

Which factors determine plant invasions in man-made habitats in the Czech Republic?

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Questions

- Which man-made habitats are most invaded?
- What environmental characteristics determine the level of invasion by alien plant species?
- Are there any differences between invasions of archaeophytes and neophytes in man-made habitats of the Czech Republic?

Data set

Relevés of annual and perennial ruderal vegetation occurring on different man-made habitats and vegetation of trampled habitats were obtained from the Czech National Phytosociological Database. Only plots of size 4–25 m² and recorded in the Czech Republic in 1945–2005 were used. The final dataset contained 3420 relevés with 913 species.

Methods

The analysis of regression tree models was used to determine the relationship between the proportion of aliens (archaeophytes, neophytes) and environmental factors (10-fold cross-validation method, Standard error Rule = 1).

Response variables:

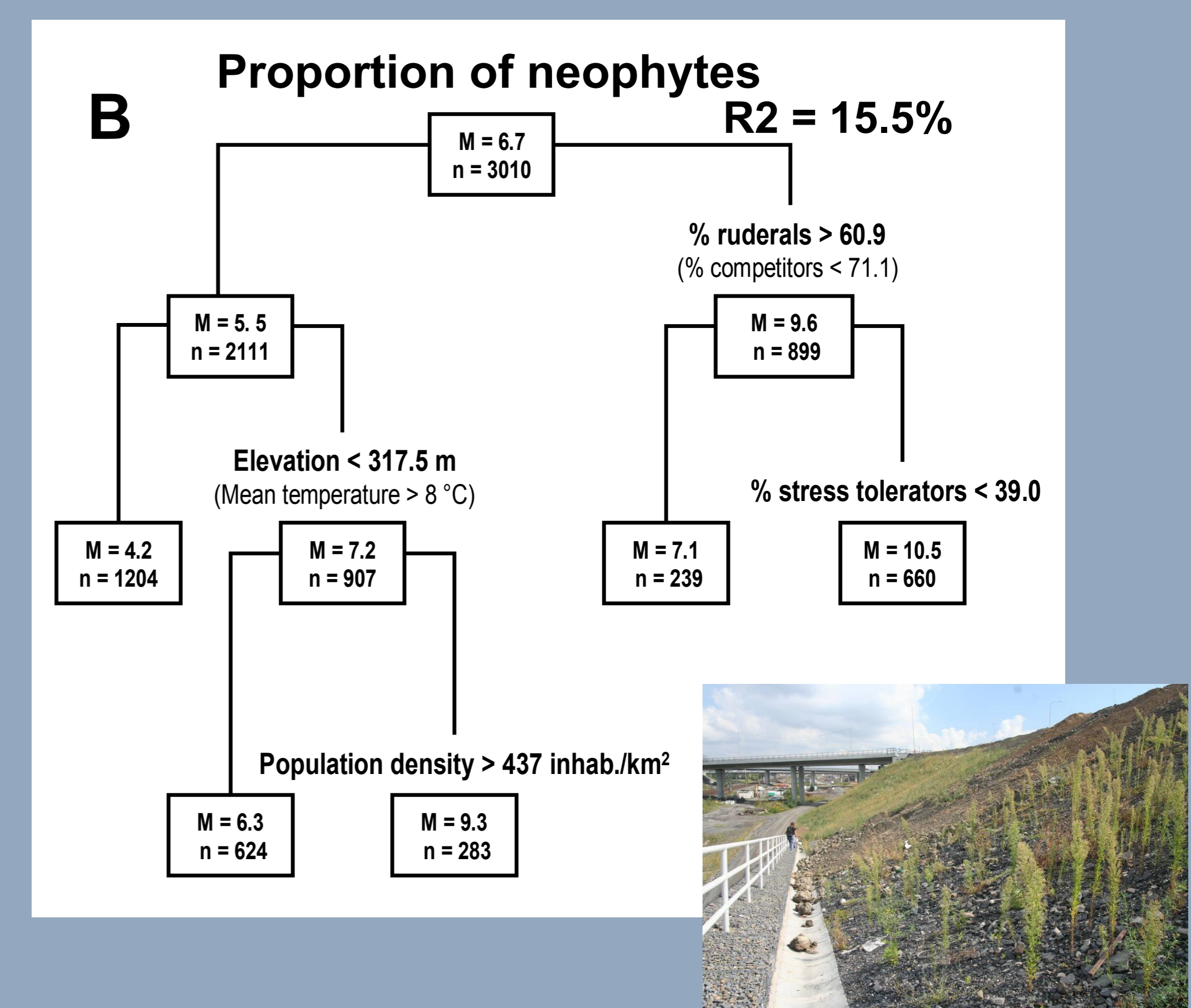
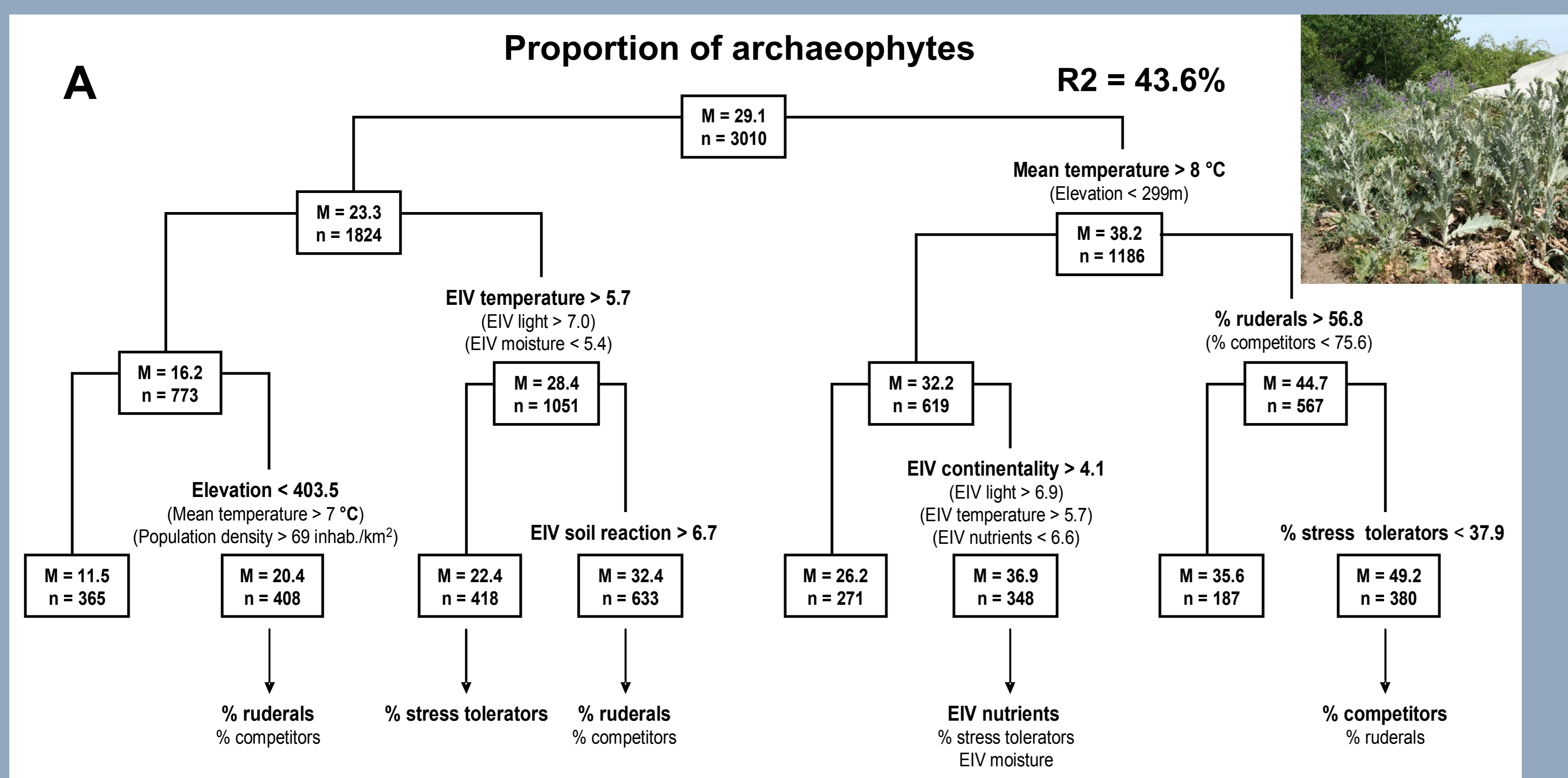
Percentage proportions of archaeophytes or neophytes in relevés

Explanatory variables (predictors):

- Climate (mean annual temperature and precipitation, elevation)
- Influence of surroundings, propagule pressure (Population density – number of inhabitants/km²)
- Local abiotic conditions (Ellenberg indication values (EIV) for native species, CSR-strategies)

Across all relevés, the mean proportion of archeophytes was 31.9% and neophytes 7.3%. The representation of archaeophytes and neophytes in particular vegetation types is illustrated in the table (mean ± SD).

