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Conservation of the yellow-bellied toad in Gesäuse National Park: collecting baseline data

Magdalena Baumgartner & Günter Gollmann

Abstract

The threatened yellow-bellied toad (*Bombina variegata*) was first recorded in Gesäuse National Park in 2004. To gain further information about its status, a mark-recapture study was conducted in 2016. Small populations were found on several disjunct sites, mainly located at altitudes between 1100-1300 m above sea level. Total population size was estimated as about 60 individuals. Relatively high body length and body mass as well as high survival rates indicate old and isolated populations. Body condition was positively correlated with altitude. Since suitable breeding ponds, which mainly occur on pastures, are rare, conservation and creation of habitats as well as regular monitoring and collaboration with forestry workers may be vital management tasks in the future.

Keywords

Amphibia, mark-recapture, population size, reproduction, biometry, body condition

Introduction

Due to habitat loss, the yellow-bellied toad (*Bombina variegata*) is regarded as vulnerable on the Austrian red list (GOLLMANN 2007) and is listed in Appendix II and IV of the Habitats Directive. Although the German trivial name 'Bergunke' refers to its occurrence in mountainous regions, this species is predominantly found at altitudes between 200 m and 800 m above sea level (CABELA et al. 2001). Doubtlessly, higher altitudes are challenging for toads because of a shortened activity period. The rocky Gesäuse National Park (Styria, Austria) extends from 490 m to 2369 m above sea level. It is the youngest National Park in Austria, established in 2002, and also part of a Natura 2000 area. There, *Bombina variegata* was first detected in 2004. Since preservation of biodiversity and protection of rare species are one of the main goals of the National Park and, additionally, Natura 2000 areas are focusing on species of the Habitats Directive, gaining more information about the threatened amphibian in this area is vital. In addition to updating distribution records, the focus of the current investigation was to assess population structure, reproduction, habitats and body condition of the toads.

Methods

From May to September 2016, a mark-recapture study was conducted. All sites were visited four to six times. The toads were captured, their ventral patterns were photographed for individual registration and biometrical measurements (snout-vent length, body mass) were taken. Water bodies were described regarding several parameters (e.g. size, depth, water temperature, vegetation). Additionally, comparative studies in nearby areas and in the Kalkalpen National Park were carried out. Population size was estimated using the Peterson-Lincoln method modified by Chapman (AMSTRUP et al. 2005). The body condition of each toad was calculated with the Scaled Mass Index (PEIG & GREEN 2009).

Results

In the Gesäuse National Park a total of 53 individuals of yellow-bellied toads was captured (BAUMGARTNER 2017). The population size was estimated to be 60 individuals, distributed over several disjunct sites. Local populations were mostly small, consisting of less than ten toads (Fig.1). Contrarily, a comparatively high number of toads (>40) was counted in external areas next to the western part of the National Park, which are used for forestry and logging and are located at lower altitudes. Toads showed high site fidelity: more than half of the captured toads (n = 31) were recaptured at least one more time.

Bombina variegata was found in various water bodies, located mainly on pastures. Ponds, formed by trampling of the cattle, wallows of the red deer, road ditches, wheel ruts and even drinking troughs were used. Despite the relatively high availability of ponds at higher altitudes, toads were predominantly found at 1100-1300 m above sea level.

Only one juvenile toad was captured, which suggests low reproductive success in the previous year. Limited evidence of reproduction was obtained in 2016: in five water bodies spawn or tadpoles were recorded, in two of them larvae actually reached metamorphosis.

Pictures of the toads' ventral patterns taken in 2010 (WERBA 2011) enabled their recognition in 2016. More than half of those toads were recaptured in 2016 (17 of 33 individuals); since they had already been adult in 2010, their minimum age was 9 years.

On average, snout-vent length and body mass of toads were lowest in external areas nearby the National Park and highest in areas 1100 m above sea level. Body condition, which is considered to be an indicator for the energy capital and, by extension, for an animal's health (PEIG & GREEN 2009), was positively correlated with altitude ($r = 0{,}208$; $t(127) = 2{,}3975$, $p = 0{,}018$) (Fig.2).

