

Supporting information to the paper

Tichý, L., Chytrý, M., & Landucci, F.: GRIMP: a machine-learning method for improving groups of discriminating species in expert systems for vegetation classification. *Journal of Vegetation Science*.

Appendix S1. Structure and formal language of the Expert System functions used in the JUICE 7.0 program (www.sci.muni.cz/botany/juice). This is an update of Appendix S2 published by Landucci et al. (2015).

Expert System

An **Expert System** is a method that converts expert knowledge to a formal code, emulating decision-making by human experts (Jackson 1998). In the JUICE 7.0 program, the **Expert System** function is found in the **Analysis** menu. Its purpose is performing automatic assignments of vegetation plots (relevés) to defined vegetation types according to a pre-existing set of conditions defined by an expert. The classification algorithm follows a set of rules defined in a TXT file named **Expert System file**.

This file consists of at least three sections:

- **Section 1: Species aggregation.** It contains the rules for merging the species (or other taxa such as subspecies, henceforth called “species”) occurring in more than one layer or aggregating the species occurring in the dataset under different names to a single taxonomic entity (Fig. S1).
- **Section 2: Species groups.** It defines any kind of species group (### sociological species group, #TC and #SC functional species group, ##D discriminating species group) used in the logical formulas in Section 3 (Fig. S2). Species groups are labelled by the first three characters indicating the group type.
- **Section 3: Group definitions.** It comprises all the logical formulas that define the units of the

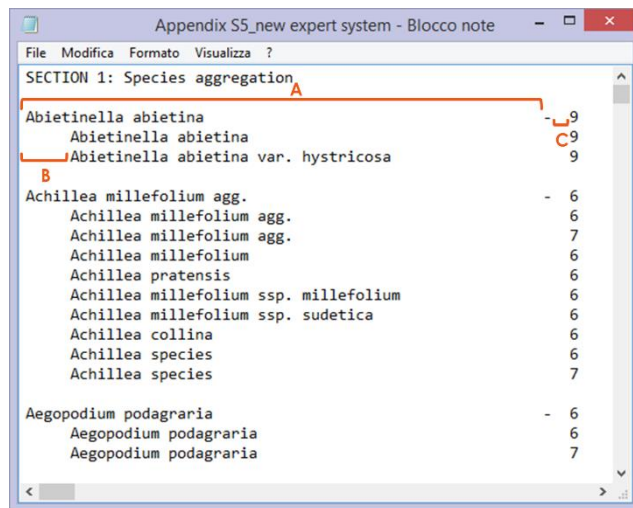


Fig. S1. Section 1 of the Expert System file: Species aggregation. The distance A is 58 characters including spaces, B is 5 spaces and C is 2 spaces. Vegetation layers are indicated by the numbers on the right and play a role only in Section 1.

