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Karaman, Z. 1973: Revision der *Euconnus*–Arten der Balkanhalbinsel. Acta entomol. Jugosl. 9, 1–2: 23–66.

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SADRŽAJ – CONTENTS

IZVORNI ZNANSTVENI RADOVI ORIGINAL SCIENTIFIC PAPERS

The papers published in this journal are selectively abstracted in the Review of Applied Entomology, compiled by the Commonwealth Institute of Entomology, London and published by the Commonwealth Agriculture Bureau.

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NEW DATA ON THE *TABANIDAE* (DIPTERA) FAUNA OF YUGOSLAVIA

J. MAJER, Pécs

Received: 20. 6. 1984.

ABSTRACT. – *MAJER, J.,* Pécs, Hungary. Depart. of Zool. „Janus Pannonius" University, Pécs.: New data on the Tabanidae (Diptera) Fauna of Yugoslavia – Acta entomol. Jugosl., 1984, **21**, 1–2, 5 – 7. (Engl., Croat. summ.).

This paper contains 15 new Tabanidae species of the fauna of Yugoslavia. These new records bring the number of Tabanidae species now known in Yugoslavia to 91. All of these were found in the collections of the National Zoological Museum of Croatia in Zagreb. The collection data are given for all species mentioned.

Diptera – Tabanidae, faunistic studies, Jugoslavia.

During my visit to Zagreb in 1983 I had the opportunity to work on the horn and deerfly material of the National Zoological Museum of Croatia. I was able to find 15 new species of the Tabanidae fauna of Yugoslavia in this material. Because of their importance with regard to disease deer flies are frequently collected and are relatively well known in most parts of Europe. The intensive animal husbandry in Yugoslavia requires elimination of all factors which decrease production. Tabanidae serve as factors in human and animal diseases and have an important effect on the health and hygiene of livestock because of irritation, blood loss, disease transmission and secondary infections at places where they bite. Tabanids are regarded as one of the harmful factors. One may conclude, from these factors, that it would be very useful to intensify surweys on Tabanidae. This would be of great practical interest to eventually control populations of this Diptera family.

Some random studies have been carried out on the distribution of Tabanidae species in Yugoslavia (Coe 1958, 1960; Leclercq 1958, 1960, 1965, 1968, 1976; Moucha 1959, 1965). The fauna of the Yugoslavian Tabanidae is an interesting mixture of Mediterranean and temperate zone elements. For each species the following data are given: country, locality and date of collecting, name of collector and determinator. In the absence of any date sign „–" can be found. Identification was carried out using Chvála, Lyneborg & Moucha's (1972), Olsufjev's (1977) and Trojan's (1979) works. A list of new species for the fauna of Yugoslavia is given below:

Haematopota Meigen, 1820

1. *H. lqmbi* Villeneuve, 1921
Croatia: Krapina, ———, 1♀, leg. Hensch, det. Majer.
Macedonia: Soluje, 27. VIII 1957, 1♀, leg. K. Igalffy, det.Majer.

2. *H. ocelligera* Krober, 1922
Croatia: Trnovec, Hrv. Zagorje, – VI. 1941, 1♀, leg. i. Igalffy, det. Majer.

3. *H. scutellata* Olsufjev, Moucha et Chvála, 1964
Croatia: Križovljan, 3. VIII 1939, 1 ♀, leg. I. Igalffy, det. Majer.

Heptatoma Meigen, 1803

4. *H. pellucens* (Fabricius, 1776)
Croatia: Zagreb, 17. V. 1890, 1 ♀, leg. Hensch, det. Majer; – Trnovec, 21. VII 1982, 1 ♀, leg. K. Igalffy, det. Majer.

Hybomitra, Enderlein, 1922

5. *H. lurida* (Fallén, 1817)
Croatia: Trnovec, – V. 1942, 1 ♀, leg. I. Igalffy, det. Majer.

6. *H. nitidifrons confiformis* (Chvála et Moucha, 1971)
Croatia: Kolansko Blato, 11. VI 1958, 1 ♂, leg. – , det. Majer; – Krapinske Toplice, 1. VI 1942, 1 ♀, leg. Novak, det. Majer; – Split, 27. V 1908, 1 ♂, leg. – , det. Majer; – Vis, 27. V 1961, 1 ♂, leg. Novak, det. Majer.

7. *H. tropica* (Meigen, 1820)
Craotia: Krapina, ———, N° 211, 1 ♀, leg. I. Igalffy, det. Majer; – Samarica, 10. VI 1953, 1 ♂, leg. ? Igalffy, det. Majer.

Tabanus Linnaeus, 1758

8. *T. armeniacus* Kröber, 1925
Croatia: Trnovec, – VI 1941, 1 ♀, leg. I. Igalffy, det. Majer.

9. *T. caucasicus* Kröber, 1925
Croatia: Vozilići–Istra, 19. VI 1975, 1 ♀, leg. Perović, det. Majer.

10. *T. fraseri* Austen, 1825
Croatia: Vozilići, 10. VIII 1973, 1 ♀, leg. Scuna, det. Majer.

11. *T. obsolescens* Pandalle, 1936
Croatia: Vozilići, 5. IX 1975, 1 ♀, leg. Perović, det. Majer.

Therioplectes, Zeller, 1842

12. *Th. gigas* (Herbst, 1787)
Croatia : Trnovec, – , VIII 1928, 1 ♀, VIII 1932, 1 ♀, 2. V 1945. 2 ♀, leg. I. Igalffy, det. Majer.

Dasyrhamphis Enderlein, 1922

13. *D. algirus* (Macquart, 1845)
Montenegro: Titograd, – , V 1956, 1 ♂, leg. K. Igalffy, det. Majer.
Croatia: Pula, 10. VI 1954, 2 ♂, leg. –, det. Majer; – Stobreč (Split), 11, VII 1960, 2 ♂, leg. Novak, det. Majer.

14. *D. antracinus* (Meigen, 1820)
Croatia: Neretva, ušće, 1. VI 1950, 1 ♂, 1 ♀, leg. K. Igalffy, det. Majer.

15. *D. denticornis* Enderlein, 1925
Croatia: Stobreč, 30. V 1962, 1 ♂, leg. Novak, det. Majer.

All new species for the fauna of Yugoslavia are deposited at the National Zoological Museum of Croatia (Zagreb).

A c k n o w l e d g e m e n t s. The author would like to thank F. Perović and B. Gjurašin (Zagreb) and J. Mikuška (Osijek) for allowing acces to the collection.

References

Coe, R.L., 1958: Diptera taken in Yugoslavia from May to July, 1955 with localities and notes. – Bull. Mus. Hist. Nat., ser, B, **12**: 181–206, Beograd.
Coe, R. L., 1960: A further collection of Diptera from Yugoslavia, with localities and notes. – Bull. Mus. Hist. Nat., ser. B, **16**: 13–67, 1 map, (Beograd)
Leclercq, M., 1959: Tabanidae (Diptera) de Yougoslavie I. – Récoltes de Macedonie, *Therioplectes simovae* n. sp. – Fragmenta Balcanica, **2**, 181–184.
Leclercq, M., 1960: Tabanidae (Diptera) de Yougoslavie II. Ibidem, **3**, 183–188.
Leclercq, M., 1965: Tabanidae (Diptera) des Balkans et de Sicile. Bull. Inst. agro. et Sta. Rech. Gembloux, **33**, 121–131.
Leclercq, M., 1968: Tabanidae (Diptera) des Balkans. Ent. Berichten, **28**, 21–23.
Leclercq, M., 1975: Tabanidae (Diptera) de Yougoslavie. – Acta entomol. Jugosl., **12**, (1–2): 51–58.
Olsufjev, N.G., 1977: Slepni (Tabanidae) Fauna USSR, Moskau, p. 433.
Trojan, P., 1979: Slepaki (Tabanidae), Fauna Polski, Tom **8**. p. 309.

Sažetak

NOVI PODACI O FAUNI *TABANIDAE* (DIPT.) JUGOSLAVIJE

J. MAJER, Pécs

U zbirci Hrvatskog narodnog zoološkog muzeja u Zagrebu autor je našao 15 vrsta obada (Tabanidae) novih za faunu Jugoslavije. S njima je broj tih dvokrilaca povećan na 91 vrstu u Jugoslaviji.

Author's address:
J.MAJER
Department of Zoology
„Janus Pannonius" University
H–7604 Pécs, Ifjuság utca 6., Hungary

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TAXONOMISCHE DIFFERENZIERUNG DER SÜDÖSTLICHSTEN POPULATIONEN VON *EREBIA STIRIUS* GODART 1824 (LEP., SATYRIDAE)

Zdravko Lorković, Zagreb

Eingegangen am 1.3. 1986.

ABSTRACT. – *LORKOVIĆ, Z.*, Yugosl. Acad. Sci. and Arts, Zagreb, YU. – Taxonomical Differentiation in the South Eastern Populations of *Erebia stirius* Godart 1824 (Lep., Satyridae). – Acta entolog. Jugosl., 1985, 21, 1–2. 9 – 15. (Germ., Serbo–Croat. summ.).

New subspecies *Erebia stirius gorana* from the upper Kupa Valley in the southeastern Croatia and neighbouring Slovenia (Yugoslavia) is described. The taxonomical and ecological differentiation between new subspecies, ssp. *kleki* Lorković 1955 and ssp. *stirius* in relation to their spatial discontinuity are discussed.

Lepidoptera – Satyridae, Erebia stirius gorana ssp. n., taxonomic description, types, intraspecific populations, distributions, habitats, spatial discontinuity, Croatia, Yugoslavia.

Einführung

Bereits nach der Entdeckung der eigenartigen stenotopen Unterart *kleki* Lorković 1955 von *Erebia stirius* Godart an den Felsen des 1182 m hohen Barges Klek im südwestlichen Kroatien, wurde schon die Vermutung geäussert, dass diese Unterart nicht nur auf diesen isolierten Berg beschränkt sein sollte, sondern auch anderswo in den gebirgigen Gegenden Kroatiens und des benachbarten Sloweniens vorkommen dürfte.* Dabei wurde zuerst an die hohen Felsen Kuželjske stijene (873 m) oberhalb des Ortes Kuželj, an dem linken Ufer des obersten Kupa–Tales gedacht, welche Felsen etwa 30 km von Klek entfernt sind. Diese nicht leicht zugänglichen Felsen blieben unerforscht, aber 25 Jahre später geht der Verdienst des Kustos des Zool. Museums in Zagreb, Frau Lidija Mladinov, am Fusse eines Steinbruches bei Čučak, an der rechten Seite des oberen Kupatales unweit des Ortes Brod Moravice, in 450 m Hohe einige ziemlich

*) Kočа (1901) führt für Bukovnik, zwischen Klek und Ogulin, ein ganz abgeflogenes altes ♀ als *Erebia gorge* an, welches erst 1925 als *E. nerine* Frr. richtiggestellt wurde, aber in einem so ungeschickten kurzen Text, dass es schien, als ob *nerine* unrichtig angeführt wäre.

abgeflogene *Erebia* – Falter gefunden zu haben, die sich nachträglich als *E. stirius* erwiesen und zuerst für ssp. *kleki* gehalten wurden (M l a d i n o v, 1978). Nachher folgten weitere Entdeckungen und zwar in der Sohle des obersten Kupatales, längs der Strasse, die von Brod na Kupi nach den Orten Osilnica und Čabar führt, zwischen 245 – 270 m Hohe. Die Falter, meistens Männchen, aber auch Weibchen, hielten sich an den Strassenböschungen und kleinen Kalksteinbrüchen, oft unterhalb überhängender grasiger Humusschichten. Die Flugplätze ziehen sich auf einer Strecke von etwa 10 km von Bosljiva loka und Mirtovići bis Ribjek am Fusse des steilen, südwestlich exponierten, blumenreichen Wiesen– und Büschenhängen des 850 – 1188 m hohen Bergzuges. Die meisten Wiesen werden Mitte Juli gemäht.

Ergebnisse und Diskussion

Je mehr Falter in der nachfolgenden Zeit eingebracht wurden, hauptsächlich aus dem obersten Kupatale (ganz besonders aber nach zwei inzwischen erfolgten Zuchten der Nachkommen je eines Weibchens von Čučak und Mirtovići), kam es hervor, dass es sich nicht einfach um Populationen handelt, die als *kleki* betrachtet sein können, da sie neben unzweideutingen Merkmalen dieser südöstlichsten kroatischen Unterart auch Züge aufweisen, die bei *kleki* nie auftreten, auch nicht in den Zuchten, sondern sich schon an Populationen der ziemlich weit entfernten Form der Julischen Alpen nähern. Dies betrifft in erster Reihe den grösseren Umfang der Falter und die hellere Unterseite der Hinterflügel beider Geschlechter, die bei den gezüchteten Weibchen einen bläulichen Schein zeigt, was bei *kleki*– Zuchten nie auftrat, sondern stets der übliche, dunkelgraue Ton erhalten blieb, wenn auch nur ganz leicht heller (Abb. 4). Es handelt sich also weder um richtige *kleki*, noch um einfache intermediäre Übergangsformen zu ssp *stirius*, sondern um ein Gemisch von Merkmalen zweier Formen, von denen der rostrote Querband auf die unverkennbare Zugehörigkeit zur *kleki* schliesen lässt (Abb. 1). Wenn der ungewöhnlich niedrige Biotop der Form von Kupatal noch dazu zugerechnet wird, ist es angebracht, die Form als eine Subspezies anzuerkennen.

Diagnose. *Erebia stirius* ssp. n. *gorana.* Mit Merkmalen der ssp. *kleki* Lorković 1955. von dem Berge Klek (1182) in südwestlichen Kroatien (Jugoslawien) leicht verändert in der Richtung der ssp. *stirius* Godart aus den Julischen Alpen. Durchschnittlich um 2,3 mm grösser als *kleki*, das rotbraune postdiskale Querband schmal (Abb. 1 und 3), ziemlich scharf begrenzt, um die zwei Apikalaugenflecke rundlich verbreitet, aber nicht so beständig wie bei *kleki* und in 12% der Individuen mit einem blinden, winzigen Augenfleck in Zwischenraum C_1C_2. Auf der Unterseite die Schwärzung der Adern der Vflügel weniger auffällig oder fehlend, die Hinterflügel etwas heller als bei *kleki*, (Abb. 2 u. 4), bei den ♀♀ mehr gräulich (Abb. 2), bisweilen mit leichtem bläulichen Anflug, was bei *kleki* nie vorkommt, häufiger bei ssp. *stirius* von den Julischen Alpen. Bei den ♂♂ nicht selten weisse Schuppen zerstreut im Vorderteil des postdiskalen Bandes.

Gute, getreue Abbildungen von *E. stirius stirius* Godt. von den Karawanken findet man in F o r s t e r– W o h l f a h r t (1955, Taf. 9., Fig. 9, 10, 13 u. 14), etwas weiniger deutliche in W a r r e n (1936, Pl. 94).

Die Variabilität in beiden Geschlechtern breiter als bei *kleki.*

Genitalien zeigen keine merklichen Unterschiede sowohl gegenüber *kleki* wie auch *stirius*. Wie schon früher berichtet (l.c.) gibt es keine geschlechtliche Abneigung zwischen

kleki und ssp. *stirius* Die F_1–Hybride sind ungefähr intermediär, sind aber ähnlicher *stirius* als *gorana.*

Habitat. Felsige Abhänge, Steinbrüche mit umgehender Gras– und Buschvegetation. Die Futter–Grasart ist noch unbekannt, wohl aber verschieden.

Holotypus: ♀, Jugoslawien, Kroatien, oberes Kupa–Tal (Gorski kotar) VL 93 Čučak, 450 m NN, 26. VII. 1980. Kalksteinbruch.

Allotypus: ♂, Jugoslawien, Slowenien, oberes Kupa–Tal, VL. 83 Mirtoviči, 254 m NN, 05. VIII. 1979., Kalksteinbruch.

Paratypen: 32 ♂♂, 15 ♀♀, id. Čučak, Pauci 450 m, rechter Abhang des Kupatales; Kuželj, Bosljiva Loka, Mirtoviči, Grintovec, Ribjek, 240 – 270 m NN, 10. VI. – 17. VIII. 1975 – 1980. (L. M l a d i n o v leg., coll. Zool. Museum Zagreb; Z. L o r k o v i ć leg. et coll. Zagreb).

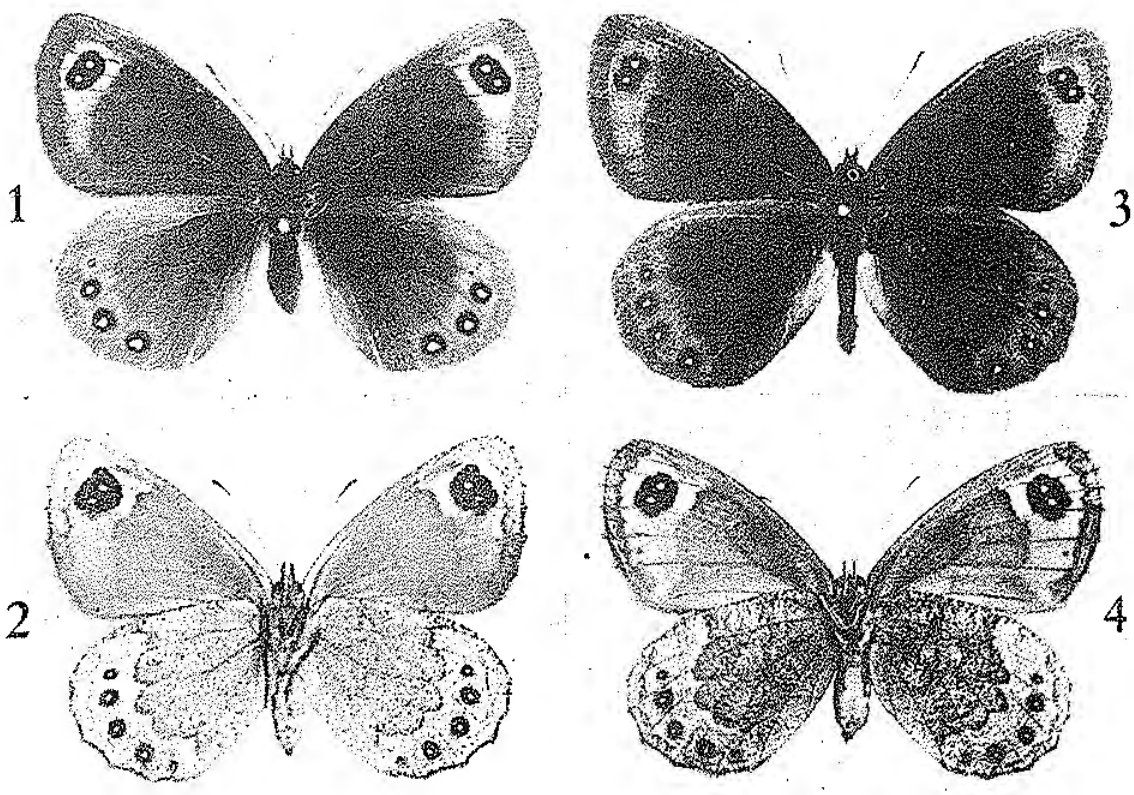

Abb. 1–3. *Erebia stirius gorana* ssp. nov.
1. ♀, VL Čučak, 450 m NN, 4. X. 1977., ex ovo
2. ♀, Unterseite, VL 83 Mirtoviči, 254 m NN, 5. VIII. 1979.
3. ♂, wie oben.

Abb. 4. *Erebia stirius kleki* Lorković 1955, ♀, Unterseite; der Felsen von Klek cca 1100 m NN, 28. V. 1961., ex ovo.

Es ist noch nicht bekannt, ob die Populationen von *gorana* auch die höheren L gen des Kupatales bewohnen, hinauf bis 875 – 1188 m, wo noch felsige Partien hervortreten, oder vielleicht auch Abkömmlinge der Höhen–Populationer sein konnten. Es werden aber in der Talsohle jedenfalls alle Lebensfasen durchgelaufen, da es alle Alterstadien der Weibchen gibt, von ganz frischen bis zum letzetn Lebenstage, denn ein für die Zucht mitgetragenes Weibchen hat nur noch drei Eier abgestzt und danach verendete.

Die südöstlichste Verbreitung von Erebia stirius Godt.

Wie aus der vorliegenden Karte (Abb. 5) ersichtlich ist, liegen keine Angaben über des Vorkommen von *E. stirius* aus dem Gebiete zwischen den Flüssen Kupa im Süden und Sava im Norden. Diese Gegend ist überhaupt sehr mangelhaft untersucht worden, wohl wegen lange Zeit fehlender besserer Verkehrswege, abseits der Hauptstrassen und Eisenbahnstrecken, nicht zuletzt aber auch wegen wenig verlockender Faunenelemente. In der alten Veröffentlichung von H o f f m a n n und K l o s (1914) für Steiermark findet man Angaben, dass *E. stirius* im Bobengraben bei Hrastnik (6. Juli), auf dem Berg Hom (Hum) 566 m bei Laško (Tüffer) und irgendwo bei Velenje (Völlau) in typischer Form gefangen wurde. Diese Angaben stimmen gut mit dem Fund das Verfassers überein, der am 8. Juli 1956 an dem felsigen zerklüfteten Nordhang des Berges Kum (1219 m) ein *stirius* ♂ fing, während ihm einige weitere unerreichbar blieben. Das Stück gehört der Nominatform an. Sämtliche angeführte Lokalitäten liegen beträchtlich östlicher als das Topla–Tal VM 84 unter Peca, das J e ž (1984) als den östlichsten Fundort der Art für Slowenien anführt.

Der südlichste bisher sicher nachgewiesene Fundort von *E. stirius* ist der Berg Klek (1182 m) bei Ogulin, aber W a r r e n (1936) führt die Art für die Velika Kapela (Grosse Kapella) und Velebit als „abundant" an. Nach der brieflichen Mitteilung von W a r r e n stammt das entsprechende Material von M o r i t z H i l f, dem ehemaligen Mitarbeiter des Landes–Museum in Sarajevo, einem eifrigen Sammler, der zu wenig Zeit hatte für eine präzisere Bezeichnung der Fangplätze. Wenn der Berg Klek mit knapper Not zu der Velika Kapela gerechnet sein könnte, und deswegen die Angabe des Vorkommens der *E. stirius* in dieser Bergkette noch einigermassen zu dulden wäre, ist das Vorkommen im Velebit–Gebirge, sei es auch in seinem nördlichsten Teile, völlig ausgeschlossen, da diese Bergkette so genau durchforscht wurde, dass eine häufige *Erebia*–Art, die um Felsen fliegt, hätte nicht übersehen werden können. Und zuletzt, *E. stirius* ist ein Bewohner der felsigen, aber niederschlagsreichen Gebiete, was für Velebit mit überwiegend trockenen Festution–Assotiationen nicht gesagt werden kann.

Es bleibt noch der Raum nordwestlich des oberen Kupatales zu besprechen. Dasselbe nämlich, das für den Raum zwischen Kupa und Sava gesagt wurde, gilt auch für das Gebiet zwischen dem oberem Kupatal und den Berg Nanos im slowenischen Karst, wo die südliche *E. stirius* Form *nerine* Frr, vorkommt. Es besteht keine bekannte Verbindung zwischen *gorana* und f. *nerine* von Nanos (1299 m). Es wäre jedenfalls vom Interesse, das Gebiet zwischen Kupatal und Nanos zu durchstreifen, wobei dichte Walder allerdings keinen besonderen Erfolg bezüglich *E. stirius* erwarten lassen. C a r n e l u t t i (1972), der jahrelang in Cerknica und derer weiteren Umgebung sammelte und bis zu den höchsten Gipfel deiser Region, den Kranjski Snežnik (1798 m) vorgedrungen ist, notiert die Art nicht.

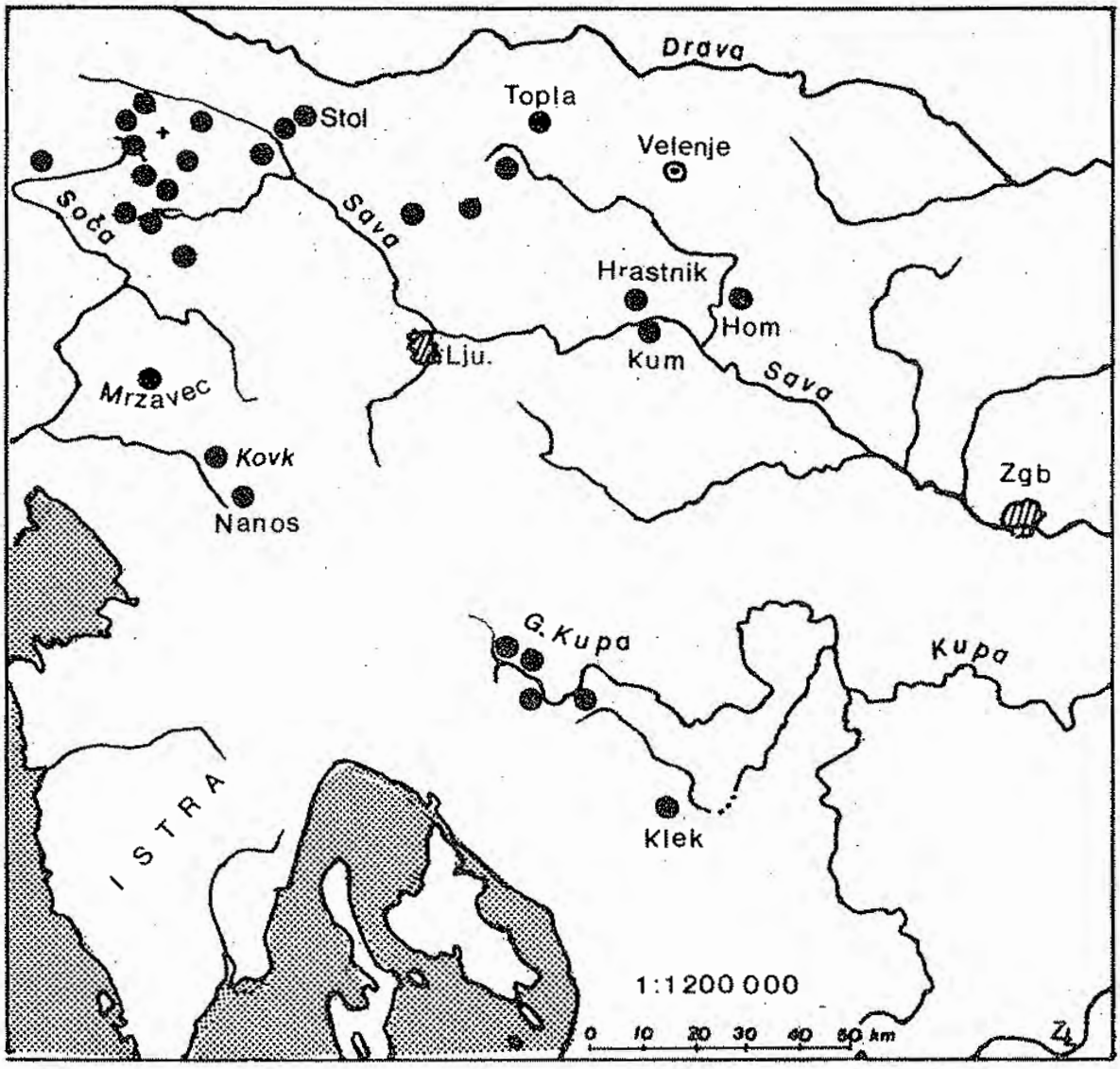

Abb. 5. Die südöstlichsten Fundplätze der *Erebia stirius* Godart, 1824, in Slowenien und südöstlichen Kroatien. Volle Kreise: selbst besichtigte oder zweifelsfrei bestimmte Exemplare; der leere Kreis mit Punkt: unsichere Literaturangabe. Die Lokalitäten zwischen Ljubljana und den Julischen Alpen sind nicht eingetragen.

Klek: *Erebia stirius kleki* Lorković, 1955,
G. Kupa: *E. stirius gorana* ssp. nov.,
Nanos: *E. stirius* f. *nerine* Freyer, 1831
Alle übrigen Fundplätze: *E. stirius stirius* Godt. 1824.

In Anbetracht dessen, dass die Population *gorana* vom obersten Kupatal unbestrittene Merkmale von *kleki* hat, anderseits aber den Populationen der Julischen Alpen ähnliche Züge zeigt, wäre es angebracht, in den erwähnten Gebieten nach dem Vorkommen oder Fehlen der Verbindung zu suchen, und zwar zwischen *gorana* und *stirius* in der Nordrichtung (etwa 70 km), zwischen der ersteren und f. *nerine* nordwestlich (60 km), sowie auch zwischen *gorana* und *kleki* südostlich, obwohl die Entfernung nur 27 km ausmacht. Solche Ergänzungen unserer Kenntnisse waren vom allgemeinen biologischen Interesse, da bekanntlich am Rande des Verbreitungsgebietes einer Art grössere Areallücken zu erwarten sind, – wie gerade hier der Fall zu sein scheint, – und demzufolge die Abspaltung der räumlich getrennten Populationen zur intensiveren genetischen Änderungen führt. Bei ssp. *kleki* hat die Beschränkung der Population auf einen kleinen, isolierten Berggipfel durch Verlust von Allelen fast zur Homozygotie der Unterart geführt, wie die Variationsanalyse und Zuchtergebnisse derselben gezeigt haben (l.c. 1955), was einen allerdings selteneren Fall unter so beweglichen Tieren wie Schmetterlinge darstellt.

Literatur

Carnelutti, J., 1957: Alpine petrophile Lepidopteren des Karstgebietes. – Verhandl. Deutschen Zool.-Ges. in Graz, 1957.: 505–511

Carnelutti, J., 1966: Macrolepidopteri Triglavskega narodnega parka in okolice I. – Varstvo narave, **5**: 107–127.

Carnelutti, J. 1978: Metulji Cerknice in okolice I. Macrolepidoptera, Rhopalocera (Die Schmetterlinge von Cerknica und Umgebung I, Macrolep., Rhopalocera). – Slovenska akad. znan. in umet. Acta carsologica, 8/5; 259–272.

Forster, W. & T.A. Wohlfahrt, 1955: Die Schmetterlinge Mitteleuropas, I. – Stuttgart.

Hafner, I., 1910: Verzeichnis der bisher in Krain beobachteten Grosschmetterlinge. – Carniola, **3**: 77–237., Laibach

Higgins, L. G. & Riley N.D., 1980: A field Guide to the Butterflies of Britain and Europe. (Ed. 4) – 384 pp., Collins, London.

Hoffmann, F. & R. Klos, 1914: Die Schmetterlinge Steiermarks (I). – Mitt. Naturw. Ver. Steierm. **50** (1913): 184–323.

Jež, M., 1984: Osnovne karakteristike favne dnevnih metuljev (Lepidoptera, Diurna) slovenskega Podravja (General Characteristics of the Day-Butterflies (Lepidoptera, Diurna) in Slovenian Podravje) Biol., Vest. (1983) **31** (1): 83–106.

Koča, Gj., 1901: Prilog fauni leptira (Lepidoptera) Hrvatske i Slavonije. – Glasn. hrv. naravosl. društ. **13**, 1–3: 1–67.

Koča, Gj., 1925: Drugi prilog fauni leptira (Lepidoptera) Hrvatske i Slavonije. – Glasn. hrv. prirodosl. društ. **16**, 1–2: 63–58.

Lorković, Z., 1955: Die Populationsanalyse zweier neuen stenochoren *Erebia*-Rassen aus Kroatien. – Biol. Glasn., **8**, 53–76.

Mladinov, Lidija, 1978: Prvi dodatak poznavanju faune Macrolepidoptera iz doline gornjeg toka rijeke Kupe. – Acta ent. Jugosl., **14**, 1–2: 63–67.

Mladinov, L. & Z. Lorković, 1980: Usporedba dolinske *Erebia oeme* Hbn. ssp. nov. iz SZ Jugoslavije s planinskim populacijama (Lepidoptera, Satyridae). – Acta ent. Jugosl., **15**, 35–54.

Warren, B.C.S., 1936: Monograph of the Genus Erebia, London.

Acta entomol. Jugosl., Vol. 21, 1985. 1–2: 9–15.

Sažetak

TAKSONOMSKA DIFERENCIJACIJA JUGOISTOČNIH POPULACIJA *EREBIA STIRIUS* GODART 1824 (Lep., Satyriuae)

Z. LORKOVIĆ, Zagreb

Dvadesetpet godina nakon otkrića osebujne stenotopne podvrste *Erebia stirius kleki* Lorković 1955 na stijeni Kleka, na oko 1100 m visine, našla je najprije L. Mladinov na kamenolomu kod Čučka, 450 m iznad Kupe blizu Brod Moravica u Hrvatskoj, nekoliko primjeraka jedne vrste *Erebia*. Nakon što su bili prepoznati kao najbliži podvrsti *kleki* naišlo se na nova nalazišta i to u samoj dolini Kupe na slovenskoj strani, na odronima uz cestu Brod na Kupi – Osilnica – Čabar, na samih 245–270 m visine kod mjesta Bosljiva loka, Mirtovići i Ribjek (M l a d i n o v leg.) kao stalna prebivališta te inače alpske vrste. Uz neprijeporne odlike podvrste *kleki* u obliku poprečnog postdiskalnog pojasa prednjih krila, ali s nešto svjetlijim tonom donje strane stražnjih krila približuje se ta populacija nominatnoj podvrsti *E. stirius stirius* iz Karavanki i Julijskih Alpa pa je nazvana *gorana* ssp. nova. Nema naprotiv sličnosti s f. *nerine* Frr. sa Nanosa, koja predstavlja kserotermnu varijaciju vrste *E. stirius* Frr. na Krasu.

Najistočnija nalazišta *E. stirius stirius* su Hom kod Laškog (566 m), Hrastnik kod Trbovlja i stjenovita sjeverna padina brda Kum nad Savom (1219 m), gdje je nađena god. 1956. na visini od 550 m u tipskoj formi. Najjužnija nalazišta su u dolini gornje Kupe te još više jugoistočno stijene Kleka. 50 km sjeverozapadno i 60 km sjeverno od gornje Kupe nisu poznata nikakva nalazišta vrste *E. stirius* pa se za sada opisane forme *gorana* i *kleki* moraju smatrati prostorno izoliranima podvrstama. Uzročna veza između niskog staništa ssp. *gorana* i klimatsko-orografskih prilika gornje doline Kupe mogu se za sada samo nagađati jer pobližih podataka nema.

Adresse des Verfassers:
Prof. Dr *Zdravko LORKOVIĆ*
III Cvjetno naselje br. 25.
YU – 41000 Zagreb

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UDK 595.783 : 591.9 (497.13)(23) = 862

RASPROSTRANJENJE MONTANIH MACROLEPIDOPTERA U FAUNI SR HRVATSKE, JUGOSLAVIJA

Lidija MLADINOV i Zdravko LORKOVIĆ
Zagreb

Primljeno: 10.6.1985.

ABSTRACT. – *MLADINOV Lidija* and *Z. LORKOVIĆ,* Zagreb, YU: Distribution of mountain Macrolepidoptera Fauna in S.R. Croatia, Yugoslavia. – Acta entomol. Jugosl., 1985, **21**, 1–2. 17–36. (Croat., Germ. summ.).

A tabular survey of 43 mountain Lepidoptera registered in 83 localities in the mountainous region of S.R. Croatia with the data of habitats, the collectors and the set of the collections. The greatest number of species are found in the coastal mountain Velebit, half of these species belong to *Erebia*. The genetics and environmental influence on the most variable species of this genus together with their distributional boundaries are discussed. A comparison of the alpine and pontomediterranean oreal faunistic elements of Velebit and the mountain Durmitor in Montenegro is given, too.

In addendum the incorrectly recorded species for the Croatian fauna from the end of the last century and the begining of the 20th are discussed and corrected.

Lepidoptera, Erebia, faunistic studies, mountain fauna, genetics, variation, climate, Velebit Mt., Durmitor Mt., Croatia, Montenegro, Yugoslavia.

Uvod

Fauna Lepidoptera SR Hrvatske poznata je do sada u potpunosti samo za Rhopalocera i Hesperiidae dok su „Heterocera" nedovoljno obrađena pa se još uvijek otkrivaju vrste susjednih zemalja koje do danas nisu bile zabilježene za faunu Hrvatske. Međutim, niti fauna Rhopalocera (s.l.) nije do sada jedinstveno obrađena niti izdana. Jedini publicirani rad koji je obuhvatio Hrvatsku početkom stoljeća bio je „Prilog fauni leptira (Lepidoptera) Hrvatske i Slavonije" od nadšumara Gj. K o č e, ali nije cjelovit jer je prikazan zapravo materijal koji je sam autor uspio sakupiti, dakle više u smislu opisa vlastite zbirke. Osim toga sadrži i nekoliko početničkih grešaka determinacije, pošto su suvremeni priručnici počeli izlaziti tek 1905. godine (V e r i t y), a izdani su 1908. (S e i t z, S p u l e r) i 1910. (B e r g e – R e b e l). Niti radovi A. G r u n d a „Beiträge zur Lepidopteren–Fauna Kroatiens" (1916, 1917) ma koliko bili suvremeni nisu cjeloviti, jer najprije daju iscrpan prikaz okolice Zagreba, a dodatno su proširenu na Gorski

kotar i sjeverni Velebit, dok se za Slavoniju autor osvrće samo kratko na sumnjive vrste navedene u literaturi i na one koje nije sam imao prilike provjeriti. Iz tog doba postoji i opis zbirke zagrebačkog gradskog senatora N. Taborskog od srednjoškolca B. Gušića, koji je nepažnjom uvršten u znanstveni časopis (1917), ali se Gušić kasnije pokazao kao vrlo zaslužan za našu faunistiku, skupivši dragocjen dokumentarni materijal iz tada još teže pristupačnih krajeva u prvom redu Velebita (1922–25), a 1926. i Durmitora. Nakon toga se njegova lepidopterološka aktivnost na žalost gasi u korist drugih znanosti. Ipak, taj Gušićev materijal ne može mimoići nijedna obrada Lepidoptera naših krajeva.

Najpotpuniji prikaz faune Macrolepidoptera jadranske obalne zone i otočja – koji se najvećim dijelom odnosi na Hrvatsku, od Istre do krajnjega juga Dalmacije – dao je H. Stauder (1920–1928), koji je dvadesetak godina živio u Trstu i stekao izvrsno poznavanje Lepidoptera toga područja, pa i mnogo šire.

Deset godina kasnije S. Steiner (1938) rekonstruira na temelju novo nađenih vrsta tadašnje stanje Rhopalocera Hrvatske i dolazi do broja 168. Nakon drugog svjetskog rata proširuje se fauna Rhopalocera na 179 vrsta. Posljednja prinova bila je 1976. god. *Apatura metis* Frr., koju se sve do 1970. smatralo podvrstom od *A. ilia* Schiff., iako je Grund već 1911. god. zastupao njezinu samostalnost i time protuslovio tadanjem nepovredivom autoritetu Rebelu koji u njoj nije vidio nešto posebno.*

Važnu ulogu u faunističkim istraživanjima preuzima i Zoološki muzej u Zagrebu, pa mlađi članovi bilo organizirano ili samostalno obrađuju pojedina područja. Višegodišnjim istraživanjima faune Macrolepidoptera u gornjem toku rijeke Kupe, koja je prirodna granica SR Hrvatske i Slovenije, obogaćena je fauna leptira Hrvatske sa 13 novih vrsta dok su tri vrste nove za faunu leptira Jugoslavije (Mladinov, 1970–1984). U prikupljanju podataka korisno djeluje i karantenska granična služba za zaštitu bilja koja angažira entomologe na determinaciji i inventarizaciji insekata uhvaćenih prvenstveno na svjetlosnim mamcima. Tako se množe novi prilozi za upoznavanje noćnih leptira (Mladinov, Uremović, 1968–1975, Kovačević, Franjević–Oštrec 1978, za internu uporabu) kako bi se i tu moglo početi kvantitativno obrađivati u smislu zoogeografskih i faunističkih istraživanja. Tome doprinose i inozemni istraživači Burgermeister 1964, Moucha 1965, Habeler 1976, von Mentzer 1980, 1981, a poznavanje unapređuju makar indirektno i istraživanja u Sloveniji.

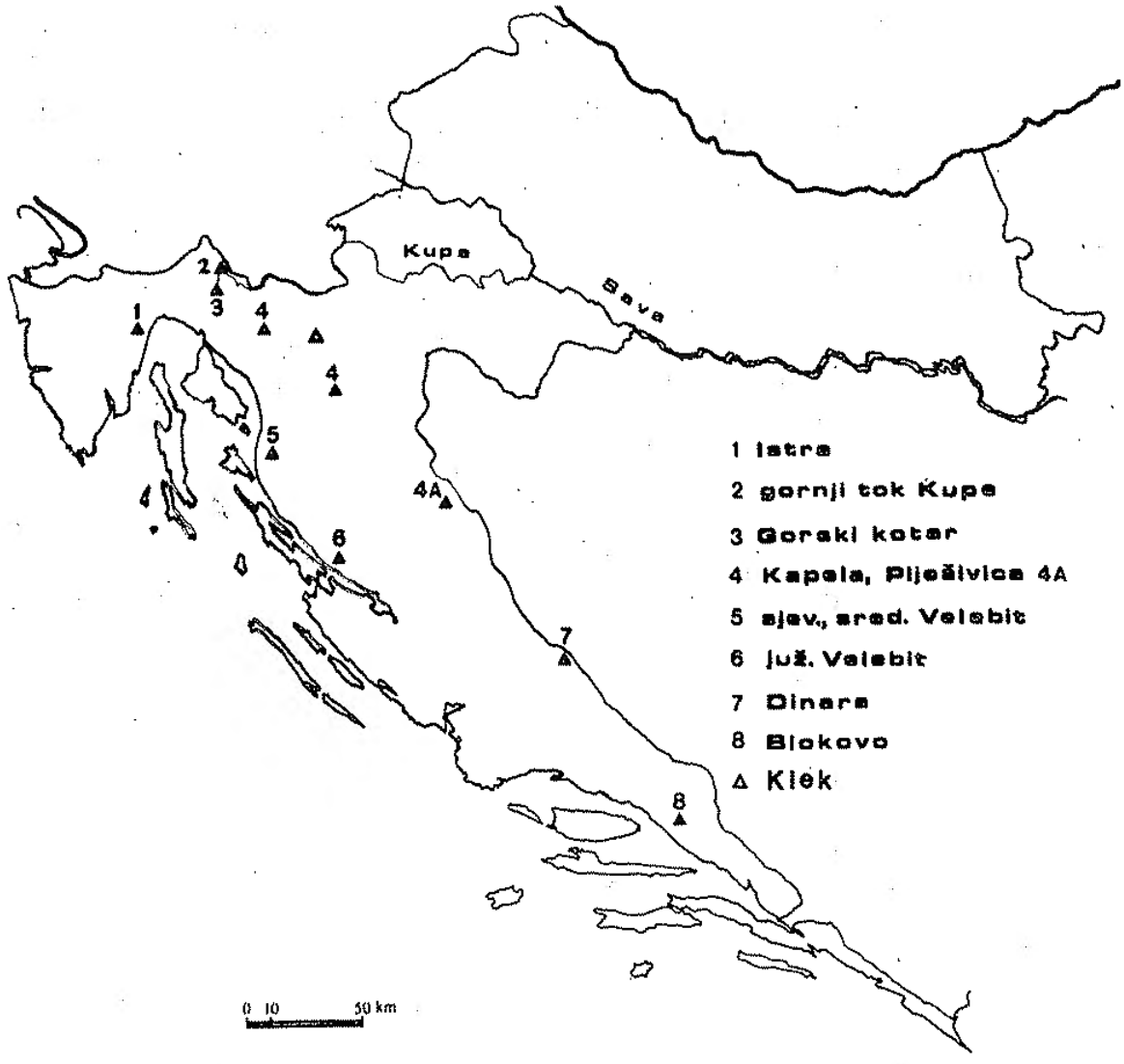
Objavljivanjem „Fauna Rhopalocera Durmitora" (Sijarić et al., 1983) i uspoređivanjem faune tog osebujnog masiva s drugim planinskim područjima Dinarida, osjetio se nedostatak suvremene obrade Lepidoptera SR Hrvatske, osobito Velebita, koji je prilično dobro poznat s obzirom na Rhopalocera, ali još nedovoljno za „Heterocera".

Priložena obrada bila bi prvi sažeti obuhvatni prikaz visokogorskih Lepidoptera na zapadnim Dinaridima. Radi se u prvom redu o vrstama Rhopalocera, stanovnika isključivo između 800 i 1800 m visine, a koje ne dolaze u nizinskim zonama kao mnogi eurosibirski elementi. Za noćne leptire nije to visinsko ograničenje uzeto tako striktno zbog razmjerno malog broja istraživanih vrsta, s nepotpunim podacima za njihovo visinsko rasprostiranje, ali je u Hrvatskoj dosta vrsta poznato samo sa planinskog područja, iako se njihova

*) Tik pred završetak rukopisa otkirvena je 26.6.1986. na Dinari *Erebia triaria orientalis* Rebel., što je njezino najsjevernije nalazište na Balkanskom poluotoku, i nova je, 181. vrsta za Hrvatsku. (M. Franković leg.).

staništa znadu naći i mnogo niže, što je gotovo redovito u srednjoevropskom dijelu njihova areala.

Rad je bio zamišljen od prvoga autora kao registracija Macrolepidoptera planinskog područja Hrvatske, s njihovim rasprostranjenjem, popisom svih lokaliteta sabirališta,



Sl. 1. Mapa momtanog područja SR Hrvatske s označenim najvišim vrhovima planinskih lanaca i najnižim nalazištima alpskih leptira blizu izvorišta Kupe.
Abb. 1. Karte des Montangebietes SR Kroatien mit den höchsten Gipfeln der Bergzüge und den niedrigsten Biotopen der alpinen Falter im Quellgebiet des Kupa–Flusses.
1 – Učka, 1396 M; 2 – Izvorište rijeke Kupe, (Quellgebiet des Kupa–Flusses), 250 M; 3 – Risnjak (Gorski kotar), 1525 M; 4 – Velika Kapela (Bjelolasica, 1533 M) i Mala Kapela, 1092 M; 5 – Mali Rajinac, 1699 M (Sjeverni Velebit – Nord–Velebit); 6 – Vaganski vrh, 1758 M (Južni Velebit – Süd–Velebit); 7 – Dinara 1831 M; 8 – Sv. Jure, 1762 M (Biokovo); Δ – Klek.

podacima nadmorske visine, datumom sabiranja, imenom sabirača i mjestom gdje je smještena zbirka. Kasnije je rad proširen s naglaskom na faunistički i ekološki najznačajnije vrste s pokušajem zoogeografske analize u odnosu na Durmitor, što će se jednom kasnije nastojati proširiti i na ostala Rhopalocera.

Pri obradi materijala postalo je neophodno da se u posebnom poglavlju ukaže na pogrešno navedene vrste u nekim našim starim publikacijama, za koje je već poodavno bila utvrđena njihova neispravna determinacija, što može unositi zabunu kod inozemnih istraživača, ako se savjesnim proučavanjem svekolike literature namjere i na te naše publicističke prvijence. Te su pogreške navedene u dodatku na kraju rada.

Materijal i metode

Istraživano planinsko područje jugozapadne Hrvatske podijeljeno je u tab. 1 na 8 regija, označenim i na sl. 1. brojevima 1–8. U podacima za sada nije označena frekvencija vrsta, koja je inače potrebna za prosuđivanje pripadnosti vrste nekom faunističkom elementu, jer bi to zahtijevalo još dugotrajni dodatni rad.

„Popis lokaliteta" (poredan od sjevera prema jugu) sadrži podatke o mjestu, nadmorskoj visini i datumu nalaza koji su obojici autora bili dostupni u domaćim zbirkama, kao i provjerene podatke iz literature. Osim toga u zagradi je sa leg. ili coll. navedeno ime sakupljača. Na taj način mogu se za svaki primjerak iz zbirke naći potrebni podaci koji nisu uvijek tako precizno zabilježeni na etiketi nalazišta.

Popis lokaliteta

1. ISTRA:

Učka, 1396 m (A b a f i – A i g n e r, 1896, 1910; S t a u d e r, 1922); 21.6.1954., 11.7.1985. (leg. et coll. L o r k o v i ć, Zagreb); 6. 1961. (leg. Đ u l i ć, coll. L o r k o v i ć); 19.7.1979. (leg. P e r o v i ć, Zool. muz. Zagreb);
Planik, 1265 m (S t a u d e r, 1922).
Vodička Griža, 1144 m (S t a u d e r, 1922).
Kamenjak, 838 m (S t a u d e r, 1928).
Kremenjak, 700–825 m (S t a u d e r, 1928).

2. DOLINA GORNJEG TOKA RIJEKE KUPE:

Hrvatsko, 289 m; 26.7.1970., 12.6.1977., 10.6.1978. (leg. M l a d i n o v, Zool. muz. Zagreb).
Ribjek, 291 m; 26.6.1976., 10.6.1978., 9.6.1979., 13.7.1980., 11.6.1982. (leg. M l a d i n o v, Zool. muz. Zagreb).
Ložec, 271 m; 21.6.1970; 28.6.1971., 10. i 15.6.1972., 10.6. i 1.7.1973., 15. i 23.6.1974., 21.6.1975., 26.6.1976., 11.6.1977., 10.6.1978., 9–10.6.1979. (leg. M l a d i n o v, Zool. muz. Zagreb).

Grintovec, oko 300 m; 11–12–6. i 6.8.1977., 10.6. i 5.8.1979., 14.6.1981. (leg. Mladinov, Zool. muz. Zagreb; leg. Lork,ović, Zagreb).
Bosljiva Loka, 260 m; 12.6.1981. (leg. Mladinov, Zool. muz. Zagreb).
Mirtoviči, 260 m; 5.8.1979., 13.7.1980., 12.6.1981. (leg. Mladinov, Zool. muz. Zagreb; leg. Lorković, Zagreb).
Srobotnik, 239 m; 14.6.1981. (leg. Mladinov, Zool. muz. Zagreb).

