Ber. nat.-med. Verein Innsbruck	Band 90	S. 61 - 71	Innsbruck, Nov. 2003

Heribaudiella fluviatilis (ARESCH.) SVED. (Phaeophyceae) and the *Hildenbrandia rivularis* (LIEBM.) J. AG. - *Heribaudiella fluviatilis* (ARESCH.) SVED. association newly recorded in Bulgaria

by

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Synopsis: The paper presents the first records of freshwater brown alga *Heribaudiella fluviatilis* (ARESCH.) SVED. in Bulgaria. The combined occurrence of the freshwater species *Hildenbrandia rivularis* (LIEBM.) J. AG. (red algae) and *Heribaudiella fluviatilis* (ARESCH.) SVED. (brown algae) in Bulgaria is also firstly documented. Additional notes on the distribution of this association and proposal for its protection are given.

Key words: *Hildenbrandia rivularis*, *Heribaudiella fluviatilis*, Bulgaria, distribution, protection

1. Introduction:

There are a few genera of brown algae (Phaeophyta) and several genera of red algae (Rhodophyta) living in freshwater habitats (SMITH 1950, BOLD & WYNNE 1978, VINOGRADOVA et al. 1980, BOURRELLY 1968, 1985, GRAHAM & WILCOX 2000, SHEATH 2003, WEHR 2003). Among these are the both epilithic uncalcified crustaceous red-algal genus *Hildenbrandia*[1] NARDO and brown-algal genus *Heribaudiella* GOMONT (Syn. *Lithodora* KLEBAHN and *Lithoderma* ARESCHOUG p.p.). Their crimson-red or dark brown thalli on the shaded surfaces of pebbles, stones and rocks in different habitats (brooks, creeks, streams, rivulets, rivers, waterfalls, lakes, fountain walls, outlets and effluents of thermal springs) attracted the attention of scientists since the first descriptions by NARDO (1834) and GOMONT (1896) and later revisions by LIEBMAN (1839), AGARDH (1851), ARESCHOUG (1875), FLAHAULT (1883), SVEDELIUS (1930) and KLEBAHN (1939). After that, many times these encrusting species (separately growing or in combinations with cyanoprokaryotes and other algae) had been recorded from Europe (HANSGIRG 1888, 1905, PASCHER 1925, SKUJA 1928, SVEDELIUS

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[1] To the nomenclature of the genus name *Hildenbrandia* see WIDDER (1958).

1926, ISRAELSON 1938, WEHRLE 1942, WAERN 1949, BLUM 1956, NICHOLS 1965, KANN 1966, STARMACH 1969a, b, 1977, 1984, LAZAR 1975, FRIEDRICH & MÜLLER 1984, WEHR & STEIN 1985, PIPP & ROTT 1994 and KUSEL-FETZMANN 1996 among the many others) and from other continents also (e.g. COLLINS et al. 1898, JAO 1941, YONEDA 1949, CHAPMAN et al. 1957, NICHOLS 1965, KUMANO & HIROSE 1959, BICUDO & BICUDO 1970, KUMANO 1978, PUESCHEL & STEIN 1983, WEHR & STEIN 1985, SHEATH et al. 1993, VIS et al. 1994, SHEATH 2003, WEHR 2003). Except on natural substrates, growth of *Hildenbrandia* was documented on an old glass bottle retrieved from a bottom of a lake (CANTER-LUND & LUND 1995).

The joined distribution of *Hildenbrandia* and *Heribaudiella* was screened by BUDDE (1927), who proposed the streams with these species to be considered for preservation and later on described by FRITSCH (1929) as association. Since then it was many times outlined as representative for running water series (SYMOENS 1950, ROUND 1981, SYMOENS et al. 1988, REYNOLDS 1992). It was referred to the broader classical ecological group 'epilithon' (ROUND 1981, p. 51) or included in category of 'extraregional communities controlled by factors that act in a similar way in all geographical situations' (MARGALEF 1960, p. 143) and recognised among them in the structural minor community of encrusting algae named 'pecton' (MARGALEF 1960, p. 143).

