

NEW RESULTS REGARDING THE MONITORING OF THE THERMAL HABITATS WITH ACTIVE AMPHIBIANS DURING WINTER FROM WESTERN ROMANIA DURING THE COLD SEASON 2010/2011

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Abstract. The 19 thermal habitats with active amphibians during winter have recorded important modifications in the three years that have passed since the last monitoring. In comparison to the previous data, only three thermal habitats have positively evolved, 6 being in regression and the amphibians have disappeared from 4 of the cases. The most serious event is represented by the complete disappearance of some thermal habitats and of the non-hibernating amphibian populations from their level. The thermal canals from Beiuș and Boghiș were intubated, thus the habitats disappeared completely. Both of the known habitats from Geoagiu were men-affected, as a result the active amphibians lacked from them during winter. There have also been unaffected habitats in the past years, in which the active amphibian populations are large and stabile, as well as new habitats, formed in the previously known localities. The only modification of the active amphibians' biology from all of the habitats is the disappearance of hibernation, while the populations from "1 Mai" Spa and Călan also present a continuous reproduction. *Pelophylax ridibundus* is present in all of the habitats. *Triturus cristatus*, a rare presence in the thermal waters, has been observed only at Călan. The monitoring results confirm the speed and magnitude of the modifications of the thermal habitats due to anthropogenic influences and their dependence on this factor.

Keywords: thermal habitats, active amphibians, Romania, cold season.

Rezumat. Noi rezultate privind monitorizarea habitatelor termale cu amfibieni activi iarna din vestul României în sezonul rece 2010/2011. Cele 19 habitate termale cu amfibieni activi iarna prezintă importante modificări în cei 3 ani scurși de la ultima monitorizare. Față de datele precedente, doar 3 habitate termale au evoluat pozitiv, 6 fiind în regres, iar în 4 cazuri amfibienii au dispărut. Cel mai grav eveniment îl reprezintă dispariția completă a unor habitate termale sau, dispariția populațiilor de amfibieni nehibernante din acestea. La Beiuș și la Boghiș canalele termale au fost intubate, habitatele dispărând complet, iar la Geoagiu ambele habitate cunoscute au fost afectate antropic, amfibienii activi iarna lipsind din acestea. Există însă și habitate neafectate antropic în ultimii ani, în care populațiile de amfibieni active iarna sunt mari și stabile, precum și habitate noi, formate în localități cunoscute anterior. În cazul amfibienilor din toate habitatele singura modificare a biologiei acestora este dispariția hibernării, în vreme ce populațiile de la Băile „1 Mai” și Călan prezintă și reproducerea continuă. *Pelophylax ridibundus* este prezentă în toate habitatele. *Triturus cristatus*, o raritate în apele termale, a fost observat doar la Călan. Rezultatele monitorizării confirmă viteza și amplitudinea modificării habitatelor termale datorită influenței antropice și dependența lor față de acest factor.

Cuvinte cheie: habitate termale, amfibieni activi, România, sezonul rece.

INTRODUCTION

The presence of active amphibians during winter in the thermal waters from western Romania has been known for over a decade, being described, in several periods, 19 thermal habitats in which there are amphibians (COVACIU-MARCOV et al., 2003, 2004, 2006, 2010; SAS et al., 2007). Data regarding the influence of thermal waters are found in the scientific literature, especially concerning the strictly aquatic animals, in many cases referring to their thermal tolerance (eg: BRUES, 1928; HOEPLI & CHU, 1932; MENNI et al., 1998).

The existence of certain species or amphibian larvae in the thermal waters is mentioned in some of these studies (MANSON 1939; CHEN et al., 2001; WU & KAM 2005). However, most of these articles do not refer to the amphibians' ecology from the thermal waters, mentioning only their presence, the water temperature from the inhabited areas and eventually some behavioural particularities connected to the thermal regime.

Regarding the modifications of the amphibians' biology from the thermal waters from Romania, the most general one is the disappearance of hibernation, together with the continuous reproduction and the larvae gigantism (COVACIU-MARCOV et al., 2003, 2006; SAS et al., 2010).

Although apparently numerous, the thermal habitats are very variable in time, regarding both their structure and the number and species diversity. It has been observed that these habitats have rapidly evolved, some of them disappearing, while others have been partially modified due to man-made activities (COVACIU-MARCOV et al., 2006; SAS et al., 2009).

