DATA ON THE DISTRIBUTION AND ECOLOGY OF *DREPANOSURUS HANKOI* (CRUSTACEA: ANOSTRACA) IN ROMANIA

LÁSZLÓ DEMETER

In this paper I present the distribution of the rare fairy shrimp *Drepanosurus hankoi* in Romania. This species is restricted to two tectonic mountain basins of the South-Eastern Carpathians, known from only 15 habitats. Detection probability of this species is lowered by early frost or drying out of the habitat, which kill larval populations usually in February and March, after which the eggs from the egg bank do not hatch in that year. Frequently, habitats are dry because of low precipitation in early spring. Also, if the habitat is wet in the previous year, the eggs will not hatch. The unpredictability of the habitat and high specialization of the species, combined with slow dispersal, makes *D. hankoi* extremely vulnerable. Protection of its habitats is very much needed.

Key words: Drepanosurus hankoi, distribution, rarity, vernal pools, Eastern Carpathians.

INTRODUCTION

Drepanosurus hankoi (Dudich, 1927) is a rare fairy shrimp (Crustacea: Anostraca), known from Hungary (Dudich, 1933), Slovakia (Dudich, 1927; Brtek, 1976), Czech Republic (Brtek & Thiéry, 1995), Belorussia (Nagorskaya *et al.*, 1998) and Romania (Demeter & Stoicescu, 2008). In Romania, it was found first by Demeter (2004, 2005) in the Ciuc Basin (Eastern Carpathians), and later also in the Braşov Basin (Demeter & Hartel, 2007). It was not detected in any other part of Romania (Botnariuc & Orghidan, 1953; Demeter & Stoicescu, 2008). While it is a relatively large and spectacular species, very few information are available on its ecology. The aims of this paper are to summarize the distribution of this species in Romania and to discuss the causes of its rarity.

MATERIAL AND METHODS

I surveyed temporary ponds for the presence of large branchiopods from February to May between 2003 and 2008 in the Ciuc, Gheorgheni and Braşov basins, parts of North-Western Romania, Banat, Southern Romania and the Transylvanian Basin (Demeter & Hartel, 2007; Demeter & Stoicescu, 2008). The largest sampling effort was done in the three large tectonic mountain basins of the South-Eastern Carpathians, where approximately 500 habitats were surveyed. Habitats where *D. hankoi* was found were checked in 3 to 6 years and they were visited one to ten times per year, totaling 57 pond years (Table 1).

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RESULTS

D. hankoi is known from 15 habitats located in five sites in two mountain basins of the South-Eastern Carpathians: the Ciuc Basin and the Braşov Basin (Fig. 1). Adult populations were recorded in 42.1% of the 57 pond years. In 26.3% of the cases the habitats were dry in spring and in 7% of the cases they did not dry out in the previous year. In 5.3% of the cases a larval population has been observed early in the season (February or early March) but did not reach adulthood because of freezing or early drought. For individual habitats, the chance of an adult population varies between 20-75% for habitats observed at least in two years. One habitat has been destroyed because of building and filling up. In two habitats eutrophication was observed with the excessive growth of *Spirogyra* sp. (Table 1).

