

Received: September 8, 2016
Accepted: November 17, 2016

ISSN 1857–9027
e-ISSN 1857–9949
UDC:595.384.06.082.5(497.7)
DOI: 10.20903/CSNMBS_MASA.2016.37.2.42

Original scientific paper

THE CATALOGUE OF FRESHWATER DECAPODA (DECAPODA: POTAMONIDAE, ASTACIDAE, ATYIDAE) FROM THE REPUBLIC OF MACEDONIA IN THE COLLECTION OF MACEDONIAN MUSEUM OF NATURAL HISTORY

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The catalogue summarizes the data found in the collection of freshwater decapods of the Macedonian Museum of Natural History in Skopje, Republic of Macedonia. In the present work we have also critically reviewed the historical data on the occurrence and distribution of representatives of decapods present in the country. The populations of decapods have never been intensively studied in Macedonia, and thus, this catalogue may serve as a valuable source of data for nature conservation and protection of crustaceans and their habitats.

Key words: catalogue; Decapoda; Macedonian Museum of Natural History; Macedonia

INTRODUCTION

Freshwater decapods are a highly diverse group of crustaceans currently known from all biogeographical regions (except Antarctica and India for crayfishes). Among an estimated number of 3.000 described freshwater decapod crustaceans, about 640 species can be considered as crayfish species (Astacidea) [1, 2]. A total of 655 freshwater shrimps (Caridea) and 1.300 freshwater crabs (Brachyura) are presently known [3, 4]. The key processes driving decapod crustaceans diversification are likely to be habitat heterogeneity, high diversity of ecological niches in freshwater ecosystems and frequent genetic isolation between populations [1, 3, 4]. Relatively low fecundity and poor dispersal abilities, probably, contributed to the evolution of rich assemblage of freshwater decapods [2].

There are scarce published data about the decapod fauna (Crustacea: Decapoda) from the Re-

public of Macedonia. The oldest data are from the 1920's, when Balss [5] registered three species for the country. On the basis of morphological criteria Karaman S. [6] gave a description of two crayfish subspecies, *Astacus astacus balcanicus* S. Karaman, 1929 (under synonymic name *Potamobius fluviatilis balcanicus* S. Karaman, 1929) and *Austropotamobius torrentium macedonicus* S. Karaman, 1929 (under synonymic name *Potamobius torrentium macedonicus* S. Karaman, 1929) in his review of freshwater decapods (Astacidea: Astacidae) in former Yugoslavia. According to Karaman S., *A. t. macedonicus* represents a national (Macedonian) endemic crayfish restricted to the River Vardar drainage. Few decades later, the most widely accepted taxonomic studies by Karaman M. [7, 8] recognized three subspecies of crayfish *Astacus astacus* (Linnaeus, 1758), confirming the presence of subspecies *A. a. Balcanicus* in the Western Balkans, in the drainage

system of the River Vardar in the Republic of Macedonia and Greece, as well as in Ohrid Lake. It must be emphasized that the taxonomic status and distribution of *A. a. balcanicus* and *A. t. macedonicus* has been discussed by many researchers (e.g. [9–11]) and still has not been fully resolved. Herein, we accept taxonomic studies by Karaman M. [7, 8, 12].

Concerning the freshwater crabs (Brachyura: Potamonidae), a more detailed research on taxonomy and distribution in Macedonia was conducted during the 1960's by Preitzmann [13] and Bott [14]. The first information about shrimps (Caridea: Atyidae) on the territory of the country was published by Karaman M. [15]. He described new subspecies named *Atyaephyra desmaresti stankoi* Karaman, 1972 (synonym of *Atyaephyra stankoi* Karaman, 1972) from material collected from Dojran Lake (Macedonia). Furthermore, Karaman M. [12] summarized and critically reviewed the existing data on taxonomy, biology, distribution and phylogeny of decapods (Potamonidae, Astacidae, Atyidae) inhabiting freshwaters in Macedonia. Recently, important nomenclatorial and taxonomic changes have been introduced in Decapoda systematics, mainly in the family Atyidae [16, 17], which contributed for updated checklist of freshwater decapods in the country [18].

Republic of Macedonia is one of the European countries where non-indigenous crayfishes, crabs and shrimps have not been introduced. According to Karaman M. [12] and Christoudoulou *et al.* [16] five indigenous decapod taxa (species and subspecies) occur in freshwater habitats in the country: noble crayfish *Astacus astacus balcanicus* S. Karaman, 1929; stone crayfish *Austropotamobius torrentium macedonicus* S. Karaman, 1929; freshwater crabs *Potamon fluviatile* (Herbst, 1785) and *P. ibericum* (Bieberstein, 1809); and freshwater shrimp *Atyaephyra stankoi* Karaman, 1972. However, insufficient information on the distribution of decapod representatives from the territory of Macedonia is available at present. Additionally, crayfishes, crabs and shrimp, like the freshwater habitats in which they are encountered, receive relatively little publicity and conservation attention in the country, in spite of their key role in the aquatic food webs and ecosystem functioning.

