The Continuum Project

EVALUATION OF APPROACHES FOR DESIGNING AND IMPLEMENTING ECOLOGICAL NETWORKS IN THE ALPS

ASSESSMENT REPORT

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30 August 2008

http://www.alpine-ecological-network.org/index.php/services-mainmenu-8/downloads-documents

The Ecological Continuum Project was started in June 2007 by ALPARC (Alpine Network of Protected Areas), CIPRA (International Commission for the Protection of the Alps), ISCAR (International Scientific Committee Alpine Research) and the European Alpine Programme of the World Wide Fund for Nature (WWF) with the aim of maintaining or restoring ecological connectivity between important areas for nature conservation in the Alps. The project is financed by the Swiss MAVA Foundation for Nature.

During a pre-project (2007-2008) the Ecological Continuum Project compiles some basic information for following project for establishing ecological networks in the Alps, mainly

- to harmonize terminology, including a common definition of the "ecological continuum" to be submitted to the alpine states and the EU;
- to evaluate and assess existing approaches in view of their application in the Alps;
- to identify the most important, appropriate and promising pilot regions;
- to define a catalogue of measures for the implementation of an ecological network,
- to develop a strategy for the involvement of authorities and stakeholders;
- to develop a coherent communication campaign;
- to finalize a proposal for a main-project to be submitted to the MAVA Foundation.

Contents

Evaluation of approaches for designing and implementing ecological networks in the European Alps

SYNTHESIS & RECOMMENDATIONS

Framework and goals

Within the Continuum Project (pre-project July 2007-December 2008, see page 2), four aspects considering the planning and implementation of ecological networks in Alpine space have been deepened: The evaluation and assessment of existing approaches (Work package A ; WPA), the listing and description of existing measures (Work package B), first elements for communication on ecological networks and mobilisation of stakeholders in appropriate pilot regions (Wok package C) and preparing future projects on ecological networks (Work package D). See: http://www.alpine-ecological-network.org

This report summarizes the results of Wok package A, aiming at an overview on existing approaches and an assessment in view of their application in Alpine space and in pilot regions.

Workflow

Four approaches already in use have been selected for the evaluation: A) WWF Ecoregion approach; B) Connectivity between Protected Areas by ALPARC; C) Pan-European Ecological network PEEN and D) Swiss Ecological Network REN. On behalf of a questionnaire (see Appendix 2 of full WPA-report on http://www.alpine-ecological-network.org) different aspects of these 4 approaches were assessed by 18 selected experts (14 scientists and 4 national representatives of the Platform Ecological Network of the Alpine Convention) as scale, data need, use for implementation, possible combinations. Additionally the experts were asked to give a general impression on actions needed. The answers to the questionnaire (see Appendix 3 of full WPA-report on http://www.alpine-ecological-network.org) had been summarised (Chapters 1-3 of this report) and verified at a Workshop in Zurich (10. and 11.12.2007).

The main goal of the Workshop in Zurich consisted in developing a procedure for pilot regions how to apply existing approaches for developing coordinated concepts for Alpine and regional ecological networks (EN).

Main concerns of ecological connectivity in the Alps

Following the experts assessment (chapter 1.1. below), **main concerns for conserving and improving ecological connectivity** in the Alps are:

- Fragmentation by urban development and intensive land and water use mainly in valleys and along river corridors and
- Issues of environmental / climate change such as changing habitats and migration, invasive plants and diseases.

Improving connectivity will only be possible by overcoming institutional and scientific gaps:

- Institutional gaps: Coordination and information across political and legal levels and interest groups towards implementation of connectivity measures, cross-border cooperation
- Scientific gaps: knowledge (mainly in functional connectivity), methodology and heterogeneity of data.

The experts set clear priorities, in which **type of regions** (defined by the Platform Ecological Network of the Alpine Convention) measures for establishing EN should focus on (chapter 1.2.):

First:

- Areas with high biodiversity values (Priority Conservation Areas PCA, Natura 2000, etc.)
- Riverine systems as connectivity elements of the wider landscape
- Densely populated areas in low altitudes
- Areas with high pressure through intensive agriculture, tourism, energy infrastructures, etc.

Second:

- Border areas of the existing protected areas
- Areas linked to large-scale European networks such as PEEN, Alpine-Carpathian network, IBA etc.
- Large scale forest areas

Finally, main achievements of **successful connectivity projects** should be (chapter 1.4.):

- Establish and improve Alp-wide databases for application in cartography, conceptual work and monitoring
- Identify main problem areas on an Alp-wide level such as structural barriers, rivers and connections within PEEN
- Focus on main concerns such as areas with high pressures and areas with a high biodiversity, and rivers
- Build up awareness of public, stakeholders and decision- & policy-makers

Assessment of 4 approaches

A main goal of WPA is an assessment of 4 approaches mentioned (WWF, ALPARC, PEEN and REN) regarding their application in the Alps (details see chapter 2). These 4 approaches had been chosen because of their large spectrum of application, existing documents or their close relation to Alpine space. There exists a range of other approaches focusing on specific ecosystems (e.g. rivers, dry meadows) or species groups (e.g. ungulates, birds). All these approaches are valuable as well and appropriate for application in a given spatial or ecological context!

The 4 chosen approaches are aiming **different goals**:

WWF: Representation of natural communities within conservation landscapes / protected areas networks; Maintenance/restoration of viable populations; Maintenance/restoration of ecological and evolutionary processes; Conservation of blocks of natural habitats.

Source: WWF (2006): A biodiversity Vision for the Alps. Proceedings of the work underatken to define a biodiversity vision for the Alps. Technical Report. WWF European Alpine Programme, Milano (unpublished).

ALPARC: Overview of the current connectivity situation for protected areas across the entire Alps; Presentation of the strategies / measures / regulations adopted by Alpine countries and the EU which contribute towards implementing the regional networking of protected areas, establishing ecological corridors, and ensuring species migration at the national and cross-border level.

Source: Netzwerk Alpiner Schutzgebiete (2004): Grenzübergreifender ökologischer Verbund. Alpensignale 3, Innsbruck (German, French, Italian and Slovenian)

PEEN: The Pan-European Ecological Network PEEN is the first objective of the Pan-European Biological and Landscape Diversity Strategy. It is a coherent assemblage of areas representing the natural and semi-natural landscape elements that need to be conserved or managed in order to ensure the favourable conservation status of the ecosystems, habitats, species and landscapes of European importance across their traditional range. The components of the Network serve three functions, namely: To provide the optimum achievable quantity and quality of environmental space (core areas);

To ensure appropriate interconnectivity between the core areas (corridors); To protect core areas and corridors from potentially damaging external influences (buffer zones).

Source: COUNCIL OF EUROPE (2007): The Pan-European Ecological Network: taking stock. Nature and Environment Nr. 146, Starsbourg

REN: The Swiss REN follows the same overriding objectives as the PEEN (recording and presenting the various functions of the landscape and its potential) and is designed to contribute towards the protection and restoration of habitats to ensure genetic exchange; the linkage of important habitats and their connection through ecological corridors; reducing the fragmentation of ecosystems; the linkage of ecological compensation areas in agriculture; the improvement of the quality and diversity of agriculture.

Source: Bundesamt für Umwelt (2004): Nationales ökologisches Netzwerk REN. Schriftenreihe Umwelt Nr. 373, Bern (German and French)

The following table reflects an overview on how the 4 approaches fit with the different criteria of the evaluation (1= fit; 2=partly fit; 3= do not fit; see also Chapter 3):

	WWF	**ALPARC**	**PEEN**	**REN**
Identification of problem areas	2	3	1	1
Application in scales:				
pan-alpine networks	2	2	1	3
regional networks	2	2	3	1
local networks	3	3	3	1
Data need	high	low	medium	high
Data availability	medium	good	medium	good
Data costs	low	low	medium	medium
Implementation /proposition of measures	3	3	3	3
Alpine space	1	1	3	2
Aims of connectivity:				
for species (functional)	1	2	2	1
between habitats (structural)	3	1	2	1
linking species & habitats	2	2	3	1
overcome barriers	2	2	3	1
in/between protected areas	1	1	1	1
environm. dynamics/change	3	3	3	2
for large carnivores	1	2	2	1

All 4 approaches can contribute to projects focusing on ecological connectivity, with the following specific profile:

WWF: analysing corridors for specific species on regional and pan-alpine scale; WWF takes into consideration biodiversity hot spots (PCA) in the context of the Alpine Ecoregion.

ALPARC: analysing landscape and land-use structures from a connectivity perspective on a regional level, ALPARC has a focus on ecological linkage in and between protected areas. Because of using available data, this pragmatic approach delivers not very precise but low-cost results.

PEEN: is appropriate for analysing connectivity on large scale (highland-lowland, several mountain ranges) and between areas of European importance.

Swiss REN is the best developed approach on regional and local level; the mapping of REN is ambitious and data and cost-intensive; REN maps provide a good basis for planning measures at regional and local level; it is also possible to break down the concept on analysing obstacles (approach of REN Isère/France).

Regarding the two main dimensions of connectivity, the spatial dimension (pan-alpine to local scale) and the habitat dimension (structural / functional), the 4 approaches show a clear complementarity:

Dimensions	structural	mix	functional
pan-alpine		PEEN	WWF
regional	ALPARC	REN	
local		REN	

Depending on the regional situation and the goals to reach in view of connectivity, each of the approaches can be valuable for developing EN. That's why, the question for developing EN is not "Which approach?" but "Which goals?".

Proposed procedure in pilot regions

Based on the assessment of the 4 approaches, WPA intended to develop a procedure for the application of existing approaches in pilot regions. Experts made suggestions how to proceed (see details Chapter 4.1. and see Appendix 3: Question 10).

This procedure was discussed and tested at the Zurich Workshop with experts and participants from the Consortium (participants see Appendix 1). For each step a matrix helped to structure the results of discussions (Chapter 4.1 - 4.4.). The proposed procedure includes 4 steps:

1. Problem analysis and setting aim:

- Identifying main problem fields in the area considered (pan-alpine, regional, local) and setting aims for solving the problem

2. Define focus activities:

- Definition of focus activities in main problem fields

3. Select appropriate approaches:

- Assess which of the methodologies (including data need) fits with the aims of a focus activity

4. Prepare implementation:

- Develop procedures to start selected focus activities

1. Problem analysis and setting aims has to reflect the situation in the pilot region. This analysis requires the cooperation of stakeholders (agriculture, forestry, hunting & fishery, tourism, traffic, landscape/nature protection, etc.). In this context it should be discussed if certain indicators (biotopes or species) should be focussed on and how far functional connectivity can be integrated. Problem analysis should be supported by geographical data (GIS) and other available data from administrations and from scientific projects. If necessary data-bases have to be completed or improved (consistency, quality). A sufficient data basis is important for a well supported analysis. At least three main analyses should cover each pilot region: 1) An analysis of the still existing potential for connectivity (->

preservation); 2) an analysis of barriers (ecological and anthropogenic) from local to European relevance; 3) an analysis of the continuum between all types of protected areas and biodiversity hot spots. If ever possible, the methods for these analyses should be strengthened and harmonised: Swiss REN for potential connectivity, PEEN/REN Isére for barriers and ALPARC for the continuum between protected areas. In this phase of the project, communication will be crucial (see Wok package C of the Continuum Project).

