

New records and description of a new species of Aeglidae (Crustacea: Anomura) from river basins in Southern Brazil

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Abstract

A new species of freshwater anomuran, *Aegla renana* n. sp. (Decapoda: Aeglidae), is described from the Caí River sub-basin, a tributary of the Jacuí/Guaíba system, from the northwest region of the state of Rio Grande do Sul, Brazil. It can be distinguished from its congeners based on both morphological and molecular evidence. Morphologically, the new species partly resembles *Aegla ligulata* because of its ligulate rostrum; however, *A. renana* has an inflated left propodus of the cheliped, similar to that of *A. manuinflata*. Based on the phylogenetic analysis of DNA sequence data, *A. renana* has a sister relationship with *A. itacolomiensis* and both are clustered with the *A. longirostri*-*A. inermis* clade. New distribution records of *A. franciscana*, *A. longirostri* and *A. inermis*, which occur in the same hydrographic basin, are provided.

Key words: Anomuran crab, biogeography, COII, mtDNA sequence, Jacuí-Guaíba System.

Introduction

The present configuration of the hydrographic basins of eastern South America began in the Jurassic with the Wealdenian reactivation (Ribeiro, 2006). This process generated the Afro-Brazilian Depression between South America and Africa. According to the model proposed by Cox (1989), during this process the upper mantle plumes created an arched deformation hundreds of kilometers wide, imposing a characteristic drainage pattern with rivers running out from the center of the megadome (a large structure resembling an arched roof). As a consequence of this reactivation, six megadomes arose in several parts of the continental margins of South America and Africa: Guyana/Guinea, NE Brazil/Niger, Mantiqueira/Angola, Uruguay/SW Africa, Somuncurá, and Deseado (Potter, 1997).

The drainage patterns created by these areas of uplift are still evident today, for example, the Uruguay megadome defines the drainage of the

Uruguay River and its tributaries. In that region, the lithosphere is relatively weak, compared to the adjacent cratonic areas, and this fragility would explain why this region is prone to deformations (Ribeiro, 2006).

Onshore and offshore geological data provide evidence that the reactivation of the southeast Brazilian margin occurred in three main phases that were separated by calm intervals. These intervals coincide with the following periods of the Andean orogeny: 1) Peruvian (90-75 Ma), 2) Incaic (50-4 Ma), and 3) Quechuan (25-0 Ma). These geological processes have probably altered the courses of some rivers located at the border of the large megadomes and at the coastal margin of South America several times (Ribeiro, 2006).

Hence, the reactivation, a complex geological process, may be one of the main factors contributing to the evolution and diversification of several groups of limnetic animals, such as the anomuran crabs of the family Aeglidae. These crustaceans are

currently grouped in a single genus, *Aegla* Leach, 1820, with a distribution restricted to southern South America (Bond-Buckup and Buckup, 1994) and comprising about 70 species.

According to Pérez-Losada *et al.* (2009), the rivers located on the edge of the Serra Geral mountain range, in the Alto Uruguay region, and in the Jacuí/Guaíba Basin, between the states of Santa Catarina and Rio Grande do Sul in Brazil, support the highest indices of diversity and endemism of aeglids. The highest genetic and phylogenetic diversities known in the group are also recorded in the Jacuí/Guaíba system.

The main river of this basin, the Rio Jacuí, which is also the largest river in central Rio Grande do Sul, starts in the Central Plateau and flows South first and then East towards the Guaíba/Patos Lagoon. Its main tributaries are the Taquari/Antas, Caí, and Sinos rivers, which flow from the slopes of the Serra Geral Range (Fig. 1). Sixteen species of aeglids were recorded in this hydrographic basin, i.e., 72.7% of the species in southern Brazil (Bond-Buckup and Buckup, 1994).

In a previous phylogenetic study of the Rio Caí sub-basin (Pérez-Losada *et al.* 2004, 2009), a new species of aeglid was identified based on DNA sequence data. Herein, the description of this new species is presented, as well as extensions of the distributions of some other aeglid species.

