



Vitality and counts of *Pedicularis sudetica* subsp. *sudetica* in known localities of the Czech Giant Mountains during more than 20 years



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The abundance and vitality of the populations of *Pedicularis sudetica* subsp. *sudetica* were evaluated in all known localities on the Czech side of the Giant Mountains over more than 20 years as part of monitoring of habitats and species organized by the Nature Conservation Agency of the Czech Republic and the Administration of Krkonoše National Park (KRNAP): 1) Changes in abundance based on repeated plant census at localities during 1989 and 2018 (after 6 years) - especially juvenile plants (up to 5 leaves), individuals (up to 10 leaves) and tufts; in fertile plants the number of all stems and browsed stems. 2) Annual micro-mapping since 2004 in 7 quadrates 1 × 1 m, since 2015 in 17 quadrates to embrace all habitats in which the species occurs. Outside the plant position, the number of stems, their length, length of inflorescence, bitten or dried inflorescences, total number of leaves and length of the longest leaf were recorded. There were a maximum of 62 plants per the quadrate (at 2008), in the last 5 years there were on average only approx. 10 plants per quadrate. The majority of the plots decreased in number of plants and other characteristics of the populations changed (less flowering stems, shorter stems, inflorescences, less leaves). This may be the consequences of a changing climate. We rate the population condition as slightly unfavourable.

Introduction

Main goal is to evaluate changes in counts and several population features in the glacial relic and endemic species *Pedicularis sudetica* subsp. *sudetica* in well-known locations of the Czech side of the Giant Mountains. This endangered species is included in the regulation 395/1992, appendix 2, part 1 (critically endangered species), in the Red list (Grulich 2012) is in the group C1r, the last version (Grulich 2017) lists this species in the group EN. It is a priority species according European Union Directive 92/43/EHS, appendix II (see also Walter, Gillett 1997). The species is currently occurring only in subalpine and alpine biotopes of the 1st protection zone of the KRNAP. It grows predominantly on peaty and waterlogged habitats on the plateau and adjacent slopes, on the wet rocks of glacier kettles and around small streams, always with greater snow accumulation. Significantly larger populations are in eastern part of the Giant Mts. Biology and ecology of the species were described in Štursová et Kociánová (2006).

Methods

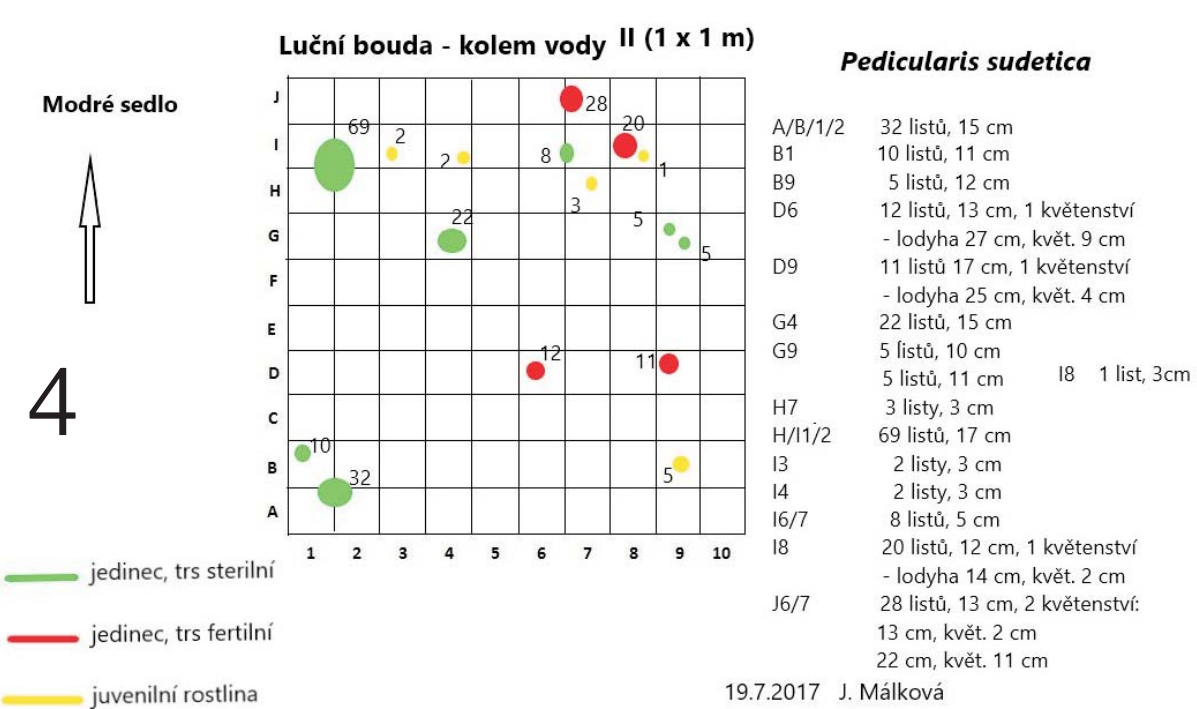
All monitoring results contain classification of individuals into three categories
- juvenile species (up to 5 leaves);
- individual plant (up to 10 leaves and leaf rose diameter up to 5 cm);
- tuft.