The aim of this study is to create a catalogue based on specimens stored in the collection of the Decapoda of the Macedonian Museum of Natural History (MMNH), in Skopje, Macedonia. In the present work we have also critically reviewed the historical data on the decapods of Macedonia. The

catalogue contributed to update our knowledge on the geographical distribution, ecology and taxonomy of the freshwater decapods in Macedonia and will serve as a valuable source of information for nature conservation and the protection of decapods and their habitats.

MATERIAL AND METHODS

The current review of freshwater decapods is based on available literature data and studied material deposited in MMNH. The collection of Decapoda comprises 258 specimens gathered during a period of almost 70 years (from 1946 to 2015). Decapod crustaceans are chronologically registered and separately numbered with inventory numbers. The specimens are in a very good state of preservation in 70% ethanol. In addition, valuable material of crayfishes was donated by V. Slavevska-Stamenković in 2016 (collected during 2008-2016). All specimens were revised by the first author following the keys by Pârvulescu [19], Zaikov [20] for crayfishes and Karaman M. [12] for crabs. The redescription presented in Christoudoulou *et al.* [16] was used for confirmation of the freshwater shrimp *Atyaephyra stankoi* in the collection of MMNH.

The catalogue comprises the following data: Valid taxa name, Published records, Material studied and Remarks.

The systematic presentation of taxa (species and subspecies) follows Karaman M. [12], De Jong *et al.* [21] and Christoudoulou *et al.* [16]. Below the valid taxa name are listed chronologically, the original names under the taxon which was cited in literature. The genera and species are arranged alphabetically within each family.

Published records are cited in a shortened form including the respective reference, name of the watercourse and adjacent settlement or mountain. Additional information may be found in original papers.

New distributional records (Material studied) are presented in the following sequence: name of watercourse, name of adjacent settlement, date of collection, number of specimens and sex (only for crayfish specimens), name(s) of collector(s), inventory numbers of the specimens deposited in MMNH (in square brackets). The geographic information and date of collection are omitted when missing. Records are arranged according to inventory numbers.

Additional information concerning ecology, distribution, population status, threats and taxonomic changes could be found in paragraph remarks.

Abbreviation used in this catalogue

Legator names: Biljana Rimčeska – BR, Despina Kitanova – DK, Djoko Djorgievski – Dj Dj, Emilija Stojkoska – ES, Irina Šoreva – IS, Jovan Kuševski – JK, Kiro Bogoevski – KB, Ognjanka Popovska – OP, Risto Grupče – RG, Svetozar Petkovski – SP, Snežana Stanković – SS, Trajan Petkovski – TP, Vasil Kostov – VK, Valentina Slavevska Stamenković – VSS and legator unknown- LU.

Other abbreviations: ♂ – male specimen(s), ♀ – female specimen(s), s. – specimen(s), v. – village, Mt. – mountain, leg. – legator(s).

THE CATALOGUE PRESENTATION

The catalogue presented herein includes data on five decapod taxa (Figure 1), including Brachyura (2), Astacidea (2) and Caridea (1). The nomenclature used in this section follows the decision of the International Commission on Zoological Nomenclature (ICZN 2000).



Figure 1. A–B: *Potamon fluviatile* (A) and its habitat from Ohrid Lake, v. Radožda (B); C–D: *Potamon ibericum* (C) and its habitat from the Stara River, v. Miravci (D); E–F: *Astacus astacus balcanicus* (E) and its habitat from the Pčinja River close to Macedonian-Serbian border (F); G–H: *Austropotamobius torrentium macedonicus* (G) and its habitat from Mt. Galicica (H); I–J: *Atyaephyra stankoi* (I) and its habitat from Dojran Lake, Macedonia (J); a-e. The studied species from MMNH with inventory numbers.

Order DECAPODA Latreille, 1802**Suborder PLEOCYEMATA Burkenroad, 1963****Infraorder BRACHYURA Linnaeus, 1758****Family Potamonidae Ortmann, 1896****Genus *Potamon* Savigny, 1816*****Potamon fluviatile* (Herbst, 1785)**= *Cancer fluviatile* Herbst, 1785= *Potamophilus edule* Latreille, 1818= *Potamon (Eutelphusa) edule* Pretzmann, 1962= *Potamon (Telphusa) fluviatilis* Pretzmann, 1983

Published records: Karaman M. [12]: Ohrid Lake's tributaries and springs (rare on the shore line), Crn Drim watershed.

Material studied: Ohrid Lake, v. Radožda, 7–8.10.2015, 11 s., leg. ES [5775].

