

The caudal skeleton of extant and fossil cyprinodontiform fishes (Teleostei: Atherinomorpha): comparative morphology and delimitation of phylogenetic characters

WILSON J. E. M. COSTA

Laboratório de Sistemática e Evolução de Peixes Teleósteos, Departamento de Zoologia, Universidade Federal do Rio de Janeiro, Caixa Postal 68049, CEP 21944-970, Rio de Janeiro, RJ, Brazil
wcosta(at)acd.ufrj.br

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> Abstract

The caudal skeleton of teleost fishes of the order Cyprinodontiformes is described and compared on the basis of 394 extant and eight fossil species, supporting delimitation of 21 phylogenetic characters, of which 13 are firstly reported. The Cyprinodontiformes are unambiguously diagnosed by the presence of a single, blade-like epural, and by principal caudal-fin rays continuous on upper and lower hypural plates. Monophyly of the suborder Cyprinodontoidei is supported by the widened neural and hemal spines of the preural centrum 3 and presence of a spine-like process on the stegural, and monophyly of the Aplocheiloidei by the absence of radial caudal cartilages. A keel-shaped lateral process on the compound centrum supports monophyly of the Nothobranchiidae. Some characters of the caudal skeleton in combination to other osteological features indicate the cyprinodontiform fossil genus †*Prolebias* to be a paraphyletic assemblage; †*P. aymardi*, †*P. delphinensis* and †*P. stenoura*, the type species of the genus, all from the Lower Oligocene of Europe, possibly are closely related to recent valenciids; †“*P.*” *meridionalis* from the Upper Oligocene of France is an *incertae sedis* cyprinodontid; and, †“*P.*” *cephalotes*, †“*P.*” *egeranus* and †“*P.*” *malzi* from the Upper Oligocene-Lower Miocene of Europe are closely related to poeciliids, probably closely related to the recent African genus *Pantanodon* due to they sharing unique derived features of pelvic fin, branchial arches and jaws.

> Key words

Cyprinodontiformes, killifishes, Miocene, morphology, Oligocene, osteology.

Introduction

Characters of the caudal skeleton play a relevant role in studies on systematics of teleost fishes, often providing useful phylogenetic information at different taxonomic levels (e.g., MONOD, 1968; ROSEN, 1973, 1985; PATTERSON & ROSEN, 1977; JOHNSON & PATTERSON, 1996; DE PINNA, 1996; ARRATIA, 1999). The broad use of the complex morphology of the caudal skeleton in phylogenetic studies may be explained by it being first easily studied in dry skeletons and via dissection, and later through radiographs and standard techniques for clearing and staining small vertebrates. In addition, the caudal skeleton is frequently well-preserved in fossil material, making possible to evaluate the evolution of comparable osteological characters in a vast array of

extinct fish lineages (e.g., PATTERSON & ROSEN, 1977; ARRATIA, 1997; HILTON & BRITZ, 2010).

The Cyprinodontiformes are a diversified order of teleost fishes comprising about 1,120 species, today classified in 125 genera and ten families occurring in freshwater and brackish environments of Asia, Europe, Africa and Americas (e.g., NELSON, 2006; COSTA, 2008). Until 1981, all living oviparous cyprinodontiforms from the whole geographic distribution of the order were classified in a single family, the Cyprinodontidae, whereas American specialised viviparous taxa were placed in four families (Anablepidae, Goodeidae, Jenynsiidae, and Poeciliidae) (e.g., ROSEN, 1964). The Cyprinodontidae then comprised the great

majority of extant cyprinodontiform taxa, as well as all fossil cyprinodontiform taxa. Cyprinodontiform classification suffered drastic changes after the first phylogenetic analysis of the order hypothesizing the broad Cyprinodontidae as a paraphyletic assemblage (PARENTI, 1981), which has been corroborated by all subsequent studies (e.g., MEYER & LYDEARD, 1993; PARKER, 1997; COSTA, 1998a; GHEDOTTI, 2000). Extant taxa previously placed in the Cyprinodontidae are today distributed among all the ten cyprinodontiform families (PARENTI, 1981; COSTA, 2004). Whereas New World fossil taxa have been classified in families according to the most recent cyprinodontiform classification (e.g., PARENTI, 1981), Old World taxa have been kept in the Cyprinodontidae without criticisms.

The cyprinodontiforms may be unambiguously diagnosed by the unique morphology of the caudal skeleton (PARENTI, 1981; COSTA, 1998a). However, characters of the caudal skeleton have been only sporadically employed in phylogenetic studies of cyprinodontiform groups (COSTA, 1998a, 1998b), and with rare exceptions (e.g., GHEDOTTI, 1998), the derived character states of the cyprinodontiform caudal skeleton have not been checked in most cyprinodontiform fossils. The objective of this study is to describe and to compare morphological traits of the caudal skeleton of all extant lineages of the Cyprinodontiformes, evaluating potentially informative phylogenetic characters, and checking the distribution of derived character states in species of uncertainly positioned fossil genera.

Material and methods

Delimitation of the order Cyprinodontiformes is according to PARENTI (1981) and ROSEN & PARENTI (1981), and classification of included suborders and families follows NELSON (2006), which is based on PARENTI (1981) with modifications proposed by COSTA (2004). Intrafamilial classification follows PARENTI (1981) for the Goodeidae and Anablepidae; PARENTI (1981) for the Cyprinodontidae, except for the inclusion of a separate tribe Aphanini, thus reflecting phylogenetic evidence provided later by COSTA (1997); GHEDOTTI (2000) for the Poeciliidae; and, COSTA (2004) for the Nothobranchiidae and Rivulidae. The classification adopted here is given in the Appendix S1, where appears the complete list of 394 extant and eight fossil species of the order Cyprinodontiformes examined, and 10 extant species belonging to other orders (Atheriniformes, Beloniformes and Mugiliformes). Fossil taxa are identified by the symbol † before the taxon name. Osteological preparations of specimens of recent taxa were made according to TAYLOR & VAN

DYKE (1985). Terminology for osteological structures follows SCHULTZE & ARRATIA (1989) and ARRATIA & SCHULTZE (1992). Descriptions focus on characters with some variation among formally recognised taxa (e.g., genera, families, suborders). In descriptions, the words 'often' and 'usually' refer to the occurrence of variability of a certain character state among included species of a given taxon. Characters refer to the morphology of adult specimens, except where noted. Character statements, listed in the Discussion, were formulated according to SERENO (2007). First author to propose characters under a phylogenetic context are cited after character statements, following recommendations described in SERENO (2009).

Results

Preural vertebra 1 and associated structures

The preural vertebra and posterior elements of the caudal skeleton form a compact compound centrum, in which the limits of the ural centrum are never conspicuous (Figs. 1, 2, 3A, B), even in embryos with about 10 mm of total length. Attached to it, there is a rudimentary stegural with poorly visible limits on the basal portion of the dorsal margin of the uppermost hypural (Fig. 4). In cyprinodontoids, except in some cyprinodontids (*Cubanichthys*, *Orestias*, *Jordanella*, *Megupsilon*), there is a lateral, short spine-shaped process on the stegural (Fig. 4A). In all nothobranchiids, there is a keel-shaped process on the central portion of the side of the compound centrum (Fig. 4B).

