New Records for Tardigrada from Cyprus

Until recently, more than 1.200 species belonging to the Tardigrada Phylum had been identified (Degma et al. 2009-2016). But the tardigrade fauna of Cyprus have rarely been examined. The first study of the tardigrades from Cyprus was carried out by Bertolani (1975) and until now only 5 papers have been published (Bertolani 1975, Michalczyk & Kaczmarek 2003, Kaczmarek & Michalczyk 2004, Pilato & Bertolani 2004, Michalczyk et al. 2006); in total 9 species belonging to 5 genera were reported (Table 1).

In this paper the Turkish part of northern Cyprus was studied for the first time, and three new tardigrade species were recorded for the country. In addition, a list of all Cyprus tardigrades is presented with some zoogeographical and taxonomical remarks (Table 1).

The four moss samples were collected from rocks and soils in Northern Cyprus: Kyrenia, Nicosia and Famagusta in October 2015.

All specimens were mounted on microscopic slides in Hoyer's medium according to Ramazzotti and Maucci (1983). Identification of specimens was carried out using a phase-contrast light microscope (Zeiss Axio Imager M1) and based on the keys in Ramazzotti & Maucci (1983) and Dastych (1988), as well as on the original species descriptions (Bertolani & Rebecchi 1993).

In this study, 97 specimens and 15 eggs of tardigrades were found. In total, six species were identified: *Macrobiotus hufelandi hufelandi* (C.A.S. Schultze, 1834), *Ramazzottius* cf. *oberhaeuseri* (Doyère, 1840), *Paramacrobiotus* cf. *richtersi* (Murray, 1911), *Hypsibius dujardini* (Doyère, 1840), *Macrobiotus persimilis* Binda & Pilato, 1972 and *Isohypsibius macrodactylus* (Maucci, 1978). The last three species are reported from Cyprus for the first time and increases the number of species known in the country to 12. The biogeographical and taxonomic data about the identified species are presented in Table 1.

These newly recorded tardigrade species from Cyprus are presented below. All specimens are deposited in the Aquatic Animals Research Laboratory at Ankara University.

Hypsibius dujardini (Doyère, 1840)

Material examined: 7 specimens collected from two soil mosses in Kyrenia (35°20'6.87"N 33°17'51.17"E and 39 meters above sea level [a.s.l.]).

Remarks: This species belongs to the widely distributed *convergens-dujardini* complex of species (Kaczmarek et al. 2014). The specimens obtained correspond perfectly to the characterization of this species by Ramazzotti & Maucci (1983) Dastych (1988) and (Miller et al. 2005).

Macrobiotus persimilis Binda & Pilato, 1972

Material examined: 6 specimens and 3 eggs col-

Table 1. A list of Tardigrada species from Cyprus with their localities, and zoogeographical and taxonomic remarks. The species originally described from Cyprus are indicated with an asterisk (*). Source codes: 1-Bertolani (1975), 2-Michalczyk & Kaczmarek (2003), 3-Kaczmarek & Michalczyk (2004), 4-Pilato & Bertolani (2004), 5- Michalczyk et al. (2006), 6- McInnes (1994), 7- present study.

