

Life History and Conservation of Spadefoot Toads (genus *Pelobates*) in Romania

By Cogălniceanu Dan, Székely Paul, Iosif Ruben, Székely Diana & Stănescu Florina

The European spadefoot toads (genus *Pelobates*) are highly specialized burrowing and nocturnal species with a narrow ecological niche. Landscape features have a strong influence on their distribution, dispersal and abundance (1). Spadefoot toad tadpoles are the largest among the European amphibian species and the larval period can last several months until metamorphosis. Because of their secretive behavior (nocturnal activity, weak underwater breeding call and cryptic coloration) their life histories are not well documented and overall there is a scarcity of information regarding this genus.

Of the four extant species of the genus two have disjunct ranges (*P. cultripipes* occurs in the Iberian Peninsula and southern France and *P. varaldii* has a restricted range in North Africa), while the ranges of the other two species (the Common spadefoot toad *P. fuscus* and the Eastern spadefoot toad *P. syriacus*) overlap in Southeastern Europe, in the Balkan Peninsula, along the lower course of the Danube and the western coast of the Black Sea. Both species reach the limits of their range there: southern limit for *P. fuscus* and northern limit for *P. syriacus* (2). Populations at the limits of their distribution range are especially vulnerable to even slight changes of climate, and since part of the area of overlap is experimenting increased aridity this represents a major threat to their persistence. The study of the two spadefoot toads populations inhabiting the relatively narrow area of overlap represents an excellent opportunity for the comparative study of their life histories, habitat requirements and possible competition. A reduction in their range was already documented during the last century, and the contraction of their ranges continues. Understanding the biology of these two related spadefoot toad species is vital in order to stop their decline.

Study Site

The main study area is located in a lagoon system in the southern part of the Danube Delta Biosphere Reserve (Romania) (Fig. 1). The terrestrial habitats are partly salinized sandy soils, covered with