Hypurals

The caudal skeleton of cyprinodontiforms usually shows high degree of fusion among the hypural elements. The proximal part of all the hypurals is always ankylosed to the compound caudal centrum, where limits between the hypurals and the compound centrum are imperceptible (Figs. 1, 2, 3A, B). The lower hypurals (i.e., hypurals 1 + 2) are always ankylosed to form a single plate. The upper hypurals are equally ankylosed in most cyprinodontiforms, except in some species of the aplocheilid genus *Aplocheilus* (*A. lineatus* (VALENCIENNES) and *A. panchax* (HAMILTON)) and the nothobranchiid genera *Epiplatys* (*E. chaperi* (SAUVAGE), *E. fasciolatus* (GÜNTHER), *E. neumanni* BERKEN-

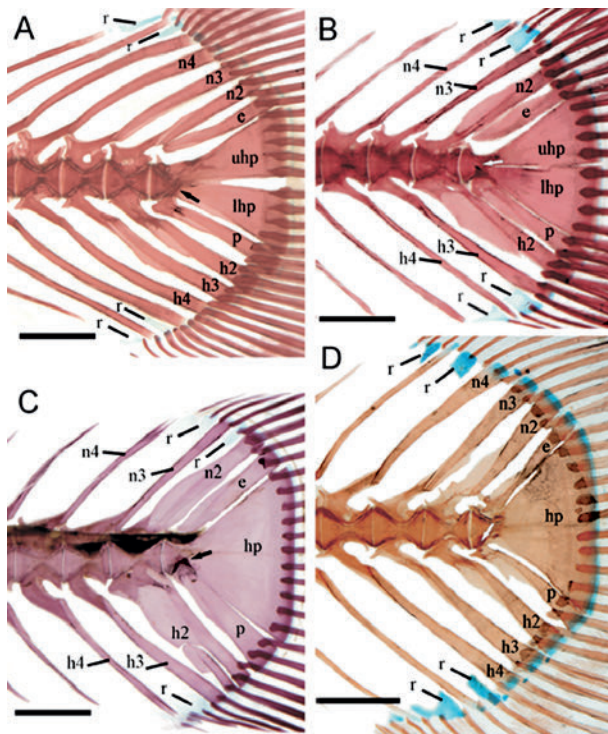


Fig. 1. Caudal skeleton, left lateral view. **A:** *Anableps dowi*; **B:** *Brachyrhaphis cascajalensis*; **C:** *Valencia letourneuxi*; **D:** *Fundulus sciadicus*. Abbreviations: e, epural; h2–4, hemal spine of preural centra 2–4; hp, hypural plate; lhp, lower hypural plate; n2–4, neural spine of preural centra 2–4; p, parhypural; r, radial cartilage; uhp, upper hypural plate. Arrow indicates hypurapophysis. Scale bar = 1 mm.

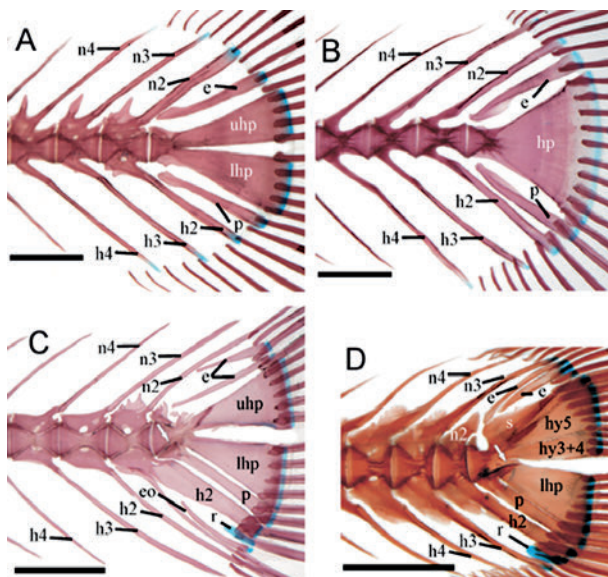


Fig. 3. Caudal skeleton, left lateral view. **A:** *Rivulus bahianus*; **B:** *Hypsolebias trilineatus*; **C:** *Oryzias matanensis*; **D:** *Craterocephalus honoriae*. Abbreviations: e, epural; eo, extra caudal ossicle; h2–4, hemal spine of preural centra 2–4; hp, hypural plate; hy3–5, hypurals 3–5; lhp, lower hypural plate; n2–4, neural spine of preural centra 2–4; p, parhypural; r, radial cartilage; s, stegural; uhp, upper hypural plate. Arrow indicates hypurapophysis. Scale bar = 1 mm.

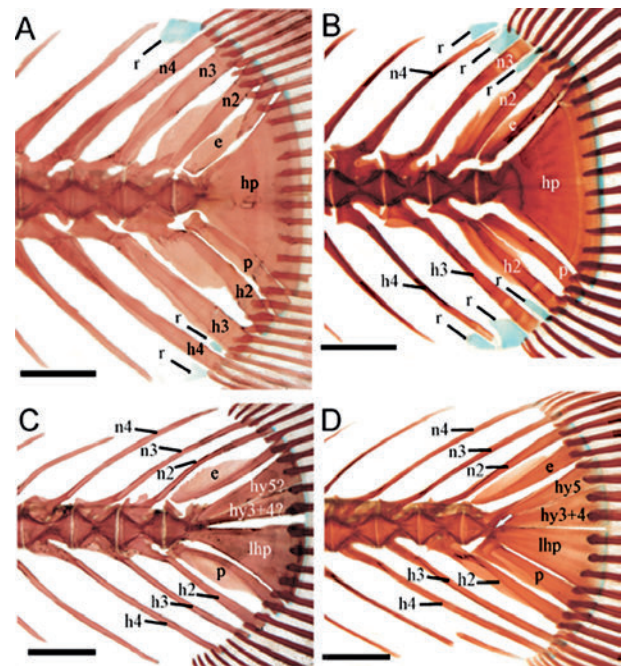


Fig. 2. Caudal skeleton, left lateral view. **A:** *Aphanis dispar*; **B:** *Cualac tessellatus*; **C:** *Epiplatys steindachneri*; **D:** *Aplocheilichthys lineatus*. Abbreviations: e, epural; h2–4, hemal spine of preural centra 2–4; hp, hypural plate; hy3–5, hypurals 3–5; lhp, lower hypural plate; n2–4, neural spine of preural centra 2–4; p, parhypural; r, radial cartilage; uhp, upper hypural plate. Arrow indicates hypurapophysis. Scale bar = 1 mm.

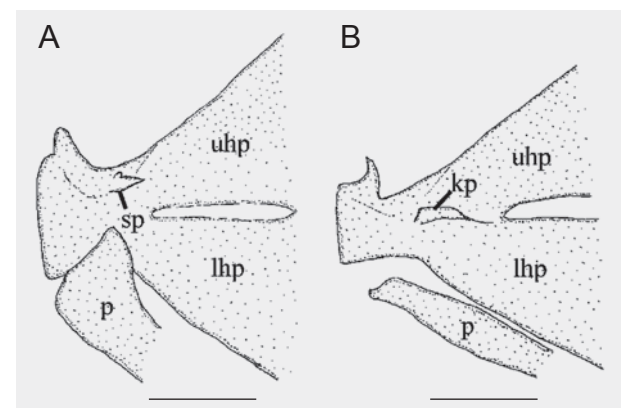


Fig. 4. Compound caudal centrum, left lateral view. **A:** *Aplocheilichthys spilauchen*; **B:** *Epiplatys sangmelinensis*. Abbreviations: kp – keel-shaped process; lhp – lower hypural plate; p – parhypural; sp – spine-shaped process; uhp upper hypural plate. Scale bar = 0.5 mm.

