

Overview of the slow worm *Anguis fragilis* Linnaeus, 1758 (Reptilia: Anguidae) findings in caves of Slovenia

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ABSTRACT

The slow worm (*Anguis fragilis*) is among the best-known reptiles in Slovenia, distributed throughout the country. Here, we report observations from caves based on information from local caving clubs' magazines and blogs, as well as our own fieldwork. Observations originate from different parts of the country. Most individuals were found under cave entrance pits (in five caves), while two observations were made in deeper cave sections away from entrance pits. In one cave, Velika jama nad Trebnjem, two dead individuals were found during two separate winter observations at the horizontal cave entrance. Although slow worms use underground shelters such as burrows of other animals or voids under stones during summer droughts and winter hibernation, their occurrences in karst caves can be considered accidental.

IZVLEČEK

Pregled najdb slepcev *Anguis fragilis* Linnaeus, 1758 (Reptilia: Anguidae) v jamah Slovenije

Slepec (*Anguis fragilis*) je med najbolj poznanimi plazilci v Sloveniji, razširjen je po vsej državi. V prispevku poročamo o opažanjih iz jam na podlagi podatkov, zbranih iz glasil in blogov lokalnih jamarskih društev, kot tudi lastnega terenskega dela. Opažanja izvirajo iz različnih delov države. Večina osebkov je bila najdena pod vhodnimi brezni jam (pet jam), medtem ko sta bila v dveh jamah osebka globlje v jami, oddaljena od vhodnih brezen. V Veliki jami nad Trebnjem sta bila v času dveh ločenih zimskih opažanj najdena dva poginula osebka na vodoravnem vhodu v jamo. Čeprav se slepci med poletnimi sušami ali med zimskim mirovanjem skrivajo v podzemnih zatočiščih, kot so rovi drugih živali ali vdolbine pod kamni, pa lahko njihovo pojavljanje v kraških jamah obravnavamo kot naključno.

INTRODUCTION

The slow worm (*Anguis fragilis* Linnaeus, 1758) is the only legless reptile living in Slovenia (Tome 1996; Krofel et al. 2009). Due to its recognisability, it is among the best-known reptiles, distributed all over the country, with findings from lowlands to up to 1,500 m altitudes (Tome 1996; Krofel et al. 2009). At a broader scale, the slow worm has one of the widest geographic ranges among Eurasian reptiles, extending far into northern Europe and approaching the Arctic Circle (Gasc et al. 2004; Sillero et al. 2014). The species is a habitat and dietary generalist,

living in forests and semi-open environments and feeding on earthworms, slugs and other invertebrates. It has a semi-fossorial lifestyle and is viviparous, traits that together with relatively low body temperatures and a predominantly thigmothermic mode of thermoregulation (Brown & Roberts 2008) facilitate persistence in cooler climates.

Despite its tolerance for low temperatures, it is generally not expected, as a reptile species, to visit caves in temperate zones. Yet, it is reported among Pleistocene fossil remains of herpetofauna in some caves in Europe, like in Belgium (Blain et al. 2014), Italy (Delfino 2004), Serbia (Đurić et al. 2017) and





UK (Holman 1993). On the other hand, surprisingly, there are virtually no recent reports of the species from caves in searchable scientific literature and portals. In the citizen science portal iNaturalist, there is a single observation of the species from a cave, reporting on the finding of a dead individual from »the water of a small cave pool« in Küsnacht in Switzerland (Spyr 2025). Additional records come from Italy, including a note in the Italian Alpine club's magazine (Ruocco 2007), and a photographic record published on the web page of a Ligurian speleological club (Bartolini 2016). Interestingly, even one Italian cave right on the border with Slovenia has been named after this species (CGEB 2025).

Own recent findings of slow worms in caves, and a lack of published data in the literature, encouraged the preparation of this contribution, where all records of the species from caves of Slovenia are gathered. Besides our own records, they include findings reported in grey literature (blogs, local cave clubs' magazines), that are not easily accessible to international readership.

MATERIAL AND METHODS

Our own field observations derive from visits to caves, performed during cave explorations to search for cave invertebrates or counts of bats. If a slow worm individual was found, photographs of the animal were taken and, in most cases, the individual was taken out of the cave for release at an appropriate site on the surface. In one case, the length of the animal was measured in the field and weighed, while in most cases, the length was estimated from the photographs, including sexing them based on characteristic body colour pattern (Arnold & Ovenden 2004).

