Appendix S1. Details of the conservation assessment methodology (endangerment, conservation value and need for action) in the Red List of plant communities of Mecklenburg-Vorpommern.

This appendix is a shortened English version of the methodological chapters by Abdank et al. (2004a), Berg et al. (2004b) and Abdank et al. (2004b) in the monograph *Die Pflanzengesellschaften Mecklenburg-Vorpommerns und ihre Gefährdung* (Berg et al. 2004a).

General framework

One major aim of the project *Die Pflanzengesellschaften Mecklenburg-Vorpommerns und ihre Gefährdung* (*Plant communities of Mecklenburg-Vorpommern and their vulnerability*; Berg et al. 2001, 2004a; further referred to as RLPGMV) was to provide a comprehensive conservation assessment of all listed vegetation types occuring or having occurred on the territory of this federal state in NE Germany. We name the overall product the *Red List of plant communities of Mecklenburg-Vorpommern*, while acknowledging that its scope goes significantly beyond that of traditional Red Lists (sensu stricto).

Our conservation assessment methodology consists of three major parts, which correspond to the sections of this Appendix: (i) assessment of **endangerment**, (ii) assessment of **conservation value** and (iii) the combination of (i) and (ii) to derive the **need for action**. In this context, **endangerment** means the scientific estimation of how strongly and how fast a certain community type is declining, and thus how high the risk is that it will totally vanish from the territory considered should the current environmental framework with its threats remain unchanged. By contrast, the **conservation value** represents a normative evaluation of how important it is to maintain viable stands of a certain community type in Mecklenburg-Vorpommern from various perspectives. Only the joint consideration of endangerment and conservation value according to our understanding allows the meaningful definition of priorities in nature conservation.

Endangerment

State of the art

The development of conservation assessment systems with objective and comparable criteria has been mainly discussed for Red Lists of species. Examples Germany include Blab et al. (1984), Müller-Motzfeld (1992), Nowak et al. (1994), Schnittler et al. (1994) and Schnittler & Ludwig (1996). The perception or realisation that protecting species without appropriate conservation of habitats is most often unsuccessful, increasingly led to the development of Red Lists for habitat types. Again, examples in Germany include Riecken et al. (1994), von Nordheim & Merck (1995), and von Drachenfels (1996).

First Red Lists of plant communities, as the level between species and habitats have been developed nearly 30 yr ago and their approaches and scientific concepts are discussed e.g. by Bohn (1986), Dierßen (1986), Moravec (1986) and Preising (1986). During the last 25 yr, most of the German federal states have published Red Lists of plant communities: Saxony-Anhalt (Schubert et al. 2001), Saxony (Böhnert et al. 2001), Thuringia (Westhus et al. 1993, Heinrich et al. 2001), Schleswig-Holstein (Dierßen et al. 1988), Lower Saxony (Preising et al. 1990, 1993, 1995, 1997, 2003, Drehwald & Preising 1991, Drehwald 1993), Northrhine-Wesphalia (Verbücheln et al. 1995), Hesse (only grasslands: Bergmeier & Nowak 1988), Saarland (Sauer & Weyrath 1989), Bavaria (Walentowski et al. 1990, 1991a, 1991b, 1992). A list of endangered plant communities in the entire eastern part of Germany was published by Knapp et al. (1985). The first Red List of plant communities for the whole of Germany was developed during a symposium in 2000 in Bonn (Rennwald 2002). An overview of other regional and national Red Lists of plant communities is available in Köppel (2002).

The process of the categorisation in the mentioned lists is conducted with varying intensity. Often, these Red Lists provide just a brief explanation of the categories of endangerment, which in many cases are related to the categories and definitions used in Schnittler et al. (1994) as well as Schnittler & Ludwig 1996), and based on internationally accepted criteria for plants and animals at that time (IUCN 1994). A partial disclosure of the underlying data and the steps of estimation were presented only in some Red Lists (e.g. Walentowski et al. 1990, 1991a, 1991b, 1992, Heinrich et al. 2001, Rennwald 2002).

Outline of our concept

The methodology of the conservation assessment in our opinion should satisfy the following essential requirements:

- Objective logical and comprehensible system.
- Comparability with Red Lists of plant communities for larger areas of consideration, e.g. with Red Lists in other federal states and at the country level.
- Use of Red List categories that correspond to or are at least comparable with the current national and international standards.

Therefore, the presented concept combines benefits from Red Lists for species and habitats as well as conceptual approaches of Red Lists of plant communities of individual federal states, particularly Walentowski et al. (1990, 1991a, 1991b, 1992). Concerning the Red List categories the concept mainly follows the methodological proposals of Schnittler & Ludwig (1996), which were used for many Red Lists of animals and plants in Germany and also in the Federal German Red List of plant communities (Rennwald 2002). The selected aspects used for the endangerment concept are discussed below. To get at a logical, consistent and transparent conservation assessment, in our opinion it is useful to concentrate on a few, clearly defined criteria. In contrast to other Red Lists, these criteria are not only explained verbally, but quantified numerically and connected with a decision matrix. The initial ideas behind this concept have been published by Abdank et al. (2002) and were later adopted with some minor modifications stemming from theoretical considerations and experience from practical applications.