The high rate at which these thermal habitats evolve has been described in other cases, being a particularity (LUTZ, 1931). Most of the thermal habitats are a result of the economic and therapeutic purposes in which geothermal waters are used, situation also signalled in other areas (STAVREVA-VESELINOVSKA & TODOROVSKA, 2010; ORUȚI, 2010) and which ultimately endangers these habitats (MENNI et al., 1998; COVACIU-MARCOV et al., 2006). Consequently, our study aims to reanalyse the situation of the 19 known thermal habitats with active amphibians during winter recorded in western Romania until the beginning of winter 2010/2011, in order to establish their evolution in relation with the previous data (SAS et al., 2009).

MATERIAL AND METHODS

The research was realised in the cold season of 2010/2011, during the interval December - February. There were analysed 19 previously known habitats, performing field departures. The study involved observing the amphibian species present in the cold season in these habitats, estimating the size of the active populations and identifying the modifications induced by the thermal regime. The purpose of the action was to establish the modifications that have intervened within the amphibian populations from the thermal waters in comparison to the last monitoring activity, realised in the cold season 2007/2008 (SAS et al., 2009). Not all of the known 19 thermal habitats were included in the respective study, some of them being afterwards described (COVACIU-MARCOV et al., 2010). The reason for the repetitive monitoring is provided by the speed with which the thermal habitats change under the action of the anthropogenic factors. The thermal habitats were covered along the shores, observing and sometimes counting the frogs. The frogs were not usually captured, but in the case in which it was necessary, we used a net. The captured frogs were photographed, being afterwards released in their habitat. It was also important to identify the frogs that sing, the pairs found in amplex and the larvae (COVACIU-MARCOV et al., 2006).

RESULTS

The situation of some of the monitored thermal habitats is stationary (Table 1). However, in comparison with the previous data, 6 thermal habitats are found in regression, while 4 have completely disappeared. The habitat has disappeared in two of these cases (Beiuş and Boghiş – new thermal puddle) following the intubation of the evacuation canal of thermal water. In the other two cases (Geoagiu) the anthropogenic intervention has modified the aspect of the habitat or its supply with thermal water, facts that have stopped the remaining of the amphibians in activity.

Table 1. The situation of the monitored thermal habitats and the observed species in relation to the data from the scientific literature (S=Stationary, P=Progress, R=Regress, D=Disappeared; T.c.=*Triturus cristatus*, P.r.=*Pelophylax ridibundus*, R.d.=*Rana dalmatina*, B.b.=*Bombina bombina*, R.t.=*Rana temporaria*, Bu.b.=*Bufo bufo*). / Tabel 1. Situația monitorizării habitatelor termice și a speciilor observate în raport cu datele din literatura de specialitate (S=Staționare, P=Progres, R=Regres, D=Dispărut; T.c.=*Triturus cristatus*, P.r.=*Pelophylax ridibundus*, R.d.=*Rana dalmatina*, B.b.=*Bombina bombina*, R.t.=*Rana temporaria*, Bu.b.=*Bufo bufo*).

Thermal habitat	Situation of the habitat				The observed amphibian species					
	S	P	R	D	T.c.	P.r.	R.d.	B.b.	R.t.	Bu.b.
1. 1 Mai Spa	X	-	-	-		X	-	-	-	-
2. Felix Spa	-	-	X	-		X	-	-	-	-
3. Răbăgani	-	X	-	-		X	-	-	-	-
4. Mădăras	-	X	-	-		X	-	X	-	-
5. Livada	-	-	X	-		X	-	-	-	-
6. Chişlaz	X	-	-	-		X	-	X	-	-
7. Sănnicolau de Munte	X	-	-	-		X	-	-	-	-
8. Cheşa	-	-	X	-		X	-	-	-	-
9. Roşiori	-	-	X	-		X	-	-	-	-
10. Săcuieni	X	-	-	-		X	-	-	-	-
11. Beiuş	-	-	-	X		-	-	-	-	-
12. Chiraleu	X	-	-	-		X	-	-	-	-
13. Acâş	X	-	-	-		-	X	-	-	-
14.1. Geoagiu Spa thermal canal	-	-	-	X		-	-	-	-	-
14.2. Geoagiu Spa roman basin	-	-	-	X		-	-	-	-	-
15.1. Călan Spa thermal canal	X	-	-	-	-	X	-	-	-	-
15.2. Călan Spa old basin	-	-	X	-	-	X	-	-	-	-
15.3. Călan Spa roman basin	X	-	-	-	X	X	-	-	-	-
16. Cărpiniş	X	-	-	-	-	X	-	-	-	-
17. Călacea Spa	-	X	-	-	-	X	-	X	-	-
18. Şimleul Silvaniei	-	-	X	-	-	X	-	-	-	-
19.1. Boghiş old thermal canal	X	-	-	-	-	X	-	-	-	-
19.2. Boghiş new thermal puddle	-	-	-	X	-	-	-	-	-	-
TOTAL	10	3	6	4	1	18	1	3	-	-

