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DRAFT GUIDELINES ON THE MANAGEMENT OF EMERALD SITES AT NATIONAL LEVEL, INCLUDING CLIMATE CHANGE ADAPTATION AND MITIGATION

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1. INTRODUCTION

The Emerald Network of Areas of Special Conservation Interest and the Natura 2000 Network are the two major instruments of the Pan-European Ecological Network (PEEN), promoted under the Pan-European Biological and Landscape Diversity Strategy (PEBLDS).

The setting-up of the Emerald Network was envisaged as early as 1989 and was given practical form in 1996 by the Standing Committee to the Bern Convention with a view to supplementing the Natura 2000 Network, on a similar basis, in non-Community countries, based on the highest possible methodological synergy. Work on the setting-up of the Emerald Network has been speeding-up in the last years, with the implementation of dedicated projects taking place in several countries (Central and Eastern Europe, the Russian Federation, South Caucasus, Norway, Switzerland and the West Balkans).

According to the three Phases of the constitution process of the Emerald Network[1], once the identification of potential sites is finished (Phase I), a new phase begins, consisting of the scientific assessment of the sufficiency of these sites to ensure the long-term survival of threatened species and habitats (Phase II). In this relation, countries need to receive guidance on what they are expected to do for the management of the sites on their territory, which will join the Emerald Network. At a third and last stage (Phase III), the countries are supposed to designate the sites at national level, through national legislation or administrative measure.

This document is designed to provide practical advice for site managers and policy makers with respect to the management of Emerald sites at national level and to guide on ways for taking integrated action to mitigate and adapt to climate change with two objectives:

i. *Increasing available habitat* - to increase the available habitat for species and ensure the existence of suitable pathways for species dispersal; to underline benefits from Emerald Network sites for mitigating the impacts of climate change, reducing vulnerability and increasing resilience for species and habitats;

ii. *Enhancing diversity and resilience of the protected-area network* - biodiversity depends on the protection and management of designated sites: these sites are central for ensuring that biodiversity is able to adapt to a changing environment, particularly because of climate change.

Proposed actions in this document take into account previous Bern Convention recommendations relevant to the management of Emerald sites, which have already been approved by the Standing Committee and should be applied in the climate change adaptation and mitigation:

Bern Convention Recommendation No. 152 (2011) on Marine Biodiversity and Climate Change, recommending that Contracting Parties 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; by ensuring that they are managed in a sustainable way; by examining how marine invasive alien species may affect the biodiversity and, in particular, how Lessepsian species may affect native Mediterranean biodiversity;

Bern Convention Recommendation No. 147 (2010) on guidance for Parties on wildland fires, biodiversity and climate change, recommending that Contracting Parties 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; adapt land use and land management policies, including forestry, to make forests and other ecosystems more resilient to fires in a context of climate change;

Bern Convention Recommendation No. 146 (2010) on guidance for Parties on biodiversity and climate change in European islands, recommending that Contracting Parties carry out inventories and specific research on island biodiversity that will be most affected by climate change,

[1] Criteria for assessing the National Lists of proposed ASCIs at biogeographical level and procedure for examining and approving Emerald candidate sites, Council of Europe (2010)

monitor their change, identify in particular species that may go extinct in the next decades, and propose solutions for the conservation of their genetic diversity; 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;

Bern Convention Recommendation No. 145 (2010) on guidance for Parties on biodiversity and climate change in mountain regions, recommending that Contracting Parties carry out specific 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 neighbouring states in shared mountain ranges.

Bern Convention Recommendation 143 (2009) on further guidance for Parties on biodiversity and climate change, and in particular the 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 135 (2008) on addressing the impacts of climate change on biodiversity, recommending an integrated approach to climate change response activities, including 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 No 141 (2009) on potentially invasive alien plants being used as biofuel crops, recommending to Contracting Parties to monitor for possible spread of biofuel crops into natural habitats and their effects on species and habitats protected under the Convention; to introduce appropriate mitigation measures to minimise its spread and impact on native biological diversity.

2. MANAGEMENT PLANNING STEPS FOR EMERALD SITES

The management planning for each Emerald network site should be developed in several steps as follows:

Step 1: Pre-planning – selection of the site subject of planning

Step 2: Data gathering

Step 3: Assessment of the major climate change aspects and their effect and impact on biodiversity.

Step 4: Identification of key elements (habitats and species) within the site subject of planning

Step 5: Adaptive Management plan

Step 1: Pre-planning – Selection of the site subject of planning

All Emerald sites are subject to the implementation of the present Guidelines. The management planning therefore has to be proceeded for each of the officially nominated 'candidate Emerald sites' and/or for each nationally designated Emerald sites. One planning document can include several sites, especially if the sites are part of common green infrastructure or corridors.

Step 2: Data gathering

2.1.General information

Location and borders

The physical-geographic location of the site should be described and the borders of the site should be defined on the basis of the designation paper. The location and borders should be shown on maps illustrating:

- The location of the site in relation to Europe and to the borders of the country in a suitable scale;
- The site's borders, the adjacent settlements, the main existing tourist sites, the road network around and in the site, the main water courses etc. in a suitable scale.

Legal status

The legal framework for the site's management should be given. This implies:

- Development and legal status of the site
- Legal frames of the site's management
- Status of the sites according to international legislation, agreements and standards

A number of international conventions pay special attention to biodiversity problems and the need for its conservation and restoration. These conventions and European Directives are the reference points in defining the main goals and management measures.

Ownership

The available information concerning the ownership on the sites, i.e. existing buildings, equipment, infrastructure, etc., should be updated. Where ownership is not clear, then we have a plan on paper and schedules for implementation but little real progress. Thus, it is critical from the outset of the management measures that the ownership issue is addressed in a comprehensive manner.

Management structure

The management body is of crucial importance for the implementation of the measures. In the field of protected areas management, there are a number of "*best practices*" that can be used for Emerald sites management. This is the only guaranty to achieve the main management objectives: increasing available habitat and enhancing diversity and resilience of the protected-area network.

