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RECOVERY OF NATURAL POPULATIONS OF AMPHIBIANS AS A WAY OF BIODIVERSITY CONSERVATION

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Captive breeding and reintroduction serve for recovery of wild populations of animals, particularly amphibians. This study was aimed at the assessment of today's status of the northern banded newt *Ommatotriton ophryticus* (Berthold, 1846) and the eastern spadefoot *Pelobates syriacus* Boettger, 1889 in Armenia and the features of growth and development of these species in captivity. In the Red Data Book of Animals of Armenia, as per IUCN criteria the newt is classified as Critically Endangered and the spadefoot as Vulnerable. The paper describes the development of newts in a population originated from 19 founders captured near the Shamlukh village, Alaverdi district. We also consider the metamorphosis and development of captive spadefoots and their release into the Azat Reservoir.

The capability of living organisms to adapt to environmental conditions has certain limits as demonstrated by population declines and extinction of species ensuing from ambient changes in scales far beyond an organism's tolerance thresholds. Species react in different ways to anthropogenic activities which destroy the natural equilibrium.

One of the ways to recover the natural populations of threatened species is their captive breeding and further release into the wild, i.e. reintroduction, which allows to improve the status of fading populations and the species in general.

The family *Salamandridae* numbers about 55 species one of which, the northern banded newt *Ommatotriton ophryticus* (Berthold, 1846), occurs in northern parts of the Republic of Armenia. Till now the northern banded newt remains one of the least studied amphibians in Armenia.

The northern banded newt is distributed mostly, but sporadically, in the West Caucasus, from northern and western foothills of the Greater Caucasus Ridge to the Stavropol and Krasnodar regions in the north [1, 2]. Further to the east it occurs at elevations from 600 m to 2050 m above sea level because of aridity increasing from west to east. The dry basin of the Kura River, being unavailable to newts, gets deep into the species range. In light of this, recent find of an isolated newt population on the southern piedmonts of northern Armenia's Somakheti Mts. (Lori Province) was absolutely striking [3, 4]. Notably, the closest record site is located 60-70 km to the north in Georgia, within the vicinities of the Marneuli village and Tbilisi city.

The northern banded newt is listed in the Red Data Book of Animals of Armenia in which it is classified, in compliance with the International Union for Conservation of Nature (IUCN) criteria, as Critically Endangered CR B2ab (iii,v).

The eastern spadefoot *Pelobates syriacus* Boettger, 1889 is distributed in Syria, Palestine, Israel, Asia Minor, Balkan Peninsula and the Caucasus. In Armenia, it occurs in the central (Lake Komsomolí Lich in Yerevan, villages of Jrvezh, Arinj and Volkhaberd) and southern (neighbourhoods of the Rind village and Sisian town) parts of the country [5, 6]. The eastern spadefoot lives in treeless, grassland and semi-desert foothill areas and intermountain troughs [5]. It inhabits open landscapes and avoids woodlands.

This species is included in the IUCN Red List of Threatened Species as Least Concern (ver. 3.1), but in Armenia it is classified as a Vulnerable VU B2ab (ii, iii) taxon of declining population.

Present study was directed towards the up-to-date assessment of status of these two amphibians in the country and to studies of their development and growth in captivity.

OBJECTIVES AND METHODS

The founders of captive-bred newt population were 19 individuals of *Ommatotriton ophryticus* captured by net or fishing rod near the Shamlukh village, Alaverdi district in June 2000. Some of these individuals were kept in aquaria for cross-breeding in laboratory. For newt rearing, plants with laid eggs were placed into wide and low aquaria with water (the most optimal temperature 15-20°C). Water was changed with pollution and overheating. The hatchlings were fed with infusoria and daphnids, then by finely shredded sludge worms or mosquito grubs.

The captive population of the eastern spadefoot originated from adults and tadpoles captured near the Rind village (Vayots Dzor Province) and Sisian town (Syunik Province). Field surveys were carried out at nights with flashlight. Record sites, habitat characteristics, elevation, sex and size of captured individuals, their physiological condition and behaviour were documented.

RESULTS AND ANALYSIS

Juveniles differ from adults not only in biochemical processes related to intensive growth and cell differentiation,

but also in reaction to environmental conditions. For this reason, studies of early stage development of animals take a significant place in ontogenetic investigations. A number of papers describing development and growth of hatchlings of tailless amphibians have been published [7-9], but similar works on tailed amphibians are only few [10].

Captive breeding and reintroduction of eastern spadefoots was aimed at the establishment of self-maintaining gene bank for further replenishment of wild population. Doubtless, the effectiveness of this methodology can be assessed only during many years of its practical implementation.

In both wild and captive conditions, spadefoots remain to be nocturnal. They positively respond to stimulation by hormonal substances which induce gamete maturation. The experiments have shown that good feeding and temperatures ranging from +20°C to +22°C may lead one female to produce two generations per annum. Frequently changed water, constant ventilation and pH 6-9.8 are essential for normal development of hatchlings.

That oocytes stay in the body of female spadefoot for quite a long time before reaching some level of development ensures high effectiveness of application of hormonal substances [11].

Hatchlings and actively feeding tadpoles were translocated to aquaria with different colonization densities. The most optimal colonization density is 4 individuals per litre of aquarium water [11, 12]. In these conditions, metamorphosis proceeds normally and survival rates reach 90%.

After metamorphosis, spadefoots were translocated to terrariums with wet sand or turf, with substrate thickness 3-5 cm. Juveniles were fed with locust and cockroach *Blatella germanicä* and *Galerida melonella* grubs. Depending on seasons, air temperature in terrariums varied from 18°C to 24°C. Growing individuals were regularly resettled. Some juveniles died, possibly for density-dependent reasons.