Data on reported observations were taken from grey literature, including blogs and caver clubs' magazines. These sources were scrutinised during the routine work carried out by the Centre for Cartography of Fauna and Flora (CKFF), which collects distributional data of species in Slovenia in private database (CKFF 2025). All records reporting on slow worms were gathered, with all relevant details presented here.

RESULTS AND DISCUSSION

Slow worms were reported from eight different caves in Slovenia (Tab. 1, Fig. 1). Firstly, we present the findings taken from grey literature.

In Ferranova buža, an individual was found deeper in the cave some 35 m away from the cave entrance pit (Ferran 2003). From Medvedjak, there are two different observations of animals, in both cases found under the cave's 40 m deep entrance pit. The first observation is from Simić (1992), referring to the finding of a live animal. According to the notes in the registry of cave excursions by the Ljubljana Cave Exploration Society, this cave visit took place in March 1989 (Tab. 1). The second mention of an animal from Medvedjak is by Jazbec (2004), reporting on a dead individual, also under the cave entrance pit. As bats were also reported from this visit (CKFF 2025), the exact

date of the excursion in November 2003 could be determined (Tab. 1). Apart from these records, only the observation from Bokalovo brezno v Kovkah included a photograph of the animal published on a blog, taken at the bottom of about 9 m deep entrance shaft (Ramšak 2015). This small cave is not registered in the Slovenian Cave Registry (eKataster 2025), so its position could be determined approximately based on the description. From the photograph on the blog, we estimated the animal being a male.

Further seven records, originating from five different caves, are reported here for the first time.

In July 2003, one slow worm was observed at the bottom of the few metres deep entrance pit in the cave Turške jame in the North of the country (Tab. 1, Fig. 1).

In October 2023, one slow worm was found in the cave Dolenca in Western Slovenia (Tab. 1, Fig. 1). The individual was observed in a cave chamber, approximately 15 m deep and 20 m horizontal distance from the cave's gated entrance pit. When discovered, the animal was lying on rocks on the cave floor and was moving slowly. It was measured and weighed (length 33 cm, weight 13 g), and released after returned to the surface at least 50 m away from the cave entrance at the edge of the forest. According to the body colour pattern, it was most likely a pale female (Fig. 2).

In January 2024, one individual was found at the bottom of the 15 m deep entrance pit of the cave Habjanova jama in Central Slovenia (Tab. 1, Fig. 1), resting on a mixture of decaying wood, leaves and soil. After visiting the cave, and despite inhospitable conditions (snow) on the surface, the individual was released under a large boulder, approximately 100 m from the cave entrance. According to the body colour pattern, it was most likely a female of at least 28 cm in length (Fig. 2).

In summer 2025, we found two different slow worms upon two visits to the cave Logarček in Central Slovenia (Tab. 1, Fig. 1). In both cases, individuals were found on the muddy bottom, among leaves and soil, right under the about 20 m deep entrance pit of the cave. We collected the animals on both occasions and released them in the forest at least 50 m away from the cave entrance. The animal collected in June 2025 was about 30 cm in length, and with colouration of a female; the animal in July was smaller, about 16 cm long and most likely a female (Fig. 2).

Here we also report on two different observations of slow worms at the horizontal entrance to the cave Velika Jama nad Trebnjem (Tab. 1, Figs. 1, 3). In both cases, dead animals were lying approximately 1 m inside the cave. In the first case (February 2009), the animal was found lying in snow, with the posterior part missing, suggesting that a predator might have found the animal hibernating at the edge of the cave entrance (Fig. 3). In the second case, the cave was visited after a snowfall in January 2018. The animal was found lying on a bed of moist leaves immediately after the cave entrance.



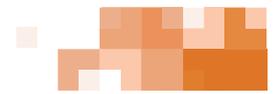


Table 1. Caves with records of slow worms. Numbers in brackets after cave name refer to the official registry numbers in the Slovenian Cave Registry (eKataster 2025). Loc. No. – Consecutive number of the cave; X, Y – latitude (North) and longitude (East) in WGS84 decimal degrees of the cave entrance (x – cave not registered, coordinates given approximately according to description of the position); Alt. – altitude of the cave entrance; No. – number of individuals; Alive – whether live individuals were found live or not; M – male, F – female, nd – sex not determined; Pos. – position within the cave: pit – under entrance pit, deep – deeper in the cave, h.entr. – at the horizontal entrance. The published records are listed first, followed by new observations. Dates marked with * are determined from secondary sources (see text for details).