The management structure (administrations, institutions, consultative forums, scientific bodies, NGOs etc.), responsible for the management of the site and for the implementation of the measures should be clearly described. Information of the funding sources – the state budget, the national funds for environmental protection and others should be specified.

Existing projects

Projects related to the use of resources and other activities on the site's territory, like urban projects, municipal development plans, etc., should be conceptually presented in order to generate and realise greater synergies and integrated collaborative approaches. Review of policies and strategic projects, related to climate change management has to be done. In terms of adaptation of biodiversity to climate change the following policies are relevant:

- Review existing biodiversity strategies for relocation of species and habitats;
- Review existing policies for combating invasive species and diseases;
- Incorporate green infrastructure concepts in spatial planning policies;
- Review existing fire prevention, management plans and policies.

2.2.Abiotic information

The basic information from the available information for the site should be mainly used for the description of the abiotic features, as follow:

Climate

Local climate conditions: The climatic zone and the typical for the site climate conditions should be described, including the specific climate changes affecting local climate, as well as how local relief, aspect and other landscape elements influence climatic conditions.

Geology and geomorphology

The present tectonic status of the territory should be described, including the rising, sinking, seismic activity (seismic area – assessment and forecast) and the deep erosion intensity ratio. The geomorphology of the relief should also be presented, including the forms of the present relief and characteristic of relief-changing processes like:

- River erosion: river terraces, meanders, and other typical river structures;
- Denudation erosion: traces, ditches, valleys and etc.;
- Calcareous: caves, caverns and etc.;
- Anthropological: fasted erosion; quarries, road-constriction etc.;
- Assessment and forecast of the development of the contemporary relief;
- Others.

Hydrology and hydro-biology

The basic hydrologic and hydro-graphic characteristics should also be presented. The hydrographical network can be illustrated with a map, showing the existing hydro-technical equipment, water reservoirs, etc if any. Hydro-chemistry - Analysis of the quality of the surface waters should be done.

Soils

The distribution and characteristics of the soils types and the soil processes like the erosion processes (kind, degree), should be checked and described. The places of newly emerged erosion processes (kind, degree) should be studied and described.

2.3 Biological information

2.3.1 Information for natural habitats in the site subject of planning

The inventory of natural habitats on site includes all habitats with conservation or landscape value of the CORINE BIOTOPS. In order to facilitate the comprehension of habitat types it is recommended CORINE BIOTOPS codes to indicate the corresponding equivalent EUNIS codes and Annex I of Directive 92/43. The team may include other important habitat for the Emerald site.

Mapping of natural habitats

The mapping of natural habitats should be made by carrying out field researches for collecting the data necessary for identification of habitats and their spatial boundaries, as well as the area of distribution.

There are two basic approaches for determining the type and range of habitats:

(1) The first approach is to establish the habitats with clear physiognomy, landscape and ecological differentiation. Here fall the majority of the rocky habitats and caves, some waterlogged moors, mires and bogs, and some coastal and halophytic habitats. The identification and mapping are based on the detection and delineation of their boundaries.
(2) The second approach applies to all other habitat types that can be identified mainly through plant communities as their major components. Using the indicator features of vegetation, the boundaries of habitat are determined by the boundaries of phytocenoses, which are typical for the habitat. There are cases where the plant continuum exists and plant communities have no clear spatial, temporal and syntaxonomic borders. Furthermore, within a habitat various combinations of fragments of more plant communities can be represented. In that case, mapping is (to some extent) conditional.

In most cases, these approaches are applied in combination, with predominant weight on case by case. The boundaries of the natural habitats are plotted on a map base. For relatively small sites, recommended inventory and mapping will be done after a thorough research and study across on the

whole territory. For relatively large sites and in the presence of additional information (descriptions taxonomy, GIS) is recommended to explore all the key (typical) areas and mapping of habitats in other areas can be achieved through interpolation and extrapolation, after analysis of available information. If the area of natural habitat (or complexes) is small for real mapping at an appropriate scale they can be represented as points.

For accurate mapping (especially high priority habitats) is a recommended boundary to be taken on the field using GPS. The identified boundaries of natural habitats (polygons or points) and localities of plant species (polygons or points) are placed in a Geographic Information System.

Assessment of the conservation status of habitats identified in the site subject of planning

Criteria for assessing the conservation status of habitats:

(1) Size distribution of natural habitat;
(2) Its structure and specific functions;
(3) Status of its typical species.

The evaluation is done for each habitat type for each of the criteria. The first criterion estimates the area of habitat in the mapped areas. The evaluation of criteria such as fragmentation, changes in area should be used, at the discretion of the responsible team. The naturally occupied area of different habitats is characterized by inequality in quantitative terms. The area is commensurate with the areal-minimum of the range-expression of plant communities that are based on natural habitats. For example, the area of karst springs is very small, quite another and very large for steppes, oak and pine forests. For some habitats (e.g. caves), this criterion is not applicable.

As the second criterion is concerned, structure may affect quantitative or qualitative factors such as species composition, vegetation floors, reaction of the environment. Possible changes include, for example, replacement of local species with invasive ones, the eutrophication of water bodies and the alternation of the age structure of populations of diagnostic or habitat-specific taxa.

Generally it can be considered that the changes affecting 20% of the qualitative and quantitative characteristics of the habitat could be described as minor; between 20 and 70% - as significant, and over 70% drastical. For example, in riparian willow-poplar forests, the autochthonous grass and shrub species are equal to or less than the number of invasive species. The shrub floor is practically only composed of invasive species (Amorha fruticosa). In this case we need to characterize these changes as drastic. The relevant activities are planed according to the assessment.

To define the third criterion, the presence of the species characteristic for the corresponding habitat should be explored, and how big their population is. It is very important to see the development trends of the population and – given it is below the critical minimum – define the reasons for that and plan the necessary measures.

2.3.2 Determination of plant and animal species in the site subject of planning

The inventory of plant and animal species during the site planning process includes at least all species belonging to Annexes I, II and III of the Bern Convention. It is advisable to perform inventory of all other important species of conservation value.