Two approaches were applied:

(1) **Monitoring in localities:** A locality is a continuous area where the species occurs. Two localities must be at least 100 m apart. Localities and selected their features are listed in the Table and fig. 7. First results were published in Štursová et Kociánová (2006). Last methods were adopted in Kociánová et Málková (2013). Plants were counted according to the categories. Number of stems was recorded with such features as browsing or another damage. Larger sites were divided into strips 1m in width using cords. See also figs. 5-6.
(2) **Monitoring in permanent quadrates** 1 × 1 m in size: Position of each plant according to the plant category was mapped. Number and length of stems, length of inflorescence, number of bitten or dried inflorescences, number of leaves and length of the longest leaf were recorded. State of the vegetation and the site were commented. Phytocoenological relevés were recorded each 5 years for the permanent quadrates and in other localities with the species. Example of the field record at fig. 4.

| Locality | Quadrat | Location - name | Since | Biotope (Chytrý et al. 2010) |
|----------|---------|-------------------------------|-------|------------------------------|
| 1 | 1 | Harrachova louka | 2004 | R3.1 |
| 2 | 1 | Labská louka I | 2004 | R3.1 |
| | 2 | Labská louka II | 2008 | R3.1 |
| 3 | 1 | Luční bouda I | 2004 | R3.1 (A4.1) |
| | 2 | Luční bouda II | 2004 | R3.1 (A4.1) |
| | 3 | Luční bouda III | 2015 | R3.1 |
| 4 | 1 | Luční bouda - vany | 2015 | R3.4 (R1.5) |
| 5 | 1 | Nad Horním Úpským vodopádem | 2015 | R1.5 |
| 6 | 1 | Stříbrná bystřina springs | 2006 | R3.1 (R1.5) |
| 7 | 1 | Rennerovka I | 2004 | R3.1 (R3.2) |
| | 2 | Rennerovka II | 2015 | R3.1 (R3.2) |
| 8 | 1 | Studniční hora - north slopes | 2004 | R3.1 (R1.5) |
| 9 | 1 | Sněžový žlab | 2004 | R1.5 |
| 10 | 1 | Stříbrný hřbet I | 2006 | R3.1 |
| | 2 | Stříbrný hřbet II | 2009 | R3.1 |
| 11 | 1 | Údolí Bílého Labe I | 2004 | R3.1 (R1.5) |
| | 2 | Údolí Bílého Labe II | 2012 | R3.1 (R1.5) |

Abbrev.: A4.1 - Subalpine tall grasslands; R1.5 - Subalpine springs; R3.1 - Open raised bogs; R3.2 - Raised bogs with Pinus mugo; R3.4 - Degraded raised bogs



Example of results Monitoring in localities

Western part of the Giant Mts.

Harrachova louka locality (wet and not yet closed peat stands) represents an example of population with increase in the number of pieces.

| Year | Number |
|------|--|
| 1995 | 15 |
| 2005 | 94 |
| 2011 | 91 (juveniles 44, individual plants 21, tufts 26) |
| 2018 | 169 (juveniles 51, individual plants 67, tufts 51) |

Labská louka locality is example of the significant deterioration mainly due to succession (increase of species of higher growth and old age).

| Year | Number / Comment |
|------|---|
| 1995 | 200 |
| 2005 | 105 |
| 2011 | 60 (juveniles 10, individual plants 23, tufts 27) fertility 60 %, browsing 8 % |
| 2018 | 59 (juveniles 11, individual plants 17, tufts 31) fertility 8.5 % |

Eastern part of the Giant Mts.