KAMP, and *E. steindachneri* (SVENSSON)) and *Pseudepiplatys* (*P. annulatus* (BOULENGER)), in which there are two separated elements (Figs. 2C, D). In those species of *Aplocheilus* (Fig. 2D), the ventral element of the upper hypurals, possibly corresponding to hypurals 3 + 4, is wider than the dorsal element, which is here

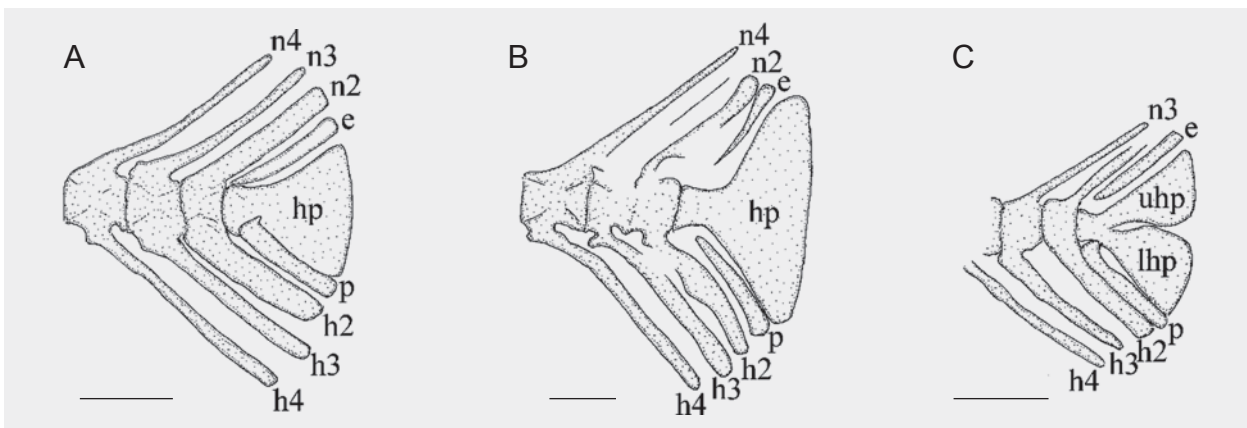


Fig. 5. Caudal skeleton, left lateral view. **A:** †*Prolebias delphinensis*, reconstruction based on MNHN.P.MBR-49 and MBR-53; **B:** †“*Prolebias*” *meridionalis*, reconstruction based on MNHN.P.MSQ-1D and MNHN.P.MSQ-44G; **C:** †“*Pantanodon*” *cephalotes*, reconstruction based on BMNH.P20071 and MNHN.P.Aix-67. Abbreviations: e, epural; h2–4, hemal spine of preural centra 2–4; hp, hypural plate; lhp, lower hypural plate; n2–4, neural spine of preural centra 2–4; p, parhypural; uhp, upper hypural plate. Scale bar = 1 mm.

tentatively identified as hypural 5 due to its relative position when compared to other atherinomorphs. In the double upper hypural plate of epiplatines (Fig. 2C), the two elements are about equal in width or the dorsal plate is slightly wider, making propositions about homology more subjective.

In all cyprinodontiforms, the upper and lower hypural plates are placed in close proximity, when not completely fused. The principal caudal-fin rays are arranged nearly regular and continuously (Figs. 1, 2, 3A, B), not presenting the middle hiatus typical for advanced teleosts (e.g., DE PINNA, 1996; ARRATIA, 1999) (Figs. 3C, D).

In cyprinodontoids, the upper and lower hypural plates are often completely fused (Figs. 1C, D, 2A, B). Exceptions are concentrated in the Anablepidae, Poeciliidae and Profundulidae. Among anablepids, *Anableps* (Anablepidae) have the plates always separated by an interspace (Fig. 1A) and *Jenynsia* (Anablepidae) may have plates separated or partially fused. The latter condition consists of a middle gap between the upper and lower plates restricted to the anterior portion, whereas the posterior portion the plates are in contact (Fig. 1B) or are fused. In anablepid embryos the plates are separated.

A similar partially fused hypural, with a conspicuous anterior gap between hypurals, is found in most poeciliids, but several species have a complete fusion, whereas others a complete separation. Complete fusion is common in miniature species of the Procatopodinae reaching about 20 mm as maximum adult size. Embryos of viviparous species have partially fused hypural, even in species having separate hypurals when adults. A similar anterior gap is present in adult specimens of some species of *Profundulus*, embryos of viviparous species of the Goodeidae, and

in the European cyprinodontiform fossil †*Prolebias cephalotes* (AGASSIZ) (Fig. 5C).

Among aplocheiloids, the upper and lower plates are usually separated (Figs. 2C, D, 3A), but they are fused to compose a single hypural plate in the aplocheilid *Pachypanchax*, and in *Aplocheilus blockii* (ARNOLD), *A. dayi* (STEINDACHNER) and *A. wernerii* MEINKEN; in the nothobranchiid *Nothobranchius*; and, in several rivulids, including all Cynolebiasinae and Pleisiolebiasini genera (Fig. 3B). A partial posterior fusion as that above described for poeciliids and profundulids is never found among aplocheiloids.

Epural

Cyprinodontiforms have a single, elongate epural bone (Figs. 1, 2, 3A, B). Its distal extremity bears a cartilaginous terminal and supports some caudal-fin rays, whereas its proximal extremity is placed close to the preural centrum 1. The epural is a blade-like bone with a flat core abruptly narrowing ventrally and a thin flap on the anteroventral portion, which may be close or in contact with the neural spine of preural centrum 2. The whole proximal region of the epural is distinctively narrow in cynolebiasine rivulids (Fig. 3B). In some recent species of *Aphanius* (i.e., *A. dispar* (RÜPPELL), *A. isfahanensis* HRBEK, KEIVANY & COAD, *A. richardsoni* (BOULENGER), *A. splendens* (KOSSWIG & SÖZER), and *A. sureyanus* NEU) and in *Crenichthys bailey* (GILBERT), the core part of the epural is restricted to its dorsal portion, usually the whole bone exhibiting a slightly sinuous shape (Fig. 2A). In the fossil taxa †*Brachylebias persicus* PRIEM and †*Prolebias meridionalis* GAUDANT,