Mapping of species

- *Mapping of plant species*

It is recommended that the mapping of plant species should be made together with the mapping of natural habitats. Species are marked as point objects and / or polygons and entered into GIS database. Furthermore, the identified species of Annex I of the Bern Convention is recommended to include all species of nature conservation value under national laws and other important species at the discretion of the team.

- *Mapping of invertebrates*

The suitable for each species habitats should be mapped. When beetles are concerned, the habitat is the place where the imago is regularly found. As habitat of butterflies, in most cases should be considered the place where the "food" plant of the larvae (caterpillars) is present, and not only the locality where the adult insect is observed. As dragonflies habitats should be mapped the water bodies where larvae develop in the surrounding area to 500 m from the pond. When mapping water forms of molluscs, suitable habitats that are most often associated with specific characteristics of the pond bottom (sandy, silty, clay, etc.) and the flow speed should be considered. In terrestrial forms of shellfish, habitat means the place where their shells are regularly presented. The habitats are placed as point objects or polygons (Land Cover).

- *Mapping of fishes*

It is recommended to determine the research stations which cover the representative areas of the water body, contain all characteristic habitats and can provide representative information on the species composition. Individual stations are mapped with GPS.

- *Mapping of amphibians and reptiles*

Most species are easily detectable and easily identifiable. It is desirable that the mapping is done with GPS. Subsequent accurate application of observed instances of habitats gives an idea of the specific habitat preferences of species, which greatly facilitates and helps further management.

- *Mapping of birds*

When mapping the different groups of birds it is advisable to use maps with UTM grid of 1x1 km, 5x5 km, 10x10 km. Depending on the size of the research area can be used different sizes and the UTM grid. Where possible a thorough mapping with GPS of breeding pairs of the rare species should be done. The received field data is imported into GIS.

- *Mapping of mammals (excluding bats)*

When mapping the different groups of mammals is advisable to use maps with UTM grid of 1x1 km, 5x5 km, 10x10 km. Depending on the size of the research area, different sizes of UTM grid are used. It is recommended to map the established localities of the species with GPS. The received field data should be imported into GIS.

- *Mapping of bats*

The bats are usually mapped to their specific roosts (caves, galleries, hollows, etc.). Localities are detected by GPS or plotted on maps of appropriate scale. When caching bats by nets must be put down the coordinates of the place are taken. They represent the food habitat or habitat corridor for local migrations. Upon detection of ultrasonic detectors is expected approximate polygon around the observer, which is the size of the microphone sensitivity. For each location, should be recorded all species and their absolute or relative numbers.

- *Assessment of the conservation status of species identified in the site subject of planning*

The assessment is made for each species / species group / against each of the criteria, which are the following:

(1) Population dynamics of species and number of species;
(2) Size of the natural range of the species;
(3) Size of habitat that ensures the survival of populations of species;
(4) Sex and age structure of population of the species.

The assessment on the first criteria - **the number of species** – should be done by regular monitoring, according to the biology and physiology of the species and coverage of data in standard forms to have comparable information and track trends in population dynamics.

For the assessment on the second criteria - **the size distribution /area/ of any kind of species** - systematic mapping of each of the localities of the species within the territory of the zone is necessary.

This process requires a different time depending on the size of the area, natural conditions and specificity of the species. Mapping needs to be done every 10 years and compare with any previous mapping to determine the trend in the range of species – expansion, stability or narrowing.

In respect of the third criterion - **size of habitat for each species** –, it is necessary to determine the status of preferred habitat areas identified in the site planning. It is necessary to determine the following parameters of the habitat - area (enough or not enough to maintain viable populations of priority species), stability / instability, vulnerability, human pressure, existing and future threats, the presence of changes in habitat through natural succession and other processes. The state of the habitats is essential to maintain concentrations of migratory species.

Regarding the fourth criterion - **sex and age structure for each species** -, it is necessary to conduct research. Depending on the species (species group) it is required a different period to monitor the population for evidence of significant trends in the numbers. Certain deviations from the normal sex ratio and age, most often caused by anthropogenic factors are usually an indication of future negative trends in the population.

Step 3: Assessment of the major climate change aspects and their effect and impact on biodiversity.

The assessment of the major climate change aspects and their effects on biodiversity is based on the expected impact for Emerald species and habitats resulting from:

- Sea level rise;
- Overall temperature increase;
- Changing precipitation patterns;
- Increase of extreme events.

1) To assess vulnerability of species:
   - Increased population fluctuations and local extinctions;
   - Altitudinal and longitudinal movement of species;
   - Changes in species relationships (mutualism, predator-prey, parasite-host, new pathogens and invasives);
   - Loss of habitat;
   - Increased physiological stress;
   - Change in ability reproduce leading decreasing population or change in sex rations;
   - Changes in competitive ability.
2) To assess vulnerability of habitats:
   - Erosion;
   - Submersion;
   - Salinity;
   - Drought;
   - Acidification;
   - Nutrient balance / eutrophication;
   - Higher groundwater tables waterlogging;
   - Increased frequency and severity of fire, flooding, storms.
3) To assess possible influence of the areas surrounding the Emerald sites:

It is very important that the surrounding landscape is included in an assessment of the vulnerability of species and habitats to climate change of a Emerald site – are there conditions can be used in case of extreme events(i.e. green infrastructure, fragmented of habitats)

4) Prioritization of the impacts:

Following the review of the identified impacts, all threats and the level of their impact is determined.

It is advisable to make a matrix and each expert to evaluate the corresponding threat of habitats and species. After identification and assessment, of the threats are prioritized according of their impact.

Step 4: Identification of key elements (habitats and species) within the site subject of planning

For the purposes of the selection process of key elements the following sequence of operation can be used:

1. Prepare a list of all natural habitats CORINE biotopes and species of flora and fauna specific to the site being planned, which are included in Appendices I, II and III of the Bern Convention and others which are considered by the team as important for the territory.