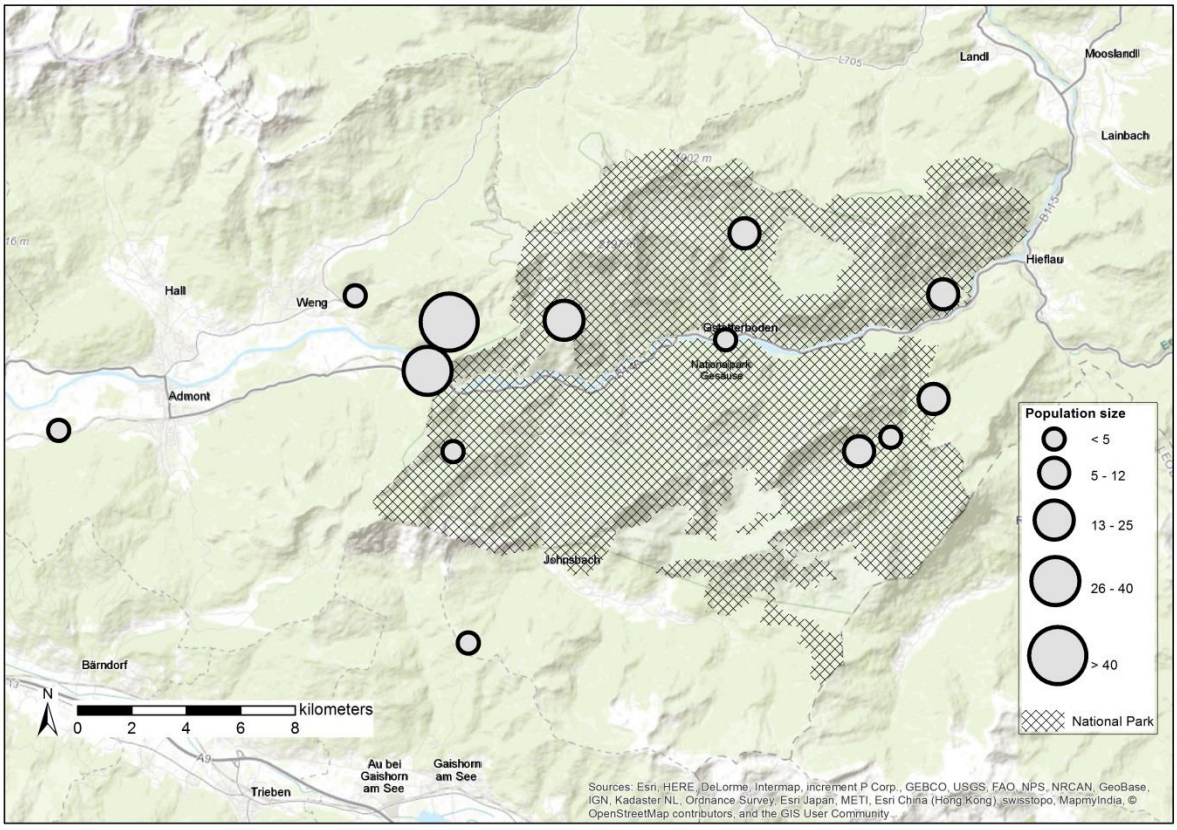

Figure 1: Estimated population size by using the Peterson-Lincoln method in the Gesäuse National Park and areas nearby (© M. Baumgartner)

