

## The Distribution and Conservation Status of Amphibians in Dobrudja (Romania)

Paul SZÉKELY<sup>1,\*</sup>, Rodica PLAIĂȘU<sup>2</sup>, Marian TUDOR<sup>3</sup>, Dan COGALNICEANU<sup>3</sup>

<sup>1</sup>Romanian Ornithological Society, Bd. Mărăști No. 61, 011464, Bucharest - ROMANIA

<sup>2</sup>Institute of Speology, Emil Racovita, Calea 13 Septembrie 13, 050711, Bucharest - ROMANIA

<sup>3</sup>University Ovidius Constanta, Faculty of Natural Sciences, bvd. Mamaia 124, Constanta - ROMANIA

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**Abstract:** The distribution of amphibian species in Dobrudja has been studied for more than a century; however, the available information was scattered among tens of publications and museum collections. In the present paper we synthesized the available distribution records from published papers, museum collections, and our own field data. These distribution data were treated separately as historical data (before 1990), continuous data (records from both before and after 1990), and recent ones (after 1990). Based on distribution records we performed a cartographic analysis consisting of 3 indexes that attempt to indicate shifts in geographic range over time. Using these indexes as a measure of the conservation status, we propose a Red List for the amphibians of Dobrudja based on the distribution data and the changes in species range before and after 1990.

**Key Words:** Amphibians, inventory, mapping, conservation status, Red List, Dobrudja, Romania

### Introduction

The mapping of amphibian species has become a fashionable assignment in Europe and has resulted in a continental (Gasc et al., 1997) and many regional and national atlases (Dodd et al., in press). Amphibians are extremely sensible to environmental changes and are good indicators of the quality of the environment (Diamond, 1996).

Amphibians are declining worldwide and are considered more threatened than either birds or mammals (Stuart et al., 2004). A recent initiative, The Global Amphibian Assessment (GAA), did a comprehensive assessment of the conservation status of the world's known species of amphibians. In response to this crisis, an Amphibian Conservation Summit was organized by the

IUCN in 2005. One of the resulting outputs was the Amphibian Conservation Action Plan.

Reliable and updated distribution data is an essential requirement for evaluating the status of animal species within a certain geographical frame as regional, national, or continental. Detailed distribution data provide invaluable zoogeographical information and help understand the history and estimate the future of animal populations. Understanding how amphibians are distributed and documenting changes in their ranges is extremely useful for conservation measures and environmental policies.

The region of Dobrudja (Romania) is part of the Balkan Peninsula, which harbors a biogeographical uniqueness (Dzukic and Kalezic, 2004). It is bordered by

\* E-mail: szpaulro@yahoo.com

the Danube River and Delta and the Black Sea. It encompasses 2 European bioregions (pontic/Black Sea and steppic) of which the former is only shared with Bulgaria and the latter reaches its western limit in the east of Romania. Due to their limited distribution in the European Union, these 2 bioregions require special attention.

In the present study we have combined the existing information on the distribution of amphibians in Dobrudja together with our own data. Our goals were to (i) prepare updated distribution maps and (ii) evaluate the conservation status of amphibians in the region based on historical and present distribution records.

## Materials and Methods

### Distribution mapping

The province of Dobrudja has an area of 15,579 km<sup>2</sup> and includes 2 administrative regions, Constanta and Tulcea counties (Figure 1). Despite the fact that large parts of this area are affected by human activities, there are still places with unique or highly valuable ecosystem types (e.g. the Danube Delta, Macin Mountains, Babadag, Hagieni, and Dumbraveni Forests).

We have used distribution data from published articles or books, museum collections, and our own field data consisting of unpublished original records from fieldwork gathered between 1998 and 2008. From the total of

1062 recordings, 779 represent previously published data, 11 come from museum collections (Iasi, Deva, and Oradea Museums) and 272 are unpublished field data. From these unpublished data, 219 are our own (representing 20.6%) and the rest were provided by Ion Fuhn, Gheorghe Sin, Martin Kyek, Jan (Pim) Arntzen, Török Zsolt, Mathieu Denöel, and Tatiana Kotenko.

The distribution records were treated separately as historical data (before 1990), continuous data (records from both before and after 1990) and the recent ones (only after 1990). The 1990 threshold was selected because during the eighties very few studies were published, but after 1992 more than 20 publications were devoted to the amphibians from Dobrudja. The 1990 threshold seems the best option, separating 2 periods of more or less intensive inventories in the area. The complete list of the known amphibian distribution records for this province is given in Székely et al. (in press).