2. It is recommended to include in the list both the habitats and / or the species of flora and fauna that existed in the past and may be recovered, and those that can be pre-located.

3. Add to the list these ecological processes and other aspects (significant for the protection or recovery of species or habitats), which can be considered a key element of the territory.

4. Remove from the list those elements that are not important to the protected area and are therefore not necessary to formulate management objectives. Priority species and habitats should not be excluded, even if their management should be planned only as monitoring.

5. The elements that remain are considered key for the management

6. It is the purpose of formulating management regimes and norms.

Step 5: Adaptive Management plan

The improvement of management strategies with respect to climate change impacts begins with a site-specific integrated management approach, addressed by adaptive management planning. Adaptive management is a dynamic process where people of many talents and disciplines come together to make the right decision in the best interests of the resources.

Adaptive management must be a social as well as scientific process. It must focus on the development of new institutions and institutional strategies just as much as it must focus upon scientific hypotheses and experimental frameworks. Adaptive management attempts to use a scientific approach, accompanied by collegial hypotheses testing to build understanding, but this process also aims to enhance institutional flexibility and encourage the formation of the new institutions that are required to use this understanding on a day-to-day basis.

5.1 Regulatory recommendations for the implementation of measures

5.1.1 Managing zones

The zoning is a key element in the existing protected areas management practices. If the territory of the selected Emerald site needs different regimes for different parts, the zoning approach is suitable for its management.

This part should define the functional zoning of the site, as well as the possible range of operational management decisions and constraints, related to the access, construction or use of resources in each of the zones. All proposed decisions should:

- Ensure the consideration of the analytical information and evaluations given in step 2 in a justified and logical way;
- Ensure or lead to the achieving of the goals, overcoming or limiting the impact of the threats, identified in Steps 3,4;
- Allow flexibility in the taking of management decisions in case of potential or unexpected changes in the situation, e.g. calamities, etc.

5.1.2 Regimes and norms

This chapter should list the valid regimes and recommendations with respect to the habitats and species stand for the whole site territory, or for part of its zones:

- Common management regimes should be established for the site, to maintain or improve the conservation status of key habitats and species defined in Step 4;
- For each of the zones defined in 5.1.1 the general and / or specific management regimes should be determined and measures to prevent disturbance and endangered species subject to protection should be established;
- For each habitat, species and habitats of species estimated as being in bed conservation status in Step 3, specific restoration measures should be defined;
- For the habitats, species and habitats of species estimated as being in good conservation status in Step 3, concrete measures for their maintenance should be defined;
- Concrete steps to recover habitats and species that have existed in the past within the zone and could be restored should be identified.

5.2 Measures, focused on managing climate change adaptation and mitigation at the level of the Emerald Network sites

Managers of protected areas need to take a long-term vision, and actions to promote adaptation of species to climate changes for periods up to 20 to 50 years, depending on the speed with which ecosystem changes are expected. The vision is important for ensuring continuity of the Emerald Network management. The measures should be bound with the defined long- and short-term objectives and should contain a number of tasks, which are realistic in time and financial respect.

The vision should be a "Management route map" which:

- Furthers local, national and international conservation principles and standards;
- Clarifies exactly what is to be conserved and shows how their status and qualities of the site will be safeguarded and improved;
- Is socially, economically and environmentally acceptable to all who use the area;
- Functionally links rather than isolates the property with its surrounding landscapes or seascapes;
- Shows how the site will contribute to the improved biodiversity.

This vision should:

- Include a set of the strategic management principles which are unlikely to change;
- Explains what the desired condition of the area should be in the future;
- Identify the main changes that need to take place to improve and protect the site in terms of adaptation of species to climate changes.

The relation between the impacts of climate change as described in step 3 and the main measures proposed has to be identified: i.e. which measures are applicable at the site level depends on the habitat types and species as well as the local context of the site.

1. Reduce existing pressures:

Measures which can be considered within or around the site that contribute to reducing existing pressures are:

- Restoration activities;
- Increase the size of the protected area to minimise negative influences;
- Development of buffer zones around protected area;
- Control of invasive (alien) species and diseases;
- Development of ecological corridors, ecotunnels or greenbridges between the protected areas;
- Reduce or eliminate external pollution sources.

2. Enhance ecosystems and species resilience:

The objective being to enhance biodiversity in and around Emerald sites, some of the possible measures for eliminating or reducing the impact of the factors leading to the instability of the habitats or species are:

- Maintenance and/or restoration of ecosystems;
- Establishment of zones with strict nature conservation regime;
- Limiting access to the localities of species of conservation significance;
- Protection of species in a critical status;
- Relocation of species as an adaptive strategy - re-introduction and/or translocation and/or conservation or assisted migrations;
- Maintenance of genetic diversity;
- Monitoring of the process in and around the Emerald site.

Accommodating the natural landscape forming processes may be based on:

- The implementation of management actions in the forests, keeping dead wood in;
- The conservation of the gene pool of native tree species;
- Meandering of rivers and freshwater-salt water gradients;
- Maintenance of optimal open habitats for birds;
- Meadows and pasture habitats protection;
- Improving forestry practices;
- Integrated protection of the biodiversity in the agriculture;
- Sedimentation;
- Marshland development.

It should equally be considered if the size of the sites can ensure the necessary prerequisites for achieving their conservation purposes, as well as their management objectives, or if there is a need to establish new areas:

- Justifying the need of changes of boundaries of the site for protection of the habitats stands;
- Declare suitable territorial corridors if there are areas of high specific diversity outside the site.

The identification of existing and potential possibilities for species movement underlies the analysis of the need to form an ecological corridor, which will facilitate species migration.

3. Ensure required abiotic conditions

The following measures should be considered:

- Increasing water retention within the site - for example, adapting the existing drainage system, restoring meanders of rivers and streams or reforestation;
- Maintenance of the passability of rivers and gallery riverine forests - for example, increase in the total area of floodplain forests of native species;
- Restoration of the former hydrological network and wetland areas - for example, surface water inundation can be re-introduced to a site by allowing a river or lake to naturally flood the land;
- Ensuring water drainage from the site during excessive periods of rainfalls;
- Periodic mowing of vegetation or removal of the topsoil to avoid nutrient enrichment of the site.

