Historical insights into the terrestrial herpetofauna of the Madeira Island

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Abstract - This review provides a comprehensive historical account of the terrestrial herpetofauna of Madeira Island, covering about six centuries of zoological records. It reassesses early species descriptions, misattributed specimens, and forgotten synonyms, highlighting persistent confusion of historical records surrounding species such as *Teira dugesii*, *Pelophylax perezi*, and *Gallotia galloti*. Special attention is given to 19th-century expeditions and the island's role as a hub for species introductions. The study also revisits historical snake records, which, although probably based on misidentifications, represent the earliest documented attempts to describe and name a reptile species allegedly from Madeira. Special emphasis is given to *Teira dugesii,* considering that it is the only endemic reptile species found on Madeira Island. By addressing these historical inconsistencies, this work contributes to a clearer and more accurate understanding of the history of Madeira's terrestrial herpetofauna records.

Key words: herpetofauna of islands, historical records, Macaronesia, Madeira Island.

Riassunto - Approfondimenti storici sull'erpetofauna terrestre dell'isola di Madeira.

Questa rassegna fornisce una disanima storica completa sull'erpetofauna terrestre dell'isola di Madeira, coprendo circa sei secoli di dati zoologici. Essa rivaluta le prime descrizioni delle specie, gli esemplari erroneamente attribuiti e i sinonimi dimenticati, evidenziando la persistente confusione dei dati storici relativi a specie quali *Teira dugesii*, *Pelophylax perezi* e *Gallotia galloti*. Particolare attenzione è riservata alle spedizioni del XIX secolo e al ruolo dell'isola come centro nevralgico per l'introduzione di specie. Lo studio rivisita anche i dati storici sui serpenti che, sebbene probabilmente basate su errate identificazioni, rappresentano i primi tentativi documentati di descrivere e denominare una specie di rettile presumibilmente originaria di Madeira. Particolare enfasi è data a *Teira dugesii*, considerando che è l'unica specie di rettile endemica presente sull'isola di Madeira.

Affrontando queste incoerenze storiche, questo lavoro contribuisce a una comprensione più chiara e accurata della storia delle ricerche relative all'erpetofauna terrestre di Madeira.

Parole chiave: erpetofauna insulare, Macaronesia, Isola di Madeira, dati storici.

INTRODUCTION

Oceanic islands are typically species-poor in terms of herpetofauna, particularly when compared to taxa such as terrestrial molluscs or insects (Whittaker & Fernández-Palacios, 2007). However, despite this limited diversity, reptiles, and amphibians play a key role in shaping the biogeographical narratives of these regions (Losos & Ricklefs, 2009). The Madeira Archipelago serves as a compelling example, being home to a single endemic non-flying vertebrate species, the lacertid lizard *Teira dugesii* (Jesus *et al*., 2009).

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Received for publication: 1 August 2025
Accepted for publication: 8 April 2026
Online publication: 15 April 2026

Over the centuries, Madeira has played a prominent role in the advancement of natural sciences. Its strategic location in the northeastern Atlantic made it a crucial stopover for numerous scientific expeditions during the 18th and 19th centuries. The island's rich and unique biodiversity attracted the attention of renowned naturalists, zoologists and botanists, who contributed to the early documentation of its flora and fauna (Francisco-Ortega *et al*., 2015). These included Richard Thomas Lowe (1802-1874), a British naturalist and long-term resident of Madeira (Mesquita *et al*., 2022); Pierre Antoine Delalande (1787-1823), collector for the Muséum national d'Histoire naturelle of Paris, who gathered the specimens that led to the description of *Teira dugesii* (Câmara *et al*., 2025); Philip Barker Webb (1793-1854), who, together with Sabin Berthelot, co-authored the influential *Histoire Naturelle des Îles Canaries*, which includes substantial references to Madeira. The island of Madeira also drew the interest of Thomas Vernon Wollaston (1822-1878), a prominent entomologist and malacologist, who relocated to the island for health reasons, as it was regarded as a favourable location for recovery from illness (Carrilo, 2006). His extensive work, which greatly contributed to

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the entomological knowledge of the Madeira Archipelago (Pão, 2012), was repeatedly referenced by Charles Darwin (1809-1882) in *The Origin of Species* (1859 and subsequent editions).

Most of the specimens collected during these expeditions are currently housed in major natural history institutions such as the Muséum National d'Histoire Naturelle and the Zoological Research Museum Alexander Koenig in Bonn (Bringsøe, 1993; Câmara *et al*., 2025; Chagnoux, 2025). These historical collections continue to play a key role in current taxonomic and historical research on Madeira's biodiversity. This enduring legacy has firmly established the archipelago as a natural laboratory for island biology, supporting ongoing studies in systematics, biogeography, and conservation.

This study offers a timely and meaningful contribution to herpetology, both within the Macaronesian region and at a broader European level, by providing new perspectives that help clarify historical uncertainties and enrich the scientific understanding of insular herpetofauna diversity.

MATERIAL AND METHODS

Data were obtained by performing a historical review of zoological literature, museum records, historical chronicles, and early expedition accounts from the 16th to the 21st century. Digitized archives such as the Biodiversity Heritage Library - BHL (https://www.biodiversitylibrary.org/), Internet Archive (https://archive.org/), Gallica - Bibliothèque nationale de France (https://gallica.bnf.fr/accueil/fr/html/accueil-fr), Real Jardín Botánico Digital Library (https://bibdigital.rjb.csic.es/en/), and Lacerta (https://www.lacerta.de/AS/Home.php) were extensively used to access rare and out-of-print publications. In addition, relevant taxonomic and biogeographical data were retrieved from The Reptile Database (https://reptile-database.reptarium.cz/) and Web of Science. This integrative approach enabled a reassessment of taxonomic attributions and historical inconsistencies regarding Madeira's terrestrial herpetofauna.

