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TERENSKI NOTICI / FIELD NOTES

New records of two rare neuropterans (Insecta: Neuroptera) in Slovenia

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Abstract. Two neuropteran species, the antlion *Neuroleon microstenus* (McLachlan 1898) and the mantispid *Mantispa aphavexelte* Aspöck & Aspöck 1994, are known as extremely rare in Slovenia. New records of the species are presented. Both neuropterans occur only in the Submediterranean region of the country. Due to the insufficient knowledge of its ecology, the threat status of *M. aphavexelte* is unknown, whilst *N. microstenus* should be considered as endangered considering that its habitats are shrinking.

Keywords: distribution, *Neuroleon microstenus*, *Mantispa aphavexelte*, Neuroptera, Slovenia

Izvleček. NOVI PODATKI O NAJDBAH REDKIH VRST MREŽEKRILCEV (INSECTA: NEUROPTERA) V SLOVENIJI - Dve vrsti mrežekrilcev, volkec vrste *Neuroleon microstenus* (McLachlan 1898) in zaponcica vrste *Mantispa aphavexelte* Aspöck & Aspöck 1994, veljata za izjemno redki v Sloveniji. Predstavljeni so novi podatki o razširjenosti obeh vrst, ki se v Sloveniji pojavljata le v submediteranski regiji. Zaradi slabega poznavanja ekologije je status ogroženosti za *M. aphavexelte* neznan. Vrsto *N. microstenus* pa lahko štejemo za ogroženo zaradi krčenja njenih habitatov.

Ključne besede: razširjenost, *Neuroleon microstenus*, *Mantispa aphavexelte*, mrežekrilci, Slovenija

Introduction

Neuroptera of Slovenia are still insufficiently investigated. There are some 100 species known from the country (Devetak 1992 and unpublished data). Two species, the antlion *Neuroleon microstenus* (McLachlan 1898) and the mantispid *Mantispa aphavexelte* Aspöck & Aspöck 1994, are considered extremely rare in Slovenia.

In 1990, *M. aphavexelte* was recorded for the first time in Slovenia (Devetak 1995). Knowledge of the species' ecology is poor and it was believed to be an extremely rare neuropteran. During the field studies carried out in the Submediterranean region of Slovenia in the recent years it has been revealed, however, that the species is not as rare as expected.

Neuroleon microstenus was found in Slovenia in 2001 (Devetak & Devetak 2004). Only scarce information is available on the biology of the species. It is a polycentric Mediterranean species (for review of its distribution see Aspöck *et al.* 2001). Morphology of the first instar larvae was described by Gepp (1974). It is a non-pit-building antlion species. Adults can easily be distinguished from other *Neuroleon* species following key-characters (Aspöck *et al.* 1980). Among the other characters, abdomen of males is much longer than the wings. Characteristic are also two dark pigmented spots in forewings. The only known finding-place of *N. microstenus* in Slovenia was destroyed in 2003, and consequently the species was considered to be extinct in Slovenia. In 2005, however, the occurrence of the species in the country was re-confirmed. Documentation of the recent records is presented in this paper.

Material and methods

Individuals were collected with sweep-net, and fluid-preserved specimens are deposited in Dušan Devetak's collection (Maribor). The nomenclature of the determined neuropterans follows Aspöck *et al.* (2001).

Results

Neuroleon microstenus (McLachlan, 1898)

Literature records:

- Devetak & Devetak (2004): Srmin (UTM coordinate: VL04).

New records:

- Črni Kal, 185 m above sea level, flysch slope near the road, N 5412036 E 5046038 (UTM coordinate: VL14), 6. VIII. 2005, 5 males, 4 females, leg. P. Devetak.
- Hrastovlje, 190 m, N 5414158 E 5041757 (VL14), 5. VIII. 2005, 2 males, 2 females, leg. P. Devetak.
- Izola, Jagodje, 85 m, N 5394426 E 5043164 (UL94), 6. VIII. 2005, 2 males, 1 female, leg. P. Devetak.
- Sečovlje, 165 m, N 5393942 E 5037614 (UL93), 5. VIII. 2005, 2 females, leg. P. Devetak.

Distribution in Slovenia is shown in Fig. 1.

Ecology: The adults were collected in a grassland (near Izola and Sečovlje) and on eroded flysch slopes (Hrastovlje and Črni Kal).

Mantispa aphavexelte Aspöck & Aspöck, 1994

Literature records:

- Devetak (1995): Osp (VL14); Sočerga: Mlini (VL13).

New records:

- Hrastovlje, 180 m, N 5414158 E 5041757 (VL14), 1. VIII. 2003, 1 male, leg. P. Devetak.
- Kraški rob: Kastelec, Socerb, 315 m, N 5411690 E 5048637 (VL14), 5. VIII. 2005, 5 males, 8 females, leg. P. Devetak.

Distribution in Slovenia is shown in Fig. 2.

Ecology: Individuals collected in Kastelec occurred on *Quercus pubescens*. On the same trees, individuals of closely related *Mantispa styriaca* (Poda 1761) were found.

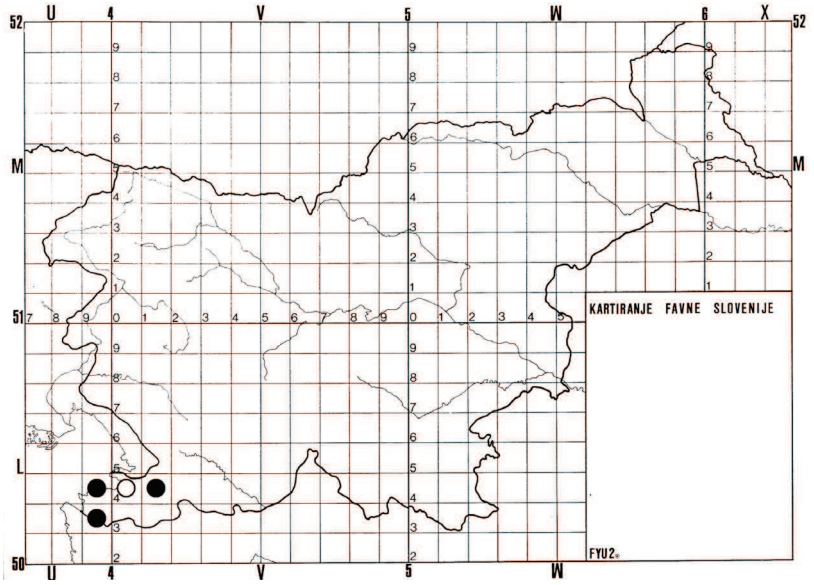

Figure 1. Known distribution of *Neuroleon microstenus* in Slovenia. Location of Srmin, where the habitat has been destroyed and the species is extinct, is marked with an open circle (o).
Slika 1. Znana razširjenost volkca vrste *Neuroleon microstenus* v Sloveniji. Položaj Srmina, kjer je habitat uničen in vrsta iztrebljena, je prikazan s praznim krogcem (o).

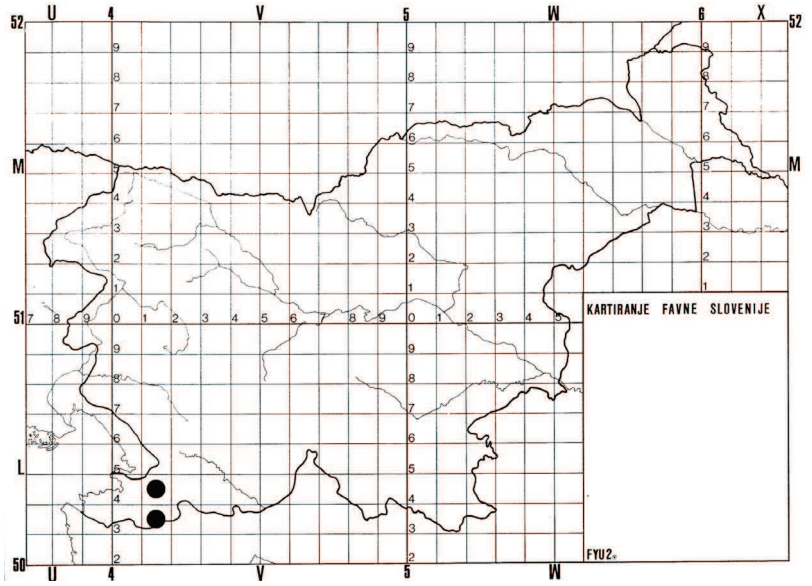

Figure 2. Known distribution of *Mantispa aphavexelte* in Slovenia.
Slika 2. Znana razširjenost zaponcice vrste *Mantispa aphavexelte* v Sloveniji.

Discussion

The genus *Neuroleon* Navás, 1909 includes small non-pit-building antlions and is confined to Africa, southern Europe and large parts of Asia (Hölzel 1986). There are about 120 valid species of the genus, but only two of them occur in the western part of the Balkan Peninsula (Devetak & Devetak 2004).

Knowledge of ecology and distribution of *Neuroleon* species is poor; usually, only single animals have been collected in European countries. The only exception in this respect is France, where ecology and distribution of the genus was studied in detail by Steffan (1971). According to Aspöck *et al.* (1980), the typical habitats of the species are forests or macchia. My findings, however, do not confirm this statement. In Slovenia, *N. microstenus* populates habitats devoid of trees and bushes. In Hrastovlje and Črni Kal, a great number of adults was observed flying on dry eroded flysch slopes.

In 2003, the only known locality of *N. microstenus* at Srmin was destroyed, when the material excavated during road construction was deposited at this locality and the eroded flysch slopes were filled up. However, typical habitats of the species are endangered due to natural reforestation of grassland ecosystems. Reforestation is a phase of natural process of succession.

Despite the fact that in Slovenia *M. aphavexelte* is distributed only in its Submediterranean region, it is not considered an endangered species. In some places, like Kastelec, it occurs sympatrically with *M. styriaca*.

Povzetek

Favna mrežekrilcev Slovenije še vedno ni dovolj raziskana. V prispevku navajam podatke o razširjenosti dveh vrst mrežekrilcev, za kateri smo do sedaj domnevali, da sta izjemno redki. Vrsta volkca *Neuroleon microstenus* (McLachlan 1898) je znana za Slovenijo le s štirih lokalitet iz submediteranske regije, na peti lokaliteti pa je izumrla. Vrsta je zaradi krčenja habitatov ogrožena. Vrsto zaponcice *Mantispa aphavexelte* Aspöck & Aspöck 1994, znano tudi s štirih submediteranskih lokalitet, pa ne štejemo med ogrožene vrste, čeprav je v Sloveniji redka.

Acknowledgements

I thank Dušan Devetak for identifying *Quercus pubescens*.

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Pomen mejic za dnevne metulje (Lepidoptera: Rhopalocera) na Ljubljanskem barju

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Izvleček. Mejice služijo kot zatočišča, preletni koridorji in larvalni ter prehranjevalni habitat za dnevne metulje. Za ugotavljanje številčnosti in obnašanja metuljev v 5-metrskem pasu na in ob mejicah v zahodnem delu Ljubljanskega barja smo uporabili transektno metodo. Transekti so bili opravljeni dvakrat na teden v primernem vremenu. Skupaj je bilo opaženih 43 vrst. Okar *Maniola jurtina* je bil dominantna vrsta z 58% vseh opažanj. Konec junija je bil iz vidika številčnosti in pestrosti zabeleženih vrst sezonski vrh. Večina metuljev je bila opažena na pasu vegetacije ob mejici (73%), kjer je bilo letenje najpogostejše obnašanje (59%). Pestrost metuljev na transektih je bila višja tam, kjer so bili sosednji habitati v ekstenzivni rabi. Na mejicah, ki so mejile na njive, smo ugotovili večjo pestrost in številčnost metuljev na tistih odsekih, kjer je bil med njivo in mejico ohranjen pas travniške vegetacije. Uporaba mejic se je po košnji statistično značilno povečala za 15%. Pomen mejic za dnevne metulje v Sloveniji je manj izrazit kot v severni Evropi. Kljub temu mejice predstavljajo pomemben habitat za metulje in jih je treba varovati in obnavljati.

Ključne besede: dnevni metulji, pestrost, varstvo, habitat, transekt

Abstract. IMPORTANCE OF HEDGEROWS FOR BUTTERFLIES (LEPIDOPTERA: RHOPALOCERA) ON LJUBLJANSKO BARJE (SLOVENIA) - Hedgerows serve as shelters, disperison corridors, and as larval and nectaring habitat for butterflies. A line transect method was used for recording butterfly abundance and behavior on a 5 m wide transect including hedgerows and a strip of vegetation along their edges in western part of Ljubljansko barje. Transects were walked in suitable weather twice a week. Altogether 43 species were recorded. The Meadow brown (*Maniola jurtina*) was the dominant species with 58% of all records. The peak of the season, both in terms of abundance and species diversity, was at the end of June. Most of the butterflies were recorded at the adjacent strip of vegetation (73%), where flying was most common behaviour (59%). The butterfly diversity on transects was higher where adjacent habitats were extensively used. On the hedgerows bordering arable fields butterfly diversity and numbers were higher where a 2,5 m strip of extensively used grasses was preserved. The utilization of hedgerows significantly increased for 15% after mowing of adjacent grasslands. The importance of hedgerows for butterflies in Slovenia is less prominent as in northern Europe. Nevertheless, they still comprise a valuble habitat for butterflies and shuld be preserved and/or restored.