For the cartographic representation we have used UTM grid maps system with 5 × 5 km squares (Lehrer and Lehrer, 1990). This was preferred to geographical coordinates since most of the previous studies refer mostly to localities, and few to toponymies, and they offer no information on the area covered within a location. The use of UTM squares confers an equivalent area value to each record. For locality citations without precise location covering several UTM squares, we filled



Figure 1. Bioregions and the province of Dobrudja (with red) in Romania.

all the squares, so a single record can be represented by more than one square. In some cases different records may be located in the same UTM square, counting as a single one. The data analysis used for compiling the Red List was based on surface data (UTM 25 km<sup>2</sup> squares) and not the actual number of records.

The recently published Amphibian Tree of Life (Frost et al., 2006) has proposed important changes in amphibian classification, which also involve amphibians from Dobrudja (Table 1). We consider that the new names should receive priority; however, since the

Table 1. Taxonomic changes affecting amphibian species from Dobrudja, according to Frost et al. (2006).

Species name	Proposed new name
<i>Triturus vulgaris</i>	<i>Lissotriton vulgaris</i>
<i>Bufo viridis</i>	<i>Pseudepidalea viridis</i>
<i>Rana lessonae</i>	<i>Pelophylax lessonae</i>
<i>Rana esculenta</i>	<i>Pelophylax esculentus</i>
<i>Rana ridibunda</i>	<i>Pelophylax ridibundus</i>

legislation and their conservation status have not yet been changed, we will continue using the old names. To avoid confusion and maintain a certain nomenclatural stability, we have adapted the solution proposed by Smith and Chiszar (2006), by using the subgenus in parentheses. We have considered water frogs as *Rana* (*Pelophylax*) *esculenta* complex consisting of *R. esculenta* and *R. ridibunda*. This was performed based on the fact that most reports on water frogs did not discriminate between species, and that water frogs are difficult to identify correctly based solely on morphology only (Pagano and Joly, 1998). *Rana* (*Pelophylax*) *lessonae* was considered separately since it can be distinguished more easily based on morphology from the other 2 species. There are several recent reliable reports on its presence in Dobrudja, allowing it to be presented separately.

### Cartographic analysis

Based on the distribution records we computed 3 indexes for the cartographic analysis that attempt to capture shifts in geographic range and measure our degree of knowledge of their distribution (see Santos et

al., 2007 for a similar approach). Distribution records were classified as records before 1990 (P), continuous records i.e. both before and after 1990 (C), records after 1990 (N) and the total number of records (T). The 3 indexes proposed are the relative change in species distribution [ $Rc = P / (C + N)$ ], the continuity index [ $Ci = C \times 100 / (P + C)$ ], and the relative degree of knowledge [ $K = (C + N) \times 100 / T$ ]. The relative change in species distribution ratio when greater than unity indicates a reduction in area occupied from a larger historical range to a smaller present range. The continuity index is a measure of the constant sighting at a particular site, the higher the value the higher the continuity. Finally, the relative degree of knowledge is a ratio between the recent number of records (both new and re-sights) and the total number. A high value indicates that most records are after 1990, while a lower value indicates that more records were previous to 1990, i.e. historical records.

### Results

In the studied area, 12 amphibian species (9 species and a species complex) are present, some with a restricted distribution while others widely distributed (Figure 2). We had distribution records from 340 squares (5 × 5 km) (Figure 3), covering 48.5% of the total number of squares (i.e. 700 squares, counting also the squares that cover marine coastal area, the southern border with Bulgaria, and the Danube River) or 54.6% of the total area of Dobrudja.

Of the total number of records 78% are after 1990 and 22% before 1990. According to the administrative units, 39.4% of the records are located in Constanta and 60.6% in Tulcea. This situation reflects the differences in area but also a bias caused by more detailed inventories carried out in the large protected areas in Tulcea (Danube Delta Biosphere Reserve and Macin Mountains National Park).

