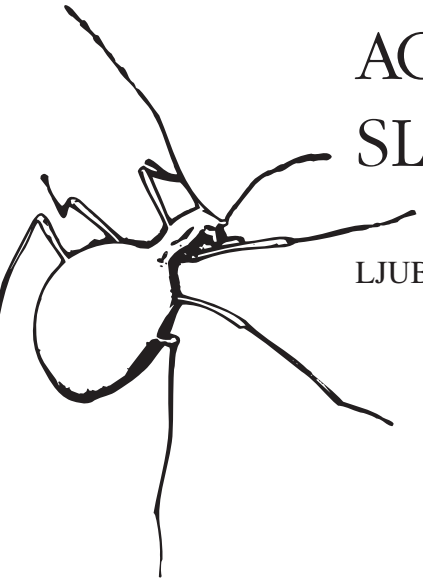


ACTA ENTOMOLOGICA SLOVENICA

LJUBLJANA, JUNIJ 2016 Vol. 24, št./No. 1

PRIRODOSLOVNI MUZEJ SLOVENIJE
SLOVENSKO ENTOMOLOŠKO DRUŠTVO
ŠTEFANA MICHIELIJA

ACTA ENTOMOLOGICA SLOVENICA

Revija Slovenskega entomološkega društva Štefana Michielija
in Prirodoslovnega muzeja Slovenije
Izhaja dvakrat letno / Issued twice a year

ISSN 1318-1998
CODEN: AESLFM
UDC (UDK) 595.7(051)

Izdajatelja / Publishers

Slovensko entomološko društvo
Štefana Michielija
ZRC SAZU, Novi trg 5
SI-1000 Ljubljana

Prirodoslovni muzej Slovenije
Prešernova 20, p.p. 290
SI-1001 Ljubljana

letnik/Vol. 24, št./No. 1, 2016
Tisk / Printed by: Trajanus, d.o.o., Kranj
Ljubljana, junij 2016

http://www.pms-lj.si/si/o-nas/arhiv-publikacij/acta-entomologica-slovenica

Povzeto v / To be abstracted in: The Zoological Record, CAB Abstracts

Revijo dobivajo člani Slovenskega entomološkega društva Štefana Michielija
(članarina 20 EUR)
Cena posamezne številke je 8,50 EUR
Zamenjava je zaželjena / Exchanges appreciated
Publikacija je natisnjena s pomočjo Javne agencije za raziskovalno dejavnost R Slovenije.
Uredniško delo podpira Ministrstvo za kulturo R Slovenije.

Vsebina / Contents

D. Bevk, V. Treven, A. Vrezec, A. Čokl: Uporaba medonosne čebele (*Apis mellifera*) za izboljšanje opraševanja vrtne jagode in raznos organizmov za biotično zatiranje sive plesni (*Botrytis cinerea*)
Using honeybees (*Apis mellifera*) to improve pollination of strawberries and to deliver biocontrol agent for protection from grey mould (*Botrytis cinerea*) 5

H. Mohammadi, A. Azarm, M. Zamanpour: Determination of codling moth, *Cydia pomonella* (Lep.: Tortricidae), generation numbers and adult population fluctuation in Yasouj through two different methods
Določanje števila generacij jabolčnega zavijača, *Cydia pomonella* (Lep.: Tortricidae) in spremljanje spreminjanja velikosti odrasle populacije v Yasouju z dvema metodama 15

B. Kofler: Prispevek k poznavanju favne hroščev v Jami pri Lipniški skali
Contribution to the knowledge of beetle fauna in the cave Jama pri Lipniški skali 27

E. Demir, A. Demirsoy: Preliminary report on the Cicadomorpha (Hemiptera) fauna of Kemaliye (Erzincan Provınce, East Turkey)
Predhodno poročilo o favni podreda Cicadomorpha (Hemiptera) Kemalije (pokrajina Erzincan, vzhodna Turčija) 35

FAVNISTIČNI ZAPISKI / FAUNISTICAL NOTES

A. Gogala, J. Kamin, M. Zdešar: Three new records of Heteroptera in Slovenia
Tri nove najdbe stenic (Heteroptera) v Sloveniji 55

IN MEMORIAM

Prof. Dr. Božidar Ćurčić (1946 – 2015) 59
Dr. Bogdan Horvat (26. 8. 1961 – 3. 1. 2016) 63

Navodila avtorjem

Acta entomologica slovenica je glasilo Slovenskega entomološkega društva Štefana Michielija in Prirodoslovnega muzeja Slovenije. Objavlja izvirna znanstvena dela, pregledne članke in ocene knjig s področja entomologije. Članki lahko obravnavajo favnistiko, sistematiko, ekologijo, etologijo, fiziologijo ali zoogeografijo žuželk. Pisani naj bodo v slovenskem ali angleškem jeziku, z obveznim angleškim in slovenskim izvlečkom. Članki so strokovno recenzirani. Letno izideta dve številki.

Avtorje prosimo, da se pri oblikovanju člankov zgledujejo po zadnji številki revije. Če je le mogoče, svoj tekst pošljite po elektronski pošti ali oddajte na digitalnem nosilcu. Izpis članka na papirju naj ima dvojne presledke med vrsticami, da je možno popravljanje. Risbe naj bodo kontrastne, pri debelini črt pa upoštevajte tudi morebitno pomanjšanje na format revije. Slike naj bodo v izvirnih datotekah, če jih oddajate v elektronski obliki.

Citirana literatura naj se navede na koncu članka in naj bo razvrščena po abecedi glede na priimke avtorjev.

Avtorji člankov dobijo brezplačno 20 posebnih odtisov in članek v elektronski obliki.

Instructions to authors

Acta entomologica slovenica is the Journal of the Slovenian Entomological Society Štefan Michieli and the Slovene Museum of Natural History. It publishes original scientific works, overview articles, and book reviews in the field of Entomology. Articles may deal with faunistics, systematics, ecology, etology, physiology, or zoogeography of insects. They may be written in Slovene or English, with abstracts in English and Slovene (the editors will ensure translations into Slovene). All articles are reviewed. Two issues are published a year.

We ask all authors to model the layout of their manuscripts on a previous issue of the Journal. If possible, send the text by e-mail or on a digital carrier, as well as on paper with double spacing between lines. Drawings must have high contrast. Please, consider that all line widths may be reduced during layout of the issue. Pictures should be in their original files if prepared in digital form.

References should be listed at the end of the article in the alphabetical order of the authors' names.

20 reprints and electronic version will be sent to the Authors free of charge.

ACTA ENTOMOLOGICA SLOVENICA
LJUBLJANA, JUNIJ 2016 Vol. 24, št. 1: 5–13

UPORABA MEDONOSNE ČEBELE (*APIS MELLIFERA*) ZA IZBOLJŠANJE OPRAŠEVANJA VRTNE JAGODE IN RAZNOS ORGANIZMOV ZA BIOTIČNO ZATIRANJE SIVE PLESNI (*BOTRYTIS CINEREA*)

Danilo Bevk[1], Vinko Treven[2], Al Vrezec[1], Andrej Čokl[1]

[1]Nacionalni inštitut za biologijo, Večna pot 111, SI-1000 Ljubljana, Slovenija
e-mail: danilo.bevk@nib.si
[2] Smrečje 50, 1373 Rovte, Slovenija

Abstract – USING HONEYBEES (*APIS MELLIFERA*) TO IMPROVE POLLINATION OF STRAWBERRIES AND TO DELIVER BIOCONTROL AGENT FOR PROTECTION FROM GREY MOULD (*BOTRYTIS CINEREA*)

Foraging activity of honeybees on strawberry flowers and protection of strawberries from grey mould, using spores of the fungus *Gliocladium catenulatum* in Prestop Mix was studied. *G. catenulatum*, which acts as an antagonist of grey mould, was delivered to strawberry flowers using honeybees. A honeybee colony was placed next to a 0.25 ha strawberry field in Dvorska vas (NW Slovenia) during May and June of 2013 and 2014. Bees gathered Prestop Mix in a dispenser placed at the exit of the hive and delivered it to the flowers. Foraging activity and yield were at different distances from the bee colony. Honeybees were most active in warm weather and in the afternoon. In 2013 Prestop Mix increased proportion of healthy berries for approximately 50 % compared to untreated control. Next year no statistically significant differences between treated and untreated plots were found, presumably due to higher humidity and lower temperature during fruit ripening.

Key words: pollination, biocontrol, entomovectoring, grey mould, pesticides

Izvleček – Raziskovali smo pašno dejavnost medonosne čebele na cvetovih vrtne jagode in njihovo možnost uporabe pri zaščiti pred sivo plesnijo z uporabo spor glive *Gliocladium catenulatum* v pripravku Prestop Mix. *G. catenulatum*, ki deluje kot antagonist sive plesni, smo na cvetove jagod nanesli s pomočjo čebel. Čebeljo družino smo imeli ob nasadu jagod v Dvorski vasi na Gorenjskem maja in junija v letih 2013

in 2014. Čebele so Prestop Mix pobrale v razdelilniku, ki je bil nameščen na izhodu panja, in ga raznesle na cvetove. Na različnih razdaljah od panja smo spremljali pašno dejavnost in pridelek. Čebele so bile najbolj dejavne v toplem vremenu in popoldne. Leta 2013 je uporaba sredstva Pestop Mix s čebeljim raznosom delež zdravih plodov povečala za polovico. V letu 2014 razlike med tretiranimi in netretiranimi rastlinami niso bile statistično značilne, domnevno zaradi višje vlage in nižje temperature v času zorenja plodov.

KLJUČNE BESEDE: opraševanje, biokontrola, entomovektoring, siva plesen, pesticidi

Uvod

Večina kulturnih rastlin za uspešno oploditev potrebuje navzkrižno opraševanje (Abrol 2012), od opraševanja pa ni odvisna samo količina, ampak tudi kakovost pridelka (Hoehn s sod. 2008, Garratt s sod. 2014), oboje pa vpliva na kakovost prehrane in s tem na zdravje ljudi (Smith s sod. 2015). Opraševanje žuželk je zato pomembna ekosistemska storitev, katere vrednost je na svetovni ravni zgolj pri pridelavi hrane ocenjena na 153 milijard EUR letno (Gallai s sod. 2009). Potrebe po opraševanju naraščajo in med tem ko je v svetovnem merilu v zadnje pol stoletja število gojenih čebeljih družin naraslo za 45 %, se je potreba po opraševanju kmetijskih rastlin povečala za 300 % (Aizen in Harder 2009). Poleg medonosne čebele je sicer zelo pomembna tudi vloga divjih opraševalcev (Garibaldi s sod. 2011, 2013).

Pri pridelavi vrtnih jagod nastaja veliko škode zaradi sive plesni, ki jo povzroča gliva *Botrytis cinerea.* Najbolj se razvija pri visoki zračni vlažnosti, pri temperaturah med 15 in 25 °C in dlje časa prisotni površinski mokroti (Wilcox in Seem 1994, Williamson s sod. 2007). Za okužbo so najbolj dovzetni na novo odprti cvetovi (Sutton 1998). Za zaščito jagod pred sivo plesnijo se uporablja različne fungicide, s katerimi se škropi v intervalih v času cvetenja in zorenja (Rosslenbroich in Stuebler 2000). Uporaba fungicidov je najbolj učinkovita pri na novo odprtih cvetovih, manj pa pri zelenih, še ne zrelih plodovih (Mertely s sod. 2002). Problemi uporabe fungicidov so razvoj odpornosti sive plesni, ostanki v pridelkih (Sutton 1998) in negativen vpliv na okolje vključno z opraševalci (Desneux s sod. 2007).

Za zmanjšanje negativnih vplivov na okolje in pridelavo bolj varne hrane se pri zatiranju sive plesni vedno bolj uporablja biotično zatiranje (biokontrolo), ki temelji na uporabi antagonistov sive plesni, npr. glive *Gliocladium catenulatum* (Williamson s sod. 2007). Najprej so organizme za biotično zatiranje nanašali s škropljenjem (Sutton in Peng 1993, Lima s sod. 1997, Cota s sod. 2008, Cota s sod. 2009), vendar je bila učinkovitost zaščite večinoma premajhna. Težava je predvsem nanašanje sredstva ob pravem času, saj zaradi kratkoživosti cvetov precej le-teh ostane nezaščitenih. Poleg tega le majhen del sredstva doseže tarčo in se ga veliko sprosti v okolico in tla (Yu in Sutton 1997). Kasneje se je razširila metoda raznosa s pomočjo opraševalcev (entomovektoring), ki sredstvo nanašajo neposredno na cvet (Ngugi s sod. 2002). Pri raznosu najpogosteje uporabljajo medonosno čebelo (Thomson s sod. 1992, Macca-

gnani s sod. 1999, Shafir s sod. 2006, Dedej s sod. 2004) in čmrlje (Albano s sod. 2009, Al-mazra'awi in sod. 2006, Yu in Sutton 1997).

V raziskavi smo ugotavljali uspešnost in uporabnost kranjske čebele *(Apis melifera carnica)* pri nanosu sredstva za biokontrolo sive plesni Prestop Mix, ki vsebuje spore glive *G. catenulatum,* na cvetove jagod. Zanimalo nas je ali čebele obiskujejo cvetove jagod in učinkovitost metode pri zagotavljanju zdravja pridelka.

Materiali in metode

Raziskave so potekale maja in junija v letih 2013 in 2014 v Dvorski vasi na Gorenjskem (530 m n. v.) v gospodarskem nasadu vrtnih jagod *Fragaria x ananassa* Duch. sorte elsanta velikem približno 0,25 ha. V nasad smo 8. 5. 2013 in 29. 4. 2014, ko je bilo odprtih približno 10 % cvetov jagod, pripeljali čebeljo družino na 10 satih v nakladnem panju z eno naklado. Družina je imela zalego v vseh razvojnih fazah in dovolj prostora za širjenje. Panj smo namestili na južnem robu nasada, 25 cm od tal, z izhodom obrnjenim proti nasadu. Na vhod panja smo namestili razdelilnik BeeTreat® (proizvajalec AASATEK Ltd, Helsinki, Finska), na katerega smo čebele navadili že prej. Razdelilnik ima dva prehoda. Skozi spodnjega čebele zapuščajo panj, prek zgornjega pa se vračajo. V spodnji prehod smo vsako jutro okoli 8. ure nasuli 5 g sredstva Prestop Mix (proizvajalec Verdera Oy, Finska).

Pred prvo uporabo sredstva Prestop Mix smo v štirih vrstah, ki so potekale v smeri od panja, z vrvicami označili osem vzorčnih ploskev, velikih 2 × 2 m. V vsaki ploskvi je bilo 32 rastlin. Prvi dve ploskvi sta bili od panja oddaljeni 10 metrov, preostale pa 20, 30 in 40 m. Štiri ploskve, ki so služile kot kontrola, smo pokrili z mrežo proti žuželkam in tako preprečili dostop čebelam.

Na nepokritih vzorčnih ploskvah smo opazovali pašno dejavnost čebel. Na podlagi predhodnih izkušenj smo vedeli, da čebele večino pripravka porabijo prve ure po nasutju sredstva, zato smo pašno dejavnost opazovali predvsem dopoldne in sicer 10 dni med 9. in 10. uro ter 11. in 12. uro, 4 dneve pa tudi med 13. in 14. ter 16. in 17. uro. Vsako opazovalno uro smo na vsaki izmed štirih poskusnih ploskev desetkrat po eno minuto opazovali število čebel na cvetovih. Pri vsakem enominutnem opazovanju smo zabeležili največje število čebel, ki so bile istočasno znotraj poskusne ploskve. Skupaj smo opravili 1120 štetij oziroma 280 na posamezno vzorčno ploskev.

Učinkovitost metode raznosa sredstva Prestop Mix smo ugotavljali z vzorčenjem jagod na vseh osmih vzorčnih ploskvah. Plodove smo nabrali zjutraj, jih ločili na zdrave in bolne, prešteli in stehtali ter izračunali število in delež zdravih ter obolelih plodov. Skupaj smo v 56 vzorcih v letu 2013 in 64 vzorcih v letu 2014 nabrali 2504 jagod.

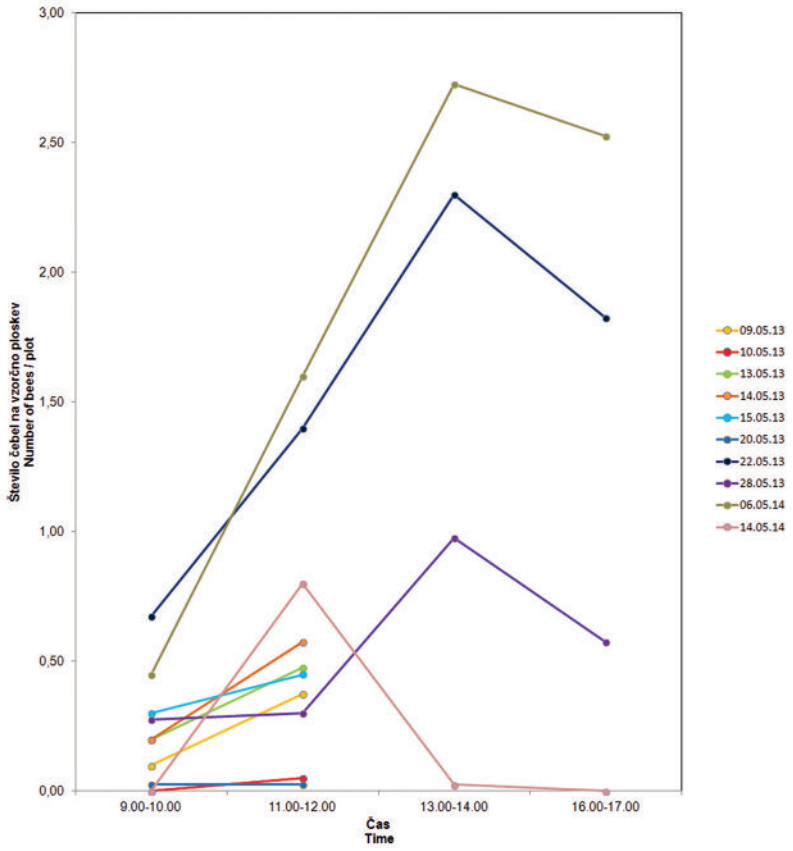
Podatke o temperaturi zraka, padavinah in relativni vlagi smo pridobili iz samodejne meteorološke postaje Lesce – Letališče, oddaljene 3 km (ARSO).

Za statistično obdelavo podatkov smo uporabili program SPSS 14.0 for Windows proizvajalca SPSS Inc. Izračunali smo osnovne statistične parametre. Za ugotavljanje statistično značilnih razlik smo uporabili neparametrični Mann-Whitneyev U test.

Rezultati in razprava

Kljub alternativnim pašnim virom v oklici nasada (sadno drevje, travniške rastline), so čebele obiskovale tudi vrtne jagode. Najbolj dejavne so bile popoldne (Slika 1), njihova dejavnost pa se je od dneva do dneva precej razlikovala, kar lahko razložimo kot posledico različnih vremenskih razmer in dostopnosti alternativnih pašnih virov. Najbolj dejavne so bile v toplem in sončnem vremenu, medtem ko je bila dejavnost v hladnem in vetrovnem vremenu precej manjša.

Primerjava vzorčnih ploskev je pokazala, da se z oddaljenostjo od panja število čebel na cvetovih ni spreminjalo. Razlike med vzorčnimi ploskvami niso bile statistično značilne ($p > 0,05$; Mann-Whitney U test). Ker čebele lahko letijo na pašo celo nekaj kilometrov daleč (Visscher in Seeley 1982, Beekmen in Ratnieks 2000), je 40 m razmeroma majhna razdalja, zato je bil tak rezultat tudi pričakovan.

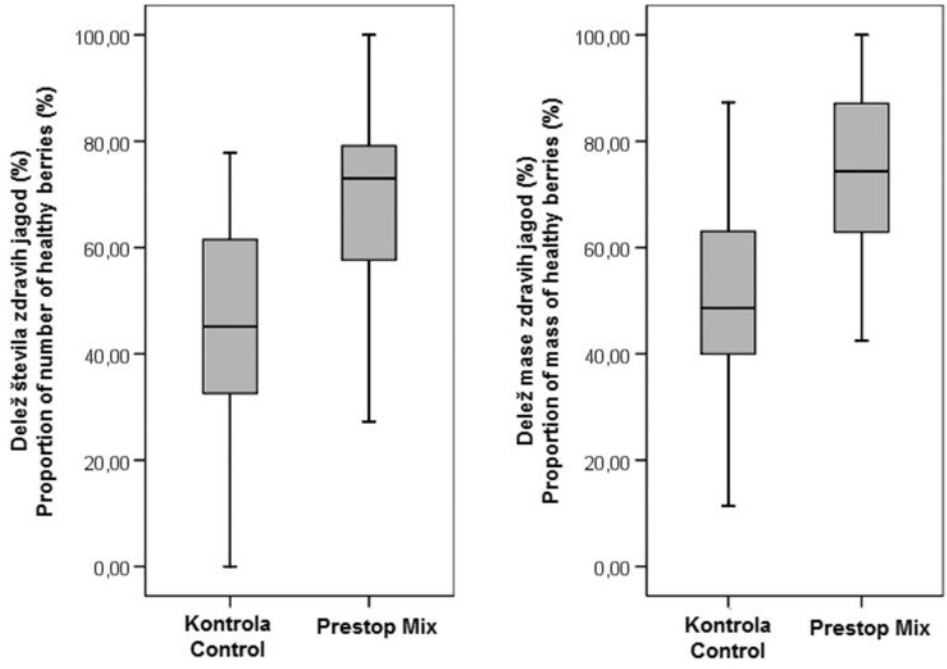


Slika 1: Pašna dejavnost čebel na cvetovih jagod v letih 2013 in 2014.