Key words: Rhopalocera, diversity, conservation, habitat, transect

Uvod

Mejica je ozek pas grmov, ki rastejo tesno skupaj in s katerimi se upravlja tako, da oblikujejo bolj ali manj neprekinjeno bariero (Clements & Tofts 1992). Izginjanje mejic in z njimi pogosto tudi sonaravno rabljenih travišč, je predvsem posledica intenziviranja kmetijstva. Danes so mejice pomemben habitat in ponekod refugij za veliko število rastlin in živali (Garbutt & Sparks 2002), služijo kot koridorji za gibanje dnevnih metuljev v agrarni pokrajini in z osenčenostjo vplivajo na vedenje dnevnih metuljev (Carter & Anderson 1987). Prisotnost dnevnih metuljev na mejicah je povezana z naslednjimi dejavniki: zavetrje, osončenost, gostota nektarskih rastlin, vrstno bogastvo rastlin ter raba sosednjega zemljišča (Dover 1996). V tujini so vlogo mejic že raziskovali, vendar spoznanj zaradi razlik v ohranjenosti habitatov ne moremo prenesti neposredno v slovenski prostor.

Dosedanje raziskave na mejicah v Evropi so pokazale, da z izginjanjem habitatov, vključno z izgubo mejic, število dnevnih metuljev upada (Pavlicek-van Beek et al. 1992, Pollard & Yates 1993). Dnevni metulji so ena izmed ključnih indikatorskih skupin za proučevanje vplivov na negozdne habitate, lahko pa imajo vlogo krovnih vrst za ohranjanje pestrosti na splošno in karizmatičnih vrst med nevretenčarji za spodbujanje ohranjanja mejic (New 1997) ter habitatnih tipov, kot so npr. mokrišča in suha travišča.

Ljubljansko barje je eno zadnjih večjih območij z ekstenzivno košenimi vlažnimi travniki v Sloveniji in je zatočišče nekaterim redkim in ogroženim vrstam dnevnih metuljev (Verovnik 2001). Mejice, ki še danes predstavljajo mejo med parcelami različnih lastnikov, so razpredene po celotnem Ljubljanskem barju. Ker do sedaj v Sloveniji še ni bilo raziskav o dnevnih metuljih na mejicah, smo želeli v okviru raziskave s spremljanjem sezonske dinamike dnevnih metuljev na mejicah Ljubljanskega barja dobiti natančen vpogled v to, kakšno vlogo imajo mejice pri vrstni pestrosti le-teh. Ugotoviti smo želeli, v kakšni meri dnevni metulji uporabljajo mejice kot zatočišče pred neugodnimi vremenskimi razmerami, prehranjevalni habitat, povezovalni koridor med ustreznimi habitatnimi krpami in ali mejice nudijo nadomestni prehranjevalni habitat v času, ko so travniki pokošeni. Poleg tega smo skušali ugotoviti, ali je pestrost dnevnih metuljev na mejicah vezana na rabo zemljišč v neposredni bližini.

Materiali in metode

Območje raziskave

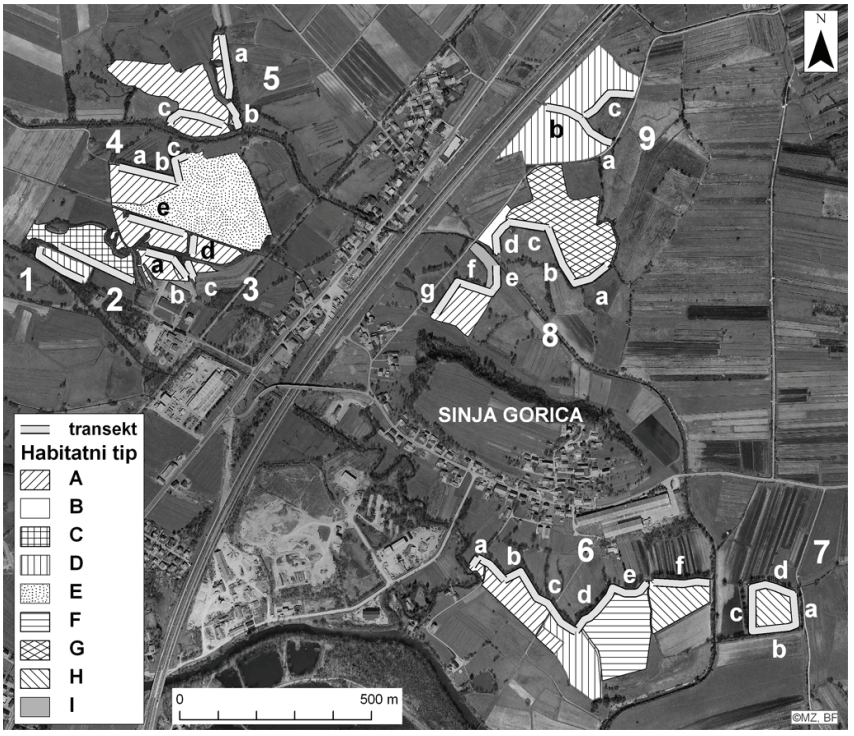
Popisovanje dnevnih metuljev je potekalo na zahodnem delu Ljubljanskega barja, in sicer na devetih transektih v okolici Sinje Gorice ter severovzhodno od Vrhnike pri Ljubljani. Transekti od 1 do 5 se nahajajo vzhodno od regionalne ceste Ljubljana–Vrhnika, transekti od 6 do 9 pa so zahodno od te ceste (Sl. 1). Skupna dolžina transektov je bila 4063 metrov. Transekti so bili izbrani na terenu predvsem na podlagi ohranjenosti mejic in pestrosti habitatov ob mejici. Vsi transekti so bili označeni s količki neposredno ob robu mejice v začetku sezone, tako da je bila pot popisovanja vedno enaka. Dolžina posameznega transekta in odsekov je bila izmerjena s pomočjo naravovarstvenega atlasa (Tabela 1). V mejicah med drevesnimi vrstami prevladuje črna jelša (*Alnus glutinosa*), med grmovnicami pa navadna krhlika (*Frangula alnus*). Poleg teh so bile v mejicah pogosto opaženi še hmelj, različne vrste vrb, kovačnik, brogovita, liguster in črni bezeg.

Tabela 1. Dolžine transektov in delež posameznih habitatnih tipov ob njih. Za razlago okrajšav habitatnih tipov glej Materiale in metode.
Table 1. Lenght of transects and portions of habitat types along them. Explanation of habitat type abbreviations is given in Materials and methods.

Transekt	**Dolžina transekta** [m] **Lenght of the transect**	**Habitatni tipi ob transektu (% dolžine)** **Habitat type (% of length)**
1	186	mokrotni (100)
2	266	gojeni (100)
3	480	nižinski (93) stožka (7)
4	299	nižinski (57) stožka (43)
5	467	nižinski (100)
6	825	nižinski (21) mokrotni (25) šaši (35) njive (18)
7	486	njive (100)
8	687	pašniki (51) nižinski (40) njive (9)
9	367	mokrotni (100)

Habitatni tipi ob mejicah so bili razdeljeni v naslednje kategorije:

- njive: njive ter druge dotlej obdelovalne površine (koruzna njiva ob mejici 7);
- pašnik: ograjeni neprekinjeni pašniki (le ob mejici 8);
- gojeni: intenzivno gojeni ter dosejevani ali v celoti sejani travniki (dvakrat pokošeni v času popisovanja);
- nižinski: srednjeevropski mezotrofni do evtrofni nižinski travniki ter srednjeevropski higromezofilni nižinski travniki na srednje vlažnih tleh s prevladujočo visoko pahovko (prevladujoč habitatni tip ob opazovanih mejicah);
- mokrotni: mezotrofni mokrotni travniki;
- stožka: mokrotni travniki z modro stožko (le ob mejici 4, košen konec septembra);
- šaši: sestoji visokih šašev (le ob mejici 6).



Slika 1. Zračni posnetek območja raziskovanja z vrisanimi transekti in ob njih ležečimi habitatnimi tipi (glej poglavje Materiali in metode). Transekti so označeni z zaporednimi številkami in vrisani z rdečo črto. Odseki posameznega transekta so označeni s malimi črkami. Legenda: A – srednjeevropski mezotrofni do evtrofni nižinski travniki; B – srednjeevropski higromezofilni nižinski travniki na srednjevlažnih tleh s prevladujočo visoko pahovko; C – intenzivno gojeni ter dosejevani ali v celoti sejani travniki; D – mezotrofni mokrotni travniki; E – mokrotni travniki z modro stožko; F – sestoji visokih šašev; G – ograjeni neprekinjeni pašniki; H – njive; I – neobdelane njive in druge dotlej obdelovane površine.

Figure 1. Aerial photograph of the surveyed region with marked transects and neighbouring habitat types (see the Material and methods section). Trasects are numbered consecutively and demarcated by red line. Sections of each transect are marked by lowercase letters.

Popisovanje

Terensko delo je potekalo od aprila do oktobra 2005. Od maja do sredine avgusta smo popisovali odrasle osebke dnevnih metuljev dvakrat tedensko, prej in kasneje pa enkrat tedensko, če so bili izpolnjeni naslednji pogoji: temperatura zraka višja od 15°C, brez močnejšega vetra in brez dežja (v nasprotnem primeru smo počakali na prvi primeren dan). Pomlad in poletje 2005 sta bila zelo deževna in s pogostimi nizkimi temperaturami, zato smo začeli s popisovanjem šele konec aprila. Zaradi neprimernih vremenskih razmer smo opravili le 25 od načrtovanih 36 popisnih dni. Vsak popis je trajal povprečno 6 ur, popisovanje pa je potekalo vedno med 9. in 17. uro.

Podatke o datumu, začetku in koncu popisovanja na posameznem transektu, vremenu, stanju transekta ter številčnosti osebkov in njihovem vedenju smo sproti vnašali v popisne liste. Vedenje je bilo razdeljeno v naslednje kategorije:

- hranjenje na mejici (osebki, ki so se hranili na cvetočih rastlinah v mejici),
- počivanje na mejici (upoštevali smo tudi osebke, ki so zleteli iz mejice),
- letenje vzporedno z mejico,
- hranjenje na 2,5-metrskem pasu vegetacije ob mejici (osebki, ki so se hranili na cvetočih rastlinah v tem pasu),
- počivanje na 2,5-metrskem pasu vegetacije ob mejici (upoštevali smo tudi osebke, ki so zleteli iz tega pasu),
- letenje po 2,5-metrskem pasu vegetacije ob mejici (letenje pravokotno na mejico, ter nad tem pasom).

Za ocenjevanje številčnosti osebkov posamezne vrste smo uporabili transektno metodo Pollardova hoja (Pollard & Yates 1993). Popisovalec je hodil počasi in z enakomernim tempom vzporedno z mejico, od katere je bil oddaljen 20 centimetrov. Popisal je vse osebke dnevnih metuljev, ki so bili v razdalji 5 metrov pred njim ter 2,5 metra levo ali desno od njega. To pomeni, da je bil v opazovanje zajet celoten pas vegetacije v mejici ne pa tudi travniška vegetacija na drugi strani mejice. Težje določljive vrste smo ujeli z metuljnico in jih po določitvi izpustili. V redkih primerih, ko določitev ni bila zanesljiva, smo osebek shranili in določili naknadno. V času postanka zaradi določitve smo štetje metuljev na transektu prekinili. Glavni vir za določanje vrst na terenu so bile slikovne priloge Tolman & Lewington (1997). Vrste so poimenovane v skladu s seznamom Karsholt & Razowski (1996). Vrsti *Leptidea sinapis* (Linnaeus, 1758) in *Leptidea reali* Reissinger, 1989, ki za pravilno določitev zahtevata pripravo in pregled genitalnih preparatov, sta bili združeni v kompleks vrst *Leptidea sinapis/reali*. Popisovalca sta se med seboj izmenjavala, tako da istega transekta ni vedno

popisoval isti popisovalec. Naključno smo izbrali tudi vrstni red in smer popisovanja na transektih. Tako posamezna mejica ni bila popisana ob enakem času dneva, dosežena pa je bila tudi boljša primerljivost popisov, saj so se morebitne napake posameznega popisovalca s tem enakomerno razporedile.