Vegetation type (Moravec et al. 1995)	No. of plots	Plot area	Species richness	Archaeophytes (%)	Neophytes (%)
Chenopodietea annual nitrophilous vegetation on disturbed soils					
1 <i>Malvion neglectae</i> nitrophilous vegetation of low-grown herbs in villages	54	11±5	14±5	54±15	10±8
2 <i>Bromo-Hordeion murini</i> thermophilous vegetation of low-grown winter annual grasses	81	13±6	17±7	53±15	8±6
3 <i>Sisymbrium officinalis</i> tall-herb vegetation of spring annuals on sandy or skeletal soils	514	13±6	16±8	50±14	11±9
4 <i>Eragrostion minoris</i> xerophilous vegetation of sandy soils	29	9±5	14±4	48±12	17±8
5 <i>Salsolion ruthenicae</i> vegetation of heavily disturbed anthropogenic substrates	22	8±4	14±4	42±7	22±8
Artemisietea vulgaris perennial and thistle-rich (sub)xerophilous vegetation					
6 <i>Onopordion acanthii</i> vegetation of tall thorny biennials on nutrient-rich soils	42	15±7	21±8	46±17	6±6
7 <i>Dauco-Mellilotion</i> xero-mesophilous vegetation on nutrient-rich skeletal soils	374	14±6	20±10	33±16	7±6
Gallio-Urticetea tall-herb mesophilous anthrop. vegetation of woodland and scrub fringes					
8 <i>Gallio-Alliarion</i> semi-natural nitrophilous vegetation of biennials in moist fringe habitats	187	13±6	17±5	18±12	5±6
9 <i>Arction lappae</i> vegetation of anthropogenic substrates of rubbles and dumps	514	16±6	18±8	37±15	6±7
10 <i>Aegopodion podagrariae</i> vegetation of nitrophilous perennials in moist anthropogenic substrates	450	12±6	17±7	13±11	3±5
Agropyreteae repentis tall-herb grass-dominated vegetation on dry loamy and base-rich soils					
11 <i>Convolvulo-Agropyron</i>	252	13±7	17±9	32±16	6±6
Plantaginetea majoris vegetation of trampled habitats					
12 <i>Polygonion avicularis</i>	901	9±5	12±6	26±18	8±7



Regression tree models explaining the proportion of archaeophytes (A) and neophytes (B). Each node is characterized by the primary splitter variable and its split value, mean percentage of archaeophytes/neophytes (M) and number of vegetation plots (n) assigned to that node. Surrogates (variables assigning at least 30% of the cases to the same group as the primary splitter variable) are in parentheses.

Values of relative variable importance of the explanatory variables based on the regression trees. Explanatory variables are ranked according to the decreasing value of the contribution to variance explanation in proportion of archaeophytes and neophytes (values for two individual regression trees).

Variable	Archaeophytes	Variable	Neophytes
% ruderals	100	Elevation	100
EIV temperature	92	% ruderals	83
EIV continentality	84	Population density	64
% stress tolerators	81	% stress-tolerators	58
Elevation	79	EIV light	57
EIV light	74	Mean temperature	46
EIV soil reaction	63	EIV continentality	41
Mean temperature	62	EIV moisture	39
Population density	52	EIV temperature	38
EIV moisture	48	EIV soil reaction	32
Mean rainfall	45	% competitors	31
% competitors	31	EIV nutrients	19
EIV nutrients	23	Mean rainfall	12

Conclusions

- Both archaeophytes and neophytes were found predominantly in strongly disturbed habitats with a high nutrient supply located at low elevations in warmer climatic areas of the Czech Republic.
- Archaeophytes are more influenced by local habitat conditions and preferentially colonize sunny and dry man-made habitats with higher soil reaction.
- Neophytes have no special preferences for local habitat conditions and their highest proportion was found mainly in disturbed habitats at low elevations.