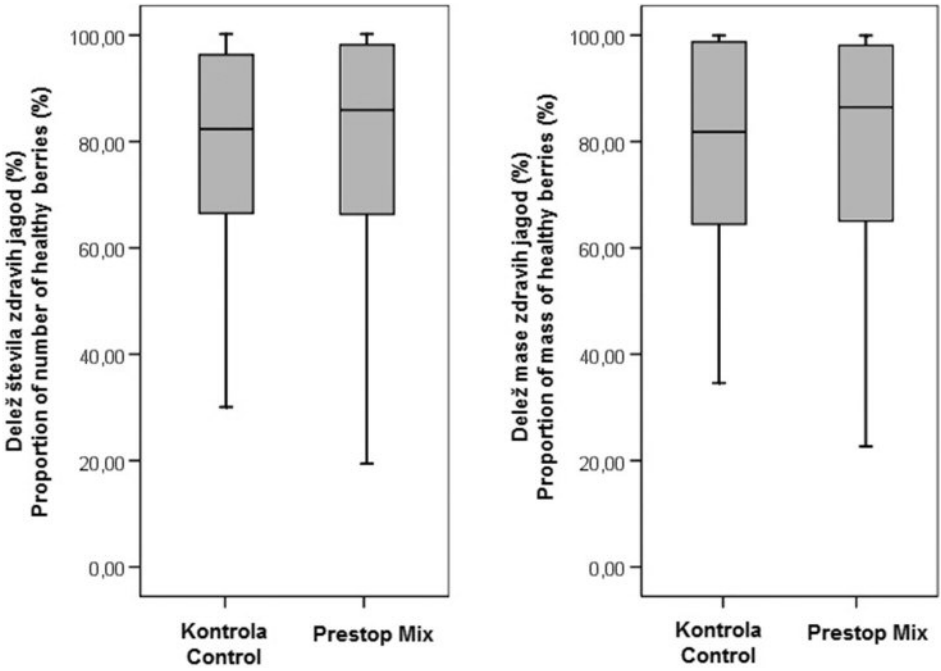
Figure 1: Foraging activity of honeybees on strawberry's flowers in 2013 and 2014.

Ker je bilo znotraj radija 1 km od nasada še sedem drugih čebelnjakov, na cvetovih zagotovo nismo opazili samo čebel iz poskusnega panja, temveč tudi druge. Glede na to, da je bil panj ob nasadu, domnevamo, da so naše čebele prevladovale, čeprav neposrednih dokazov za to nimamo, posredno pa lahko o prisotnosti sklepamo po učinku na zdravje jagod. Poleg čebel smo na cvetovih jagod opazili tudi druge opraševalce. Največ je bilo muh trepetavk, ki so bile najbolj številčne ob začetku cvetenja. Opazili pa smo tudi posamezne čmrlje (*Bombus* spp.), vitke čebele (npr. iz rodu *Lasioglossum*) in hrošče.

Metoda nanosa organizmov za biotično zatiranje z medonosnimi čebelami je bila v letu 2013 zelo uspešna, saj je bila pri tretiranih rastlinah mediana deleža zdravih plodov približno za polovico višja kot pri kontrolni skupini (Slika 2). Mediana deleža mase zdravih jagod netretiranih rastlin je bila 48,6 %, tretiranih 74,4 %, razlika pa statistično značilna ($U=150{,}00$, $p < 0{,}01$). Podobno je bil pri tretiranih rastlinah statistično značilno večji tudi delež zdravih jagod. Mediana deleža števila zdravih plodov netretiranih jagod je bila 45,1 %, tretiranih jagod pa 73,0 % ($U=146{,}50$, $p < 0{,}01$). Učinek je bil primerljiv z rezultati raziskav Hokkanena s sod. (2015). Podobno kot smo ugotovili za pašno dejavnost, oddaljenost vzorčne ploskve od panja ni vplivala na delež zdravih jagod ($p > 0{,}05$; Mann-Whitney U test).



Slika 2: Delež števila in mase zdravih jagod leta 2013
Figure 2: Proportion of number and mass of healthy berries in 2013



Slika 3: Delež števila in mase zdravih jagod plodov leta 2014
Figure 3: Proportion of number and mass of healthy berries in 2014

V letu 2014 je bil učinek veliko manjši (Slika 3). Delež zdravih plodov tretiranih rastlin je bil v primerjavi s kontrolo višji, vendar pa razlika ni bila statistično značilna (U_{masa}=391,50, NS; $U_{število}$=376,00, NS). Možna razlaga za slabšo učinkovitost metode bi lahko bile vremenske razmere v času zorenja. V letu 2013 je bila v obdobju zorenja povprečna zračna vlaga 62 %, povprečna temperatura zraka pa 21°C, v letu 2014 pa je bila vlaga višja (69 %), temperatura pa nižja (17°C), zato so bile razmere za razvoj sive plesni boljše (Wilcox in Seem 1994, Williamson s sod. 2007), sredstvo za biotično zatiranje pa mogoče zaradi tega neučinkovito. Hokkanen s sod. (2015) sicer nasprotno ugotavlja, da je metoda učinkovita v vseh vremenskih razmerah.

Kontrolne rastline, pokrite z mrežo, niso bile zaščitene le pred sredstvom za zatiranje sive plesni, ampak tudi pred opraševanjem čebel, zato smo primerjali tudi maso pridelka in število plodov na posamezno obiranje na vzorčno ploskev odkritih in pokritih rastlin. Količina pridelka pokritih rastlin je bila nekoliko manjša. Razlika v masi pridelka na ploskvah z odkritimi rastlinami (mediana 2013: 286,5 g; mediana 2014: 156,5 g) je bila v primerjavi s pokritimi (197,0 in 136,5 g) obe leti statistično neznačilna (U_{2013}=326,50 , U_{2014}=404,50). Prav tako niso bile značilne razlike v številu plodov. Mediana števila plodov na obiranje na vzorčno ploskev odkritih rastlin je bila prvo leto 26,5, drugo leto 15,5, pokritih pa 21,0 in 13,0 (U_{2013}=366,00 , U_{2014}=369,00). Glede na odsotnost čebel pri pokriti skupini smo pričakovali večje razlike v količini pridelka. Domnevamo, da so odsotnost čebel nadomestile številne

druge žuželke, predvsem muhe, ki smo jih opazili pod mrežo. Tam so se izlegle ali pa so tja zašle. Zaradi omejenega prostora in stalnega iskanja izhoda, so z gibanjem verjetno prenašale tudi cvetni prah med cvetovi in jih oprašile.

Rezultati poljskega poskusa so pokazali, da je uporaba medonosne čebele pri nanosu Prestopa Mix tudi v pogojih slovenske pridelave lahko učinkovita, a ne vedno zanesljiva metoda za zaščito jagod pred sivo plesnijo. Ena od pomanjkljivosti metode je lahko odvisnost nanosa sredstva za biotično zatiranje od dejavnosti čebel, ki lahko v slabem vremenu odpove. Ker so v Sloveniji nasadi razmeroma majhni, lahko predstavljajo težavo tudi bolj privlačni alternativni pašni viri, zaradi česar čebele lahko opustijo obiskovanje cvetov ciljne kulture. Zaradi obeh razlogov je pri uporabi čebel za raznos biokontrolnih sredstev nujno redno spremljanje obiskovanja cvetov. Čebele bi sicer k obiskovanju jagod lahko spodbujali z dražilnim krmljenjem s sladkorno raztopino z vonjem jagodnih cvetov (Abrol 2012). Kot alternativo čebeli bi lahko uporabili čmrlje, ki so dejavni tudi v slabem vremenu (Bevk 2007), letajo na krajše razdalje in so se že izkazali kot uspešni opraševalci jagod (Kardinar 2012). Zaradi nevarnosti genskega onesnaženja in vnosa novih bolezni (Graystock s sod. 2013), bi bila uporaba čmrljev okoljsko sprejemljiva le, če bi šlo za domorodne vrste vzrejene v Sloveniji.

Zahvala

Raziskava je bila izvedena v okviru mednarodnega projekta BICOPOLL, ki je bil financiran v okviru iniciative ERA-NET CORE Organic II in katerega slovenski del je financiralo Ministrstvo za kmetijstvo, gozdarstvo in prehrano.

Viri

Abrol, D. P, 2012: Pollination biology, Springer, London.

Aizen, M.A., Harder, L.D., 2009: The Global Stock of Domesticated Honey Bees Is Growing Slower Than Agricultural Demand for Pollination. *Current Biology*, 19: 1-4.

Albano, S., Chagon M., de Oliveira D., Houle E., Thibodeau P. O., Mexia A., 2009: Effectiveness of *Apis mellifera* and *Bombus impatiens* as dispensers of the Rootshield biofungicide (*Trichoderma harzianum*, strain T-22) in a strawberry crop. *Hellenic Plant Protection Journal*, 2: 57-66.

Al-mazra'awi, M. S., Shipp, J. L, Broadbent A. B., Kevan P. G., 2006: Biological control of *Lygus lineolaris* (Hemiptera: Miridae) and *Frankiniella occidentalis* (Thysanoptera: Thripidae) by *Bombus impatiens* (Hymenoptera: Apidae) vectored *Beauveria bassiana* in greenhouse sweet pepper. *Biological Control*, 37: 89-97.

ARSO, Agencija Republike Slovenije za okolje, Arhiv – opazovani in merjeni meteorološki podatki po Sloveniji. http://meteo.arso.gov.si

Beekman M., Ratnieks, F.L.W., 2000: Long-range foraging by the honey-bee, *Apis mellifera* L. *Functional Ecology*, 14: 490-496.

Bevk, D., 2007: Dejavnost čmrljev preko dneva in sezone. *Acta entomologica slovenica*, 15 (2) : 113-120.

Cota, L. V., Maffia L. A., Mizubuti E. S. G., Macedo P. E. F., 2009: Biological control by *Clonostachys rosea* as a key component in the integrated management of strawberry gray mold. *Biological Control*, 50: 222-230.

Cota, L. V., Maffia, L. A., Mizubuti, E. S. G., Macedo P. E. F., Antunes R. F., 2008: Biological control of strawberry gray mould by *Clonostachys rosea* under field conditions. *Biological Control*, 48: 515-522.

Dedej, S., Delaplane, K. S., Scherm ,H., 2004: Effectiveness of honey bees in delivering the biocontrol agent *Bacillus subtilis* to blueberry flowers to suppress mummy berry disease. *Biological Control*, 31: 422-427

Desneux, N., Decourtye, A., Delpuech, J., 2007: The Sublethal effects of Pesticides on Beneficial Arthropods. *Annu. Rev. Entomol*., 52: 81-106.

Gallai, N., Salles, J.M., Settele, J., Vaissiere, B.E., 2009: Economic valuation of the vulnerability of world agriculture confronted with pollinator decline. *Ecological economics*, 68, 810-821.

Garratt, M.P.D., Breeze, T.D., Jenner, N., Biesmeijer, J.C., Potts, S.G., 2014: Avoiding a bad apple: Insect pollination enchances fruit quality and economic value. *Agriculture, Ecosystem and environment*, 184, 34-40.

Garibaldi, L. A. et al., 2013: Wild pollinators enhance fruit set of crops regardless of honey bee abundance. *Science* 339, 1608-1611.

Graystock, P., Yates, K., Evison, S. E., F., Darvill, B., Goulson, D. Hughes W. O. H., 2013: The Trojan hives: pollinator pathogens, imported and distributed in bumblebee colonies. *Journal of Applied Ecology*, 50: 1207–1215.

Hoehn, P., Tscharntke, T., Tylianakis, J.M., Steffan-Dewenter, I., 2008: Functional group diversity of bee pollinatiors increases crop yield*. Proceedings of the royal society*, 275: 2283-2291.

Hokkanen, H. M. T, Menzler-Hokkanen, I. M, Lahdenperä, 2015: Managing Bees for Delivering Biological Control Agents and Improved Pollination in Berry and Fruit Cultivation. *Sustainable Agriculture Research*, 4 (3): 89-102.

Kardinar, D., 2012: Vloga čmrljev pri opraševanju jagod. Univerza v Mariboru, Fakulteta za kmetijstvo in biosistemske vede, Maribor, 39 p.

Lima G., Ippolito A., Nigro, F. and Salerno, M., 1997: Effectiveness of *Aureobasidium pullulans* and *Candida oleophila* against postharvest strawberry rots. *Postharvest Biology and Technology*, 10: 169-178.

Maccagnani B., Mocioni M., Gullino, M. L., Ladurner, E., 1999: Application of *Trichoderma harzianum* by using *Apis mellifera* as a vector for the control of grey mold of strawberry: first results. *IOBC Bull*, 22: 161-164.

Ngugi H. K., Scherm H., Lehman, J. S., 2002: Relationship between blueberry flower age, pollination and conidal infection by *Monilinia vaccinii-corymbosi*. *Ecology Population Biology*, 92: 1104-1109.

Orford, K.A., Vaughan, I.P., Memmott, J., 2015: The forgotten flies: the importance of non-syrphid Diptera as pollinators. Proc. R. Soc. B, 282: 20142934.

Rosslenbroich H.-J., Stuebler D., 2000: *Botrytis cinerea* - history of chemical control and novel fungicides for its management. *Crop Protection*, 19: 557-561.

Shafir S., Dag A., Bilu A., Abu-Toamy, M., Elad Y., 2006: Honeybee dispersal of the biocontrol agent and *Trichoderma harzianum* T39: effectiveness in suppressing *Botrytis cinerea* on strawberry under field conditions. *European Journal of Plant Pathology*, 116: 119-128.

Smith, M.R., Singh, G.M., Mozaffarian, D., Myers, S.S., 2015: Effects of decreases of animal pollinators on human nutrition and global health: modelling analysis. *Lancet*, 386, 1964-1672.

Sutton, J. C., 1998: Botrytis fruit rot (gray mold) and blossom blight. In: Compendium of Strawberry Diseases. Maas, J. L. (Edit.), APS Press: St. Paul 28-31.

Sutton, J. C., Peng G., 1993: Manipulation and vectoring of biocontrol organisms to manage foliage and fruit diseases in cropping systems. *Annual Review Phytopathology*, 31: 473-493.

Thomson, S. V., Hansen, D. R., Flint, K. M., Vandenberg, J. D., 1992: Dissemination of bacteria antagonistic to *Erwinia amylovora* by honey bees. *Plant Disease*, 76: 1052–1056.

Visscher, P.K., Seeley, T.D., 1982: Foraging strategy of honeybee colonies in a temperate deciduous forest. *Ecology*, 63 (6): 1790-1801.

Wilcox, W. F., Seem R. C., 1994: Relationship between strawberry gray mold incidence, environmental variables, and fungicide applications during different periods of the fruiting season. *Phytopathology*, 84: 264-270.

Williamson, B., Tudtyinski, B., Tudzynski, P, van Kan J. A. L., 2007: *Botrytis cinerea*: the cause of grey mould disease. *Molecular Plant Pathology*, 8, 5: 561-580.

Yu H., Sutton J.C., 1997: Effectiveness of Bumblebees and Honeybees for Delivering Inoculum of *Gliocladium roseum* to Raspberry Flowers to Control *Botrytis cinerea*. *Biological Control*, 10: 113-122.

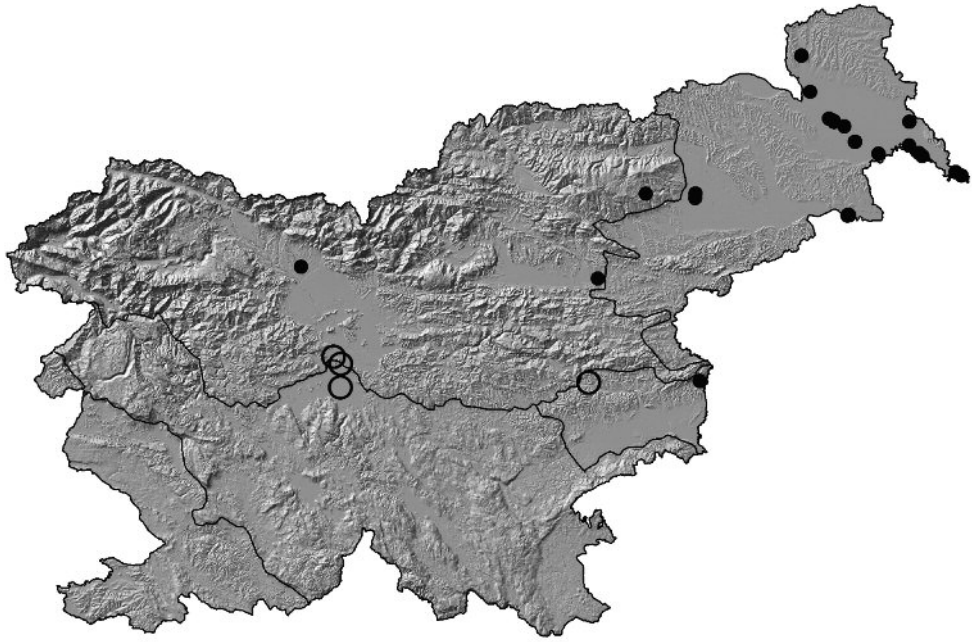
Prejeto / Received: 3. 6. 2016

Popravek

V članku Ambrožič, Š., Kapla, A., Vrezec, A. 2015: Razširjenost in status vrst rodu gladkih plavačev, Graphoderus (Coleoptera: Dytiscidae), v Sloveniji, Acta entomologica slovenica, 23, 2: 69-92, so potrebni naslednji popravki:

Na strani 73 je v besedilu, kjer so naštete lokacije za vrsto *Graphoderus austriacus* v dinarski regiji, napačen podatek za Ljubljansko barje, Ljubljana, 22.7.1986, ldcAGs, rŠAm. Tega podatka ni.

Na strani 74 polni krogec z najdbo na Ljubljanskem barju ni pravilen. Prilagamo pravilno karto, brez tega podatka.



Slika 2: Pregledna karta zgodovinske in današnje razširjenosti malega plavača (*Graphoderus austriacus*) Sloveniji. S praznimi krogci so označene najdbe pred letom 1950, s polnimi pa podatki o najdbah vrste po letu 1950.

Figure 2: Historical and present distribution of G*raphoderus austriacus* in Slovenia. The empty circles represent records of species before the year 1950, full circles represent records of species after the year 1950.

ACTA ENTOMOLOGICA SLOVENICA

LJUBLJANA, JUNIJ 2016 Vol. 24, št. 1: 15–26

DETERMINATION OF CODLING MOTH, *CYDIA POMONELLA* (LEP.: TORTRICIDAE), GENERATION NUMBERS AND ADULT POPULATION FLUCTUATION IN YASOUJ THROUGH TWO DIFFERENT METHODS

Hojjatollah MOHAMMADI*, Amrollah AZARM, Mostafa ZAMANPOUR

Department of Plant Protection, Faculty of Agriculture, Yasouj University, 75914-353 Yasouj, Iran
**Corresponding author, e-mail: h.mohammadi@yu.ac.ir*

Abstract - Population fluctuation of adult codling moth was studied in Yasouj through two methods, (1) sex pheromone-baited trapping and (2) collecting of larvae and maintaining them in natural conditions, to determine its appropriate spraying time. In the first method, three generations of adults emerged from mid-April to early June (45 days), late May to mid-July (60 days) and mid-July to mid-September (60 days). Their flight peaks occurred after mid-April, after mid-June and early August. At the time of flight peak, second and third generation adult populations were equal but twice as high as first generation adult population. In the second method, three generations of adults emerged during April (25 days), early June to mid-July (45 days) and mid-July to late August (45 days). Their flight peaks occurred in mid-April, mid-June and end July. Both methods were congruent for showing population fluctuation. Flying periods of the second and third generations were equal but longer than flying period of the first generation. Flying periods in the second method were shorter than flying periods in the first method. Flight peaks of both methods coincided but with slight delay for the first method. Some of first generation larvae remained dormant for one year and emerged as adults next year which shows that some individuals were monovoltine. Spraying time for the study area can be adjusted according to the findings of this study and the type of pesticide which have to be used.

KEY WORDS: Monitoring and forecasting, Codling moth, Population fluctuation, Yasouj

Izvleček – DOLOČANJE ŠTEVILA GENERACIJ JABOLČNEGA ZAVIJAČA, *CYDIA POMONELLA* (LEP.: TORTRICIDAE) IN SPREMLJANJE SPREMINJANJA VELIKOSTI ODRASLE POPULACIJE V YASOUJU Z DVEMA METODAMA

Spreminjanje velikosti populacije odraslih jabolčnih zavijačev v Yasouju smo ugotavljali z dvema metodama, (1) lovom na feromonske pasti in (2) zbiranjem ličink in njihovim gojenjem v naravnih razmerah, da bi določili pravilen čas škropljenja. Po prvi metodi so se tri generacije odraslih osebkov pojavljale od srede aprila do začetka junija (45 dni), od konca maja do srede julija (60 dni) in od srede julija do srede septembra (60 dni). Viški letanja metuljev so bili po sredini aprila, po sredini junija in v začetku avgusta. V času viškov sta bili druga in tretja generacija enaki, a dvakrat večji kot prva generacija metuljev. Po drugi metodi so se tri generacije odraslih osebkov pojavljale aprila (25 dni), od začetka junija do srede julija (45 dni) in od srede julija do konca avgusta (45 dni). Njihovi viški letanja so bili sredi aprila, sredi junija in konec julija. Obe metodi sta bili primerni za spremljanje spreminjanja populacije. Obdobji letanja druge in tretje generacije sta bili enaki, a daljši od obdobja letanja prve generacije. Obdobja letanja po drugi metodi so bila krajša kot po prvi metodi. Viški letanja po obeh metodah so se ujemali, vendar z rahlim zaostankom po prvi metodi. Nekaj ličink prve generacije je ostalo dormantnih celo leto in so se kot metulji pojavile naslednje leto, kar kaže, da je nekaj osebkov monovoltinih. Čas škropljenja v območju raziskav lahko prilagodimo glede na ugotovitve te raziskave in vrste pesticida, ki ga uporabljamo.

Ključne besede: Spremljanje in napovedovanje, jabolčni zavijač, spreminjanje velikosti populacije, Yasouj

Introduction

Iran has been one of the ten top apple producers in the world with average production of 1.7 to 2.7 million tons per year (FAOSTAT, 2014). Codling moth, *Cydia pomonella* L. (Lep.: Tortricidae), is a key pest of apple in various regions of Iran (Rajabi *et al.*, 2007). Its full-grown larvae either pupate and emerge as adults after 10 to 20 days or enter diapause until the following spring. Therefore, codling moth could have different number of generations per year in different regions or even in the same region depending on weather conditions (Rajabi *et al.,* 2007; Kot, 2010). Its control is essential to harvest crop in commercial orchards and there have been many control tactics such as fruit thinning, fruit bagging, trunk banding, sanitation methods (Judd *et al*., 1997; Witzgall *et al*., 2008; Anonymous, 2014), mating disruption, trapping (Knight, 1996, Gut *et al.*, 1998, Light *et al.,* 2001) and sterile insect technique (Vreysen *et al.,* 2010; Dyke, 2010). Nevertheless, insecticides have been the main control method. Since larvae bore into fruit and they are protected from insecticide exposure, insecticide spray should be timed and targeted either at the egg stage or newly-hatched larvae depending on the insecticide used (Alston *et al.,* 2010; Ranjbar Aghdam, 2015). That is the reason why codling moth monitoring has always been one of the widely investigated aspects of this pest (Witzgall *et al*., 2008) and many monitoring systems have been devised and examined including: (1) Fermented molasses mixture (Brunner, not dated), (2) Black light traps (Madsen and Sanborn, 1962), (3) Sampling of larvae or the damage caused by larvae, (4) Female moths

placed in a cage inside a trap (Hathaway, 1966), (5) kairomone-baited traps (Knight and Light, 2005; Hicher, 2009), (6) Degree day which predict codling moth development and activity based on the heat unit accumulation (Procter, *et al*., 1986; Roltsch et al., 1999; Jones *et al*., 2013) and (7) pheromone-baited traps. The detection sensitivity and species selectivity of pheromone-baited traps make them ideal tools to detect the presence of insects and monitor their flight period phenology (Brunner *et al*., 2002; Fadamiro, 2004). They have been widely used to monitor pest population density and fluctuation and determine spraying time in fruit orchards (Knight et al., 1999; Rajabi et al., 2007).

