FOLIA ENTOMOLOGICA HUNGARICA
ROVARTANI KÖZLEMÉNYEK
Volume 77 2016 pp. 79–85

Exeristes roborator (Fabricius, 1793) (Hymenoptera: Ichneumonidae) in the parasitoid community of Diplolepis galls in the Carpathian Basin

Z. László*, H. Prázsmári & T. I. Kelemen

Hungarian Department of Biology and Ecology, Faculty of Biology and Geology, University Babeş-Bolyai, Strada Clinicilor 5–7, 400006 Cluj-Napoca, Romania.
E-mail: laszlozoltan@gmail.com

Abstract – *Exeristes roborator* (Fabricius, 1793) is usually known as the parasitoid of lepidopteran pupae, but was also recorded as the parasitoid of different Cynipidae species in the southern parts of Europe and parts of Middle East. In samples of *Diplolepis rosae* (Linnaeus, 1758) and *D. mayri* (Schlechtendal, 1876) galls collected in the eastern Carpathian Basin after 2010 *E. roborator* appeared in large numbers compared to those collected before 2010, when the species was not present in the gall communities. Here we report the differential presence of *Exeristes roborator* in the two rose gall species, which points out the host shift of the ichneumonid parasitoid spreading towards north. With 3 figures.

Key words – Parasite ecology, host preference, host shift, Cynipidae

INTRODUCTION

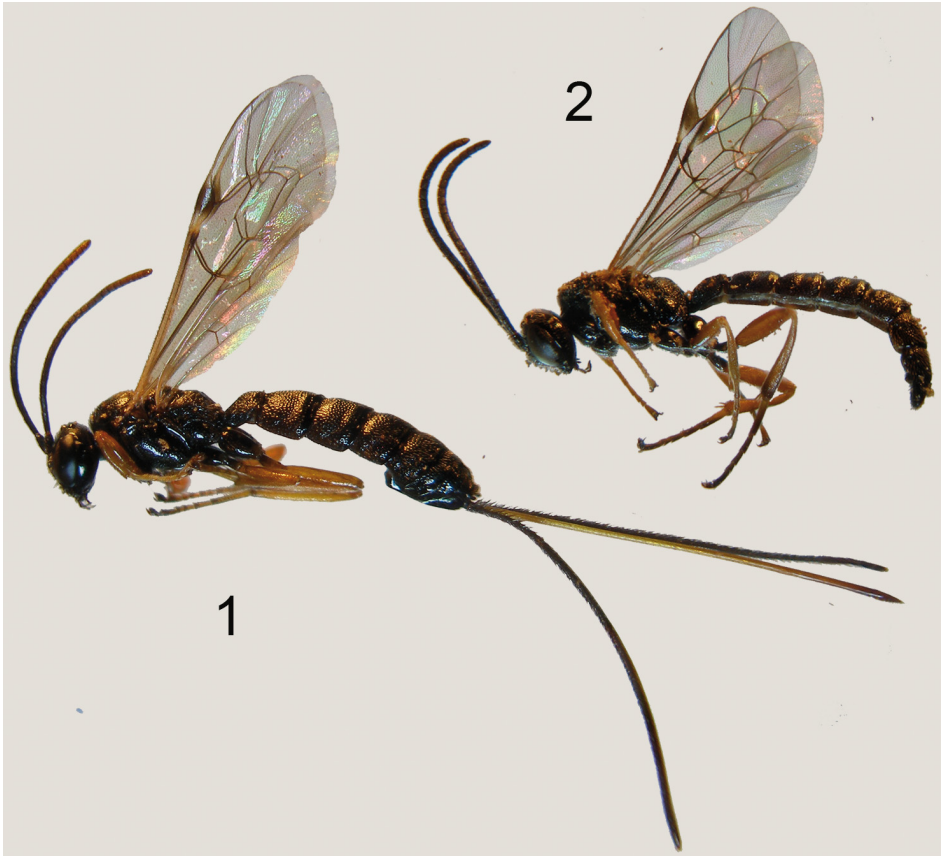
Exeristes roborator (Fabricius, 1793) is a polyphagous ectoparasitoid of the family Ichneumonidae and is widely distributed throughout Europe (Baker & Jones 1934). However, it was found to be more frequent in southern Europe (Paillot 1928, Sachtleben 1930). Its hosts are mainly larvae of Lepidoptera, Coleoptera and Hymenoptera (Thompson & Parker 1928).

