

THE STONE CRAYFISH *AUSTROPOTAMOBIOUS TORRENTIUM* (SCHRANK) IN THE CZECH REPUBLIC.

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ABSTRACT

Five species of crayfish, comprising two native species *Austropotamobius torrentium* and *Astacus astacus*, one introduced European species, *Astacus leptodactylus* and two alien American species, *Orconectes limosus* and *Pacifastacus leniusculus*, occur in open waters of the Czech Republic. The stone crayfish is highly endangered species in the country, known only from several recent records. Four localities have been confirmed for the presence of the stone crayfish in the Czech Republic. Basic characteristics of the following stone crayfish occurring localities are described: Míza and Upořský brook in Křivoklát protected area, Zubřina brook near Domažlice, Luční brook near Trutnov and Klabava brook in Brdy Military Training Area. The present localities have been investigated for chemical, structural and terrestrial environments. Properties of these waters (morphology, supply of substrate, current, aquatic and terrestrial environment) are compared with literature data. Strong conservation actions are necessary to save the endangered stone crayfish on most north-eastern limit of its distribution.

L'ÉCREVISSE DES TORRENTS *AUSTROPOTAMOBIOUS TORRENTIUM* EN RÉPUBLIQUE TCHÈQUE.

RÉSUMÉ

En République Tchèque, on trouve dans la nature cinq espèces d'écrevisses - deux autochtones *Austropotambius torrentium* et *Astacus astacus*, une espèce européenne introduite, *Astacus leptodacylus* et deux espèces américaines banales *Orconectes limosus* et *Pacifastacus leniusculus*. L'écrevisse de torrents e été confirmée dans quatre localités de la République Tchèque. Les principales caractéristiques des sites où ont été rencontrées les écrevisses de torrents ont été notées dans les ruisseaux de Miza dans le CHKO Krivoklat, de Zubrina près de la ville de Domazlice, de Lucni près du Trutnov et de Klabava dans le camp d'instruction militaire de Brdy. Dans ces localités, des analyses chimiques d'eau ont été effectuées et l'état de l'environnement apprécié. Les données obtenues : morphologie du terrain, substrat, courant d'eau, milieu aquatique et environnement sont comparées avec celles de la littérature. La répartition de l'écrevisse de torrent dans le nord-est révèle la nécessité de sa protection.

INTRODUCTION

Crayfish belonging to the largest freshwater invertebrates play an irreplaceable role of big macrophages in aquatic ecosystems and by their occurrence (noble crayfish *Astacus astacus* and stone crayfish *Austropotamobius torrentium*), they indicate water quality in the range of oligosaprobity and beta-mesosaprobity (DYK, 1977; SLÁDEČEK *et al.*, 1981). Since sixties of the 19th century, crayfish population in Europe has been decimated by crayfish plague caused by the fungus *Aphanomyces astaci*. European native crayfish are being replaced by aggressive American crayfish species *Orconectes limosus* (Rafinesque), *Pacifastacus leniusculus* (Dana), *Procambarus clarkii* (Girard), which are resistant to crayfish plague (SÖDERHÄLL and CERENIUS, 1999). However it was proved that besides the resistance to crayfish plague, the American crayfish might also be its vectors and so they threatened even more the remaining populations of native species when coming into contact with them (DIÉGUEZ-URIBEONDO and SÖDERHÄLL, 1993). At present, the steps are performed for the resolution of European crayfish crisis. An action plan of protection exists already in Great Britain where also corrections in the legislation are proposed (ROGERS and HOLDICH, 1995, 1997). Proposal for crayfish protection were submitted also in France (LAURENT *et al.*, 1993; GRANDJEAN *et al.*, 1997) and Germany (HAGER, 1996). National action plans of these countries accordingly contain the following points: 1. New mapping and evidence of existing stocks and distribution of native and alien crayfish species. 2. The prevention from introductions of non-native species. 3. The elimination of non-native species. 4. The control of recent distribution of crayfish plague. 5. Artificial culture and reintroduction of autochthonous species into suitable waterbodies. 6. The support of national crayfish research programs and international co-operation. 7. The education of professionals and public. 8. Legislation corrections for crayfish protection and support of the interest from the public.