The biggest populations were occurred at localities Rennerovka, Luční bouda, Bílé Labe valley, Stříbrný hřbet.

Rennerovka locality (figs. 8-9)

| Year | Number | Comment |
|------------|---------------|---------------------------------|
| 1990, 2006 | approx. 4 500 | |
| 2012 | 6 011 | fertility 29 %, browsing 21 % |
| 2018 | 3 461 | fertility 17 %, browsing 39.3 % |

The locality conclusion: in addition to reducing the number of pieces, reducing the size of clumps and individuals, decreased fertility, shorter stems and inflorescences (often dried), more dry leaves. The species give away mainly along the abandoned track.

Bílé Labe valley (fig. 10)

| Year | Number | Comment |
|------|--------|-------------------------------|
| 2006 | 421 | |
| 2012 | 638 | fertility 43 %, browsing 22 % |
| 2018 | 571 | fertility 19 %, browsing 15 % |

Monitoring in permanent quadrates

Monitoring reveal prevailing an count decrease not only, but statistically significant changes in stem length (fig. 11) and inflorescence size (fig. 12).

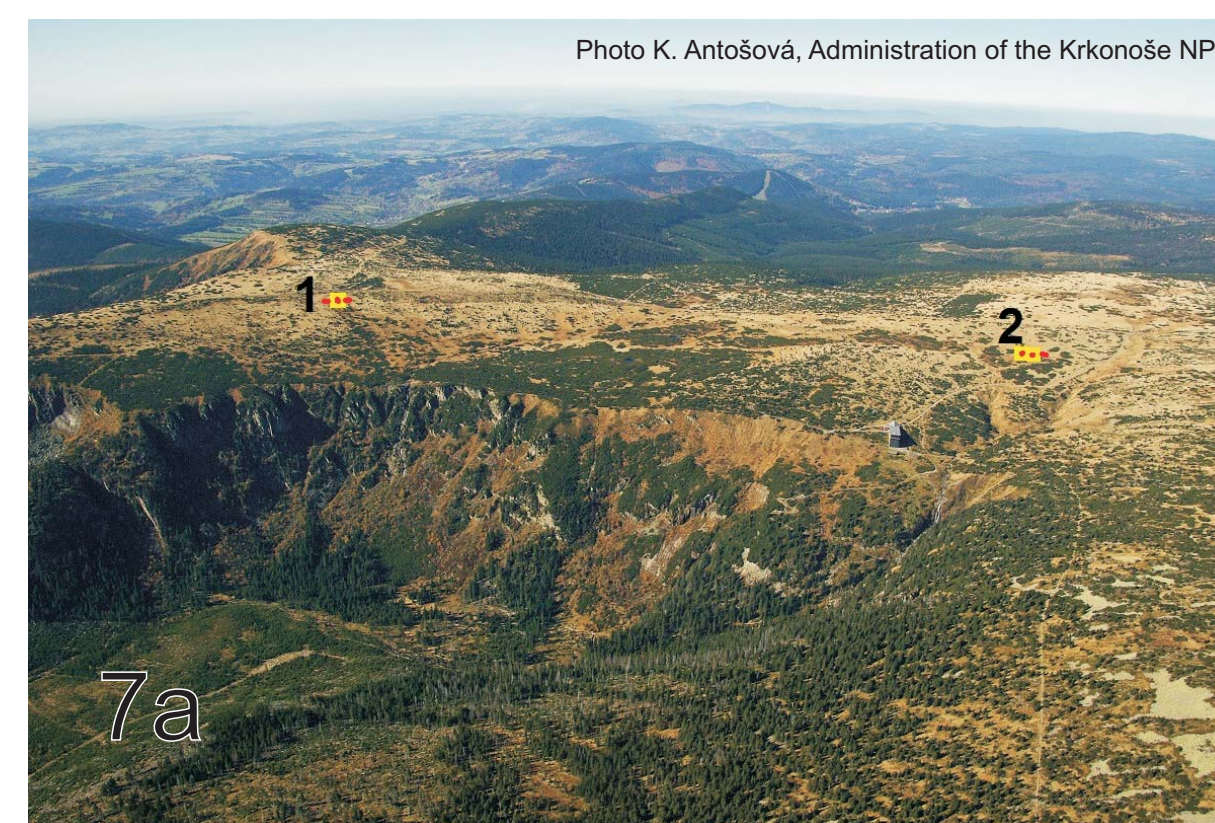
Conclusions

There is possible effect of the climate change (warming and low precipitation sums; www.infodatasy.cz/climate/) in worsening of the *Pedicularis sudetica* population status. Hydrological situation is changing. As a consequence of succession, taller species and dwarf pine are growing, old material accumulates. The browsing effect of game is evident. Possible is influence of farming abandonment, snow mowing on slopes, etc. Localities usually do not require a special management with several exceptions as minimization of speeding of tall herbs, dwarf pine and anthropophytes. Managing of hydrological status of some localities would be suitable.

Thanks to Laura Šimková for the technical assistance in transcribing the data.