In spite of the opinion, that *Hildenbrandia* and *Heribaudiella* are fairly common in flowing waters at least in Europe (WEHR & STEIN 1985), it could be stated that still the knowledge on the distribution of these algae (both joined and separately) is far away from being complete and is one of the interesting biogeographical problems (SABATER et al. 1989). According to WEHR (2003) the co-occurrence of *Hildenbrandia* and *Heribaudiella* is far from consistent. The combined growing of *Hildenbrandia-Heribaudiella* had been recorded as 'community' or 'association' mostly from the northern and central parts of Europe (e.g. SKUJA 1925, BUDDE 1927, FRITSCH 1929, GEITLER 1932, WAERN 1938, KANN 1966, HOLMES & WHITTON 1977 a, b, c, KUSEL-FETZMANN 1996). In southern parts of Europe the both species were reported mainly separately (DE TONI 1894, MARGALEF 1953, ANAGNOSTIDIS 1968, RÓBERT 1976, SABATER et al. 1989, DELL'UOMO 2001). The distribution of *Hildenbrandia* in Bulgaria has been documented in 3 publications from the beginning of 20th century (PETKOFF 1908-1909, 1929, 1950) and recently was extended by STOYNEVA et al. (2002). By contrast, no data have been ever published on any freshwater phaeophycean alga in Bulgaria.

The present paper documents the first findings of freshwater brown algae in Bulgaria and the first records of *Hildenbrandia-Heribaudiella* association in this country, represented by *Hildenbrandia rivularis* (LIEBM.) J. AG. and *Heribaudiella fluviatilis* (ARESCH.) SVED.

2. Material and methods:

Submerged stones and pebbles with brown and dark-red spots were examined and collected from the outlet of the karst spring Zhitolyub nearby the village Lakatnik in Stara Planina Mt (UTM-square FN 96) on 18 May 2002 and in the rivulet Vedena near to Zheleznitsa village in Vitosha Mt

(FN 91) on 7 July 2002. The water temperature was 14 and 18 °C, and pH – 7.6 and 7.8, respectively. Surrounding deciduous woodland shadowed both localities. Additional collecting was made on 8 June 2003 from stones and pebbles with red and brown crusts in Dragalevska Reka at Vitosha Mt (two of the localities of *Hildenbrandia rivularis* pointed in STOYNEVA et al. 2002 – FN 82). The same brown crusts were scraped and analysed from the stones collected previously in Reka Iskur (also a locality of *H. rivularis* in STOYNEVA et al. 2002 – FN 91). Mapping of the localities was made by GPS Garmin 12. The horological map (Fig. 1) was prepared by Bulgarian UTM Directory computer programme (MICHEV 1999).

The stone-crusts have been scraped in the laboratory and examined alive on microscope Amplival-Jena with magnification up to 1200x. All photos were taken directly from living material. Additionally semi-permanent glycerine-formalin slides have been prepared. After that the materials were fixed with 2-4% formalin and deposited together with the slides in the algal collection of the Department of Botany of Sofia University "St Kliment Ohridski".

3. Results:

The preliminary field observations revealed that the crustose thalli of *Hildenbrandia* found in all localities generally were round-shaped, up to 1-2 cm in diameter (Figs. 2, 4, 5) and much more rare were with irregular shape (Fig. 3). The brown spots of *Heribaudiella* were round only in small dimensions (up to 1-2 cm in diameter), while the biggest thalli had irregular shape (Figs. 2, 4, 5). Generally, both species grow in close vicinity to each other (Figs. 2, 6). An overlapping growth of *Heribaudiella* by *Hildenbrandia* was observed in several cases (particularly in Dragalevska Reka and in Reka Iskur) – Figs. 5, 8. In Dragalevska Reka both species grow mainly on different exposed stone surfaces (Fig. 3).

