The populations of *Rana arvalis* Nills. 1842 from the Ier Valley (The Western Plain, Romania): present and future

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Abstract. The objectives of the current study were to identify, in detail, the distribution of the largest moor frog populations from the Ier Valley region and to assess the zones that represent important habitats and present measures for their protection. Our study was conducted from March to October during the years 2001-2003. We identified 49 populations of *Rana arvalis* in The Ier Valley area. Most of these populations can be considered distinct, isolated from each other, apart from a few exceptions. This fact increases their regional chance of extinction. The *Rana arvalis* populations in the studied area occupy very different habitats. Only a few of these habitats can be considered natural biotopes. As a result of intense dry out of the swamps in the Ier Valley area, the populations of *Rana arvalis* had reduced in atypical smaller sized habitats, which had a limitating effect on the size of these populations. Small numbers of moor frogs were found in most sites surveyed (less then 6 specimens / site / visit) in the region. We were able to calculate quantitative population assessments for five populations. The largest population was found near Andrid, with 675 ±57 adult specimens, making this one of the largest known population of *Rana arvalis* in Romania. The second significant population was estimated to be 354 ±25 individuals and it was located near Resighea. The other populations' sizes were estimated at fewer than 200 adults. We consider the protection of the large breeding populations of *Rana arvalis* in the Ier Valley area to be a priority, by managing both the breeding and foraging habitats. The potential for the biggest moor frog populations to be part of a single infrastructure is discussed.

Key words: *Rana arvalis*, distribution, habitats, population size, management measures

Introduction

The species *Rana arvalis* is spread throughout Northern Europe, being found in Romania at the Southern limit of its areal (Cogălniceanu et al., 2000). It is believed that this species is among the most rare to be found in Romania's herpetofauna (Fuhn, 1960, Poliş, 1977). Gleed-Owen (2000) concluded, based on fossil evidence, that the moor frog historically existed in England as well. *Rana arvalis* fossils are also known from Northern Germany (Böhme, 1982) and the Pannonic Basin in the Pleistocene Epoch (Venczel, 1997).

The presence of *Rana arvalis* in Romania, particularly in Transylvania, was first observed in 1891 by Méhely. Subsequently, Fejérvári-Lángh (1943) noted the subspecies *Rana arvalis arvalis* in the Braşov Depression, where it was

recently recorded by Csata and Csata in 1997. *Rana arvalis* was first found in the area of the Western Plain, more precisely, near Carei locality in 1960 (Fuhn 1960). Simonkai (1893) documents *Rana arvalis* in Arad County and Călinescu (1931) signals the presence of the moor frog in Tulcea (The Danube Delta), hypotheses that were later proven wrong. The presence of the moor frog in Ier Valley was first known about in 1977, when Rozalia Poliş had found it there. Knowing the distribution of *Rana arvalis* species in Transylvania became a debated subject in some publications such as: Dély (1953, 1964), Fuhn (1956), Strugren and Popovici (1960), Stugren (1966) and Micluța (1969).

In Romania, the moor frog lives in the northern half of the country. In the year 2000 and previously, it was found in a few localities from the Western Plain (Fuhn 1960, Micluță 1969, Poliş 1977, Cogălniceanu 1991, Cogălniceanu et al. 2000). As a result of the herpetological investigations made by the Herpetological Club of Oradea between 2000 and 2003, a continuous distribution of the moor frog was mapped in the plain area from North-West Romania as a completion of previous mapping data (Covaciu-Marcov et al. 2003). The moor frog is spread along the North of the Western Plain, in the entire plain sector from Satu-Mare County and in the Northern areas of the Bihor County (There are a few isolated populations South of Oradea, on a limited surface in Cefa area (Covaciu-Marcov et al. 2003)). Once the populations of *Rana arvalis* in North-West Romania were identified, it was possible to make a map showing 75 localities, 50 of which were new localities for Romania's herpetofauna (Covaciu-Marcov et al. 2003). Out of these localities, 34 are situated in the hydrographic basin of the Ier Valley. But this study was locality based, not a population based one.