3. GORSKI KOTAR:

Gornje Jelenje, 882 m; 5.6.1965. (coll. Lorković, Zagreb).
Platak, 1111 m, 11.7.1985. (col. Lorković, Zagreb)
Snježnik, 1061–1506 m; 9.8.1913., leg. Steiner (coll. Grund, Zool. muz. Zagreb); 7–8.8.1921., 10.8.1961. (coll. Lorković, Zagreb).
Risnjak, 1528 m; 20.8.1920., 8–12.8.1961. (coll. Lorković, Zagreb); 9–10.7. i 8.1961. (leg. K. Igalffy, Zool. muz. Zagreb).
Fužine, 732 m (Abafi – Aigner, 1896, 1910; Grund, 1916); 5.7.1952. (coll. Lorko,vić, Zagreb).
Lič, 726 m; 28.7.1908. (coll. Grund, Zool. muz. Zagreb); 30.6. i 20.8.1912. (coll. Taborski, Zool. muz. Zagreb); Gušić, 1917; 800 m; 6.7. i 8.1952. (coll. Lorković, Zagreb).
Medveđak, 1027 m; 5.7.1952. (coll. Lorković, Zagreb).
Javorje, 1288 m (Grund, 1916).
Bitoraj, 1385 m; 29.6.1913. (coll. Grund, Zool. muz. Zagreb).
Lokve, 723 m; 30.7.1912. (Grund, 1916); 18.8.1920. (coll. Lorković, Zagreb).
Sopača–Lokve, 7.7.1916. (coll. Grund, Zool. muz. Zagreb).
Delnice, 698 m; 29.7.1908. (coll. Grund, Zool. muz. Zagreb); 16.8.1920. (coll. Lorković, Zagreb).
Čučak, 500 m; 17.8.1975., 13. i 26.7.1980., 12–14.6.1981., 15.8.1982. (leg. Mladinov, Zool. muz. Zagreb; leg. Lorković, Zagreb).

4. VELIKA KAPELA i MALA KAPELA:

Velika Kapela, 1533 m (Koča, 1901; Lorković, 1956).
Crni Vrh, 1102 m; 4.7.1912. (leg. Spratek, coll. Lorković, Zagreb).
Begovo razdolje, 1076 m (leg. Gušić, coll. Lorković, Zagreb).
Mala Višnjevica (Bašjakov vrh), 1099 m; 5.7.1924. (leg. Gušić, coll. Lorković, Zagreb).
Maj vrh, 1269 m; 4.8.1964. (leg. et coll. Lorković, Zagreb).
Bijele Stijene, 1333 m; 21.7.1954. (coll. Lorković, Zagreb).
Bjelolasica, 1533 m; 23.7.1954. (coll. Lorković, zgreb).
Gomirkovica Poljana, 1250–1300 m; 23.7.1954. (coll. Lorković, Zagreb).
Klek, 1182 m; 14.8.1897. (coll. Koča Zool. muz. Zagreb; Koča, 1901, 1925); 6.7.1952., 10.8.1953., 19.7.1953., 21.7.1954., 27.7.1959., 4.8.1959. (coll. Lorković, Zagreb; coll. H. de Lesse, Mus. Hist. Nat. Paris).

Ogulin, 320–500 m; 8.7.1891. (coll. Koča, Zool. muz. Zagreb; Koča, 1901, 1925).
Plitvička jezera, 570–660 m (Abafi–Aigner, 1896, 1910; Koča, 1901); 25–28.8.1918., 2.–4.8.1922., 24.6.1923., 17.7.1925., 16.–17.6.1926., 16.7.1927., 8.–10.7.1952., 4.9.1956., 7.–13.8.1969. (coll. Lorković Zagreb).
Plitvički Ljeskovac, 660 m; 17.7.1891. (coll. Koča, Zool. muz. Zagreb); 20–23.7. i 17–18.8.1962., 15–16.5.1970., 23–24.5.1973. (coll. Lorković, Zagreb).

4A. PLJEŠEVICA LIČKA:

Plješevica Lička, 1200 m; 10–13.7.1927. (coll. Valjavec, Zool. muz. Zagreb); 10–13.7.1927. (coll. Lorković, Zagreb); 11.6.1976., 21.5.1977. (leg. K. Igalffy, Zool. muz. Zagreb).
Mala Lička Plješevica, 1.8.1922. (coll. Lorković i coll. Badovinac, Zagreb).
Karlovića Korita, 1100–1200 m; 31.7.1922. (coll. Lorković, Zagreb).
Ruda Poljana, 1.8.1922. (coll. Lorković i coll. Badovinac, Zagreb).
Ozeblin, 1657 m; 30.7.1922. (coll. Lorković i coll. Badovinac, Zagreb).

5. SJEVERNI I SREDNJI VELEBIT:

Krivi Put, 698–839 m (Abafi–Aigner, 1910; Stauder, 1925, 1928).
Vratnik, 698 m; 22.7.1975. (leg. Mladinov, Zool. muz. Zagreb).
Skorupov dolac, 1100 m; 8.7.1925. (leg. Gušić, coll. Lorković, Zagreb).
Vučjak, 1450–1600 m; 15.7.1935., 22.8.1980. (coll. Lorković, Zagreb); 22.7.1979. (leg. Perović, Zool. muz. Zagreb).
Zavižan, 1600 m; 15.7., 14–16.8.1940. (coll. Lorković, Zagreb); 8.9.1979. (leg. Perović, Zool. muz. Zagreb).
Jezera, 1405–1450 m; 9.7.1925. (col.. Gušić, Zool. muz. Zagreb); 1.8.1981. (leg. Tvrtković, Zool. muz. Zagreb).
Krasno, 807 m; 24.7.1912. (coll. Taborski, Zool. muz. Zagreb); Gušić (1917); 14.7.1935. (coll. Lorković, Zagreb).
Apatišan, 1130 m (coll. Taborski, Zool. muz. Zagreb); Gušić (1917).
Rosijeva Koliba, 1400 m; 18.7.1935. (coll. Lorković, Zagreb).
Kozjak, 780 m; 31.7.1912. (coll. Taborski, Zool. muz. Zagreb); Gušić (1917).
Laminica, 911 m; 7.1911., 7.7.1912. (coll. Grund, Zool. muz. Zagreb); Grund (1916).
Alan, 1262–1412 m; 12–14.6.1908., 7.1909., 25.7.1910., 7.1911. (coll. Grund, Zool. muz. Zagreb); Grund (1916); Gušić (1917); 25–27.7.1910., 1.8.1912. (coll. Taborski, Zool. muz. Zagreb); 18.7.1935. (coll. Lorković, Zagreb).
Mrkvište, 1276 m; 28.7.1912. (coll. Taborski, Zool. muz. Zagreb); Grund (1916): 5.6.1920. (coll. Lorković, Zagreb).
Štirovača, 1102 m; 9.8.1922. (coll. GLušić, Zool. muz. Zagreb).
Visibaba, 1140–1443 m; 7.1909., 9–12.7.1911., 6. i 10.7.1912. (coll. Grund, zool. muz. Zagreb); Grund (1916); coll. Lorković, Zagreb.

Pliševica, 1449 m; 7.1912. (coll. Grund, Zool. muz. Zagreb).
Grabarje, oko 900 m; 22.7.1910., 6. i 10.7., 2.8.1912. (coll. Grund, Zool. muz. Zagreb); Grund (1916).
Opaljeno Brdo, 1265 m; 14.7.1925. (coll. Gušić, Zool. muz. Zagreb).
Crni Dabar, 667 m; 4.8.1922. (coll. Gušić, Zool. muz. Zagreb).
Ravni Dabar, 723 m; 3.8.1922. (coll. Gušić, Zool. muz. Zagreb).
Metla, 1200 m; 29.7.1933., 24.7.1951. (coll. Lorković, Zagreb).
Velebit, 7.1910., 25.7.1912. (coll. Taborski, Zool. muz. Zagreb); Pável (1897); Abafi–Aigner (1896, 1910); Gušić (1917); Stauder (1928).

6. JUŽNI VELEBIT:

Brušane, 589 m; (Abafi–Aigner, 1910); 25.7.1933. (coll. Lorković Zagreb).
Jadovno–Brušane, 27.8.1915. (col. Taborski, Zool. muz. Zagreb); 28.7.1933. (coll. Lorković, Zagreb).
Sadikovac, 1286 m; 23.7.1951. (coll. Lorković, Zagreb).
Pasji Klanac, 1000 m; 17.7.1925. (coll. Gušić, Zool. muz. Zagreb).
Ravni Samar, 1157–1175 m; 19.7.1925. (coll. Gušić, Zool. muz. Zagreb); coll. Lorković, Zagreb.
Klepetuša, 1450 m; 13.8.1939., 24.7.1951. (coll. Lorković, Zagreb).
Visočica, 1450–1500 m; 19.7.1925. (coll. GLušić, Zool. muz. Zagreb); 10–12.7.1932., 26.7.1933., 8.8.1935., 12–14.8.1940. (coll. Lorković, Zagreb).
Badanj–Doci, 1400–1639 m; 29.–30.7.1922., 28.7.1926. (coll. Gušić, Zool. muz. Zagreb); 24.7.1924., 24–27.7.1937. (coll. Lorković, Zagreb).
Debelo Brdo, 1271 m; 23.7.1911. (coll. Taborski, Zool. muz. Zagreb); Gušić (1917).
Golić, 1303 m; 26–27.7.1922. (coll. Gušić, Zool. muz. Zagreb).
Malovan, 1708 m; 24.7.1924. (coll. Lorković i coll. Badovinac, Zagreb).
Babin Vrh, 1741 m; 26.7.1937. (coll. Lorković, Zagreb).
Vaganski Vrh, 1700–1758 m (Abafi–Aigner, 1910); Steiner (1938); 25.7.1924., 26–27.7.1937., 4–11.8.1940. (coll. Lorković i coll. Badovinac, Zagreb).
Sv. Brdo, 1753 m; 28–29.7.1922. (coll. Gušić, Zool. muz. Zagreb); 26.7.1937. (coll. Lorković, Zagreb).
Velika Paklenica, 30.7.1922. (coll. Gušić, Zool. muz. Zagreb); Stauder, (1923); 26.7.1924. (coll. Lorković i coll. Badovinac, Zagreb).
Podprag, 684 m; 26–27.7.1922. (coll. Gušić, Zool. muz. Zagreb).

7. DINARA:

Dinara, 1800 m; 15.7.1927., 25. i 28.6. i 2.7.1929., 15.6.1931. (coll. Valjavec, Zool. muz. Zagreb); leg. Častek, (coll. Lorković, Zagreb).

TABELA 1

Planinske vrste Macrolepidoptera u SR Hrvatskoj	Istra	Dolina gornje Kupe	Gorski kotar	Velika i Mala Kapela	Lička Plješevica	Sjev. i srednji Velebit	Južni Velebit	Dinara	Biokovo
	1	2	3	4	4A	5	6	7	8
1. *Parnassius apollo liburnicus* Rb. et Rg.	–	–	+	+	+	+	+	+	–
2. *Palaeochrysophanus candens leonhardi* F.	–	–	+	+	+	+	–	–	–
3. *Aricia artaxerxes balcanica* Vrty.	–	–	+	+	–	–	+	–	–
4. *Aricia anteros* Frr.	–	–	–	–	–	+	+	–	–
5. *Eumedonia eumedon* Esp.	+	–	+	–	–	+	+	–	–
6. *Polyommatus eros* Ochs.	–	–	–	–	–	–	+	+	–
7. *Clossiana titania* Esp.	–	–	–	+	–	–	–	–	–
8. *Erebia ligea herculeana* Warr.	+	–	+	+	+	+	+	+	–
9. *Erebia euryale syrmia* Fruhst.	–	–	+	–	–	+	–	–	–
10. *Erebia epiphron aetheria* Esp.	–	–	+	–	–	+	–	–	–
11. *Erebia triaria orientalis* Rebel	–	–	–	–	–	–	–	+	–
12. *Erebia medusa euphrasia* Fruhst.	+	–	–	–	–	+	+	+	–
Erebia medusa hippomedusa Ochs.	–	+	+	+	+	–	–	–	–
13. *Erebia ottomana balcanica* Rbl.	–	–	–	–	–	–	+	+	–
14. *Erebia pronoe fruhstorferi* Warr.	–	–	+	–	–	+	–	–	–
15. *Erebia melas leonhardi* Fruhst.	+	–	+	+	+	+	+	+	+
16. *Erebia stirius kleki* Lork.	–	+	+	+	–	–	–	–	–
17. *Erebia oeme vetulonia* Fruhst.	–	–	–	–	+	+	+	+	–
Erebia oeme megaspodia Mlad. et Lork.	–	+	+	–	–	–	–	–	–
18. *Erebia gorge vagana* Lork.	–	–	–	–	–	–	+	–	–
19. *Coenonympha rhodopensis occupata* Rbl.	–	–	–	–	–	+	+	+	–
20. *Pyrgus serratulae major* Stgr.	–	–	–	–	–	+	+	–	–
21. *Parasemia plantaginis hercegovinensis*	–	–	–	–	–	–	+	–	–
22. *Standfussiana nictymera* B.	+	–	–	–	–	–	–	+	–
23. *Epipsilia latens* Hbn.	+	–	–	–	–	+	–	–	–
24. *Discestra marmorosa* Borkh.	+	–	–	–	–	–	?	–	–
25. *Hadena caesia* Schiff.	+	–	–	–	–	–	–	–	–
26. *Apamea rubrirena* Tr.	–	–	–	–	–	+	–	–	–
27. *Apamea platinea* Tr.	+	–	–	–	–	+	–	–	–
28. *Panchrysia v–argenteum* Esp.	+	–	–	–	–	–	–	–	–
29. *Schistostege decussata* Schiff.	–	–	–	–	–	–	–	+	–
30. *Anaitis simpliciata* Tr.	–	–	–	+	+	+	–	–	–
31. *Triphosa sabaudiata* Dup.	+	–	–	–	–	–	–	–	–
32. *Distroma citrata* L.	–	–	+	–	–	–	–	–	–
33. *Calostigia aqueata hercegovinensis* Rbl.	–	–	–	–	–	+	–	–	–
34. *Entephria cyanata* Hbn.	+	–	–	–	–	+	–	–	–
35. *Coenotephria tophaceata* Schiff.	–	–	–	–	–	+	–	–	–
36. *Coenotephria nebulata* Tr.	+	–	–	–	–	+	–	–	–
37. *Euphyia scripturata* Hbn.	+	–	+	+	–	+	–	–	–
38. *Euphyia molluginata* Hbn.	+	–	–	–	–	+	–	–	–
39. *Perizoma minorata* Tr.	+	–	–	–	–	–	–	–	–
40. *Venusia cambrica* Curt.	+	–	–	–	–	–	–	–	–
41. *Gnophos myrtillata* Thnbg.	–	–	–	–	–	+	+	–	–
42. *Gnophos pullata* Schiff.	–	–	–	+	+	+	–	–	–
Gnophos pullata impectinata Guen.	–	–	–	–	–	+	–	–	–
43. *Catascia dilucidaria* Schiff.	+	–	–	+	–	–	–	–	–
44. *Catascia serotinaria* Schiff.	–	–	–	–	–	–	+	–	–
45. *Catascia sordaria mendicaria* H.S.	–	–	–	–	–	+	+	–	–
Ukupno:	18	3	14	12	7	27	17	11	1

Prolog, 900 m (S t a u d e r, 1925).
Dinara, 1300–1800 m, 18.–28.7.1962 (Fernbach leg., coll. L o r k o v i ć, Zagreb); 350–1900 m, 24.–26.6., 24–27.7.1985. (M. Franković leg. coll. L o r k o v i ć, Zagreb).

8. BIOKOVO:

Biokovo, 1762 m; 8.1921. (coll. G u š i ć, Zool. muz. Zagreb); „S t a u d e r (1923); 16.8.1938. (coll. L o r k o v i ć, Zagreb).

Rezultati

Prisutnost planinskih vrsta Macrolepidoptera u SR Hrvatskoj prikazana je u tabeli 1.

U sistematsku tabelu uvrštena je visokogorska vrsta *Discestra marmorosa* Borkh. za Učku u Istri prema S t a u d e r u (1925), a budući da S p e y e r – S p e y e r (1862) navode jedno najviše brdo u Hrvatskoj, a A b a f i – A i g n e r (1896) spominje samo Hrvatsku, vrstu smo uvrstili i u područje južnog Velebita, gdje se nalazi njegov najviše vrh (1758 m). Radi nedostatka dokaznog materijala podatak je u tabeli za Velebit ipak označen znakom pitanja (?). Navedeni podaci ove planinske vrste za Hrvatsku povezuju njenu rasprostranjenost prema susjednim republikama u Jugoslaviji, gdje je zabilježena za Sloveniju (H a f n e r, 1910; C a r n e l u t t i, 1973), Bosnu i Hercegovinu (R e b e l, 1904) kao i Makedoniju (T h u r n e r, 1964). Montana vrsta *Coenotephria tophaceata* Schiff. zabilježena je u Hrvatskoj za sjeverni Velebit (S t a u d e r, 1928), dok A b a f i – A i g n e r (1910) navodi lokalitet Krapinu u Hrvatskom zagorju. Ovaj nalaz čini, za sada, krajnju sjevernu točku raširenosti ove vrste u Hrvatskoj, koja je inače brojno zastupljena na istraživanim alpskim lokalitetima Slovenije (C a r n e l u t t i, 1957). Od vrste *Gnophos pullata* Schiff. u tabelu je unesena i podvrsta ssp. *impectinata* Guen. koju smo, osim za sjeverni Velebit (S t a u d e r, 1929, leg. D o b i a s c h), utvrdili sada i za Bosiljevo, 25 km jugozapadno od Karlovca (coll. K o z u l i ć, Zool. muz. Zagreb), det. M l a d i n o v).

Diskusija

Od 45 navedenih planinskih vrsta Macrolepidoptera u Hrvatskoj otpada 19 vrsta na Rhopalocera, jedna na Hesperiidae, jedna na Arctiidae, 7 na Noctuidae i 17 na Geometridae. Nesrazmjer između pojedinih skupina ne znači ništa drugo nego da su danji leptiri bolje istraženi nego noćni. Od 7 evropskih porodica Rhopalocera u montanoj fauni zastupljene su 3: Papilionidae, Lycaenidae i Satyridae, među kojima glavninu predstavlja planinski rod *Erebia* sa 11 vrsta ili 24,44%. Najbogatiji vrstama roda *Erebia* je Velebit, na kojemu dolazi 9 vrsta, manjkaju samo *Erebia stirius* Godt. i *E. triaria* Prun.

Iz tabele 1. se vidi da je s montanim vrstama Rhopalocera najbrojniji Velebit, 16, za njim dolazi Gorski kotar, 10, dok svi ostali krajevi daleko zaostaju. Mali broj za Dinaru i Biokovo nema dakako nikakve realnosti, odrazuje samo posve nedovoljno sabiranje na tim planinama. Niti brojke za Heterocera nisu mjerodavne, pošto su Istru s Učkom

početkom stoljeća obrađivali austrijski lepidopterolozi, pa odatle potječe i relativno tako veliki broj od 14 vrsta. Začuđuje odakle je toliko vrsta poznato za sjeverni i srednji Velebit, čak 15, dok iz južnog ima samo 3 vrste.

Sjeverni i srednji Velebit odnose se u pogledu Rhopalocera alternativno prema južnom Velebitu: 4 vrste iz sjevernog i srednjeg nisu nađene u južnom: *E. euryale, E. epiphron, E. pronoe* i *Palaeochrysophanus candens,* ali nema 3 vrste koje nastavljaju južni Velebit: *E. gorge, E. ottomana* i *Polyommatus eros,* što pokazuje kolika je raznolikost Velebita u ekološkom pogledu. Na sjevernom je Velebitu veći broj mezofilnih vrsta, a osim toga analiza pokazuje da *P. candens,* makar je pontomediteranska oreofilna vrsta, ne dolazi ni u južnom ni u srednjem Velebitu, ali je zato brojna na više mjesta Gorskog kotara.

Najznačajnije vrste u montanoj fauni Lepidoptera Hrvatske jesu *Erebia stirius* i *E. gorge.* Jugoistočno–alpska vrsta *E. stirius* doseže na stijeni Kleka (1182 m) svoju najjugoistočniju granicu rasprostranjenja, pa je i opisana kao ssp. *kleki* (Lorković, 1955) ističući se oznakama kakove nisu poznate niti u rijetkim varijantama drugih podvrsta, a osobito svojom stenotopnošću na samu stijenu Kleka u vrlo malom broju individua i vjerojatno zbog toga i minimalnom varijabilnošću. Dugo je taj nalaz ostao osamljen dok nije nakon 25 godina prvi autor ovoga rada, prolazeći dolinom Kupe, otkrila tu vrstu najprije nedaleko Brod Moravica na samo 450 m n.v. (Mladinov, 1978), a nakon toga i u samoj dolini gornje Kupe uz cestu na strmoj, lijevoj, jugozapadno izloženoj obali i to na visini tek 245–270 m n.v. Primjerci ove populacije nisu jednaki onima sa Kleka, ali su toj podvrsti najbliži i samo se jednom osobinom približuju populacijama sa Julijskih Alpa i Karavanki. No budući da se tim oznakama, odnosno njihovim kombinacijama, razlikuju od *kleki* i tipske *stirius* opisana je ta kupska forma kao *Erebia stirius* ssp. *gorana* (Lorković, 1986).

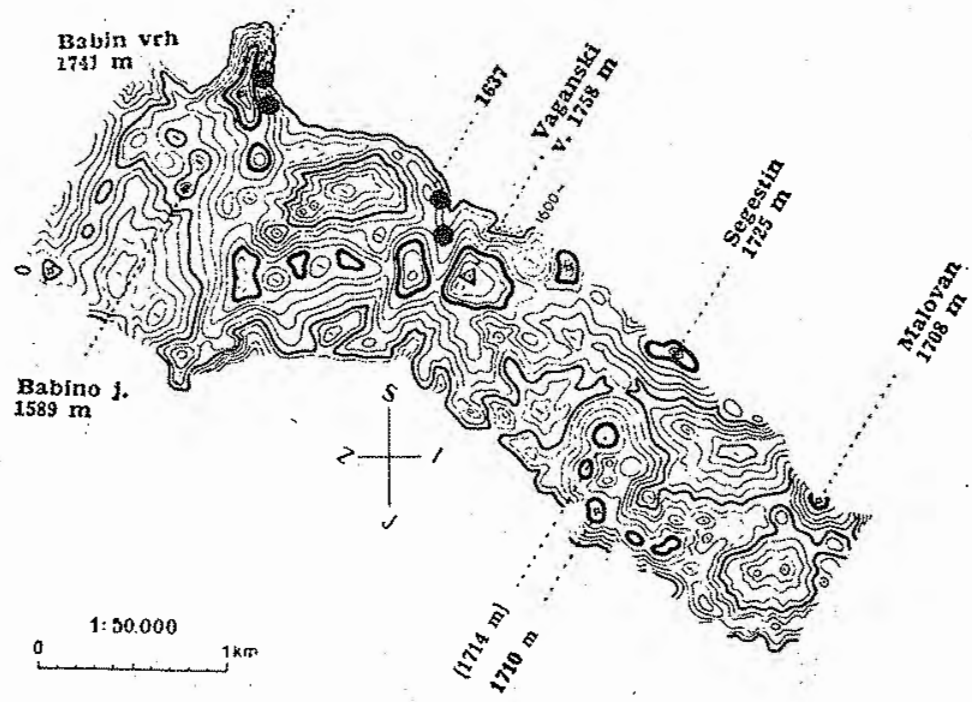
Pojava alpske vrste *E. stirius* tako nisko u dolini Kupe doimlje se manje neobično ako se znade da su u toj dolini otkrivene još druge dvije alpske vrste roda *Erebia, E. medusa* i *E. oeme.* Ta druga pojavljuje se u posebnoj luksurantnoj formi *megaspodia* (Mladinov i Lorković, 1980) i bogatoj populaciji. Osim u toj dolini nema je na okolnim brdima, a najbliža je na Zavižanu u sjevernom Velebitu.

Nisu konkretnije poznati klimatski faktori koji pogoduju opstanku tih alpskih vrsta u dnu te niske doline, ali vjerojatno je razmjerno jako noćno hlađenje i u najtoplijem dobu godine, a intenzivno zagrijavanje preko dana, što uz obilne snježne padavine može imitirati alpsku klimu na nižem nivou.

Druga značajna vrsta *E. gorge,* poznata je u Hrvatskoj samo sa Velebita i to u najvišoj zoni od Babina Kuka (1741 m) do Vaganskog Vrha (1758 m) između 1600–1700 m, kakovu visinu ne dosiže ni jedna druga planina u Hrvatskoj pa radi toga ne može predstavljati pogodne biotope za tu visoko alpsku vrstu. Na Durmitoru je donja visinska granica te vrste kod 1700 m, ali tamo ostaje još 800 m do vrha, dovoljno za preživljavanje u kriznim oscilacijama klimatskih zona. Zato je pitanje kako se je *E. gorge* mogla poslije glacijala održati u tako uskom visinskom pojasu od samo 100 m, osobito za vrijeme kseroterma. Ograničena je u malim populacijama na najhladniji sjeveroistočni gornji rub stijena i na točila (sl. 2 i 3). Trebalo bi se poput alpinista na užetu spuštati niz stijene da bi se moglo ustanoviti koliko duboko zalazi do gornjeg ruba stijena.

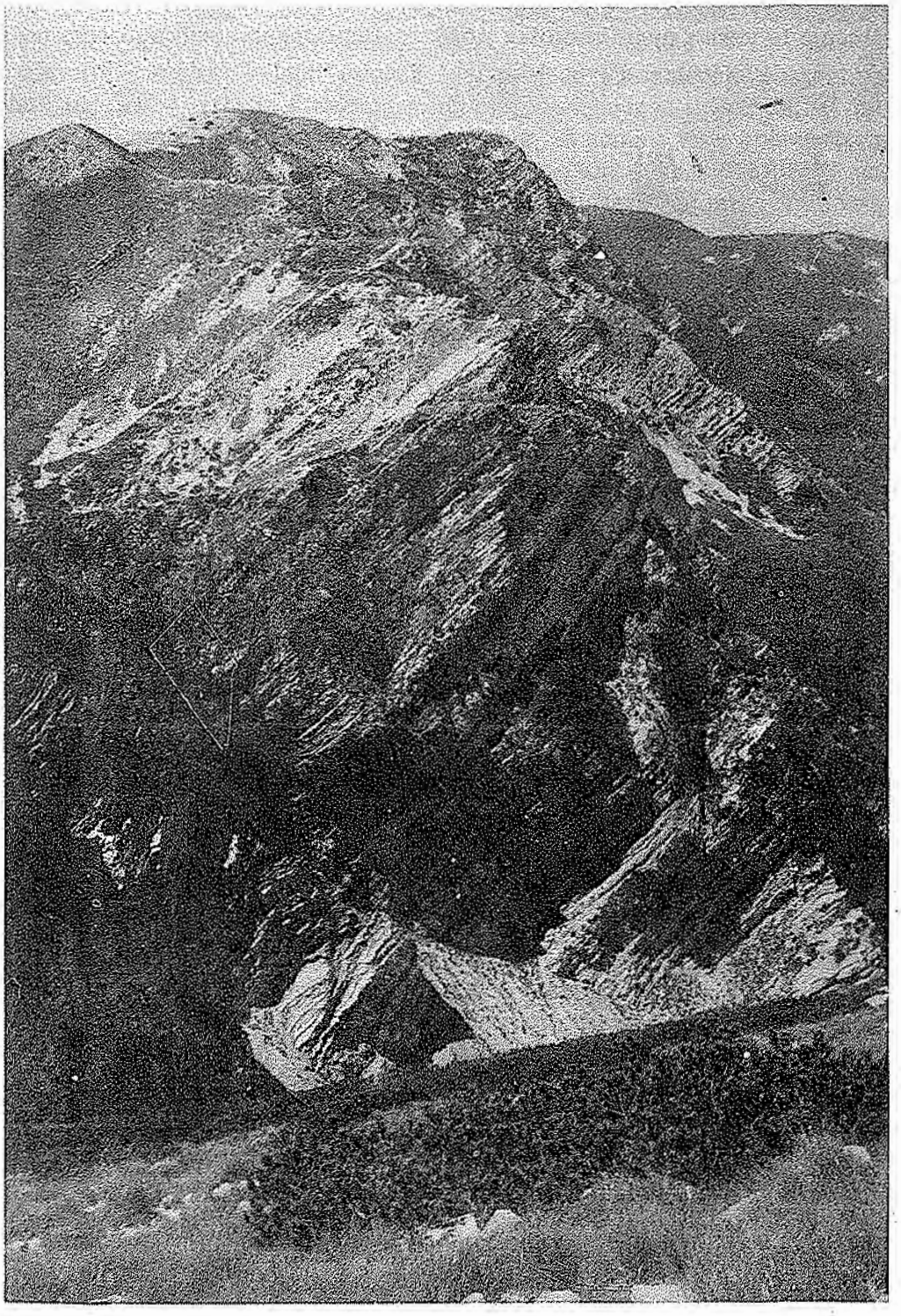
Morfološki je vrsta sličnija najbližoj alpskoj podvrsti Julijskih Alpa nego hercegovačkoj ssp. *hercegovinensis* Rebel, ali ima svoje značjke pa je opisana kao ssp. *vagana* (Lorković, 1955). Vrste nema ni na Sv. Brdu koje je samo 5 m niže od

Vaganskog Vrha, ali je sjeverna strana manje stjenovita. Vrijedilo bi bolje proučiti rasprostranjenje te vrste i njene ekološke prilike o čemu nema novih podataka od 1940. godine.



Sl. 2. Detalj lokaliteta 6: Najviši predjel Velebita iznad slojnice 1600 m s Vaganskim vrhom, 1758 m i nalazištima *Erebia gorge vagana* Lorković, 1955. (prema L o r k o v i ć, 1937).
Abb. 2. Detail der Lokalität 6: Der höchste Teil des Velebit–Gebirges, oberhalb der Schichtenlinie von 1600 M, mit Vaganski vrh, 1758 m und den Fundplätzen von *Erebia gorge vagana* Lorković, 1955 (nach L o r k o v i ć, 1937).

Kao kontrast jednoličnosti vrsta tih malih i ograničenih populacija, ističe se velikom raznolikošću *Erebia medusa,* koja je na cijelom svom širokom eurosibirskom arealu najvarijabilnija *Erebia.* Rasprostranjena je na cijelom planinskom području u dvije divergentne forme: u živo obojenoj formi s velikim očnim pjegama (ocelama) i širokim svjetlo crvenim poljima oko ocela (na Velebitu), dok su u Gorskom kotaru (Bitoraj, G r u n d, 1916) i na Bjelolasici u Velikoj Kapeli (1350–1500 m) sve oznake reducirane, nerijetko do potpunog iščezavanja, pružajući jednolično taman izgled primjeraka. Slična pojava većeg broja očnih pjega u populacijama na Velebitu ustanovljena je i za neke druge vrste leptira, a pobliže je istražena kod *Coenonympha rhodopensis occupata* Rbl. (S i j a r i ć, 1979) u vezi s različitim klimatskim uvjetima na Velebitu i središnjoj Bosni i Hercegovini. Koliko u takvoj zavisnosti aspekta leptira o vanjskim faktorima ima ulogu nasljeđe, a koliko je samo odraz fenotipske plastičnosti kao reakcija organizma na vanjske utjecaje, pokazao je slijedeći eksperiment. Potomci ženki sa Visočice u južnom Velebitu (1440–1500 m) zadržali su u laboratorijskom uzgoju sve oznake tamošnje živo obojene forme *euphrasia* Fruhst., a pod istim prilikama uzgojeni potomci leptira s Bjelolasice bili su identični s primjercima s njihova terena (nepublicirani podatak). Obje forme imaju, prema tome, karakter podvrsta. Tamna forma unutrašnjosti najviše se približava ssp.



Sl. 3. Lokaliteti *Erebia gorge vagana* Lork. na stijenama Babinog vrha, 1741 m, gledano od strane Vaganskog vrha. (Foto Z.Lorković, 1940).
Abb. 3. Flugplätze von *Erebia gorge vagana* Lork. auf den Felsen Babin vrh, 1741 M, betrachtet von der Seite des Vaganski vrh.

hippomedusa (Ochs.), dok je velebitska bila označena imenom *psodea* Hbn. (Grund, 1916), ali se ne može s njome posve identificirati, jer se samo oko 10% ekstremno razvijenih primjeraka približava toj podvrsti poznatoj samo iz jugozapadnog luka Karpata Herkulane (loc. typ.) u Rumunjskoj (Warren, 1936), pa je nađena djelomično samo još u sjeveroistočnoj Srbiji (Stol, 1156 m, Zečević i Radovanović, 1974); Rtanj, 1100 m, ♀ 27.6.1921. (Lorković). Južnije i zapadnije na Balkanskom poluotoku prelazi *psodea* u ssp. *euphrasia*, u koju se ubrajaju populacije iz Velebita i Učke, jer je bila i opisana sa Rilo planine u Bugarskoj i Učke (Monte Maggiore) u Istri (Fruhstorfer, 1917). Zapravo postoje svi prelazi između *euphrasia* i *hippomedusa* pa prevlađuje jedna ili druga prema prilikama staništa. Na osnovu statističke analize 90 primjeraka tih dviju forma, populacije Učke su brojem očnih pjega gotovo jednake velebitskim, ali zaostaju veličinom očnih pjega te širinom i intenzitetom žutocrvenih polja oko ocela. Budući da primjerci s Učke nadvisuju rastom (duž. pred. krila 22–26 mm) i gustoćom populacije sve ostale, vjerojatno su životni uslovi na Učki povoljniji pošto s jedne strane izostaju sušne periode kakve nastupaju povremeno na Velebitu, a s druge strane manja količina oborina i veća insolacija nego u Gorskom kotaru i na Kapeli, pružaju bujnošću livadske vegetacije optimalne uvjete za razvitak gusjenica i dovoljno cvatućeg bilja za leptire.

U ovom sažetom prikazu velike raznolikosti *E. medusa* u planinskom području Hrvatske ne treba zaboraviti, da u populaciji te vrste oko izvora Kupe, na cca 300 m n.v. prevlađuje mimo očekivanja tamna *hippomedusa* iako u velikim primjercima, ali 10 puta malobrojnija nego očnim pjegama bogata *E. oeme* u toj istoj dolini nedavno opisana kao ssp. *E. oeme megaspodia* (Mladinov i Lorković, 1979). Nalazišta *E. medusa* nalaze se u toj dolini nešto sjevernije nego od *E. oeme* i manje su izložena insolaciji, a među njima prolazi u smjeru istok-zapad izoterma od 16°C prosjeka za mjesece travanj do rujna (Atlas Klime SFRJ, Hočevar 1978), ali to ne može biti razlog za nejednakost varijabilnosti tih dviju vrsta *Erebia* u toj dolini.

Granice areala. U faunističkim radovima uvijek su važne granice rasprostranjenja pojedinih vrsta na istraživanom području. U našem montanom području tri su takve vrste: Lycaenida *Palaeochrysophanus candens* raširena je u planinskom pojasu od Irana preko Balkana do Gorskog kotara (Lorković i Mladinov, 1970), gdje se na liniji: Maj vrh (1269 m) – Begovo razdolje (1076 m) – Mala Višnjevica (Bašjakov vrh, 1099 m) približuje na 14 km udaljenosti od najbližih nalazišta nizinske vikariante *P. hippothoe* u dolini Kupe. Karakteristično je i nije slučajno da se na toj istoj graničnoj liniji u Gorskom kotaru sučeljava jugoistočna granica alpske *E. stirius* sa sjeverozapadnom granicom pontomediteranske orealne *P. candens*. Zato iznenađuje da je nađena na Ličkoj Plješevici, ali nije ni na srednjem niti južnom Velebitu, a na sjevernom našao ju je Gušić početkom srpnja u Skorupovu Dolcu (1100 m) južno od Oltara, odijeljenu jedva stotinjak metara širokom šumskom uzvisinom od otvorene primorske vegetacije i samo 6 km od morske obale kod Lukova.

Ova naša opažanja se podudaraju s rezultatima biljno-geografskih istraživanja na tome terenu pa citiramo S. Bertovića (1968): „Goransko–lička regija u biljno-geografskom pogledu, predstavlja područje gdje srednjeevropske alpske grupacije postižu svoju jugoistočnu granicu, a mediteranske svoju sjevernu... Kod toga Gorski kotar u potpunosti pripada eurosibirskoj regiji..."

U južnom Velebitu ima sjeverozapadnu granicu areala *E. ottomana balcanica* Rbl., koje nema više na srednjem i sjevernom Velebitu pa se tako prostorno izolirana raspoznaje

i morfološki od ostalih forma podvrste *balcanica* po posve jednolično zelenkasto ilovastoj donjoj strani stražnjih krila većine ženki, koja je u drugim populacijama na Balkanu prisutna kod manje od 50% primjeraka, pa je radi jednostavnosti označujemo kao popul. *velebitana.*

F a u n i s t i č k a k o m p a r a c i j a. Objavljivanjem „Faune Rhopalocera Durmitora" 1984. pruža se prilika za uspoređivanje jednog i drugog područja osobito Velebita. Nije nam ovdje namjera uspoređivanje sa klimatskim i geomorfološkim faktorima nego samo s obzirom na zastupljenost faunističkih elemenata. U tom pogledu oslanjamo se na zoogeografsku rasčlanjenost kako ju je V a r g a (1977) razradio za sve evropske Rhopalocere i koja vrlo jasno odražava prilike i na tom teritoriju. Za Noctuidae i Geometridae nema još adekvatne zoogeografske analize, a kako su te porodice za oba masiva još nedovoljno poznate, nisu za sada uzete u obzir.

Kod komparacije najprije se uočava da planinski prostor Hrvatske ne sadrži dvije vrste *Erebia* koje dolaze na Durmitoru *(E. cassioides, E. pandrose),* ali i Durmitoru nedostaju dvije iz zapadnih Dinarida : *E. triaria* i *E. stirius,* no tih vrsta nema ni na Velebitu, tako da jedan i drugi masiv sadrži isti broj vrsta *Erebia,* tj. 12. Ta brojčana izjednačenost je dosta neočekivana s obzirom na 765 m viši Durmitor koji bi radi područja koja se protežu na većim visinskim razlikama mogao pružiti mogućnosti opstanka još i drugim vrstama *Erebia.* No posebno treba istaći, da evroalpski i pontomediteranski orealni (oreofilni) elementi na Velebitu drže ravnotežu: 4:4, dok na Durmitoru neznatno pretežu alpski, 7:6, kao što se vidi iz tabele:

Evroalpski faunistički elementi

Species	Durmitor	Velebit
Boloria pales Schiff.	+	–
Erebia epiphron Knoch	+	+
Erebia gorge Hbn.	+	+
Erebia cassioides Hohenw.	+	–
Erebia pronoe Esp.	+	+
Erebia stirius Godt.	–	–
Erebia oeme Hbn.	+	+
Coenonympha gardetta Prun.	+	–
Ukupno:	7	4

Pontomediteranski orealni faunistički elementi

Species	Durmitor	Velebit
Colias balcanica Rbl.	+	–
Palaeochrysophanus candens H.S.	+	+
Boloria graeca Stgr.	+	–
Erebia ottomana balcanica Rbl.	+	+
Erebia melas leonhardi Fruhst.	+	+
Coenonympha rhodopensis Elw.	+	+
Ukupno:	6	4

Iako bi se zbog veće blizine pontomediteranske planinske regije očekivalo baš obratno: stanište *Erebia triaria* nalazi se tako reći u neposrednoj blizini Durmitora, a specifični balkanski endem *E. rhodopensis* susreće se već na Šar-planini, dok je Velebit naprotiv, mnogo bliži Alpama i njihovu utjecaju. Tako na historijsko–ekološkoj faunističkoj vagi Velebit i Durmitor drže ravnotežu; očigledno niža visinska razina i toplija klima Velebita pogodnije su pontomediteranskim planinskim elementima nego alpskim. Ne smije se, međutim, izgubiti iz vida da se Velebit proteže na trostruko većoj duljini nego Durmitor pa odatle proističe i mnogo veća ekološka diferenciranost velebitske faune (i flore), pošto se jednim krajem primiće Alpama, a drugim zaranja u Mediteran. Možda ne bi trebalo mnogo dodatnog terenskog rada za prikaz faune Rhopalocera i Velebita s toliko osebujnosti za zapadne Dinaride.

DODATAK

Pogrešno navedene vrste Lepidoptera u starijoj literaturi Hrvatske

Za nekadašnju Hrvatsku i Slavoniju, pa tako i za njeno planinsko područje, bilježi se u lepidopterološkoj literaturi iz kraja prošlog i početka ovog stoljeća poveći broj pogrešno navedenih vrsta kojih nema u Hrvatskoj, a većinu njih niti u Jugoslaviji. Nekoje od tih vrsta bile su prigodice već i prije ispravljene (Lorković, 1955, 1974, Mladinov, 1968, 1976, 1980), što se pokazalo nedostatno, pa su ovom prilikom popisane sve pogrešno navedene vrste, a najveće pogreške obuhvaćaju upravo planinske vrste, koje se tiču ovoga rada.

Tabelarno su navedene najprije planinske vrste, a zatim one s ostalog područja SR Hrvatske.

Pogrešno (Error)	**Ispravljeno (Recte)**
Montane vrste	
1. *Erebia melampus* Fuessl., Velebit, (Gussich, 1917)	*Erebia epiphron* Knoch
2. *Erebia nerine stelviana* Curo, Velebit (Gussich, 1917)	*E. melas leonhardi* Fruhst.
3. *Erebia meolans stygne* O., Velebit (Gussich, 1917)	*E. oeme vetulonia* Fruhst.
4. *Hesperia cacaliae* Rmb., Vinkovci, (Koča, 1901)	*Pyrgus alveus* Hbn. Visoko alpska vrsta *P. cacaliae* ne dolazi u Slavoniji, pa je najvjerojatnije zamijenjena sa *Pyrgus alveus* Hbn., koja se ne navodi u popisu.
Otok Krk (Veglia), (Stauder, 1923)	Navodno je Reverdin označio tim imenom jedan par leptira sa otoka Krka, što je mogla biti samo neka zbrka, ne tako rijetka zadnjih godina života tog glasovitog hesperidologa, ali je čudno da je Stau-

	der kao dobar poznavalac Lepidoptera mogao u taj nalaz ozbiljno povjerovati.
5. *Vacciniina optilete* Knoch Biokovo, (Mann, 1869)	Nije vjerojatno da bi se ta higro–i tirfofilna vrsta mogla održati na suhom krškom Biokovu, kada je iz Jugoslavije poznata sa 1600–2600 m NN na Šar-planini, a 1972. god. nađena na 1530 m na mezofilnom staništu na Pohorju u Sloveniji (M. Jež, 1983).

Ostali krajevi Hrvatske

6. *Euchloe belia* L. Josipdol, (Mann, 1867)	*Euchloe ausonia* Hbn., ne dolazi u granicama tadašnje Hrvatske, nego tek u Dalmaciji, ali je teško vjerovati da je bila zamijenjena sa ženkom *Anthocharis cardamines* L.?
7. *Melitaea arduina rhodopensis* Frr. Josipdol (Mann, 1867)	Ta ponto-mediteransko–turkestanska vrsta ne dolazi u Hrvatskoj, nego tek na jugu Makedonije.
8. *Melitaea partheniae* Bork., Josipdol, (Mann, 1867), Papuk, Velika, (Kočа, 1901)	Podatak nepouzdan. U doba kad se još nije dovoljno znalo za specifičko značenje genitalija, prepoznavanje nekih *Melitaea* vrsta graničilo je s lutrijom.
9. *Satyrus alcyone* D. & S., Rijeka, (Mann, 1857)	Te vrste nema u Hrvatskoj ni u Jugoslaviji. Može biti samo zabuna sa *Hipparchia fagi* Scop., jer se ne bi moglo raditi ni o *H. syriaca* Stgr., koja ne dopire sjevernije od Jablanca.
10. *Endrosa aurita* Esp., Zagrebačka gora (Vukotinović, 1879)	*Philea irrorella* Cl.
11. *Scotia fatidica* Hbn., Dalmacija (Speyer–Speyer, 1862)	? Nema pobliže oznake.
12. *Anarta melanopa* Thnbg., Zagrebačka gora (Vukotinović, 1879)	*Hadena rivularis* F.
13. *Isturga carbonaria* Cl., okolica Zagreba (Vukotinović, 1879)	*Chiasma clathrata* L.

Osim navedenih pogrešaka determinacije u tadašnjim stručnim časopisima postoji prilog fauni leptira Hrvatske pod naslovom „Fauna leptirah u okolišu zagrebačkom" od akademika Ljudevita Vukotinovića, izašla u „Radu" Jugoslavenske akademije znanosti i umjetnosti u Zagrebu za god. 1879. To je prvi rad o Kukcima uopće pisan hrvatskim jezikom s namjerom da potakne mladež „da bi se s vremenom našlo više ljubitelja ove do sada kod nas malo njegovane struke". Leptire su sabrali i većim dijelom i determinirali stranci koji su tada živjeli u Zagrebu (Gestättenbauer, Geiger, Vodnjanski, Appeldauer i, od domaćih, Vormastini). Razmjerno za ono doba je vrlo dobar i informativan opći dio od 13 stranica, dakako kompilacija nekog njemačkog priručnika koji se ne navodi, a sistematski popis je sastavljen prema Katalogu dra Staudingera. U radu je pobrojeno i opisano 445 vrsta iz 234 roda Macrolepidoptera iz okolice Zagreba i Samobora, a samo *Parnassius appolo* je iz Tuhobića, Javorja i Fužina, *Macroglossa croatica* iz južnih strana Hrvatske i još neki drugi noćni leptiri.

Razumljivo je da u takvom nepretencioznom stručnom radu ima mnoštvo neispravno opredijeljenih vrsta, pa se na pr. za okolicu Zagreba nabraja *Erebia ligea, E. medusa, E. nerine* i *E. stygne* što nisu drugo nego varijacije od *E. aethiops,* koja nije navedena, a jedina je *Erebia* zagrebačke okolice. Zatim se navode *Melanargia lachesis* (Francuska) namjesto *M. galathea* zatim *Argynnis laodice* umjesto *B. daphne, S. alcyone* namjesto *H. fagi, Pararge hiera* namjesto *P. maera* a za *Lycaena damon* se ne zna koja je to vrsta mogla biti. Najveća je pogreška *Lycaena orbitulus* L. (danas *Agriades glandon* odnosno *A. pyrenaicus)* koja se navodi za 753 m visoki Oštre u Samoborskom gorju, što je isključeno, jer je to visoko alpska vrsta, koja je u Jugoslaviji poznata samo sa Čvrsnice i Vran planine.

Od noćnih leptira (Heterocera) iz Vukotinovićevog rada ovdje su nabrojane samo planinske vrste koje se tiču ovoga rada, dok se za mnoge druge ne može utvrditi s kojom su vrstom bile zamijenjene.

Literatura

Abafi–Aigner, L., . Pável et F. Uhryk, 1896: Fauna Regni Hungariae, Budapest.
Abafi–Aigner, L., 1910: Adálaka Magyar tengernallák, Horvátország és Dalmaczia lepkefaunajához, Rovart Lapok, *17,* 71–105, Budapest.
Atlas klime SFRJ, Savezni hidrometeorološki zavod, Beograd
Burgermeister, F., 1964: Makrolepidopteren aus dem Raume Dubrovnik, Zeit. d. Wiener Entomol. Gesell., *49,* 137–152, Wien.
Carnelutti, J., 1957: Alpine petrophile Lepidopteren des Karstgebietes, Verhandl. d. Deutschen Zool. Gesell. in Graz, 506–511.
Carnelutti, J., 1973: Makrolepidopteri Triglavskoga narodnega parka in okolice III, Varstvo narave, *7,* 65–95, Ljubljana.
Forster, W. i T.A. Wohlfahrt, 1971: Die Schmetterlinge Mitteleuropas IV, Stuttgart.
Forster, W. i T.A. Wohlfahrt, 1981: Die Schmetterlinge Mitteleuropas V, Stuttgart.
Fruhstorfer, H.Altes und Neus über Erebien. Dt. ent. Z. Dresden, XXXI: 43–56.
Grund, A., 1913: Ueber neue und wenig bekannte Lepidopteren–Formen der kroatisch-slawonischen Fauna, Int. ent. Z. Guben. VII. (19): 127–128.
Grund, A., 1916: Beiträge zur kroatischen Lepidopteren–Fauna, Glasnik hrv. prirod. društva, God. XXVIII, (1–2): 95–105, (3–4): 114–168, Zagreb.
Gušć, B., 1917: Ein Beitrag zur Schmetterlingsfauna Kroatiens, Glasnik hrv. prirod. društva, God. XXIX, *3–4,* 209–225, Zagreb.
Habeler, H., 1976: Beitrag zur Lepidopterenfauna Dalmatiens, Acta entomol. Jugosl., 12, *1–2;* 67–87, Zagreb.

Hafner, J., 1910: Verzeichnis der bisher in Krain beobachteten Grosschmetterlinge, Carniola, *3,* 1, Laibach.

Higgins, L.G. i N.D. Riley, 1978: Die Tagfalter Europas und Nordwestafrikas, Hamburg u. Berlin.

Hočevar, A., 1978: Einige Grundzüge des Klimas Sloweniens. Spominski zbornik Maksa Wraberja, SAZU, 14, Ljubljana.

Koča, Gj., 1900: Prilog fauni gore Papuka i njegove okoline, Hrv. naravosl. društvo, *12,* 100–134, Zagreb.

Koča, Gj., 1901: Prilog fauni leptira (Lepidoptera) Hrvatske i Slavonije, Glasnik hrv. naravosl. društva, *13,* 1–3: 1–67, Zagreb.

Koča, Gj., 1925: Drugi i treći prilog fauni leptira (Lepidoptera) Hrvatske i Slavonije, Glasnik Hrv. prirod. društva, *16,* 1–2: 63–68, Zagreb.

Lorković, Z., 1955: Die Populationsanalyse zweier neuen stenochoren *Erebia*–Rassen aus Kroatien, Biol. glasnik, *8,* 53–76, Zagreb.

Lorković, Z. i R. Sijarić, 1967: Stupanj morfološke i ekološke diferencijacije između *Aricia agestis* Schiff. i *A. allous* Hbn. u okolici Sarajeva, Glasnik zemaljskog muz. BiH, *6,* 129–170, Sarajevo.

Lorković, Z. i L. Mladinov, 1971: Lepidoptera iz doline gornjeg toka rijeke Kupe, Acta entomol. Jugosl., *7,* 2: 65–70, Zagreb.

Lorković, Z., 1978: Komentar popisu Rhopalocera (Lepidoptera, Diurna) Jugoslavije, Acta entomol. Jugosl., *14,* 1–2: 110–113, Zagreb.

Lorković, Z., 1985: Taxonomische Differenzierung der südöstlichsten Populationen von *Erebia stirius* Godart 1825. Acta entomol. Jugosl. *21,* 1–2. 9–15.

Mann, J., 1857: Verz. der im Jahre 1853 in der Gegend von Fiume gesammelten Schmetterlinge. Wiener ent. Monatschrift, *(5.* u *6),* 139–159, 161–189.

Mann, J., 1867: Schmetterlinge gesammelt im Jahre 1866 um Josefsthal in der kroatischen Militärgrenze. Verh. zool.–bot. Ges. Wien. *17,* 63–76.