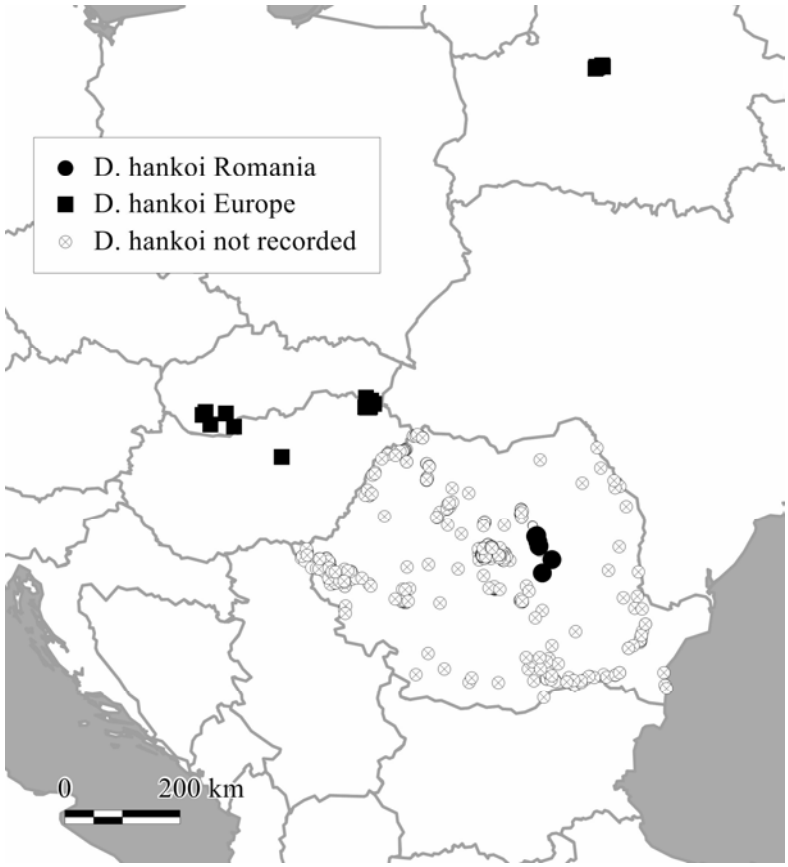

Fig. 1. Distribution of *Drepanosurus hankoi* in Romania and neighbouring countries. The map shows localities and habitats where the species was not recorded (personal data and data from the literature).

Table 1
List and short characterization of habitats and the presence of *Drepanosurus hankoi* populations

Pond code and locality	Latitude (N)	Longitude (E)	Short description	2003	2004	2005	2006	2007	2008	Frequency of breeding success of late detection probability (number of years with population reaching adulthood/total number of years of observation)	**Years of observation**
1. Sâncrăieni, Ciuc Basin	46.3187	25.8347	Mown meadow	1	0/D	0/D	1	0/D	0/habitat destroyed	0.33	6
2. Sâncrăieni, Ciuc Basin	46.3188	25.8311	Occasionally mown meadow very low density)	1	0/D	0/D	1	0/D	0	0.33	6
3. Ciceu, Ciuc Basin	46.4056	25.7881	Mown meadow	X	1	1/F	1/P	0/D	1	0.40	5
4. Ciceu, Ciuc Basin	46.4071	25.7879	Mown meadow (very low density)	X	1	0	0	0/D	0	0.20	5
5. Sânsimion, Ciuc Basin	46.2546	25.8631	Ditch and filled pond	X	1	1	1	0/D	X	0.75	4
6. Delnița, Ciuc Basin	46.409	25.8065	Tussocky pond	X	X	1	0/W	0/W	0/W	0.25	4
7. Delnița, Ciuc Basin	46.4156	25.8074	Tussocky pond (low density)	X	X	1	0/W	0	0	0.25	4
8. Sânsimion, Ciuc Basin	46.2513	25.8632	Arable field	X	X	X	1	0/D	X	0.50	2
9. Ciceu, Ciuc Basin	46.4051	25.7903	Artificial basin near railway	X	X	X	1	0/D	1/D	0.33	3
10. Ciceu, Ciuc Basin	46.4054	25.7921	Occasionally mown meadow	X	X	X	1	1/D	1	0.67	3
11. Ciceu, Ciuc Basin	46.4046	25.7914	Occasionally mown meadow	X	X	X	1	0/D	1	0.67	3
12. Ciceu, Ciuc Basin	46.4025	25.8005	Occasionally mown meadow (small specimens)	X	X	X	1	0/D	0	0.33	3
13. Reci, Brașov Basin	45.8343	25.9346	Pond with *Glyceria maxima*	X	X	1	0	0/D	1	0.50	4
14. Reci, Brașov Basin	45.833	25.933	Pond with *Glyceria maxima*	X	X	1	0	0/D	1	0.50	4
15. Sânzieni, Brașov Basin	46.042	26.152	Pond with *Carex* sp.	X	X	X	X	X	1	1.00	1
Percentage of ponds where the species was observed (number of ponds where the species was present/total number of observed ponds)				100%	50%	66.6%	64.3%	7.1%	53.8%		
Total precipitation (mm)				418.9	604.4	768.3	592.9	666.6	667.1		