RESULTS AND DISCUSSION

Amphibia

Hyla meridionalis Boettger 1874 or ***Hyla arborea*** (Linnaeus 1758)

In the Madeira Archipelago, the first mention of a frog species dates back to *Viagem de Pompeo Arditi de Pesaro à ilha da Madeira e aos Açores* (first published 1567) (Anonymous, 1948), where the author noted: "nor are there any harmful animals other than rats and small frogs the size of a finger". Pompeo Arditi had been commissioned by King Sebastian of Portugal to plan the island's fortifications (Correia, 2007). This early mention was interpreted as being *Hyla arborea* (Anonymous, 1948), suggesting the species may have been recorded as present on the island well before any formal zoological account was published.

From the 19th century onward, further references to the presence of *Hyla arborea* in Madeira were made by Bedriaga (1891) and Palacký (1898). Later, however, Pereira (1989) contradicted the earlier records of the 19th century, by arguing that the species was introduced only in the middle of that century (original excerpt and English translation provided in the Supplementary Materials). However, Pereira's timeline is challenged by the earlier work of Webb & Berthelot (1840), who had already documented the species' presence on the island. Their account suggests that *Hyla* was established in Madeira earlier than Pereira proposed.

By the mid-20th century, *Hyla* was thought to have disappeared from the island. Sarmento (1948) noted that individuals were kept at Quinta de Santana "*until a few years ago*", but the population was evidently in decline. One of the potential causes mentioned was predation by domestic animals such as cats and ducks.

More recent taxonomic interpretations have questioned the original species identification. Báez (1993) proposed that the *Hyla* species historically observed in Madeira corresponds not to *Hyla arborea*, but to *Hyla meridionalis*. The same had already been hinted at by Dürigen (1897), who referred to the Madeiran population as a *meridionalis* variety, and by Boulenger, who examined a specimen collected by P.B. Webb and likewise identified it as belonging to this *taxon*.

Currently, there is no evidence of the presence of *Hyla* species on Madeira Island or elsewhere in the archipelago. The reasons behind the species' disappearance remain speculative. While predation may have played a role, competition with the introduced *Pelophylax perezi* has also been considered. However, as Báez (1993) noted, both species coexist in the Canary Islands without apparent competitive exclusion.

A similar introduction-extinction event occurred on the island of Mallorca, where *Hyla meridionalis* was once established but later disappeared (Mayol Serra, 2003).

Pelophylax perezi (Seoane 1885)

The Iberian green frog, *Pelophylax perezi* (formerly *Rana perezi*), is currently the only amphibian species found in the Madeira Archipelago (Malkmus, 2009). According to Sarmento (1948), it was introduced to Madeira in 1834 by the first Count of Carvalhal.

However, throughout the literature, other species of genus *Rana* have been referred to Madeira Island such as *Rana temporaria* and *Rana esculenta*. But, as noted by Báez (1993), "This species was previously erroneously identified as both *Rana temporaria* (Bertin, 1946) and Rana esculenta (Sarmento, 1948)", probably due to morphological similarities. References to *R. temporaria* in relation to Madeira are less frequent than those of *R. esculenta*, with early mentions including Fritsch (1898) and more recent references such as Stauder (1991).

Another species mentioned only once in the literature is *Rana maritima* Risso 1827, and *Rana viridis* (Roesel 1758) now regarded as a synonym of *Pelophylax lessonae* (Camerano 1882). Hallowell (1860) listed two specimens from Madeira under this name, noting that their dorsal pattern appeared less spotted than in European *R. viridis*.

Importantly, Girard (1858) provided a detailed description of these same Madeiran specimens.

However, he explicitly expressed doubts about the accurate identification of these animals: "...we consider it our duty to state that we are not yet fully satisfied of its real identity with Risso's species. As it is, however, the one which it comes nearest, we have not deemed it expedient to multiply the names, already so numerous, which have been bestowed upon European frogs.". Girard also criticized Risso's original description for lacking diagnostic morphological features to distinguish *R. maritima* from *R. viridis*, *R. esculenta*, and *R. temporaria*.

In the anatomical analysis, Girard noted several differences between the Madeira specimens and *R. viridis* (an invalid junior synonym of *Rana esculenta* Linnaeus 1758; Dubois & Ohler, 1994). These include the vomerine teeth arranged in two clusters rather than a transverse row, a more truncated snout, reduced interorbital space, smaller tympanum, swollen – in place of tapered – toe tips, and flattened toes. Girard also highlighted distinctions from *R. temporaria*, such as differences in finger length, tympanum size and interorbital width. Despite these observations, Girard refrained from assigning the specimens to any known species (Fig. 1).

Given this uncertainty and the known resemblance to other species within the genus *Pelophylax*, a group now widespread in Madeira, it is plausible that the specimens analysed by Girard represented early records of this highly variable taxon (Doniol-Valcroze *et al*., 2022). Consequently, the few historical mentions of this *taxon* in Madeira do not constitute compelling evidence for the past presence of *P. lessonae* or any other distinct *Pelophylax* species on the island. Nonetheless, we do not rule it out entirely.

One of the earliest and most significant references to the presence of *Rana esculenta* in Madeira is found in volume 11 of the Dictionnaire Universel d'Histoire Naturelle (D'Orbigny, 1848), page 51 (original excerpt provided in the Supplementary Materials). This reference is particularly important, as it highlights *R. esculenta* as one of the earliest documented cases of amphibian acclimatization on oceanic islands as a result of human activity.

Fig. 1 - Illustration of a specimen of *Pelophylax* spp. captured in Madeira Island (Girard, 1858), U.S. Exploring Expedition, (1844-1874). / Illustrazione di un esemplare di *Pelophylax* spp. catturato sull'isola di Madeira (Girard, 1858), U.S. Exploring Expedition, (1844-1874).

From the mid-19th century onwards, records of *P. perezi* in Madeira became increasingly frequent. White & Johnson (1857) reported that the Iberian green frog was widely distributed in the island's streams, occurring in large numbers. Similarly, Greeff (1872), gives a corresponding account (original excerpt provided in the Supplementary Materials).

According to Sarmento (1948), the frog population had grown so big that, by 1840, a local journalist wrote a chronicle lamenting his inability to sleep due to the incessant noise produced by the frogs.