Material and Methods

Specimens were collected in watercourses of the Rio Caí sub-basin during several sampling campaigns, and were deposited in the Collection of Crustaceans of the Department of Zoology, Institute of Biosciences, Federal University of Rio Grande do Sul (UFRGS), and in the Museu de Zoologia da Universidade de São Paulo (MZUSP).

The description of the new species is based on the characters of the type-series. The identification of the other species collected at the same hydrographic basin was determined according to Bond-Buckup and Buckup (1994). For the measurements of the specimens, the methodology of Bond-Buckup and Buckup (1994) was adopted, with the following abbreviations: Letter “m” represents males, “f” females, “f ov” ovigerous females, “j” juveniles, TCL – total cephalothorax length (between the tip of rostrum and the midpoint of the posterior margin of the carapace), PCW – pre-

cervical width (between the left and right epibranchial margins), FW – frontal width (between the tips of the spines of the anterolateral angles of the carapace), AL – areola length, AW – areola width, RL – rostrum length (between the tip of the rostrum and the midpoint of the orbital margin). Museum codes: MCPUC – Museu de Ciências da Pontifícia Universidade Católica do Rio Grande do Sul, Porto Alegre, Brazil; MZUSP – Museu de Zoologia da Universidade de São Paulo, São Paulo, Brazil; UFRGS – Universidade Federal do Rio Grande do Sul, Porto Alegre, Brazil.

Morphometric analysis: For the description of the new species, the following body dimensions were recorded for all animals of the type series, and also the non-paratype animals: TCL, PCW, FW, AL, AW, and RL. The morphometric ratios TCL/RL, PCW/FW, and AL/AW were calculated for the set of animals from each locality.

Molecular analysis: The maximum-likelihood and Bayesian phylogenetic analyses were obtained from Pérez-Losada *et al.* (2009). However, at the time of that publication, the taxonomic status of the species described here was unknown. The new species herein described was referred to as *Aegla* n. sp. 4 by Pérez-Losada *et al.* (2009).

Results

Guided by the discovery of a distinct evolutionary lineage through a molecular phylogenetic

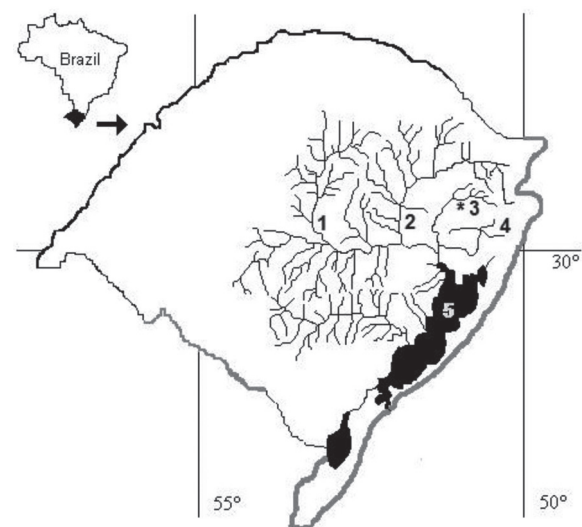


Figure 1. Jacuí-Guaíba system, with the localities of its main watersheds: 1: Jacuí River, 2: Taquari/Antas River, 3: Caí River, 4: Sinos River, 5: Patos Lagoon. * = sampling localities.

study (Pérez-Losada *et al.* 2004, 2009), we examined specimens collected in the Rio Caí and identified a morphologically and genetically distinct new species. These additional collections also allowed us to add new localities of occurrence of three previously described species of aeglids.

***Aegla renana* n. sp. Bond-Buckup & Santos
(Figure 2)**

Type-material: Holotype male, Brazil, state of Rio Grande do Sul, tributary of Rio Caí, Nova Petrópolis, 12.xii.1991, Bittencourt, W. leg. 1 male (MZUSP 20822).