The previous studies about the *Rana arvalis* populations from Romania refer to the spreading of this species only in some areas, without specific details on the position of these populations. So far, in Romania only one previous study make an estimation of the size of some *Rana arvalis* populations, from the Ciuc Depression (Demeter & Mara 2006).

Thus, the objectives of the current study were as follows:

i.) Detailed identification of the positions of the moor frog populations from The Ier Valley region;

ii.) Estimating the size of moor frog populations from The Ier Valley region;

iii.) Presenting the impact of the human activities on the populations;

iv.) Assessing the zones that represent important habitats and presenting measures for their protection.

Materials And Methods

The period of the study

The study was made during the years 2001-2003, from March to October each year. Identifying the spreading of the populations of *Rana arvalis* was a continuous process along the entire period of the study. The population assessments were made during March and April, which is the spawning period for moor frogs.

Study area

The research area was the hydrographic basin of the Ier (the Ier Valley), which is located in the Western Plain and is a strip of swampy meadow (Fig. 1). Ier is the most northern river from the hydrographic basin of three Criş rivers, its whole

length being found in the study area. It springs from the Tăşnad Hills and it does not have a mountain flow. It has a reduced stream-flow and is almost entirely embanked, and in the past there were important moist areas around it (Cogălniceanu & Venczel, 1993).

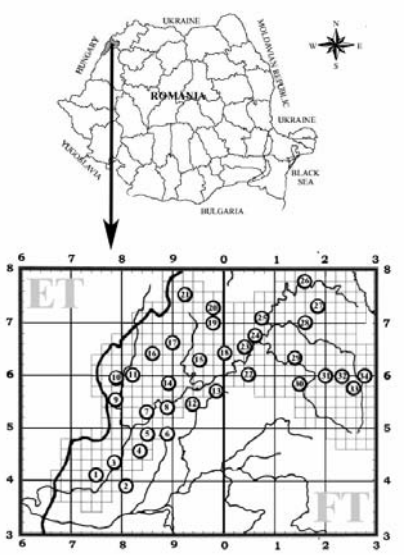

Figure 1 The study area and the nearest localities to the *Rana arvalis* populations in The Ier Valley (according to data from Covaciu-Marcov et al. 2003) (UTM scale 10x10 and 2x2 km, For the name of localities see the Table no.1)

The Ier Valley is situated on an alignment of some 90 km in North-West Romania, continued for a few kilometers in Hungary. It is a considerable hydrographic basin of 1417 square kilometers and represents an important geographical element of the Bihor and Satu-Mare Counties. Looking back at the geological past of the area, the river bed sits in a tectonic ditch which was a common valley for the river Tisa and its tributaries to flow trough it during the Ice Age (Tufescu et al. 1995). The Ier Valley, as all the plains in north-west Romania, was a big swampy area. However, due to drainage activities and construction of canals, the landscape was converted into agricultural fields. The main canal from the Ier Valley was built in the 1960's (Cogălniceanu & Venczel 1993). Despite the fact that most of the swamps were drained, even nowadays the water table level is still very high and can be responsible for flooding and swamping of some fields (Berindei et al. 1977).

Population size estimates

During our study, investigating the populations of *Rana arvalis* from the Ier Valley, quantitative and qualitative analyses were only possible for five populations of moor frogs out of 49. This number is a consequence of the small number of moor frogs found at most sites (less than 6 specimens /site) in the greater part of the investigated region, making the quantitative studies impossible. Therefore, we were only able to carry out quantitative population assessments for five populations located near the following localities: Văşad (47º31'00''N 22º16'00''E), Andrid (47º31'00''N 22º21'00''E), Resighea (47º36'00''N 22º19'00''E), Curtuiuşeni (47°33'0" N, 22°12'0" E) and Voivozi (47°26'0" N, 22°3'0" E).

When estimating the population size we used mark-recapture methods. To apply this method we needed repeated capture events with differentiated marking for each capture. Thus, adult specimens (estimating only the size of the breeding populations) were marked by toe-clipping and the wound treated with antiseptic (Donnelly et al. 1994). In order to reduce the impact of our study on the populations, we did not use individual markings but we marked them in a different way (using 4 capture / recapture events):

- We cut the tip of the long toe from the left hind limb of all individuals found during the first capture event;
- We cut the tip of the long toe from the right hind limb of the un-marked individuals during the second capture event:
- During the third capture event we cut both long toes from left and right hind limbs of previously un-marked individuals:
- We did not cut any toes during the fourth capture event.

