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DISTRIBUTION OF THE GENUS *ZOSPEUM* BOURGUIGNAT 1856 (GASTROPODA, PULMONATA, ELLOBIIDAE) IN CROATIA

RAJKO SLAPNIK[1] & ROMAN OZIMEC[2]

[1] Institute of Biology, Centre for Scientific Research of the Slovenian Academy of Sciences and Arts Novi trg 2, 1000 Ljubljana, Slovenia (rajkosl@zrc- sazu.si)

[2] Croatian Biospeleological Society, Demetrova 1, 10000 Zagreb, Croatia (roman.ozimec@zg.htnet.hr)

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This is a contribution to the knowledge of troglobiont snails of the genus *Zospeum* Bourguignat 1856 (Gastropoda, Pulmonata, Ellobiidae) of the karst region in Croatia. Records of the various taxa are listed and a UTM distributional map of Croatia is presented. Six species and two subspecies were found.

Key words: Gastropoda, Ellobiidae, Carychiinae, *Zospeum*, troglobiont snails, distribution, caves, Croatia

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Rad je prinos poznavanju zemljopisnog rasprostranjenja troglobiontnih puževa iz roda *Zospeum* Bourguignat 1856 (Gastropoda, Pulmonata, Ellobiidae) na području krša Hrvatske. Navedena su nalazišta pojedinih svojti uz prikaz areala na UTM karti Hrvatske. Utvrđeno je šest vrsta i dvije podvrste.

Ključne riječi: Gastropoda, Ellobiidae, Carychiinae, *Zospeum*, troglobiontni puževi, rasprostranjenost, špilje, Hrvatska

INTRODUCTION

The genus *Zospeum* (Gastropoda, Pulmonata, Ellobiidae) includes troglobiont land snails. The animals live subterraneously in the central Pyrenees, the southern Alps, and the Dinaric karst, from a few meters above sea level to an altitude of 2,000 meters (HAMANN, 1896; ZILCH & JAECKEL, 1962; BOLE, 1974; PEZZOLI, 1992; SLAPNIK, 1991; 1994).

Our knowledge about the ecology of *Zospeum* species is very sparse. The snails live in caves and fissures and probably feed on detritus from the loam and cave sediments (VELKOVRH, 1973). In caves, they occur on walls, on the ground beside puddles, or on organic matter like rotten wood.

The taxonomy of the genus is based primarily on conchological characters. The lamellae and teeth in the aperture as well as in the ultimate and the penultimate whorl are considered diagnostic. However, these characters can vary considerably in larger populations. The anatomy of the *Zospeum* species has partially been examined (BOLE, 1974; GIUSTI, 1975).

The first record of *Zospeum* in Croatia was published by the famous malacologist Spiridion Brusina, based on material collected in middle of the 19th century in two caves by F. Erjavec (BRUSINA, 1870). This was also the first record of troglobiont snails in Croatia (HIRC, 1902; OZIMEC & GOTTSTEIN, 2001). The genus *Zospeum*, with the species *Z. alpestre* and *Z. kusceri*, was included in first lists of cave- dwellingfauna (LANGHOFFER, 1912; 1915a; 1915b). The Slovene malacologist L. Kuščer collected *Zospeum* in several caves (KUŠČER, 1925) and mentioned a new form of the south of the Kupa as *Z. subobesum* nom nud (KUŠČER, 1932). The most systematic research project to collect troglobiont snails was performed by two Slovene investigators, J. Bole and F. Velkovrh. Numerous new localities were recorded and three endemic species were described (BOLE, 1960; 1974). A monograph of *Zospeum* in the former Yugoslavia was published by J. Bole (BOLE, 1974).

MATERIAL AND METHODS

To collect subterranean terrestrial snails, we took samples of clay, sand, fine rubble and organic waste in caves and collected the tiny shells by wet sieving. We also collected live specimens from the rocks. The material dealt with was collected by: J. Bole, F. Velkovrh and R. Slapnik (Slovenia), J. Bedek, H. Cvitanović, B. Jalžić, D. Lacković, G. Polić, I. Rašić, S. Rešetar and T. Rubinić (Croatia). The species collected and examined have been classified and are preserved in the malacological collection of the Biological Institute (coll. MZBI) of the Centre for Scientific Research of the Slovenian Academy of Sciences and Arts in Ljubljana, the collections of Roman OZIMEC (coll. ROC) and Branko JALŽIĆ (coll. BJ) which are part of Croatian Biospeleological Society Collection and the private collection of France VELKOVRH (coll. FV) (Slovenia).

Localities are defined by UTM (Universal Transverse Mercator Grid) coordinates transferred onto a map of Croatia.

RESULTS AND DISCUSSION

Zospeum isselianum Pollonera 1886

(*Zospeum alpestre* Bourguignat (part.) 1856, Amen. malac., 2, 15; *Zospeum isselianum* Pollonera 1886, Boll. Soc. malac. Ital., 12, 205; *Zospeum alpestre isselianum* Pollonera 1886, stat. n., Razprave IV. Razreda SAZU XVII/5, 255)

Shells are 1.0 to 1.6 mm high. The major variability is the size of shells, and the shape of the parietal lamella is characteristic of this species. The non- expressed parietal lamella in the aperture continues only in traces within the shell. The size and shape of the shell and aperture, with exceptionally visible parietal lamella indicates the similarity with *Z. amoenum*. *Z. isselianum* occurs in north- east Italy, southern Austria, Slovenia and north- west Croatia (BOLE, 1974; MAIER, 1975; MILDNER, 1976; SLAPNIK, 1991; 1994).

Localities of *Z. isselianum* in Croatia:

Note: For the (10 × 10 km) UTM grid mark, the name of the locality (for example: cave, spring), the name of the closest settlement, the name of the closest settlement listed in maps, the data collected, the name of the collector (leg.) or collection (coll.), the number of sample and the number of specimens are cited. (Lit.) means that data are cited from references (BOLE, 1974; SCHÜTT, 2000).

VK78 Baška Draga (quarry), Baška, island Krk, 10. 1972, coll. FV 21253, 1 specimen; 10. 1972, coll. FV 24000, 1 specimen;

VK79 Biserujka (cave), Rudine, island Krk, 11.74, coll. FV 27956, 500 specimens;

VL23 Špilja iznad Bresta (cave), Lupoglav, 06.76, coll. FV 32712, 7 specimens; 22.05.68, leg. J. Bole, coll. MZBI 30004, 4 specimens;

VL30 Izvor kod mlina na Mrežnici (spring), Tržić, Ogulin, 07.83, coll. FV 42962, 4 specimens;

VL43 Špilja na kraj travnika (cave), Škalnica, Rijeka, leg. J. Bole (Lit.);

VL 83 Izvor Kupica (spring), Delnice, leg. J. Bole (Lit.); Rakovica pećina (cave), leg. J. Bole (Lit.)

VL93 Muževa hiža (cave), Skrad, 05.75, coll. FV 29900, 10 specimens; 05.75, coll. FV 29996, 15 specimens;

WK06 Ledenica (cave), Zavižan, 29.09.83, leg. J. Bole, coll. MZBI 21085, 4 specimens;

WK08 Siničić špilja (cave), Brinje, 09.64, coll. FV 3025 30 specimens; 09.64, coll. FV 21253, 30 specimens; 09.09.64, leg. J. Bole, coll. MZBI 3195, 50 specimens;

WK15 Mramor špilja (cave), Lipovo Polje, Donji Kosinj, 09.64, coll. FV 3003, 4 specimens; 09.64, coll. FV 19017, 4 specimens;

WK22 Torine ponor (cave), Brušane, Gospić 12.09.64 leg. J. Bole, coll. MZBI 3196, 20 specimens;

WK33 Ostrvička špilja (cave), Ostrvica, Lički Osik, 08.05.71, leg. J. Bole, coll. MZBI 6171, 10 specimens;

WK42 Pčelina špilja (cave), Buljmize, Mogorić, 08.85, coll. FV 44392, 15 specimens; 08.88, leg. R. Slapnik, coll. MZBI 33098, 50 specimens;

WK44 Zelena špilja (cave), Bunić, Krbava, 1964, coll. FV 3015, 4 specimens; coll. FV 31590, 8 specimens;

WK46 Špilja kod Plitvica (cave), Plitvice, coll. FV (Lit.); Medvjeđa jama (cave), Bigina poljana, Plitvice 17.10.65, leg. J. Bole, coll. MZBI 3452, 50 specimens; Mračna špilja (cave), Plitvice, 20.10.65, leg. J. Bole, coll. MZBI 3451, 20 specimens; Rodićeva špilja (cave), Plitvički klanac, Plitvice, 16.10.65, leg. J. Bole, coll. MZBI

31374, 10 specimens; Šupljara, Plitvice, 20.10.65, leg. J. Bole, coll. MZBI 3450, 4 specimens;

WK53 Mamulina špilja (cave), Jošani, 1964, coll. FV 36386, 10 specimens; 1964, coll. FV 3011, 40 specimens;

WK57 Kukuruzovićeva špilja (cave), G. Vaganac, Ličko Petrovo selo, 18.10.85 leg. J. Bole, coll. MZBI 22184, 3 specimens;