Additional material

Paratypes: Brazil: 1 male, 1 female (UFRGS 1416P), with the same data as the holotype; state of Rio Grande do Sul, tributary of Rio Caí sub-basin, Nova Petrópolis, vii.1992. Bittencourt, W. leg., 7 males, 4 females (UFRGS 1430P); Morro Korb creek, Rio Caí sub-basin, 01.xi.2000, Voltz, E, Hang, H.R. cols. (UFRGS 3004P); Cascata Grings creek, Nova Petrópolis, state of Rio Grande do Sul, 29°21'17.4"S, 51°02'44.1"W, 593 m, 25.xi.2009, Santos, S.; Campos-Filho, I.; Buckup, L.; Bond-Buckup, G. cols.; UFRGS 3459, 1 male, 1 female, 3 juv.

Diagnosis

Anterolateral spine of carapace short, not exceeding base of cornea; protogastric lobes absent; extra-orbital sinus absent; rostrum ligulate, slightly recurved distally, lacking carina on distal third; outer proximal margin of movable finger of cheliped with lobe absent but with scales; palmar crest of cheliped subrectangular, with scales on its margin; anterior angle of ventral margin of epimeron 2 unarmed; inner margin of ventral surface of ischium of cheliped with four tubercles. Dorsal margin of dactylus, propodus, and carpus of second, third, and fourth pereopods with rows of setae, scales.

Description

Carapace flat, area of gastric region flattened, dorsal surface scabrous, covered with punctations.

Front narrow; LPC/FL ratio of male holotype 1.95.

Rostrum ligulate, straight, and slightly recurved in distal portion, length short, wide from base and up to extremity, excavated in middle portion, carinate on proximal 2/3. Sub-rostral process well developed; in profile, ventral portion of rostrum deeper than dorsal. Rostral carina beginning between epigastric prominences, scales sparse, absent on distal third. Lateral margins of rostrum with scales, denser on distal portion.

Orbits moderately wide, deep, U-shaped. Orbital spine absent. Orbital margin with few scales. Extra-orbital sinus absent.

Antero-lateral angle of carapace projecting anteriorly in a scale, which does not reach base of cornea. Outer margin of antero-lateral lobe with scales; inner margin with few scales.

First hepatic lobe delimited anteriorly by a groove; lateral margin with scales; second and third, hepatic lobes not delimited, with only shallow incision; lateral margins with subequal scales.

Epigastric prominences little evident, low, indefinite in form. Protogastric lobes absent; anterior margin marked only by several scales.

Transverse dorsal line slightly sinuous. Areola sub-rectangular to rectangular, with indistinctly subparallel margins in distal third. AL/AW ratio in male holotype: 1.78.

Epibranchial area triangular, little developed, with apical tubercle followed by smaller, scale-shaped tubercles. Lateral margins of anterior and posterior branchial area with subequal scale-shaped tubercles.

Anterior angle of ventral margin of epimeron 2 unarmed; ventro-lateral margin straight; posterior angle of ventral margin unarmed. Epimera of 3rd to 6th segments projecting; on 3rd and 4th segments, the lateral projection is ornamented with an apical scale.

Telson divided by longitudinal suture.

Anterior extremity of third sternite tapered, projecting between coxae of the exopodites of third maxillipeds. Fourth thoracic sternite flat, lateral margins not recurved; antero-lateral margin projecting; tuft of long setae, transversely on anterior part of segment.