Statistična analiza

Primerjava številčnosti osebkov in pestrosti vrst dnevnih metuljev je potekala na dveh nivojih. Izhodišče je bila primerjava transektov, nadgradnja pa je bila primerjava med habitatnimi tipi. Pri tem smo celotne dolžine posameznega habitatnega tipa sešteli vzdolž vseh transektov. Da bi bili rezultati primerljivi, je število osebkov preračunano na 100 metrov transekta oziroma habitatnega tipa, število vrst pa na logaritem 100 metrov, saj število vrst ne narašča premo sorazmerno z dolžino. Za izračun podobnosti med mejicami ter podobnosti med habitatnimi tipi smo uporabili Renkonenovo število. Za izračun te mere podobnosti mora biti vsak vzorec standardiziran v deležih vrst, tako da je vsota relativnih abundanc v vsakem vzorcu enaka ena. Kljub preprostosti je ta indeks eden najboljših kvantitativnih koeficientov podobnosti (Wolda 1981), saj imata velikost vzorca in vrstna pestrost nanj majhen vpliv (Krebs 1989). Na podlagi Renkonenovega števila smo izrisali dendrogram povprečne podobnosti med transekti ter med habitatnimi tipi.

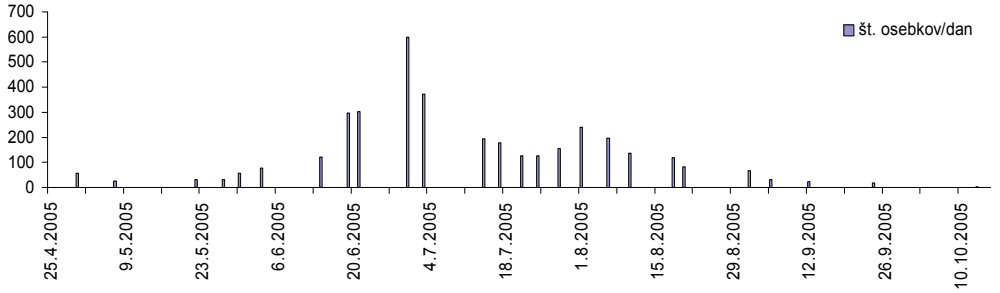
Pri proučevanju vpliva košnje smo primerjali vedenje dnevnih metuljev pred košnjo in po njej. V obdelavo vedenja po košnji so bila vključena opazovanja od dneva košnje do vključno 10 dni po košnji. Statistična značilnost razlik v vedenju pred in po košnji smo izračunali s Studentovim t-testom za odvisne vzorce (Excel Analysis Toolpack, Microsoft).

Rezultati

Na devetih mejicah je bilo skupaj zabeleženih 3667 osebkov, ki so pripadali 43 vrstam dnevnih metuljev. To predstavlja 48% vseh do sedaj opaženih vrst dnevnih metuljev na Ljubljanskem barju (Verovnik 2001). Med zabeleženimi osebki je izrazito prevladoval v Sloveniji splošno razširjen okar *Maniola jurtina* (Linnaeus, 1758) z 58% deležem. Poleg te vrste sta bila pogosta tudi belin *P. napi* (Linnaeus, 1758) s 14% in okar *Melanargia galathea* (Linnaeus, 1758) z 8%. Tako tri najpogosteje opažene vrste predstavljajo več kot tri četrtine

vseh zabeleženih osebkov. Med zanimivejšimi opaženimi vrstami velja omeniti tiste iz Rdečega seznama metuljev (Lepidoptera) Slovenije (Uradni list RS, št. 82/02): *Melitaea diamina* (Lang, 1789) – V, *Clossiana selene* (Denis & Schiffermüller, 1775) – V, *Maculinea alcon* (Denis & Schiffermüller, 1775) - E in *Carcharodus floccifera* (Zeller, 1847) - E. Zadnji dve vrsti sta bili opaženi le na pasu vegetacije ob mejici na transektih z ekstenzivno rabljenimi travniki.

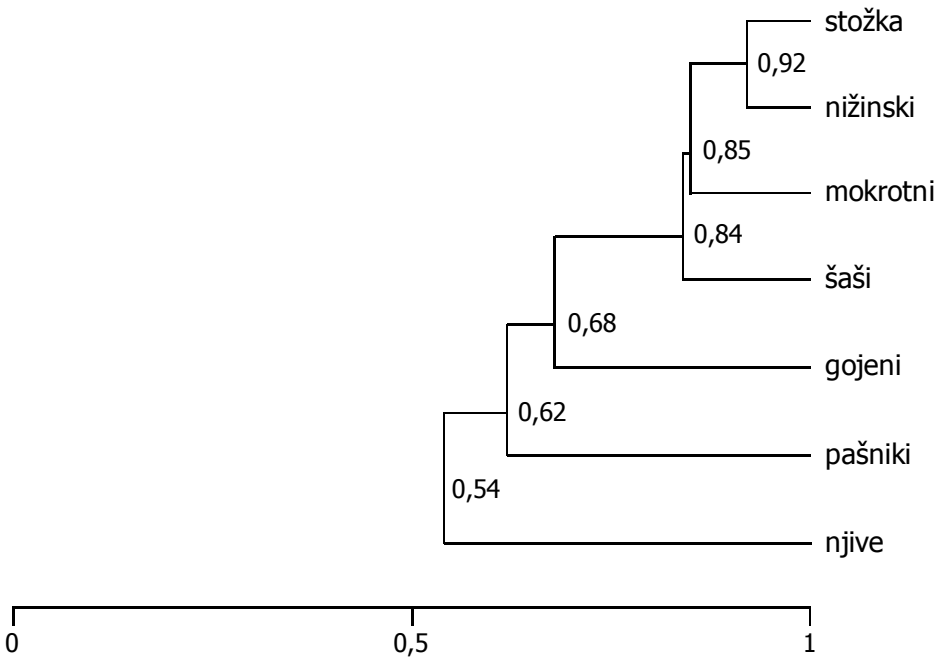
V sezoni sta bila dva vrha v številu zabeleženih osebkov, prvi 30. 6. 2005 (600 osebkov), ko so prevladovale tri najpogostejše vrste (*P. napi* (13%), *M. galathea* (23%) in *M. jurtina* (44%)). Hkrati je bil to tudi maksimum v številu opaženih vrst na dan – 21 vrst. Drugi vrh je bil 1. 8. 2005 (239 osebkov), ko je večina osebkov pripadala vrstama *M. jurtina* (75%) in *P. napi* (10%) (Sl. 2.).



Slika 2. Sezonska dinamika dnevne številčnosti dnevnih metuljev na transektih zahodnega dela Ljubljanskega barja.
Figure 2. Seasonal dynamics of number of recorded specimens per day on the transects in the western part of Ljubljansko barje.

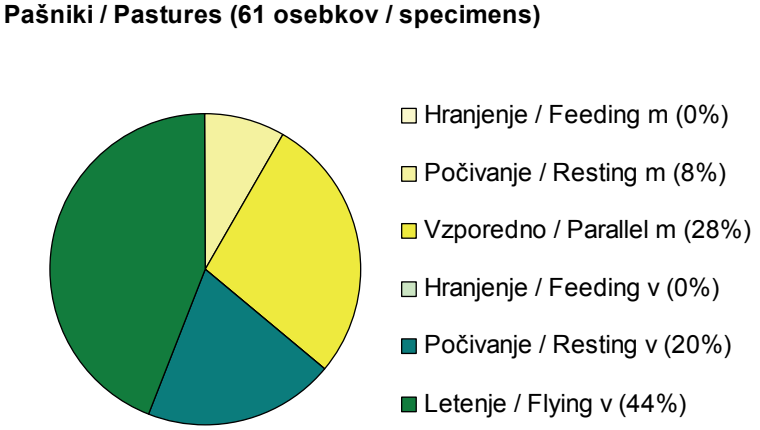
Razmerje med zabeleženimi osebki na pasu vegetacije ob mejici in na mejici je bilo približno 3 : 1. Od tega je bilo 11 vrst prisotnih samo na pasu vegetacije ob mejici, 2 vrsti pa sta bili opaženi samo na mejici. Po pestrosti so izstopali transekt 3 z 31 vrstami, transekt 5 s 25 vrstami ter transekta 4 in 6 s po 24 vrstami. Po številu osebkov na 100 metrov so z največ osebki izstopale mejice ob habitatnih tipih nižinski (134 osebkov/100 metrov) in stožka (130 osebkov/100 metrov). Pričakovano je bilo najmanjše število osebkov ob mejicah habitatnega tipa gojeni (43 osebkov/100 metrov), pašniki (17 osebkov/100 metrov) in njive (17 osebkov/100 metrov), kjer je veliko manjša tudi številčnost in pestrost nektarskih rastlin. Pestrost vrst je bila razporejena podobno, kar potrjuje tudi visok koeficient korelacije med številčnostjo osebkov in številom vrst (R=0,86). Najbolj je izstopala mejica ob habitatnem tipu nižinski, kjer je bilo opaženo 85% vseh zabeleženih vrst. Preseneča pa dejstvo, da je bila pestrost vrst najnižja na mejicah ob pašniku in gojenem travniku (oba 7 vrst/logaritem 100 metrov) in ne ob njivi (12 vrst/logaritem 100 metrov).

Na podlagi Renkonenovega števila izrisano drevo podobnosti razdeli združbe dnevnih metuljev posameznih habitatnih tipov ob mejicah v dva dela (Sl. 3). V prvi skupini so habitatni tipi ob mejicah z ekstenzivno rabo - nižinski, mokrotni, stožka in šaši. Razlike med združbami v tej skupini so razmeroma majhne. Če izvzamemo vrste, ki so bile zabeležene le enkrat, imajo samo mejice ob habitatnem tipu nižinski dve značilni vrsti (se ne pojavljata v drugih habitatnih tipih). V drugem delu drevesa so razlike med združbami večje, najbolj pa izstopajo mejice ob habitatnem tipu njive. Tu se pojavljajo predvsem vrste, ki so dobri letalci (veliki pisančki, belini), ali pa so vezane na grmovno vegetacijo same mejice (npr. *Celastrina argiolus* (Linnaeus, 1758)).



Slika 3. Dendrogram povprečne podobnosti združb (Renkonenovo število) dnevnih metuljev med habitatnimi tipi ob mejicah Ljubljanskega barja. Za razlago okrajšav habitatnih tipov glej Materiale in metode.
Figure 3. Dendrogram of average similarity of butterfly species composition (Renkonen number) among habitat types along hedgerows on Ljubljansko barje. Explanation of habitat type abbreviations is given in Materials and methods.

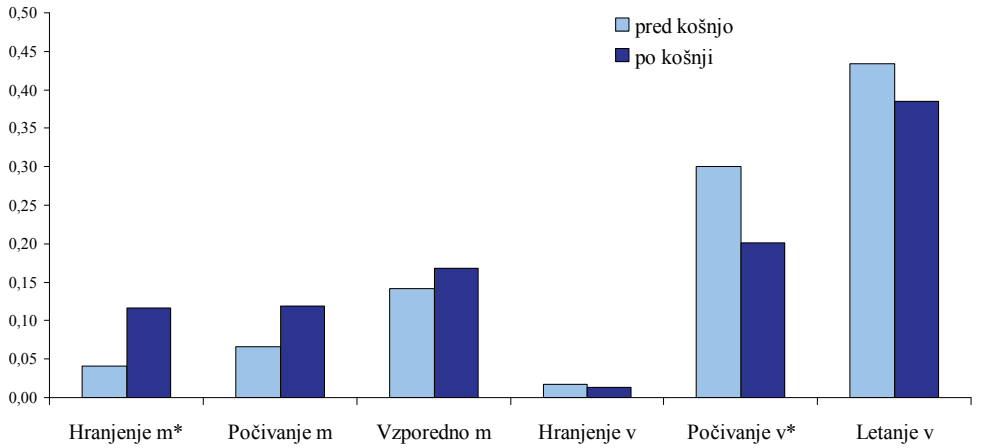
Na mejicah so bili deleži vedenj hranjenje, počivanje in letenje približno enako veliki, nasprotno pa je na pasu vegetacije ob mejici prevladovalo letenje (43% vseh vedenj na in ob mejici), zelo malo pa je bilo hranjenja (2%). Opažene so bile tudi razlike med razporeditvijo in vedenji posameznih vrst. Okar *M. galathea* (Linnaeus, 1758) je bil opažen skoraj izključno na pasu vegetacije ob mejici (91%), prevladovalo pa je letenje nad pasom vegetacije ob mejici (64%). Pri vrsti *M. jurtina* je bil delež opaženih osebkov na mejici višji (26%), delež letenja nad pasom vegetacije ob mejici in vzporedno z mejico pa za 22% nižji od povprečja ostalih vrst. Pri belinu *P. napi* je bil delež vedenj na mejici še višji (32%) predvsem zaradi velikega deleža osebkov, ki so letali vzporedno z mejico (20%). Velja izpostaviti, da je hranjenje na mejici pri posameznih vrstah in gledano v celoti (7%) prevladovalo nad hranjenjem na pasu vegetacije ob mejici (2%). Vedenje je bilo pogojeno tudi s habitatnim tipom (Sl. 4). Tako na delih trasektov ob habitatu pašnik hranjenje sploh ni bilo opaženo, izrazito pa je prevladovalo letenje (72%). Na mejicah ob habitatu mokrotni in šaši, je bila vloga mejic najmanjša (17%, 22% osebkov) zelo velik pa je bil delež počivanja v pasu vegetacije ob mejici.



