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Updated distribution of *Hydromantes italicus* Dunn, 1923 (Caudata Plethodontidae): a review with new records and the first report for Latium (Italy)

Giacomo Bruni[1,*], Riccardo Novaga[2], David Fiacchini[3], Cristiano Spilinga[4] & Dario Domeneghetti[5]

[1]Vrije Universiteit Brussel, Boulevard de la Plaine 2, 1050 Ixelles, Bruxelles, Belgium
[2]Sapienza University of Rome, Piazzale Aldo Moro 5, 00185 Rome, Italy
[3]Via Frontillo 29, 62035 Pievebovigliana, Macerata, Italy
[4]Studio Naturalistico Hyla s.n.c., Via Aganoor Pompili 4, 06069 Tuoro sul Trasimeno, Perugia, Italy
[5]University of Rome "Tor Vergata", Via della Ricerca Scientifica 1, 00133 Rome, Italy
[*]Corresponding author, email: giacomo.b90@gmail.com

ABSTRACT The Italian cave salamander *Hydromantes italicus* Dunn, 1923 (Caudata Plethodontidae) is an eutroglophilic amphibian found along the Appennines from Emilia-Romagna to Abruzzo, however the available bibliography shows inconsistencies in distribution data. Herein we provide an updated distribution of the species, with new records and the first detection for Latium in the Gran Sasso and Monti della Laga National Park in the Province of Rieti.

KEY WORDS Italian cave salamander, *Hydromantes*; distribution data; Monti della Laga; Latium.

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INTRODUCTION

Hydromantes italicus Dunn, 1923 (Caudata Plethodontidae) is an eutroglophilic salamander species found both in natural and artificial environments, such as underground cavities (caves, mines, etc.) and surface habitats (rock outcrops, dry-stone walls, etc.).

Like the other plethodontids, *H. italicus* has no lungs and breathing occurs through the skin and the buccal mucosa, for this reason this amphibian can live only in humid and fresh conditions; in fact *H. italicus* spends most of its life into the ground, coming to the surface at night or concomitantly with wet weather (Lanza et al., 2005).

Hydromantes italicus is one of the three species of the genus *Hydromantes* found along the Italian Peninsula. The known range of the species goes from the northern limit of Onfiano, province of Reggio Emilia (Gigante, 2009) to the the southern limit of Pescosansonesco, province of Pescara (Lanza et al., 2006). According to Lanza et al. (2005), *H. italicus* is present in the regions of Emilia-Romagna (Provinces of Reggio Emilia, Modena, Bologna, Ravenna and Forlì-Cesena), Tuscany (Provinces of Lucca, Pistoia, Prato, Firenze and Arezzo), Umbria (Province of Perugia), Marche (Provinces of Pesaro-Urbino, Ancona, Macerata, Fermo and Ascoli Piceno) and Abruzzo (Provinces of Teramo and Pescara). Despite the proximity of certain reports, the species had never been found in Latium (Bologna et al., 2000; Lanza et al., 2006). *Hydromantes italicus* is also present in the Republic of San Marino.

Outside of its natural range *H. italicus* has been introduced in a cave in the Province of Siena (Cimmaruta et al., 2013), in the "Gessi di Brisighella" area (Bassi & Fabbri, 2006) and in Germany in the "Weser Uplands" in Lower Saxony (e.g. www.fieldherping.eu/Forum/).

The altitudinal range varies from 80 m (Garfagnana, province of Lucca) up to 1598 m above sea level (Apuan Alps, province of Lucca) (Lanza et al., 1995). Despite the presence of suitable environment, *H. italicus* is absent from high altitudes on Apennines (Lanza et al., 1995). To explain this trend, Lanza et al. (2005) have speculated that the highest mountains still haven't been re-colonised since the Quaternary glaciations, or that *H. italicus* isn't an euryzonal species and is effectively incapable to occupy habitats above 1600 m asl.