4. Management of extreme events

In relation to the protection and conservation of biodiversity there is always a risk of anthropogenic disasters e.g. major pollution spill, fire, point source pollution in the site and adjoining areas. To a lesser extent, there is the risk of natural disasters e.g. catastrophic windblown, pests and disease, pests and flooding. Possible measures are:

- Identifying the main risks (natural and anthropogenic);
- Collaborating with local authorities and other relevant bodies in identifying and combating risks and in co-ordination of resources;
- Ensuring procedures are developed to manage and monitor all known risks in the site and adjoining areas;
- Ensuring safety is an integral component in undertaking works programmes and capital developments within the protected area;
- Providing information to local population and visitors that highlights potentially hazardous areas and activities, as well as appropriate preventative actions and emergency procedures;
- Preparing Contingency Plans for each of the main identified risks including as a minimum contingency plan for (a) pollution, (b) major flooding, (c) fire, (d) storms;
- Putting in place any necessary equipment and facilities needed for implementing a Contingency Plan;
- Providing any necessary training for implementing the Contingency Plans.
- Minimising the occurrence or the impact of uncontrolled fires.

The FAO's handbook on Forest Fire Protection provides a large number of technical measures to reduce the occurrence and impact of fires.

- *Storms* - These measures are relevant for coastal habitats and forests. Possible measures include:
  - Ecological enhancement of existing forests - improve the proportion and range of native species in existing forests while enhancing forest structure and age class distribution;
  - Individual approach of forest management in regions with reported protected species;
  - Technical measures, such as the development of dams, or sand suppletion.
- *Flood-control* - These measures are more technical, taken from the perspective of overall flood protection of the area. Possible measures include:
  - Allowing a river or lake to naturally flood the land. This can be achieved by removing the flood defence embankments. If this is not appropriate then surface water can be routed from rivers, ditches or lakes via pipes and drains. Water control structures such as dams, sluices or

weirs can be used to control the input and output of water to mimic the natural water level fluctuations within the area.

- Restoration of riverain forests
- Maintenance of the passability of rivers and gallery riverine forests.

5. Control of invasive (alien) species

Invasive alien species (IAS) are species whose introduction and/or spread outside their natural past or present distribution threaten biological diversity. IAS occurs in all taxonomic groups, including animals, plants, fungi and microorganisms, and can affect all types of ecosystems. For a species to become invasive, it must successfully out-compete native organisms, spread through its new environment, increase in population density and harm ecosystems in its introduced range.

Possible measures for control include:

- Determination of the distribution and abundance of known invasive species within the site and surround areas;
- Assessment of which invasive species have the potential to impact on overall site management goals;
- Detection, prevention and eradication of new alien species;
- Enhancement of knowledge and capacity to deal with invasive species;
- Evaluation of the effects of management measures on targeted plant species and the ecosystems that they have invaded;
- Determination of the status and trends of species invasions over time and space and develop predictive capabilities to better guide future monitoring and management efforts.

Species expanding their range as a natural response to climate change should not be considered as alien species. Acceptance of new species compositions and a good consideration for the need of species specific measures are part of climate change adaption.

5.3 Measures at the network level

If the site is large and connected to others then there is an opportunity for successful network management. However, if the site is small and isolated then this forms a difficulty for the successful implementation of the Network measures.

- *Selection of priority conservation natural habitats that would help species movement*

On the basis of the results from the evaluation and analysis of biodiversity in the sites, as well as the possibilities and limitations for species movement, natural habitats of key importance for securing species migration in and between the protected territories have to be identified. The connection between the different habitats and their specific role for species migration has to be defined in order to establish better conditions for the free movement of species between protected sites.

- *Improve connectivity by development of stepping-stones and corridors.*

Network managers can help by managing connections between the sites, as follows:

- Creating “stepping stones” for particular species;
- Maintenance of pastures – habitats of small mammals, part of the food chain of predatory birds and orchids;
- Restoration and maintenance of wet meadows and water bodies – habitats of amphibians, food base of water-loving birds; habitats for hydrophilous and hygrophilous plant species, etc.;
- Maintenance of the passability of rivers and gallery riverine forests;
- Individual approach of forest management in regions with reported protected species;

- Implementation of management actions in the forests, keeping old trees and leaving dead wood;
- Declare the some forest stands for “Old growth Forest”

- *Implementation of appropriate management of the wider landscape and development of a green infrastructure.*

With the purpose of building a green infrastructure between the protected sites, analysis has to be made of the possibilities to establish species migration corridors. Recommendations for protection of habitats and landscapes, which are to be discussed and agreed with local municipalities, should be made. A place in the future planning of regional economic development should also be ensured. The analysis, justification and planning include the protected sites and areas, as well as the possibilities for their natural connections.

The Network management requires the implementation of the following major tasks:

- Analysis and evaluation of the biodiversity of protected areas/sites in the selected territory, in the context of species movement;
- Identification of the opportunities and limitations (threats) to species movement in and between protected areas;
- Selection of priority conservation natural habitats that would help species movement;
- Elaboration of a model management plan of an ecological corridor and monitoring of processes.

5.4 Implementation of measures

Spatial planning

Spatial planning has an important role in mitigation and adaptation to climate change for many sectors (Wilson & Piper 2010). Spatial planners at all levels need to adapt their existing plans to climate change. From the point of view of mitigation and adaptation to climate change, it is very important to see planning and management in the context of an integrated relationship between ecological processes and the needs and perceptions of local population. Biodiversity protection, economic development, social development and the enhancement of public involvement are the basic prerequisites for sustainable development underlying the planning and management of the green infrastructure. The planning and management of the green infrastructure appear in the context of the spatial planning at four levels – *international, national, regional and local.* Effective planning at all these levels requires modern forms of institutional mutual help and social support in conformity with the following principles:

1) Treating each protected site as an *integrated system* of abiotic factors (land, air, water), biodiversity and human activity;
2) Taking into consideration that each system is affected by larger or smaller ecological, economic, social or political systems;
3) Accepting people as a central element of the system and assessing the social, economic, technical and political factors that will influence the way natural resources are being used;
4) Connecting, in a balanced way, the economic policy and the environmental opportunities;
5) Stimulating technologies that will help people use the resources more effectively.

