THE ADEQUACY OF SOME COLLECTING TECHNIQUES FOR OBTAINING REPRESENTATIVE ARTHROPOD SAMPLE IN DRY GRASSLANDS

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Abstract


The number of remarkable species on a locality is an important indicator of locality value. The ecological requirements of the rare species may help to target correct landscape management activities. Our objective was to find out if standardly used capture methods for different group of invertebrate are able to detect really representative composition of species including rare taxa. Our experiment was carried out at the Moravský kras Protected Landscape Area (Macošská and Vilémovická stráň slope) where secondary dry grasslands are typical for each investigated locality. We used five groups of invertebrates (spiders, ground beetles, rove beetles, leaf beetles and weevils) and three capture methods (pitfall traps, sweeping on vegetation and yellow Möricke traps). Arthropods were determined and classified according to their rarity. Using the three capture methods, we obtained in total 127 spider species (Areneae), 31 ground beetle species (Carabidae), 29 rove beetle species (Staphylinide), 52 leaf beetle species (Chrysomelidae) and 55 weevil species (Curculionidae). Results showed that the different capture methods significantly influenced number of detected remarkable species. It was statistically proved for spiders (P = 0.025), weevils (P = 0.038) and marginally also for rove beetles (P = 0.051). Spiders of climax (C species) and semi-natural (SN species) habitats were rather detected by pitfall traps, whereas spiders of disturbed habitats were collected by sweeping on vegetation and Möricke yellow pans eventually. Relict species of weevils (R species) were detected by pitfall traps, typical species (T species) were collected by Möricke yellow pans and expansive species (E species) were found by sweeping on vegetation.

Keywords: collecting techniques, ground beetles, spiders, rove beetles, leaf beetles, weevils

INTRODUCTION

Documentation of invertebrate diversity is an important component of the studies of biodiversity, community dynamics, global change and landscape evaluation (Ward & Larivière, 2004). Conservation assessment of given locality and its affect on a future planning is dependent on many factors. Number of rare invertebrate species found on investigated locality is one of them. A lot of ecological works from central Europe are established on the basis of natural origin of habitat and invertebrates, classified according to natural origin of habitats categories (Tropek et al., 2010; Franc and Korenko 2008; Samu et al., 2008, etc.). Arachnologists evaluate spider communities according Buchar & Růžička (2002), who classified individual species into categories according to their occupied habitat. The same approach have Hůrka et al. (1996) on ground beetles, Boháč et al. (2006) on rove beetles and Strejček (2000, 2001) on leaf and weevil beetles.
Sampling the components of the diversity, however, depends on the ability to detect the species and rely on the capture method. Furthermore, it is not surprising that different taxa need different capture methods, e.g. pitfall traps for ground beetles or Mörícke pans traps for Diptera or Hymenoptera (Majíčan & Rychlík, 2000; Toler et al., 2005). We can call these techniques the “standard methods”.

For investigation of a specific area, these methods should meet three conditions: to be efficient, repeatable and representative (Popiec et al., 2013).

On the other hand, it is frequently far of reality and it was documented that capture methods may affect the results (Buffington & Redak, 1998; Lang, 2000; Popiec et al., 2013; Ward et al., 2001). Therefore, many experts realized necessity to improve and modify capture methods (Majer, 1978; White et al., 1990) and examine differences between new methods and traditional way (Alinvi et al., 2007). Some entomologists compared effectiveness of sampling techniques for collecting in different type of habitats (Meissle & Lang, 2005; Standen, 2000). Standen (2000) compared several traditional methods for different taxa on limestone grasslands and she offered some recommendation for collecting techniques for species richness estimation. It was also documented that capture methods not usually used for the target taxa (hence “non-standard methods”) may likely detect species otherwise considered to be rare (Niedobová et al., 2011). Generally, “non-standard methods” bring some good data about particular species (Patrick & Hansen, 2013; Pekár, 1996; Růžička, 1982; Růžička, 2000; Szentétár et al., 2012a, b).