Taxa	Locality	Source	Remarks
Echiniscus testudo (Doyère, 1840)	Surroundings of the Kykko monastery and Mts. Troodos, a.s.l: 450 m and 700 m respectively.	3	Moss from rock, tree and soil; Holoarctic (McInnes 1994, Jørgensen et al. 2007).
Milnesium tardigradum (Doyère, 1840)	Surroundings of the Kykko monastery, a.s.l: 450 m.	3	Moss from soil. A cosmopolitan.
Hypsibius dujardini (Doyère, 1840)	Kyrenia, a.s.l: 39 m.	7	Collected from soil mosses & studied habitats. A cosmopolitan species (Dastch 1988).
Ramazzottius cf. *oberhaeuseri* (Doyère, 1840)	Kykko monastery, Mts. Olympus and Famagusta, a.s.l: 450 m. Present study: Nicosia, a.s.l: 13 m.	3,7	Moss from rock, tree and soil. In this study, it was found in rock mosses. A cosmopolitan (Dastch 1988).
Isohypsibius macrodactylus (Maucci, 1978)	Famagusta, a.s.l: 13 m.	7	Holoarctic. Known only from a few localities (McInnes 1994). It was found in rock and soil mosses.
Macrobiotus dariae Pilato & Bertolani, 2004*	Mts. Troodos, a.s.l: 1350 m.	4	It was extracted from a moss sample.
Macrobiotus hufelandi hufelandi (C.A.S. Schultze, 1834)	Mts. Troodos and Kyrenia. Present study: Famagusta, a.s.l: 13 m.	1,7	In this study, it was collected from soil mosses. A cosmopolitan species (Dastch 1988).
Macrobiotus marlenae (Kaczmarek & Michalczyk, 2004)*	Surroundings of the Kykko monastery, a.s.l: 1450 m.	3	Moss from rock. Known only from one locality in Cyprus.
Macrobiotus persimilis Binda & Pilato, 1972	Nicosia, a.s.l: 142 m.	7	In this study, it was collected from two rock mosses.
Macrobiotus reinhardti (Michalczyk & Kaczmarek 2003)*	Mts. Troodos, southern slope of Mts. Olympus.	2	Moss from rock, tree and soil.
Paramacrobiotus cf. *richtersi* (Murray, 1911)	Kykko monastery, a.s.l: 450 m. Present study: Nicosia, a.s.l: 142 m.	3,6	A cosmopolitan, but the species' geographic range is unknown (Kaczmarek et al. 2012). In this study, it was collected in rock mosses.
Paramacrobiotus sklodowskae (Michalczyk, Kaczmarek & Węglarska, 2006)	Surroundings of the Kykko monastery, a.s.l: 1450 m.	5	Moss. Known only from a few localities in Cyprus.

lected from two rock moss samples in Nicosia (35°13'9.05"N 33°19'48.49"E and 142 m a.s.l.).

Remarks: They are from the Palearctic region, but also found in Australia (Kaczmarek et al. 2011).

Isohypsibius macrodactylus (Maucci, 1978)

Material examined: 4 specimens collected from one rock and one soil moss in Famagusta (35° 7'29.68"N 33°56'30.22"E and 35° 7'30.38"N 33°56'33.83"E and 13 m a.s.l).

Remarks**:** It was originally discovered for the first time in Turkey (Maucci 1978). This species is not common in Italy, the Caucasus and Algeria (McInnes 1994).

Although the present study of the number of known tardigrades from Cyprus has now reached twelve, the real number of Tardigrada species in Cyprus is apparently much greater than those already known; thus, the study of island fauna is only just beginning.

References

Bertolani, R. (1975): Cytology and systematics in Tardigrada. Memorie dell'Instituto Italiano di Idrobiologia 32: 17-35.

Bertolani, R., Rebecchi, L. (1993): A revision of the *Macrobiotus hufelandi* group (Tardigrada, Macrobiotidae), with some observations on the taxonomic characters of eutardigrades. Zoológica Scripta 22: 127–152.

Dastych, H. (1988): The Tardigrada of Poland. Monografie Fauny Polski 16: 1-255.

Degma, P., Guidetti, R., Bertolani, R. (2009-2016): Actual checklist of Tardigrada species. Ver.30:15-09-2016 <http://www.tardigrada.modena.unimo.it/miscellanea/Actual%20checklist%20of%20Tardigrada.pdf>, accessed at: 2016.05.12.

Jørgensen, A., Møbjerg, N., Kristensen, R. (2007): A molecular study of the tardigrade *Echiniscus testudo* (Echiniscidae) reveals low DNA sequence diversity over a large geographic area. Journal of Limnology 66: 77-83.

Kaczmarek, Ł., Michalczyk, Ł. (2004): New records of Tardigrada from Cyprus with a description of the new species *Macrobiotus marlenae* (*hufelandi* group) (Eutardigrada: Macrobiotidae). Genus 15(1): 141-152.

Kaczmarek, Ł., Diduszko, D., Michalczyk, Ł. (2011): New records of Mexican Tardigrada. Revista Mexicana de Biodiversidad 82: 1324-1327.

Kaczmarek, Ł., Jakubowska, N., Michalczyk, L. (2012): Current knowledge on Turkish Tardigrades with a description of *Milnesium beasleyi* sp. nov. (Eutardigrada: Apochela: Milnesiidae, the *granulatum* group). Zootaxa 3589: 49-64.