2. Define focus activities: Establishing EN is a multi-level topic and a concentration on specific aims, on areas with high need for action or on most effective measures will be necessary. Therefore, a broad discussion on focus activities should be held with stakeholders in the pilot region. A feasibility study should not be forgotten at this stage of the procedure. A debate on focus activities should include all dimensions (pan-alpine, regional, local) independent of borders. In this context, other than purely ecological arguments also need to be considered: Maybe a certain species of regional interest is appropriate for the promotion of EN (flagship species) or some stakeholders are ready to implement particular measures (e.g. some framers, tourist agencies or a hydropower company).

3. Select appropriate approaches: As far as aims and corresponding focus activities are tied, appropriate methodologies have to be selected. Beyond the 4 approaches evaluated in this project, a range of complementary methodologies should be considered (chapter 2.5.).

***4. Prepare implementation projects*:** The last methodological step will consist in planning implementation projects and measures. The procedure differs widely depending on the type of activity, but the evaluation of the project with appropriate indicators has to be considered as well. In this phase of the project, available experience from implemented measures will be helpful (see Work package B of the Continuum Project).

Of corse this proposed procedure has to be tested and further improved in pilot regions.

1. Introduction

1.1. Main problems identified regarding connectivity in the Alps

Question 1: What are the three most important problems when improving ecological connectivity in the Alps?

All answers to question 1 see Appendix 3 of full WPA-report on http://www.alpine-ecological-network.org)

The answers can be summarized under 5 topics:

a. Urban development, intensive land use

The Alps are a geographical entity with main-fold continuums of diversified natural habitats, most of them still intact and well functioning in coherent ecological networks. More and more human activities and constructions are interfering with ecological connectivity, especially in corridors.

As main problem is regarded the fragmentation of habitats due to human development in large alpine valleys. Growing settlements, tourism and traffic infrastructures as well as intensive agriculture cause barrier effects along the valleys for different taxa and degradation of landscape diversity and functions (ecological and aesthetic). The expansion of settlements around cities is affecting more and more valley slopes, which are often key habitats for many taxa. In suitable farmland, habitat quality is still decreasing, and intensification caused a large-scale decline of many species inhabiting nutrient-poor open land (e.g. birds, grasshoppers, butterflies, reptiles).

Another problem is a practical one, which relates to the topography of the area, and the distribution of urbanized areas. Urban development and intensive land use is developing mainly in valley grounds. Alpine valleys play a crucial role as connecting areas between protected areas, but also between highland and surrounding lowlands. In many cases socio-economic pressure will render difficult the implementation of ecological network in such areas.

b. River corridors

Catchments and rivers are key units for ecological connectivity. Main problems concerning connectivity are:

- Hydropower infrastructures: Loss of longitudinal connectivity, habitat (and genetic) fragmentation due to dam construction and change in the flow regime
- Land reclamation, flood protection: Loss of lateral connectivity, primarily through channel regulation, floodplain modification
- Loss of vertical connectivity, primarily through the channel modification and flow regulation (clogging, intense bio film development, lack of sediment transport, vertical incision of river channel, hydrological decoupling from hill slope). Restoring the sediment regime in altered systems is an important issue also identified by the EU Water Framework Directive

c. Institutional gaps: Coordination and information across political levels and interest groups towards implementation of connectivity measures

Politicians and decision makers are rarely aware of consequences of biodiversity loss. Following, there is no political will and not enough resources (money, land, humans) and local agreement for measures (e.g. to allow natural dynamics). Thus, coordination, communication and information across political levels (from regional to international) – concerned ministries, authorities and interest groups – are essential for the implementation of connectivity measures. Ecological connectivity should be involved

into the spatial planning system across regional and national borders. Concerned political and administrative sectors as well as stakeholders should participate at the processes. In many countries (e.g. in Austria), decision making is dependent of communities, and following, the implementation of cross-border planning and measures is difficult, as community and economic interest do not fit with regional concepts.

d. Scientific gaps: Methodology, heterogeneity of data background, open questions

To improve ecological connectivity in the Alps, the harmonization of different initiatives is needed. Clear common goals are (still) missing and there are no answers for the following questions: where is connectivity appropriate; for which taxa; how will ecological connectivity improve biodiversity and ecological persistence. Knowledge on fauna, flora and habitats, evaluation tools, data sources, methods, scales and references are very heterogeneous regarding different regions. There is also a lack of theoretical knowledge concerning practical effects of connectivity on habitats or species conservation.

It is necessary to make clear, who will set which standards for good/acceptable connectivity. This includes the questions, which approach should be chosen for which situation and whether this approach should be species (functional) or habitat (structural) orientated. The standards have to be accepted by the scientific community as well as by practitioners and stakeholders.

e. Other items: invasive plants/diseases, climate change

Improvement of ecological connectivity in the Alps also improves the distribution of diseases and "pests" and invasive plants along corridors.

Regarding the effects of climate change, the safeguard of lateral and altitudinal ecological continuums will be a crucial element in adaptation to changing conditions for many species and populations, mainly in urbanised areas and in areas of actual and potential tree-line.

1.2. Main types of areas where the Continuum Project should focus on

Question 2: The connectivity project wants to act in a pragmatic way and work with areas where there is a high need for connectivity and where measures for improving ecological connectivity are most efficient. On what types of areas should the project focus?

All answers to question 2 see Appendix 3 of full WPA-report on http://www.alpine-ecological-network.org

The answers (see table below) reveal a preference for safeguarding or improving connectivity mainly in areas with high biodiversity (not only protected areas!), riverine systems, urbanised areas and areas with high land use pressures, and less in large forest areas, around protected areas and in areas of interest for PEEN.

Some experts recommend, that the project should focus on the identification of barriers within important corridors and concentrate on such problem areas, or, inverse, focus on identifying still open corridors and concentrate on their conservation.

On the other hand, some experts highlight the risks of pragmatic approaches: Ecological connectivity cannot be simplified by setting territorial priorities or choosing some priority habitats or species. Problem areas have to be found by quantitative analysis or by taking into account needs for connectivity in a regional and local context, and pragmatic measures should not only be implemented in areas with the lowest potential or (land use) conflicts.

Legend: Type of area: defined by the Platform Ecological network of the Alpine Convention

Priority: h= high, m = medium, l=low

Type of area	Priority			Comments
	h	m	l	
Areas with high biodiversity values (Priority Conservation Areas (PCA), Natura 2000, etc.)	**8**	2	1	Areas with high biodiversity values (e.g. Priority Conservation Areas PCA, NATURA 2000 sites) have a very important status for improving ecological connectivity in the Alps since they work as core areas *and* connectivity areas. The problem pressure is not so strong like in other areas: Priority areas are already identified, data long-term monitoring led to good data availability, public awareness towards biodiversity maintenance is often good, social acceptance for measurements is increasing and some projects or attempts were already undertaken to increase connectivity. Nevertheless, an alpine-wide project could probably boost such initiatives as long as the maintenance of regional natural treasures is integrated. High biodiversity regions contain important source populations, which have to be preserved to improve ecological connectivity. Without maintaining habitats for source populations, no dispersal will occur anywhere, even though measures are implemented in other areas.
Riverine systems as connectivity elements of the wider landscape	**7**	3	1	Riverine systems (including land strips on both sides) serve as key corridors for aquatic *and* terrestrial organisms, matter (water, sediment, nutrients, organic matter), and energy (stream power). Thus, river-floodplain corridors can be considered as keystone ecosystems for maintaining local and regional diversity and ecosystem processes. Furthermore, a correlation to densely populated low altitude areas exists. Since rivers are already existing linear features, there is no debate about where to create a connectivity zones. An amelioration of the existing situation can often easily be done. But measures are only efficient, if the immediate surroundings of rivers are considered. There are two priorities to focus on: (1) to enlarge existing free-flowing sections, (2) to focus on key "ecological nodes" (e.g. tributary confluences, backwater-main channel intersections, alluvial zones) for enhancing connectivity.
Densely populated areas in low altitudes	**6**	3	2	Densely populated low altitude areas obviously concentrate a great part of the problems encountered and often build long continuous total barriers along valleys. Negative ecological effects because of high fragmentation are permanent and difficult to reverse. These areas cause problems to restore since the costs to install/maintain zones of connectivity are often very high and the social acceptance for connectivity projects might be low.
Areas with high pressure through intensive agriculture, tourism, energy infrastructures, etc.	**6**	3	1	In areas with intensive land use through agriculture, tourism and energy infrastructures problem pressure is strong and fragmentation is high. Monocultures (especially in big valleys), tourism and high wire cables are a big problem (e.g. for birds). But the impacts through tourism and energy use are seasonal and generally reversible and permeability is quite high. Traditional agricultural landscapes, which are of high interest for tourism, also preserve elements of connectivity due to natural constraints. Surfaces with intensive agricultural use are degraded only temporally; the connectivity of such areas can be improved or restored and partial barrier effects are reversible. Already small connectivity projects may substantially increase the inter-linkage between zones of high biological interest (e.g. expending semi natural structures in intensive agricultural land from 2% up to 4% might be a success. But including such measures in an alpine wide strategy is impossible. It must be included into agro environmental subsidies systems. Areas with high land use pressures have often a high need for connectivity measures, but such measures have, even with a high input of resources, very little chances for success.
Border areas of the existing protected areas	4	**5**	-	Border areas are an important link to core areas (often large, long border) and ideal for improving connectivity. Studies were carried out about the functioning of “membranes” (borders, buffer zones of protected areas, etc.) for connectivity, particularly on larger (more detailed) scale. The problem pressure is medium because they are frequently less modified than distant areas. Depending on the distance between borders of existing protected areas, these zones can often easily be connected without huge investments in time and money. Moreover, border zones often already act as connectivity areas for several species and

				habitats.
Areas linked to large scale European networks such as PEEN, Alpine-Carpathian network (key corridors), IBAs etc.	3	**4**	3	These areas should of course be included to use synergies. But no special efforts are necessary as those areas are already inscribed in other networks. Many important reflexion needed at the start of the project have already been undertaken and much data is available, often already in the right format.
Large scale forest areas	-	3	**5**	Large-scale forest areas are supposed to be functional and in general, forests are increasing. But disruption of the forest continua on valley slopes (e.g. by tourist infrastructures) can cause regionally problems for umbrella species, (e.g. the break down of capercaillie populations) and creates barriers for wildlife.
Others				Future regime shifts as a consequence of average change in temperature and flow and an increase in flow/temperature extremes (e.g. how to enhance ecosystem resilience, e.g. by providing thermal refugia for many Alpine species during hot summers? Areas with endangered species by the climate change and e. g. species of Birds Directive, Habitats Directive, the Red List of the IUCN and the Red Lists in the different countries Ecotones, transition areas, i.e. regions with (steep) environmental gradients (e.g. forested/non-forested; sub alpine/alpine; wet/dry) to include rich habitat diversity, as complementary areas to stable, large-scale habitat types (e.g. large forested areas) that promote (umbrella) species requiring large home ranges or allow for (seasonal) dispersal Still existing open and not/little urbanised areas of importance for connectivity between pristine habitats for wildlife (key-corridors) have to be identified and safeguarded by spatial planning with high temporal priority, especially in areas with a high pressure for urbanisation.