WK58 Donja Baraćeva špilja (cave), Stara Kršlja, Rakovica, leg. J. Bole, (Lit.); Gornja Baraćeva špilja (cave), Stara Kršlja, Rakovica, 23.10.65, leg. J. Bole, coll. MZBI 3453, 15 specimens; Izvor ispred Jovine špilje (spring), Nova Kršlja, Rakovica, 10.75, coll. FV 31104, 2 specimens; Jama iznad Jovine špilje (cave), Nova Kršlja, Rakovica, 10.75, coll. FV 30798, 15 specimens; Jelina jama (cave), Nova Kršlja, Rakovica, 10.75, coll. FV 31074, 2 specimens; Špilja preko puta izvora Suvaje (cave), Nova Kršlja, Rakovica, 02.11.65, leg. J. Bole, coll. MZBI 16904, 1 specimen; Špilja u Ponoru (cave), Stara Kršlja, Rakovica, 23.10.65, leg. J. Bole, coll. MZBI 3455, 50 specimens; Točkova špilja (cave), Stara Kršlja, Rakovica, 23.10.65, leg. J. Bole, coll. MZBI 3456, 60 specimens;

WK59 Ponor pod Kremenom (sinkhole), Kremen, 21.10.01, Leg. R. Ozimec, coll. ROC 222, 20 specimens;

VL91 Jama kod Ratkovog skloništa (cave), Samarske stijene, 26.09.98, leg. R. Ozimec & G. Polić, coll. ROC 57, 40 specimens;

WL10 Zagorska peć (cave), Zagorje, Ogulin, 10.86, coll. FV 46165, 2 specimens;

WL11 Vitunj (spring), Ogulin, 07.83, coll. FV 43187, 20 specimens;

WL21 Kukača (cave and spring), Tounj, 10.84, coll. FV 44057, 1 specimen; 10.84, coll. FV 44590, 16 specimens; 10.84, coll. FV 40340, 30 specimens; Mikašinovića špilja (cave), Slunj, 05.83, coll. F. Velkovrh 42945, 7 specimens; Špilja na izvoru Rupećica (cave), Ivanci, Ogulin, 11.3.00, leg. B. Jalžić, coll. BJ 32401; Tamnica (cave), Tounj, 27.6. 00, leg. R. Slapnik, coll. MZBI 3105, 10 specimens; Tounjčica (cave), Tounj, 07.83, coll. FV 42976, 10 specimens; leg. Kuščer (Lit.); 26.10.62, leg. J. Bole, coll. MZBI 2087, 4 specimens; 27.6.00, leg. R. Slapnik, coll. MZBI 3116a, 1 specimen; 27.6.00, leg. R. Slapnik coll. MZBI 3117a, 2 specimens; 27.6.00, leg. R. Slapnik coll. MZBI 4380, 3 specimens; leg. R. Slapnik coll. MZBI 3119, 15 specimen, Vrelo Rudnice (cave), Tounj, 07.83, coll. FV 43293, 6 specimens;

WL22 Vodotečina (cave), Bosiljevo, 10.62, leg. J. Bole, coll. MZBI 2082, 2 specimens;

WL24 Špilja Đot (cave), Netretić, Karlovac, 23.10.98, leg. R. Ozimec, coll. ROC 120, 10 specimens;

WL25 Špilja Pivnica (cave), Žakanje, Ozalj, 13.07.98, leg. R. Ozimec & I. Rašić, coll. ROC 135, 30 specimens;

WL26 Špilja Gojkova draga (cave), 15.03.98, leg. T. Rubinić, coll. ROC 4, 1 specimen; Špilja kod Juraševe livade (cave), Sekulići, 10.08.97, leg. T. Rubinić, coll. ROC 65, 30 specimens; 10.97, leg. T. Rubinić, coll. ROC 174, 5 specimens; Špilja na izvoru Pećine (cave), Malinci, 27.07.97, leg. T. Rubinić, coll. ROC 21, 5 specimens; 22.06.97, leg.T. Rubinić, coll. ROC 12, 50 specimens; 22.06.97, leg.T. Rubinić, coll. ROC 20, 4 specimens;

WL35 Ozaljska špilja (cave), Ozalj, leg. J. Bole, coll. MZBI 30003, 15 specimens; coll. MZBI 2492, 20 specimens; leg. L. Kuščer, coll. MZBI 1038, 25 specimens; coll. FV (Lit.); Ponor Vrulje (cave), Cerovica, Krašić, 31.08.97, leg. T. Rubinić, coll. ROC 102, 10 specimens; Vrlovka (cave), Kamanje, coll. FV 5817, 7 specimens; 02.74, coll. FV 25746, 20 specimens; 06.10.60, leg. J. Bole, coll. MZBI 1233, 20 specimens; 27.10.62, leg. J. Bole, coll. MZBI 2086, 30 specimens;

WL36 Špilja Drobovnik (cave), Kunčani, 07.88, coll. FV 46791, 1 specimen; Špilja Jamura (cave), Slapnica, 02.12.89, coll. FV 47797, 1 specimen; Jamina (cave), Donji Oštrc, 02.11.97, leg. T. Rubinić, coll. ROC 54, 10 specimens; 17.10.99, leg. R. Ozimec & I. Rašić coll. ROC 182, 1 specimen; Mikulićka (cave), Rajići, Budinjak, 07.02.99, leg. R. Ozimec & T. Rubinić, coll. ROC 58, 20 specimens; Špilja na izvoru Slapnice (cave), Kostanjevac, 30.08.98, leg. I. Rašić, coll. ROC

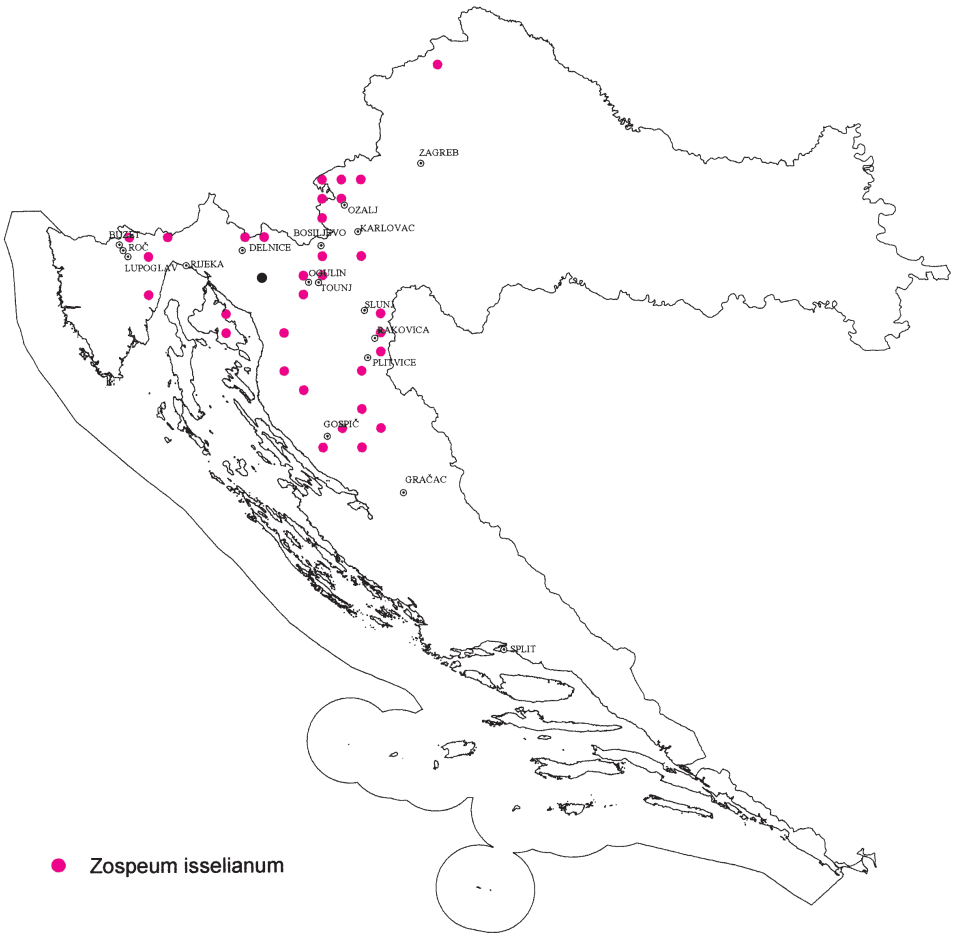

Fig. 1. UTM map of the distribution of the species *Z. isselianum* in Croatia.