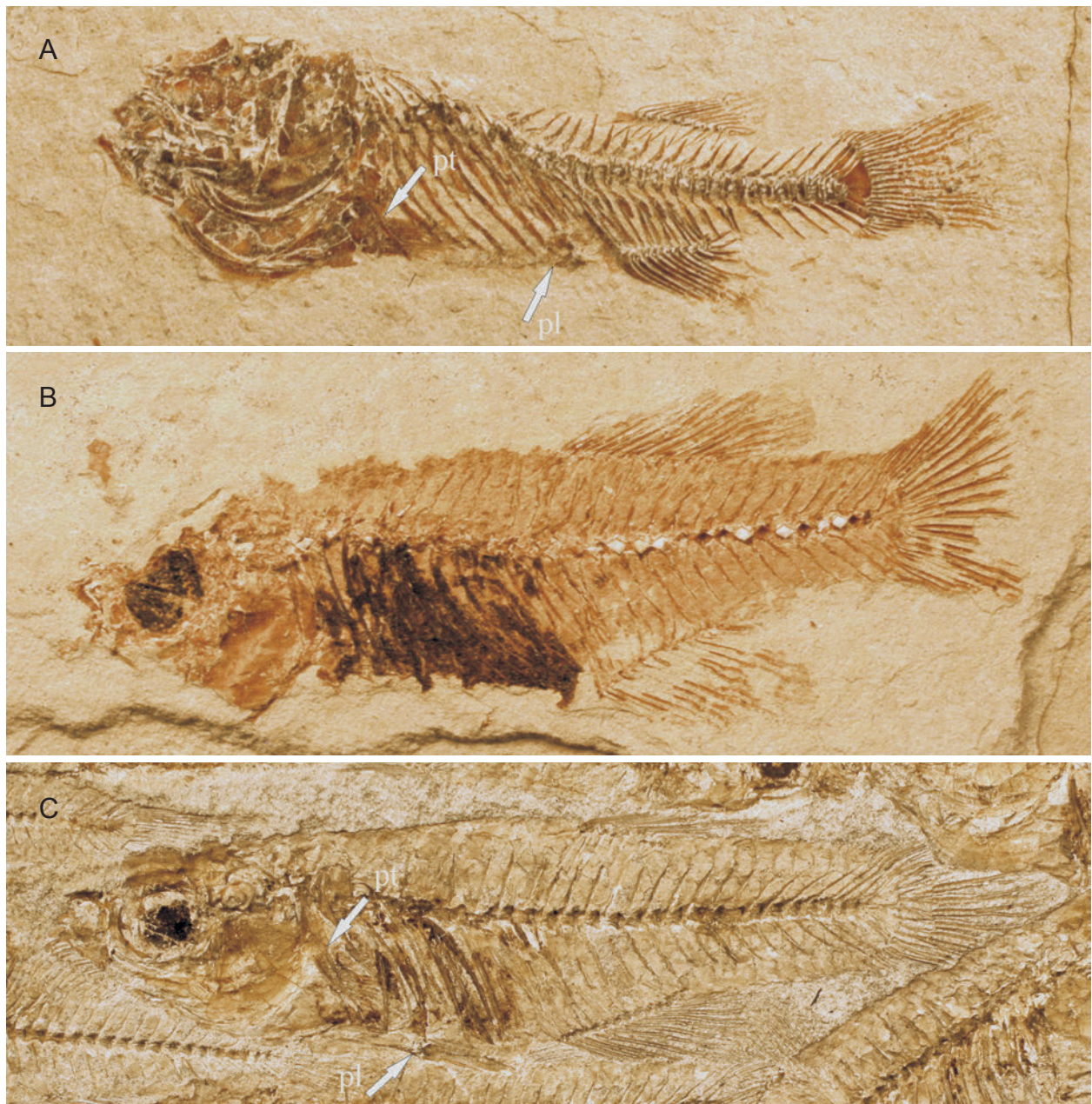


Fig. 6. Cyprinodontiform fossils. **A:** †*Prolebias delphinensis*, MNHN.P.MBR-49, holotype, 27.0 mm SL (inverted); **B:** †“*Prolebias*” *meridionalis*, MNHN.P.MSQ-1D, paratype, 39.3 mm SL; **C:** †“*Pantanodon*” *cephalotes*, BMNH.P20071, syntype, 29.9 mm SL. Abbreviations: pl, pelvic-fin insertion; pt, dorsalmost limit of pectoral-fin base.

it is possible to observe an epural with short and narrow proximal region, with a developed core part on the distal region (Fig. 6B).

Parhypural

The parhypural of the cyprinodontiforms is a subrectangular bone, in which the distal end is always truncate, terminating in a cartilaginous edge supporting some caudal-fin rays (Figs. 1, 2, 3A, B). Among cypri-

nodontoids, in anablepids, poeciliids, profundulids, valenciids, most species of the fundulid *Fundulus*, and the goodeid *Crenichthys* the proximal end of the parhypural overlaps the preural centrum 1, and it bears a pointed dorsoposteriorly directed hypurapophysis (Fig. 1A–D). A similar condition is present in the fossil taxa †*Prolebias aymardi* (SAUVAGE), †*P. cephalotes*, †*P. delphinensis* GAUDANT, and †*P. stenoura* SAUVAGE (Fig. 5C). In the remaining extant goodeids, the fundulids *Leptolucania* and *Lucania*, and all extant cyprinodontids, the proximal part does not reach the preural centrum 1, whereas the hypurapophysis is rudimentary or absent (Figs. 2A, B).

Among aplocheiloids, in species of the Aplocheilidae the parhypural is similar to those in poeciliids (Fig. 2D); in nothobranchiids and rivulids, the proximal end of the parhypural does not touch the preural centrum 1, it is usually narrowed and directed to the basal portion of the hemal spine of the preural centrum 2, and the hypurapophysis is absent (Fig. 3A, B), except in some species of *Epiplatys* (*E. fasciolatus* and *E. steindachneri*) and *Pseudepiplatys* (*P. annulatus*), that have their parhypural slightly abutting the preural centrum 1 and the hypurapophysis is rudimentary (Fig. 2C).

Preural vertebrae 2–5 and associated cartilages

In most cyprinodontiforms there are four or five preural vertebrae participating in the caudal skeleton; these vertebrae are easily distinguished from the remaining vertebrae not associated to the caudal skeleton by the former ones having the tips of the neural and hemal spines slightly longer and connected to caudal-fin rays (Figs. 1B, C, 2, 3A, B). Exceptions are found in all species of the genera *Anableps*, *Fundulus*, and *Orestias*, in which there are six preural vertebrae (Figs. 1A, D). The neural spine of the preural centrum 2 is always well-developed, long, its tip supporting some caudal-fin rays (Figs. 1, 2, 3A, B). In cyprinodontoids, the neural and hemal spines of the preural centra 2 and 3 are wider than the spines of the vertebrae anterior to them (Figs. 1, 2A, B), whereas in aplocheiloids, only the neural and hemal spines of the preural centrum 2 are distinctively wider (Figs. 2C, D, 3A, B). In cyprinodontids (except *Cualac tessellatus* MILLER, and species of *Cubanichthys* and *Orestias*), poeciliids, anablepids, profundulids (except *Profundulus guatemalensis*), the fundulid *Fundulus luciae* (BAIRD), and in the goodeids *Chapalichthys encaustus* (JORDAN & SNYDER) and *Characodon lateralis* GÜNTHER there is a constriction on the proximal portion of the neural spine of the preural centrum 2 (Figs. 1A, B, 2A, B). A similar constriction on the proximal portion of the hemal spine of the preural centrum 2 occurs in cyprinodontids (except *Cualac tessellatus*, and species of *Cubanichthys* and *Orestias*) (Fig. 2A, B) and in †*Brachylebias persicus* and †*Prolebias meridionalis*.

In cyprinodontoids, there are large radial cartilages between both neural spines and hemal spines of preural centra (Figs. 1, 2A, B). Usually there is one or two dorsal and one or two ventral cartilages, which are positioned between the anteriormost preural centrum spines (Figs. 1, 2A), but minute accessory cartilages adjacent to radial cartilages are also often present (Fig.

1D). Exceptions are the species of the cyprinodontid *Cualac*, *Cyprinodon* and *Megupsilon*, which have three dorsal and three ventral radial cartilages (Fig. 2B). In aplocheiloids, radial cartilages are always absent (Figs. 2C, D, 3A, B).

Discussion

The Cyprinodontiformes

GOSLINE (1963) characterized the caudal skeleton of the Cyprinodontiformes by the presence of a “plate-like hypural fan”, formed by the fusion of terminal vertebrae and hypurals (GOSLINE, 1961a). In addition to the fusion of hypurals, subsequently, ROSEN (1964) described a unique symmetry among some bones of the dorsal and ventral parts of the caudal skeleton of the cyprinodontiforms, in which a single bladelike epural forms the symmetrical dorsal counterpart of the parhypural, a condition previously reported by HOLLISTER (1940). Monophyly of the order Cyprinodontiformes was later discussed by PARENTI (1981), who diagnosed that order on the basis of an apomorphic symmetrical caudal-fin support, in which a single epural mirrors the parhypural in shape and position, and an upper hypural plate formed by the fused hypurals 3–5 opposed to a lower hypural plate formed by the fused hypurals 1 and 2. She noted that complete fusion of all hypurals occurs in several monophyletic groups within the Cyprinodontiformes as well as unfused hypurals 4 and 5 are present in some species of *Epiplatys* and *Aphyosemion*, as already recorded for *Aplocheilus panchax* by ROSEN (1964).