Additional records from the late 19th and early 20th centuries further support the widespread establishment and proliferation of this species across the island. This rapid expansion illustrates how *Pelophylax perezi* adapted swiftly and successfully to the Madeiran ecosystem, where it remains a well-established introduced species to this day (Personal observation). Despite its long-standing presence, the ecological impact of *P. perezi* in Madeira remains poorly studied. Today, *P. perezi* is the only species of amphibian present in Madeira.

Reptilia

***Anolis* sp.**

Concerning this genus, Bell *et al*. (1826) described the structure of the throat in *Anolis* species, noting that some of the examined specimens originated from Madeira Island. This claim can be interpreted in two ways. First, it is possible that Bell *et al*. (1826) misattributed the provenance of the specimens. Given that Madeira served as a major resupply point for transatlantic expeditions, both outbound and inbound, specimens collected elsewhere may have been erroneously considered as collected on the island. Alternatively, as previously discussed, Madeira's role as a frequent stopover for ships may have facilitated the accidental release of exotic animals, including *Anolis* species, which could explain their temporary or incidental presence on the island.

Agama agama (Linnaeus 1758)

Agama agama was first recorded on Madeira in the 1990s when two specimens of this species were found in the collection of the Museu Municipal do Funchal, Madeira. One of these specimens was a gravid female, while the other was an adult male. The male individual was discovered alive on Madeira inside a container of timber imported from the Ivory Coast. It was then kept in captivity at Quinta da Glicinha for two months before it died. The specimen is now preserved in the museum's collection (Wagner, 2012).

Chamaeleo chamaeleon (Linnaeus 1758**)**

Wagner (2012) refers the introduction of the common chameleon *Chamaeleo chamaeleon* to the Island of Madeira, by mentioning three specimens stored in

the Funchal Municipal Museum's collection. These specimens were all collected in Funchal during the 1960s. Of these, one was collected on 5 August 1960 at Levada de Santa Luzia, one on 8 August 1960 at Rua do Dr. Juvenal and another on 11 September 1962 at Rua da Carreira. After the 1960s, no more individuals of this species were found.

Hemidactylus mabouia (Moreau de Jonnès 1818)

The first record of *Hemidactylus mabouia* in Madeira was reported by Jesus *et al*. (2002), based on morphology and mtDNA partial sequences (12S rRNA and *cytochrome b*) of individuals captured in the city of Funchal. In a subsequent and more detailed study, Rato *et al*. (2021) investigated the origin of this introduced species. In this study, samples were collected not only in Funchal, but also in the nearby municipality of Câmara de Lobos. Phylogenetic analysis, based on 12S rRNA sequences of these specimens and others from different parts of the world, revealed the presence on the island of four major clades within *H. mabouia*, with *H. mercatorius* as the closest related taxon, although most of these relationships were weakly supported. While the genetic diversity of *H. mabouia* is not unexpected (Carranza & Arnold, 2006), the findings from Madeira are particularly noteworthy. In addition to the lineage previously associated with Cape Verde populations, a second genetically distinct lineage was identified. This lineage, found exclusively in three individuals from Câmara de Lobos – both the city centre and industrial area – shows close genetic affinity to South American populations. Despite the absence of an international port in Câmara de Lobos, its industrial zone is among the most active commercial areas on the island, making it a likely entry point. However, the precise geographic origin remains unclear, as the lineage is widespread and genetically homogeneous across Central and South America. Since both lineages occur in sympatry in parts of Brazil – e.g., Rio Grande do Norte – a Brazilian origin via a single introduction remains a plausible, though unconfirmed, scenario (Rato *et al*., 2021).

Tarentola mauritanica (Linnaeus 1758)

The presence of *Tarentola mauritanica* in Madeira was first reported by Báez & Biscoito (1993) in Garajau, a locality situated approximately 8 km east of Funchal. Since then, the species has expanded considerably and is now established along much of the island's southern coastline (Rato *et al*., 2021; Silva-Rocha *et al*., 2022). Due to its ecological plasticity and bioclimatic suitability, it is expected that *T. mauritanica* will continue to spread, potentially colonizing favourable habitats on the northern coast, where it has not yet been recorded (Silva-Rocha *et al*., 2022).

Tarentola boettgeri bischoffi Joger 1984

Tarentola boettgeri bischoffi, the gecko subspecies endemic to the Selvagens Islands (Jesus *et al*., 2009), was formally recognized as a distinct subspecies by Joger in the late 20th century (Joger, 1984). Prior to its designation as a distinct *taxon*, specimens from the Selvagens islands were often broadly referred to as originating from Madeira Island. Accordingly, in the first description of these geckos by Duméril & Bibron (1836), their presence is already noted in Madeira (Fig. 2). The specimens used for that description are currently preserved in the collections of the Muséum National d'Histoire Naturelle in Paris (MNHN-RA-0.2276, MNHN-RA-2012.463) (Fig. 3) as *Platydactylus delalandii*. According to the authors, the specimens were collected by Delalande in Madeira and were transported to the museum under the care of Mr. Gallot.

Following this, Fitzinger (1843) listed "*Ascalabotes Delalandii*" occurring in Madeira. Gray (1845) cited two juvenile specimens collected by Philip Webb, also referring to Madeira as the locality. Later, in 1861, Drouët again noted the presence of these geckos on Madeira Island.

Chalcides viridanus (Gravenhorst 1851) and ***Chalcides sexlineatus*** Steindachner 1891

Boulenger (1887) reported the occurrence of *Chalcides viridanus* in both Tenerife and Madeira, stating that the specimen from Madeira was collected by Philip Barker Webb. Later, in 1896, Sclater reaffirmed the presence of this species on the island of Madeira.

Pasteur (1981) suggested the coexistence of *Chalcides viridanus* and *Chalcides sexlineatus* in Madeira, proposing that individuals of the species were introduced relatively recently, as the Madeiran populations lacked the diversification observed within the Canary Islands. However, no recent searches and studies conducted after Pasteur's work have confirmed the presence of either species in Madeira. This suggests that earlier reports may have resulted from misidentifications or unsuccessful introductions.