24, 1 specimen; Špilja na izvoru Vrelo (cave), Budinjak, 07.09.97, leg. T. Rubinić, coll. ROC 50, 1 specimen; Špilja Provala (cave), Bučari, Donji Oštrc, 1997, leg. T. Rubinić, coll. ROC 138, 2 specimens;

WL42 Barilović špilja (cave), Karlovac, coll. FV (Lit.); Jopićeva špilja (cave), Krnjak, Karlovac, 14.11.98, leg. H. Cvitanović, coll. ROC 64, 1 specimen; 29.02.00, leg. H. Cvitanović, coll. ROC 193, 10 specimens; Špilja Gvozdenica (cave), Krnjak, Karlovac, 09.12.97, leg. R. Ozimec, coll. ROC 122, 3 specimens; 04.12.97, leg. R. Ozimec, coll. ROC 121, 1 specimen; Špilja Vražić (cave), Barilović, Karlovac, 02.74 coll. FV 25737, 10 specimens; 03.74, coll. FV 25815, 2 specimens; coll. FV 3003 2 specimens;

WL46 Vugrinova špilja (cave), Cerje, 03.10.99, leg. I. Rašić, coll. ROC 179, 2 specimens; Ciganska špilja (cave), Smoljana, leg. J. Bole (Lit.);

WM82 Cerjanska špilja (cave), Klenovnik, Varaždin, 11.1. 02, leg. R. Ozimec, coll. ROC, 20 specimens;

Z. isselianum is a generally widespread species in the northwest part of Croatia. Its appearance in Cerjanska špilja by Varaždin shows that its distribution extends much further east into the central part of the state. A considerable number of new sites have been added recently to the numerous localities in which Bole and Velkovrh (BOLE, 1974) found this species (VK79, VL30, VL93; WK06, WK15, WK42, WK57, WL10, WL11, WL22, WL24, WL25, WL26, WL36, WL46, WM82) (Fig. 1)), which have filled the gap between three mutually fairly distant regions that BOLE (1974) characterised as the regions in which *Z. isselianum* appears. In the cave of Špilja na kraj travnika in north eastern Istria, *Z. isselianum* appears together with the species *Z. kusceri*. Towards the east, it shares its area of distribution with the species *Z. likanum*. Shells of both species have been found in Donja Baraćeva špilja by Rakovica. More southerly sites are known around Plitvice and Gospić, which is the most southerly habitat of this species.

Zospeum likanum Bole 1960

(*Zospeum likanum* Bole, 1960, Biol. vestnik, 7, 61; *Zospeum alpestre likanum* Bole 1960 stat. n., Razprave IV. Razreda SAZU XVII/5, 256; *Zospeum alpestre likanum* (Bole, 1960), Encyclopedia Biospeleologica, III, 2256)

BOLE (1960) described this species from caves in the vicinity of Gračac in Lika (Loc. typ.: Gornja Cerovačka špilja). The shells are slightly larger than the shells of *Z. alpestre*, they have a slight bulge at the spire and the aperture is more oblique. The parietal lamella is lower within the interior of the shell.

Localities of *Z. likanum* in Croatia:

WK50 Brkina špilja (cave), Ričice, Gračac, 08.06.58, leg. J. Bole, coll. MZBI 1236, 30 specimens;

WK58 Donja Baraćeva špilja (cave), St. Kršlja, Rakovica, 27.10.65, leg. J. Bole, coll. MZBI 3457, 40 specimens; Gornja Baraćeva špilja (cave), Rakovica, 27.10.65, leg. J. Bole, coll. MZBI 3458, 50 specimens;

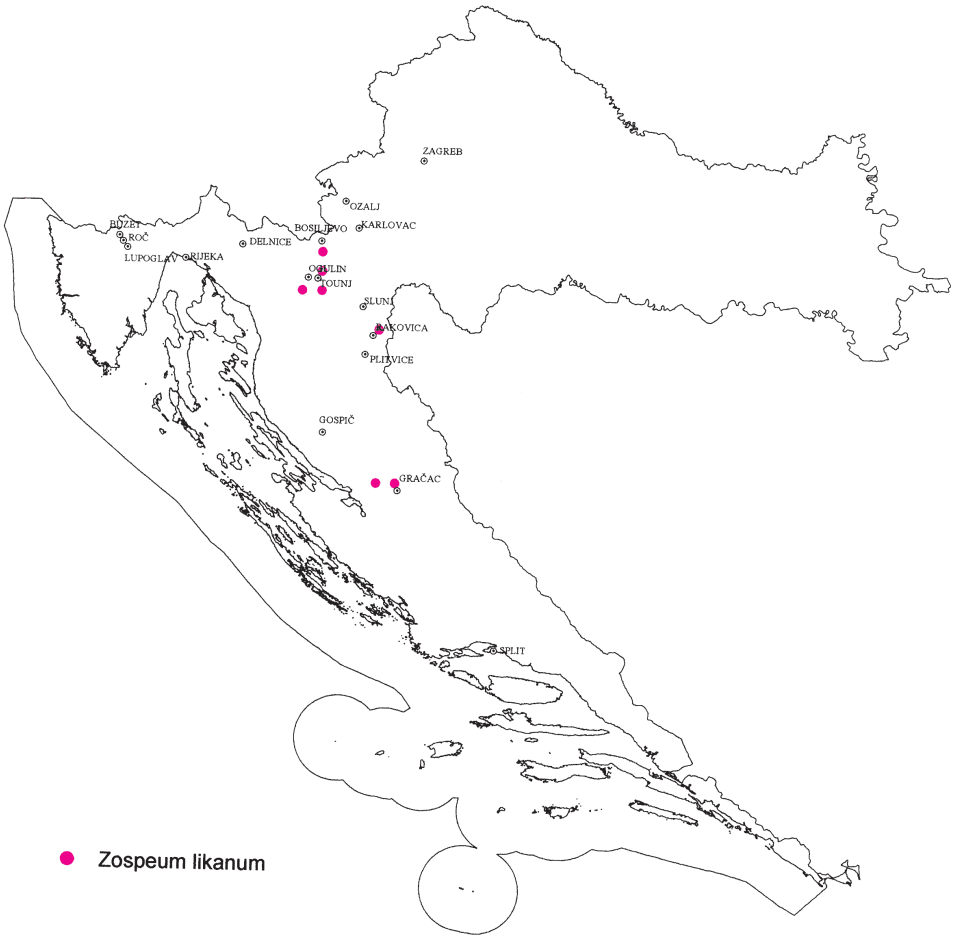

Fig. 2. UTM map of the distribution of the species *Z. likanum* in Croatia.

WK60 Donja Cerovačka špilja (cave), Gračac, coll. FV (Lit.); 13.06.63, leg. J. Bole, coll. MZBI 2249, 5 specimens; Gornja Cerovačka špilja (cave), Gračac, coll. FV (Lit.); 06.06.58, leg. J. Bole, coll. MZBI 1237, 10 specimens; coll. MZBI 1234, 20 specimens; 20.07.97, leg. S. Rešetar, coll. ROC 5, 5 specimens; Pekićina špilja, Gračac, 07.06.58, leg. J. Bole coll. MZBI 1228, 1 specimen; Svetinja, Gračac, 07.06.58, leg. J. Bole, coll. MZBI 1235, 10 specimens;

WL10 Zagorska peć (cave), Modruško Zagorje, Ogulin, 09.1. 99, leg. Jalžić, coll. BJ 32390, 5 specimens;

WL20 Mandelaja (cave), Oštarije, Ogulin, 09.85, coll. FV 44385, 15 specimens;

WL21 Špilja na izvoru Gojak (cave), Ogulin, 10.10.99, leg. Jalžić, coll. Jalžić, 20 specimens;

WL22 Jama Jankonka (cave), Bosiljevo, 16.01.98, leg. R. Ozimec, coll. ROC 55, 3 specimens; 02.04.00, leg. R. Ozimec, coll. ROC 190, 5 specimens; 30.05.00, leg. R. Slapnik, coll. MZBI 189, 120 specimens; Špilja Đutno (cave), Bosiljevo, 02.04.00, leg. R. Ozimec, coll. ROC 183, 3 specimens; 30.05.00, leg. R. Slapnik, coll. MZBI 4331, 100 specimens;

Z. likanum is an endemic species in Croatia. For a long time it was only known from caves in the vicinity of Gračac (BOLE, 1974). New habitats by Rakovica and Ogulin have extended the area of distribution northwards right up to the border with Slovenia (Fig. 2). The species appears nowhere in large numbers. Further research will certainly fill the gaps that now appear between the three disconnected centres with individual habitats. Shells that are slightly different from the typical have been found in caves in the vicinity of Ogulin, Bosiljevo and Rakovica, which in itself confirms the greater variability of shells within this species. In the cave of Špilja na izvoru Gojak, it appears sympatrically with the species *Z. subobesum*.

Zospeum amoenum (Frauenfeld 1886)

(*Carychium amoenum* Frauenfeld 1886 Sitzber. Akad. Wiss. Wien, 19, 70)

Z. amoenum is a widespread species BOLE (1974). There is minimal variation in shell. The presence of any kind of lamella is in most localities a sign distinctive enough to establish membership of this species beyond any doubt. The species is very closely related to *Z. isselianum*, with which it is sympatric.

Localities of *Z. amoenum* in Croatia:

BN62 River Ombla (spring) in Komolac near Dubrovnik, leg. Schütt (Lit.)

