide support to research and conservation in high diversity islands. Islands should receive the appropriate means to be able to cope with the responsibility of conserving such a rich common European heritage.

5. Island biodiversity research needs

In addition to research needs already identified in previous reports (including improving the information base on the vulnerability of Bern Convention species and habitats, and strengthening monitoring schemes) and by other Expert Groups (including the identification of knowledge gaps in European island threatened biodiversity and on invasive alien species on European islands), the following specific research needs should be addressed:

- improving knowledge about island endemic species in less well researched groups,
- monitoring climate change impacts on island biota (including impacts on migratory species),
- further development of appropriate approaches to assess the vulnerability of rare and endemic species to climate change, including trait-based assessment frameworks,
- improving climate projections at a resolution which is appropriate for consideration of climate change effects on islands,
- improving knowledge on species that depend both on islands and the marine environment to see how their survival may be affected by climate change.

Appendix 6: Appendix to Recommendation No. 147 (2010)

GUIDANCE

This guidance draws on the expert report commissioned by the Council of Europe and discussed by the Group of Experts on Biodiversity and Climate Change at its meeting in 2010.

Measures that may be considered as appropriate for addressing the impacts of climate change on biodiversity, for the purposes of the application of the Convention, are listed for consideration by Contracting Parties. These measures are offered as examples of action that may be taken by authorities at all levels of governance to address this issue. Other complementary measures may be identified by governments as equally appropriate to their particular circumstances and concerns. Notwithstanding these adaptation measures, there is an urgent need for climate change mitigation actions at local, regional, country and global levels. Effective mitigation is crucial to contain climate change to levels within which we may have a reasonable chance of achieving effective adaptation. Although these recommendation focus on the adaptation to climate change, it is important to bear in mind that, on the one hand, climate change mitigation activities may be harmful to biodiversity and, on the other hand, the conservation and restoration of certain ecosystem types in particular forests and wetlands have to play an important role in the overall mitigation effort.

The effects of wildland fires on ecosystems and their biological communities are complex. The impacts of a changing climate on the species and habitats protected by the Bern Convention may differ widely, depending on the species and the interactions with other species and/or their habitats, as well as according to location. The effects that climate change mitigation and adaptation measures, taken in other sectors, can have on species and habitats should also be considered in order to avoid negative impacts.

Wildland fires, biological diversity and climate change

Fire has a complex impact on ecosystems. It helps shape vegetation and it can be a major factor of plant communities change in a climate change context. Mediterranean ecosystems have evolved in a world with fire, so numerous plant traits can be associated to a long evolution with fire.

Fires do not burn the landscape at random, and tend to affect certain vegetation types more often than others, and occur at certain locations. Fires burn through natural protected areas as well. During the last three years, of all the area burned in the largest EU Mediterranean countries nearly 1/3 was part of the Natura 2000 network. Areas close to or at intermediate distance to roads or towns are the ones that burn most frequently. These elements of fire risk are important for conservation areas.

Although many ecosystems of Southern Europe and the Mediterranean can be considered to have evolved under fire, the current fire regime is different from what it might have been in the past. Changes in fire regime, such as increased frequency and severity of fires, threatens ecosystem stability and, in some areas, favours degradation loops that impedes the recovery of the vegetation towards more mature stages.

Postfire regeneration usually follows the autosuccessional pattern. Plants are able to withstand fires mainly by surviving the blaze and resprouting or by germinating from seeds that survive the fire as well and, in many instances, require heat-related stimuli to germinate. In a few years after fire the plant community resembles that before the burn. However, direct regeneration is not always warranted, especially if the climatic on soil conditions have changed. Furthermore, there are many emblematic species that do not regenerate well after fire.

It is not excluded that, with climate change, parts of Southern Europe and the Mediterranean become more arid and that many areas of Central and Northern Europe where fire does not affect at present large surfaces may see more frequent fires as temperatures rise and rainfall patterns change.

Difficult as it is to project future impacts of climate and other global changes on the vegetation and species composition of any system in the first type, much more difficult it is to do so in Southern Europe

and the Mediterranean areas. Restoration has no easy models to use them as a reference, and many ideas need to be revisited at the light of new paleo-ecological evidence. Given the threats of changes in fire and other climate and global changes over the values at hand, not the least its distinct and rich biodiversity, the challenge of conserving these territories under the ongoing climate and land-use/land cover changes and other global changes is paramount.

