



## A third species of the rare frog genus *Holoaden* (Terrarana, Strabomantidae) from a montane rainforest area of southeastern Brazil

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### Abstract

A new species of the rare anuran genus *Holoaden* is described from a montane rainforest area in Rio de Janeiro State, southeastern Brazil. The new species is characterized by its large body size, large head, moderately bulging dorsal glands, limbs long and slender, a deeply dark dorsal coloration, and dark ventral surface with a light abdominal blotch of variable size. The new species expands the range of the genus 200 km eastward in Brazil.

**Key words:** new species; Atlantic Forest; *Holoaden*; Holoadeninae; Strabomantidae

### Resumo

Uma nova espécie de um raro gênero de anuro, *Holoaden*, é descrita de uma área de floresta pluvial serrana do Estado do Rio de Janeiro, sudeste do Brasil. A nova espécie é caracterizada pelo seu grande tamanho corpóreo, grande cabeça, glândulas dorsais moderadamente elevadas, membros longos e delgados, coloração geral dorsal intensamente escura e superfície ventral escura com uma mancha clara abdominal de tamanho variável. A descoberta desta nova espécie expande a distribuição do gênero em 200 km para o leste no Brasil.

**Palavras-chave:** *Holoaden*; Holoadeninae; Mata Atlântica; nova espécie; Strabomantidae

### Introduction

The genus *Holoaden* Miranda-Ribeiro (Anura, Strabomantidae, Holoadeninae) currently consist of two species endemic to the Atlantic rainforests of southeastern Brazil (Caramaschi & Pombal 2006; Frost 2008). The type species, *H. luederwaldti* Miranda-Ribeiro, 1920, was described from Campos do Jordão (altitude ca. 1600 m), São Paulo State. A second species, *H. bradei* Lutz, 1958, was described from Brejo da Lapa (altitude ca. 2100 m), in the Itatiaia highlands (municipality of Itamonte, Minas Gerais State; Caramaschi & Pombal 2006). Morphologically, the genus *Holoaden* can be easily characterized by its densely glandular dorsum, toes free of webbing, fingers and toes with rounded tips not expanded into disks, large and relatively wide head, absence of a tympanum, big forward-directed eyes, and rhomboid or round (when dilated) pupils (Lutz 1958;

Lynch 1971; Hedges *et al.* 2008). The phylogenetic relationships of *Holoaden* within the New World direct-developing frogs (Terrarana *sensu* Hedges *et al.* 2008) has recently been assessed, based on molecular data, by Hedges *et al.* (2008). In that study, the genus was recovered as monophyletic and nested within a highly supported clade (Holoadeninae) within family Strabomantidae, which also includes the geographically distant genera *Barycholos*, *Bryophryne*, *Noblella*, and *Psychrophrynella*, as well as (tentatively) the sympatric *Euparkerella*. The genus *Holoaden* is rare in herpetological collections and currently known from only a few specimens (Caramaschi & Pombal 2006).

Fifty years after the last description of a species in the genus *Holoaden* (Lutz 1958), a third species is herein described from a montane rainforest area in the state of Rio de Janeiro, representing the easternmost record for the genus.

## Material and methods

The specimens examined are listed in the Appendix and are deposited at the Museu Nacional, Rio de Janeiro, Brazil (MNRJ) and Museu de Zoologia, Universidade de São Paulo, Brazil (MZUSP). Measurements were taken with a caliper to the nearest 0.1 mm, following Duellman (2001) and Ceï (1980) (except for forearm length which was taken from elbow to wrist). All measurements given in the text are in millimeters. Drawings of the holotype were made using a Zeiss Stereomicroscope coupled to a camera lucida.

### *Holoaden pholeter* sp. nov.

Figs. 1–3

**Holotype.** MNRJ 51475, adult female, collected on a forested mountain slope (22°22'23" S; 42°33'16" W; ca. 1200 m above sea level) in the district of Theodoro de Oliveira, municipality of Nova Friburgo, Rio de Janeiro State, Brazil, on 17 March 2008 by Thiago A. Dorigo. The area is located within the Parque Estadual dos Três Picos, a recently created Conservation Unit that encompasses much of the Serra dos Órgãos mountain range.

**Paratypes.** MNRJ 53482 (male) and MNRJ 53483 (female), both collected at the same locality of the holotype, on a nearby mountain slope (22°21'59" S; 42°33'31" W; ca. 1400 m a.s.l.), on 14 August 2008 by Carla C. Siqueira.