Selection of criteria

A comparison of various Red Lists according to conservation assessment shows similarities, but also differences (Table 1). Each Red List should be based on clearly defined time periods: past, present and future. According to Müller-Motzfeld (1992), the differentiation of a past assessment period (in retrospect), a reference period (at present) and a forecast period (forward looking) is sensible. The past assessment period should be documented with accurate data so that a historical baseline can be compared with the current status. The consideration of a defined forecast period allows the estimation of further development, which is essential for a conservation assessment. While many Red Lists of plant communities consider the development in the past and in the present situation as an evaluation criterion, the question of the threat during the forecast period is usually not included. Partly there is also no clear separation between the development in the past and the current situation, for example in Rennwald (2002: p. 109), where *Flächengröße und Bestandstendenz* (total area and trend) are apparently merged into a single criterion. According to the concept for Red Lists of species (Schnittler & Ludwig 1996), we used the three criteria **current situation** (present), **past trend** (since 1960) and **prognosis**, i.e. threat from human activities within the next 10 yr (future).

Another frequently used criterion for the evaluation of plant communities is the ‘quality trend’ or ‘quality loss’ (see Böhnert et al. 2001). Such changes meight be visible through change in abundance of species or structural changes in the communities. In the literature (Bohn 1986, Dierßen 1986, Dierßen et al. 1988, Westhus et al. 1993, Heinrich et al. 2001, Rennwald 2002), sometimes even two quality criteria ("floristic changes’ and ‘decreasing number of subtypes’) are assessed separately. Regarding species, the determination of the "qualitative risk" (i.e. the consideration of intra-specific genetic loss) is still in its infancy, but will certainly play an increasing role in the future. In contrast, ‘quality loss’ is wildy used as criterion in Red Lists of plant communities and habitat types (see Table 1). However, we prefer a classification aimed to be able to reflect the changes needed for Red List assessement, and important changes in sturucture or species composition should result in leads to another plant community type. For example, in the case of abandonment and eutrophication, typical stands of the *Arrhenatheretum elatioris* turn into the *Artemisia vulgaris*-subtype and finally into the tall herb ruderal community *Tanaceto-Artemisietum vulgaris*. For such cases we used a separate conservation assessment of the different subtypes or the new comunity. However, slight qualitative changes within a plant community cannot be included in our criteria system even for our fine scaled classifcation system, but are described verbally.

Table 1. Criteria used in the Red List of plant communities in Mecklenburg-Vorpommern in comparison to other Red Lists in Germany. Qualitative changes are indirectly reflected by past trend as strong qualitative changes lead to a differen community type, thus, loss of area.

<table>
<tr><th colspan="6">Criteria</th></tr>
<tr><td colspan="2">for</td><td>Species
(Schnittler & Ludwig 1996)</td><td>Habitats
(Riecken et al. 1994, von Drachenfels 1996)</td><td>Plant communities
(Heinrich et al. 2001, Rennwald 2002)</td><td>Plant communities M-V</td></tr>
<tr><td rowspan="2">Loss of area</td><td>present</td><td>Current status</td><td>Rarity</td><td rowspan="2">Area and trend

Threat by loss of area</td><td>Current status</td></tr>
<tr><td>past</td><td>Past trend</td><td>Past trend (loss of area)</td><td>Past trend</td></tr>
<tr><td colspan="2">Quality decline</td><td>So far impossible</td><td>Quantitative development (quality loss)</td><td>Changes in species and structure
decrease in the variety of subtypes</td><td>[Quantitative trend]</td></tr>
<tr><td>Future</td><td>prediction</td><td>Threat from human activities</td><td>not used</td><td>not used</td><td>Prognosis</td></tr>
<tr><td colspan="2">Other influencis</td><td>Risk factors</td><td>Regenerability</td><td>Primary/ secondary habitats</td><td>–</td></tr>
</table>

In the literature, additionalcriteria for risk assessement in Red Lists are discussed: Schnittler & Ludwig (1996) highlighted that ‘biological risk factors’ are applicable only to species. Riecken et al. (1994) and von Drachenfels et al. (1996) use ‘regenerability’ as an additional criterion of the assessement of habitat types. In our concept this is included in the conservation value (see below). The question whether a community type is able to colonize primary and/or secondary sites is considered when assessing future threat and also in the criterion ‘degree of naturalness’ of the conservation value.

Basic principle

Comparing species, plant community and habitats there are similarities and differences in the methodological approaches of conservation assessment. Essential ideas for the development of our methodology have been provided by Schnittler & Ludwig (1996), complemented by Bohn (1986), Bergmeier & Nowak (1988), Walentowski et al.