The distribution of amphibian species in Dobrudja is presented in the following figures: *Triturus* (*Lissotriton*) *vulgaris* (Figure 4), *Triturus dobrogicus* (Figure 5), *Bombina bombina* (Figure 6), *Pelobates fuscus* (Figure 7), *Pelobates syriacus* (Figure 8), *Bufo bufo* (Figure 9), *Bufo* (*Pseudepidalea*) *viridis* (Figure 10), *Hyla arborea* (Figure 11), *Rana dalmatina* (Figure 12), *Rana* (*Pelophylax*) *lessonae* (Figure 13), and the *Rana* (*Pelophylax*) *esculenta* complex (Figure 14).

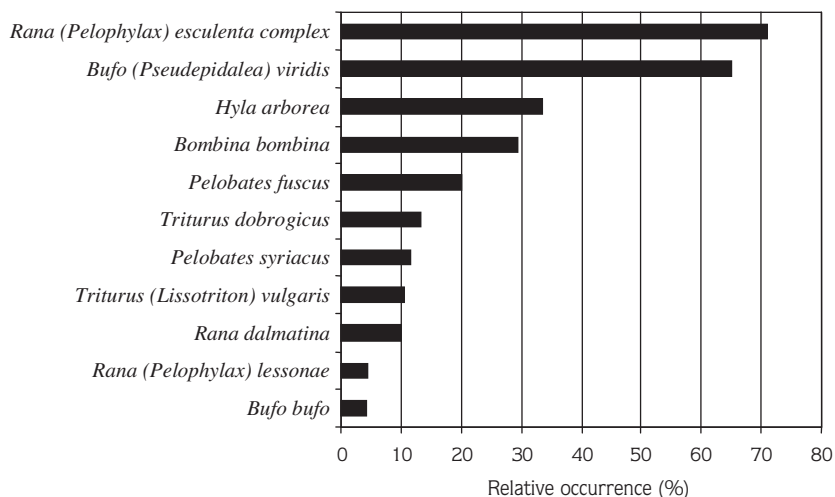


Figure 2. The relative occurrence of amphibians based on the number of quadrates occupied by a species as a percentage of the total number of records (i.e. 340 squares of 25 km<sup>2</sup>).

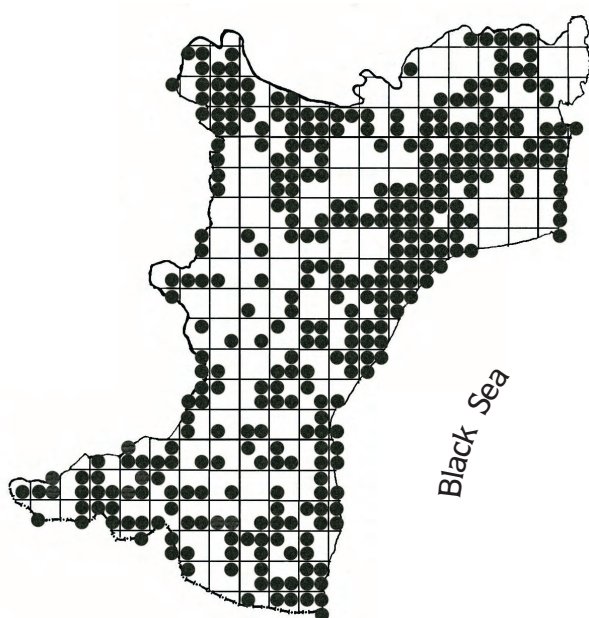


Figure 3. The total number of 5 × 5 km squares with distribution records.

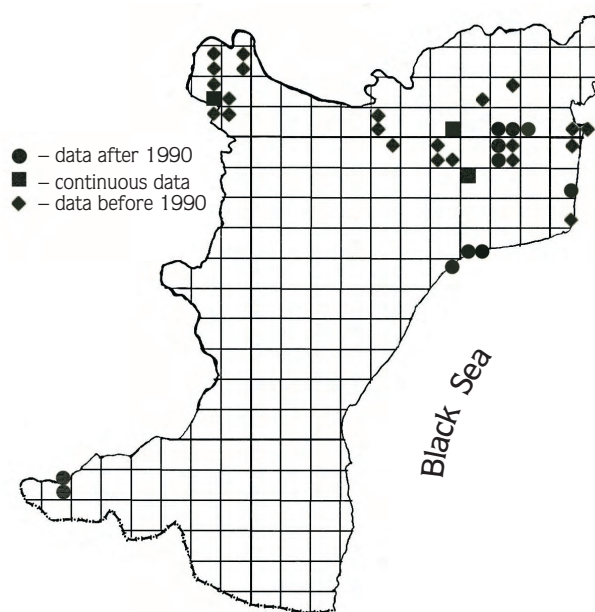


Figure 4. Distribution of *Triturus (Lissotriton) vulgaris* in Dobrudja.