1.3. Priorities in setting aims for improving connectivity in different types of areas (general and specific)

Question 3. What are the most important aims which can be reached by improving ecological connectivity in the Alps? Please set priorities and give reasons for general aims and specific aims

All answers to question 3 see Appendix 3 of full WPA-report on http://www.alpine-ecological-network.org

General aims	**priority**			**Comments**
	h	m	l	
Improve both, habitat connectivity and connectivity for specific species or populations	**12**	1	0	It would be most appropriated to improve both, habitat connectivity and connectivity for specific species or populations as it includes both, the species and the habitat approach. But it is the most difficult as most complex aim. Habitat connectivity is especially needed for plants, fungi and smaller animals, whereas larger animals and birds need a connectivity for specific species or populations (e.g. stepping-stones, corridors). Connectivity is species-specific and therefore habitat connectivity per se is not something to always favour. Often we do not have information for all species and therefore we have to rely on habitat connectivity as a surrogate. In general the habitat approach is suitable to find connectivity need for most species. For some species the population level has to be considered for finding their needs of connectivity. Selected species are appropriate for working in specific areas. To focus

				on selected species may be in contradiction to integrated landscape analysis. This aim guarantees a general approach with selected species.
Improve/preserve habitat diversity and connectivity between habitats	**4**	2	0	Diverse habitat types offer niches for a large set of species, while corridors in-between provide areas for dispersal (-> range shifts) The most important reason for species extinction or population decline is habitat loss. The negative impact of fragmentation on populations is in most cases accompanied with habitat loss. In real life, there are only very few examples that show population extinction or decline as a result of pure fragmentation processes. Therefore, I argue that the ecological continuum project should focus strongly on the quality of habitats. And the most sensitive habitats in the Alps (e.g. nutrient-poor, extensively used meadows, dry meadows) are often not covered with protected areas. Preserving, or even better improving habitat diversity includes the protection of endangered species and of (today) common species living in these habitats. It's a more complete approach and should be preferred of the pure species approach. But the specious approach should be used well directed and related to specific regions. But it is always an important aspect of a general, landscape-oriented approach.
Improve / preserve habitat connectivity for (endangered) species or (isolated) populations	1	0	**2**	Would be better than nothing, but preserving the connectivity would more or less just keep the status quo. However, many conservationists would prefer a "habitat approach" over a "species (flagship) approach" Increasing connectivity may also facilitate the exchange of non-native species.
Other general aims				Prevent "common" biodiversity erosion through global climatic changes and increase ecosystem resilience (e.g. re-colonization potential after major disturbance events), maintain biodiversity at both local and regional scales. Allow for environmental dynamics within conservation/connectivity areas (-> ecological and/or evolutionary processes). Connectivity of large area habitats (e.g. forest) and line-like habitats (e.g. freshwater). Increasing the degree of connectivity between contrasting ecosystems (e.g. land-water, high Alpine and lowlands; hillslope-alluvium; etc.). The link between the contrasting systems is very crucial, e.g. for less productive systems the link to highly productive systems is very important. Information of the public and authorities.

Specific aims	**Priority**			**Comments**
	h	**m**	**l**	
Identify and overcome important ecological barriers (terrestrial and aquatic)	**6**	3		With the overcoming of ecological barriers many problems can probably be solved and it's particularly important regarding needs of measures. It seems that e.g. large carnivores can travel far distances through areas that are under high pressure (population). The real problems seem to be the total ecological barriers. If need be, there could be a focus on priority taxa groups. I consider this as a methodological aspect. This point is probably a sub-aspect of the following aim. The question of ecological barriers must in any case be implemented in the reflections of the connectivity in and between protected areas.
Focus on connectivity in and between protected areas and priority conservation areas	**6**	2	1	The focus only on already existing conservation areas will be not enough. The presently protected areas mostly cover habitats at high altitudes that are less endangered than lower lands. Also, nature reserves must not necessarily contain the important source populations (e.g. farmland birds, insects). Corridors should be completed by potential source areas (as at least priority conservation areas are assumed to be). To focus on connectivity in and between protected areas is very important because good data is available, high social acceptance, good monitoring possibilities. Protected areas have a high biological interest (that's why they are protected) and linking them in

				an appropriate way would clearly improve their quality. It not only a matter of scale but also of system dynamics (i.e. land-use change within and between protected areas differs)
Focus on priority species (groups): which ones?	**4**	2	1	The project should try to aim higher and focus on the connectivity of habitats and one should avoid fragmenting the landscape further. However, when it comes to restoring or improving connectivity, the project should do it for the species depending on it. Obviously, the choice is clear if one has to choose what to protect, a very connected or a very fragmented landscape, without knowing anything about the habitat and the species. But the answer is not that simple when one has to set priorities, and the persistence of many species is at play. I would focus on particular species that are a) protected by legislation, b) representative of the Alps, and c) threatened by habitat loss and fragmentation at a particular scale. Some of these species would have connectivity needs at a Pan-European scale, others at the scale of the Alps, some at the National level, others within smaller protected areas. - Mainly aquatic; e.g. "Bodensee-Seeforelle", long-distance migrating species like salmon or *Hucho hucho* - Umbrella species, large carnivores, large herbivores - Insects: butterflies - Birds, amphibians and reptiles - Vegetation: dry meadow species To keep the level of complexity at a reasonable level, we will have to focus on priority species (groups; by the way: "focussing on priority species" is more a strategy than an aim). Criteria for selecting the species are: - requirements of species to habitat quality and spatial distribution (species with high demands that may serve as umbrella species) - species of conservation concern - species, for which the region has a special responsibility (endemic species, hosting a high proportion of European or World population) There are already many attempts to select species of special concern. The Continuum Project should rely on this work, i.e. regarding the lists of priority species of birds (Keller & Bollmann, 2004) or species for which a region has a high responsibility (endemic species). Identify and overcome important ecological barriers are also important aims.
Improve connectivity for the survival of large carnivores	2	0	**4**	There are problems with connectivity (large carnivores still migrate in the Alps), but with social acceptance. At I local /regional context, the social acceptance of such projects would be quite low.
Other specific aims				Promotion for extensive exploitation in agricultural areas Identify existing corridors and man made barriers. Ecological network concept should be broad enough taking into account existing areas where nature can move and man made structures which are hindering possible movement. In first cases the activities are focused to conservation principles in the second one to the restoration measures. We mustn't forget that our aim are ecosystems and not only particular species. If we are looking one group we can easily fall into the trap when a corridor for one species becomes a barrier for another. Improve connectivity in "normal landscapes" (valleys and slopes).

Additional comments are concerning the prioritisation (hierarchy) of aims. The prioritisation is seen as problematical in following terms:

- The general aims incorporate the priority aims for designing ecological networks. Under local conditions (e. g. in case of migration corridors for endangered species) the aims should be specified. Specific aims should contain the preservation and improvement of habitats of

endangered species in the focus of connectivity, in and between protected and priority areas. There are the existing potentials for quick efforts of implementation.

- Indeed the problem is more complex regarding that landscape is composed by interactive systems within a given ecological potential, which is itself more or less modified (disturbed) by human transformation. More important than priority aims (species and areas) is a tool for analysing the existing ecological potential for connectivity.
- However, it is not clear if lack of connectivity is currently a problem. Connectivity has become fashionable and currently there is an interest in connecting elements that may not require connections; this may also have negative consequences. Good planning, after a proper analysis of fragmentation effects, is required.
- All aims have to be considered together. It is not useful isolate specific aims, especially the concentration only on protected areas.
- Selected species are needed regarding protection (high need), monitoring and also PR (communication).

1.4. Achievements of a mid-term connectivity project: visions of the experts

11. Your personal vision: what would be the greatest success of the connectivity project at its supposed end after 5 years?

All answers to question 11 see Appendix 3 of full WPA-report on http://www.alpine-ecological-network.org

This question should give some indication on priorities in view of a following main project. The expressed visions can be pointed out along four axes:

a. Establish and improve Alp-wide databases for applying in cartography, conceptual work and monitoring:

To develop, at alp-wide scale (-> at the catchment, subcatchment scale) a spatially explicitand comparative GIS data-base with relevant data concerning ecological networks as a working tool (minimum 1:100 000) for planning, modelling, monitoring etc. in areas of main interest (e.g. protected areas with extension zones). Such data should focus on key environmental pressures (present and future), on selected biota (e.g. fish, amphibians, mammals, birds, some insect groups), but also a catalogue of localised projects.