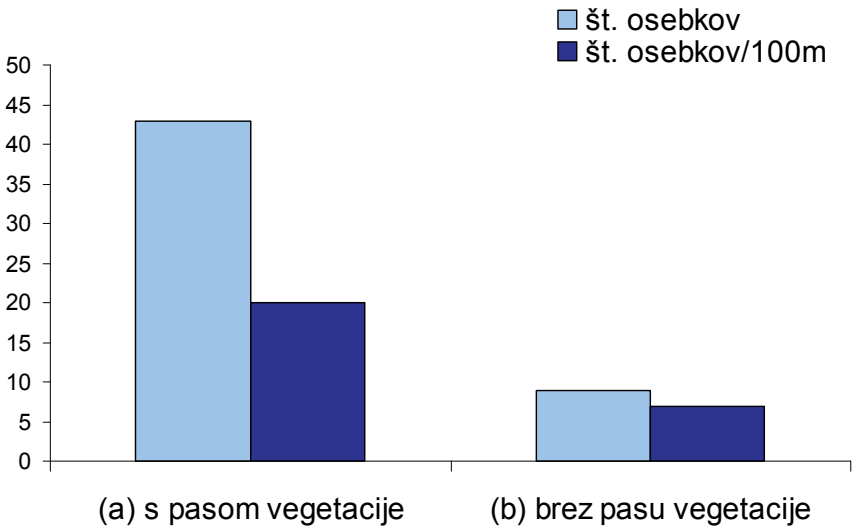
Slika 4. Razlike v vedenju dnevnih metuljev glede na habitatni tip ob mejici na Ljubljanskem barju. **M** je okrajšava za mejico, **v** pa za 2,5 metrski pas vegetacije habitatnega tipa ob mejici..
Figure 4. Differences in behaviour of butterflies in relation to habitat type along hedgerows of Ljubljansko barje. **M** stands for hedgerow and **v** for a 2,5 m strip of vegetation along its edge.

Skupni delež osebkov na mejicah se je s 25% pred košnjo povečal na 40% po košnji (Sl. 5). Predvsem se je zaradi pomanjkanja nektarskih rastlin in zatočišča povišal delež hranjenj in počivanj na mejici. Razlike v vedenju pred in po košnji so bile statistično značilne za skupni delež vedenj osebkov na mejicah (p=0,057), hranjenje na mejici (p=0,054) in počivanje na 2,5-metrskem pasu vegetacije ob mejici (p=0,079). Vrstna pestrost na mejicah se je po košnji minimalno povečala, na travniku pa zmanjšala za 40%.

Pomen pasu vegetacije med njivo in mejico smo ugotavljali na transektu 8 (Sl. 6). Ugotovili smo velike razlike v številčnosti osebkov na 100 m z razmerjem 1:3 v prid njive s pasom nekošene vegetacije. Pri vrstni pestrosti so bile razlike manjše, kar je povezano z majhno pestrostjo in veliko mobilnostjo večine v habitatu njive opaženih vrst.



Slika 5. Spremembe vedenj dnevnih metuljev na mejicah Ljubljanskega barja pred in po košnji. Zvezdica označuje vedenje, kjer so razlike statistično značilne. **m** je okrajšava za mejico, **v** pa za 2,5 metrski pas vegetacije ob mejici.
Figure 5. Changes in behaviour of butterflies on hedgerows on Ljubljansko barje before and after the mowing. Asterix delineates behaviours with statistically significant changes. **m** stands for hedgerow and **v** for a 2,5 m strip of vegetation along its edge.



Slika 6. Število osebkov in vrst dnevnih metuljev preračunano na 100 metrov njive ob mejici na Ljubljanskem barju: (a) med njivo in mejico je prisoten 2,5 metrski pas vegetacije, (b) med njima ni pasu vegetacije.
Figure 6. Number of specimens and species calculated on 100 meters of arable field along hedgerow on Ljubljansko barje: (a) a 2,5 m strip of vegetation is present between hedgerow and arable field, (b) no vegetation is present between them.

Diskusija

Favna metuljev Ljubljanskega barja je zaradi bližine Ljubljane med najbolj raziskanimi v Sloveniji (Hafner 1909, Verovnik 2001, Škvarč 2002). Skupno število se je z nekaj novimi podatki (Verovnik, lastna opažanja) tako povzpelo že čez 90 vrst. Razlogov, da je bilo tekom raziskave opaženo manj kot polovica vseh vrst, je več. Najpomembnejši je zagotovo geografska omejitev raziskave na manjše območje, ki ne zajema vrstno najbogatejših apnenčastih osamelcev na južnem robu Ljubljanskega barja (Verovnik 2001). Drugi razlog je metodološki, saj natančno opazovanje transekta ne dovoljuje opazovanja širše okolice, metulji na in v mejici pa so slabše opazni. Tretji razlog pa je bila izjemno neugodna sezona z dolgimi obdobji slabega vremena. To je najverjetneje tudi razlog za tako izrazito dominantno pojavljanje *M. jurtina* v tej sezoni. Tudi v raziskavi v Veliki Britaniji so ugotovili, da se ob mejicah v večjem številu pojavlja le nekaj vrst, druge pa so redke (Dover & Sparks 2000).

Pomen mejic za dnevne metulje v Sloveniji smo skušali ovrednotiti s popisovanjem vedenja osebkov na mejici v primerjavi s pasom vegetacije ob njej. Na ta način smo ugotovili, da so dnevni metulji trikrat pogostejši na bližnjih travniških površinah, kar je v nasprotju z raziskavami v Veliki Britaniji (Dover et al. 2000, Croxton et al. 2004) in Franciji (Ouin & Burel 2002). Pri omenjenih raziskavah so mejice mejile na njive in intenzivno gojene travnike, ki so favnistično in floristično bistveno manj pestri od ekstenzivnih vlažnih travnikov na Ljubljanskem barju. Prisotnost nektarskih in ovipozicijskih rastlin pa je zagotovo najpomembnejši dejavnik, ki vpliva na razširjenost in razporeditev metuljev. To je razvidno tudi iz razporeditve metuljev na transektih na Ljubljanskem barju, saj je bilo na habitatnih tipih z nizko pestrostjo rastlinskih vrst (pašnik in njiva) opaženo približno sedemkrat manj osebkov in trikrat manj vrst kot na transektih z ekstenzivnimi vlažnimi travniki (nižinski in mokrotni). Tudi združbe dnevnih metuljev v različnih habitatnih tipih (Sl. 3) so razločno deljene na tiste na ekstenzivnih travnikih in tiste na območjih z intenzivnim kmetijstvom.

Razlika med mejicami in travniško vegetacijo je razvidna tudi iz vrstne sestave in pestrosti dnevnih metuljev. Tako so na mejicah prevladovale splošno razširjene in pogoste vrste, ter mobilne vrste, ki so mejice uporabljale kot koridorje. Slednje je razvidno predvsem iz prisotnosti vrst na mejicah ob habitatnih tipih njiva in pašnik, kjer prehranjevalnih habitatov za metulje skoraj ni. Dunning et al. (1992) ter Dover & Sparks (2000) so ugotovili, da dnevni metulji v za njih manj primernem okolju mejico uporabljajo kot koridor za prehod med habitatnimi krpami.

Vedenjski vzorci na mejicah se razlikujejo od vrste do vrste in so pogojeni predvsem s prisotnostjo nektarskih rastlin na ali ob mejici. Prisotnost cvetočih rastlin je bilo v primeru raziskave v Angliji povezano predvsem s škropljenjem z insekticidi in herbicidi do mejice ali pa s 5 m pufrsko cono, ki je omogočala rast travniških rastlin. Na mejicah z ohranjenim pasom vegetacije je bilo opaženo bistveno več hranjenja, na škropljenih robovih mejic pa pri večini vrst le letenje (Dover 1997). Tudi na mejicah Ljubljanskega barja so bili vedenjski vzorci vrstno in habitatno specifični. Na floristično osiromašenih habitatih, kot sta pašniki in njive, smo opazili večinoma le prelete metuljev, drugih vedenj pa bolj malo (Sl. 4). Med pogostejšimi vrstami je bilo opazno izrazito manjše število letečih osebkov pri okarju *M. jurtina* kot pri drugih vrstah. Razlike so bile tudi v pestrosti vrst na robovih njiv s pasom vegetacije in tistimi, kjer so njive segale do mejice (Sl. 6). Na slednjih je bilo opaženo trikrat manj osebkov, kar potrjuje pomembno vlogo ohranjanja vegetacije ob njivah za žuželke.

Vlogo mejic kot zatočišče in prehranjevalni habitat smo potrdili na pokošenih travnikih, kjer so se metulji zaradi pomanjkanja nektarskih rastlin umaknili na mejice. To se je odražalo tudi v vedenju metuljev, saj se je statistično značilno povečalo hranjenje in počivanje na mejicah, ter zmanjšalo počivanje ob mejicah. Zanimivo je, da se pri tem pestrost vrst na mejici ni povečala kljub drastičnemu zmanjšanju pestrosti na pasu vegetacije. To dokazuje, da se specializirane travniške vrste po košnji umaknejo na druge ustrezne travnike in se ne zadržujejo na mejicah.

Mejice na Ljubljanskem barju imajo v primerjavi z raziskavami v zahodni Evropi precej manj vidno vlogo pri ohranjanju pestrosti dnevnih metuljev. To je povezano predvsem z ohranjenostjo ekstenzivnih travnikov ob mejicah na Ljubljanskem barju, ki so pomemben habitat za specializirane travniške vrste metuljev. Žal so mejice v slovenski kulturni krajini zelo redke in jih na območjih z intenzivnim kmetijstvom skoraj ni več, zato območja raziskave ni bilo mogoče izbrati v primerljivem intenzivno obdelovanem okolju. Tudi pri nas smo ugotovili, da imajo mejice pomembno vlogo za metulje kot koridorji, ki povezujejo ustrezne travniške habitate in nadomestni habitat za nekatere manj specializirane vrste v času po košnji. Zaradi tega je tudi z vidika varstva metuljev ohranjanje in obnavljanje mejic nujno.

Summary

Ljubljansko barje is one of the best studied regions in Slovenia regarding butterflies (Hafner 1909, Verovnik 2001, Škvarč 2002). The total number of species is just over 90 (Verovnik, personal observations), with many species limited to calcareous outcrops at the southern edge of the area. Hedgerow importance for butterflies in Slovenia was evaluated by recording different behavior types (feeding, flying, resting) on the hedgerows and adjacent 2.5 m strip of grassland. Less than 50% species recorded during the study could be explained by geographically restricted sampling area, the transect method itself and extremely poor season with long periods of rainy and cold weather. This is possibly one of the reasons why meadow brown (*M. jurtina*) was such a dominant species. Similarly Dover & Sparks (2000) have found that dominance of few species is one of the characteristics of hedgerows in the UK.

The butterflies were in general three times commoner on the grasslands than along the hedgerows, which is opposite to studies in the UK (Dover et al. 2000, Croxton et al. 2004) and France (Ouin & Burel 2002). These studies however were carried out in more intensive farmland with faunistically and floristically much more impoverished grasslands compared to unimproved wet grasslands dominating the study site in Ljubljansko barje (Fig. 1). Within the study area there was a significant difference in spatial distribution of butterflies among different habitat types. The intensively farmed habitats (arable land, intensive pastures) had seven times less specimens and three times less species as unimproved grasslands. This was confirmed also by partitioning butterfly associations on unimproved habitats group and others in dendrogram (Fig. 3) based on Renkonen numbers.

The butterfly fauna of hedgerows and adjacent grassland strips was also different in species composition, with many specialized grassland species not present along hedgerows at all. Hedgerows were utilized mainly by the most common and mobile species, which use them as flying corridors. This is well exemplified by the presence of such species along hedgerows bordering arable fields and intensive pastures, where feeding habitats are almost entirely lacking. Dunning et al. (1992) and Dover & Sparks (2000) have noted that butterflies in less favorable habitats use hedgerows as corridors for moving from one habitat patch to another.