A few relatively well represented species in some parts of Dobrudja, such as *Rana dalmatina*, *Bufo bufo*, and *Pelobates syriacus*, were accounted for late (Bacescu, 1954, Popescu, 1977) indicating a limited historical knowledge of their distribution.

The structure of the distribution records according to the species investigated, date of observation, and the indexes calculated are presented in Table 2. Thus, the 2

newt species have suffered the highest reduction in area, as suggested by the values of the Rc and Ci indexes. The 2 most common species, the green toad (*Bufo (Pseudepidalea) viridis*) and water frogs (*Rana (Pelophylax) esculenta complex*), show the highest values for the Ci index and also for the K index. *Bufo bufo* also presents a high value of K index since it has a restricted distribution and most records are recent.



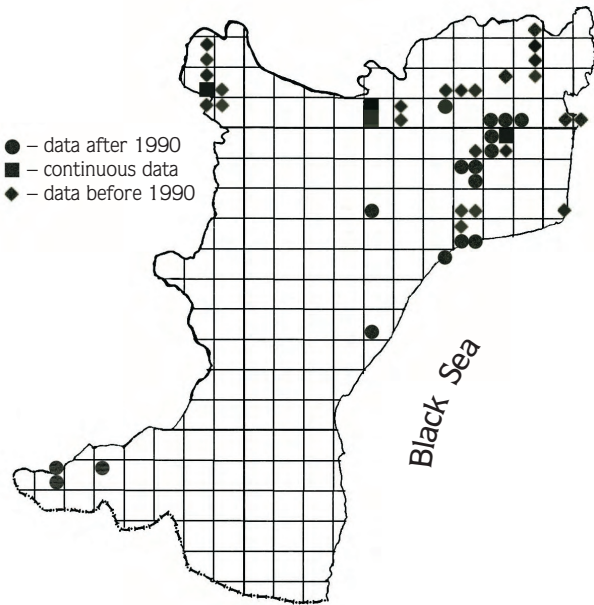


Figure 5. Distribution of *Triturus dobrogicus* in Dobrudja.

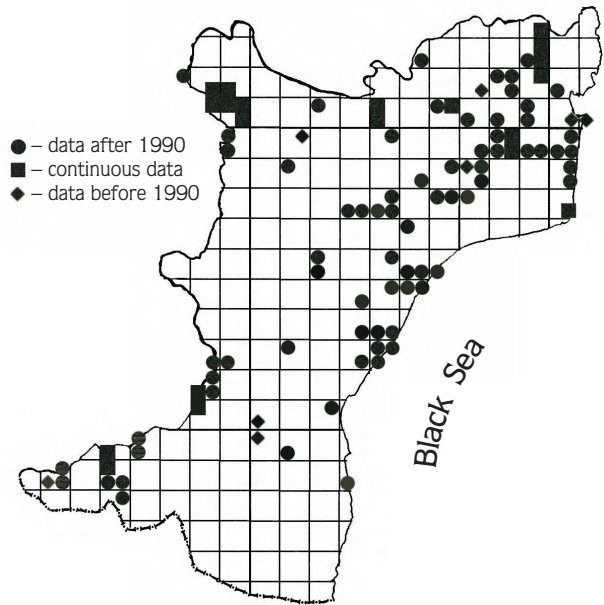


Figure 6. Distribution of *Bombina bombina* in Dobrudja.

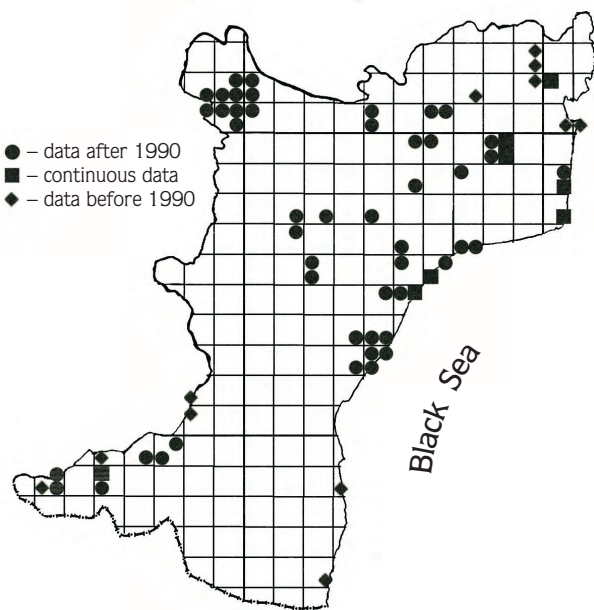


Figure 7. Distribution of *Pelobates fuscus* in Dobrudja.