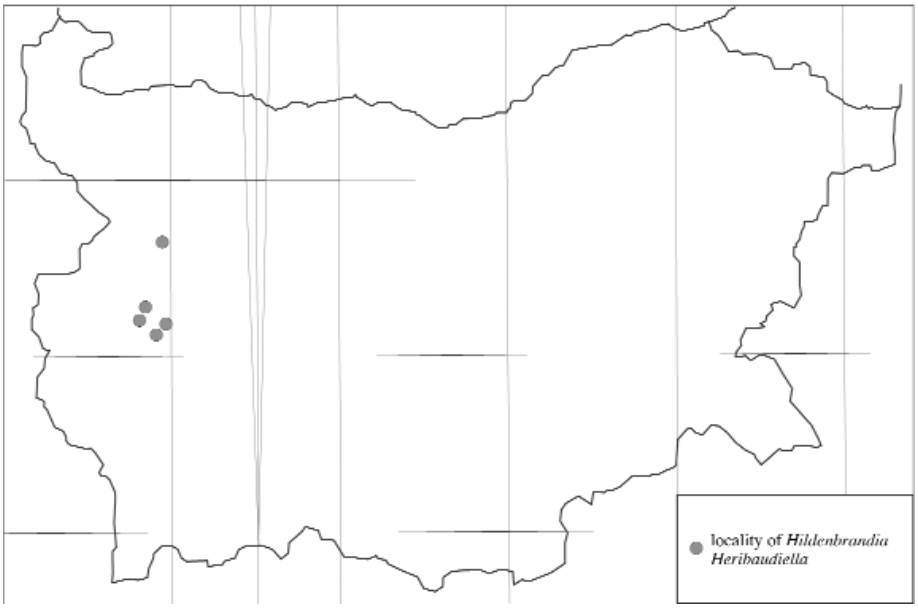

Fig. 1.: UTM-grid map of Bulgaria (computer version by MICHEV 1999) with localities of *Hildenbrandia rivularis* (LIEBM.) J. AG. - *Heribaudiella fluviatilis* (ARESCH.) SVED. association.

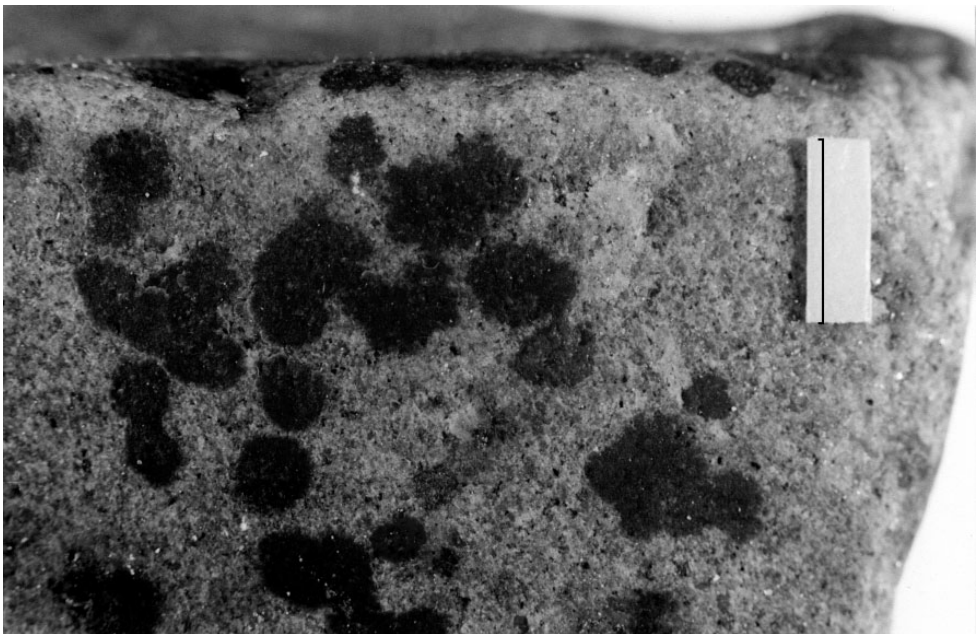

Fig. 2.: Thalli of *Hildenbrandia rivularis* (LIEBM.) J. AG. (red spots) and *Heribaudiella fluviatilis* (ARESCH.) SVED. (brown spots) on a stone from Vedena rivulet. Scale: 2cm.

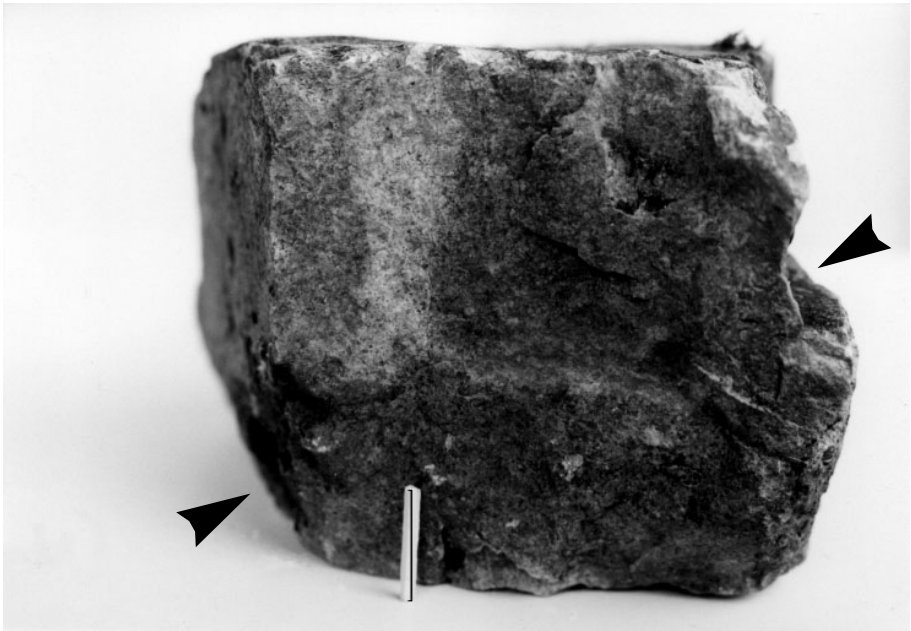

Fig. 3.: Thalli of *Hildenbrandia rivularis* (LIEBM.) J. AG. (red on the right side and arrow) and *Heribaudiella fluviatilis* (ARESCH.) SVED. (brown on the left side and arrow) growing on different surfaces of a stone from Dragalevska Reka. Scale: 2cm.