Codling moth has not been well studied in Yasouj and control measurements are mostly based on the available results from the other parts of the country. In present study, it was attempted to monitor emergence and population fluctuation of adult codling moth in this region through sex pheromone-baited traps accompanied with collecting, maintaining and rearing codling moth in natural conditions. Both methods were applied simultaneously in the same orchard and results were compared to verify the capability and reliability of sex pheromone-baited traps as a conventional method for monitoring and forecasting codling moth in this region. Usually, monitoring systems are used together to provide better information to growers to increase effectiveness of their control programs.

Materials and Methods

The study was carried out from August 2012 to September 2013 continuously in an abandoned and infested apple orchard in Darshahi village (30° 49′ 42″ N and 51° 22′ 12″ E) that is located thirty kilometers northwest of Yasouj.

A) Trapping using sex pheromone trap (First method)

Three pheromone traps were installed at a height of 1.5 to 2 meters above the ground level within tree canopy in late March 2013. Pheromone trade mark was Scentomos and traps were delta type. Traps were more than 150 meters away from each other. They were being inspected daily and replaced once every seven days. Trapped moths were being removed with a forceps and recorded in each inspection. This observation continued from late March to late September when no more moths were trapped. Finally, mean of trapped adults was calculated for every day and plotted against time to determine generation numbers, flying periods and flight peaks.

B) Collecting, maintaining and rearing larvae in natural conditions (Second method)

B-1) Large numbers of overwintering larvae were collected during late August and September 2012 by collecting maggoty apples and wrapping corrugated cardboard around the trunk of apple trees. These larvae were maintained in natural conditions in the garden and monitored on a daily basis from late March 2013 onwards to follow adult emergence. In fact this group of adult moths was the **first generation of adults** in 2013 whose flying period and peak flight were determined (Table 1).

B-2) In the next year, inspection of orchard started in mid-April on a daily basis to search for signs of codling moth infestation. From May 10th (when the first sign of

codling moth infestation was seen) up to June 15th (ten days after emergence of the first adult of second generation), maggoty apples were collected daily and maintained in containers under natural conditions in the orchard. Larvae inside fruits were allowed to complete their development and pupate in corrugated cardboards. These pupae were maintained in natural conditions in the orchard and monitored on a daily basis to record emergence of the **second generation adults** (Table 1).

B-3) Adults of the second generation were being placed in a separate box and provided cotton wads of 10 percent honey solution as food and small apple fruits for egg laying. Fruits were taken out after one or two nights and maintained by date in separate containers in natural conditions. Newly-hatched larvae were allowed to bore into fruits, complete their development and pupate in corrugated cardboards. Albeit, once fruits were being withered, larvae were being transferred to a new and fresh fruit. These pupae were kept in natural conditions in the garden and monitored on a daily basis to record emergence of the **third generation adults** (Table 1).

B-4) The previous process was repeated exactly once again with the third generation adults. All larvae of this generation started to **overwinter** and no adult emerged up to the next April. Finally, the number of adult moths was plotted against time to determine population fluctuation.

Table. 1. Codling moth adult emergence during the year by the second method, with some landmark dates.

Date	Event	Adult emergence in order
Aug 2012	Collecting of larvae	
Sep 2012	Collecting of larvae	
26 Mar 2013	Emergence of first adult of 1st generation	
15 Apr 2013	1st generation flight peak	1st generation
19 Apr 2013	Emergence of last adult of 1st generation	
10 May 2013	Start to collect maggoty apples	
6 Jun 2013	Emergence of first adult of 2nd generation	
15 Jun 2013	Stop collecting maggoty apples 2nd generation flight peak	2nd generation
12 Jul 2013	Emergence of first adult of 3rd generation	
16 July 2013	Emergence of last adult of 2nd generation	3rd generation
30 Jul 2013	3rd generation flight peak	
25 Aug 2013	Emergence of last adult of 3rd generation	

Results

A) Trapping using sex pheromone trap (First method)

The first adult moth was trapped after mid April 2013. There was an intense increase in the number of trapped moths two nights after and then it decreased sharply. Whole May to early June, number of trapped moths was low and with more fluctuation. From June 10th trapped moths increased again, reached its peak on June 20th, and decreased during late June. Whole July, number of trapped moths was low and with more fluctuation. Late July trapped moths started to increase once again and reached its peak end July to early August. 8th September onwards no moth was trapped (Figure 1).

B) Rearing pest on apple fruit in natural conditions (Second method),

B-1) Of overwintering larvae which had been collected during late August and September 2012, nearby 28 percent died. The rest emerged as first generation adults from late March to late April (25 days) and their flight peak occurred in mid-April.

B-2) First brood larvae, which had been collected from infested fruits during early May to mid-June 2013, completed their development and crawled to corrugated cardboards. Of them, about five percent died and four percent remained dormant up to the next year and then emerged as adults. The rest emerged as second generation adults from early June to mid-July (45 days) and their flight peak occurred mid-June. In fact, most of adults emerged from June 5th to 25th and the rest emerged sporadically

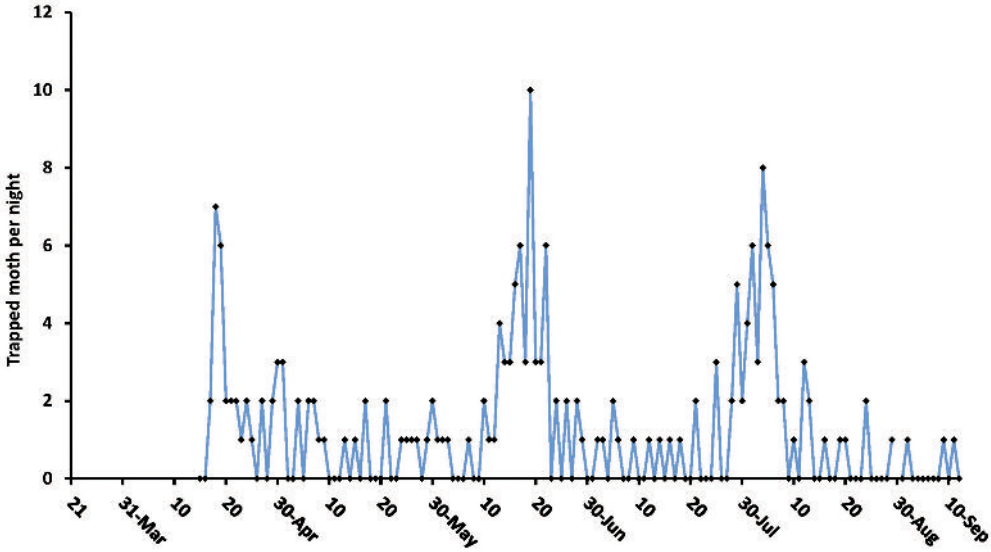


Fig. 1. Adult codling moth trapping through first method (pheromone-baited trap) in the year 2013 in Yasouj.

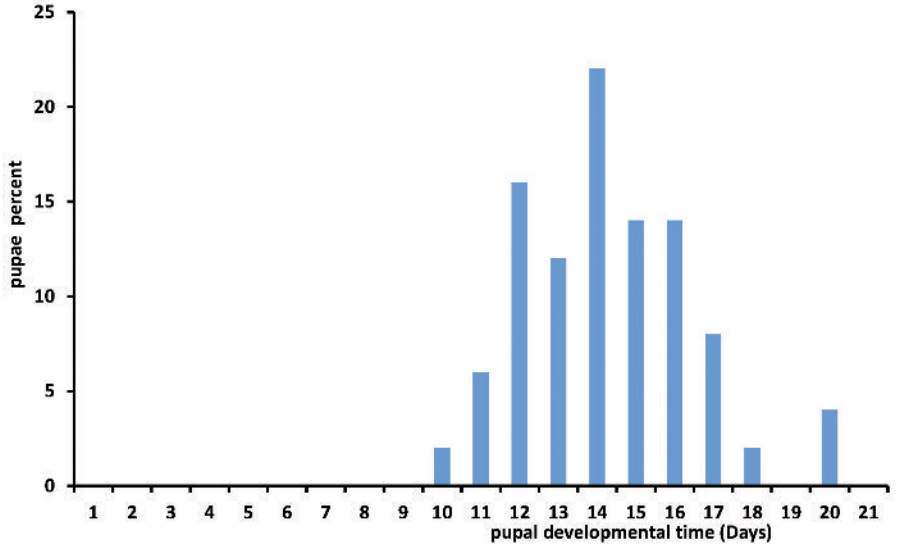


Fig. 2. Developmental time of first brood pupae of codling moth in the year 2013 in Yasouj.

during July. In this part, pupal developmental time was also measured which varied from 10 to 20 days and its mean was 14.28 days. This population showed a normal distribution for pupal developmental time in such a way that a large portion of population (25 percent) had 14 days of pupal developmental time and the rest of population was distributed normally on both sides. Pupal developmental time for 2 percent of population was 10 days and for 4 percent of population was 20 days (Figure 2).

B-3) Of second brood larvae, which were the offspring of second generation adults, about 16 percent died and the rest emerged as third generation adults during mid-July to late August (45 days). Flight peak occurred in late July (Figure 3).

B-4) Third brood larvae (offspring of third generation adults) entered diapause, started to overwinter and no adults emerged up to the next April.

Discussion

Codling moth is the most destructive insect pest of apple orchards in Kohgiluieh and Boyer Ahmad province, although no systematic survey has been carried out to estimate its damage. Chemical insecticides have dominated attempts to control this pest in the region; nevertheless, farmers are unhappy and always complaining about chemical control inefficiency which is mainly rooted in inappropriate spraying time. This pest has not been studied sufficiently in the region and control decisions mostly rely on the available results from the other parts of the country. In view of establishment of new apple orchards, codling moth could be a serious problem in this region in future. Hence, monitoring of codling moth and determination of its optimal spraying

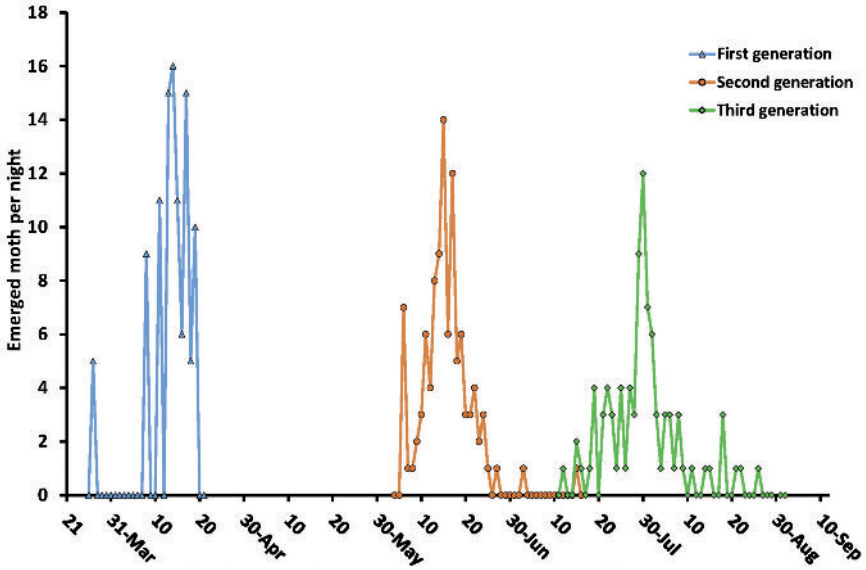


Fig. 3. Adult codling moth emergence through second method in the year 2013 in Yasouj.

time seems to be necessary. In present work, Sex pheromone-based traps accompanied with collecting, maintaining and rearing pest in natural conditions were applied to monitor adult emergence and fluctuation.

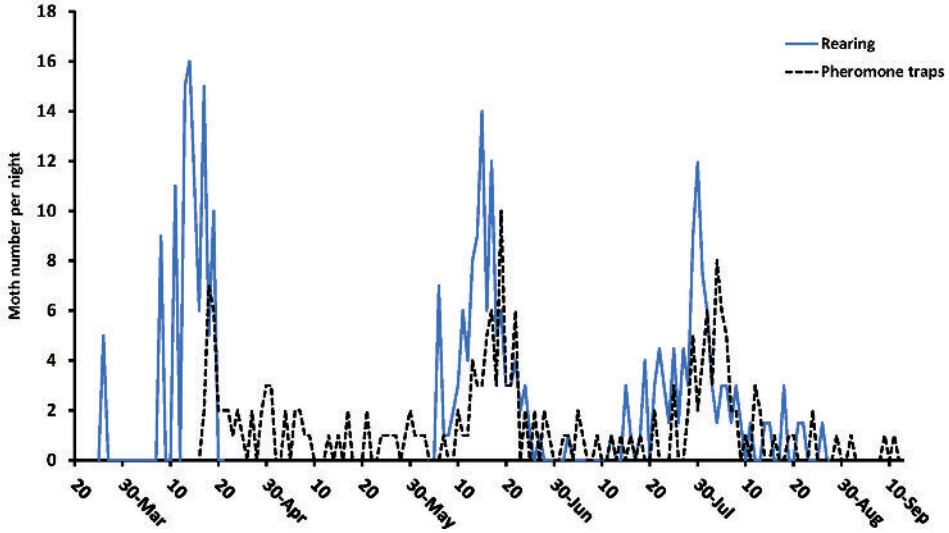


Fig. 4. Congruence of two methods in determination of population fluctuations of adult codling moth.

In both methods, results were indicative of three generations per year in this region. There are many papers, which have reported three generations per year for this pest (Rajabi *et al.,* 2007; Daneshnia *et al.,* 2012; Ranjbar Aghdam, 2015). It was seen that four percent of first generation larvae remained dormant for one year and emerged as adults in the next year. This implies that codling moth has diversity in voltinism. Rajabi (1978) reported between 8 to 12 percent of first brood larvae entered diapause. The incidence of diapause in first generation larvae indicates an influence of some other factors on diapause induction (Mansour, 2007). According to Brown *et al*. (1979), first generation larvae have a higher diapause rate (thus they are univoltine) when they are reared in apples crowded with larvae. In this work, maggoty apples were maintained together which might be the reason for this phenomenon. However, diapause induction in first generation larvae could serve as a protection mechanism for codling moth population in front of unfavorable conditions.

Flight peaks occurred during mid-April, mid-June and the end of July. Flight peaks of both methods coincided but with slight delay for the first method (Fig. 4). This slight delay in flight peak coincidence could be explained by the time interval between emergence and trapping of adults in the first method which does not exist for the second method. In second method, adult emergence and recording were at the same day while there might be a time interval between emergence and trapping (recording) in the first method. It could be concluded that the second method is more precise than first method for showing flight peaks. In the second method, adults were recorded on the same day they emerged while in the first method, trapped adults might have emerged some days back.

Flying periods of second and third generations were approximately equal but they were 15 to 20 days longer than first generation flying period (Fig. 1, 3). Emergence of first generation adults in a shorter period could be justified by source of emerging adults. Second and third generation adults are coming out of a gradual egg laying during season which will be led to a longer flying period and overlapping of generations (Table 1). While first generation adults are emerging from overwintering larvae which have been a long time (from September to April) full grown larvae. Most probably they would be uniform enough to emerge as adults in a shorter period.

Adult generations emerged during 45, 60 and 60 days in first method (Fig. 1) and 25, 45 and 45 days in second method (Fig. 3). As we can see for the same generation, flying periods in first method were 15 to 20 days longer than that in second method. This difference could be attributed to maintaining and rearing pest in an even condition in second method. In second method, place and condition of growth and development was similar for all members of each developmental stage (including eggs, larvae or pupae) to complete their embryonic, larval and pupal periods simultaneously and emerge as adults in a shorter period. While outside larvae and pupae are living in diverse places which have significant differences. For example, pupae or overwintering larvae on different sides of the same trunk experience different environmental conditions. Therefore, their developmental rate will be different which in turn leads to gradual adult emergence in nature. Normally, more gradual emerging of adults entails the longer flying period and overlapping of generations. The exact time of generation

overlapping could not be determined by the first method. There was no overlapping between first and second generations in the second method, but overlapping between second and third generations occurred during second ten days of July (Table 1).

In first method, second and third generation adult populations were equal but twice as high as first generation adult population especially at the time of flight peak (Fig. 1). This could be due to mortality of overwintering larvae during winter. It was mentioned that nearby one third of overwintering larvae died in second method.

Monitoring both males and females, showing exact time of generation overlapping, right and sharp detecting of flight peaks, detecting monovoltine and bivoltine individuals and precise detecting of first adult emergence in all generations especially in first generation could be considered as advantages of second method. However, this method is more time consuming and labor-intensive.

Finally, both methods were good enough to monitor pest in order to determine its generation numbers and flight peaks which can help us to determine optimal spraying time. Spraying time could be adjusted based on population fluctuation and insecticide to be used. As a usual, insect growth regulators (e.g., Diflubenzuron and Tebufenozide) should be applied before egg laying or egg hatching. Contact and ingested insecticides (e.g., spinosad, organophosphates, pyrethroids, and carbamates) should be applied after egg hatching to kill larvae as they emerge from eggs.

Conclusion

Both methods were congruent for monitoring of flight period and population dynamics of codling moth adults. Second method was more precise but time consuming and labor-intensive. In this region, codling moth was trivoltine whose adults emerged from April to late May or early June, late May or early June to mid-July and mid-July to mid-September in order. Flight peaks occurred in mid-April, mid-June and end July or early August. About four percent of first generation larvae entered diapause until the next year, which is indicative of monovoltine individuals inside population. Finally, optimal spraying time could be anticipated based on the obtained population fluctuation and type of insecticide which have to be used.

References

Alston, D., Murray, M. & Reding, M. (2010) Codling moth (*Cydia pomonella* L.). Utah State University Extension and Utah Plant Pest Diagnostic Laboratory. Available from: *http://extension.usu.edu/files/publications/factsheet/codling-moths06.pdf* (accessed 20 April 2014).

Anonymous, (2014) Codling Moth Management in Organic Orchards. Okanagan-Kootenay Sterile Insect Release Program. Available from: *http://www.oksir.org/docs/CodlingMothManagementInOrganicOrchards.pdf* (accessed 10 March 2015).

Brown, G. C., Berryman, A. A. & Bogyo, T. P. (1979) Density-dependent induction of diapause in the codling moth, *Cydia pomonella* (lep.: Tortricidae). *The Canadian Entomologist* 111, 431-433.

Brunner, J., Welter, S., Calkins, C., Hilton, R., Beers, E., Dunley, J., Unruh, T., Knight, A., Steenwyk, R., Buskirk, P. (2002) Mating disruption of codling moth: a perspective from the Western United States. *IOBC Wprs Bulletin* 25, 11–19

Brunner, J. (not dated) Monitoring methods for codling moth. A workshop sponsored by WSU cooperative extension and the IFAFS and RAMP grants. WSU TFREC, Wenatchee. Available from: *http://entomology.tfrec.wsu.edu/stableipm/workshoppdfs/cmmonitoring.pdf* (accessed 15 February 2015).

Butt, B. A. & Hathaway, D. O. (1966) Female sex pheromone as attractant for male codling moths. *Journal of Economic Entomology* 59, 476-477.

Daneshnia, N., Alichi, M. & Heidari, B. (2012) Determining the appropriate spray time for *Cydia pomonella* (Lep: Totricidae) in apple orchards using sex pheromone and degree day in Khanehzenyan. *Plant Protection Journal* 4, 37-44. [In Persian].

Dyck, V. A. (2010) Rearing codling moth for the sterile insect technique. FAO Plant Production and Protection Paper. FAO and IAEA. Available from: *http://www.fao.org/docrep/013/i1537e/i1537e.pdf* (accessed 15 February 2015).

Fadamiro, H. Y. (2004) Monitoring the seasonal flight activity of *Cydia pomonella* L. and *Argyrotaenia velutinana* in apple orchards by using pheromone-baited traps. *Environmental Entomology* 33, 1711-1717.

FAOSTAT, (2014) Crop production. Food and Agriculture Organization of the United Nations. Available from: *http*://*Faostat3.fao.org/browse/Q/QC/E* (accessed 15 February 2015).

Gut, L. J. & Brunner, J. F. (1998) Pheromone-based management of codling moth (Lepidoptera: Tortricidae) in Washington apple orchards. Journal of Agricultural Entomology 15, 387-406.

Hicher, A., Vandevan, R., Williams, D., & Penfold, N. (2009) Monitoring codling moth *Cydia pomonella* (Lep: Tortricidae) in Victorian pomes fruit orchards with pear ester. *Journal of General and Applied Entomology* 38, 57-64.

Jones, V., Hilton, R. Brunner, J., Bentley, W., Alston, D., Barrett, B. Steenwyk, R., Hull, L., Walgenbach, J., Coates, W. & Smith T. (2013) Predicting emergence of codling moth, *Cydia pomonella* (lepidoptera: Tortricidae) on a degree-day scale in North America. *Pest Management Science*, 69: 1393-1398.

Judd, G., Gardiner, M. & Thomson, D., (1997) Control of codling moth in organically-managed apple orchards by combining pheromone-mediated mating disruption, post- harvest removal and tree banding. *Entomologia Experimentalis et Applicata* 83, 137–146.

Khani, A., Moharramipour, S. & Barzegar, M. (2007) Cold tolerance and trehalose accumulation in overwintering larvae of the codling moth, *Cydia pomonella* (Lep.: Tortricidae). *European Journal of Entomology* 104, 385–392.

Knight A. L. & Light D. M. (2005) Seasonal flight patterns of codling moth (Lepidoptera: Tortricidae) monitored with pear ester and codlemone-baited traps in sex pheromone treated apple orchards. *Environmental Entomology* 34, 1028–1035

Knight, A. (1996) The impact of codling moth (Lepidoptera: Tortricidae) mating disruption on apple pest management in Yakima Valley, Washington. *Journal of the Entomological Society of British Columbia* 92, 29-38.

Kot, I. (2010) Monitoring of codling moth (*Cydia pomonella* L.) in apple orchards using two methods. *Journal of Plant Protection Research* 50, 220-223.