Chelipeds unequal, hand sub-rectangular to globose. Major cheliped globose, palm inflated in posterolateral region, covered with corneous scales. Minor cheliped smaller, subrectangular. Palmar crest sub-rectangular, margin with three projections ornamented with scales. Pre-dactylar lobe forming small step with anterior margin

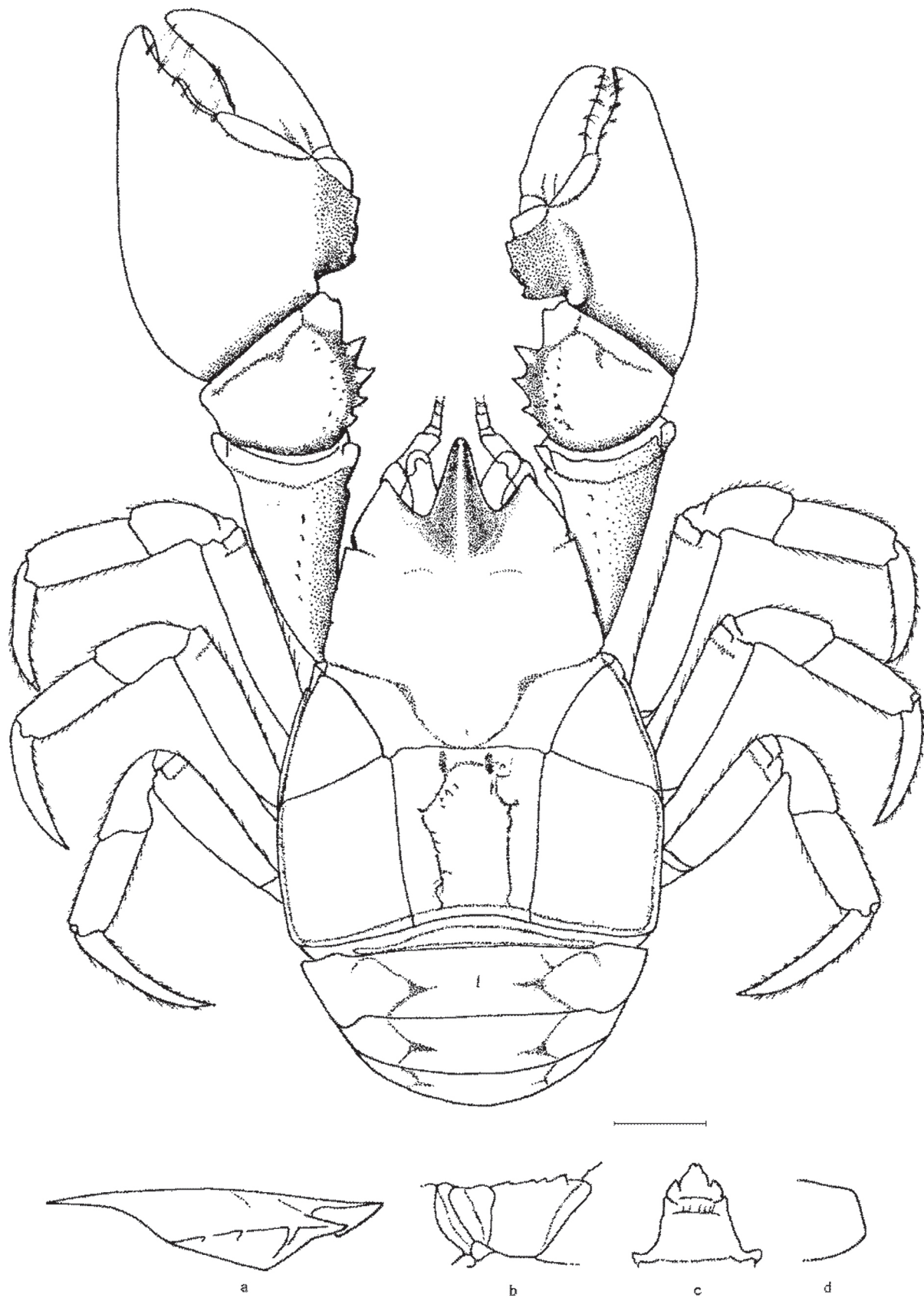


Figure 2. *Aegla renana*, new species: male holotype, dorsal view: a: precervical portion of carapace, lateral view; b: ischium of cheliped, ventral view; c: third and fourth sterna, ventral view; d: second pleomere epimeron.