Applications of such databases could be: To develop maps, which can help to build understanding about the rational of the continuum, specially in light of the climate change, or an ecological risk map for the Alps that identifies areas that are at high future risk but play important roles (similar to the "red" zones for natural disasters). To come up with common baselines for main connectivity axes (and first examples how to preserve/improve/restore connectivity along such axes and with clear recommendations on how to set priorities in increasing connectivity among the various core areas.

b. Identify main problem areas:

- the most important problems (and information of the responsible managing authorities),
- the main lacks of knowledge needed and development of a pan-alpine scientific project on the functional aspects of connectivity, both aquatic and terrestrial,
- human-induced ecological barriers (e.g. highways, settlements) for the entire alpine arc and several projects to overcome these barriers are launched/ started or already done.

c. Focus on main concerns (not complete):

A clear vision for

- the rivers an the restoration of links between watercourses, wetland and lakes;
- the large carnivores and the installation of quiet protected large areas for ungulates and big carnivores and the connection of isolated populations, especially of ungulates and big carnivores;
- how to deal with the intensification in the farmland in the Alps (e.g. by changing the system of subsidies in a way to improve habitat quality for endangered farmland species);
- improving connectivity of open habitats and permeability of open habitats for forest or ecotone species;
- migrant birds and migrant routes ("footpath"- and feeding areas) and ecological networks for endangered amphibians.

d. Build up awareness of public, stakeholders and decision- & policy-makers

Awareness will be improved

- by realising projects in regional/national contexts, which are based on participatory processes (e.g. advisory board, stakeholder platform for discussions) and successfully supported by locals (policy, economy, population);
- by integrating ecological connectivity topics in national policies and implementations strategies (e.g. national strategies for conservation biodiversity) and by harmonizing the implementation possibilities in the authorities of the various countries in the Alps;
- by arguing with concrete data and facts (on rapid changes in the Alps), and using (interactive) visualisation tools (examples are in use!) and maps for presenting the need for ecological networks.

The Continuum Project will be known

- by the dissemination of proposed measures to persons engaged in nature conservation and protection areas management
- by triggering a few demonstration projects that will apply the proposed approaches, and to develop a clear strategy on how to assess the success of the "connectivity projects", resp. by implementing of appropriate measures to establish ecological corridors in pilot areas, and proof of their (re-gained) functionality (i.e. gene flow!), in particular where formerly connected species occurrences had been interrupted owing to fragmentation and/or (human-induced) barriers
- by supporting stakholders in applying the most suitable methods.

However, the Continuum Project may act as moderator between different groups of interest and pushes the process of implementation. Communication and the involvement of local stakeholders and practitioners is one of the most important actions, which should be undertaken in this context. Further the ECONNECT-Project (www.econnect.org) may act as project manager/coordinator and initiator for the harmonisation of monitoring methods, elaboration of common standards, facilitator of the exchange between stakeholders, and communicator of methods of "good practise". At all three levels, the question of the coordination seems to be important. Not to be neglected are the legal and organisational differences within and between theAalpine countries.

2. Theories and approaches used to design and implement ecological networks in the Alps

2.1. Biodiversity vision for the Alps (WWF)

Source: WWF (2006): A biodiversity Vision for the Alps. Proceedings of the work underatken to define a biodiversity vision for the Alps. Technical Report. WWF European Alpine Programme, Milano (unpublished).

Goals

Representation of natural communities within conservation landscapes / protected areas networks; Maintenance/restoration of viable populations; Maintenance/restoration of ecological and evolutionary processes; Conservation of blocks of natural habitats

Methodology

Methodology for the identification of connection areas: In the development of the biodiversity vision for the Alps, high biodiversity areas and connection areas were areas to focus on and they were identified purely on their biological values. A workshop with biodiversity experts (scientists) and observers (who work on policy and implementation issues) was the key event of the process. Their task was to identify priority areas for a taxon or a habitat type, corridors among the priority areas and preliminary long-term goals for the priority areas themselves.

The identification of main potential areas was coordinated with the ALPARC initiative (Chapter 2.2.). While the ALPARC approach identified corridors at a more precise scale (based mainly on land use and habitats), WWF defined "macro-corridors" or "main potential connection areas" at a rough, non-detailed scale and only approximately located (based mainly on species). Both existing (functional) and potential (no longer functioning but needed and possible to restore) connection areas were considered.

The connection areas have been identified according to experts' knowledge and experience (expert approach) and based on certain given criteria, through a workshop and through further consultations with experts. The intention was to capitalize on what already exists and to maximise synergies. Thus, it had to take into consideration other initiatives: National Ecological Networks, PEEN, NATURA 2000.

The geographic scope of analyses and mapping was the entire alpine range according to the boundaries defined by the Alpine Convention. The regions adjacent to the Alps were also considered as a necessary geographic addition for the identification of connection areas between the Alps and their surroundings. Three principles were defined according to which connection areas could be identified, and which could be integrated into the experts approach: 1. Ecological need, 2. Feasibility and opportunity, 3. Policy relevance and political acceptance.

Results

Important areas for major taxon groups: vegetation/flora, large carnivores, large herbivores, medium and small mammals, birds, herpetofauna, terrestrial invertebrates (insects); Important freshwater habitat; Priority areas on which to focus conservation work; Preliminary wildlife/vegetation corridors among priority areas; Level of threat of the different priority areas; Level of ecological integrity of the different priority areas; Level of biological importance of the different priority areas; Gap analysis of priority areas with protected areas, Natura 2000 and Emerald sites, Important Birds Areas, Ramsar sites, remote areas, developed areas; Distribution of urbanization hotspots, domestic animal breeds;

Representation analysis by bio-geographic subdivision and by natural potential vegetation; Map of external connection areas: incomplete; e.g. river corridors and several others were not considered; Map of internal connection areas: incomplete; criteria for their identification were hard to define and then to apply, limited number of experts

The work undertaken to identify potential connection areas was a first test of how to proceed and therefore methodology and results should be validated and reviewed by other experts.

2.2. Cross-border ecological network of protected areas (ALPARC)

Source: Netzwerk Alpiner Schutzgebiete (2004): Grenzübergreifender ökologischer Verbund. Alpensignale 3, Innsbruck (German, French, Italian and Slovenian)

Goals

Overview of the current connectivity situation for protected areas across the whole of the Alps; Presentation of the strategies / measures / regulations adopted by Alpine countries and the EU which contribute towards implementing the networking of protected areas, establishing ecological corridors, and ensuring species migration at the national and cross-border level.

Methodology

Methodology for the identification of connection areas: The study focuses on transboundary protected areas as the starting point for a successful networking beyond administrative borders and large-scale protected areas (mainly > 1000 ha or groupings of protected areas, each of which covers a surface area of at least 100 ha).

Results

Recommendations were drawn up for wide-area strategies across the Alps to complement or usefully connect protected areas and for expedient regional links, which make sense by virtue of their geographic vicinity and ecological significance. The implementation possibilities were examined using indicators. In concrete terms the following products were created: Cartographic material of potentially suitable connecting axes between protected areas (model regions only) (1:100'000); Catalogue of indicators enabling a comparison of individual areas as well as a comparison over time. These indicators are then used to assess the progress made with the implementation of connectivity measures; Proposals for measures to improve the connectivity of habitats in the model regions (in the fields of agriculture, forestry, tourism, regional planning, transport); Basis for potential expansion areas in the model regions

2.3. Pan-European Ecological Network PEEN

Source: COUNCIL OF EUROPE (2007): The Pan-European Ecological Network: taking stock. Nature and Environment Nr. 146, Strasbourg

Goal

The Pan-European Ecological Network PEEN is the first objective of the Pan-European Biological and Landscape Diversity Strategy. It is a coherent assemblage of areas representing the natural and semi-natural landscape elements that need to be conserved or managed in order to ensure the favourable conservation status of the ecosystems, habitats, species and landscapes of European importance across their traditional range. The components of the Network serve three functions, namely: To provide the optimum achievable quantity and quality of environmental space (core areas);

To ensure appropriate interconnectivity between the core areas (corridors); To protect core areas and corridors from potentially damaging external influences (buffer zones). PEEN takes into consideration other programmes and initiatives, especially NATURA 2000, Emerald Network, UNESCO Biosphere reserves.

Methodology

Methodology for the identification of connection areas: The project has focused on habitats and species with an explicit European status. The planning scale of the project is such that ecological corridors can only be migration or dispersal corridors. Foraging corridors function on a lower scale and are not included. In this project corridors are included that function on a European scale and that have been analysed on species requirements as well as on system characteristics.

Results

An indicative map (1:5'000'000), showing core areas of international importance and so-called search areas (-> area enlargement or connection via corridors is considered an effective contribution to a robust ecological network).

2.4. Swiss National Ecological Network (REN)

Source: Bundesamt für Umwelt (2004): Nationales ökologisches Netzwerk REN. Schriftenreihe Umwelt Nr. 373, Bern (German and French)

Goals

Setting up a national ecological network (REN) is one of the main objectives of the Swiss Landscape Concept and of the Landscape 2020 model of the Federal Office for the Environment (FOEN). The REN is Switzerland's contribution to the three pillars of the strategy for the conservation of biological and landscape diversity at the European level: the NATURA 2000 network, the Emerald Network, and the Pan-European Ecological Network or PEEN (Chapter 2.3.). It follows the same overriding objectives as the PEEN (recording and presenting the various functions of the landscape) and is designed to contribute towards the protection and restoration of habitats to ensure genetic exchange; the linkage of important habitats and their connection through ecological corridors; reducing the fragmentation of ecosystems; the linkage of ecological compensation areas in agriculture; the improvement of the quality and diversity of agriculture.

Methodology

Methodology for the identification of connection areas: The guidelines described in the PEEN have been incorporated into the REN. However the ecosystem approach adopted for the REN differs from the PEEN due to the specific national characteristics (e.g. geographic extension, parcelling, etc.), the methodology used for obtaining information, the procedure used for interpreting the functions of the designated ecological network and the use of additional basic concepts. The REN is founded on the following basic concepts: continuum, core area, expansion area, development area, ecological corridors and the potentiality of landscapes. REN draws great attention to measures for overcoming obstacles. The implementation of the REN is based on overlaying the results of various complementary methods which taken individually do not allow any conclusive statements.

Results

The REN survey maps (1:500`000 and 1:100000) show the degree of networking among the specific networks and the fragmentation of ecosystems in Switzerland. REN working maps (1:25000) which at the regional level can serve as a basis for more detailed maps.

2.5. Comparing the 4 approaches regarding goals, methodologies and data

The elements of the 4 approaches that should preferably be combined are listed below, subdivided into the sections goals, methodology, and data. The approach at the beginning of each paragraph indicate the approach from which the text element comes.

2.5.1. Goals

WWF

Representation of natural communities; maintenance/restoration of viable populations; maintenance/restoration of ecological and evolutionary processes; conservation of blocks of natural habitats

PEEN

The components of the Network serve three functions, namely: to provide the optimum achievable quantity and quality of environmental space (core areas); to ensure appropriate interconnectivity between the core areas (corridors); to protect core areas and corridors from potentially damaging external influences (buffer zones).

