
New data on the distribution of the Sardinian brook salamander (*Euproctus platycephalus*) in the southern and western Limbara mountain complex (Sardinia).

STEFANO BOVERO^{1*}, GIUSEPPE SOTGIU², CLAUDIO ANGELINI³, STEFANO DOGLIO¹, ENRICO GAZZANIGA⁴ and LUCA PICCIAU⁴

¹ *Dipartimento di Biologia Animale e dell'Uomo, Università degli Studi di Torino, Italy*

² *Dipartimento di Zoologia e Antropologia Biologica, Università degli Studi di Sassari, Italy*

³ *Dipartimento di Biologia Animale e dell'Uomo, Università "La Sapienza" di Roma, Italy*

⁴ *Museo Regionale di Scienze Naturali di Torino, Italy*

* Corresponding author: Email: stefano.bovero@tin.it

THE Sardinian brook salamander (*Euproctus platycephalus*) is an endangered species of newt, endemic to the island of Sardinia (Italy), where it is still present mainly in the eastern part of the island, in the mountains of Limbara (north), Gennargentu (centre), and Sette Fratelli (south). Grossenbacher (quoted by Andreone & Luiselli, 2000) considered this species to be the rarest and most threatened salamander in Europe. It is listed as critically endangered on the IUCN Red List (2000), is protected by the Bern Convention (1998), is included in Appendix IV of the Habitat Directive, and is protected by Regional Law n° 23/1998. From the early 1980s, however, the species has severely declined both in the number of populations and in the number of mature individuals per population (Puddu *et al.*, 1998; Van Rooy & Stumpel, 1995; Giacomina *et al.*, in press). The building of dams and excessive water catchments predominantly for agricultural or home use can increase both fragmentation and disappearance of habitat for this species (Van Rooy & Stumpel, 1995; Giacomina *et al.*, in press). Other factors also detrimentally affecting small Sardinian streams include water pollution (mainly pesticides and other chemicals for agricultural use) and illegal fishing methods (electric batteries, poisons and pool drainage) still in use in many wild areas on the island (Schenck *et al.*, 1995).

Among the causes responsible for the decline of the Sardinian brook salamander, the introduction

of allochthonous fish (*Salmo trutta* and *Oncorhynchus mykiss*) for angling purposes, which began around 1900 and continued for almost a century (Regione Sardegna, 1997), can represent another serious hazard for newt populations, as reported for *E. asper* (Serra-Cobo *et al.*, 2000). In order to investigate fish-salamander interaction, we obtained a grant from the Declining Amphibian Population Task Force and began a study in 2004 in the Limbara mountain complex, where allochthonous Brown trout (*Salmo trutta*) had recently been introduced. In this paper, we report on the occurrence of *E. platycephalus* in this area and present some new records and ecological remarks.

The Limbara Mountain Complex is a palaeozoic granite massif in N.E. Sardinia which ranges in altitude between 400 and 1353 m a.s.l.. One of the peculiarities characterising the Limbara area is the presence of numerous springs. Although the area has been plagued by forest fires, the vegetation, mostly represented by Mediterranean maquis, is remarkably rich with cork oak, lentisc trees, holm oak, *Cistus* spp., myrtle, strawberry trees and juniper plants.

The data herewith reported were collected during two surveys undertaken in June (1st to 7th) and in September (10th to 16th), 2004 on southern and western versants of the limbara mountain complex. Using cartographic and field reconnaissance, bibliographical data, and

Site	Research stretch and altitude range	Type of site	June records	September records	Preceding record	Presence of fish	Serious dangers
Rio Pisciaroni	2.3 km (550-910 + 1009-1025 m a.s.l.)	stream pools	-	larvae < 5	Lecis & Norris (2003)	-	summer drainage
Rio Sa Mela	3.2 km (597-1010 m a.s.l.)	stream pools	adults < 5	adults < 10 larvae < 10		<i>Salmo trutta</i>	summer drainage
Rio Pagghiolu	1.7 km (600-910 m a.s.l.)	canalised stream	adults < 5	-	-	<i>Anguilla anguilla</i>	summer drainage, water catchments, illegal fishing methods
Rio Li Reni	1.4 km (725-800 m a.s.l.)	Slow flowing streams	adults < 5	-	-	<i>Anguilla anguilla</i>	summer drainage, water catchments, illegal fishing methods
Rio Val di Musca	1.8 km (730-880 m a.s.l.)	-	-	-	Forest Guards (1996)	-	summer drainage
Rio Lu Frassu	1.5 km (544-830 m a.s.l.)	-	-	-	Forest Guards (1996)	<i>Salmo trutta</i>	summer drainage
Rio Contra Manna	1.3 km (960-1000 m a.s.l.)	-	-	-	Forest Guards (1995)	<i>Salmo trutta</i>	summer drainage