**Diagnosis.** Dorsum densely glandular, toes free of webbing, fingers and toes with rounded tips not expanded into disks, large and relatively wide head, absence of a tympanum, big forward-directed eyes, and rhomboid or round (when dilated) pupils. *Holoaden pholeter* is a comparatively large *Holoaden* species with a large head, glandular texture on dorsum, limbs long and slender, overall dorsal coloration deeply dark, and ventral body surface dark with a light abdominal blotch of variable size.

**Comparisons with the other species.** The new species differs from *Holoaden bradei* in its larger body size (maximum 37 mm SVL in *H. bradei*; Lutz 1958), longer limbs, wider head, palmar and plantar tubercles and tips of digits leaden gray in life (yellow in *H. bradei*; Lutz 1958), and dorsal coloration uniformly dark purplish-brown (upper surfaces olive brown with irregular soot-black suffusions in *H. bradei*; Lutz, 1958; see color picture in Haddad *et al.* 2008, page 80). *Holoaden pholeter* is morphologically more similar to *H. luederwaldti*, but is distinguished from the latter by its moderately bulging dorsal glands (dorsal glands markedly bulging and more conspicuous in *H. luederwaldti*; see figures 1-2 in Caramaschi & Pombal 2006 and figure 98 in Hedges *et al.* 2008), darker dorsal coloration (dorsal surfaces brown to reddish brown in *H. luederwaldti*; see figure 98 in Hedges *et al.* 2008), and ventral surfaces dark (slightly lighter than dorsum) with a light blotch on abdomen (ventral surfaces uniformly cream, distinctly lighter than dorsum in *H. luederwaldti*).



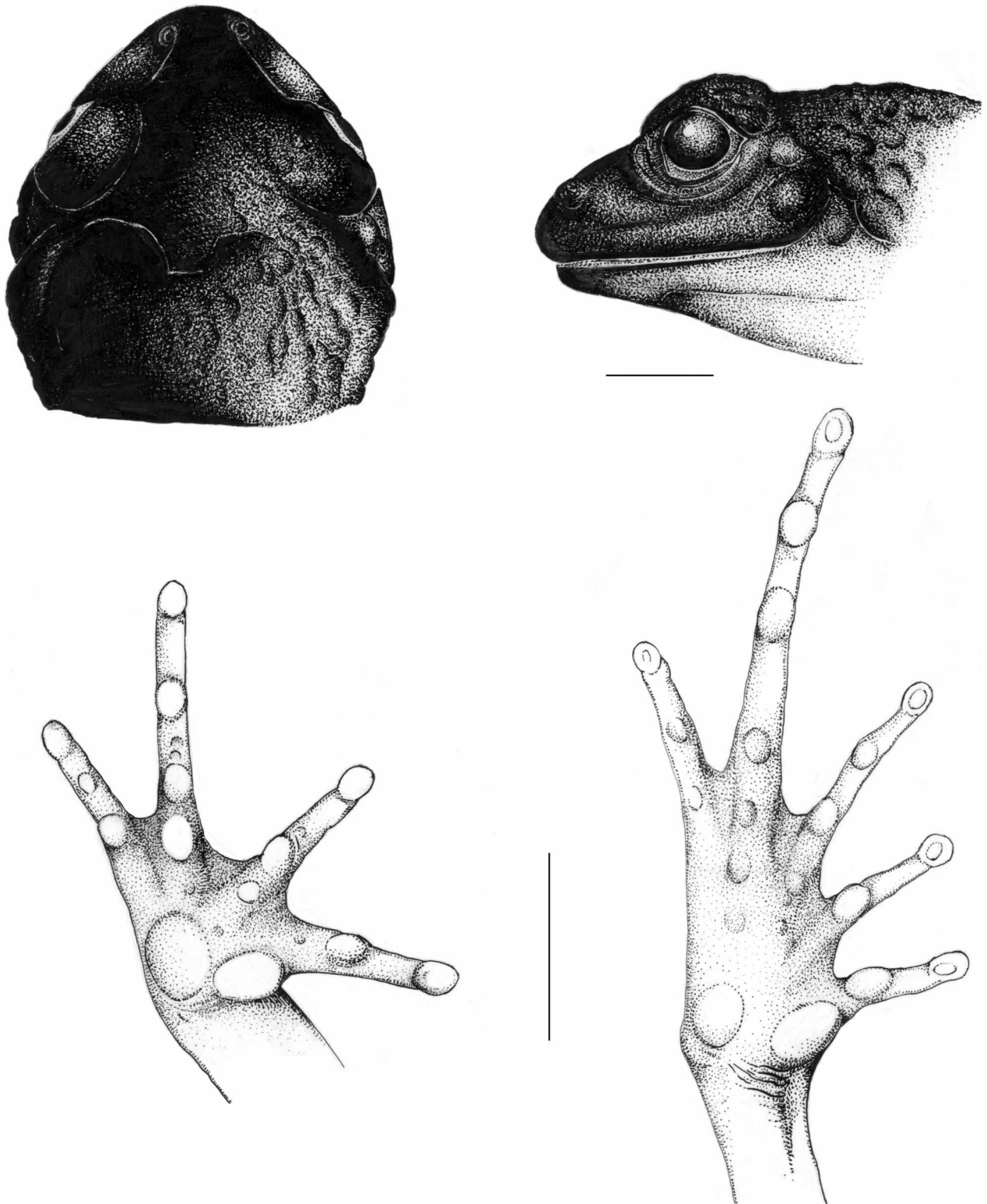
**FIGURE 1.** *Holoaden pholeter* sp. nov., holotype (MNRJ 51475, adult female, SVL 44.6 mm), in life.