The objective of the present study was to analyse capture methods and compare their effectiveness in each investigated invertebrates group with focusing on rare species. The investigated groups were spiders (Araneida), ground beetles (Carabidae), rove beetles (Staphylinidae), leaf beetles (Chrysomelidae) and weevil beetles (Curculionidae).

MATERIALS AND METHODS

Study area
The invertebrate sampling was conducted in the northern part of Moravský kras Protected Landscape Area on the west end of the Suchý žleb valley (Czech Republic). Collecting was performed on a total of four transects of the Macošská stráň and Vilémovická stráň slopes. Both localities are typical by steep slopes, which originated in the limestone bedrock. Well developed limestone pavements with habitats of secondary dry grasslands are characteristic for them. The whole area was previously used as a communal pasture (Kotouč, 2006). In 2006, regular sheep grazing was restored. Individual transects (T1–T4) were given by GPS coordinates:
- Macošská stráň slope T1: 49°22'14"N, 16°44'13"E;
- Macošská stráň slope T2: 49°22'13"N, 16°44'21"E;
- Vilémovická stráň slope T3: 49°22'7"N, 16°44'32"E;
- Vilémovická stráň slope T4: 49°22'9"N, 16°44'38"E.

The entire site is located in the faunistic square 6666 (Pruner and Mika, 1996).

Sampling of the invertebrates
The investigation was conducted in 2008. We used three collecting methods: 1) pitfall traps, 2) yellow Mörícke pans and 3) sweeping on vegetation.

Pitfall traps are standards used as a capture method for epigeic invertebrate fauna (ground beetles, rove beetles and spiders). This capture method is widely used by many experts in the Czech Republic as well as in Europe for decades (Adis, 1979; Absolon et al., 1994; Kůrka, 1982; Jonas et al., 2002; Larsen et al., 2003; Raemakers et al., 2001; Kwiatkowski, 2011 etc.). On the other hand, this method is non-standard for weevils and leaf beetles.

Sweeping on vegetation is widely used as a standard method for beetles living on vegetation (i.e. leaf beetles and weevil beetles) (Novák, 1969; Meek et al., 2001; Wąsowska, 2006; Scibor and Dunus, 2006; Raemakers et al., 2001; Batáry et al., 2007; Hall and Barney, 2011), but not used for ground beetles and rove beetles collecting.

Yellow Mörícke traps are standards used for collecting hymenoptera especially (Kula and Tynr, 2003; Dvořák and Bogush, 2008; Santos and Aguia, 2008; Aguiar and Santos, 2010; Ljubomirov, 2008). Yellow Mörícke traps were nonstandards used for collecting spiders, ground beetles, rove beetles, leaf beetles or weevils.

Five pitfall traps were placed in each of the four transects. We used plastic cups (capacity 500 ml) with 4% formaldehyde solution as a fixative medium. The traps were arranged in lines along the slope at about five-metre intervals.

Placement and emptying of traps took place on April 22, May 22, June 18, July 22, August 18, September 21, October 21 and November 28. Thus, pitfalls traps were inspected and the trapped material was collected every month.

Yellow Mörícke pans consisted of food boxes 10 × 10 cm with yellow acrylate colour spot number 6400 in the middle of each box. Five pans were placed in lines at five-metre intervals. Saline solution with the addition of few drops of detergent as a wetting agent served as killing and fixation medium. Yellow Mörícke pans were installed at the locations on April 22, 2008 and the material was collected every two weeks; or every week in the hot summer months.

Sweeping on vegetation was also done every two weeks, always with frequency 200 sweeps per transect line.

Material of all taxonomic group obtained from the study was preserved in 70% alcohol solution.