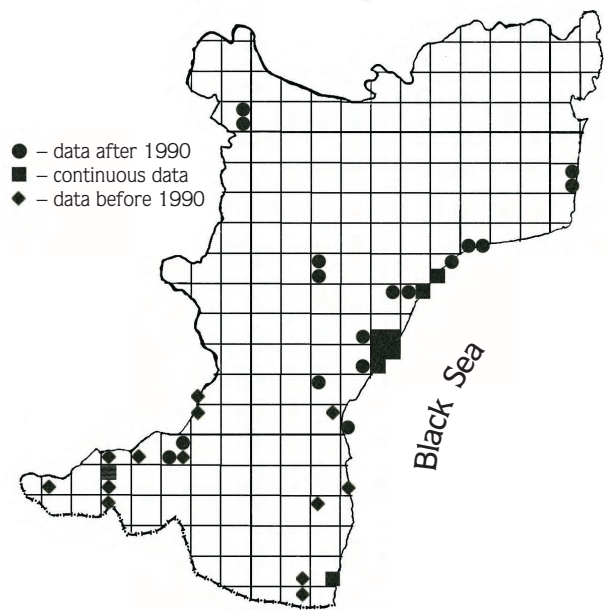


Figure 8. Distribution of *Pelobates syriacus* in Dobrudja.

While proposing the Red List for Dobrudja, we did not refer to previously proposed statuses at global, national, or local levels, but attempted to base them on the

cartographic analysis carried out (Table 3). Including the 5 species in the “Endangered” category is based on their limited distribution or decreased re-sighting after 1990.

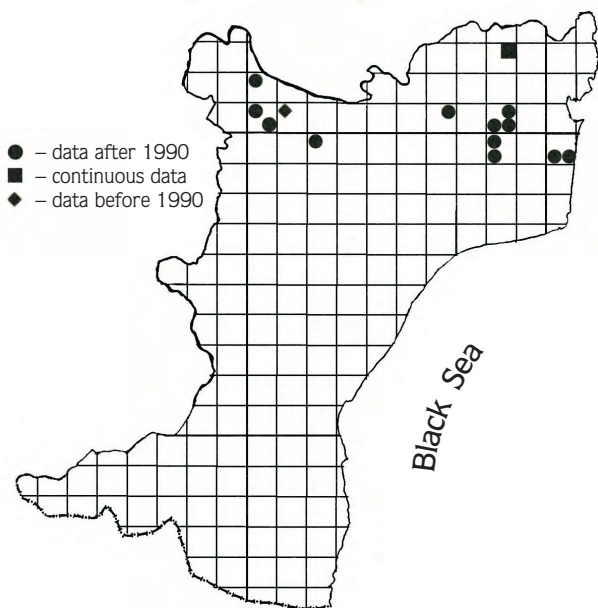


Figure 9. Distribution of *Bufo bufo* in Dobrudja.

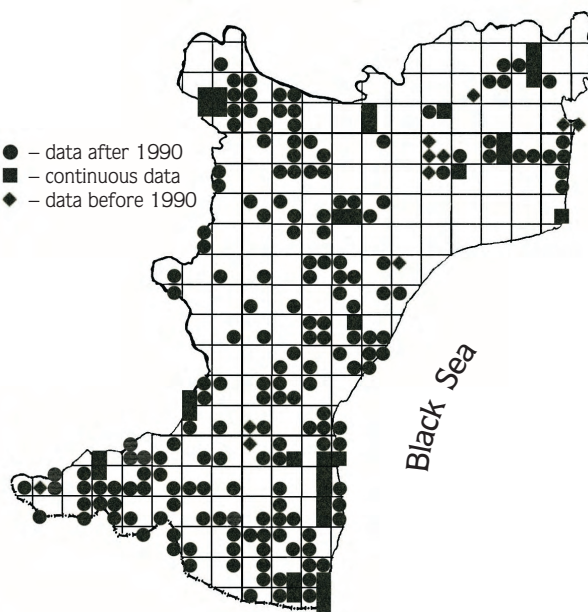


Figure 10. Distribution of *Bufo (Pseudepidalea) viridis* in Dobrudja.