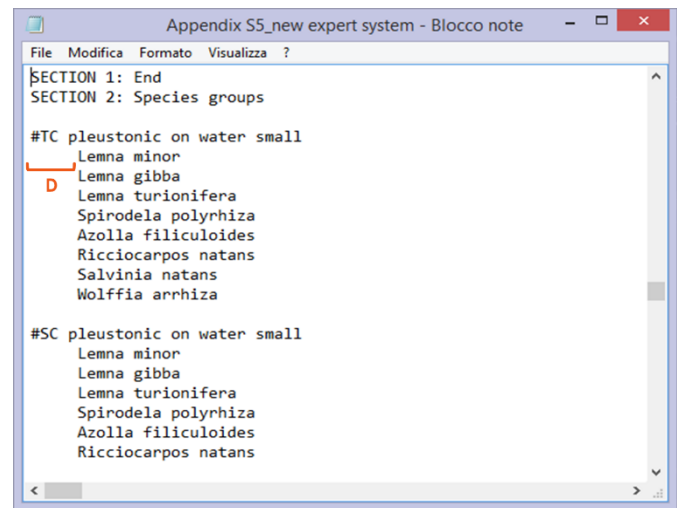
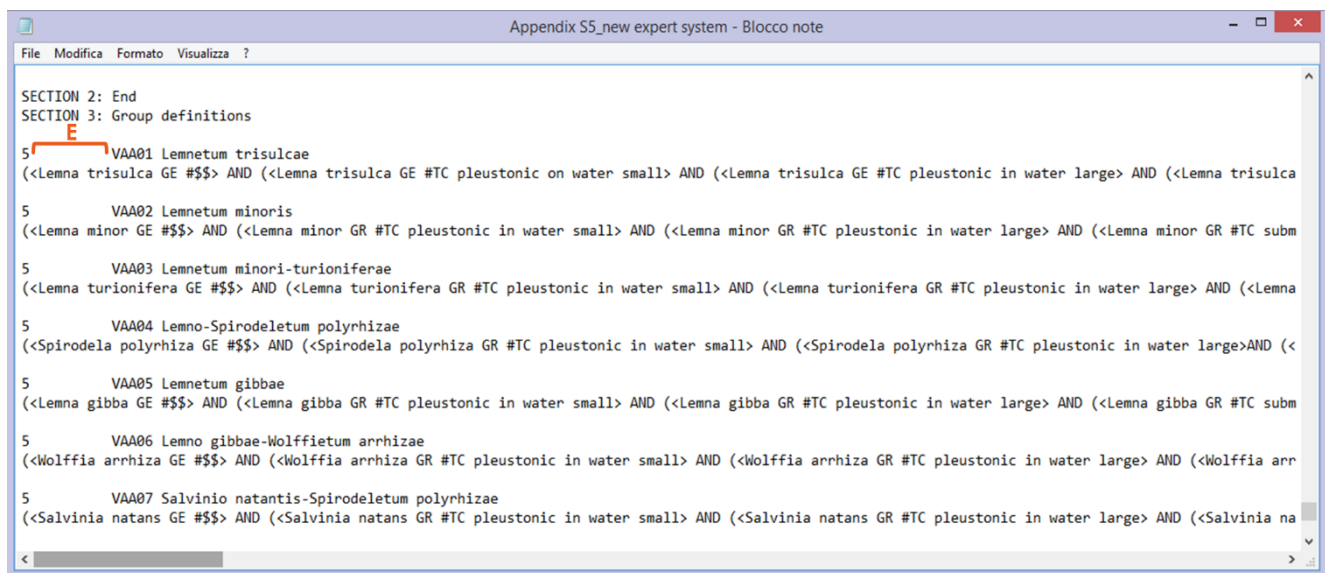


Fig. S2. Section 2 of the Expert System file: Species groups. The distance D is 5 spaces.

classification (vegetation types; Fig. S3).

Classification hierarchy

One-digit number (0–9) before the name of each vegetation type in Section 3 of the Expert System file indicates its priority level in the classification process, which can be used for defining the classification hierarchy. The higher the number, the higher priority in the classification process. More priority levels than 10 can be added by additionally using the characters A–Z and a–z. If a vegetation type has a higher priority, its formula is applied first in the classification process. Then the formulas corresponding to vegetation types with the next lower priority are applied only to those vegetation plots that remained unclassified in the previous step, and the process proceeds to the lower levels one by one. For example if the Expert System file contains formulas for phytosociological classes (priority level 1, i.e. lowest), orders (2), alliances (3) and associations (4), each plot that corresponds to the definition of an association will be classified to the association, because the level of associations has the highest priority level in this case. Only those plots that do not correspond to the definition of any association can be assigned to the alliances, those that do not correspond to the definition of any association or alliance can be assigned to orders and so on. The plots classified to two (or more) vegetation types at the same hierarchical level will be marked by ‘+’ in the classification output. The codes of all vegetation types to which the plot is assigned can be saved to the clipboard.



```
SECTION 2: End
SECTION 3: Group definitions
5      E VAA01 Lemnetum trisulcae
(<Lemna trisulca GE #$$$> AND (<Lemna trisulca GE #TC pleustonic on water small> AND (<Lemna trisulca GE #TC pleustonic in water large> AND (<Lemna trisulca
5      VAA02 Lemnetum minoris
(<Lemna minor GE #$$$> AND (<Lemna minor GR #TC pleustonic in water small> AND (<Lemna minor GR #TC pleustonic in water large> AND (<Lemna minor GR #TC subm
5      VAA03 Lemnetum minori-turioniferae
(<Lemna turionifera GE #$$$> AND (<Lemna turionifera GR #TC pleustonic in water small> AND (<Lemna turionifera GR #TC pleustonic in water large> AND (<Lemna
5      VAA04 Lemno-Spirodeletum polyrhizae
(<Spirodela polyrhiza GE #$$$> AND (<Spirodela polyrhiza GR #TC pleustonic in water small> AND (<Spirodela polyrhiza GR #TC pleustonic in water large>AND (<
5      VAA05 Lemnetum gibbae
(<Lemna gibba GE #$$$> AND (<Lemna gibba GR #TC pleustonic in water small> AND (<Lemna gibba GR #TC pleustonic in water large> AND (<Lemna gibba GR #TC subm
5      VAA06 Lemno gibbae-Wolffietum arrhizae
(<Wolffia arrhiza GE #$$$> AND (<Wolffia arrhiza GR #TC pleustonic in water small> AND (<Wolffia arrhiza GR #TC pleustonic in water large> AND (<Wolffia arr
5      VAA07 Salvinio natantis-Spirodeletum polyrhizae
(<Salvinia natans GE #$$$> AND (<Salvinia natans GR #TC pleustonic in water small> AND (<Salvinia natans GR #TC pleustonic in water large> AND (<Salvinia na
```