REN

REN is designed to contribute towards:

- the protection and restoration of habitats to ensure genetic exchange;
- the linkage of important habitats and their connection through ecological corridors;
- reducing the fragmentation of ecosystems;
- the linkage of ecological compensation areas in agriculture;
- the improvement of the quality and diversity of agriculture.

2.5.2. Methodology for the identification of connection areas

WWF

The geographic scope of analyses and mapping was the entire alpine range according to the boundaries defined by the Alpine Convention. The regions adjacent to the Alps were also considered as a necessary geographic addition for the identification of connection areas between the Alps and their surroundings.

In the development of the biodiversity vision for the Alps, high biodiversity areas and connection areas were areas to focus on and they were identified purely on their biological values (first step).

Three principles were defined according to which connection areas could be identified, and which could be integrated into the experts approach: 1. Ecological need, 2. Feasibility and opportunity, 3. Policy relevance and political acceptance. Assumptions and decisions made for the identification of the connection areas p.75

ALPARC

Selection of indicators to assess the analysed surface areas with regard to their suitability as a potential element and to specify how the network area should be fragmented (establishment of corridors, implementation of measures).

PEEN

Prior planning scale (less detailed) of the project is such that ecological corridors are only be migration or dispersal corridors. Foraging corridors function on a lower scale. On this scale corridors are included that function on a European scale:

- migration corridors for birds
- dispersal corridors for large mammals (terrestrial corridors for the most demanding forest species)
- migration/reproduction/dispersal corridors for fish and water related systems, dispersal corridors for wetlands (including bogs, mires, fens, peat cuttings).

All three should be analysed on species requirements as well as on system characteristics.

ALPARC

In-depth examination using model regions (larger, more detailed scale). These regions were analysed using the selected indicators and, with the help of suitable measures, can contribute towards an ecological network.

REN

As REN it should be founded on the following basic concepts: continuum, core area, expansion area, development area, ecological corridor (determination criteria p. 26-28). As in REN a great deal of importance should be attached in principle to obstacles.

As in REN the implementation should be based on overlaying the results of various complementary methods which taken individually do not allow any conclusive statements:

- Use of detailed statistical data on land use so the land can be divided up into ecologically similar areas.
- Grouping of individual species into guilds to complement the collated data on the distribution of habitats or guilds used.
- Compilation of potential maps (as a basis for further complementary field work).
- Systematic search for landscape elements which influence the networking situation of the fauna either favourably (e.g. hedges, embankments along motorways) or unfavourably (obstacles such as roads, walls, etc.).
- Involvement of the relevant regional departments and ecology specialists to carry out terrain clarifications.
- Gathering additional regional data.
- Systematic mapping of the structures of specific networks.
- Functional test of the specific networks mapped in order to differentiate areas with a satisfactory networking situation from those with a deficit in this respect (particularly in model areas).

2.5.3. Data

PEEN

Based upon the following key data sets an analysis has been made to assess where core areas are, where corridors should be formed or reinforced and where area enlargement could maintain target species:

- habitat map showing existing natural areas.

- selected species with high demands on area size and critical distances between habitats; those species and related demands which are habitat-specific.
- classification of (core) areas based upon insights in the probability of containing a certain percentage of all species including the most demanding in three classes:
  - very large areas (> 5 times the critical size): long term survival of all populations quite probable;
  - large areas (1-5 times the critical size): when isolated this area may suffer some loss of species: connection or area enlargement is recommended;
  - areas with a suboptimal size: a percentage between 70 – 100 % of species can maintain viable populations; the most demanding species can only be maintained or restored by enlargement and/or connections with comparable habitats by corridors; critical size area and selected thresholds are based on expert judgement based on literature sources (Tab 12 p.60).
- Definition of critical distances to bridge gaps, taking large animals and birds as key organisms, (resulting in distances of 50 –100 km ?);
- Location of major rivers as important natural corridors
- The distribution of internationally designated and acknowledged areas as already acknowledged elements of the network; MAB, Ramsar, World Heritage Convention (p.38/39).

Data base for large (more detailed) scale similar to REN.

ALPARC

For model regions also interviews suitable.

2.6. Other approaches for developing and implementing ecological networks

Question 4 : Do you know other approaches, which are appropriate to develop and implement ecological networks in the Alps? Which ones (please add a short description or a citation of literature)?

Full answers to question 4 see Appendix 3 of full WPA-report on http://www.alpine-ecological-network.org

The experts mentioned the following, additional approaches (presented here only in short terms):

- Austria: Wildökologische Raumplanung für Schalenwildarten im Alpenraum. Reimoser, F., 1996: In: Sauteria, Salzburg, Bd. 8, 207-220.
- Austria: Catchment approach in Vorarlberg (yet in elaboration)
- Austria/Carpathians: Der Alpen-Karpaten-Korridor (WWF Austria; http://www.wwf.at/de/menu80/)
- Austria: Wildökologische Korridore Österreich (BOKU model; http://ivfl.boku.ac.at/upload/)
- Austria: RVS 04.03.12 Wildschutz (September 2007), vom Österreichischen Bundesministerium BMVIT; enthält rechtsverbindliche Richtlinien für Wildtierpassagen (WTP) an Verkehrswegen (http://www.fsv.at/)
- EU: Natura 2000, Smaragd

- EU: IBA (Important Bird Areas) build a network of stepstones for birds; Natura 2000/Emerald: Network for threatened animals, plants and habitats
- Methods applied in France:

  a) „Trame verte et bleue“

  b) „Réseaux écologiques dans les Parc naturels régionaux“

  c) Réseau écologique Isère (REDI) et réseau écologique Rhône-Alpes

  b) and c) are based on PEEN or Swiss REN
- General / Finland : There are tools or softwares that deal with this type of conservation planning accounting for biodiversity,connectivity, and socio-economic constraints (e.g. zonation: www.helsinki.fi/consplan).
- For rivers: Methods developped by Muhar et al. (1998) and Dynesius & Nilsson (1994)

3. Comparing 4 proposed approaches regarding their application in the Alps

3.1. Identification of areas with a high need for actions

Question 5 : One of the main goals of this connectivity project will be identifying areas with a high need for connectivity. How far the presented methods are appropriate for identifying such areas?

Full answers to question 5 see Appendix 3 of full WPA-report on http://www.alpine-ecological-network.org

None of the discussed four approaches was developed in view of analysing the need for connectivity. The four approaches focus on potential connectivity in general (REN), defining corridors (WWF, PEEN) or connections areas between selected core (protected) areas (WWF, ALPARC, PEEN). All 4 approaches have some limiting factors in analysing the needs for connectivity, as: not enough available data, only based on species (WWF, PEEN), not specific to the Alps (PEEN, REN), too precise (REN), linear elements missing.

Regarding the use of the proposed methods the answers show a clear preference for PEEN and REN, arguing that these methods follow a hierarchy and can be adapted to areas, where minimum data is available. Anyhow, these methods have to be adapted to analyse connectivity needs.

On the other hand, WWF and ALPARC are seen by a minority as more pragmatic (-> corridors, protected areas) and adapted better to alpine space. It is suggested a combination of both, WWF (functional/species) and ALPARC (structural /habitats).

None of the 4 approaches integrates linear connectivity along rivers sufficiently. For analysing connectivity needs in river systems specific approaches are proposed (Muhar, Nilsson).

Approaches	suitable	suitable to only a limited extent	Hardly/not suitable
Biodiversity visions network / functional connectivity (**WWF**)	Pan-alpine, specific to the Alps (N=2)	Only species, only in combination with ALPARC approach, no hierarchy, not systematic **(N=5)**	Only corridors (N=1)
Cross-border ecological networks / structural connectivity (**ALPARC**)	optimum level for measures (N=1)	Pragmatic, only for existing PA, mainly corridors **(N=4)**	Too regional, oriented on neighboured PA, tools **(N=3)**
Pan-European ecological network **PEEN** / European perspective	European level, for catchments, for identifying core areas **(N=4)**	Only species (of European Importance), data need!, focus on corridors **(N=5)**	Not Alp specific (N=1)
Swiss ecological network **REN** / national perspective	Enlarge to the Alps, data need, spatial analysis possible, use a lower resolution than in CH **(N=7)**	limited continuum (data until 2100 m asl,)data need (to be very precise), linear elements missing, focus on corridors **(N=5)**	Not Alp specific (N=1)
General remarks	For rivers use Nilsson or	Available data is limiting	PEEN and REN not

Muhar	factor Success-indicators?	developed specifically for the Alps
For Alps combine WWF & ALPARC	Methods only looking for corridors No analysis of needs.	
Combine all 4 approaches		

3.2. Application in different scales

Question 6: Another goal of this connectivity project will be to work on different scales: Which of the 4 approaches can be used for working on which pan-alpine, regional or local networks?

Full answers to question 6 see Appendix 3 of full WPA-report on http://www.alpine-ecological-network.org

	Pan-alpine ecological networks including surrounding regions (>1:500'000)	**Regional ecological networks (1:100'000 – 1: 500'000)**	**Local ecological networks (< 1:100'000)**
Biodiversity visions network / functional connectivity (developed by WWF)	++ (n=7)	++ (n=6)	+ (n=2)
Cross-border ecological networks / structural connectivity (developed by ALPARC)	++ (n=7)	++ (n=7)	+ (n=3)
Pan-European ecological network PEEN / European perspective	+++ (n=12)	+ (n=2)	(n=0)
Swiss ecological network REN / national perspective	+ (n=2)	+++ (n=10)	+++ (n=13)

The WWF method can be used for working on a pan-alpine and regional scale. The priority areas are at larger scale than the protected areas – they can contain several protected areas. The ALPARC method is also applicable on the pan-alpine scale, but with description of measures for improving connectivity at regional or even local ecological networks.

The PEEN-method is applicable for coarse scales above 1:500'000 and allows for a provisional overview that visualizes the reality and the complexity of the problem.

For the work on local ecological networks the REN-Method is the most appropriate method. It combines a high spatial resolution (maps at 1: 25 000) with local expert knowledge. The detailed maps of the REN can be used as baseline data for improving connectivity also at the regional level. Thus a progressive approach from local to general as used in the REN-method is preferable for establishing a coherent ecological network.

Often a combination of elements of different methods is useful, e.g. on the pan-alpine scale the ALPARC method can be combined with elements of WWF-method (corridors).

3.3. Data need (existing and new)

Question 7: The connectivity project will use mainly existing data (inventories, cartography, species data, population models, etc.) and expert information. Please compare the application of the 4 approaches regarding data need, availability of needed data, cross-boundary consistence and costs.