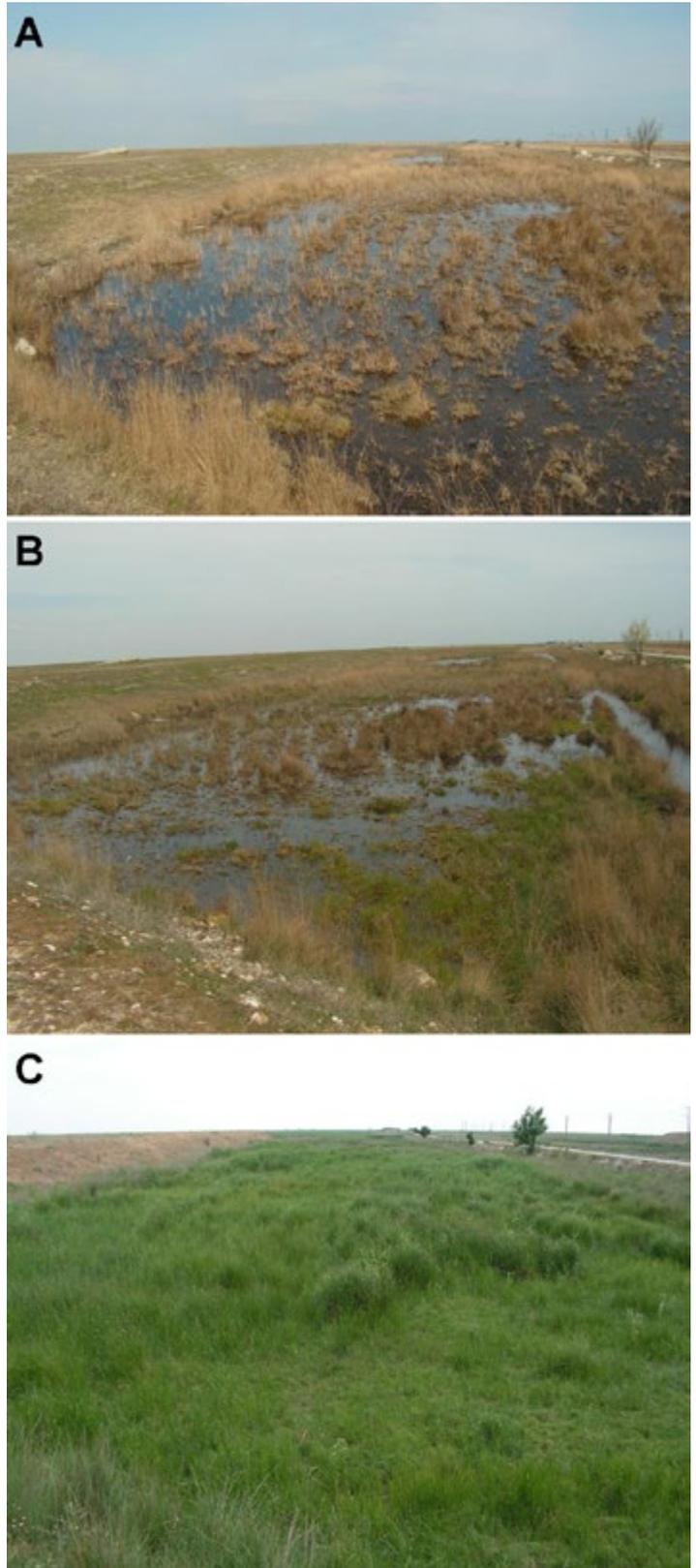


Figure 2. Rapid changes in water level and vegetation: (A) early spring, (B) late spring and (C) summer.

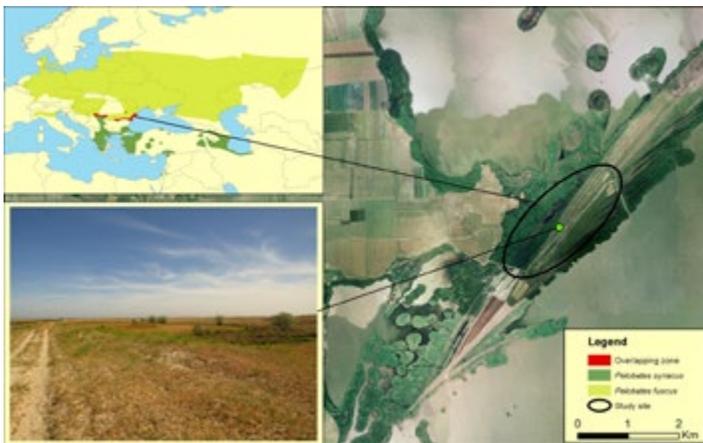


Figure 1. The geographic ranges of *Pelobates fuscus* and *P. syriacus* (top left box) and the location of the study site.

University Ovidius Constanța, Faculty of Natural Sciences, Constanța, Romania. www.pelobates.ro

steppe vegetation, while wetlands are dominant (both temporary and permanent). The annual rainfall regime is low (350 mm) but the relative air humidity is high due to the extensive water bodies and the vicinity of the Black Sea. The extent and persistence of water bodies are extremely variable in the study area, depending on the Danube water flow, making the environment highly unpredictable (Fig. 2).