Many behavioural and ecological data regarding *E. roborator* are available from biological control studies targeting the species as the controlling agent of the European corn borer *Pyrausta nubilalis* (Hübner, 1796) (Baker & Jones 1934), the honeycomb moth *Galleria melonella* Linnaeus, 1758 (Wardle & Borden 1989), the pink bollworm *Pectinophora gossypiella* (Saunders, 1844), the potato tuber moth *Phthorimaea operculella* (Zeller, 1873) (Thompson 1975) and the weevil *Larinus sturnus* Schaller, 1783 (Zwölfer 1974).

* Corresponding author

Among the species from the family Cynipidae, it is known as a parasitoid of *Biorhiza pallida* (Olivier, 1791) and *B. terminalis* Hartig, 1840 on oak (*Quercus* sp.) (Fulmek 1968), *Diplolepis rosae* (Linnaeus, 1758) (Rizzo & Massa 2006), *D. mayri* (Schlechtendal, 1876) (Özbek *et al.* 1999) and *D. fructuum* (Rübsaamen, 1895) (Lotfalizadeh *et al.* 2009) on rose (*Rosa* sp.), and *Barbotinia oraniensis* (Barbotin, 1964) (Pisică & Popescu 2009).

Belonging to the community inhabiting galls of *Diplolepis* species, *E. roborator* was reported until now only from southern Europe and the Middle East (Iran, Turkey and Sicily (Italy) (Lotfalizadeh *et al.* 2009, Özbek *et al.* 1999, Rizzo & Massa 2006). Studies dealing with the same community from central, north and western parts of Europe have not reported the presence of the ichneumonid *E. roborator* (Askew *et al.* 2006, Constantineanu *et al.* 1956, László *et al.*



Figs 1–2. *Exeristes roborator* (Fabricius, 1793) emerged from *Diplolepis rosae* (Linnaeus, 1758) galls, 1 = female, 2 = male (photo credits: 1 = F. Lászlóffy, 2 = Z. László)

2014, Nordlander 1978, Randolph 2005, Redfern 2011, Schröder 1967, Todorov *et al.* 2012).

In this paper, we report the appearance of *E. roborator* in galls of *D. rosae* and *D. mayri* in the eastern Carpathian Basin (Partium and Transylvania, Romania). We also describe quantitatively the changes through time in the numbers of *E. roborator* emerged from both galls.

Abbreviation – MZBBU = Museum of Zoology, Babeş-Bolyai University, Cluj-Napoca.

THE HOST SHIFTING NEW COMMUNITY MEMBER

Exeristes roborator (Fabricius, 1793) (Figs 1–2)

Material examined – Galls were collected in the Carpathian Basin between 2004–2006 and 2011–2015. All rose galls were collected from dog rose bushes (*Rosa canina*). The galls belong to the multilocular species *D. rosae* and *D. mayri*. The collected galls were placed in plastic cups and covered with cellophane cover, which enabled airing and were kept under standard laboratory conditions. We separated the emerged specimens, then preserved them in 70% ethanol for later identification. Voucher specimens are deposited in MZBBU.

Specimens emerged from the host *D. mayri*: Fânaţe, near Cluj-Napoca, Cluj county, collected in 2011–2012, 2014, February-March, 1 female and 6 males; Suceagu, near Cluj-Napoca, Cluj county, collected in 2012–2013, 2014, February-March, 2 females and 6 males; Chibed, near Sovata, Mureş county, collected between 2012–2015, February-March, 37 females and 66 males; Gherţa-Mică, near Turulung-Vii, Satu Mare county, collected in 2012 and 2015, February-March, 4 females and 9 males.

Specimens emerged from the host *D. rosae* (Figs 1–2): Baciu, near Cluj-Napoca, Cluj county, collected between 2012–2014, February-March, 2 females and 4 males, Fânaţe, near Cluj-Napoca, Cluj county, collected in 2011–2013, 2015, February-March, 4 females and 25 males; Suceagu, near Cluj-Napoca, Cluj county, collected in 2012–2013, February-March, 3 females and 12 males; Chibed, near Sovata, Mureş county, collected between 2012–2015, February-March, 46 females and 183 males; Gherţa-Mică, near Turulung-Vii, Satu-Mare county, collected in 2012–2013, 2015, February-March, 3 females and 21 males; Turulung-Vii, Satu Mare county, collected in 2013 and 2015, February-March, 2 males.