Full answers to question 7 see Appendix 3 of full WPA-report on http://www.alpine-ecological-network.org

	Data need	Availability of data	Consistency of data	Data costs
Biodiversity visions network / functional connectivity (developed by WWF)	Medium-**High** High (n=4) Medium (n=3) Low (n=1)	**Medium**-Good Good (n=3) Medium (n=4) Bad (n=1)	1) Good (n=4) Medium (n=1) Bad (n=3)	1) High (n=3) Medium (n=1) Low (n=5)
Cross-border ecological networks / structural connectivity (developed by ALPARC)	**Low**-Medium High (n=1) Medium (n=3) Low (n=5)	**Good** Good (n=6) Medium (n=1) Bad (n=1)	**Good** Good (n=7) Medium (n=1) Bad (n=0)	**Low** High (n=1) Medium (n=0) Low (n=8)
Pan-European ecological network PEEN / European perspective	**Medium** High (n=3) Medium (n=3) Low (n=3)	**Medium** Good (n=2) Medium (n=4) Bad (n=2)	**Bad** - Medium Good (n=2) Medium (n=1) Bad (n=5)	Low-**Medium** High (n=1) Medium (n=5) Low (n=3)
Swiss ecological network REN / national perspective	**High** High (n=6) Medium (n=2) Low (n=1)	**Good** Good (n=5) medium (n=2) bad (n=2)	2) Good (n=4) Medium (n=0) Bad (n=4)	Medium-**High** High (n=5) Medium (n=2) Low (n=1)

1) The WWF-approach relies strongly on expert opinions, and might therefore be less quantitative or transparent.

2) The data consistency of REN is good for Switzerland but is not consistent across Europe/other countries. Maps that had been produced for the EC are consistent, but only for EC countries (e.g. CORINNE map not consistent for Switzerland). Data on biota (e.g. on aquatic and semiterrestrial organisms) are very unevenly distributed across the Alps.

All methods require the mobilisation of existing data and the collection of new data. The approaches WWF and ALPARC are those methods that can cope best with only existing data. For methods PEEN and REN the collection of new data is compulsory. To achieve better results, data efforts should be combined.

REN is a very data demanding approach, as it is a local approach requiring information at fine resolution. If existing data is used costs can be kept low. There may be problems of data availability for some European regions/nations.

3.4. Introduced / mentioned measures

Question 8: The connectivity project aims as well to propose and implement measures to improve or preserve connectivity. Which measures for implementation mentioned in the four approaches or deriving from them are most suitable for improving ecological connectivity on pan-alpine, regional and local level?

Full answers to question 8 see Appendix 3.

The four methods are not very specific about measures and their implementation; WWF method provides a rather broad summary, ALPARC method gives general reommendations on how to implement the approach (by existing protected areas). PEEN method gives a rough guideline to argue for regional or local planning and implementation. REN method contains a rather long list with specific situations and hardly examples for concrete measures. The measures mentioned by the experts can be found under the answers to question 8 in Appendix 3. These suggestions will be treated in a further step in Work package B of the Continuum Project.

3.5. How far do the 4 approaches fit with proposed aims

Question 9: Regarding the most important aims which can be reached by improving ecological connectivity mentioned by you in question 3: How far the proposed 4 approaches are fitting with these aims?

Full answers to question 9 see Appendix 3 of full WPA-report on http://www.alpine-ecological-network.org

General aims

	WWF	ALPARC	PEEN	REN
Improve/preserve connectivity for (endangered) species or (isolated) populations	Some important species groups are not included **Fit** (n=3) Partly fit (n=1) Not fit (n=1)	Mainly concentrated on habitats, but includes some ideas of connectivity for species (ibex) Fit (n=1) **Partly fit** (n=2) Not fit (n=1)	Concentrated on species with European importance - many species with regional importance may not be included **Fit** (n=2) **Partly fit** (n=2) Not fit (n=1)	Approach makes important efforts to create guilds for ecotypes, but restricts the guilds mainly to insects **fit** (n=5) Partly fit (n=1) not fit (n=0)
Improve/preserve habitat diversity and connectivity between habitats	Evaluation of habitats tries to equally distribute the protected zones within the different biogeo-graphic regions; connection areas allow to set priorities at the pan-alpine and national scale	Clearly concentrated on habitats but based mainly on protected areas. These include the important habitats for endangered spe-cies only for some biomes (e.g. for wetlands, but prob-ably not for farmland and forests	Only takes into account major habitats an may be too coarse for the Alpine scale	Combines identification of core areas, "potential areas", and connecting corridors

	Fit (n=3) Partly fit (n=2) **Not fit** (n=3)	**Fit** (n=4) Partly fit (n=2) Not fit (n=1)	Fit (n=1) **Partly fit** (n=4) Not fit (n=2)	**Fit** (n=8) Partly fit (n=0) Not fit (n=0)
Improve both, habitat connectivity and connectivity for specific species or populations	Includes both, a species/ population approach and a habitat approach. **Fit** (n=4) Partly fit (n=2) Not fit (n=2)	Species and populations are only slightly touched. **Fit** (n=3) Partly fit (n=2) Not fit (n=1)	Connectivity is reduced to species level Fit (n=2) Partly fit (n=2) **Not fit** (n=3)	Some missing elements mainly in the assessment of the guilds **Fit** (n=7) Partly fit (n=1) Not fit (n=0)

Further general aims mentioned and the methods that fits best:

- Environmental dynamics: WWF, ALPARC and PEEN partly fit, REN does not fit
- Prevent "common" biodiversity erosion through global climatic changes: ALPARC and REN partly fit, WWF and PEEN do not fit;
- Value of the protected areas in terms of "productive capacity": all methods partly fit
- Improve/preserve connectivity for protected areas along artificial frontiers: ALPARC
- Creation of supra-national ecological networks beyond only connectivity: PEEN
- Creation of national ecological networks beyond only connectivity: REN as a part of PEEN

Specific aims

	A (WWF)	**B (ALPARC)**	**C (PEEN)**	**D (REN)**
Identify and overcome important ecological barriers (terrestrial and aquatic)	Approach is aiming at viable populations. The corridors are looked at at a "macro"-scale which is too rough for overcoming ecological barriers, and only considers traffic elements; could easily be improved if altitudinal distribution is analyzed with respect to topographical barriers fit (n=2) **partly fit** (n=5) not fit (n=2)	Identifies connections and barriers in trans-border networks or national assemblages of protected areas, but connection areas are on a scale that is still too large. Only traffic elements are considers; could easily be improved if altitudinal distribution is analyzed with respect to topographical barriers fit (n=4) **partly fit** (n=5) not fit (n=0)	Approach mainly aims at increasing the connectivity of certain zones and doesn't include the evaluation of barriers. The result is a set of so-called search-areas where connection via corridors is needed. Scale is too rough fit (n=1) **partly fit** (n=4) **not fit** (n=4)	Topographical barriers are not considered, no complete information on the permeability of potential barriers (e.g. highways), thus on the present quality of corridors **fit** (n=8) partly fit (n=2) not fit (n=0)
Focus on connectivity in and between protected areas and priority conservation areas	The protected areas and PCA are used to find important corridors for connecting the selected priority areas **fit** (n=3) partly fit (n=1)	Study aims at increasing the connectivity between existing protected areas **fit** (n=5) partly fit (n=2)	Aims in particular at connecting areas with a particular interest at the European scale **fit** (n=3) partly fits (n=2)	The protection status of areas is not specifically considered **fit** (n=5) partly fit (n=1)

	A (WWF)	B (ALPARC)	C (PEEN)	D (REN)
	not fit (n=2)	not fit (n=0)	not fit (n=1)	not fit (n=1)
Focus on priority species (groups): which ones?	Approach does not focus on priority species, but takes them into account as one important factor among others. Fits for vegetation, large carnivores, large herbivores, medium and small mammals, birds, herpetofauna, terrestrial invertebrates fit (n=3) **partly fit** (n=4) not fit (n=0)	Priority species were not explicitly used to identify protected and connection areas Fits for vegetation, large carnivores (wolf, bear, lynx), large herbivores (e.g. red deer, chamois, ibex, wild boar), medium and small mammals, herpetofauna, terrestrial invertebrates, further specific fish and migratory birds **fit** (n=3) partly fit (n=2) **not fit** (n=3)	Identification of core areas was based on the distribution of priority species. Fits for large carnivores (wolf, bear, lynx), large herbivores (e.g. red deer, chamois, ibex, wild boar), further specific fish, migratory birds and butterflies **fit** (n=4) partly fit (n=3) not fit (n=1)	The continua in REN are based on dispersal abilities of indicator species (groups). Fits for large carnivores (wolf, bear, lynx), large herbivores (e.g. red deer, chamois, ibex, wild boar), further specific fish, migratory birds and other vertebrates and invertebrates, reptiles and amphibians **fit** (n=5) partly fit (n=1) not fit (n=2)
Improve connectivity for the survival of large carnivores	Report states that an approach focused on large carnivores could have a negative impact on the perception of the study by the public **fit** (n=4) partly fit (n=1) not fit (n=1)	Large carnivores not particularly mentioned fit (n=2) **partly fit** (n=3) not fit (n=2)	Large carnivores listed as species proposed for identification of PEEN fit (n=2) **partly fit** (n=3) not fit (n=2)	No particular schemes for improving the particulars needs of large carnivores **fit** (n=4) partly fit (n=1) not fit (n=2)

3.6. Combination of proposed approaches

Question 10a: Which elements of the four approaches are important and for what reasons?

Full answers to question 10a see Appendix 3 of full WPA-report on http://www.alpine-ecological-network.org

General

Species based approaches are not convenient, mainly because of knowledge of heterogeneity, and as they exclude "common" biodiversity. Especially, local endemic species as indicators don't need pan-alpine connectivity to persist. But: Species reinforced approaches (guilds in REN) could help, if only data were generally available !

It's important to take into account all kind of semi-natural or natural habitats, not only pre-identified, well known or protected areas, these being too depending on national policies.

Whatever the method will be, it has to easily integrate every new produced data that could enrich the analyses. This is particularly important for developing countries (like France) where inventories are scarce, poor and partial (but improving...)

Selection of indicators: The indicators should show whether an analysed surface is appropriate for being a priority area. The indicators must be well discussed.

Europe has a certain responsibility for species that support Alpine biodiversity. Therefore the project should take these into account. Because if a species does not life in a protection area, it does not benefit from the protection measures applied in these areas.