(1990, 1991a, 1991b, 1992), Westhus et al. (1993), Riecken et al. (1994) and von Drachenfels (1996).

Plant communities are threatened by a complex of factors (see Appendix S3). To provide an adequate characterization of the effects of these factors on plant communities – and thus the assessment of their degree of endangerment, meaningful criteria have to be used (Schnittler & Ludwig 1996). To describe complex issues by one or two aspects it is needed to consider two or more criteria together, so that these must be aggregated (see Bastian & Schreiber 1994: pp. 52 et seq.). The **criteria** are assessed by simple **scales** and then combined in a **system** (Tables 2 and 3). This is done by means of a matrix, which finally provides the Red List category.

Table 2. The three steps of our approach.

Basic principle (indicator approach)		
First step	**Second step**	**Third step**
Criteria	**Scale**	**Criteria system**
Indicators to describe presence past future	**Quantification** of the criteria **Aggregation**	Classification into categories of endangerment by combination of criteria

The tree criteria of endangerment

As essential criteria for evaluating the level of endangerment of plant communities (Red List category sensu stricto), we use the following (Table 3):

- **current status**, i.e. the present number, distribution and size of the community stands in the reference area,
- **past trend** in the past, that means the trend of the occurrence in the assessment period, and
- **prognosis** in the forecast period, i.e. the properties of existing or foreseeable, direct or indirect effects on the survival of a plant community type.

Table 3. Indicators and scales used for the three criteria of endangerment in the *Red List of plant communities in Mecklenburg-Vorpommern*.

Endangerment criteria			
	Current status	**Past trend**	**Prognosis**
	Indicators		
	Total area covered Area covered by the plant community in the area of consideration during the last 10 yr	**Past trend** Comparison of the total area during a defined time range, e.g. in M-V since 1960	**Prognosis** Prediction of the threat from direct and indirect human activities within the next 10 yr
	Spatial distribution Distribution of a plant community within the area under consideration during the last 10 yr		
	general ranges of the criteria		
0	absent	–	–
1	very rare	very high decrease	very high threat
2	rare	high decrease	high threat
3	infrequent	less decrease	moderate threat
4	frequent	more or less unchanged	none
5	common	expanding	support

Current status (present)

The current status of a community was evaluated by considering both the total area covered and the spatial distribution of the stands within the area of consideration (during the last 10 yr). This concept reflects two of the three aspects of rarity introduced by Izco (1998): range size and frequeny. A reference to the number of occurrences, as in Red Lists of species is not meaningful for plant communities as different stands are clearly separated in some associations but not so in others. The two related indicators were defined as follows:

- **Total area covered** (Table 4): This means the area of the currently extant occurrence and is assessed on basis of the available data, e.g. direct records of associations and diagnostic species as well as expert knowledge. A roughly logarithmic scale should avoid estimation errors. Total area is classified according to Table 4 in four size categories, depending on the vegetation height.

Table 4. Scaling of the indicator total area in dependence on the average vegetation height of the stands *h*.

Size categories (dependent on vegetation type)					
Total area (Size of M-V: 23,170 km²)		**very small**	**small**	**moderately large**	**large**
Calculation scheme	average vegetation height *h*	up to 20,000 m × *h*	up to 200,000 m × *h*	up to 2,000,000 m × *h*	more than 2,000,000 m × *h*
Examples:					
Communities on trampled habitats and walls	0.05 m	up to 1,000 m²	up to 1 ha	up to 10 ha	> 10 ha
Heathlands, dry grasslands, peat bogs	0.3 m	up to 6,000 m²	up to 6 ha	up to 60 ha	> 60 ha
Meadows, arable fields	1 m	up to 2 ha	up to 20 ha	up to 2 km²	> 2 km²
Tall herb vegetation, reed beds	2 m	up to 4 ha	up to 40 ha	up to 4 km²	> 4 km²
Shrubland	5 m	up to 10 ha	up to 1 km²	up to 10 km²	> 10 km²
Woodland	30 m	up to 60 ha	up to 6 km²	up to 60 km²	> 60 km²

- **Spatial distribution** (Table 5): The determination of the spatial distribution in the considered area was done by counting the number of geographical defined entities with proven or suspected occurrence of the association. In Germany an alternatively used reference system are entities of topographic maps 1:25,000 or 1:50,000 (TK 25, TK 50) or so-called landscape-units.

Table 5. Scaling of the indicator for the current status in dependence on the proportion of geographicaly defined entities (Ordnance Survey Maps 1:25,000 and 1:1:50,000, landscape units).