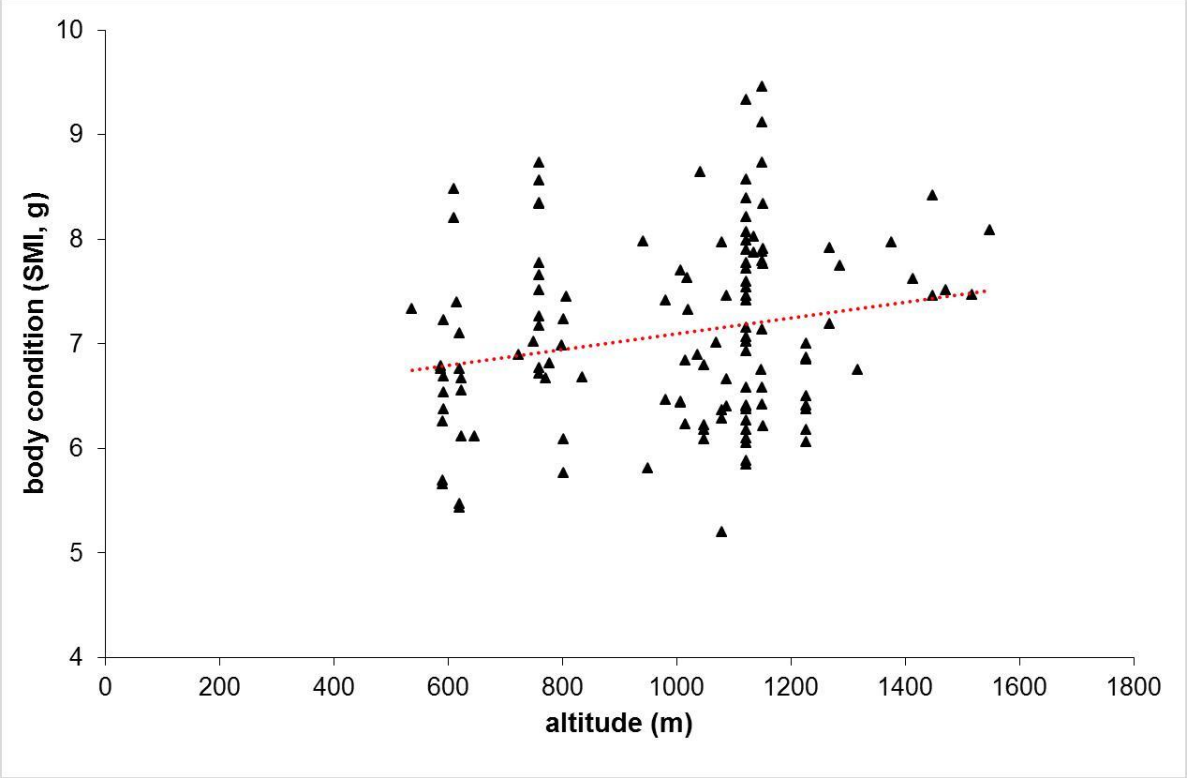

Figure 2: Correlation of body condition (Scaled mass index calculated for a reference length of 45,1 mm SVL) with altitude. Toads from all investigated sites (Gesäuse National Park, external areas and Kalkalpen National Park) are included (n = 129) (© M. Baumgartner)

Discussion

The small number of individuals of *Bombina variegata* and the low reproductive success in Gesäuse National Park presumably relate to several factors. First, the National Park is located close to the Central Alps, which probably are a natural distribution boundary. Additionally, this area is characterized by steep and rough cliffs. Possibly suitable breeding habitats for the species are thus rare especially at lower altitudes. The colder climate conditions at higher altitudes lead to a shortened activity period of the toads. Second, flatter areas with ponds only occur above 1000 m. They are often used as pastures; cattle and big game are important for creating and renewing temporary pools. These animals, however, can represent a threat to the toads if trampling and wallowing happen too often. Furthermore, the alpine newt (*Ichthyosaura alpestris*), which often occurs in the same waters as the yellow-bellied toad, is considered to be a predator especially of spawn and tadpoles.

The total number of individuals in the National Park is probably underestimated by our mark-recapture analysis. Fast colonization of newly formed habitats (e.g. drinking troughs for cattle) suggests that, beside the philopatric toads, also mobile individuals ('floaters') live in the National Park. The high recapture rates refer to high and partly longstanding site fidelity of the toads but may also be the consequence of isolation. Far distances between the populations may make it difficult for toads to switch between sites.

The small number of juveniles as well as the large sizes of adults in the National Park suggest a high average age of the toads. Many amphibians tend to get older at higher altitudes and latitudes (HEMELAAR 1988, SMIRINA 1994). The high body condition at higher altitudes suggests that these habitats provide more favourable growth conditions. Higher body condition, however, may also be connected to the shortened activity period and the lower reproductive participation of the toads at higher altitudes.

Conclusion

In the Gesäuse National Park, populations of *Bombina variegata* are highly endangered. Hence, conservation and management tasks should secure and improve their situation by saving and providing appropriate habitats, which are mainly located on the pastures. Conservation and creation of spawning ponds as well as regular monitoring are crucial. As this species can benefit from secondary habitats originating from human disturbances, e.g. roadside ditches or wheel ruts (GOLLMANN & GOLLMANN 2012), it seems to be of particular importance to raise awareness of this species and to spread knowledge about its preferred habitats among local people in order to preserve newly formed water bodies. Therefore, collaboration with people working in forestry and agriculture is vital.

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Contact

Magdalena Baumgartner, Günter Gollmann
Magdalena.Baumgartner@gmx.at; guenter.gollmann@univie.ac.at
University of Vienna
Department of Theoretical Biology
Althanstr. 14
1090 Vienna
Austria