Fig. S3. Section 3 of the Expert System file: Formal definitions (logical formulas) of vegetation types. Each logical formula occupies two lines. The first line contains one character indicating the hierarchical level of the classification (number 5 in this example), followed by 10 spaces (distance E), the code of the vegetation type (5 characters) and the full name of the vegetation type. The second line contains the formula.

The formal definitions of vegetation types and their language

Structure of the logical formulas

Formal definitions of vegetation types are expressed in logical formulas in Section 3 of the Expert System file. Each formula consists of **membership conditions** combined using **logical operators**. Each membership condition is composed of **terms** related by **relational operators**. The terms that can be used in the membership conditions include **species**, **species groups** and in most cases **threshold cover values** (Fig. S4). Each **membership condition** is delimited by the symbols < >. The simplest formula may consist of one membership condition without any logical operator.

The meaning of the logical operators is as follows:

AND: Both of the two membership conditions must be true.

OR: At least one of the two membership conditions must be true.

NOT (meaning AND NOT): The first membership condition must be true and the condition following this operator must not be true.

Each logical operator combines two membership conditions. Combinations such as **X AND Y AND Z** or **X OR Y OR Z** must be written using pairs of membership conditions in brackets such as (**<X> AND <Y>**) **AND <Z>** or **<X> AND (<Y> AND <Z>)** or (**<X> OR <Y>**) **OR <Z>** or **<X> OR (<Y> OR <Z>)**. The brackets () are used to group pairs of membership conditions inside the formulas. Other bracket types such as [] and { } can be used in addition to round brackets to make the hierarchy within the formula more easily visible.

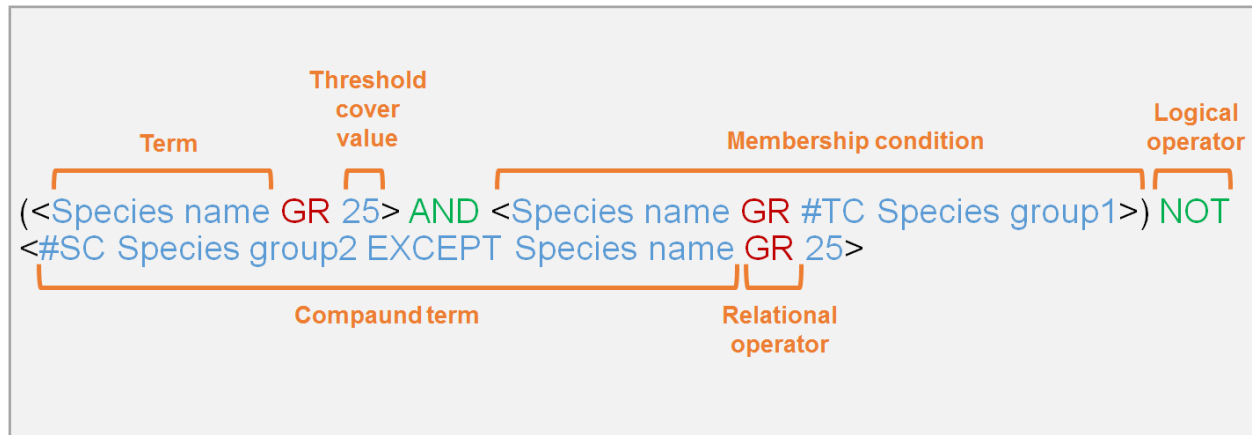


Fig. S4. A general example of a logical formula (formal definition) and its syntax. The terms and compound terms are in blue, the relational operators in red and the logical operators in green.