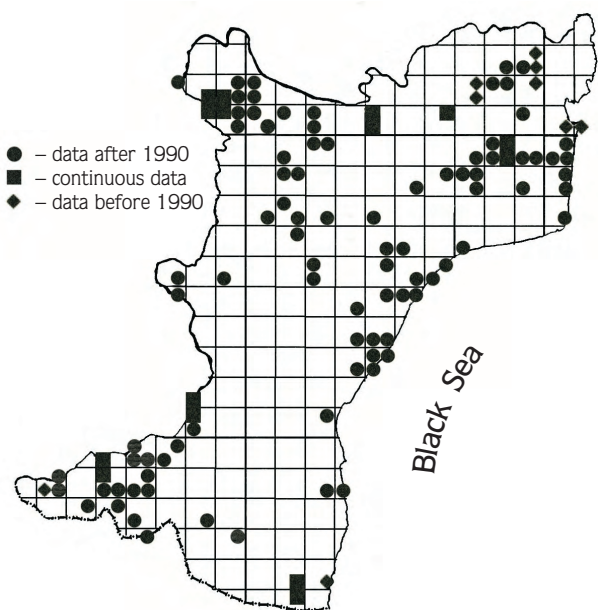


Figure 11. Distribution of *Hyla arborea* in Dobrudja.

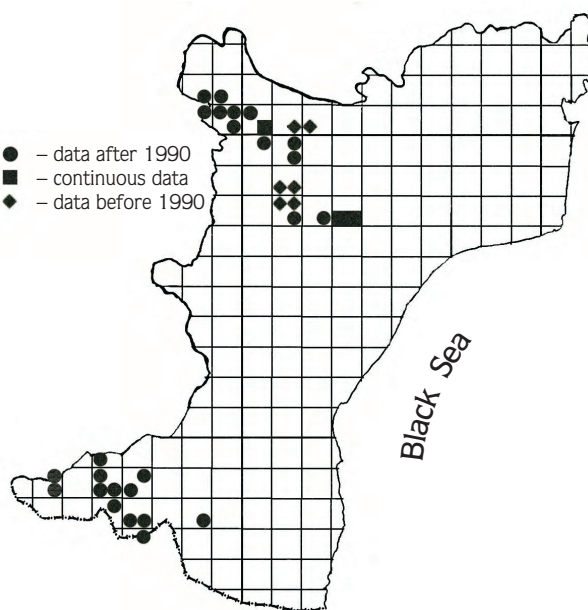


Figure 12. Distribution of *Rana dalmatina* in Dobrudja.

**Discussion**

There are several recent distribution maps covering the province of Dobrudja; however, their precision is not sufficient for specific management programs. For

example, the European Atlas (Gasc et al., 1997) used 50 × 50 km squares (i.e. 2500 km<sup>2</sup>, 100 times larger than the spatial scale used in the present study), while national maps (Cogalniceanu, 1991 and Cogalniceanu et al.,