of propodus. Fingers thickened and covered by scales and punctations. Proximal outer margin of movable finger without lobe. Prehensile margins of fingers with scale-shaped denticles along their entire length and with enclosing opposing lobular teeth, with space between fingers. Dorsal surface of carpus rugose, with scales; inner margin with four to five spines, first and second distal spines the most robust of them; these spines are smooth and with setae on lateral margins; inner anterolateral angle subobtuse, with apical scales; anterodorsal margin with scales. Carpal crest of minor cheliped modestly pronounced, especially in distal region; in proximal region, two crests formed, with scales clustered into groups of three to five units on elevations of crest; crest absent in distal region, with sparse scales; outer ventral angle of carpus with only one scale; ventral face with scale-shaped tubercle. Dorsal margin of merus of cheliped with elevations and scale-shaped tubercle; antero-dorsal margin with sparse scales. Lateral surfaces scabrous, with scales and punctations. Inner ventral margin of merus with four to five projections and scales along margin; outer ventral margin with prominent distal projection. Dorsal margin of ischium with elevation ornamented with scales and tufts of setae; inner margin of ventral surface with four elevations tipped by a scale; proximal and distal elevations more pronounced.

Dorsal margin of dactylus, propodus, and carpus of second, third, and fourth pereopods with rows of setae tufts. On dactylus and propodus, setal tufts with velvet appearance. Carpus of second and third pereopods unarmed.

Variations

A few variations were observed, the more pronounced being the presence of an incision in the middle portion of the anterior margin of the fourth thoracic sternite; on the ventral face of the carpus of the cheliped, up to three tubercles can be found in some specimens.

Measurements

Male holotype, TCL 25.88 mm. Paratypes with mean TCL 22.01 mm for males ($n = 10$), ranging from 18.26 to 28.59; mean TCL 19.15 mm for the females ($n = 2$).

TCL/RL ratio of paratypes ranging from 1.90 to 2.23, with mean of 2.06 for males and 2.12 for females.

AL/AW ratio

Paratypes ranging from 1.77 to 1.97, mean AL/AW ratio 1.89 for males and 1.85 for females.

Etymology

Named in honor of the community of Nova Petrópolis, RS, the type-locality of the species, who are descendants of German immigrants from the region of the Rhine River. The care of the population and of the local administration with regard to the environmental protection of the river basins in the municipal district has assured the survival of a highly diverse fauna of benthic macro-invertebrates, as the aeglids, in that region.

Conservation status

Critically Endangered (CR) – B2ab(iii): Area of occupancy estimated to be less than 10 km²; known to exist at only a single location; continuing decline, inferred in quality of habitat (IUCN, 2001).

Biology

Unknown.

Distribution

Brazil, Rio Caí sub-basin, state of Rio Grande do Sul.

Remarks

A. renana resembles *A. ligulata* Bond-Buckup and Buckup, 1994 in the ligulate rostrum. However, the rostrum of the latter is narrower, ending in a spine, and the carina is more elevated and excavated. In *A. renana* the rostrum is round in its distal portion. It also differs from *A. ligulata* in having an inflated cheliped and a palmar crest.

The shape of the inflated cheliped, a key feature in *A. renana*, also occurs in *A. manuinflata* Bond-Buckup and Santos in Santos *et al.* (2009). However, the inflated cheliped propodus of *A. renana* has a subrectangular palmar crest, which is absent in *A. manuinflata* (Santos *et al.*, 2009).