An example of a formula for the association *Nymphaeetum albae* is in Fig. S5.

```
((<Nymphaea alba GE $$$> AND <Nymphaea alba GR #TC non-aquatic>) OR (<Nymphaea alba GR 25>  
NOT <#SC nymphaeoid EXCEPT Nymphaea alba GR 25>)) NOT <#TC non-aquatic GR 25>
```

Fig. 5. An example of a logical formula of a specific association: *Nymphaeetum albae* (from Landucci et al. 2015). See Fig. S4 for the explanation of colours.

Some formulas can be temporarily disabled by the user (e.g. for testing purposes when several alternative formulas of the same vegetation type are being compared) by inserting the characters '---' at the start of both lines (the line with the vegetation type code and name and the line with the formula).

Logical operators

Relational operators

The meaning of the relational operators is as follows:

GR (UP*): Greater than ('>'; *The operator UP was used in the first versions of JUICE 7.0, it is still available in the program, but its use is no longer recommended in order to avoid possible confusion with other relational operators).

GE: Greater than or equal to ('≥').

EQ: Equal ('='). This operator is useful only for special cases. Percentage covers of merged species needn't perfectly fit the equality of two species covers in any cover scale.

In addition, the operator | can be used to merge groups or species. When it is inserted between two groups, the species of both groups are considered by the program as a single species group. When it is used between two species, they are considered as a species group.

Terms

Possible terms and examples of membership conditions in which these terms are used are provided below. The examples summarize all membership conditions available in JUICE version 7.0.192.

• Species

The logical formulas can contain individual species names. Each species name in a formula must be identical with the name of a corresponding species in the JUICE data table. Each species in a membership condition is related by a relational operator to (1) a threshold cover value, (2) a threshold cover value relative to the total cover, (3) another species, or (4) a functional species group.

Examples:

<Species name GR 25> <Species name GE 25> <Species name EQ 25>	The cover of the species is <i>greater than, greater than or equal to, equal to 25%</i> (any other threshold percentage values can be used as well)
<Species name GR \$05> <Species name GE \$25>	The cover of the species is <i>greater than 5%, greater than or equal to 25%</i> of the total cover of the plot.
<Species name GR #\$\$>	The cover of the species is <i>greater than</i> the cover of any other species in the plot
<Species name GR #SC Functional species group name>	The cover of the species is <i>greater than</i> the cover of any single species in the functional species group
<Species name GR #TC Functional species group name> <Species name GE #TC Functional species group name> <Species name EQ #TC Functional species group name>	The cover of the species is <i>greater than, greater than or equal to, equal to</i> the total cover of the functional species group
<Species name 1 GR Species name 2>	The cover of species 1 is <i>greater than, greater than or equal to, equal to</i> the cover of

<Species name 1 GE Species name 2>	species 2
<Species name 1 EQ Species name 2>	

- **Threshold cover values**

Threshold cover values are expressed in percentages and are always used after relational operators. Any percentage value from '00' to '99' can be used as a threshold. Total covers of species from the functional species group are merged accounting for random overlap of covers of individual species as explained in Fischer (2015; see below) to prevent the total cover to exceed 100%. However, for simplicity we suggest to use a limited number of threshold cover values as whole percentage numbers, e.g. 00 (value 0%), 05 (value 5%), 10, 25, 50.

Examples:

<Species name GR 05> <Species name GE 25> <Species name EQ 50>	The cover of the species is <i>greater than 5%, greater than or equal to 25%, equal to 50%</i>
<#TC Functional species group name GR 05> <#TC Functional species group name GE 25> <#TC Functional species group name EQ 50>	The total cover of the functional species group is <i>greater than 5%, greater than or equal to 25%, equal to 50%</i>
<#SC Functional species group name GR 05> <#SC Functional species group name GE 25>	The cover of any species in the functional species group is <i>greater than 5%, greater than or equal to 25%</i>
<#\$\$ GR 05> <#\$\$ GR 05>	The cover of any species occurring in the plot is <i>greater than 5%, greater than or equal to 25%</i>
<Species name GR \$05> <Species name GE \$25>	The cover of the species is <i>greater than 5%, greater than or equal to 25%</i> relative to the total cover of the plot.
<#TC Functional species group name GR \$05> <#TC Functional species group name GE \$25>	The total cover of the functional species group is <i>greater than 5%, greater than or equal to 25%</i> of the total cover of the plot

- **Species groups**

The user can create three main kinds of species groups (sociological species groups, functional species groups and discriminating species groups). Each of these group types is indicated by a specific symbol in the Expert System file. If a group containing the same species is once used as sociological and once as functional species group, it is possible to define such group in Section 2 of the Expert System file only once with the symbol ###. If the same group name is used in a formula with symbols of other types of species groups (#nn, #TC or #SC), it is considered to be the type of the group corresponding to the symbol.