Remarks: The freshwater crab *Potamon fluviatile* (Figure 1: A, a) was the first described species from the Eurasian genus *Potamon* [22]. Because the species was extremely used for human consumption, the former species' name was *P. edule* (Latin word "edulis" = edible) [23]. *P. fluviatile* has a highly fragmented geographic distribution over a wide area in a number of countries that have a Mediterranean coastline [24]. This species inhabits unpolluted rivers, streams and lakes throughout its range. Recent ecological survey by Barbaresi *et al.* [25] suggested that the populations of *P. fluviatile* have declined dramatically as a result of pollution, regulation and desiccation of streams, overexploitation for human consumption and introduction of exotic crayfish species.

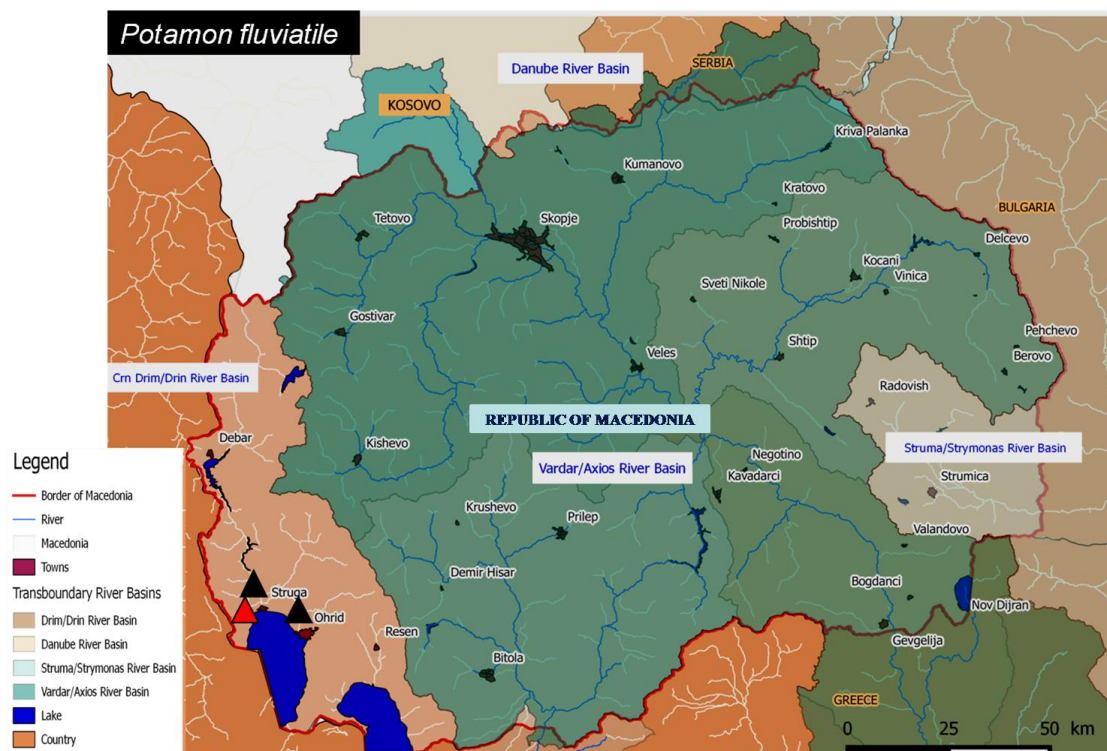


Figure 2. Distribution of *Potamon fluviatile* in Macedonia. Black triangles = published records, red triangles = material studied

Although in IUCN Red List of Threatened Species is listed as "Near Threatened" (Table 1), it is possible that the species is under higher risk of extinction on global scale [24, 25] and thus in Macedonia too. Bearing in mind that the species has a narrow geographical distribution in our country (Ohrid Lake watershed; Figures 1, 2), in our opinion, the protection should be strongly regulated on national level of legislation. Habitat protection and

preservation of freshwater ecosystems are obviously the main goal for conservation of *P. fluviatile* in Macedonia.

***Potamon ibericum* (Bieberstein, 1809)**= *Cancer ibericum* Bieberstein, 1809= *Thelphusa intermedia taurica* Czerniavsky, 1884= *Potamon (Pontipotamon) ibericumtauricum* Pretzmann, 1962

Published records: Karaman M. [12]: Dojran Lake spring near Toplec, lower part of the River Vardar and its tributaries, springs on Mt. Gradeška, Gevgelija valley.

Material studied: Dojran Lake, 7 s., leg. LU [2377]; 4 s., leg. LU [2391]; Gabrovo stream, 22.04.1986, 2 s., leg. SS [2392]; Dojran Lake, spring near Toplec, 28.06.1986, 2 s., leg. SS [2393]; Dojran Lake, spring near Toplec, 09.09.1988, 7 s., leg. SS [2397]; Dojran Lake, spring near Toplec, channel besides spawning place, 11.06.1997, 3 s., leg. SS [2773]; stream near v. Balakli, Mt. Gradeška, 08.05.2012, 1 s., leg. ES [5773]; Konjska Reka river, under v. Gorničet, Mt. Kožuf; 11.09.2000, 1 s., leg. ES [5774]; Stara River, v. Miravci, 11.11.2015, 2 s., leg. ES [5793]; Konjska Reka river, v. Konjsko, Gevgelija, 12.11.2015, 6 s., leg. ES [5794].