Chalcides ocellatus (Forskål 1775)

Chalcides ocellatus, a species of skink, was reported from Madeira by Drouët (1861) under the name *Scincus ocellatus*. Gray (1845) also listed material allegedly collected on the island by Philip Barker Webb, although he expressed uncertainty regarding the provenance by annotating the record as "Madeira?". The lack of

Fig. 2 - Labels of historical specimens collected by Pierre Antoine Delalande and preserved at the Muséum National d'Histoire Naturelle (Paris). A) Label of the paralectotype of *Tarentola boettgeri bischoffi*; B) Label of one of the syntypes of *Teira dugesii*, collected in Madeira in the early 19th century. / Etichette di esemplari storici raccolti da Pierre Antoine Delalande e conservati presso il Muséum National d'Histoire Naturelle (Parigi). A) Etichetta del paralectotipo di *Tarentola boettgeri bischoffi*; B) Etichetta di uno dei sintipi di *Teira dugesii*, raccolto a Madeira all'inizio del XIX secolo. (Photo: Nicolas Vidal and GBIF, Jérôme Courtois).

corroborating modern evidence suggests that these early records may have resulted from misidentifications, erroneous locality data, or unsuccessful introduction attempts.

Chioninia fogoensis (O'Shaughnessy 1874)

Chioninia fogoensis seems to represent the most recent record of a reptile species introduced to Madeira. According to Clemens & Allain (2020), an individual arrived in the United Kingdom carried inside the luggage of tourists travelling from the island of Madeira. However, to date, no specimens confirming the presence of a population or even a specific locality where the species may have occurred have been found in any scientific publication. Likewise, citizen science databases such as Biodiversity4All contain no records of *C. fogoensis* on the island of Madeira.

Fig. 3 - Paralectotypes of *Tarentola boettgeri bischoffi* (MNHN-RA-0.2276, MNHN-RA-2012.463). / Paralectotipi di *Tarentola boettgeri bischoffi* (MNHN-RA-0.2276, MNHN-RA-2012.463). (GBIF, Jérôme Courtois).

Aspidoscelis sexlineatus (Linnaeus 1766)

Francis H. Brown (1868) reported the presence of *Ameiva sexlineata*, a historical combination now referable to *Aspidoscelis sexlineatus*, in Madeiran gardens and vineyards, where it was allegedly responsible for significant crop damage, reportedly causing together with rats. Given the exclusively American distribution of *A. sexlineatus* and the absence of corroborating records, this account almost certainly represents a misidentification.

Lacerta agilis Linnaeus 1758

Historical records, such as those provided by Bedriaga (1886), mention the presence of *Lacerta agilis* in Madeira, based on a specimen inventoried as no. 397 in the Zurich Museum collection. However, the author himself expresses scepticism regarding the accuracy of the locality, emphasizing that erroneous collection localities were not uncommonly reported in 19th-century museum specimens. This highlights the broader taxonomic and biogeographic uncertainties of that period, particularly in island faunas.

Gallotia galloti (Oudart 1839)

One of the most intriguing historical cases in the herpetology of Madeira involves the attribution of the lacertid lizard *Gallotia galloti* to the island. One of the earliest references appears in the Catalogue of the Specimens of Lizards in the Collection of the British Museum (Gray, 1845), which lists Madeira as the only locality of origin for these specimens. They were collected by the eminent naturalist and botanist Philip Barker Webb, a renowned connoisseur and admirer of the Macaronesian region.

In 1887, Boulenger revisited this attribution, again citing Madeira as part of the species' distribution range but also including the Canary Islands. His statement was based on a specimen reportedly collected by Webb. Even earlier, *G. galloti* was listed as occurring in Madeira by Duméril & Bibron (1839, 1854), and later by Bedriaga (1886).

The question of whether *G. galloti* ever occurred naturally in Madeira or was introduced remains unresolved. According to Bringsøe (1993), the species was apparently introduced to Madeira in the early 19th century. An old specimen (ZFMK-26545), a subadult individual, which Richter (1986) briefly referred to, is preserved in the collection of the Zoological Research Museum Alexander Koenig in Bonn. Previously, Cyrén (1934) had limited the species' distribution to Tenerife, La Palma, La Gomera, and El Hierro.

Surprisingly, in 1993, *Gallotia galloti* was once again observed on Madeira, this time within the grounds of the Funchal Botanical Garden. According to Bringsøe (1993), it is possible that a small number of individuals had persisted unnoticed, although no verified sightings had been recorded for over a century in this heavily visited area. He suggests that the individuals present in the garden most likely result from a more recent introduction.

Bringsøe further posits that *G. galloti*, as a eurytopic and non-specialised species, should theoretically be capable of establishing in Madeira - particularly in the relatively dry and warm southern coast around Funchal. However, despite these favourable ecological conditions, *G. galloti* has apparently failed to establish a self-sustaining population in Madeira following historical or modern introductions.

Gallotia atlantica (Peters & Doria 1882)

Gallotia atlantica, the Atlantic lizard, is another lacertid species endemic to the Canary Islands that was historically reported from the island of Madeira. As with other cases, these records originate from the 19th century. Boulenger (1887) included Madeira in the species' distribution, based on a specimen collected by the naturalist Philip Barker Webb. Similarly, Bedriaga (1886) and Palacký (1899) also referred to *G. atlantica* as occurring in Madeira. No posterior references were made on this species for Madeira Island.

Gallotia caesaris (Lehrs 1914)

Gallotia caesaris is native to the Canary Islands of El Hierro and La Gomera (Bowler, 2018) and has been reported only once in the Funchal Botanical Garden (Wagner, 2012). No evidence of an established population exists. Nevertheless, the record was later cited by Bowler (2018), who references Wagner's (2012) report to include *G. caesaris* as present on the island of Madeira.

Dalmatolacerta oxycephala (Schlegel 1839)

In the *Catalogue of the Specimens of Lizards in the Collection of the British Museum*, Gray (1845) listed *Dalmatolacerta oxycephala* as originating from "Madeira?", explicitly indicating uncertainty regarding the accuracy of the specimen's labelling and provenance. These inconsistencies highlight the challenges faced by early taxonomists and underscore the importance of revisiting historical records with a critical perspective, particularly when dealing with island biogeography and species introductions.