**FIGURE 2.** *Holoaden pholeter* sp. nov., holotype (MNRJ 51475, adult female, SVL 44.6 mm), dorsal and ventral views.

**Description of holotype.** Body robust; head large, wider than long, and wider than body; snout nearly semicircular in dorsal view and slightly protruding in lateral view; eyes large, protuberant, directed slightly forward; pupil round; nostrils protuberant, directed dorsolaterally; canthus rostralis not well marked and slightly concave; loreal region concave; tympanum absent; a glandular supratympanic fold extending from corner of eye to insertion of front limb; tongue large; vomerine teeth in two short series behind and between choanae; choanae circular; a single small toothlike process in front of lower jaw with a small single socket between premaxillae; numerous teeth on maxilla and premaxillae. Arms slender; forearms and fingers long and slender; finger lengths II<IV<I<III; finger tips rounded, without expanded discs; fingers not webbed nor fringed; subarticular tubercles single, slightly elliptical or rounded; inner metatarsal tubercle large, ovoid;

outer metatarsal tubercle large, slightly rounded; few supranumerary tubercles. Legs short, slender; toes long, slender; toe lengths I $\approx$ II<III $\approx$ V<IV; toes tips rounded, without expanded discs; toes not webbed or fringed; subarticular tubercles slightly elliptical; inner metatarsal tubercle large, ovoid; outer metatarsal tubercle medium-sized, slightly rounded. Head and dorsum glandular; loreal region, fore limbs and hind limbs smooth; undersurfaces smooth.



**FIGURE 3.** *Holoaden pholeter* sp. nov., holotype (MNRJ 51475). Dorsal and lateral views of head; ventral views of hand and foot; scale bars represent 5 mm.

**Color of holotype.** In life, upper surfaces and flanks dark purplish-brown; eyes slightly lighter than dorsum (Fig. 1); throat and ventral surfaces slightly lighter than dorsum, with a whitish patch on abdomen; palmar and plantar tubercles and tips of digits leaden gray; in close-up view, dorsal surfaces and eyes have a pattern of numerous very small light dots on a dark brown background. In preservative, upper surfaces and flanks dark purplish-gray, almost black.

**Measurements of holotype.** Snout-vent length 44.6; head length 15.2; head width 16.3; eye diameter 5.4; interorbital distance 5.9; eye-nostril distance 4.6; internasal distance 3.6; forearm length 12.9; hand length 11.2; femur length 19.9; tibia length 19.0; foot length 17.7.

**Variation.** Measurements for the male and female paratypes are, respectively: snout-vent length 41.6, 47.7; head length 14.7, 18.4; head width 16.4, 19.3; eye diameter 4.7, 6.6; interorbital distance 4.2, 6.2; eye-nostril distance 3.7, 4.4; internasal distance 3.1, 3.4; forearm length 11.9, 12.8; hand length 11.0, 12.0; femur length 17.7, 20.6; tibia length 18.0, 19.3; foot length 17.7, 19.5. The forearm in the male paratype is slightly more robust and longer than in the two females. The light abdominal blotch is variable in size, being smallest in the male paratype and largest in the female paratype.

**Etymology.** The specific epithet “pholeter” is a Greek word, herein used in apposition, which means “one who lurks in a hole”, in allusion to the cryptic habits of the species (see below).

**Distribution.** *Holoaden pholeter* is known only from the type locality, at 1200-1400 m a.s.l., on the eastern portion of the Serra dos Órgãos (a subdivision of the Serra do Mar mountain range), within the Atlantic Forest domain (fig. 4).