BN63 Špilja za Gromačkom vlakom (cave), Gromača, Dubrovnik, 18.4.1998, leg. Jalžić, coll. BJ 32398, 10 specimens;

VK79 Brestovska špilja (cave), Rudine, island of Krk, coll. FV (Lit.);

WK42 Pčelina špilja (cave), Buljmize, Nevada, 08.81, coll. FV 44463, 3 specimens;

WK46 Mračna špilja (cave), Plitvice, leg. J. Bole, coll. MZBI 2493, 2 specimens;

XH29 Bazgova jama (cave), Nerežišće, island of Brač, leg. J. Bole, coll. MZBI 2500, 3 specimens;

XJ22 Jama u Dubokom dolu (cave), Mosor mountain, leg. J. Bole (Lit.);

XJ32 Špilja Vranjača (cave), Kotlenice, Dugopolje, 04.77, coll. FV 35787, 2 specimens;

XJ50 Špilja Pozjata (cave), Biokovo mountain, leg. J. Bole, coll. MZBI 2499, 10 specimens;

XJ60 Sv. Jure (soil sample), Biokovo mountain, 26.05.85, leg. J. Bole, coll. MZBI 21687, 3 specimens; Amfora (cave), Biokovo mountain, 13.10. 00, leg. Jalžić, coll. ROC 230, 3 specimens; 3.11. 01, leg. J. Bedek, coll. ROC 214, 2 specimens;

In former Yugoslavia, Bole, Kuščer and Velkovrh found the species *Z. amoenum* in caves on the island of Krk, by Gospić, Sinj, by Cetina, on Brač, Biokovo, above Popovo polje, north of Ombla, by Zavala and in caves by Cetinje (BOLE, 1974). New

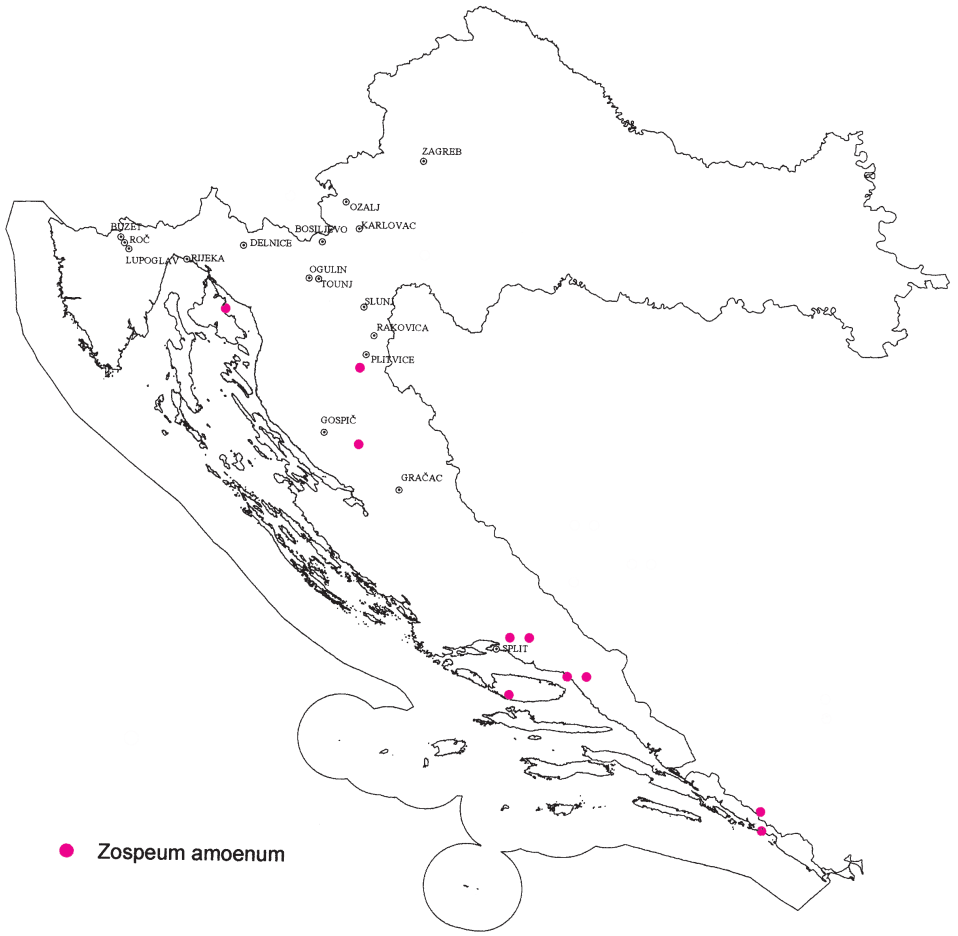

Fig. 3. UTM map of the distribution of the species *Z. amoenum* in Croatia.

habitats have merely confirmed its area of distribution, which covers four mutually fairly distant regions (Fig. 3). SCHÜTT (2000) mentions it at the source of the Ombla by Dubrovnik. In Mračna špilja by Plitvice and Slovačka jama in Veliki Lubenovec it appears together with the species *Z. isselianum*.

Zospeum kusceri (A. J. Wagner 1912)

(Zospeum frauenfeldi kuščeri A. J. Wagner 1912 Verh. zool.- bot.Ges. Wien, 62:257)

Even BOLE (1974: 263) claims that *Z. kusceri* is an independent species, since its area partially overlaps with that of the species *Z. frauenfeldi*, with which it even li-

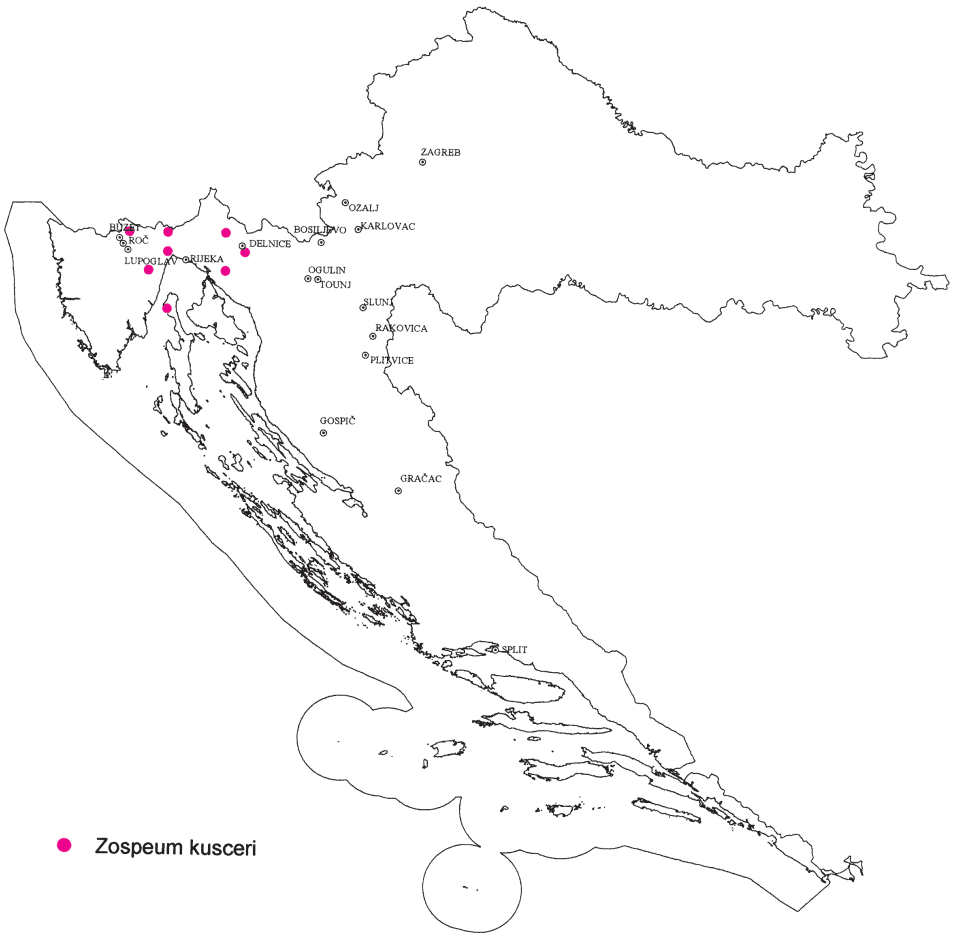

Fig. 4. UTM map of the distribution of the species *Z. kusceri* in Croatia.

ves together in some habitats and is its closest relative. In all the mentioned localities, there is very low diversity of shells of *Z. kusceri*. The number of shells found is always small. There are significant differences among more or less isolated populations or parts of populations. In individual cases, major differences were even noticed within populations. The radial ribs, lamella and aperture and the interior of the shell, the shape and size characterize this species in relation to different habitats, although it is not possible to claim on the basis of the material collected that essential differences among individual regions exist.

Localities of *Z. kusceri* in Croatia:

VK49 Jama Čampari (cave), Petričevi, island of Cres, 8.4.2001, leg. R. Ozimec & B. Jalžić, coll. ROC, 5 specimens; 29.4.2001, leg. B. Jalžić, coll. BJ 32389, 8 specimens;

VL23 Novačka špilja (cave), Jelovice, 03.67, coll. FV 3890, 15 specimens; 20.05.68, leg. J. Bole, coll. MZBI 4098, 20 specimens; Rabakova špilja (cave), Roč, 26.03.67, leg. J. Bole, coll. MZBI 3960, 20 specimens; Špela (cave), Brest, Lupoglav, 04.75, coll. FV 29888, 1 specimen; coll. FV 1379, 1 specimen;

VL31 Jama 2. (cave), Lovranski lazići, Učka, 18.02.01, leg. Jalžić, coll. BJ 32392, 10 specimens;

VL42 Špilja u selu Puži (cave), Permani, 24.05.61, coll. FV 3010, 1 specimen; 19.05.68, leg. J. Bole, coll. MZBI 4096, 70 specimens;

VL43 Špilja Lazi (cave), Permani, 24.05.68, leg. J. Bole, coll. MZBI 4100, 5 specimens; Špilja u selu Ružići (cave), Permani, 19.05.68, leg. J. Bole, coll. MZBI 4097, 70 specimens; Špilja na kraj travnika (cave), Škalnica, Rijeka, 19.05.68, leg. J. Bole, coll. MZBI 8 specimens;

VL71 Špilja Vrelo (cave), Fužine, 07.02.64, coll. FV 5954, 20 specimens; coll. FV 3010, 20 specimens; 07.02.64, leg. J. Bole, coll. MZBI 3006, 200 specimens; 20.02.99, leg. R. Ozimec & G. Polić, coll. ROC 170, 10 specimens; 20.02.99, leg. R. Ozimec & G. Polić, coll. ROC 169, 2 specimens;

VL73 Prva jama (cave), Risnjak, 30.5. 97, Leg. R. Ozimec, coll. RO, (det. Rađa); Soderičak 3 (cave), Risnjak, 2.3. 97, Leg. R. Ozimec, coll. ROC (det. Rađa);

VL82 Hajdova hiža (cave), Drgomalj, Delnice, coll. FV 447, 3 specimens; Špilja Lokvarka (cave), Lokve, 12.09.96, leg. R. Ozimec, coll. ROC 123, 10 specimens;

The species *Z. kusceri* in Croatia inhabits an area that covers the north eastern part of Istria and Gorski Kotar (Fig. 4). It is not common anywhere. In the most recent research, it was also found on the island of Cres, the first island site of this species.