Teira dugesii (Milne-Edwards 1829)

Synonyms

Lacerta maderensis, Fitzinger 1826 *Lacerta dugesii,* Milne-Edwards 1829 *Teira punctata,* Gray 1838

Alsodromus maderensis, Fitzinger 1861 *Lacerta punctata*, Boulenger 1881 *Podarcis dugesii*, Engelmann 1993

Important data before the original description by Milne-Edwards 1829

The Madeira wall lizard (also referred to as Sharp-headed lizard in 1896 by Philip Sclater), *Teira dugesii*, is the only non-flying terrestrial vertebrate species endemic to Madeira Archipelago and Selvagens Islands (Jesus *et al*., 2009). This species was already present in Madeira when the first Portuguese arrived in Madeira Island, in 1419. A passage from Valentim Fernandes (1507) reported by Monod (1986) states: "In this island of Madeira there were no animals at all, neither tame nor wild, nor beasts nor rats, but now there are animals of all sorts, except that no venomous creature or beast exists here, except for some very small little lizards about a palm in length, yet they do no harm to anyone" (original excerpt provided in the Supplementary Materials).

Later, in 1794, Wilhelm described an intriguing detail about the species' population density, stating that lizards were so abundant that monks had to place polished brass containers in monastery gardens to prevent them from entering, as they would slide in and be unable to escape.

The first documented attempt to name the Madeira wall lizard was made by Austrian zoologist Leopold Fitzinger (1802-1884) in 1826, who referred to the species as *Lacerta maderensis* in his work. However, the species was formally described by Milne-Edwards in 1829 as *Lacerta dugesii*, with the specific epithet *dugesii* honoring the French naturalist Antoine Louis Dugès (1797-1838).

Milne-Edwards' original description of *T. dugesii*

According to Milne-Edwards (1829), *Teira dugesii* presents the following characteristics:

"Without occipital scale; six rows of abdominal scales. Temples covered by small granular scales and lacking a masseteric disc. Hind limb capable of reaching the axilla. A single large median scale in front of the anus. Frontal plate poorly developed and considerably narrowed posteriorly - about half as wide at the back as at the front".

"The second species brought back by Lalande is the one I dedicated to Mr. Dugès; it inhabits Madeira Island and appears to be quite common there. As in all the species previously mentioned, the frontal plate of this lizard is large, and its posterior edge is as wide as the fronto-parietal plates (Pl. 6, fig. 2); there is no occipital plate. The temporal regions are covered with small, granulated scales and, like those of Lalande's lizard, do not show a masseteric disc.

The collar is free throughout its extent, straight, and formed of rather small scales; those of the abdomen are rectangular: there are about twenty-six transverse rows and six longitudinal ones, of which the two median rows are much narrower than the others.

The dorsal scales are very small and somewhat roughened. There is a single large median scale in front of the anus. Under each thigh, there are about twenty-three femoral pores, and the hind limbs are long enough to reach the armpits.

In terms of coloration, Dugès's lizard shows, depending on the age and individual, rather considerable variation. In the young specimens of this species preserved in the Museum, the back is often greyish in tone, and the flanks brownish-green; near the median dorsal line, there are two longitudinal rows of black spots, and two similar lines located between the back and the flanks. Thus, the upper surface of the body is marked by four black longitudinal stripes and three pale grey ones, one of which occupies the median line, while the others extend from the upper edge of the temples down to the tail. In older individuals, there are sometimes two whitish lines on the sides, bordered in black, while the back and

flanks are a greenish-grey, speckled with black. Finally, in the largest individuals (about 20 centimetres), the entire upper surface of the body is a dark brownish colour, less dark on the back than on the flanks, and speckled with green. The abdominal surface is always whitish, and some individuals showed me all the intermediate shades between those just described." (French original excerpt provided in the Supplementary Materials) (Fig. 4).

Boulenger's important data about *Teira dugesii* populations from different Islands of Madeira archipelago

In 1916, Boulenger provided one of the earliest and most detailed morphological descriptions of *Teira dugesii*. One of Boulenger's most notable contributions was the identification of differences among lizards from Madeira Island, Porto Santo, Bugio, Deserta Pequena, and Selvagem Grande. The inclusion of the Selvagens Islands in his study was especially intriguing, as these islands are remote and ecologically distinct. He documented that those individuals from Selvagem Grande had fewer femoral pores (12-19) compared to those from the other islands (16-24). For the Madeiran wall lizards from Porto Santo, it was observed that they exhibit snouted pointed features compared to those from other islands.

Boulenger also noted variation in dorsal colouration, describing individuals ranging from brown and grey to nearly black, with juveniles typically bearing a pair of light dorsal stripes. He recorded melanistic specimens, particularly from the Desertas, and described the absence of blue spots on the ventral scales, a trait that distinguishes *Teira dugesii* from other lacertids. His meticulous documentation of scalation patterns, digital lamellae, and body proportions continues to serve as a reference for researchers studying island biogeography and reptile adaptation in Macaronesia (Mertens, 1938; Arnold, 1989; Mayer & Arriba, 2003) (Fig. 5).

The author also gives an identification key for the genus *Lacerta*, in which he presents the distinguishing factor of the Madeiran wall lizard from the other species under analysis as showing "Upper temporal and masseteric shields absent" and having between 51 and 81 scales in the middle of the back. He also mentions that among the species under analysis, the Madeiran Wall Lizard reveals itself as the closest to *Lacerta muralis* (current name: *Podarcis muralis*).

Beyond its descriptive value, Boulenger's work contributed to a broader understanding of intraspecific variation in insular reptiles.