Cross-border corridors

Networks’ management requires the identification of international climate adaptation zones (Vos et al., 2010) and the establishment of cross-border corridors. Climate adaptation zones are defined as key zones for adaptation measures on the ecological network level. A cross-border ecological corridor is a ‘*geographical space containing a combination of ecosystems characterized by relief forms, plantation cover, determined on managerial and scientific basis, which are of importance for the*

protection of biodiversity and landscape'. The cross-border ecological corridor must be sufficiently large to secure the preservation of habitats and valuable species. On the other hand, the corridor must be sufficiently small to be considered a 'home' by local population. The cross-border ecological corridor does not necessarily coincide with administrative boundaries and may be expanded beyond these, which is of great importance for its functioning.

Public involvement

It is recommended to organise better targeted campaigns regarding the goals, activities and expected results from Emerald Network, as well as the possibilities to participate. The representatives at the discussions are the important connection between the protected territories and the municipalities located within the territory. Appropriate measures are:

- Training and expanding public involvement regarding the protection of endangered species in the protected territories;
- Introducing the public to the recommended activities such as organic farming and other ecologically sustainable economic activities;
- Training and expanding public involvement regarding the alternative models for regional development.

For facilitating the practical implementation of the measures at the site, around the site and at the network level two matrices are elaborated as a part of these guidelines - Measures Management Matrix and Time Management Matrix. These are to be found as Annex 1 and Annex 2 of the present document.

5.5 Monitoring and review of the implementation of measures

5.5.1 Monitoring guidelines and requirements

Long-term biodiversity conservation monitoring is carried out on three inter-related levels:

Baseline monitoring of key biodiversity indicator elements

This involves assessments of the status of important habitats and species according to protocols developed by national management body. The protocols will specify the methods to be used, frequency of survey, data to be collected, analyses to be applied, and reporting format. The results from the monitoring is used to determine whether or not existing management tools have to be changed (and if so in what ways) as part of the periodic review process of the Management process (so-called adaptive management).

Monitoring of management interventions

This involves evaluating the actual results of specific management actions against the expected outcomes for them. The actions may be specified in Management Plan (for example, restoration of floodplain forests and wetlands) or arise from the results of baseline monitoring described above (e.g. translocating a species or removing a new threat), or from an event (see below). The monitoring may be carried out by Management body or external specialists as required.

Routine and Event Monitoring

This involves the systematic reporting and logging of casual observations made by responsible management body and others, for example the occurrence of a rare migratory bird, unusual behaviour of an animal, or early flowering of a plant. For this purpose, a data form and special GIS layer will be developed.

The other aspect of the monitoring level is to report incidents that may have management consequences, for example floods, fires, storm damage in forests, dumping of waste and outbreaks of diseases.

5.5.2 Indicators for the effectiveness of the measures and their effects

The adaptive management includes reviewing the effect of management measures taken. Harley & Van Minnen (2010) propose which kind of indicators can be used for the monitoring process to show whether the adaption measures are effective to reduce vulnerability of habitats and species. The review of the goals and measures achievement should consider the following:

- To what extent the goals and the expected results have been achieved;
- Which constraints and threats have been removed or their impact on the achievement of the goals has been decreased;
- Are the methods for measures implementation appropriate;
- Is it necessary to include new measures;

Conservation targets need to be regularly reviewed to ensure resources are directed towards conservation priorities as some species increase, others decline and habitats change in character as a result from climatic changes (Smithers *et al.*, 2008).

3. FUNDING FOR THE MEASURES IDENTIFIED

Funding for the measures programme will come from a variety of sources according to the aspect covered: national government, local authority, university/institute, NGO or internal resources. For each of the identified measures, it will be useful to identify the relevant stakeholders that may be involved in the process of implementing measures. Very important for the stakeholder involvement is to stress on the ecosystem services that will mitigate climate change or address impacts of climate change for other sectors and the wider society. Also, it is necessary to find out which (human) resources are needed for the different measures.

Pro-Biodiversity Business Opportunities

One method of addressing this issue is to identify and promote appropriate forms of financing for businesses that can either increase the positive ecological impact of small and medium enterprises (SMEs), or help to mitigate / reduce the negative impacts of their operations on biodiversity. In fact, the best way of addressing these issues is to encourage the establishment of intrinsically biodiversity-related investments.

It is of crucial importance to the whole of Europe that these biodiversity resources are managed in a wise and sustainable way. This is especially relevant now that emphasis in biodiversity management is moving towards care of biodiversity outside the traditional domain of protected areas, such as through the establishment of ecological networks in general and the Pan-European Ecological Network in particular.

The first step will be to collate and analyse existing knowledge about the challenges of ecologically responsible entrepreneurs (who are also most likely to be farmers, foresters, fish pond owners, tourist service providers, or shop keepers/craftsmen) that are engaging in biodiversity-related investment. This can take place through interviews with government officials who are knowledgeable about biodiversity priorities and also with entrepreneurs who are already operating in environmentally sensitive areas; there will also be interviews to assess the awareness of the financial sector (banking and social investment funds) regarding the potential for bio-diversity related investments to be profitable, and to learn about their reasons for not supporting such types of investments.

Compensation mechanism

An alternative approach is to engage landowners in conservation action Incentives may be positive (payments for positive conservation actions, e.g., the agri-environmental measures) or negative (taxes or other fees imposed on actions that negatively affect biodiversity, e.g., fees paid for killing or destroying species or habitats of European concern). Positive incentives can provide full compensation for conservation actions, or they can provide partial compensation, leveraging the willingness of landowners to engage in conservation for other reasons (Doremus 2003).