Sociological species group (symbol ### in Section 2, symbols ### or #nn in Section 3). This kind of group is commonly used in the logical formulas created by the Cocktail method (Bruelheide 1995, 2000; Kočí et al. 2003). It is particularly useful for creating formal definitions of species-rich vegetation types at the low hierarchical level of the syntaxonomic classification system (typically associations). The general concept of sociological species group follows Doing (1969). Each sociological species group contains species with a high tendency of co-occurrence in vegetation stands or vegetation plots. The co-occurrence tendency of the species can be measured using the coefficients of statistical association, e.g. the *phi* coefficient (Sokal & Rohlf 1995; Chytrý et al. 2002). Sociological species groups are the only groups, which existence may be evaluated statistically. This approach is discussed in detail in Bruelheide (1995) and can be created using a supervised procedure in JUICE before the group is included to the Expert system. The user suggests to the program a combination of species; the program calculates a coefficient of association between each species and the group of vegetation plots that contains the combination of species and provides a response to the user; the user decides whether to accept, reject or modify the species group. For further explanation on how to construct and use sociological species groups see the JUICE manual (Tichý & Holt 2006), Bruelheide (1995, 2000) and Kočí et al. (2003).

Sociological species groups, as well as Functional species groups, are identified in Section 2 of the Expert System file with the symbol ###. However, the use of the species group in the classification depends on the symbol that comes before the group name in the formulas in Section 3. If the symbol used in Section 3 is ###, the group is considered to occur in the plot when at least half of the species of the group are present in the plot. When the symbol used is #nn, the group is considered to occur in the plot when at least *nn* species of the group are in the plot (e.g. #02 means at least two species and #15 means at least 15 species).

Examples:

<### Sociological species group name>	At least half of the species of the sociological species group are present (except for groups with two species in which both of them are present)
<#02 Sociological species group name> <#05 Sociological species group name> <#10 Sociological species group name>	At least 2, 5, 10 species of the sociological species group are present
<### Sociological species group name 1 GR ### Sociological species group name 2>	The number of species of sociological species group 1 is <i>greater than</i> the number of species of sociological species group 2
<### Sociological species group name 1 ### Sociological species group name 2 GR ### Sociological species group name 3>	The number of species of sociological species groups 1 and 2 together is <i>greater than</i> the number of species of sociological species group 3
<### Sociological species group name 1 ### Sociological species group name 2 GR ### Sociological species group name 3 ### Sociological species group name 4>	The number of species of sociological species groups 1 and 2 together is <i>greater than</i> the number of species of sociological species groups 3 and 4 together (the number of groups that can be merged by the operator is unlimited)

<### Sociological species group name 1 EXCEPT ### Sociological species group name 2 ### Sociological species group name 3 GR ### Sociological species group name 4>	The number of species of sociological species group 1 except for the species included in sociological species groups 2 and 3 is <i>greater than</i> the number of species of sociological species group 4
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- 1) **Functional species group (accepted symbols ###, #TC or #SC in Section 2, symbols #TC or #SC in Section 3).** Functional species groups comprise species with similar functional traits (e.g. life form), with similar distribution ranges, or species related to the same habitat types. Their composition is defined by the user according to pre-established (usually expert-based) rules. Functional species groups are identified in Section 2 of the Expert System file with one of the symbols ###, #TC and #SC. However, the exact use of a species group is defined in a formula in Section 3 by the symbol that comes before the group name. Two sub-types of functional species groups can be used in the formulas:

Functional species group with selection based on the total cover of all species (symbol #TC in Section 3).

This sub-type of functional species group is considered to occur in a vegetation plot if the total cover of all the species included in the group is greater than or equal to a given threshold cover value. The total cover is calculated under the assumption that covers of different species randomly overlap. Therefore the total cover of two species x and y is calculated as $C_t = C_x + C_y \times (1 - C_x)$, where C_t is the total cover, C_x is the cover value of species x , and C_y is the cover value of species y . All cover values are scaled from 0 to 1 (see explanations in Chytrý et al. 2005, Tichý & Holt 2006 and Fischer 2015). This sub-type of functional species group is always related by a relational operator to a percentage value (absolute definition of a threshold cover value) or to a species or group name (relative cover with respect to some species or functional species group).