Current status				
Proportion	**Number of occupied TK 25**	**Number of occupied TK 50**	**Number of occupied landscape units**	
			terrestrial	**marine**
up to 2%	< 6	< 2	< 2	< 2
3–10%	6–24	2–7	2–5	2
11–33%	25–80	8–23	6–15	3–4
34–66%	81–161	24–46	16–30	5–7
67–100%	> 161	> 46	> 30	> 7
total number in M-V	244*	70*	47	11**

* with ≥ 10 % area in Mecklenburg-Vorpommern
** only marine units with vegetation out of 17 in total

The current status is obtained as the **minimum** of the indicators of area covered and current distribution of a community, i.e. the respective lower value is decisive (see Table 6). Thus, with a large total area covered, the spatial distribution of the community decides whether it is classified as frequent or common.

Table 6. Derivation of the criterion current status as minimum of both indicators (area covered, spatial distribution).

Current status (present)		
Indicators	**Total area covered**	**Spatial distribution**
0 vanished	no recent occurrence	–
1 very rare	total area of stands very small	Occurrence in up to 2% of the geographically defined units
2 rare	total area of stands small	Occurrence in 3–10% of the geographically defined units
3 infrequent	total area of stands moderately large	Occurrence in 11–33% of the geographically defined units
4 frequent	total area of stands large	Occurrence in 34–67% of the geographically defined units
5 common		Occurrence in 67–100% of the geographically defined units

In assessing the current distribution, the study intensity of the individual areas has to be considered. If it is known that a species is largely restricted to a particular association, information about the distribution of taxa (e.g. Benkert et al. 1996) can be used to assess the current status of a community. In addition, maps of the actual occurrences of a vegetation type (based on the classified vegetation plots) and of the potential distribution (derived by overlaying distribution maps of diagnostic species can be used (Dengler 2003, Berg & Dengler 2004).

The period after the last evidence from which a community is categorised as vanished was defined as follows:

- In general, 10 yr are applied as appropriate time range.
- For 'shuttle' communities with generally episodical occurrence and long-lived permanent seed banks, like associations of the classes *Littorelletea* and *Isoeto-Nano-Juncetea*, 40 yr are appropriate (compare Schnittler & Ludwig 1996: p. 717).

If a community classified as vanished is recorded again, the current situation has to be checked again, there is no automatic classification into Category 1.

Past trend (retrospective)

This criterion compares the present extent (i.e. total area covered and/or spatial distribution) of a community with that of a reference period in the past for which sufficient data are available (Table 7). In the project RLPGMV, we used as historical reference time, the year 1960 because at that time large-scale land use changes with profound effects on the vegetation occurred in Eastern Germany (industrialisation of agriculture, intensive use of chemicals in agriculture and forestry, large-scale drainage, urbanisation). Further, there are a relatively large number of phytosociological surveys from the 1940s and 1950s, which can be used for a comparison with the current state.

In nature conservation, often the year 1850 (highest species and habitat diversity in Central Europe) has been used as a historical reference time. This year marks a turning point in land use (invention of the mineral fertilizer). For various reasons this period seem to be too long for the assessement of plant community types, especially because there are no phytosociological data from the 19th century.

Table 7. Scaling of the criterion past trend. The term 'stands' is used to summarize area covered and spatial distribution (i.e. number of occupied grid cells).

Past trend (retrospective)		
Indicator		**Change in community extent (area covered or spatial distribution) (since 1960)**
1	**very strong decline**	Loss of most of the stands (> 50 %), regional complete loss
2	**strong decline**	Loss of a substantial portion of the stands (25–50 %), local complete loss
3	**moderate decline**	Loss of a small but significant portion of the stand (10–25 %)
4	**constant**	More or less constant situation or only minor local loss (± 10 % range)
5	**increase**	Increase of stands (> 10%)

Prognosis (future)

This criterion describes the prediction of the current and foreseeable human impact on the plant communities during a forecast period, e.g. in Mecklenburg-Vorpommern 10 yr. We choose this period because (1) it is reasonably manageable and, (2) we recommend to update the Red List within this period in terms of a permanent environmental monitoring. Considered are direct effects like excavation, reforestation, peat mining, construction and land-use abandonment as well as any large-scale indirect factors, e.g. eutrophication, lowering of the ground water table, loss of potential habitat types. A separate assessment of indirect and direct threats (like in Schnittler & Ludwig 1996) is not implemented because of its difficulties. Natural processes like coastal dynamics are not defined as a threat in the sense used here. The indicator 'prognosis' is quantified in a five-step scale (proportion of stands concerned, see Table 8). Relevant is the summary effect of all positive and negative impacts.

Table 8. Scaling of the criterion prognosis.