Direct observations on recaptured frogs indicated that all incisions healed, and there was no necrotic tissue present upon recapture.

Results

Identified populations

The 34 localities correspond to 49 sites (populations) where *Rana arvalis* was found (Fig.2, Table 1). Most of these sites can be considered inhabited by independent populations of moor frog which are isolated from each other, apart from a few exceptions (Fig.2). The *Rana arvalis* habitats are situated a few kilometers apart from one-another, separated by agricultural fields and man populated places. Only a small number of populations were found to have continuity with other populations. Among these are the population from Voievozi and the one from Şilindru (SITE 15-16). Situated in an area of reduced width subjected to floods; the connection between the two populations is made by a small stream that often dries out by mid-spring. This continuity between the two populations is only interrupted for a few hundreds meters where agricultural fields reach the sides of the stream. Similar to this situation, there is a possibility of migration of individuals between two populations near Curtuişeni locality (SITE 26-27), where the populations are separated by agricultural fields, of relatively small size (a few hundred meters). Also, there may be a connection between two *Rana arvalis* populations (SITE 30-37) at the end of the fishing lake from Andrid.

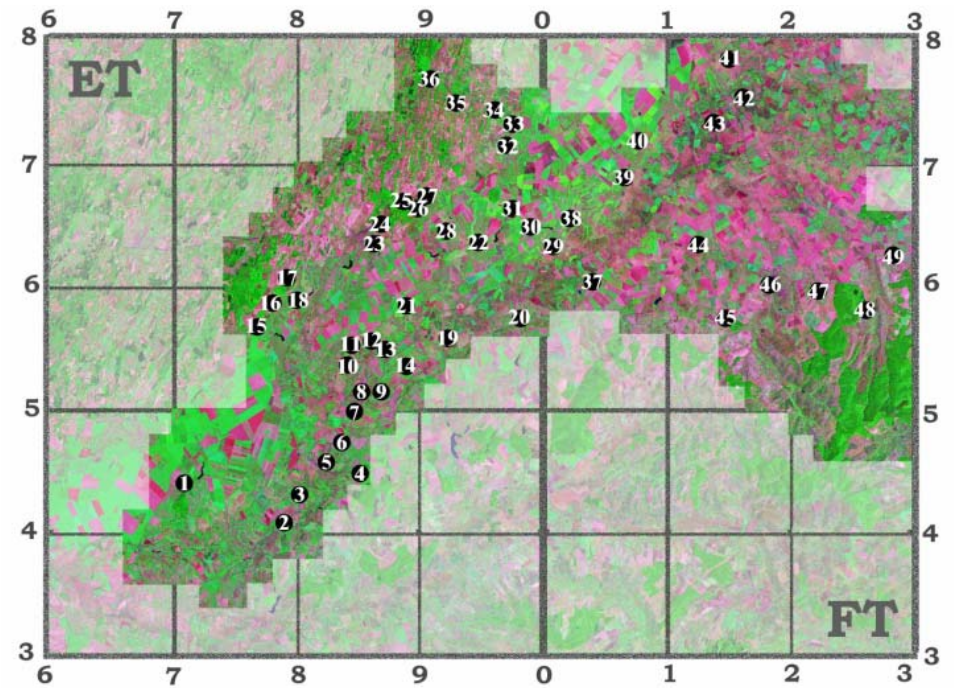

Figure nr.2 The detailed position of recorded *Rana arvalis* populations in The Ier Valley area. (UTM scale 10x10 and 2x2 km, For the name of localities see the Table no.1)

Table no. 1 The list of the identified *Rana arvalis* population in the Ier Valley area, with the description of habitats (* - see the position of localities and sites in the Figures no.1 and 2)