In fact, the character proposed by PARENTI (*i.e.*, symmetry of caudal-fin support) comprises four independent characters relative to the number of epurals, shape of the epural, fusion of hypurals 1 and 2, and fusion of hypurals 3, 4 and 5. Each of these characters contains a derived character state that would be diagnostic for the Cyprinodontiformes: one epural; epural shaped as parhypural (*i.e.*, blade-like as described by ROSEN, 1964); lower hypurals (1 and 2) fused; and, upper hypurals (3, 4 and 5) fused. The two latter character states cannot be unambiguously considered as synapomorphic for cyprinodontiforms, since lower hypurals fused also occurs in all other atherinomorphs, fusion of upper hypurals occurs in several beloniforms (*e.g.*, PARENTI, 2008), which is hypothesized to be the sister group of the cyprinodontiforms (ROSEN & PARENTI, 1981), but not in some species of *Aplocheilus* and

Epiplatys (PARENTI, 1981; COSTA, 1998a). Characters useful to diagnose the Cyprinodontiformes are listed and discussed below.

1. Epurals, number: (0) three or two; (1) one (ROSEN, 1964; PARENTI, 1981). The presence of three or fewer epurals has been considered as a synapomorphy for a group comprising living teleosts and some fossil lineages (e.g., DE PINNA, 1996). Mugilids and non-cyprinodontiform atherinomorphs have two epurals (e.g., GOSLINE, 1961b; PARENTI, 1981, 2008; SAEED, IVANTSOFF & ALLEN, 1989; STIASSNY, 1990; IVANTSOFF *et al.*, 1997) (Figs. 3C, D) or sometimes three in beloniforms (ROSEN, 1964), whereas all cyprinodontiforms have a single epural (Figs. 1, 2, 3A, B), thus confirming that condition as diagnostic for the order.
2. Epural, shape: (0) rod-like; (1) blade-like (ROSEN, 1964). Non-cyprinodontiform teleosts have narrow rod-like epurals (Figs. 3C, D), which contrasts with the typical cyprinodontiform blade-like shape (Figs. 1, 2, 3A, B), thus confirming the derived condition as diagnostic for the Cyprinodontiformes.
3. Caudal-fin rays, zone between upper and lower hypural plates, arrangement: (0) separated by broad interspace; (1) continuously arranged. A distinctive condition of cyprinodontiform caudal skeleton involving the middle hypural zone is the continuous arrangement of adjacent caudal-fin rays (Figs. 1, 2, 3A, B). This morphology contrasts with the typical condition of most advanced teleosts, including atheriniforms and most beloniforms, in which a wider interspace between hypural 2 and 3 is reflected by a hiatus between the corresponding caudal-fin rays (e.g., DE PINNA, 1996; ARRATIA, 1999) (Figs. 3C, D).
4. Preural vertebra 2, neural spine: (0) absent; (1) well-developed, distal tip acting in support of caudal-fin rays. The presence of a fully developed neural spine on the preural vertebra 2 is a derived condition occurring in all cyprinodontiforms (Figs. 1, 2, 3A, B), but is also present in adrianichthyids (Fig. 3C). The neural spine of the preural vertebra 2 is absent in atheriniforms and most beloniforms (e.g., CHERNOFF, 1986; SAEED *et al.*, 1989; STIASSNY, 1990) (Fig. 3D), whereas it is poorly developed in percomorphs (e.g., GOSLINE, 1961b). Since true epurals have been considered as those bones ontogenetically derived from the detachment of the neural spine of the adjacent vertebrae (e.g., SCHULTZE & ARRATIA, 1989), the most anterior epural of atheriniforms and non-adrianichthyids beloniforms may be derived from the detachment of the neural spine of the preural vertebra 2. On the other hand, the long neural spine of the preural centrum 2 occurring in cyprinodontiforms and adrianichthyids may be either an early ontogenetic condition retained in adult individuals, or a secondary lengthening of the spine, a question only explained after long range ontogenetic studies.
5. Stegural, development: (0) well-developed; (1) minute. Another derived character state of the caudal skeleton occurring in all cyprinodontiforms, but also in adrianichthyids, is the minute uroneural (stegural). The presence of uroneurals (*i.e.* modified ural neural arches into paired bones) has been considered as a synapomorphy of teleosts, with a tendency to number reduction from seven to fewer in some recent teleost lineages (DE PINNA, 1996). A long stegural bordering most dorsal margin of the hypural 5, bearing an anterodorsal membranous growth (Fig. 3D), which may be diagnostic for euteleosts (WILEY & JOHNSON, 2010), is found in Atheriniformes and most Beloniformes. In all the Cyprinodontiformes and in adrianichthyid beloniforms, the stegural is rudimentary, restricted to the basal portion of the adjacent hypural plate (Figs. 1, 2, 3A, B, D).
6. Preural vertebra 2, neural spine, width relative to neural spines of preural vertebrae 4 and 5: (0) about equal; (1) wider. A condition uniquely occurring in all cyprinodontiforms is the presence of a wide neural spine of the preural centrum 2, which is wider than the anterior neural spines (Figs. 1, 2, 3A, B). In adrianichthyids, that spine is not widened (Fig. 3D), but the condition is not comparable in atheriniforms and other beloniforms, in which the spine is absent (Fig. 3C). Therefore, this condition may be useful to diagnose cyprinodontiforms, but its polarization is doubtful.
7. Upper hypurals and compound caudal centrum, degree of fusion: (0) attached, limited by cartilage edge; (1) complete ankylosis. Only in cyprinodontiforms, the proximal part of all the hypurals is ankylosed to the compound caudal centrum, being imperceptible the limits between the hypurals and the compound centrum (Figs. 1, 2, 3A, B). In other atherinomorphs, only the lower hypurals are fused to the compound caudal centrum, whereas the upper hypurals are often separated by a cartilaginous contact area (Fig. 3D).

The Cyprinodontoidei

Monophyly of the Cyprinodontoidei has been consistently supported by apomorphic character states of the branchial and hyoid arches, jaws, and jaw suspensorium (PARENTI, 1981). COSTA (1998a) included among the cyprinodontiform synapomorphies the fusion of dorsal and ventral hypurals plates. This character and others corroborating the Cyprinodontoidei clade are listed and discussed below.

8. Upper and lower hypural plates, degree of fusion: (0) unfused; (1) partially fused (anterior portion unfused, posterior portion fused); (2) completely fused (modified from COSTA, 1998a: character 88). COSTA (1998a) assumed the fusion of all hypural elements as a synapomorphy of the Cyprinodontoidei (Figs. 1C, D, 2A, B), with reversals in poeciliids and anablepids that frequently have upper and lower hypurals plates unfused or partially fused (Figs. 1A, B). However, fusion of dorsal and ventral hypurals plates is also present in lineages of all aplocheiloid families (Fig. 3B). Therefore, fusion of upper and lower hypurals cannot be assumed as synapomorphic for cyprinodontoids without ambiguity.
9. Preural vertebra 3, neural and hemal spines, width relative to neural and hemal spines of preural vertebrae anterior to preural vertebra 4: (0) about equal; (1) wider. The neural and hemal spines of the preural centrum 3 usually are wider than the spines of the vertebrae anterior to the preural vertebra 4 in all cyprinodontoids (Figs. 1, 2A, B), a condition not occurring in aplocheiloids, which have narrow spines of preural vertebra 3 (Figs. 2C, D, 3A, B).
10. Stegural, ventral portion, lateral process: (0) absent; (1) present. The presence of a lateral spine-like process on the stegural (Fig. 4A), previously reported for the poeciliid genus *Gambusia* by RAUCHENBERGER (1989), is a derived condition uniquely found in cyprinodontoids, although absent or rudimentary in some cyprinodontids (see results above).

Among Cyprinodontoidei families, members of the Cyprinodontidae concentrate some informative morphological variability as discussed below.