Prognosis (future)		
Indicator		**Direct and indirect human impact**
1	**very strong**	very strong negative direct or indirect impacts; most (> 50%) of the stands and/or of the corresponding habitat type are affected
2	**strong**	strong negative direct or indirect impacts; large part (25-50%) of the stands and/or of the corresponding habitat type are affected
3	**low**	low negative direct or indirect impacts; a small, but remarkable part (10-25%) of the stands and/or of the corresponding habitat type are affected
4	**no**	no negative direct or indirect impacts; effects are not recognisable and/or not more than 10% of the stands and of the corresponding habitat type are affected
5	**support**	Support of particular habitat quality or quantity by human impact, e.g. creation of replacement habitats

System of criteria and Red List categories

For the systematic derivation of each Red List category, a **criteria system** (matrix) was developed (Table 9). The overall endangerment represents a combination of the three criteria described in the previous section: **current status** – **past trend** – **prognosis**. The matrix follows a few basic principles starting from the definitions of the criteria,.leading to a systematic and transparent construction. The criterion current status is attributed a greater importance for the derivation of the overall threat than the past trend or future prognosis. Therefore, the matrix represents a diagonally-symmetrical structure, based on the following four rules:

- Current status 0 results in Red List category 0.
- The Red List category equals the category of current status, if the sum of the categories of past trend and prognosis is 4 or 5. The category NT corresponds to the current status level 4, the category * (least concern) the current status level 5.
- The Red List category is increased by one compared to the category of current status for levels 2–5 when the sum of past trend and prognosis categories is 2 or 3. When the current status is 1, the Red List category remains 1.
- The Red List category is reduced by one compared to the category of current status for levels1–4 when the sum of past trend and prognosis categories exceeds 5. When the current status is 5, the Red List category is * (least concern).

If the past trend is constant or increasing (4 or 5) and there is no negative prognosis (4 or 5), the following additional rules are applied:

- If the current status is 1, the Red List category R (naturally rare, but not actually threatened) is assigned.
- If the current status is 2–5, the Red List category * (least concern) is assigned when the past trend was constant and *< (least concern and expanding) when the past trend was positive.

Table 9. Matrix for the determination of Red List categories, based on the three criteria current status, past trend and prognosis.

Current status	Past trend	Prognosis 1	Prognosis 2	Prognosis 3	Prognosis 4	Prognosis 5
0	1	0	0	0	0	0
1	1	1	1	1	1	2
	2	1	1	1	2	2
	3	1	1	2	2	2
	4	1	2	2	R	R
	5	2	2	2	R	R
2	1	1	1	2	2	3
	2	1	2	2	3	3
	3	2	2	3	3	3
	4	2	3	3	*	*
	5	3	3	3	*<	*<
3	1	2	2	3	3	NT
	2	2	3	3	NT	NT
	3	3	3	NT	NT	NT
	4	3	NT	NT	*	*
	5	NT	NT	NT	*<	*<
4	1	3	3	NT	NT	*
	2	3	NT	NT	*	*
	3	NT	NT	*	*	*
	4	NT	*	*	*	*
	5	*	*	*	*<	*<
5	1	NT	NT	*	*	*
	2	NT	*	*	*	*
	3	*	*	*	*	*
	4	*	*	*	*	*
	5	*	*	*	*<	*<

For the naming of the Red List categories we use, as far as possible, the terminology of the international IUCN categories (IUCN 1994, 2001) as well as adaptations of Schnittler & Ludwig (1996). These categories also correspond to the terms used in the *Red List of plant communities in Germany* (Rennwald 2002). Only in the definition of the Red List category NT (near threatened) do we differ from Schnittler & Ludwig (1996) and Rennwald (2002). While these authors (and most of the recent Red Lists) include all non-threatened, but declining species and plant communities in this category (see Schnittler & Ludwig 1996: p. 722), we define, as mentioned above, the 'near threatened' category analogous to the categories 1–3.

These following verbal descriptions illustrate the idea of each category, while decisive for the assignment of communities to categories is the matrix (Table 9) alone.

0 Vanished: plant communities, known from the area under consideration in former times, but not recorded since an appropriate time (for definition, see above) IUCN: *EX – extinct*).

1 Critically endangered: Very rare plant communities, the last of whose stands in Mecklenburg-Vorpommern will likely disappear in the foreseeable future if the threat factors continue and no conservation measures take effect. This category also includes rare communities if they are subject to a (very) high anthropogenic threat and have a strongly declining trend (IUCN: *CR* – 1994: *critical*, 2001: *critically endangered*).

2 Endangered: Very rare to rare plant communities that are bearing a high risk of disappearance in the future if the threat factors continue and no conservation measures take effect. This category includes infrequent communities if they are subject to a (very) high anthropogenic threat and have a strongly declining development (IUCN: *EN – endangered*).

3 Vulnerable: Rare to infrequent plant communities that are facing a high threat in the foreseeable future. This category includes frequent communities if they are subject to a (very) high anthropogenic threat and have a strongly declining trend (IUCN: *VU – vulnerable*).

R Very rare but not currently threatened: Very rare plant communities that are neither threatened nor declining. Because of rarity and small total area, they are potentially endangered by unforeseen events (IUCN 1994: SU – susceptible, 2001: no equivalent).

NT Near threatened (German version: V – *Vorwarnliste*): Moderately to very frequent plant communities, currently not endangered, but under a high anthropogenic threat or with a strongly negative trend, so that under persistence of the threat a reclassification to category 3 in the foreseeable future will become necessary (IUCN: *NT – near threatened*).