Name of locality	Cod Loc*	Nr. Site*	Habitat description	Max. Nr. of specimens / visit in 2001-2003
Disosig	LOC 1	SITE 1	Bank of a stream, surrounded by agricultural fields (Fig. 3)	1
Cadea	LOC 2	SITE 2	Edge of a canal, surrounded by agricultural fields	2
Ciocaia	LOC 3	SITE 3	Edge of a ditch, surrounded by agricultural fields	2
Săcuieni	LOC 4	SITE 4	On the banks of a canal, surrounded by grass-land	1
Săcuieni	LOC 4	SIT 5	On the banks of a canal, surrounded by a plantation	2
Săcuieni	LOC 5	SITE 6	Narrow grass-land, bordered by a secondary canal of the Ier River and agricultural fields	1
Cherechiu	LOC 5	SITE 7	The small swamp, surrounded by a dry grass-land (Fig. 5)	13
Cherechiu	LOC 5	SITE 8	Grass-land on the bank of a dirty canal with fish (Fig. 6)	1
Târguşor	LOC 6	SITE 9	Edge of a ditch, surrounded by grass-land and agricultural fields	6
Cheşereu	LOC 7	SIT 10	On the bank of a ditch at the edge of the village, surrounded by grassland (Fig. 7)	6
Cheşereu	LOC 7	SITE 11	Short canal with a small grass-land, bordered by houses and a small pasture	1
Cheşereu	LOC 7	SITE 12	Small marsh, bordered by houses and agricultural fields	3
Cheşereu	LOC 7	SITE 13	Short ditch, bordered by agricultural fields (Fig. 8)	1
Adoni	LOC 8	SITE 14	Secondary canal of the Ier River, bordered by grass-land and agricultural fields	5
Şilindru	LOC 9	SITE 15	Near a stream, surrounded by a wet grass-land and agricultural fields	2
Voivozi	LOC 10	SITE 16	Near a stream, surrounded by a wet grass-land and agricultural fields	20
Voivozi	LOC 10	SITE 17	The small wetland from inside an acacia plantation, on sandy soil	1
Şimian	LOC 11	SITE 18	The small wetland from the bank of a lake	2
Otomani	LOC 12	SITE 19	canal surrounded by a small grass-land	3
Sălacea	LOC 13	SITE 20	The wetland near a dam	5
Tarcea	LOC 14	SITE 21	A canal surrounded by a grass-land and agricultural fields	14
Văşad	LOC 15	SITE 22	The swamp with clubrush, surrounded by agricultural fields (Fig. 22)	55
Valea lui Mihai	LOC 16	SITE 23	The swamp from inside the town, of relatively small surface	3
Valea lui Mihai	LOC 16	SITE 24	Edge of a village, between the houses of the villagers and the railway	1

Table 1 - Continued

Name of locality	Cod Loc*	Nr. Site*	Habitat description	Max. Nr. of specimens / visit in 2001-2003
Curtuişeni	LOC 17	SITE 25	The small swamp, surrounded by an acacia plantation and vineyards, on sandy soil (Fig.10)	37
Curtuişeni	LOC 17	SITE 26	A forest swamp, with a relatively reduced surface, on sandy soil (Fig. 11)	3
Curtuişeni	LOC 17	SITE 27	A relatively small swamp, bordered by agricultural fields and a dry grass-land	20
Curtuişeni	LOC 17	SITE 28	The small swamp from the edge of the town, used as a dump yard	1
Andrid	LOC 18	SITE 29	Ditch from near the main course of the Ier River	2
Andrid	LOC 18	SITE 30	Medium swamp, on the banks of a fishing lake (Fig. 12)	134
Andrid	LOC 18	SITE 31	Small dirty ditch, without any substantial vegetation	3
Pişcolţi	LOC 19	SITE 32	Bank of a canal, surrounded by agricultural fields	2
Resighea	LOC 20	SITE 33	Very small wetland, surrounded by sand dunes	1
Resighea	LOC 20	SITE 34	Swamp of significant surface, surrounded by dry grass-land and agricultural fields (Fig. 13)	43
Resighea	LOC 20	SITE 35	A canal that crosses agricultural fields	4
Scărişoara Nouă	LOC 21	SITE 36	Swamp near an acacia forest, on sandy substratum	10
Piru Nou	LOC 22	SITE 37	The small swamp with clubrush, on the banks of a lake	6
Dindeşti	LOC 23	SITE 38	Short canal, towards the Ier River, surrounded by agricultural fields	1
Irina	LOC 24	SITE 39	Canal towards the Ier River, surrounded by grass-lands and agricultural fields	15
Portiţa	LOC 25	SITE 40	Bank of a ditch, surrounded by agricultural fields	1
Ghenci	LOC 26	SITE 41	Bank of a canal, surrounded by agricultural fields	2
Rădulești	LOC 27	SITE 42	On the bank of a canal, surrounded by agricultural fields	1
Căuaş	LOC 28	SITE 43	On the bank of a canal, surrounded by agricultural fields	2
Santău	LOC 29	SITE 44	Small wetland with clubrush	1
Silvaş	LOC 30	SITE 45	Marsh with clubrush on the bank of a secondary canal of the Ier River, bordered by agricultural fields	3
Tăşnad	LOC 31	SITE 46	The wetland from the edge of a canal	3
Săcăşeni	LOC 32	SITE 47	The small forest swamp	3
Sărăuad	LOC 33	SITE 48	Swamp from the edge of the forest, crossed by a canal	4
Sânmiclăuş	LOC 34	SITE 49	Wetland with clubrush, used for watering cows	2