Stone crayfish *A. torrentium* is the most critically endangered crayfish species in the Czech Republic protected by law No. 114/1992. No manipulation is allowed without permission from Ministry of Environment. Catch is prohibited, as well as breeding in captivity, disturbing, injuring and killing the animals. Not only the animals are protected but also their natural and artificial places and biotopes (KOZÁK *et al.*, 1998). Stone crayfish is listed as protected in Appendix III of Bern Convention. Their occurrence is known from many European countries: France, Luxembourg, Switzerland, Germany, Austria, Czech Republic, Slovakia, Hungary, Romania, Slovenia, Croatia, Italy (MACHINO, 1997; HOLDICH, 1998; TROSCHER, 1999). In the neighbouring countries, stone crayfish is the most abundant in Austria and Germany. In Austria, there are known 534 localities which are 46% of all crayfish populations (PÖCKL, 1999). In Germany, there are known 141 localities (BOHL, 1987). The upper regions close to the Rhine river near Cologne and the northern tributaries of the Main and the Danube rivers are the borders of its northern distribution in Europe (TROSCHER and DEHUS, 1993). There are several records about occurrence of stone crayfish in the Czech Republic (DYK, 1977; MOUCHA, 1981; LENSKÝ, 1982; LOHNISKÝ 1984a, b; HOUDA and TICHÝ, 1987; HAJER, 1994; PEŠOUT *et al.*, 1996; KOZÁK and POLICAR, 1999; POLICAR and KOZÁK, 2000). Some of them are biased and out of date with possible confusion of the species. The aim of this work was to evaluate data about occurrence of the stone crayfish in the Czech Republic and to check out its stocks on the most important localities.

MATERIAL AND METHODS

For the first time, distribution data of stone crayfish all over the Czech Republic were selected from the literature. Records were reported by their location, their altitude above sea level and date of citation (Table I). We selected the most important localities firstly and carried out the research on these localities personally. Localities with occurrence of stone crayfish took places only in shallow running waters. Crayfish were caught by searching

suited hiding places such as larger stones and wooded debris during the daytime. Sampling took place from May to September 2000. If crayfish were found, a brook was sampled, and density, sex ratio, total length, carapace length, and state of health were determined. Habitat parameters such as water depth, percentage of rocks, gravel, sand or tree roots were observed. Water quality was recorded by chemical analysis. Records of biotic impacts included fish stocks, saprobic situation and food sources.

Table I

Records of stone crayfish *Austropotamobius torrentium* occurrence in the Czech Republic.

Tableau I

Endroits où l'écrevisse des torrents a été rencontrée en République Tchèque.

No.	Municipality	Locality	Altitude	The first finding	The last finding	Literature
Central Bohemia						
1 st	Broumy (Beroun)	Miza brook	390 m	1998	1998	SMUTNÝ (2000 pers. comm.)
2 nd	Broumy (Beroun)	Uporský brook	335 m	1977	1977	LOHNISKÝ (1984a)
3 rd	Týrovice (Rakovník)	Uporský brook	265 m		1982	LOHNISKÝ (1984a)
4 th	Lány (Rakovník)	Klíčava	300 m		1982	LOHNISKÝ (1984a)
5 th	Nový Dům (Rakovník)	Ryšava brook	370 m		1982	LOHNISKÝ (1984a)
6 th	Křivoklát Prot.Area.	Berounka			1981-2	PRIVETIVÝ (1982)
7 th	Zákolany (Kladno)	Týnecký brook	205 m		1983	LOHNISKÝ (1984a)
8 th	Zákolany (Kladno)	Zákolanský brook		before 1979		PECINA (1979)
9 th	Revnice (Prague)		215 m	1904	1904	LOHNISKÝ (1984a)
10 th	Chýnice (Prague)	Dubenecký brook	350 m		1963	LOHNISKÝ (1984a)
11 th	Dubenský mill (Prague)	Radotinský brook	350 m		1963	LOHNISKÝ (1984a)
12 th	Křečovice (Benešov)	Křečovický brook	400 m	1981	1981	LENSKÝ (1982), POUPE (1982)
North Bohemia						
13 th	Podbořany (Louny)			before 1987		HOUDA, TICHÝ (1987)
South Bohemia						
14 th	Horní Vltavice		900 m		1925	ŠTĚPÁN (1932), DYK (1977)
15 th	Písek (Písek)	Otava river		before 1991		HAJER (1994)
16 th	Rychnov u Nových Hradů	Svinenský brook		before 1996		PĚSOUT <i>et al.</i> (1996)
West Bohemia						
17 th	Domazlice	Zubřina brook		1985	2000	DURIŠ <i>et al.</i> (2001)
East Bohemia						
18 th	Javorník (Trutnov)	Luční brook	490 m	1982	1983	LOHNISKÝ (1984a, b)
19 th	Rudník (Trutnov)	Luční brook	490 m		1983	LOHNISKÝ (1984b)
South Moravia						
20 th	Cikháj (Žd'ár n. Sázavou)	Světnovský brook				NENADÁL (1982)
21 st	Cikháj (Žd'ár n. Sázavou)	Cikhájský brook			1983	NENADÁL (1982), LOHNISKÝ (1984a)