Remarks – *Exeristes roborator* was not present in our samples of *D. rosae* collected between 2004 and 2006 (for example László & Tóthmérész 2013). However, in the later samples collected partly from the same locations (near Cluj-

Napoca, Cluj county) the species appeared in a quite large number. From 89 (out of a collected total 1068) *D. mayri* galls and 197 (out of a collected total 5997) *D. rosae* galls 445 specimens of *E. roborator* emerged (Table 1), which implies a prevalence of *E. roborator* of 3.28 for *D. rosae* and of 8.33 for *D. mayri*. The adult sex ratio of *E. roborator* was of 3.4 males to 1 female. The male dominance may indicate that for *E. roborator* the galls are lesser quality hosts. Egg laying females are assumed to control their offsprings sex ratio as a function of host size. Haplodiploid sex determination provides parasitoid females with a physiological mechanism for this control. If hosts are of good quality than the females will have daughters, otherwise sons (Charnov *et al.* 1981). The presence of the species must have become stable in the community of these multilocular rose galls. Another pattern we found is that the number of *E. roborator* specimens showed an increase towards increasing heights above sea level (Fig. 3). In mountain or hilly regions we found a larger community membership by *E. roborator* than on plains.

Since no other rose gall community data are available from the last few years from other parts of Europe, except Bulgaria (Todorov *et al.* 2012) we cannot conclude that this is a widespread phenomenon in the communities of multilocular rose galls. However, in the samples of Todorov *et al.* (2012) *E. roborator* was not present which presumably refers to the fact that this host shift have not happened in the Bulgarian populations.

If geographically distant rose gall communities would show the appearance of *E. roborator* towards North in Europe than this could be a case of a geographic host switch. Since *E. roborator* is present in the Carpathian Basin, but even in the last decade was not reared from rose gall samples collected from a wide area (Hungary and Romania) it seems that this host switch happened in the last few years.

Since this is the first report of presence of *E. roborator* in the communities of rose galls in northern regions compared to the Mediterranean or Middle East ones,

Table 1. Emerged specimens of *Exeristes roborator* (Fabricius, 1793) between 2004–2015 in Partium and Transylvania (Romania) from multilocular rose galls

Years	*Diplolepis rosae*	*Diplolepis mayri*
2004	0	na
2005	0	na
2006	0	na
2011	4	2
2012	141	40
2013	43	17
2014	72	40
2015	42	44

we only can speculate that as possible cause behind the appearance of the new community member may not be the creation of new contact zones between parasites and formerly isolated hosts (Rózsa *et al.* 2015). According to Rózsa *et al.* (2015) such host switches are regarded to the worldwide reshuffling of the geographic distributions of animal species which are initiated by recent climatic changes. However, this may not be the case for the *E. roborator D. rosae*/*D. mayri* relationship, since all host species and the parasitoid species were present in the region and none of them appeared as the consequence of area shifting initiated by climatic changes.

Several possible explanations may be hypothesized. First, *E. roborator* may have switched to *Diplolepis* galls from other galling species, as *Biorhiza* spp. or *Barbotinia* sp. Second, as *E. roborator* parasitizes lepidopteran herbivores, and as their caterpillars pupate between the emergences found on the surfaces of rose galls, and *E. roborator* may have switched to the inhabitants of rose galls. Third, *E. roborator* may have been the parasitoid of lepidopteran species which pupate inside the chambers of old rose galls, and from those may have switched to the larvae of *D. rosae* and *D. mayri*.