In Europe, agri-environmental schemes are a well-known mechanism for rewarding farmers for farming in an environmentally sensitive way. While not created specifically for climate change adaptation, they contribute to softening intensive production landscapes and thus can play a significant role in reducing biodiversity impacts from climate change (Donald and Evans 2006, Nillesen and van Ierland 2006).

BioBanking scheme's methodology (Department of Environment and Climate Change NSW 2008b)

The BioBanking Scheme is established under Part 7A of the *Threatened Species Conservation Act 1995* (TSC Act). A key element of the BioBanking Scheme is the establishment of the BioBanking Assessment. Methodology under section 127B of the TSC Act The methodology assesses the biodiversity values currently at development sites and biobank sites, and describes the process for measuring the loss of biodiversity values that results from removing native vegetation, threatened species habitat and threatened species on a development site, and the gain in biodiversity values from management actions on a biobank site.

4. MAIN CONCLUSIONS AND RECOMMENDATIONS

Ecological networks can positively influence the conditions for the survival of species populations in the fragmented natural areas and human dominated landscapes in Europe. In addition, they allow a suitable and sustainable use of natural resources through the interconnectivity of their physical elements with the landscape and existing social/institutional structures. Together, the Emerald and the Natura 2000 Networks could contribute to managing climate change by:

- *Providing natural storage capacity for carbon* - prevent the loss of carbon that is already present in vegetation and soils. Especially peat lands and forest have a high storage capacity for carbon;
- *Increasing capture of carbon dioxide in natural ecosystems and reduced CO2 emissions* – through restoration activities of different habitat types (f.i. peat lands and forest habitats);
- *Reducing the risks and impacts from extreme events* –providing temporarily space for floodwaters and forming natural defences;
- *Effecting local and regional micro-climate* - positive impact of forests on the local climate in settlements;
- *Reducing impacts of sea level rise* - the sites located along the coast or river form natural defences, often also using soft engineering techniques to reduce the impacts of sea level rise and at the same time bringing benefits for biodiversity
- *Ensuring natural water retention and protection from erosion* - through reducing surface runoff.

In order to facilitate the implementation of the above enumerated functions by the Emerald sites, the following actions are recommended for their management:

Policy and Regulatory Aspects

- Legal acknowledgment of Emerald sites is an important step towards simplifying the process of policy and regulatory development for Emerald network.
- It is essential to integrate policies and planning tools for Emerald network sites into mainstream planning practices and policies for local development.
- Effective inter-institutional governance should be assured by the creation of voluntary management partnerships.

Management Systems

- An independent management structure is the most effective at coordinating and implementing the Emerald sites.
- A long term, jointly agreed management strategy is a pre-requisite for successful management

- Management strategies should include a system for monitoring and evaluating site management structures, in the context of continuous learning and improvement.

Environmental Aspects

- The Emerald sites must be part of an wider ecological network
- Knowledge of the site and it surrounding area is a prerequisite for climate change mitigation and/or adaptation. Based on this knowledge, managers can make decisions on environmental priorities and environmental restoration within the site itself.
- The various ecological and land use features of the Emerald sites should be seen as an added value not as an limitation, but it requires significant work in ensuring that activities are orientated towards overall sustainable use and improvement of the environmental and landscape resources (e.g. organic agriculture, hedge reconstruction, planting, breeding and protection of endogenous species, volunteering).

Social and Communication Aspects

- Involvement of stakeholders is a key part of site creation and management, but one that requires careful evaluation of each groups' different demands.
- The Emerald network is a tool for social promotion, for social capital, for involving social groups and inhabitants and raising levels of responsibility for the public space.
- Level of involvement can vary according to site's and territorial characteristics and to the specific theme in question.
- Periodic monitoring of site users and/or visitors is important, in order to gain feedback on their levels of satisfaction and on their demands and concerns.

Economic Aspects

- Emerald sites should highlight their unique ability to add social, environmental and economic value to the surrounding area. Emerald sites need greater financial independence, especially in the current situation of limited public funds.
- Emerald sites should use their unique added value, providing ecosystems services, reducing risks from natural disasters, adapting to and mitigating climate change, health, water and other sectors, at all levels;
- Economic activities should not compromise the internal mission or role of the Emerald sites, particularly in terms of environmental protection

Green infrastructure

- Emerald sites must participate in the design for urban infrastructure, in order to ensure minimum disruption to the site.
- Emerald sites must be part of an integrated green- infrastructure network, within and around the protected areas.
- The management structures can use existing infrastructure, including integration of existing systems to establish buffer zones, corridors and restored landscapes.

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Annex 1

GUIDANCE FOR PRACTITIONERS ON CLIMATE CHANGE AND EFFECTIVE MANAGEMENT OF ECOLOGICAL NETWORKS, WITH A PARTICULAR FOCUS ON MANAGING CLIMATE CHANGE

Measures Management Matrix

	TYPE OF MEASURES	On site	Around site	Network level
H A B I T A T S	***1. Reduce existing pressures:***			
	Restoration activities	x		
	Increase the size of the protected area to minimise negative influences		x	
	Development of buffer zones around protected area		x	
	Development of green infrastructure - ecological corridors, ecotunnels or greenbridges between the protected areas			x
	Reduce or eliminate external pollution sources		x	
	2. Enhance ecosystems resilience:			
	Maintenance and/or restoration of ecosystems	x		
	Establishment of zones with strict nature conservation regime	x		
	Monitoring of the process in and around Emerald site	x	x	
	Implementation of management actions in the forests, keeping dead wood in	x		
	Meandering of rivers and freshwater-salt water gradients	x	x	x
	Maintenance of optimal open habitats for birds	x		
	Meadows and pasture habitats protection	x		
	Improving forestry practices	x	x	
	Integrated protection of the biodiversity in the agriculture	x	x	
	Sedimentation	x		
	Marshland development	x	x	
	Justifying the need of changes of boundaries of the site for protection of the habitats stands	x	x	
	Declare suitable territorial corridors if there are areas of high specific diversity outside the site		x	x
	Maintenance of pastures – habitats of small mammals, part of the food chain of predatory birds and orchids;	x		
	Restoration and maintenance of wet meadows and water bodies – habitats of amphibians, food base of water-loving birds; habitats for hydrophilous and hygrophilous plant species, etc.	x		

