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Centipede catch in pitfall traps with leading boards

Ulov strig v talnih pasteh z vodili

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Abstract: In investigations of soil arthropods, different methods are used for collecting specimens. During centipede community investigation in unevenly aged beech stand in Dinaric forests in Slovenia pitfall traps with leading boards were used to catch centipedes that walked in a certain direction. In present paper these traps and catching centipedes using them is presented. In studied stand 30 pitfall traps (each having 2 collecting vessels) with leading boards were placed and emptied through the whole year of 2003. 2367 centipedes from 37 species (out of 44 species already found in this stand) were caught. The majority of catch presents well mobile, bodily bigger epigeic lithobiids that prefer litter layer. The portion of juveniles was very low.

Keywords: sampling methods, pitfall-trapping, migration, community dynamics, soil arthropods

Izvleček: Pri raziskavah združbe strig uporabljamo različne metode vzorčenja za zbiranje osebkov. Med raziskavo združbe strig raznomernega bukovega sestoja v Dinarskih gozdovih Slovenije so bile uporabljene talne pasti z vodili za lov strig, ki so hodile v določeni smeri. V prispevku so predstavljene te pasti in ulov strig z njimi. V raziskovanem sestoju je bilo postavljenih 30 talnih pasti z vodili (vsaka je imela po 2 lovilni posodici). Praznjenje posodic z ulovom je potekalo skozi vse leto 2003. Ujetih je bilo 2367 strig iz 37 vrst. Večina ulova predstavljajo dobro mobilni, telesno večji lithobiidi ki preferirajo sloj stelje. Delež mladostnih osebkov je zelo majhen. Osebki vrste *Eupolybothrus tridentinus* predstavljajo 45% celotnega ulova v pasteh.

Ključne besede: metode vzorčenja, lov s pastmi, migracija, dinamika združbe, talni členonožci

Introduction

In investigations of soil arthropod communities one of the first obstacle we face is usually the selection of adequate sampling method(s). Different methods differ by effort required, efficiency, time required for realisation, suitability for a certain group or its part, quality of gathered data, its quantity and applicability.

In centipede community studies different common sampling methods are used for collecting specimens. Pitfall trapping, soil sampling, litter sifting and hand collecting are mainly employed. Using different methods, differently large and differently active centipedes with different body structure and way of life can be caught. That is why mostly different sampling methods give dissimilar impressions of the structure of arthropod

communities at the certain location (Kos 1988, 1995a,b, Mesibov & al. 1995, Grgič & Kos, in preparation). During centipede investigation using two different sampling methods Grgič (2005) distinguished two larger groups of centipedes: smaller lithobiomorphs and geophilomorphs that appear in deeper soil layers and larger epigeic lithobiomorphs that prefer litter layer. But Tuf (in preparation) during comparative study of four different collection methods divided centipedes into five groups with different biology: larger abundant lithobiomorphs, larger less frequent lithobiomorphs, smaller soil lithobiomorphs, abundant geophilomorphs and not frequent geophilomorphs.

While some sampling methods are more effective than others, the ideal sampling method for a particular project is ultimately based on the goals of that project (Snyder & al. 2006). During investigation of active centipede migrations between different forest development phases, which were found to have certain influence on their communities (Grgič & Kos 2003, 2005), we used pitfall traps with leading boards (Grgič 2005). In present paper these traps and catching centipedes using them is presented.

So called Barber traps (Barber 1930) are commonly used for collecting soil invertebrates. These are plastic or glass vessels embedded in soil with margins in the surface level or a bit lower. They are filled with conservation solution. In this form traps are simple, time and effort saving, and can be exposed for a long time. Tuf (in preparation) found pitfall trapping one of the most effective collection methods for centipedes. Fründ and co-workers (1997) found that efficiency of catching is higher with leading boards in comparison with traps alone. Even more, with such traps we are able to establish the dynamics of surface centipedes, and their active migration in certain direction (Grgič 2005).

Material and methods

Soil trap with leading boards

For catching surface dwelling centipedes, pitfall traps with leading boards were used. These are somewhat modified and adapted traps as Fründ and co-workers (1997) used for catching walking centipedes. Traps were made up of three one meter long and 30 cm high plastic plates that were placed in Z-shape at right angle to each other (Fig. 1). About 20 cm of plates were under the ground and 10 above the ground. Opened parts of the traps were oriented towards particular phase. In each of 2 angles the 8x8 cm plastic vessel with Monoethylene Glycol that kills and partly conserves animals was placed. Margins of the vessels were about 5 cm under the surface level. Vessels were partly covered with leaves and bark, so that falling leaves and precipitations couldn't fill up the vessel and prevent the trapping.