Select taxon priority areas for each taxon: Logical next step following the preceding point.

Identify bio-geographical sub-regions: Alpine habitat is not uniform. In order to maintain the maximum number of alpine habitats, the project must try to focus on a good distribution of the protection areas over the bio-geographical sub-regions.

Potentials of landscapes for connectivity are important.

WWF

Division into ecoregions (WWF) seems important, especially to identify value of core areas

Experts consultations (WWF), local validation (REN) (especially political ones) have to be avoid, because of their subjectivity, and the impossibility to reiterate the process...

This approach reveals the areas where expert are interested in (location of rare species, endemics etc.); pan-alpine these areas are well known (see the study “Biodiversity Vision”; they do not need connection per se; the approach might be useful locally (e.g. a network for Appenzell; e.g. where are the best spots with species rich meadows and how to connect them).

There is a representative data-background for the identification of the main potential areas in discussion with the proposals of the method WWF. And so we have a combination of the biodiversity vision proposals with the connectivity corridors in the model regions of ALPARC.

ALPARC

Indicators, as described in ALPARC project, are a quite good method to normalize (or automate) landscape analysis and could be useful to study connectivity areas or corridors (rather than core areas)

ALPARC is the most pragmatic approach, based on availability of protected land or land which might be requirable, and on well known corridor demands for some flagship species;

Recording of the current inventory of protected areas: The implementation of measures is easiest done in protected areas (core and border areas).

For connectivity projects start with existing protected areas (status of protection has to be claryfied!).

Analysis of gaps in protected/conservation managed areas is important, as a solution to preserve/restore connectivity.

The data base and the indicators used in method A are the basic planning elements for the implementation of the connectivity project in the Alps.

PEEN

PEEN is theory driven and not demand related; provides the theoretical background, and how it can be applied to “white spots” for a first exploration.

Calculated “permeability” or “moving costs” seems to be hard to implement and probably more interesting at local level

PEEN is as an overall network and all other networks, core areas and corridors are just contributing to it, following an Alpine ecological network should link to PEEN and be a part of it.

Swiss REN

Continuums, as defined in Swiss Ecological Network are theoretically interesting, even if data are probably not sufficient in most cases to implement these analyses...

REN concentrates on particular habitats, providing a methodology for measuring connectivity (continuum approach); sound theoretical background.

Based on WWF and ALPARC, the REN-principals of continuum, core area, expansion area, development area and ecological corridor should be transferred to the whole Alpine region.

Question 10b : How far structural connectivity, functional connectivity or a combination of both are appropriate?

Full answers to question 10b see Appendix 3 of full WPA-report on http://www.alpine-ecological-network.org

General

Most answers highlight that structural and functional connectivity have to be combined. As connectivity is dependent mainly from structural diversity and regarding available data, the basic analysis should focus on landscape/habitat structures (diversity, mosaique, etc.). Functional connectivity has to be considered in a second step and if possible based on structural data.

All answers highlight that the goals (connectivity for what and why?) and approaches dealing with connectivity are dependent from scale and differing from pan-alpine to national /regional and to local level. Some answers say that works should progress from pan-alpine to local level (top-down), while some say that local measures should be realised first and then be integrated into regional and finally pan-alpine measures (bottom-up).

In view of implementation, the bottom –up approach is more appropriate. For implementation systems of subsidies have to be changed towards improving habitats for biodiversity.

Pan-alpine

Structural data have to be used to combine protected areas and priority areas and to establish a harmonized map of core areas and to identify existing ecological barriers (man-made as well as natural barriers as rivers and topography).

Functional connectivity can hardly be considered on a pan-alpine scale because data are not covering the whole area. The pan-alpine dimension is necessary to know more on bio-geographic migration routes, which may be active again in future.

National/regional

REN is a general strategy on regional (national) level. As all countries have different data, REN shouId be developed for national contexts but harmonised for trans-national exchange.

Local

Functional connectivity should be considered mainly on local level (depending on data; new data needed).

4. Proposed procedure (toolbox) for establishing ecological networks regarding different types of areas and specific aims

The experts proposed a range of structured procedures from problem analysis and identification to implemen-tation of ecological networks (details see question 10).

All experts proposed to start with a problem analysis aiming at the identification of core areas (mainly in protected areas and specific habitats) and connectivity areas between such core areas and, as well, with the identification of the "biggest problems (barriers, etc.).

Some scientific experts emphasised, that for such an analysis the data-base (for present state) has to be improved (data quality, consistency) and completed (inventories, expert validation of existing GIS data, etc.). Geographic scale (pan-alpine to local) is a relevant factor problem analysis regarding available data.

Problem analysis should, if possible, follow the hierarchy from pan-alpine to local in a coherent way: start on a pan-alpine level ("big picture"; PEEN as a reference) and then scale down to regional / local level. At least, beginning on a regional level, problem analysis should identify connectivity areas of pan-alpine relevance.

All experts agree that before planning measures a selection of areas and demands has to be made in order to focus on effective measures in priority areas. For such a selection, one has to be clear about the aims. Most experts recommend following aims in both, the structural dimension (landscape, habitats) and the functional dimension (selection of species groups).

Based on the experts proposals, a general procedure has been proposed at the Workshop in Zurich (10 /11. 12.2007). The following procedure has been discussed and tested by the participants of the Workshop:

- Problem analysis and setting aim:
  - Identifying main problem fields in the area considered (pan-alpine, regional, local) and setting aims for solving the problem
  - (= crosscutting main types areas and general goals of ecological networks in Matrix 1)
- Define Focus activities:
  - Definition of Focus activities in main problem fields (Matrix 2)
- Select appropriate approaches:
  - Assess which of the methodologies (including data need) fits with the aims of a focus activity (Matrix 3)
- Prepare Implementation:
  - Develop procedures to start selected focus activities (Matrix 4)

The results of the Zurich Workshop concerning these 4 steps are summarised as follows. All results of the Workshop shown in the 4 matrices are examples and the matrices have not been filled in completely. Depending on regional specificities (fragmentation, data availability, etc.) other outcomes are possible.

4.1. Problem analysis and setting aims

The participants assessed in a general way regarding the Alps main areas

All participants had 5 points for first (red) and 5 points for second (blue) priority (max. 1 red and 1 blue per field). The result is shown in Matrix 1: Eight main problem fields have been selected, covering four main areas and four general goals.

Matrix 1: Crosscutting main areas and general goals of ecological networks:

Result of the participants assessment (Workshop 10./11.12.2007 in Zurich)

R: first priority; B: second priority; 1-15: Number of choices

Grey: Main problem fields

General goals **Main areas**	Improve/ preserve connectivity for species or populations	Improve/ preserve habitat diversity and conn-ectivity between habitats	Improve/pre-serve habitat connectivity and connec-tivity for species or populations	Identify and overcome important ecological barriers (terrestrial and aquatic)	Focus on connectivity in and between protected areas and PCAs	Focus on priority species (groups): which ones?	Improve connectivity for the survival of large carnivores
Areas with high biodiversity values (PCA, Natura 2000, etc.)	R: 3 B: 1	**R: 9** B: 5	**R: 8** B: 5	**R: 9** **B: 9**	**R: 9** B: 4	R: 2 B: 5	R: 4 B: 1
Riverine systems as connecitivity elements of the wider landscape	R: 4 B: 3	R: 6 B: 1	R: 2 B: 0	**R: 8** **B: 15**	R: 2 B: 0	R: 3 B: 0	R: 0 B: 0
Densely populated low altitude areas	R: 0 B: 5	R: 4 B: 5	R: 3 B: 3	R: 6 **B: 14**	R: 2 B: 0	R: 1 B: 4	R: 1 B: 1
Areas with high pressure through intensive agriculture, tourisme, energy infrastructures	R: 2 B: 3	R: 5 **B: 11**	R: 5 B: 5	R: 6 **B: 12**	R: 5 B: 0	R: 1 B: 5	R: 1 B: 2
Border areas of the existing protected areas	R: 1 B: 1	R: 0 B: 3	R: 3 B: 3	R: 1 B: 3	R: 2 B: 3	R: 1 B: 3	R: 2 B: 0
Areas linked to large scale European networks such as PEEN, Alpine-Carpathian network (key corridors), IBAs etc.	R: 2 B: 0	R: 3 B: 2	R: 4 B: 2	R: 4 B: 3	R: 3 B: 1	R: 1 B: 0	R: 2 B: 0
Large scale forest areas	R: 0 B: 0	R: 2 B: 0	R: 1 B: 4	R: 2 B: 3	R: 3 B: 3	R: 0 B: 0	R: 1 B: 0

4.2. Define Focus activities

In a second step, the participants worked out in 4 groups focus activities for the 8 main problem fields (grey fields of Matrix 1). A clear distinction was made between pan-alpine and regional/local focus activities, looking for the appropriate level for an activity. In total, 23 focus activities have been identified.

Matrix 2 (selection from Matrix 1; grey fields only):

Definition of 23 focus activities (pan-alpine / regional-local) for the 8 main problem fields: Overview; description see list below

General goals **Main areas**	Improve/ preserve habitat diversity and connectivity between habitats	Improve / preserve habitat connectivity and connectivity for species or populations	Identify and overcome important ecological barriers (terrestrial and aquatic)	Focus on connectivity in and between protected areas and PCAs
Areas with high biodiversity values (PCA, Natura 2000, etc.)	**A: Panalpine:** Activity 1: Management plans for habitats (transboundry) Activity 2: Natural disturbance regimes	**B: Panalpine** Activity 3: Habitats that are important for species of conservation interest Activity 4: Permeability between high biodiversity value areas	**C: Panalpine** Activity 5: Biogeographical analysis Activity 6: Mapping of large scale barriers **D: Regiona/Local** Activity 7: Functionality of connectivity areas for selected species	**E: Panalpine** Activity 8: Implement large scale transects Activity 9: Strengthen contractual nature protection measures Activity 10: Make sure that process goes on
Riverine systems as connectivity elements of the wider landscape			**F: Panalpine** Activity 11: Analysis/ evaluation of riverine systems / catchments: **G: Regiona/Local** Activity 12: Implementation of EU-water framework directive	
Densely populated low altitude areas			**H: Regiona/Local** Activity 13: Identify ecological barriers in valleys Activity 14: Spatial planning: Find agreements on barrier free “windows”	
High risk areas/areas with high pressure/ through intensive agriculture, tourism, energy infrastructures	**K: Regiona/Local** Activity 21: Improvement of low intensity farming Activity 22: Implement best practices Activity 23: Share experiences with other areas		**J: Regiona/Local** Activities 15-19: Identify ecological barriers Activity 20: Special measures for high altitude areas	

4.2.1. List of 23 identified Focus activities (corresponding to Matrix 2)

Areas with high biodiversity values (PCA, Natura 2000, etc.)