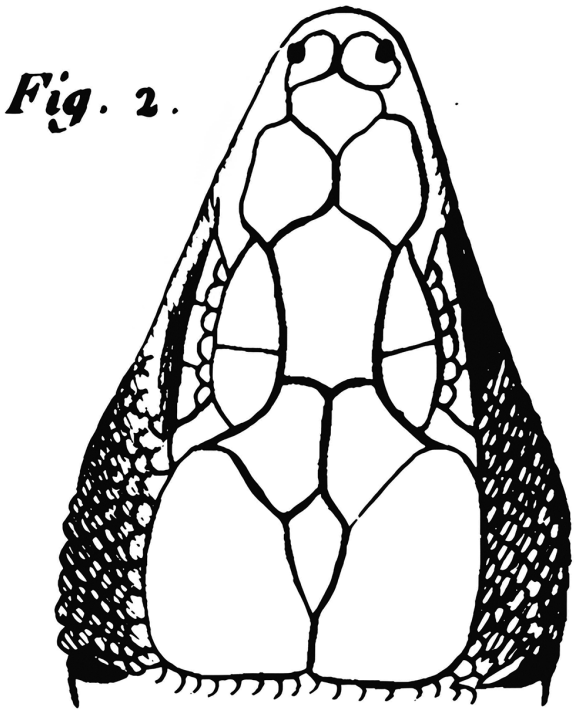

Fig. 4 - Illustration of the Head scales by Milne-Edwards, 1829. / Illustrazione delle squame della testa secondo Milne-Edwards, 1829. (*Annales des sciences naturelles*, Milne-Edwards, 1829, plate 6 fig. 2).

Subspecies of *Teira dugesii*

As mentioned above, Boulenger (1916) was one of the first zoologists to mention the variation among populations of the species living on different islands. However, it was not until 1938 that Mertens described and named a new subspecies from Desertas Islands, with the original name of *Lacerta dugesii mauli.*

Later, Bischoff *et al.* (1989), using morphological and enzyme electrophoresis data, named two new subspecies: *Podarcis dugesii jogeri* from Porto Santo Island and *Podarcis dugesii selvagensis* from Selvagens Islands. The former subspecies *Podarcis dugesii mauli* was considered as a synonym of *Podarcis dugesii dugesii*, the subspecies of Madeira Island.

Afterwards, Brehm *et al.* (2003), using mtDNA partial sequences of 12S rRNA and Cytochrome b, suggested the existence of four subspecies, resurrecting the subspecies from Desertas Islands, now named as *Teira dugesii mauli*. The genetic distances, the well-supported clades for each subspecies in the phylogenetic tree, and the absence of gene flow between subspecies reinforced the suggestion for four subspecies: *Teira dugesii dugesii* (Madeira Island), *Teira dugesii mauli* (Desertas Islands), *Teira dugesii selvagensis* (Selvagens Islands), and *Teira dugesii jogeri* (Porto Santo Island).

Snakes in Madeira Island?

Currently and apparently, only one snake species is found on Madeira Island, the *Indotyphlops braminus* (Daudin 1803), probably introduced from the Canary Islands due to the significant ferry traffic between Madeira and the Canary Islands in recent years (Jesus *et al*., 2013). However, since the initial study on its introduction, no further research has been conducted to determine whether it has established a small population or not.

During the 18th and 19th centuries, the existence of snakes in Madeira was mentioned by renowned naturalists such as Albertus Seba (1665-1736), Josephi Nicolai Laurenti (1735-1805), Johann Friedrich Gmelin (1748-1804), and François Marie Daudin (1776-1803).

Fig. 5 - Plate by Boulenger (1916) showing the various specimens examined. / Tavola di Boulenger (1916) che raffigura i diversi esemplari esaminati (*Transactions of the Zoological Society of London*) (Plate VII).

Fig. 6 - Illustration by Seba (1734) of the *Vipera, Africana, convoluta*, from the island of Madeira (Table LIIII, figure 2). / Illustrazione di Seba (1734) della *Vipera, Africana, convoluta* proveniente dall'isola di Madeira (Tabella LIIII, figura 2).

The first records of snakes on the island of Madeira were documented by Albertus Seba in 1734, who mentioned it as *Vipera, Africana, convoluta*. (Fig. 6).

The following excerpt of Seba (1734) and the Fig. S1 describes a viper reportedly transported from the island of Madeira (English translation by the Authors):

"We received this viper transported from the island of Madeira, located in the Atlantic Ocean. It is presented here wrapped in a bundle of hair, in the position vipers prefer when basking under the warm rays of the sun, gently heating themselves and resting drowsily with their heads exposed. The head of this viper is flat and broad, with jaws widely open at the posterior. Its body, greyish in colour, is covered with rhomboidal scales arranged in a yellowish chain pattern. The ventral scales are yellowish grey, with sparse dark spots scattered across them, resembling marble".

Josephus Laurenti, in his 1768 work described a snake under the name *Vipera maderensis*, providing a brief diagnosis (Fig. 7): "Body with a network of somewhat yellowish lines, with lead-coloured spots.".

Twenty years later, Johann Friedrich Gmelin reassigned the species originally described by Albertus Seba, introducing the name *Coluber maderensis* in 1788. Similarly, the snake was said to have originated from "Maderaspatam," an old European name for Madras –

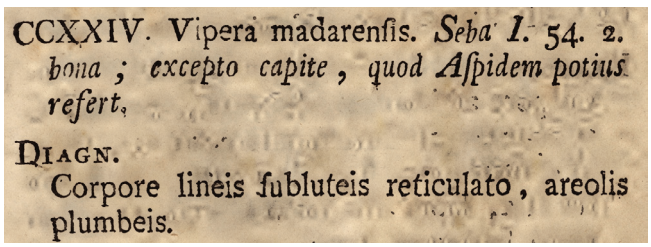
CCXXIV. Vipera madarenſis. *Seba I.* 54. 2.
bona ; excepto capite , quod Aſpidem potius refert.
DIAGN.
Corpore lineis ſubluteis reticulato , areolis plumbeis.

Fig. 7 - Page 102 of the *Specimen Medicum: Exhibens Synopsin Reptilium Emendatam cum Experimentis circa Venena et Antidota Reptilium Austriacorum* where Laurento provides the description of *Vipera madarensis*. / Pagina 102 di *Specimen Medicum: Exhibens Synopsin Reptilium Emendatam cum Experimentis circa Venena et Antidota Reptilium Austriacorum*, in cui Laurenti fornisce una descrizione della *Vipera madarensis* (*ex* Laurenti, 1768).