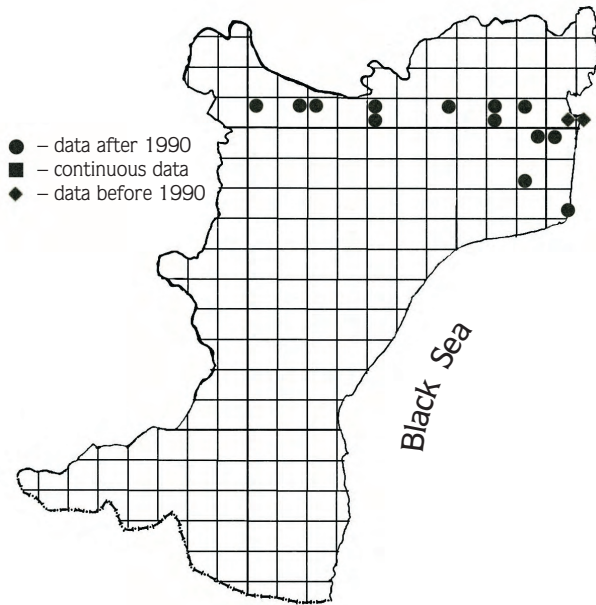
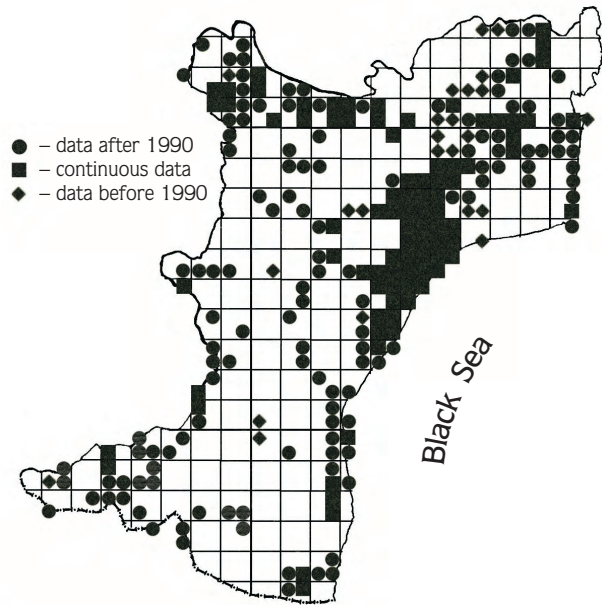
Figure 13. Distribution of *Rana (Pelophylax) lessonae* in Dobrudja.Figure 14. Distribution of the *Rana (Pelophylax) esculenta* complex in Dobrudja.

Table 2. The distribution records of the amphibian species from Dobrudja and their 3 indexes calculated.

Species	Records before 1990 (P)	Continuous records (C)	Records after 1990 (N)	Total number of records (T)	Relative change in species distribution (Rc) $P / (C + N)$	Continuity index (Ci) $C \times 100 / (P + C)$	Relative degree of knowledge (K) $(C + N) \times 100 / T$
<i>Triturus (Lissotriton) vulgaris</i>	22	3	11	36	1.6	12.0	38.9
<i>Triturus dobrogicus</i>	24	4	17	45	1.1	14.3	46.7
<i>Bombina bombina</i>	8	20	72	100	0.1	71.4	92.0
<i>Pelobates fuscus</i>	12	8	48	68	0.2	40.0	82.4
<i>Pelobates syriacus</i>	13	9	17	39	0.5	40.9	66.7
<i>Bufo bufo</i>	1	1	12	14	0.1	50.0	92.9
<i>Bufo (Pseudepidalea) viridis</i>	11	33	177	221	0.1	75.0	95.0
<i>Hyla arborea</i>	9	15	90	114	0.1	62.5	92.1
<i>Rana dalmatina</i>	6	3	25	34	0.2	33.3	82.4
<i>Rana (Pelophylax) lessonae</i>	2	0	13	15	0.2	0.0	86.7
<i>Rana (Pelophylax) esculenta</i> complex	24	89	128	241	0.1	78.8	90.0

2000) used  $10 \times 10$  km squares (i.e.  $100 \text{ km}^2$ ). A recently published report on the geographical distribution of herpetofauna in Dobrudja (Covaciu-Marcov et al., 2006) used only dot maps, without any specific area coverage.

The present paper has considered all previously published records from the area and produced updated

distribution maps at a space scale adapted to the area of the province.

The conservation status of the amphibian fauna of a given region is often hard to estimate due to low detectability and restricted and fragmented habitats. The IUCN Red List criteria are relatively hard to apply to most amphibian species due to the lack of detailed

Table 3. The conservation statuses assessed for the amphibian species in Dobrudja by different Red Lists at global, national, and local levels. The last column represents our proposal for the Red List of Dobrudja (<sup>1</sup>Baillie et al. 2004, <sup>2</sup>Botnariuc and Tatole 2005, <sup>3</sup>Macin Mountains National Park Red List, Török 2006 and <sup>4</sup>Danube Delta Biosphere Reserve Red List, Otel 2000).