Functional species group with selection based on the highest cover of a single species (symbol #SC in Section 3).

This sub-type of functional species group is considered to occur in a vegetation plot if the highest cover of a single species included in the group is greater than or equal to a given threshold. Groups of this sub-type are always related by a relational operator to a percentage value or a species.

Examples:

<#TC Functional species group name GR 05> <#TC Functional species group name GE 25> <#TC Functional species group name EQ 50>	The total cover of the functional species group is <i>greater than 5%, greater than or equal to 25%, equal to 50%</i>
<#TC Functional species group name GR \$05> <#TC Functional species group name GE \$25> <#TC Functional species group name EQ \$50>	The total cover of the functional species group is <i>greater than 5%, greater than or equal to 25%, equal to 50%</i> of the total cover of the plot.
<#TC Functional species group name 1 #TC Functional species group name 2 GR 05> <#TC Functional species group name 1 #TC Functional species group name 2 GE 25>	The total cover of the functional species groups 1 and 2 together is <i>greater than 5%, greater than or equal to 25%, equal to 50%</i>

<#TC Functional species group name 1 #TC Functional species group name 2 EQ 50>	
<#TC Functional species group name GR #T\$> <#TC Functional species group name GE #T\$> <#TC Functional species group name EQ #T\$>	The total cover of the functional species group is <i>greater than, greater than or equal to, equal to</i> the total cover of all other species occurring in the plot
<Species name GR #TC Functional species group name> <Species name GE #TC Functional species group name> <Species name EQ #TC Functional species group name>	The cover of the species is <i>greater than, greater than or equal to, equal to</i> the total cover of the functional species group
<#TC Functional species group name 1 GR #TC Functional species group name 2> <#TC Functional species group name 1 GE #TC Functional species group name 2> <#TC Functional species group name 1 EQ #TC Functional species group name 2>	The total cover of functional species group 1 is <i>greater than, greater than or equal to, equal to</i> the total cover of the functional species group 2
<#TC Functional species group name 1 #TC Functional species group name 2 GR #TC Functional species group name 3 > <#TC Functional species group name 1 #TC Functional species group name 2 GE #TC Functional species group name 3 > <#TC Functional species group name 1 #TC Functional species group name 2 EQ #TC Functional species group name 3 >	The total cover of functional species groups 1 and 2 together is <i>greater than, greater than or equal to, equal to</i> the total cover of functional species group 3 (the number of groups that can be merged by the operator is unlimited)
<#TC Functional species group name 1 EXCEPT #TC Functional species group name 2 GR #TC Functional species group name 3> <#TC Functional species group name 1 EXCEPT #TC Functional species group name 2 GE #TC Functional species group name 3> <#TC Functional species group name 1 EXCEPT #TC Functional species group name 2 EQ #TC Functional species group name 3>	The total cover of functional species group 1 , except for the total cover of functional species group 2 (which is assumed to be a subset of functional species group 1), is <i>greater than, greater than or equal to, equal to</i> the total cover of functional species group 3

<#TC Functional species group name 1 GR #TC Functional species group name 2 EXCEPT #TC Functional species group name 3> <#TC Functional species group name 1 GE #TC Functional species group name 2 EXCEPT #TC Functional species group name 3> <#TC Functional species group name 1 EQ #TC Functional species group name 2 EXCEPT #TC Functional species group name 3>	The total cover of functional species group 1 is <i>greater than, greater than or equal to, equal to</i> the total cover of functional species group 2 except for the total cover of functional species group 3 (which is assumed to be a subset of functional species group 2)
<#SC Functional species group name GR 05> <#SC Functional species group name GE 25>	The cover of at least one species in the functional species group is <i>greater than 5%, greater than or equal to 25%</i>
<#SC Functional species group name 1 #SC Functional species group name 2 GR 05> <#SC Functional species group name 1 #SC Functional species group name 2 GE 25>	The cover of at least one species in functional species groups 1 and 2 together is <i>greater than 5%, greater than or equal to 25%</i>
<#SC Functional species group name GR #\$\$> <#SC Functional species group name GE #\$\$>	The cover of any species in the functional species group is <i>greater than, greater than or equal to</i> the highest cover in the plot of a single species that does not belong to this functional species group
<Species name GR #SC Functional species group name> <Species name GE #SC Functional species group name>	The cover of the species is <i>greater than, greater than or equal to</i> the highest cover of a single species in the functional species group
<#SC Functional species group name EXCEPT Species name 1 Species name 2 GR 05> <#SC Functional species group name EXCEPT Species name 1 Species name 2 GE 25>	The cover of at least one species in the functional species group except for species 1 and 2 (which are assumed to be members of this functional species group) is <i>greater than 5%, greater than or equal to 25%</i>
<#SC Functional species group name 1 EXCEPT #SC Functional species group name 2 GR 05> <#SC Functional species group name 1 EXCEPT #SC Functional species group name 2 GE 25>	The cover of at least one species in functional species group 1 except for the species of functional species group 2 (which is assumed to be a subset of functional species group 1) is <i>greater than 5%, greater than or equal to 25%</i>