On the Apuan Alps there is a hybrid zone in which the genome of *H.italicus* populations is, to varying degrees, introgressed with genes of *H. ambrosii bianchii* Cimmaruta, Lanza, Forti, Bullini et Nascetti, 2005. Ruggi (2007) has shown that *H. italicus* with introgressed alleles occurs at least up to the provinces of Florence, Bologna and Modena; instead pure populations are present from Umbria to Abruzzo and also in the northern limit in the province of Reggio Emilia.

Consulting the distributional data reported in the available bibliography, we have noticed inconsistencies and lacks of occurrences in some areas. In this paper we provide a review of the known distribution with new reports and the first data for Latium.

MATERIAL AND METHODS

To establish the known distribution of *H. italicus*, we consulted and compared the distributional data provided in CKmap (Checklist and Distribution of the Italian Fauna - version 5.3.8), in national and regional atlas and in conference papers.

In particular, we referred to the Atlas of Amphibians and Reptiles of Italy (Razzetti et al., 2006), Atlas of Amphibians and Reptiles of Tuscany (Vanni & Nistri, 2006), Amphibians and Reptiles of Umbria (Ragni et al., 2006), Atlas of Amphibians and Reptiles of Emilia-Romagna (Mazzotti et al., 1999), Atlas of Amphibians of Abruzzo (Ferri & Soccini, 2007) and Atlas of Amphibians and Reptiles of Sibillini Mountains National Park (Fiacchini, 2013).

Some data for Marche, Umbria and Abruzzo have been obtained from the following conference papers: Fiacchini (2008), Spilinga et al. (2008), Ferri et al. (2008), Cameli et al. (2016) and from the monography on European cave salamanders edited by Lanza et al. (2005).

Moreover, some documented sightings in new UTM 10x10 km squares were derived from the maps available on Ornitho.it database (www.ornitho.it) and from nature enthusiasts.

In addition to searching for new localities in our back data, we conducted a field research during the season 2015-2016, looking for *H. italicus* in some UTM 10x10 km squares in which the species is reported as absent and in particular in the Province of Rieti (North-East Latium). We actively searched the species in surface mainly in rainy nights via flashlight or during the daytime inspecting the rock crevices or the stonewalls. We also evaluated the presence of suitable habitats via Google Street View (http://maps.google.com). We used a digital camera for documenting the sightings and a GPS to register the exact location.

On the updated distributional map (Fig. 1), the presence sites are shown on the centroid of the respective UTM square 10x10 Km, sample sites of Rieti Province (Fig. 2) are shown in WGS 84 Longitude - Latitude coordinates. Maps were drawn by Quantum GIS - Valmiera 2.2.0 version.

RESULTS

Layering data reported in the various publications, we noticed some discrepancies that were unrelated to the publiction dates.

During field surveys, we found *H. italicus* in 11 localities in 9 new UTM 10x10 km squares (Table 1).

We detected the presence of *H. italicus* in only one locality in the Province of Rieti, Latium (Table 3). We found 3 adult individuals along the watercourse "Fosso di Valle in Sù" that flowing down from the area of lakes "Lago Secco" and "Lago della Selva", not far from the locality Poggio d'Api, on a sandstones and marls outcrop in the lower bound of the beech forest (Figs. 3, 4).

One of the Authors (D.F.) received on August 2015 a documented sighting of *H. italicus* from a

small unregistered cave on the eastern slope of Monte Utero, in the Municipality of Accumoli, virtually in the new UTM square 33T UH52. Nevertheless, we have investigated neighbouring areas without being able to corroborate the data.

Excluding two UTM squares where the Italian cave salamander has been introduced artificially, the UTM squares occupied by the species according to published data are 125.

Our new sightings and unpublished data show that *H. italicus* is present in at least 142 UTM squares (Fig. 1).