*** Least concern:** Frequent to very frequent plant communities, currently not endangered, but declining and/or threatened by human activities as well as rare or infrequent plant communities, currently not threatened by human activities nor declining (IUCN 1994: *not threatened*, 2001: *LC – least concern*).

***< Least concern and expanding:** Currently not threatened, rare to very frequent expanding plant communities (IUCN: no equivalent).

If no clear assignment to a specific category is possible due to insufficient data of one or more criteria, the resulting Red List category is 'calculated' for all these combinations. Should the calculation result in different potential categories of overall endangerment, the **additional categories** # and D are used, introduced by Schnittler & Ludwig (1996: 716) for cases of **inadequate data** (see Table 109): # is used if the calculated Red List categories are all within the 'red-listed' categories (e.g. 2–3). D is used if the calculated Red List categories are partly within and partly outside the red-listed categories (e.g. 3–*). We further use * in cases where the calculated Red List categories outside of the Red List categories fluctuate (e.g. NT–*):

\# **Probably threatened** (German version: G – *Gefährdung anzunehmen*): Communities that are likely endangered, but where the available data do not allow the classification into one of the precise Red List categories (IUCN: no equivalent).

D **Data deficient:** Communities for which the knowledge of past trend and currend status is insufficient to classify into another category. In this case, research and monitoring is necessary, because an overall endangerment cannot be excluded (IUCN: *DD – data deficient*).

Table 10. Use of the additional categories of inadequate data PT = probably threatened, * = not threatened (without differentiation) and D = data deficient.

Red-listed communities			
0	Vanished	#	D
1	Critically endangered		
2	Endangered		
3	Vulnerable		
R	Naturally rare, but not actually threatened		
Non red-listed communities			
NT	Near threatened	*	
*****	Least concern		
***<**	Least concern and expanding		

Conservation value

General approach

The selection of criteria to evaluate the conservation value should meet various requirements:

- Easy and transparent determination.
- Concentration on a few criteria that cover all relevant aspects.
- Selection of criteria which are largely independent of each other.
- Independence from the conservation assessment and its criteria.

After a long and controversal discussion among the project members, we selected three criteria: **relevance for species conservation**, **degree of naturalness** and **global relevance**, following Paulson & Jeschke (1996), Müller-Motzfeld et al. (1997) and Schnittler & Günther (1999)

In the literature, many more possible criteria have been proposed for the assessment of conservation value, including potential for regeneration, maturity, aesthetic value, cultural-historical relevance, occurrence in conservation areas, rarity, species diversity, structural diversity, area, representivity for a landscape unit. We decided not to use these because they are:

- closely correlatated with degree of naturalness (e.g. potential for regeneration, maturity),
- already included in the subcritiera of endangerment (e.g. occurrence in conservation areas, rarity, representativity for a landscape unit),
- hard to quantify (e.g. aesthetic value, cultural-historical relevance), and/or
- questionable as a value *per se* (e.g. total species richness [particularly when without reference to an area size], structural diversity).

The three selected criteria

Relevance for species conservation

This criterion describes the role of a plant community as habitat for endangered plant species. We defined the relevance for species conservation as the mean density of endangered species within a plant community, using the recent regional Red List status of vascular plants (Fukarek 1992), bryophytes (Berg & Wiehle 1992), lichens (Litterski 1996) and stoneworts (Schmidt 1994).

To determine the numerical value of the relevance for species conservation for an association or a subtype, the percentage constancy of each red-listed species occurring in a community type was multiplied by the weighting factor from Table 11 and then summed across all species. Accordingly a numeric relevance level of 1,000, for example, means that in a typical relevé of this vegetation type, 10 red-listed species of the categories 3 or #, or five of category 2 or R occur, respectively. The applicability of such a calculation depends on the representability of the floristic information for every vegetation unit (Jansen et al. 2012).

Table 11. Weighting factors for different categories of the Red List of species for determining the relevance for species conservation.

Weighting factors of Red List categories		
Factor	**Category**	**Verbal explanation**
4	0, +	extinct or missing
	1, !!!	critically endangered
2	2, !!	endangered
	R, 4, (!!!)	rare
1	3, !	vulnerable
	#, ?	assumed threat

The resulting values of the relevance for species conservation ranged from 0 to 4,111, with a median of 245.5. These values more or less follow an exponential distribution (Fig. 1).