Table 1. Occurrence of *Euproctus platycephalus*, *Salmo trutta trutta* and *Anguilla anguilla* in southern and western Limbara.

information from the Forest Guards of the Ente Sardo delle Foreste and local people, we searched in brooks and other water bodies in areas where salamanders and fish were likely to inhabit. Initially we looked for animals in the water by sight. We then overturned underwater rocks and one of our party, Giuseppe Sotgiu, snorkelled and dived.

We located *Euproctus platycephalus* at four sites, which are listed in table 1. With the exception of Rio Pisciaroni (Lecis & Norris, 2003), the other three sites represent new records for this species. We failed to find the species at three historical sites suggested to us by the Forest Guards. Rio Sa Mela populations were observed for the first time by GS in 1993 (unpublished data) and, following the negative results of the Lecis & Norris (2003) expedition, we can reconfirm the presence of *E. platycephalus* in this area. All sites were either pools or streams with slow-running

water. However, in one case, we observed salamanders in a heavily canalised stream. During the June survey, water levels were high and streams were flowing rapidly while, in September, summer drought brought about the isolation of ponds and water shrinkage. At all sites only a low population density was observed.

It is possible that the number of salamanders found was negatively influenced by the rapid water flow in June. In September, when we predominantly observed larvae, the water level of the streams was very low and several pools, observed to contain water in June, were completely dry. During the same months, we conducted a survey in the Gorroppu Valley (east side of central Sardinia) and found a large number of adults in the water. The Gorroppu populations live in deep, permanent pools in a very harsh environment, where wet refuges are nearly absent. The Limbara populations live in streams where the water level rises and falls with the seasons but the surrounding Mediterranean maquis permits the presence of refuges. We hypothesise that the species has different adaptive strategies depending

on the environment in which the populations are located. Natural terrestrial phases such as hibernation and aestivation, although as yet not documented for this species, may occur in contexts where access to water is not available all year round (Limbara streams for example). Bovero *et al.* (2003) suggest the occurrence of terrestrial phases in *E. platycephalus*, and, indeed, terrestrial phases are documented for the other two species of the same genus, *E. asper* (Montori, 1990) and *E. montanus* (Alcher, 1978). Moreover, Alcher (1980) observed that some *E. platycephalus* adults, in lab conditions, had terrestrial phases.

Nevertheless, the small number of larvae we found, taking into account that they can take up to 15 months to metamorphose, leads us to believe that Limbara populations are decreasing in individual numbers. Additionally, we failed to locate the species in Rio Val di Musca, Rio Lu Frassu and Rio Contra Manna. And in Rio Pagghiolu and Rio Li Reni where the Forest Guards recalled seeing *E. platycephalus* up until 1996, we observed a distinctly lower number of individuals than expected. Finally, Lecis & Norris (2003) reported a 'high density' of salamanders in Rio Pisciaroni – we only found a few larvae in this area.

We consider extraordinary summer drainage, such as that which occurred in the last few years (Decree of the 3rd of June 2002 of the Ministero delle Politiche Agricole e Forestali) to be a serious threat to the Limbara populations. Furthermore, we discovered two water catchments for agricultural purposes located alongside two different streams inhabited by *Euproctus*. Water catchments reduce and fragment water habitat (Van Rooy & Stumpel, 1995; Giacomina *et al.*, in press). The use of chloride to capture eels and trout presents yet another serious threat as this illegal method of fishing can kill all newts for several hundred metres along the stream (pers. obs.).

With regards to fish-salamander interaction, the significant decrease of *E. platycephalus* in Rio Pisciaroni and its apparent disappearance in Rio Val di Musca where there are no fish is interesting, particularly as in Rio Sa Mela we observed a

relative abundance of salamanders co-habiting with fish in brooks. During our surveys in Limbara, we flushed the stomachs of some *Salmo trutta* specimens that were living alongside the salamanders. We did not find any trace of predation on *E. platycephalus* eggs, larvae or metamorphosed specimens in the stomach contents (Bovero *et al.*, in prep.). Nevertheless, when intense stream drainage (due both to severe summer droughts and water catchments) reduces food resources, fish could potentially feed upon salamanders as well as compete for food in restricted habitat (Serra-Cobo *et al.*, 2000).