Habitat use

The *Rana arvalis* populations in the study area occupied very different habitats (Table 1). All these habitats represent different types of humid zones, all of which were surrounded by agricultural fields, roads or even local people's houses. Only a few of these habitats can be considered natural biotopes (with reduced human activity). In a few habitats, represented almost entirely by swamps, we managed to find moor frogs; some of these are located in forested areas, embedded in or surrounded by plantations of acacias. Other swamps are located in open fields surrounded by agricultural fields, pastures, on the sides of lakes or dams or even inside a locality, such as at Valea lui Mihai (SITE 28). Most of the habitats are small canals / streams limited by narrow pastures, or even ditches on the side of the roads limited by agricultural fields (Table 1). We identified once a specimen of *Rana arvalis* in the main stream of the Ier River, near Andrid locality. Specimens of *Rana arvalis* were also identified in swamps used totally (e.g. SITE 28) or partially (e.g. SITE 22/23) as waste deposits.

The size of the populations

For most of the *Rana arvalis* populations from the area a maximum number of 1 to 6 specimens per visit were found (Table 1). For three populations a maximum number of specimens per visit of 10 to 14 was recorded (SITE 7/12/39). In the case of the above populations, we couldn't estimate the size of the populations. However, we managed to estimate the population size for five populations of *Rana arvalis* (Table 2). Juveniles were encountered in only 5 populations (Resighea – SIT 67, Andrid – SITE, and in another three: SIT 32, 48 and 49). Freshly metamorphosed froglets were encountered in summertime only at Resighea and Andrid (in the summer of 2003, over 120 froglets from the current year were recorded).

Table 2 The breeding population estimation results for five populations of moor frog within the Ier Valley area

Locality	Site	Estimate no.		
		Total	Males	Females
Văşad	SIT 22	190 ±23	118 ±18	72 ±24
Andrid	SIT 30	675 ±57	200 ±31	470 ±23
Resighea	SIT 67	354 ±25	168 ±25	152 ±26
Curtuişeni	SIT 26	170 ±41	107 ±26	63 ±14
Voivozi	SIT 16	155 ±57	Not det.	Not det.

Figure 3. Habitat at Diosig (SITE 1)

Figure 4. Habitat at Săcuieni (SITE 6)

Figure 5. Habitat at Cherechiu (SITE 7)

Figure 6. Habitat at Cherechiu (SITE 8)

Figure 7. Habitat at Chşereu (SITE 10)

Figure 8. Habitat at Chşereu (SITE 13)

Figure 9. Habitat at Vășad (SITE 22)

Figure 10. Habitat at Curtuișeni (SITE 25)

Figure 11. Habitat at Curtuișeni (SITE 26)

Figure 12. Habitat at Andrid (SITE 30)

Figure 13. Habitat at Resighea (SITE 34)

Figure 14. Burnt habitat at Cherechiu (SITE 7)

According to our results, the largest population was living near Andrid (SITE 30), in a swamp by a fishing lake. The size of this population was estimated to 675 ±57 adult specimens. The second significant population of 354 ±25 individuals was located near Resighea (SITE 67). The other populations' sizes were estimated at less than 200 adults (SITE 16/22/25) (Table 2).