PROPOSED ACTIONS

1. Include the role of fire in conservation of species and habitats in fire prone areas

Fires have been occurring, and will most certainly occur within many protected areas in southern Europe and in the landscape matrix that surrounds them. Fires are generally considered as a threat, and fire suppression is the dominant policy throughout SEM. There are enormous skills and capacities to fight fires. Yet, when they break out inside or around protected areas they will burn through them. But since the main/only policy is to fight them, provisions to understand how they directly or indirectly affect protected areas and species once burned are, for the most part, lacking. Until now, the ecological role of fire is ignored. Consequently, when they occur there is no contingency plan as to how the affected system will be impacted. Therefore, even without any climate change, biodiversity conservation plans need to consider how fires will affect species and habitats throughout the territory. Fire ecology is a must in all management and conservation plans, and strategies to incorporate this knowledge must be enacted.

2. Identify the role of natural fire or prescribed burning in conservation

Some ecosystems and species depend on fire or can benefit from it. Identifying them might be critical since current policies will jeopardize their persistence. In these cases, plans for introducing fire, either by prescribed burning, or, when appropriate, with wild fires within acceptable conditions to avoid other risks must be made. Because the prevailing view is that fires are undesired, and the risks that entail managing fires is great, conservation plans in need of fire must be implemented with great care to avoid accidents that would stop the continuation of needed plans with the concourse of fire.

3. When drawing up conservation plans aimed at specific target species, consider how fire will affect them

Species or groups of species are impacted by fire differently, depending of fire characteristics and other factors. In the case of protected areas whose objective is one or a group of particular species, the viability of their conservation in a context of fire needs to be specifically considered. Management plans that address the possible impacts of fire need to be species or group specific, since different species are likely to respond differently to fire.

4. Assess the vulnerability of the protected areas network to fire

Corridors and stepping stones are important elements for insuring population persistence and species migration, more so in view of the impending threats. These elements, however, may be subject to fire. When these components are formed by forest, fire can alter their functioning capacity for long. Since it is very likely that some of these more isolated elements are in areas with greater human influence, their susceptibility to fire and repeated fire might be rather great and needs to be quantified since its long-term persistence may be severely threatened. As with the rest of the protected areas, the impact of fire needs to be known in advance in order to better evaluate their capacity to continue playing their role. Robust network designs, capable of not succumbing to a single fire, are needed to allow these places continue playing their vital service.

5. Ensure, where urban developments and roads are near protected areas, that measures are taken to extreme fire vigilance

Most fires are lit by people. Towns and roads are the main sources of ignitions. However, the probability of burning is still high at some intermediate distance to roads and towns since fire can travel long distances. Protected areas within these domains are at higher risk of fire than those further away.

Urban developments into the wildlands and near protected areas can be a threat to these due to increase ignition probability and subsequent fire. Also, the network of roads crossing protected areas, in addition to other perils, can clearly add risk. These two elements must be cautiously considered when declaring protected spaces and be particularly monitored during the time of high fire risk. Eventually, specific restrictions might have to be put in place to minimize risks. Risk mapping of protected spaces taking into consideration proximity to roads and towns is critically needed.

6. Identify synergies/conflicts between fire and conservation

Fire fighting includes, among other, fire break lines or fire-break areas. These can provide open space and hence favour species persistence different to those in the preserved matrix, particularly when these are forest. The role of such areas and corridors as sources of rapid colonization after fire needs to be appraised. These areas can serve as colonization points but there are positive or negative elements (increasing potential for invasive species) that need to be fully considered. The advantages and disadvantages of these areas in the event of fire need to be taken into consideration.

7. Assess changes in the landscape matrix through fire

Abandonment will continue in response to changes in socioeconomics and with climate change. Abandonment modifies the landscape matrix towards homogenization and that can threatened the persistence of many species. Fires can open up space and introduce large changes in the landscape matrix. Not all organisms will be equally affected but such changes in the landscape structure. Some, through the openings made by fire, will be favoured. Others will be negatively affected. Conservation plans must therefore contemplate the landscape scale changes that are introduced by fire.

8. Assess future risks

Changes in fire frequency, intensity/severity, size and season must be specifically contemplated for conservation areas under scenarios of climate and land-use/land cover change. This must be done for current areas with fires and for those in which fires were not present but that are likely to occur due to the changes in climatic conditions and other factors. Each of the parameters that define the fire regime can differentially affect the various species. Changes in fire season, particularly when migrant species are concerned, need to be cautiously considered. Consequently, the impact of each of them needs to be assessed in general or for the particular species or group of species that are of interest.