RESULTS

We found the following 4 different localities with occurrence of stone crayfish: Miza brook and Uporský brook in Krivoklát Protected Area, Lucni brook near Krkonose National Park, Zubřina brook near Domazlice town, Klabava brook in Brdy Hills (military training area) (Figure 1).

The locality Miza brook and Uporský brook in Krivoklát Protected Area represented one of the most important and abundant localities with occurrence of stone crayfish, cited in several publications. There were several thousand of individuals with density more than 1 ind. per m². Stream width was 0.5 – 2 m and 1 – 2.5 m, respectively. This area was located in a forest and it was relatively safe because it was included in Protected Area with special protection.

In contrary, the population of stone crayfish in Lucni brook near Krkonose National Park was very endangered by flood and organic pollution. We found very disturbed population structure there. Crayfish occurred only in 1.6 km part of brook. Stream width

was 2 – 4 m. We caught 20 individuals only (12 adults females – 8 egg-caring, 5 adults males, 3 juv. 1+) of stone crayfish in this part of brook. There was a big flood in spring 2000, which destroyed banks of the brook. The brook is flowing through a village where there is big risk of organic pollution. The locality has been reviewed recently by V. BÁDR (2001, unpub. report) finding also another small sub-population of 30-40 adult specimens in the lower part of the brook.

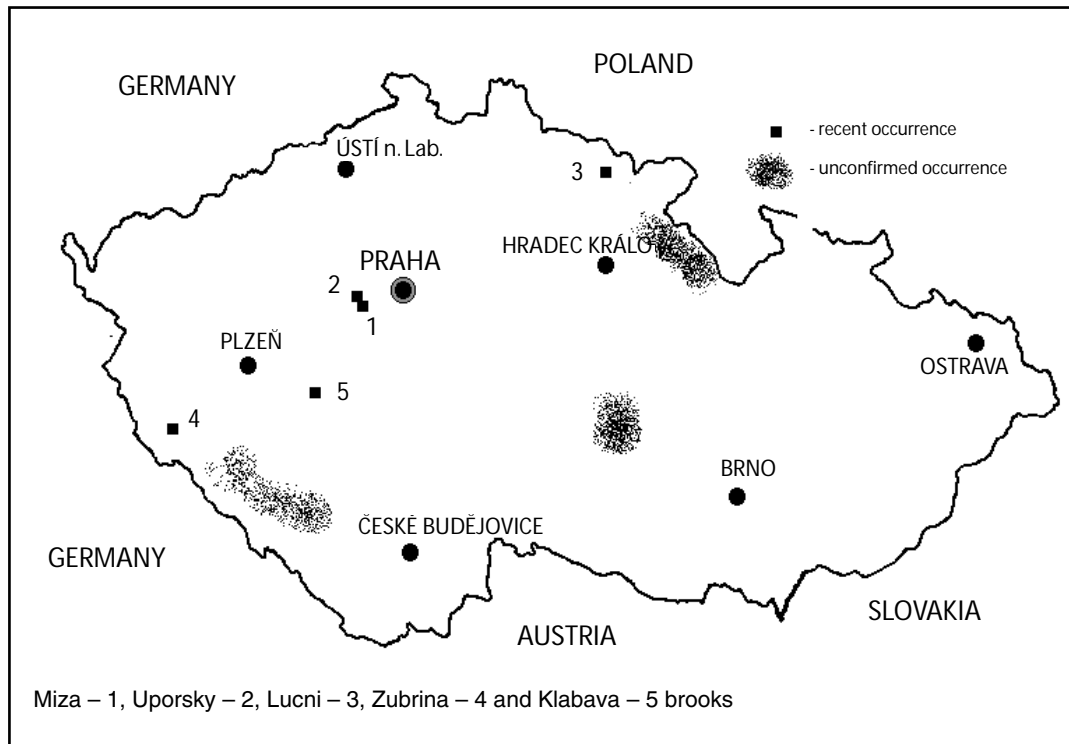


Figure 1
Occurrence of stone crayfish *Austropotamobius torrentium* in the Czech Republic

Figure I
Présence de l'écrevisse des torrents en République Tchèque.