A: Panalpine: Improve/ preserve habitat diversity and connectivity between habitats

1. Identify sites with habitats that need intervention esp. in trans-boundary areas (habitats according to EU-directives and Bern Convention) and define and implement management plans for (trans-boundary) habitats.
2. Support and maintain large scale natural disturbance regimes for pioneer habitats (avalanches, floods, land slides etc.)

B: Panalpine: Improve / preserve habitat connectivity and connectivity for species or populations

3. Identification of habitats (actual and potential) that are important for priority species (e.g. umbrella species, habitat directive, red list species, etc.)
4. Verify the permeability between high biodiversity value areas for the identification of not sufficiently connected sites, taking account of climate change, Local scale interventions in low permeable sites improving the level of connectivity (e.g. ecological bridges)

C: Panalpine: Identify and overcome important ecological barriers (terrestrial and aquatic)

5. Biogeographical analysis
6. Mapping of large scale barriers between protected areas on habitat level (landscape analysis)

D: Local: Identify and overcome important ecological barriers (terrestrial and aquatic)

7. Functionality of connectivity areas for selected species

E: Panalpine: Focus on connectivity in and between protected areas and PCAs

8. Implement large scale transects, Use existing opportunities for N-S transects, Develop strategies for E-W transects. Work out connectivity variants, evaluate the potentials, Make feasibility studies (technical/economic feasibility)
9. Strengthen contractual nature protection measures especially outside protected areas
10. Long term: make sure that process goes on, Alp-wide coordination (ALPARC)

Riverine systems as connectivity elements of the wider landscape

F: Panalpine: Identify and overcome important ecological barriers (terr. and aquatic)

11. Analysis/evaluation of riverine systems / catchments: structures, complete existing data

G: Local Identify and overcome important ecological barriers (terrestrial and aquatic)

12. Structure analysis Implementation of EU- water framework directive

Densely populated low altitude areas

H: Local: Identify and overcome important ecological barriers (terrestrial and aquatic)

13. Identify ecological barriers:, Mapping (fences, noise walls, big settlements, infrastructures, large monocultures). Identify interfaces between migration ways and barriers, Take historical migration ways into account, Define indicator species for the migration ways

14. Influence on spatial planning and land use planning (on a community level 1:5000 to 1:25000): Find agreements on barrier free "windows", Legal framework on national level, Subventions to reduce economic concurrence by including socio-economic aspects, Sensitisation and environmental education

High risk areas / areas with high pressure/ through intensive agriculture, tourism, energy infrastructures

J: Local: Identify and overcome important ecological barriers (terrestrial and aquatic)

15. Identify ecological barriers:, Mapping (fences, noise walls, big settlements, infrastructures, large monocultures)
16. Identify interfaces between migration ways and barriers, Take historical migration ways into account, Define indicator species for the migration ways.
17. Influence on spatial planning and land use planning (on a community level 1:5000 to 1:25000)
18. Find agreements on barrier free "windows" on migration ways, legal framework on national level.
19. Subventions to reduce economic concurrence by including socio-economic aspects (socio-economic barriers), Sensitisation and environmental education.
20. Specific indicators and measures for higher altitude areas (not densely populated low altitude areas) for conflicts between habitats and e.g. tourism activities, energy structures, cable cars. Example for a sensitive species: black grouse

K: Local: Improve/ preserve habitat diversity and connectivity between habitats

21. Programs, e.g. improvement of low intensity farming, and incentives for set aside, hedge planting, etc.
22. Identify pilot areas to implement and improve best practices linked to agriculture, tourism and energy infrastructures
23. Share experiences with other areas

4.3. Select appropriate approaches

In a next step was proposed to assess the 4 approaches in order to know, which of the methodologies (including data need) fits with the aims of a focus activity (Matrix 2). Even if the assessment in Matrix 2 is not complete, the result is, that the assessed approaches do not cover all proposed focus activities. Consequently, the range of approaches has to be enlarged or new methods have to be developed.

Matrix 3: Approaches (or specific elements of approaches) to be applied in order to work on focus activities (A1 – K4; p = pan-alpine; r= regional):

Focus activities	A (WWF)	B (ALPARC)	C (PEEN)	D (REN)	Remarks
High biodiversity					
1 Intervention need		Best for management	complement ary		Natura 2000/Emerald
2 Disturbance regimes	Layer ecological processes				Habitalp (regional), Natural hazard maps; link to riverine areas processes F1
3 Protection need	ok		Ok (migra-tory birds)	Ok (guilds,	

				corridors)	
4 Permeability			Ok buffer areas, landscape corridors	Ok, most appropriate	
5 Biogeographical situation					Basic data for species (available/needed), basic for Activity 3 and 4, climate change
6 Identify		OK		OK layer (to be verified)	
7 Functionality	–	–	–	–	Link Activity 4. Hard work, not only connectivity
8 Transects		OK (areas between existing PA)	PEEN (birds)		C1 (needed barriers) F1, combination with Natura 2000 (Piemont/ Lombardy new), not species needs
9 Contractual measures	indrectly	Partly (indicator)	–	Partly in implementation	Important for implementation (in- and outside PA, Natura 2000, PCA)
10 Support/Coordination					
Riverine systems					
11 Analysis catchment					
12 Implement WFD					
Densely populated					
13 Identify barriers					
14 Measures					
High pressure/risk					
15 Identify barriers				X	REN and more detailed scales, e.g. 1:5'000 (property adequate, ÖQV - ecological compensation on farm land)
16 Identify interfaces	X			X	WWF species and taxa related, partially and/or indirectly in REN
17Influence on planning					None of the approaches, only notes and recommendations (mainly ALPARC)
18 Barrier free "windows					None of the approaches References: «RVS Wildschutz, österr. Bundesministerium für Verkehr, Innovation und Technologie». «UVEK-Richtlinie 2001: Sanierungskonzept des Schweizerischen Nationalstrassennetzes». Tools for implementation: «MAMS:

					Merkblatt für Amphibienschutz an Strassen; Bundesrichtlinie Deutschland». VSS-Normen zur Fauna (Schweiz).
19 Socio-economic aspects					None of the approaches, only notes and recommendations (mainly ALPARC and REN)
20 High altitude areas					No direct comments in the approaches, but close to WWF approach (priority species/groups and their habitat needs) and REN (up to 2'100 m altitude only).
21 Farming					None of the approaches, only notes and recommendations (mainly ALPARC and REN)
22 Best/good practices	X	X			
23 Share experience	X	X	X	X	All 4 approaches, but not systematically

4.4. Prepare Implementation

The last step tested at the workshop was developing procedures to start selected focus activities (Matrix 4). Each of the 4 groups selected 1-3 Focus activities and defined the procedure (see Matrix 4). The results for 4 focus activities (2, 6, 16, 18) are shown in Matrix 4 (1,2). With this result it will be possible to plan a detailed project.

Matrix 4 (1): Steps to follow for focus activities 16 and 18

	Focus activity 16: **Identify interfaces between migration ways and barriers**. Take historical migration ways into account, Define indicator species for the migration ways. WWF species and taxa related, partially and/or indirectly in REN	**Focus activity 18:** **Find agreements on barrier free "windows" on migration ways, legal framework on national level.** References: «RVS Wildschutz, österr. Bundesministerium für Verkehr, Innovation und Technologie». «UVEK-Richtlinie 2001: Sanierungskonzept des Schweizerischen Nationalstrassennetzes». Tools for implementation: «MAMS: Merkblatt für Amphibienschutz an Strassen; Bundesrichtlinie Deutschland». VSS-Normen zur Fauna (Schweiz). None of the approaches
Step 1	Define responsibilities: For step 2 and 3: Platform Ecological Networks of the Alpine Convention (Sonderfall CH?)	Define responsibilities: For step 2 and 3: Platform Ecological Networks of the Alpine Convention (Sonderfall CH?)
Step 2	Collection of existing methods, data, maps and legal tools (related to indicator species or groups/taxa) in the countries and show the gaps	Collection of existing methods, thresholds, tools and legal frameworks in the different countries
Step 3	Common recommendations for harmonized/adjusted guidelines and standards for migration ways and dispersal for the Alpine region.	Common recommendations for harmonized/adjusted guidelines and standards for the Alpine region
Step 4	Define responsibilities:	Define responsibilities:

	For step 5: national governments and ministries	For step 5: national governments and ministries
Step 5	Stepwise implementation into the national legal frameworks	Stepwise implementation into the national legal frameworks

Matrix 4 (2): Steps to follow for focus activities 2 and 6

step	**Focus Activity 6:** **Identify barriers**	**Focus Activity 2:** **Disturbance Regimes (sc.)**
Step 1	Required data (recent, aerial f., land cover, land use ..) for needed scale (max. 1: 100`000 ca.)	Typology of disturbance
Step 2	Collect available data, identify databases, use existing data-base (converse Geostat/Corine)	Pan-alpine communication
Step 3	Define what is a barrier on large scale	Choose case study sites
Step 4	(ev. + identify potential = high risk areas by regional experts or working subgroups)	Analysis of disturbed areas and of potential areas (related to human activities)
Step 5	Data analysis / define hierarchy of information / modelling (indicators)	Colonisation events & migration of pioneer species; indicator how dynamic a region is
Step 6	Map barriers between PA/PCA (/result)	
Step 7	Verification of mapping	
Step 8	Typology of barriers & areas (all) and define action need	
Step 9	Develop guidelines for measures (= sensibilisation/ information)	
Step 10	Up-date of data & information (follow-up)	

4.5. Conclusions

The assessment of the 4 approaches showed, that none of them will cover all aspects of connectivity. Each of the approaches is specific and oriented on certain outcomes. Swiss REN nevertheless seems to be the best practicable method on a regional level.

We conclude from the Workshop, that the proposed 4 steps are appropriate to develop connectivity projects on pan-alpine or region/local level. It is important that discussion starts regarding problem areas, action need and aims and selecting most effective focus activities. Discussion regarding appropriate methodologies will follow after the definition of focus activities.

If such a procedure is followed in all pilot regions, co-operations between neighbouring regions will be possible on the strategic level (problem areas, action need) and led to a common definition of focus activities.

Appendix 1

List of experts

(Q and underlined: filled in questionnaire; W: participated in the Workshop)

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