Zospeum subobesum Bole 1974

(Zospeum subobesum *Kuščer, nom. nud. Coll Kuščer*)

KUŠČER (1932) reported a special form of shells south of the River Kolpa (Kupa). He did not describe the species, but called it *Z. subobesum.* BOLE (1974) later described it from a cave Tounjčica near Tounj, 5 km northeast of Ogulin. The shells are small, the whorl is low, the spire is smooth and columnular, the parietal lamella is low. The species has been found in some additional sites in southern Slovenia and the central Dinarids in Croatia and Bosnia.

Localities of *Z. subobesum* in Croatia:

VL71 Izvor Ličanke (spring) (Loc.typ.), Gorski kotar, leg. L. Kuščer (Lit.);

WK05 Lukina jama (cave), Hajdučki kukovi, leg. Jalžić, coll. BJ 32405, 1 specimen;

WK55 Vrelo (spring), Korenica, 1970, leg. J. Bole, coll. MZBI 26899, 1 specimen;

WK60 Markov ponor (cave), Kosinj, 20.6. 99, leg. D. Lacković, coll. BJ 32404, 5 specimens;

WL11 System Đula- Medvedica (cave), Ogulin, 02.68, coll. FV 5432, 8 specimens; 29.11.69, coll. FV 9702, 3 specimens; coll. FV 5429 1 specimen; Izvor Vitunj (spring), Ogulin, 07.83, coll. F. Velkovrh, 43188, 40 specimens;

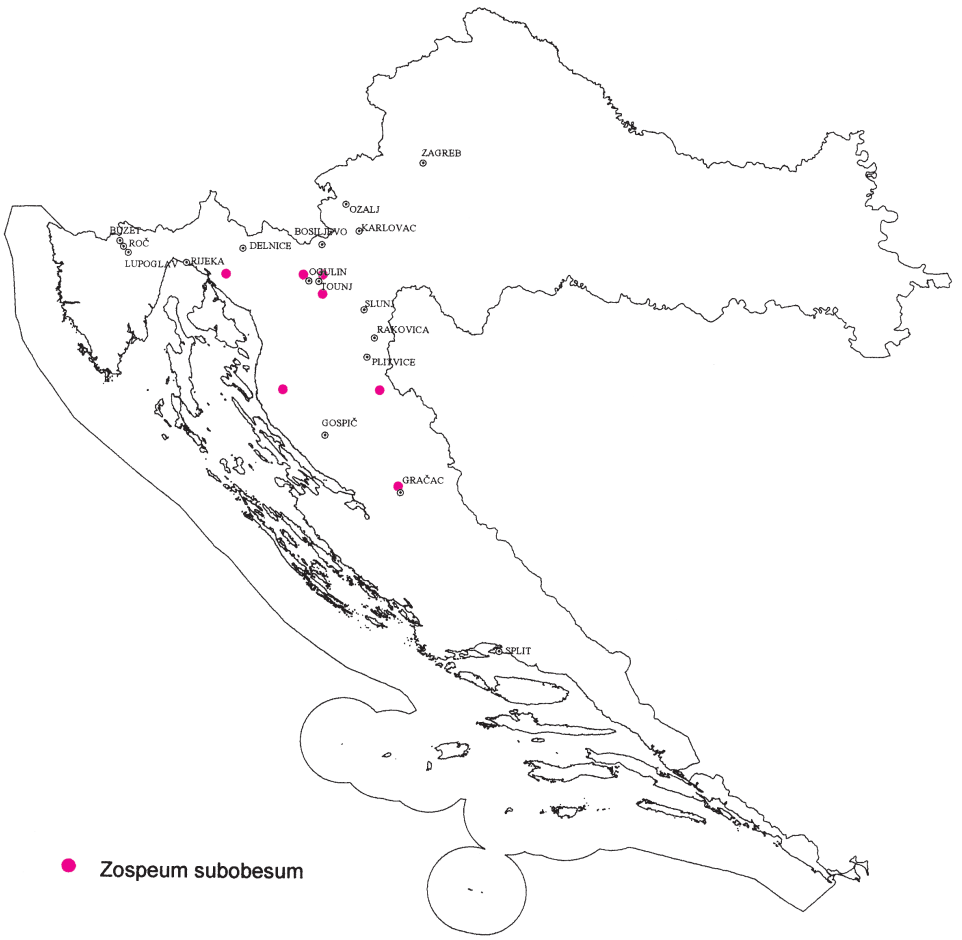

Fig. 5. UTM map of the distribution of the species *Z. subobesum* in Croatia.

WL20 Rudnica špilja (cave), Kamenica, Tounj, 10.79, coll. FV 39456, 2 specimens; Špilja na izvoru Rudnice (cave), Kamenica, Tounj, 08.85, coll. FV 44492, 1 specimen; coll. FV 44832, 5 specimens; 19.10.85, leg. J. Bole, coll. MZBI 22219, 1 specimen;

WL21 Okence (cave), Kukača, Tounj, 10.84, coll. FV 44053, 7 specimens; Špilja Zala u kanjonu Bistraca (cave), Donje Dubrave, 1969, coll. FV 10109, 1 specimen; Špilja na izvoru Gojak (cave), Dobra, 10.10.99, leg. B. Jalžić, coll. BJ 32399, 1 specimen; Špilja na izvoru Rupećica (cave), Ivanci, Ogulin, 11.3.00, leg. Jalžić, coll. BJ 32400, 2 specimens; Tounjčica, Tounj, 26.10.62 leg. J. Bole coll. MZBI 2083, 1 specimen; 10.75, coll. FV 30861, 1 specimen; 7.83, coll. FV 42976, 1 specimen; 01.10.84, coll. FV 45666, 1 specimen; Vrelo Rudnice

(spring), Tounj, 10.79, coll. FV 39705, 1 specimen; coll. FV 43057, 5 specimens; 07.82, coll. F. Velkovrh, 43006, 7 specimens; Tamnica (cave), Tounj, 27.6. 00, leg. R. Slapnik, coll. MZBI 3113a, 7 specimens;

The species *Z. subobesum* is common in caves in the vicinity of Ogulin, where the cave of Tounjčica, which is its typical habitat (BOLE, 1974) is also located. Westerly, on the basis of Kuščer's material, BOLE (1974), mentions it at the source of the Ličanka in Gorski kotar. On the basis of a single shell only, the species was also ascertained in Lukina jama and in Vrelo, which are located southwest and southeast of Ogulin (Fig. 5). In Tounjčica, Vrelo Rudnice and at the source of the Vitunj it lives together with the species *Z. isselianum.*

Zospeum spelaeum schmidti (Frauenfeld 1854)

(*Carychium Schmidtii* Frauenfeld 1854, Verh. zool.- bot.Ver. Wien, 4:34 (Carychium Schmidti), *Carychium pulchellum* Freyer 1855, *Zospeum aglenum* Bourguignat 1856, *Zospeum nycteum* Bourguignat 1856, *Carychium bidentatum* Hauffen 1856, *Carychium reticulatum* Hauffen 1856, *Carychium carinatum* Hauffen 1856, *Zospeum auritum* Stossich 1898, *Zospeum istrianum* Stossich 1898)

Shells of *Z. spelaeum schmidti* were first found in cave Pasjica on Gornji Ig in Slovenia in the middle of the 19th century. The great variability of shells was the reason why so many subspecies were described. KUŠČER (1923; 3) and latter (BOLE, 1974: 271–274) put them in synonymy.