Pelophylax ridibundus is the only species present in all of the thermal habitats during the cold season (Fig. 1). Together with this, *Bombina bombina* populations were signalled in the plain habitats. Occasionally, active *Rana dalmatina* individuals were observed in the areas neighbouring the shores of the thermal habitats. The crested newt was recorded to be active during winter only at Călan Spa (Fig. 2). Except for *P. ridibundus*, all of the other species present as modifications only the disappearance of hibernation. The continuous reproduction was observed only in two habitats at *P. ridibundus*.

The anthropogenic impact is very high upon all of the thermal habitats. Thus, these are frequently polluted with detergents or oil products due to the locals that use the thermal waters to wash different domestic objects. Meanwhile, domestic wastes are deposited in many of the habitats. In some cases, supplying the habitats with thermal water is very variable, fact, which affects the frogs.

DISCUSSIONS

The thermal waters from western Romania can be directly used for economic purposes, for heating (ANTAL & ROȘCA, 2008; ANTAL et al., 2009). Humans generally use thermal waters, this activity being practised in many areas, fact that ecologically endangers the thermal habitats (MENNI et al., 1998). The same negative effect is also observed in the case of the active amphibians from the thermal waters from western Romania (COVACIU-MARCOV et al., 2006). Although some of the thermal habitats have appeared following anthropogenic activities (COVACIU-MARCOV et al., 2006), man is the factor that has sealed their faith. Unfortunately, in comparison to the situation registered 3 years ago (SAS et al., 2009), many of the thermal habitats and amphibian populations have negatively evolved. The number of habitats found in regression and the ones from which the amphibians have disappeared is identical to the stationary ones. Unlike these, only 3 habitats (Răbăgani, Mădăras and Călăcea) present a favourable evolution.



Figure 1. *Pelophylax ridibundus* from Călan.
Figura 1. *Pelophylax ridibundus* de la Călan



Figure 2. *Triturus cristatus* from Călan.
Figura 2. *Triturus cristatus* de la Călan.

At Răbăgani, after a negative impact phase, the water level is presently stable and higher than in the past (COVACIU-MARCOV et al., 2006), the thermal basin being full up to the concrete dam limit. Thus, the water depth that surpasses 1 m and is covered by rich aquatic vegetation is extremely favourable to the lake frogs. We counted 51 *P. ridibundus* individuals in January 2011, but these are probably many more. We also observed singing frogs and pairs found in amplex, but we did not encounter larvae, probably due to the high water level and the locals' aquatic birds (SAS et al., 2009). Although the habitat from Mădăras was affected in the past by desilting activities (SAS et al., 2009), presently it is found in a very positive situation. The vegetation from the shores and the aquatic one have completely recovered, the habitat being presently unaffected by man. Consequently, at least 200 – 300 lake frogs were present at Mădăras at the end of December 2010, when the day temperature was - 4°C. Moreover, in comparison to the previous data, *B. bombina* individuals have reappeared, species that has been affected by the desilting from 2007 (SAS et al., 2009). The situation from Călăcea is favourable due to the reduced anthropogenic impact, fact that allows the maintaining of the *P. ridibundus* populations and even the appearance of active *B. bombina* individuals during winter. Meanwhile, a new thermal habitat has risen here due to a new thermal water overflow in a stream in which lake frogs are present. The appearance and disappearance of new secondary thermal habitats has been previously signalled at Călăcea (COVACIU-MARCOV et al., 2006; SAS et al., 2009).