The Zubřina brook near Domazlice town was a new locality unknown from literature. There was found a very interesting parallel occurrence of stone crayfish and noble crayfish populations – quite rare in Europe. Abundance of stone crayfish was several hundreds of individuals in 2 km part of brook. Stream width was 0.3 – 2.5 m. The lower and the upper part of brook were regulated by concrete prefabricate. There was a risk of communal pollution from a village in the upper part of the brook. Three ponds (with occurrence of noble crayfish) served as a biological filter there.

The last locality Klabava brook in Brdy Hills – military training area, was monitored by the team of FISHER *et al.* (2000, unpubl. report) from County Museum of Příbram town. Several thousands of individuals of stone crayfish occurred in about 10 km part of brook with maximum densities 12 ind. per m². Mean stream width was about 3 m. It was an area relatively safe from human impact but with strong predatory pressure of introduced mink (*Mustela vison*).

DISCUSSION

The stone crayfish occurs in smaller cold and fast-flowing forest headwaters at higher altitudes (PÖCKL, 1999). We found crayfish almost exclusively in forest streams. According to KAPPUS *et al.* (1999), the determining parameters for density and biomass of an *A. torrentium* community are number of shelters in the embankment, presence of larger roots and stream depth. This was confirmed by our study. *A. torrentium* communities have been found mostly at sites showing a richness in embankment hollows and stony bottoms of stream. According to BOHL (1987), average width of streams containing crayfish communities was 1.47 m and according to KAPPUS *et al.* (1999) 1 – 2 m, which was corresponding with our examination.

BOHL (1987) presented the average distance from source for stone crayfish and noble crayfish 2.1 km and 15.1 km, respectively, except for finding one locality with stone crayfish occurrence below noble crayfish site. This was analogous with occurrence of both species in Zubrina brook near Domazlice town. Noble crayfish occurred except for parallel occurrence of sites, also in the more upper part of stream than stone crayfish. The co-occurrence of the two species is quite rare in Europe. But the source of noble crayfish population was in ponds with lower water quality.

The limit of lowest summer temperature is between 11 – 14°C (TROSCHEL *et al.*, 1995; BOHL, 1987). The stone crayfish starts their activity at 7°C and stop their activity at 5°C (TROSCHEL and DEHUS, 1993). According to BOHL (1987) it can be active also below this limit. The highest temperature limits for the stone crayfish is between 21 – 26°C according to those authors. We found the stone crayfish in running water with summer temperature 11.4 – 15.7°C, which corresponded with those authors.

The physical and chemical parameters of water quality can be characterised according to BOHL (1987) and our values measured were as followed: pH 5 – 8.6, conductivity 80 – 700 $\mu\text{S}\cdot\text{cm}^{-1}$, calcium 7 – 70 $\text{mg}\cdot\text{l}^{-1}$, magnesium 2.6 – 21.0 $\text{mg}\cdot\text{l}^{-1}$, iron up to 1.2 $\text{mg}\cdot\text{l}^{-1}$, chloride up to 16.7 $\text{mg}\cdot\text{l}^{-1}$, nitrite up to 0.05 $\text{mg}\cdot\text{l}^{-1}$, nitrate up to 10 $\text{mg}\cdot\text{l}^{-1}$ and saprobity value 1.4 – 2.6.

Population densities varied in each of our examined brooks and also in parts of brook. RENZ and BREITHAUPT (1999) presented population density 6 – 12 individuals per meter of stream and KAPPUS *et al.* (1999) presented 0.04 – 3.8 ind. per m^2 . We found the maximum crayfish density of 12 ind. per square meter in Klabava brook.

According to BOHL (1987), associated fish species are brown trout (*Salmo trutta*), sculpin (*Cottus gobio*) and small cyprinids. We found also lamprey (*Lampetra planeri*) and introduced rainbow trout (*Oncorhynchus mykiss*) in Lucni brook.

CONCLUSION

Occurrence of stone crayfish in the Czech Republic is very low, located to 4 small regions. Strong conservation actions of all populations are necessary to save the endangered stone crayfish mainly on the most north-eastern limit of its distribution in Lucni brook near Krkonose National Park, where there is very disturbed population. In case of extinction of stone crayfish at this locality, we would lose probably a long-term isolated part of the gene pool of this species.

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