DISCUSSION

Knowing the distribution of a species is essential for its conservation and to better understand its ecology and biogeography. The UTM squares reported in the Atlas of Amphibians and Reptiles of Italy where *H. italicus* naturally occurs are 105 (Lanza et al., 2006). Nevertheless, by adding up pre-existing and subsequent published data, unpublished data and new sightings, we demonstrate the presence of *H. italicus* in a total of 142 UTM squares. The report by Ruggi (2007) for Capo d'Acqua, in

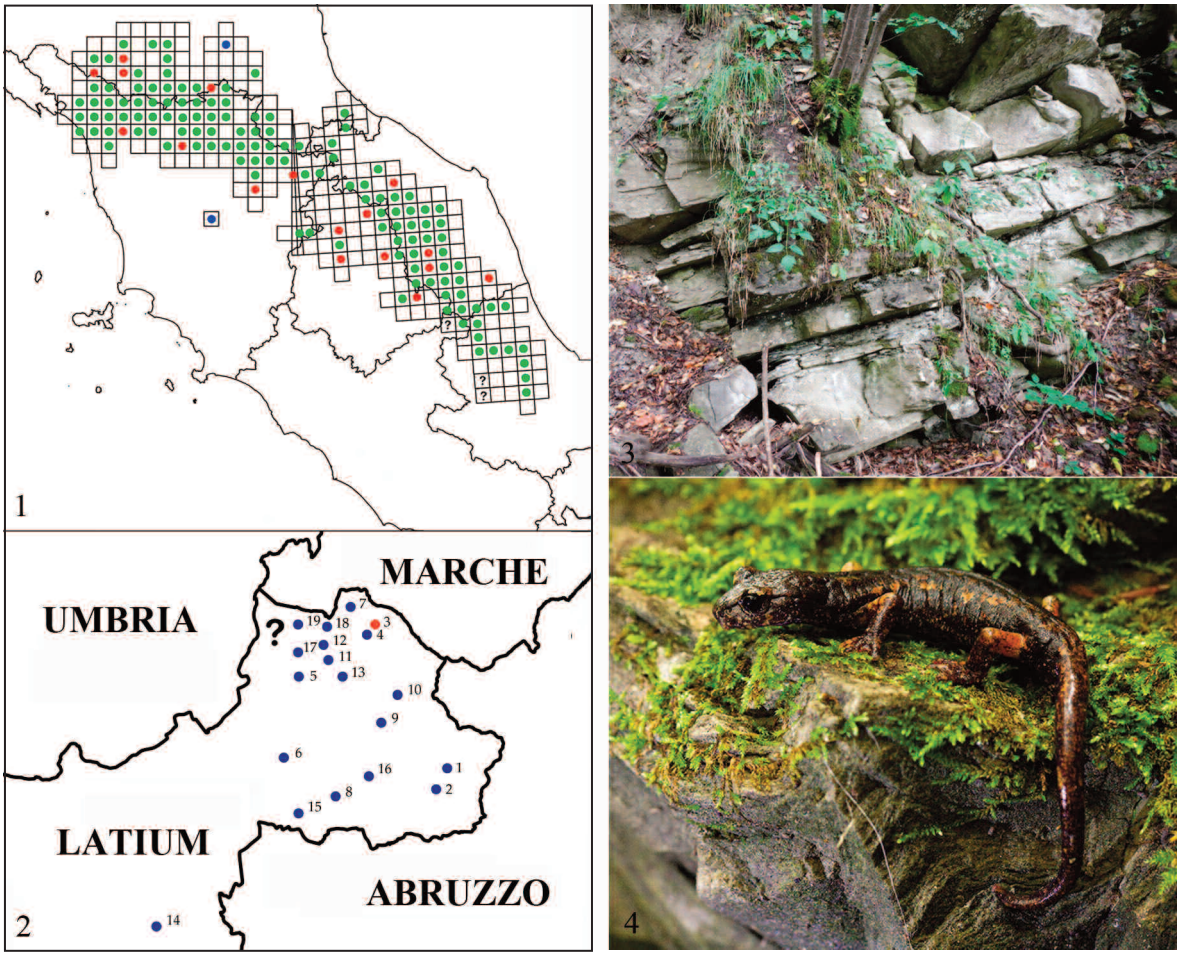

Figure 1. *Hydromantes italicus* updated national distribution. Green dots represent sites in UTM previously published. Red dots represent new occurences in UTM not yet published: from this study and second-hand data. Blu dots represent the two known introduced populations. Question marks represent UTM doubtful and not yet confirmed. Figure 2. Sample sites of the field reserch in Province of Rieti (Latium): 1 Sacro Cuore di Capricchia; 2 Preta; 3 Poggio d'Api (1); 4 Poggio d'Api (2); 5 Villanova; 6 Pasciano; 7 Grisciano; 8 Cornelle; 9 Sant'Angelo; 10 unnamed road to Macchie piane; 11 between Tino and Accumoli; 12 rx tributary "F.so di Valle Castello"; 13 Libertino; 14 Posta; 15 Scai; 16 Collemagrone; 17 "F.te Crocetta"; 18 Tino; 19 "F.te i Trocchi". Question mark represent the "M. Utero" area, not confirmed in our study. Figures 3, 4. *Hydromantes italicus* habitat in Poggio d'Api locality (Fig. 3), one of the three adult individuals observed in the same site (Fig. 4).