Localities of *Z. spelaeum schmidti* in Croatia:

UL91 Markova jama (cave), Tar, 31.10.98, leg. R. Ozimec, coll. ROC 76, 10 specimens; coll. ROC 80, 10 specimens; coll. ROC 78, 2 specimens; 21.12.00, leg. R. Slapnik, coll. MZBI 3761, 130 specimens; Glina, (cave), Nova vas, Poreč, 27.7.01, leg. Slapnik, coll. MZBI 4663, 5 specimens; 27.7.01, leg. Slapnik, coll. MZBI 4689, 10 specimens; 27.7.01, leg. Slapnik, coll. MZBI 4707, 2 specimens; 27.7.01, leg. Slapnik, coll. MZBI 4743, 70 specimens; 27.7.01, leg. Slapnik, coll. MZBI 4759, 10 specimens; Jama kod Labinci (cave), Poreč, 17.07.02, leg. Slapnik, coll. MZBI 31213, 5 specimens;

UL92 Jama u Tribanu, (cave), Buje, 22.07.02, leg. Slapnik, coll. MZBI 31238, 10 specimens; 22.07.02, leg. Slapnik, coll. MZBI 31233, 30 specimens; Mermelinka (cave), Buje, 24.07.02, leg. Slapnik, coll. MZBI 31230, 60 specimens;

VK08 Jama Maškarada (cave), Gajana, Bale, 06.08.00, leg. Jalžić, coll. BJ 32391, 7 specimens;

VL21 Piskovica (cave), Gologorica, Cerovlje, 01.11.98, leg. R. Ozimec, coll. ROC 130, 1 specimen; 13.5.01 leg. Slapnik, coll. MZBI 3941, 1 specimen; 13.5.01 leg. Slapnik, coll. MZBI 4033, 12 specimens;

VL23 Gradski bulaž (spring), Istarske toplice, Buzet, 11.02.76, leg. J. Bole, coll. MZBI 20279, 7 specimens; leg. J. Bole, coll. MZBI 10910, 7 specimens; Rabakova špilja (cave), Roč, 03.67, coll. FV 1697, 3 specimens; coll. FV 3896, 20 specimens; 05.76, coll. FV 32422, 2 specimens, coll. FV 3889, 20 specimens; 23.05.68, leg. J. Bole, coll. MZBI 4111, 30 specimens; 10.87, leg. R. Slapnik, coll. MZBI 3120, 3 specimens; Sikirićeva špilja (cave), Roč, 23.05.68, leg. J. Bole, coll. MZBI 10300, 30 specimens; leg. J. Bole, coll. MZBI 4112, 3 speci-

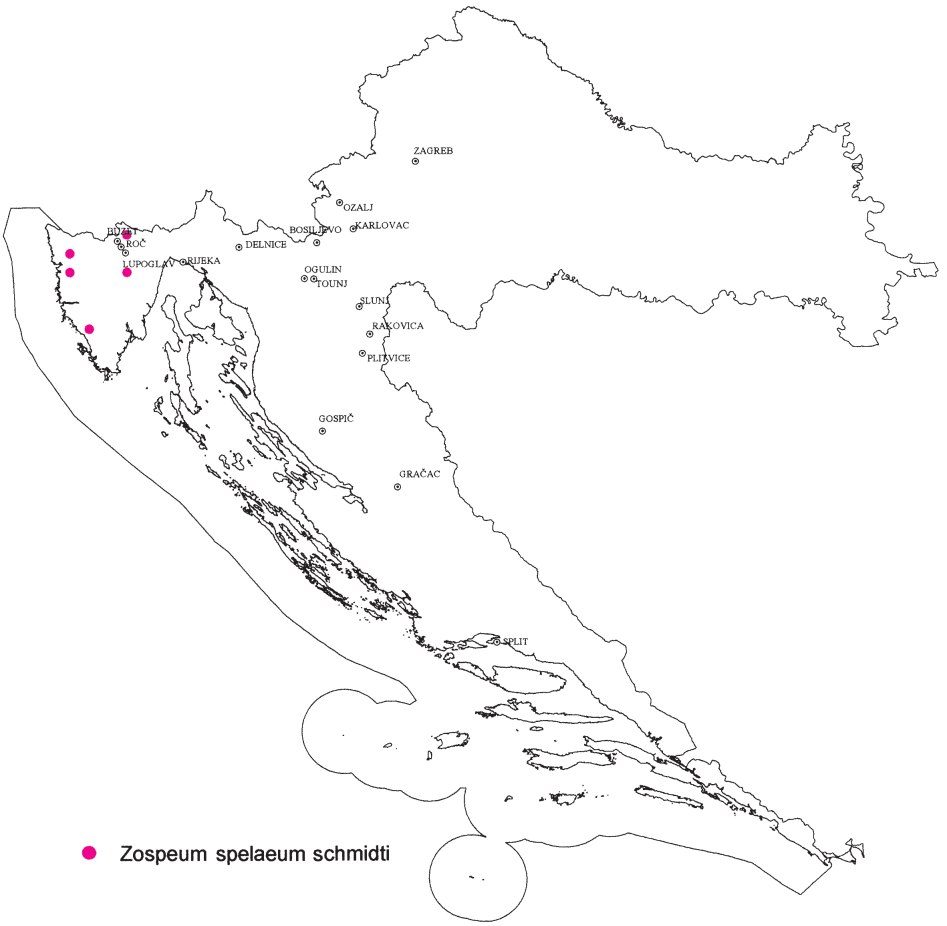

Fig. 6. UTM map of the distribution of the species *Z. spelaeum schmidti* in Croatia.

mens; Špilja na brdu Radota (cave), Brest, Istra, 20.05.68, leg. J. Bole, coll. MZBI 4109, 30 specimens; Špilja Potkroh (cave), Slum, 22.05.68, leg. J. Bole, coll. MZBI 4110, 4 specimens;

Z. spelaeum schmidti inhabits the whole of Istria (Fig. 6) although individual habitats are fairly distant from each other. To caves in the vicinity of Roč (BOLE, 1974) have been added caves around Poreč (Markova jama, Glina, Jama kod Labinci), Buje (Mermelinka, Jama u Tribanu), Cerovlje (Piskavica) and Bale (Jama Maškarada).

Zospeum pretneri Bole 1961

The species is conchologically well differentiated. The shells have a narrow, conical and high whorl which in most cases is twice the height of the aperture. The

small, semicircular aperture, which gives it a greatly thickened and slightly extended aperture edge, is a particularity. The parietal lamella is also characteristic, starting deep in the mouth and shaped like a sharp ridge (BOLE, 1974).

Localities of *Z. pretneri* in Croatia:

WK06 Slovačka jama (cave), V. Lubenovac, Velebit Mt. 08.08.98, leg. Jalžić, coll. BJ 32395, 5 specimens; 6.8.99, leg. B. Jalžić, coll. JB, 10 specimens; 11.08.98, leg. S. Rešetar, coll. ROC 108, 10 specimens;

WK42 Pčelina špilja (cave), Buljmize, Mogorić, 08.88, coll. FV 44391, 50 specimens;

WK60 Donja Cerovačka špilja (cave) (Loc. typ.), Gračac, 06.58, leg. J. Bole, coll. MZBI 1226, 10 specimens; 06.58, leg. J. Bole, coll. 1227, 1 specimen; 09.64, coll. FV 3894, 300 specimens; 09.64, coll. FV 44391, 300 specimens; 13.09.64, leg. J. Bole, coll. MZBI 3194, 150 specimens; Gornja Cerovačka spilja (cave), Gračac, leg. J. Bole, (Lit.);

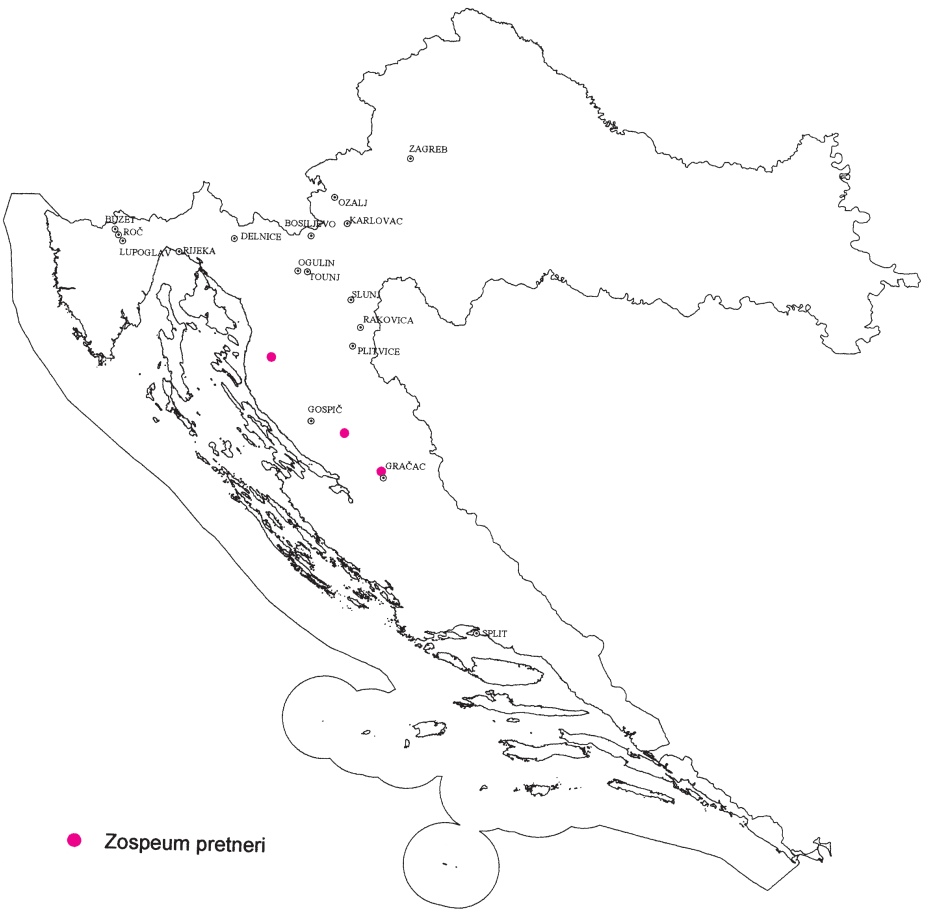

Fig. 7. UTM map of the distribution of the species *Z. pretneri* in Croatia.