Light, D. Knight, A., Henrick, C., Rajapaska, D., Lingren, B., Dickens, J., Reynolds, K., Buttery, R., Merrill, G., Roitman, J. & Campbell, B. (2001) A pear-derived kairomone with pheromonal potency that attracts male and female codling moth, *Cydia pomonella* (L.). *Naturwissenschaften* 88, 333-338.

Madsen, H. F. & Sanborn, R. R. (1962) Black light traps help determine flights of codling moths and other deciduous fruit pests. California agriculture. Available from: *https://ucanr.edu/repositoryfiles/ca1602p12-64969.pdf* (accessed 15 March 2015).

Mansour, M. (2007) Biological characteristics of the codling moth, *Cydia pomonella* (L.), wild population from Southern Syria. *Polish Journal of Entomology* 76, 323-331

McDonough, L. M., Davis, H. G., Chapman, P. S & Smithhisler, C. L. (1993) Response of male codling moths (*Cydia pomonella*) to components of conspecific female sex pheromone glands in flight tunnel tests. *Journal of Chemical Ecology* 19, 1737–1748.

Procter, P. J., Dyck V. A. & Williams, R. J. (1986) Predicting codling moth spray dates with degree days. Available from: *http://www.agf.gov.bc.ca/cropprot/tfipm/cm_degree_days.pdf* (accessed 15 February 2015).

Rajabi G., Beheshti N. D., Akrami F., Bayatassadi H., Dickler E. & Davoudi, Z. (1978) Codling moth in Iran. An abstract of results obtained during the years 1975, 1976 and 1977. *Applied Entomology and Phytopathology* 46, 1–54. [In Persian].

Rajabi, G., Malmir, A. & Naderian, H. (2007) Comparative study of the number of generations, flight span and population density of codling moth in walnut and apple orchards in various altitudes of Iran. *Applied Entomology and Phytopathology* 74, 113-125. [In Persian].

Ranjbar Aghdam, H. (2015) Are pheromone traps applicable to forecast an insect pest phenology? A case study on codling moth. *Journal of Crop Protection* 4, 121-130.

Roelofs, W. L., Comeau, A., & Hill, G. M. (1971) Sex attractant of the codling moth: characterization with electroantennogram technique. *Science* 174, 297-299.

Roltsch, W. J., Zalom, F. G., Strawn, A. J., Strand, J. F. & Pitcairn, M. J. (1999) Evaluation of several degree-day estimation methods in California climates. *International Journal of Biometeorology* 42, 169-176.

Vreysen, M. J. B., Carpenter, J. E. & Marec, F. (2010) Improvement of the sterile insect technique for codling moth *Cydia pomonella* (L.) (Lep.: Tortricidae) to facilitate expansion of field application. *Journal of Applied Entomology* 134, 165–181.

Witzgall, P., Stelinski, L., Gut, L. & Thomson, D. (2008) Codling Moth Management and Chemical Ecology. *Annual Review of Entomology* 53, 503–522.

Received / Prejeto: 19. 2. 2016

ACTA ENTOMOLOGICA SLOVENICA

LJUBLJANA, JUNIJ 2016 Vol. 24, št. 1: 27–34

PRISPEVEK K POZNAVANJU FAVNE HROŠČEV V JAMI PRI LIPNIŠKI SKALI

Bojan KOFLER

Podlubnik 301, 4220 Škofja Loka,
e-mail: bojan.kofler@telemach.net, bojan.kofler@gmail.com

Izvleček – Predstavljeni so rezultati devetletnih vzorčenj favne hroščev v Jami pri Lipniški skali v kraju Lipnica pri Kamni Gorici (severozahodni del Slovenije). Najdenih je bilo 16 vrst.

KLJUČNE BESEDE: Coleoptera, Carabidae, Trechinae, Cholevidae, Cryptophagidae, Leiodidae, Staphylinidae, Bothrideridae, favna, nova najdišča, Slovenija

Abstract - CONTRIBUTION TO THE KNOWLEDGE OF BEETLE FAUNA IN THE CAVE JAMA PRI LIPNIŠKI SKALI

Results of a nine years sampling of the beetle fauna in the cave Jama pri Lipniški skali (north-western part of Slovenia) are presented. Sixteen species in all were found.

KEY WORDS: Coleoptera, Carabidae, Trechinae, Cholevidae, Cryptophagidae, Leiodidae, Staphylinidae, Bothrideridae, fauna, new records, Slovenia

Uvod

Jama pri Lipniški skali je krajša konglomeratna jama v peščenjaku, ki leži plitvo pod površjem. Ima prostoren vhodni del, ki se nadaljuje z rovom. Svetloba in klimatski vplivi s površja segajo daleč v njeno notranjost. Le v zadnjih metrih edinega rova, ki pa so zaradi svoje ozkosti in kot nož ostrih skal le stežka dostopni, vladajo jamske razmere, primerne za preživetje troglobiontov (popolna tema, visoka relativna zračna vlaga in bolj ali manj stalna letna temperatura zraka).

Jama je tipsko nahajališče slepega jajčarja vrste *Aphaobius robustus* (slika 1), ki ga je tu prvi našel Egon Pretner. V mapi Jama pri Lipniški skali, ki se nahaja v Katastru jam Jamarske zveze Slovenije v Ljubljani, obstajata dva zapisnika (Pretner

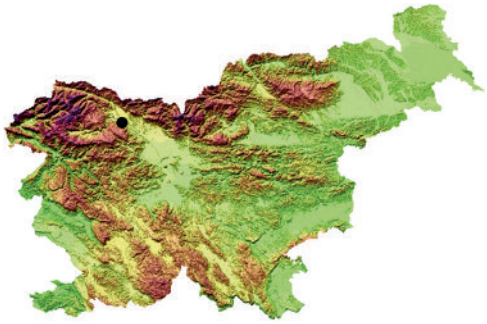
Slika 1: *Aphaobius robustus* – naravna velikost 2,8 mm (foto Miroslava Kofler).

1936, 1945) o njegovih kasnejših obiskih jame. Tako je 11. 6. 1936 zapisal: „ Na dne 24. maja 1936 v desnem rovu nastavljenih vabah nisem našel ničesar. Pred leti sem tu ulovil na vabah *Aphaobius heydeni subsp. robustus* Muell.- locus classicus. Ali ta žival je tu zelo redka, medtem ko je *Laemostenus schreibersi* prav pogost.“ Ob obisku 9. 12. 1945 pa še: „ Izvanredno suho v jami. V ozki razpoki so med drugo svetovno vojno ojstro kamenje nekaj odbili, vsled česar se obleka ne raztrga več tako kakor poprej. Dne 18. XI. 1945 nastavil 2 vabi, ali dne 9. XII. 1945 nisem na vabah ničesar našel.“ V mapi se nahaja še M. Chvatalov zapisnik (Chvatal 1980), ki vsebuje načrt in skop opis jame, zato v nadaljevanju prispevka podajam njen dopolnjen opis.

Po drugi svetovni vojni so tu razen Pretnerja in avtorja raziskovali še Jože Broder, Manfred Egger in Manfred Kahlen. Publicirane so bile le Pretnerjeve, Koflerjeve in Kahlenove najdbe vrste *Aphaobius robustus* (Bognolo & Vailati 2010). V pričujočem prispevku podajam celoten pregled podatkov o favni hroščev v Jami pri Lipniški skali, ki sem jih zbral skozi devetletna vzorčenja.

Lega in opis jame

Jama pri Lipniški skali, kat. št.: 397 (Kataster jam 2015) se nahaja v severozahodnem delu Slovenije (slika 2) v kraju Lipnica pri Kamni Gorici na Gorenjskem. Vhod v jamo leži na strmem gozdnem pobočju približno 30 metrov nad cesto in sicer tik

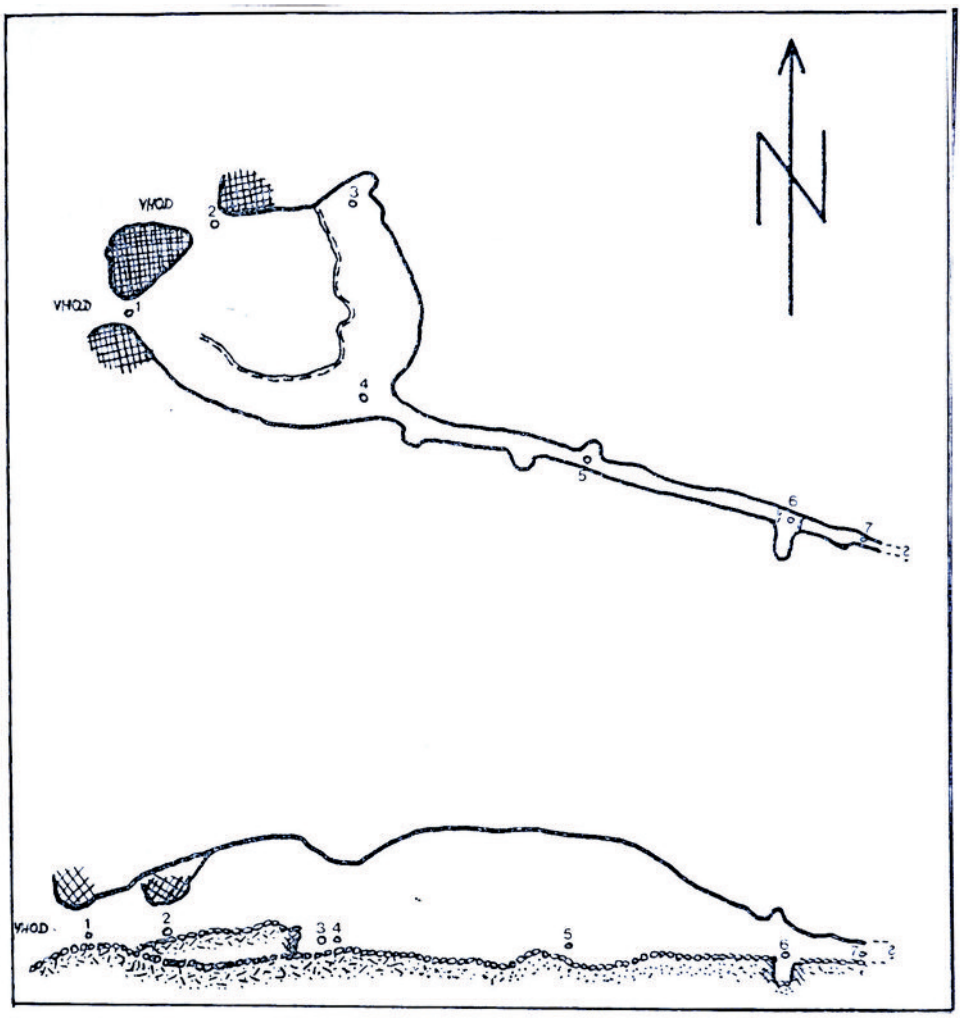


Slika 2: Lega Jame pri Lipniški skali.

pod 4 do 5 metrov visoko konglomeratno steno. Njene WGS-84 koordinate so: E 14.2137, N 46.3054, kota vhoda pa 465 metrov nad morjem.

Ta 31 metrov dolga in 6 metrov globoka (visoka) jama ima (slika 3) dva vhoda, spodnji je širok 3, zgornji 2 metra; višina oboka pa pri obeh znaša okrog 2,5 metra. Vhodna manjša dvorana je ovalne oblike, dolga 10 in široka 9 metrov, ter je edini večji prostor v jami. Strop dvorane na najvišji točki doseže višino 5 metrov. V prostoru je polmrak, tla so pokrita z večjimi odkruški konglomeratnih skal in so večji del leta suha. V vlažnih obdobjih kaplja s stropa voda.

Od tu se na desni strani odcepi 21 metrov dolg, na začetku dobro pohoden, nato pa ozek (0,25 – 0,75 metra) in 2 do 5,5 metrov visok rov, ki se konča v za človeka ne-



Slika 3: Načrt Jame pri Lipniški skali – tloris in prerez (M. Chvatal).

prehodni razpoki. Tla pokriva mokra ilovica, s stropa kaplja voda in polzi po stenah, ki so polne kot nož ostrih konglomeratnih kamnov. Zato je gibanje močno ovirano in pogosto prav boleče. Ostri kamni se zatikajo v oblačila, režejo v boke, kolena in prste, ko se mukoma plaziš naprej. Na koncu je komaj dovolj prostora za postavitev pasti. Ta zadnji del se obiskovalcu dozdeva pozimi topel in poleti hladen. Po Chvatalovi opombi v zapisniku (Chvatal 1980) ta visok, meandrast, dokaj erodiran rov nakazuje, da je iz jame nekoč tekel potok.

Biološke raziskave

V jami sem raziskoval med letoma 2001 in 2009. Glavna metoda lova so bile pasti s trohnečim mesom ali sirom in konzervirno tekočino, ki sem jih porazdelil po jami in sicer v vhodni dvorani štiri in v stranskem rovu tri pasti. Da sem preprečil masovne ulove najpogostejšega prebivalca te jame, hrošča vrste *Laemostenus schreibersi*, sem pasti prekril s kovinsko mrežico, ki je bila dovolj gosta, da je preprečevala prehod te vrste in dovolj redka, da je omogočila prehod ostalim vrstam. Ulovljene osebke sem pobiral v različnih časovnih presledkih. Ob obiskih jame sem tudi redno pregledoval stene in tla, ter obračal kamne, vendar sem s to metodo nabiranja našel zgolj vrsto *Laemostenus schreibersi.*

Vzorčenja po letu 2006 so bila opravljena z dovoljenjem Agencije Republike Slovenije za okolje št. 35601-85/2007-4.

Rezultati in razprava

Pestra favna hroščev v jami po dosedanjem vedenju šteje šestnajst vrst:

1) ***Anophthalmus egonis*** **Mueller 1923**

Ulov: 5.4. - 7.9.2002: 2 osebka; 4.6. - 28.6.2003: 1 osebek; 14.5. - 8.9.2005: 1 osebek; 1.4. - 8.9.2006: 4 osebki; 8.9.2006 – 16.2.2007: 2 osebka; 15.7. - 12.11.2007: 1 osebek. Leg., det., col. B. Kofler.

2) ***Anophthalmus micklitzi rovnicensis*** **Daffner 1996**

Ulov: 2.6. - 15.8.2001: 1 osebek; 5.4. - 7.9.2002: 1 osebek; 1.4. - 8.9.2006: 1 osebek; 8.9.2006 – 16.2.2007: 1 osebek; 16.7. - 12.11.2007: 1 osebek; 6.9.2008 – 4.7.2009: 1 osebek. Leg., det., col. B. Kofler.

3) ***Laemostenus schreibersi*** **Kuester 1846**

Ulov: 18.2. - 2.6.2001: 2 osebka; 2.6. - 15.8.2001: 2 osebka; 5.4. - 7.9.2002: 3 osebki; 7.9. - 21.12.2002: 2 osebka; 21.12.2002 – 4.5.2003: 1 osebek; 4.5. - 28.6.2003: 2 osebka; 4.10.2004 – 14.5.2005: 2 osebka; 14.5. - 8.9.2005: 2 osebka; 1.4. - 8.9.2006: 2 osebka; 8.9.2006 – 16.2.2007: 2 osebka; 16.2. - 15.7.2007: 2 osebka; 15.7. - 12.11.2007: 2 osebka; 12.11.2007 – 16.2.2008: 2 osebka; 16.2. - 6.9.2008: 2 osebka; 6.9.2008 – 4.7.2009: 1 osebek. Leg., det., col. B. Kofler.

4) ***Aphaobius robustus* J. Mueller 1914**

Ulov: 2.6. - 15.8.2001: 1 osebek; 9.2. - 5.4.2002: 1 osebek; 5.4. - 7.9.2002: 4 osebki; 7.9. - 21.12.2002: 4 osebki; 21.12.2002 – 4.5.2003: 1 osebek; 4.5. - 28.6.2003: 1 osebek; 27.3. - 4.10.2004: 1 osebek; 4.10.2004 – 14.5.2005: 1 osebek; 1.4. - 8.9.2006: 6 osebkov; 8.9.2006 – 16.2.2007: 3 osebki; 16.2. - 15.7.2007: 1 osebek; 15.7. - 12.11.2007: 1 osebek; 12.11.2007 – 16.2.2008: 3 osebki; 16.2. - 6.9.2008: 3 osebki; 6.9.2008 – 4.7.2009: 3 osebki. Leg., det., col. B. Kofler.

5) ***Bryaxis argus* Kraatz 1863**

Ulov: 5.4. - 7.9.2002: 5 osebkov; 14.5. - 8.9.2005: 4 osebki, 8.9.2006 – 16.2.2007: 1 osebek; 16.2. - 15.7.2007: 4 osebki; 15.7. - 12.11.2007: 4 osebki; 16.2. - 6.9.2008: 5 osebkov; 6.9.2008 – 4.7.2009: 7 osebkov. Leg., col. B. Kofler, det. B. Kofler in S. Brelih.

6) ***Leptinus testaceus* Mueller 1817**

Ulov: 8.9.2006 – 16.2.2007: 1 osebek. Leg., col. B. Kofler, det. S. Brelih.

7) ***Paederus littoralis* Gravenhorst 1802**

Ulov: 5.4. - 7.9.2002: 1 osebek. Leg., det., col. B. Kofler.

8) ***Catops subfuscus* Kellner 1846**

Ulov: 5.4. - 7.9.2002: 1 osebek. Leg., det., col. B. Kofler.

9) ***Catops fuliginosus* Erichson 1837**

Ulov: 6.9.2008 – 4.7.2009: 1 osebek. Leg., col. B. Kofler, det. M. Kahlen.

10) ***Nargus wilkini* Spence 1815**

Ulov: 5.4. - 7.9.2002: 1 osebek. Nabral in kolekcioniral B. Kofler, det. M. Kahlen.

11) ***Choleva agilis* Illiger 1798**

Ulov: 6.9.2008 – 4.7.2009: 1 osebek. Leg., col. B. Kofler, det. M. Kahlen.

12) ***Choleva oblonga* Latreille 1807**

Ulov: 1.4. - 8.9.2006: 1 osebek; 16.2. - 15.7.2007: 1 osebek; 15.7. - 12.11.2007: 1 osebek. Leg., col. B. Kofler, det. M. Kahlen.

13) ***Choleva sturmi* Brisout 1863**

Ulov: 16.2. - 6.9.2008: 1 osebek; 6.9.2008 – 4.7.2009: 1 osebek. Leg., det., col. B. Kofler.

14) ***Cryptophagus pilosus* Gyllenhal 1828**

Ulov: 8.9.2006 – 16.2.2007: 4 osebki; 16.2. - 6.9.2008: 1 osebek. Leg., col. B. Kofler, det. M. Kahlen.

Slika 4: *Anophthalmus egonis* – naravna velikost 6,0 milimetrov (foto Miroslava Kofler).

15) ***Cryptophagus distinguendus*** **Sturm 1845**
Ulov: 8.9.2006 – 16.2.2007: 5 osebkov; 15.7. - 12.11.2007: 7 osebkov; 16.2. - 6.9.2008: 2 osebka. Leg., col. B. Kofler, det. M. Kahlen.

16) ***Oxylaemus variolosus*** **Dufour 1843**
Ulov: 14.5. - 8.9.2005: 1 osebek. Leg., col. B. Kofler, det M. Kahlen.

Izmed 16 ugotovljenih vrst sem v vhodni dvorani našel kar 12 vrst: *Bryaxis argus, Leptinus testaceus, Paederus littoralis, Catops subfuscus, Catops fulginosus, Nargus wilkini, Choleva agilis, Choleva oblonga, Choleva sturmi, Oxylaemus variolosus, Cryptophagus pilosus in Cryptophagus distinguendus.* Vrsta *Laemostenus schreibersi* je bila prebivalec vseh jamskih delov. Vrsta A*phaobius robustus je poseljevala* celoten stranski rov, nisem pa je našel v vhodni dvorani. Vrsti *Anophthalmus egonis* in *Anophthalmus micklitzi rovnicensis* sem ulovil samo v končnem delu stranskega rova.

Zanimiva je najdba brezokca vrste *Anophthalmus egonis* (slika 4), saj je to njegovo najjužnejše najdišče in je od tipskega nahajališča Pesjakov buden v zračni črti oddaljeno kar 15 kilometrov. Za brezokca *Anophthalmus micklitzi rovnicensis* (slika 5) pa je Jama pri Lipniški skali šele drugo znano najdišče in je od klasičnega najdišča v zračni črti oddaljeno 5 kilometrov.

Summary

Nine years of research of the beetle fauna in the cave Jama pri Lipniški skali confirmed presence of the following species: *Anophthalmus egonis, Anophthalmus mic-*

Slika 5: *Anophthalmus micklitzi rovnicensis* – naravna velikost 5,7 milimetrov (foto Miroslava Kofler).

klitzi rovnicensis, Laemostenus schreibersi, Aphaobius robustus, Bryaxis argus, Leptinus testaceus, Paederus littoralis, Catops subfuscus, Catops fulginosus, Nargus wilkini, Choleva agilis, Choleva oblonga, Choleva sturmi, Cryptophagus pilosus, Cryptophagus distinguendus, and *Oxylaemus variolosus.* The cave Jama pri Lipniški skali is the classical finding place of the species *Aphaobius robustus.* The finding of the species *Anophthalmus egonis* was quite a surprise as this is the most southern finding place, 15 km distance from the so far known finding places of this species. Even more surprising was the finding of the species *Anophthalmus micklitzi rovnicensis*. The cave Jama pri Lipniški skali is only the second known finding place where this species was found, and is also 5 km away from the classical finding place.

Literatura

Bognolo M., Vailati D., 2010: Revision of the genus *Aphaobius* Abeille de Perrin, 1878 (Coleoptera, Cholevidae, Leptodirinae). *Scopolia,* **68**: 35 – 37, Ljubljana.

Chvatal M., 1980: Zapisnik terenskih ogledov – Jama pri Lipnici. DZRJ Kranj. Kranj**.**

Jamarska zveza Slovenije, 2015: *Kataster jam,* Ljubljana.

Pretner E., 1936: Zapisnik terenskih ogledov – Jama pri Lipniški skali ali pod Goračem. DZRJ Ljubljana. Ljubljana.
Pretner E., 1945: Zapisnik terenskih ogledov – Jama pri Lipniški skali ali pod Goračem. DZRJ Ljubljana. Ljubljana.