11. Radial caudal cartilages, number: (0) one or two; (1) three. An increasing in the number of radial caudal cartilages, from one or two on the dorsal portion and one or two on the ventral portion of

the caudal skeleton to three well-developed cartilages on each portion of the caudal skeleton, occurs in the American cyprinodontid genera *Cualac*, *Cyprinodon* and *Megupsilon* (Fig. 2B).

12. Parhypural, proximal part, relative position to preural centrum 1: (0) overlapped; (2) not overlapped (modified from COSTA, 1998a: character 91). An apomorphic reduced proximal part of the parhypural, in which it does not overlap the preural centrum 1 and the hypurapophysis is rudimentary or absent, besides occurring in all cyprinodontids (Figs. 2A, B), is found in some fundulids (*Leptolucania* and *Lucania*), most goodeids, and all nothobranchiids (Fig. 2C) and rivulids (Figs. 3A, B).
13. Caudal skeleton preural vertebrae, number: (0) 4–5; (1) 6. An apomorphic increasing in the number of vertebrae participating of the caudal skeleton from four or five to six vertebrae occurs both in the anablepid genus *Anableps*, cyprinodontid genus *Orestias* and in the fundulid genus *Fundulus* (Figs. 1A, D), supporting independent acquisitions in those three distantly related genera (e.g., PARENTI, 1981; COSTA, 1998a).
14. Preural vertebra 2, hemal spine, sub-basal region, deep constriction: (0) absent; (1) present (modified from COSTA, 1998a: character 92). An apomorphic deep constriction in the sub-basal region of the hemal spine of the preural vertebra 2 supports sister group relationships between American (Cyprinodontini) (Fig. 2B) and Eurasian cyprinodontids (Aphanini) (Fig. 2A) as proposed by COSTA (1997).
15. Preural vertebra 2, neural spine, sub-basal region, deep constriction: (0) absent; (1) present. A similar constriction as discussed in the character 14 above, also occurs in the neural spine of the same preural vertebra of cyprinodontines and aphanines, but also is present in other taxa of the suborder Cyprinodontoidei (e.g., poeciliids, anablepids, profundulids) (Figs. 1B, 2A, B), thus not informative to unambiguously support monophyly of formally designated taxonomic units.
16. Epural, core part, extent and position: (0) long, at same axis of whole bone; (1) short, restricted to dorsal portion of bone, posteriorly placed. A unique morphology of the epural is found in *Aphanius dispar*, *A. isfahanensis*, *A. richardsoni*, *A. splendens*, and *A. sureyanus* (Fig. 2A). However, according to the molecular phylogeny

proposed by HRBEK & MEYER (2003), these species do not form a clade.

The Aplocheiloidei

Monophyly of the Aplocheiloidei has been supported both by morphological and molecular characters (PARENTI, 1981; MURPHY & COLLIER, 1997; COSTA, 1998a), although recently contrary view based on morphology was published (HERTWIG, 2008), in which the Aplocheiloidei may be a paraphyletic assemblage. Monophyly hypothesis was first established by PARENTI (1981) based on characters of the external anatomy, neurocranium, pelvic girdle, infraorbital series, cephalic laterosensory system, hyoid arch, and colour pattern. COSTA (1998a) found additional derived character states supporting monophyly of the Aplocheiloidei, among which was a unique derived character state of the caudal skeleton (*i.e.*, absence of radial caudal cartilages). Characters with informative distribution among aplocheiloids are discussed below.

17. Radial caudal cartilages: (0) present; (1) absent (COSTA, 1998a: character 89). Radial caudal cartilages are commonly found in atherinomorphs (*e.g.*, STIASSNY, 1990), a condition also found among several other acanthomorph lineages. In all the aplocheiloids examined here, radial cartilages are absent (Figs. 2C, D, 3A, B), confirming this diagnostic feature of aplocheiloids.
18. Hypurals 4 and 5, degree of fusion: (0) unfused; (1) fused (modified from PARENTI, 1981). PARENTI (1981: 395) considered upper hypural plate divided as evidence of close relationships between the aplocheiloid genera *Aplocheilus*, *Epiplatys* and *Pachypanchax*, since this condition does never occur in cyprinodontoids, the immediate sister group to aplocheiloids. However, upper hypural plate divided is usually present in outgroups to cyprinodontiforms, thus being considered as a plesiomorphic condition, retained in some aplocheilids and nothobranchiids (see Results above to character state distribution among examined taxa).
19. Preural vertebra 2, hemal spine, width relative to hemal spines of preural vertebrae 4 and 5: (0) distinctively wider; (1) slightly wider (modified from COSTA, 2004: character 43). The clade comprising the genera *Aplocheilus* and *Pachypanchax* was first hypothesized to be the sister group of the clade including nothobranchiids and riv-

ulids in a phylogeny based on mitochondrial DNA (MURPHY & COLLIER, 1997). COSTA (2004) found morphological evidence supporting the clade comprising nothobranchiids and rivulids, describing eight derived character states, among which the hemal spine of preural centrum 2 being narrow, only slightly wider than the hemal spines of anteriorly adjacent vertebrae (Figs. 2C, 3A, B), which is herein corroborated. Another derived condition of the caudal skeleton shared by rivulids and nothobranchiids described by COSTA (2004) and herein confirmed is the shortened proximal end of the parhypural, not overlapping the preural centrum, with a rudimentary or absent hypurapophysis (Figs. 2C, 3A, B), a condition also occurring in some cyprinodontoid lineages (see character 12 above). The plesiomorphic state for both characters are exhibited by *Aplocheilus* and *Pachypanchax* (Fig. 2D).

20. Compound centrum, central portion of side, keel-shaped process: (0) absent; (1) present. Monophyly of all the aplocheiloids endemic to continental Africa was first proposed based upon mitochondrial DNA phylogeny (MURPHY & COLLIER, 1997); COSTA (2004) first formally recognized that group as the Nothobranchiidae, which was diagnosed on the basis of bifid pleural ribs, already reported to occur in some nothobranchiid lineages by PARENTI (1981), but later confirmed to occur in all nothobranchiids (COSTA, 2004). In addition, all nothobranchiids have a prominent keel-shaped lateral process on the middle part of the compound centrum (Fig. 4B). This process is never present in any other cyprinodontiform and outgroups.
21. Epural, proximal region, width relative to distal region: (0) wider to slightly narrower; (1) conspicuously narrower (COSTA, 1998b: character 105). The rivulid subfamily Cynolebiasinae has been diagnosed by a series of apomorphic morphological characters, including the unique shape of the proximal region of the epural (Fig. 3B). Possibly associated to this character is the absence of neural prezygapophyses and postzygapophyses on preural vertebrae.

The caudal skeleton of cyprinodontiform fossil taxa

Cyprinodontiform fossil taxa have been recorded from Americas, Europe and west Asia (*e.g.*, PARENTI,

1981). New World fossil record includes a few North American Pliocene taxa belonging to recent genera (e.g., MILLER, 1945; PARENTI, 1981) and †*Carrionellus diumortuus* White from the Lower Miocene of Ecuador, recently considered as closely related to *Orestias* (COSTA, 2011), being only known from impression fossils with no resolution for details of the caudal skeleton. Therefore, no informative data on the caudal skeleton could be extracted from New World taxa.

Old World cyprinodontiform fossils have been placed in five genera: *Aphanius* NARDO, †*Brachylebias* PRIEM, †*Cryptolebias* GAUDANT, †*Prolebias* SAUVAGE and †*Aphanolebias* REICHENBACHER & GAUDANT, all currently considered as members of the Cyprinodontidae (e.g., PARENTI, 1981; REICHENBACHER & GAUDANT, 2003). *Aphanius* comprises about 20 living species from an area comprising southern Europe, western Asia and northern Africa and at least four valid fossil species (not including taxa only known from otoliths) from the Oligocene-Miocene of southern, central and western Europe, and western Asia (HRBEK & MEYER, 2003; GAUDANT, 2009; REICHENBACHER & KOWALKE, 2009). The only fossil species herein examined, †*Aphanius illunensis* GAUDANT, osteological features concordant to those above described for living species of *Aphanius*. Similar morphology was found in †*Brachylebias persicus*, the only species of the genus, known from the Miocene of northwestern Iran, corroborating its current position among cyprinodontids.