Consequently, as a conservation measure, we suggest the limitation of water catchments, especially in areas inhabited by salamanders. Furthermore, the introduction of fish should be limited, or at least regulated, to ensure that current fish biomass does not increase. Most importantly, the introduction of alien fish species such as Rainbow trout or Brown trout from non-Mediterranean stock should be avoided.

Lastly, we wish to point out the importance of employing snorkelling and diving as an investigative technique. This method enabled us to find the greatest number of salamanders and could, therefore, be essential in the research of not only *E. platycephalus*, but also other species sharing similar behavioural traits and/or rarefaction trends.

ACKNOWLEDGEMENTS

We wish to thank the D.A.P.T.F. organisation for its financial contribution; Mr. Gian Piero Serra and all the other Ente Sardo Foreste workers who helped us locate many of the sites; and the geometrician, Mr. Sussarello, who assisted us with logistics and obtaining permission to operate in protected areas.

REFERENCES

- Alcher, M. (1978). *Euproctus* corse en Atlas préliminaire des Reptiles et Amphibiens de France. *Soc. herpet. Fr.* Montpellier, 137 pp.
- Alcher, M. (1980). *Maintien en captivité des Amphibiens torrenticoles Euproctus*

- platycephalus* et *E. montanus* (Urodela, Salamandridae). Conditions d'obtention de la reproduction de l'espèce sarde. *Rev. fr. Aquariol.* **7**, 61–64.
- Andreone, F. & Luiselli, L. (2000). Italian batrachofauna and its conservation status: a statistical assessment. *Biol. Conserv.* **96**, 197–208.
- Bern Convention, (1988). Appendix II/Annexe II; Strictly Protected Fauna Species. Available from: <http://www.enc.nl/doc/europe/legislat/bernapp2.html>.
- Bovero, S. Sotgiu, G., Castellano, S. & Giacoma, C. (2003). Age and Sexual Dimorphism in a Population of *Euproctus platycephalus* (Caudata: Salamandridae) from Sardinia. *Copeia* **2003**(1), 149–154.
- Cobo, J., Marquès-Bonet, T. & Martínez-Rica, J. P. (2000). Ecological segregation between *Rana pyrenaica* and *Rana temporaria*, and differential predation of *Euproctus asper* on their tadpoles. *Neth. J. Zool.* **50** (1), 65–73.
- Giacoma, C. Bovero, S. Balletto, E. (in press). The Sardinian Brook Salamander *Euproctus platycephalus* (Gravenhorst, 1829). I.U.C.N. (Ed.) Action Plan for Threatened European Herpetofauna.
- Lecis, R. & Norris, K. (2003). Geographical distribution of the endemic Sardinian Brook Salamander, *Euproctus platycephalus*, and implications for its conservation. *Herpetol. J.* **13**, 125–133.
- Ministero delle Politiche Agricole e Forestali – Decreto del 3 giugno 2002: Dichiarazione dell'esistenza del carattere eccezionale degli eventi calamitosi nelle province di Cagliari, Nuoro, Oristano e Sassari. Gazzetta Ufficiale italiana n. 156 del 5 luglio 2002.
- Montori, A. (1990). Skeletochronological results in the Pyrenean newt *Euproctus asper* from one Prepyrenean population. Lecture from the 1st World Congress of Herpetology, Canterbury 1989. *Annls. Sci. nat. Zool.* **11**, 209–211.
- Puddu, F. Viarengo, M. & Ermineo, C. (1988). Euproctus sardo. In: *Animali di Sardegna: gli Anfibi e i Rettili*. Ed. Della Torre, Cagliari. Regione Sardegna (1997). Valutazione della popolazione della trota sarda *Salmo trutta macrostigma* nelle acque interne della Sardegna ai fini del suo recupero. Assessorato alla Difesa dell'Ambiente & Dipartimento di Biologia Animale ed Ecologia (Università di Cagliari). Relazione. Cagliari.
- Rimpp, K. (1998). *Euproctus platycephalus* (Gravenhorst, 1829). In *Atlas of Amphibian and Reptiles in Europe*. Societas Europea Herpetologica & Museum National d'Histoire Naturelle.
- Schenk, H. Aresu, M. & Fozzi, A. (1995). Libro rosso dei vertebrati terrestri del Marghine-Planargia. Legambiente-Circolo di Iniziativa Ambientale (Macomer).
- Van Rooy, T.J.C. & Stumpel, A.H.P. (1995). Ecological Impact of Economic Development on Sardinian Herpetofauna. *Conserv. Biol.* **9**, 263–269.