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CONVENTION ON THE CONSERVATION OF EUROPEAN WILDLIFE
AND NATURAL HABITATS

**Group of Experts on
Biodiversity and Climate Change**

6th meeting
10 – 11 October 2011
Council of Europe, Strasbourg,
Room 10

**EXTRACT FROM THE LIST OF DECISIONS AND ADOPTED TEXTS
OF THE 30TH MEETING OF THE STANDING COMMITTEE
OF THE BERN CONVENTION**

*Memorandum of the Secretariat
Established by the Directorate of Culture and Cultural and Natural Heritage*

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CONTENTS

Point 5.1 Group of Experts on Biodiversity and Climate Change	3
 Appendix 1	
Recommendation No. 145 (2010) on guidance for Parties on biodiversity and climate change in mountain regions	4
 Appendix 2	
Recommendation No. 146 (2010) on guidance for Parties on biodiversity and climate change in European islands	8
 Appendix 3	
Recommendation No. 147 (2010) on Guidance for Parties on wildland fires, biodiversity and climate change.	13

5.1 Group of Experts on Biodiversity and Climate Change – Draft Recommendations

The Chair of the Group of Experts on Biodiversity and Climate Change, Mr Snorri Baldursson, presented the report of the meeting held in Reykjavik (Iceland) on June 2010, stressing that the Group examined 3 reports, on “Climate change and mountain biodiversity”, on “Climate change and island biodiversity”, and on “Climate change, wildland fire and biodiversity in Europe”. These resulted in three draft recommendations for the Standing Committee’s analysis and possible adoption. Mr Baldursson further presented the proposals of the Group for its future work, highlighting the valuable interaction with other Bern Convention Groups of Experts, the preparation of further guidance as well as the focus on adaptation and mitigation measures.

The Secretariat briefly presented the Standing Committee’s opinion on Recommendation 1918 (2010) of the Parliamentary Assembly on “Biodiversity and Climate Change”, submitted by the Bureau on behalf of the Standing Committee to the Council of Europe Committee of Ministers.

The Secretariat further introduced the three draft recommendations; the delegate of Belgium, speaking on behalf of the European Union, expressed full support to the three draft recommendations and made some proposals of amendments.

Decision: The Committee thanked the authorities of Iceland for the excellent preparation of the meeting and the excellent hospitality, and took note of the report of the meeting of the Group of experts, including the proposals for the future work.

The Committee further took note of the Comments of the Bureau on behalf of the Standing Committee on Recommendation 1918 (2010) of the Parliamentary Assembly on Biodiversity and Climate Change, submitted by the Bureau to the Committee of Ministers of the Council of Europe.

The Committee amended and adopted the following three recommendations:

- 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.



Appendix 1

Convention on the Conservation of European Wildlife and Natural Habitats

Standing Committee

Recommendation No. 145 (2010) of the Standing Committee, adopted on 9 December 2010, on guidance for Parties on biodiversity and climate change in mountain regions

The Standing Committee of the Convention on the Conservation of European Wildlife and Natural Habitats, acting under the terms of Article 14 of the Convention;

Having regard to the aims of the Convention to conserve wild flora and fauna and its natural habitats;

Recognising that climate change affects biological diversity in the territory covered by the Convention, including species, habitats and the Areas of Special Conservation Interest of the Emerald Network;

Recognising the need to adapt conservation work to the challenges of climate change so as to minimise its impacts on the species and natural habitats protected under the Convention;

Bearing in mind that uncertainties surrounding the precise nature of future climate change and its impacts on biodiversity should not delay practical conservation action;

Noting that the biodiversity of mountain regions in Europe is particularly vulnerable to climate change as many species, particularly those in the upper parts of mountains are going to experience important reductions in their distribution area as the climate warms up;

Noting that biodiversity of European mountain systems is to be more affected than other mountain ranges of the world as migration of species Northwards following temperature increase will not be possible because of their West-East orientation;

Noting that many European mountain ranges have a high degree of habitat fragmentation and can be considered “evolutionarily isolated ecosystem”, which increases the vulnerability of their biodiversity to climate change;

Recalling CBD COP 10 Decision X/33 on Biodiversity and climate change;

Recalling Recommendations No. 135 (2008) and No. 143 (2009) of the Standing Committee, on addressing the impacts of climate change on biodiversity;

Welcoming and bearing in mind the report “*Impacts of climate change on Mountain Biodiversity in Europe*” by Ms Eva Spehn [doc. T-PVS/Inf (2010) 8];

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 mountain 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.