Kaczmarek, Ł., Michalczyk, Ł., McInnes, S.J. (2014): Annotated zoogeography of non-marine Tardigrada. Part I: Central America. Zootaxa 3763(1): 1-107.

Maucci, W. (1978): Tardigradi muscicoli della Turchia (terzo contributo). Bollettino Museo civico Storia naturale 5: 111-140.

McInnes, S. (1994): Zoogeographic distribution of terrestrial/freshwater tardigrades from current literature. Journal of Natural History 28: 257-352.

Michalczyk, Ł., Kaczmarek, Ł. (2003): A description of the new tardigrade Macrobiotus *reinhardti* (Eutardigrada, Macrobiotidae, *harmsworthi* group) with some remarks on the oral cavity armature within the genus *Macrobiotus* Schultze. Zootaxa 331: 1-24.

Michalczyk, L., Kaczmarek, L., Weglarska, B. (2006): *Macrobiotus sklodowskae* sp. nov. (Tardigrada: Eutardigrada:Macrobiotidae, *richtersi* group) from Cyprus. Zootaxa 1371: 45-56.

Pilato, G., D'Urso, V.. (1976). Contributo alla conoscenza dei Tardigradid'Australia. Animalia, Catania 3: 135-145.

Miller, W.R., McInnes, S.J., Bergstrom, D.M. (2005): Tardigrades of the Australian Antarctic: *Hypsibius heardensis* (Eutardigrada: Hypsibiidae: dujardini group) a new species from sub-Antarctic Heard Island. Zootaxa 1022: 57-64.

Pilato, G., Bertolani, R. (2004): *Macrobiotus dariae* sp. n., a new species of eutardigrade (Eutardigrada, Macrobiotidae) from Cyprus. Zootaxa 638: 1-7.

Ramazzotti, G., Maucci, W. (1983): II Phylum Tardigrada. Memorie dell'Istituto Italiano di Idrobiologia 41: 1-1012.

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Subsequently, we established models to investigate contributions of socioeconomic and environmental factors to spatial variations of COVID-19 mortality rate across England (N = 317). Two newly developed specifications of spatial regression models were established successfully to estimate COVID-19 mortality rate (R2 = 0.49 and R2 = 0.793). The level of spatial inequalities of COVID-19 mortality is higher than that of non-COVID-19 mortality in England. Although global spatial association of COVID-19 mortality and non-COVID-19 mortality is positive, local spatial association of COVID-19 mortality and non-COVID-19 mortality is negative in some areas. Expectedly, hospital accessibility is negatively related to COVID-19 mortality rate. How important are environmental factors for the population structure of co-occurring scorpion species in a tropical forest? November 2014. Canadian Journal of Zoology 93(1).Â Six environmental factors (litter dry mass, remnant area, leaf litter depth, diameter at breast height of tree, canopy openness, and tree density) were assessed. Field surveys were conducted at night using ultraviolet lamps.Â These results suggest differences in the response of the species to environmental factors on a smaller scale. Behavior difference in foraging between T. pusillus (sit-and-wait) and A. mauryi (wandering) and microhabitat selection may also contribute to explain the influence of litter dry mass on the abundance of T. pusillus but not on the abundance of A. mauryi. Lira, A.F.A., Rego, F.N.A.A., Albuquerque, C.M.R. (2015): How important are environmental factors for the population structure of co-occurring scorpion species in a tropical forest? Canadian Journal of Zoology 93: 15-19. LourenÃ§o, W.R. (2002): Scorpions of Brazil.Â December 2016 Available online: 12. January 2017 / Printed: December 2017. AndrÃ© Felipe de Araujo LIRA1,*, Adriano Medeiros DESOUZA2 and Cleide Maria Ribeiro de ALBUQUERQUE3. 1. Programa de PÃ³s-graduaÃ§Ã£o em Biologia Animal, Departamento de Zoologia, Universidade Federal de Pernambuco â€“ UFPE. 2. Programa de PÃ³s-graduaÃ§Ã£o em CiÃªncias BiolÃ³gicas, Departamento de SistemÃ¡tica e Ecologia, Universidade Federal da ParaÃba â€“ UFPB, Rua Castelo Branco.