Evaluation methods
Arachnologists evaluate assemblages of spiders by the so called “natural origin” of habitats (Buchar et al., 2002; Larsen et al., 2003; Raemakers et al., 2001; Wąsowska, 2006; Scibor and Dunus, 2006; Raemakers et al., 2001; Batáry et al., 2007; Hall and Barney, 2011), but not used for ground beetles and rove beetles collecting.

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and Růžička, 2002; Řezáč, 2009). They classified species to four groups: species of climax habitats (C), semi-natural habitats (SN), disturbed habitats (D) and artificial habitats (A). The advantage of this approach is that individual species may simultaneously occupy several categories and its fit to the four groups. Occupation of several categories was converted to the percentages.

Similar evaluation but with the other marking was assumed for some Coleoptera. Ground beetles were divided into three groups: The R-species, A-species and E-species (Hůrka et al., 1996). R species have relic character. They are rare and endangered and we can find them in such natural habitats like screes, steps and rocky steps, heathlands, natural forests, spring areas, marshlands, natural river bangs, bottom lands and species with arcto-alpine and boreoalpine occurrence etc. The A-species are characterised as adaptable species. They occur in altered habitats close to natural condition – forests, stagnant and running water banks, meadows, pastures etc. The E-species occur in naturally disturbed habitats and habitats influenced by man s activities. This group includes also expansive or invasive species.

The above mentioned classification was adapted with some distinction by Boháč et al. (2006) also on Rove beetles (Staphylinidae). His RI category included species living on well-preserved biotopes not influenced by human activity (or with weak human activity) like species with arcto-alpine, boreomontane and boreoalpine occurrence, they inhabit mainly mountains and meadows, or only occur in remnants of forests stands, which resemble recent climax forests. The R2 category was for species living in biotopes moderately affected by human activity. The E category was for species of heavily affected anthropogenic sites and this category includes eurytopic species that successfully occupy deforested sites and are also found in areas strongly anthropogenic influenced.

Scales with the same meaning were used for leaf beetles (Chrysomelidae) (Strejček, 2000). The R-species were regarded as the relict species, the T-species were adapted to alternate biotops and the E-species adapted to secondary biotops (including artificial habitats). One year later he (Strejček, 2001) divided also the weevils (Curculionidae) into the same three categories (Strejček, 2001). The R-species are relics occuring on naturally relict localities only. The T-species are typical for specific biotopes and are able to adapt to alternate biotopes. The E-species are expansive, very adaptable species.

### Data analyses

We classified each individual to the category of „relicness“ (in the case of Coleoptera) or „natural origin“ habitat category (in the case of Araneae) and we recorded the capture method.

Effects of species characteristic mentioned above were tested by Canonical Correspondence Analysis (CCA) from CANOCO for Windows v. 4.5 (Lepš and Šmilauer, 2003). We used Monte Carlo permutation test with 999 permutations. Capture methods of each individual species represented species data. Species of each invertebrates group according the classification categories were used as explanatory variables.

### RESULTS

Using the three capture methods, we obtained in total 127 spider species (2076 individuals), 31 ground beetles species (2204 individuals) (Carabidae), 29 rove beetles species (239 individuals) (Staphylinide), 52 leaf beetles species (1044 individuals) (Chrysomelidae) and 55 weevil species (323 individuals) (Curculionidae).

CCA analysis showed significant results for spiders (F = 3.389, P = 0.025) and weevils (F = 2.838, P = 0.038), results for rove beetles were only marginally significant (F = 2.761, P = 0.051). It means that representative samples of these three groups of invertebrates were influenced by capture methods (Tab. I).

Spiders of climax (C species) and semi-natural (SN species) habitats were rather detected by pitfall traps (standard method), whereas spiders of disturbed habitats were collected by sweeping on vegetation and Mörckie yellow pans eventually (nonstandard method) (Fig. 1).

Relict species of weevils (R species) were detected by pitfall traps (nonstandard method), typical species (T species) were collected by Mörckie yellow pans (nonstandard method) and expansive species (E species) were found by sweeping on vegetation (standard method) (Fig. 3).