Behavioral patterns of butterflies on hedgerow differ from species to species and are conditioned by the presence of oviposition and nectaring plants. In England the presence of nectaring sites was linked to the presence of conservation headlands along arable fields. Flying was dominant behavior for most of the studied species along hedgerows that were sprayed by herbicides to the edge and was less prominent on conserved headlands (Dover 1997). Similarly on Ljubljansko barje flying was dominant on floristically impoverished habitats (arable land, pastures) (Fig. 4). There was an evident difference between hedgerows adjacent directly to arable fields and those with headlands where three times more specimens were observed (Fig. 6).

The importance of hedgerows as shelter and nectar source for butterflies was revealed on mown grasslands, where statistically significant increase in feeding and resting on hedgerows, and decrease in resting on grasslands was observed. Despite 40% decrease of species diversity on grasslands the diversity on hedgerows increased only slightly. This could be explained by presence of specialized grassland species that do not utilize hedgerows and have migrated to other suitable grasslands.

Hedgerows in Slovenia have a less prominent role in butterfly conservation as in Western European countries. This could be partially explained by the choice of the study area which is dominated by unimproved butterfly rich wet grasslands. Unfortunately there are almost no hedgerows left in more intensively used farmland in Slovenia and we could not select a more appropriate site for comparison. The role of hedgerows as corridors and surrogate habitat after mowing was confirmed also in Slovenia, therefore maintenance and restoration of hedgerows should be an important part of butterfly conservation efforts.

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On the distribution and status of *Carcharodus lavatherae*, *Pyrgus carthami*, and *P. serratulae* (Lepidoptera: Hesperiidae) in Slovenia

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Abstract. A detailed survey of the publications and main Slovenian collections showed that only limited information on the distribution of *Carcharodus lavatherae*, *Pyrgus carthami*, and *Pyrgus serratulae* is available. Within the framework of the Slovenian butterfly atlas survey, several additional records have been gathered during the past two decades. *C. lavatherae* was found in four separate areas, but the knowledge about its threat status and habitat preference is still insufficient due to the scarcity of the encounters. The distribution of *Pyrgus carthami* in Slovenia is much more limited than considered by previous authors. All confirmed records are confined to southwest Slovenia, where the main strongholds are the south facing slopes north of the Vipava valley and western part of the Kras plateau. The large number of unpublished records is somewhat masking the actual decline of the species in Slovenia. *P. serratulae* is the most enigmatic of the three species with numerous published records but no vouchers that could verify its presence in Slovenia. The discovery of the species in the Poček military area is the first confirmed observation in Slovenia, putting this species right to the top of the conservation priorities in butterflies.

Key words: butterflies, Skippers, habitat, endangerment, Rhopalocera

Izvleček. O POJAVLJANJU *PYRGUS SERRATULAE* Z DODATNIMI INFORMACIJAMI O REDKIH DEBELOGLAVČKIH (LEPIDOPTERA: HESPERIIDAE) V SLOVENIJI - Kljub natančnemu pregledu literature in pomembnejših zbirk metuljev v Sloveniji je le malo znanega o razširjenosti treh preučevanih vrst *Carcharodus lavatherae*, *Pyrgus carthami* in *Pyrgus serratulae*. V zadnjih dveh desetletjih je bilo zbrano veliko število novih najdb, deloma tudi v okviru raziskav za atlas dnevnih metuljev Slovenije. *C. lavatherae* je bil najden na štirih ločenih območjih, vendar je poznavanje njegove ogroženosti in izbire habitatov zaradi majhnega števila opazovanj še vedno pomanjkljivo. *Pyrgus carthami* ima v Sloveniji veliko bolj omejeno razširjenost kot jo opisujejo prejšnji avtorji. Vsi potrjeni podatki so namreč iz jugovzhodne Slovenije, kjer je vrsta najbolj razširjena na pobočjih severno od Vipavske doline in na Komenskem krasu. Veliko število neobjavljenih podatkov deloma zakriva dejansko upadanje številčnosti vrste v Sloveniji. Najbolj skrivnostno pa je pojavljanje *P. serratulae* v Sloveniji, saj kljub velikemu številu objavljenih podatkov v zbirkah ni bil najden niti eden dokazni primerek. Tako lahko odkritje te vrste na vojaškem poligonu Poček jemljemo kot prvo potrjeno najdbo za Slovenijo. S tem se je *P. serratulae* znašel prav pri vrhu seznama najbolj ogroženih vrst metuljev v Sloveniji.

Ključne besede: dnevni metulji, debeloglavčki, habitat, ogroženost, Rhopalocera

Introduction

Butterflies are one of the best studied groups of insects. Their distribution and ecology at regional or country scale are well known, especially in Europe. Skippers, however, are an exception, as they are less attractive for amateur lepidopterists based on inconspicuous coloration, small size, fast flight and problematic identification. Apart from a few easily recognizable species, their distribution is usually less known and regularly obscured by erroneous records. Among the especially troublesome in Europe are the species of the genera *Pyrgus* and *Carcharodus*, which differ only in minor details in wing pattern and coloration. There are also species groups in both genera where dissection of genitalia is necessary to confirm determination.

The last published list of butterflies available for Slovenia (Carnelutti 1992a) included 23 species of the family Hesperiidae. Three species *Pyrgus cacaliae* (Rambur, 1839), *Pyrgus onopordi* (Rambur, 1839) and *Pyrgus sidae* (Esper, 1784) are considered extinct. Their presence in Slovenia is based on literature records from the 19th and beginning of the 20th century (Mann 1854, Hafner 1912, Carnelutti 1955). As these records could not be verified, their former occurrence in Slovenia is questionable. None of the mentioned species was found in a survey of the two largest butterfly collections in Slovenia: one at Slovenian Academy of Sciences and Arts (SAZU), Biological Institute, and Slovenian Natural History Museum (PMS).

During the last years, extensive field work has been carried out throughout Slovenia to collate records for the Slovenian butterfly atlas. These have shown much a more limited range for some skipper species than was indicated by Carnelutti (1992a) for biogeographical regions of Slovenia. The three species presented here in detail, *Carcharodus lavatherae* (Esper, 1783), *Pyrgus carthami* (Hübner, 1813), and *Pyrgus serratulae* (Rambur, 1839), all have a very limited distribution in Slovenia. Actually no material supporting the presence of *P. serratulae* in Slovenia was found in the studied collections, despite numerous published records (Hornig 1854, Galvagni 1909, Carnelutti & Michieli 1966, Carnelutti 1979, Carnelutti 1992a, Withrington 2001 and 2003, Phillips & Pickles 2007). *C. lavatherae* was always rare in Slovenia with only handful of records in the literature (Hafner 1909, Stauder 1923, Carnelutti 1979 and 1992b). *P. carthami*, however, was described as common and widespread in the SW part of Slovenia (Primorska) in older publications (Mann 1854, Hafner 1910, Stauder 1923), followed also by Carnelutti (1992a) who indicates widespread occurrence of this species in Slovenia. Surprisingly, the revision of major collections in Slovenia revealed that it was collected only at few sites in the Primorska region. Due to possible large scale declines suggested by the

comparison of the published and recent records, *C. lavatherae* (E - threatened) and *P. carthami* (V - vulnerable) have been included in the red list of Slovenia (Uradni list RS, No. 82/02).

Unpublished records

Carcharodus lavatherae (Marbled Skipper, čišljakov ostrozob)

Records are confined to four separate areas in SW Slovenia on or within close proximity of south facing slopes of Gora, Nanos, Vremščica and Volovja reber Mts. (Fig. 1).

1. date: 9.6.1999, locality: Vipava, Poreče, southern part of Mlake military area, altitude 130 m; Verovnik R.
2. date: 16.6.2001, locality: Vipava, Poreče, northern part of Mlake military area, altitude 130 m; Verovnik R.
3. date: 12.6.2002, locality: Ajdovščina, along the river Hubelj 400 m north of Hubelj hydroelectric power station, altitude 120 m; Kosmač M.
4. date: 8.6.2003, locality: Pivka, Volče, grasslands south of the village, bellow eastern slopes of Mt. Vremščica, altitude 620 m; Keymeulen A.
5. date: 6.7.2005, locality: Ilirska Bistrica, Mt. Volovja reber, eastern slopes of peak Lunjevica, altitude 1000 m; Lafranchis T.
6. date: 19.6.2006, locality: Vipava, Podnanos, on the lowest screes west of the road to Mt. Nanos, altitude 490 m; Verovnik R.
7. date: 19.6.2006, locality: Ajdovščina, at source of the river Hubelj, below the bridge and on a path on the western side of the stream, altitude 210-220 m; Verovnik R.
8. date: 21.6.2007, locality: Senožeče, Mt. Vremščica, north facing slope near ridge west of peak Čemparjev vrh, altitude 860 m; Zakšek V.

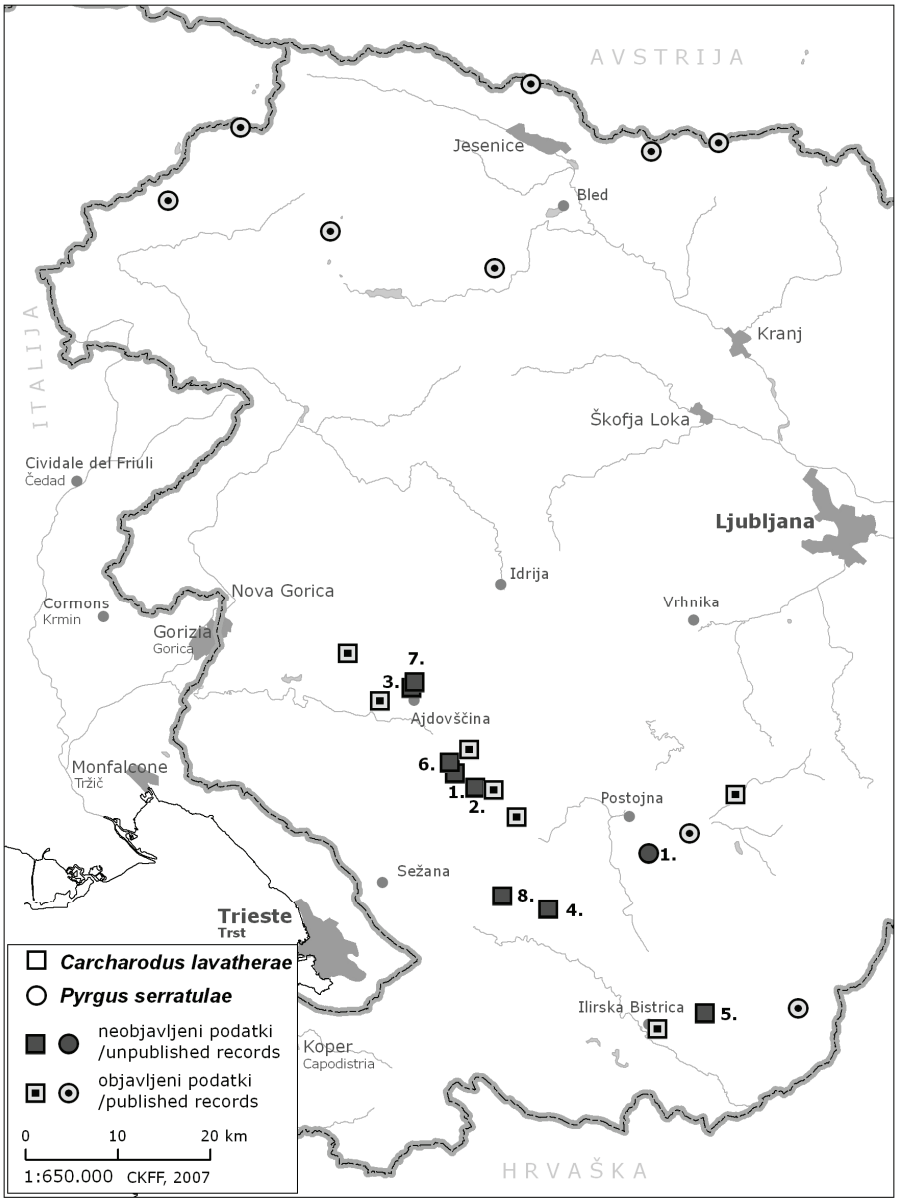

Figure 1. Distribution of *Carcharodus lavatherae* (Esper, 1783) and *Pyrgus serratulae* (Rambur, 1839) in Slovenia. The published records for *P. serratulae* could not be verified and should be considered questionable. The sites are numbered as in the list of the localities.

Slika 1. Razširjenost vrst *Carcharodus lavatherae* (Esper, 1783) in *Pyrgus serratulae* (Rambur, 1839) v Sloveniji. Objavljeni podatki o razširjenosti *P. serratulae* niso potrjeni, zato so te najdbe vprašljive. Lokacije so oštevilčene tako kot v seznamu lokalitet.