Prejeto / Received: 6. 6. 2015

ACTA ENTOMOLOGICA SLOVENICA

LJUBLJANA, JUNIJ 2016 Vol. 24, št. 1: 35–54

PRELIMINARY REPORT ON THE CICADOMORPHA (HEMIPTERA) FAUNA OF KEMALİYE (ERZİNCAN PROVINCE, EAST TURKEY)*

Emine DEMİR[1] and Ali DEMİRSOY[2]

[1] Uğur Mumcu M., 51 nolu kooperatif, 1626 S., 6/2, Batıkent Ankara, Turkey.
E-mail: eminedemird@yahoo.com
[2] Hacettepe University, Faculty of Science, Department of Biology,
Beytepe Ankara, Turkey.
E-mail: demirsoy@hacettepe.edu.tr

Abstract - Cicadomorpha specimens collected in the years 2006 and 2007 in the Kemaliye (Erzincan province) in east Turkey were examined. 63 species belonging to 7 families were found: 4 species belong to the family Cicadidae, 1 to Tibicinidae, 1 to Cercopidae, 6 Aphrophoridae, 1 to Membracidae, 1 Ulopidae and 49 species to Cicadellidae. Distribution of these species in Turkey and their host plants are given along with their locality records. 52 species records are new to the Kemaliye district, 32 new to Erzincan province and 8 species records are new to eastern Turkey.

KEY WORDS: Hemiptera, Cicadomorpha, fauna, Kemaliye district, eastern Turkey.

Izvleček – PREDHODNO POROČILO O FAVNI PODREDA CICADOMORPHA (HEMIPTERA) KEMALIJE (POKRAJINA ERZINCAN, VZHODNA TURČIJA)

Pregledani so bili primerki podreda Cicadomorpha, zbrani v letih 2006 in 2007 v Kemaliji (pokrajina Erzincan) v vzhodni Turčiji. Najdenih je bilo 63 vrst, pripadajočih 7 družinam: 4 vrste pripadajo družini Cicadidae, 1 Tibicinidae, 1 Cercopidae, 6 Aphrophoridae, 1 Membracidae, 1 Ulopidae in 49 vrst družini Cicadellidae. Poleg podatkov o najdiščih je navedena razširjenost teh vrst v Turčiji in njihove hranilne rastline. 52 vrst je prvič najdenih v okraju Kemalija, 32 je novih za pokrajino Erzincan, 8 vrst pa za vzhodno Turčijo.

KLJUČNE BESEDE: Hemiptera, Cicadomorpha, favna, okraj Kemaliye, vzhodna Turčija.

*This study was supported by TUBITAK (The Project number: CAYDAG-105Y016). The present work includes only Cicadomorpha (Hemiptera) part of the project.

Introduction

In the studies of Lodos and Kalkandelen on the Auchenorrhyncha of Turkey (1981a, 1981b, 1981c, 1982a, 1982b, 1983a, 1983b, 1983c, 1984a, 1984b, 1984c, 1984d, 1985a, 1985b, 1985c, 1986a, 1986b, 1986c, 1987a, 1987b, 1987c, 1987d, 1988) 43 Cicadomorpha species from the Erzincan province (East Turkey) and one from the Kemaliye district were recorded. Later, the study of Demir and Demirsoy (2008) presented records of 10 additional species, raising the total species number for the province to 54.

District of Kemaliye (in south Erzincan province), which was selected as the study area, is located in east Turkey, between 38º 15' - 39º 0' eastern longitude and 39º 30' – 39º 0' northern latitude. The elevation ranges between 950 m and 2350 m. 11 Cicadomorpha species were known in the Kemaliye area prior to our study, a compilation of records in the studies of the authors mentioned above.

Material and Methods

Field studies were carried out in the years 2006 and 2007. 1404 adult Cicadomorpha specimens were collected and analyzed. They were collected by sweeping the herbaceous plants with a net. The material is kept dry in the first author's collection.

Fig. 1: Photos of the research area (Kemaliye district). Euphrates and surrounding areas, photo E. Demir.

Fig. 2: Sarıçiçek Plateau, photo E. Demir.

Results

Altogether 63 species were found. Along with their distribution in Turkey and the plants found to be their hosts, the examined material of these species is listed below.

Suborder CICADOMORPHA
Superfamily CICADOIDEA
Family CICADIDAE
Subfamily CICADINAE
Tribe CICADINI
***Cicadatra atra* (Olivier, 1790)**
Material examined: Kemaliye: Kuşak Village (Dere), 06.07.2006, 1♀, 1070 m, Kocaçimen Village (Silk Road), 04.07.2007, 1♂, 1300 m. **Distribution in Turkey:** Adana, Amasya, Ankara, Antalya, Bitlis, Edirne, Erzincan, Gaziantep, İstanbul, İzmir, Kahramanmaraş, Muğla, Siirt, Sivas, Şanlıurfa (Fahringer, 1922; Lodos & Kalkandelen, 1981a).

***Cicadatra hyalina* (Fabricius, 1798)**
Material examined: Kemaliye: Yeşilyamaç Village (Dere), 08.07.2006, 1♀, 1290 m, Sarıçiçek (Mazman Well), 07.07.2006, 3♂♂, 1690 m, Sarıçiçek (Mazman Well), 04.07.2007, 1♀, 1650 m, Kocaçimen Village (Silk Road), 04.07.2007, 1♂, 1300 m. **Distribution in Turkey:** Adıyaman, Ankara, Antalya, Elazığ, Erzincan, Gaziantep, Gümüşhane, Hakkari, Hatay, Isparta, İzmir, Konya, Kahramanmaraş, Nevşehir, Niğde,

Fig. 3: Munzur mountains Barriers, photo E. Demir.

Siirt, Urfa, Van (Dlabola, 1957, 1981; Lodos & Kalkandelen, 1981a; Kartal & Zeybekoğlu, 1999; Demir, 2007a, 2007b).

***Cicadatra persica* Kirkaldy, 1909**

Material examined: Kemaliye: Aşağı Umutlu Village, 05.07.2006, 1♂ (N. Kocatepe leg.). **Distribution in Turkey:** Adana, Ankara, Bitlis, Burdur, Gümüşhane, Kahramanmaraş, Malatya (Fahringer, 1922; Dlabola, 1981, Lodos & Kalkandelen, 1981a; Demir, 2007b).

Subfamily PLATYPLEURINAE
Tribe CRYPTOTYMPANINI
***Lyristes plebejus* (Scopoli, 1763)**

Material examined: Kemaliye: Ocak Village (Çeşme), 06.07.2006, 1♂, 1350 m, Kırkgöz, 08.07.2006, 5♂♂ 2♀♀, 1300 m on *Paliarus*. **Distribution in Turkey:** Adana, Ankara, Antalya, Artvin, Aydın, Balıkesir, Bursa, Denizli, Erzincan, Gaziantep, İzmir, İstanbul, Kahramanmaraş, Kırıkkale, Kırklareli, Kütahya, Manisa, Mardin, Muğla (Fahringer, 1922; Dlabola, 1957, 1981; Linnavuori, 1965; Lodos & Kalkandelen, 1981a; Demir, 2007a; Tezcan et al, 2013).

Family TIBICINIDAE
Subfamily TIBICININAE
Tribe CICADETTINI
***Cicadivetta tibialis* (Panzer, 1788)**

Fig. 4: Euphrates and surrounding areas, photo E. Demir.

Material examined: Kemaliye: Kekikpınarı Village (Köprü), 06.07.2006, 8♂♂ 4♀♀, 1320 m. **Distribution in Turkey:** Ankara, Artvin, Çorum (Lodos & Kalkandelen, 1981a; Demir, 2006a).

Superfamily CERCOPOIDEA
Family CERCOPIDAE
***Cercopis intermedia* Kirschbaum, 1868**
Material examined: Kemaliye: Yeşilyayla Village (Subaşı), 04.06.2007, 1♂, 1350 m, Yeşilyurt Village-Dutluca, 10.06.2006, 1♀, 1000 m, Sarıçiçek (Mazman Well), 02.06.2007, 2♂♂, 6♀♀, 1650 m, Kabataş Village (İkisu Place), 03.06.2007, 2♂♂, 3♀♀, 1550 m, Munzur Mountain (Doymuş Top), 04.06.2007, 1♂, 2350 m, Kuşak Village, 10.06.2006, 1♀, 1100 m, Yeşilyurt Village-Dutluca, 10.06.2006, 2♀♀, 970 m. **Distribution in Turkey:** Adıyaman, Amasya, Artvin, Ankara, Kırıkkale, Balıkesir, Bitlis, Çanakkale, Diyarbakır, Elazığ, Eskişehir, Gaziantep, Giresun, Hakkari, Hatay, Isparta, İzmir, Kayseri, Konya, Kütahya, Kırklareli, Mardin, Maraş, Niğde, Rize, Samsun, Siirt, Trabzon, Urfa, Uşak (Dlabola, 1971; Lodos & Kalkandelen, 1981b; Kartal et al., 1994; Demir, 2006a, 2006b, 2007b).

Family APHROPHORIDAE
***Lepyronia coleoptrata* (Linnaeus, 1758)**
Material examined: Kemaliye: Yeşilyurt Village-Dutluca, 10.06.2006, 2♂♂, 1000 m, Kabataş Village (İkisu Place), 03.06.2007, 2♂♂, 3♀♀, 1550 m, Sarıçiçek (Mazman Well), 04.07.2007, 1♀, 1650 m, Kekikpınarı Village (Köprü), 06.07.2006,

1♂, 1♀, 1320 m, Kabataş Village (Pınarbaşı Well), 25.09.2006, 1♀, 1640 m, Yeşilyamaç Village (Geşo Pass), 08.07.2006, 3♂♂, 1670 m, Kuşak Village (Dere), 06.07.2006, 1♂, 1♀, 1070 m, Kırkgöz, 08.07.2006, 2♂♂, 1300 m, Salihli Village (Opposite of Dump), 09.07.2006, 1♂, 1500 m, Yeşilyurt Village, 10.06.2006, 1♂, 950 m, Kuşak Village, 10.06.2006, 3♂♂, 2♀♀, 1100 m, Yeşilyamaç Village (Geşo Park), 11.06.2006, 1♀, 1320 m. **Distribution in Turkey:** Adana, Afyon, Ankara, Antalya, Artvin, Aydın, Bilecik, Bursa, Çanakkale, Çankırı, Çorum, Diyarbakır, Edirne, Erzincan, Gümüşhane, İzmir, Kars, Kütahya, Maraş, Manisa, Mardin, Muğla, Muş, Sakarya, Siirt, Tokat, Samsun (Fahringer, 1922; Dlabola, 1957; Lodos & Kalkandelen, 1981b; Kartal et al., 1994; Demir, 2004a; Demir, 2006b, 2007a, 2007b.

***Neophilaenus campestris* (Fallen, 1805)**

Material examined: Kemaliye: Sarıçiçek (Mazman Well), 02.06.2007, 1♂, 1650 m, Sarıçiçek (Subatan), 11.06.2006, 2♀♀, 1890 m, Başpınar (Konsar Village), 04.06.2007, 1♂, 1468 m, Yeşilyamaç Village (Geşo Park), 11.06.2006, 3♂♂, 1320 m, Yeşilyamaç Village (Geşo Pass), 11.06.2006, 1♀, 1689 m. **Distribution in Turkey:** Adana, Adıyaman, Afyon, Ankara, Antalya, Artvin, Balıkesir, Bitlis, Bursa, Çanakkale, Eskişehir, Giresun, Hatay, İzmir, Kırklareli, Kütahya, Manisa, Muğla, Nevşehir, Samsun, Sinop, Siirt, Trabzon, Van (Linnvuori, 1965; Lodos & Kalkandelen, 1981b; Demir, 2006a, 2006b, 2007a, 2007b).

***Neophilaenus lineatus* (Linnaeus, 1758)**

Material examined: Kemaliye: Salihli Village (Opposite of Dump), 09.07.2006, 3♂♂, 1500 m. **Distribution in Turkey:** Afyon, Ankara, Erzincan, İzmir, Nevşehir, Van (Lodos & Kalkandelen, 1981b; Demir, 2006a)**.**

***Aphrophora alni* (Fallen, 1805)**

Material examined: Kemaliye: Rabat River (Tunceli border) on *Salix*, 03.07.2007, 1♂, Yeşilyurt Village-Dutluca, 10.06.2006, 1♀, 1000 m on *Salix*, Kekikpınarı Village (Köprü), 06.07.2006, 1♀, 1320 m, Kuşak Village (Dere), 06.07.2006, 1♂, 4♀♀, 1070 m on *Salix*, Kuşak Village, 10.06.2006, 1♀, 1100 m on *Salix*. **Distribution in Turkey:** Afyon, Ankara, Artvin, Aydın, Balıkesir, Bolu, Bitlis, Çanakkale, Çorum, Diyarbakır, Erzincan, Erzurum, Giresun, İstanbul, İzmir, Kayseri, Kırklareli, Konya, Kütahya, Mardin, Muğla, Manisa, Ordu, Rize, Samsun, Sinop, Tekirdağ, Trabzon, Yozgat (Linnvuori, 1965; Lodos & Kalkandelen, 1981b; Kartal et al., 1994; Demir, 2006a).

***Aphrophora salicina* (Goeze, 1778)**

Material examined: Kemaliye: Yeşilyurt Village-Dutluca, 10.06.2006, 4♂♂, 2♀♀, 1000 m on *Salix*, Kekikpınarı Village (Köprü), 06.07.2006, 1♀, 1320 m on *Salix*, Kuşak Village (Dere), 06.07.2006, 10♂♂, 11♀♀, 1070 m on *Salix*. **Distribution in Turkey:** Ankara, Balıkesir, Çanakkale, Giresun, Gümüşhane, Kırklareli, Kütahya (Lodos & Kalkandelen, 1981b; Demir, 2006a).

***Philaenus spumarius* (Linnaeus, 1758)**

Material examined: Kemaliye: Rabat River (Tunceli Border), 03.07.2007, 3♂♂, 1♀, Yeşilyayla Village (Hınsoy), 04.06.2007, 1♀, 1500 m, Yuva köy, 03.06.2007, 12♂♂, 3♀♀, 970 m, Yeşilyayla Village (Subaşı), 04.06.2007, 1♂, 1♀, 1350 m, Yeşilyurt Village-Dutluca, 10.06.2006, 13♂♂, 11♀♀, 1000 m, Sarıçiçek (Mazman Well), 02.06.2007, 1♀, 1650 m, Kabataş Village (İkisu Place), 03.06.2007, 11♂♂, 9♀♀, 1550 m, Sarıçiçek (Subatan), 04.07.2007, 1♀, 1890 m, Sarıçiçek (Mazman Well), 04.07.2007, 1♂, 1650 m, Kocaçimen Village (Silk Road), 04.07.2007, 1300 m 2♀♀, Munzur Mountain (Doymuş Top), 04.06.2007, 1♀, 2350 m, Kekikpınarı Village (Köprü), 06.07.2006, 2♂♂, 1320 m, Yeşilyamaç Village (Dere), 08.07.2006, 2♂♂, 1290 m, Yuva Köy, 23.09.2006, 2♂♂, 3♀♀, 970 m, Yeşilyamaç Village (Geşo Pass), 08.07.2006, 1♂, 2♀♀, 1670 m, Sarıçiçek (Subatan), 07.07.2006, 31♂♂, 18♀♀, 1890 m, Kuşak Village (Dere), 06.07.2006, 2♂♂, 3♀♀, 1070 m, Ocak Village 8, 06.07.2006, 1♂, 2♀, 1480 m, Yuva Village, 08.07.2006, 4♂♂, 2♀♀, 930 m, Yeşilyamaç Village, 12.06.2006, 1♂, 1250 m, Kekikpınar Village, 06.07.2006, 3♀♀, 1070 m, Yeşilyurt Village, 10.06.2006, 10♂♂, 10♀♀, 950 m, Sarıçiçek (Mazman Well), 11.06.2006, 1♀, 1690 m, Kuşak Village, 10.06.2006, 23♂♂, 15♀♀, 1100 m, Yeşilyamaç Village (Geşo Park), 11.06.2006, 2♂♂, 2♀♀, 1320 m, Yeşilyamaç Village (Geşo Pass), 11.06.2006, 1♀, 1689 m. **Distribution in Turkey:** Adana, Ağrı, Amasya, Ankara, Antalya, Artvin, Aydın, Balıkesir, Bartın, Bilecik, Bitlis, Bolu, Bursa, Çanakkale, Elazığ, Eskişehir, Erzincan (Bahçeliköy, Centrum, Çağlayan, Dumanlıdağ, Demirpınar, Refahiye, Üzümlü), Erzurum, Giresun, Gümüşhane, Hakkari, İzmir, İstanbul, Kars, Iğdır, Kırklareli, Kütahya, Kocaeli, Malatya, Manisa, Mardin, Muğla, Ordu, Rize, Samsun, Siirt, Sinop, Sivas, Tekirdağ, Trabzon, Tokat, Van (Fahringer, 1922; Linnvuori, 1965; Dlabola, 1957, 1981; Lodos & Kalkandelen, 1981b; Kartal et al., 1994; Demir, 2004a, 2006a, 2006b, 2007a, 2007b; Tezcan et al, 2013).

Superfamily MEMBRACOIDEA
Family MEMBRACIDAE
Subfamily CENTROTINAE
***Gargara genistae* (Fabricius, 1775)**

Material examined: Kemaliye: Kırkgöz, 08.07.2006, 2♂♂, 1300 m. **Distribution in Turkey:** Ankara, Antalya, Aydın, Balıkesir, Çorum, Erzurum, İzmir, Muğla (Dlabola, 1957; Lodos & Kalkandelen, 1981b; Demir, 2006a, 2006b, 2007a).

Family ULOPIDAE
***Utecha trivia* (Germar, 1821)**

Material examined: Kemaliye: Yeşilyurt Village, 10.06.2006, 1♀, 950 m. **Distribution in Turkey:** Ağrı, Ankara, Antalya, Bilecik, Çanakkale, Çorum, Denizli, Edirne, Elazığ, Erzurum, Gümüşhane, İzmir, Kastamonu, Malatya, Manisa, Mardin, Muğla, Nevşehir, Rize, Siirt, Sivas, Urfa (Dlabola, 1957, 1981; Lodos & Kalkandelen, 1981c; Güçlü & Özbek, 1992; Demir, 2006a, 2006b, 2006c, 2007b).

Family CICADELLIDAE
Subfamily MEGOPHTPHALMINAE
***Megophtphalmus scabripennis* Edwards, 1915**

Material examined: Kemaliye: Yuva Köy, 03.06.2007, 1♂, 970 m. **Distribution in Turkey:** Adana, Ankara, Antalya, Bursa, İçel, İzmir, Manisa, Muğla (Dlabola, 1957; Lodos & Kalkandelen, 1981c; Başpınar & Uygun, 1991a; Demir, 2006c).

Subfamily AGALLIINAE
Tribe AGALLIINI
***Anaceratagallia ribauti* (Ossiannilsson, 1938)**

Material examined: Kemaliye: Yeşilyurt Village-Dutluca, 10.06.2006, 1♀, 1000 m, Yuva Village, 08.07.2006, 1♂, 930 m. **Distribution in Turkey:** Adana, Ankara, Antalya, Balıkesir, Bilecik, Çankırı, Erzurum, Hatay, Isparta, İçel, İzmir, Malatya, Mardin, Nevşehir, Samsun, Tekirdağ, Trabzon (Dlabola, 1971; Lodos & Kalkandelen, 1981c; Başpınar & Uygun, 1991a; Güçlü & Özbek, 1992; Demir, 2006a).

Subfamily PENTHIMIINAE
***Penthimia nigra* (Goeze, 1778)**

Material examined: Kemaliye: Yeşilyurt Village-Dutluca, 10.06.2006, 1♀, 970 m. **Distribution in Turkey:** Ankara, Antalya, Bilecik, Isparta, İzmir, Kocaeli, Nevşehir, Sakarya, Tekirdağ, Trabzon (Dlabola, 1971; Lodos & Kalkandelen, 1982b; Demir, 2006b, 2007b).

Subfamily DORYCEPHALINAE
***Eupelix cuspidata* (Fabricius, 1775)**

Material examined: Kemaliye: Yuva Köy, 03.06.2007, 1♂ 4♀♀, 970 m, Yeşilyurt Village-Dutluca, 10.06.2006, 1♂, 1000 m, Munzur Mountain (Doymuş Top), 04.06.2007, 2♂♂, 2350 m, Sarıçiçek (Subatan), 07.07.2006, 1♀, 1890 m, Ocak Village-Kuşak Village, 10.06.2006, 1♂, 1025 m. **Distribution in Turkey:** Adana, Adıyaman, Afyon, Ankara, Antalya, Artvin, Balıkesir, Çanakkale, Diyarbakır, Erzurum, İçel, Konya, Malatya, Mardin, Nevşehir, Niğde, Urfa (Dlabola, 1957, 1981; Lodos & Kalkandelen, 1982b; Başpınar & Uygun, 1991a, Güçlü & Özbek, 1994a; Demir, 2006a, 2006b, 2006c, 2007b).

Subfamily APHRODINAE
***Aphrodes makarovi* Zachvatkin, 1948**

Material examined: Kemaliye: Sarıçiçek (Subatan), 02.06.2007, 1♀, 1890 m, Munzur Mountain (Doymuş Top), 04.06.2007, 2♀♀, 2350 m, Kuşak Village (Dere), 06.07.2006, 1♂, 1070 m. **Distribution in Turkey:** Adana, Ankara, Antalya, Balıkesir (Başpınar & Uygun, 1991b; Demir, 2006a, 2006b, 2006c).

***Anoscopus assimilis* (Signoret, 1879)**

Distribution in Turkey: Antalya, Kemaliye (Demir, 2006c; Demir & Demirsoy, 2008).

Subfamily CICADELLINAE
Tribe CICADELLINI
***Cicadella viridis* (Linnaeus, 1758)**

Material examined: Kemaliye: Rabat River (Tunceli Border), 03.07.2007, 5♂♂, 19♀♀, Yeşilyurt Village-Dutluca, 10.06.2006, 1♂, 1000 m on *Juncus*. **Distribution in Turkey:** Amasya, Artvin, Balıkesir, Bolu, Çanakkale, Diyarbakır, Edirne, Erzincan, Erzurum, İzmir, Kars, Kırklareli, Manisa, Mardin, Muğla, Samsun, Tekirdağ (Linnavuori, 1965; Lodos & Kalkandelen, 1983a; Güçlü & Özbek, 1994a).

Subfamily TYPHLOCYBINAE
Tribe ALEBRINI
***Alebra albostriella* (Fallen, 1826)**

Material examined: Kemaliye: Salihli Village (Opposite of Dump), 09.07.2006, 3♂♂, 36♀♀, 1500 m. **Distribution in Turkey:** Adana, Ankara, Antalya, Artvin, Balıkesir, Bitlis, Bolu, Çorum, Hatay, İzmir, Kayseri, Kırıkkale, Kocaeli, Kütahya, Ordu (Linnavuori, 1965; Dlabola, 1957, 1971, 1981; Lodos & Kalkandelen, 1983b; Demir, 2006a, 2006b, 2006c).