Captive-bred spadefoots were released into the Azat Reservoir where only green toad *Bufo viridis* and lake frog *Rana ridibunda* were known to live and where the coastline substrates and water were studied in advance for their suitability for spadefoots.

The first lot of animals was released in 1985. The monitoring of introduced spadefoots was carried out during 5 years. The newcomers were found to fare well. Juveniles were kept close to the wet areas along a small stream. In the third year, spawning adults were recorded. Until now, local population size remains relatively stable.

In mid-June 2000, in the vicinity of the Shamlukh village of the Lori Province we have found a big population of the northern banded newt. Newts occurred in a small lake of surface area ca. 200 m^2 located below the lower limit of a mixed forest, at depths 1-4 m. The water body was overgrown with aquatic vegetation. This locality is certainly of relic origin.

In spite of quite high densities, total population size of the newt is moderate because of low number of water bodies suitable for newt occurrence. Our surveys in June have brought the following results. On 15 June 2000, 49 individuals were captured, studied and released in several hours. Eleven of them were males, of which one still had breeding colouration. On the next day, 18 newts were captured, including 6 males of which none had crests. On the third day, 11 individuals (including 3 males) were captured. Several newts were found ashore, at 10-15 m away from the water, beneath the stones.

The northern banded newts emerge in the water in late March. During warm winters they do not hibernate and emerge in the water even in December. Males come first to the water (under its temperature ca. 3-5°C), followed by females. By the beginning of the breeding season, the crests of males become higher and stay so until the end of breeding regardless of spawning peaks. For example, among the males captured in June only one had clearly distinct crest.

The spawning periods in newts depend mostly on weather in winter and elevation of the occurrence site. In piedmonts, spawning takes place in February-March, on middle elevations in April-May and on highlands in June-July. As the breeding season is quite prolonged, the same water body can be inhabited simultaneously by spawn and hatchlings close to metamorphosis. The spawning occurs under water temperature 15-17°C. The spawn is laid in shallows on plants growing at depths 10-30 cm. In laboratory conditions, newts began spawning on 20 April under water temperature 20°C.

During the spawning in aquarium, the female held the leaf of an underwater plant by hind legs, folded it in the middle and laid the spawn by attaching single eggs between the folds. During this period, the male remained close to the female. The female spawned daily from singular to dozens of eggs, in clusters, 1-50 eggs/day. The clutch consisted of 50-240 eggs laid either as individual eggs or in a short line. The spawning period lasted up to 10-12 days, depending on temperature and food availability. On average, the female produced 100 eggs.

The newt eggs are ball-shaped, ca. 1.5-3 mm in diameter, telolecithal (i.e., their yolk quantities are low). The nucleus is located near the colourless animal pole. The vegetative pole has yellowish tint. Newt eggs are covered with three membranes. The internal membrane is thin, transparent and vitelline closely attached to the surface of the cytoplasm. The other two membranes are jelly-like, swelling in the water. The denser outer membrane forms a rigid capsule around the egg. Water temperature is very important for newt development [9].

It should be noted that development of the newt, like of any other vertebrate, is split into the cell division (stages 0-7), gastrulation (stages 8-13), neurulation (stages 14-21), tail bud period (stages 22-32) and larval period divided into the initial phase (stages 33-37) and active larval phase (38-56).

In laboratory conditions, the process of hatching out takes place on the 9-11^{th} day. In nature, it occurs later, on the 25-30^{th} day. The embryonic mortality is very high. On average, only 14% of eggs led to hatching and some clutches completely died. The hatchling emerges out of membranes in the stage 32. Having some amount of yolk, in the first days it hangs by attaching itself to a plant or an aquarium wall, and does not swim. When the resources of endogenic nutrition come to their end, hatchlings begin to actively feed (stage 38). This is the period of rapid growth. Closer to metamorphosis, linear growth slows down, feeding activity retards and hatchlings begin to

show the signs of adults' colouration, structure of skin cover, changes in head shape, reduction of gills and fin folds and others. Newts attempt to leave the water.

In northern banded newts, the entire period of development in natural conditions from spawning to moving onto land takes 70-150 days (5.5-6 months). Before the metamorphosis, the body length of a hatchling reaches 51 mm and that of the tail is 50 mm. Under captive breeding, the development period becomes shorter and the whole metamorphosis takes 59-60 days.

In 1999, an attempt was made to release the captive northern banded newts into the Lake Parz Lich in Dilijan Reserve (now national park).

This species is poorly adapted to co-existence with humans what enhances the adverse impact of environmental factors.

Looking nice in its breeding colouration, since recent times the northern banded newt has been intensively and illegally captured for sales and its overall population in Armenia is shrinking.

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ВОССТАНОВЛЕНИЕ ПРИРОДНЫХ ПОПУЛЯЦИЙ АМФИБИЙ КАК ОДИН ИЗ ПУТЕЙ СОХРАНЕНИЯ БИОРАЗНООБРАЗИЯ

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Разведение в неволе и реинтродукция является одним из путей восстановления естественных популяций животных, в частности, амфибий. Целью данного исследования была оценка современного состояния малоазиатского тритона *Ommatotriton ophryticus* (Berthold, 1846) и сирийской чесночницы *Pelobates syriacus* Boettger, 1889 в Армении и изучение развития и роста особей этих видов в неволе. По данным Красной книги животных Армении, согласно критериям МСОП тритон классифицируется как "находящийся под угрозой исчезновения", а чесночница – как "уязвимый" вид. В работе описываются особенности развития тритонов в популяции, полученной от 19 особей, отловленных близ с. Шамлух Алавердского района. Также рассматриваются аспекты метаморфоза и развития чесночниц при разведении в неволе и их выпуске в Азатекое водохранилище.