Mann, J., 1869: Lepidopteren gesammelt während dreier Reisen nach Dalmatien in den Jahren 1850, 1862 u. 1868. Verh. zool.–bot. Ges. Wien. *19,* 371–388.

Metzner, E. von, 1974: Taxonomische Bemerkungen über *Perizoma flavofasciata* (Wagner) nebst Beschreibung einer neuen Unterart, *uniformata* ssp. n. aus Jugoslawien. Ent. Tidskr. *95.* 3–4.

Metzner, E. von, 1981: *Paradrina suscianja* n. sp. (Lep., Noctuidae). Ent. scand. *12:* 403–404.

Mladinov, L., 1968: Nova istraživanja faune leptira Riječkog zaljeva I i II (Noctuidae), Rep. sekret. za priv. SRH, *1,* 5: 85–107; *1,* 7: 149–162, Zagreb.

Mladinov, L., 1974: Istraživanje faune sovica (Noctuidae) u Dalmaciji s osvrtom na štetne vrste, Rep. sekret. za privr. SRH, *2,* 1: 1–10, Zagreb.

Mladinov,L., 1975: Istraživanje faune sovice (Lepidoptera, Noctuidae) u južnoj Dalmaciji (II), Rep. sekret. za privr. SRH, *3,* 2: 27–38, Zagreb.

Mladinov, L., 1976–1980: Lepidoptera iz doline gornjeg toka rijeke Kupe, II., III., IV., Acta entomol. Jugosl., *12,* 1–2: 89–98; *13,* 1–2: 77–88; *14,* 1–2: 63–67; *16,* 1–2: 69–91, Zagreb.

Mladinov, L. i Z. Lorković, 1979: Usporedba dolinske *Erebia oeme* Hbn. ssp. nov. iz SZ Jugoslavije s planinskim populacijama (Lepidoptera, Satyridae), Acta entomol. Jugosl., *15,* 1–2: 35–54, Zagreb.

Moucha, J., 1965: Tagfalterfauna der Insel Brač (Lepidoptera), Acta Faun. Entomol. Musei Nation., Pragae, *11,* 6: 265–275, Prag.

Pável, J., 1897: Ujabb adatok Magyarország lepke–faunajához, Termeszetrajzi Füzetek, *XX,* 71–77, Budapest.

Pinker, R., 1968: Die Lepidopterenfauna Mazedoniens III., Prirod. muz. Skopje.

Rebel, H., 1904: Sistematski spisak lepidoptera (lepirova) Bosne i Hercegovine, Glasnik zemalj. muz. BiH *16,* 375–416, Sarajevo.

Sijarić, R., 1979: Sistematsko-ekološka diferencijacija među populacijama vrste *Coenonympha rhodopensis* Elwes na Balkanskom poluostrvu. Acta ent. Jugosl. Zagreb, *15* (1–2): 55–70.

Sijarić, R., Z. Lorković, J. Carnelutti i P. Jakšć, 1984: Fauna Durmitora 1. Rhopalocera (Insecta, Lepidoptera), Titograd.

Speyer, A. i A.Speyer, 1862: Die geographische Verbreitung der Schmetterlinge Deutschlands und der Schweiz, Leipzig.

Stauder, H., 1920–1923: Die Schmetterlingsfauna der illyroadriatischen Festland- und Inselzone, Zeit. f. wiss. Insektenbiol., Berlin.

Steiner, S., 1918: Die in Kroatien vorkommenden *„Erebia"* – Arten, Entomol. Jahrbuch 1918, Frankfurt/M.

Steiner, S., 1938: Die heutige Stand der Rhopalocera– und Hesperiidae–Arten für die Lepidopterenfauna Kroatiens, Entomol. Zeitschr. mit Internation. Entomol. Zeitschr., *42,* 373–375, Frankfurt a M.

Thurner, J., 1964: Die Lepidopterenfauna jugoslavisch Mazedoniens, I., Prirodonaučen muzej Skopje. Pos. izd. Nr. 1.

Uremović, V., 1974: Prilog poznavanju faune grbica (Lepidoptera, Geometridae) u okolici Rijeke, Rep. sekret. za polj.–preh. ind. i šum. SRH, *2,* 3; 33–70,Zagreb.

Varga, Z., 1977: Das Prinzip der areal–analitischen Methode in der Zoogeographie und die Faunenelemente–Einteilung der europaischen Tagschmetterlinge (Lep., Diurna). – Acta biol. Debrecina, *14,* 223–285.

Vukotinović, Lj. 1879: Fauna leptirah u okolišu Zagrebačkom, Rad. Jugosl. akad. *58,* 1–129, Zagreb.

Warren, B.C.S., 1936: Monograph of the Genus *Erebia.* British Museum. London. 1–407.

Wolfsberger, J., 1959: Die Verbreitung der boreoalpinen Grossschmetterlinge in den nördlichen Kalkalpen zwischen dem Bodensee und der Salzach, Nachrichtenblatt d. Bayer. Entomol. *VIII* Jahr., 3; 19–28.

Zečević, M. i S. Radovanović, 1974: Leptiri Timočke krajine (makrolepidoptera), Zaječar.

Zusammenfassung

DAS VORKOMMEN DER MONTANEN LEPIDOPTEREN IN DER FAUNA SR KROATIENS, JUGOSLAWIEN

Lidija MLADINOV und Z. LORKOVIĆ
Zagreb

Eine tabellarische Übersicht der in dem südwestlichen montanen Gebiet der SR Kroatien, Jugoslawien, bzw. den westlichen Dinariden vorkommenden montanen Lepidopteren mit Anführung sämtlicher in dem UG registrierten Flugplätzen mit Angaben von Ort, Meereshöhe, Fangzeit und Namen des Sammlers mit Bewährungsstelle der Sammlung. Das Gebiet ist in 8 Zonen gegliedert, deren Lage und Begrenzung aus der beigegebenen Kartenskizze ersichtlich wird.

Es werden ingesamt 45 Arten angeführt, davon 19 Rhopalocera, 1 Hesperiidae, 1 Arctiidae, 7 Noctuidae und 17 Geometridae. Die grösste Zahl der Tagfalter gehört der Gattung *Erebia,* bei welchen auch die Subspecies, soweit bekannt, angeführt werden. Die Artenzahl der Tagfalter kann als vollständig betrachtet werden, die der Nachtfalter nur sehr lückenhaft, da ein regelmässiger Lichtfang nur ausnahmsweise stattfand (M l a d i n o v, 1976 – 1984).

Die grösste Zahl der Gebirgsarten befindet sich im Velebit–Gebirge das zugleich die adriatische Meeresküste bildet, mit dem höchsten Gipfel Kroatiens, Vaganski vrh 1758 M NN. Von 10 in UG vorkommenden *Erebia*–Arten fehlen im Velebit *E. stirius* und *E. triaria.* Viele von den 25 angeführten Heteroceren zählen nicht zu den eigentlichen montanen Arten, sondern sind im UG nur häufiger oder ausschliesslich dort gefunden worden.

Der Süd–Velebit verhält sich alternativ zum mittleren und nördlichen: *E. euryale, E. epiphron, E. pronoe* und *Palaeochrysophanus candens* sind bis jetzt noch nicht im südlichen Velebit gefunden worden, *E. gorge, E. ottomana* und *Polyommatus eros* nicht in mittleren und nördlichen, was in Bezug auf das 150 Km sich von Norden nach Süden hinziehende Velebit–Gebirge nicht wundern darf.

Zwei der auffälligsten Arten des UG–es sind *Erebia stirius* und *E. gorge.* Die südostalpine *E. stirius* wurde vor 34 Jahren auf dem Felsen von Berge Klek (1182 M) in einer Form gefunden, die wegen ihrer einzigartigen Merkmale und einer ganz geringen Variabilität als ssp. *kleki* (L o r k o v i ć, 1955) gekennzeichnet wurde: Ein schmaler, bis zur A_1 reichenden rotbraunder Querband mit ständig nur 2 Apical–Augenflecken und bei den ♂♂ tief gleichmässig schwarzbrauner, bei den ♀♀ graubrauner Hfl.–Useite. Bevor *kleki* bekannt war, hielt man die ssp. *nerine* Frr. für die südlichste Unterart, mit

entsprechend heller Färbung, die keine Ähnlichkeit mit der noch südlicher auftretenden *kleki* hat. Neurlich wurde *kleki* im Talboden des Flusses Kupa zwischen 250 – 300 m NN, angetroffen (M l a d i n o v, 1978), jedoch mit Anklängen an die Nominatform aus den Julischen Alpen, von der diese Lokalform räumlich getrennt ist. und als ssp. *gorana* Lork. 1985. bezeichnet wurde.

Aus dem gleichem Tale ist unlängst in dichter Population auch die grosse, reichgeäugte *E. oeme* ssp. *megaspodia* beschrieben worden (M l a d i n o v u. L o r k o v i ć, 1979), was eine ungewöhnlich niedrig liegende Lokalität bedeutet, da *E. oeme* in der ssp. *vetulonia* Fruhst. sonst die Höhen zwischen 1300 – 1500 m am Velebit, Lička Plješevica und Dinara bewohnt. Auch die dritte Art *E. medusa,* kommt auch am Grunde des Kupatales in einer grossen, der *hippomedusa* entsprechenden Population vor, obwohl auch diese Art sonst alle Berge bis zu der Gipfelregion einnimmt. Eine befriedigende Erklärung für das recht niedrige Vorkommen der drei erwähnten Arten steht noch aus.

Die zweite nennenswerte Art des Gebietes ist *E. gorge,* die auf die höchste Gipfelregion des Velebit Gebirges um Vaganski vrh, 1758 m beschränkt ist, wo die Schmetterlinge Geröllhalden oder um die nordöstlich exponierten steilen Felswänden fliegen und bis jetzt nicht unter 1500 m gefunden wurden. Auch diese Population verdiente benannt zu werden *vagana* (L o r k o v i ć, 1955.) und steht den alpinen Tieren näher als der ssp. *hercegowinensis* Rbl.

Zu der geringen Variabilität der zwei räumlich eng begrentzten *Erebia*–Arten steht die weit verbreitete und recht variable *E. medusa* als Gegensatz. Das kühler–feuchtere Innere das UG–es (Velika Kapela, Bjelolasica 1533 M, Bitoraj 1382 m) bewohnt eine der *hippomedusa* entsprechende zeichnungsarme, im männlichen Geschlecht zuweilen eintönig braunschwarze, augenlose Form, die an den wärmeren und sonnigen Velebit und Učka (Monte Maggiore, 1398 m) durch die buntgezeichnete augenreiche ssp. *euphrasia* Fruhst. ersetzt wird. Dabei nähern sich die Populationen das südlichen wärmeren Velebit mehr der extrem bunten *psodea* als diejenigen von Učka. Dass die entgegengesetzte Variationsrichtung von *hippomedusa* und *euphrasia* klimatisch abhängig und genetisch fixiert ist, wurde durch die Labor–Zuchten unter gleichen Bedingungen der Nachkommen der Weibchen von Bjelolasica (1300 m) wie des südlichen Velebit (Visočica, 1450 – 1500 m) bestätigt. Dabei wirkt in gleicher Variationsrichtung auch die phanotypische Modifikabilität bzw. Plastizität im Sinne der Reaktionsnorm des Genotypus.

In dem montanen Gebiet Kroatiens erreicht die pontomediterranoreale Art *Palaeochrysophanus candens* und die ssp. *balcanica* von *E. ottomana* ihre nördliche Verbreitungsgrenze, *E. stirius* in der Form *kleki* ihre südliche Verbreitungsgrenze was auch mit den fitogeographischen Ergebnisen über die Verbreitung beider Arealtypen in diesem Teil der nordwestlichen Dinariden übereinstimmt. (T r i n a j s t i ć, B e r t o v i ć).

Im Vergleich mit der vor kurzem herausgegebenen Rhopalocerenfauna von Durmitor (S i j a r i ć et all., 1984) fällt ins Auge, dass es im kroatischen Montangebiet nur zwei alpine *Erebia*–Arten weniger gibt als am Durmitor *(E. cassioides, E. pandrose),* während am Durmitor *E. stirius* fehlt, was nur einen geringen Unterschied bedeutet. Überhaupt ist der relative Anteil der euroalpinen Elemente einerseits und der pontomediterran–orealen anderseits am Durmitor und Velebit sehr ähnlich (sieh Tab. p. 24.), als ob sich auf die faunistiche Zusammensetzung von Velebit kein grösserer Einfluss der alpinen Elemente als am Durmitor zeigt, obwohl derletzte Berg 300 Km südlicher liegt.

ANHANG

Unrichtig bestimmte Arten in der alteren Literatur Kroatiens

In der alteren lepidopterologischen Literatur Kroatiens vom Ende des vorigen und Anfang dieses Jahrhunderts findet man unrichtig bestimmte Arten, die hier im Anhang berichtigt werden, soweit Belegmaterial noch vorhanden oder die Fehler sonstwie festgestellt werden konnten. Auf der linken Seite der Tabelle befindet sich die unrichtige, auf der rechten die richtige Bestimmung.

Adrese autora:
Lidija MLADINOV
41000 Zagreb, Medvedgradska 48.
Prof. Dr *Zdravko LORKOVIĆ*
41000 Zagreb, III Cvjetno naselje 25.

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NOVE VRSTE MACROLEPIDOPTERA (LEP. *LEMONIIDAE, NOCTUIDAE, GEOMETRIDAE*) ZA FAUNU SR HRVATSKE

Lidija MLADINOV, Zagreb

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ABSTRACT: – *MLADINOV, L.*, Zagreb (YU). – New species of Macrolepidoptera Fauna of SR Croatia (Lep. Lemoniidae, Noctuidae, Geometridae). – Acta entomol. Jugosl., 1984, **20**, 1–2: 37 – 41. (Croat., Germ. Summ.).

Four species were reported for the continental area of Croatia for the first time. There are: *Apamea rubrirena* Tr., *Oligia versicolor* Bkh., *Hydraecia petasitis vindelicia* Frr. and *Calostigia aqueta hercegovinensis* Rbl.

The supplement works out 5 new species of Heterocera in the moth fauna of the upper Kupa–Valley. In the material collected in the year 1983–1984, one species of Lemoniidae, two of Noctuidae and Geometridae respectively as yet not found in this area were quoted. Taking into account the results of previous contributions a total of 499 species have been identified.

Lepidoptera–Lemoniidae, – Noctuidae, – Geometridae, faunistic studies, Croatia, Yugoslavia.

Objavljujemo nova nalazišta nekih rijetkih i lokalnih vrsta Heterocera, koje do danas nisu bile ustanovljene u fauni leptira Hrvatske, čime se ujedno proširuju i upotpunjuju njihovi areali. To su: *Apamea rubrirena* Tr., *Oligia versicolor* Bkh., *Hydraecia petasitis vindelicia* Frr. i *Calostigia aqueata hercegovinensis* Rbl.

U dodatnom dijelu navedena je 1 vrsta Lemoniidae, 2 vrste Noctuidae i 2 vrste Geometridae, kojima se nadopunjuje istraživanje lepidopterske faune u gornjem toku rijeke Kupe. Prema dosadašnjem proučavanju sveukupno je ustanovljeno 499 vrsta makrolepidoptera.

Apamea rubrirena Tr. (Noctuidae)

Prema Seitzu (1906) i drugim standardnim djelima areal ove alpske vrste obuhvaća Norvešku, Finsku, Čehoslovačku, švicarske Alpe, Mađarsku i Bosnu u Jugoslaviji, a Wolfsberger (1966) navodi i područje Garda jezera. Podatak za Trebević u Bosni potječe od Rebela (1904), ali ta je sovica prema Hafneru (1910) i Carnelutti-u (1973) poznata i u fauni leptira Slovenije: Mojstrana, Julijske Alpe, Nanos, Dolina Triglavskih jezera, Planina na Kraju. Ovim se podacima za

našu zemlju sada treba dodati i Vučjak, 1590 m, na sjevernom Velebitu u Hrvatskoj, gdje je ta vrsta ulovljena 22.7.1982, 2 ♂♂ (leg. Perović, det. Mladinov). Kako nema drugih podataka u pregledanoj lepidopterskoj literaturi za Hrvatsku, smatramo spomenuti lokalitet kao prvi nalaz sovice *A. rubrirena* u Hrvatskoj. Ovim se podacima te planinske vrste u Jugoslaviji povezuje njena rasprostranjenost prema navedenim susjednim zemljama.

Za ovu lokalnu i rijetku vrstu Forster i Wohlfahrt (1971) navode da se nominatna forma javlja u Alpama od 1000 m do 2300 m, dok je u Schwarzwaldu zastupljena forma f. *abnoba* Guth., u Harzu f. *hercyniae* Stgr., a Krampel i Levy (1974) u svom radu napominju da populacije južne Čehoslovačke pripadaju podvrsti ssp. *asciburgensis* Koch. Navedenim je formama bitna morfološka oznaka habitusa izražajni crtež boja u raznim varijantama (bijela, žuta, svijetlo žutocrvena) na crnosmeđoj temeljnoj podlozi. Budući da su primijećena vidljiva odstupanja kod ulovljenih primjeraka na Velebitu, to će specifička morfološka razlika biti drugom prilikom iscrpnije proučena, kada bi mogao biti poznat veći broj primjeraka.

Oligia versicolor Bkh. (Noctuidae)

Areal ove euroazijske vrste (Dufay, 1976) obuhvaća u Evropi prema Boursinu (1970) Španjolsku, Francusku, Italiju i Austriju. Međutim, u novije vrijeme navode Fazekas (1978–1981) i Uherkovich (1978) ovu vrstu za Mađarsku, dok je u južnoj Evropi poznata i iz Jugoslavije još od 1955. godine, premda u navedenim publikacijama to nije nigdje označeno. Naime, Carnelutti i Michieli (1955) navode pod imenom *Miana versicolor* Bkh. *(Procus versicolor)* lokalitete Kamnik i Krvavec za Sloveniju, a Zečević i Radovanović (1974) spominju nekoliko nalaza za Timočku krajinu u Srbiji. Iako je u Makedoniji fauna leptira u novije vrijeme najbolje istražena, o toj vrsti nema podataka (Thurner, 1964). Godine 1974. taj je specijes ulovljen i u zapadnom dijelu Like u Hrvatskoj: Lička Plješevica 9.8.1974, 2 ♂♂, 1♀ (leg. K. Igalffy, det. Mladinov).

O. versicolor je u mnogim zbirkama ostala anonimna unutar drugih vrsta roda *Oligia* s obzirom na njihovu morfološku sličnost, te se može sa sigurnošću odrediti jedino pretragom genitalnih organa, pogotovo ako se u obzir uzme ne mala individualna varijabilnost. Iz tih je razloga izvršena revizija materijala *Oligia* vrsta u Zoološkom muzeju u Zagrebu. Nakon pregledanih 75 primjeraka vrste *O. latruncula* Schiff. i 56 primjeraka vrste *O. strigilis* L. (čiji podaci datiraju od 1900. godine sve do današnjih dana), specijes *versicolor* utvrđen je samo kod leptira ulovljenih na Ličkoj Plješivici. Determinacija je provjerena prema strukturi genitalnih organa prikazano na slici u radu Forstera i Wohlfahrta (1971) te Fazekasa (1978).

Otkriće ove sovice na Ličkoj Plješivici bio bi za sada i jedini podatak u fauni Noctuidae Hrvatske, stojeći između nalazišta u Sloveniji i onih u istočnoj Srbiji.

Hydraecia petasitis vindelicia Frr. (Noctuidae)

Hydraecia petasitis Dbl. pripada euroazijskom arealnom tipu, čiji su pobliži prikaz geografske rasprostranjenosti dali Nordström–Kaaber et all. (1969) i Prola

– P r o v e r a et all. (1977) i to: Švedska, Finska, Danska, Velika Britanija, Francuska, Njemačka, Švicarska, Austrija, Mađarska, Čehoslovačka, Rumunjska, Italija i Altaj. U ovaj se areal mora dodati i Jugoslavija u kojoj prvi podatak te lokalne i rijetke vrste datira unazad 70 godina, jer H a f n e r (1910) navodi 1 ♀ za Kamnik u Sloveniji. Premda je lokalitet (Stein ?) označen znakom pitanja prema saopćenju J. C a r n e l u t t i - a nalaz se može smatrati ispravnim. K tome dolazi i sada ulovljen leptir na Ličkoj Plješivici, 1200 m, 28.7.1982, 1 ♂ (leg. K. I g a l f f y, det. M l a d i n o v) kao i 1 primjerak u Koprivnici (K r a n j č e v, 1981) pa *H. petasitis* predstavlja novu vrstu u fauni leptira Hrvatske.

F o r s t e r i W o h l f a h r t (1971) napominju da tipični *petasitis* dolazi u Velikoj Britaniji, dok je u srednjoj Evropi zastupljena podvrsta ssp. *vindelicia,* koju za južnu Bavarsku navodi V o l f s b e r g e r (1974). Leptiri ove podvrste su veći, imaju izražajniji crtež i purpurniju temeljnu boju krila te prema ovim morfološkim karakteristikama mogli smo i primjerak s Ličke Plješivice uvrstiti u taj subspecies.

S obzirom na sličnost među vrstama *H. petasitis* Dbl. i *H. micacaea* Esp., kod determinacije obratili smo pažnju na vanjske oznake habitusa po kojima se obje vrste mogu razlikovati, a za komparaciju poslužio je materijal iz zbirke Zoološkog muzeja u Zagrebu: *H. micacaea* – Ross. m. 1887 (coll. L o c k e), Steinitz VIII.1904, IX.1905 (coll. I. I g a l f f y) te *H. xanthenes* Guen. – Sicilija 1892 (coll. L o c k e).

Prema iznesenim podacima vidljivo je da je ta rijetka sovica bila do sada u Jugoslaviji poznata jedino u Sloveniji, a lokalitet Lička Plješivica može se za sada označiti kao najjužnija točka njenog areala, jer je *H. petasitis* u Italiji zabilježena jedino za Olgiate, koji po svom geografskom položaju leži sjevernije od nalaza u Hrvatskoj.

Calostigia aqueata hercegovinensis Rbl. (Geometridae)

Calostigia aqueata Hbn. je izrazita planinska petrofilna grbica, koja nastavlja pretežno alpsku zonu i ujedno pripada alpskom arealnom tipu. Njezin areal obuhvaća planinske sisteme srednje i djelomično južne Evrope (S e i t z, 1915; B l e s z y n s k i, 1965). Ovu su vrstu u Jugoslaviji zabilježili u Sloveniji na Snežniku (Črni Dol, 1100 m) C a r n e l u t t i (1957), u Bosni na Trebeviću, 1628 m, R e b e l (1904) i u Makedoniji na Pelisteru, 2600 m, P i n k e r, (1968).

Karakteristična morfološka oznaka nominatne forme je zeleni ton temeljne boje prednjih krila, koji je otsutan u primjeraka podvrste ssp. *hercegovinensis* Rbl. Taj je subspecies do sada bio zabilježen za Bosnu i Hercegovinu: Kalinovik, Bjelašnica 1867 m, Prenj 1785 m, Vran pl. 2074 m i Orjen 1895 m (R e b e l, 1904), zatim Žljeb 1700 m u Crnoj Gori (R e b e l, 1917) i na Popovoj Šapki 1800 m u Makedoniji (M i c h i e l i, 1963). Sada je *C. aqueata hercegovinensis* utvrđena i u Hrvatskoj za Velebit. Leptir je ulovljen na Vučjaku, 1590 m, 22.7.1982, 1 ♀ (leg. P e r o v i ć, det. M l a d i n o v). Primjerak je prema morfološkim oznakama (bez primjese zelenog tona u temeljnoj boji prednjih krila) mogao biti određen kao ssp. *hercegovinensis,* dok je specifička pripadnost provjerena i prema građi genitalnog organa prema ključu za određivanje Geometridae (B l e s z y n s k i, 1965). Ulov leptira na Vučjaku ima zapravo dvostruko značenje. Prvo, njime se prvi ut potvrđuje prisustvo vrste u fauni grbica Hrvatske, a pored toga taj se lokalitet može za sada označiti kao najzapadnija točka u arealu ssp. *hercegovinensis* u našoj zemlji.

DODATAK

U toku 1983–1984. godine utvrdili smo u gornjem toku rijeke Kupe još slijedećih 5 vrsta Heterocera, koje nisu bile do danas navedene u radovima o lepidopterskoj fauni istraživanog područja. To su:

1. *Lemonia taraxaci* Esp. – Osilnica 31.8. i 1.9.1984.
2. *Gortyna flavago* Schiff. – Osilnica 23.9.1983.
3. *Dasycampa erythrocephala* Schiff. – Osilnica 22.9.1983.
4. *Puengeleria capreolaria* Schiff. – Hrvatsko 23.9.1983.
5. *Ennomos autumnaria* Wrnbg. – Osilnica 22.9.1983.

Literatura

Bleszynski, S., 1965: Klucze do oznaczania owadów Polski, zeszyt 46 b, Warszawa.
Boursin, Ch., 1970: Neue Funde von interessanten Noctuiden–Arten in Europa. Nachrichtenbl. d. Bayer. Entomol., **18**, 4–6, Munchen.
Carnelutti, J. in Š. Michieli, 1955: Prispevek k favni lepidopterov Slovenije, Biol. vestn. **4**, 43–55, Ljubljana.
Carnelutti, J., 1957: Alpine petrophile Lepidopteren des Karstgebietes. Verhandl. d. Deutschen Zool. Gesell. in Graz, 506–511.
Carnelutti, J., 1973: Makrolepidopteri Triglavskega narodnega parka in okolice III. Varstvo narave, **7**, 65–95, Ljubljana.
Dufay, Cl., 1976: Liste systématique des Lépidoptères Noctuidae de France et de Belgique. Bull. C.L.B. /B.L.K., **V**, 6, 1976; **VI**, 1, 2, 1977. Lyon.
Fazekas, I., 1978: Analyse taxonomique et zoogéographique d' *Oligia versicolor* Bkh. (Lepidoptera: Noctuidae). Fol. entomol. Hung., **31**, 2: 151–156.
Fazekas, I., 1981: Die Gattung *Oligia* Hb. in der Lepidopterensammlung des Ungarischen Naturwissenschaftlichen Museums, Budapest, I. (Lepidoptera: Noctuidae). Fol. entomol. Hung., **XLII** (XXXIV), 2: 61–63.
Forster, W. und A. Wohlfahrt, 1971: Die Schmetterlinge Mitteleuropas, IV. Stuttgart.
Hafner, J., 1910: Verzeichnis der bisher in Krain beobachteten Gross–Schmetterlinge. Carniola, **2**, Laibach.
Krampel, F. i J. Ley, 1974: Prispevek k poznani fauny čeledi Noctuidae (Lepidoptera) južnich Čech. Acta sci. nat. Mus. Bohem. merid. Česke Budejovice, **14**, 113–127.
Kranjčev, R., 1981: Odnos faune Macrolepidoptera prema prirodnim i antropogenim faktorima Podravine i Podr. pijesaka. Disertacija.
Michieli, S., 1963: Beitrag zur Kenntnis der Makrolepidopterenfauna Mazedoniens (SR Makedonija). Acta mus. Maced. scientiar. nat., **9**, 2: 15–31, Skopje.
Nordström, F., S. Kaaber, M. Opheim et O. Sotavalta, 1969: De Fennoskandiska och Danska nattflynas utbredning (Noctuidae), Lund.
Pinker, R., 1968: Die Lepidopterenfauna Mazedoniens, III. Geometridae. Prirodonauč. muz. Skopje, **4**, 1–71, Skopje.
Prola, C., P. Provera, T. Racheli e V. Sbordoni, 1977: Macrolepidotteri dell' Appennini centrale, Noctuidae. Boll. d. Entomol., Vol. (1977), 1–4, **32**, Roma.
Rebel, H., 1904: Studien über die Lepidopterenfauna der Balkanländer, II. Bosnien und Herzegowina. Ann. des k.k. Naturh. Hofmus., **19**, 2–3: 97–377, Wien.
Rebel, H., 1917: Lepidopteren aus Neumontenegro, Sitzungsberich., Abt. I, 125 Bd., p. 765–813, Wien.
Seitz, A., 1906, 1915: Die Gross–Schmetterlinge der Erde. **3**, **4**, Stuttgart.
Thurner, J., 1964: Die Lepidopterenfauna jugoslavisch Mazedoniens, I. Skopje.
Uherkovich, A., 1978: Makrolepidopteren der Mecseker Flaumbuscheinchenwälder (Lepidoptera). Janus Pann. Muz. Evk. (1977), **22**, 61–72, Pecs.
Wolfsberger, J., 1974: Neue und interessnate Makrolepidopterenfunde aus Südbayern und den angrenzenden Nördlichen Kalkalpen. Nachrichtenbl. d. Bayer. Entomol., **23**, 3: 33–56.
Zečević, M. i S. Radovanović, 1974: Leptiri Timočke krajine (makrolepidoptera). Zaječar.

Acta entomol. Jugosl., Vol. 21, 1985, 1–2: 37–41.
MLADINOV, L.: Nove vrste Macrolepidoptera... u SRH

Zusammenfassung

NEUE MACROLEPIDOPTEREN–ARTEN *(LEMONIIDAE, NOCTUIDAE, GEOMETRIDAE)* IN DER FAUNA S.R. KROATIENS

L. MLADINOV
Zagreb

In Kroatien sind 4 weitere bemerkenswerte neuerlich festgestellte Heterocera–Arten bearbeitet worden. Dies sind: *Apamea rubrirena* Tr., *Oligia versicolor* Bkh., *Hydraecia petasitis vindelicia* Frr. und *Calostigia aqueata hercegovinensis* Rbl.

Zur Ergänzung werden noch 4 nachträglich gefundene Schmetterlingsarten des oberen Kupatales besprochen. Die 2 Noctuidae– und 2 Geometridae– Arten stellen die Fortsetzung der Makrolepidopteren Fauna im Forschungsgebiet dar, die in der Zeitschrift „Acta Entomologica Jugoslavica" veröffentlicht wurde.

1. *Apamea rubrirena* Tr. (Noctuidae) war bis jetzt in Jugoslawien aus Bosnien und Slowenien bekannt, wie dies aus den Arbeiten von Rebel (1904), Hafner (1910) und Carnelutti (1973) hervorgeht. Im vergangenen Jahr wurde die Art in zwei ♂♂ Stücken am Vučjak, 1590 MH, Velebit–Gebirge, in Kroatien am 22.7.1982 gefunden, was den Erstfund dieser Art für Kroatien bedeutet. Diese alpine, lokale und seltene Art kommt nach Forster–Wohlfahrt (1971) als typische *rubrirena* in den Alpen vor, im Harz die f. *hercyniae* Stgr., im Schwarzwald f. *abnoba* Guth., während die Population in den Süd–Tschechoslowakei nach Krampel–Levy (1975) zu der Unterart ssp. *asciburgensis* Koch gehört. Das vorliegende Material, 2 ♂♂ ist aber mit den typischen und erwähnten Formen nicht ganz identisch, deswegen wird es an anderer Stelle näher beschrieben und abgebildet.

2. *Oligia versicolor* Bkh. (Noctuidae) wurde am 9.8.1974 an Lička Plješivica gefunden, was den Erstfund der Art für Kroatien bedeutet. Die Art wurde sonst in Slowenien (Carnelutti–Michieli, 1955) und in Serbien (Zečević–Radovanović, 1974) festgestellt. Da das äussere Aussehen der einzelnen *Oligia*–Arten weitgehend ähnlich ist, wozu noch eine erhebliche individuelle Variabilität zukommt, musste man sich immer auf die Untersuchung der Genitalien stützen. Nach der Revision der Arten *Oligia latruncula* Schiff., 75 Exemplare, und *Oligia strigilis* L., 56 Exemplare, in den Sammlungen des Zoologischen Museums in Zagreb, entfielen auf *O. versicolor* nur einige Schmetterlinge von Lička Plješivica.

3. *Hydraecia petasitis vindelicia* Frr. (Noctuidae) ist als eine neue Eule für Kroatien auf Grund des Materials aus dem Zoologischen Museum in Zagreb, festgestellt worden. Sie war bis jetzt in Jugoslawien nur aus Slowenien bekannt, wie dies aus den Arbeiten von Hafner (1910) hervorgeht. Hafner endeckte die Art am Kamnik und dazu kommt jetzt der Fang dieser Art in Kroatien: Lička Plješivica und Koprivnica in Podravina (Kranjčev, 1981), welche die ersten Funde dieser Art in Kroatien sind.

Die typische *petasitis* kommt in England vor (Forster–Wohlfahrt, 1971) und die grössere, mehr purpurgrau und kräftiger gezeichnete ssp. *vindelicia* Frr. in Mitteleuropa, was jetzt auch fur Südeuropa gilt. Der Fund Lička Plješivica ist die bis jetzt südlichste Lokalität dieser lokalen Art, da die nächste Fundstelle dieser Eule in Nord Italien, Olgiate (Prola–Provera et all, 1977) liegt.

4. *Calostigia aqueata hercegovinensis* Rbl. (Geometridae) die seit langem aus Bosnien und Herzegowina (Rebel, 1904) bekannt ist, wurde später auch in Crna Gora (Rebe 1917) und Mazedonien (Michieli, 1963) entdeckt. Der jetzige Fundplatz in Kroatien, Vučj . 22.7.1982, 1 ♀ Velebit–Gebirge, ist die westlichste Lokalität dieser Unterart in Jugoslawien.

Im Anhang werden 5 Heterocera – Arten von nachträglich im oberen Kupatal gefundenen Schmetterlingen angeführt. Die Arten stellen die Forsetzung der Macrolepidopteren Fauna des erwähnten Gebietes dar. Dies sind: *Lemonia taraxaci* Esp., *Gortyna flavago* Schiff., *Dasycampa erythrocephala* Schiff., *Puengeleria capreolaria* Schiff. und *Ennomos autumnaria* Wrngb.

Insgesamt sind 499 Arten bekannt.

Adresa autora:
Lidija MLADINOV,
41000 Zagreb, Medvedgradska 48

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STUDIES ON ERIOPHYID MITES (ACARIDA: *ERIOPHYOIDEA*) OF YUGOSLAVIA, I.

Radmila PETANOVIĆ
Beograd–Zemun

Received: 20.9.1984.

ABSTRACT. – *Radmila PETANOVIĆ*, Fac. of Agric., Beograd–Zemun, YU. – Studies on eriohyid mites (Acarida: Eriophyoidea) of Yugoslavia. Acta entomol. Jugosl., 1985, **21**, 1–2: 43–48. (Engl., Serbo–croat. summ.).

Five species of Eriophyoidea are discussed. Four of them are new for Yugoslavia. Taxonomic position of *Aculops eximius* (L i r o), *Aculops centaureae* (F a r k a s) and *Aculops clinopodii* (L i r o) is corrected.

Acariformes–Prostigmata, Eriophyoidea, taxonomy, faunistic studies, Yugoslavia

Aceria marginemvolvens (Corti) (Fig. 1.)

D e s c r i p t i o n: Female 166 μm long, 61 μm wide, wormlike. Dorsal shield 30 μm long, dorsal tubercle 18 μm apart, dorsal setae 52 μm long. Rostrum 24 μm long. chelicerae 16 μm long. Featherclaw 5–rayed. Hysterosoma with about 73 microtuberculated rings. Epigynium 20 μm wide, 12 μm long with 12 longitudinal ribbs. Setae accessoriae present.

H o s t p l a n t: *Artemisia vulgaris* L. (Asteraceae)

C o l l e c t e d: 30.09.1981., Beograd by Slobodanka Lazić.

M a t e r i a l: 4 slides ♀♀

D i s c u s s i o n: This species was described for the first time by C o r t i 1910 as a leaf roller of *Artemisia vulgaris* L. It was desribed under the name *Eriophyes marginemvolvens*. Besides Italia it was also find in Finland (L i r o, 1941) and Sweden (R o i v a i n e n, 1950). On the same host plant C a n e s t r i n i (1892) described *Phytoptus artemisiae* and it was found in Poland (B o c z e k, 1961; S z u l c, 1966), Austria (N a l e p a, 1929) and Finland (L i r o & R o i v a i n e n, 1951).

In Yugoslavia it was registrated in cecidological papers (J a n e ž i č, 1974, 1976a, 1976b, 1977, 1982), but newer described or drawn.

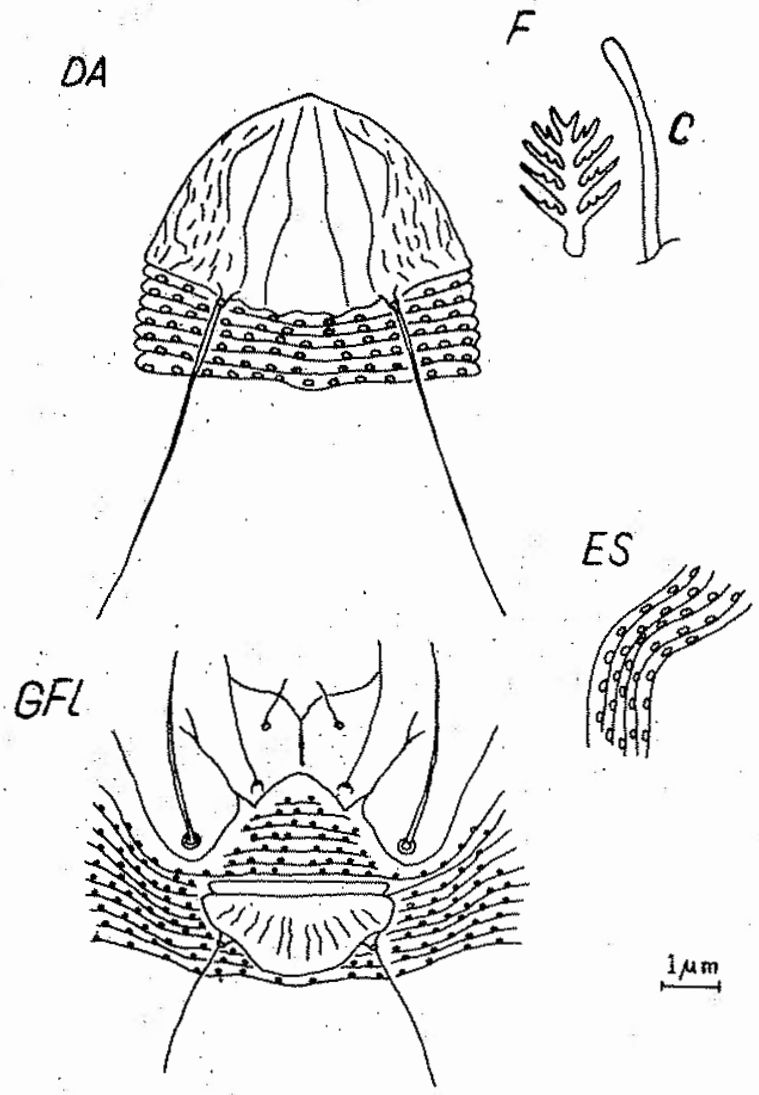

Fig. 1. DA–dorsal shield, F–featherclaw, C–claw, ES–lateral surface, GFl–female genitalia and coxae.

Aceria heimi (Nal.) (Fig. 2.)

Description: Female 154 µm long, 61 µm wide, wormlike. Dorsal shield 24 µm long, dorsal tubercle 22 µm apart, dorsal setae 48 µm long. Rostrum and chelicerae 20 µm long. Featherclaw 5–rayed. Hysterosoma with about 73 microtuberculated rings. Epigynium 21 µm wide and 14 µm long with 10 longitudinal ribbs. Setae accessoriae present.

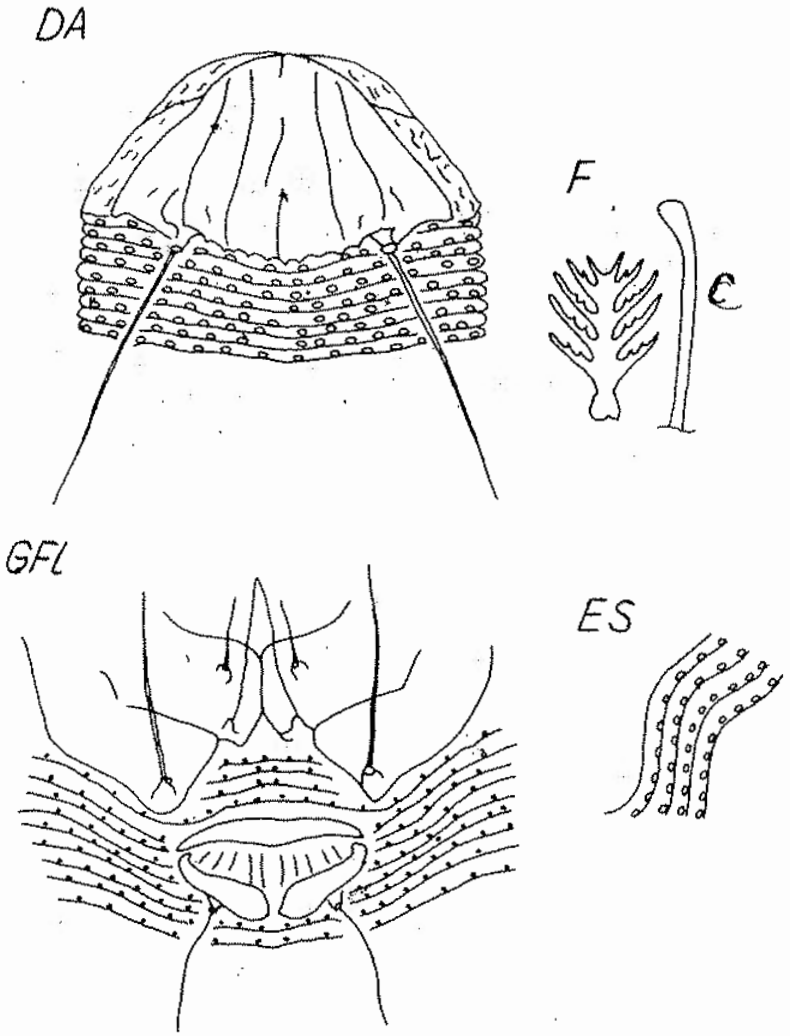

Fig. 2.

Host plant: *Atriplex hastata* L. (Chenopodiaceae).
Collected: 2.10.1981., Beograd by Slobodanka Lazić.
Material: 4 slides, ♀♀

Discussion: Nalepa 1899 described it for the first time as *Eriophyes heimi*– flower deformation and erineum mite (Newkirk, 1982). Besides Austria it was also found in Hungary by Farkas (1965), who put it in genus *Aceria.*

Aculops eximius (Liro) comb. n. (Fig. 3.)

Description: Female 214 μm long, 73 μm wide, fusiform. Dorsal shield 48 μm long, dorsal tubercle 24 μm apart, dorsal setae 44 μm long. Featherclaw 7–rayed.

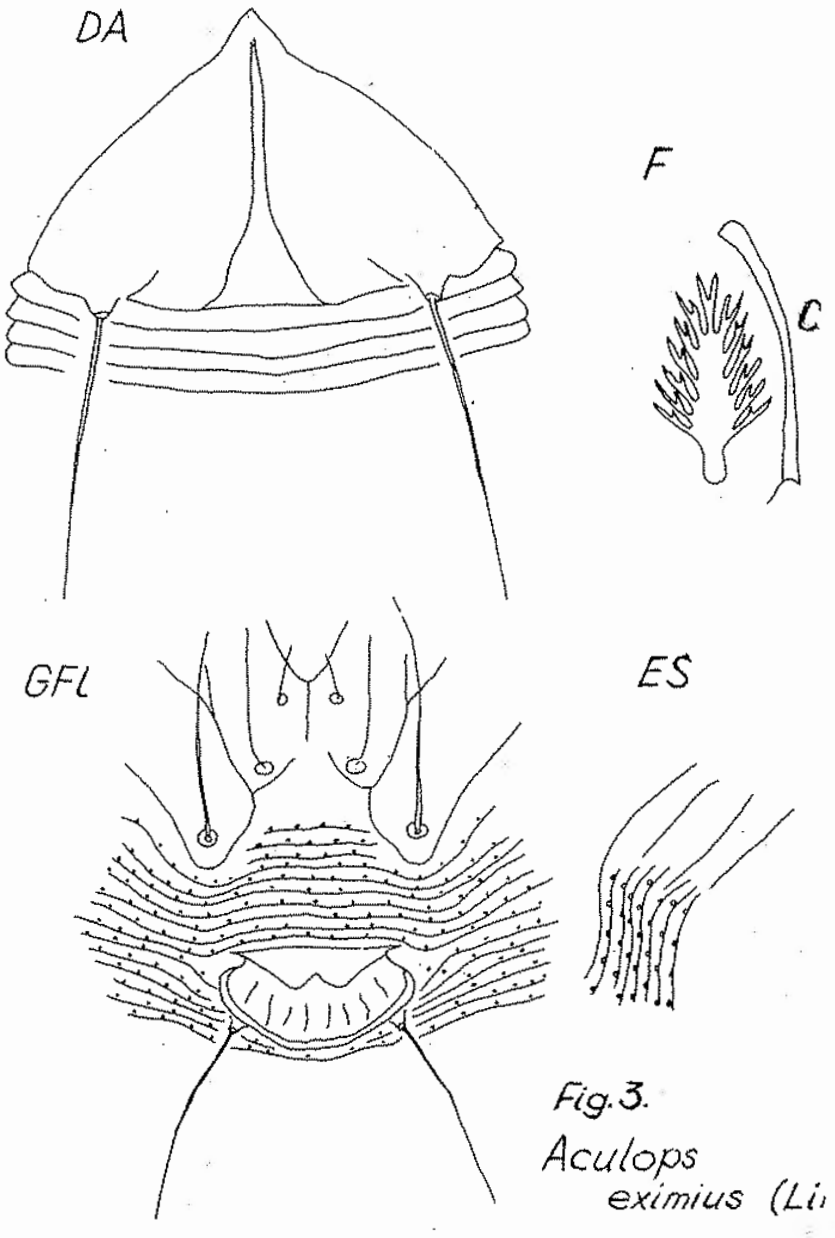

Fig. 3.

Hysterosoma with about 41 smooth terites and about 72 microtuberculated sternites. Epigynium 20 μm wide, 16 μm long, with 8 longitudinal ribbs. Setae accessoriae present.

Host plant: *Trifolium pratense* L. (Fabaceae).

Collected: 14.10.1981., Beograd, by Slobodanka Lazić.

Material: 4 slides, ♀♀

Discussion: Liro (1941) described this species for the first time as *Phyllocoptes eximius,* but he didn't drew it. This species was found on *Trifolium medium* L., *T. arvense* L. and *T. hybridum* L. Roivainen (1950) put it in genus *Vasates.* Up to now it is known only from Finland. According to Newkirk & Keifer key (1975) we decided to put it in genus *Aculops* (Petanović et al., 1983).

Aculops centaureae (Farkas) comb. n.

Description: Female 178 μm long, 74 μm wide, fusiform. Dorsal shield 36 μm long, dorsal tubercle 22 μm apart, dorsal setae 38 μm long. Rostrum 20 μm long, chelicerae 16 μm long. Featherclaw 6–rayed. Hysterosoma with 38 smooth tergites and about 66 microtuberculated sternites. Epigynium 24 μm wide, 16 μm long with 10 longitudinal ribbs. Setae accessoriae present.

Host plant: *Inula britanica* L. (Asteraceae).
Collected: 30.09.1981., Beograd by Slobodanka Lazić.
Material: 6 slides, ♀♀

Discussion: Farkas (1960) described for the first time this species as *Vasates centaureae* on *Centaurea* ssp. It was known only from Hungary and Bulgaria (Davis et al., 1982).

Aculops clinopodii (Liro) comb. n.

Description: Female 166 μm long. 60 μm wide, fusiform. Dorsal shield 44 μm long, dorsal tubercle 32 μm apart. Dorsal setae 14 μm long. Rostrum 28 μm long, chelicerae 21 μm long. Featherclaw 4–rayed. Hysterosoma with 28 smooth tergites, and about 60 microtuberculated sternites. Epigynium 22 μm wide, 17 μm long with 6 longitudinal ribbs. Setae accessoriae present.

Host plant: *Prunella vulgaris* L. (Lamiaceae).
Collected: 17.10.1981., Beograd. by Slobodanka Lazić.
Material: 3 slides, ♀♀

Discussion: This species was described for the first time by Liro (1941) as vagrant on *Satureja vulgaris* (L.) under the name *Phyllocoptes clinopodii.* It was also known from Sweden (Roivainen, 1950). Roivainen (1951) put it in genus *Vasates.* We decided to put it in genus *Aculops* according to new taxonomy of eriophyid mites (Newkirk & Keifer, 1975).

Materials are deposited at the Department of Applied Entomology, Agricultural University of Beograd.

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References

Boczek, J., 1961: Badania nad roztoczami z rodziny Eriophyidae (szpecielowate) w Polsce. I Prac. IOR, Poznan, 3: 5–85.

Canestrini, G., 1892: Prospetto dell' Acarofauna Italiana. Parte Va. Famiglia die Phytoptini (Phytoptidae). Atti Soc. Veneto–Trentina Sci. Nat. **1**: 541–722.

Corti, A., 1910: Le Galle della Valtelliana. Terzo contributo alla conoscenza della Cecidologia Valtellianese. Atti Soc. Ital. Sci. Nat. **49**: 297–354.

Davis, R., C. Flechtman, J. Boczek & H. Barke, 1982: Catalogue of Eriophyid Mites (Acari: Eriophyoidea). Warsaw Agricultural University press, pp. 254.

Farkas, H.K., 1960: Ueber die Eriophyiden (Acarina) Ungarns. I. Beschreibung neuer und wenig bekannter Arten. Acta Zool. Acad. Sci. Hungar. **7**: 73–76.

Farkas, H.K., 1965: Spinnentiere, Eriophyidae (Gallmilben). Die Tierwelt Mitteleuropas. **3**: 1–155.

Janežič, F., 1974: Četvrti prispevek k poznanju živalskih šišk (zoocecidijev) na rastlinah v Sloveniji. Zbornik biotehniške fakultete Univerze v Ljubljani, **23**: 75–97.

Janežič, F., 1976a: Šesti prispevek k poznanju živalskih šišk (zoocecidijev) na rastlinah v Sloveniji. Zbornik biotehniške fakultete Univerze v Ljubljani, **26**: 61–90.

Janežič, F., 1976b: Sedmi prispevek k poznanju živalskih šišk (zoocecidijev) na rastlinah v Sloveniji. Zbornik biotehniške fakultete Univerze v Ljubljani, **28**: 131–160.

Janežič, F., 1977: Nekaj zoocecidijev na rastlinah vzhodnega dela Jugoslavije. Zbornik biotehniške fakultete Univerze v Ljubljani, **30**: 115–130.