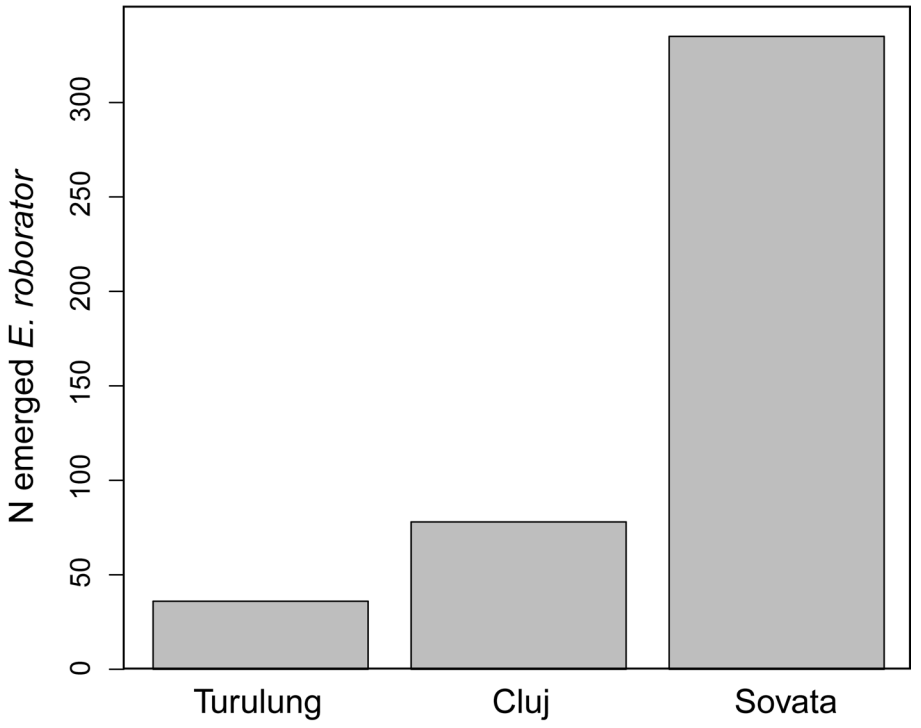


Fig. 3. Partition of emerged specimens of *Exeristes roborator* (Fabricius, 1793) between regions in Partium and Transylvania (Romania). Samples were pooled for the three collecting regions (near Turulung, 132 m a.s.l., Satu Mare county; near Cluj-Napoca, 352 m a.s.l., Cluj county; near Sovata 384 m a.s.l., Mureș county) which differ in their heights above the sea level

We think that the most possible explanation is the first one. Parasitoids such as *Eupelmus vesicularis* (Retzius, 1783) and *E. urozonus* (Dalman, 1820) are generalists which rarely appear in the galls of *Diplolepis* species, but they can also be found in galls of *Andricus* spp. and pupae of Lepidoptera and Coleoptera. *E. roborator* may be in the community of *D. rosae* and *D. mayri* as those generalist species.

The second explanation is less likely because there is not any known Lepidoptera species which pupates between the emergences of rose galls and have *E. roborator* as parasitoid. Moreover, the emergences of *D. mayri* are scarcer than in the case of *D. rosae*. Therefore, in the case of *D. mayri* this explanation is not plausible. However, in some cases we have reared ichneumonid parasitoids from the pupae found between the emergences of the *D. rosae* galls.

The third explanation fails because *E. roborator* specimens have not emerged from old galls collected by us. Usually we found emerging Aculeata, as Formicidae, or Chalcidoidea, as Asaphinae or Encyrtidae which are parasitoids of Aphidae.

Since the most acceptable explanation for the recent appearance of *E. roborator* in *Diplolepis* galls in the Carpathian Basin considers the parasitoids' generalist character, this host association should have been recorded before in northern parts of Europe. But we do not have such data which means that this host shift happened only recently and that we do not know the reasons why it happened.

*

Acknowledgements – We thank Ottó Merkl and Zoltán Vas (HNHM) for their valuable comments and help during the manuscript preparation. The work of Z. László was supported by grants of the Romanian Ministry of Education (CNCSIS-UEFISCSU, PN II-RU 413/2010 and CNCS-UEFISCDI, PN-II-RU-PD 0065/2012).

REFERENCES

Askew R. R., Gómez Sánchez J. F., Hernández Nieves M., & Nieves-Aldrey J. L. 2006: Catalogue of parasitoids and inquilines in galls of Aylacini, Diplolepidini and Pediaspidini (Hym., Cynipidae) in the West Palaearctic. – *Zootaxa* **1301**: 1–60.

Baker W. A. & Jones L. G. 1934: *Studies of Exeristes roborator (Fab.), a parasite of the European corn borer, in the Lake Erie area. Technical Bulletin 460.* – United States Department of Agriculture, Washington D.C., 26 pp.

Charnov E. L., Hartogh R. L. L., Jones W. T. & Assem J. van den 1981: Sex ratio evolution in a variable environment. – *Nature* **289**: 27–33.

Constantineanu I. M., Suciu I., Andriescu I., Ciochia V. & Pisică C. 1956: Contribuţii la studiul chalcidoidelor parazite în cinipide galicole de pe Rosa canina L. din R. P. R. – *Studii şi cercetari ştiinţifice, Academiei R. P. R.* **8**: 3–27.

Fulmek L. 1968: Parasitinsekten der Insektengallen Europas. – *Beiträge zur Entomologie* **18**: 719–952.