9. Assess how drought and other stresses may increase fire risks when drawing management plans for biodiversity

Conservation scenarios that include fire must take into consideration the level of stress being endured by the various species since, little by little, they will inhabit areas that are more stressful for them due to changes in climate among other stressors. The capacity of particular species or groups to respond to fire under such circumstances and to changes in fire regime needs to be appraised. As fires might occur under extreme conditions not seen until now (drought being the most relevant) this type of interactions need to be fully taken into consideration in future management plans for biodiversity conservation. Additional stresses due to more frequent and intense heat waves, particularly in the open habitats of the first years of regeneration after fire, must also be known.

10. Include worst case scenarios in conservation plans

Although the great majority of fires are of small size, some of then can attain very large sizes, in the order of thousands of hectares. In Spain, the maximum size of any fire recorded is around 30.000 ha, and the maximum length is 45 km (Moreno et al. 1998). The potential for one fire to spread over a whole protected area at once is not negligible. Smaller and homogeneous areas in a matrix of high fire risk are the most threatened. The prospect of increasing fire size under future conditions further adds to this. Consequently, worst case scenarios that include burning a large portion or even the whole protected area when these do not exceed several thousands of hectares needs to be contemplated. The role of buffer zones in this context needs to be equally appraised.

11. Examine how fires may bring opportunities to accommodate species to the new climate

Fires, by opening new space, and by having reduced competition among organisms in the early phases can open new space for species to move upwards or northwards in search of suitable climate. But this can also be used for invaders. Differentiating the new colonizers that are now attuned to the new conditions from those invading is important. Identifying the potential for fire to act as stepping stones must also be considered.

12. Identify species at greater risk

Species of late successional stages, thus requiring longer time to colonize burned areas, are probably the ones at greater risk in scenarios of increased fire frequency. Moister sites should regenerate quicker than more xeric sites, but their rate of recovery will be delayed with the onset of reduced precipitations under future climate for large parts of SEM. Consequently, their recovery period will be extended and the probability of burning again in earlier stages of regeneration indicates that species proper of mature successional stages might suffer. Studies should emphasize determining which groups of species enter at which state of the postfire succession and on the time needed for their recovery.

13. Identify which species may never recover after fire

Among those species most likely to suffer from fire are those of reduced distribution that are linked to particular systems that are fire sensitive. That is, those that do not regenerate after fire. A fire, particularly a large one, can severe these populations for long, making its recovery difficult. Identification of bottle-necks and deadly-traps among organisms and their systems in the event of fire is critical for those species that may be most threatened.

14. Promote research in the ecological links between species that may suffer a mismatch by the combination of fire and climate change

Climate change is producing mismatches among species (in pollination, in dispersal). Furthermore, fire con contribute to alter them. Identifying mismatches that are enhanced by the combination of fire and climate change might be of relevance for the maintenance of species that may already be in danger.

15. Examine risk of fire in possible changes in the protected area network

With climate change, the size of the protected areas will have to be increased to achieve the same conservation objectives. Until now, fire has not been taken into consideration in the design of the network of protected areas. Yet, its effectiveness can vary. Consequently, future modifications must consider how fire would affect its effectiveness. Since it is likely that the protected areas of the current network are those in a better state of conservation, which, presumably, are those further away from human influence, it is likely that new additions will be closer to human habitations, thence with higher risk of fire. Risk of fire must be included at the time of modifying the network of protected areas.

16. Improve awareness on the ecological role of fire

Fire is commonly seen as something negative, but it can play a dual role in the conservation of biodiversity. Fire, for the most part, hardly receives any attention in education, even in university programs, or not as much as its relevance demands. Every effort must be done to form and inform the general public and students at all levels about the role of fire in ecosystems and biodiversity conservation.

17. Promote research in how wildland fires affect biodiversity in a context of climate change

Knowledge on how fire affects the various groups of organisms across gradients is still a must. Long term observation sites, where the main groups of are studied jointly should be established.

Large fires, particularly large fires episodes, are laboratories that should be explored in depth for their role on biodiversity. Since many of these fires occur along gradients, these are opportunities that should not go by unexplored.

Maps with fire history are now possible for the last decades. These offer opportunities to study the impact of repeated fires on biodiversity across groups and across landscapes.

Protected areas are not static and will change with climate change. Modelling their fate and their vulnerability under scenarios of climate and fire change are crucial to understanding their future role in biodiversity conservation.

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