Remarks: Similar to *P. fluviatile*, freshwater crab *P. ibericum* (Figure 1: C, b) has a wide and highly fragmented distribution. Due to human impact there has been a distinct decline in population abundance in most parts of its range since the mid 1970's, and in some places the populations of crabs

may have already disappeared [24]. Mainly, the populations are threatened by water pollution, non-purified sewages and habitat destruction, such as river-bed straightening, building of reservoir, withdrawal of water for local needs, stream channelization. Further, freshwater crabs are an important protein source and are consumed in many parts of its range [4], which significantly contributed to the decline of the populations of *P. ibericum*. Therefore, IUCN Red List of Threatened Species (Table 1) assessed the species as Near Threatened (NT), with an indication that in the future it may be close to qualifying as Vulnerable (VU) under A2 [24].

The results of this study show that in the last twenty years no specimen of *P. fluviatile* was registered in the springs near Toplec, Dojran Lake, Macedonia (Figure 3). It is possible that habitat alteration of the springs caused extinction of subpopulations of the species. In this connection we strongly recommended urgent protection of the species, at least under national regulations. Unfortunately, protection limited to local regulations often is not sufficient to preserve the species from decline.

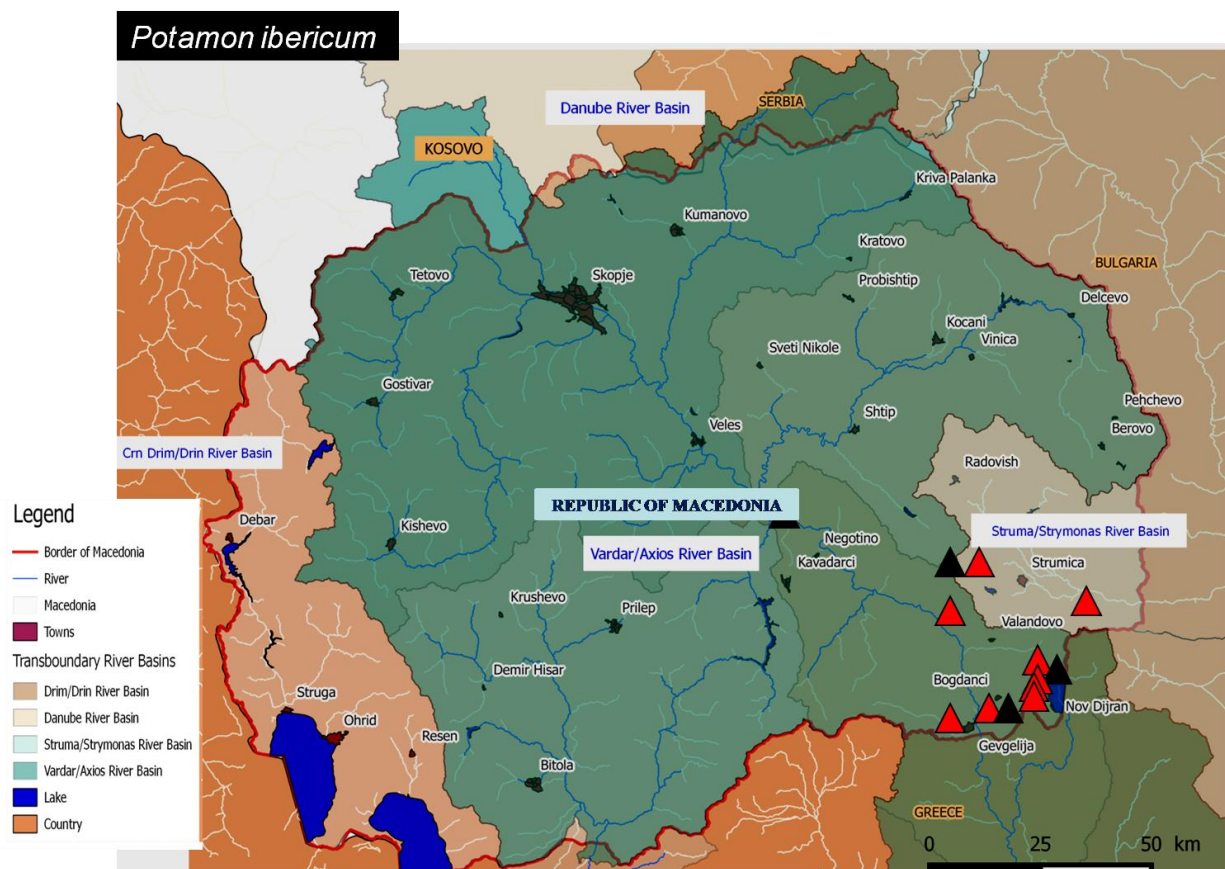


Figure 3. Distribution of *Potamon ibericum* in Macedonia. Black triangles = published records, red triangles = material studied