Janežič, F., 1982: Trinajsti prispevek k poznanju živalskih šišk (zoocecidijev) na rastlinah v Sloveniji. Zbornik biotehniške fakultete Univerze E.K. v Ljubljani, **39**: 95–143.

Keifer, H.H., 1969: Eriophyid studies C–3, ARS–USDA, 1–24.

Liro, J.I., 1941: Über neue und seltene Eriophyiden (Acarina). Ann. Zool. Soc. Zool. Bot. Fenn., Vanamo **8**: 1–54.

Liro, J.I. & H. Roivainen, 1951: Akamapunkit Eriophyidae–Suomen Elaimet. Anim. Fenn. **6**: 1–281.

Newkirk, R.A.M., 1982: The Eriophyid mites of Alfred Nalepa. pp. 196 (in press).

Newkirk, R.A. & H.H. Keifer, 1975: Synoptic keyes to groups and genera. Eriphyoidae. **In**: Jeppson, L.R., H.H. Keifer & E. W. Baker, Mites injurious to economic plants. Univ. Calif. Press. 562–578.

Petanović, R., K. Dobrivojević, J. Boczek i S. Lazić (1983): Eriofidne grinje (Eriophyoidea, Acarina) na korovskim biljkama u okolini Beograda. Arhiv za polj. nauke **44**, 156 (1983/4), 455–460.

Roivainen, H., 1950: Eriophyid news from Sweden. Acta Entomol. Fenn. **7**: 1–51.

Roivainen, H., 1951: Contribution to the Knowledge of the Eriophyidae of Finland. Acta Entomol. Fenn. **8**: 1–70.

Szulc, W., 1966: Gall mites (Eriophyoidea) of Lodz Upland. Zesz. Nauk. Univ. Lodz II **21**: 27–55.

Sažetak

PROUČAVANJA ERIOFIDNIH GRINJA (ACARIDA: *ERIOPHYOIDEA*) JUGOSLAVIJE. I.

Radmila PETANOVIĆ
Beograd–Zemun

Pre nekoliko godina započeli smo sa proučavanjem faune Eriophyoidea i u ovom radu koji obuhvata 5 vrsta navode se prvi put ne samo lokaliteti i biljke hraniteljke, već i ostali relevantni podaci za vrste *Aceria marginemvolvens* (Corti), *A. heimi* (Nal.), *Aculops eximius* (Liro), *A. centaureae* (Farkas) i *A. clinopodii* (Liro).

Address of the author:
Radmila PETANOVIĆ
Poljoprivredni fakultet
11080 Zemun
Nemanjina 6

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UDK 595.732.2 : 591.9 (497.1) = 862

NOVE VRSTE *PSOCOPTERA* (INS.) ZA FAUNU JUGOSLAVIJE

Irma KALINOVIĆ, Osijek
Kurt K. GÜNTHER, Berlin, DDR

Primljeno: 30.9.1985.

ABSTRACT. – *Irma KALINOVIĆ,* Fac. of Agric., Osijek, YU, and *K. K. GUNTHER,* Zool. Mus., Humboldt Univ., Berlin, DDR. – New species of Psocoptera (Ins.) for the fauna of Yugoslavia. – Acta entomol. Jugosl., 1985, **21**, 1–2, 49–54. (Serbo–Croat., Engl. summ.).

On the territory of Slavonia and Baranya (Croatia) two new species of Psocoptera were found: *Psyllipsocus ramburi* Sel. – Longch. f. *troglodytes* Enderl. and *Liposcelis palatinus* Roesl.

Psocoptera, faunistic studies, Croatia, Yugoslavia.

Uvod

Fauna Psocoptera naše zemlje istražuje se od 1973. godine i do sada su ispitivanja obavljena u svim republikama osim SR Slovenije.

Do danas izvršena su istraživanja Psocoptera, koje žive u zatvorenim prostorima (Domicole) i to na uskladištenim žitaricama i prehrambenim proizvodima (Kalinović, Ilić, Pivar, 1976; Kalinović, 1979; Kalinović, Pivar, Günther, Kalinović, 1981), na gvalama sove (*Tyto alba* Scop.) u zvoncima, visokim zgradama i raznim skladištima (Kalinović, Günther, 1981) te Psocoptere koje žive u pčelinjacima i osinjacima (Kalinović, Günther, 1982).

U prirodi, na kulturnom i drugom bilju, ispitivane su Psocoptere koje žive na lišću (Foliicole), drveću i granama (Arboricole), te ispod kore (Corticole), Günther, Kalinović, 1975; 1977, 1980; Kalinović, Pivar, Günther, 1977, 1980, 1980a; Kalinović, Günther, Pivar, 1978, 1979.

Vlastitim ispitivanjima u našoj zemlji do sada su ustanovljene 82 vrste Psocoptera, dok je danas u svijetu poznato oko 2.000 vrsta ovih insekata.

Nalaz vrste *Psyllipsocus ramburi* Sel. – Longch. f. *troglodytes* Enderl. prema literaturi (Günther, 1974) spominje se u južnim dijelovima Francuske, Korzike,

*Rad financira SIZ IV. za znanost SRH.

Španije i Alžira. Prema B a d o n n e l - u, 1981, ova vrsta utvrđena je u Indiji, na nadmorskoj visini od 700 metara. Dosadašnjim istraživanjima ova vrsta nije registrirana u srednjoj Evropi.

Slijedeća vrsta *Liposcelis palatinus* Roesl. do sada je ustanovljena u Nemačkoj (R o e s l e r, 1954), te u Švicarskoj (L i e n h a r d, 1985). Navodi se da je to termofilna vrsta i da se može očekivati i u južnim dijelovima Evrope.

Metoda rada

Psocoptere su sakupljene metodom stresanja sa grana i lišća, te hvatanjem u entomološku mrežu, ili direktnim sakupljanjem sa podloge finim četkicama i stavljanjem u 80% alkohol.

Krilni oblici determiniri su pomoću stereomikroskopa, a beskrilni metodom maceracije (G ü n t h e r, 1974).

Determinacija je obavljena u Osijeku, a provjera rezultata izvršena je u Prirodoslovnom muzeju Humboldt Univerziteta, u Berlinu, DDR.

Rezultati

Nalazi novih vrsta Psocoptera za faunu naše zemlje su slijedeći:

Podred TROGIOMORPHA

Familija **P s y l l i p s o c i d a e**

Vrsta *Psyllipsocus ramburi* Sel. – Longch. forma *troglodytes* Enderlein, 1909

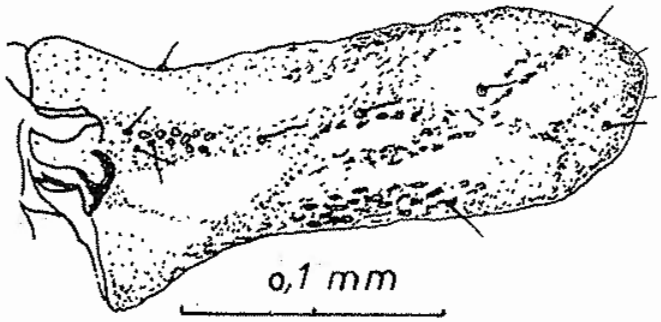
P o r i j e k l o: Osijek, laboratorij, među pljesnivim papirom,

N a l a z: 20.07.1981. – 1 ženka i 2 nimfe. Radi bolje komparacije donosimo crteže pojedinih dijelova tijela.

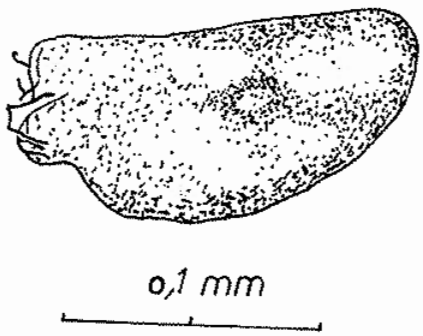
B o j a: Formu *troglodytes* (=*Nymphopsocus troglodytes* Enderl.) karakterizira blijedo do bezbojno tijelo, sa rđasto–žutom glavom. Ticala i noge su žutosmeđe.

M o r f o l o g i j a: Glava posuta rijetkim dlačicama. Oči vrlo sitne. Ocele nedostaju. Rudimenti prednjih krila dugi su jedva 0,27 mm sa bezbojnim tragovima žilica (Sl. 1). Stražnja krila nešto kraća od prednjih (Sl. 2). Imaju duge, tanke noge, kandžice završavaju preapikalnim zupcem i finim dlačicama (50 milimikrona) u obliku četkice, na kojima je često vidljiva nahvatana prašina (Sl. 3). Lacinija je trozuba, njen je unutrašnji zubac vidljiv (Sl. 4). Maksilarni palpus je bezbojan, zadnji članak kijačast i distalno koso zaoštren (Sl. 5). Svaki segment zatka je posut dlačicama. Paraprokt je s jednom snažnom čekinjom i nekoliko jačih dlačica (Sl. 6). Gonapofize su jednostavne, sastoje se iz vanjske valvule posute dužim dlakama i duguljaste ventralne valvule (Sl. 7).

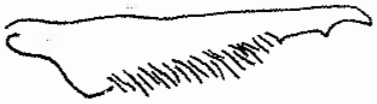
Radi uporedenja svih formi *Psyllipsocus ramburi* donosimo tablicu za determinaciju:



Sl. 1 – Prednje krilo (forewing)



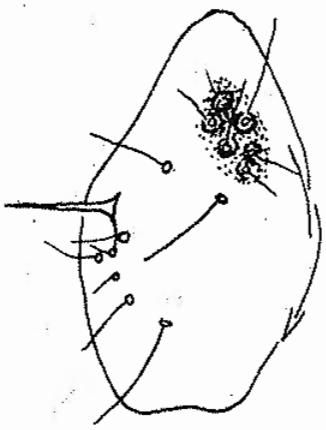
Sl. 2 – Stražnje krilo (hindwing)



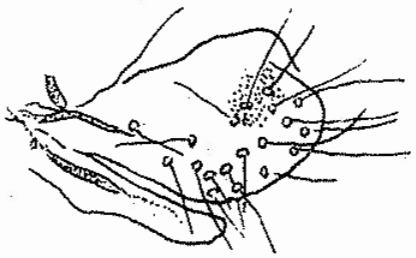
Sl. 3 – Kandica (ungues)

Sl. 4 – Lacinija (lacinia)

Sl. 5 – Maksilarni palpus (maxillary palpus)



Sl. 6 – Paraprokt (paraproct)



Sl. 7 – Gonapofiza (gonapophyses)

Psyllipsocus romburi SEL. – LONGCH. *f. troglodytes* ENDERL.

1. Makroptera. Prednja krila duga, prelaze vrh zatka . . . . . forma *macroptera*
(1) Krila su više ili manje reducirana, dosežu skoro vrh zatka 2
2. Brahiptera. Prednja krila dosežu skoro ili potpuno vrh zatka. Ožilje na krilima pojednostavnjeno ali normalno . . . . . forma *brachyptera*
(2) Mikroptera. Krila su reducirana u obliku kratkih rudimenata, koja dosežu do sredine zatka, bez ožilja 3
3. Ocele izražene. Boja tijela svjetlije ili tamnije smeđa . . . . . forma *destructor*
(3) Ocele nedostaju. Tijelo skoro bezbojno . . . . . forma *troglodytes*

Biologija: Način života *Psyllipsocus ramburi* proučen je detaljno (Pearman, 1928., Badonnel, 1938). To je u srednjoj Evropi obligatno partenogenetska vrsta. Živi u zatvorenim prostorima (Domicola) ili u prirodi, u spiljama (Cavernicola). Hrani se gljivicama, uglavnom plijesnima. Iz bijelih, eliptičnih jajašca kod 20°C, cjelokupni razvoj traje 50 dana, od čega 18–20 dana otpada na embrionalni razvoj, a svaki larveni stadij traje 9–10 dana. Forma *destructor* ima 5, dok forme *brachyptera* i *macroptera* imaju 6 razvojnih stadija.

Podred TROCTOMORPHA

Familija **Liposcelidae**

Vrsta *Liposcelis palatinus* Roesl., 1954

Porijeklo: Zaštićeni Zoološki rezervat Kopački rit, Podunavlje

Nalaz: 1.09.1981, na lišću i granama *Pinus nigra* i *Abies* sp. – 6 ženki.

Boja: Tijelo svijetlo smeđe do sivo. Glava dorzalno tamno siva. Oči crne, ticala i maksilarni palpusi svjetlo sivi. Zadak dorzalno jednobojno tamnosiv. Prvi abdominalni segment tamno siv sa finim svjetlijim poprečnim i uzdužnim razdjelima. Drugi abdominalni segment poprečno podijeljen na prednju i stražnju polovicu – prednja tamno siva i medijalno podijeljena, – stražnja polovica, kao i tergiti od 3–7 segmenata svijetlo do bijelo sive boje. Prednja ivica 3–7 tergita u sredini crno išarana. Širina ovih šara dopire do vrha zadnjeg abdominalnog segmenta. Terminalia zadnjeg segmenta tamno siva. Noge su nešto svijetlije, a donji dio zatka bijele boje.

Morfologija: Oči sastavljene iz 8 omatida. Ticala imaju 20–26 članaka. Lateralni lobusi prototoraksa na vrhu imaju jaču humeralnu čekinju, zatim 2 kraće čekije i 2–3 manje dlačice. Prototorakalni sternit sa 5–6 snažnih čekinja. Abdominalni tergit sa kraćim cilindričnim dlačicama. Baza gonapofiza rašljasta.

To je jedna od najvećih *Liposcelis*–vrsta, dužine tijela 1,40–1,48 mm.

Liposcelis palatinus živi u slobodnoj prirodi na kori i ispod kore drveća. U Švicarskoj je 1983. godine ustanovljena na drveću kestena, na nadmorskoj visini od 540 m (Lienhard, 1985). Prvi puta otkrivena je u Njemačkoj, ispod kore platana (Roesler, 1954).

Prema literaturi (Lienhard, 1985) pojava ove vrste može se očekivati u južnim dijelovima Evrope, što je i potvrđeno našim nalazima u Baranji, SR Hrvatska. Ova vrsta registrirana je na četinarima (*Pinus nigra* i *Abies* sp.), što do sada u literaturi nije spominjano, pa zaključujemo da *Liposcelis palatinus* osim bjelogoričnog nastava i crnogorično drveće.

Zaključak

Na osnovu stalnog ispitivanja insekatskog reda Psocoptera na području SR Hrvatske (Slavonija i Baranja), utvrđene su 2 nove vrste za faunu Jugoslavije i to: *Psyllipsocus ramburi,* forma *troglodytes* i *Liposcelis palatinus.*

Ove dvije vrste do sada nisu registrirane u srednjim i južnim dijelovima Evrope.

Literatura

Badonnel, A., 1981: Psocopteres (Insecta: Psocoptera) de l'Inde. Mission Besuchet–Löbl (1978) et voyage entomologique Löbl 1979. Revue suisse Zool., **88,** (2): 381–411.

Günther, K.K., 1974: Staubläuse (Psocoptera): Tierwelt, 61 Teil, Gustav Fischer Verlag; 1–314.

Günther, K. K., Kalinović, I., 1975: *Ectopsocopsis cryptomeriae* (Enderlein, 1907) eine bemerkenswerte Art der Psocoptera–Fauna Jugoslawiens (Peripsocidae, Psocoptera). Dtsch. Ent. Z., N.F. **22,** (IV–V): 351–357.

Günther, K. K., Kalinović, I., 1977: Beiträge zur Kenntnis der Psocoptera–Fauna Jugoslawiens. Mitt. Zool. Mus. Berlin, **53:** 307–323.

Günther, K. K., Kalinović, I., 1980: Bemerkenswerte Psocoptera–Funde in Istrien (Hrvatska, Jugoslawien). Entomol. Nachrichten, **2:** 19–23.

Kalinović, I., 1979: Liposcelidae (Psocoptera) skladišta žitarica i tvornice tjestenine u Slavoniji i Baranji. Acta entomologica Jugoslavica, **15,** (1–2): 145–154.

Kalinović, I., Ilić, B., Pivar, G., 1976: Psocoptere u skladištima. Zbornik radova Poljoprivrednog fakulteta u Osijeku, **2:** 165–179.

Kalinović, I., Priver, G., Günther, K.K., 1977: Psocoptera–Fauna im Freiland Slawoniens und Baranyas (Hemipteroidea). Acta entomologica Jugoslavica, **13,** (1–2): 51–58.

Kalinović, I., Günther, K. K., Pivar, G., 1978: Faunistička istraživanja Psocoptera u Specijalnom zoološkom rezervatu Kopački rit u Baranji. Zbornik Poljoprivrednog fakulteta u Osijeku, **4:** 63–74.

Kalinović, I., Günther, K. K., Pivar, G., 1979: Fauna Psocoptera Kopačkog rita (Insecta, Hemipteroidea). Zbornik radova Poljoprivrednog fakulteta u Osijeku, **5:** 51–66.

Kalinović, I., Pivar, G., Günther, K.K., 1980: Fauna Psocoptera na prizemnom dijelu stabljika pšenice. Zbornik radova Poljoprivrednog fakulteta u Osijeku, **6:** 45–48.

Kalinović, I., Pivar, G., Günther, K.K., 1980a: Prilog istraživanju Psocoptera u Specijalnom zoološkom rezervatu Kopački rit u Baranji. Acta entomologica Jugoslavica, **16,** (1–2): 111–119.

Kalinović, I., Pivar, G., Günther, K. K., Kalinović, D., 1981: Fauna Psocoptera na prehrambenim proizvodima (Insecta). Zbornik radova Poljoprivrednog fakulteta u Osijeku, **7:** 61–66.

Kalinović, I., Günther, K. K., 1981: Psocopteren von Gewöllen der Schleiereule (Tyto alba Scop.) aus Jugoslawien. Faunistische Abhandlungen, Staatliches Museum fur Tierkunde in Dresden, **8,** (7): 83–85.

Kalinović, I., Günther, K.K., 1982: Fauna Psocoptera pčelinjaka i osinjaka (Insecta). Znanost i praksa u poljoprivredi i prehrambenoj tehnologiji, **4:** 35–42.

Lienhard, Ch., 1985: Sur quelques espèces intéressantes de Psocoptères du Bassin Lemaique et Valais. Bulletin romand d'Entomologie, **3:** 73–79.

Roesler, R., 1954: Neue Gattungen und Arten der deutschen Psocopteren–Fauna (Psocoptera). Beitr. Ent., **4:** 559–574.

Summary

NEW SPECIES OF *PSOCOPTERA* (INS.) FOR THE FAUNA OF YUGOSLAVIA

Irma KALINOVIĆ, Osijek
Kurt K. GÜNTHER, Berlin, DDR

During the investigations of Psocoptera in the special Nature Reservation Kopački rit in Baranya (Croatia) on *Abies* sp. and *Pinus nigra* was found *Liposcelis palatinus* Roesl., while in the laboratory in Osijek on the old paper was detected *Psyllipsocus ramburi* Sel.–Longch. f. *troglodytes* Enderl. Both species are new for the Psocoptera fauna of Yugoslavia.

Adrese autora:
Irma KALINOVIĆ
Poljoprivredni fakultet
YU – 54000 Osijek, Tenjska b.b.
Kurt K. GÜNTHER
Museum für Naturkunde
Zoologisches Museum, Humboldt Universität
Berlin, DDR

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RASPROSTRANJENJE, BROJNOST I OSJETLJIVOST ANOFELINA (DIPT., *CULICIDAE*) NA INSEKTICIDE U BARANJI, JUGOSLAVIJA

Rudolf PAULUS
Osijek

Primljeno: 14.4.1984.

ABSTRACT. – *PAULUS, R.,* Centre for Public Health „Drava", Osijek, YU. - Distribution, Abundance and Susceptibility of the Anopheline Mosquitoes (Dipt., Culicidae) to Insecticides in Baranya, Jugoslavia. – Acta entomol. Jugosl., 1985, 21, 1–2: 55–60. (Serbo–Croat., Engl. summ.).

The distribution and abundance of two anopheline species were studied in Baranya, which was formerly an area of endemic malaria in NE Croatia, Yugoslavia. *Anopheles maculipennis* was the prevailing species at three out of thirteen of the examined sites, while *A.messeae* dominated at ten of the investigated sites. In the village of Branjin Vrh both species are tolerant to the insecticide Malation which is widely applied in Baranya.

Diptera – Culicidae, Anopheles, faunistic studies, mosquito control, tolerance, Croatia, Jugoslavia

Uvod

Baranja, područje u kome su obavljena ispitivanja, nalazi se u sjeveroistočnom dijelu SR Hrvatske, a čini ga trokut terena omeđen na sjeveru jugoslavensko–mađarskom granicom, na istoku rijekom Dunavom, a na jugu rijekom Dravom. Ovo područje je veliko hidrografsko čvorište i predstavlja najvlažniju aluvijalnu ravan Jugoslavije, s bogato zastupljenim biljnim pokrovom i životinjskim naseljem. Upravo naznačeni ekološki parametri omogućuju opstanak i razvoj džinovskih populacija komaraca. – Baranja je sa Osijekom smatrana prije drugog svjetskog rata za oblast endemske malarije (K o s t i ć, 1945). Pa ipak, istraživanja komaraca bila su do sada vršena samo u okolini Osijeka (B a r a n o v, 1943).

Cilj ovih istraživanja bio je da se prikupe, prikažu i prokomentarišu osnovni entomološki i ekološki podaci o vrstama i populacijama roda *Anopheles* na cijeloj teritoriji jugoslavenskog dijela Baranje, i drugo – da se ispita osjetljivost *Anopheles*–a na insekticide i ukaže na epidemiološki rizik od *Anopheles*–a u Baranji.

Metodi rada

Do entomoloških i ekoloških podataka o vrstama i populacijama anofelina došlo se u toku ispitivanja prikupljanjem materijala na terenu, identificiranjem vrsta u laboratoriju i statističkom obradom podataka. Vrste komaraca određivane su u stadiju imaga a vrste kompleksa *A. maculipennis* determinacijom položenih jaja, uz upotrebu nekoliko standardnih djela (P e u s, 1942; M o h r i n g, 1969; N e ž i ć, 1948). – Ispitivanja gustine populacije ženki kompleksa *A. maculipennis* u stajama vršena su metodom „kvadrata" stranice 25 cm. Ženke, naime, masovno ulaze u staje, a predstavljaju i potencijalne vektore. – Ispitivanja osetljivosti–rezistencije *Anopheles*–a na insekticidna sredstva vršeno je s materijalom i po uputama Svjetske zdravstvene organizacije (WHO, 1976), kako su kod nas radili i prethodni istraživači (S i t a r, 1980).

Rezultati i diskusija

Populacija anofelina

Tokom 1980. i 1982. godine obrađeno je u Baranji 13 lokaliteta i tom prilikom je sakupljeno 4266 ženki roda *Anopheles*. Gustina populacije kretala se od 2.88 (Đarda) do 20.89 (Kozjak) primjeraka po kvadratu (Tab. 1). Na pojedinim mjestima apsolutna gustina anofelina po jednom kvadratu kretala se i do 80 jedinki. Ovako velika gustina populacije ima značajno mjesto u epidemiologiji, a direktno je srazmjerna ekološkim uvjetima, posebno hidrografskim i klimatskim vrijednostima staništa.

Ukupno 1303 ženki *Anopheles*–a (30.5%) položile su jaja pogodna za identifikaciju vrsta. Broj identifikovanih ženki po lokalitetima kretao se od 71 (Duboševica) do 131 (Kopačevo), odnosno u prosjeku nešto više od 100 ženki po jednom obrađenom mjestu. Polaganje jaja u laboratorijskim uvjetima pokazuje određenu pravilnost. Maksimalni broj položenih jaja dešava se trećeg ili petog dana, a završava se jedanaestog ili trinaestog dana od kada su ženke ulovljene. Maksimalan broj uginuća ženki koje nisu položile jaja, dešava se devetog dana a poslednja uginuća devetnaestog dana.

Identificirane su dvije vrste kompleksa *maculipennis*, i to: *Anopheles maculipennis* Meigen 1818 i *Anopheles messeae* Falleroni 1926. Vrsta *A maculipennis* nađena je na 11 mjesta a bila je dominantna samo na tri od njih. Njena opća zastupljenost na prostoru Baranje je 29.2%. Može se reći da je ova vrsta u Baranji široko rasprostranjena, ali da je samo lokalno abundantna. – Vrsta *A. messeae* nađena je na 12 lokaliteta, a kao dominantna na 10 od njih, te učestvuje sa 70.8% u ispitivanom području. Obavljena ispitivanja su pokazala da je nizina Baranje oblast vrste *A. messeae*, koja je ovdje ne samo široko zastupljena nego i vrlo abundantna.

Anofeline, naročito kompleks *maculipennis*, čine redovno glavnu masu komaraca u stajama. U manjem broju, ali redovno, nalaze se u istim stajama i ženke podporodice Culicinae, koje su također sakupljane. Nešto više od polovine sakupljenih primjeraka pripada vrsti *Aedes vexans* Meigen 1830 (52,8%) zatim slijede *Culiseta annulata* Schrank 1776 (28,1%), *Aedes sticticus* Meigen 1838 (8.4%), *Culex pipiens* Linnaeus 1758 (5.1%) te *Aedes cantans* Meigen 1818 (1.1%). Na području Baranje nađena je po prvi put i vrsta *Mansonia richiardii* Ficalbi 1889, zastupljena sa 4.5% u ukupnoj populaciji. Ovo je prvi nalaz vrste *M. richiardii* u sjevero–istočnoj Hrvatskoj.

Tab. 1. Gustina mješovite populacije ženki kompleksa *maculipennis* u stajama, broj identificiranih ženki, te broj i procenat (brojke u zagradama) dviju vrsta ovoga kompleksa, ispitivanih u trinaest mjesta u Baranji od 1980. do 1982. godine.

Tab. 1. The number of the mixed population of indoor resting anopheline females of the *maculipennis*–complex, the number of identified females, and the number and percentage (figures in brackets) of two species of the same complex, examined at thirteen sites in Baranya, from 1980 to 1982.

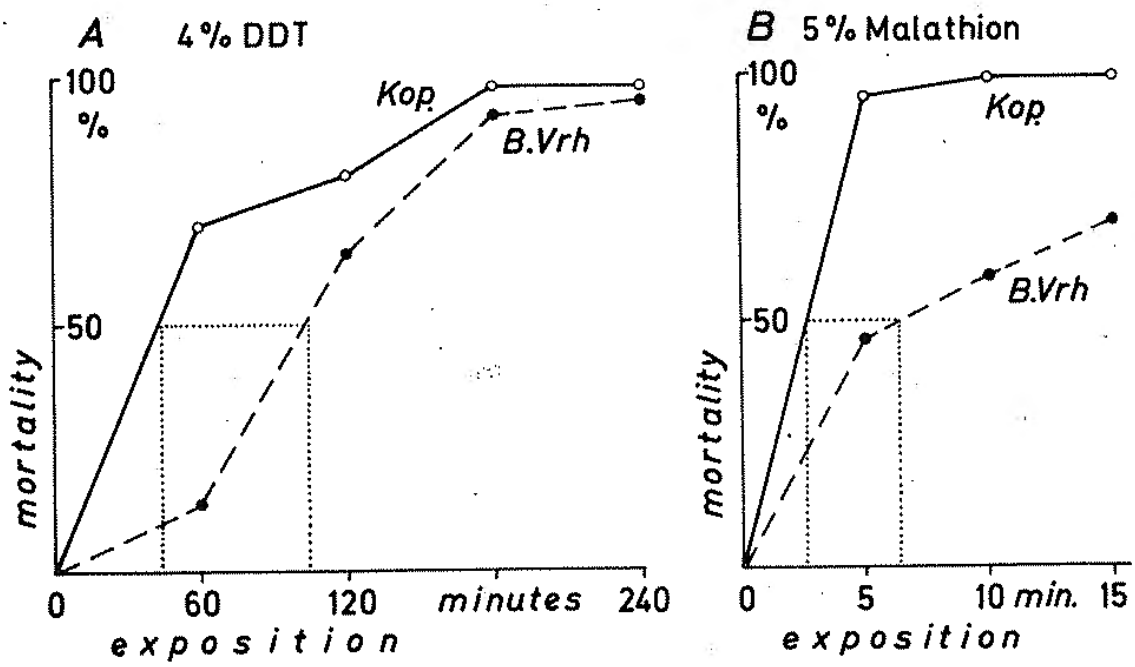
Mjesta / Sites	Broj ženki po jednom kvadratu (25x25 cm) / Number of females per a quadrant (25x25 cm)		Broj identificiranih ženki / Number of identified females	Broj i procenat dviju *Anopheles* vrsta / Number and percentage of two *Anopheles* species	
	M ± m	SD		*maculipennis*	*messeae*
Banovo Brdo	13.8 ± 0.72	4.345	73	73 (100.0)	0 (0.0)
Branjin Vrh	11.1 ± 1.30	7.819	103	96 (93.2)	7 (6.8)
Novi Čeminac	17.2 ± 2.43	14.559	121	77 (63.6)	44 (36.4)
Torjanci	14.2 ± 1.79	10.731	109	35 (32.1)	74 (67.9)
Darda	2.9 ± 0.46	2.746	115	31 (27.0)	84 (73.0)
Zornica	13.3 ± 2.17	13.000	119	29 (24.4)	90 (75.6)
Dobuševica	13.1 ± 1.71	10.259	71	13 (18.3)	58 (81.7)
Kneževi Vinogradi	13.9 ± 1.57	9.449	83	12 (14.5)	71 (85.5)
Tvrdžavica	13.8 ± 1.84	11.021	85	8 (9.4)	77 (90.6)
Zlatna Greda	11.8 ± 1.41	8.477	91	4 (4.4)	87 (95.6)
Batina	14.2 ± 1.86	11.189	82	3 (3.7)	79 (96.3)
Kozjak	20.9 ± 2.74	16.419	120	0 (0.0)	120 (100.0)
Kopačevo	18.4 ± 2.15	12.927	131	0 (0.0)	131 (100.0)
		Total	1303	381 (29.2)	922 (70.8)

Osjetljivost anofelina na insekticide

Ispitivanje osjetljivosti–rezistencije ženki kompleksa *maculipennis* na DDT i najčešće upotrebljavani insekticid Malation, izvedeno je tokom 1982. godine na dva lokaliteta. Na lokalitetu Kopačevo apsolutno dominira vrsta *A. messeae,* koja je u našim testovima bila zastupljena sa 100%. U mjestu Branjin Vrh nađena je mješovita populacija u kojoj je izrazito dominirala vrsta *A. maculipennis* sa 93.2% dok je vrsta *A. messeae* učestvovala sa 6.8%. Oba lokaliteta su upravo i odabrana s obzirom na razlike u dominaciji jedne odnosno druge vrste.

Rezultati testa pokazuju da je populacija *A. messeae* u Kopačevu osjetljiva na DDT i Malation. Kod DDT se LD_{50} postiže u četrdeset drugoj minuti, pri koncentraciji od 0.7%, dok kod Malationa, čije je inicijalno djelovanje brzo, LD_{50} postignut je nakon dvije minute i pedeset sekundi (Sl. 1, A i B), pri koncentraciji od 0.90%, što je veoma pogodno za praktičnu primjenu.

Kod mješovite populacije na lokaciji Branjin Vrh (Sl. 1, A i B) LD_{50} za DDT postiže se za 100 minuta pri koncentraciji 1.65 %. Kako se u praksi upotrebljava DDT 2%, a trajanje je unutar dva sata, to se ovo sredstvo može upotrebiti, ali pri veoma povoljnim



Kop. – LD_{50} = 42 min.– C 0.70%
LD_{90} = 150 min.– C 2.50%
B. Vrh – LD_{50} = 100 min.– C 1.65%
LD_{90} = 174 min.– C 2.90%

Kop. – LD_{50} = 2.50 min. – C 0.90%
LD_{50} = 4.50 min.– C 1.50%
B. Vrh – LD_{50} = 7.00 min.– C 2.25%

Sl. 1. Osjetljivost vrste *Anopheles messeae* ispitivane u mjestu Kopačevo (Kop.) i mješovite populacije vrsta *Anopheles maculipennis* i *Anopheles messeae* ispitivane u mjestu Branjin Vrh (B. Vrh) izražene kao LD_{50} na: A – 4% DDT, i B–5% Malation.
Fig. 1. Susceptibility of the species *Anopheles messeae* examined in the village of Kopačevo (Kop.) and the mixed population of the species *Anopheles maculiepnnis* and *Anopheles messeae* tested in the village of Branjin Vrh (B. Vrh), expressed by LD_{50} to: A – 4% DDT and B – 5% Malathion.

klimatskim uvjetima. Na ovom lokalitetu isključuje se upotreba Malationa jer ni poslije ekspozicije od 15 minuta ni na jednoj koncentraciji nije postignut LD_{90} što znači da je došlo do određene tolerancije populacije *Anopheles*–a prema insekticidu Malation.

Epidemiološki rizik od *Anopheles*–vrsta u Baranji

Ispitivanja anofela, potencijalnih vektora malarije, nisu do sada vršena u Baranji. Međutim, u literaturi ima podataka o malariji u ovom izrazito močvarnom području. Vjerojatno najstariji podatak potječe iz 1899. godine, koji kaže da je tada među vojnicima u Osijeku bilo 12,74% oboljelih od malarije (citirano prema C h l o u p e k - u, 1948). Baranja je sa Osijekom smatrana prije drugog svjetskog rata za oblast endemske malarije, a poslije rata pa do 1952. godine za područje hipoendemske malarije (K o s t i ć, 1945; S i m i ć, 1956). Sasvim je vjerojatno da su vektori u to vrijeme bile sada utvrđene zoofilne vrste anofela. Naša uporna traganja za vrstom *A. atroparvus* u Baranji ostala su bez rezultata. Ni na jednom od 13 ispitanih lokaliteta široom Baranje ova vrsta nije

utvrđena odnosno među 1303 identificirane ženke roda *Anopheles* nije nađena ni jedna ženka vrste *A. atroparvus*. To je, razumije se, vrlo povoljno za epidemiološku situaciju u Baranji jer je ta vrsta dokazani vektor malarije u Evropi. Vrsta *A. atroparvus* je česta, a mestimično i dominantna u basenu Tise i Tamiša na terenima sa prostranim slatinama tipa solonjec, gdje stajaća i sporo tekuća voda ima povišeni salinitet; to važi i za stariju terasu Dunava u Bačkoj, izgrađenoj od pretaloženog lesa (A d a m o v i ć, 1978, 1979). Pitanje zoofilije vrsta *A. maculipennis* i *A. messeae* u Baranji je razumljivo sve dok postoji dobro razvijeno stočarstvo i mnoštvo dijvljači. Međutim, eventualnom promjenom ekoloških uvjeta, smanjenjem ili drastičnim uništenjem stočnog fonda i divljači, anofeline bi doživjele trofičku devijaciju i masovno ušle u nastambe ljudi te postale antropofilne u pogledu korišćenja izvora krvi.

Malarija je iskorenjena iz naše zemlje. Poslednje domaće transmisije ove bolesti odigrale su se u Makedoniji 1964. godine. Međutim, razvoj privrednih veza, odlazak naših ljudi na rad u zemlje gdje još uvijek hara malarija, često u opasnoj tropskoj formi, imaju za posljedicu povećanje broja slučajeva malarije unešene u našu zemlju. Slična pojava je zapažena i u drugim zemljama Evrope, a posebno zabrinjava činjenica da malarija nije iskorenjena u Grčkoj i Turskoj. Prema podacima što ih je iznio L i t v i n j e n k o (1981) u Jugoslaviji je zabilježeno 320 slučajeva importirane malarije za razdoblje 1975–1980, ili u SR Hrvatskoj 43 slučaja od 1977–1981. godine. Godine 1983. u mjesecu junu otkrivena je malarija kod jednog Tunižanina na zaraznom odjelu Osiječke bolnice. Općenito, više od polovine registriranih slučajeva malarije kod nas se odnosi na izazivača tropike, to jest imaju izazivača *Plasmodium falciparum;* slijede po opadajućoj učestalosti *P. vivax, P. malarie* i najzad *P. ovale.* – Tomu treba dodati da vrste roda *Anopheles* prenose i određene viruse (G l i g i ć i A d a m o v i ć, 1976).

Zaključci

Izneseni rezultati ispitivanja predstavljaju prve podatke o vrstama i populacijama podporodice *Anophelinae* u jugoslavenskom dijelu Baranje. Vrsta *A. maculipennis* nađena je na 11 mjesta, a samo na tri mjesta bila je dominantna. Na cijelom području Baranje zastupljena je u prosjeku sa 29.2%. Vrsta *A. messeae* nađena je na 12 lokaliteta, dominirala je na 10 mjesta te učestvuje sa 70.8% na ovom području.

U ispitanim stajama nađene su i slijedeće vrste molestanata *Aedes vexans* (52.8%), *Culiseta annulata* (28.1%), *Aedes sticticus* (8.4%), *Culex pipiens* (5.1%), *Aedes cantans* (1.1%) te *Mansonia richiardii* (4.5%). Poslednja vrsta je nova za ovo područje.

Vrste *A. maculipennis* i *A. messeae* u naselju Branjin Vrh su tolerantne na insekticid Malation što je od praktičnog značaja.

Epidemiološki rizik od vrsta roda *Anopheles*u Baranji, koja je ranije bila područje endemske malarije, je znatan te zaslužuje punu pažnju istraživača.

Literatura

Adamović, Ž., 1978: Anopheline mosquitoes species (Diptera, Culicidae) in West Bačka, Yugoslavia. – Acta veterinaria, Beograd, **26** (6): 243–249.

Adamović, Ž., 1979: Distribution and abundance of anopheline mosquitoes (Diptera, Culicidae) in Voyvodina,Serbia. – Acta entomol. Jugosl., Zagreb, **15**, (1–2): 75–82.

Baranov, N., 1943: Zur Mückenplage in Osijek. – Veter. Arh., Zagreb, **13** (4): 150–163.
Chloupek, D., 1948: Prilog historiji malarije u našim krajevima. – Zbornik o malariji, 1: 190–192.
Gligić, A. and Adamović, Ž., 1976: Isolation of *Tahyna* virus from *Aedes vexans* mosquitoes in Serbia. – Mikrobiologija, Beograd, **13** (2): 119–129.
Kostić, D., 1945: Pregled rasprostranjenja malarije u Jugoslaviji. – Narodno zdravlje, Beograd, **4:** 20–23.
Litvinjenko, S., 1981: Rad na sprovođenju mera budnosti posle ostvarenja eradikacije malarije. – Zdravstvena zaštita, Beograd, **7–8:** 37–42.
Mohring, W., 1969: Die Culiciden Deutschlands, Untersuchungen zur Taxonomie, Biologie und Oekologie der einheimischen Stechmücken. – Gustav Fischer Verlag, Jena 260 pp.
Nežić, E., 1948: Naše vrste i rase anofelesa. – Zbornik o malariji, Beograd, Medicinska Knjiga, 1: 136–143.
Peus, F., 1942: Die Fiebermücken des Mittelmeergebietes. - Leipzig, 150 pp.
Simić, Č., 1956: Le paludisme en Yougoslavie. – Bull. Wld Hlth Org., Geneve, **15:** 753–766.
Sitar, A., 1980: Značaj fenomena rezistencije insekata na sintetičke insekticide. – II simpozijum „Dezinfekcija, dezinsekcija i deratizacija u zaštiti zdravlja ljudi", Beograd, 132–139.
WHO, 1970: Technical Report, Series No. 443, World Health Organization, Geneva.

Summary

DISTRIBUTION, ABUNDANCE AND SUSCEPTIBILITY OF THE ANOPHELINE MOSQUITOES (DIPT., *CULICIDAE*) TO INSECTICIDES IN BARANYA, YUGOSLAVIA

Rudolf PAULUS
Osijek

The results of the investigations presented in this paper are the first data on the species and populations of the Anopheline mosquitoes in Baranya, a marshy and swampy lowland, situated between the river Drava, the Danube and the Hungarian frontier in NE Croatia, Yugoslavia. During 1980 and 1982 thirteen localities were examined and 4226 mosquito females of *Anopheles* were collected in stables in Baranya. The species *A. maculipennis* Meigen 1818 was found in eleven of the sites examined. It was a dominant species only in three sites, and was represented by 29.2% on average. The species *A. messeae* Falleroni 1926 was found in twelve localities. It was a dominant species in ten sites, and was represented by 70.8% in the examined region. While collecting *Anopheles* in the stables, the following species of molestants were also found: *Aedes vexans* Meigen 1830 (52.8%), *Culiseta annulata* Schrank 1776 (28.1%), *Aedes sticticus* Meigen 1838 (8.4%), *Culex pipiens* Linnaeus 1758 (5.1%), *Aedes cantans* Meigen 1818 (1.1%) and *Mansonia richiardii* Ficalbi 1889 (4.5%). The latter species has not previously been recorded in Baranya.

The species *A. maculipennis* and *A. messeae* in the village of Branjin Vrh are tolerant to the insecticide, Malation, which is of practical interest, since Malation is widely applied in extermination of mosquitoes. Both anopheline species are mostly zoophylic due to the amount of cattle and other domestic animals. However, should something damage or destroy this barrier, these anophelines would probably become anthropophylic. Epidemic risk of *Anopheles* in Baranya is considerable, since it is known that Baranya was once an area of endemic malaria, and it is, therefore, worthy of research workers' attention.

Adresa autora:
Mr. *Rudolf PAULUS,*
Dom za zaštitu zdravlja „Drava"
YU 54000, Osijek,
Prolaz V. Bubnja bb
Jugoslavija

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MORPHOLOGY AND ADAPTIVE VALUE OF THE STING APPARATUS OF DIGGER WASPS *(HYM. SPHECIDAE)*

Ivica T. RADOVIĆ
Belgrade

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ABSTRACT. – *RADOVIĆ, I.T.,* Inst. Zool., Dep. of Biol. Univ. Belgrade, YU.–Morphology and adaptive Value of the Sting Apparatus of Digger Wasps (Hymen., Sphecidae). – Acta entomol. Jugosl., 1985, **21**, 1–2; 61–74. (Engl. Serbo–Croat. Summ.).

On the basis of comparative morphological study of the sting apparatus in 246 species of 120 genera of the family Sphecidae certain adaptive changes in the structure of this organ have been observed. These changes are particularly pronounced in the structure of the stylet (valvulae I + valvulae II) and are reflected in the correlation between its form and the mobility of the prey. In the species of the Sphecidae whose preys are flying insects (adults of Diptera, Hymenoptera and Lepidoptera), the stylet of the sting is clearly curved. On the other hand, in the species whose preys consists of sedentary or slow moving insects (Homoptera, Coleoptera and caterpillars of Lepidoptera) or spiders, the styled of the sting is less curved or even straight.

Hymenoptera–Sphecidae, comparative morphology, female terminalia, sting apparatus

Introduction

The sting apparatus of representatives of the family Sphecidae has been studied by many authors (Bordas, 1895; Pavlowsky, 1927; D' Rozario, 1940; Oeser, 1961; Robertson, 1968; Maschwitz and Kloft, 1971; Matsuda, 1976; Radović, 1976, 1981b; Richards, 1977; Rathmayer, 1978; Kasparyan, 1980) but, nevertheless, the structure of the female terminalia is much less well known than that of the males, as is also the case with other aculeate Hymenoptera. In fact, it was long believed (Bernard, 1951; Stephen et al., 1969) that the structure of the female terminalia could not be considered a feature of high taxonomic value, primarily because of the pronounced variability of these structures. More recently, however, (Bohart and Menke, 1976) it has been suggested that a comparative–morphological study of these structures might offer information of taxonomic and

Tab. 1 Tribes of the family Sphecidae, shape of stylet, degree of curvature, presence of teeth at the distal part of lancetae and kind of their prey

Tribes of the fam. Sphecidae	Aranea	Collembola	Ephemeroptera	Odonata	Orthoptera	Psocoptera	Hemiptera	Homoptera	Thysanoptera	Neuroptera	Trichoptera	Lepidoptera	Mecoptera	Diptera	Coleoptera	Hymenoptera	Shape of stylet	Teeth on lancetae	Degry of curvature
Dolichurini					+												slightly curved nearly straight	oo	1
Ampulicini					+												slightly curved nearly straight	•	1
Sceliphrini	+				+												nearly straight or straight	•	1
Stangeellini					+												slightly curved	■	2
Sphecini					+												slightly curved	o	2
Ammophilini					+							+			+	+	straight in most specimens	oo	1
Psenini								+									slightly curved nearly straight	•	1
Pemphredonini		+						+	+								slightly curved nearly straight	oo	1
Astatini							+										curved or slightly curved	•	2
Dinetini							+										slightly curved	o	2
Larrini					+		+	+				+					curved or slightly curved	o	2
Palarini																+	curved	•	3
Miscophini	+				+	+	+	+				+		+			curved to slightly curved	•	2
Trypoxylonini	+																curved	•	3
Oxybelini								+						+	+		extremely curved	oo	4
Crabronini			+		+	+	+	+		+	+	+	+	+	+	+	curved	•	3
Entomosericini																			—
Xenosphecini														+			extremely curved	•	4
Mellinini														+			curved	oo	3
Heliocausini							+										slightly curved nearly straight	•	1
Alyssonini							+										curved to slightly curved	•	2
Nyssonini																+	long and straight	•	4
Gorytini								+									curved to slightly curved	•	2
Stizini					+												curved	•	3
Bembicini			+	+			+			+		+		+		+	extremely curved in most specimens	•	4
Eremiasphecini																		•	—
Philanthini																+	extremely curved	•	4
Aphilanthopsini																+	extremely curved	•	4
Odontosphecini																	slightly curved	•	3
Pseudoscolini																+		•	—
Cercerini															+	+	curved, sometimes nearly straight	•	2

■ always; oo nearly always; o sometimes; • never (Modified from Bohart and Menke, 1976)
1 extremely straight, 2 slightly curved, 3 curved, 4 extremely curved

phylogenetic importance particularly in the case of taxa above the genus level. Kugler (1978) recently revised the taxonomically difficult subfamily Myrmicinae (Formicidae) using comparative morphology of the sting apparatus.

In the paper I describe some basic morphological caracteristics of the structure of the skeletal parts of the sting apparatus of representatives of eleven subfamilies of the family Sphecidae with particular reference to certain adaptive changes in their structure. The structure appears to be closely correlated with the type and mobility of prey (Tab. 1).

Materials and Methods

The specimens used in this study represent 246 species from 120 genera and eleven subfamilies of the family Sphecidae (Tab. 2). The classification of the family Sphecidae as presented by Bohart and Menke (1976) is used in this study. Part of the material is used from the collection of the Institute of Zoology, Faculty of Science, University of Belgrade, but the majority of the species are from the U.S. National Museum of Natural History, Smithsonian Institution, Washington, D.C.

The sting apparatus was dissected and taken through a series of solutions for clearing and dehydration (Radović and Hurd, 1980, Radović, 1981a, b). All illustrations were prepared by me self using a Bausch and Lomb Tri–Simplex microprojector. For terminology used in this paper and for detailed explanation of morphology and origin of skeletal parts of the sting apparatus see Radović and Hurd (1980). Scale lines are in millimeters.

Ampulicinae:

The stylet (valvulae I + valvulae II) of the sting apparatus of the representatives of the subfamily Amplicinae is relatively elongated, narrow and slightly curved or nearly straight (Figs. 1, 2). The preys of Ampulicinae are Blattoidea (Tab. 1).

Genera in the Dolichurini have one–segmented sting palpi (valvulae III). Species of the genus *Trirogma* are distinguished by the presence of spines on the distal part of the lancet (valvulae I). This may be correlated with the less sclerotised body wall of their prey – nymphs of the genus *Periplaneta.* Perhaps the spines on the lancet make it possible to keep the stylet in the body of victim.

Species of *Ampulex,* the only genus in the tribe Ampulicini, have a considerably narrower of more elongate and slightly curved stylet which is somewhat shorter than that of Dolichurini. Sting palpi are two–segmented and considerably narrower than those in the genera *Trirogma* and *Dolichurus.* The shape and structure of the stylet in *Ampulex* is presumably correlated with the kind of prey and manner of stinging the prey. Namely, *Ampulex* holds the prey (cockroaches) with mandibles during stinging.