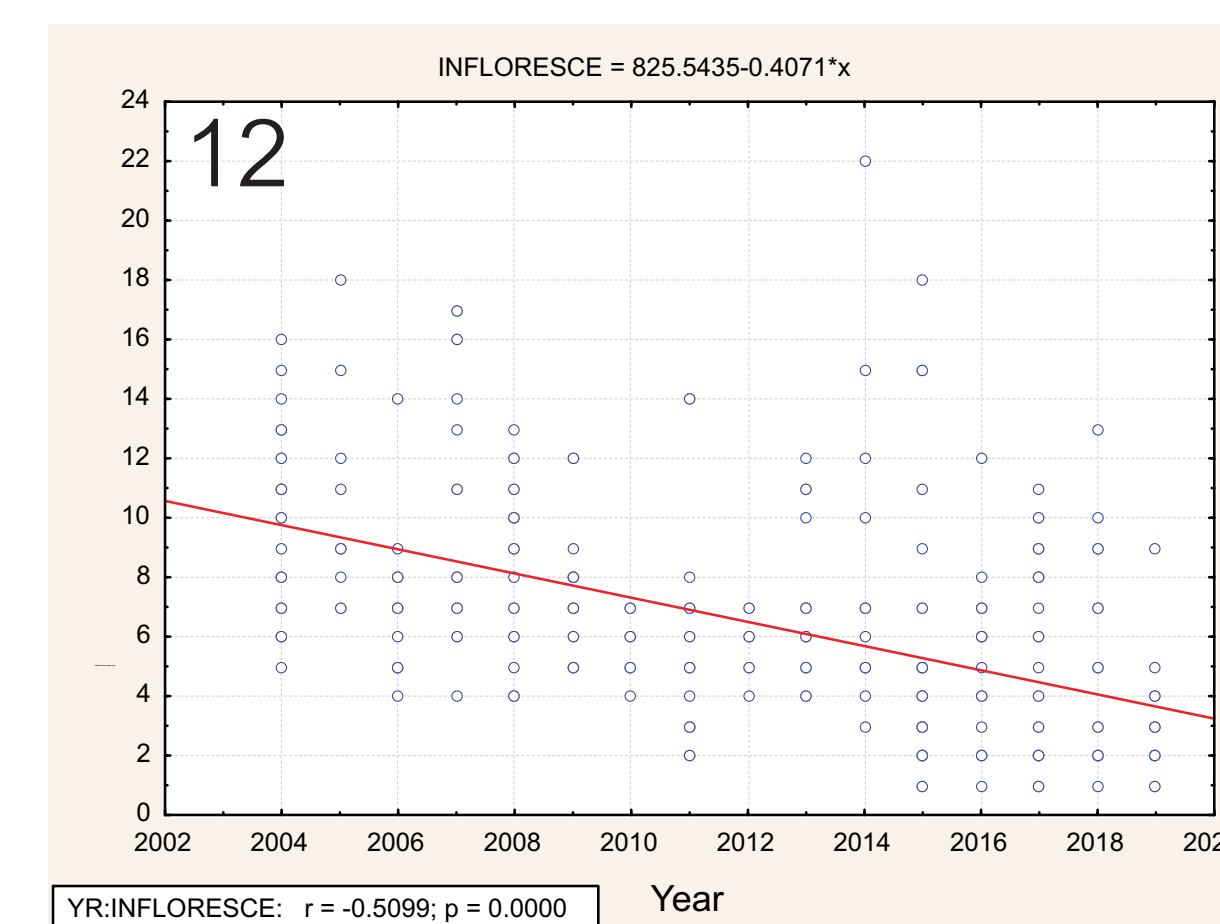