Our previous phylogenetic analyses (Pérez-Losada *et al.*, 2004, 2009) showed that *A. renana* is sister to *A. itacolomiensis* Bond-Buckup and Buckup, 1994 and that this clade is also sister to *A. longirostri* Bond-Buckup and Buckup, 1994 and *A. inermis* Bond-Buckup and Buckup, 1994 clade (Fig. 3). According to Pérez-Losada *et al.* (2004) *A. renana* (identified as *Aegla* n. sp. 4) and the other three above-mentioned species belong to Clade

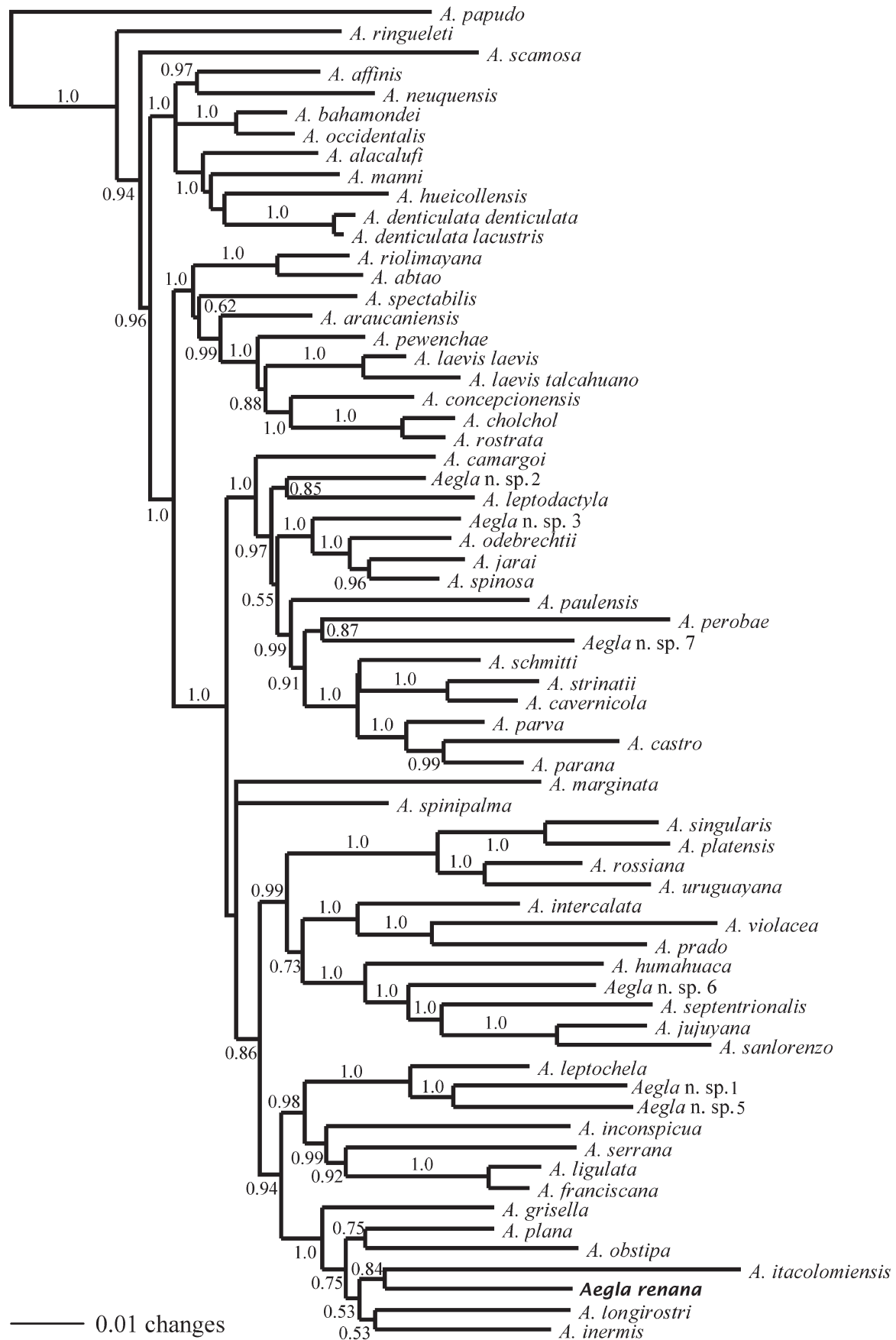


Figure 3. Maximum-likelihood and Bayesian trees as modified from Pérez-Losada *et al.* (2009). Posterior probabilities (if > 0.5) are indicated for each clade.