Pyrgus carthami (Safflower Skipper, veliki slezovček)

The species was recorded mostly on the south facing edge of the Trnovski gozd plateau and Komenski kras – western part of the Kras plateau. Some of these microlocalities were merged as they most likely represent sampling of the same population. Isolated records come from Mt. Nanos, surroundings of Postojna and Pivka to the east and sites near Divača and Rakitovec to the south (Fig. 2). Alltogether, 35 records of the species are listed.

1. date: 21.5.1989, locality: Nova Gorica, Renče, at village Mrljaki, altitude 50 m; Štanta R.
2. date: 23.5.1990, locality: Nova Gorica, Bilje, at village Frnaža, altitude 50 m; Štanta R.
3. date: 15.6.1990, locality: Kobjeglava, grasslands near Jelenca hill, altitude 290 m; Štanta R.
4. date: 30.6.1990, locality: Kostanjevica na Krasu, Temnica, altitude 390 m; Štanta R.
5. date: 14.5.1991, locality: Kostanjevica na Krasu, Lipa, top of Mt. Trstelj, altitude 670 m; Štanta R.
6. date: 22.6.1991, locality: Kozina, Petrinje, altitude 430 m; Štanta R.
7. date: 26.6.1992, locality: Ajdovščina, Čaven, upper slopes of Mt. Kucelj, altitude 1100 – 1237 m; Štanta R. Subsequent records: 1.7.1993, Štanta R.; 19.7.1995, Verovnik R.; 25.7.1998, Verovnik R.; 25.6.1999, Verovnik R.; 7.7.2000, Verovnik R.; 17.7.2004, Štanta R.; 27.6.2005, Štanta R.
8. date: 1.7.1993, locality: Ajdovščina, Čaven, south facing slopes bellow Čaven chalet towards peak Mala Gora, altitude 1100-1200 m; Štanta R. Subsequent records: 4.7.1994, Štanta R.; 6.7.2000, Valič P.
9. date: 25.6.1998, locality: Ajdovščina, Kovk, grasslands on the eastern slopes of peak Sinji vrh, altitude 920 – 980 m; Verovnik R.
10. date: 25.6.1998, locality: Ajdovščina, Gozd, grasslands near ridge at farm Krog, altitude 860 – 880 m; Verovnik R.
11. date: 4.6.2000, locality: Vipava, Podnanos, Mt. Nanos at Lanišče, altitude 950 m; Štanta R.
12. date: 4.6.2000, locality: Vipava, Podnanos, Mt. Nanos, in the valley northeast of Šembijska bajta, altitude 800 m; Štanta R.
13. date: 6.6.2000, locality: Kozina, Vrhpolje, at top of the Golič peak, altitude 600 m; Verovnik R.
14. date: 29.5.2001, locality: Divača, Matavun, above road on the western slopes of dolina Globoček, altitude 415 m; Čelik T.
15. date: 24.6.2001, locality: Rakitovec, Zazid, near Zazid railway station, altitude 510 m; Verovnik R.

16. date: 16.6. 2002, locality: Gorjansko, Brestovica, Možci, altitude 100m; Štanta R.
17. date: 1.7.2002, locality: Kostanjevica na Krasu, Mali Dol, grasslands east of the road on the Komenšček plateau, altitude 270 m; Valič P. Subsequent records: 12.6.2005, Polak S.; 10.6.2006, Polak S.
18. date: 5.7.2002, locality: Kostanjevica na Krasu, Škofi, grasslands near road south of the village, altitude 210 m; Valič P.
19. date: 21.6.2005, locality: Nova Gorica, Trnovo, grasslands west of the village, altitude 700 m; Lafranchis T.
20. date: 9.6.2006, locality: Sežana, Orlek, meadow southeast of the village, altitude 360 m; Verovnik R.
21. date: 10.6.2006, locality: Rakitovec, grasslands on the slopes of Mt. Lipnik northwest of the village, altitude 580 m; Zakšek V.
22. date: 11.6.2006, locality: Divača, Lokev, top of the Mt. Jirmanec, altitude 660 m; Čelik T.
23. date: 28.6.2006, locality: Pivka, Volče, grasslands south of the village, bellow eastern slopes of Mt. Vremščica, altitude 620 m; Verovnik R.
24. date: 27.6.2007, locality: Postojna, Poček military area, small valley east of Grmača hill, altitude 560 m; Verovnik R.

***Pyrgus serratulae* (Olive Skipper, olivni slezovček)**

Two specimens seen in the largest Slovenian military area east of Postojna are the first confirmed records for Slovenia.

1. date: 6.7.2007, locality: Postojna, Poček military area, southern slopes of Praprotna reber, altitude 670 m; Verovnik R.

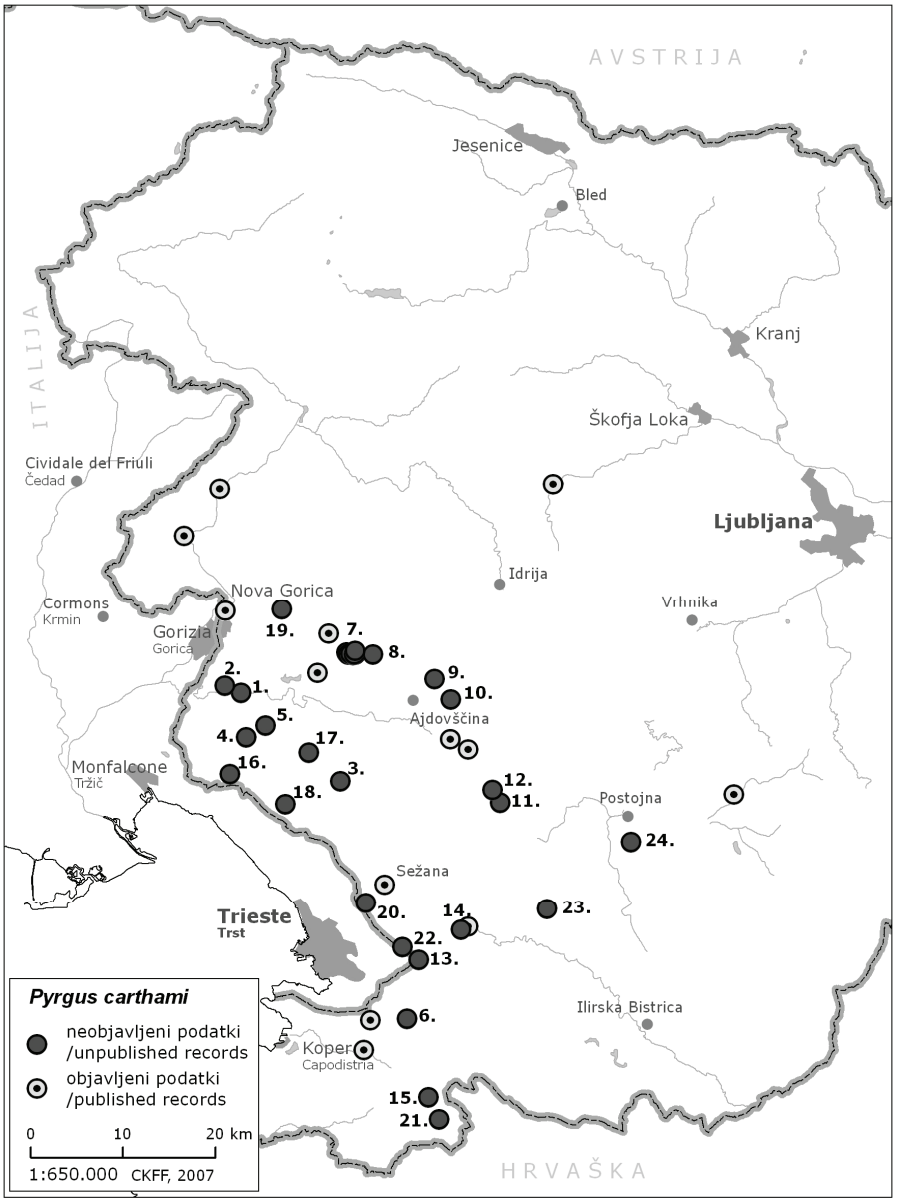

Figure 2. Distribution of *Pyrgus carthami* (Hübner, 1813) in Slovenia. The sites are numbered as in the list of the localities. The spots at site No. 7 reperesent microlocalities at this site.

Slika 2. Razširjenost *Pyrgus carthami* (Hübner, 1813) v Sloveniji. Lokacije so oštevilčene tako kot v seznamu lokalitet. Večje število točk pri št. 7 prikazuje pozicijo mikrolokacij, ki so v seznamu združene.

Discussion

Despite broader objectives of the survey for the Slovenian butterfly atlas, many interesting rare species were recorded. This is certainly true for the three studied skippers, which have not been searched for specifically at those sites. Given the limited information available from collections and scarcity of published records, the new finds substantially increase the knowledge about their distribution and habitat preferences in Slovenia.

Distribution and status of *C. lavatherae*

The new records for *C. lavatherae* did not extend its known range in Slovenia as they are all sandwiched between historical finds at Ilirska Bistrica in the southeast (collected by Hafner J. in 1911; PMS) and Mt. Čaven in the northwest (collected by Michieli Š. in 1966; PMS). According to Carnelutti (1979, 1992a, b), the Marbled Skipper was observed also near Cerknica northeast of the known range and even in the Dolenjska region in the southeastern part of Slovenia. As *C. lavatherae* is a habitat specialist of rich, flowering rocky calcareous grasslands (Pro Natura – SBN 1997, Huemer 2004, Slamka 2004), there are hardly any suitable habitats left for the species outside the Primorska region. Therefore, the presence of this species in Dolenjska without voucher specimens and no information on the exact localities is questionable.

One of the possible strongholds of the species is Mt. Nanos, especially the south facing slopes above the Vipava valley. It has been observed or collected there by Mann in 1854 (Mann 1854), Karlinger in 1902, Preissecker in 1907 (both reported by Hafner 1909), Michieli in 1955 (PMS), and recently confirmed by records from Mlake and the southern slopes. Mlake military area is situated at the base of Mt. Nanos and butterflies were seen on two occasions mud puddling at two different sites far from presumed larval habitat. Although small stands of *Stachys recta* L. occurred in the vicinity, no larvae were found despite intensive search. Due to the current motorway constructions and modernization of the shooting range, most of the area, including the mud puddling sites, was destroyed. The female observed on the southern slopes was nectaring on larval food plants on isolated scree in the middle of the forest, confirming that the species still persists on Mt. Nanos. Due to contiguous natural reforestation,

suitable patches for larval development will become fewer and smaller, making a long term survival of the species in this area questionable.

The site near Ajdovščina along the river Hubelj is also a mud puddling area as there are no larval food plants in the vicinity and butterflies were always seen on or near moist sands. The butterflies possibly descend from the screes of Mt. Gora, which are almost inaccessible and have not yet been surveyed. The scarcity of the observations (only three specimens) indicates that the population here is small and natural succession is again possibly the major threat for this population. Other sites in Vipava valley, where this species has been observed in the past, were also checked, but without any success.

Mt. Vremščica forms the next ridge southeast of Mt. Nanos and the species was discovered here only recently. However, most of the grasslands here are either intensively pastured or abandoned, so there is little suitable habitat left for the species. The situation near Volče east of the main ridge is even worse as the abandoned calcareous grasslands are now almost entirely overgrown. *P. carthami* still survives here on steeper rocky south facing slopes of small dolinas. After a short gap, a ridge continues in same general direction with Volovja reber. Some parts of the area there, especially near the actual observation site, still provides best possible habitat with abundant larval food plant, rocky south facing slopes and abundance of nectaring plants. Lower parts of these slopes, which are now mostly covered by forest, were a possible collecting site of the Hafner J. specimen labelled 'Ilirska Bistrica' (PMS), as this is the nearest large town situated just below the slopes. These slopes are among the most butterfly rich areas in Slovenia and were visited on several occasions, but no further specimens of *C. lavatherae* were found.

The Marbled Skipper is considered a sedentary species with males occupying and defending their territories (Pro Natura – SBN 1997), but they are also very strong flyers capable of flying long distances away from their larval habitat (pers. observ.). Combined with predominantly whitish colour, they are extremely hard to spot or follow, making it one of the hardest species to detect. Despite being possibly underrecorded, the species is extremely rare in Slovenia and its potential larval habitats are disappearing rapidly, therefore the red list status as threatened species (E) is adequate. The closest known populations are in South

Tyrol (Reichel 1992, Huemer 2004) in Italy and in Lower Austria in the northeast of the country (Reichel 1992, Höttinger & Pennerstorfer 1999). In Lower Austria, the species is nearly extinct (Höttinger & Pennerstorfer 1999), with a possibly single population surviving in the Wachau valley (Höttinger, pers. observ.).