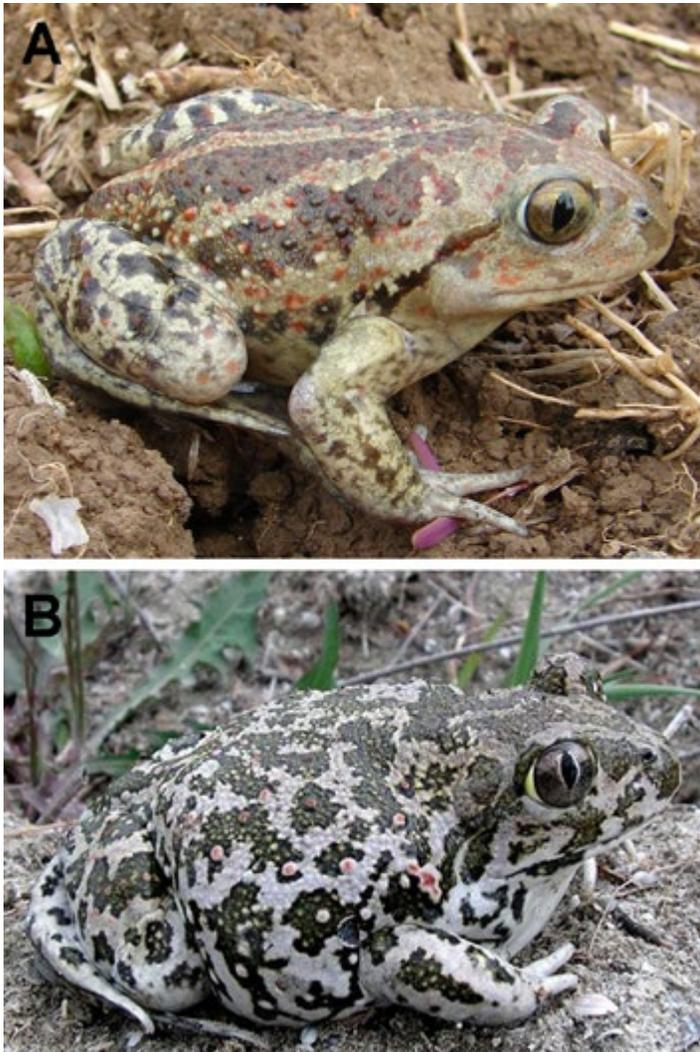


Figure 3. (A) *Pelobates fuscus*, (B) *Pelobates syriacus*.

Life-history Differences Between Spadefoot Toad Species

While there is little ecological differentiation between the two co-existing species in terms of habitat requirements and use, there are major differences in body size and sexual dimorphism. *Pelobates fuscus* is smaller in size and it shows a clear sexual dimorphism, with females larger than males, while *P. syriacus* is much larger in size with males slightly larger than females (Fig. 3). At metamorphosis the juveniles do not differ significantly in snout-vent length, but the ratio between the two species *fuscus-syriacus* decreases from 98% in metamorphs to 65% in adults. The changes in body mass are even more impressive, the ratio between *fuscus-syriacus* decreases from 89% in metamorphs to 24% in adults. We also found differences in the age structure of the syntopic populations: *P. fuscus* individuals were on average 5.0 years old (maximum age recorded 8), while *P. syriacus* were on average 7.4 years old (maximum age recorded 12), despite the fact that sexual maturity (i.e., the age of

the youngest adults observed) was reached at a similar age. The two species experienced varying growth rates before and after reaching sexual maturity: males growth rate was higher before reaching sexual maturity in both species, but in *P. syriacus* growth rate continued at a similar rate even after reaching sexual maturity.



Figure 4. Male competition for females during reproduction in *P. syriacus*.

We examined the adaptive value of interspecific variation in behavioural patterns, such as level of activity, since any type of movement includes trade-offs, in terms of energetic costs, exposure to predation and drought, but at the same time provides increased access to food. The nocturnal activity was monitored in a laboratory using webcams to capture time-lapse photographs of the toads' movement, which were then used to obtain tracks for each individual. Our results showed that *P. syriacus* was significantly more active than *P. fuscus* with almost 2.5 overall distance covered and more than twice the speed achieved, but with approximately the same time spent outside burrows. This suggests that the species differ in patterns of foraging behaviour, *P. fuscus* being relatively sedentary ('sit-and-wait') whereas *P. syriacus* is a more active predator ('widely-foraging').

Reproductive Investment in *Pelobates syriacus*

We focused on the investment in reproduction in this species in an attempt to understand how resources are allocated to growth and reproduction and how the costs differ between males and females. Eastern spadefoot toads are explosive breeders, the reproduction lasting less than a week (Fig. 4). We found that in females body mass loss during mating and egg deposition averaged 27%, while in males it was 3.9%. Bigger females lost more weight than

smaller ones since they deposited larger egg clutches. The size of the egg clutches varied between less than 1000 to almost 6,000 eggs, with an average value of 2,800 eggs per clutch (3).

Adaptations to the Environment

The spadefoot toads have specific adaptations that mitigate the risks associated with inhabiting a highly variable and unpredictable environment. The persistence of water bodies varies largely between years, seasons and during a season, so the tadpoles are well adapted. In various controlled experiments, we found that tadpoles exposed to pond drying accelerated their development, managing to complete their metamorphosis before the water dried out. However, this reduction of the developmental time determined a smaller body size at metamorphosis. The response of the tadpoles was not influenced by actual water level, but by water level decrease rate. We also observed differences in the tolerance to salinity between the two species, with *P. syriacus* eggs and tadpoles having a higher survival rate.

Conservation Needs

The most serious threat to spadefoot toads in our study area is the reduction in the number and quality of aquatic habitats, mostly due to coastal development, coastal erosion and saltwater intrusion. The introduction of alien fish species that can tolerate low levels of oxygen (e.g. mosquitofish, goldfish, pumpkinseed sunfish)

represent an important threat to the survival of tadpoles. The recently reported range expansion of alien crayfish downstream the Danube represents a potential risk. Increased road kill mortality due to traffic intensification in the area represents an additional threat. Perhaps the highest threat to their survival is urban development, restricted now by the high protection status of the area. Many spadefoot toads populations are declining in the Black Sea coast region due to habitat loss. Although still abundant in our study site, they are nevertheless vulnerable. As long as human activities in the area are kept to the present level, no specific measures are required for the persistence of the spadefoot toads (Fig. 5).