APPENDIX

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 recommendations 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-caused disturbances (e.g. fragmentation, nitrogen addition or other pollution) that hinder the ability of species or ecosystems to withstand climatic events. 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. 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 2



Convention on the Conservation of European Wildlife and Natural Habitats

Standing Committee

Recommendation No. 146 (2010) of the Standing Committee, adopted on 9 December 2010, on guidance for Parties on biodiversity and climate change in European islands

The Standing Committee of the Convention on the Conservation of European Wildlife and Natural Habitats, acting under the terms of Article 14 of the Convention;

Having regard to the aims of the Convention to conserve wild flora and fauna and its natural habitats;

Recognising that climate change affects biological diversity in the territory covered by the Convention, including species, habitats and the Areas of Special Conservation Interest of the Emerald Network;

Recognising the need to adapt conservation work to the challenges of climate change so as to minimise its impacts on the species and natural habitats protected under the Convention;

Bearing in mind that uncertainties surrounding the precise nature of future climate change and its impacts on biodiversity should not delay practical conservation action;

Recalling CBD COP 10 Decision X/33 on Biodiversity and climate change;

Recalling the “*Message from Reunion Island*” issued at the conference “The European Union and its Overseas Entities: Strategies to Counter Climate Change and Biodiversity Loss” (July 2008) and the exceptional importance of the biodiversity of the EU’s Overseas Countries and Territories and Outermost Regions and their vulnerability to climate change;

Recalling Recommendation No. 99 (2003) of the Standing Committee on the European Strategy on Invasive Alien Species;

Recalling Recommendation No. 91 (2002) of the Standing Committee on Invasive Alien Species that threaten biological diversity in Islands and geographically and evolutionary isolated ecosystems;

Recalling Recommendations No. 135 (2008) and No. 143 (2009) of the Standing Committee, on addressing the impacts of climate change on biodiversity;

Noting that European islands are home to many species and habitats of conservation concern, that they contain a large number of endemic species (particularly in the Mediterranean and Macaronesian Regions), many of which are listed in Appendices I and II of the Convention as strictly protected species;

Noting that often, due to their geographical characteristics, many islands biodiversity is already vulnerable because of their limited space in islands and the high concentration of human activities affecting natural ecosystems, particularly in their costs;

Noting also that island biodiversity, because of its endemism, the reduced possibilities in increasing habitat connectivity and the reduced distribution area of many species, is particularly vulnerable to climate change and the risk of spread of invasive alien species;

Noting that, following the report of the Group of Experts on European Islands Biological Diversity [document T-PVS (2009) 13], the geographic scope of this recommendation is restricted to islands in the Mediterranean and Black Seas, the Baltic Sea, the Arctic and East Atlantic (from Iceland to Ascension Island);

Welcoming and bearing in mind the report “*Climate change and the biodiversity of European islands*’ by Ms Cordula Eppele [document T-PVS/Inf (2010) 9];

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.

APPENDIX

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 recommendations 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 led 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 Mediterranean 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 3



Convention on the Conservation of European Wildlife and Natural Habitats

Standing Committee

Recommendation No. 147 (2010) of the Standing Committee, adopted on 9 December 2010, on guidance for Parties on wildland fires, biodiversity and climate change

The Standing Committee of the Convention on the Conservation of European Wildlife and Natural Habitats, acting under the terms of Article 14 of the Convention;

Having regard to the aims of the Convention to conserve wild flora and fauna and its natural habitats;

Recognising that climate change affects biological diversity in the territory covered by the Convention, including species, habitats and the Areas of Special Conservation Interest of the Emerald Network;

Recognising the need to adapt conservation work to the challenges of climate change so as to minimise its impacts on the species and natural habitats protected under the Convention;

Bearing in mind that uncertainties surrounding the precise nature of future climate change and its impacts on biodiversity should not delay practical conservation action;

Recognising that fire is a major factor in shaping vegetation and that it may trigger important permanent ecosystem change in a context of climate change;

Aware that both many natural and seminatural habitats and forest plantations may be more prone to burn if rainfall decreases and temperatures rise with climate change in some parts of Europe;

Conscious that nature conservation and forestry policies need to take into account and be adapted to changing patterns of fire that will accompany climate change;

Recalling CBD COP 10 Decision X/33 on Biodiversity and climate change;

Recalling Recommendations No. 135 (2008) and No. 143 (2009) of the Standing Committee, on addressing the impacts of climate change on biodiversity;

Welcoming and bearing in mind the report “*Climate change, wildland fires and biodiversity*” by Mr Jose Manuel Moreno [doc T-PVS/Inf (2010) 10];

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; identify 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

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 recommendations 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 or 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 concurrence 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 threaten 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 them 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. Moist 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 can 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.