E, whose origin was estimated to be 24.3 ± 0.7 million years ago.

Three species were already recorded for the sub-basin of river Caí: *A. inconspicua* Bond-Buckup and Buckup, 1994, *A. plana* Buckup and Rossi, 1977 and *A. serrana* Buckup and Rossi, 1977. Based on new samples and revision of the previous collections, we extend the known distribution of the following species:

***Aegla franciscana* Buckup and Rossi, 1977**

Formerly known distribution: Brazil: Southeastern part of the state of Santa Catarina, Pelotas basin, and northeastern part of Rio Grande do Sul, Pelotas, Sinos, and Antas sub-basins (Bond-Buckup and Buckup, 1994).

New records: Brazil: State of Rio Grande do Sul: Rio Caí basin: tributary of Rio Caí, Montenegro, RS (UFRGS 2449); tributary of Rio Caí, São Francisco de Paula (UFRGS 3781).

Conservation status: least concern (IUCN, 2001). The new records do not change its previous conservation status (Pérez-Losada *et al.*, 2009).

Biology: The population ecology of *A. franciscana* was studied by Gonçalves *et al.* (2006), where the size-frequency distribution, sex ratio, recruitment, reproductive period (frequency of ovigerous females) and fecundity were evaluated.

***Aegla longirostri* Bond-Buckup and Buckup, 1994**

Formerly known distribution: Brazil: The majority of records refer to the central region of the state of Rio Grande do Sul, Jacuí basin, and to the east in the Antas and Sinos rivers (Bond-Buckup and Buckup, 1994).

New records: Brazil: State of Rio Grande do Sul: Rio Caí basin, Nova Petrópolis, São José creek $29^{\circ}20'32.1''\text{S}$, $51^{\circ}08'5.5''\text{W}$, 86 m (UFRGS 2095); *idem*, $29^{\circ}20'42.2''\text{S}$, $51^{\circ}04'50.9''\text{W}$, 537 m (UFRGS 2096).

Conservation status: least concern (IUCN, 2001). The new records do not change its previous conservation status (Pérez-Losada *et al.*, 2009).

Biology: Sperm structure was investigated by Tudge and Scheltinga (2002); size at onset of sexual maturity, size-frequency distribution, sex ratio, ovigerous-rate, and recruitment were characterized by Colpo *et al.* (2005); its growth was studied by Silva Castiglioni *et al.* (2006); Sokolowicz *et al.* (2007) studied the diurnal activity; and Santos *et al.* (2008) analyzed the natural diet.

***Aegla inermis* Bond-Buckup and Buckup, 1994**

Formerly known distribution: Brazil: state of Rio Grande do Sul, only in Caraá creek, sub-basin of the Sinos River, municipality of Osório (Bond-Buckup and Buckup, 1994).

New records: Brazil: State of Rio Grande do Sul: Rio Caí sub-basin: Arroio do Pinto, São Francisco de Paula $29^{\circ}25'25''\text{S}$, $50^{\circ}30'51''\text{W}$ (UFRGS); Santo Antônio da Patrulha, Sinos sub-basin (UFRGS 2177); Barra do Ouro, *idem* (UFRGS 2050); Rio das Cobras, *idem* (UFRGS 2465).

Conservation status: vulnerable. The destruction and/or changes of the natural habitat, as well as the restricted distribution of this species, constitute the main factors which threaten its populations (IUCN, 2001; Bond-Buckup *et al.*, 2003; Pérez-Losada *et al.*, 2009).

Biology: Unknown.

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