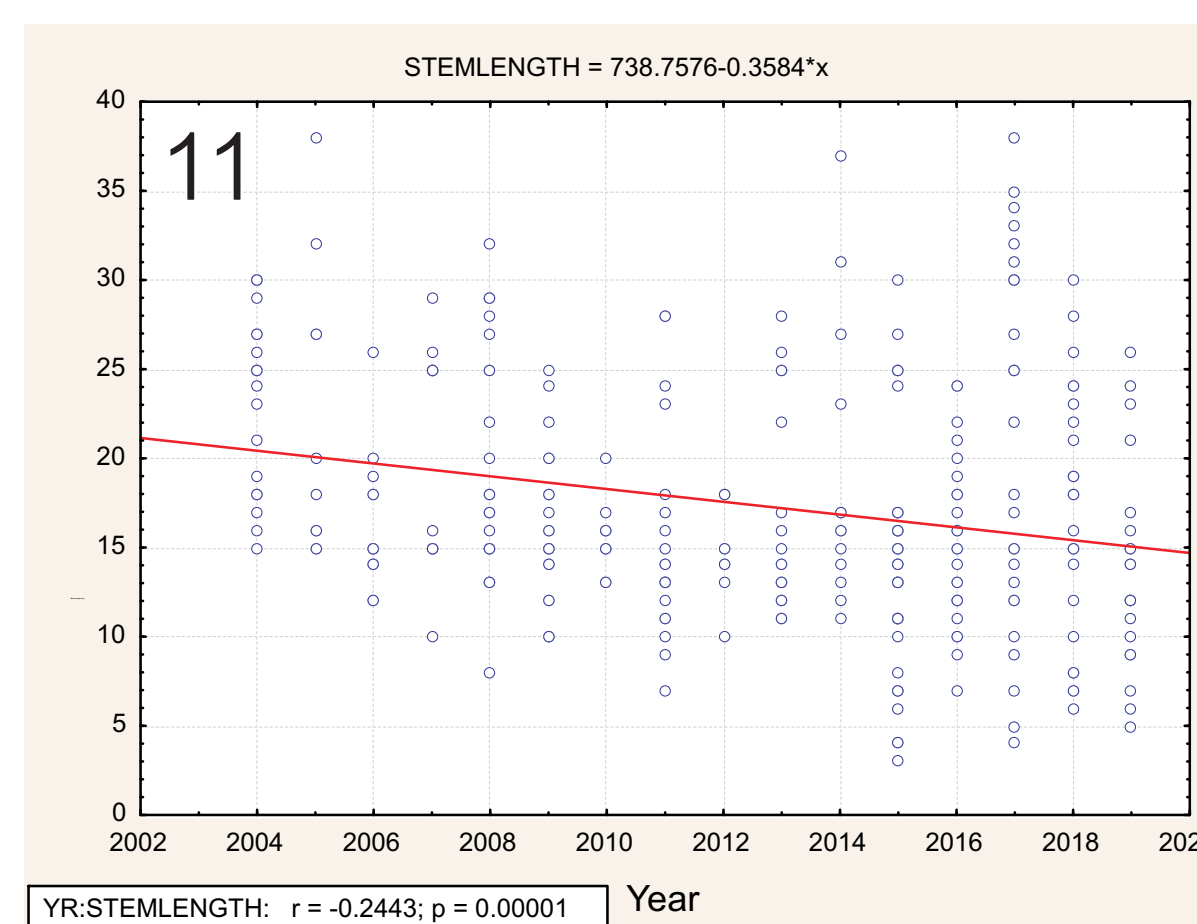
References