The species is narrowly endemic within the context of the fauna of Croatia. It was only known from Donja Cerovačka špilja (Loc. typ.) and Gornja Cerovačka špilja by Gračac, where it was found together with *Z. likanum*. Velkovrh later additionally found it in Pčelina špilja by Mogorić and Slovačka jama on Velebit Mt. (Fig. 7).

Zospeum exiguum Kuščer 1932

The shape of the shell of this species is very similar to shells of the species *Z. obesum*, except that it is considerably smaller. Shells are 1.4 to 1.8 mm high. The columellar shoulder is very strong, the parietal lamella is narrow and high. The shell surface is minutely and equally striped, and the lines are stronger on the upper edge of the curve (BOLE, 1974).

Locality of *Z. exiguum* in Croatia:

VL73 Kupa (spring), Brod na Kupi, 1967, coll. FV 5251, 1 specimen;

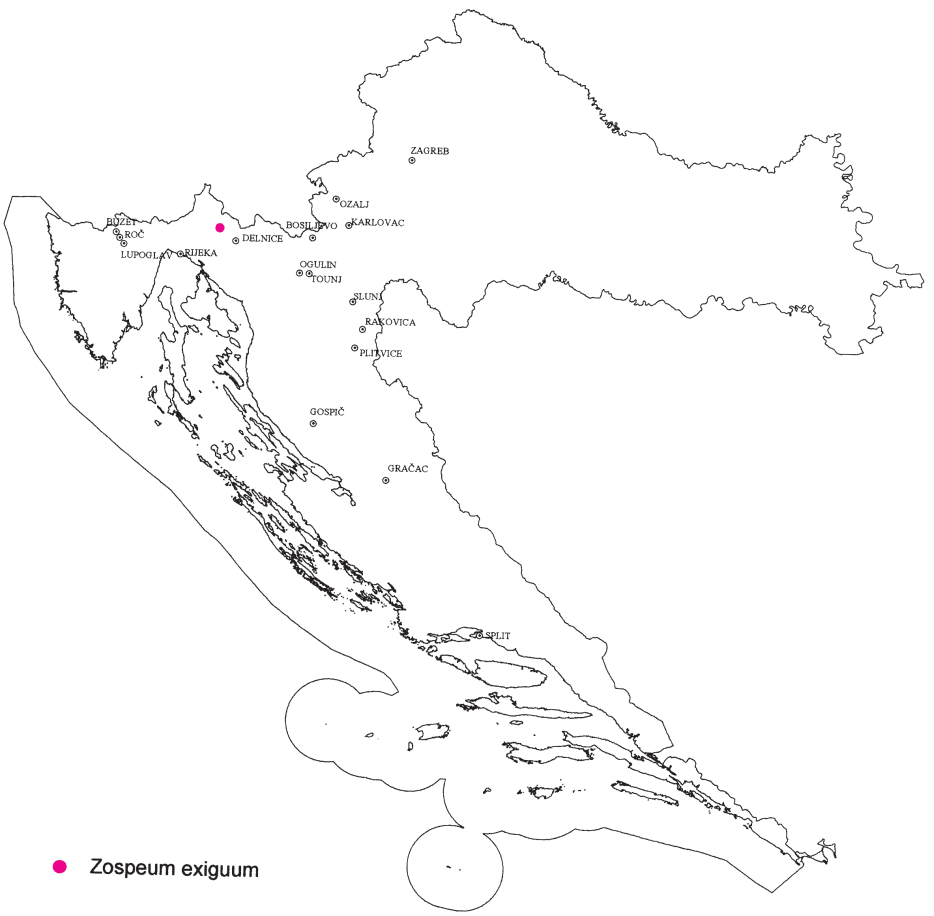

Fig. 8. UTM map of the distribution of the species *Z. exiguum* in Croatia.

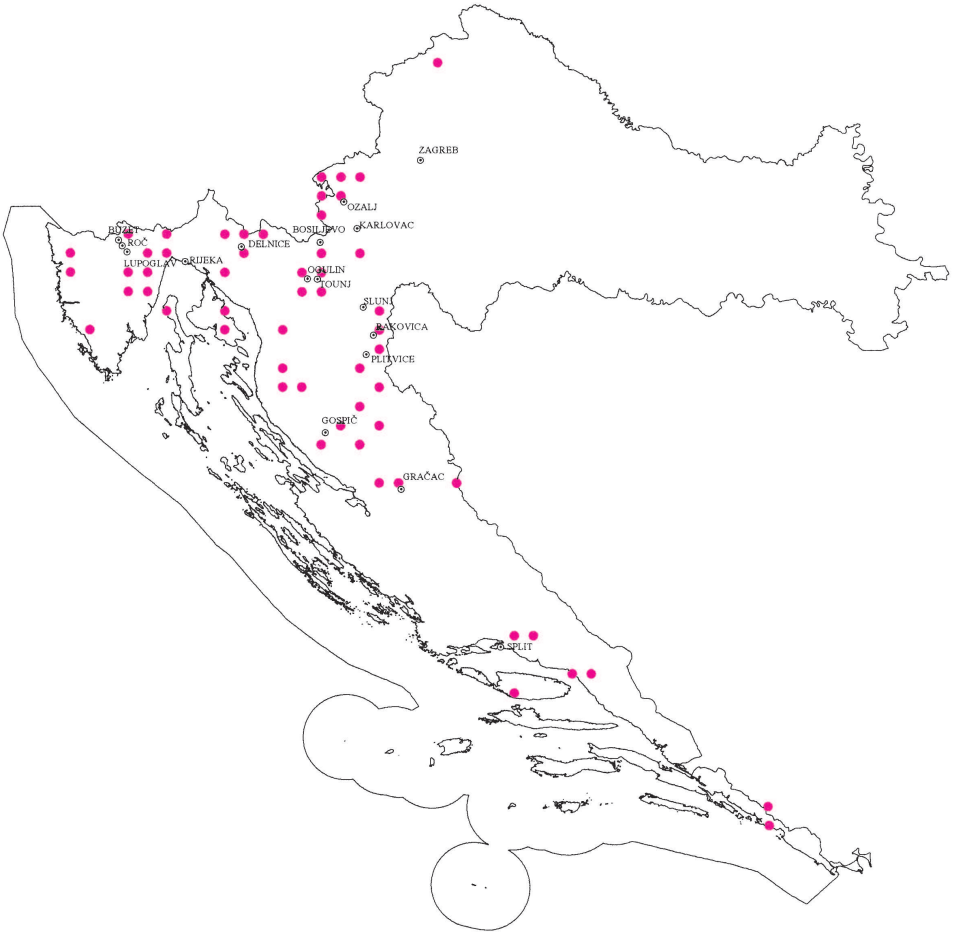

Fig. 9. UTM map of the distribution of the genus *Zospeum* in Croatia.

CONCLUSION

In a review of the genus *Zospeum* in Yugoslavia, BOLE (1974) established on the basis of scattered habitats in the Dinarid karst that the genus *Zospeum* is fairly widespread in western Yugoslavia, noting however that extensive areas had been too little investigated. In the last thirty years, many new cave sites have been discovered in Croatia and biospeleologists have also entered some of them. *Zospeum* species have thus been discovered in newly discovered caves, mainly of the uninvestigated karst world in the central part of the Dinarids, north of Split to Gračac and between Split and Dubrovnik, which is also reflected in the distribution map of the *Zospeum* genus in Croatia (Fig. 9). Of the six species and two sub- species,there are

three species with typical habitats (*Z. likanum, Z. subobesum, Z. pretneri*) and two endemic species (*Z. likanum, Z. pretneri*) (ŠTAMOL, 2001). The areas of distribution of individual species overlap in some places and different species are found together fairly often. *Z. isselianum, Z. amoenum* and *Z. pretneri* live sympatrically in Pčelina špilja; this is the largest number of species of the *Zospeum* genus found in a single locality.

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REFERENCES

BOLE, J., 1960: Novi vrsti iz rodu *Zospeum* Bourg. (Gastropoda), Biol. vestn. 7, 61–64.

BOLE, J., 1974: Rod *Zospeum* Bourguignat, 1856 (Gastropoda, Ellobiidae) Jugoslavije, Razprave SAZU, IV. razr. XVII, 251–291.

BRUSINA, S., 1870: Contribution a la Malacologie de la Croatie. Travaux de l' Academie Slavo- meridionale,1, 1–40.

GIUSTI, F., 1975: Prime indagini anatomiche sul genere *Zospeum* (Pulmonata, Basommatophora). Conchilie 11 (3–4), 53–64.

HAMANN, O., 1896: Europäische Höhlenfauna. p. 44–50, Jena.

HIRC, D., 1902: Die Höhlenfauna Österreich- Ungarns und des Okkupationsgebietes (von Paganetti Hummler), Gl. Hrv. Nar. Dr., 14, 470–473.

KUŠČER, Lj., 1925: Jamski mehkušci severozapadne Jugoslavije in sosednega ozemlja, Glasn. muzejskega društva za Slovenijo, 4/6 B, 39–49.

KUŠČER, Lj., 1932: Höhlen- und Quellenschnecken aus dem Flussgebiet der Ljubljanica, Arch. Moll. 64, 2, 48–62.

LANGHOFFER, A., 1912: Fauna hrvatskih pećina (spilja) (Fauna cavernarum Croatie) I. Rad JAZU, 193, 339–364.

LANGHOFFER, A., 1915a: Beiträge zur Kenntnis der Höhlenfauna Kroatiens. Barlangkutatas, Budapest, 3, 2, p. 63–71, p. 109–110.