Most of the cases in which the thermal habitats are found in regression are due to man. The decrease of thermal water flow has occurred in many situations, which has determined a restriction of the sector available for the frogs. The limitation was sometimes natural, being probably due to the decrease of the pressure from the deposit, while in other cases it was a consequence of the exaggerate exploitation by man. This last scenario is registered at "1 Mai" Spa, where, due to the constant use of thermal water by the touristic and economic objectives from the area, the level of the thermal lake is in a continuous decrease, the water even freezing at the shores in the cold days. Therefore, the frogs withdraw towards the centre of the lake and towards the areas with abundant vegetation from the shores. At "1 Mai" Spa, a better situation is registered downstream of the thermal lake, where the building of a dam in 2002 helped in maintaining the water level constant, favouring the frogs. A good situation is also registered on the two branches that form here. Beside the disappearance of hibernation, the continuous reproduction is also registered at "1 Mai" Spa. The phenomenon occurs both in the lake, as well as in the areas downstream of it, at the dam, where the frogs constantly sing in the sunny days.

The thermal habitat disappeared from Beiuș and Boghiș. The fact is a consequence of the intubation of the thermal canal from Beiuș and of the reparation of the crack from the pipe from Boghiș. Thus, the two habitats can be added to the one from Acâș, where the intubation of the thermal canal led to the disappearance of the frogs (COVACIU-MARCOV et al., 2006). It is very concerning the disappearance of the active frogs from both of the habitats from Geoagiu Spa, despite the good situation from the past and of the large size of at least one of the habitat. Thus, the roman

basin was desilted and rearranged, the frogs being completely eliminated. However, it is possible that the frogs should repopulate the basin in time, on the premises that the anthropogenic interventions will stop. The disappearance of the active frogs from the thermal canal is a consequence of a non-thermal water afflux. Its high flow strongly cooled the water from the thermal canal, fact that determined the frogs to go into hibernation.

P. ridibundus is the only species present in all of the thermal habitats, as until now (COVACIU-MARCOV et al., 2006). *B. bombina* appears in three habitats, but its populations are always smaller than the ones of the lake frogs. The fact is a consequence of the more aquatic life of *B. bombina*, which normally stays longer in the water than *P. ridibundus*, which sometimes distances from the water (COGĂLNICEANU et al., 2000). *P. ridibundus* also stays on the shores of the thermal waters on many occasions. The incursions in the terrestrial environment advantage this species in relation to *B. bombina* in the thermal waters with high temperatures. Meanwhile, many of the studied habitats are situated at altitudes that surpass the limits of *B. bombina*. The species has also been previously observed at Mădăras and Chişlaz (COVACIU-MARCOV et al., 2006), but it is signalled in a premier at Călăcea Spa, although the habitat has been known for a long period. It is very important the identification of the crested newt at Călan. It has not been recorded in the thermal waters for 10 years, in the past being observed only at "1 Mai" Spa (COVACIU-MARCOV et al., 2006). The remaining in activity over winter of the species and the agile frogs confirms the action mechanism of the thermal waters upon the terrestrial amphibians that hibernate in them (COVACIU-MARCOV et al., 2006).

The modifications induced by the thermal waters upon the amphibians are the classical ones described in the scientific literature (COVACIU-MARCOV et al., 2003, 2006). Thus, in all of the thermal habitats in which there are present non-hibernating amphibian populations, the frogs remain active during winter. The continuous reproduction is registered only at 1 Mai and Călan Spa. This phenomenon has also been recorded at Felix Spa in the past. The habitat from Felix Spa records a negative evolution, despite the fact that in 2007 it evolved in a general positive manner (SAS et al., 2009). The modification of the thermal basins' shores and the rising of massive concrete curbstones, isolate the already reduced populations within each basin. Moreover, the *P. ridibundus* populations have been greatly affected by the introduction of fish and exotic tortoises. These factors have caused the gigantic larvae, signalled in the past, to disappear (COVACIU-MARCOV et al., 2003).

The best situation is presently recorded at Călan Spa. Thus, both large populations of *P. ridibundus* with a continuous reproduction as well as crested newts that are active during winter are present here. However, the evolution was also negative in the case of the old basin due to the desalting and the building of a dam that raised the water level until the superior limit of the basin. Thus, both the lake frogs and the common toads that were active during winter disappeared from them (SAS et al., 2007). However, the effect was not devastating for the lake frogs, due to the fact that active frogs are present in the canal in which the excess of the thermal water is eliminated. Practically, one habitat disappeared and another appeared. The two habitats from Călan are not modified, due to the reduced anthropogenic influence, at least during winter. The swimming pool is situated at a distance from localities, not being frequented by tourists during winter. Thus, the *P. ridibundus* populations are large in the thermal canal and the roman basin, numerous individuals being observed singing and in amplex. *Triturus cristatus* is also present in the roman basin as proof of the age of the thermal habitats from Călan and the reduced level of anthropogenic impact.

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