Tabela 1. Jame s podatki o najdbah slepcev. Številke v oklepajih za imeni jam se nanašajo na katastrsko številko v Katastru jam Slovenije (eKataster 2025). Loc. No. – zaporedna številka navedene jame; X, Y – severna širina in vzhodna dolžina jamskega vhoda (WGS84 decimalne stopinje) (x – jama ni registrirana, koordinate so približne glede na opis lege); Alt. – nadmorska višina jamskega vhoda; No. – število osebkov; Alive – ali je bil najden osebek živ (yes) ali ne (no); M – samec, F – samica, nd – spol ni določen; Pos. – položaj znotraj jame: pit – pod vhodnim breznom, deep – globlje v jami, h.entr. – na vodoravnem vhodu. Najprej so navedeni objavljeni podatki, nato pa nova opažanja. Datuma označena z * sta povzeta iz sekundarnih virov (podrobnosti v besedilu).

Loc. No.	Cave	Town near	X, Y	Alt. [m]	Date	<i>Anguis fragilis</i> individuals				Reference/Legators
						No.	Alive	M/F	Pos.	
1	Medvedjak (881)	Markovščina	45.55728 14.00778	520	11. 3. 1989*	1	yes	nd	pit	Simič (1992)
					29. 11. 2003*	1	no	nd	pit	Jazbec (2004)
2	Ferranova buža (8085)	Stara Vrhnika	45.97632 14.25218	657	Not given	1	yes	nd	deep	Ferran (2003)
3	Bokalovo brezno v Kovkah*	Dol pri Hrastniku	46.1241* 15.1325*	unknown	15. 7. 2015	1	yes	M	pit	Ramšak (2015)
4	Turške jame (4461)	Koroška Bela	46.43098 14.10464	640	30. 7. 2003	1	yes	nd	pit	Primož Presetnik, Katerina Jazbec
5	Velika jama nad Trebnjem (104)	Trebnje	45.90050 15.00486	440	6. 2. 2009	1	no	F	h.entr.	Primož Presetnik, Monika Podgorelec, Tomaž Miklavčič
					8. 1. 2018	1	no	nd	h.entr.	Primož Presetnik, Tomaž Miklavčič
6	Dolenca jama (785)	Brestovica na Krasu	45.80922 13.64050	40	7. 10. 2023	1	yes	F	deep	Maja Zagmajster, Hans Recknagel
7	Habjanova jama (4419)	Novi Svet	45.92575 14.12496	575	21. 1. 2024	1	yes	F	pit	Teo Delič, Aja Zamolo
8	Logarček (28)	Laze pri Planini	45.86493 14.26832	498	26. 6. 2025	1	yes	F	pit	Maja Zagmajster, Teo Delič
					21. 7. 2025	1	yes	F	pit	Maja Zagmajster, Teo Delič, Svit Zagmajster Lovrek

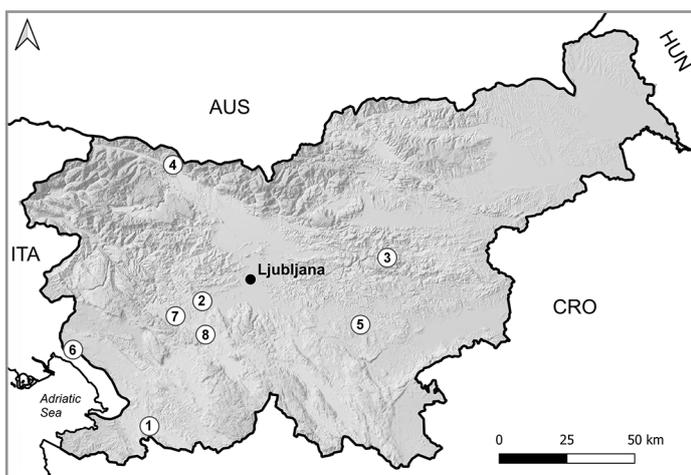


Figure 1. Map with cave localities in Slovenia (white circles), where slow worms were found. Numbers refer to names in [Tab. 1](#).

Slika 1. Zemljevid lokacij jam v Sloveniji (beli krogi), kjer so bili najdeni slepci. Številke se nanašajo na imena v [Tab. 1](#).

As almost all findings of slow worms occurred in caves with relatively deep pits at their entrance, we find it very unlikely that they entered these caves intentionally, even though the species can tolerate low temperatures. Slow worms exhibit a semi-fossorial lifestyle, seeking daily shelter under stones, within soil and among debris, while being primarily active during the night. During winters, in the period from October to February, they search for underground shelters where they semi-hibernate. While searching for appropriate subterranean refuges, individuals may have inadvertently fallen into caves with deep entrance shafts; their fossorial tendencies likely increased the risk of such accidental encounters. The findings of dead individuals or remains (especially in fossil studies), also indicate a possibility that their carcasses were brought to the caves by predators.