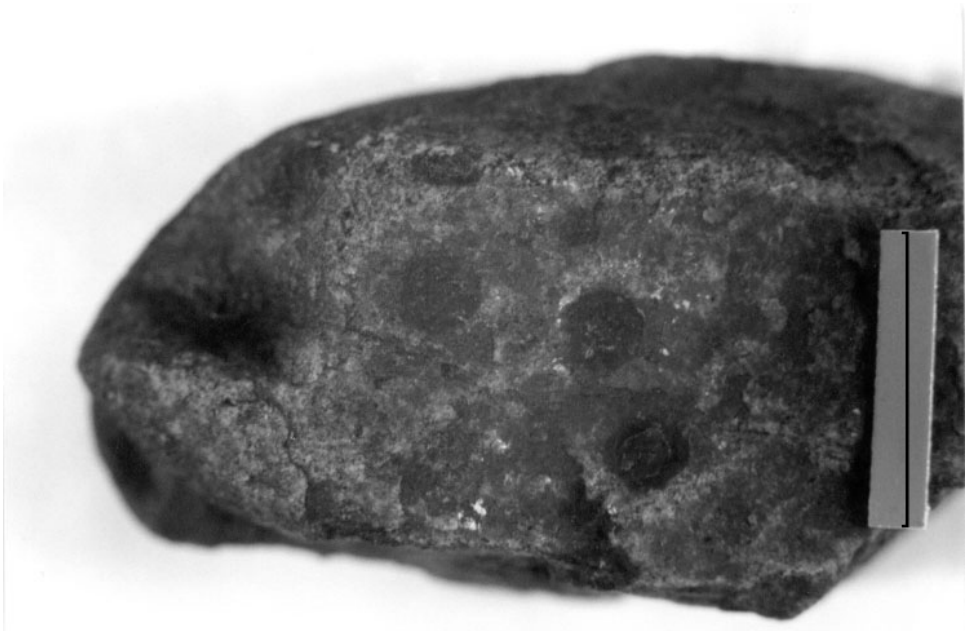

Fig. 4.: Thalli of *Hildenbrandia rivularis* (LIEBM.) J. AG. (red) and *Heribaudiella fluviatilis* (ARESCH.) SVED. (brown) on a stone from Reka Iskur. Scale: 2cm.

Fig. 5.: Thalli of *Hildenbrandia rivularis* (LIEBM.) J. AG. (red) overlapping *Heribaudiella fluviatilis* (ARESCH.) SVED. (brown) on a stone from Reka Iskur. Scale: 2cm.

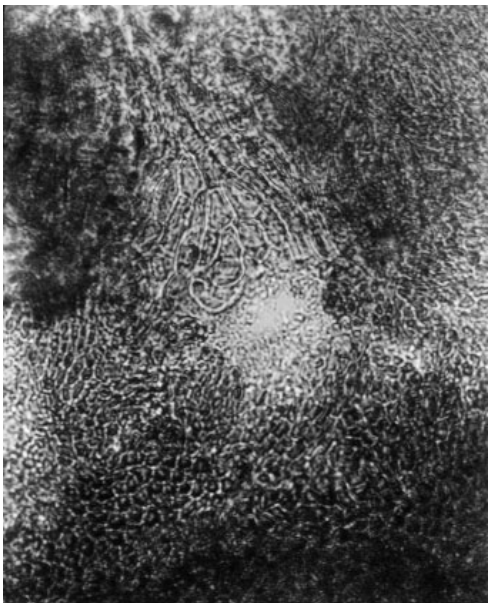

Fig. 6.: Thalli of *Hildenbrandia rivularis* (LIEBM.) J. AG. (red) and *Heribaudiella fluviatilis* (ARESCH.) SVED. (brown) growing close to each other on a pebble from Vedena rivulet (magnification 800x).

Fig. 7.: Thalli of *Hildenbrandia rivularis* (LIEBM.) J. AG. (red) and *Heribaudiella fluviatilis* (ARESCH.) SVED. (brown) growing close to each other on a pebble from Zhitolyub outlet (magnification 800x).