Date	Locality	UTM square	Elevation (m)	Environment
27/01/16	Bruceto, Carmignano (PO)	32T PP65	240	Epigeal
2003	Monte Ingino, Gubbio (PG)	33T UJ00	645	Hypogeal
11/01/08	Monte Acuto, Umbertide (PG)	33T TH89	878	Hypogeal
1998	Piano di Nese, Umbertide (PG)	33T TH89	400	Hypogeal
15/05/04	Santa Sabina, Corciano (PG)	33T TH87	226	Hypogeal
09/04/16	Monte Subasio, Assisi (PG)	33T UH17	633	Epigeal
10/08/06	Balza Tagliata, Cerr. di Spoleto (PG)	33T UH34	424	Hypogeal
06/10/06	Bagni di Triponzo, Cerr. di Spoleto (PG)	33T UH34	700	Hypogeal
07/06/15	Valdiea di Camerino, Camerino (MC)	33T UH47	390	Epigeal
12/10/14	Alfi, Fiordimonte (MC)	33T UH46	630	Hypogeal
16/04/16	Vallotica, Sassoferrato (AN)	33T UJ22	460	Epigeal

Table 1. New localities collected during field survey and not yet published.

Locality	UTM square	References
Ligonchio, Ventasso (RE)	32T PQ00	Sara Lefosse & Alessandro Riga Pers. Comm.
"F.so di Carpineti", Palagano (MO)	32T PQ20	Massimo Gigante Pers. Comm.
Cà Falchetti, San Benedetto Val di Sambro (BO)	32T PP89	Francesco Nigro Pers. comm.
Ponte alla Piera, Anghiari (AR)	32T QP43	Elia Serafini Pers. Comm.
Monte Ascensione, Ascoli Piceno (AP)	33T UH85	Amedeo Capriotti & Giorgio Marini Pers. Comm.
Faeto, Loro Ciuffena (AR)	32T QP12	Nicola Baccetti - Ornitho.it
Anchiano, Borgo a Mozzano (LU)	32T PP26	Enrico Lunghi & Domenico Verducchi - Ornitho.it
Corneto, Toano (RE)	32T PQ21	Massimo Gigante - Ornitho.it

Table 2. New localities collected from second-hand data.