†*Cryptolebias* is known from a single species, †*C. senogalliensis* (COCCHI) from the Miocene of Italy, which was not available for the present study. That species has a unique morphology among cyprinodontiforms, combining a very slender body with dorsal and anal fins positioned anteriorly to the middle of the trunk (GAUDANT, 1978). Caudal skeleton morphology cannot be fully appreciated from the original description of the genus (GAUDANT, 1978), but the presence of a long parhypural articulating with the preural centrum, as illustrated in that paper, suggests that it is not a cyprinodontid.

†*Prolebias* from the lower Oligocene–Middle Miocene of Europe was first described by SAUVAGE (1874) to include some species formerly described by AGASSIZ (1839) and SAUVAGE (1869), but some others have been incorporated to the genus since then (e.g., GAUDANT, 2009). †*Prolebias* has not been diagnosed by unique derived features, but by plesiomorphic character states (i.e., jaw teeth conical and absence of an anteroventral process on the dentary) (e.g., GAUDANT, 2003) opposed to those apomorphic states occurring in the cyprinodontid genus *Aphanius* (i.e., teeth tricuspidate and a conspicuous process on the dentary; PARENTI, 1981; COSTA, 1997). Although previous authors had suggested close relationships

between †*Prolebias* and fundulines (then comprising species today placed in Fundulidae and Valenciidae) (WOODWARD, 1901; REGAN, 1911), †*Prolebias* was kept in the Cyprinodontidae by PARENTI (1981), which was followed by subsequent authors (e.g., GAUDANT, 1989, 1991, 2003; REICHENBACHER & GAUDANT, 2003; REICHENBACHER & PRIETO, 2006).

A great diversification in the caudal skeleton morphology was observed among species of †*Prolebias* herein examined. †*Prolebias aymardi*, †*P. delphinensis* and †*P. stenoura*, all from the Lower Oligocene of Western Europe, do not exhibit the derived features of the caudal skeleton of cyprinodontids. There is no constriction on the basal portion of the hemal spine of the preural centrum 2 and the parhypural overlaps the preural centrum 1 (Fig. 5A) (vs. a pronounced constriction in that hemal spine and parhypural not reaching preural centrum 1 in Eurasian and North American cyprinodontids; Figs. 2A, B). In fact, on the basis of caudal skeleton characters, those three species of †*Prolebias* cannot be unambiguously placed in any cyprinodontiform group by not exhibiting any of the derived character states described above. The jaw dentition consisting of multiple series of conical teeth precludes the placement in the Cyprinodontidae (e.g., COSTA, 1997). The ascending process of the premaxilla is long as that occurring in valenciids, profundulids and fundulids (COSTA, 1998a), contrasting with the shorter ascending process of the remaining cyprinodontoids. In fact, the jaws, fins and the caudal skeleton of †*P. aymardi*, †*P. delphinensis* and †*P. stenoura* (Fig. 6A) are similar to those exhibited by recent valenciids (Fig. 1C). However, the apomorphic feature used to diagnose the family Valenciidae, long and narrow dorsal process of maxilla (PARENTI, 1981), could not be observed in the examined material, thus preventing the unambiguous transference of those three species to the Valenciidae. Consequently, since †*P. stenoura* is the type species of †*Prolebias*, the latter name should be considered as an *incertae sedis* cyprinodontoid genus, probably closely related to or part of the Valenciidae. An identical situation is found in †*Aphanolebias meyeri* (AGASSIZ) from the Lower Miocene of central Europe, not available for the present study. Characters described and illustrated by REICHENBACHER & GAUDANT (2003) are concordant with those described above to †*P. aymardi*, †*P. delphinensis* and †*P. stenoura*, supporting †*Aphanolebias* as an *incertae sedis* cyprinodontoid genus, probably close to recent valenciids.

The fourth species of †*Prolebias* examined, †*P. meridionalis*, from the Upper Oligocene of France, has the caudal skeleton similar to that described for Eurasian and North American cyprinodontids, with a constriction on the basal portion of the hemal spine of the preural centrum 2 and a short proximal part of the parhypural, not reaching the preural centrum 1 (Fig.

5B). The morphology of the unpaired fins, including the dorsal-fin origin anterior to the anal-fin origin (Fig. 6B), is typical among cyprinodontids. However, †*P. meridionalis* differs from aphanines by having conical teeth (vs. tricuspidate). Therefore, †“*Prolebias*” *meridionalis* is considered as an *incertae sedis* cyprinodontid, not a congener of the other three species discussed in the above paragraph.

The fifth nominal species of †*Prolebias* examined, †*P. cephalotes* also from the Upper Oligocene of France, has a different caudal skeleton. There is an anterior gap between the dorsal and hypural plates (Fig. 5C), a condition also recorded for †*P. egeranus* LAUBE and †*P. malzi* REICHENBACHER & GAUDANT from the Upper Oligocene–Lower Miocene of central Europe, not available to this study, but finely described by OBRHELOVÁ (1985) and REICHENBACHER & GAUDANT (2003), respectively. As described above, among extant cyprinodontiforms this morphology of hypurals is found in some American anablepids, American profundulids, and American and African poeciliids (see distribution of characters states among taxa in Results above), but never in cyprinodontids, fundulids and valenciids (Fig. 1B). In addition, uniquely among species of †*Prolebias*, †*P. cephalotes*, †*P. egeranus* and †*P. malzi* have the pectoral-fin base laterally placed (vs. latero-ventrally placed) (Fig. 6C) and pelvic-fin base nearer pectoral-fin base than to anal-fin origin (vs. nearer anal-fin origin or midway between pectoral-fin base than to anal-fin origin), two derived conditions uniquely found in poeciliids among cyprinodontoids (PARENTI, 1981; COSTA, 1998a), which support the transference of those taxa for the family Poeciliidae. Thus, †“*Prolebias*” *cephalotes*, †“*P.*” *egeranus* and †“*P.*” *malzi* are considered as *incertae sedis* poeciliids.

The Poeciliidae is today geographically restricted to Africa and Americas (PARENTI, 1981; COSTA, 1998a; GHEDOTTI, 2000). In Africa, it is represented by the subfamily Aplocheilichthyinae and the greatest part of the subfamily Procatopodinae, whereas in North, Middle and South America it is represented by the Poeciliinae (e.g., ROSEN & BAILEY, 1963; PARENTI, 1981), and in South America by the procatopodine genus *Fluviphylax* WHITLEY (e.g., COSTA, 1996; GHEDOTTI, 2000). A phylogenetic analysis involving representatives of the several poeciliid lineages, which is beyond the scope of the present study, would be necessary to establish rigorous hypotheses about the placement of †“*P.*” *cephalotes*, †“*P.*” *egeranus* and †“*P.*” *malzi* among poeciliids. However, some morphological evidence of possible phylogenetic relationships deserves attention. The subfamily Poeciliinae has been diagnosed by the presence of a complex organ in males for internal insemination, the gonopodium, mainly formed by the anal-fin rays 3–5 (e.g., ROSEN & BAILEY, 1963; GHEDOTTI, 2000). The absence of any vestige

of that complex structure in those three fossil species precludes relationships with the Poeciliinae. On the other hand, †“*P.*” *cephalotes*, †“*P.*” *egeranus* and †“*P.*” *malzi* have thickened pelvic-fin rays (GAUDANT, 2009), a unique condition, similar to that occurring in the recent African procatopodine poeciliid genus *Pantanodon* MYERS (WHITEHEAD, 1962; ROSEN, 1965). Among those three species, osteological structures of the branchial arches were described only for †*P. egeranus* (OBRHELOVÁ, 1985), including the presence of a wide dentigerous plate on the fifth ceratobranchial and third pharyngobranchial, with small teeth regularly arranged in transverse rows, each of which is separated from the adjacent row by regular interspaces, a condition occurring only in *Pantanodon* (WHITEHEAD, 1962; PARENTI, 1981). In addition, OBRHELOVÁ (1985: figs. 5D, F) described and illustrated a dentary bone with a long coronoid process, a condition uniquely found in *Pantanodon* (ROSEN, 1965) among living cyprinodontoids. The derived morphology of the pelvic fin, branchial arches and dentary strongly suggest close relationships between the European fossil taxa †“*P.*” *cephalotes*, †“*P.*” *egeranus* and †“*P.*” *malzi*, and the recent African poeciliid genus *Pantanodon*.