Infraorder ASTACIDEA Latreille, 1802**Family Astacidae Latreille, 1802****Genus *Astacus* Fabricius, 1775*****Astacus astacus balcanicus* S. Karaman, 1929**

= *Potamobius fluviatilis balcanicus* S. Karaman, 1929

= *Astacus colchicus balcanicus* M. Karaman, 1961

= *Astacus (Astacus) astacus balcanicus* M. Karaman, 1963

Published records: Karaman S. [6]: Ohrid Lake, Vardar River watershed; Holothuis [26]: Vardar River near Vazarci south of Skopje; Albrecht [9]: Ohrid Lake, Sateska River; Subchev & Gelder [27]: Dojran Lake, Skopje.

Material studied: Vardar River, Demir Kapija, Gevgelija, 27.08.1965, 5♂♂, 7♀♀, leg. KB, RG [2373]; Vardar River, Demir Kapija, Gevgelija, 27.08.1965, 3♂♂, 11♀♀, leg. KB, RG [2374]; Ohrid Lake, 20.07.1965, 4♂♂, leg. TP [2375]; Struga, 15.08.1976, 5♂♂, 1♀, leg. TP [2376]; Ohrid Lake, 20.07.1965, 12♂♂, leg. TP [2378]; Dojran Lake,

3♂♂, 1♀, leg. LU [2390]; Bregalnica River, v. Razlovci, 10.1985, 5 s., leg. JK [2399]; Mavrovica Reservoir, Sv. Nikole, 10.2013, 2♂♂, 2♀♀, leg. VSS, VK [5770]; Pčinja River, near border with Serbia, 18.07.2009, 1♂, leg. VSS [5785].

Remarks: *Astacus astacus* (Figure 1: E, c) is indigenous and widespread crayfish throughout Europe [28]. This species occurs in rivers, lakes, ponds and reservoirs, where shelter availability like, stones, logs, roots and aquatic vegetation prevail [29]. Populations of noble crayfish are at risk of becoming endangered as a result of various stressors such as: i) habitat alteration and degradation, ii) pollution, iii) increased siltation, iv) over-exploitation, v) the virulent disease commonly known as crayfish plague, caused by pathogen oomycete *Aphanomyces astaci* and vi) competition with invasive non-indigenous crayfish species [30, 31]. Therefore, IUCN Red List of Threatened Species classifies the noble crayfish as a vulnerable species (VU) with a decreasing population trend [32]. The noble crayfish is further included in the Bern Convention (Appendix III) and listed in the EU Habitat Directive 92/43/EEC (Appendix V).