Marginally significant were data of rove beetles and their affinity to capture methods. We found that the relict species (RI species), namely Ontholestes haroldi (Eppelsheim, 1884) and Eusphalerum semicoleoptratum (Panzer, 1795) were found by sweeping on vegetation (nonstandard method) (Fig. 2). This findings is very important, because sweeping on vegetation is not used for rove beetles collecting.
DISCUSSION

When studying five groups of arthropods, which are often used for ecological assessment of protected areas and subsequent landscape management, we found that the capture method influenced number of caught ecologically important species of spiders, weevils and also marginally significantly rove beetles, especially in the terms of their rarity or specificity to natural habitats.

It is not surprising that different capture methods detect different composition of species because of their specific lifestyle, ecological or ethological differences or species' functional role. Cherrill and Sanderson (1994) proved that pitfall traps capture different composition of Hemiptera compared with sweep netting. Popic et al. (2013) evaluated common methods for sampling invertebrate pollinators. They found that net sampling is more effective than pan traps in the sense of number of species and abundance.

Standen (2000) solved the question of adequacy of collecting techniques for estimation of species richness of grassland invertebrates. He proved that root feeding weevils were captured predominantly by pitfall traps. Though, a lot of coleopterologists use sweeping for collecting of weevils (Batáry et al., 2007; Raemakers et al., 2001; Salsbury and Dinkins, 1979; Seibor and Dunus, 2006 etc.), our results showed that the weevils pitfall traps assemblages contained more “rare” species than the weevil composition from sweeping or yellow Möricke traps.

We confirmed that pitfall traps are able to afford representative sample (with the most ecological important species) of spiders too. Rushton et al. (1989) proved with using pitfall traps that there were some resemblance of change in ground beetle and spider species among habitat types. Standen (2000) found out that ground beetles and spiders were more abundant in pitfall traps than in sweeping net and D-vac samples. Therefore, we strongly recommend combining several collecting methods when inventorying an area.

Different capture methods collect different arthropod assemblages. Difference is in the quantity of habitat specialist and also in the arthropod assemblages in the sense of species rarity. It is likely that the problem is in arbitrary selection of appropriate taxa in the classification of all the investigated invertebrate groups. It is likely that some of the species obtained higher “rarity” rank only because of their lower detection rate by standard methods.

CONCLUSIONS

During our study, we found that different capture methods can affect not only composition of the
detected species but also different communities in the sense of rarity and habitat specificity. Whereas no bias was observed in leaf beetles and ground beetles, the differences were strongly or at least marginally in rove beetles. Significant results were detected in all the other groups: spiders and weevils. Therefore, we urge to combine several collecting methods for locality inventories.

SUMMARY

Number of rare species on locality is a very important indicator of locality value. Furthermore, the ecological requirements of the rare species may help to target correct landscape management activities. Our objective was to investigate whether standardly used capture methods for different groups of arthropods are able to detect really representative composition of species (criteria were the rare species collected). Our experiment was situated at the Moravský kras Protected Landscape Area (Macošská and Vilémovická stráň slope) where secondary dry grasslands are typical for each investigated locality. We used five groups of arthropods (spiders, ground beetles, rove beetles, leaf beetles and weevils) and three capture methods (pitfall traps, sweeping on vegetation and yellow Möricke traps). The arthropods were determined and each species was classified according to its scarceness. Using the three capture methods, we obtained in total 127 spider species, 31 ground beetle species (Carabidae), 29 rove beetle species (Staphylinidae), 52 leaf beetle species (Chrysomelidae) and 55 weevil species (Curculionidae).

Each capture method was evaluated in the context of scarce species. Results showed that the different capture methods significantly influenced number of detected rare species. It was statistically proved for spiders ($P = 0.025$), weevils ($P = 0.038$) and marginally also on rove beetles ($P = 0.051$).
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REFERENCES


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