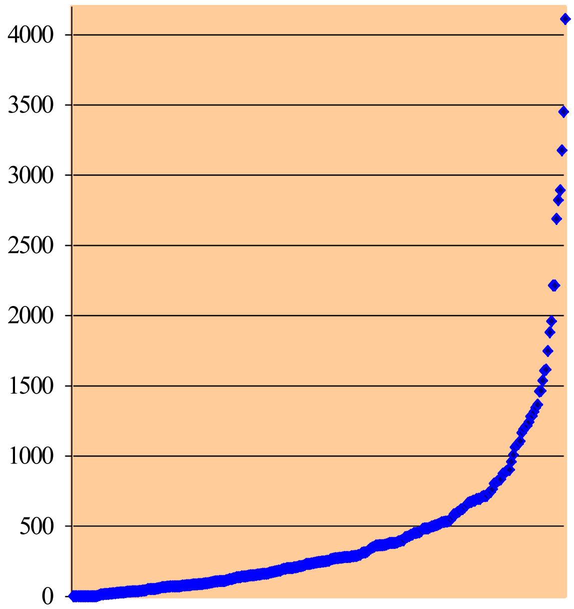

Fig. 1. Distribution of the numerical relevance for species conservation when ordering the 285 associations in ascending order.

In order to reach the desired five-point scale, the numerical relevance for species conservation values had to be classified. A variety of approaches, e.g. the normative appointment of category limits was discussed. Since these category limits are subjective, a simple mathematical approach was taken. The associations were sorted in an ascending order of the sums of the content of threat, and then divided in five (approximately) equally sized groups (quintiles). This approach resulted in an approximate "logarithmic" classification (Table 12), in which two consecutive category limits differ approximately by a factor of 2.

Table 12. Classification of the relevance for species conservation with a 5-point scale.

Relevance for species conservation	
Category	**Sum**
1	from 670
2	330 to 669
3	170 to 329
4	70 to 169
5	to 69

Table 13. The five categories of the degree of naturalness.

Degree of naturalness					
Category		**Formations**	**Definition (land use, habitat features)**	**Degree of human impact (hemeroby)**	**Examples**
1	**Natural**	Unmodified remains of natural vegetation	No management, natural habitat dynamics	Lacking human impact (oligohemerobic)	Vegetation of natural forests, unspoiled water bodies, living bogs and semi-natural coastal landscapes (dunes, brackish reedbeds, active cliffs)
2	**Semi-natural**	Modified remains of natural vegetation	Land use without direct habitat impects and without compensation of material deficiencies (e.g. fertilization)	Weak human impact (oligo- to mesohemerobic)	Managed natural forests with low timber harvest, spontaneous shrub grows, pioneer and intermediate forests, slightly eutrophic water bodies, low intensity used fen meadows and grasslands, older fallows of anthropogenic communities.
3	**Pre-industrial anthropogenic**	Managed vegetation originating in pre-industrial times	Land use with substantial habitat influence and occasional material compensation by organic fertilization	Moderate human impact (Mesohemerobic)	Managed forests of predominantly native species, spontaneous secondary forests on anthropogenic soil, dwarf shrub heaths, permanent grassland and pastures, natural fallows of strong anthropogenic communities
4	**Industrial anthropogenic**	Managed vegetation originating in industrial times	Intensive land use on the basis of habitat changes (irrigation and drainage, strong mineral fertilization, liming, biocides, grading, ploughing), anthropogenic habitat dynamics, allochthonous substance loads	Strong human impact (euhemerobic)	Intensive and disturbed secondary forests, intensive grassland, lawns, arable fields and gardens with weeds, recent mine trailings, waste places
5	**Artificial**	Largely human-controlled vegetation	Complete habitat conversion, chemical treatments, cover with non-native substrata	Excessive human impact (polyhemerobic)	Weed communities on artifical or highly degraded soils, arable fields and gardens

Naturalness (absence of human impact)

Numerous concepts for quantifying naturalness have been published (in Germany e.g. Dierschke 1984). The degree of naturalness is closely linked to the 'hemeroby' as a measure of human impact on the vegetation (e.g. Sukopp 1997). Hemeroby thus represents the reciprocal value of naturalness. Hemeroby can be quantified by the average indicator value for hemeroby of the vascular plant species occurring in the syntaxon (Kowarik 1988, Frank & Klotz 1990, Kowarik 1999, Hill et al. 2002). As the cultural influence is important for the development of vegetation types it is also possible to estimate the degree of naturalness using the type and intensity of land use. This third approach has been applied in the project RLPGMV by connecting the degree of naturalness to the hemeroby levels according to Sukopp (1997) (Table 13).

Global relevance

The responsibility for the maintenance of a particular plant community results in the project RLPGMV of the proportion of the respective distribution area of a syntaxon, attributable to the area under consideration (Table 14). If a direct assessment of the global syntaxon distribution was impossible due to limited knowledge, the number of diagnostic species with a small world distribution range was considered („stenochorous taxa') as an alternative. The term 'Central European' for the Central European floral region in Table 14 is used according to Meusel & Jäger (1992); main distribution means the center of the world range.

Table 14. The criterion global relevance divided in five categories. The highest value counts.