Abbreviations: 1 – larval or adult population observed; 0 – no specimens observed; x – no data; F – larval population frozen; P – larval population disappeared probably because of predation; D – pond dried before individuals reached adulthood; W – pond did not dry out in the previous year.
Note that frequency of breeding success is equal to frequency of detection probability late in the season (April) – i.e. adults could be detected in only 20-30% of ears in the case of many habitats.

DISCUSSION

According to the literature (Botnariuc & Orghidan, 1953) and personal investigations (Demeter & Hartel, 2007; Demeter & Stoicescu, 2008), *D. hankoi* is restricted to two mountain basins in Romania, namely the Ciuc Basin and the Braşov Basin. This is an interesting geographic pattern, because these landscapes are special from a geomorphological (tectonic basins with a rich hydrographic network) and climatic (cold climate with thermal inversions and high humidity, but low precipitation) point of view. These areas are also rich in plant species considered glacial relics, so the question arises whether *D. hankoi* can be considered a relic species too?

Based on the available data the probability of the existence of more habitats in the Braşov Basin is high. I did not find any habitats in the Gheorgheni Basin, but the occurrence of this species is also probable.

D. hankoi habitats are temporary ponds of up to 300 m^2, 50-70 cm maximum depth and an average duration of less than three months. Most habitats are of natural origin, usually periglacial ponds (Demeter *et al*., 2012 b). The few artificial habitats (a drainage ditch and basins along a railway) are former natural habitats transformed by human activities. Habitats of this species are not conspicuous outside spring, being dry and the land is used for agricultural purposes (arable or mowing). Furthermore, many of these habitats are unpredictable on a short term for the human observer, because of unfavorable hydroperiod (drought, frost, excessive wetness in the previous year), habitat conditions (algal blooms), predation, or the combination of these. As a result, adult populations develop in every second year on average, but as rarely as one in five years. This is not an exceptional case for Anostraca, a group adapted to temporary wetland habitats, often semidesert or desert (Beladjal & Mertens, 2003).

The available data show that *D. hankoi* is a very rare species in the Romanian fauna (as well as in the European fauna), and as such, it deserves strict protection. Currently it is not listed in the national or European lists of protected species.

Although no experimental data are available, field observations suggest that for the activation of resting eggs (hatching) drying and freezing are necessary. No second hatching has been observed in cases when the ponds dried out and became rewetted during early spring, and nor when the ponds were not dry in the previous year. Excessive growth of *Spirogyra* algae and macrophytes has been suggested to be a factor responsible for the absence of *B. schaefferi*, probably because they obstruct the swimming of Anostraca (Hössler *et al*., 1995). We observed blooms of *Spirogyra* in two *D. hankoi* habitats, and in one of them we observed unusually small-sized individuals and low fertility (Demeter *et al*., 2012 a).

The rarity of *D. hankoi* is caused by several factors: first of all, detection probability is low because some populations appear only in some years (as low as

once in four or five years), and larval populations can be killed by frost or early drying of the habitat. A single late sampling in April will not be able to detect such a population. The available population genetic data show large genetic distances between populations (Korn & Demeter, unpublished data), suggesting that slow dispersal may be a cause of rarity in this species. This explains why the species is missing from many apparently suitable habitats.

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Sapientia University
Department of Bioengineering
530104, Miercurea-Ciuc, P-ţa Libertăţii nr. 1
Romania
e-mail: domedve@gmail.com