	3. Ensure required abiotic conditions			
	Increasing water retention within the site	x		
	Maintenance of the passability of rivers and gallery riverine forests	x	x	
	Restoration of the former hydrological network and wetland areas	x	x	
	Ensuring water drainage from the site during excessive periods of rainfalls	x		
	Periodic mowing of vegetation or removal of the topsoil to avoid nutrient enrichment of the site.	x		
	4. Management of extreme events			
	Technical measures, such as the development of dams, or sand suppletion	x		
	Allowing a river or lake to naturally flood the land.	x	x	
	Removing the flood defence embankments.	x		
	Route surface water from rivers, ditches or lakes via pipes and drains.	x	x	
	Water control structures such as dams, sluices or weirs to control the input and output of water to mimic the natural water level fluctuations within the area.	x		
	Maintenance of the passability of rivers and gallery riverine forests.	x	x	
S	***1. Reduce existing pressures:***			
	Restoration activities	x		
P	Increase the size of the protected area to minimise negative influences		x	
	Development of buffer zones around protected area		x	
E	Development of ecological corridors, ecotunnels or greenbridges between the protected areas			x
C	Control of invasive (alien) species and diseases	x	x	
	Reduce or eliminate external pollution sources		x	
I				
	2. Enhance species resilience:			
E	Limiting access to the localities of species of conservation significance	x		
	Protection of species in a critical status	x		
S	Relocation of species as an adaptive strategy - re-introduction and/or translocation and/or conservation or assisted migrations	x	x	
	Maintenance of genetic diversity	x		
	Conservation of the gene pool of native tree species	x		
	Creating “stepping stones” for particular species			x
	Declare the some forest stands for “Old growth Forest”	x	x	x
	Maintenance of pastures – habitats of small mammals, part of the food chain of predatory birds and orchids;	x		

	3. Management of extreme events			
	Improve the proportion and range of native species in existing forests while enhancing forest structure and age class distribution	x		
	Individual approach of forest management in regions with reported protected species	x		
	Restoration of riverain forests	x	x	
	4. Control of invasive (alien) species			
	Determination of the distribution and abundance of known invasive species within the site and surround areas.	x	x	
	Assessment of which invasive species have the potential to impact on overall site management goals.	x		
	Detection, prevention and eradication of new alien species.	x	x	
	Determination of the status and trends of species invasions over time and space	x		

This matrix provides an overview of the various measures you might consider. The main categories of measures are:

- Reduce existing pressures

- Increase ecosystem resilience

- Ensure abiotic conditions

- Manage impact of extreme events

If national information of the expected impacts for species and habitats is available, it should certainly be used. Once the main impacts have been determined, we can begin with formulating measures to mitigate or adapt to climate change. A good way to quickly combine all available knowledge is organising a workshop (with stakeholders and experts) to address the impacts of climate change on your site.

As each Emerald site is different, an assessment of the local context is required.

- For extreme events: are refuge areas for species available.

- For altitudinal ('up the mountain') and longitudinal movement of species: is the area embedded in a network of green infrastructure.

- For sea level rise: Are there coastal defences, roads or urban areas in the vicinity or coastal barriers that prevent habitats from moving inland.

Based on the outcomes of the relevant questions a provisional listing of the measures which help to address climate change can be prepared.

Except for the measures mentioned in this matrix, it remains important to think of any additional adaptation measures, which might be relevant based on national, regional and/or local knowledge. For each of the identified measures, it will be useful to identify the relevant stakeholders that we may want to involve in the process of appointing adaptation measures, as certainly some of the stakeholders will gain benefits (ecosystem services) from the adaptation measures and are therefore willing to contribute to set and realize the targets.

Annex 2

GUIDANCE FOR PRACTITIONERS ON CLIMATE CHANGE AND EFFECTIVE MANAGEMENT OF ECOLOGICAL NETWORKS, WITH A PARTICULAR FOCUS ON MANAGING CLIMATE CHANGE

Time Management Matrix

European and national information sources, are available that provide spatial scenario of the expected climate changes (e.g. EEA, 2004, Ciscar et al., 2009, Clearing House Mechanism on climate change impacts, vulnerability and adaptation.).This base information of changes in seasonal climatic conditions, will allow to better assessing how the specific Emerald site can contribute to the adaptation and mitigation of some of the expected climate change impacts which will affect other sectors.

Based on the outcomes of the information above an indicative list of measures can be prepared which help to address climate change and a first prioritization can be done. The matrix bellow helps to the protected areas managers to focus on two main ingredients of **Time Management:** importance and urgency. Identifying each measure that have to be implemented the practitioners can see what they realy need to be doing and what can be ignored, and what needs to be done first, and what can wait.

	URGENT	NOT URGENT
IMPORTANT	**I** Measures, related to climate changes, **serious impediment that will be likely to act long time** Measures, related to constraints / threats **can be remove by the management** of the site and it must take urgent adaptation and mitigation in this regard. Measures, related to potential climate changes within the site have an **impact over the whole territory** of the site.	**II** Measures, related to the climate changes with **potential impact** of the site and its removal is important but can be reduced or controlled over time by the protected area management. Measures, related to potential climate changes within the site have an **impact on discrete small areas**, habitats and/or species in the site.
NOT IMPORTANT	**III** Measures, related to potential climate changes within the site have an impact, generally or locally, **under certain conditions.** Measures, related to the removal of **potential climate changes impacts** not only by the Management body of the site, but it should take the initiative in this respect.	**IV** Measures, related to climate changes with **low potential impact** – require additional research and involvement of more institutions and partners in order to undertake the necessary measres.