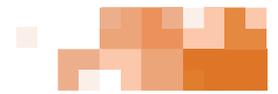


Figure 2. Slow worms observed in three caves in Slovenia: A – Dolenca, October 2023; B – Habjanova jama, January 2024; C – Logarček, June 2025; D – Logarček, July 2025 (photo taken upon being released on the surface). Hands on the photos for scale (Photo: M. Zagmajster – A, C, D; A. Zamolo – B).

Slika 2. Slepici, najdeni v treh jamah v Sloveniji: A – Dolenca, oktober 2023; B – Habjanova jama, januar 2024; C – Logarček, junij 2025; D – Logarček, julij 2025 (fotografija posneta ob izpustu na površini). Roke na fotografijah so za merilo (foto: M. Zagmajster – A, C, D; A. Zamolo – B).



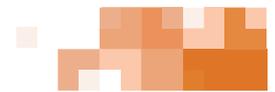


Figure 3. Dead slow worm, found dead approximately 1 m inside the entrance to Velika jama nad Trebnjem cave, lying on the snow (photo: M. Podgorelec).

Slika 3. Mrtev slepec, najden približno 1 m za vhodom v Veliko jamo nad Trebnjem, kjer je ležal na snegu (foto: M. Podgorelec).

We found it surprising that we could not get any published resources in international literature on observations of slow worms in caves. It could be assumed that such encounters do happen more often, but are not reported, or remain in local magazines in national languages (ex. Jazbec 2004; Bartolini 2016). Even though such findings of slow worms are accidental, they should be systematically reported to improve the knowledge of the species' biology.

POVZETEK

Slepec (*Anguis fragilis*) je edini breznoži plazilec, ki živi v Sloveniji, kjer je splošno razširjen (Tome 1996; Krofel et al. 2009). Je prehranski generalist, živoroden in lahko preživi tudi v razmeroma hladnih okoljih. Čeprav je toleranten na nizke temperature, ga ne bi pričakovali v jamah zmernih klimatov. Obstaja kar nekaj najdb slepcev v kraških jamah iz pleistocenskih nanosov (Blain et al. 2014; Đurić et al. 2017), opažanj o sodobnih najdbah pa v dostopni znanstveni literaturi ni.

Zbrali smo podatke o opažanjih slepca v kraških jamah, objavljene v glasilih in na blogih jamarskih društev ter lastnega terenskega dela. Opažanja iz osmih jam izvirajo iz različnih delov države. Prve navedbe so iz jame Medvedjak, kjer sta bila v dveh različnih primerih najdena en živ in en mrtev

osebek (Simić 1992; Jazbec 2004). V Bokalovem breznu v Kovkah je bil najden živ samec na dnu 9 m brezna (Ramšak 2015). V dveh jamah, v Ferranovi buži (Ferran 2003) in Dolenci, so bili osebkii najdeni globlje v jami, odmaknjeni od vhodnih brezen. Živali so bile najdene še v treh jamah, v Turških jamah, Habjanovi jami in Logarčku (Tab. 1, Sl. 1). V Veliki jami nad Trebnjem sta bila v dveh različnih zimah najdena mrtva slepca, obakrat tik za vhodom v jamo.

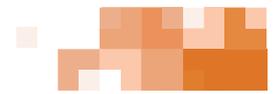
Čeprav se slepci med poletnimi sušami ali med zimskim mirovanjem skrivajo v podzemnih zatočiščih, je njihovo pojavljanje v jamah naključno. Nadaljnja objava najdb v jamah bo pripomogla k boljšemu poznavanju biologije tega plazilca.

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dimension of conservation: A cost-effective plan to incorporate subterranean ecosystems in post-2020 biodiversity and climate change agendas, with the funding organisations Ministry of Universities and Research (Italy), Agencia Estatal de Investigación – Fundación Biodiversidad (Spain), Fundo Regional para a Ciência e Tecnologia (Portugal), Suomen Akatemia – Ministry of the Environment (Finland), Belgian Science Policy Office (Belgium), Agence Nationale de la Recherche (France), Deutsche Forschungsgemeinschaft e.V. – BMBF-VDI/VDE INNOVATION + TECHNIK GMBH (Germany), Schweizerischer Nationalfonds zur Forderung der Wissenschaftlichen Forschung





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