Sphecinae:

On the basis of sting apparatus structure I consider it justified to distinguish four tribes within the stubfamily Sphecinae: Stangeellini, Sceliphrini, Sphecini and Ammophi-

Tab. 2 List of analysed taxa

Superfamilia SPHECOIDEA
Familia: Sphecidae

I Subfamilia: *Ampulicinae*

Tribus: Dolichurini
1.Gen: Dolichurus Latreille
1.1. Dolichurus stantoni Ashmead
2.Gen: Trirogama Westwood
2.2. Trirogama prismatica F.Smith

Tribus: Ampulicini
3.Gen: Ampulex Jurine
3.3. Ampulex compressa (Fabricius)
3.4. Ampulex dissector (Thunberg)

II Subfamilia: *Sphecinae*

Tribus: Sceliphrini
5.Gen: Chlorion Latreille
5.6. Chlorion aerarium Patton
5.7. Chlorion lobatum (Fabricius)
5.8. Chlorion maxillosum (Poiret)
5.9. Chlorion splendidum Fabricius
6.Gen: Penepodium Menke
6.10. Penepodium luteipenne (Fabricius)
7.Gen: Dynatus Lepeletier
7.11. Dynatus nigripes (Westwood)
8.Gen: Podium Fabricius
8.12. Podium luctuosum F.Smith
8.13. Podium rufipes Fabricius
9.Gen: Chalybion Dahlbom
9.14. Chalybion (Chalybion) californicum (Saussure)
9.15. Chalybion (Chalybion) ommisum (Kohl)
9.16. Chalybion (Chalybion) targionii (Caruccio)
9.17. Chalybion (Hemichalybion) femoratum (Fabricius)
10.Gen: Sceliphron Klug
10.18. Sceliphron(Sceliphron) madraspartanum (Fabricius)
10.19. Sceliphron(Sceliphron) spirifex(Linnaeus)
10.20. Sceliphron(Sceliphron) destillatorium (Illiger)
10.21. Sceliphron(Sceliphron) assimilae (Dahlbom)
10.22. Sceliphron(Sceliphron) caementarium (Drury)

Tribus: Stangeellini
4.Gen: Stangeella Menke
4.5. Stangeella cyaniventris (Guerin - Méneville)

Tribus: Sphecini
Subtribus: Sphecina
11.Gen: Sphex Linnaeus
11.23. Sphex dorsalis Lepeletier
11.24. Sphex ichneumones (Linnaeus)
11.25. Sphex pruinosus Germar
11.26. Sphex rufocinctus Brulle (=S maxillosus)
11.27. Sphex flavipennis Fabricius
12.Gen: Isodontia Patton
12.28. Isodontia philadelphica (Lepeletier)
12.29. Isodontia paludosus (Rossi)
Subtribus: Prionychina
13.Gen: Plamodes Kohl
13.30. Plamodes carbo Bohart and Menke
13.31. Plamodes occitanicus (Lepeletier and Serville)
14.Gen: Prionyx Vander Linden
14.32. Prionyx atratus (Lepeletier)
14.33. Prionyx albisectus (Lepeletier and Serville)
14.34. Prionyx lividocinctus (A Costa)
14.35. Prionyx subfuscatus (Dahlbom)

Tribus: Ammophilini
15.Gen: Parapsammophila Taschenberg
15.36. Parapsammophila ponderosa (Gerstaecker)
16.Gen: Hoplammophila Beaumont
16.37. Hoplammophila aemulans (Kohl)
17.Gen: Podalonia Fernald
17.38. Podalonia hirsuta (Scopoli)
17.39. Podalonia affinis (W.Kirby)
17.40. Podalonia tydei (Le Guilou)
18.Gen: Eremochares Gribodo
18.41. Eremochares dives (Brulle)
19.Gen: Ammophila W.Kirbi
19.42. Ammophila heideni Dahlbom
19.43. Ammophila sabulosa (Linnaeus)
19.44. Ammophila campestris Latreille
19.45. Ammophila holosericea (Fabricius)

III Subfamilia: *Pemphredoninae*

Tribus: Psenini
Subtribus: Psenina
20.Gen: Mimumesa Malloch
20.46. Mimumesa dahlboni (Wesmael)
21.Gen: Pseneo Malloch
21.47. Pseneo simplicicornis (W.Fox)
22.Gen: Psen Latreille
22.48. Psen barthi Viereck
22.49. Psen bakeri Rohwer
23.Gen: Nesomimesa Perkins
23.50. Nesomimesa kauaiensis Perkins
Subtribus: Psenulina
24.Gen: Pluto Pate
24.51. Pluto arenivagus Krombein
25.Gen: Psenulus Kohl
25.52. Psenulus pallipes (Panzer) (=P.atratus)
25.53. Psenulus fuscipennis (Dahlbom)
Tribus: Pemphredonini
Subtribus: Pemphredonina
26.Gen: Diodontus Curtis
26.54. Diodontus minutus (Fabricius)
26.55. Diodontus virginianus (Rohwer)
27.Gen: Pemphredon Latreille
27.56. Pemphredon concolor Say
27.57. Pemphredon unicolor (Panzer)
28.Gen: Passaloecus Shuckard
28.58. Passaloecus cuspidarius F.Smith
Subtribus: Stigmina
29.Gen: Arpactophilus F.Smith
29.59. Arpactophilus steindachneri Kohl
30.Gen: Stigmus Panzer
30.60. Stigmus americanus Packard
31.Gen: Carinostigmus Tsuneki
31.61. Carinostigmus congruus (Walker)
32.Gen: Spilomena
32.62. Spilomena enslini Blüthgen

IV Subfamilia: *Astatinae*

Tribus: Astatini
33.Gen: Diploplectron W.Fox
33.63. Diploplectron peglowi Krombein
34.Gen: Astata Latreille
34.64. Astata boops (Schrank)
34.65. Astata minor Kohl
34.66. Astata australasiae Shuckard
34.67. Astata bicolor Say
35.Gen: Dryudella Spinola
35.68. Dryudella caerulea (Cresson)

Tribus: Dinetini
36.Gen: Dinetus Panzer
36.69. Dinetus pictus (Fabricius)

V Subfamilia: *Laphyragogininae*
37.Gen: Laphyragogus Kohl
37.70. Laphyragogus pictus Kohl

VI Subfamilia: *Larrinae*

Tribus: Larrini
Subtribus: Larrina
38.Gen: Larra Fabricus
38.71. Larra analis Fabricus
38.72. Larra anathema (Rossi)
39.Gen: Liris Fabricius
39.73. Liris nigra (Fabricius)
Subtribus: Tachytina
40.Gen: Gastrosericeus Spinola
40.74. Gastrosericeus rothneyi Cameron
41.Gen: Larropsis Patton
41.75. Larropsis tenuicornis (F.Smith)
42.Gen: Ancistromma W.Fox
42.76. Ancistromma distincta (F.Smith)
43.Gen: Tachytes Panzer
43.77. Tachytes europaeus Kohl
44.Gen: Tachysphex
44.78. Tachysphex terminatus (F.Smith)

Tribus: Palarini
45.Gen: Palarus Latreille
45.79. Palarus variegatus (Fabricius)
Tribus: Miscophini
46.Gen: Lyroda Say
46.80. Lyroda subita (Say)
47.Gen: Larrisson Menke
47.81. Larrisson abnormis (Turner)
48.Gen: Paranysson Guérin - Meneville
48.82. Paranysson 4-dentatus (Cameron)
49.Gen: Plenoculus W.Fox
49.83. Plenoculus davis W.Fox
49.84. Plenoculus propinquus W.Fox
50.Gen: Solierella Spinola
50.85. Solierella affinis (Rohwer)
50.86. Solierella fossor (Rohwer)
51.Gen: Miscophus Jurine
51.87. Miscophus imitans Giner-Marf
51.88. Miscophus nigripes Honoré
52.Gen: Nitela Latreille
52.89. Nitela spinolae Latreille

Tribus: Trypoxylonini
53.Gen: Pisonopsis W.Fox
53.90. Pisonopsis clypeata W.Fox
54.Gen: Pison Jurine
54.91. Pison argentatum Shuckard
54.92. Pison chilense Spinola
54.93. Pison ignavum Turner
54.94. Pison punctifrons Shuckard
55.Gen: Aulacophilus F.Smith
55.95. Aulacophilus eumenoides Ducke
55.96. Aulacophilus jansoni Turner
56.Gen: Trypoxylon Latreille
56.97. Trypoxylon fabricator F.Smith
56.98. Trypoxylon clavicerum Lepeletier and Serville
56.99. Trypoxylon figulus (Linnaeus)
56.100. Trypoxylon scutatum Sheyrier
56.101. Trypoxylon (Trypargilum) albitarsae Fabricius
56.102. Trypoxylon (Trypargilum) mexicanum Saussure

I Subfamilia: *Crabroninae*

Tribus: Oxybelini
57.Gen: Belomicrus A.Costa
57.103. Belomicrus italicus A.Costa
58.Gen: Oxybelus Latreille
58.104. Oxybelus africanus Kohl (=O.ficheri Spinola)
58.105. Oxybelus argentinus Brethes
58.106. Oxybelus bipunctatus Oliver
58.107. Oxybelus subulatus Robertson
58.108. Oxybelus uniglumis (Linnaeus)
58.109. Oxybelus emarginatus Say
58.110. Oxybelus victor Lepeletier
58.111. Oxybelus 14-notatus Jurine
58.112. Oxybelus mandibularis Dahlbom

Tribus: Crabronini
59.Gen: Anacrabro Packard
59.113. Anacrabro ocellatus Packard
60.Gen: Encopognathus Kohl
60.114. Encopognathus wenonah (Banks)
61.Gen: Entomognathus Dahlbom
61.115. Entomognathus brevis (Vander Linden)
62.Gen: Lindenius Lepeletier and Brullé
62.116. Lindenius albilabris (Fabricius)
62.117. Lindenius panzeri (Vander Linden)
63.Gen: Quexua Pate
63.118. Quexua sp.
64.Gen: Rhopalum Stephens
64.119. Rhopalum rufigaster
65.Gen: Podagritus Spinola
65.120. Podagritus aemulans (Kohl)
66.Gen: Moniaecera Ashmead
66.121. Moniaecera abdominalis (W.Fox)
67.Gen: Crossocerus Lepeletier and Brullé
67.122. Crossocerus (Crossocerus) chromatipus Pate
67.123. Crossocerus (Crossocerus) elongatulus (Vander Linden)
67.124. Crossocerus (Crossocerus) emarginatus (Kohl)
67.125. Crossocerus (Crossocerus) impressifrons (F.Smith)
67.126. Crossocerus (Blepharipus) annulipes (Lepeletier and Brullé)
67.127. Crossocerus (Belpharipus) megacephalus (Rossi)
67.128. Crossocerus (Cuphopterus) dimidiatus (Fabricius)
67.129. Crossocerus (Stictoptila) maculipennis F.Smith
67.130. Crossocerus (Hoplocrabro) quadrimaculatus (Fabricius)
68.Gen: Crabro Fabricius
68.131. Crabro advena (advena grupa) F.Smith
68.132. Crabro argusinus R.Bochart (cribrarius grupa)
68.133. Crabro cingulatus (Packard) (hilaris grupa)
68.134. Crabro cribrellifer (Packard) (cribrarius grupa
68.135. Crabro monticola (Packard) (cribrarius grupa)
68.136. Crabro peltista Kohl (tumidus grupa)
68.137. Crabro cribrarius (Linnaeus) (cribrarius grupa)
69.Gen: Piyuma Pate
69.138. Piyuma makilingi (Turner) (=P.prosopoides)
70.Gen: Enoplolindenius Rohwer
70.139. Enoplolindenius pugnans (F.Smith)
71.Gen: Vechtia Pate
71.140. Vechtia rugosa (F.Smith)
72.Gen: Dasyproctus Lepeletier and Brullé
72.141. Dasyproctus bipunctatus Lepeletier and Brullé
72.142. Dasyproctus agilis (F.Smith)
73.Gen: Ectemnius Dahlbom
73.143. Ectemnius arcuatus (Say)
73.144. Ectemnius atriceps (Cresson)
73.145. Ectemnius continuus (Fabricius)
73.146. Ectemnius rufifemur (Packard)
73.147. Ectemnius spinifer (W.Fox)
74.Gen: Lestica Billberg
74.148. Lestica alata (Panzer)
74.149. Lestica clypeata (Schreber)
74.150. Lestica constricta Krombein

VIII Subfamilia: *Entomosericinae*

75.Gen: Entomosericus Dahlbom
75.151. Entomosericus concinnus Dahlbom

IX subfamilia: *Xenosphecinae*

Tribus: Xenosphecini
76.Gen: Xenosphex Williams
76.152. Xenosphex xerophilus Williams

X Subfamilia: *Nyssoninae*

Tribus: Mellinini
77.Gen: Mellinus Fabricius
77.153. Mellinus arvensis (Linnaeus)
Tribus: Heliocausini
78.Gen: Heliocausus Kohl
78.154. Heliocausus argentinus Brethes
Tribus: Alyssonini
79.Gen: Alysson Panzer
79.155. Alysson conicus Provancher
79.156. Alysson guignardi Provancher
79.157. Alysson spinosus (Panzer)
80.Gen: Didineis Wesmael
80.158. Didineis nodosa W.Fox
80.159. Didineis texana (Cresson)
Tribus: Nyssonini
81.Gen: Nysson Latreille
81.160. Nysson lateralis Packard
81.161. Nysson spinosus (J.Foster)
82.Gen: Synnevrus A.Costa
82.162. Synnevrus aequalis (Patton)
82.163. Synnevrus plagiatus (Cresson)
83.Gen: Epinysson Pate
83.164. Epinysson guatemalensis (Rohwer)ssp
84.Gen: Brachystegus A.Costa
84.165. Brachystegus scalaris (Illiger)
85.Gen: Zanysson Rohwer
85.166. Zanysson plesius (Rohwer)
86.Gen: Foxia Ashmead
86.167. Foxia navajo Pate
Tibus: Gorytini
87.Gen: Clitemnestra Spinola
87.168. Clitemnestra gayi (Spinola)
88.Gen: Ochleroptera Holmberg
88.169. Ochleroptera bipunctata (Say)
89.Gen: Argogroytes Ashmead
89.170. Argogroytes mystaceus (Linnaeus)
90.Gen: Dienoplus W.Fox
90.171. Dienoplus elegans (Lepeletier)
91.Gen: Gorytes Latreille
91.172. Gorytes atricornis Packard
91.173. Gorytes quadrifasciatus (Fabricius)
91.174. Gorytes similimus F.Smith

92.Gen: Pseudoplisus Ashmead
92.175. Pseudoplisus phaleratus (Say)
93.Gen: Neoplisus R.Bohart
93.176. Neoplisus notabilis (Handlirsch)
94.Gen: Oryttus Spinola
94.177. Oryttus gracilis (Patton)
95.Gen: Sphecius Dahlbom
95.178. Sphecius convallis Patton
95.179. Sphecius grandis (Say)
95.180. Sphecius speciosus (Drury)
95.181. Sphecius nigricornis (Dufour)
96.Gen: Tanyoprymnus Cameron
96.182. Tanyoprymnus moneduloides (Packard)
97.Gen: Ammatomus A.Costa
97.183. Ammatomus rogenhoferi (Handlirsch)
98.Gen: Hoplisoides Gribodo
98.184. Hoplisoides costalis (Cresson)

Tribus: Stizini
99.Gen: Stizus Latreille
99.185. Stizus iridis Dow
99.186. Stizus marthae Handlirsch
100. Gen: Stizoides Guérin-Méneville
100.187. Stizoides renicinctus (Say)
101.Gen: Bembecinus A.Costa
101.188. Bembecinus quinquespinosus (Say)
101.189. Bembecinus tridens (Fabricius)
101.190. Bembecinus hungaricus (Frivaldsky)

Tribus: Bembicini
102. Gen: Bicyrtes Lepeletier
102.191. Bicyrtes quadrifasciata (Say)
102.192. Bicyrtes variegata (Oliver)
103.Gen: Microbembex Patton
103.193. Microbembex argentifrons (Cresson)
103.194. Microbembex californica R.Bohart
103.195. Microbembex nigrifrons (Provancher)
104.Gen: Rubrica J.Paker
104.196. Rubrica nasuta (Christ)
105.Gen: Stictia Illiger
105.197. Stictia carolina Fritz
105.198. Stictia maculata (Fabricius)
106.Gen: Bembix Fabricius
106.199. Bembix americana Fabricius ssp. comata J.Parker
106.200. Bembix americana Fabricius ssp. spinolae Lepeletier
106.201. Bembix amoena Handlirsch
106.202. Bembix melanaspis J.Parker
106.203. Bembix olivacea Fabricius
106.204. Bembix bidentata Vander Linden
106.205. Bembix tarsata Latreille
106.206. Bembix sinuata Panzer
106.207. Bembix oculata Panzer
106.208. Bembix rostrata Linnaeus
106.209. Bembix flavescens F.Smith ssp.bolivari Handlirsch
107.Gen: Trichostictia J.Parker
107.210. Trichostictia vulpina (Handlirsch)
108.Gen: Zyzzyx Pate
108.211. Zyzzyx chilensis (Eschscholz)
109.Gen: Stictiella J.Parker
109.212. Stictiella callista J.Parker
110.Gen: Glenostictia Gillaspy
110.213. Glenostictia pictifrons (F.Smith)
111.Gen: Steniolia Say
111.214. Steniolia tibialis Handlirsch
111.215. Steniolia scoparga Handlirsch ssp.albicantia J.Parker

XI Subfamilia: *Philanthinae*

Tibus: Eremiasphecini
112.Gen: Eremiasphecium
112.216. Eremiaspheciunm schmiedeknechtii Kohl

Tibus: Philanthini
113.GEn: Philanthus Fabricius
113.217. Philanthus bilunatus Cresson
113.218. Philanthus crabroniformis F.Smith
113.219. Philanthus basalis F.Smith
113.220. Philanthus ventilabris Fabricius
113.221. Philanthus triangulum (Fabricius)
113.222. Philanthus venustus (Rossi)
113.223. Philanthus coronatus (Thunberg)
114.Gen: Trachypus Klug
114.224. Trachypus elongatus (Fabricius)
114.225. Trachypus petiolatus (Spinola)

Tibus: Aphilanthopini
Subtribus: Aphilanthopina
115.Gen: Aphilanthops Patton
115.226. Aphilanthops frigidus (F.Smith)
116.Gen: Clypeadron Patton
115.227. Clypeadron laticinctus (Cresson)

Tribus: Odontosphecini
117.Gen: Odontosphex Arnold
117.228. Odontosphex paradoxus Menke

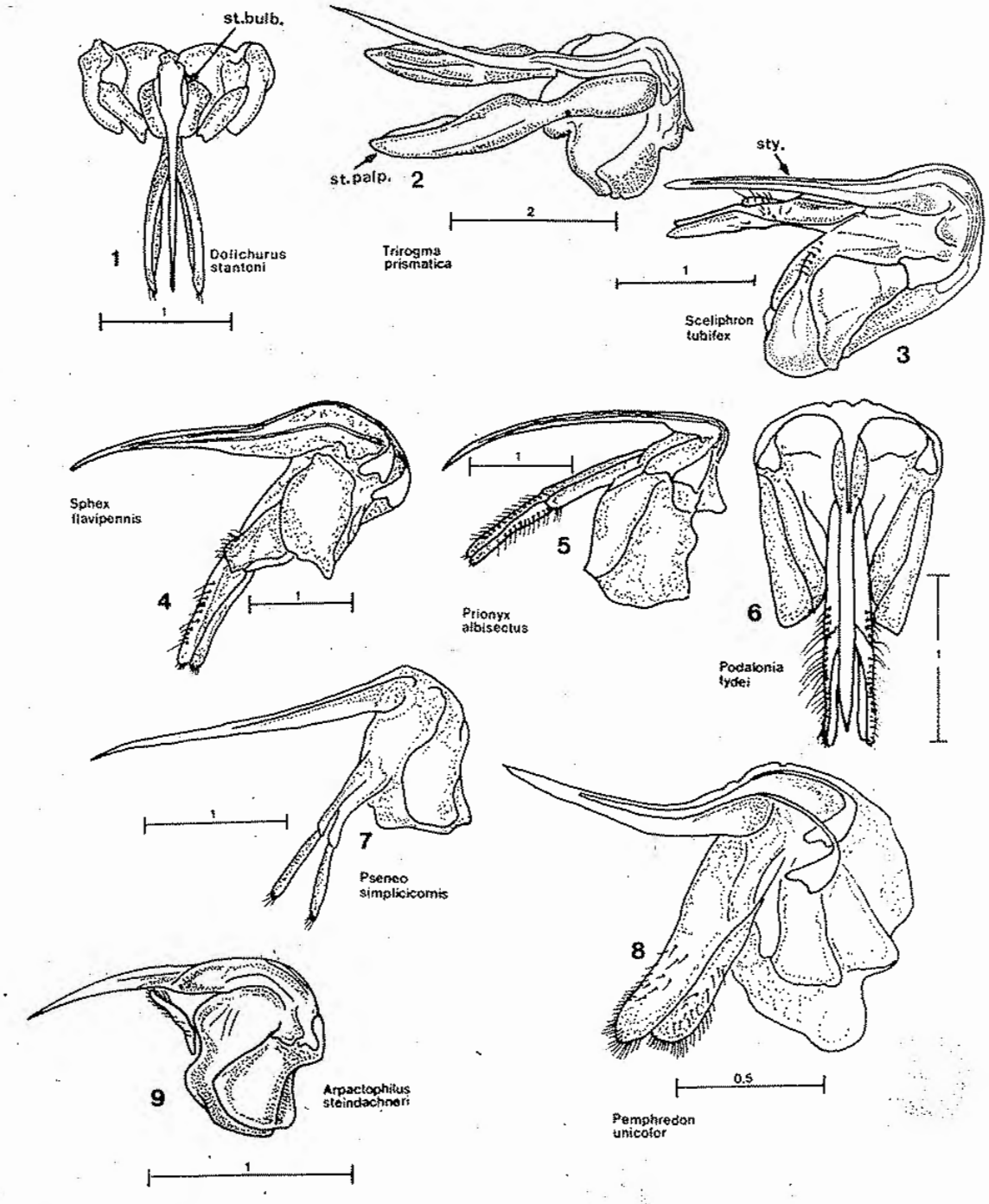
Tribus: Pseudoscolini
118.Gen: Pseudoscolia Radoszkowski
118.229. Pseudoscolia dewitzii (Kohl)

Tribus: Cercerini
119.Gen: Cerceris Latreille
119.230. Cerceris bicornuta Guérin - Méneville (=C.Fidelis)
119.231. Cerceris atramontensis Banks
119.232. Cerceris californica Cresson
119.233. Cerceris fumipennis Say
119.234. Cerceris frontata Say
119.235. Cerceris mimica Cresson
119.236. Cerceris ruficornis (Fabricius)
119.237. Cerceris rybiensis Ed.André
119.238. Cerceris sabulosa (Pauzer)
119.239. Cerceris flavilabris (Fabricius)
119.240. Cerceris quadrifasciata (Pauzer)
119.241. Cerceris arenaria (Linnaeus)
119.242. Cerceris albofasciata (Rossi)
120. Gen: Eucerceris Cresson
120.243. Eucerceris canaliculata (Say)
120.244. Eucerceris flavocincta Cresson
120.245. Eucerceris rubripes Cresson
120.246. Eucerceris zonata (Say)

lini. Bohart and Menke, 1976, recognized only three bribes– Sceliphrini, Sphecini and Ammophilini.

Stangeella, the only genus of the tribe Stangeellini, is characterized by strong and robust stylet. The basal part of the sting apparatus (bulbus) is elongate and narrow. Sting palpi are two–segmented. Lancets are with spines on the distal end. Preys consists primarily of Mantidae, but species of the genus *Bacteria* have also been recorded. The general structure of the sting apparatus is highly suggestive of the tribe Sphecini, rather than the tribe Sceliphrini. However, the presence of spines on the lancets is distinctive in *Stangeella;* these spines are absent in the Sceliphrini and Sphecini, but are present in the Ammophilini.

Species of the genus *Sceliphron* (Sceliphrini) have a straight sting stylet. This correlates with their less vagile prey (Aranea) (Fig. 3).



Figs. 1–9. Sting apparatus of some analysed species. 1 and 6 anterodorsal view; 2, 3, 4, 5, 7, 8 and 9 lateral view. st. bulb. = sting bulbus; st. palp. = sting palpus; sty. = stylet

Representatives of the tribe Sphecini have a rather elongate sting apparatus, the stylet is narrow and slightly curved, and their preys are various species of Orthoptera (Figs. 4,5).

The sting lancets in the Ammophilini (Fig. 6) have spines. Except for *Eremochares*, the genera of this tribe attack lepidopterous caterpillars exclusively. The completely straight stylet of the sting is probably correlated with their slowly moving prey. Their lancets have spines on the distal part, which, as in the species of the genus *Trirogma*, is probably correlated with the less sclerotised body wall of the prey.

Pemphredoninae:

Species of the subfamily Pempredoninae (Figs. 7, 8, 9) have an extremely sclerotised stylet which is slightly curved or almost straight. Such a structure of the stylet is certainly linked with the lesser mobility of their preys, which is made up of various species of Homoptera.

Reperesentatives of the tribe Pemphredonini (preys Aphididae) are characterized by presence of spines, while Psenini (preys Cicadidae, Cercopidae, Fulgoridae) have no spines on the distal part of lancet. The presence or absence of spines on the lancets in these can thus be correlated with the sclerotisation of the body wall of the prey.

Astatinae:

Some species of the subfamily Astatinae (representatives of the tribe Astatini) are distinguished by one–segmented sting palpi, which is relatively rare within the Sphecidae. The slightly curved stylet of the sting apparatus of the species of the subfamily Astatinae is certainly correlated with their less vagile preys (Hemiptera).

Larrinae:

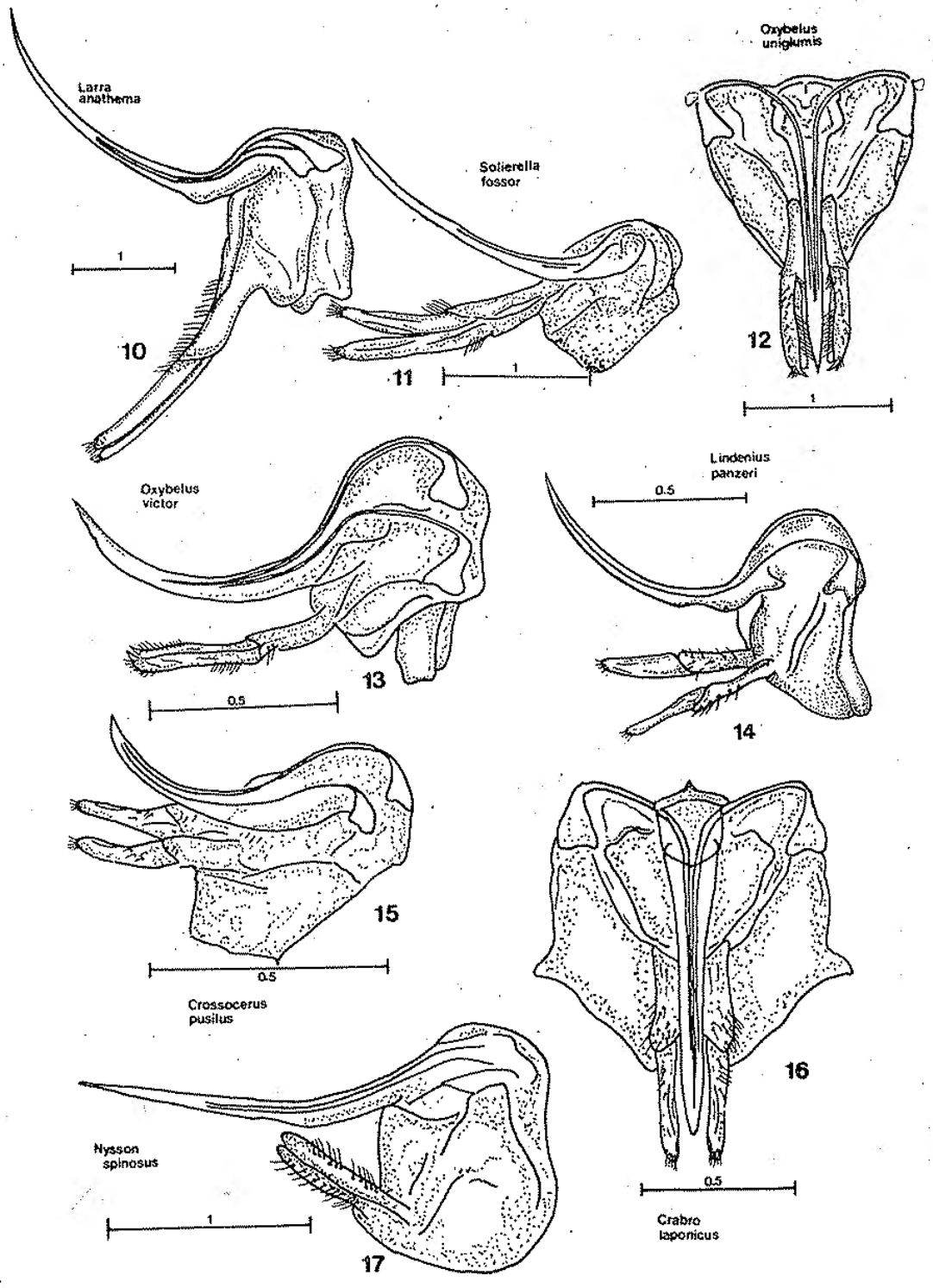
Within the subfamily Larrinae, the genus *Larra* (Larrini) (Fig. 10) frequently attacks its large and powerful preys Gryllotalpidae – underground. The powerful and extremely curved stylet of the sting apparatus is probably connected with this habit.

Representatives of the tribe Palarini are distinguished, too, by their very curved sting stylet, and they find their prey among the highly vegile species of the many families of Hymenoptera (Ichneumonidae, Tiphidae, Scoliidae, Sphecidae, Pompilidae, Vespidae and various bees).

The long and slightly curved stylet of the species of the genus *Larrisson* (tribe Miscophini), whose biology is otherwise unknown, points to the supposition that their preys are probably found among the less vagile insect species. We can perceive the influence of the mobility of the prey on the shape of the stylet of the sting within this tribe very graphically in the species of the genus *Solierella*. Thus in the species whose preys are Hemiptera, the stylet of the sting is slightly curved, but almost straight, while in the species whose prey are Acrididae it is clearly curved (Fig. 11).

Crabroninae:

Within the subfamily Crabroninae, representatives of the tribe Oxybelini, i.e. species of the genus *Oxybelus* exibit a particularly interesting structure of the sting apparatus (Figs. 12, 13). The preys of the species of this genus are the highly vagile Diptera – Muscidae, which it attacks and stings in flight. The extremely curved stylet is



Figs. 10–17. Sting apparatus of some analysed species. 12 and 16 anterodorsal view; 10, 11, 13, 14, 15 and 17 lateral view.

certainly connected with this highly vagile preys and the method of stinging. Species of the genus *Oxybelus* transport their paralysed prey impaled on the stylet of the sting to their nest. The presence of thorny outgrowths on the distal part of the palpi (valvulae III), which probably have the function of securring prey impaled on the stylet of the sting in transport, represents adaptation to this kind of transportation. Apart from that, the presence of well developed spines on the distal part of the lancets probably also has the function of securing the prey impaled on the stylet of the sting, similarly to the species which sting less sclerotised prey.

It is also possible to see a clear correlation between the shape of the stylet (the degree of its curve) and the species and mobility of prey in the case of representatives of the tribe Crabronini. Thus the species of the genus *Encopognathus* (preys Formicidae), *Lindenius, Podagritus, Moniaecera, Crossocerus, Crabro, Piyuma, Dasyproctus, Ectemnius* (prey Diptera) and *Lestica* (prey adults of Lepidoptera) are distinguished by their extremely curved stylet (Figs. 15, 15, 16).

Xenosphecinae:

Species of this subfamily are also distinguished by the extremely curved stylet of the sting, and their preys consists of the vagile Diptera – Bombyliidae.

Nyssoninae:

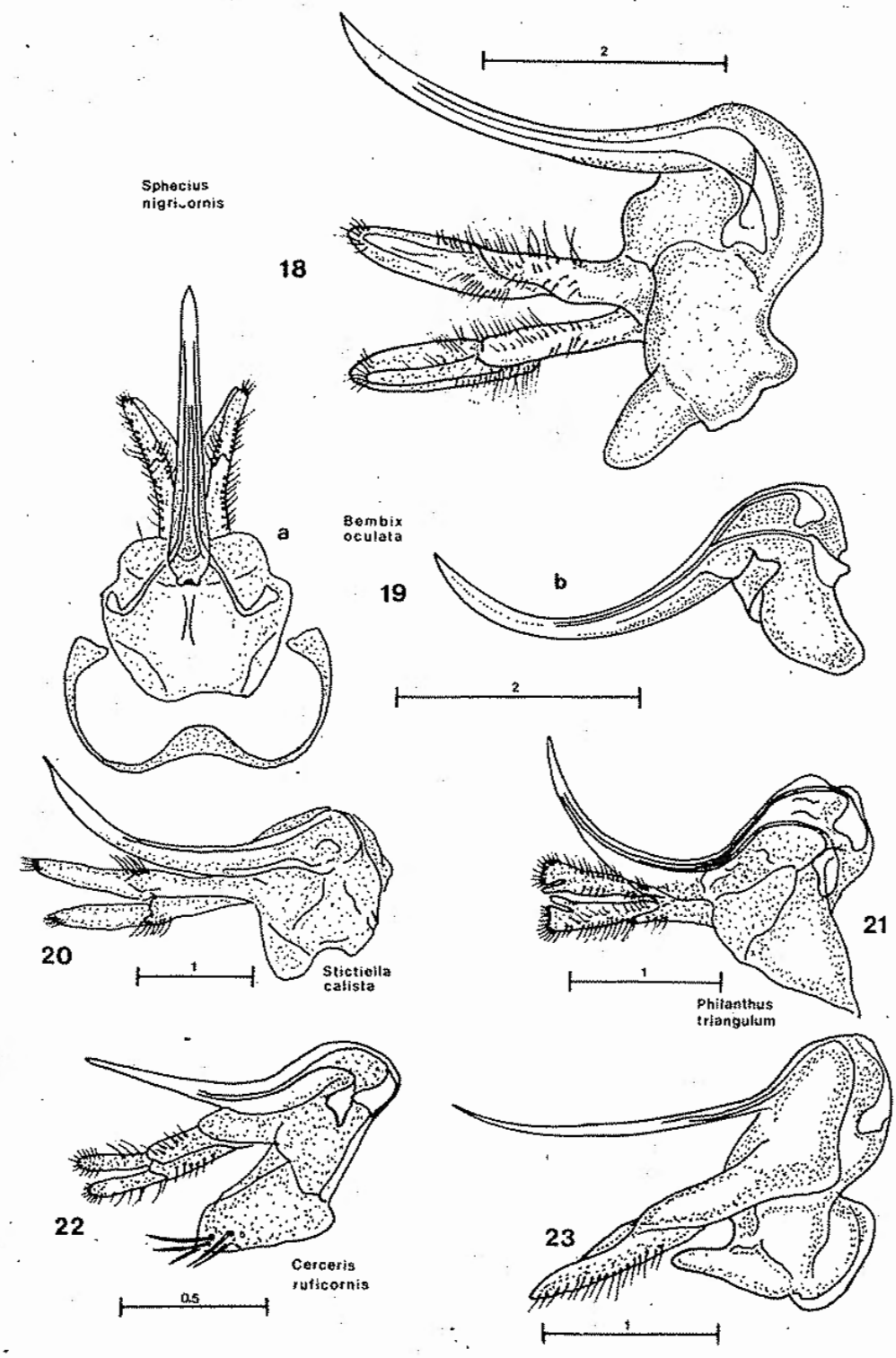
Within this subfamily, species of the tribe Nyssonini are cleptoparasites. Species of this tribe use as food for their larvae the paralysed preys of other species of the family Sphecidae and lay their eggs beside the eggs of the host. In this way their sting apparatus does not have the function of an organ for securing food. The stylet of their sting is completely straight and devoid of spines on the lancetae (Fig. 17) and sting apparatus is practically without any adaptation correlated with the mobility of their preys.

Within the tribe Gorytini, in the species of the genus *Sphecius,* we encounter the most highly developed sting apparatus within the whole family Sphecidae, which is without a doubt correlated with the large species of cicadas which are their preys (Fig. 18).

Species of the tribe Bembicini supply their larvae successively with frech preys, in which process the species and size of the preys depends on the stage of development of the larvae. Species of the genus *Bembix, Rubrica* and *Zyzzyx* use Diptera as preys, and their sting apparatus has a powerfully developed and curved stylet (Fig. 19). A similar structure of the sting apparatus with a powerfully developed and curved stylet is also found in the species of the genus *Stictiella* whose preys are adults of the Lepidoptera (Fig. 20). The correlation between the structure of the sting apparatus, i.e. the form of the stylet and the mobility of the preys, is clearly seen in species of the genus *Microbembix,* which use dead insects or other arthropods as their preys. The stylet of their sting apparatus is rather tender and short.

Philanthinae:

Within the subfamily Philanthinae, species of the genus *Philanthus,* have a highly specific structure of the sting palpi, which are bifurcate on their distal part and are clearly



Figs. 18–23. Sting apparatus of some analysed species. 19a anterodorsal view; 18, 19b, 20, 21, 22 and 23 lateral view.

differentiated from the sting palpi of the species of the genus *Trachypus*. In the species of both these genera the stylet of the sting is clearly curved, and their preys concists of the highly vagile insect species (Hymenoptera, Apidae), (Fig. 21).

The correlation between the mobility of the prey and the form of the stylet of the sting is also seen in the representatives of the tribe Cercerini. Thus in the species of the genus *Cerceris*, whose preys are Hymenoptera, the stylet is clearly curved, while in the species whose preys are the less vagile Curculionidae (Coleoptera) the stylet is almost straight. Straightness of the stylet is also characteristic of the species of the genus *Eucerceris*, which use Curculionidae as preys too (Figs. 22, 23).

Conclusion

The results of this comparative–morphological study of the sting apparatus (female terminalia) of Sphecidae have confirmed family classification and phylogenetic relationships suggested by B o h a r t and M e n k e (1976). The only exception is placing the genus *Stangeella* into a separate tribe.

As regards adaptive changes in the structure of the sting apparatus within all subfamilies of the Sphecidae there is a clear correlation between the structure and shape of the stylet of the sting apparatus on the one hand, and species, sclerotisation and mobility of the prey on the other hand.

These adaptive changes can be summarized as follows :

– sphecids whose preys are good fliers (Diptera, Hymenoptera, Lepidoptera) and who sting while in flight, have an extremely curved sting stylet;

– sphecids preying on slower moving or nonflying insects (Orthoptera, Hemiptera, Coleoptera) and which sting their prey in situ, have a slightly curved sting stylet;

– the representatives of the family Sphecidae whose preys are slow moving catarpillars of Lepidoptera or slow moving spider species have a somewhat curved or straight stylet of the sting;

– the representatives of the family Sphecidae whose preys are adults or larvae of the insect species with the less sclerotized body wall are characterized by the spines on the distal part of the lancets which probably make it possible to keep the stylet in the body of the victim;

– some *Oxybelus* species with a special prey–carrying mechanism (prey is impaled on the sting and carried at flight) are characterized by the presence of thorny outgrowths on the distal part of the palpi (valvulae III) which probably have the function of securing prey impaled on the stylet.

A c k n o w l e d g e m e n t s: I wish to dedicate this paper to early deceased Dr. Paul D. H u r d, Jr. in dear memory and gratitude for his kind and unselfish help during my stay in Smithsonian Institution in 1979/80.

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Literature Cited

Bernard, F. 1951: Ordre des Hymenoptères; Anatomie et physiologie, pp. 771–820. In Grasse, P.P., Traité de Zoologie, Tome X, Premier fascicule. Masson et C^ie Editeurs. Paris.

Bohart, R.M. and A.S. Menke, 1976: Sphecid Wasps of the World, a generic revision. University of California Press. Berkeley, 695 pp.

Bordas, L. 1895: Appareil glanulaire des Hymenoptères. Ann. Sci. nat. Zool. **7**, ser. 19. 1. 362.

Kasparyan, D.R. 1980: A functional aspect of the evolution of the sting of Hymenoptera. Rev. Entomol. URSS **59** (1): 60–66.

Kugler, Ch. 1978: A comparative study of the myrmicine sting apparatus (Hymenoptera, Formicidae). Studia Entomol., **20** (1–4): 413–548.

Maschwitz, U. and W. Kloft. 1971: Morphology and function of the venom apparatus of insects – bees, wasps, ants and caterpillars. In: W. Buchler and E.E. Buckley eds., Venomous Animals and Their Venoms. Vol. III. Academic Press, New York.

Matsuda, R. 1976: Morphology and evolution of insect – abdomen. Pergamon Press Inc., New York, 534 pp.

Oeser, R. 1961: Vergleichend – morphologische Untersuchungen über den Ovipositor der Hymenopteren. Mitt. Zool. Mus. Berl., **37**: 3–119.

Pawlowsky, E.N. 1927: Gifttiere und ihre Giftigkeit. G. Fisher Verlag, Jena, 516 pp.

Radović, T.I. 1976: Morphological characteristics of living forms of digger-wasps (Sphecidae) with the special regard to adaptive changes of fore leg structure and sting. Unpublished M.S. thesis. Faculty of Science, University of Belgrade, Belgrade, Yugoslavia, 120 pp. 149 figs.

Radović, T.I. 1981a: Anatomy and function of the sting apparatus of the stingless bees (Hymenoptera: Apidae: Apinae: Meliponini). Proc. Entomol. Soc. Wash. 83: 269–273.

Radović, T.I.1981b: Comparative–morphological study of Sphecoidae and Apoidae with special reference to their phylogeny and position in the classification of the aculeate Hymenoptera. Unpublished Ph. D. thesis. Faculty of Science, University of Belgrade, Belgrade, Yugoslavia, 308 pp. 542 figs.

Radović, T.I. and P.D. Hurd, Jr. 1980: Skeletal parts of the sting apparatus of selected species in the family Andrenidae (Apoidae: Hymenoptera). Proc. Entom. Soc. Wash. 82: 562–567.

Rathmayer, W. 1978: Venoms of Sphecidae, Pompilidae, Mutillidae and Bethylidae pp. 661–690. In; Bettini, S. ed., Handbook of experimental pharmacology, Vol. **48**, Arthropod Venoms. Springer Verlag. Heidelberg – New York.

Robertson, P.L. 1968: A morphological and functional study of the venom apparatus in representatives of some major groups of Hymenoptera. Aust. J. Zool. **16**: 133–166.

D'Rozario, A.M. 1940: On the development and homologies of the genitalia and their ducts in Hymenoptera. Trans. R. Entomol. Soc. London. **92**: 363–415.

Richards, O.W. 1977: Hymenoptera. Introduction and key to families. Handbook for the identification of British insects. Vol. 6. Part 1: 1–100.

Stephen, W.P., G.E. Bohart and P.F. Torchio. 1969: The biology and external morphology of bees. Dep. of printed Oregon State University, Corvallis, Oregon. 140 pp.

Acta entomol., Jugosl., Vol. 21, 1985, 1–2: 61–74.
RADOVIĆ, I.T.: Morphology... of the Stind Apparatus of Digger Wasps (Hym., Sphecidae)

Sažetak

MORFOLOGIJA I ADAPTIVNA VREDNOST ŽAOČNOG APARATA OSA KOPAČICA (HYM. SPHECIDAE)

Ivica T. RADOVIĆ
Beograd

Uporedno–morfološka studija žaočnog aparata 246 vrsta iz 120 rodova fam. Sphecidae (Tab. 1) ukazala je na određene adaptivne promene u građi ovih organa. Ove promene su posebno uočljive u građi stileta žaoke (valvule I i valvule II) i manifestuju se u korelaciji između oblika stileta i mobilnosti plena (Tab. 2). Kod onih vrsta iz fam. Sphecidae čiji plen predstavljaju insekti dobri letači (adulti Diptera, Hymenoptera i Lepidoptera) stilet žaoke je jasno povijen. Na drugoj strani one vrste čiji plen čine slabije pokretni insekti (Homoptera, Coleoptera i gusenice Lepidoptera) i pauci odlikuju se manje povijenim ili čak potpuno pravim stiletom žaoke.

Address of the author:
Ivica T. RADOVIĆ
Institute of Zoology, Department of Biology,
Faculty of Science, University of Belgrade,
11000 Belgrade, Studentski Trg 16.

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RESPONSE OF *MORIMUS FUNEREUS* L. (COL., CERAMBYCIDAE) LARVAE TO THE EFFECT OF DIFFERENT FACTORS AT THE LEVEL OF NEUROSECRETORY SYSTEM, HAEMOLYMPH AND MIDGUD

Jelisaveta IVANOVIĆ, Miroslava JANKOVIĆ–HLADNI, Vlasta STANIĆ and Dobrila KALAFATIĆ
Belgrade

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ABSTRACT. – *IVANOVIĆ Jelisaveta, JANKOVIĆ–HLADNI Miroslava, STANIĆ Vlasta and KALAFATIĆ Dobrila,* Inst. for Biol. Res. „S. Stanković", Belgrade, YU. – Response of *Morimus funereus* L. (Col., Cerambycidae) larvae to the effect of different factors at the level of neurosecretory system, haemolymph and midgud. – Acta entomol. Jugosl., 1985. **21**. 1–2. 75–78. (Engl., Serbo–Croat. summ.).

The complex effect of different factors (unfavourable temperature, starvation, injection of potassium saline and/or cerebral complex extract into larvae) on protocerebral neurosecretory cells, haemolymph trehalose concentration, midgut proteolytic and amylolytic activities of *Morimus funereus* larvae (Coleoptera, Cerembycidae) has been studied. The experimental factors exhibit either stimulatory or inhibitory effects on the parameters studied. These effects were dependent upon the factor itself and the exposure time of the larvae to it, the parameter studied and the previous physiological state of the larvae.

Coleoptera–Cerambycidae, Morimus funereus, enzyme activity, neurosecretory cells, hemolymph, stress

Introduction

Recently the diversity of the structure and function of neurohormones in insects has been indicated, as well as their significance in the evolution, adaptation and stress. It was expected that the effect of different factors (physical, chemical, biological) comparatively studied at the level of neurosecretory system and target tissues in *Morimus funereus* larvae would reveal some crucial links in the protective mechanisms of insects, giving more informations about the role of the peptidergic neurons in these mechanisms, as was already suggested by our previous studies (Ivanović et al., 1980; Janković – Hladni et al., 1983).

Materials and methods

Larvae of the cerambycid beetle *M. funereus* were collected from oak stumps of a saw–mill depot at the end of September. These larvae were used as the control (NC). The larvae were divided into identical experimental groups according to body weight (300–1000 mg) and exposed to the effect of the following factors : 1. larvae exposed to 23°C for 7 days (F); 2. temperature treated larvae starved for 4 days (ST); 3. temperature treated and starved larvae injected with 0.7% KCl solution (S) or 4. with the cerebral complex extract (E). The extract was prepared from the larval cerebral complex (without corpora allata) homogenate suspended in potassium saline (18 heads/ml) and filtered prior to injection. Each recipient received 0.2 μl/mg body weight of the extract or potassium saline. The treated larvae were killed at different time intervals following injection (see Fig. 1 B,C.D) but always betwen 7 and 9 hours a.m.

The cytological and biochemical parameteters were studied comparatively : 1. activity of the protocerebral neurosecretory system i.e. medial (MNC) A1 and A2, and lateral (LNC) L1 and L2 neurosecretory cells; 2. digestive enzyme activity (proteolytic activity – SPA and amylolytic activity – SAA) and 3. haemolymph trehalose concentration (TC). The cerebral neurosecretory system was severed, fixed in Bouin's solution, embedded in paraffin wax (56°C m.p.). The sections were stained with paraldehyde fuchsin–azocarmin G or with paraldehyde–thioninparaldehyde fuchsin (PTh–PF) techniques (P a n o v, 1980). The SPA and SAA were determined in aqueous midgut extracts as reported previously (I v a n o v i ć et al., 1975). The TC was determined in pooled haemolymph spectrophotometrically at 630 nm using the anthron reaction (W y a t t and K a l f, 1957).

Results and discussion

The results concerning these studies are presented in Fig. 1 A,B,C,D. The analysis of the protocerebral MNC (A1,A2) and LNC (L1, L2) shows that under the experimental conditions different changes in the size of nucleoli, as well as in the quality, quantity and appearance of neurosecretory material take place. These findings indicate the selective response at the level of different neurosecretory cell subtypes, suggesting the differences in their physiological role as well. The most conspicuous changes are observed in the subtype A1 i.e. these cells are probably the most sensitive to the changes in the external and internal environment.

The results related to the digestive enzyme activity (SPA, SAA) and haemolymph trehalose concentration (TC) show that SPA and TC in the majority of the experimental conditions are decreased, while SAA is increased when compared to the control (NC). It is evident that the decrease of SPA and TC has different physiological significance. From the biochemical parameters studied the SPA shows the highest sensitivity to the effect of different factors, while the TC was the most unaffected. The temperature treated larvae show an abrupt decrease of SPA, significant increase of SAA (compensatory response) and slight decrease of TC. The double stress (unfavourable temperature and starvation) provokes compensatory response at the level of SPA. The potassium saline and cerebral complex extract have stimulatory or inhibitory effect on the activity of both enzymes, depending on the exposure time of the larvae to their action. It is interesting to note that

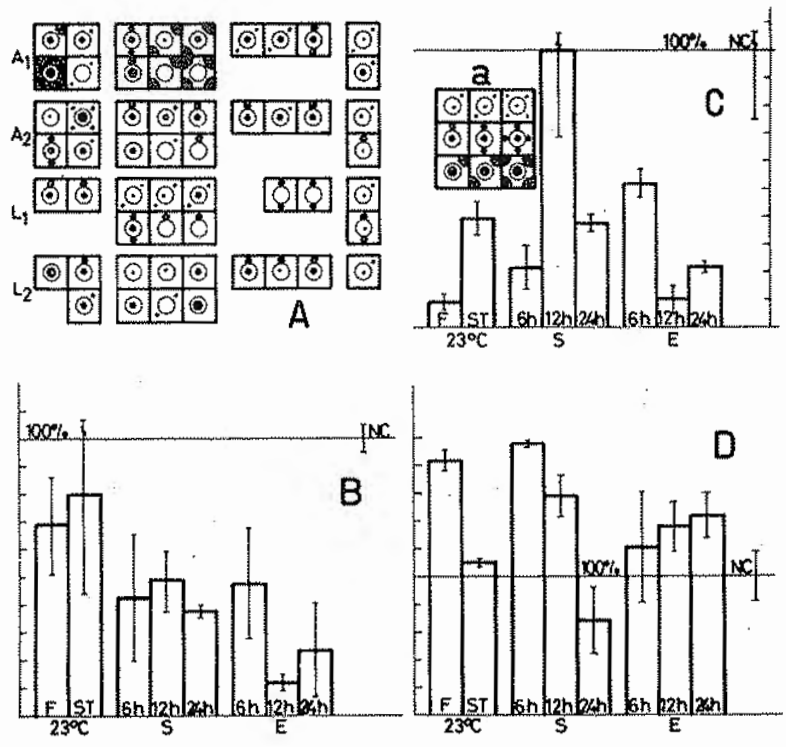

Fig. 1. The complex effect of different factors (constant temperature, starvation, KCl solution, cerebral complex extract) on *M. funereus* larvae.
A. The activity of protocerebral medial (A1 and A2) and lateral (L1 and L2) neurosecretory cells. Criteria for the evaluation of the cell activity : size of nucleoli, size and quantity of neurosecretory granules, designated as small, medium or large.
B. Haemolymph trehalose concentration;
C. Midgut proteolytic activity;
D. Midgut amylolytic activity.
NC – control larvae from natural conditions; F – fed larvae; ST – starved larvae; S – injected with KCl solution; E – injected with cerebral complex extract. Vertical bars indicate ± S.E. (standard error).

SPA reaches the control level again, 12 hours after the potassium saline has been injected, whereas after the injection of the cerebral complex extract it drops to a negligible value, similar to that observed in temperature treated larvae.

Conclusion

From the above results one may conclude that the interrelationship between the activity of protocerebral MNC and LNC, – SPA, SAA and TC could be used as the criterion for the evaluation of the intensity of a stress in *M. funereus* larvae. Having in mind the sensitivity of the neurosecretory cells to the effect of different factors, as well as the selective response of different cell subtypes to the same factor, it could be suggested that peptidergic neurons play the crucial role in the protective mechanisms against stress factors.

Sažetak

ODGOVOR LARAVA *MORIMUS FUNEREUS* L. (COL., CEREMBYCIDAE), NA NIVOU NEUROSEKRETNOG SISTEMA, HEMOLIMFE I CREVA NA DELOVANJE RAZLIČITIH FAKTORA

Jelisaveta IVANOVIĆ, Miroslava JANKOVIĆ–HLADNI, Vera STANIĆ i Dobrila KALAFATIĆ
Beograd

Ispitano je složeno delovanje različitih faktora (nepovoljna temperatura, gladovanje, ubrizgavanje 0.7% rastvora KCl i/ili ekstrakta cerebralnog kompleksa larava *M. funereus*) na aktivnost protocerebralnih neurosekretnih ćelija, aktivnost digestivnih enzima (proteaza, amilaza) i koncentraciju trehaloze u hemolimfi larava *M. funereus*.