**Natural history.** All three specimens of *Holoaden pholeter* were collected at night. The holotype was found when it emerged from the leaf litter that was accumulated among tree roots after the site was disturbed by one of us (TAD). Paratype MNRJ 53483 was collected on the leaf litter, whereas MNRJ 53482 was found shortly afterwards, hidden inside a hole at the base of a tree, ca. 1 m from where the female was found. The hole where it was found (ca. 10 cm high, 10 cm deep, and 5 cm wide) was adjacent to a second hole, quite similar in dimensions and structure, which may have been used by the female. The floor of these holes consisted of bare soil with a shallow depression (on which the male was nested). Although there was abundant leaf litter on the forest floor surrounding this double den, its interior was clean of litter, as was the small area within 10 cm of its entrance. Judging by these observations, it is possible that this shelter was “cleaned up” by its occupant(s). We cannot assure that *Holoaden pholeter* (and maybe other congeners) actually “prepare” such dens, but if they do, this would represent a unique behavior among terraranan frogs. Nevertheless, our observations, along with those of Lutz (1958), suggest that *Holoaden* spp. are reclusive animals, frequently hiding in various types of shelters.

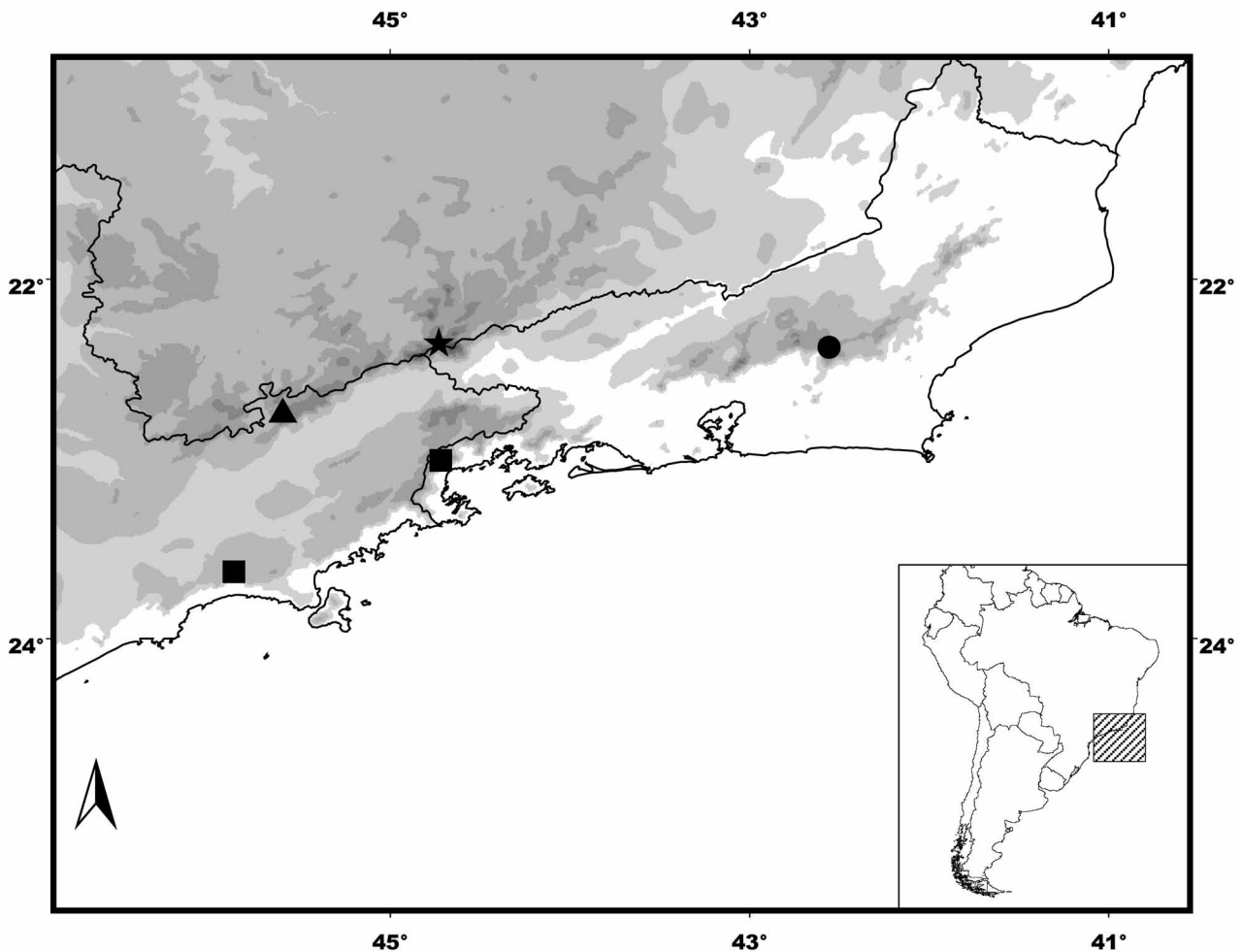
Upon capture, MNRJ 53483 released a copious amount of a colorless and very sticky secretion. It is likely that the numerous, conspicuous dorsal glands of *Holoaden* are responsible for secreting that substance, possibly as a defense, though there is currently no information on other species of the genus regarding such behavior nor the chemical nature of such secretions.