Fig. 8 - Illustration by Seba (1735) entitled *Vipera, Serpens, mirè picta, ex Java* (Plate LIII, no. 1). / Illustrazione di Seba (1735) intitolata *Vipera, Serpens, mirè picta, ex Java* (Tavola LIII, n. 1).

present-day Chennai, India –, which was erroneously interpreted as referring to the island of Madeira. This stands as a clear example of the challenges of 18th-century zoological documentation, in which geographical names were frequently misinterpreted or inaccurately transmitted.

In 1803, Daudin once again described a species, this time referring to it as the "Vipère de Madère" (Viper of Madeira). He stated that the specimen measured approximately one meter in length. The upper part of the body was lead-coloured, adorned with a prominent network of yellow lines arranged in a chain-like pattern. The ventral plates were greyish, tending toward yellow, and shaded here and there with black spots. The elongated head bore small lead-coloured markings on the top and three lines of the same colour above the eyes, toward the posterior region. At the time, this specimen was preserved at the Muséum d'Histoire Naturelle de Paris. Daudin highlighted that the specimen described in the first volume (Seba, 1734) closely resembled another one described in volume two, referred to as *"Serpens, mirè picta, ex Java"* (Fig. 8). It also bore a strong resemblance to the figure in Plate XX from Russell (1796) (Fig. 9).

Later, Duméril & Bibron (1844), followed by Boulenger (1893), and even current taxonomic databases have attributed the various accounts by early zoologists and naturalists to the species *Corallus hortulanus*, with both *Coluber maderensis* and *Vipera maderensis* listed as synonyms.

Given its native distribution in South America (Henderson, 1997) and the fact that Madeira Island was a common stopover for transatlantic voyages during that period, it is plausible that the specimen may have escaped from a ship during a stop at the island, leading observers to mistakenly assume it was native to Madeira. Another possibility is that the specimen had been collected from the Rio Madeira region in Brazil, within the species' natural range (Duarte *et al*., 2015), and that Albertus Seba misinterpreted the locality, assuming it referred to Madeira Island.

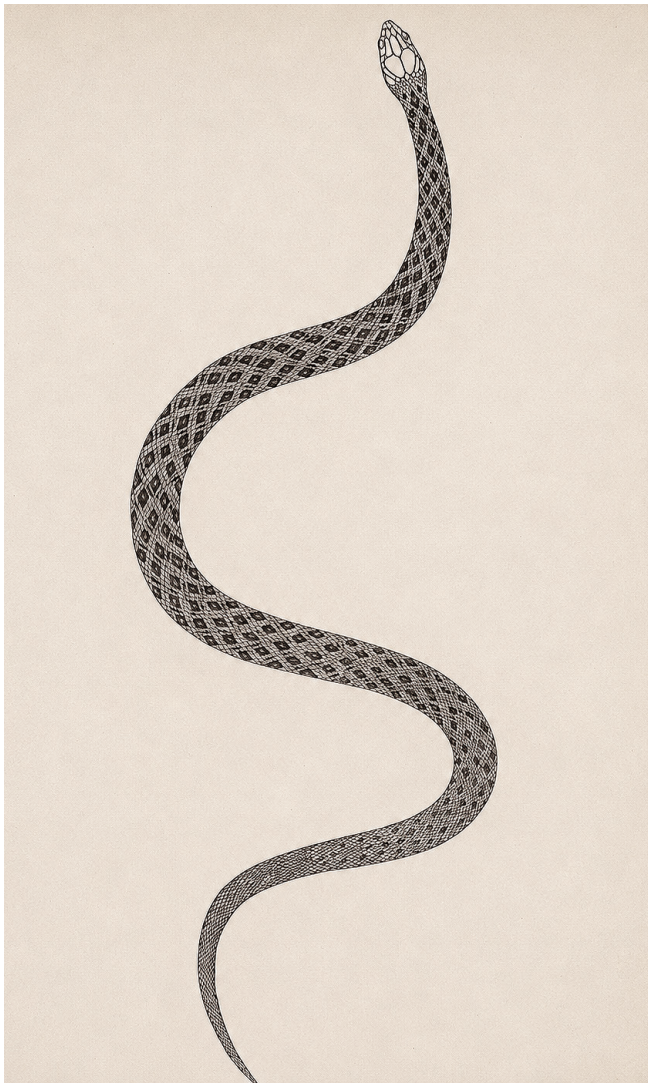

Fig. 9 - Illustration by Russell (1796), depicting a specimen very similar to *Vipera africana convoluta*, according to Daudin (1803). / Illustrazione di Russell (1796), raffigurante un esemplare molto simile alla *Vipera africana convoluta*, secondo Daudin (1803).

Although it was most likely a case of misidentification, it may nonetheless represent one of the earliest documented attempts to name and describe a vertebrate specimen allegedly originating from Madeira Island. As such, this record provides valuable insight into the early zoological exploration and scientific curiosity surrounding the island's fauna. Even erroneous identifications contribute to the historical framework of biodiversity research, highlighting the progression of taxonomic knowledge and the challenges faced by early naturalists working with limited resources and communication.

The second mention occurs in Albertus Seba (1734), where the snake is named "*Serpens, Africana, ex insulâ Maderâ, cursu velocissima, russula*".

Albertus Seba reported the following: "It is reported that this snake from Madeira is extremely fast, to the point that a man cannot catch it due to its enormous leaps and rapid turns, by which it moves. When it spots a bird, a dormouse, or a rat, it swiftly captures them. Its oblong-rhomboidal scales display a homogeneous reddish colouration, while the head stands out, and the ventral scales are slightly lighter." (Figs. 10 and S2).

The third snake was called *"Serpens, Africana, ex Madera, macilenta, Levipes dicta*.". In the work of Albertus Seba (1734), the following is stated (translated to English from Latin by the Authors) "Due to its slender and elongated shape, it is called *macilenta*. However, it is said to be extremely fast, hence the name *Levipes*. It has a pale violet colouration with dark brown rhomboidal spots arranged along parts of its back, sometimes appearing dispersed and variegated. Along more than half of its ventral length runs a yellow stripe, which eventually fades. The ventral scales are of a pale gray color. The head is adorned with scales of a soft violet hue. The margin of the mouth is fringed with yellow." (Figs. 11 and S3).