László Z. & Tóthmérész B. 2013: Landscape and local effects on multiparasitoid coexistence. – *Insect Conservation and Diversity* **6**: 354–364.

László Z., Sólyom K., Prázsmári H., Barta Z. & Tóthmérész B. 2014: Predation on rose galls: parasitoids and predators determine gall size through directional selection. – *PLoS ONE* **9**: e99806.

Lotfalizadeh H., Ezzati-Tabrizi R. & Masnadi-Yazdinejad A. 2009: Diplolepis fructuum (Rübsaamen) (Hym.: Cynipidae) a new host for Exeristes roborator (Fabricius) (Hym.: Ichneumonidae) in Iran. – *North-Western Journal of Zoology* **3**: 171–173.

Nordlander G. 1973: Parasitic wasps in galls of Diplolepis rosae (L.) and D. mayri Schlechtd. (Hymenoptera: Cynipidae) (Hym.: Ichneumonoidea, Chalcidoidea, Cynipoidea). – *Entomologisk Tidskrift* **94**: 148–176.

Özbek H., Güçlü S. & Tozlu G. 1999: Biology and natural enemies of Diplolepis mayri Schld. (Hymenoptera: Cynipidae), a pest of Rosa canina L. in Erzurum province. – *Türkiye Entomoloji Dergisi* **23**: 39–50.

Paillot A. 1928: On the natural equilibrium of Pyrausta nubilalis Hb. – *Scientific Reports. International Corn Borer Investigations* **1**: 77–106.

Pisică C. & Popescu I. E. 2009: *Le catalogue des ichneumonides (Hymenoptera: Ichneumonidae) de Roumanie*. – PIM Publishing, Iaşi, 360 pp.

Randolph S. 2005: *The natural history of the Rose Bedeguar gall and its insect community*. – British Plant Gall Society, Sudbury, 92 pp.

Redfern M. 2011: *Plant galls*. – HarperCollins Publishers, London, 576 pp.

Rizzo M. C. & Massa B. 2006: Parasitism and sex ratio of the Bedeguar gall wasp Diplolepis rosae (L.) (Hymenoptera: Cynipidae) in Sicily (Italy). – *Journal of Hymenoptera Research* **15**: 277–285.

Sachtleben H. 1930: Notes on Pyrausta nubilalis Hb. and its Parasites in Bulgaria and Roumania. – *Scientific Reports. International Corn Borer Investigations* **3**: 42–57.

Schröder D. 1967: Diplolepis (= Rhodites) rosae (L.) (Hym.: Cynipidae) and a review of its parasite complex in Europe. – *Technical Bulletin of the Commonwealth Institute of Biological Control* **9**: 93–131.

Rózsa L., Tryjanowski P. & Vas Z. 2015: Under the changing climate: how shifting geographic distributions and sexual selection shape parasite diversification. – In: Morand S., Krasnov B. R. & Littlewood D. T. J. (eds): *Parasite Diversity and Diversification: Evolutionary Ecology Meets Phylogenetics*. Cambridge University Press, Cambridge, pp. 58–76.

Thompson S. N. 1975: Defined meridic and holidic diets and aseptic feeding procedures for artificially rearing the ectoparasitoid Exeristes roborator (Fabricius). –*Annals of the Entomological Society of America* **68**: 220–226.

Thompson W. R. & Parker H. L. 1928: *The European corn borer and its controlling factors in Europe. Technical Bulletin 59***.** – United States Department of Agriculture, Washington D.C., 63 pp.

Todorov I., Stojanova A., Parvanov D. & Boyadzhiev P. 2012: Studies on the Gall Community of Diplolepis rosae (Hymenoptera: Cynipidae) in Vitosha Mountain, Bulgaria. – *Acta Zoologica Bulgarica, Supplement* **4**: 27–37.

Wardle A. R. & Borden J. H. 1989: Learning of an olfactory stimulus associated with a host microhabitat by Exeristes roborator. – *Entomologia experimentalis et applicata* **52**: 271–279.

Zwölfer H. 1975: Vergleichende Untersuchungen an Alpinen und Nicht-Alpinen Populationen von Larinus Sturnus Schall.(Col.: Curculionidae): Diversität und Produktivität im Ökologischen Grenzbereich. – In: Müller P. (ed.): *Verhandlungen der Gesellschaft für Ökologie Erlangen 1974*. Springer Netherlands, Dordrecht, pp. 47–53.