Date	Locality	UTM square	Amphibian species
8/10/15	Sacro Cuore di Capricchia, Amatrice	33T UH62	
8/10/15	Preta, Amatrice	33T UH61	
9/10/15	Poggio d'Api, Accumoli (1)	33T UH63	*Hydromantes italicus*
10/10/15	Poggio d'Api, Accumoli (2)	33T UH63	*Rana temporaria*
10/10/15	Villanova, Accumoli	33T UH52	*Rana italica*
10/10/15	Pasciano, Amatrice	33T UH52	*Rana italica*
8/4/16	Grisciano, Accumoli	33T UH53	
8/4/16	Cornelle, Amatrice	33T UH51	*Triturus carnifex*
8/4/16	Sant'Angelo, Amatrice	33T UH62	*Rana temporaria*, *Pelophylax* sp., *Hyla intermedia*
8/4/16	Unnamed road to Macchie Piane, Amatrice	33T UH62	*Rana italica*, *Bufo bufo*
9/4/16	Poggio d'Api, Accumoli	33T UH63	*Rana italica*
9/4/16	Between Tino and Accumoli, Accumoli	33T UH52	*Hyla intermedia*, *Bufo bufo*
9/4/16	Right tributary "F.so di Valle Castello", Accumoli	33T UH52	*Salamandrina perspicillata*, *Rana italica*
9/4/16	Libertino, Accumoli	33T UH52	*Triturus carnifex*, *Rana dalmatina*
15/5/15	Posta	33T UH40	
15/5/15	Scai, Amatrice	33T UH51	
15/5/15	Collemagrone, Amatrice	33T UH51	*Rana dalmatina*
15/5/15	Cornelle, Amatrice	33T UH51	*Rana italica*
16/5/15	"F.te Crocetta", Accumoli	33T UH53	
27/6/16	Tino, Accumoli	33T UH53	*Rana italica*, *Pelophylax* sp.
27/6/16	"F.te i Trocchi", Accumoli	33T UH53	*Pelophylax* sp.

Table 3. Localities investigated in the Province of Rieti (Latium, Italy).

UTM square 33T VG08, is particularly relevant since represents the first data for the Province of L'Aquila. Our sighting in the locality of Poggio d'Api in the Province of Rieti, despite laying in the UTM UH63 formerly known for the species, constitutes the first report for the Latium Region. Our field survey in other zones of the Province of Rieti, lead us to assume that the species has colonized this area relatively recently, probably moving up the right side of the Tronto river's valley. Furthermore, it seems plausible that in future the species could possibly spreads in the area, given the absence of natural obstacles and the presence of environmental characteristics compatible with its ecological requirements. On the other hand, the documented sighting of Italian cave salamander for Monte Utero, if correct, combined with our negative result in the search of the species on the left side of the Tronto's valley, that anyway could have been caused by research limits, opens the door to a different way of colonization for this part of the Province of Rieti. On the basis of genetic findings, Ruggi (2007) considers reasonable that *H. italicus* has had a recent expansion from the Tosco-Emiliano Apennine south to Abruzzo. This scenario would explain the partial rarity of the species in the southern portion of its range, where it could be considered really threatened (Lanza et al., 2006). In fact already in the southern part of the Monti Sibillini, the species is reported in few localities despite the abundance of limestone substrates that provides suitable microhabitats (Fiacchini, 2013). The occurrence in the Monti della Laga area, at the boundary between Latium, Abruzzo and Marche regions, needs to be investigated more carefully in order to work out the availability and suitability of habitats, and to evaluate both natural and human threats.

Considering the rarity of *H. italicus* in the area of Monti della Laga, protection measures of the only locality where the species is present will be strongly required. In fact, it is well-known that an excessive frequentation of ravines, talwegs, caves and artificial cavities by the public, together with the alteration of the natural environment (e.g. wood cutting) could have a highly negative impact on salamanders both for microclimate variation in the refuge surrounding and for habitat damage (Fiacchini, 2008; Spilinga et al., 2008). Even though *H. italicus* has never been reported in Latium before this study, the species is listed as protected in the Regional Law No. 18/1988, and this makes conservation measures easier to apply.

Many of our recent new records refer to individuals found in epigean environment, where the detectability of the species is strictly influenced by meteorological conditions and quite lower than the one in caves. In order to improve the results during the investigations of *H. italicus* in new areas, we therefore underline the importance of focusing the research on the surface habitats during favourable weather conditions (e.g. wet nights or rainy days).

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