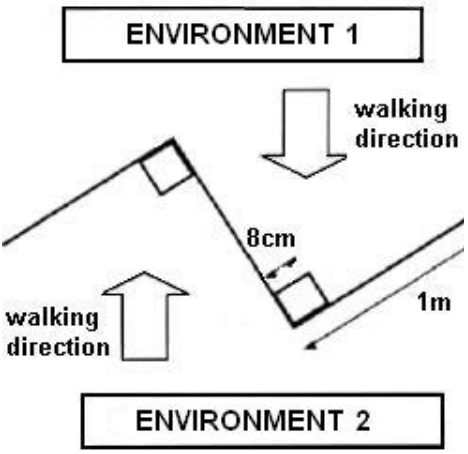

Fig. 1: Sketch of soil trap with leading boards.
Slika 1: Skica talne pasti z vodili.

In autumn 2002, 30 traps were placed in investigated unevenly-aged beech stand in Iška, a village 15 km south of Ljubljana, Slovenia. On each of the five borders between two different phases we placed 6 pitfall traps (each having 2 collecting vessels) with leading boards. On 25 November 2002 we started with trapping. We emptied traps after 17–40 days depending on the amount of precipitation till 5 January 2004.

Results

Leading boards directed specimens that walked in the certain direction into vessels, so we were able to separately catch animals that walked between two phases. We caught 2367 centipede from 37 species (out of 44 species already found

Table 1: Taxonomical review and specimens number (N) of Chilopoda species caught in pitfall traps with leading boards and currently known distribution (D) (en-endemic, il-Illyric, pa-Palearctic, se-South (-East) European, me-Mediterranean, eu-European, mi- Middle European).

Tabela 1: Taksonomski pregled in število osebkov (N) strig ujetih v talnih pasteh z vodili in trenutna znana razširjenost (D) (en-endemična, il-ilirska, pa-palearktična, se-jugo (-vzhodno) evropska, me-mediteranska, eu-evropska, mi- srednje evropska).

	SPECIES	N	D
Scolopend.	*Cryptops* cf. *anomalans* Newport, 1844	1	pa
	Cryptops hortensis Leach, 1815	33	pa
	Cryptops parisi Brolemann, 1920	47	eu
	Cryptops cf. *umbr icus* Verhoeff, 1931	2	en
Geophilomorpha	*Clinopodes flavidus* C. L. Koch, 1847	4	?
	Dicellophilus carniolensis C. L. Koch, 1847	72	il
	Stenotaenia sorrentina (Attems, 1903)	1	?
	Geophilus electricus (Linne, 1758)	2	eu
	Geophilus cf. *proximus* C. L. Koch, 1847	24	eu
	Henia illyrica (Meinert, 1870)	2	il
	Schendyla carniolensis (Verhoeff, 1902)	30	en
	Schendyla montana Attems, 1895	1	mi
	Strigamia acuminata (Leach, 1815)	121	eu
	Strigamia crassipes (C. L. Koch, 1835)	30	pa
	Strigamia transsilvanica (Verhoeff, 1928)	77	il
Lithobiomorpha	*Eupolybothrus tridentinus* (Fanzago, 1874)	1067	se
	Harpolithobius cf. *anodus* (Latzel, 1880)	109	eu
	Lithobius agilis C. L. Koch, 1847	27	pa
	Lithobius borealis Meinert, 1868	1	pa
	Lithobius castaneus Newport, 1844	260	me?
	Lithobius cf. *cyrtopus* Latzel, 1880	1	se
	Lithobius dentatus C. L. Koch, 1884	126	pa
	Lithobius forficatus (Linne, 1758)	22	pa
	Lithobius lapidicola Meinert, 1872	16	pa
	Lithobius latro Meinert, 1872	15	se
	Lithobius cf. *melanops* Newport, 1845	3	pa
	Lithobius cf. *muticus* C. L. Koch, 1847	19	pa
	Lithobius sp. (cf. *silvivagus*)	3	?
	Lithobius nodulipes Latzel, 1880	97	mi
	Lithobius cf. *pelidnus* Haase, 1880	4	mi
	Lithobius pygmaeus Latzel, 1880	42	il?
	Lithobius cf. *subtilis* Latzel, 1880	4	?
	Lithobius tenebrosus Meinert, 1872	3	eu
	Lithobius validus Meinert, 1872	57	mi
	Lithobius (*M.*) *aeruginosus* L. Koch, 1862	4	eu
	Lithobius (*S.*) n. sp. (*anici*)	5	?
	Lithobius (*S.*) *burzenlandicus carinthiacus* Koren, 1992	9	?
undet.	*Lithobius* juven.	15	
	Lithobius sp.	10	
	Schendyla sp.	1	
TOTAL		**2367**	