Eksperimentalni uslovi utiču stimulativno ili inhibitorno na ispitivane parametre. Dobijeni efekti su zavisni od vrste faktora koji deluje, trajanja njegovog delovanja na larve, ispitivanog parametra i prethodnog fiziološkog stanja larve.

References

Ivanović, J., Janković–Hladni, M., and Milanović, M., 1975: Effect of constant temperature on survival rate, neurosecretion and endocrine cells, and digestive enzymes in *Morimus funereus* larvae (Cerambycidae; Coleoptera). Comp. Biochem. Physiol., **50A**, 125–130.

Ivanović, J., Janković–Hladni, M., Stanić, V. and Milanović, M., 1980: The role of the cerebral neurosecretory system of *Morimus funereus* larvae (Insecta) in thermal stress. Bull. Acad. Serbe Sci. Arts, **20**, 91–97.

Janković–Hladni, M., Ivanović, J., Nenadović, V. and Stanić, V., 1983: The selective response of the protocerebral neurosecretory cells of the *Cerembyx cerdo* larvae to the effect of different factors. Comp. Biochem. Physiol., **74A**, 131–136.

Panov, A.A., 1980: Demonstration of neurosecretory cells in the insect central nervous system. In: Neuroanatomical Techniques, Insect Nervous System (Edited by Strausfeld, N.J. and Miller, T.A.), pp 26–50, Springer Verlag, New York–Heidelberg–Berlin.

Wyatt, G.R. and Kalf, G.F., 1957: The chemistry of insect haemolymph – II. Trehalose and other carbohydrates. J.Gen. Physiol., **40**, 833–846.

Address of the authors:
Jelisaveta IVANOVIĆ
Miroslava JANKOVIĆ–HLADNI,
Vlasta STANIĆ,
Dobrila KALAFATIĆ
Department of Insect Physiology and Biochemistry,
Institute for Biological Research „Siniša Stanković"
11000 Belgrade, 29. novembra 142.

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CYTOLOGICAL CHANGES IN CORPORA ALLATA OF NEWLY EMERGED ADULT WORKER BEES *APIS MELLIFERA* L. (HYM., APIDAE)

Vera NENADOVIĆ, Miroslava JANKOVIĆ–HLADNI, Jelisaveta IVANOVIĆ and Vlasta STANIĆ

Belgrade

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ABSTRACT. – *NENADOVIĆ Vera, JANKOVIĆ–HLADNI Miroslava, IVANOVIĆ Jelisaveta and STANIĆ Vlasta,* Inst. Biol. Res. "S.Stanković", Belgrade, YU. – Cytological changes in the corpora allata of newly emerged adult worker, bees *Apis mellifera* L. (Hym., Apidae). – Acta entomol. Jugosl., 1985, 21. 1–2. 79–85. (Engl., Serbo–Croat. Summ.).

Cytological studies on the corpora allata (CA) and distal part of corpora cardica (CC) of adult worker bees *Apis mellifera* L., 0, 1, 3, 6, 12, 24 and 48 hr after emergence, has been carried out. Cyclical changes in the number of the CA cells, the size of the organ and its cells, and the degree of chromatin condensation were observed. The amount of PF+ neurosecretory material (NSM) accumulated in the distal part of the CC and nervi corpori allati (NCA) also show cyclical changes. Over the period studied, the secretory cells of the CA show successive phases of mitotic and secretory activity. The dependence of these phases, observed in the CA cells, upon the amount of PF+ NSM accumulated in the CC and NCA, is discussed.

Citology, neurohormones chromatin, mitosis, corpus allatum, corpus cardiacum

Introduction

It has been previously established that insect corpora allata (CA) i.e. the juvenile hormones (JH) play an important role in the regulation of several physiological processes, the most important being the larval development and adult reproduction. In recent years, the multiple role of the CA i.e. the JH III in worker honey bees has been intensively studied (R u t z and L ü s c h e r, 1974; R u t z et al., 1976; F l u r i et al., 1982; B ü h l e r et al., 1983). These glands i.e. the titre of the JH in the haemolymph, affecting

several physiological and behavioural processes during adult development, seem to be important for the regulation of polyphenism in worker bees (L ü s c h e r, 1976) and thus, responsible for the occurrence of the division of labour in the hive. Numerous studies have revealed that the activity of CA is regulated by the cerebral neurosecretory and nervous systems (R a a b e, 1982). Little is known about the complex mechanisms that control the activity of the CA, which could be important from the theoretical and practical aspect. Thus, more knowledge about the regulation of their activity in worker honey bees i.e. the sterile females, is desirable. We started to examine the regulation of the CA activity in relation to the activity of the neurosecretory system of worker bees, which were supposed to be the suitable model system for the above studies.

Materials and methods

Newly emerged adult worker bees (O–hour-old), offspring of the same queen from a field hive were collected at the end of May, marked with laquer and taken back to the hive. Bees 0, 1, 3, 6, 12, 24 and 48 hour after emergence were used throughout these experiments. The cerebral–complex was fixed in Bouin's solution and embedded in paraffin wax (m.p. 56°C). Serial sections of about 5 μm were stained with paraldehyde –fuchsin (PF)–azan (AZ) and paraldehyde–thionin–paraldehyde–fuchsin (PThPF) techniques (P a n o v, 1980).

The CA activity was assessed according to the size of the organ, and the number and size of its cells and nuclei. The staining properties of the neurosecretory material (NSM) and the chromatin were also considered. The size was calculated by multiplication of the major (a) and minor (b) diameters, measured at right angles on serial sections of mounted histological preparations, using a micrometer eyepiece. The mean and the standard error were calculated for each parameter analyzed. The results were presented in percents, taking the control (bees O–hour–old) as 100%. An arbitrary scale ranging from 1 (low quantity) to 4 (large quantity) was established to express the amount of NSM accumulated in the distal part of the corpora cardicca (CC) and nervi corpori allati (NCA). The cytological analysis was done using three CA i.e. 39–60 CA cells for each experimental condition.

Results

N e u r o s e c r e t o r y m a t e r i a l (NSM) i n c o r p o r a c a r d i a c a (CC) a n d n e r v i c o r p o r i a l l a t i (NCA)

Results showing cyclical changes in the amount of PF+ NSM accumulated in the distal part of the CC and NCA of adult worker bees over the period studied (0–48 hr) are presented in Fig. 1. The largest amount of NSM accumulated in the distal part of the CC was observed in worker bees 3 and 48 hr after emergence. Small quantity was found in bees O–hr–old, while in those aged 12 hr, it was below the control. In bees 1, 6, and 48 hr after emergence the amount of NSM accumulated in NCA reaches a maximum, while in 12 and 24–hr–old bees it is at the control level.

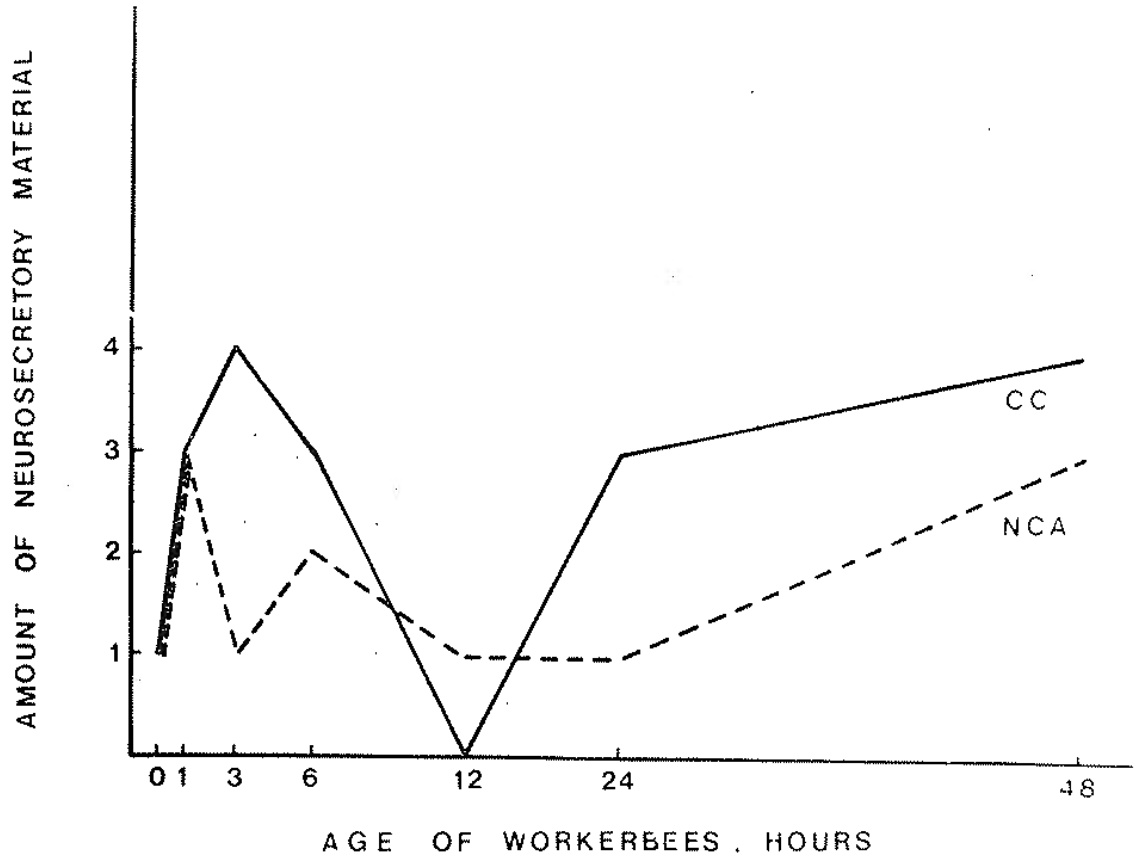

Fig. 1. Changes in the amount of NSM in the distal part of the CC and NCA in newly emerged adult worker bee, *Apis mellifera.*

Corpora allata (CA)

Changes in the number of CA cells and the size of the CA, their cells and nuclei are shown in Fig. 2A, B. Significant cyclical changes in the number of the CA cells were observed in worker bees in time intervals studied. The greatest number of cells was found in 1– and 12–hr–old bees, the smallest one in those aged 6 and 48 hr (Fig. 2A).

The size of the whole organ and its cells show parallel cyclical changes (Fig. 2B). The same trend is observed in the size of nuclei, but here, it is less pronounced. All the three parameters studied reach their first maximum in bees 3 hr after emergence. This maximum is phase shifted in comparison to that shown for the number of the cells (1–hr–old). The second peak is seen in 12–hr–old bees, and the third one in bees aged 48 hr, i.e. at the moment of a significant drop in the number of the CA cells.

Cytological studies on CA cells (Fig. 3) reveal a cycle in the staining properties and the degree of the condensation of the chromatin. In newly emerged adult bees (0–hr–old), the nuclei show AZ+ reaction and a high degree of chromatin condensation. In the cytoplasm RF+ dusty granules are visible. The chromatin of worker bees 1– and 6–hr–old has similar characteristics, but in these bees also cell division of the CA cells takes place. In the bees aged 3 and 48 hr heterochromatin is less condensed i.e.

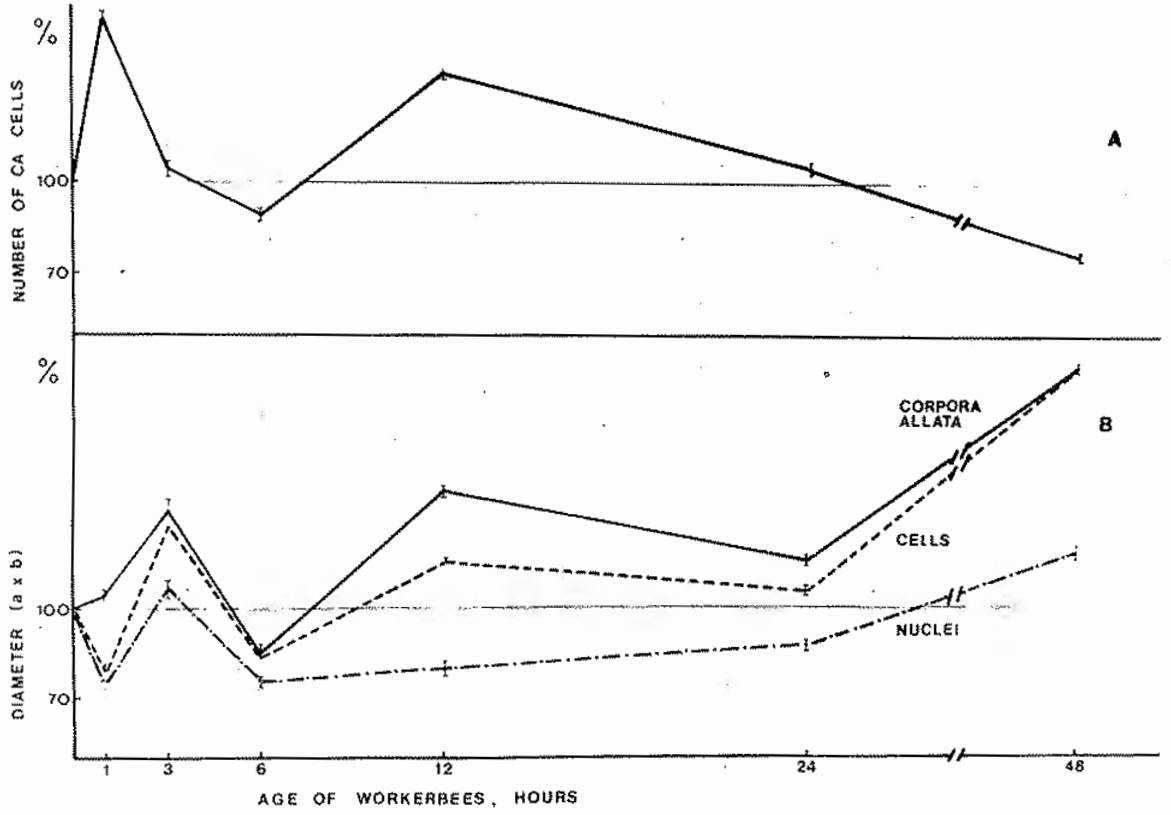

Fig. 2. Changes in the number of the CA cells (A) and in the size of the CA, their cells and nuclei (B) in newly emerged adult worker bee, *Apis mellifera*.

euchromatin becomes dominant. Heterochromatin retain the affinity for acid dyes, altough its reaction changes from AZ+ to orange G+. An intermediate degree of chromatin condensation, when compared to the above mentioned cases, is seen in bees 12 and 24 hr after emergence. It is interesting to note, that in the cells of 12–hr–old bees mitosis is observed, whereas the CA cells of 24–hr–old bees show degenerative changes. The nuclei show AZ+ and orange G+ reaction.

Discussion

Our results, showing that there are cyclical changes in the CA activity in adult worker bees aged from 0–48 hr agree with those obtained for species belonging to other insect orders (Raabe, 1982). Rutz et al., (1976) found a positive correlation between the volume of the CA and the titre of JH III in the haemolymph of the worker bees, thus, the changes in the CA volume reflect the changes in the synthetic activity of the gland. In earlier studies, performed on hive bees aged 0 to 25 days and at time intervals of 48 hr, the cyclical activity of the CA was not evident (Gast, 1967; Rutz and Lüscher, 1974). The discovery of such cycle in the activity of the CA of worker bees was possible in studies performed in shorter time intervals (0, 1, 3, 6 and 12 hr).

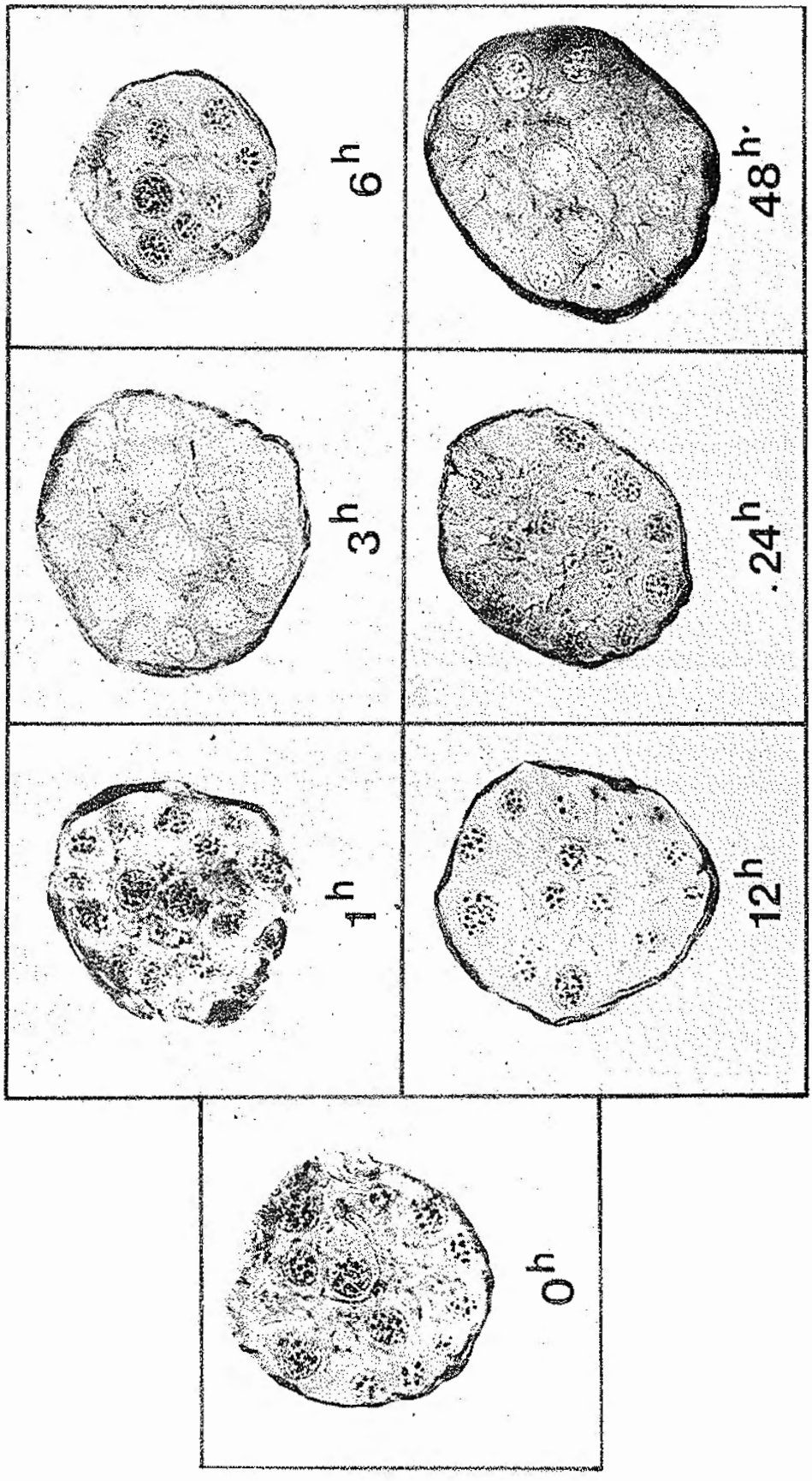

Fig. 3. Cytological changes in the CA of newly emerged adult worker bee, *Apis mellifera*. PF–AZ; PThPF; X 560

In the period preceeding the transformation process of newly emerged bees into nurse bees, significant cyclical changes in the amount of NSM in the distal part of the CCA and NCA were observed. It is possible that these changes are in correlation with the cyclical changes in the activity of the CA cells. In some cases, a correlation between the concentration of NSM in CA and the intensity of the gland activity was described. In *Periplaneta americana*, either in larvae or in adults, the amount of NSM in the CA decreases with an increase in the gland volume (K h a n et al., 1978).

In the course of our investigation, two phases in the CA activity, cyclically interchanged, were distinguished: 1) domination of mitotic nuclei surrounded by a narrow strip of cytoplasm and cell divisions (0, 1, 6 hr); 2) domination of the nuclei in the interphase, with abundant cytoplasm (3, 48 hr). In the phase in which mitotic nuclei are dominant, there is an increase in the amount of NSM in NCA (1, 6 hr). On the other hand, in the phase in which interphase nuclei are abundant (3 hr), the quantity of NSM in NCA decreases. Simultaneously, it increases in the distal part of the CC (3 hr). S c h a r r e r (1964, 1978) described in secretory cells of active and inactive CA of *Leucophaea maderae* a positive correlation between the volume of the cytoplasm and the degree of development of their cell organelles (Golgi bodies, ergastoplasm, mitochondria). An examination of the secretory CA cells during larval development of worker bees has shown that their nuclei undergo the phases of condensation and decondensation of the chromatin (U l r i c h and R e m b o l d, 1983). The authors assume that these phases of chromatin condensation and decondensation were correlated with the changes in the activity of the CA, suggesting that during chromatin condensation endomitosis takes place. Our studies concerning the chromatin properties have shown, that during the experimental period lasting from 0 to 48 hr, the nuclei of the CA cells show phases of high chromatin condensation, followed by mitosis and increase in the number of the cells, and phases of low degree of chromatin condensation, followed by an increase in the size of the organ and its cells. The increased size of the CA and its cells, as well as the characteristics of the chromatin, led us to the conclusion, that at this phase the JH III is synthetized.

It is yet not clear what induces the cyclical changes in the activity of the CA of *Apis mellifera* i.e. which role play the neurohormones (allatotropin, allatoinhibin), which one the feed back mechanism via the JH III (M c C a f f e r y and H i g h n a m, 1975) as well as the changes in the membrane permeability (L e z z i and F r y g, 1971; M e d d r e l and N o r d m a n n, 1979).

References

Bühler, A., Lanzrein, B. and Wille, H., 1983: Influence of temperature and carbon dioxide concentration on juvenile hormone titre and dependent parameters of adult worker honey bees *(Apis mellifera L.)*. J. Insect Physiol. **29**: 885–893.

Fluri, P., Lüscher, M., Wille, H. and Gerig, L., 1982: Changes in weight of the pharyngeal gland and haemolymph titres of juvenile hormone, protein and vitellogenin in worker honey bees. J. Insect Phyisiol. **28**: 61–68.

Gast, R., 1967: Untersuchungen über den Einfluss der Königinnensubstanz auf die Entwicklung der endokrinen Drüsen bei der Arbeiterin der Honigbiene *(Apis mellifica)*. Insectes Soc. **14**: 1–12.

Khan, T.R., Singh, S.B., Singh, A.K. and Singh, T.K., 1978: Neurosecretory control of corpora allata activity in cockroach, *Periplaneta americana* L. Experientia **34**: 49–51.

Lezzi, M. and Frigg, M., 1971: Specific effects of juvenile hormone on chromosomic function. Mitt. Schweiz. Ent. Ges. **44**: 163–170.
Lüscher, M., 1976: Phase and caste determination in insects. Endocrine Aspects. Proc. XV Int.Cong.Ent., Washington DC, 1976.
Maddrell, S.H.P. and Nordmann, J.J., 1979: Neurosecretion, p. 173, Blackie, Glasgow.
McCaffery, A.R. and Highnam, K.C., 1975: Effects of corpora allata on the activity of the cerebral neurosecretory system of *Locusta migratoria* R. and *F.* Gen. Comp. Endocrinol. **25**: 358–372.
Panov, A.A., 1980: Demonstration of neurosecretory cells in the insect central nervous system. In Neuroanatomical Techniques, Insect Nervous System (Ed. by Strausfeld, N.J. and Miller, T.A.), 26–50, Springer, New York.
Raabe, M., 1982: Insect Neurohormones, p. 352, Plenum Press, New York.
Rutz, W. and Lüscher, M., 1974: The occurrence of vitellogenin in workers and queens of *Apis mellifica* and the possibility of its transmission to the queen. J. Insect Physiol. **20**: 897–909.
Rutz, W., Gerig, L., Wille, H. and Lüscher, M., 1976: The function of juvenile hormone in adult worker honeybees, *Apis mellifera*. J. Insect Physiol. **22**: 1485–1491.
Scharrer, B., 1978: Histophysiological studies on the corpus allatum of *Leucophaea maderae*. IV Ultrastructure during normal activity cicle. Z. Zelforsch. Mikrosk. Anat. **62**: 125–148.
Scharrel, B., 1978: Histophysiological studies on the corpus allatum of *Leucophaea maderae*. VI Ultrastructural characteristics in gonadectomized females. Cell Tissue Res. **194**: 533–545.
Ulrich, G.M. and Rembold, H., 1983: Cast–specific maturation of the endocrine system in the female honey bee larva. Cell Tissue Res. **230**: 49–55.

Sažetak

CITOLOŠKE PROMENE CORPORA ALLATA KOD TEK IZLEGLIH RADILICA PČELE *APIS MELLIFERA L.* (HYM., APIDAE)

Vera NENADOVIĆ, Miroslava JANKOVIĆ–HLADNI, Jelisaveta IVANOVIĆ i Vlasta STANIĆ

Beograd

Vršena su citološka ispitivanja corpora allata (CA) i distalnog dela corpora cardiaca (CC) kod radilica *Apis mellifera,* starih 0, 1, 3, 6, 12, 24 i 48 h. Rezultati pokazuju da postoje ciklične promene u broju ćelija CA, veličini CA i njegovih ćelija i u stepenu kondenzacije hromatina. Ciklične promene su konstatovane i u količini PF+ neurosekretnog materijala (NSM) u distalnom delu CC i u nervi corpori allati (NCA).

Sugerisano je da tokom ispitivanog perioda sekretne ćelije ovog organa prolaze sukcesivno kroz različite faze aktivnosti: mitotsku i sekretnu. Diskutovana je zavisnost ovih faza od količine PF+NSM u distalnom delu CC i u NCA.

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Address of the authors:
Vera NENADOVIĆ,
Miroslava JANKOVIĆ–HLADNI,
Jelisaveta IVANOVIĆ,
Vlasta STANIĆ
Department of Insect Physiology and Biochemistry
Institute for Biological Research „Siniša Stanković"
11000 Belgrade, 29. novembra 142.

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FEEDING HABITS, BEHAVIOUR, OVIPOSITION AND LONGEVITY OF THE ADULT CERAMBYCID BEETLE *MORIMUS ASPER FUNEREUS* MULS. (COL., CEREMBYCIDAE) UNDER LABORATORY CONDITIONS

Vlasta STANIĆ, Jelisaveta IVANOVIĆ, Miroslava JANKOVIĆ–HLADNI, Vera NENADOVIĆ and Radovan MAROVIĆ

Belgrade

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ABSTRACT. – *STANIĆ, Vlasta, IVANOVIĆ, Jelisaveta, JANKOVIĆ–HLADNI Miroslava, NENADOVIĆ Vera* and *MAROVIĆ R.*, Inst. Biol. Res. „S. Stanković", Belgrade, YU. – Feeding habits, behaviour, oviposition and longevity of the adult cerambycid beetle *Morimus asper funereus* Muls. (Col., Cerembycidae) under laboratory conditions. – Acta entomol. Jugosl., 1985, **21**. 1–2, 87–94. (Engl. Serbo–Croat. Summ.).

Under laboratory conditions the adults of *Morimus asper funereus* change their food preferences during the annual cycle i.e. during winter, they feed on oak bark and crackers, while during warm season they consume lucerne stems and fruits. In hiding places (dry leaves) the adults were able to overwinter under out–door conditions. This supports the fact that females may fulfil 2 oviposition cycles during 2 years, separated by a dormant period (diapause) which starts always at the beginning of September. Under laboratory conditions dormancy is ended at the end of November i.e. adults resumed feeding; during December mating took place and the first eggs of the second cycle were deposited in January. Females never oviposit at temperatures bellow 21°C. The temperature is probably the main limiting factor of the geographic distribution of this insect. Its distribution in the Europe overlaps with areas having an average summer temperature of 25°C.

Coleoptera–Cerambycidae, *Morimus asper funereus*, feeding, behaviour, oviposition, longevity, insect rearing

Introduction

Since the larval stage of the xylophagous cerambycid *Morimus asper funereus* lasts 3–4 years under natural conditions i.e. the larvae are for long periods exposed to continuously changing environmental factors during the annual cycle, the insect represents a very suitable object of studies on the role of the neuroendocrine system in

the processes of stress and adaptation (Ivanović et al., 1979; 1980; 1985; Janković – Hladni et al., 1984).

Little information has been available up to now on the biology of *M.a.f.* Eggs and newly emerged larvae were never seen in its natural habitat namely on longs and stumps of oak and other trees in the forest. Only seldom, early in spring few pupae were found under the oak bark. The adults emerged in April, May and/or June, depending upon the environmental temperature, and disappeared at the end of August. Nothing is known about their feeding habits, behaviour, oviposition and longevity, including their overwintering capacities under natural conditions.

In the present paper we report the results of our studies concerning nutrition, behaviour, oviposition and longevity of the adult *M.a.f.* under laboratory conditions, as well as the hibernating capacities of adults under out–door conditions.

Materials and methods

Insects: Two kinds of adults of *M.a.f.* were used in this study: 1. adults, reared under laboratory conditions from full–grown larvae collected from oak stumps in Fruška Gora mountain, and 2. adults of unknown age, developing in natural habitat and collected during spring and summer. Pupation of the larvae and adult development took place at constant temperature of 23°C, in the dark. At that temperature emergence of adults started 17 – 19 days after pupation.

Rearing conditions: One female and 2 males were introduced to each transparent, plastic container (18 x 12 x 12 cm) for mating and oviposition. Males which died in the course of the study were replaced by the new ones. Pieces of oak bark placed at the bottom of the container covered with filter paper, served as food substrate, hiding place and oviposition site. Additional food comprised broken sweet crackers, lucerne stems and seasonal fruits. Water was supplied by use of wet cotton wool. In order to provide the relative humidity of about 50%, the bark was regularly sprinkled with water. The containers, covered with fine wire meshes were maintained at room temperature. The average annual temperatures in the room varied between 21°C in the cold season, and 26°C in the warm one.

Oviposition: The deposited eggs were removed daily, placed on moistened crumbled oak bark in a petri dish, transferred to the constant temperature of 23°C and examined daily for viability.

Behaviour and longevity: For the study of the adult behaviour in the laboratory and their overwintering capacities under out–door conditions, mixed groups, each comprising 6–13 adults were employed. Confined into transparent plastic containers (37 x 25 x 14 cm), adults were provided with bark, food and water in the manner as mentioned above. At the beginning of the cold season, the containers were buried into thick layer of dry leaves accumulated in a wooden case. From time to time the leaves were moistened with water, to provide relative humidity necessary for survival of the insects.

Results

The presented results were obtained in studies performed during six successive years.

Feeding habits

The appearance and the amount of produced faeces enable us to conclude about the nature of the ingested food and the intensity of food consumption. It is noteworthy, that under laboratory conditions the adults change their food preferences during the annual cycle. Independently of their physiological state in respect to reproduction, during the winter period they consume only oak bark and sweet crackers, while during the warm season, they prefer lucerne stems and fruits. The crumbled, but not eaten oak bark served in summer as oviposition site. It is to be mentioned, that at the end of August, some adults started to feed on bark.

Behavior

The activity of adults depends upon the season and the environmental temperature. At temperatures ranging from 12 – 30°C adults feed actively and mate repeatedly. Exceptions were made only during the dormancy which starts always, and independently of the external temperatures, at the beginning of September and is brought to an end under laboratory conditions, at the end of November. During that time adults cluster on the bark or hide beneath it; their locomotory activity is reduced to a minimum. In the second half of November, adults, especially the males being actively to feed. Males attempted to copulate with females which were at that time mainly nonreceptive and repulsed the males. In December adults mated repeatedly. The first eggs after the resting period were deposited in January. Regardless of the environmental temperature, the adults were at daily rest between 12 and 15 h. At temperatures below 12°C the locomotor activity, as well as nutrition were entirely suppressed.

Oviposition

In newly emerged females the oviposition started about 16 days after emergence. The females lay single eggs at a rate of approximately 1 egg/day during the oviposition cycle. The oval elongated, 3–4 mm long eggs, protected by rigid chorion were found to be inserted into bark crevices, deposition on the surface of the bark, on faeces, wet cotton wool and filter paper on the bottom of the container. The results showing oviposition rate, average percentage of egg viability, number of oviposition cycles per female and duration of the total oviposition period are summarized in Tables 1 and 2.

Table 1 shows that 32% of our laboratory–reared females were sterile. Among the fertile ones, 80% have deposited all their eggs during 1 oviposition cycle, and 20% did so during 2 cycles. The number of deposited eggs varied greatly. Females with 1 cycle laid an average of 26 eggs (4–47), those with 2 cycles 79 eggs (43–119). It is interesting to note, that 20% of fertile females have laid only nonviable eggs. The egg–hatchability of the others was 49%.

Among forest–collected females, 1 oviposition cycle was observed in 42% of females, 2 in 58% of individuals. The average percentage of egg–hatchability amounted to 75% (Table 2).

The oviposition rate of 3 females of approximately identical age, collected simultaneously in May, was followed during 2 oviposition cycles. As seen in Fig. 1, the first eggs appeared in June. During the first oviposition cycle the highest number of

Table 1. Oviposition rate and longevity of females reared under laboratory conditions

No. of fem.	Emerged in month:	Longevity, days	No. of eggs/ fem.	% of viability	No. of ovipos. cycles	Interrupted oviposition months, days	Total ovipos. period days
1	XI	122	0	–	–	–	–
2	VIII	72	0	–	–	–	–
3	VI	127	0	–	–	–	–
4*	VI	243	0	–	–	–	–
5*	VI	240	0	–	–	–	–
6	VII	207	0	–	–	–	–
7	V	126	0	–	–	–	–
8*	I	166	30	0	1	–	133
9	V	153	36	50	1	–	92
10*	VIII	230	4	0	1	–	100
11	VIII	435	47	49	1	–	57
12*	V	235	14	55	1	–	36
13*	V	118	5	0	1	–	73
14	VI	495	41	40	1	–	96
15*	VI	205	11	27	1	–	21
16	VI	490	43	70	2	VIII–II, 204	130
17	VI	401	24	45	1	–	84
18*	VI	317	20	37	1	–	80
19*	VI	560	38	33	1	–	107
20*	VI	516	43	65	1	–	102
21	VIII	459	119	60	2	VI–VII, 33	178
22	VII	464	76	62	2	V–VII, 40	150
M±S.E:		290±34 (72–560)	37±8 (0–119)	40±6 (0–70)			96±11 (21–178)

*Females with males reared in laboratory

Table 2. Oviposition rate and longevity of females developing in natural habitat

No. of fem.	Collected in month:	Longevity in laborat., days	No. of eggs/ fem.	% of viability	No. of ovipos. cycles	Interrupted oviposition months, days	Total ovipos. period days,
1	VI	481	151	84	2	VIII–I, 154	222
2	VI	386	187	78	2	VIII–I, 147	206
3	VI	98	56	72	1	–	79
4	VIII	316	48	77	1	–	135
5	VIII	356	53	73	1	–	127
6	VIII	444	130	72	2	V–VI, 31	181
7	V	363	21	60	2	IX–II, 165	128
8	V	366	44	70	2	IX–II, 162	176
9	V	170	49	80	1	–	56
10	V	217	73	79	1	–	75
11	V	407	139	85	2	VIII–I, 161	204
12	VI	400	142	75	2	IX–I, 159	200
M±S.E.		334±33 (98–481)	91±16 (21–151)	75±2 (60–85)			149±17 (56–222)

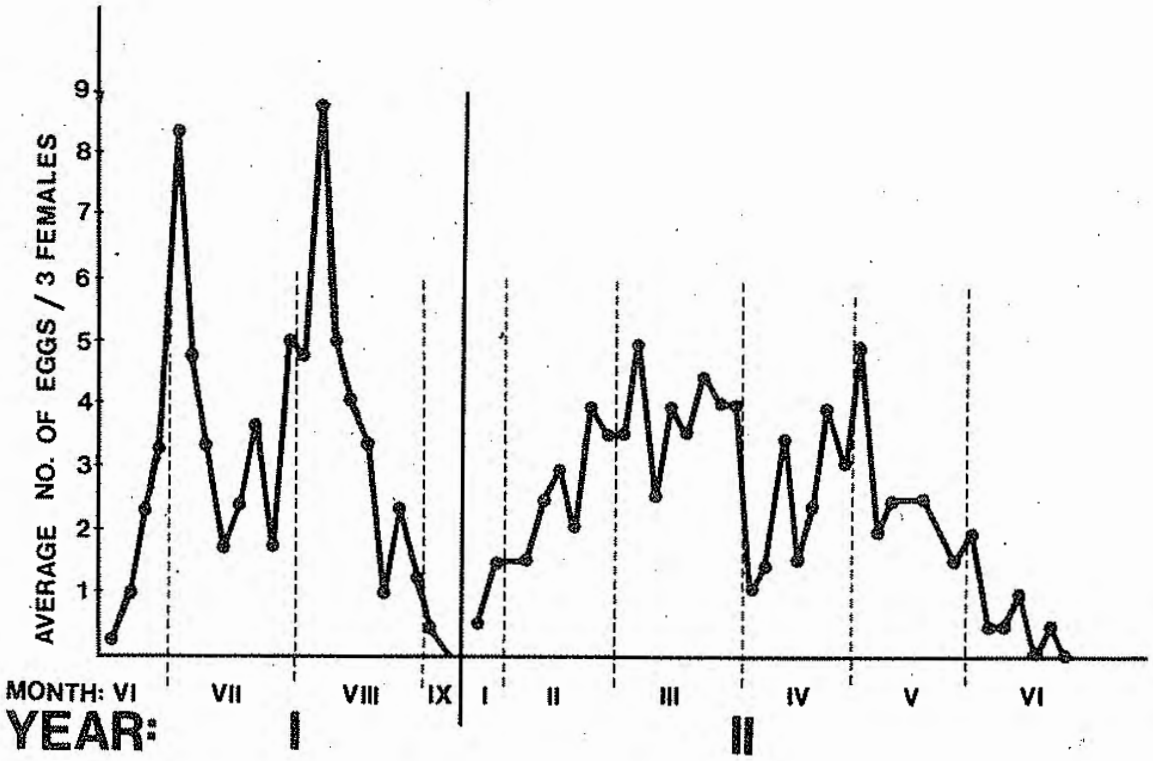

Fig. 1. The oviposition rate of 3 females developing in natural habitat. – The results were calculated as an average number of eggs laid by 3 females and were presented in 4–day intervals, in the course of 2 oviposition cycles.

deposited eggs was observed at the beginning of July (first peak) and August (second peak). At the end of August egg laying gradually decreases. The cessation of oviposition takes place during first days of September, regardless of favourable ambient temperatures. After an average of 165 days of reproductive inactivity, the oviposition is resumed in January. In the second cycle which ends in June, fewer eggs were laid than in the first one. Although in a number of experiments many females survived till the next January, the third oviposition cycle was never observed. It is to be mentioned, that all the females emerging in August were unable to oviposit during the same year. They began to lay eggs in January and ended it in May. After an interruption of reproductive activity lasting about 32 days, oviposition was resumed in July and definitively completed at the end of August. Many of these females were still alive in the next January, but also here, the oviposition was not resumed for the third time. The females did not oviposit at temperatures bellow 21°C and above 30°C.

Longevity

The average longevity of females bred in laboratory accounts 290 days, ranging from 72–560 days (Table 1). There were no differences in the longevity between females and males. Females of unknown age collected in forest lived under laboratory conditions at an average time of 334 days, with a range from 98–481 days (Table 2). The results indicate that adults developing under natural conditions lived longer than those bred in

laboratory. Moreover, they were older than stated in the study, because they were surely not collected on the first day after emergence.

Overwintering capacity

It was supposed that the few adults with abraded elytrae, collected during spring, probably overwintered. The result of our studies verifies this expectacion. At higher spring temperatures the containers were taken out of the case and left unprotected under out–door conditions. Adults were alive (95%) and were very active at temperatures above 12°C. An abrupt decrease of the environmental temperature to 4 and 6°C resulted in 50% of adult mortality. The survivors started to oviposit in June.

Discussion

The results of our long–lasting studies concerned with the feeding habits, behaviour and reproduction in the adult *M.a.f.* show cyclical changes in food preferences, locomotory activity and oviposition during the annual cycle.

At the end of summer and at the beginning of autumn, the adults cease to feed, move and oviposit under laboratory conditions, namely, they enter diapause. As stated in other insect species, the diapause induction is regulated via the neuroendocrine system, which is the central mediator between the extrinsic factors of the environment and the response of the organism at the subcellular level (De Wilde et al., 1959; De Wilde, 1978; 1981). Another coleopterous species, the chrysomelid *Leptinotarsa decemlineata*, enter adults diapause also in the autumn under the effect of the photoperiod (short day). Detailed studies have revealed that short days lowered the juvenile hormone titer in the haemolymph of the insect. Thus, the deficiency of the hormone leads to the reduced protein (vitellogenin) synthesis in the fat body, as well as to the fat body 's diminished capacity of substrate mobilization, important for the development and energy metabolism of the flight muscles (De Kort, 1981).

It seems probably, that analogous processes take place in diapausing adults of *M.a.f.*, induced by the disturbed hormonal balance, itself being provoked by extrinsic factors. The assumption, that the diapause and the annual rhythm are in general controlled by the neuroendocrine system is supported by the evidence, that in the larval *M.a.f.* there are pronounced seasonal changes at the level of the neuroendocrine system and the target organs – the midgut and haemolymph (Ivanović et al., 1979; 1982). During larval development lasting under natural conditions 3–4 years, metabolic changes take place during the year. Two crytical periods were recognized: the first period (end of winter, beginning of spring) during which preparatory processes leading to domination of the anabolic processes take place (growth, development), while during the second one (end of summer, beginning of autumn), catabolic processes are in progress.

It is believed, that in adult *M.a.f.* similar critical periods could be detected during the annual cycle. To test this, detailed studies, with the emphasis on the metabolic and endocrinological aspects must be done.

In Coleoptera, four types of oviposition cycle are recognized. In the fourth type, – to which belongs *M.a.f.* and some species of Curculionidae, Chrysomelidae and Scolytidae – are included those longlived species which lay eggs more or less continuously in two or

more seasons, separated by a period of interrupted oviposition (D i c k, 1937). In forest–collected females, about 50% of them had 1 i.e. 2 oviposition cycles. This data are in favour of our assumption that one part of the forest population is able to oviposit during 2 years; the same was not true for another cerambycid, *Cerambyx cerdo,* which had only 1 oviposition cycle during its life (M a r o v i ć, 1973).

Although long–lived, the majority of laboratory–reared females, which pupae developed at constant temperature of 23°C, completed only 1 oviposition cycle. Since 30% of these females were sterile, and 20% of the fertile ones deposited only nonviable eggs, one may suppose that the above mentioned constant temperature has altered the processes of oogenesis and/or vitellogenesis in the pupal stage.

Our previous studies have revealed that prolonged exposure of *M.a.f.* larvae to the constant temperature of 23°C exhibited unfavourable influence on the larvae, namely, it provoked an inactivation of the neuroendocrine system and the digestive enzymes (I v a n o v i ć et al., 1975). One will also recall, that females did not oviposit at temperatures bellow 21°C and above 30°C. It looks likely, that the temperature is the main limiting factor of the distribution of this insect in the middle and northern areas of the Europe. Its distribution in eastern and southern regions, especially on Balkan peninsula (M i k š i ć, 1963; H o r i o n, 1974; M i k š i ć and K o r p i č, 1985, personal communication) overlaps approximately with the areas characterized by an average summer temperature of 25°C.

References

De Kort, C.A.D. 1981: Hormonal and metabolic regulation of adult diapause in the Colorado beetle, *Leptinotarsa decemlineata* (Coleoptera: Chrysomelidae). Entomologia Generalis 7(3): 261–271.

De Wilde, J. 1978: Seasonal states and endocrine levels in insects. In „Environmental Endocrinology": 334, Springer Verlag, Berlin.

De Wilde, J. 1981: Insect diapause, an example of environment–controlled homeostasis. Entomologia Generalis 7(3): 193–194.

De Wilde, J., Duintjer, C.S. and Mook, W. 1959: Physiology of diapause in the adult Colorado beetle *(Leptinotarsa decemlineata* Say) I. The photoperiod as a controlling factor. J. Insect. Physiol. 3: 75–85.

Dick, J. 1937: Oviposition in certain Coleoptera. Ann. Appl. Biol. 24: 762–796.

Horion, A. 1974: Faunistik der mitteleuropäischen Käfer: 155–156, Uberlingen.

Ivanović, J., Janković–Hladni, M. and Milanović, M. 1975: Effect of constant temperature on survival rate, neurosecretion and endocrine cells, and digestive enzymes in *Morimus funereus* larvae (Cerambycidae: Coleoptera). Comp. Biochem. Physiol. 50A: 125–130.

Ivanović, J., Janković–Hladni, M., Stanić, V., Milanović, M. and Nenadović, V. 1979: Possible role of neurohormones in the process of acclimatization and acclimation in *Morimus funereus larvae* (Insecta). I. Changes in the neuroendocrine system and target organs (midgut, haemolymph) during the annual cycle. Comp. Biochem. Physiol. 63A: 95–102.

Ivanović, J., Janković–Hladni, M., Stanić, V. and Milanović, M., 1980: The role of the cerebral neurosecretory system of *Morimus funereus* larvae (Insecta) in thermal stress. Bull. Acad. Serbe Sci. Art 20: 91–97.

Ivanović, J., Janković–Hladni, M., Milanović, M., Stanić, V. and Božidarac, M. 1982: Possible role of neurohormones in the process of acclimatization and acclimation in *Morimus funereus* (Insecta). II Changes in the haemolymph free amino acid content and digestive enzyme activity. Comp. Biochem. Physiol. 71B: 695–701.

Ivanović, J., Janković–Hladni, M., Stanić, V. and Kalafatić, D. 1985: Differences in the sensitivity of the protocerebral neurosecretory cells arising from the effect of different factors in *Morimus funereus* larvae. Comp. Biochem. Physiol. 80A: 107–113.

Janković–Hladni, M., Ivanović, J., Stanić, V. and Milanović, M., 1984: Effect of different factors on the metabolism of Morimus funereus larvae. Comp. Biochem. Physiol. 77A: 351–355.
Marović, R. 1973: Razviće velike hrastove strižibube *Cerambyx cerdo* L. u laboratorijskim uslovima. Acta entomol. Jugosl. 9(1–2): 3–11.
Mikšić R. 1963: Prilog poznavanju faune strižibuba (Cerambycidae) Jugoslavije. Acta biologica III; 55–188, Jug. akad. znanosti i umjetnosti.
Mikšić, R. i Korpič, M. 1985: Cerambycidae Jugoslavije III dio. Akademija nauka i umjetnosti BiH. Knjiga LXII. Odjelj. prir. i mat. nauka, Knjiga 5. Sarajevo 1985. 148 pp.

Sažetak

NAČIN ISHRANE, PONAŠANJE, OVIPOZICIJA I DUŽINA ŽIVOTA IMAGA STRIŽIBUBE *MORIMUS ASPER FUNEREUS* MULS. (COL.,CERAMBYCIDAE) U LABORATORIJSKIM USLOVIMA

Vlasta STANIĆ, Jelisaveta IVANOVIĆ, Miroslava JANKOVIĆ–HLADNI, Vera NENADOVIĆ i Radovan MAROVIĆ
Beograd

Ispitivani su način ishrane, ponašanje, ovipozicija u dužina života imaga *Morimus asper funereus* u laboratorijskim uslovima.

Ustanovljeno je da u toku godine imaga menjaju način ishrane tj. zimi se hrane hrastovom korom i keksom, a leti stabljikama lucerke i voćem. U odgovarajućim skloništima (na pr. u suvom lišću) mogu da prežive zimu u spoljašnjim uslovima, što je u saglasnosti sa postojanjem kod nekih ženki dva ovipoziciona ciklusa u toku godine, između kojih, uvek početkom septembra nastupa dijapauza. U laboratorijskim uslovima imaga postaju trofički aktivna već krajem novembra, u decembru kopuliraju, a u januaru polažu prva jaja drugog ovipozicionog ciklusa. Ženke ne polažu jaja na temperaturi nižoj od 21°C, pa je verovatno temperatura glavni limitirajući faktor u rasprostranjenju ovog insekta u severnijim delovima srednje Evrope. Granice njegovog rasprostranjenja u istočnoj i južnoj Evropi se približno poklapaju sa granicama srednje letnje temperature od 25°C.

Address of the authors:
Vlasta STANIĆ,
Jelisaveta IVANOVIĆ,
Miroslava JANKOVIĆ–HLADNI,
Vera NENADOVIĆ,
Radovan MAROVIĆ
Institute for Biological Research „Siniša Stanković"
11000 Belgrade, 29. novembra 142.

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GLUTAMATE OXALATE TRANSAMINASE ACTIVITY DURING AGEING OF FEEDING AND NONFEEDING INSECTS

Nirmal RAI, Renu WADHWA and Suraj P. SHARMA

Amritsar, India

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ABSTRACT. – *RAI, N., WADHWA, R.* and *SHARMA, S.P.,* Depart. Biol., Guru Nanak Dev Univ., Amritsar, India. – Glutamate oxalate transaminase activity during ageing of feeding and nonfeeding insects. – Acta entomol. Jugosl., 1985, **21**, 1–2. 95–98. (Engl. Serbo–Croat Summ).

Age–related comparative study on glutamate oxalate transaminase activity was carried out on both the sexes of feeding *Drosophila bipectinata* (Diptera) and nonfeeding *Callosobruchus maculatus* (Coleoptera) insects. The nonfeeding insects at all age intervals have the higher activity than the feeding insects. A significant increase in the glutamate oxalate transaminase activity was observed during reproductive periods in both the insects. The results partially attempt to resolve the controversy of ageing versus starvation in the nonfeeding insects.

Drosophila, Callosobruchus, protein metabolism, transaminases, aging, feeding, starvation

Introduction

The process of interconversion of amino acid to keto acid plays an important role in maintaining the differential biological expression during various phases of life cycle of an organism (Robinson et al. 1976). Transaminases form an important part of this metabolism in which the amino acids are subsequently chanelled to TCA cycle for energy production in response to the physiological need of an organism (Lehninger, 1975). The most active transamination reactions involve glutamate, aspartate, alanine and transaminases, GOT EC 2.6.1.1 and GPT EC 2.6.1.2. Insects constitute a suitable system for gerontological studies (Rockstein and Miquel, 1973). The present report delineates the comparative age–related changes in glutamate oxalate transaminase during ageing of both the sexes of feeding and nonfeeding insects.