Distribution and status of *P. carthami*

The main dilemma when describing the distribution of Safflower Skipper in Slovenia arises from Carnelutti's list (1992a) who describes the species as common or at least present in all Slovenian biogeographic regions. This is highly contrasted with available published and collection records indicating a much more limited range with only two records outside the Primorska region at Trebija in the Idrijsko-Cerkljansko region (Withrington 2003) and Cerknica in Notranjska (Carnelutti 1979), again without exact locality. How this wider distribution was obtained, is still a mystery and would require further investigation. The large number of unpublished records confirms well with the older reports (Mann 1854, Hafner 1910, Stauder 1923), presenting the species as common and widespread. But this is not entirely true as the species has not been mentioned from some of the sites discovered in the nineties, furthermore most of the records are based on single or few specimen observations in suboptimal already partially overgrown dry calcareous grasslands.

The only evident stronghold of the species in Slovenia is the Mt. Kucelj area (Verovnik 2000), where it can be abundant at peak flight season. It is much sparser further to the southeast on the ridges of Gora and Nanos Mts., where it has not been seen in the past five years. It is likely that small populations still exist in this region, as suitable habitats are widely available. In this respect, the situation on the Kras plateau is much worse with only few remaining dry calcareous grasslands suitable for the species. Both abandonment, causing swift encroachment of bushes, and fertilization pose great threats to the survival of P*. carthami* in this region. If this trend continues, the species will shortly disappear in more than half of the known range in Slovenia.

Among three outlying records, the site at Lipnik on the southern edge of the Kras plateau is the most promising with large areas of suitable open dry calcareous grasslands. Mapping of the detailed distribution of the Safflower Skipper in this region could be rewarding. The sites at Volče and near Postojna are possibly at the lower threshold of survivor of the species with dominant bush coverage and suitable habitats limited to small patches on steep slopes of small dolinas. It is very unlikely that these populations will survive the next decade, unless there are unknown more suitable habitats in the vicinity. The populations in Slovenia seem isolated, as there are no records from northeast Italy and southern Austria (Reichel 1992). *P. carthami* is therefore one of the most threatened skippers in Slovenia and should be considered threatened (E) in the next red list proposal.

On the presence of *Pyrgus serratulae*

One of the most intriguing questions regarding skippers in Slovenia is the presence and distribution of the Olive Skipper (Fig. 1). It was first mentioned by Hornig (1854) for summits of Mt. Rombon and Mt. Mangart in the western Julian Alps. Galvagni (1909) found it on Mt. Golica in the Karavanke Mts. and Carnelutti & Michieli (1966) found it in the central Julian Alps. The first two records were proven hard to verify as no material of this species from Slovenia was found in the Vienna Natural History Museum, hosting many important old collections partially covering Slovenian territory. However, both Golica and Mangart are among the easily accessible high alpine localities that have been surveyed many times in the past two decades. The only skippers observed there were the specimens of the alpine form of *Pyrgus alveus* (Hübner, 1803) and on Mangart also *Pyrgus warrenensis* (Verity, 1928) (pers. observ.). In the collection of Carnelutti at SAZU and Michieli's collection in PMS no *P. serratulae* was found from Slovenia, but there were several alpine forms of *P. alveus* collected at or near the site reported for *P. serratulae*. A possible misidentification is even more plausible as they reported *P. alveus* only from a lowland locality near Bohinj Lake. Records of Withrington (2001, 2003) refer to single female collected near Rakitna south of Ljubljana basin. After careful examination it turned out to be *P. alveus* again. The last published records by Phillips & Pickles (2007) referring to observations in the coastal region in 2003 are also highly suspicious due to other even more evident identification errors in their species list. Thus, there

was little hope that situation would ever be solved and the species was on the way out of the Slovenian species list.

It was a great surprise to finally find the species flying in one of the less accessible parts of Slovenia – the Poček military area. This brings us to the last unverified report by Carnelutti (1979) who describes the species as rare on the summits of Javorniki Mts. and Mt. Snežnik above 1000 m. Without voucher specimens, these records were considered doubtful, but in the perspective of this new discovery they seem more likely as Poček covers, in part, the southwestern slopes of Javorniki Mts. Most of the higher peaks of Javorniki were grazed in the past and could provide habitat for *P. serratulae*.

The two specimens were observed on rich flowering slopes above the main airplane target area, which is occasionally exposed to fires caused by shelling. Actually the exact site where *P. serratulae* was flying showed sings of recent burns. The military activities certainly have a positive effect on grassland species like butterflies, as they maintain great diversity of habitats in different succession stages and barren grounds frequented by many rare species for thermoregulation and mineral uptake. The potential habitat of Olive Skipper in this area is partly secured by their activities and still extensive, but further studies will be necessary to determine more precise distribution of the species. Being currently known only from a single site, the species should be considered highly threatened in Slovenia. The closest known populations are in the Austrian part of Styria (Meier 1963, Habeler 1965) and northern Carinthia (Habeler 1990, Huemer *et al*. 2001) mainly in the non-calcareous Alps and adjacent montane region. According to Reichel (1992), there are no records from northeast Italy as far westwards as South Tyrol. Other higher peaks and ridges on the Kras plateau should be next to search for this elusive species in Slovenia

Povzetek

Dnevni metulji so med najbolj raziskanimi skupinami žuželk v večjem delu Evrope, kar pa le deloma velja za debeloglavčke. Ti so namreč manj opazni, težavni za določanje in hitri, zaradi tega pa tudi manj atraktivni za amaterske lepidopterologe. Posledica tega je slabše poznavanje njihove razširjenosti in številne napačne določitve ter nepotrjene literaturne navedbe. V Sloveniji je po Carneluttijevem seznamu (Carnelutti 1992a) 23 vrst debeloglavčkov, od katerih so tri vrste, in sicer *Pyrgus cacaliae* (Rambur, 1839), *Pyrgus onopordi* (Rambur, 1839) in *Pyrgus sidae* (Esper, 1784), že izumrle. Te vrste navajajo nekateri starejši viri (Mann 1854, Hafner 1912, Carnelutti 1955), pri katerih pa je preverjanje najdb nemogoče. Tudi o pojavljanju treh predstavljenih vrst *Carcharodus lavatherae* (Esper, 1783), *Pyrgus carthami* (Hübner, 1813) in *Pyrgus serratulae* (Rambur, 1839) je v Sloveniji zelo malo znanega in tudi marsikaj vprašljivega. Zaradi možnega zmanjšanja areala sta v Rdeči seznam Slovenije vključena *C. lavatherae* kot ogrožena (E) in *P. carthami* kot ranljiva vrsta (V) (Uradni list RS, št. 82/02).

Čišljakov ostrozob (*C. lavatherae*) je v Sloveniji redka vrsta in tudi nova opažanja temeljijo na opazovanju največ enega ali dveh osebkov. Vrsta je vezana na bogato cvetoče kamnite kraške travnike (Pro Natura – SBN 1997, Huemer 2004, Slamka 2004), ki v Sloveniji pospešeno izginjajo. Nove najdbe so umeščene med dve že znani lokaciji: Čavnom na severozahodu (Michieli Š. leta 1966; PMS) in Ilirsko Bistrico na jugovzhodu (Hafner J. leta 1911; PMS). Precej širši areal vrste v Sloveniji omenja Carnelutti (1979, 1992b), vendar pa so njegove navedbe za okolico Cerknice in Dolenjsko preveč splošne. Čišljakov ostrozob je bil doslej največkrat najden na južnih pobočjih Nanosa, če k temu prištevamo tudi vojaško strelišče Mlake na njegovem vznožju. Vrsta je bila opažena tudi ob potoku Hubelj, na ovršju in vzhodnem vznožju Vremščice ter na pobočju Lunjevice na Volovji rebri. Predvsem slednje se najbolj odlikuje po ohranjenosti habitata, primernega za *C. lavatherae*. Vrsta je zelo slabo opazna predvsem zaradi zelo hitrega leta in prevladujoče svetle obarvanosti. To otežuje nadaljnje raziskave, ki pa so vendarle nujno potrebne.

Največji razkorak med objavljeno razširjenostjo in dejansko ugotovljenimi podatki o razširjenosti je bil ugotovljen pri velikem slezovčku (*P. carthami*), ki naj bi bil po Carneluttiju (1992b) razširjen v vseh biogeografskih regijah Slovenije. Že pregled objavljenih podatkov in zbirk kaže popolnoma drugačno sliko, saj se vrsta zunaj Primorske pojavlja le pri Trebiji na Cerkljanskem (Withrington 2003) in pri Cerknici na Notranjskem (Carnelutti 1979), vendar v tem primeru spet brez natančne navedbe lokacije. Tudi neobjavljeni podatki potrjujejo zelo omejeno razširjenost te vrste v Sloveniji z dvema glavnima območjema razširjenosti: Komenskim krasom in pobočji Čavna, Gore in Nanosa nad Vipavsko dolino. Posamične najdbe so tudi s Kraškega roba, okolice Divače in dveh verjetno izoliranih populacij pri Pivki ob vzhodnem vznožju Vremščice in na vojaškem poligonu Poček blizu Postojne. V obeh primerih so suhi kraški travniki tu že v večji meri zarasli, zato je dolgoročno preživetje populacij vprašljivo. Podobne procese zaraščanja in deloma tudi intenziviranja kraških travnikov z uporabo gnojil je opaziti tudi na Komenskem krasu, zato veliki slezovček sodi med naše najbolj ogrožene debeloglavčke.

Olivni slezovček (*P. serratulae*) je zaradi podobnosti z drugimi vrstami iz rodu *Pyrgus* eden izmed najbolj skrivnostnih slovenskih debeloglavčkov. Kljub velikemu številu objavljenih podatkov o pojavljanju vrste od Karavank, Julijskih Alp, Javornikov, Snežnika do slovenske obale (Hornig 1854, Galvagni 1909, Carnelutti & Michieli 1966, Carnelutti 1979, 1992a, Withrington 2001, 2003, Phillips & Pickles 2007), v več kot desetletju intenzivnega iskanja v zbirkah in na terenu ni bil najden niti en dokazni primerek. Tako je bila vrsta skoraj že umaknjena s slovenskega seznama do presenetljivega odkritja dveh osebkov te vrste na vojaškem poligonu Poček v letu 2007. Oba osebka sta bila opažena na bogato cvetočem kraškem travniku, ki je pred nekaj leti pogorel. Travnik je namreč del pobočja nad osrednjim vojaškim območjem, kjer so cilji letalskega in topovskega obstreljevanja, zato so občasni manjši požari pogosti. Ravno vojaške aktivnosti so za travniške vrste metuljev zelo koristne, saj preprečujejo zaraščanje in tvorijo pester mozaik delno zaraščenih travniških površin. Potencialni habitat olivnega slezovčka je razmeroma obsežen in vsaj deloma zavarovan zaradi vojaških aktivnosti, vendar pa bo treba natančneje raziskati razširjenost vrste na tem območju. Ker je razširjenost *P. serratulae* v Sloveniji omejena zgolj na eno samo znano lokacijo, vrsta zagotovo sodi med naše najbolj ogrožene metulje.

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Records of Horvath's Rock Lizard (*Iberolacerta horvathi*) from the Notranjsko podolje region (central Slovenia)

NAJDBE HORVATOVE KUŠČARICE (*IBEROLACERTA HORVATHI*) NA OBMOČJU NOTRANJSKEGA PODOLJA

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In July 2006, a survey on the distribution of reptiles was carried out in the Notranjsko podolje region. Altogether, 7 species were registered. Most interesting were the finds of Horvath's Rock Lizard (*Iberolacerta horvathi*) whose distribution in Slovenia is relatively poorly known. Individual lacertids were captured or approached to a close distance and determined by the position of supranasal, frontonasal and rostral scales, according to the available determination keys (Tome 1999, Arnold 2004, Mršić 1997). Altogether, we found 23 individuals of Horvath's Rock Lizard at 6 localities around Cerknica, Rakek, and Planina: 6 males, 5 females, 8 adults (undetermined sex), 1 subadult, and 3 juveniles. We found them on rocky grounds in karst terrain, on walls of ruins and in a dry riverbed. The altitude of the localities ranged from 458 to 640 m and all of them were located in the same UTM square – VL47. At one location we captured both Horvath's Rock Lizard and Common Wall Lizard (*Podarcis muralis*) on the same wall. These data show that Horvath's Rock Lizard may be relatively common in the Notranjsko podolje region and that it also occurs at lower altitudes than at the minimum (650 m a.s.l.) reported by Tome (1996).