Global relevance			
Category		Estimated proportion of the wold range of vegetation type in the study area	Ranges of diagnostic species
1	Highest global relevance	more than 1/2	several stenochorous taxa with small ranges
2	High global relevance	1/5 – 1/2	one stenochorous taxon with a small range
3	Moderate global relevance	1/20 – 1/5	several taxa with their main distribution in Central Europe
4	Low global relevance	1/50 – 1/20	one taxon with a main distribution in Central Europe
5	Least global relevance	Less than 1/50	all taxa with a wider distribution, mainly Eurasian

Determination of the conservation value

The conservation value is derived from the combination of the three criteria presented. Although initially a greater weight of the naturalness had been discussed (Berg et al. 2001), we now suggest that all three criteria should be treated equally. This approach one hand is a compromise between different valuation preferences and on the other hand results in a more transparent evaluation. The conservation value is calculated based on two simple rules:

- The conservation value corresponds to the highest category (i.e. lowest value) if this appears at least in two of the three criteria.
- The conservation value equals the highest category (i.e. lowest value) plus 1 if this appears in only one of the three criteria.

These two rules have been implemented in a matrix (Table 15) to determine the conservation value for combination of criteria. If a plant community regularly occurs at sites with different degrees of naturalness, the calculations use the value of the lowest degree of naturalness, i.e. the highest value.

Table 15. Matrix for determination of the conservation values.

relevance for species	Degree of naturalness	Global relevance				
		1	2	3	4	5
1	1	1	1	1	1	1
	2	1	2	2	2	2
	3	1	2	2	2	2
	4	1	2	2	2	2
	5	1	2	2	2	2
2	1	1	2	2	2	2
	2	2	2	2	2	2
	3	2	2	3	3	3
	4	2	2	3	3	3
	5	2	2	3	3	3
3	1	1	2	2	2	2
	2	2	2	3	3	3
	3	2	3	3	3	3
	4	2	3	3	4	4
	5	2	3	3	4	4
4	1	1	2	2	2	2
	2	2	2	3	3	3
	3	2	3	3	4	4
	4	2	3	4	4	4
	5	2	3	4	4	5
5	1	1	2	2	2	2
	2	2	2	3	3	3
	3	2	3	3	4	4
	4	2	3	4	4	5
	5	2	3	4	5	5

The following terms are used for naming the conservation value categories (Table 16):

Table 16. Terms used for the conservation values.

Conservation value	
1	highest conservation value
2	high conservation value
3	medium conservation value
4	low conservation value
5	lowest conservation value

Need for action

A central goal of any Red List is to imorove conservation actions concerning the particular conservation objects. In the past, it was often assumed that the need for action automatically increases with the degree of endangerment. Particularly in plant communities, however, the conservation value has to be taken into account as a second aspect to define priorities. The need for action is determined using a matrix (Table 17) with the following priority levels:

- **!!! Priority need for action** for communities of the Red List categories 1–2 if the sum of Red List category and conservation value is 3 or a less.
- **!!: High need for action** for communities of the Red List categories 1–3 if the sum of Red List category and conservation value is 4 or 5.
- **!: Moderate need for action** for communities of the Red List categories 1–3 if the sum of Red List category and conservation value is more than 5 as well as for communities at least categorised as conservation value 1–3 within the category near threatened (NT).
- In case of category of endangerment #, the need for action equals the value for Red List category 3 (because this is the most positive possible category). At the same time there is need for research.
- **[!!!], [!!], [!]: Restoration demand** is given when a plant community has vanished. The demand is decreasing with increasing time after the last stand of the community type has been destroyed because the chance of re-establishing a community becomes lower and lower with time. For recently vanished communities, the restoration demand equals that of communities of Red List category 1.
- **(!!!), (!!), (!): Potential need for action** is given in rare communities of the Red List category R. Concrete action is only required if a currently not foreseeable threat occurs.
- **?: Need for research** concerning the actual endangerment exists for communities with insufficient data (D).
- **–: No need for action** for all other communities.

Table 17. Matrix to determine the need for action by combining the Red List category and the conservation value. The inner values mean: [!!!], [!!], [!] = restoration demand; !!! = priority need for action; !! = high need for action; ! = moderate need for action; • (!!!), (!!), (!): potential need for action; – = no need for action; ? = need for research.

Combination of endangerment and conservation value = need for action										
Vulnerability / **Cons. value**	**0** vanished	**1** critically endangered	**2** endangered	**3** vulnerable	**#** probably threatened	**R** rare	**NT** near threatened	***** Least concern	**<** expanding	**D** data deficient
1 highest value	[!!!]	!!!	!!!	!!	!!	(!!!)	!	–	–	?
2 high value	[!!!]	!!!	!!	!!	!!	(!!!)	!	–	–	?
3 medium value	[!!]	!!	!!	!	!	(!!)	!	–	–	?
4 low value	[!!]	!!	!	!	!	(!!)	–	–	–	?
5 lowest value	[!]	!	!	!	!	(!)	–	–	–	?

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