Assessing the anthropogenic impact on moor frog populations

The impact of the human activities on the population of moor frog from the Ier Valley is represented by the fragmentation of the habitats through artificial dry-outs, dams and roads. Specimens were found to be victims of road traffic infrequently (Resighea and Curtuişeni, both located near countryside roads). It is important to mention that many populations of moor frog from the Ier Valley are living in habitats (aquatic and terrestrial) that are used for grazing, watering and mowing. Many *Rana arvalis* habitats from the Ier Valley (the ones that shelter the largest populations are counted among these too) are used for grazing by pigs, sheep (e.g. Văşad) and cattle herds (Curtuişeni, Resighea). During our study, on several occasions we encountered frogs that were crushed by tame animal herds grazing on the field. In the moist areas represented by swamps, ditches and canals surrounded by hay fields, we often found *Rana arvalis* specimens with wounds and cuts made during mowing. Many of the ones we identified had cuts on their bodies, missing limbs (frequently the forelimbs) or sometimes one missing eye. One other problem is that all the swamps with *Rana arvalis* were used to store house-hold waste. Another negative human activity is burning the hay in the swamp areas, usually in April and May, with a negative impact on all living animals including the moor frog.

Discussions

Identified populations

The possibility of dispersal between the populations of moor frog in the studied area is highly reduced (Fig. 2). Therefore, we cannot talk about a metapopulation of *Rana arvalis* in the Ier Valley area, but rather about a collection of independent populations having no possible connections between them. Therefore, moor frog metapopulations can only be considered the populations with possible connections between them (SITE 15-16; 26-27; 30-37 – Fig. 2).

The migrating possibilities of some *Rana arvalis* populations in the Ier Valley region, as well as other's populations of amphibians, prevents local extinction of sink populations in a metapopulation (Pulliam and Danielson, 1991; Sinsch, 1997). Nevertheless, we must specify that these migrations are limited to close populations. This is possible for species as *Rana arvalis, Rana temporaria* and *Bufo bufo* which often exhibit summer home ranges of less than 100 m (Haapanen 1970, Loman 1994, Tramontano 1997).

The number of specimens / population

As a result of intense dry out of the swamps in the Ier Valley area, the

populations of *Rana arvalis* had reduced in atypical habitats, of smaller sizes, which had limiting effects on the size of these populations. This having been said, it is better understood why the moist zones by ditches and canals seldom contained more than six specimens of moor frogs / visit (Table 1).

These persistent aquatic habitats are narrow and not too deep and have a rich aquatic fauna represented by leeches (e.g. the medical leech – *Hirudo medicinalis* and *Haemopis sanguisuga*), back-swimmers (e.g. *Notonecta glauca*), great diving beetles and their larvae (*Dytiscus marginalis*), dragonfly larvae (e.g. *Aeshna* sp.), newts (e.g. *Triturus vulgaris*) and fish (e.g. *Carassius auratus, Cobitis teniae* or *Umbra kramerii* – Covaciu-Marcov & Sas unpublished data). These aquatic animals are known to predate frogspawn and amphibian larvae, the moor frog being no exception. It is known that the leech *Haemopis sanguisuga* attacks *Rana arvalis* spawn (Laurila et al. 2002), and after our observations, leeches readily attack spawn clumps of *Rana arvalis* in the investigated region. Newts also eat large amounts of frogspawn (Cicort et al. 2004), in some incidences newts almost exclusively eat frogspawn (Covaciu-Marcov et al. 2002). Moor frog larvae are frequently eaten by the great diving beetle (*Dytiscus marginalis*) (Kriska, 2000) or by the *Aspae* sp. dragonfly larvae (Laurila et al. 2002). Fish may also pray upon juvenile or adult amphibians, as well as their eggs and larvae (Semlitsch & Gibbons 1988).

Thus, despite the fact that these spawn habitats (ditches and canals) are quite deep, these small sized habitats expose the *Rana arvalis* spawn and larvae to a large number of predators. The size of the populations of moor frog from the moist areas along the canals is likely to be influenced by both the small sized terrestrial habitats and the presence of spawn and larvae predators in the aquatic habitats.