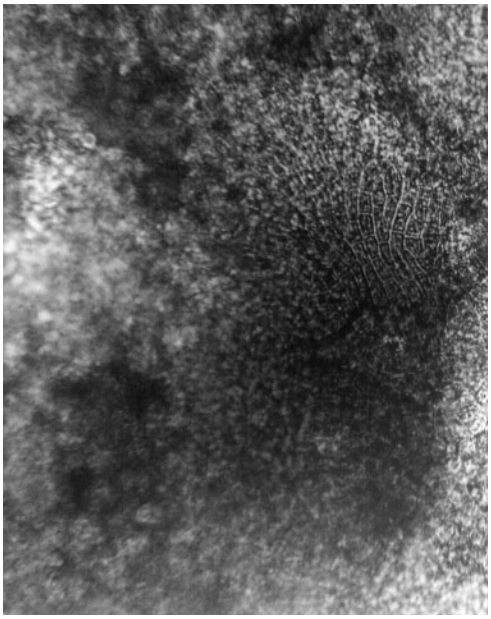

Fig. 8.: Thalli of *Hildenbrandia rivularis* (LIEBM.) J. AG. (red) overlapping *Heribaudiella fluviatilis* (ARESCH.) SVED. (brown) on a stone from Vedena rivulet (magnification 800x).

In the material from rivulets Vedena, the much more abundant growth and development of *Heribaudiella* on some of the pebbles and stones were obvious (Fig. 2). However, concerning the whole stretch *Hildenbrandia* was more abundant. In the material from outlet of Zhitolyub karst spring, from Dragalevska Reka and in Reka Iskur both species were almost equally developed. Another preliminary comparison shows, that in the visited stretches of Vedena, Iskur and Dragalevska Reka both species covered the surface of many stones and pebbles, while in Zhitolyub outlet they occurred quite seldom (being found on 1 stone and 3-4 pebbles).

According to the macroscopic investigations of thallus structure, cell dimensions and chloroplasts *Hildenbrandia* was represented in the studied material by *Hildenbrandia rivularis* (LIEBM.) J. AG. and *Heribaudiella* – by *Heribaudiella fluviatilis* (ARESCH.) SVED. (Figs. 6, 7, 8).

4. Discussion:

One of the problems concerning knowledge in combined occurrence of *Hildenbrandia* and *Heribaudiella* is the questionable taxonomy of some of their species according to their considerable morphological variability (WEHR & STEIN 1985, SHEATH et al. 1993, STOYNEVA et al. 2002). The full discussion of taxonomic problems is beyond the scope of the present study. However, we have to outline that the clear decisions on systematic position and state of the species of both genera will contribute significantly to understanding of their distribution.

Also different and controversially discussed are the ecological requirements of *Hildenbrandia* and *Heribaudiella* (WEHR & STEIN 1985, SHEATH 2003, WEHR 2003), which could be one of the possible explanations of the few data on their combined occurrence. While *Hildenbrandia rivularis* is mainly known from well-aerated alkaline clear water habitats (see literature in STOYNEVA et al. 2002), according to WEHR & STEIN (1985) and WEHR (2003) *Heribaudiella fluviatilis* was found in much more broad range of ecological conditions.

The third reason for less documentation of joined distribution of *Hildenbrandia* and *Heribaudiella*, most probably, was that one of the species was simply overlooked. Obviously this was *Heribaudiella fluviatilis* as commented in HOLMES & WHITTON (1975), WEHR & STEIN (1985), WEHR (2003) and as documented in this study also.

Hildenbrandia rivularis has been included in the red lists of rare and threatened algae in West European countries and because of damage of habitats should be included in the list of rare, endangered and threatened species of Bulgaria (STOYNEVA at al. 2002). Data on *Heribaudiella fluviatilis* for Bulgaria still are quite scarce, but seemingly it occurs in the same habitats as *Hildenbrandia* and therefore is also endangered. Following BUDDE (1927) and KUSEL-FETZMANN (1999) we propose the habitats of both species separately and the association to reach a protection status.

Acknowledgements: The authors wish to thank Assoc. Prof. T. Michev who put the computerised version of his Bulgarian UTM Directory program at our disposal free of charge and to Mr B. Michev and Ms Y. Stoyneva for the logistic help. Special thanks are due to Mr M. Mikhaylov for his help in colour photos of Figs. 2, 3 and 4. A part of this study was carried out with the financial support of the Austrian Scientific Research Fund (MOEL project nr. 12).

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