LANGHOFFER, A., 1915b: Fauna hrvatskih pećina (spilja) (Fauna cavernarum Croatiae) II. Prir. Istr. Hrv. i Slav., JAZU, 7, 1–22.

MAIER, H. C., 1975: Wiederentdeckung einer Kärntner Höhlenschnecke *Zospeum alpestre* (Freyer 1855), Carinthia 165./85, 295–296.

MILDNER, P., 1976. Ein weiterer Fundort von *Zospeum alpestre* (Freyer 1855) in Österreich, Mitt. Zool. Ges. Braunau (8–9).

OZIMEC, R. & GOTTSTEIN, S., 2001: History of biospeleology. In: JUBERTHIE, C. & V. DECU (eds.): Croatia. Enciclopaedia Biospeologica. III. Société de Biospéologie, 2237–2287.

PEZZOLI, E., 1992: Il genere *Zospeum* Bourguignat, 1856 in Italia (Gastropoda Pulmonata Basommatophora) censimento delle stazioni ad oggi segnalate. Natura Bresciana 27, 123–169.

SCHÜTT, H., 2000: Die Hohlenmollusken der Ombla- Quelle, Natura Croatica, 9(3), 203–215.

SLAPNIK, R., 1991: Razširjenost *Zospeum alpestre* (Freyer 1855), *Z. isselianum* Pollonera 1886 in *Z. alpestre bolei* ssp. n. (Gastropoda, Carychiidae) in njihova variabilnost v jamah Kamniško- Savinjskih Alp, Razprave IV. razreda SAZU XXXII, 3–73.

SLAPNIK, R., 1994: Razširjenost rodu *Zospeum* Bourguignat 1856 (Gastropoda, Pulmonata, Carychiidae) v osamelem krasu vzhodne Slovenije. Razprave SAZU, IV. razr. XXXV 298–320.

ŠTAMOL, V., 2001: Mollusca. In JUBERTHIE, C. & V. DECU (eds.): Croatia. Enciclopaedia Biospeologica. III. Société de Biospéologie, 2237–2287.

VELKOVRH, F., 1973: Razširjenost gastropodov po drobnih razpokah v krasu, Naše jame 15, 77–81.

ZILCH, A. & JAECKEL, S. G. A., 1962: Mollusken. Die Tierwelt Mitteleuropas II (1), Ergänzung 1–294.

WAGNER, A. J., 1912: Beschreibungen neuer Land- und Süsswasserschnecken aus Südösterreich, Kroatien und Bosnien, Verh. zool.-bot. Ges. Wien 62, 246–260.

SUMMARY

Distribution of the genus *Zospeum* Bourguignat 1856 (Gastropoda, Pulmonata, Ellobiidae) in Croatia

R. Slapnik & R. Ozimec

Genus *Zospeum* includes terrestrial troglobiont snails. They inhabit subterranean habitats of the central Pyrenees, the southern Alps, and the Dinaric karst from a few meters above sea level to an altitude of 2,000 meters. Knowledge about the ecology of the *Zospeum* is very sparse. It is known that they live in caves and fissures and that they probably feed on the detritus that is found in loam and in cave sediment. In caves, they occur on walls, on the ground beside puddles, or on organic matter (rotten wood). The taxonomy of the genus is based primarily on conchological characteristics. Their anatomy has been partially examined. The first record of *Zospeum* findings in Croatia was published by the celebrated malachologist Spiridion Brusina, based on material collected in middle of the 19th Century. This was also first record of troglobiont snails in Croatia. *Z. isselianum* is a generally widespread species in the northwest part of Croatia. Its appearance in Cerjanska špilja by Varaždin shows that its distribution extends much further eastwards into the central part of the state. A considerable number of new sites have been added recently to the numerous localities in which Bole and Velkovrh found this species.

Z. likanum is an endemic species in Croatia. For a long time it was only known from caves in the vicinity of Gračac (BOLE 1974). New habitats by Rakovica and Ogulin have extended the area of distribution northwards right up to the border

with Slovenia. The species appears nowhere in large numbers. In former Yugoslavia, Bole, Kuščer and Velkovrh found the species *Z. amoenum* in caves on the island of Krk, by Gospić, Sinj, by the Cetina, on Brač, Biokovo, above Popovo polje, north of Ombla, by Zavala and in caves by Cetinje. New habitats have merely confirmed its area of distribution, which covers four mutually fairly distant regions. The species *Z. kusceri* in Croatia inhabits an area that covers the north eastern part of Istria and Gorski Kotar. It is not common anywhere. In the most recent research, it was also found on the island of Cres, the first island site of this species.

The species *Z. subobesum* is common in caves in the vicinity of Ogulin, where the cave of Tounjčica, which is its typical habitat, is also located. On the basis of a single shell only, the species was also ascertained in Lukina jama and in Vrelo, which are located southwest and southeast of Ogulin. *Z. spelaeum schmidti* inhabits the whole of Istria although individual habitats are fairly distant from each other. The species *Z. pretneri* is narrowly endemic within the context of the fauna of Croatia. It was known from Donja Cerovačka špilja (Loc. typ.), Gornja Cerovačka špilja by Gračac in Pčelina špilja by Mogorić and Slovačka jama on Velebit Mt.

In the last thirty years *Zospeum* species have been discovered in newly discovered caves, mainly of the uninvestigated karst world in the central part of the Dinarids. Of the six species and two sub- species,there are three species with typical habitats (*Z. likanum, Z. subobesum, Z. pretneri*) and two endemic species (*Z. likanum, Z. pretneri*). The areas of distribution of individual species overlap in some places and different species are found together fairly often.

SAŽETAK

Rasprostranjenost roda *Zospeum* Bourguignat 1856 (Gastropoda, Ellobiidae) u Hrvatskoj

R. Slapnik & R. Ozimec

Pužići iz roda *Zospeum* pripadaju troglobiontnoj kopnenoj fauni. Naseljavaju podzemna staništa centralnih Pireneja, južnih Alpi i dinarskog krša, od samo nekoliko metara nadmorske visine sve do 2000 metara nad morem. O ekologiji roda zna se vrlo malo. Poznato je da žive u špiljama i pukotinama u kojima se najvjerojatnije hrane detritusom kojeg sadrži glina i drugi špiljski sedimenti. U špiljama se pojavljuju na zidovima, na tlu u blizini nakapnica i na organskoj tvari (trulo drvo). Taksonomija roda temelji se primarno na konhiološkim karakteristikama. Anatomija je tek djelomično istražena. Prvi nalaz roda *Zospeum* u Hrvatskoj zabilježio je čuveni malakolog Spiridion Brusina, na osnovi materijala sakupljenog polovicom 19. stoljeća. To je ujedno prvi zabilježeni nalaz troglobiontnog puža u Hrvatskoj. *Z. isselianum* je rasprostranjen na području centralne Hrvatske. Nalaz u Cerjanskoj špilji kod Varaždina ukazuje da je vrsta proširena znatno na sjeverozapad Hrvatske. Veći broj novih nalazišta dodan je brojnim lokalitetima koje su utvrdili Bole i Velkovrh. *Z. li-*

kanum endemna je vrsta za Hrvatsku. Dugo vremena bila je poznata samo za špilje u okolici Gračaca (BOLE, 1974). Nova nalazišta utvrđena za područje Rakovice i Ogulina proširila su areal vrste znatno na sjeverozapad, sve do granice sa Slovenijom. Vrsta se nigdje ne javlja u većem broju. Na području bivše Jugoslavije Bole, Kuščer i Velkovrh utvrdili su vrstu *Z. amoenum*na otoku Krku, kod Gospića, Sinja, uz Cetinu, na Braču, na Biokovu, iznad Popovog polja, sjeverno od Omble, kod Zavale i špiljama na području Cetinja. Nova nalazišta potvdila su ovu distribuciju koja pokriva četiri međusobno prilično udaljene regije.

Vrsta *Z. kusceri* u Hrvatskoj je proširena u sjeveroistočnoj Istri i zapadnom dijelu Gorskog kotara. Ne dolazi svugdje često. Prilikom novijih istraživanja utvrđena je za otok Cres, prvo otočno nalazište te vrste. Vrsta *Z. subobesum* rasprostranjena je u špiljama na području Ogulina, gdje se nalazi špilja Tounjčica, tipsko nalazište vrste. Na osnovi jedne jedine kućice vrsta je utvrđena za Lukinu jamu i za špilju Vrelo koje se nalaze jugozapadno i jugoistočno od Ogulina. *Z. spelaeum schmidti* naseljava cijelu Istru, iako su pojedina nalazišta prilično udaljena jedno od drugog. Vrsta *Z. pretneri* je usko endemna i u kontekstu hrvatske faune. Poznata je iz Donje Cerovačke špilje (loc. typ.), Gornje Cerovačke špilje kod Gračaca, Pčeline špilje kod Mogorića i Slovačke jame na Velebitu.

U posljednjih trideset godina vrste roda *Zospeum* utvrđene su u novoistraženim špiljama, većinom na području neistraženog krša centralnih Dinarida. Od šest vrsta i dvije podvrste, tri vrste imaju tipsko nalazište na području Hrvatske (*Z. likanum*, *Z. subobesum*, *Z. pretneri*), a dvije su vrste endemske za Hrvatsku (*Z. likanum*, *Z. pretneri*). Distribucijski areal pojedine vrste se na nekim područjima preklapa i prilično često se različite vrste nalaze zajedno.