- 2) **Discriminating species group** (symbol **##D** in Section 2, symbols **##D**, **##C** and **##Q** in Section 3). This type of species group is used to compare the number of species or total cover of species of this group against each of the other **##D** groups defined in the Expert System file. In Section 2 of the Expert System, this group

is always indicated as **##D**. In Section 3, it can be indicated as **##D to compare numbers of species belonging to the groups**, or **##C to compare total covers of the groups**, or **##Q to compare totals of square-rooted covers of species belonging to the groups**. However, any group defined as **##D** in Section 2 can also be used in Section 3 as **###**, **#TC** or **#SC** to perform the functions of these groups if needed.

Examples:

<##D Discriminating species group>	The number of species of the discriminating species group is greater than the number of species of any other discriminating species group defined in Section 2.
<##C Discriminating species group>	The total cover of the discriminating species group is greater than the total cover of any other discriminating species group defined in Section 2.
<##Q Discriminating species group>	The sum of the square-root covers of the species of the discriminating species group is greater than the sum of the square-root covers of the species of any other discriminating species group defined in Section 2.

At least two groups with the same symbol must be defined for the correct discrimination. The Expert System file can contain more than one set of discriminating species groups. In such a case, comparisons are made only within each defined set. The sets of discriminating species groups can be defined by inserting the character '+' followed by a two-digit number after the symbol of the group. For example, let's define two sets of discriminating species groups, each with two groups: <##D +01 Discriminating species group 1>, <##D +01 Discriminating species group 2>, <##D +02 Discriminating species group 3>, <##D +02 Discriminating species group 4>. The discriminating species groups 1 and 2 are in the set 01, while the discriminating species groups 3 and 4 are in the set 02. When the expert system is designed to classify two types of vegetation (e.g. forest and grasslands) separately and independently, the comparisons among the groups of the first set are used for the classification of the first type and comparisons among the groups of the second set for the classification of the second type.

- 3) **Any species (symbols \$\$\$ and #T\$ in Section 3)**. Unlike the other kinds of species groups, which must be defined by the user, this group is automatically generated by the program. Therefore, these symbols cannot be used for defining groups in Section 2. This kind of group comprises all the species included in the analysed dataset. Similarly to the functional species groups, it has two sub-types: one, indicated by the symbol **#T\$**, is used for the total cover of all the species occurring in the plot; the other indicated by the symbol **\$\$\$**, is used for a cover of any single species occurring in the plot. When the symbols **#T\$** or **\$\$\$** are used after the relational operator **GR**, **EQ** or **GE**, the group automatically excludes the species mentioned before the operator (in this case it means 'Total cover of all other species' or 'Any other species'). This kind of group is always related by a relational operator to a threshold cover value or a species name with an implicit cover value.

Examples:

<#T\$ GR 05> <#T\$ GE 25> <#T\$ EQ 50>	The total cover of all species in the plot is <i>greater than 5%, greater than or equal to 25%, equal to 50%</i>
<#TC Functional species group name GR #T\$> <#TC Functional species group name GE #T\$> <#TC Functional species group name EQ #T\$>	The total cover of the functional species group is <i>greater than, greater than or equal to, equal to</i> the total cover of all other species in the plot
<#T\$ EXCEPT Species name 1 GR 05> <#T\$ EXCEPT Species name 1 GE 25> <#T\$ EXCEPT Species name 1 EQ 50>	The total cover of all species in the plot except for species 1 is <i>greater than 5%, greater than or equal to 25%, equal to 50%</i>
<#T\$ EXCEPT Species name 1 Species name 2 Species name 3 GR 05> <#T\$ EXCEPT Species name 1 Species name 2 Species name 3 GE 25> <#T\$ EXCEPT Species name 1 Species name 2 Species name 3 EQ 50>	The total cover of all species in the plot except for species 1, 2 or 3 is <i>greater than 5%, greater than or equal to 25%, equal to 50%</i>
<#T\$ EXCEPT #TC Functional species group name GR 05> <#T\$ EXCEPT #TC Functional species group name GE 25> <#T\$ EXCEPT #TC Functional species group name EQ 50>	The total cover of all species in the plot except for the total cover of the functional species group is <i>greater than 5%, greater than or equal to 25%, equal to 50%</i>
<#\$\$ GR 05> <#\$\$ GE 25>	The cover of at least one species in the plot is <i>greater than 5%, greater than or equal to 25%</i>
<Species name GR #\$\$>	The cover of the species is <i>greater than</i> the cover of any other species in the plot

- *Compound terms with the conjunction EXCEPT*

The compound terms include any kind of **species group** followed by the conjunction **EXCEPT** and one or several **species** or **species groups**. If several elements occur after the conjunction **EXCEPT**, they are separated by the symbol |, **which** merges species and groups. These terms are used before a relational operator and

threshold cover value to refine the selection determined by the first term. Others than explicitly defined combinations are not supported.

Examples:

<p><### Sociological species group name 1 EXCEPT ### Sociological species group name 2 ### Sociological species group name 3 GR ### Sociological species group name 4></p> <p><### Sociological species group name 1 EXCEPT ### Sociological species group name 2 ### Sociological species group name 3 GE ### Sociological species group name 4></p> <p><### Sociological species group name 1 EXCEPT ### Sociological species group name 2 ### Sociological species group name 3 EQ ### Sociological species group name 4></p>	<p>The number of species of sociological species group 1 except for those of sociological species group 2 and sociological species group 3 (assuming that these two groups are a subset of sociological species group 1) is <i>greater than, greater than or equal to, equal to</i> the number of species of sociological species group 4</p>
<p><#TC Functional species group name 1 EXCEPT #TC Functional species group name 2 GR #TC Functional species group name 3></p> <p><#TC Functional species group name 1 EXCEPT #TC Functional species group name 2 GE #TC Functional species group name 3></p> <p><#TC Functional species group name 1 EXCEPT #TC Functional species group name 2 EQ #TC Functional species group name 3></p>	<p>The total cover of functional species group 1, except for the total cover of functional species group 2 (assuming that this group is a subset of functional species group 1), is <i>greater than, greater than or equal to, equal to</i> the total cover of functional species group 3</p>
<p><#TC Functional species group name 1 GR #TC Functional species group name 2 EXCEPT #TC Functional species group name 3></p> <p><#TC Functional species group name 1 GE #TC Functional species group name 2 EXCEPT #TC Functional species group name 3></p> <p><#TC Functional species group name 1 EQ #TC Functional species group name 2 EXCEPT #TC Functional species group name 3></p>	<p>The total cover of functional species group 1 is <i>greater than, greater than or equal to, equal to</i> the total cover of functional species group 2 except for the total cover of functional species group 3 (assuming that this group is a subset of functional species group 2)E</p>
<p><#SC Functional species group name EXCEPT Species name 1 Species name 2 GR 05></p>	<p>The highest cover of a single species included in the functional species group except for species 1 and species 2 is <i>greater than 5%</i></p>

<#SC Functional species group name 1 EXCEPT #SC Functional species group name 2 GR 05>	The highest cover of a single species included in functional species group 1 except for the species included in functional species group 2 is <i>greater than 5%</i>
<#\$\$\$ EXCEPT #SC Functional species group name GR 05> <#\$\$\$ EXCEPT #SC Functional species group name GE 25>	The cover of at least one species in the plot except for the species included in the functional species group is <i>greater than 5%, greater than or equal to 25%</i>
<#\$\$\$ EXCEPT #SC Functional species group name 1 #SC Functional species group name 2 Species name 1 GR 05> <#\$\$\$ EXCEPT #SC Functional species group name 1 #SC Functional species group name 2 Species name 1 GE 25>	The cover of at least one species in the plot except for the species included in functional species group 1 , functional species group 2 and species 1 is <i>greater than 5%, greater than or equal to 25%</i> (the number of groups that can be merged by the operator is unlimited)

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