Materials and methods

Drosophila bipectinata (Duda) were reared on corn meal agar medium constituting agar agar, maize powder, brown sugar and yeast (24:72:64:24) in culture bottles (250 ml capacity) at 26 ± 2°C. Newly emerged flies were collected after 24 hr intervals, and on every tenth day, they were transferred to fresh medium to prevent the mixing of old culture with newly emerging flies. Thus the cultures ranging from 0–24 hr to 25 days age were continuously maintained. The mean life spans of male and female insects were 21 and 23 days respectively in the present experimental conditions (Sharma and Wadhwa, 1983).

Callosobruchus maculatus Fabr. were reared and maintained on moong grains (*Phaseolus vulgaris* Roxb.) at 26 ± 2°C in glass jars ($1^{1}/_{2}$ lt capacity) covered with fine muslin cloth. The bruchids of various age groups ranging from one to six days age were collected at regular intervals. The mean life spans of male and female bruchids were 5.3 and 7.9 days respectively (Sharma and Sharma, 1979).

Male and female flies of different age groups (1, 2, 3, 4, 5, 6 days in *C. maculatus* and 1, 5, 10, 20, 25 days in *D. bipectinata*) were separated by the methods of Halstead (1963) and Rockstein and Miquel (1973) respectively. The insects (5% w/v) were homogenized in 0.1 M phosphate buffer (pH 7.4) which was then centrifuged at 12,000 g for 20 minutes at –4°C. The supernatant was used for glutamate oxalate transaminase (GOT) activity (Reitman and Frankel, 1957). The reaction mixture consisted of 0.5 ml buffer substrate (0,1 M phosphate buffer, pH 7.4; 0.1 M aspartate, 2 mM oxoglutarate) and 0.1 ml of enzyme extract. The above mixture was incubated in a water bath at 37°C for 60 minutes. The chromogen solution (1mM 2,4–dinitrophenyl hydrazine; 0.5 ml) was mixed and allowed to stand for 20 minutes. The extinction was read at 540 nm, after addition of 0.4 N NaOH solution (5 ml). The standard curve was prepared by using different concentrations of sodium pyruvate with buffer substrate solution. Protein was measured according to Lowry et al. (1951).

Different chemicals were purchased from Sigma Chemicals and BDH Glaxo chemicals.

Results and discussion

Age–related changes in glutamate oxalate transaminase activity in *D. bipectinata* and *C. maculatus* are summerized in Table 1. Glutamate oxalate transaminase volume activity increased during first 3 days of survival in both the sexes of *C. maculatus*, attaining the maximum value on 3rd day. A second leap was recorded in both the sexes on 6 th day. However, in *D. bipectinata* it decreased continuously with age in both the sexes. The highest volume activity of GOT is observed in females of both the insects during their reproductive period, 2–3 days in *C. maculatus* (Sharma et al. 1984) and 5–10 days in *D. bipectinata* (Wadhwa and Sarma, 1984). It depicts that the energy and protein synthesis requirements of females at this period are significantly increased as compared to the males. This supports the earlier findings of Samis et al. (1971) and Sharma et al. (1984). However, the corresponding decrease in specific activity during this period in *D. bipectinata* might be the resultant of their increased protein synthesis, which is more pronounced than that of *C. maculatus* (Wadhwa et. al. 1984).

Table 1. Age-related changes in volume activity (μg of sodium pyruvate released/60 min/5 mg body weight) and specific activity (units/mg protein) of glutamate oxalate transaminase in *D. bipectinata* and *C. maculatus*.

Age in days	D.bipectinata				Age in days	C. maculatus			
	Volume activity		Specific activity			Volume activity		Specific activity	
	Male	Female	Male	Female		Male	Female	Male	Female
1	64.82 ± 1.11	62.65 ± 1.37	.3655	.4085	1	75.87 ± 1.10	86.46 ± 0.76	.5548	.5610
5	60.28 ± 1.07	63.18 ± 1.02	.4784	.3624	2	80.08 ± 0.78	92.40 ± 0.87	.6270	.6666
10	52.88 ± 1.38	59.09 ± 0.74	.4230	.3685	3	84.30 ± 1.42	95.92 ± 0.88	.6386	.6606
15	49.28 ± 0.96	47.78 ± 2.47	.4084	.3192	4	64.24 ± 1.47	89.12 ± 0.87	.6650	.5823
20	47.33 ± 0.76	44.88 ± 1.37	.4316	.2298	5	54.56 ± 0.22	72.60 ± 0.76	.4071	.4653
25		37.75 ± 1.05		.3255	6	69.16 ± 1.26	90.20 ± 0.20	.4911	.5857

No. of observations = 6
$p < 0.01$ significant at all age intervals

The increase in glutamate oxalate transaminase activity in both the sexes of *C. maculatus* during reproductive period is possibly required to supply metabolites for energy production as well as maintenance of amino acid pool for altered levels of protein synthesis (W a d h w a et al. 1984). Conversely the missing increase in *D. bipectinata* might be because of the diet medium (carbohydrate rich) which is easily metabolized hence curtailing the amino acid usage for energy production.

At all comparable age groups, both the sexes of *C. maculatus* have significantly higher glutamate oxalate transaminase activity than the respective sexes of *D. bipectinata* showing that amino acids are more frequently metabolized in the former due to its nonfeeding habit and probably also accounts for its shorter life span. W a d h w a et al. (1984) have reported similar results for glutamate pyruvate transaminase in these insects.

During the senescent period in both the insects there is an increase in the specific activity (Table 1). This can be referred to as the adaptive increase which attempts to compensate fot the increased level of degenerative processes.

Age–related changing pattern of glutamate oxalate transaminase activity is somewhat similar in feeding and nonfeeding insects. This suggests that changes in nonfeeding insects are due to the normal phenomenon of ageing leading to degradation and loss of functions, and is not due to depletion associated with starvation.

Literature

Robinson, A.B., Willoughby, R. and Robinson, L.R. 1976: Age dependent amines, amides and amino acid residues in *Drosophila melanogaster*. Exp. Geront. **11**: 113–120.

Lehninger, A.L. 1975: Oxidative degradation of amino acids. In „Biochemistry" p. 562 by A.L. Lehninger Worth Publishers Inc. New York.

Rockstein, M. and Miquel, J. 1973: Ageing in insects. In „Physiology of Insecta" Vol. 1, pp. 371–478 (ed.) by M. Rockstein, Academic Press, New York.

Sharma, S.P. and Wadhwa, R. 1983: Effect of butylated hydroxy toluene (BHT) on the life span of *Drosophila bipectinata*. Mech. Age. Develop. **23**: 67–72.

Sharma, S.P. and Sharma, G. 1979: Age–related protein changes in bruchids. Indian J. exp. Biol. **17**: 1197–1200.

Halstead, D.G.H. 1963: External sex differences in stored products Coleoptera. Bull. Ent. Res. **54**: 119–134.

Reitman, S. and Frankel, S. 1957: In Methods in Enzymatic Analysis Vol. 2, pp. 760–764 (ed) by H.U. Bergmeyer, Academic Press, New York and London.

Lowry, O.H.; Rosenbrough, N.J.; Farr, A.L. and Randall, R.J. 1951: Protein measurement with folin–phenol reagent. . Biol. Chem. **193**: 265–275.

Sharma, S.P., Jit, I. and Rai, N. 1984: Age–related changes in nucleic acids and protein in *Callosobruchus maculatus* Fabr. (Coleoptera). Gerontology, **30**: 26–29.

Wadhwa, R. and Sharma, S.P. 1984: Changes in nucleic acid content in ageing *Drosophila bipectinata*. Exp. Geront. **19**: 199–204.

Samis, H.J.Jr,; Erk, F.C. and Baird, M.B. 1971: Senescence in *Drosophila* I. Sex difference in nucleic acid, protein and glycogen levels as a function of age. Exp. Geront. **6**: 9–18.

Wadhwa, R.; Rai, N. and Sharma, S.P. 1984: Glutamate pyruvate transaminase activity during ageing of feeding and nonfeeding insects. New York Entomological Society (Communicated).

Sažetak

AKTIVNOST GLUTAMAT–OKSALAT–TRANSAMINAZE ZA VRIJEME STARENJA HRANJENIH I NEHRANJENIH INSEKATA

Nirmal RAI, Renu WADHWA and Suraj P. SHARMA

Amritsar, Indija

Provedena su istraživanja o aktivnosti glutamat–oksalat–transaminaze na oba spola hranjenih mušica *Drosophila bipectinata* (Duda) (Diptera) i nehranjenih žižaka *Callosobruchus maculatus*. Fabr. (Coleoptera). Nehranjeni insekti u svim stadijima starosti pokazuju veću aktivnost od hranjenih insekata. Značajan porast aktivnosti glutamat–oksalat–transaminaze primjećen je u doba razmnažanja kod oba spola. Rezultati djelomično upućuju na rješavanje kontroverze između starenja odnosno gladovanja nehranjenih insekata.

Address of the authors:
Nirmal RAI
Renu WADHWA
Suraj P. SHARMA
Department of Biology,
Guru Nanak Dev University,
Amritsar–143005, India.

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MICROSCOPIC ANATOMY OF CORPUS PEDUNCULUS OF *LEPISMA SACCHARINA* L. (THYSANURA)

Suraj P. SHARMA and Moninder KAUR

Amritsar, India.

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ABSTRACT. – *S.P. SHARMA* and *M.KAUR,* Guru Nanak Dev Univ. Amritsar, India.–Microscopic anatomy of corpus pedunculus of *Lepisma saccharina* (Thysanura). – Acta entomol. Jugosl., 1984, **20** (1–2):99–107. Engl. Serbo–Croat. Summ.).

The corpus pedunculus in *Lepisma saccharina* L. is constituted by two fused calyx cups. a stalk, four lobes (alpha. beta, gama and delta) and a group of globuli cells. Commissural fibres join the gamma lobes and feet of opposite sides. The corpus pedunculus has fibrous connections with protocerebral lobes, and deutocerebrum. The results are discussed in relation to the mode of living of this insect.

Thysanura, Lepisma saccharina, brain, neurons, corpus pedunculus, behavior

Introduction

More evolutionary advanced insects are said to be socially active due to the development of corpus pedunculus which is considered the centre of intelligence in the insect brain. Bretschneider (1921) observed the presence of corpus pedunculus in apterygotes insects. However, the absence of corpus pedunculus was reported in a machilid *Petrobius brevistylis* by Satija (1957). Despite the fact that silverfish has economic and academic importance, its neurobiology has attracted only a few workers like Hesse (1901), Hilton (1936), Hanström (1940, 1943), Denis (1949), Barnhart, (1961), Schmitt (1962) and Rousset (1975). The present work on the detailed organization of corpus pedunculus of *L. saccharina* was undertaken so as to establish the possible correlation of this cerebral structure with its habits and habitat.

Materials and methods

The adults of both the sexes of *Lepisma saccharina* L. (Thysanura: Lepismatidae) were collected from the old books, bindings, labels and starched clothes. The specimens

were maintained in the laboratory on fine cuttings of glued paper or paper tapes in culture bottles. The brain were exposed by removing cuticle of the head and immersed immediately in one of the following fixatives: Bouin's, Alcoholic Bouin, Susa, Carnoy and Zenker. Tissues were embedded in paraffin wax (57.0°C) for 24 hrs. Sections were cut at 5–7 μ thickness and stained in one of the following methods: Harris and Heidenhain's haematoxylin, methylene blue, or Mallory's triple (H u m a s o n, 1969). Reduced silver impregnation method was also successfully employed (S t r u s f e l d and M i l l e r, 1980).

Results

The c o r p u s p e d u n c u l u s in *L. saccharina* is a very large and complicated structure having a peculiar shape and a great divergence from the normal type met in insects in general. It is made up of two fused calices, a stalk burried in protocerebral

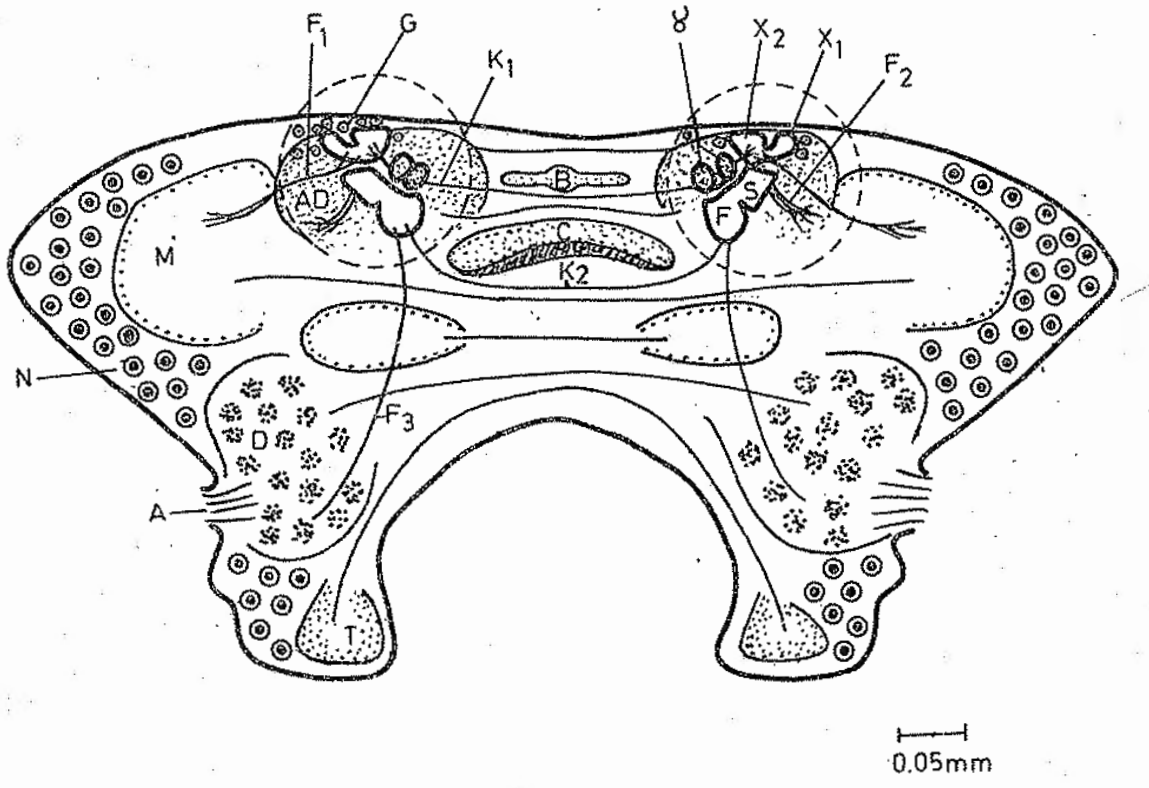

Fig. 1. Reconstructed diagram (from serial transverse sections) of the brain of *L. saccharina* showing topographic position of the corpus pedunculus (encircled). Outline camera lucida, details reconstructed from various serial sections.
A–antennary nerve; AD–anterodorsal protocerebral lobe; B–pons cerebralis; C–central complex; D–deutocerebrum; F–foot, F_1–Fibrous connections between calyx and mediolateral protocerebral lobe; F_2–fibrous connection between calyx and anterodorsal protocerebral lobe; F_3–fibrous connection between the foot and deutocerebrum; G–globuli cells; K_1–commissural fibres between the calices; K_2–commissural fibres between the feet; ML–mediolateral protocerebral lobe; N–neurons; S–stalk; T–tritocerebrum; X_1 and X_2–calices; γ–gamma lobe.

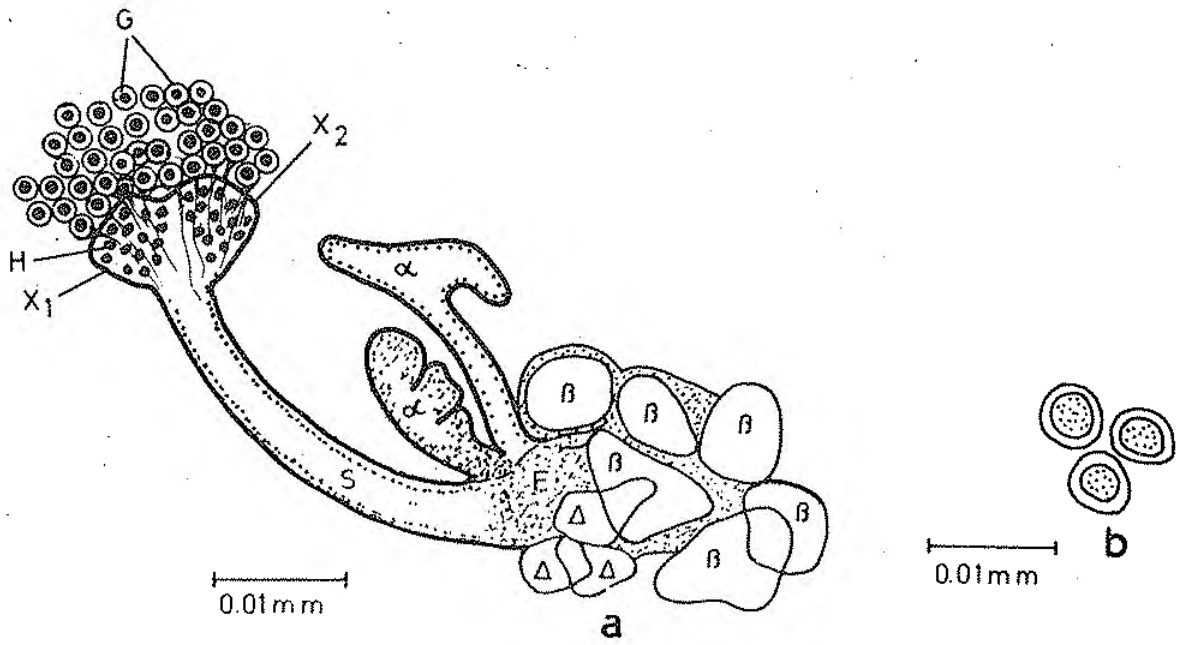

Fig. 2a.Reconstructed diagram of the corpus pedunculus in tangenital frontal plane showing details.
α–alpha lobe,
β–beta lobe,
γ–gamma lobe
Δ–delta lobe,
F–foot: G–Globuli cells; H–glomeruli; S–stalk; X_1 and X_2–Calices
2.b. Globuli cells

neuropile and a foot giving rise to four lobes which are alpha, the beta, the gamma and the delta lobes (Figs. 1, 2, 3).

The c a l i c e s are two pairs of cup–shaped structures situated in the anterior and dorsal part of anterodorsal protocerebral lobe. Each pair is fused with one another. The calyx is constituted by small, ovoidal and darkly stained masses called glomeruli. Well defined cup–like calyx is not observed. The glomeruli are small dense neuropile masses formed by the end branching and synapses of axons of the globuli cells (Figs. 2, 3, 4, 5, 6). The globuli cells are characteristic neurons associated with such type of neuropiles. These are situated at the anterior end of pedunculate bodies and are quite distinct from other cortical neurons. The diameter of each globuli cell varies from 3–5 μ. The cells send fibres to calyx cups, but the individual fibres originating from globuli cells agregate in the form of fibrous tract (Figs. 2,4).

The s t a l k is a posterior continuation of the calyx and is formed primarily by the axons of globuli cells (Fig. 2). The stalk can be distinguished from the neuropile of the protocerebrum by its dense staining reaction and smooth texture, which indicates that it is a tightly packed mass of axon branchings. It penetrates obliquely, into dorsal protocerebral neuropile and then bends towards medial plane (Figs. 3, 5, 6, 7). Its distal extremity lies near lateral side of the central complex. The distal end of the stalk is swollen and is named as foot. At this level, the bundles of the fibres are divided into four groups to form the alpha, the beta, the gamma and the delta lobes (Figs. 2, 3, 5, 6).

The alpha and gamma lobes arise from the anterior distal part of the foot. Firstly they travel towards one another. Then the alpha lobe takes a slight turn towards dorsal side where its distal end dilates. It is divided there to become a bilobed structure. The gamma lobe has three lobules. These lobules appear simultaneously in frontal sections lying linearly one behind the other (Figs. 2, 5, 8).

The beta lobes originate from the posterior end of the foot and travels medially in the brain. Topographically, it lies posterior to the central body and is made up of six ovoid or rounded lobules arranged around its common central axis (Figs. 2, 3, 5, 6, 8). The delta lobe arises from the posterior surface of the foot. It is dorsal to beta lobe and travels medially. It is made up of three lobules (Figs. 2,9).

Commissures and connections of corpus pedunculus: The gamma lobes of the opposite sides are joined by a distinct band of fibres which runs dorsal to the beta lobes of the corpus pedunculus. The commissure connecting the stalks of pedunculate bodies run transversaly in the brain parallel to the commissure of the median lateral protocerebral lobe. In addition to the above commissures, two fibrous tracts have been observed. One tract emerges anterolaterally from each calyx cup and goes to medio–lateral lobe while other emerging from the postero–ventral side connects with antero-dorsal protocerebral lobe. The corpus pedunculus is connected to the deutocerebral lobe by a pair of connectives (Figs. 1,4).

Discussion

The marked difference found in the structure of corpus pedunculus in different insects is an interesting feature. The degree of development of corpus pedunculus is generally considered related to the degree of optic activity of the insects. Rabl–Ruckard (1875) reported the presence of well developed pedunculate bodies in an African blind ant, *Typhlopone* (Hymenoptera), which indicates that the optic activity does not govern the development of this structure. Satija and Dass (1963 a,b) reported a well developed corpus pedunculus in *Onthophagus catta* (Coleoptera) though this beetle is a passive and an inactive animal with a negligible amount of optic activity. Flögel (1878) and Power (1943) reported optic activity of high order in Hemiptera and Diptera respectively though the corpus pedunculus is inconspicuous. Satija (1957) has described well developed optic lobes in a thysanuran, *Petrobius brevistylis* but the corpus pedunculus was absent. The absence of corpus pedunculus has also been reported by Hanström (1940, 1943) in *Petrobius* and *Machiloides*. In *L. saccharina,* which is another thysanuran, it is seen that the corpus pedunculus is a very conspicuous and complicated structure, showing divergence from the normal type met within the insects while the optic ganglia are poorly developed and the number of optic ganglia is reduced to two from the normal three. So, it can be said in conclusion that the development of corpus pedunculus is not related in all the insects to the degree of development of optic activity and the present investigation supports this.

The calyx with two cups has been reported in *Periplaneta americana* (Satija and Singla, 1967). *Danaus chrisippus* and *Tapinoma melonocephalum* (Khanna, 1977), *Monomorium indicum* (Satija and Walia, 1967), *Odontotermes obesus* (Sharma and Sharma, 1984–communicated); whereas single calyx has been reported in *Rhizopertha dominica* (Sharma and Singh, 1984–communicated)

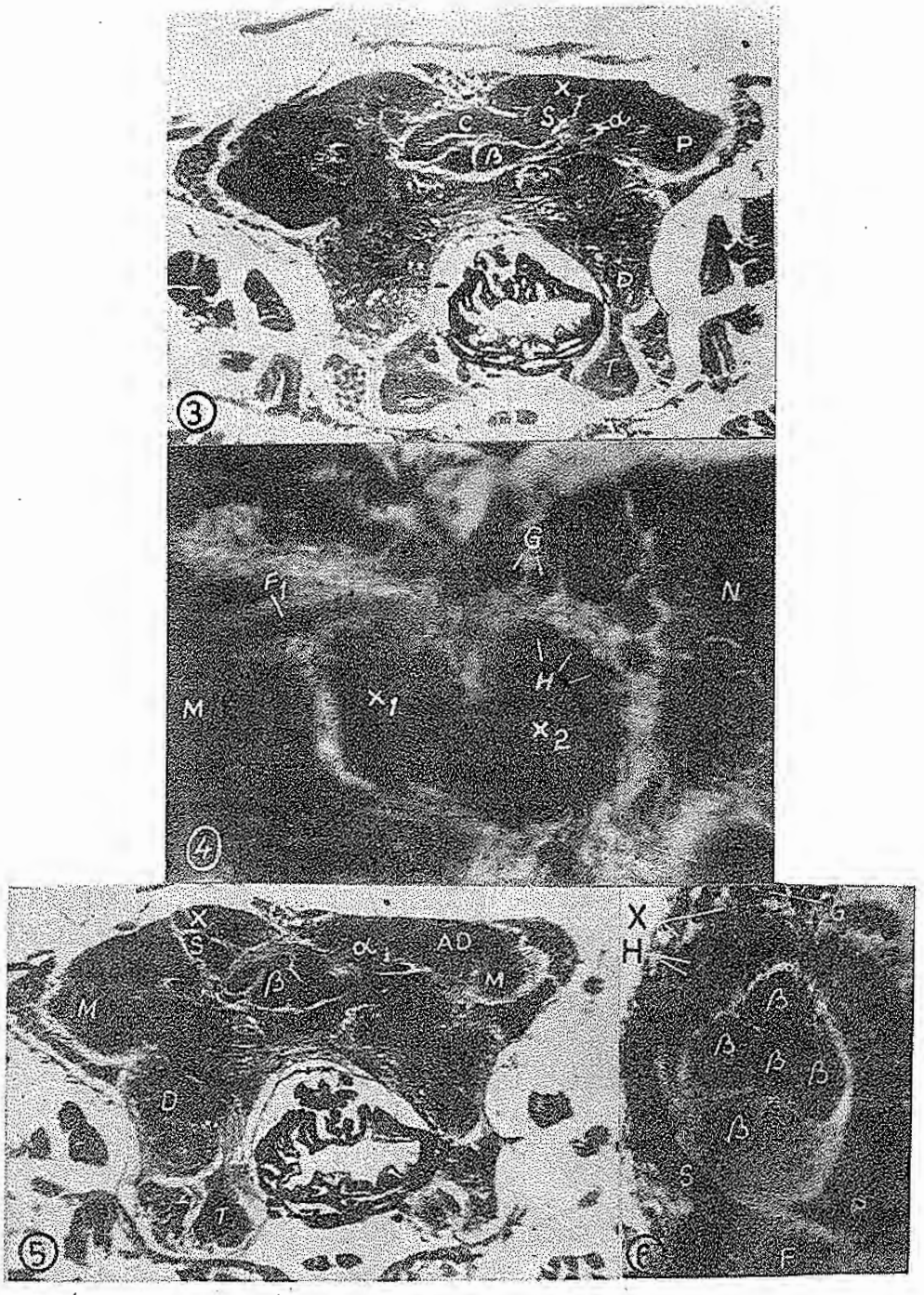

Fig. 3. Transverse section of the brain showing topographic position of some parts of corpus pedunculus. C–central complex; D–deutocerebrum; P–protocerebrum; S–stalk; T–tritocerebrum; X–calux cup; α–alpha–lobe; β–beta lobe. (Heidenhain's haematoxylin, x ~450).

Fig. 4 A part of T.S. of the brain showing calices and their associated structures. F–fibrous connection between calyx and mediolateral protocerebral lobe; G–globuli cell; H–glomeruli; M–mediolateral protocerebral lobe; N–neurons; X_1 and X_2–calices. (Heidenhain's haematoxylin, x 4,500).

Fig. 5. Frontal section of the brain showing calyx (X) and Stalk (S) and various other brain neuropiles. C–central complex; P–protocerebral lobe (Harris's haematoxylin, x 450).

Fig. 6. Longitudinal section of brain passing through corpus pedunculus region. β–beta lobe; F–foot G–globuli cells– H–glomeruli; P–protocerebrum; S–stalk; X–calyx (Harris haematoxylin) eosir x ~1200).

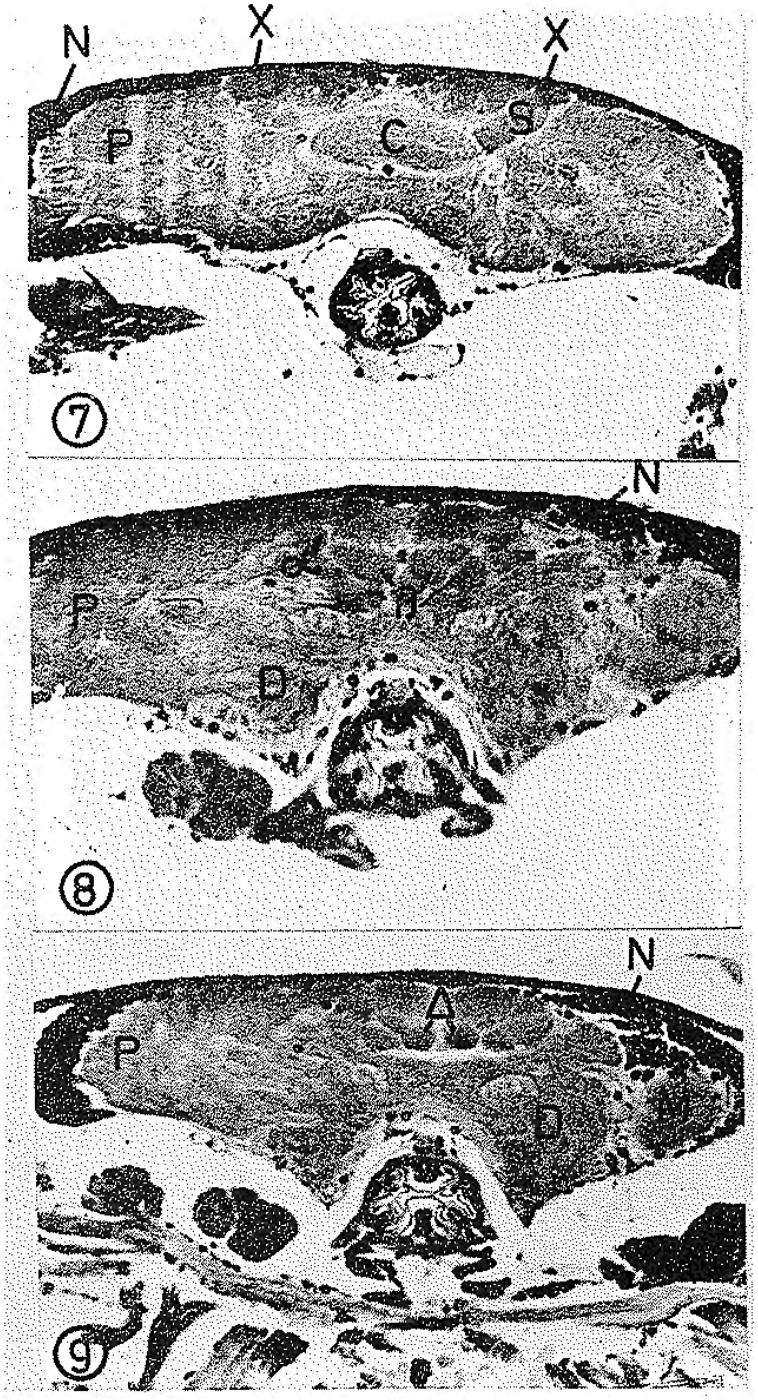

Fig. 7. Transverse section (oblique) of the brain showing lobes of corpus pedunculus and other neuropiles of the brain. A – anterodorsal protocerebral lobe; D–deutocerebrum; M–mediolateral protocerebral lobe; S–stalk; X–calyx cup; – alpha lobe; β–beta lobe (Heidenhain's haematoxylin, x 450).

Fig. 8. Frontal section of the brain showing lobe and B lones of corpus pedunculus, D–deutocerebrum; N–neurons; P–protocerebrum. (Harris haematoxylin/eosin, x 450).

Fig. 9. Frontal section of the brain showing delta lobules of the corpus pedunculus (Δ) D–deutocerebrum; M–mediolateral protocerebral lobe; N–neurons; P–protocerebrum. (Harris haematoxylin/eosin, x 400).

and *Epilachna vigintioctomaculata* (S i n g h, 1974). The absence of the cup-like calyx was reported by K e n y o n (1896) in bugs, by M a n t a k a (1974), S h a r m a and K a u r (1983) and G u p t a (1980) in *Dacus* sp., *Zaprionus paravittiger* and *Culex fatigens* respectively. In *L. saccharina* the two calices are poorly developed and are very closely fused with one another. The globuli cells are arranged around the fused calices in a single group in each hemisphere of the brain.

The present investigations and literature available indicate that no generalized statement can be made about the number and lobes of corpora pedunculata though terminology given by V o w l e s (1955) for various lobes have been accepted by majority of the workers. The only justifiable conclusion drawn from the comparative study of corpora pedunculata depends upon the conditions and requirements to which an insect is exposed. An excessive development of the corpus pedunculus in one animal and its suppression in the other is to fulfil the physiological needs. For example, in a collembolan *Seira cinerea* (T a n e j a and T a n e j a 1978) typical calices are lacking instead a mass of globuli cells is present. Axons from these cels run together to form stalks of corpora pedunculata and *Seira cinera* is a passive animal hiding in moist wood, presents a good example of inter–relation of habits, habitat and structure. *L. saccharina* is a nocturnal insect but it is quite active and runs fast to escape. It may be attributed to its complicated pedunculate bodies having a peculiar shape and shows a great divergence from the normal.

Another subject of discussion is the relationship between the development of the pedunculate bodies and the intelligence of the insect which was realised by D u j a r d i n (1850) and later confirmed by a number of workers. In *Sphaerodema rusticum*, P r e s s w a l a and G e o r g e (1936) suggested that absence of corpus pedunculus is intimately connected with the inactive habits on the insect. This deduction, though based on some observations, is not true for many insects. e.g., *Onthophagus catta* (S a t i j a and D a s s, 1963b) has a well developed corpus pedunculus but the insect recorded a very little of psychic development. Though, *L. saccharina* belongs to primitive group yet it is quite active due to the development of corpus pedunculus. However, in the absence of the physiological and functional data, no definite correlation can be made with the structure of corpus pedunculus and the intelligence.

References

Barnhart, C.S. 1961: The internal anatomy of the silverfish, *Ctenolepisma cambelli* and *Lepisma saccharinum* (Thysanura, Lepismatidae). Ann. Entomol. Soc. Amer., **54**, 177–196.

Bretschneider, F. 1921: Über das Gehirn des Wolfsmilchschwärmers *(Deilephila euphorbiae)*. Jena Z. Naturw., **57**, 423.

Bullock, T.H. and Horridge, G.A. 1965: Structure and function in the Nervous Systems of Invertebrates. Vol. II, pp. 1190–1192, W.H. Freeman and Co., San Francisco.

Denis, R. 1949: Sous–classe des Apterygotes. Grasse's Traité de Zoologie, **9**, 111–275.

Dujardin, F. 1850: Memoire sur le système nerveux des insectes. Ann. Sci. nat. (Zool.), **14**, 195–205.

Flögel, J. H.L. 1878: Ueber der einheitlichen Bau des Gehirns in den verschiedenen Insekten–Ordnungen. Z. wiss. Zool., Suppl., **30**, 566–592.

Gupta, K.L. 1980: Histological study on the brain of *Culex fatigens* Say. (Culicidae, Diptera). M. Phil thesis submitted to Guru Nanak Dev University, Amritsar.

Hanström, B. 1940: Inkretorische Organe, Sinnesorgane and Nerven System des Kopfes einiger niederen Insekten–Ordnungen. K. svenska Vetensk Akad. Handl., **18**, 1–266.

Hanström, B. 1943: Ergänzende Beobachtungen über das corpus cardiacum und das Stirnauge der Machiliden und das Gehirn der Campodeiden. K. fysiorgr. Sallsk. Lund Förh., **13**, 215–219.

Hilton, W.A. 1916: Nervous system and sense organs. LIX Insecta–Thysanura. J. Ent. Zool., **28**, 41–53.

Humason, G.L. 1979: Animal Tissue Techniques. 9th edition, W.H. Freeman and Co., San Francisco.

Khanna, S. 1977: Histology and histopathology of the brain in class insects. Ph. D. thesis submitted to Panjab University, Chandigarh.

Mantaka, A.S. 1974: Anatomie des Gehirns von *Dacus*. Annls. Inst. phytopath. Benaki (N.S.) **11**, 59.

Power, M.E. 1943: The brain of *Drosophila melanogaster*. J. Morphol., **72**, 517–559.

Presswala, M.J. and George, C.J. 1936: The morphology of *Sphaerodema rusticum* Fabr. J. Univ. Bombay, **4**, 29–67.

Rabl–Ruckard, 1975: Studien über Insekten Gehirns von Reichert und du Bois–Raymonds. Arch f. anat. Physiol. wiss. Midl., **42**, 468.

Rousset, A. 1975: Innervation sensorielle et motrice des regions abdominable postérieures de la female de *Thermobia domestica* (Packard). Insecta: Apterygota lepismatida. Int. J. Insect Morphol. and Embryol., **4**, 61–76.

Satija, R.C. 1957: A histological study of the brain, optic lobes and thoracic nerve cord of *Petrobius brevistylis* with special reference to the descending nervous pathways. Res. Bull. Panjab Univ. No. 131, 493–510.

Satija, R.C. and Dass, B. 1963a: Histological studies on the brain of *Onthophagus catta* (F) (Coleoptera). Res. Bull. Panjab Univ., **14**, 231–241.

Satija, R.C. and Dass, B. 1963b: The status of the corpora pedunculata of *Onthophagus catta* (F) in order Coleoptera. Res. Bull. Panjab Univ., **14**, 243–244.

Satija, R.C. and Singla, O.P. 1967: Structure of the brain of *Periplaneta americana* L. (Dictyoptera). Res. Bull. Panjab Univ., **18**, 297–302.

Satija, R.C. and Walia, D. 1967: Studies on the brain of *Monomorium indicum* Ford. (Hymenoptera). Res. Bull. Panjab Univ., **18**, 237–241.

Schmitt, J.B. 1962: The comparative anatomy of the insect nervous system. Ann. Rev. Entomol. **7**, 137–156.

Sharma, S.P. and Kaur, P. 1983: Histological organization of the brain of *Zaprionus paravittiger* (Diptera). Adv. Biol. Res. **1**, 119–127.

Sharma, S.P. and Sharma, U.K. 1984: Neurohistology of corpus pedunculus of *Odontotermes obesus* (Rambur). J. Neurobiology (Communicated).

Sharma, S.P. and Singh, P. 1984: Corpus pedunculus of *Rhizopertha dominica* Fabr. (Coleoptera). Folia Morphologica (Communicated).

Singh, Y.N. 1975: Microanatomy of the brain of the Indian wasp, *Polistes hebraeus* Fabr. (Hymenoptera, Vespidae). J. Nat. Hist., **9**, 471–480.

Strausfeld, N.J. and Miller, T.A. 1980: Neuroanatomical techniques. Insect Central Nervous, Springer, Berlin.

Taneja, S.K. and Taneja, S. 1978: Brain of *Seira cinerea* (Collembola) with special reference to tractus connections. J. ent. Res., **2**, 181–185.

Vowles, D.M. 1955: The structure and connections of the corpora *pedunculata* in bees and ants. Quart. J. micr. Sci. **96**, 239–255.

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Sažetak

MIKROSKOPSKA ANATOMIJA CORPUS PEDUNCULUSA
KOD *LEPISMA SACCHARINA* L. (THYSANURA)

Suraj P. SHARMA i Moninder KAUR
Amritsar, India

Opisana je mikroskopsko–anatomska građa corpus pedunculusa u cerebralnom živčevlju beskrilnog insekta „srebrne ribice", *Lepisma saccharina,* kojemu se organu pripisuju inteligentni čini socijalnih kukaca. Kod *L. saccharina* taj se organ sastoji od dviju spojenih čaški, drška i četiri lobula (alfa, beta, gama i delta) i jedne skupine stanica globula. Poprečne komisure povezuju gama lobule sa suprotnim krajevima. Corpus pedunculus je uzdužnim vlaknima (komisurama) povezan s protocerebralnim naborima i deuterocerebrumom. Rezultati se razmatraju u odnosu na način života toga insekta. Dolazi se do zaključka da iako *L. saccharina* pripada doduše primitivnoj skupini, ipak je kao noćna životinja vrlo aktivna zbog razvitka corpus pedunculusa, no zbog još manjkavih fizioloških i funkcionalnih podataka ne može se dati definitivno gledište o povezanosti strukture corpus pedunculusa sa inteligencijom.

Address of the authors:
Suraj P. SHARMA
Moninder KAUR
Department of Biology
Guru Nanak Dev University
Amritsar – 143005, India

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THE DAILY ACTIVITY RHYTHM OF *DROSOPHILA SUBOBSCURA* COLLIN (DIPT., DROSOPHILIDAE) AT RAVNIŠTE (JASTREBAC) LOCALITY, YUGOSLAVIA

Marko ANĐELKOVIĆ, Marina STAMENKOVIĆ–RADAK and Milan SEKULIĆ
Belgrade

Recieved: 21. 11. 1985.

ABSTRACT. – *ANĐELKOVIĆ M., STAMENKOVIĆ–RADAK M., SEKULIĆ M.,* Inst. Biol.Res. „S.Stanković", Belgrade, YU.–The daily activity rhythm of *Drosophila subobscura* (Dipt., Drosophilidae) at Ravnište (Jastrebac) locality, Yugoslavia. – Acta entomol. Jugoslav. 1985, **21**, 1–2 109–118. (Engl.,Serbo–Croat. Summ.).

The daily activity rhythm curve of *Drosophila subobscura* Collin flies at Ravnište locality shows bimodal shape, characteristic for summer woodlands. The majority of flies was collected early in the morning and late in the afternoon and the little activity was observed at midday.

Mathematical analysis show the absence of linear dependance of the daily activity of *D. subobscura* on temperature and humidity. This does not exclude the possibility of the influence of these factors, but rather persumes the phenomenon exhibits it's plasticity within a combination of many environmental factors.

Diptera, *Drosophila subobscura*, behavior, diurnal rhythms, environmental factors, woodland habitats

Introduction

The *Drosophila* flies are widely used in the field of population genetics research and speciation. From this point of view and for better understanding the behaviour of populations, a permanent need exists for detailed ecological informations collected from natural habitats of these organisms.

The daily activity of the flies is of special interest among different aspects of problems in this field (Dobzhansky and Epling, 1944; Pavan et al., 1950; Mitchel and Epling, 1951; Hachiya, 1952; Makino et al., 1954; Lee, 1962; Kaneko, 1968; Toda, 1973). Generally, *Drosophila* flies exhibit significant variability in the daily activity in different habitats. This fact becomes expecially important when

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it is known that temporal and spatial differentiation in natural populations of *Drosophila* is related to certain genetic variability (Jungen and Wunderlich, 1972; Krimbas and Aevizos, 1973; Taylor and Powell, 1977; Atkinson and Miller, 1980; Cabrera et al. 1985).

As *Drosophila subobscura* Collin is a species very intensively used in population genetics research, ecological data about this species are of great importance. This species shows the existance of certain daily activity rhythm (Taylor and Calmus, 1954; Dyson–Hadson, 1956; Rocha Pité, 1978, Kekić and Marinković, 1979). The distribution area of this species comprises rather various habitats in Europe, North Africa and Asia Minor (for details see Krimbas and Loukas, 1980; Bächli and Rocha Pité, 1982). It is therefore necessary to collect informations on such a type of bahaviour from a greater number of localities. This paper shows the daily activity rhythm of *D. subobscura* flies at a mountain locality of Yugoslavia.

Material and methods

The study was carried out at Ravnište, situated on the mountain Jastrebac at the altitude of 600m. This is an area with beech being the predominant tree (*Fagus silvatica* L.).

The flies were caught on fermenting fruit baits with yeast added. The day before the start of collecting the traps were randomly set up in different places, mainly in shadow during the whole day. The collecting area was in the shape of an elipsoid (Fig. 1.)

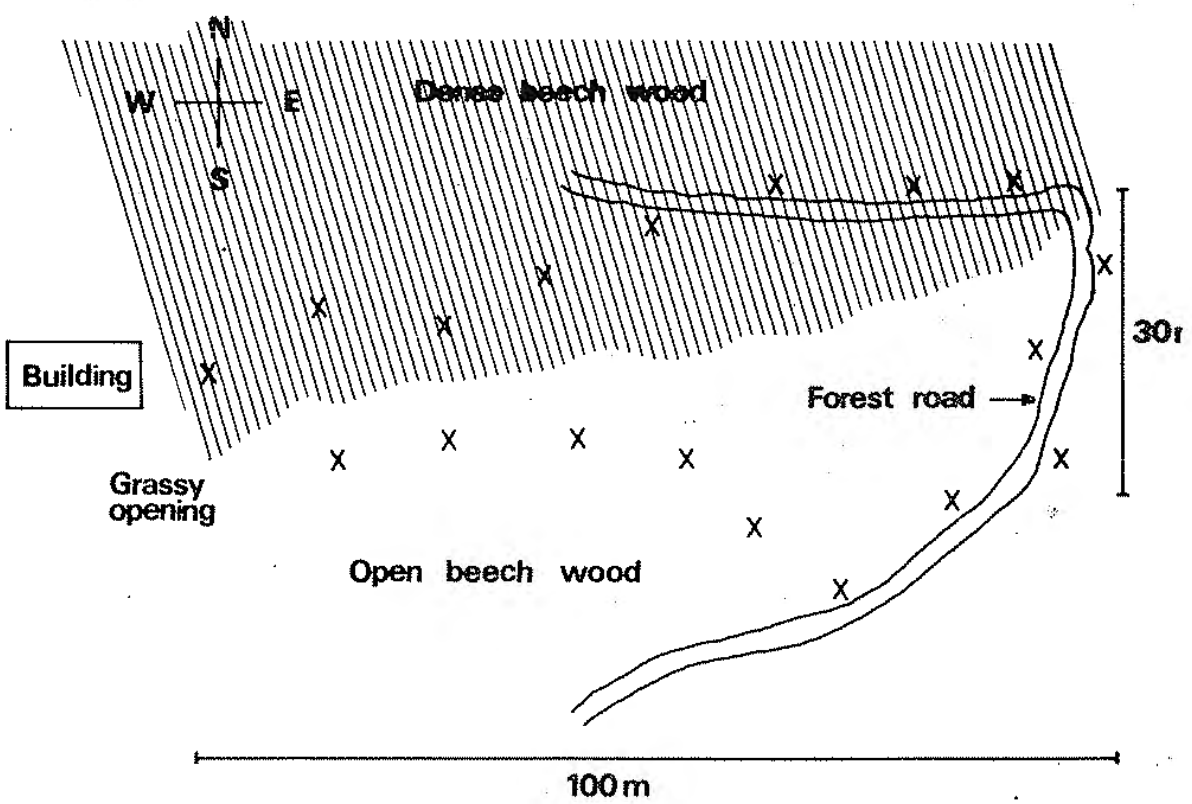

Figure 1. Arrangement of traps

Table 1. Number (n) and proportion (p) of *D. subobscura* flies collected at different times of the day in three successive years at Ravnište locality

hour	25th june 1983						20th june 1984						20th june 1985					
	female		male		total		female		male		total		female		male		total	
	n	p	n	p	n	p	n	p	n	p	n	p	n	p	n	p	n	p
5	–	–	–	–	–	–	1	.002	25	.022	26	.017	–	–	–	–	–	–
6	4	.018	18	.025	22	.023	3	.007	32	.028	35	.023	1	.001	14	.005	15	.004
7	8	.035	68	.013	76	.079	23	.057	117	.103	140	.091	12	.011	135	.046	147	.036
8	13	.057	70	.096	83	.087	30	.074	92	.081	122	.079	55	.049	317	.107	372	.091
9	12	.053	14	.019	26	.027	23	.057	43	.038	66	.043	81	.072	226	.076	307	.075
10	4	.018	13	.018	17	.018	19	.047	45	.040	64	.041	54	.048	126	.043	180	.044
11	3	.013	5	.007	8	.008	10	.025	16	.014	26	.017	54	.048	108	0.36	162	.040
12	9	.039	18	.025	27	.028	9	.022	12	.011	21	.014	56	.050	124	0.42	180	.044
13	4	.018	15	.021	19	.020	10	.025	13	.011	23	.015	57	.050	53	0.18	110	.027
14	12	.053	2	.003	14	.015	25	.062	24	.021	49	.032	78	.070	78	.026	156	.038
15	5	.022	5	.007	10	.010	39	.096	35	.031	74	.048	75	.067	136	.046	211	.052
16	23	.101	27	.037	50	.052	24	.059	14	.012	38	.025	95	.085	191	.065	286	.070
17	17	.075	55	.075	72	.075	46	.114	30	.026	76	.049	140	.125	314	.106	454	.111
18	21	.092	92	.126	113	.118	72	.178	150	.132	222	.144	179	.160	444	.150	623	.153
19	40	.175	178	.244	218	.228	30	.074	225	.198	255	.165	147	.131	565	.191	712	.173
20	53	.232	150	.205	203	.212	40	.099	264	.232	304	.197	35	.031	129	.044	164	.040
21	–	–	–	–	–	–	1	.002	1	.001	2	.001	–	–	1	.000	1	.000
	228		730		958		405		1138		1543		1119		2961		4080	

and traps were set up 6–8 m apart from each other. Such an arrangment of traps ensured collecting of *Drosophila* flies at about 1500 m^2 since the effective attractive radius of a trap is about 30 mm (D o b z h a n k y and E p l i n g, 1944). The evening before the start of studing the daily activity (about 9 p.m.) all traps were visited and flies were caught. During the experiment flies were captured every hour between 5 a.m. and 9 p.m., local time. The flies caught in one round were kept separately and species were determined and flies counted in the same day. The observations on the daily activity of *D. subobscura* were done in three successive years: 25th june 1983, 20th june 1984, and 20th june 1985. The physical parameters such as temperature and humidity were measured always at the same place in the collecting area. The cloudiness was also recorded each day.