Lastly, in 1735, another record of a snake named *"Serpens, Ranivora, ex Maderâ."* emerged from Madeira (Fig. 12). Its description is given in Fig. S4 (translation to English from Latin by the Authors) "A very large head

Fig. 10 - Illustration by Seba (1734) depicting the *Serpens, Africana, ex insulâ Maderâ, cursu velocissima, russula* from the island of Madeira (Table LIIII, figure 3). / Illustrazione di Seba (1734) raffigurante *Serpens, Africana, ex insulâ Maderâ, cursu velocissima, russula* proveniente dall'isola di Madera (Tabella LIIII, figura 3).

is adorned with slightly reddish scales, speckled with a deeper red. The rest of the body, yellowish red in colour, is covered with tessellated red scales. The ventral scales are a deep ash grey. The tail is not very slender and ends in a blunt tip. It feeds on frogs, which I, myself, extracted from its stomach". The presence of frogs in the stomach of this specimen could support the account from Pompeo Arditi's voyage, which took place in 1508, suggesting the existence of frogs on Madeira prior to the 19th century. No fossil records of any snake species have yet been found on the island, so the attribution of this specimen to Madeira may stem from two possible explanations. First, the snake might have escaped from a ship during a resupply stop and subsequently established itself in the study location, preying on frogs in Madeira's streams. Second, the claim could result from a misinterpretation by the author or a misattribution by those who either delivered or documented the specimen.

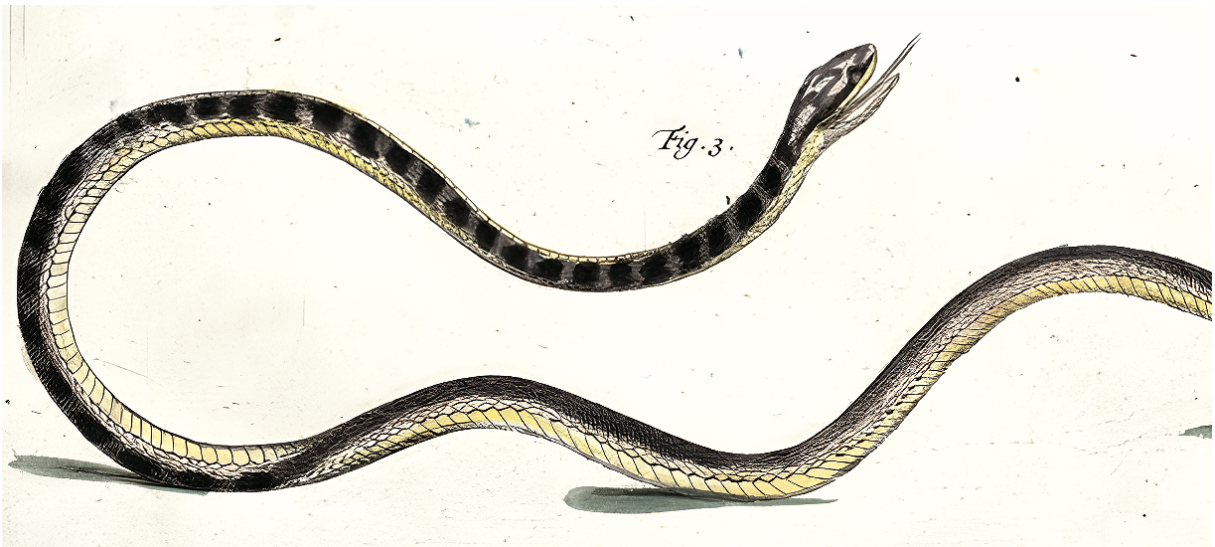

Fig. 11 - Illustration by Seba (1734) depicting the *Serpens, Africana, ex Madera, macilenta, Levipes dicta* from the island of Madeira. / Illustrazione di Seba (1734) raffigurante *Serpens, Africana, ex Madera, macilenta, Levipes dicta* proveniente dall'isola di Madera.

Fig. 12 - Illustration by Seba (1735) depicting the *Serpens, Ranivora, ex Maderâ* from the island of Madeira (Table LI, figure no. 4). / Illustrazione di Seba (1735) raffigurante il *Serpens, Ranivora, ex Maderâ* proveniente dall'isola di Madeira (Tabella LI, figura n. 4).

CONCLUSIONS

This work offers the first comprehensive historical review of the terrestrial herpetofauna records of Madeira Island, spanning over six centuries of zoological records. Beyond compiling early reports and species descriptions, it critically reassesses forgotten synonyms, lost records, and overlooked morphological observations of *Teira dugesii*.

The article also brings to light 19th-century expeditions, which significantly contributed to the documentation of Madeira's reptile and amphibian fauna. Additionally, it contextualizes the presence of introduced species within their historical and ecological frames, showing that *Pelophylax perezi* represents one of the earliest known acclimatization of amphibians on oceanic islands.

Importantly, this study revisits historical records of snakes in Madeira. While likely based on misidentifications or misunderstandings, these reports nevertheless represent the first documented attempts to describe and name a species of snake supposedly from the island. Although there is no evidence of a stable or native snake population on Madeira, these early efforts are of great significance for the history of herpetology in the region.

By recovering neglected sources and identifying misinterpretations across time, this study not only refines the faunistic knowledge of the island but also contributes to the broader understanding of the development of herpetology and biogeography in Macaronesia.

Acknowledgments

We thank Dr. Nicolas Vidal, curator of the Reptile and Amphibian Collection (RA) at the Muséum National d'Histoire Naturelle (MNHN-Paris), for providing photos of the labels of the specimens collected by Delalande.

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SUPPLEMENTARY INFORMATION / INFORMAZIONI SUPPLEMENTARI

Additional Supplementary Information may be found online for this article.

S1-S4 - Figures of excerpts in the original language from the works cited in the main text.