- Grulich V. (2012): Red List of vascular plants of the Czech Republic: 3rd edition. - Preslia, 84: 631-645.
- Grulich V. [eds.] (2017): Červený seznam cévnatých rostlin ČR. - Příroda, 35: 75-132.
- Chytrý M., Kučera T., Kočí M. [eds.] (2010): Katalog biotopů České republiky. 2nd Ed. - AOPK ČR, Praha.
- Kociánová M., Málková J. (2013): Metodika monitoringu *Pedicularis sudetica* subsp. *sudetica* na české straně Krkonoš. - Ms. [Depon in: Agentura ochrany přírody a krajiny ČR, Praha]
- Štursová H., Kociánová M. (2006): Poznámky k rozšíření, biologii a ekologii všivce *Pedicularis sudetica* subsp. *sudetica* [Notes on distribution, biology and ecology of *Pedicularis sudetica* ssp. *sudetica*]. - Opera Corcontica, 43: 157-178.
- Walter K.S., Gillett H.J. [eds.] (1997): 1997 IUCN Red list of threatened plants. - IUCN, Gland & Cambridge, 862 p.



Description of figures:

1. A fully developed individual of *Pedicularis sudetica*.
2. Individual with short and drying inflorescence.
3. Sterile plant with significant damage.
4. Example of a field record with map of the permanent quadrate.
5. Counting and measurement of individuals in the field.
6. During field work, the sites were divided into 1m wide cross-sections.
7. Location of permanent areas in the Krkonoše National Park.
- 7a. Western part with localities 1 and 2 - aerial photo.
- 7b. Eastern part - aerial photo.
8. Segments of the Rennerovka locality.
9. The segments were further divided into homogeneous parts.
10. The Bílé Labe Valley Location.
11. Stem length (in cm) decreased significantly during monitoring.
12. Inflorescence length (in cm) decreased significantly during monitoring.



Rennerovka - example of 2018

| Segment | Path | A1 | A2 | A3 | A4 | A5 | A6 | B1 | B2 | B3 | C1 | C2 | D | Total |
|----------------|------|------|-----|----|-----|-----|----|-----|-----|----|----|-----|-----|-------|
| All plants | 5 | 1145 | 254 | 1 | 163 | 296 | 22 | 546 | 228 | 60 | 26 | 220 | 495 | 3461 |
| - fertile | 2 | 130 | 29 | 0 | 9 | 34 | 0 | 305 | 34 | 7 | 3 | 15 | 10 | 578 |
| - sterile | 3 | 1015 | 225 | 1 | 154 | 262 | 22 | 241 | 194 | 53 | 23 | 205 | 485 | 2883 |
| Stems | 2 | 146 | 36 | 0 | 7 | 40 | 0 | 95 | 45 | 11 | 3 | 16 | 16 | 433 |
| Inflorescences | 2 | 75 | 10 | 0 | 5 | 30 | 0 | 68 | 36 | 10 | 1 | 7 | 12 | 263 |
| Browsed | 0 | 71 | 26 | 0 | 2 | 10 | 0 | 27 | 9 | 1 | 2 | 9 | 4 | 170 |

Bílé Labe valley - example of 2018

| Segment | 1A | 1B | 2 | 3 | 4A | 4B | 5 | 5A | 5B | 6 | Total |
|----------------|----|----|----|-----|----|----|----|-----|----|----|-------|
| All plants | 4 | 4 | 74 | 114 | 46 | 28 | 39 | 183 | 16 | 63 | 571 |
| - fertile | 1 | 2 | 30 | 13 | 1 | 4 | 6 | 49 | 3 | 0 | 109 |
| - sterile | 3 | 2 | 44 | 101 | 45 | 24 | 33 | 134 | 13 | 63 | 462 |
| Stems | 1 | 2 | 43 | 14 | 1 | 4 | 10 | 72 | 4 | 0 | 151 |
| Inflorescences | 1 | 0 | 40 | 11 | 0 | 0 | 10 | 63 | 3 | 0 | 128 |
| Browsed | 0 | 2 | 3 | 3 | 1 | 4 | 0 | 9 | 1 | 0 | 23 |