Tribe DIKRANEURINI
***Micantulina* (*Mulsantina*) *stigmatipennis* (Mulsant et Rey, 1855)**

Material examined: Kemaliye: Rabat River (Tunceli Border), 03.07.2007, 1♂, 2♀♀, on *Verbascum*, Sarıçiçek (Subatan), 07.07.2006, 1♀ 1890 m on *Verbascum*. **Distribution in Turkey:** Ankara, Antalya, Balıkesir, Burdur, Erzurum, Isparta, İstanbul, İzmir, Manisa, Van (Dlabola, 1957, 1981; Lodos & Kalkandelen, 1983b; Güçlü & Özbek, 1994b; Demir, 2006a, 2006b, 2006c).

Tribe EMPOASCINI
***Kybos candelabricus* Dlabola, 1958**

Material examined: Kemaliye: Başpınar (Konsar Village), 04.06.2007, 2♀♀, 1468 m on *Salix*, Yeşilyamaç Village (Geşo Pass), 24.09.2006, 1♂, 4♀♀, 1670 m on *Salix*, Yeşilyamaç Village (Geşo Pass), 08.07.2006, 2♀♀, 1670 m on *Salix*, Kuşak Village (Dere), 06.07.2006, 2♀♀, 1070 m on *Salix*, Yeşilyamaç Village (Geşo Pass), 11.06.2006, 2♂♂, 1♀, 1689 m on *Salix*. **Distribution in Turkey:** Ankara, Erzincan, Kırşehir, Nevşehir, Van, Yozgat (Linnavuori, 1965; Lodos & Kalkandelen, 1983c; Demir, 2006a).

Tribe ERYTHRONEURINI
***Arboridia spathulata* (Ribaut, 1931)**

Distribution in Turkey: Kemaliye (Demir & Demirsoy, 2008).

***Fruticidia sanguinosa* (Rey, 1891)**

Distribution in Turkey: Adana, Antalya, Kemaliye (Dlabola, 1957; Demir, 2006c; Demir & Demirsoy, 2008).

***Tamaricella cypria* (Ribaut, 1948)**

Material examined: Kemaliye: Rabat River (Tunceli Border), 03.07.2007, 1♀, on *Tamarix*, Ocak Village-Kuşak Village, 10.06.2006, 1♂, 1025 m on *Tamarix*. **Distribution in Turkey:** Ankara, Antalya, Kırıkkale, Malatya (Dlabola, 1981; Lodos & Kalkandelen, 1984c; Demir, 2006c).

Tribe TYPHLOCYBINI

***Eupteryx pavlovskii* Zachvatkin, 1947**

Material examined: Kemaliye: Sarıçiçek (Subatan), 02.06.2007, 1♂, 1890 m, Sarıçiçek (Subatan), 11.06.2006, 1♂, 6♀♀, 1890 m, Sarıçiçek (Subatan), 11.06.2006, 5♀♀, 1890 m, Sarıçiçek (Mazman Well), 04.07.2007, 1♂, 1♀, 1650 m, Yeşilyamaç Village (Geşo Pass), 08.07.2006, 2♂♂, 1♀, 1670 m. **Distribution in Turkey:** Erzincan (Lodos & Kalkandelen, 1984b).

Subfamily DELTOCEPHALINAE

Tribe GONIAGNATHINI

***Goniagnathus bolivari* (Melichar, 1907)**

Material examined: Kemaliye: Kocaçimen Village (Silk Road), 04.07.2007, 1♂, 1300 m. **Distribution in Turkey:** Adana, Ankara, Edirne, Nevşehir, Urfa (Dlabola, 1957; Linnavuori, 1965; Lodos & Kalkandelen, 1985a).

***Goniagnathus brevis* (Herrich-Schaeffer, 1835)**

Material examined: Kemaliye: Sarıçiçek (Subatan), 07.07.2006, 1♀, 1890 m. **Distribution in Turkey:** Adana, Amasya, Ankara, Antalya, Burdur, Diyarbakır, Edirne, Erzurum, Manisa, Mardin, Niğde, Samsun, Sinop, Tokat (Dlabola, 1957; Kalkandelen, 1974; Lodos & Kalkandelen, 1985a; Başpınar & Uygun, 1991b; Kartal & Zeybekoğlu, 1991; Zeybekoğlu, 1998; Güçlü & Özbek, 1994c; Demir, 2004b, 2006b, 2007b).

Tribe OPSIINI

***Opsius cypriacus* Lindberg, 1948**

Material examined: Kemaliye: Yuva Köy, 23.09.2006, 1♂, 1♀, 970 m on *Tamarix*. **Distribution in Turkey:** Adana, Amasya, Ankara, Antalya, Artvin, Aydın, Diyarbakır, Edirne, Erzincan, Erzurum, İzmir, Kırıkkale, Kütahya, Malatya, Manisa, Nevşehir, Samsun, Siirt, Van, Yozgat (Linnavuori, 1965; Dlabola, 1981; Lodos & Kalkandelen, 1985a; Demir, 2006c).

***Circulifer haematoceps* (Mulsant et Rey, 1855)**

Material examined: Kemaliye: Sarıçiçek (Mazman Well), 02.06.2007, 2♂♂, 1♀, 1650 m, Başpınar (Konsar Village), 04.06.2007, 1♀, 1468 m, Munzur Mountain (Doymuş Top), 04.06.2007, 1♂, 5♀♀, 2350 m, Sarıçiçek (Subatan), 07.07.2006, 2♂♂, 5♀♀, 1890 m, Salihli Village (Opposite of Dump), 09.07.2006, 1♂, 1500 m, Yeşilyamaç Village (Geşo Park), 11.06.2006, 1♂, 1320 m. **Distribution in Turkey:** Adana, Ağrı, Ankara, Antalya, Aksaray, Bitlis, Erzurum, Hakkari, İçel, Konya, Muğla,

Nevşehir, Sivas, Van (Linnavuori, 1965; Kalkandelen, 1974; Dlabola, 1957, 1971, 1981; Lodos & Kalkandelen, 1985a; Başpınar & Uygun, 1991c; Güçlü & Özbek, 1994c; Kartal et al., 2001; Demir, 2004a, 2006c, 2007b).

***Neoaliturus fenestratus* (Herrich-Schaeffer, 1834)**

Material examined: Kemaliye: Sarıçiçek (Mazman Well), 07.07.2006, 1♂, 1690 m, Yeşilyamaç Village (Geşo Pass), 08.07.2006, 1♂, 1670 m, Salihli Village (Opposite of Dump), 09.07.2006, 1♂, 2♀♀, 1500 m. **Distribution in Turkey:** Adana, Ağrı, Aksaray, Amasya, Ankara, Antalya, Bolu, Çorum, Diyarbakır, Edirne, Erzurum, Giresun, Gümüşhane, İçel, İzmir, Iğdır, Mardin, Nevşehir, Ordu, Samsun, Sivas, Sinop, Tokat, Urfa, Van (Linnavuori, 1965; Dlabola, 1957, 1981; Kalkandelen, 1974; Lodos & Kalkandelen, 1985a; Başpınar & Uygun, 1991c; Kartal & Zeybekoğlu, 1991; Güçlü & Özbek, 1994c; Zeybekoğlu, 1998; Demir, 2006b, 2006c).

***Neoaliturus transversalis* (Puton, 1881)**

Material examined: Kemaliye: Yeşilyamaç Village (Geşo Pass), 11.06.2006, 1♂, 1689 m. **Distribution in Turkey:** Ankara, Çorum, Diyarbakır, Erzincan, İzmir, Muş, Siirt, Van (Kalkandelen, 1974; Lodos & Kalkandelen, 1985a).

Tribe MACROSTELINI

***Balclutha pellucens* Horvath, 1909**

Material examined: Kemaliye: Yeşilyayla Village (Hınsoy), 04.06.2007, 1♀, 1500 m, Yuva Köy, 03.06.2007, 1♀, 970 m, Yeşilyurt Village-Dutluca, 10.06.2006, 1♂, 1000 m, Sarıçiçek (Subatan), 11.06.2006, 1♂, 1890 m, Başpınar (Konsar Village), 04.06.2007, 1♀, 1468 m, Sarıçiçek (Mazman Well), 07.07.2006, 1♂, 1690 m, Yeşilyamaç Village (Geşo Pass), 08.07.2006, 1♂, 1670 m, Salihli Village (Opposite of Dump), 09.07.2006, 3♀♀, 1500 m. **Distribution in Turkey:** Adıyaman, Ağrı, Amasya, Ankara, Artvin, Bitlis, Bolu, Burdur, Çankırı, Diyarbakır, Elazığ, Erzincan, Erzurum, Hakkari, Kars, Iğdır, Mardin, Samsun, Van (Lodos & Kalkandelen, 1985b).

***Macrosteles forficula* (Ribaut, 1927)**

Material examined: Kemaliye: Salihli Village (Opposite of Dump), 09.07.2006, 1♂, 1500 m. **Distribution in Turkey:** Adana, Amasya, Ankara, Antalya, Bolu, Erzincan (Ilıç, Refahiye), Erzurum, Samsun, Sinop, Van (Dlabola, 1957, 1981; Kalkandelen, 1974; Lodos & Kalkandelen, 1985b; Güçlü & Özbek, 1994d; Zeybekoğlu, 1998; Demir, 2006c).

***Macrosteles laevis* (Ribaut, 1927)**

Material examined: Kemaliye: Sarıçiçek (Subatan), 11.06.2006, 41♂♂, 43♀♀, 1890 m. **Distribution in Turkey:** Adana, Afyon, Amasya, Ankara, Artvin, Bitlis, Burdur, Giresun, Hakkari, Karaman, Konya, Malatya, Nevşehir, Ordu, Rize, Sakarya, Samsun, Sinop, Tokat, Trabzon, Van (Kalkandelen, 1974; Dlabola, 1957, 1971, 1981; Lodos & Kalkandelen, 1985b; Kartal & Zeybekoğlu, 1991; Zeybekoğlu, 1998; Kartal et al., 2001).

***Macrosteles sexnotatus* (Fallen, 1806)**

Material examined: Kemaliye: Sarıçiçek (Subatan), 02.06.2007, 1♀, 1890 m, Sarıçiçek (Subatan), 11.06.2006, 138♂♂, 86♀♀, 1890 m. **Distribution in Turkey:** Aydın, Ağrı, Amasya, Ankara, Artvin, Bolu, Çankırı, Diyarbakır, Düzce, Erzurum, Giresun, Hakkari, İzmir, Konya, Nevşehir, Ordu, Rize, Samsun, Sinop, Tokat, Trabzon, Van (Kalkandelen, 1974; Lodos & Kalkandelen, 1985b; Kartal et al., 2001; Güçlü & Özbek, 1994d; Zeybekoğlu, 1998).

Tribe DORATURINI

***Doratura stylata* (Boheman, 1847)**

Material examined: Kemaliye: Sarıçiçek (Mazman Well), 04.07.2007, 1♀, 1650 m, Kocaçimen Village (Silk Road), 04.07.2007, 2♂♂, 1♀, 1300 m, Karanlık Canyon (Venkağ Top), 09.07.2006, 2♂♂, 1♀, 1400-1680 m. **Distribution in Turkey:** Amasya, Ankara, Erzurum, Gümüşhane, Kars, Ordu, Samsun, Sinop, Tokat, Van (Kalkandelen, 1974; Lodos & Kalkandelen, 1985c; Kartal & Zeybekoğlu, 1991; Güçlü & Özbek, 1994c; Zeybekoğlu, 1998).

Tribe ATHYSANINI

***Platymetopius cruentatus* Haupt, 1927**

Material examined: Kemaliye: Yeşilyamaç Village (Geşo Pass), 24.09.2006, 5♂♂, 3♀♀, 1670 m on *Euphorbia*. **Distribution in Turkey:** Adana, Ankara, Muğla, Nevşehir (Dlabola, 1957; Kalkandelen, 1974; Lodos & Kalkandelen, 1986b; Başpınar & Uygun, 1992a).

***Platymetopius henribauti* Dlabola, 1961**

Material examined: Kemaliye: Ocak Village 8, 06.07.2006, 1♂, 1480 m, Ocak Village-Kuşak Village, 10.06.2006, 1♀, 1025 m. **Distribution in Turkey:** Ankara, Antalya, Balıkesir, Konya, Kütahya, Sivas (Kalkandelen, 1974; Dlabola, 1981; Lodos & Kalkandelen, 1986b; Demir, 2006b, 2006c, 2007b).

***Platymetopius obsoletus* (Signoret, 1880)**

Distribution in Turkey: Antalya, Kemaliye, Samsun (Lodos & Kalkandelen, 1988; Kartal & Zeybekoğlu, 1991; Zeybekoğlu, 1998; Demir & Demirsoy, 2008).

***Platymetopius manfredi* Abdul-Nour, 1987**

Distribution in Turkey: Kemaliye, Tokat (Kartal & Zeybekoğlu, 1991; Demir & Demirsoy, 2008).

***Phlepsius intricatus* (Herrich-Schaeffer, 1838)**

Material examined: Kemaliye: Rabat River (Tunceli Border), 03.07.2007, 1♂, Yeşilyurt Village-Dutluca, 10.06.2006, 1♀, 1000 m, Kabataş Village (Pınarbaşı Well), 25.09.2006, 1♀, 1640 m. **Distribution in Turkey:** Amasya, Ankara, Antalya, Bartın, Bolu, Çanakkale, Diyarbakır, Isparta, İzmir, Kars, Kırşehir, Malatya, Mardin, Muğla, Nevşehir, Samsun, Trabzon (Linnavuori, 1965; Kalkandelen, 1974; Lodos & Kalkandelen, 1986c; Kartal & Zeybekoğlu, 1991; Zeybekoğlu, 1998; Demir, 2006b, 2006c).

***Hardya anatolica* Zachvatkin, 1946**

Material examined: Kemaliye: Yeşilyayla Village (Hınsoy), 04.06.2007, 10♂♂, 6♀♀, 1500 m, Sarıçiçek (Subatan), 02.06.2007, 10♂♂, 11♀♀, 1890 m, Yuva Köy, 03.06.2007, 1♀, 970 m, Yeşilyayla Village (Subaşı), 04.06.2007, 2♀♀, 1350 m, Sarıçiçek (Mazman Well), 02.06.2007, 4♂♂, 2♀♀, 1650 m, Sarıçiçek (Subatan), 11.06.2006, 3♂♂, 6♀♀, 1890 m, Sarıçiçek (Subatan), 11.06.2006, 3♂♂, 4♀♀, 1890 m, Kabataş Village (İkisu Place), 03.06.2007, 1♂, 1550 m, Sarıçiçek (Mazman Well), 04.07.2007, 1♂, 1650 m, Munzur Mountain (Doymuş Top), 04.06.2007, 4♂♂, 26♀♀, 2350 m, Kabataş Village (Pınarbaşı Well), 25.09.2006, 5♂♂, 2♀♀, 1640 m, Sarıçiçek (Subatan), 07.07.2006, 2♂♂, 9♀♀, 1890 m, Ocak Village 8, 06.07.2006, 1♀, 1480 m, Sarıçiçek (Mazman Well), 11.06.2006, 1♀, 1690 m. **Distribution in Turkey:** Adıyaman, Ankara, Antalya, Balıkesir, Bolu, Elazığ, Erzincan, Erzurum, Isparta, İzmir, Kayseri, Kırşehir, Karaman, Malatya, Nevşehir, Ordu (Zachvatkin, 1946; Dlabola, 1957, 1981; Linnavuori, 1965; Kalkandelen, 1974; Dlabola, 1981; Lodos & Kalkandelen, 1987a; Güçlü & Özbek, 1994e; Demir, 2004a, 2006a, 2006b, 2006c, 2007b).

***Stenometopiellus angorensis* Zachvatkin, 1946**

Material examined: Kemaliye: Sarıçiçek (Subatan), 02.06.2007, 1♂, 1890 m, Sarıçiçek (Subatan), 11.06.2006, 2♀♀, 1890 m, Sarıçiçek (Subatan), 11.06.2006, 1♀, 1890 m, Munzur Mountain (Doymuş Top), 04.06.2007, 1♂, 2350 m, Karanlık Canyon (Venkağ Top), 09.07.2006, 1♂, 1400-1680 m, Yeşilyamaç Village (Geşo Pass), 08.07.2006, 1♀, 1670 m, Sarıçiçek (Subatan), 07.07.2006, 1♀, 1890 m, Salihli Village (Opposite of Dump), 09.07.2006, 2♂♂, 1500 m. **Distribution in Turkey:** Ağrı, Ankara, Bitlis, Diyarbakır, Erzincan, Erzurum, Hakkari, Iğdır, Kars, Konya, Malatya, Nevşehir, Urfa, Van (Zachvatkin, 1946; Kalkandelen, 1974; Lodos & Kalkandelen, 1987a; Güçlü & Özbek, 1994e; Kartal et al., 2001).

***Rhopalopyx vitripennis* (Flor, 1861)**

Distribution in Turkey: Ankara, Kemaliye, Konya (Kalkandelen, 1974; Lodos & Kalkandelen, 1987a; Demir & Demirsoy, 2008).

***Cicadula* (*Henriana*) *lineatopunctata* (Matsumura, 1908)**

Material examined: Kemaliye: Sarıçiçek (Mazman Well), 02.06.2007, 5♂♂, 4♀♀, 1650 m, Sarıçiçek (Subatan), 11.06.2006, 1♀, 1890 m, Çanakçı Village, 02.06.2007, 1♂, 1400 m, Kuşak Village (Dere), 06.07.2006, 1♀, 1070 m, Salihli Village (Opposite of Dump), 09.07.2006, 1♂, 1♀, 1500 m, Sarıçiçek (Mazman Well), 11.06.2006, 1♂, 1690 m. **Distribution in Turkey:** Adana, Ankara, Antalya, Aydın, Balıkesir, Bolu, Düzce, Bursa, Çankırı, Diyarbakır, Erzincan (Centre), Erzurum, İzmir, Malatya, Mardin, Sakarya, Sinop, Urfa (Kalkandelen, 1974; Dlabola, 1957, 1981; Lodos & Kalkandelen, 1987a; Güçlü & Özbek, 1994e; Demir, 2006a, 2006c).

***Cicadula* (*s. str.*) *quadrinotata* (Fabricius, 1794)**

Material examined: Kemaliye: Kuşak Village (Dere), 06.07.2006, 1♂, 1070 m. **Distribution in Turkey:** Ankara, Bolu, Çankırı, Sakarya (Kalkandelen, 1974; Lodos & Kalkandelen, 1987a).

***Handianus ignoscus* (Melichar, 1896)**

Distribution in Turkey: Ankara, Kemaliye (Dlabola, 1957; Demir & Demirsoy, 2008).

***Conosanus obsoletus* (Kirschbaum, 1858)**

Material examined: Kemaliye: Rabat River (Tunceli Border), 03.07.2007, 3♂♂, 2♀♀, Karanlık Canyon (Venkağ Top), 09.07.2006, 3♂♂, 1♀, 1400-1680 m, Salihli Village (Opposite of Dump), 09.07.2006, 2♂♂, 3♀♀, 1500 m. **Distribution in Turkey:** Adana, Ankara, Aydın, Balıkesir, Bolu, Düzce, Erzurum, İzmir, Kırşehir, Niğde (Dlabola, 1957; Kalkandelen, 1974; Lodos & Kalkandelen, 1987b; Başpınar & Uygun, 1992b, Güçlü & Özbek, 1994f; Demir, 2004a, 2006b).

***Euscelis incisus* (Kirschbaum, 1858)**

Material examined: Kemaliye: Sarıçiçek (Mazman Well), 02.06.2007, 1♀, 1650 m, Sarıçiçek (Subatan), 07.07.2006, 1♀, 1890 m, Yuva Village, 08.07.2006, 8♂♂, 3♀♀, 930 m. **Distribution in Turkey:** Adana, Ankara, Antalya, Balıkesir, Burdur, Edirne, Eskişehir, Erzurum, Isparta, İçel, İstanbul, Kayseri, Kocaeli (Fahringer, 1922, Dlabola, 1957; Kalkandelen, 1974; Başpınar & Uygun, 1992b, Güçlü & Özbek, 1994f; Demir, 2004a, 2006a, 2006b, 2006c, 2007b).

***Artianus manderstjernii* (Kirschbaum, 1868)**

Material examined: Kemaliye: Yuva Köy, 03.06.2007, 1♂, 970 m, Sarıçiçek (Mazman Well), 04.07.2007, 1♂, 1650 m, Karanlık Canyon (Venkağ Top), 09.07.2006, 1♀, 1400-1680 m, Yeşilyamaç Village (Geşo Pass), 08.07.2006, 1♂, 1♀, 1670 m, Kuşak Village (Dere), 06.07.2006, 1♂, 1♀, 1070 m. **Distribution in Turkey:** Ağrı, Ankara, Antalya, Balıkesir, Çankırı, Diyarbakır, Edirne, Gaziantep, İzmir, Kırklareli, Urfa, Van, Zonguldak (Dlabola, 1957, Kalkandelen, 1974; Lodos & Kalkandelen, 1987b; Demir, 2004a, 2006a, 2006b, 2006c, 2007b).

***Zercanus rubroocellatus* Dlabola, 1965**

Distribution in Turkey: Adana, Antalya, Kemaliye (Lodos & Kalkandelen, 1987b; Demir, 2006c; Demir & Demirsoy, 2008).

Tribe PARALIMNINI

***Arocephalus* (*s. str.*) *longiceps* (Kirschbaum, 1868)**

Material examined: Kemaliye: Yeşilyayla Village (Subaşı), 04.06.2007, 2♂♂, 1350 m, Kabataş Village (İkisu Place), 03.06.2007, 1♂, 1550 m, Munzur Mountain (Doymuş Top), 04.06.2007, 1♀, 2350 m, Kabataş Village (Pınarbaşı Well), 25.09.2006, 1♂, 1♀, 1640 m, Yeşilyamaç Village (Geşo Pass), 11.06.2006, 1♀, 1689 m. **Distribution in Turkey:** Ankara, Bolu, Erzincan, Erzurum, Hakkari, İzmir, Konya (Lodos & Kalkandelen, 1987c; Güçlü & Özbek, 1995; Kartal et al., 2001).