in this stand; Grgič 2005): 22 from the group Lithobiomorpha, 11 from Geophilomorpha and 4 from the group Scolopendromorpha (Tab. 1). In 11 species, more than 40 specimens were caught and represent 87.6% of the whole catch in traps. The most frequent were: *Eupolybothrus tridentinus*, *Harpolithobius anodus*, *Lithobius castaneus*, *Lithobius dentatus*, *Lithobius nodulipes*, *Lithobius validus*, *Strigamia acuminata* and *Strigamia transsylvanica*. These are mostly well mobile, bodily bigger species, which body in adults is larger than 15 mm. The portion of juveniles in traps was very low. The most frequent were specimens of *Eupolybothrus tridentinus that* present 45% of the whole catch in traps. Specimens of this species are the biggest lithobiids found in investigated stand. We also caught some specimens of two for science new, not yet described species: *Lithobuis* (*Sigibius*) n. sp. (*"anici"*) and *Lithobius (L.) n.* sp. (cf. *silvivagus*).

The catch was highest in summer, and lowest in winter months (Fig. 2), but in each month some centipedes were caught. Some individuals were caught even in the period when snow cower was present all the time.

Traps with leading boards proved to be convenient for assessment of centipede migrations (Grgič 2005). Species differ among each other in frequency, season and directions of migrations. It has been found that migrations of centipedes depend on period of the year, as well as on forest phase and environmental conditions. Differences in catch among months and among directions were found (Grgič & Kos, in preparation).

Discussion

The catch was highest in summer (Fig. 2), when centipedes most intensively walked on the surface. Centipedes are exothermic animals and thus active mostly in the warmer period of the year. But some individuals were caught even in the period when snow cower was present all the time. We assume that centipedes walk under the snow cover.

The main reason for high catch of most frequent species *Eupolybothrus tridentinus in our study* probably lays in large body size, walking abilities and suitability of the sampling method. We caught mainly bodily bigger centipedes, as traps are not convenient for catching small ones. For larger centipedes it is hard to avoid the vessel when they enter the trap area. But smaller centipedes

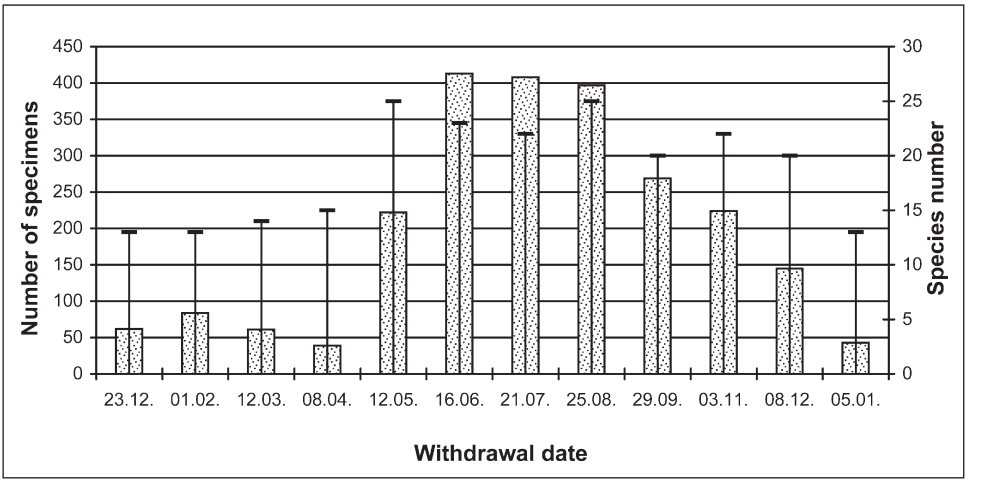

Fig. 2: The comparison of species number (black line) and specimens number (bars) of centipedes caught in pitfall traps with leading boards in a certain period.

Slika 2: Primerjava števila vrst (črne črte) in števila osebkov (stolpci) strig ujetih v talnih pasteh z vodili v določenem obdobju.

easily find a crack in the soil or between the soil and vessel and this way avoid the trap. In case that they come above the vessel on leaves or bark with which vessels were covered, small centipedes can walk back on the other side of leaves or bark and again avoid the vessel. Larger centipedes because of their body structure and weight in such case fall into the vessel. In our research vessels were under the surface level, in small cavities, so we caught also some representatives of species that live deeper in the soil. Plastic plates 20 cm deep in the soil also contributed to this. Low portion of juveniles shows that migrating individuals are mainly adults. Also Fründ and co-workers (1997) already came to this conclusion.