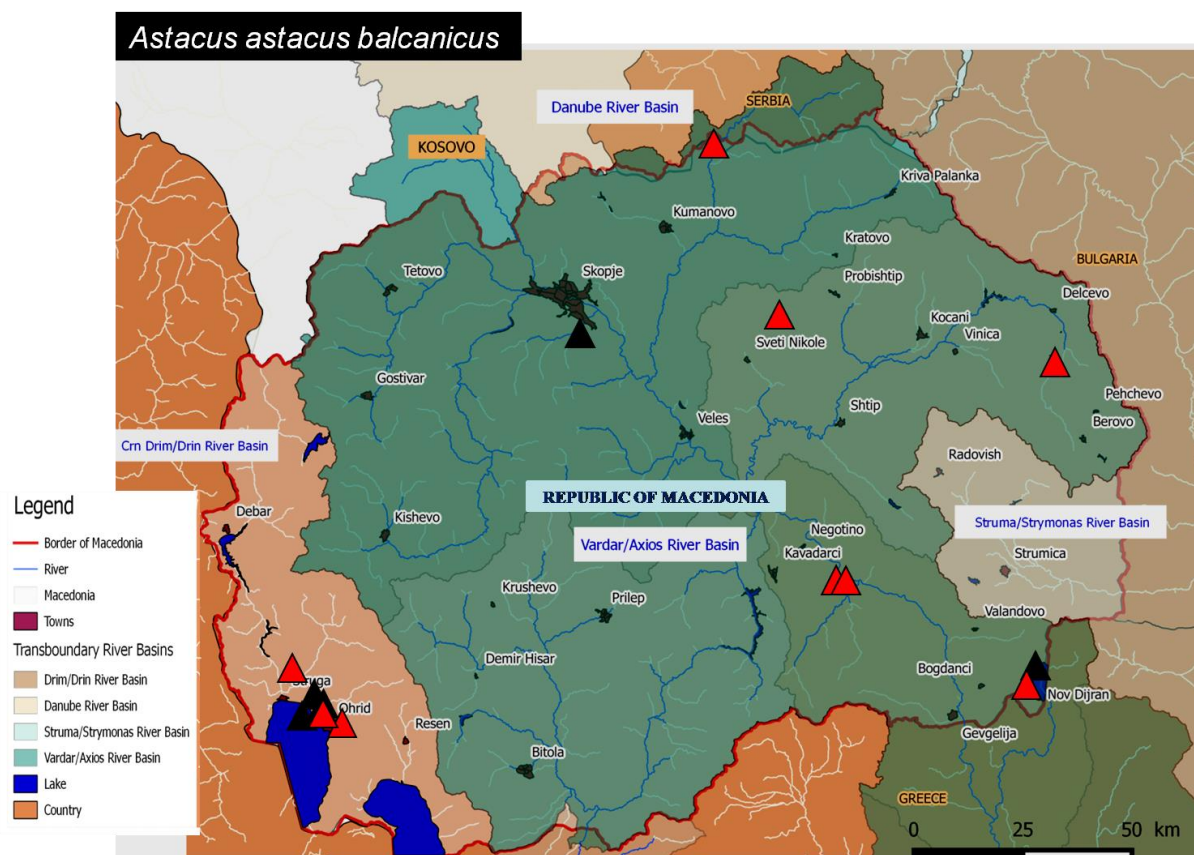


Figure 4. Distribution of *Astacus astacus balcanicus* in Macedonia. Black triangles = published records, red triangles = material studied

The results presented in this Catalogue indicate that the current status of the noble crayfish (in Macedonia accepted as *A. a. balcanicus*) is alarming. In comparison with the stone crayfish, *A. astacus* is rarer, with restricted and fragmented distribution, mainly in the Vardar and Drim drainage systems (Figure 4). Although the species' status is 'protected wild species' in Macedonia, it is only formally protected by local regulations [33].

Moreover, recent molecular-based studies covering a large portion of distribution range of *A. astacus* confirmed that the Balkans were relatively unaffected by geological events during the glacial cycles and that genetic diversity is more conserved in comparison to Central Europe [30, 34]. Taking into consideration that an analysed material from Macedonia is missing, increased data set should be used to resolve the large-scale genetic structure of noble crayfish.

Genus *Austropotamobius* Skorikov, 1908

Austropotamobius torrentium macedonicus S. Karaman, 1929

= *Potamobius torrentium macedonicus* S. Karaman, 1929

= *Austropotamobius (Austropotamobius) torrentium macedonicus*, Bott, 1950

Published records: Karaman S. [6]: Treska Gorge near Skopje, mountain springs in the Vardar River watershed; Karaman M. [12]: mountain springs without specification of the settlement; Albrecht [9]: Treska River, the village of Bukovo; Subchev [35]: Skopska Crna Gora (Karadah Mt.).

Material studied: Lipkovo, v. Goshince, 19.09.1979, 1♂, 2♀♀, leg. TP [2379]; Belchishko wetland, 04.10.1978, 1♀, leg. SP [2380]; Matica spring, v. Cer, Kičevo, 17.09.1981, 2♂♂, 2♀♀, leg. SS [2381]; v. Raec, 19.10.1970, 1♂, 1♀, leg. TP [2382]; captured spring between v. Bansko and v. Gabrovo, 27.06.1986, 11♂♂, 5♀♀, leg. SP [2383]; spring before v. Kolešino, 06.06.1986, 2♀♀, leg. Gj Gj [2384]; v. Bansko, 22.12.1987, 7♂♂, leg. TP [2394]; spring above v. Smolare, Mt. Belasica, 08.07.1986, 1♂, leg. SP [2396]; Lipkovska Reka river, v. Gošince, 17.07.1979, 4♂♂, 3♀♀, leg. TP [2398]; Demir Hisar, v. Brezovo toward v. Zasle, 28.07.2013, 1♀, leg. ES [5771]; Mt. Kozuf, Visoka Čuka (Konjarnik), 17.07.2002, 1♀, leg. ZN [5772]; Ratevska Reka River, 07.2013, 1♂, 1♀, leg. VK, VSS [5781]; Orevovečka Reka river, after fishpond, 11.09.2011, 1♀, leg. BR [5782]; Orevovečka Reka River, after fishpond,

12.08.2011, 1♂, leg. BR [5783]; Mala Livada River, 11.09.2011, 1♀, leg. BR [5784]; Bezgašteska Reka river, 30.05.2015, 1♂, 1♀, leg. BR, VSS [5786]; Plavaja river, 06.06.2016, 1 s., leg. BR, VSS [5787]; Zelenogradska Reka river, Mt. Osogovo, 08.2008, 1 s., leg. VSS [5788]; Brajčinska Reka river (upstream), 07.2010, 1♀, leg. IS [5789]; Zrnovska Reka river, 05.2015, 2♀♀, leg. VSS [5790]; Bregalnica river, v. Mačevo, 13.06.2015, 1♂, leg. VSS, DK [5791]; Pehčevska river, 14.06.2015, 1♀, leg. VSS, DK [5792].