The holotype and paratype MNRJ 53483 contained large unpigmented eggs, as is believed to occur in all Terrarana, a clade of direct-developing frogs (Hedges *et al.* 2008). Similar eggs were reported for *H. bradei* by Lutz (1958) who observed parental care and direct development in that species.

## Discussion

B. Lutz (1958) cited a specimen identified as *H. luederwaldti* from the Serra da Bocaina (a subdivision of the Serra do Mar range) housed at the MNRJ, but this specimen was not found by us in the MNRJ collection and it is assumed lost. She also mentioned a specimen of *H. luederwaldti* from “Cidade Azul, Minas Gerais” (not examined by us) housed at the MZUSP, but that locality is actually situated in the municipality of Campos do

Jordão (the type locality of *H. luederwaldti*) and not in the State of Minas Gerais. Heyer *et al.* (1990) referred to specimens of *Holoaden* from Boracéia (also in the Serra do Mar range) as *H. luederwaldti*, but superficial examination of one specimen from Boracéia (MZUSP 138348) suggests that it may be distinct from *H. luederwaldti* and may correspond to an undescribed species.



**FIGURE 4.** Distribution of the species of *Holoaden*. *Holoaden pholeter* sp. nov. (dot); *H. luederwaldti* (triangle); *H. luederwaldti* and *H. bradei* (star); *Holoaden* sp. (square).

All specimens of the genus *Holoaden* are known from montane Atlantic Forest areas above 1000 m of altitude in the Serra do Mar and Serra da Mantiqueira mountain ranges (Fig. 4). It is possible that *H. luederwaldti* and *H. bradei* may be endemic to the Serra da Mantiqueira mountain range, whereas *H. pholeter* and the possible undescribed species from Boracéia may be endemic to the Serra do Mar mountain range. The discovery of *Holoaden pholeter* expands the distribution of the genus eastwards approximately 200 km airline in Brazil (Fig. 4).

The Brazilian Atlantic Forest is a greatly endangered biome (Dean 1997) that possibly houses the world's greatest anuran richness and rates of endemism (Duellman 1999). In terms of the status of conservation of *Holoaden* spp., it is worth observing that *H. luederwaldti* is listed as “data deficient” by the IUCN red list, whereas *H. bradei* is listed as “critically endangered” having been last seen in the wild in 1976 (Rocha *et al.* 2004). However, the cryptic habits of *Holoaden* (Lutz 1958; present study) may make it difficult for a collector to find these frogs and perhaps making it appear rarer than they actually are. Indeed, the leptodactylid *Paratelmatobius gaigeae* (Cochran 1938), previously known from only two specimens (see Pombal and Hadad 1999), was recently re-discovered 70 years after it was first found (Zaher *et al.* 2005). It should thus not

be too surprising if a similar “comeback” occurs with *H. bradei* in the near future.

The current knowledge on taxonomy, geographic distributions, and conservation status of Brazilian amphibians is still far from satisfactory and new species are constantly being discovered or re-discovered (Pimenta *et al.* 2005). The finding of another new species of frog in an area relatively close (ca. 85 km airline) to Rio de Janeiro city, the second largest urban center in Brazil, attests to the present insufficient status of knowledge of the fauna of the Atlantic Forest biome.

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#### **Appendix. Specimens examined.**

*Holoaden bradei*. Brazil, State of Minas Gerais: Parque Nacional do Itatiaia, Itamonte MNRJ 4087 (holotype), MNRJ 4088-89, 23682-84, 23685, 23714-15, 23779-83, 23784-89, 23799-812, 23814-32, 24272-88, 24289-91 (paratypes); MNRJ 23551-68.

*Holoaden luederwaldti*: Brazil. State of Minas Gerais: Itamonte, Brejo da Lapa MNRJ 24292-93; State of São Paulo: Campos do Jordão MUZSP 87 (lectotype), MZUSP 891 (paralectotype); MNRJ 40635-36.

*Holoaden* sp. Brazil. State of São Paulo: Boracéia, Salesópolis MZUSP 138348.