According to Blower (1955) large lithobiids prefer litter layers whereas small lithobiids and geophilomorphs occur mostly in deeper layers. With traps mostly larger epigeic lithobiids that prefer litter layers can be caught. But for small centipedes that live deeper in the soil the method of soil samples is selective (Kos 1995a). Fründ and co-workers (1997) also found great difference in catch between soil samples and pitfall traps. Species that are usually frequent in soil samples rarely appear in traps and vice versa (Grgič 2005).

Also Lock and co-workers (2001) quote that with pitfalls as a rule only the epigeic species can be captured. Tuf (in preparation) found that larger abundant lithobiomorphs with mainly epigeic life style can be recorded by several methods, but with higher probability by pitfall trapping, while larger less frequent lithobiomorphs can be recorded by pitfall trapping exclusively. Also smaller soil lithobiomorphs with low epigeic activity and abundant geophilomorphs can be often found in traps, but are mainly recorded by soil sampling. These statements correspond also to our species list from traps (Tab. 1).

Advantages and disadvantages of traps with leading boards

Pitfall traps with leading boards have their advantages, but also some weaknesses. Pitfall traps are one of the most effective methods for collecting walking centipedes and leading boards even increase the effect of catch in traps. At the same time these traps enable to determine the walking direction of ground-dwelling arthropods (Grgič & Kos, in preparation). Traps can be installed throughout the year so that we can also determine yearly dynamics and compare activity among months or seasons.

Perhaps the main weakness is the trap's difficult installation. The appeal of pitfall trapping generally lies in the ease with which traps can be set and the replicability of trapping over space and time, but to place leading boards in very stony soil can be very hard and time consuming, as it is necessary to dig 3 meters of ditch for the boards. When the trap is already in place, big animals (e.g. bears, wild boars, badgers) can destroy or dig out both leading boards and vessels. This actually happened in few occasions during our investigation. Also if precipitation is high, the vessels can be full very quickly and for not losing the catch collecting must be done immediately.

Such traps can not give the information about species that live deeper in the soil or are too small to be caught in traps, as small specimens can easily avoid the trap. Unfortunately mainly surface-active species are caught by pitfall traps, so selecting animals of desired group can be long-lasting. The size of catch is affected by environmental factors (climate, microclimate, precipitation, temperature, type of soil, structure of soil, vegetation and others) and trap parameters. As the number of caught specimens doesn't depend only on density of species, therefore is not possible to estimate the density directly on the basis of catch in traps (Perner & Schueler 2004). For this defined designs of sampling and mathematical models are needed.

Conclusion

Traps with leading boards proved to be suitable to establish active migrations of centipedes inside the stand (Grgič 2005). We found that pitfall traps with leading boards are one of the most effective collection methods for centipedes and they also enable to determine other centipede community characteristics. But with pitfall traps mostly epigeic species can be captured.

The centipede collection from a certain area in a great extent depends on sampling methods used. That is why in centipede community investigations

it is a must to exactly define the methods. The decision about which and how many sampling methods should be used in an investigation must be directly linked with the aim of the study, so it is necessary to know advantages and disadvantages of different methods and to know what kind of information can be expected from the catch with certain method.

Povzetek

Pri raziskavah združbe strig uporabljamo različne metode vzorčenja za zbiranje osebkov. Največkrat so uporabljene talne pasti, vzorčenje tal, sejanje tal in ročno pobiranje. Z različnimi metodami ujamemo različno velike in različno aktivne strige z različno telesno zgradbo in načinom življenja. Zato dobimo običajno z uporabo različnih metod vzorčenje različne predstave o zgradbi talnih združb na določenem mestu (Kos 1988, 1995a,b, Mesibov in sod. 1995, Grgič & Kos, v pripravi).

Ker so različne metode različno učinkovite, idealna metoda za določeno raziskavo temelji direktno na ciljih raziskave (Snyder in sod. 2006). V raziskavi aktivnih migracij strig med različnimi razvojnimi fazami gozda smo uporabili talne pasti z vodili, ki so opisane v tem prispevku. Tuf (v pripravi) je ugotovil, da so talne pasti ena najučinkovitejših metod vzorčenja strig. Fründ in sodelavci (1997) pa navajajo, da vodila še povečajo samo učinkovitost lova.