Horvath's Rock Lizard is a relict endemic species of the Alpine-Dinaric mountain range. It occurs in western Croatia, western Slovenia, north-eastern Italy, western Austria and southern Germany (Gasc *et al*. 1997). It is one of the least known species of lacertids in Slovenia. Previously it had been assumed that its distribution is limited to a high mountainous regions of the Julian Alps, Trnovski gozd and Mt. Snežnik (Brelih 1954, Tome 1996, Mršić 1997) and it is only in recent years that specimens have also been found outside this range in the Dinaric mountains (Tome 2001; V. Cafuta, A. Kapla, F. Kljun, M. Krofel, G. Planinc, S. Polak and A. Žagar, unpublished data). Thus the species may be much more widespread throughout the Dinaric range in Slovenia than suggested by current data, and additional surveys are needed.

Due to the similarities in coloration and habitat preferences of *I. horvathi* and *P. muralis*, it is usually necessary to catch an individual to determine the species. As it was thought in the past that Horvath's Rock Lizard is limited to the high regions of the Alps and Dinaric Mts., this species has often not been considered an option when determining lizards in the lower regions of the Dinaric range. Therefore some of the finds recorded as *P. muralis* might actually be *I. horvathi*. We recommend that additional care should be taken when determining the small lacertids, and that the position of snout scales should be inspected whenever possible. We also call attention to the fact that both species can occur sympatrically at the same locality. Therefore, each individual should be examined separately.

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Evidence of the Brown Bear (*Ursus arctos*) tracking the Eurasian Lynx (*Lynx lynx*) on the Snežnik plateau, Slovenia

OPAŽANJE SLEDENJA RJAVEGA MEDVEDA (*URSUS ARCTOS*) EVRAZIJSKEMU RISU (*LYNX LYNX*) NA SNEŽNIŠKI PLANOTI

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Between 27th and 30th January 2007, one of the authors (M.K.) was snow tracking a Eurasian Lynx (*Lynx lynx*), probably a male, over the Snežnik plateau of the northern Dinaric Mountains in Slovenia. Tracking data were obtained with the aid of a handheld GPS and all comments by the observer were recorded on a dictaphone. On the last day of tracking – it was near Ždrocle (1478 m a. s. l.) in the south-eastern part of the plateau – it was noticed that an adult Brown Bear (*Ursus arctos*) came upon a lynx track and started to follow it (Fig. 1). The bear clearly followed the lynx for 692 meters (Fig. 2). It kept close to its track all the way, except at two points, where a track of a Chamois (*Rupicapra rupicapra*) and a Wild Boar (*Sus scrofa*) crossed the lynx's track (points A and C in Fig. 2, respectively). The bear followed both tracks for a few meters, perhaps temporarily mistaking it for a lynx, but then returned and started to follow the lynx track again. Several more tracks of wild boars, chamois, and Red Fox (*Vulpes vulpes*) crossed the lynx path, but except for those two instances, the bear did not pay attention to them. At one point (B), the lynx turned around and back-tracked its own trail for 15 m, and the bear did the same. After tracking the lynx for almost 700 meters, the bear lay down, as was evident from the prints in the snow (D). Afterwards it headed due S-SW, leaving the lynx track, which continued due SE towards the Croatian border. Both tracks were fresh, less than 24 hrs old. From the overlapped footprints it could be ascertained that the bear had walked after the lynx. The width of the central (interdigital) pad on the fore foot of the bear was 14.5 cm. According to the correlation calculated from the data of culled bears in Slovenia (Slovenian Forest Service & Dept. of Biology, Biotechnical Faculty, unpublished data), this would correspond to a male bear, weighing approximately 170 kg (min-max: 110-260 kg).

Although it had been observed before that a brown bear followed a Eurasian Lynx track in Slovenia (F. Kljun, I. Kos, M. Krofel, T. Marinčič, unpublished data), to our knowledge this has never been suitably documented in the literature. Blažič (1997) reported on two instances of a bear walking along a lynx track at Velika gora near Ribnica, however, in these cases the bear walked in the opposite direction than the lynx.

Snow tracking in Sweden revealed that Wolverines (*Gulo gulo*) and red fox follow lynx track in order to locate and scavenge on its kill (Haglund 1996). It was also reported that Coyotes (*Canis latrans*) and red foxes often track Grey Wolves (*Canis lupus*) to their prey (Paquet 1991, Selva 2004). Searching for prey remains may also be the reason why bear followed lynx in our case. It is possible that the bear smelled a scent of carrion in the lynx footprints, as the lynx had earlier fed on a juvenile chamois, which it killed on a previous night. It is known that in Slovenia brown bears relatively often feed on carcasses of ungulates killed by Eurasian lynx (Krofel 2006). Preliminary results show that kleptoparasitism by brown bears may have an important effect on a predation rate of the Eurasian lynx in the northern Dinaric Mountains (Krofel *et al.*, in prep.). Further studies would be needed to determine how often bears find lynx prey by means of following their tracks.

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Figure 1. Footprints of the Eurasian Lynx (*Lynx lynx*) (left) and the Brown Bear (*Ursus arctos*) (right) on the Snežnik plateau, southern Slovenia, 30 Jan 2007 (photo: Miha Krofel).
Slika 1. Stopinji evrazijskega risa (*Lynx lynx*) (levo) in rjavega medveda (*Ursus arctos*) (desno) na Snežniški planoti, južna Slovenija, 30.1.2007 (foto: Miha Krofel).

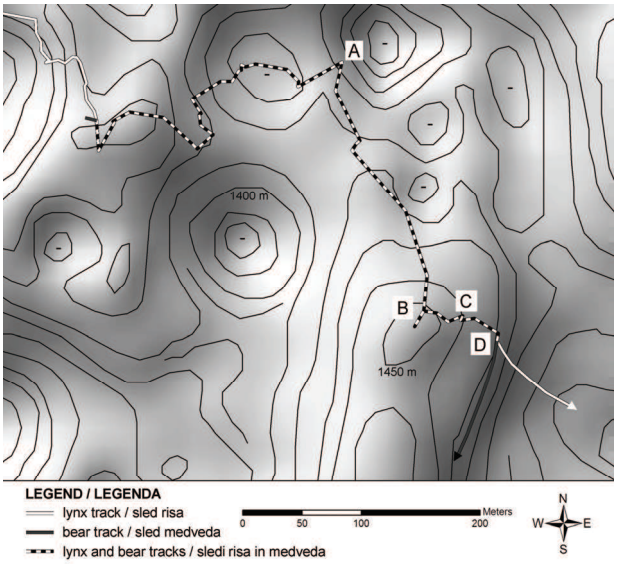

Figure 2. Mapped tracks of the Eurasian Lynx (*Lynx lynx*) and Brown Bear (*Ursus arctos*) on the Snežnik plateau in southern Slovenia. Contour line interval is 10 meters. See text for details of observations at points A, B, C, and D.
Slika 2. Vrisani poti evrazijskega risa (*Lynx lynx*) in rjavega medveda (*Ursus arctos*) na Snežniški planoti, južna Slovenija. Ekvidistanca med plastnicami znaša 10 m. Opažanja na točkah A, B, C in D so opisana v besedilu.

NAVODILA AVTORJEM

NATURA SLOVENIAE objavlja izvirne prispevke, ki imajo za ozadje terensko delo s področja biologije in/ali prispevajo k poznavanju favne in flore osrednje in jugovzhodne Evrope. Prispevki so lahko v obliki znanstvenih člankov, kratkih vesti ali terenskih notic.

Znanstveni članek je celovit opis izvirne raziskave in vključuje teoretično ozadje tematike, območje raziskav in metode uporabljene pri delu, podrobno predstavljene rezultate in diskusijo, sklepe ter pregled literature. Dolžina naj ne presega 20 strani.
Kratka znanstvena vest je izvirni prispevek, ki ne vsebuje podrobnega teoretičnega pregleda. Njen namen je seznaniti bralca z delnimi ali preliminarnimi rezultati raziskave. Dolžina naj ne presega petih strani.
Terenska notica je krajši prispevek o zanimivih favnističnih ali floristističnih opažanjih in najdbah na področju Slovenije. Dolžina naj ne presega treh strani.

Vsi prispevki bodo recenzirani. Avtorji lahko v spremnem dopisu sami predlagajo recenzente, kljub temu pa urednik lahko izbere tudi kakšnega drugega recenzenta. Recenziran članek popravi avtor oz. avtorji sami. V primeru zavrnitve se originalne materiale skupaj z obrazložitvijo glavnega urednika vrne odgovornemu avtorju.

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Prispevki naj bodo napisani v programu Word for Windows, v pisavi "Times New Roman CE 12", z levo poravnavo in 3 cm robovi na A4 formatu. Med vrsticami naj bo dvojni razmak, med odstavki pa prazna vrstica. Naslov prispevka in naslovi posameznih poglavij naj bodo natisnjeni krepko v velikosti pisave 14. Latinska imena rodov in vrst morajo biti pisana ležeče. Uredniku je potrebno prispevek oddati v primerni elektronski obliki (disketa, CD, elektronska pošta) v Rich text (.rtf) ali Word document (.doc) formatu.

Naslov prispevka (v slovenskem in angleškem jeziku) mora biti informativen, jasen in kratek. Naslovu naj sledijo celotna imena avtorjev in njihovi naslovi (vključno z naslovi elektronske pošte).
Izvleček v slovenskem jeziku mora na kratko predstaviti namen, metode, rezultate in zaključke. Dolžina izvlečka naj ne presega 200 besed za znanstveni članek oziroma 100 besed za kratko znanstveno vest. Pod izvlečkom naj bodo ključne besede, ki predstavljajo področje raziskave. Njihovo število naj ne bo večje od 10. Sledi abstract in key words v angleškem jeziku, za katere velja enako kot za izvleček in ključne besede.
Glavnina prispevka znanstvenega članka in kratke znanstvene vesti je lahko pisana v slovenskem jeziku čeprav je bolj zaželjen angleški jezik. Prispevek, ki je pisan v slovenskem jeziku mora vsebovati obširnejši angleški povzetek - summary, prispevek pisan v angleškem jeziku pa obširnejši slovenski povzetek (200-500 besed). Terenska notica je v celoti napisana v angleškem jeziku, brez izvlečka, ključnih besed in povzetka. Pri oblikovanju besedil naj se avtorji zgledujejo po zadnjih številkah revije.

SLIKE IN TABELE
Skupno število slik in tabel v prispevku naj ne bo večje od 10, njihovo mesto naj bo v članku nedvoumno označeno. Posamezne tabele z legendami naj bodo na ločenih listih. Naslovi tabel naj bodo nad njimi, naslovi slik in fotografij pa pod njimi. Naslovi in legenda slik in tabel naj bodo v slovenskem in angleškem jeziku. Pri navajanju slik in tabel v tekstu uporabljajte okrajšave (npr. angl: Tab. 1 ali Tabs. 1-2, Fig. 1 ali Figs. 1-2 in slo.: Tab. 1 in Sl. 1).

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Navajanje literature v besedilu mora biti na ustreznem mestu. Kadar citiramo enega avtorja, pišemo Schultz (1987) ali (Schultz 1987), če sta avtorja dva (Parry & Brown 1959) in če je avtorjev več (Lubin et al. 1978). Kadar navajamo citat večih del hkrati, pišemo (Ward 1991, Pace 1992, Amman 1998). V primeru, ko citiramo več del istega avtorja objavljenih v istem letu, posamezno delo označimo s črkami (Lucas 1988a, b). Literatura naj bo urejena po abecednem redu.

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Lubin Y.D., Eberhard W.G., Montgomery G.G. (1978): Webs of Miagrammopes (Araneae: Araneaidae) in the neotropics. Psyche 85: 1-13.
Lucas S. (1988a): Spiders in Brasil. Toxicon 26: 759-766.
Lucas S. (1988b): Spiders and their silks. Discovery 25: 1-4.

- knjige, poglavja iz knjig, poročila, kongresne povzetke citiramo:
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Nentwig W., Heimer S. (1987): Ecological aspects of spider webs. In: Nentwig W. (Ed.), Ecophysiology of Spiders. Springer Verlag, Berlin, 211 pp.
Edmonds D.T. (1997): The contribution of atmospheric water vapour to the formation of a spider's capture web. In: Heimer S. (Ed.), Proceedings of the 17th European Colloquium of Arachnology. Oxford Press, London, pp. 35-46.

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Lubin Y.D., Eberhard W.G., Montgomery G.G. (1978): Webs of Miagrammopes (Araneae: Araneaidae) in the neotropics. Psyche 85: 1-13.
Lucas S. (1988a): Spiders in Brasil. Toxicon 26: 759-766.
Lucas S. (1988b): Spiders and their silks. Discovery 25: 1-4.

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Nentwig W., Heimer S. (1987): Ecological aspects of spider webs. In: Nentwig W. (Ed.), Ecophysiology of Spiders. Springer Verlag, Berlin, 211 pp.
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