***Psammotettix alienus* (Dahlbom, 1850)**

Material examined: Kemaliye: Rabat River (Tunceli Border), 03.07.2007, 6♂♂, 6♀♀, Sarıçiçek (Subatan), 02.06.2007, 10♂♂, 36♀♀, 1890 m, Yuva Village,

03.06.2007, 4♂♂, 5♀♀, 970 m, Sarıçiçek (Mazman Well), 02.06.2007, 12♂♂, 8♀♀, 1650 m, Sarıçiçek (Subatan), 11.06.2006, 14♂♂, 23♀♀, 1890 m, Sarıçiçek (Mazman Well), 07.07.2006, 2♂♂, 1690 m, Yeşilyamaç Village (Geşo Pass), 08.07.2006, 5♂♂, 4♀♀, 1670 m, Sarıçiçek (Subatan), 07.07.2006, 12♂♂, 12♀♀, 1890 m, Salihli Village (Opposite of Dump), 09.07.2006, 36♂♂, 40♀♀, 1500 m. **Distribution in Turkey:** Adana, Amasya, Ankara, Antalya, Balıkesir, Bolu, Bursa, Diyarbakır, Erzincan (Centre, Çağlayan, Dumanlı Mountain, Refahiye), Erzurum, Hakkari, Iğdır, İçel, Kastamonu, Konya, Malatya, Mardin, Muş, Nevşehir, Sakarya, Siirt, Sinop, Uşak, Van, Yozgat (Kalkandelen, 1974; Dlabola, 1971, 1981; Lodos & Kalkandelen, 1987c; Kartal & Zeybekoğlu, 1991; Kartal et al., 2001; Demir, 2004a, 2006a, 2006b, 2006c, 2007b).

***Psammotettix confinis* (Dahlbom, 1850)**

Material examined: Kemaliye: Yuva Village, 03.06.2007, 1♂, 970 m, Yeşilyurt Village-Dutluca, 10.06.2006, 3♂♂, 2♀♀, 1000 m, Sarıçiçek (Mazman Well), 02.06.2007, 6♂♂, 2♀♀, 1650 m, Kuşak Village (Dere), 06.07.2006, 1♂, 1070 m. **Distribution in Turkey:** Adana, Ağrı, Ankara, Antalya, Balıkesir, Bitlis, Erzincan (Centre, Altıntepe, Çağlayan, Kovalık, Ilıç, Refahiye, Üzümlü), Edirne, Erzurum, Giresun, Hakkari, Iğdır, Isparta, Konya, Ordu, Samsun, Sivas, Van (Dlabola, 1957, 1971; Kalkandelen, 1974; Lodos & Kalkandelen, 1987c; Kartal & Zeybekoğlu, 1991; Güçlü & Özbek, 1995; Kartal et al., 2001; Demir, 2006a, 2006c).

***Psammotettix poecilus* (Flor, 1861)**

Distribution in Turkey: Kemaliye**,** Tokat (Zeybekoğlu, 1998; Demir & Demirsoy, 2008).

***Psammotettix provincialis* (Ribaut, 1925)**

Material examined: Kemaliye: Yeşilyayla Village (Subaşı), 04.06.2007, 2♂♂, 3♀♀, 1350 m, Karanlık Canyon (Venkağ Top), 09.07.2006, 1♂, 1♀, 1400-1680 m, Kuşak Village (Dere), 06.07.2006, 1♂, 1♀, 1070 m, Yuva Village, 08.07.2006, 1♂, 930 m, Salihli Village (Opposite of Dump), 09.07.2006, 9♂♂, 7♀♀, 1500 m, Sarıçiçek (Mazman Well), 11.06.2006, 3♂♂, 6♀♀ 1690 m. **Distribution in Turkey:** Adana, Ankara, Antalya, Bolu, Çankırı, Diyarbakır, Edirne, Erzurum, İstanbul, İzmir, Kayseri, Konya, Muğla, Nevşehir, Sakarya, Samsun, Van (Dlabola, 1957, Kalkandelen, 1974; Lodos & Kalkandelen, 1987c; Kartal & Zeybekoğlu, 1991; Başpınar & Uygun, 1992b, Güçlü & Özbek, 1995; Demir, 2006b, 2006c, 2007b; Tezcan et al, 2013).

***Ebarrius cognatus* (Fieber, 1869)**

Material examined: Kemaliye: Munzur Mountain (Doymuş Top), 04.06.2007, 1♂, 2350 m. **Distribution in Turkey:** Amasya, Ankara, Antalya, Bolu, Çankırı, Erzincan (Kemaliye), Erzurum, Kars, Kayseri, Niğde, Samsun, Sinop, Van (Dlabola, 1957, 1981; Kalkandelen, 1974; Lodos & Kalkandelen, 1987d; Güçlü & Özbek, 1995; Demir, 2004a, 2006b, 2006c).

***Diplocolenus bekiri* Kalkandelen, 1972**

Material examined: Kemaliye: Çanakçı Village, 02.06.2007, 19♂♂, 8♀♀, 1400 m, Sarıçiçek (Subatan), 07.07.2006, 1♀, 1890 m. **Distribution in Turkey:** Ankara, Erzurum, Samsun (Kalkandelen, 1974; Lodos & Kalkandelen, 1987d; Kartal & Zeybekoğlu, 1991; Güçlü & Özbek, 1995).

***Rhoananus hypochlorus* (Fieber, 1869)**

Material examined: Kemaliye: Sarıçiçek (Mazman Well), 04.07.2007, 2♀♀, 1650 m, Sarıçiçek (Mazman Well), 07.07.2006, 1♂, 1♀, 1690 m, Yeşilyamaç Village (Geşo Pass), 08.07.2006, 4♀♀, 1670 m, Yeşilyamaç Village (Geşo Pass), 08.07.2006, 4♀♀, 1670 m. **Distribution in Turkey:** Ankara, Bitlis, Erzurum, Eskişehir, Iğdır, Kars, Van (Kalkandelen, 1974; Lodos & Kalkandelen, 1987d).

***Mocuellus foxi* Kalkandelen, 1972**

Distribution in Turkey: Ankara, Kemaliye, Yozgat (Kalkandelen, 1974; Lodos & Kalkandelen, 1987d; Demir & Demirsoy, 2008).

Discussion

Our study is the first contribution to the knowledge of the Cicadomorpha fauna of the Kemaliye district. Until now, fifty four species have been known from the Erzincan province including the Kemaliye district. Fifty two of sixty three determined species are new to the Erzincan province and the number of species known from the research area increased to hundred six. *Cicadivetta tibialis* (Panzer, 1788), *Aphrophora salicina* (Goeze, 1778), *Megophtphalmus scabripennis* Edwards, 1915, *Penthimia nigra* (Goeze, 1778), *Aphrodes makarovi* Zachvatkin, 1948, *Goniagnathus bolivari* (Melichar, 1907), *Platymetopius cruentatus* Haupt, 1927 and *Platymetopius henribauti* Dlabola, 1961 are recorded for the first time in the eastern Turkey.

References

Başpınar, H., Uygun, N., 1991a. Doğu Akdeniz Bölgesi turunçgil bahçelerindeki Cicadellidae türleri üzerinde faunistik ve sistematik çalışmalar I- *Türk. entomol. derg.,* 15(2): 89-106.

Başpınar, H., Uygun, N., 1991b. Doğu Akdeniz Bölgesi turunçgil bahçelerindeki Cicadellidae türleri üzerinde faunistik ve sistematik çalışmalar II.- *Türk. entomol. derg.,* 15(3): 157-172.

Başpınar, H., Uygun, N., 1991c. Doğu Akdeniz Bölgesi turunçgil bahçelerindeki Cicadellidae türleri üzerinde faunistik ve sistematik çalışmalar III.- *Türk. entomol. derg.,* 15(4): 203-222.

Başpınar, H., Uygun, N., 1992a. Doğu Akdeniz Bölgesi turunçgil bahçelerindeki Cicadellidae türleri üzerinde faunistik v sistematik çalışmalar IV.- *Türk. entomol. derg.,* 16(1): 47-64.

Başpınar, H., Uygun, N., 1992b. Doğu Akdeniz Bölgesi turunçgil bahçelerindeki Cicadellidae türleri üzerinde faunistik v sistematik çalışmalar V.- *Türk. entomol. Derg.,* 16(2): 99-114.

Demir, E., 2004a. Karyağdı Dağı (Ankara) Auchenorrhyncha Faunası Hakkında (Homoptera).- *Priamus*, 11(1/2): 17-27.

Demir, E., 2004b. *Goniagnathus guttulinervis* (Kirschbaum, 1868) new to Turkey, with data on ditribution of the Genus in Antalya (Homoptera: Auchenorryncha: Cicadellidae).- *Acta Entomologica Slovenica*, 12 (2): 255-257.

Demir, E., 2006a. Contributions to the knowledge of Turkish Auchenorrhyncha (Homoptera) with a new record, *Pentastiridius nanus* (Ivanov, 1885).- *Munis entomology and zoology*, 1(1): 97-122.

Demir, E., 2006b. Preliminary report on the Auchenorrhyncha (Hemiptera) fauna of Kazdağı National Park with two new records for Turkey.- *Acta Entomologica Slovenica*, 14 (1): 89-102.

Demir, E., 2006c. Contributions to the knowledge of Turkish Auchenorrhyncha with twelve new records (Homoptera: Cıcadellidae).- *Munis entomology and zoology*, 1(2): 215-236.

Demir, E., 2007a. Contributions to the Knowledge of Turkish Auchenorrhyncha (Homoptera, Fulgoromorpha and Cicadomorpha , excl. Cicadellidae) with a new record, *Setapius klapperichianus* Dlabola, 1988.- *Munis entomology and zoology*, 2(1): 39-58.

Demir, E., 2007b. Auchenorrhyncha (Homoptera) data from Ankara with two new records to Turkey.- *Munis entomology and zoology*, 2(2): 481-492.

Demir, E., Demirsoy, A., 2008. Some interesting and new records of Cicadellidae (Insecta: Hemiptera) from eastern Turkey.- *Zoology in the Middle East*, 45: 116-117.

Dlabola, J., 1957. Results of the Zoological Expedition of the National Museum in Prague to Turkey 20. Homopeta., Auchenorrhyncha.- *Acta ent. Mus. Nat. Pragae,* 31(469): 19-68.

Dlabola, J., 1971. Taxonomische und chorologische Erzangungen zur türkischen und iranischen Zikadenfauna (Homopeta., Auchenorrhyncha).- *Acta faun. ent. Mus. Nat. Pragae,* 14(163): 115-138.

Dlabola, J., 1981. Ergebnisse der Tschechoslowakisch-Iranischen Entomologischen Expeditionen nach dem Iran (1970 und 1973).- *Acta ent. Mus. Nat. Pragae,* 40: 127-311.

Fahrınger, J., 1922. Eine Rhynchotenausbeute aus der Türkei, Kleinasien und den benachbarten Gebieten.- *Konowia,* 1: 296-307.

Güçlü Ş., Özbek, H., 1992. Erzurum Yöresinde Cicadellidae (Homoptera, Auchenorrhyncha) Türleri Üzerinde Faunistik ve Sistematik Çalışmalar I. Agallinae, Macropsinae, Ulopinae.- *Türkiye II. Entomoloji Kongresi,* 28-31 Ocak, Adana, 607-620.

Güçlü Ş., Özbek, H., 1994a .Erzurum Yöresinde Cicadellidae (Homoptera, Auchenorrhyncha) Türleri Üzerinde Faunistik ve Sistematik Çalışmalar II. Idiocerinae,

Iassinae, Dorycephalinae, Aphrodinae, Cicadellinae.- *Türk. entomol. derg.,* 18(2): 103-117.

Güçlü Ş., Özbek, H., 1994b. Erzurum Yöresinde Cicadellidae (Homoptera, Auchenorrhyncha) Türleri Üzerinde Faunistik ve Sistematik Çalışmalar III. Typhlocybinae.- *Atatürk Ü., Ziraat Fak. Derg.,* 25(1): 78-93.

Güçlü Ş., Özbek, H., 1994c. Erzurum Yöresinde Cicadellidae (Homoptera, Auchenorrhyncha) Türleri Üzerinde Faunistik ve Sistematik Çalışmalar IV. Deltocephalinae, Grypotini, Opsini, Deltocephalini, Doraturini.- *Atatürk Ü., Ziraat Fak. Derg.,* 25(2): 167-179.

Güçlü Ş., Özbek, H., 1994d. Erzurum Yöresinde Cicadellidae (Homoptera, Auchenorrhyncha) Türleri Üzerinde Faunistik ve Sistematik Çalışmalar V. Deltocephalinae, Macrostelini.- *Atatürk Ü., Ziraat Fak. Derg.,* 25(3): 354-366.

Güçlü Ş., Özbek, H., 1994e. Erzurum Yöresinde Cicadellidae (Homoptera, Auchenorrhyncha) Türleri Üzerinde Faunistik ve Sistematik Çalışmalar VI. Deltocephalinae, Athysanini-I.- *Atatürk Ü., Ziraat Fak. Derg.,* 25(3): 367-379.

Güçlü Ş., Özbek, H., 1994f. Erzurum Yöresinde Cicadellidae (Homoptera, Auchenorrhyncha) Türleri Üzerinde Faunistik ve Sistematik Çalışmalar VII. Deltocephalinae, Athysanini-II.- *Atatürk Ü., Ziraat Fak. Derg.,* 25(4): 520-532.

Güçlü Ş., Özbek, H., 1995. Erzurum Yöresinde Cicadellidae (Homoptera, Auchenorrhyncha) Türleri Üzerinde Faunistik ve Sistematik Çalışmalar VIII. Deltocephalinae, Paralimnini.- *Atatürk Ü., Ziraat Fak. Derg.,* 26(3): 336- 354.

Kalkandelen, A., 1974. Orta Anadolu'da Homoptera: Cicadellidae familyası türlerinin taksonomileri üzerinde araştırmalar.- *Zirai Mücadele ve Karantina Genel Müdürlüğü*, Ankara, 1-220.

Kartal, V., Zeybekoğlu, Ü., 1991. Samsun Ondokuz Mayıs Üniversitesi Kurupelit Kampüsü Çevresinde Deltocephalinae (Hom., Auch., Cicadellidae) Alt Familyası Türlerinin Faunistik Yönden İncelenmesi.- *Ondokuz. May. Ü. Fen Derg.,* 3(1): 232-257.

Kartal, V., Zeybekoğlu, Ü., 1999. *Cicadatra hyalina* (Fabricius, 1798) (Homoptera, Cicadidae) Türü Üzerine Taksonomik Bir Araştırma.- *Tr. J. of Zoology,* 23: 63-66.

Kartal, V., Zeybekoğlu, Ü., Özdemir, G., 1994. Samsun Çevresinde Cercopidae (Hom., Auchenorrhyncha) Familyası Türleri Üzerine Taksonomik Bir Araştırma.- *Ondokuz May. Ü. Fen Derg*., 5(1): 147-157.

Kartal, V., Zeybekoğlu, Ü., Dursun, A., 2001. A faunistic study on Deltocephalinae (Homoptera: Auchenorrhyncha: Cicadellidae) in Yüksekova (Hakkari).- *Türk. entomol. derg.,* 25(2): 83-92.

Linnavuori, R., 1965. Studies on the South and East-Mediterranean Hemipterous fauna.- *Acta Entomol*. *Fennica, Helsinki*, 21: 1-70.

Lodos, N., Kalkandelen, A., 1981a. Preliminary list of Auchenorrhyncha with notes on distribution and importance of species in Turkey V. Families Flatidae, Ricaniidae and Cicadidae.- *Türk. Bitki kor. Derg.,* 5(2): 67-82.

Lodos, N., Kalkandelen, A., 1981b. Preliminary list of Auchenorrhyncha with notes on distribution and importance of species in Turkey VI. Families Cercopidae

and Membracidae.- *Türk. Bitki kor. Derg.,* 5(3): 133-149.

Lodos, N., Kalkandelen, A., 1981c. Preliminary list of Auchenorrhyncha with notes on distribution and importance of species in Turkey VII. Family Cicadellidae: Ulopinae, Megophthalminae, Ledrinae, Macropsinae and Agallinae.- *Türk. Bitki kor. Derg.,* 5(4): 215-230.

Lodos, N., Kalkandelen, A., 1982a. Preliminary list of Auchenorrhyncha with notes on distribution and importance of species in Turkey VIII. Family Cicadellidae: Idiocerinae.- *Türk. Bitki kor. Derg.,* 6(1): 15-28.

Lodos, N., Kalkandelen, A., 1982b. Preliminary list of Auchenorrhyncha with notes on distribution and importance of species in Turkey IX. Family Cicadellidae: Iassinae, Penthiminae, Dorycephalinae, Hecalinae and Aphrodinae.- *Türk. Bitki kor. Derg.,* 6: 147-159.

Lodos, N., Kalkandelen, A., 1983a. Preliminary list of Auchenorrhyncha with notes on distribution and importance of species in Turkey X. Family Cicadellidae: Xestocephalinae, Stegelytrinae and Cicadellinae.- *Türk. Bitki kor. Derg.,* 7: 23-28.

Lodos, N., Kalkandelen, A., 1983b. Preliminary list of Auchenorrhyncha with notes on distribution and importance of species in Turkey XI. Family Cicadellidae, Typhlocybinae: Alebrini and Dikraneurini.- *Türk. Bitki kor. Derg.,* 7: 107-115.

Lodos, N., Kalkandelen, A., 1983c. Preliminary list of Auchenorrhyncha with notes on distribution and importance of species in Turkey XII. Family Cicadellidae, Typhlocybinae: Empoascini.- *Türk. Bitki kor. Derg.,* 7: 153-165.

Lodos, N., Kalkandelen, A., 1984a. Preliminary list of Auchenorrhyncha with notes on distribution and importance of species in Turkey XIII. Family Cicadellidae, Typhlocybinae: Typhlocybini (Part I).- *Türk. Bitki kor. Derg.,* 8: 33-44.

Lodos, N., Kalkandelen, A., 1984b. Preliminary list of Auchenorrhyncha with notes on distribution and importance of species in Turkey XIV. Family Cicadellidae, Typhlocybinae: Typhlocybini (Part II).- *Türk. Bitki kor. Derg.,* 8: 87-97.

Lodos, N., Kalkandelen, A., 1984c. Preliminary list of Auchenorrhyncha with notes on distribution and importance of species in Turkey XV. Family Cicadellidae, Typhlocybinae: Erythroneurini (Part I).- *Türk. Bitki kor. Derg.,* 8: 159-168.

Lodos, N., Kalkandelen, A., 1984d. Preliminary list of Auchenorrhyncha with notes on distribution and importance of species in Turkey XVI. Family Cicadellidae, Typhlocybinae: Erythroneurini (Part II).- *Türk. Bitki kor. Derg.,* 8: 201-210.

Lodos, N., Kalkandelen, A., 1985a. Preliminary list of Auchenorrhyncha with notes on distribution and importance of species in Turkey XVII. Family Cicadellidae, Deltocephalinae: Grypotini, Goniagnathini and Opsiini (Part I).- *Türk. Bitki kor. Derg.,* 9: 79-90.

Lodos, N., Kalkandelen, A., 1985b. Preliminary list of Auchenorrhyncha with notes on distribution and importance of species in Turkey XVIII. Family Cicadellidae, Deltocephalinae: Macrostelini (Part II).- *Türk. Bitki kor. Derg.,* 9(3): 147-161.

Lodos, N., Kalkandelen, A., 1985c. Preliminary list of Auchenorrhyncha with notes on distribution and importance of species in Turkey XIX. Family Cicadellidae,

Deltocephalinae: Deltocephalini, Scaphytopiini, Doraturini.- *Türk. Bitki kor. Derg.,* 9: 207-215.

Lodos, N., Kalkandelen, A., 1986a. Preliminary list of Auchenorrhyncha with notes on distribution and importance of species in Turkey XX. Family Cicadellidae, Deltocephalinae: Fieberiellini, Stirellini and Tetartostylini.- *Türk. Bitki kor. Derg.,* 10(1): 25-32.

Lodos, N., Kalkandelen, A., 1986b. Preliminary list of Auchenorrhyncha with notes on distribution and importance of species in Turkey XXI. Family Cicadellidae, Deltocephalinae: Athysanini (Part I).- *Türk. Bitki kor. Derg.,* 10(3): 131-139.

Lodos, N., Kalkandelen, A., 1986c. Preliminary list of Auchenorrhyncha with notes on distribution and importance of species in Turkey XXII. Family Cicadellidae, Deltocephalinae: Athysanini (Part II).- *Türk. Bitki kor. Derg.,* 10(4): 203-211.

Lodos, N., Kalkandelen, A., 1987a. Preliminary list of Auchenorrhyncha with notes on distribution and importance of species in Turkey XXIII. Family Cicadellidae, Deltocephalinae: Athysanini (Part III). *Türk. Entomol. Derg.,* 11(1): 29-40.

Lodos, N., Kalkandelen, A., 1987b. Preliminary list of Auchenorrhyncha with notes on distribution and importance of species in Turkey XXIV. Family Cicadellidae, Deltocephalinae: Athysanini (Part IV).- *Türk. Entomol. Derg.*, 11(2): 97-109.

Lodos, N., Kalkandelen, A., 1987c. Preliminary list of Auchenorrhyncha with notes on distribution and importance of species in Turkey XXV. Family Cicadellidae, Deltocephalinae: Paralimnini Distans (Part I).- *Türk. Entomol. Derg.,* 11(3): 151-162.

Lodos, N., Kalkandelen, A., 1987d. Preliminary list of Auchenorrhyncha with notes on distribution and importance of species in Turkey XXVI. Family Cicadellidae, Deltocephalinae: Paralimnini Distans (Part II).- *Türk. Entomol. Derg.,* 11(4): 195-202.

Lodos, N., Kalkandelen, A., 1988. Preliminary list of Auchenorrhyncha with notes on distribution and importance of Turkey XXVII. (Addenda and Corrigenda).- *Türk. Entomol. Derg*., 12(1): 11-22.

Tezcan, S., Gülperçin, N., Zeybekoğlu, Ü., Karavin, M., 2013. Contrubution to the Fulgoromorpha (Cixiidae, Delphacidae) and Cicadomorpha (Aphrophoridae, Cicadidae, Cicadellidae) (Insecta: Hemiptera) fauna of farming terraces in Aspat (Strobilos) ancient city and its territorium, Bodrum, Muğla western Turkey.- *Linzer biol. Beitr*., 45(2): 2149-2153.

Zachvatkin, A. A., 1946. Studies on the Homoptera of Turkey.- *Trans. R. Ent. Soc. London*, 97(6): 149-176.

Zeybekoğlu, Ü., 1998. The species of Deltocephalinae (Homoptera: Auchenorrhyncha: Cicadellidae) found in the Middle and East Black Sea Regions.- *Türk. Entomol. Derg*., 22(1): 37-45.

Received / Prejeto: 2. 3. 2016

ACTA ENTOMOLOGICA SLOVENICA

LJUBLJANA, JUNIJ 2016 Vol. 24, št. 1: 55–58

FAVNISTIČNI ZAPISKI / FAUNISTICAL NOTES

THREE NEW RECORDS OF HETEROPTERA IN SLOVENIA

Andrej GOGALA[1], Janez KAMIN[2] & Marko ZDEŠAR[3]

[1] Prirodoslovni muzej Slovenije, Prešernova 20, p.p. 290, SI - 1001 Ljubljana; agogala@pms-lj.si
[2] Gradnikove brigade 47, 5000 Nova Gorica
[3] Brezje pri Dobrovi 32, 1356 Dobrova

Abstract – Three species of Heteroptera are reported for Slovenia. *Belonochilus numenius* is an introduced Nearctic species. *Phytocoris confusus* was found in the vicinity of one of its syntype localities. *Ochetostethus balcanicus* is a north Mediterranean species found at the northern edge of its distribution.