Species	IUCN 2004 <sup>1</sup> categories	Romanian Red List <sup>2</sup> categories	NPMM <sup>3</sup> Red List categories	DDBR <sup>4</sup> Red List categories	Proposed Red List categories by this study
<i>Triturus (Lissotriton) vulgaris</i>	LC	NT	-	DD	EN
<i>Triturus dobrogicus</i>	NT	EN	-	LC	EN
<i>Bombina bombina</i>	LC	NT	-	LC	NT
<i>Pelobates fuscus</i>	LC	VU	-	LC	VU
<i>Pelobates syriacus</i>	LC	EN	-	LC	EN
<i>Bufo bufo</i>	LC	NT	EN	LC	EN
<i>Bufo (Pseudepidalea) viridis</i>	LC	NT	VU	LC	LC
<i>Hyla arborea</i>	LC	VU	VU	LC	NT
<i>Rana dalmatina</i>	LC	VU	VU	-	EN
<i>Rana (Pelophylax) lessonae</i>	LC	-	-	DD	EN
<i>Rana (Pelophylax) ridibunda</i>	LC	-	VU	LC	LC
<i>Rana (Pelophylax) esculenta</i>	LC	-	-	-	LC

Table 4. The differences between the statuses of amphibian species assessed by different Red Lists available at global, regional, national, and local levels. The values are given as percentages for each category taking into consideration the total number of species.

IUCN Red List Categories	IUCN 2004 Global (n = 5918)	IUCN 2004 Palaearctic Region (n = 466)	IUCN 2004 Romania (n = 19)	Red List Romania (n = 19)	Danube Delta Biosphere Reserve (n = 10)	Macin Mountains National Park (n = 5)	Dobrudja proposed Red List (n = 12)
Extinct and extinct in the wild (EX and EW)	0.9	0.4	0	0	0	0	0
Critically Endangered (CR)	7.7	2.8	0	0	0	0	0
Endangered (EN)	13	8.6	0	15.8	0	20	50
Vulnerable (VU)	11.3	12.4	0	42.1	0	80	8.3
Near Threatened (NT)	6.2	10.3	5.2	26.3	0	0	16.6
Least Concern (LC)	23.4	52.4	94.8	15.8	80	0	25
Data Deficient (DD)	37.8	13.1	0	0	20	0	0

distribution data and the difficulties in obtaining reliable population parameters or even consistent estimates of these. Geographic distribution data are more easily available and often include historical data. There are several recent attempts to assess the conservation status of species based on cartographic analyses (e.g. Santos et al., 2007). We have used the distribution data available to estimate shifts in habitat occupation and range in an attempt to assess the conservation status. Nevertheless,

the use of the distribution data available has a severe drawback since the data is biased and incomplete for any population dynamics studies, but it can provide useful information on range size and changes in time. Conservation is a crisis discipline and the urgent need for establishing priorities requires using the available information. Further studies will allow recalculating the indices proposed and reevaluating the conservation status.



None of the previously published amphibian Red Lists has properly used the IUCN criteria due to the limited information available. There are huge differences between the different proposed lists due not only to the different spatial scales (Table 4), but also because they are based on subjective rather than objective criteria. Some of these differences can nevertheless be easily explained by the spatial scale used, with some species locally abundant but regionally rare or having a restricted distribution.

It can be observed that the amphibian fauna within the Palaearctic Region has a better status compared to the global level. The fauna inhabiting Romania is well represented in the Palaearctic Region, most species being in the Least Concern category. This is due to their relative large distribution ranges.

At smaller spatial scales, some species become, at local or regional level, endangered and may require enhanced protection. Red Lists have no legal binding value, so it should be remembered that according to the national legislation implementing the EU Birds and Habitats

Directives (OUG 57/2007), 3 species (*Triturus dobrogicus*, *Bombina bombina*, and *Pelobates fuscus*) are included in Annex 3, 6 (*B. bombina*, *Pelobates fuscus*, *P. syriacus*, *Bufo (Pseudepidalea) viridis*, *Hyla arborea*, *Rana dalmatina*) are included in Annex 4A, 3 (*Triturus (Lissotriton) vulgaris*, *Bufo bufo*, *Rana (Pelophylax) lessonae*) in Annex 4B, and 2 (*Rana (Pelophylax) esculenta*, *Rana (Pelophylax) ridibunda*) in Annex 5A.

Their legal status reflects the situation of the species in the European Union and is less valid nationally. Shaping Red Lists to local or regional scales can increase their usefulness for decision makers. Thus, local and regional Red Lists can prove useful tools in setting priorities for conservation at smaller spatial scales.

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