Remarks: *A. torrentium* (Figure 1: G, d) is relatively widespread crayfish across Europe, confined mainly to higher regions and wooded headwaters, adapted to cold water and rocky environments [36]. This species is reported to be undergoing significant population decline in most parts of its range [37, 38]. Literature data show that the main threats to the population of stone crayfish are the following: i) the presence of non-native species *Pacifastacus leniusculus* (Dana, 1852) and *Orconectes limosus* (Rafinesque, 1817); ii) the crayfish plague, caused by pathogen oomycete *Aphanomyces astaci*; iii) domestic and industrial pollution; iv) habitat loss and degradation (with damming, water abstraction, and channelization of rivers); v) agriculture and vi) eutrophication [37, 38, 39]. However, no quantitative data on the rate of decline is available and therefore IUCN Red list of Threatened Species assessed the species as "Data Deficient" [37]. The European Habitats Directive 92/43/EEC ranks *A. torrentium* in Annex II among the animal and plant species of Community interest, whose conservation requires designation of Special Areas of Conservation (Table 1). Further, the species is included in Appendix III of Bern Convention and Annex V of EU Habitat Directive 92/43/EEC and presents a protected wild species in Macedonia [33].

Compared to the *A. astacus*, the stone crayfish (in this Catalogue accepted as *A. t. macedonicus*) is more widely distributed in Macedonia (Figure 5). Its connectivity with mountainous and wooded headwaters makes it less exposed to anthropogenic pollution and habitat degradation and contributed to its lesser vulnerability. The results presented in this Catalogue contributed to update our knowledge on the geographical distribution of the *A. t. macedonicus* in Macedonia and will serve as a baseline for the process of designation and establishment of Natura 2000 network in Macedonia.



Figure 5. Distribution of *Austropotamobius torrentium macedonicus* in Macedonia. Black triangles = published records, red triangles = material studied

Infraorder CARIDEA Dana, 1852

Family Atyidae De Haan, 1849

Genus *Atyaephyra* de Brito Capello, 1867

Atyaephyra stankoi Karaman, 1972

= *Atyaephyra desmarestii stankoi* Karaman, 1972

Published records: Karaman M. [15]: Dojran Lake; Karaman M. [12]: Dojran Lake, the channels in Skopje and Pelagonia valleys, downstream of spring Rasče near Skopje; Šapkarev *et al.* [40]: Dojran Lake near Nov Dojran and Kaldrma; Christoudoulou *et al.* [16]: Dojran Lake.

Material studied: Katlanovo wetland, drainage channel, 22.06.1946, 10 s., leg. KB [2388]; Vardar river, v. Orešani, 13.09.1951, 5 s., leg. KB [2389]; Dojran Lake, 14.09.1972, 3 s., leg. OP [5776]; Dojran Lake, Kaldrma, 01.07.1994, 36 s., leg. ES, SS [5777]; Dojran Lake, Ačikot, 02.07.1994, 7 s., leg. ES, SS [5778]; Dojran Lake, Nikolič, 09.11.1999, 28 s., leg. ES, SS [5779]; Dojran Lake, Mrdaja, 10.11.1999, 10 s., leg. ES, SS [5780].

Remarks: The freshwater shrimp *Atyaephyra desmarestii stankoi* (Figure 1: I, e) was described

by Karaman M. [12] based on specimens from Dojran Lake (Macedonia). Later, García Muñoz *et al.* [41] argued that the subspecies *A. d. stankoi* actually presents a cryptic species in *A. desmarestii* complex without confirming its status as a distinct species. Recently, Christoudoulou *et al.* [16] and García Muñoz *et al.* [17] confirmed the taxonomical validity of *A. stankoi* based on morphological and molecular data, after studying specimens from west-central Greece and from the type locality (Dojran Lake). Additionally, the neotype of *A. stankoi* Karaman 1972, was designated by Christoudoulou *et al.* [16] to stabilize the species' taxonomy.

A. stankoi is a Balkan endemic species, widespread in west-central Greece, ranging northwards to southern Macedonia (Dojran Lake) [3]. The distribution of this species in Macedonia is presented in Figure 6. The species lives in marginal areas of rivers, lakes and streams and prefers habitats rich with aquatic vegetation [12, 40]. *A. stankoi* is included in IUCN Red List of Threatened Species as being of Least Concern (Table 1), as no information is provided on population densities and no threats to the species are identified [3].