Estimating the size of some populations

It is not surprising that the largest populations from the region were found near the following localities: Voivozi (SITE 16), Curtuişeni (SITE 25), Văşad (SITE 22), Resighea (SITE 67) and Andrid (SITE 30). This is because the populations of moor frog from these areas live in habitats that are more natural than the other ones (Table 1). Populations of *Rana arvalis* were identified in other swampy habitats, but of reduced dimensions and which dry out very quickly, often before the moor frog larvae metamorphosis is completed (e.g. at Cherechiu - SITE 7).

Regarding the sizes of the *Rana arvalis* populations in Romania, the only other documented populations are in the Ciuc Depression, estimated at over 600 individuals (at Delne 600 adults and at Verebes 650 adults - Demeter & Mara 2006), making the population from Andrid one of the largest known population of *Rana arvalis* in Romania. In Holland, reports show much larger populations of moor frog, some in excess of 3400 specimens, but there are frequent populations of 600-800 specimens (in lit., Stumpel 2004). Large populations of 3309 specimens were also reported from Denmark (Hels & Buchwald 2001).

The difference between sizes of the populations in our research is mainly a

result of the differences between the habitats' sizes (both aquatic and terrestrial). The habitats from Andrid and Resighea offer optimal conditions with persistent aquatic habitats, very important for laying eggs and larvae metamorphose, and wide terrestrial habitats for adults' feeding. In the amphibians' survival strategy, besides spawning sites, the terrestrial feeding environment is crucial. When analyzing the food diversity at the populations of *Rana arvalis* from the Ier Valley area, we observed that it is significantly increased at Andrid and Resighea compared to the other populations in the area (Sas in preparation). Protection of aquatic breeding sites may have little value if adjacent terrestrial habitats used by amphibians for feeding and shelter are destroyed (Semlitsch 1998). Thus, in order to preserve the biodiversity, it is a priority to preserve and optimize the local conditions for breeding populations by managing both the breeding and foraging habitats (Adrados & Consult 2003).

The populations of *Rana arvalis* from Văşad, Voivozi and Curtuişeni regions are significantly smaller because the spawning sites dry out before the larval metamorphosis is completed. Many similar cases were observed in Russia, where the moor frog's breeding ponds dry out before the completion of metamorphosis (Ishchenko 1989). At the end of March, sometimes even at it's beginning, the ponds partially or completely dry out (e.g. Curtuişeni - 31.03.2001, Văşad - 02.03.2002) leaving the larvae or even the spawn on dry land. The ponds that persist for a shorter period are subjected to increased competition and predation as amphibians increasingly concentrate in confined aquatic sites (Donnelly & Crump 1998).

The metamorphosis of *Rana arvalis* larvae in optimal conditions (average temperature of the water to be +16 Cº) takes 67 days (Kowalewski, 1974). For many populations in the Ier Valley, the larvae metamorphosis can not happen, due to insufficient time before the drying of spawning sites. Reproductive success here can only achieve through early breeding. According to the literature concerning Romanian Populations, the moor frog lays eggs in March and April (Fuhn 1960), whereas populations in the Netherlands have been recorded in mid March (Stumpel 2004). In the present study, all spawn had been laid by mid March (e.g. 16.03.2001 - Tarcea). In late February many pairs of *Rana arvalis* can be seen laying spawn despite the fact that during the night the water surface is covered by a thin layer of ice. However, this ice melts during the day (e.g. Văşad - 25.02.2002).

A negative effect on breeding success of the populations is *communal spawning* (Waldman 1982). That means many spawns of *Rana arvalis* form large compact piles (Fuhn 1960). This phenomenon is a natural mechanism of self defense against predators such as the *Haemopis sangvisuga* leech. The problem here is that the moor frog lays the eggs on the edge of the water (water with shallow depth) and as the water progressively reduces there is a large amount of eggs ending up on dry land and desiccating.

Fluctuating populations of amphibians will be either increasing or decreasing at any time (Pechmann & Wilbur 1994), but the fact that most of the sites where the species *Rana arvalis* was found had been

represented by a small number of specimens suggests the populations from the Ier Valley area should be considered endangered.