Results and discussion

D. subobscura is a very frequent species in drosophiled fauna of Yugoslavia B ä c h l i and K e k i ć, 1983a; B ä c h l i and K e k i ć, 1983b; K e k i ć et al., 1984). At Ravnište (Jastrebac) locality it appears as the predominant species both among *Obscura* group and other *Drosophila* found at this locality (B ä c h l i and K e k i ć, 1983a). The numerical results obtained in our experiment at Ravnište in three successive years are given in Tab. 1. It is clearly noticeable that the activity measured by the frequency of captured flies of *D. subobscura* varies during tha day. For statistical data analysis, the exact numbers of captured flies were used. Both sexes exhibit the same type

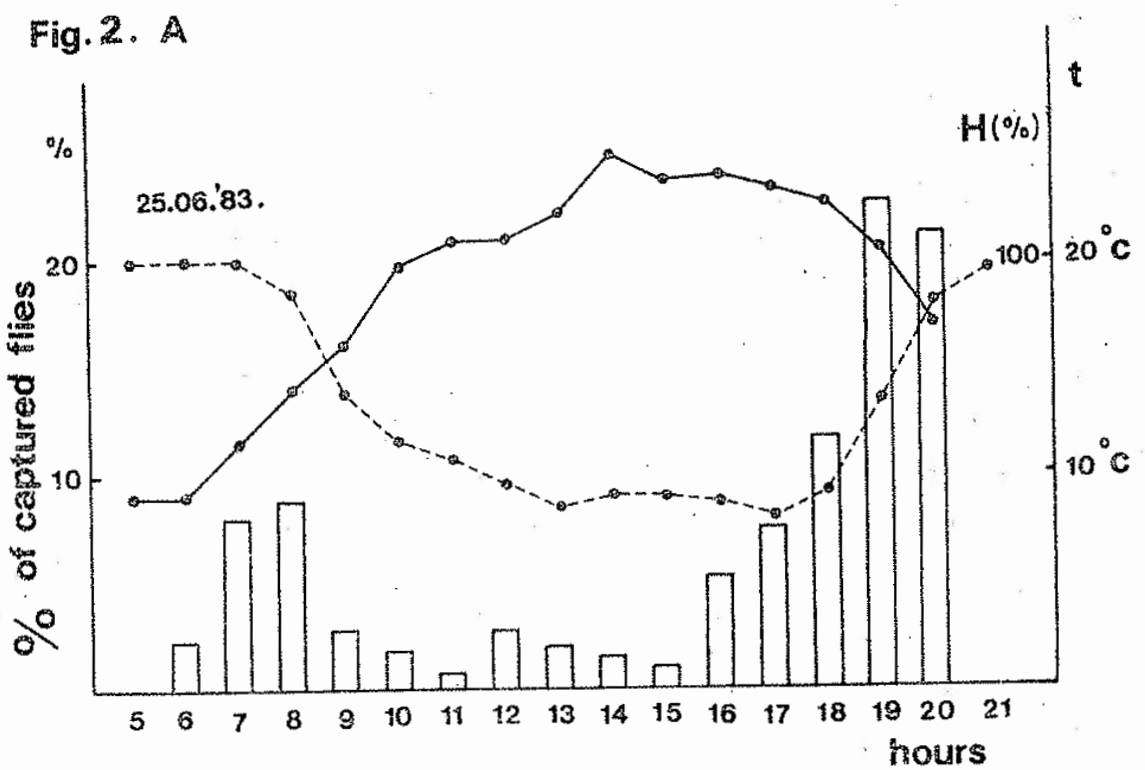

Figure 2 a.

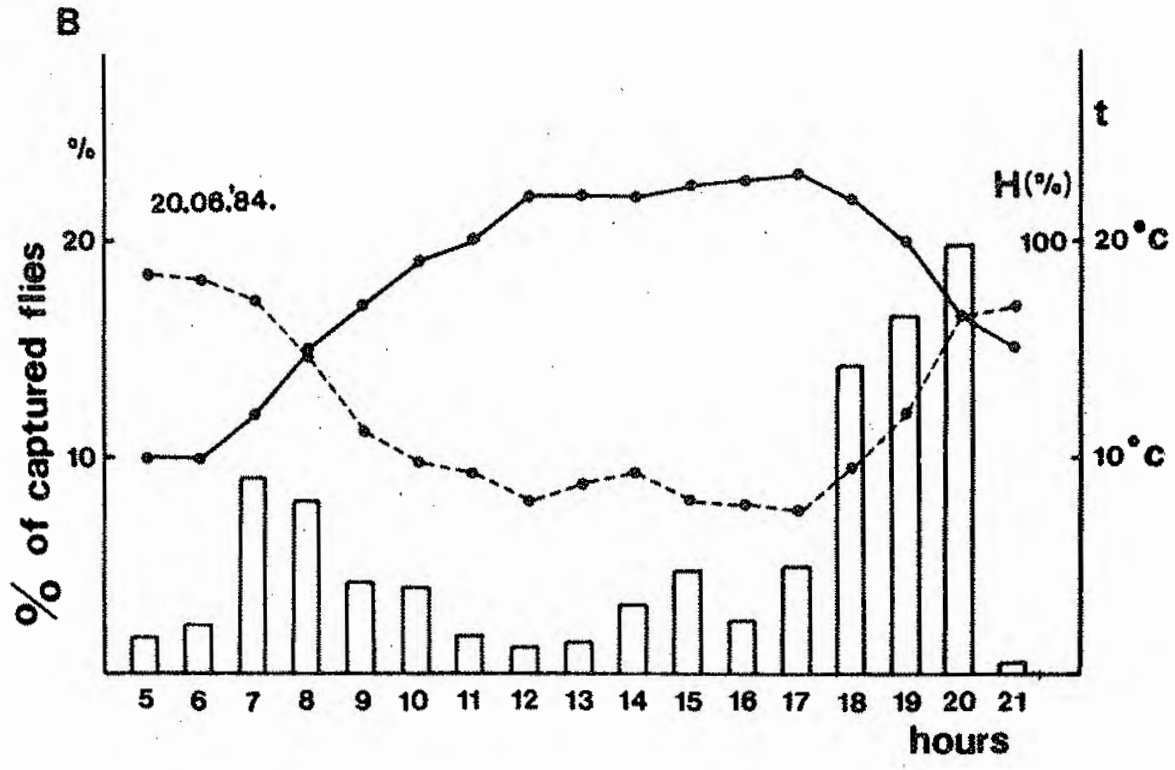

Figure 2 b.

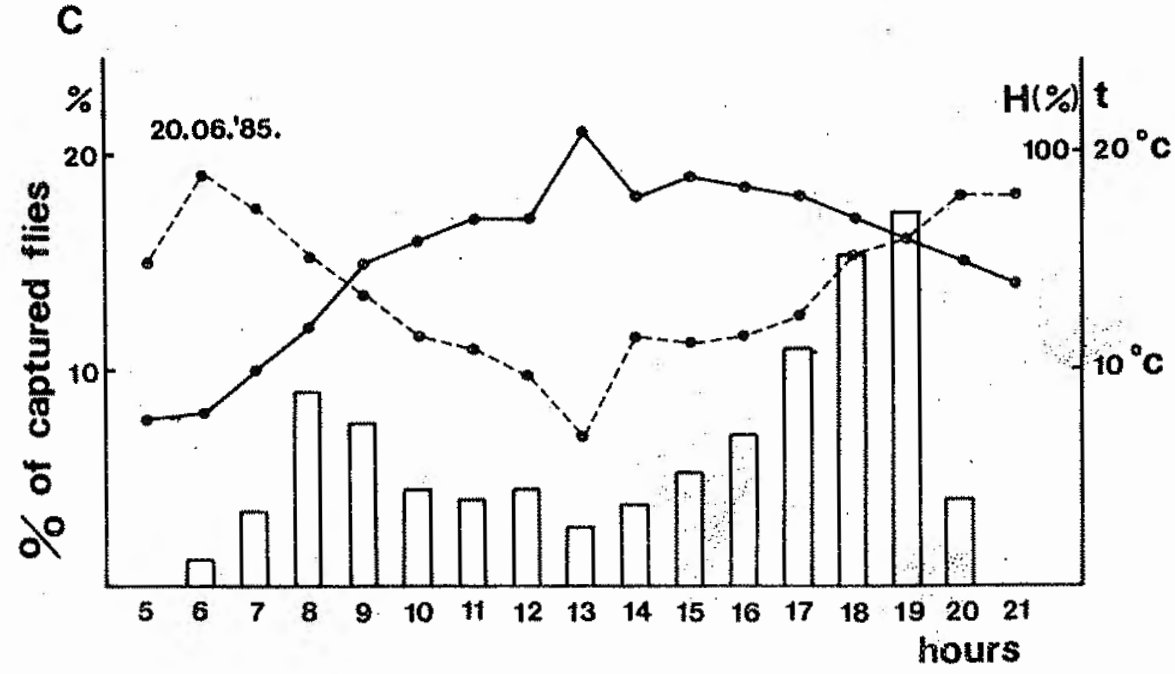

Figure 2 c.

Figures 2. The daily activity rhythm of *D. subobscura* flies and temperature and humidity conditions observed at Ravnište locality in three successive years. a) 1983; b) 1984; c) 1985. (solid line–temperature; dotted line – humidity)

of diurnal activity, which is reflected in the degree of correlation between the daily distributions of females and males (Table 2.). Therefore, it seems reasonable to regard the activity of the flies of both sexes as the unique daily activity of *D. subobscura.*

Table 2. Correlation among diurnal activities of *D. subobscura* females and males

	1983	1984	1985
r	.879	.540	.846
Sr	.123	.217	.138
p	<.01**	<.05*	<.01**

Such a type of activity shows bimodality (Figure 2.). Beside *D. subobscura* (Dyson–Hadson 1956; Rocha Pité, 1977), such activity pattern is exhibited by some of the other *Drosophila* species: *D. pseudoobscura* (Dobzhansky and Epling, 1944), *D. imigrans* (Pavan et al., 1950), *D. lacertosa* (Kaneko, 1968), *D. confusa, D. bifasciata, D. unispina* (Toda, 1973), *D. phalerata,* (Rocha Pité, 1975). The bimodal curve shape is not the same for all species and may partially depend on habitat and season in which the daily activity investigation was carried out. The daily activity pattern of *D. subobscura* at Ravnište locality is characteristic for woodlands in summer. The activity begins at dawn, continuing through out the day untill dusk. There is no activity during the night. The degree of activity varies periodically in the course of the day. Soon after sunrise, the increased activity can be noticed (morning peak), which rather decreases about the middle of the day. Late in the afternoon the activity reaches the highest level, the daily maximum (evening peak), after which the number of captured flies rapidly decreases with dark.

Comparison of the results in the three years shows that there is a significant correlation between them concerning the daily activity of *D. subobscura* at Ravnište locality (Table 3). This fact is of great importance. Naimly, the weather conditions on each of the three days of observation were not the same. The 25th june 1983. was sunny and fair with the average temperature of 18.5°C, (maximum 25.0°C at 2 p.m.) and the average humidity of 66.6 %. The 20th june 1984. was mainly sunny with a cloudy period between 10 a.m. – 6 p.m., the average temperature of 18.3° C (maximum 23.1°C at 5

Table 3. Correlation among diurnal activities of *D. subobscura* flies in different years

1983	r= .942 Sr= .086 p<01**	r= .658 Sr= .194 p <01**
1984		r= .609 Sr= .205 p<01**

p.m.) and the average humidity of 60.0 %. The 20th june 1985 was highly overcast, with drizzle between 2 p.m. – 7 p.m. The average temperature was 15.2°C (maximum 21.0°C at 1 p.m.) and the average humidity was 68.8 %. Each day was without wind.

Having in mind the repeatability of the daily activity pattern as well as the differencies in climatic factors of a habitat in the observed days, a partial consideration of the influence of temperature and humididity on the given type of the behaviour is possible.

Available results (Dyson – Hadson, 1956) suggest that this activity rhythm of *D. subobscura* is determined by two factors of the environment: temperature and light. When the temperature is above 15°C the light has the dominant influence. Rocha Pité (1978) also points out the same importance of temperature and light for the daily activity of *D. subobscura* as well as the same causal relation between these factors in *D. phalerata.* The investigations of Kekić and Marinković (1979) show that in natural habitats the number of captured flies varies with temperature and light. Dobzhansky and Epling (1944) proposed the hypothesis that the light intensity is the causal factor that determines periodicity in the daily activity rhythm of *D. pseudoobscura.* Results of Lilleland (1938) Pavan et al. (1950) and Mitchell and Epling (1951) indicate that relative humidity is of great importance for *Drosophila* flies.

Our mathematical analysis showed that there is no significant correlation between temperature and the captured males or flies at all. With regard to the daily activity of the

Table 4. The daily activity of *D. subobscura* flies in relation to temperature and humidity

T	r	.221	.023	.066	
	Sr	.252	.258	.258	
		n.s.	n.s.	n.s.	1983
	r	.027	.149	.114	
H	Sr	.258	.255	.257	
		n.s.	n.s.	n.s.	
T	r	.468	−.089	.019	
	Sr	.229	.257	.258	
		n.s.	n.s.	n.s.	1984
H	r	−.354	.282	.173	
	Sr	.241	.248	.254	
		n.s.	n.s.	n.s.	
T	r	.597	−.272	.339	
	Sr	.207	.248	.243	
		$p<.05$*	n.s.	n.s.	1985
H	r	.240	.085	−.04	
	Sr	.251	.257	.258	
		n.s.	n.s.	n.s.	

females, there is no significant correlation in the first two years of studing, while in the third year the correlation exist. There is no significant correlation with regard to the relative humidity in any of the combinations (Table 4.).

Table 5. Multiple determination test coeficients of the influence of temperature and humidity on daily activity of *D. subobscura*

	1983	
T=18.5°C		H=66.6%
N=–582.88+19.04T+4.293H		N'=1.55T'+1.54H'
r^2NT=.0042		r^2NH=.013
F_S=.0659 n.s.		F_S=.1977 n.s.
	R^2N.T.H=.2762	
	F_S=2.6171, n.s.	
	1984	
T=18.3°C		H=60.0%
N=–1063.14+3600T+8.257H		N'=1.82T'+1.89H'
r^2NT=.0004		r^2NH=.003
F_S=.0036 n.s.		F_S=.4646 n.s.
	R^2N.T,H=.3628	
	F_S=3.9849$^+$ $p<.05$	
	1985	
T=15.2°C		H=68.6%
N=–813.43+39.90T+6.733H		N'=.75T'+.55H'
r^2NT=.115		r^2NH=.00002
F_S=1.9494 n.s.		F_S=.0002 n.s.
	R^2N.T,H=.2542	
	F_S=2.3634 n.s.	

N=number of captured flies; C=constant; f_T=temperature factor; T=temperature; f_H=relative humidity factor; H= relative humidity

Calculation of the multiple determination coeficient (Table 5.) shows that in the first and the third year of studing, the temperature and relative humidity, separately or in combination, have no significant influence on the daily activity of *D. subobscura* flies. Analysing data for the observations made on the 20th june 1984, F_s value calculated in the multiple determination test show that the combination of temperature and humidity influences the examined component of behaviour according to the tested model of linear dependance. The above observations do not mean that the named factors do not have influence on the daily activity of *D. subobscura,* but that this influence can not be expressed by linear regression (which is persumed in the tested model). It is most likely that we deal with a phenomenon which exhibits its plasticity within combinations of many environmental factors not included in this model.

Remarkable cloudiness on the 20th june 1985, by all means decreased the light intensity. That day the difference between morning peak and the midday activity (11 a.m. – 3 p.m.) was much smaller. It can indicate the influence of light on the daily activity. The explanation may be in adaptation, when the light intensity indicates the climate conditions. Naimly, the increase of temperature (above 15°C) and the decrease of humidity (below 50 %) (Figure 2.) during the day are unfavourable conditions for most

of *D. subobscura* flies and are often related to the increase of light intensity. Therefore, the relative decrease of light intensity indicates the best combinations of environmental factors that enable maximal activity. Such attitude may be confirmed by the hypothesis of T a y l o r and K a l m u s (1954) who consider that *Drosophila* flies might have been adapted to the increased intensity of daily aridity. This adaptation occured not through the increased resistance to dessication like many other *Scizophora,* but through the increased visual activity in lower light intensity conditions combined with previously mentioned periods of flight during the dusky and climaticly more convinient part of the day.

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References

Bächli, G. and M.T. Rocha Pité (1982): Annotated bibliography of Palearctic species of *Drosophilidae (Diptera).* Beitr. Ent., **32**: 303–392.

Bächli, G. and V. Kekić (1983a): Studies of *Drosophilidae (Diptera)* in Yugoslavia. IV. Collections from Ohrid, Kupari and Poreč. Biosistematika, **9**, (2): 109–118.

Bächli, G. and V. Kekić (1983b): Istraživanja *Drosophilidae (Diptera)* Jugoslavije. II. Kolekcije sa Goča, Jastrebca i iz Prištine. II simpozijum o fauni SR Srbije–Zbornik, 107–110.

Dobzhansky, Th. and C. Epling (1944): Contributions to the genetics, taxonomy, and ecology of *Drosophila pseudoobscura* and its relatives. Publ. Carnegie Inst., **554**: 3–46.

Hachiya, T. (1952): The diurnal rhythm of activity in *Drosophila.* Ecological review, **13**: 107–110.

Dyson–Hadson, V. R. D. (1956): The daily activity rhythm of *Drosophila subobscura* and *D. obscura.* Ecology, **37**: 562–567.

Kaneko, A. (1968): *Drosophila* survey of Hokkaido, XXV. Some observations on summer diurnal activity of drosophilid flies in two localities of Southwestern Hokkaido. Jour. Fac. Sci, Hokkaido Univ. Ser. VI. Zool., **16**: 537–541.

Kekić, V., M. Anđelković and G. Bächli (1984): Studies of *Drosophilidae (Diptera)* in Yugoslavia. V. Collections from Mljet. Drosophila Inf. Serv., **60**: 128–129.

Krimbas, C. B. and M. Loukas (1980): The inversion polymorphism of *Drosophila subobscura.* In: Evolutionary Biology (eds. M. K. Hecht, W. C. Steere and B. Wallace), **12**: 163–234. Plenum Press, New York.

Lee, T.J. (1962): Ecological studies of *Drosophila* population in Korea. Kor. Jour. Zool., *5*: 13–20.

Makino, S., E. Momma and K. Wakahama (1954): Diurnal activity of *D. auraria.* Drosophila Inf. Serv., **28**: 133.

Marinković, D. and M. Anđelković (1972): Reproductive ability of *Drosophila subobscura* at different light intensities. Drosophila Inf. Serv., **48**: 44.

Mitchell, D. F. and C. Epling (1951): The diurnal periodicity of *Drosophila pseudoobscura* in Southern California. Ecology, **32**: 696–708.

Pavan, C., Th. Dobzhansky and H. Burla (1950): Diurnal behaviour of some neotropical species of *Drosophila.* Ecology, **31**: 36–43.

Philip, U., J. M. Rendel, H. Spurway and J. B. S. Haldane (1944): Genetics and kariology of *Drosophila subobscura.* Nature, **154**: 260–268.

Rocha Pité, M. T. (1977): Analyse statistique de l'influence des facteurs climatiques sur les rythmes d'activité des populations naturelles des *Drosophilidae* dans la région de Sintra–Colares (Portugal). Arq. Mus. Boc., Ser. 2, **6**: 133–151.

Rocha Pité, M. T. (1978): Rythmes d'activité journaliére des populations naturelles des *Drosophilidae* dans la région de Sintra–Colares (Portugal). Bolm. Soc. port. Ciênc. nat., **18**: 69–90.

Sokal, R. R. and F. J. Rholf (1981): Biometry (second ed). W.H. Freeman and Company, New York.
Taylor, L. R. and H. Kalmus (1954): Dawn and dusk flight of *Drosophila subobscura* Collin. Nature, **174**: 221–222.
Toda, M. J. (1973): Daily activity and vertical microdistribution of drosophilid flies in undergrouth layers. Jour. Fac. Sci. Hokkaido Univ. Ser. VI. Zool., **19**: 105–124.
Wallace, B. and Th. Dobzhasky (1946): Experiments on sexual isolation in *Drosophila*. VIII. Influence of light on the mating behaviour of *Drosophila subobscura, D. persimilis* and *D. pseudoobscura*. Proc. Nat. Acad. Sci., **32**: 226–234.

Sažetak

RITAM DNEVNE AKTIVNOSTI
DROSOPHILA SUBOBSCURA COLLIN (DIPT., DROSOPHILIDAE)
NA LOKALITETU RAVNIŠTE (JASTREBAC), JUGOSLAVIJA

Marko ANĐELKOVIĆ, Marina STAMENKOVIĆ–RADAK i Milan SEKULIĆ
Beograd

Dnevna aktivnost jedinki *D. subobscura* Collin na lokalitetu Ravnište pokazuje oblik karakterističan za šumovita staništa u letnjem periodu. Taj tip aktivnosti pokazuje jasnu bimodalnost. Najveći broj mušica sakuplja se rano ujutru i kasno popodne, a najmanji broj oko podneva.

Matematička analiza pokazuje da ne postoji linearna zavisnost kod uticaja temperature i vlažnosti na dnevnu aktivnost *D. subobscura*. To ne isključuje mogućnost postojanja uticaja ovih faktora, nego se, najverovatnije radi o fenomenu koji pokazuje svoju plastičnost u okviru kombinacija većeg broja faktora spoljne sredine.

Address of the authors:
Marko ANĐELKOVIĆ
Marina STAMENKOVIĆ–RADAK
Milan SEKULIĆ
Institut za biološka istraživanja
„S. Stanković"
YU – 11000 Beograd

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IN MEMORIAM

Merkuri Sergejevič Giljarov
(1912 – 1985)

Profesor Merkuri Sergejevič Giljarov preminuo je posle kratke i teške bolesti 2. marta 1985. godine. Rođen je 1912. godine u Kijevu, gde je sa nepune 22 godine sa blistavim uspehom završio studije na Kijevskom univerzitetu i potom se posvetio naučno–istraživačkom radu u oblasti biologije, entomologije i zaštite bilja. Dao je značajan doprinos u istraživanju štetočina žitarica i industrijskih biljaka, a posebno su sa teorijskog stanovišta ali i sa stanovišta primene, značajni njegovi radovi na proučavanju faune i entomofaune tla, pri čemu su njegovi radovi zasnovali ovu oblast u SSSR-u i imali značajan uticaj na ovu vrstu istraživanja u svetu.

Za svoj uspešan i plodan rad izabran je za predsednika Saveznog entomološkog društva SSSR, predsednika Stalnog komiteta svetskih entomoloških kongresa, za doživotnog predsednika Nacionalnog komiteta biologa SSSR i na niz drugih značajnih međunarodnih i nacionalnih funkcija i dužnosti.

Acta entomol. Jugosl., Vol. 21. No. 1–2: 119–120.
GLUMAC, S.: In memoriam M.S. Giljarov

Profesor Giljarov je odbranio kandidatsku disertaciju 1937. godine, doktorsku disertaciju 1949. godine, 1966. god. je izabran za dopisnog, a 1974. god. za redovnog člana Akademije nauka SSSR i člana predsedništva AN SSSR.

Njegov doprinos sovjetskoj i svetskoj entomološkoj nauci dobro je poznat. Profesor Giljarov je bio čest gost naše zemlje, sarađivao je sa Jugoslovenskim entomološkim društvom i bio lični prijatelj velikog broja jugoslovenskih engomologa. Sarađivao je sa svim entomološkim centrima Jugoslavije, institucijama u kojima su se vršila istraživanja u oblasti entomologije, faune zemljišta i zaštite bilja.

Njegova pomoć i želja da pomogne u razvoju jugoslovenske nauke bila je značajna i dragocena. Njegov odlazak je veliki gubitak kako za svetsku tako i za jugoslovensku entomološku nauku.

Dr Slobodan Glumac

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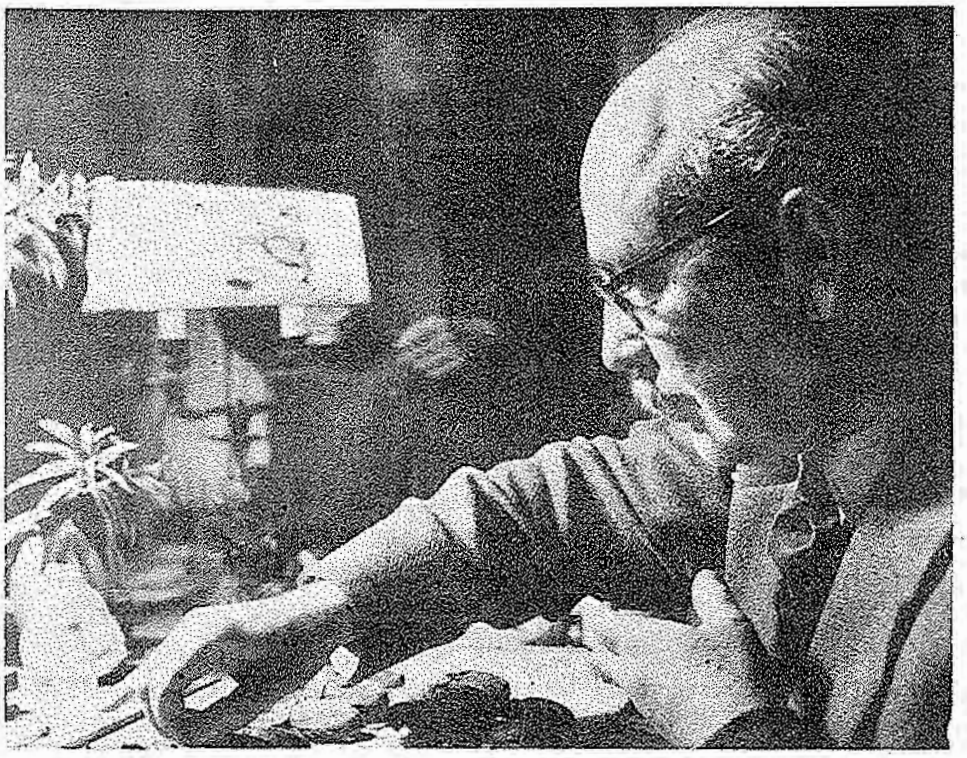

Dr Sebö Endrödi

1903–1984.

Svjetska entomološka nauka pretrpjela je težak gubitak – 12. decembra 1984. godine umro je u Budimpešti u 82. godini života jedan od najvećih entomologa našeg doba, koleopterolog dr Sebö ENDRÖDI.

Dr Sebö Endrödi je rođen 18. oktobra 1903. godine u Košicama (Čehoslovačka). Maturirao je 1923. god. u Esztergömu, a god. 1931. stekao je na Univerzitetu u Budimpešti doktorat prava. Od 1925. do 1948. godine radio je kao pravnik u Mađarskom društvu za riječnu i pomorsku plovidbu. Nakon drugog svjetskog rata radio je do god. 1956. kao naučni saradnik na Visokoj hortikulturnoj školi u Budimpešti, a kasnije na Univerzitetu za agrarne nauke u Gödöllö-u, gdje je predavao sistematiku i ekologiju insekata. Od 1961. go 1966. god. bio je zaposlen u karatinskom laboratoriju Službe za zaštitu bilja u Budimpešti. Premda je 1966. god. bio penzionisan, radio je i nadalje gotovo do smrti u Mađarskom prirodoslovnom muzeju u Budimpešti.

Dr Endrödi bavio se entomologijom već u studentskim danima, a kasnije je od pravnika prešao u profesionalnog naučnika–entomologa. Premda je relativno kasno, u

svojoj 35. godini objavio svoj prvi naučni rad „Die paläarktischen Rassenkreise des Genus *Oryctes* Ill." (Leipzig 1938) dao je u toku svog gotovo 45–godišnjeg naučnog rada ogroman naučni opus od oko 250 naučnih radova objavljenih u brojnim, pretežno veoma uglednim naučnim časopisima i edicijama na svim kontinentima. Značajno je, da je već i njegov prvi rad pokazao izuzetnu naučnu zrelost i vrlo solidno poznavanje materije koju je obradio. Dr Endrödi je bio pod utjecajem prof. Kuntzena iz Berlina, od početka svog naučnog rada pristaša tzv. „Rassenkreisforschung". Međutim, dok je Kuntzen taj ispravan i savremeni smjer istraživanja u praksi primjenjivao krajnje površno i netočno, dr Endrödi je u svojim istraživanjima bio nadasve kritičan i precizan. Većinu svojih radova i djela Endrödi je objavio na njemačkom jeziku. Glavno područje njegovog naučnog rada bile su Dynastinae (Coleoptera, Lamellicornia, Scarabaeidae) cijelog svijeta. Svojim impozantnim djelom „Monographie der Dynastinae", na kojemu je radio od 1966. do 1978. god., a koje je iz tehničkih razloga objavljeno u 22 nastavka u 7 časopisa, stekao je svjetsku naučnu reputaciju. Posmrtno, jedno, nešto skraćeno izdanje ove monografije na engleskom jeziku objavila je Mađarska akademija nauka „The Dynastinae of the World". U svom životnom djelu izgradio je na osnovu ogromnog materijala koji je proučio, jedan novi sistem, dao potpuno originalne (u većini slučajeva i prve) ključeve za određivanje svih tribusa, rodova, podrodova, vrsta i podvrsta, mnogobrojne opise novih vrsta, taksonomske i nomenklatorne izmjene itd.

Drugo veliko područje istraživanja dr Endrödia bile su tropske Aphodiinae o kojima je među ostalim objavio djelo „Die Aphodiinae des Congo–Gebietes in Rahman der Fauna von Zentral–Afrika" (Tervuren 1964). Osim toga objavio je brojne priloge o varijabilnosti vrsta roda *Goliathus* Lam., zatim za Passalidae, Lucanidae, Hybosorinae, Orphninae itd. U okviru „Fauna Hungariae" obradio je, osim Lamellicornia, i familije Anthribidae, Attelabidae, Curculinoidae (četri toma!) i Scolytidae, a u svojim faunističkim radovima o Lamellicornia i drugim familijama obuhvatio je i sjeverne dijelove Jugoslavije i time dao značajan prilog upoznavanju naše entomofaune.

Dr Endrödi je bio dugogodišnji saradnik brojnih velikih zooloških muzeja svijeta. Obradio je i materijal raznih ekspedicija iz istočne Afrike, Kine, Mongolije, Južne Amerike itd. Izvršio je naučne posjete Zoološkim muzejima u Bonnu, Museumu G.Frey u Tutzingu, muzejima u Münchenu, Ženevi, Tervurenu (Muzej bivšeg Belgijskog Konga), Lenjingradu itd. Naučni materijal prikupio je na terenima u Mađarskoj, Jugoslaviji, Austriji, Njemačkoj, Poljskoj, Gani i Južnoj Africi. Bio je član entomoloških društava Mađarske, Austrije, Jugoslavenskog entomološkog društva, te počasni član Entomološkog društva Bosne i Hercegovine. Dobio je mnoga priznanja, među ostalim 1979. god. u Hradec Králóve bronzanu medalju i povelju od VIII internacionalnog simpozija za entomofaunistiku srednje Evrope.

Dr Endrödi je bio ne samo eminentni naučnik već i skroman, veoma dobar i srdačan čovjek. U svom domu uvjek je srdačno primao entomologe i često do kasno u noć raspravljao s njima o raznim naučnim pitanjima. Kao takav i kao veliki naučnik ostaće svima koji su ga poznavali i voljeli u trajnoj uspomeni.

R.Mikšić

Acta entomologica Jugoslavica, 1985, Vol. 21, No. 1–2. UDK 595(048.1)

OSVRTI BOOK REVIEWS

Catalogue of Palearctic Diptera

U izdanju Mađarske akademije nauka i poznatog holandskog izdavača naučnih dela iz oblasti prirodnih nauka Elsevier Sciences Publisher (Amsterdam) počeo je da izlazi sveobuhvatni prikaz palearktičkih vrsta dvokrilaca utvrđenih u periodu od 1758 do 1980/81. Redaktori kataloga su mađarski specijalisti za dvokrilce A. Soós et L. Papp. Katalog će obuhvatiti 13 svezaka, dok će se u četrnaestoj svesci nalaziti indeks materije izložene u prethodnih trinaest. Do sada su objavljene dve sveske: 9. Micropezidae – Agromyzidae (1984) i 10. Clusiidae – Chloropidae, (1984). U katalogu su dati osnovni taksonomski i nomenklaturni podaci o vrstama kao i njihovo rasprostranjenje. Za svaku insekatsku familiju iznete su opšte morfološke i biološke karakteristike imaga i larvi (ukoliko su poznate) uz citiranje autora koji su dali naopsežnije podatke o familiji. Stepen obrade familija prikazanih u katalogu je različit i usaglašen sa proučavanošću istih.

Katalog predstavlja za entomologe koji se bave proučavanjem dvokrilaca izvanredan izvor informacija i pomoć u radu.

Prof. Dr Duška Simova–Tošić

ČEPELAK, J., coauct.: Diptera Slovenska I (Nematocera, Brachycera–Orthorrhapha). — Veda Vydavetel'stvo Slovenskej Akademie Vied. Bratislava, 1984. 288 strana, 1 mapa. Kčs 30.

Ovaj prvi deo faunističkog pregleda dvokrilaca (Diptera) Slovačke sadrži 1981 vrstu uključenu u 38 familija iz podreda Nematocera i grupe Orthorrhapha podreda Brachycera. Drugi deo, pripremljen za štampu i najavljen da izlazi u 1986. godini, sadrži ostale Brachycera.

Posle uvoda, kratkog istorijata istraživanja dvokrilaca Slovačke (od 1758–1984) i pregleda biogeografskih regiona Slovačke (ukupno 26, priložena mapa), sledi sistematski pregled utvrđenih vrsta po familijama. Redosled familija dat je prema D o s k o č i l et al. (1977. Klič zvireny ČSSR V., Československa Akademia Ved, Praha, 373 str.).

Za svaku vrstu navode se najpre lokaliteti nalaza po regionima, kategorisani na već poznate i publikovane i novoutvrđene, nepublikovane. Zatim slede biološke i ekološke karakteristike larvi i odraslih (stanište, zahtevi prema uslovima temperature i vlage, način ishrane, vreme leta imaga, brojnost), kao i ekonomski značaj, specijalno u zdravstvu, veterini, poljoprivredi i šumarstvu. Sve navedene karakteristike vrsta date su u skraćenicama, uglavnom prema međunarodnoj nomenklaturi, čime je u znatnoj meri postignuta sažetost i preglednost teksta. Na kraju, na 56 stranica, tabelarno je prikazano rasprostranjenje svake vrste po navedenim regionima.

U spisku literature (ukupno 93 roda) navode se samo oni radovi koji nisu dati u bibliografiji ČSSR za period 1758–1975 (R o z k o š n y, R., 1971: Bibliography of Diptera in Czechoslovakia 1758–1965, Taxonomy and Faunistics. Folia Monogr. rer. natur. fak. 2, Ujep, Brno, 240 str.; R o z k o š n y, R., 1977: Czechoslovak dipterological literature 1966–1975. Folia Fac. Sci. natur. Univ. Purk. Brun., 18, Biol., 59, 6, 152 str.), kao i oni koji su izašli posle tog perioda.

Ova publikacija je rezultat vrlo intenzivnih faunističkih istraživanja dvokrilaca u Slovačkoj, naročito tokom poslednjih dvadeset godina. U njenoj obradi učestvovalo je 19 priznatih stručnjaka za pojedine grupe, koji su uložili mnogo truda i vremena da na najsavremeniji način obrade i prikažu prikupljeni materijal i podatke. Ona će svakako biti od velike koristi stručnjacima raznih disciplina, naročito faunistima, biocenolozima i primenjenim entomolozima. Faunistima ona može da posluži kao uzor za sažeto i pregledno prikazivanje faunističkih podataka, a dipterolozima faunistima i za upoređenje faune pojedinih grupa dvokrilaca Slovačke sa faunom koju proučavaju, naročito faunom pojedinih karakterističnih staništa (nizije, brda, planine, kotline, kras).

P. Sisojević

Acta entomologica Jugoslavica, 1985, Vol. 21, No. 1–2

DRUŠTVENE VIJESTI

100 GODINA HRVATSKOGA PRIRODOSLOVNOG DRUŠTVA

1985. godine obilježena je stota obljetnica Hrvatskoga prirodoslovnog društva pod pokroviteljstvom Sabora SR Hrvatske, Jugoslavenske akademije znanosti i umjetnosti, Sveučilišta u Zagrebu, Sveučilišta u Rijeci, Sveučilišta u Splitu i Sveučilišta u Osijeku.

Nastajanje i rad Društva kao i obimnu izdavačku djelatnost prikazali smo opširnije već u povodu 90–godišnjice HPD–a (AEJ, vol. 12, 1976, 127–130). Sada ćemo se ograničiti samo na prikaz proslave 100–godišnjice Društva, dok za upoznavanje značenja osnivanja Društva (u vrijeme kada je npr. u tadašnjoj Hrvatskoj bilo nepismeno preko 80% stanovništva) te njegovo stoljetno postojanje, poslužit će navedene prigodne i druge publikacije.

Od brojnih akcija i manifestacija proslave najvažnije su:

1. Objavljena je „Spomenica HPD–a 1885–1985" (151 str.) u kojoj se nalaze razni podaci iz povijesti Društva, o razvitku sekcija (među njima i entomološke sekcije – na koju ćemo se osvrnuti drugom prilikom), zatim Zvjezdarnice, a navedeni su i svi predsjednici Društva te pregled izdavačke djelatnosti.

2. U Splitu je održan sastanak u povodu 40–godišnjice osnivanja Inicijativnog odbora obnovljenog Društva u januaru 1945. godine, kada su u Splitu objavljena dva dvobroja popularnog časopisa „Priroda". Obljetnica je obilježena i u Osijeku i Rijeci.

3. U „Prirodi" br. 4, 1985/86 je uz pomoć autentičnih dokumenata i slika, osobito onih najstarijih iz doba osnutka Društva, te kratkih objašnjenja slikovito prikazan stoljetni rad.

4. U Zagrebu je održano savjetovanje o odnosu matematike, prirodnih znanosti i obrazovanja, koje je trajalo tri dana.

5. O stanju prirodnih znanosti u nas objavljeni su u „Scientia Yugoslavica", vol. 11 (1–2), 1985, 19–70, vrlo interesantni pregledni članci o matematici, biologiji, fizici, kemiji, geologiji i geografiji.

Središnja proslava održana je 26. i 27. decembra 1985. god. u Zagrebu. Tom prilikom je otvorena Izložba o osnivanju i djelovanju Društva u Muzeju grada Zagreba i tiskan vodič kroz izložbu. Zatim je otkrivena Spomen–ploča na zgradi u kojoj je održana Osnivačka skupština HPD–a u Demetrovoj ul. 1 (danas Hrvatski narodni zoološki muzej). Održan je skup „Prirodne znanosti u suvremenom društvu" sa 6 referata i raspravom. Na kraju je u Hrvatskom glazbenom zavodu održana svečana akademija uz podjelu plaketa i priznanja te prigodni koncert gudačkog kvarteta „Pro arte".

Pored drugih javnih priznanja, među kojima je i Orden bratstva i jedinstva sa zlatnim vijencem, Društvo je dobilo Povelju ZAVNOH–a kao najviše društveno priznanje SR Hrvatske.

B. Britvec

Acta entomologica Jugoslavica, 1985, Vol. 21, No. 1–2.

XV GODIŠNJI SKUP ENTOMOLOGA JUGOSLAVIJE
Donji Milanovac, 18.– 20. oktobra 1985.

XV godišnji skup entomologa Jugoslavije održan je u Donjem Milanovcu u hotelu „Lepenski vir" od 18.–20. oktobra 1985. godine. Skup su organizovali Jugoslovensko entomološko društvo i Entomološko društvo Srbije, uz materijalnu pomoć Republičke zajednice nauke SR Srbije. U radu skupa učestvovalo je 57 članova JED-a.

Program skupa

1. Sednica predsedništva JED-a.
2. Entomološki kolokvijum '85 sa glavnom temom „Proučenost faune insekata Jugoslavije", zatim Faunističke vesti i Slobodne teme.
3. Izveštaji o projektima i drugim aktivnostima.
4. Zaključci.

Na početku skupa održana je 18. oktobra u 19,00 časova 9. sednica predsedništva JED–a. Sednicu je vodio predsednik Predsedništva JED–a dr Jan Carnelutti, a prisustvovali su sledeći članovi Predsedništva odnosno voditelji i članovi odbora: Ž. Adamović (Beograd), B. Britvec (Zagreb), D. Gavrilović (Sarajevo), S. Glumac (Novi Sad), M. Gogala (Ljubljana), B. Ivanov (Skopje), S. Krnjajić, M. Krunić, Lj. Mihajlović, G. Nonveiller (svi Beograd), A. Serafimovski (Skopje), R. Sijarić (Sarajevo), I. Sivec (Ljubljana) i S. Šimić (Novi Sad).

Važniji problemi o kojima je pedsedništvo raspravljalo bili su organizacioni problemi o prenosu sedišta društva iz Beograda u Ljubljanu i nove registracije društva, osvrt na prošlogodišnji skup održan na Igmanu, odnosi s Unijom bioloških društava Jugoslavije, distribucija časopisa u zemlji, popunjavanje upražnjenog mesta u Redakcijskom odboru i dr. Predsedništvo je razmatralo i mogućnost održavanja Međunarodnog simpozija o entomofauni srednje Evrope 1988. god. u Jugoslaviji, za što, međutim, sada ne postoje uslovi. Predsedništvo je donelo odluku da se članarina JED-a i pretplata za časopis uplaćuju istovremeno, a doznačuju se preko republičkih odnosno pokrajinskih društava u celosti za ukupan broj članova (kao što su neka društva već i postupila, npr. HED). Godišnja članarina fizičkih članova JED-a s pretplatom za redovan volumen Acta entomologica Jugoslavica iznosi 500.– din., a za povremene suplemente još po 400. – dinara.

Entomološki kolokvijum '85.

U okviru Entomoloških kolokvijuma '85 održano je 30 referata i saopštenja:

Janković, Lj. (Beograd): Bibliografija izučavanja cikada (Homopt., Auchenorrhyncha) Jugoslavije.

Mikšić, R. (Sarajevo): Sadašnje stanje i budući zadaci istraživanja faune Scarabaeidae, Cerambycidae i Lampyridae (Col.) Jugoslavije.

Simova – Tošić, D. (Beograd): Dosadašnja proučavanja faune Cecidomyidae (Dipt.) Jugoslavije.

Kekić, V. (Beograd): Fauna Drosophila (Dipt., Drosophilidae) Jugoslavije.

Božičić, B. (Novi Sad): Proučenost faune komaraca (Dipt., Culicidae) Jugoslavije.

Vujić, A. (Novi Sad): Istraženost faune sirfida (Dipt., Syrphidae) u Jugoslaviji.

Kropczynska, D. (Warszawa) i R. Petanović, (Beograd): Prilog poznavanju faune predatorskih grinja (Acarida, Phytoseiidae) Jugoslavije.

Acta entomol. Jugosl., Vol. 21, 1985, 1–2: 125–127.
DRUŠTVENE VESTI: XV godišnji skup entomologa Jugoslavije, Donji Milanovac, 1985.

Andjus, Lj. i Ž. Adamović (Beograd): Novi podaci o fauni Odonata Crne Gore.
Kačanski, D. (Sarajevo): Preliminarni pregled faune Plecoptera SR Srbije.
Britvec, B. (Zagreb): Uholaže (Dermapt.) – koliko ih poznamo?
Protić, Lj. (Beograd): Prvi prilog poznavanju faune Hemipt. – Heteroptera šireg područja Đerdapa.
Paulus, R. (Osijek) i Ž. Adamović (Beograd): Anophelinae (Dipt., Culicidae) Kupreškog, Duvanjskog i Imotskog polja.
Šimić, S. (Novi Sad): Zonalni raspored i rasprostranjenje sirfida (Dipt., Syrphidae) u SR Crnoj Gori.
Zečević, M. (Zaječar): Novozabeležene vrste leptira (Macrolepidoptera) u Timočkoj krajini.
Vasić, K. (Beograd) i D. Gavrilović (Sarajevo): Prilog fauni Diprionidae (Hymenopt.) SR Srbije i SR Bosne i Hercegovine.
Titovšek, J. (Ljubljana) Mravje iz subgen. *Formica, Coptoformica* in *Raptiformica* (Hym., Formicidae) v SR Sloveniji.
Bandžo, S. (Skopje): Proučenost faune insekata na uljanoj repici u Jugoslaviji.
Vasić, K. (Beograd), D. Vulević (Peć) i M. Zečević (Zaječar): Neki interesantni nalazi sovica (Lep., Noctuidae) u SR Srbiji.
Sijarić, R. (Sarajevo): Neke rijetke i ugrožene vrste Rhopalocera (Lep.) u SR Bosni i Hercegovini.
Mihajlović, Lj. (Beograd) i N. Dimić (Sarajevo): *Polynema striaticorne* Girault (Hymen., Mymaridae) jajni parazit rogatog cvrčka, nova vrsta za faunu Jugoslavije.
Nenadović, V., J. Ivanović i M. Janković – Hladni (Beograd): Diferencijacija neuroendokrinog sistema u toku embrionalnog razvića strižibube *Morimus funereus* Muls. (Col., Cerambycidae).
Stevanović, D. i J. Milin (Novi Sad): Morfofiziološke odlike neurosekretornih ćelija u mozgu lutke *Ostrinia nubilalis* Hübn. (Lep., Pyralididae).
Anđelković, M., M. Stamenković – Radak i M. Sekulić (Beograd): Ritam dnevne aktivnosti *Drosophila subobscura* Collin (Dipt., Drosophilidae) na lokalitetu Ravnište – Jastrebac.
Tomić, D. (Beograd), Đ. Đorđević (Peć) i M. Glavendekić (Beograd): Paraziti u prenamnoženoj populaciji *Diprion pini* L. (Hym., Diprionidae) u borovoj kulturi na lokalitetu Dobroševac (SAP Kosovo) u 1985. godini.
Krunić, M. (Beograd): Gajenje soliterne pčele *Megachile rotundata* Fab. (Hym., Apidae) i njena primena za oprašivanje semenske lucerne u Jugoslaviji.
Terzić, Lj. i M. Krunić (Beograd): Medonosna pčela *Apis mellifera* L. (Hym., Apidae) kao indikator zagađenosti životne sredine.
Brajković, M. (Beograd): Status roda *Hysteromerus* Wesmael u sistematici Braconidae (Hym.).
Stamenković, S. (Novi Sad): *Phorbia securis* Tiensuu (Dipt., Anthomyiidae) značajna štetočina pšenice u SAP Vojvodini.
Redžepagić, H. (Priština): Biljke hraniteljke i štetnost kasida (Col., Chrysomelidae).
Krnjajić, S. i Đ. Krnjajić (Beograd): Nematoda *Anguina millefolii* (Low, 1874) Filipjev, 1936, do sada nepoznata vrsta u nas.

Zatim su podneti sledeći izveštaji i predlozi o projektima:

Izveštaj o radu na istraživačkom projektu „Proučavanje faune Durmitora" (referent G. Nonveiller).
Izveštaj o radu na prikupljanju građe o istorijatu i bibliografiji entomologije u Jugoslaviji (referent Ž. Adamović).
Izveštaj o sudelovanju JED–a na istraživačkom projektu „Fauna Jugoslavije" (referent R. Sijarić).
Izveštaj o radu na projektu „Stanje i perspektive ekosistema područja Kopaonik sa posebnim osvrtom na Nacionalni park Kopaonik" (referent G. Mesaroš).
Predlog za pokretanje inicijative za izradu projekta o istraživanju flore i faune Đerdapske klisure (predlagač M. Zečević).
Sugestija za organizovano proučavanje živog sveta područja Velike plaže kod Ulcinja (predlagač R. Mikšić).
Izveštaj o radu na kartiranju entomofaune Jugoslavije (referent J. Carnelutti).

Posle izveštaja i predloga i diskusije dogovoreni su zaključci, koje je formulirala komisija u sastavu J. Carnelutti, M. Krunić i G. Nonveiller.

Acta entomol. Jugosl., Vol. 21, 1985, 1–2: 125–127.

Zaključci

I. Fauna Durmitora. Skup odaje priznanje Crnogorskoj akademiji nauka i umjetnosti, Organizacionom odboru projekta „Proučavanje faune Durmitora", Redakcionom odboru prve sveske „Fauna Durmitora", kao i svim saradnicima na projektu, na njihovom dosadašnjem veoma uspešnom doprinosu na ostvarivanju ciljeva ove akcije koja traje već šestu godinu te izražava uverenje da će započeti rad moći da se uspešno nastavlja i da se proširi na nove saradnike.

II. Povijest entomologije u Jugoslaviji. Skup pozdravlja izlaženje prve dve sveske „Prilozi za povijest entomologije u Jugoslaviji", koje su izašle kao suplementi Acta entomologica Jugoslavica Vol. 19. (1983) i Vol. 20. (1984), te poziva entomologe da pripreme priloge za nove sveske.

III. Fauna Jugoslavije. Skup podržava pokretanje istraživačko–izdavačkog projekta „Fauna Jugoslavije", iniciran odgovarajućim predlogom Jugoslovenskog entomološkog društva sa prošlogodišnjeg skupa, koji je svestrano prihvaćen od učesnika III kongresa ekologa Jugoslavije održanog u Sarajevu septembra 1984. Formirano je Naučno veće i Redakcioni odbor te je projekt načelno prihvaćen i od nadležnih organa. JED poziva svoje članove da se uključe u rad na ostvarivanju tog projekta.

IV. Kopaonik. Povoljno je prihvaćen izveštaj o ekosistemu planine Kopaonik i JED takove akcije podržava.

V. Fauna i flora Đerdapa. Skup prihvaća predlog M. Žečevića o kompleksnom proučavanju faune i flore Đerdapa te preporuča Entomološkom društvu Srbije da u zajednici sa Srpskim biološkim društvom, Prirodnjačkim muzejom u Beogradu, kao i sa drugim zainteresovanim društvima i organizacijama, razmotri mogućnost pokretanja predloženih istraživanja.

VI. Fauna Velike plaže kod Ulcinja. Skup podržava sugestiju R. Mikšića o proučavanju veoma interesantnog, a ugroženog živog sveta područja Velike plaže kod Ulcinja te preporučuje da Predsedništvo JED–a podnese odgovarajući predlog Crnogorskoj akademiji nauka i umjetnosti.

VII. Mikroračunari. Skup je sa interesovanjem pratio mnogobrojne mogućnosti koje pruža upotreba mikroračunara pri pisanju teksta, uspostavljanju i korišćenju banki podataka, determinaciji insekata i dr., a koje su tokom održavanja skupa prikazali G. Nonveiller, M. Gogala, A. Vujić i T. Buzasi, te preporučuje da se s time upoznaju svi entomolozi naše zemlje i da se korišćenje ove moderne metode rada uvede u što širu upotrebu.

VIII. Upućuje se poziv entomolozima SAP Kosova da se na pogodan način organizuju kao i njihovi kolege u ostalim delovima naše zemlje.

IX. Skup izražava zahvalnost Entomološkom društvu SR Srbije za uspešno provedenu organizaciju ovogodišnjeg skupa u D. Milanovcu.

X. Prihvaća se ponuda Društva entomologa Vojvodine da se sledeći XVI skup entomologa Jugoslavije održi početkom septembra 1986. godine u Vršcu. Glavna tema skupa bila bi „Proučavanost faune insekata Jugoslavije, II", a kao druga tema „Insekatska fauna Banata". Program skupa obuhvatio bi i referate po slobodnim temama, kao što je to uobičajeno, te Savetovanje o akcijama koje organizuje ili pokreće JED.

Poslednjeg dana održavanja skupa (20. X.) organizovan je izlet do brane HE Đerdap, a u povratku za Beograd, obilazak Rajkove pećine u Majdanpeku. Za prevoz učesnika korišćen je autobus Šumarskog fakulteta u Beogradu, koji je besplatno ustupljen organizatorima skupa.

Lj. Mihajlović

Za izdavanje ovog časopisa korištena su sredstva Saveza republičkih i pokrajinskih samoupravnih interesnih zajednica za naučne djelatnosti u SFR Jugoslaviji.

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