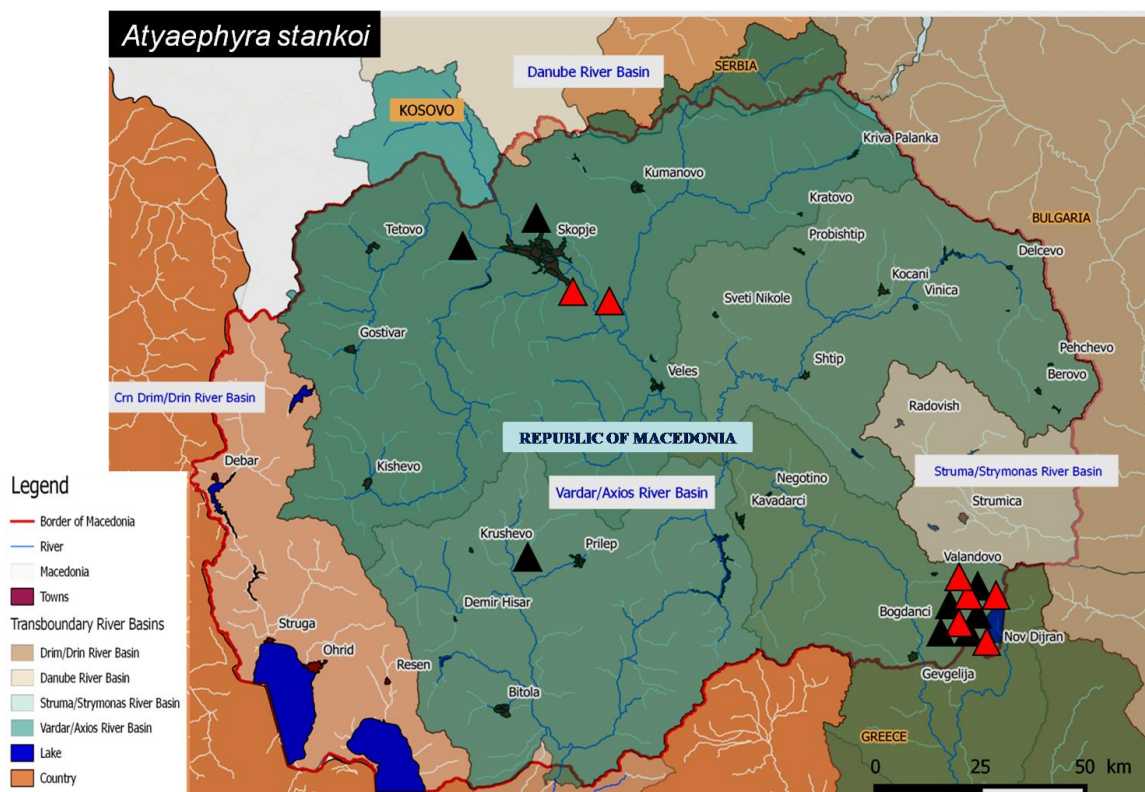


Figure 6. Distribution of *Atyaephyra stankoi* in Macedonia. Black triangles = published records, red triangles = material studied

Table 1. List of freshwater decapods in Macedonia and their associated status according to national and international criteria

Species	Habitat Directive 92/43/EEC	Bern Convention	IUCN Red List	National list
<i>Potamon fluviatile</i>			NT	
<i>Potamon ibericum</i>			NT	
<i>Astacus astacus</i>	V	III	VU	Yes
<i>Austropotamobius torrentium</i>	II/V	III	DD	Yes
<i>Atyaephyra stankoi</i>			LC	

The scarce knowledge of its ecology and biology, and the lack of economic value, significantly contributed to its low level of protection. The Macedonian law (Official Gazette of the Republic of Macedonia no. 139/2011, 2011) does not mention this species as a threatened one [33]. However, it is strange that despite intensive research in the macroinvertebrate fauna of Dojran Lake (Macedonia) during 2015–2016 (Slavevska-Stamenković, unpublished data) the presence of specimens of *A. stankoi* has not been registered, which indicates an urgent implication of conservation measures.

Acknowledgements. We would like to thank to all colleagues mentioned in Material and Methods and in other chapters for providing specimens for this study.

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КАТАЛОГ НА СЛАТКОВОДНИ РАКОВИ (DECAPODA: POTAMONIDAE, ASTACIDAE, ATYIDAE) ОД РЕПУБЛИКА МАКЕДОНИЈА ВО КОЛЕКЦИЈАТА НА ПРИРОДОНАУЧНИОТ МУЗЕЈ НА МАКЕДОНИЈА

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Каталогот ги сумира податоците од колекцијата на декаподни ракови депонирана во Природонаучниот музеј на Македонија, Скопје, Република Македонија. Во трудот е даден и критички осврт на историските податоци за појавата и дистрибуцијата на декаподните претствници кои се среќаваат во земјата. Популациите на декаподните ракови на територијата на Македонија, до денес не биле континуирано проучувани, така што овој каталог може да послужи како важен извор на податоци за зачувување и заштита на декаподните ракови и нивните живеалишта.

Клучни зборови: каталог; Decapoda; Природонаучен музеј на Македонија; Македонија