Talne pasti z vodili so nekoliko spremenjene in prilagojene pasti, ki so jih uporabljali Fründ in sodelavci (1997) za lov strig. Pasti so sestavljene iz treh en meter dolgih in 30 cm širokih plastičnih plošč v obliki črke Z (Fig. 1). Približno 20 cm širine plošč je zakopanih v tleh, 10 cm pa je nad površino tal. Odprta kraka pasti sta bila obrnjena proti določenima fazama. V vsakem od dveh kotov je bila plastična lovilna posodica velikosti 8x8 cm, napolnjena z monoetilen glikolom, ki ubije in delno konzervira živali.

Na vsaki od petih meja med različnimi razvojnimi fazami je bilo postavljenih šest talnih pasti v vodili (vsaka past je imela 2 lovilni posodici). Jeseni leta 2002 je bilo postavljenih 30 pasti v raziskovanem raznomernem bukovem sestoju v vasi Iška, 15 km južno od Ljubljane. Novembra leta 2002 smo začeli z lovom. Lovilne posodice smo praznili na 17–40 dni (odvisno od količine padavin) do januarje 2004.

Vodila so živali, ki so hodile v določeno smer, usmerjala v lovilne posodice, tako da smo lahko ločeno ujeli živali, ki so hodile v določeno smer med dvema fazama. Ujeli smo 2367 strig iz 37 vrst (od 44 vrst, ki so že bile najdene v raziskovanem sestoju, Grgič 2005): 22 iz skupine Lithobiomorpha, 11 iz skupine Geophilomorpha in 4 iz skupine Scolopendromorpha (Tab. 1). Najpogostejše sobile vrste: *Eupolybothrus tridentinus*, *Harpolithobius anodus*, *Lithobius castaneus*, *Lithobius dentatus*, *Lithobius nodulipes*, *Lithobius validus*, *Strigamia acuminata* in *Strigamia transsylvanica*. To so večinoma dobro mobilne strige, katerih telo pri odraslih je večje od 15 mm. Delež mladostnih osebkov v pasteh je bil majhen. Najpogostejša je bila vrsta *Eupolybothrus tridentinus.* Verjetno je glavni razlog za to velika telesna velikost, mobilnost in primernost metode vzorčenja. Ulov strig v pasteh je bil največji poleti in najnižji pozimi (Fig. 2), vendar noben mesec ni prišlo do izpada ulova strig. Strige so ektotermne živali in zato najbolj aktivne v toplem delu leta.

Lov strig s talnimi pastmi z vodili se je izkazal za primerno metodo vzorčenja za ocenjevanje aktivnih migracij strig (Grgič 2005). Vrste so se razlikovale v frekvenci, obdobju in smereh migracije. Ugotovljeno je bilo, da so migracije strig odvisne od sezone in strukture gozda. Najdene so bile razlike v migracijah strig med meseci in med smermi migracij (Grgič & Kos, v pripravi).

Metoda lova s talnimi pastmi z vodili ima določene prednosti, pa tudi nekatere slabosti. Je ena od najučinkovitejših metod lova talnih členonožcev, hkrati pa omogoča določitev smeri aktivnih migracij osebkov (Grgič & Kos, v pripravi). Pasti so lahko postavljene skozi vse leto, tako da lahko ugotavljamo letno dinamiko in primerjamo aktivnost v različnih delih leta. Verjetno glavna slabost teh pasti je težavnost postavitve na mesto vzorčenja, saj je treba izkopati tri metre dolg in 20 cm globok jarek za vodila, kar lahko pri zelo kamnitih tleh predstavlja veliko oviro. Ko so pasti postavljene, pa jih lahko velike živali (npr. medved) uničijo in izkopljejo tako vodila kot tudi lovilne posodice. Slabost teh pasti pa je tudi v tem, da nem ne morejo dati informacij o vrstah, ki živijo globlje v tleh ali so premajhne za lov s pastmi. Po

Blower-ju (1955) večji lithobiidi preferirajo sloj stelje, medtem ko se manjši lithobiidi in geophilidi pojavljajo večinoma v globljih plasteh. S pastmi tako večinoma ulovimo površinske lithobiide, za majhne strige v tleh pa je bolj primerna metoda lova talno vzorčenje (Kos 1995a). Na ulov v talnih pasteh z vodili vplivajo okoljski dejavniki (klima, mikroklima, padavine, temperatura, tip in zgradba tal, vegetacija in drugi).

Ker je vzorec strig z določenega vzorčnega mesta odvisen od uporabljene metode vzorčenja, je pri raziskavah združbe strig nujno treba natančno definirati uporabljeno metodo. Odločitev o metodi je povezana s cilji raziskave, zato je treba poznati prednosti in slabosti posamezna metode in vedeti, kakšne informacije lahko z njimi pridobimo.

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