Acknowledgements

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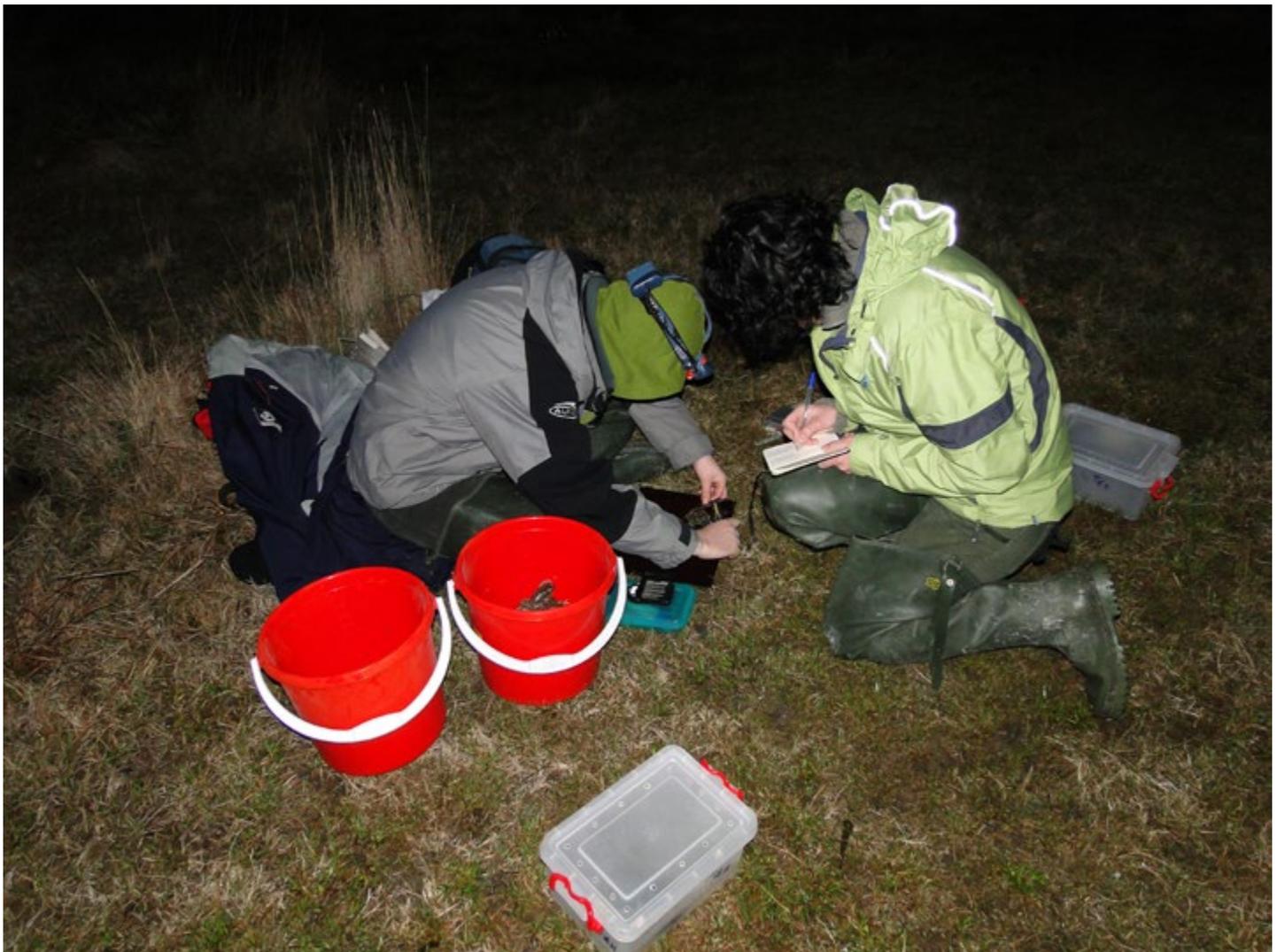


Figure 5. Measuring spadefoot toads in early spring.