KEY WORDS: Hemiptera, Heteroptera, fauna, Slovenia.

Izvleček – TRI NOVE NAJDBE STENIC (HETEROPTERA) V SLOVENIJI

Poročamo o najdbah treh vrst stenic v Sloveniji. *Belonochilus numenius* je vnesena nearktična vrsta. *Phytocoris confusus* je bila najdena v bližini enega od sintipskih najdišč. *Ochetostethus balcanicus* je severnomediteranska vrsta, najdena na severnem robu njene razširjenosti.

KLJUČNE BESEDE: Hemiptera, Heteroptera, favna, Slovenija.

Introduction

The number of alien Heteroptera species introduced into Europe increases. One of them, *Belonochilus numenius*, was expected to be found in Slovenia as it is already widely distributed in Europe (Werner 2014). Like *Corythucha ciliata* decades before, it colonized plane trees in urban parks and streets. Finds of two other additional species in the Slovenian fauna are also reported. *Ochetostethus balcanicus* is a

Fig. 1: *Phytocoris confusus* female from Korada. Photo J. Kamin.

southern species at the northern edge of distribution in Slovenian Istria. *Phytocoris confusus* is a European species and probably not found in Slovenia for the first time. One of the syntype localities was attributed to Italy, but could as well be to Slovenia. All three species were found in the sub-Mediterranean region. With these additions, 745 species of Heteroptera are known from the territory of Slovenia.

List of species

Miridae

Phytocoris confusus Reuter, 1896

Goriška Brda, Korada, UM80, 46° 2'41.55"N 13°33'50.11"E, 8. 10. 2015, 1♀, J. Kamin leg., coll. PMSL

Probably not the first record from Slovenia as one of the syntypes was collected in Illyria, Görz (= Gorica, Gorizia) by Dr. Hensch (Reuter 1896). Gorica (Gorizia) is a town on the border between Italy and Slovenia, so the exact finding place could be in any of the two countries. The new locality, Korada, is situated only 14 km north from Gorica. The specimen was lured to a light trap in a meadow. *Phytocoris confusus* is a European species living on decidous trees (Wagner 1970).

Lygaeidae

Belonochilus numenius (Say, 1832)

Nova Gorica, UL99, 26. 10. 2015, 1♀, J. Kamin leg., coll. PMSL

The sycamore seed bug is a Nearctic species native to southern Canada, United States and Mexico (Gessé, Ribes & Goula 2009). Its main food source are spherical fruits of plane (sycamore) trees (*Platanus* spp.). Eggs overwinter in them and larvae develop in spring. Adults also suck seeds with their long rostrum. Four generations may develop in a year. It was first recorded in Europe in Corsica and Languedoc, France (Matocq 2008). Already in the same year, it was found also in Catalonia, Spain (Gessé et al. 2009). Later it became clear that the earliest European record is a photograph of a specimen, taken in Palma de Mallorca in July 2008 (Baena & Torres 2012). As plane trees are common ornamentals in urban areas, the species has a capacity to spread fast in Europe. In 2010 it was found in Italy, Austria, Portugal

Fig. 2: *Belonochilus numenius* female from Nova Gorica.

(Azores) and Monaco, in 2011 in Slovakia and the Czech Republic, in 2012 in Hungary, Germany and Switzerland (Werner 2014).

Cydnidae

Ochetostethus balcanicus Wagner, 1940

Osp – Tinjan, 80 m, VL14, 11. 5. 2015, 1♂, M. Zdešar leg., coll. PMSL

The genus *Ochetostethus* includes several very similar species which are barely separable without examination of the genitalia (Magnien 2006). They were revised

Fig. 3: *Ochetostethus balcanicus* male from Osp – Tinjan. Figs. 2 & 3 photo A. Gogala.

by Kerzhner (1976) who listed a record of *O. opacus* from Topla, Slovenia. The only other published record of the genus from Slovenia or bordering region of Italy is by Montandon (1886), who listed *O. nanus* for Gorica (Gorizia). *O. nanus* is known now to be a western Mediterranean species, so Gogala (2008) listed this record as *O. opacus* with a question mark. With the discovery of *O. balcanicus* in the north Istria, the identity of the Montandon's record becomes even more dubious. *O. balcanicus* is smaller and more shiny than *O. opacus*. It is a north Mediterranean species, described from Greece. The Slovenian specimen is identical with *O. balcanicus* specimens from the Krk Island, Croatia, and Taygetos, Greece, used for comparison. It was caught with a net from undergrowth in the eastern slope of Tinjan above Osp.

References

Baena M., Torres J. L., 2012: Nuevos datos sobre heterópteros exóticos en España y Francia: Tempyra biguttula Stål, 1874, Belonochilus numenius (Say, 1832) y Zelus renardii (Kolenati, 1856) (Heteroptera: Rhyparochromidae, Orsillidae, Reduviidae). *Boln. Asoc. esp. Ent.*, 36 (3-4): 351-360.

Gessé F., Ribes J., Goula M., 2009: Belonochilus numenius, the sycamore seed bug, new record for the Iberian fauna. *Bulletin of Insectology*, 62 (1):121-123.

Gogala, A., 2008: Heteroptera of Slovenia, V: Pentatomomorpha II and additions to the previous parts. *Annales, Annals for Istrian and Mediterranean Studies, Series historia naturalis*, 18 (1): 91-126.

Kerzhner I. M., 1976: New and little-known Heteroptera from Mongolia and from adjacent regions of the USSR, III. *Nasekomye Mongolii*, 4: 30-86.

Magnien Ph., 2006: A new species from the Near East for the genus Ochetostethus Fieber 1860 (Heteroptera, Cydnidae). *Denisia*, 19: 513-516.

Matocq A., 2008: Présence en France et en Corse d'un Hétéroptère néarctique, Belonochilus numenius (Say, 1831) (Hemiptera, Lygaeidae, Orsillinae). *Bulletin de la Société Entomologique de France*, 113 (4): 533-534.

Montandon A., 1886: Hémiptères-Hétéroptères des environs de Gorice (Illyrie) et description d'une espèce nouvelle. *Revue d'Entomologie*, 5: 105-111.

Reuter, O. M., 1896: Hemiptera gymnocerata Europae. Hémiptères gymnocérates d'Europe, du bassin de la Méditerranée et de l'Asie russe, V. *Acta Societatis scientiarum fennicae*, 23 (2): 1-392, Helsingfors.

Wagner, E., 1970: Die Miridae Hahn, 1831, des Mittelmeerraumes und der Makaronesischen Inseln (Hemiptera, Heteroptera). Teil 1. *Entomologische Abhandlungen*, 37 Supplement.

Werner D. J., 2014: Die amerikanische Platanen-Samen-Wanze Belonochilus numenius (Say, 1831) (Heteroptera: Lygaeidae, Orsillinae) als Neozoon in Europa und in Deutschland: Verbreitung und Biologie. *Andrias*, 20: 245-250.

Received / Prejeto: 19. 5. 2016

In memoriam

Prof. Dr. Božidar Ćurčić
(1946 – 2015)

Prof. Dr. Božidar Ćurčić was born in Belgrade on 3rd July 1946, where he completed his elementary and secondary education. After graduating in 1969 at the Faculty of Science, University of Belgrade, he was posted in the Institute of Zoology, Faculty of Science, University of Belgrade, where he spent his whole successful and fruitful teaching and research career.

Arachnology was and remained the main focus throughout his scientific research (pseudoscorpions in particular). Several early papers were dedicated to the study of scorpions.

In the early days of his scientific career, Prof. Ćurčić met Academician Jovan Hadži, a famous Slovenian zoologist and arachnologist of Serbian origin, in Ljubljana. Although short-lasting, this cooperation between the two scientists had an important impact on Prof. Ćurčić, who directed his studies to pseudoscorpions – a small group of arachnids that has not been in the focus of arachnological investigations in Yugoslavia until then.

As a token of appreciation to the whole opus of Academician Hadži, Prof. Dr. Ćurčić named one pseudoscorpion species new to science from Bosnia and Herzegovina after him (*Pselaphochernes hadzii* Ćurčić, 1972). In 2000, Institute of Zoology, Faculty of Biology, University of Belgrade published, on the behalf of 114 years of the Serbian Academy of Sciences and Arts and 62 years of the Slovenian Academy of Sciences and Arts, a monograph entitled „The Life and Work of Academician Jovan Hadži“ by Božidar Ćurčić, Marija Fabjančič and Ozren Karamata.

Prof. Dr. Ćurčić studied different aspects of pseudoscorpions (systematics, taxonomy, developmental biology, evolutionary biology, teratology and biospeleology). More than four decades of devoted study of this group of arachnids resulted in erecting more than 160 species and genera, both epigean, endogean and cave-dwelling, new to science from Yugoslavia (Serbia, Croatia, Macedonia, Montenegro, Bosnia and Herzegovina), Albania, Greece, Bulgaria, Romania, France, USSR, China, Afghanistan, Nepal, Vietnam, Israel, the Philippines and the USA. Many of the taxa which Prof. Dr. Ćurčić has erected are endemics and relics to Serbia or the Balkan region.

As an avid biospeleologist, Prof. Ćurčić investigated numerous underground habitats in Serbia and all other republics of the former Yugoslavia and contributed immensely to the better understanding of the cave fauna (primarily pseudoscorpions). As a result of these investigations several monographs dealing with cavernicolous pseudoscorpions were published – „Cave-Dwelling Pseudoscorpions of the Dinaric Karst" (1988), „New and Little-Known False Scorpions from the Balkan Peninsula, Principally from Caves, Belonging to the Families Chthoniidae and Neobisiidae (Arachnida, Pseudoscorpiones)" (1997), „The Pseudoscorpions of Serbia, Montenegro and the Republic of Macedonia" (2004) and „Cave Fauna of Serbia, Montenegro and Macedonia" (2014).

Well aware of the importance of cave protection and conservation of these fragile ecosystems Prof. Ćurčić was the founder of the Center for Biospeleology at the Faculty of Biology, University of Belgrade, and NGO Centre for Biospeleology of Southeast Europe.

Although pseudoscorpions were the main object of his studies, Prof. Ćurčić, as a zoologist of broad interests, devoted a part of his scientific investigations to the study of some other arthropod taxa as well (spiders, millipedes, springtails, coleopterans). These studies in collaboration with his younger colleagues from the Faculty of Biology, University of Belgrade resulted in establishing numerous genera and species new to science (seven genera and 32 species of coleopterans, six genera and 16 species of millipedes, one genus and 13 species of springtails) from Serbia, Macedonia, Montenegro, Croatia, Bosnia and Herzegovina, Romania, Bulgaria, and Greece.

Among twenty monographs written by Prof. Dr. Božidar Ćurčić, two of them were published by the Slovenian Academy of Sciences and Arts. In 1974 „Catalogus Faunae Jugoslaviae: Arachnoidea, Pseudoscorpiones" was published, and in 1988 „Cave-Dwelling Pseudoscorpions of the Dinaric Karst" appeared.

Prof. Ćurčić was a fellow and a member of numerous Serbian and foreign scientific societies – Russian Arachnological Society, Japanese Arachnological Society, British Arachnological Society, American Arachnological Society, Royal Entomological Society, Council of the European Association of Arachnologists, Swiss Zoological Society, Serbian Biological Society, Entomological Society of Serbia, etc. He was the president of the latter two societies. For many years Prof. Dr. Ćurčić was the correspondent of the former Yugoslavia in the International Society of Arachnology.

Prof. Ćurčić was the editor-in-chief and the member of the editorial boards of several scientific journals and other types of publications – Archives of Biological

Sciences, Monographs of the Institute of Zoology, Faculty of Biology, University of Belgrade, Acta entomologica serbica, Proceedings of the Geographical Institute „Jovan Cvijić“ of the Serbian Academy of Sciences and Arts, Acta zoologica bulgarica and Journal of the Bulgarian Academy of Sciences. Owing to him the Archives of Biological Sciences entered the SCI list.

In the course of his studies on pseudoscorpions Prof. Ćurčić visited and spent time in research in many scientific institutions such as: Institute of Zoology, Bulgarian Academy of Sciences (Sofia); CNRS (Moulis); Smithsonian Tropical Research Institute (Barro Colorado, Panama); Museum of Natural History (Paris); Museum of Natural History (London); Russian Academy of Sciences (Moscow), to name a few. As an expert in the field of arachnology, Prof. Ćurčić had close contacts with numerous institutions and researchers in many countries worldwide. He was a visiting professor and lectured at a number of universities and scientific institutions (e.g., in Skopje, Ljubljana, Zagreb, Sarajevo, Bucharest, Paris, Moulis, Frankfurt am Main, Moscow, St. Petersburg, Boston, Cambridge, Florence, Thessaloniki, Athens).

As a token of his scientific recognition and contributions to zoology, above all arachnology, several invertebrate taxa new to science were named after him (*Curcicia* Ćurčić & Brajković, 2003, *Neobisium bozidarcurcici* Dimitrijević, 2009, *Svarogosoma bozidarcurcici* Makarov, Mitić & Ćurčić, 2003, *Schizmohetera curcici* Makarov, 2001, *Belgrandiella bozidarcurcici* Glöer & Pešić, 2014, *Serbiella curcici* Lučić, 2001, *Magdelainella bozidarcurcici* Ćurčić & Brajković, 2002).

On the behalf of forty years of Professor Ćurčić's fruitful scientific career and teaching activity, in 2008 „Advances in Arachnology and Developmental Biology – Papers Dedicated to Professor Božidar P. M. Ćurčić“ was published. This monograph contains scientific papers written by eminent Serbian and foreign zoologists.

In 2001 he was elected as a foreign member to the Bulgarian Academy of Sciences in Sofia. Prof. Ćurčić was the chairman of the Man and Biosphere (MAB) Committee, Commission of Serbia for UNESCO.

During his teaching career in the Institute of Zoology, Faculty of Biology, University of Belgrade, Prof. Ćurčić lectured several courses, both on graduate and postgraduate levels (Animal Development, Systematics and Phylogeny of Invertebrates, Human Embryology, Biology of Aging, Comparative Animal Development, Pedozoology). He was the author and co-author of 28 textbooks for secondary schools and universities.

Prof. Ćurčić paid special attention to support his younger colleagues and associates, especially in the early days of their professional careers, enabling them professional specialisation and training in eminent foreign institutions (natural history museums, institutes, faculties). His constructive criticism and valuable advices meant a lot to them. He was the mentor of 23 PhD and MSc theses.

Apart from lecturing and scientific research, Prof. Ćurčić held many important professional positions at the Faculty of Biology and the University of Belgrade. He was the Director of the Institute of Zoology; Head of the Department of Animal Development at the Institute of Zoology; President of the Trade Union, Faculty of Biology; Vice-President of the Academic Council of the Faculty of Biology; President

of the Council, Vice-Dean and President of the Executive Council of the Faculty of Biology; member of the Council on Biology and Genetics of the Serbian Ministry of Science and Technology; expert advisor at the Federal Ministry of Development, Science and Environment; and President of the Council of Biological Sciences at the University of Belgrade.

Prof. Ćurčić was both the founder and the leader of several national and international scientific projects sponsored by the Serbian Ministry of Education, Science and Technological Development, Macedonian Ministries of Culture and Ecology, Bulgarian Academy of Sciences and Serbian Academy of Sciences and Arts.

The bibliography of Prof. Ćurčić contains more than 600 entries. He was the author of 20 monographs, as well as the editor of 20 monographs.

Alongside his scientific work, Prof. Ćurčić had a broad sphere of interests and knowledge on many topics such as literature, art, languages and ethnology. He was especially interested and well versed in ancient mythology (Roman, Greek and Slavic). That enabled him to name numerous pseudoscorpion species new to science after various gods and deities.

Untimely death of Prof. Ćurčić is a great loss to Serbian science, above all arachnology, and all who knew him. He will be remembered as a devoted and fastidious scientist and a person willing to share his broad knowledge, experience and help whenever was needed. His vast professional opus will serve as a guideline to his younger associates. Although Prof. Ćurčić is no longer with us, he will not be forgotten. To me it was a great privilege to be a student, a colleague and a friend of a person of such professional and personal qualities.

Povzetek

Prof. Dr. Božidar Ćurčić se je rodil v Beogradu leta 1946. Vso svojo znanstveno pot je preživel na Zoološkem inštitutu Fakultete za biologijo Univerze v Beogradu, kjer je predaval več predmetov. Bil je začetnik srbske arahnologije in je opisal več kot 160 nadzemnih, talnih in jamskih rodov in vrst paščipalcev, novih za znanost, iz mnogih držav sveta. Prof. Ćurčić je bil ustanovitelj Centra za biospeleologijo na Fakulteti za biologijo v Beogradu in nevladne organizacije Center za biospeleologijo jugovzhodne Evrope. Njegova bibliografija obsega več kot 600 naslovov. Bil je avtor ali soavtor 20 monografij, urednik 20 monografij in avtor 28 srednješolskih in univerzitetnih učbenikov. Prof. Ćurčić je bil glavni urednik "Arhiva bioloških znanosti" in "Monografij Zoološkega inštituta Fakultete za biologijo Univerze v Beogradu" ter član uredniških odborov več znanstvenih revij. Bil je član Bolgarske akademije znanosti.

Prof. Dr. Rajko N. Dimitrijević
Institute of Zoology
Faculty of Biology
University of Belgrade
Belgrade, Serbia

In memoriam

Dr. Bogdan Horvat
(26. 8. 1961 – 3. 1. 2016)

V začetku januarja nas je mnogo prezgodaj zapustil dr. Bogdan Horvat. Čeprav je imel nekaj zdravstvenih težav je bila njegova smrt vendarle precejšnje presenečenje.

Rodil se je 26. avgusta 1961 v Ljubljani. Po končani gimnaziji in maturi leta 1980 se je potem, ko je odslužil vojaški rok v Prištini, vpisal na visokošolski študij biologije. Že pred končanjem študija je pričel delati v Prirodoslovnem muzeju Slovenije, kjer se je leta 1986 tudi redno zaposlil. Diplomiral je leta 1987 z nalogo »Biologija in ekologija rodu *Perla* (Plecoptera: Perlidae)«. To je bil rezultat skupnega dela pri intenzivni obdelavi vrbnic (Insecta: Plecoptera). Vrbnice so razmeroma majhna skupina vodnih žuželk, zato smo se že kmalu odločili, da se njegova raziskovalna dejavnost preusmeri na vodne dvokrilce, predvsem muhe poplesovalke (Diptera: Empididae). Prvo spoznavanje s temi zanimivimi vodnimi žuželkami je dobil pri dr. R. Wagnerju na limnološki postaji Max-Planck institucije v Schlitzu v zahodni Nemčiji. Pozneje pa je prišel v stik z vodilnim evropskim specialistom za to družino dvokrilcev, prof. Hvalo iz Karlove univerze v Pragi. Prof. Hvala je tudi postal njegov mentor, saj je na Karlovi Univerzi v Pragi leta 2002 uspešno zagovarjal doktorsko disertacijo z revizijo rodu *Chelifera* (Revision of the world species of *Chelifera* Macquart (Diptera: Empididae).

Izpit za muzejskega kustosa je opravil leta 1988, leta 2005 je pridobil naziv muzejskega svetovalca. Njegovo delo v muzeju je obsegalo urejanje študijske zbirke vodnih poplesovalk. Z intenzivnim delom je ta zbirka postala ena največjih zbirk te skupine žuželk za Evropo in JV Azijo. Poleg dela z zbirkami žuželk je bil tudi skrbnik

Hochenwartove zbirke konhilij, ki ima izjemen zgodovinski pomen kot ena ustanovnih zbirk Deželnega muzeja. Tako je poskrbel za predstavitev Hochenwartove zbirke konhilij, kot je še danes na ogled na stalni razstavi. Ker muzej nima stalne predstavitve žuželk, je sodeloval pri pripravi stalne razstave »Nastanek zbirke žuželk«. Prav tako je sodeloval pri številnih postavitvah občasnih muzejskih razstav in vitrin četrtletja. Za kataloge razstav je napisal daljša ali krajša strokovna besedila. Več kot desetletje je skrbel za izvedbo dezinsekcije v muzejskih zbirkah.

Njegovo znanstveno in strokovno področje sta bili taksonomija in favnistika vodnih žuželk. Tako je sodeloval pri preučevanju biotske pestrosti v Sloveniji kot tudi v tujini.

Kljub raznolikemu kabinetnemu delu v muzeju pa je bil Bogdan Horvat z dušo in srcem terenski biolog. Pri delu v naravi se je najbolj sprostil in tudi užival. V začetku se mi je pridružil, ko sva po dolgem in počez prekrižarila vso Slovenijo, spomladi in jeseni pa so prišli na vrsto tudi daljši, večtedenski obiski zanimivih predelov narave bivše Jugoslavije. Tako smo skoraj vsako leto obredli najpomembnejše naravoslovne institucije po republikah bivše Jugoslavije. Na takšnih poteh so se stkala številna prijateljstva in sodelovanja. Po razpadu skupne države so se takšni obiski za daljši čas prekinili, terensko delo pa smo preusmerili na intenzivno delo po celotnem ozemlju Grčije. Z vključevanjem v mednarodne raziskovalne projekte, pa tudi ob udeležbah na raznih znanstvenih in strokovnih srečanjih, se je njegovo terensko delo razširilo tudi po nekaterih drugih evropskih državah, kot so Italija, Avstrija, Nemčija, Švica kot tudi v Aziji z obiski Kitajske, Hong Konga, Tajske in Tajvana. Terensko delo je bilo največkrat povezano z udeležbo na kongresu ali obiskom muzeja oziroma kakšne druge naravoslovne institucije. Na teh poteh je nabral obsežen material svoje skupine žuželk in samo upamo lahko, da bodo specialisti te skupine žuželk našli čas in voljo za obdelavo tega bogatega in dragocenega materiala. Vodne žuželke sodijo med najbolj ogrožene skupine živali, tako da je marsikatero nahajališče od koder izvira material danes že uničeno in ne obstaja več.

Njegova bibliografija je obsežna. V Cobiss je vnesenih skoraj sto zapisov. Sam in v soavtorstvu je objavil več kot 30 znanstvenih člankov o rezultatih svojega dela.

Pogrešali ga bomo predvsem kot zanimivega in prijetnega sopotnika pri delu na terenu.

Dr. Ignac Sivec