The assessment of the human activities impact on the populations

Amphibian populations are declining worldwide becoming a global phenomenon in the last few decades (Blaustein et al.1994, and see in Alford & Richards 1999), primarily as a result of human activities. Draining wetlands directly affects frog populations by removing breeding sites (Johnson 1992) and by fragmenting populations (Semlitsch & Bodie 1998), which increases the regional probability of extinction (see in Alford & Richards 1999). Fragmentation of habitats has a negative impact on the moor frog's spread and use of breeding ponds (Vos & Chardon 1998). The fragmentation of habitats is directly related to increasing isolation and reduced population size, therefore increasing their likelihood of extinction (Bennett 1990). In the region of the localities Valea Lui Mihai – Resighea, there is reduced agricultural interest because the area is covered with loess. This is the reason why moist areas surrounded by sandy fields can still be found in this area - a home for many populations of *Rana arvalis* (Table 1-2).

In Denmark, road traffic is responsible for many casualties among populations of *Rana arvalis* (Hels & Buchwald, 2001). For the populations from the Ier Valley area, the road traffic casualties have no significant impact due to their relatively distant position from the roads.

The stored residues from the swamps can have a negative affect on the spawn or the development of the tadpoles. The quality of potential breeding sites and their degree of isolation from other sites determines their probability of occupation and the probability of local extinction (Alford & Richards 1999). A similar situation was seen with a population of moor frog that survived in a highly polluted habitat in central Moscow (Severtsava, 2001) and another in Satu-Mare (Covaciu-Marcov et al. 2003). It is an unusual situation for a population to survive in the centre of a city, normally, it first becomes extinct there. In the area studied by us, there was only one town (Valea Lui Mihai) which had moor frog populations in a swamp within it.

The swamp from Valea Lui Mihai was burnt in the spring 2002, subsequent to that we were not able to find any more specimens of *Rana arvalis* in the swamp. A similar situation was encountered in the Hydrographical Basin of Crasna, in a populated swamp near the locality of Vetiş. This swamp was completely burnt in summer 2003 and converted into an agricultural field, causing the localized extinction of the moor frog population (Covaciu-Marcov & Sas, personal data). Other examples of extinction of populations of *Rana arvalis* due to human activities are known to have taken place in The Someş Basin (Török, 1999), and the Baia-Mare Depression (Dehelean & Ardelean 2000).

Conservation measures

Rana arvalis is classified by IUCN as being of Least Concern (IUCN 2006, IUCN-GAA 2006), in view of its wide distribution. However, in Romania the moor frog are at the margins of their global range, and is considered strictly

endangered, and protected by the Law 13/1993 (Cogălniceanu et al. 2000). In Europe it is protected by the Bern Convention (1998). Recently, the moor frog was specified in Annex 3 of the Order number 1198 from 25/11/2005, regarding the protected natural habitats, as being a species of community interest which needs strict protection.

Knowing that in the Ier Valley only a small number of habitats are left that shelter large *Rana arvalis* populations, it would be a priority to protect these areas by making them Specially Protected Areas. The priority is to optimize the conditions for these local breeding populations by managing both the breeding and foraging habitats. Protection of aquatic breeding sites may be of little value if adjacent terrestrial habitats used by amphibians for feeding and shelter are destroyed (see in: Alford & Richards 1999). Therefore, the succession status of potential breeding and foraging habitats, in combination with the occurrence of breeding success within approximately 1 kilometer's distance will be the key elements in a conservation strategy. However, for the long-term survival of amphibian populations in a landscape, a network of habitats is needed (Stumpel 2004).

Priority should be made to protect the large populations of *Rana arvalis* in the Ier Valley area, since the zones they live in are relatively close to each other (Fig. 1) and hence it could be part of a single infrastructure. Also, priority protection for the large populations does not mean the small populations are less in need of protection and any measures in this respect are welcomed.

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***** Ordin nr. 1198 din 25/11/2005, Publicat in Monitorul Oficial, Partea I nr. 1097 din 06/12/2005. ANEXA Nr. 3A Specii de Interes Comunitar SPECII de animale şi de plante care necesită o protecţie strictă.

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