The occurrence of a poeciliid taxon in the Miocene of central Europe closely related to extant African poeciliids is not surprising. Records of terrestrial and freshwater vertebrate faunal exchanges between Africa and Europe during the Paleogene are well documented and hypotheses of dispersal routes are supported by partial land connections resulted from the displacement of the African Plate to north combined to sea-level falls (GHEERBRANT & RAGE, 2006). Among freshwater fishes, for example, the alestids are today restricted to Africa and South America (e.g., ZANATA & VARI, 2005; MALABARBA & MALABARBA, 2010), but alestid-like teeth have been often consistently identified in different outcrops of the Paleogene of Europe (e.g., DE LA PEÑA ZARZUELO, 1996; MONOD & GAUDANT, 1998; OTERO, 2010).

Conclusion

The comparative morphology of the caudal skeleton of the Cyprinodontiformes provides useful phylogenetic information. Among the 22 characters delimited in the present study, characters 1–10, 12, 14, 17, 20 and 21 corroborate formally recognized cyprinodontiform groups when their states are optimized on a phylogenetic tree condensing hypotheses generated in previous studies (Fig. 7). Other characters (11, 13, 16, 22) are potentially informative but its use is either only applicable to small assemblages within the principal

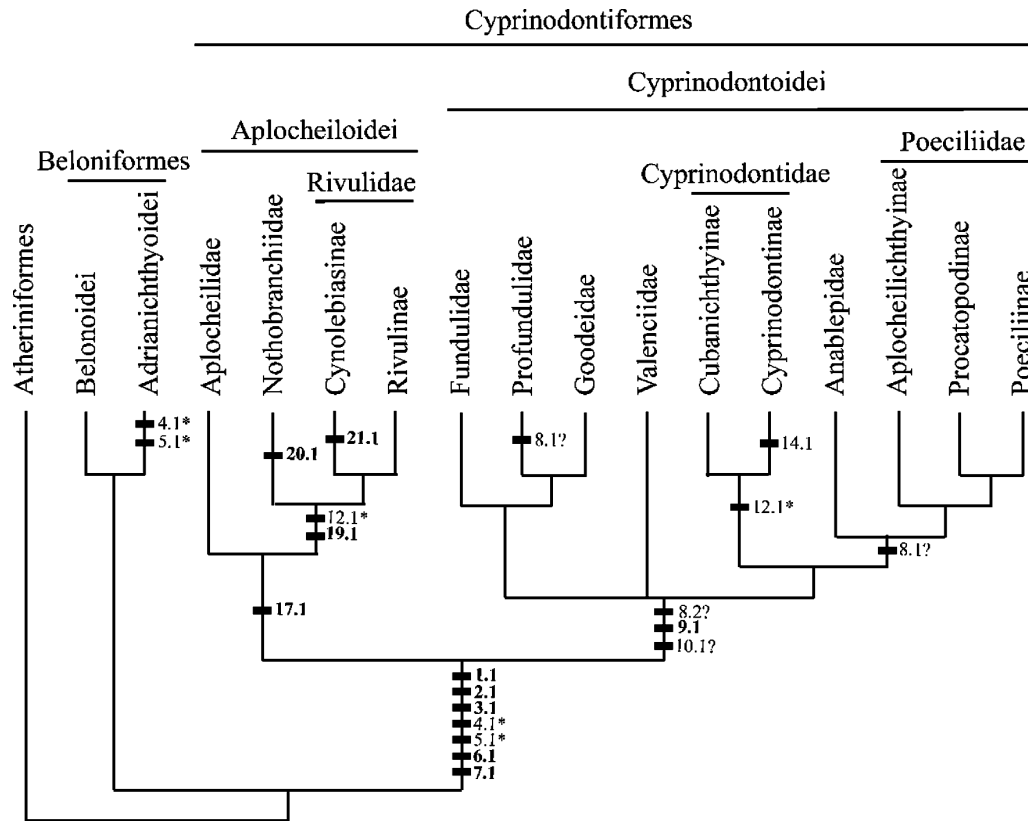


Fig. 7. Optimization of caudal skeleton characters of the Cyprinodontiformes. Relationships among atherinomorph orders and suborders are according to PARENTI (1981), ROSEN & PARENTI (1981), DYER & CHERNOFF (1996); relationships among cyprinodontiform families according to COSTA (1998a; 2004); relationships among rivulid subfamilies according to COSTA (1998b), MURPHY *et al.* (1999); relationships among cyprinodontid subfamilies according to PARENTI (1981), COSTA (1997); relationships among poeciliid subfamilies according to GHEDOTTI (2000). Number are characters and, after dot, character states, numbered according to text; in bold are unambiguous characters, asterisks indicate character states independently occurring in different lineages, question marks indicate character states of variable occurrence among terminal taxa (see text for character state distribution).

lineages or they are very variable among different lineages (15 and 18) (see Discussion above).

The morphology of the caudal skeleton combined to other osteological features indicates that the cyprinodontiform fossil genus †*Prolebias* is a paraphyletic assemblage, probably comprising taxa closely related to three distinct families, the Cyprinodontidae, the Valenciidae, and the Poeciliidae.

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Appendix

List of material examined. Most material is deposited in the ichthyological collection of Instituto de Biologia, Universidade Federal do Rio de Janeiro, Rio de Janeiro (UFRJ). Abbreviations for other institutions are: BMNH.P, Natural History Museum, Paleontology, London; CAS, California Academy of Sciences, San Francisco; MNHN.P, Muséum national d’Histoire naturelle, Paleontology, Paris; MRAC, Musée Royal de l’Afrique Centrale, Tervuren; USNM, National Museum of Natural History (former United States National Museum), Smithsonian Institution, Washington. Number of specimens is indicated after catalog number.

Order Cyprinodontiformes: Suborder Cyprinodontoidei:

Family Anablepidae: *Anableps anableps* (LINNAEUS, 1758): UFRJ 3419, 1; Brazil: Pará. *Anableps dowi* GILL, 1861: UFRJ 3290, 2; Guatemala: Los Cerritos, Rio Los Esclavos. *Anableps microlepis* MÜLLER & TROSCHER, 1844: UFRJ 3420, 2; Brazil: Pará. *Jenynsia lineata* (JENYNS, 1842): UFRJ 8131, 2; Uruguay. *Jenynsia multidentata* (JENYNS, 1842): UFRJ 8132, 2; Uruguay; UFRJ 5066, 5; Brazil: Rio de Janeiro, Lagoa Rodrigo de Freitas. *Jenynsia onca* LUCINDA, REIS & QUEVEDO, 2002: UFRJ 8130, 2; Uruguay. *Jenynsia unitaenia* GHEDOTTI & WEITZMAN, 1995: UFRJ 3422, 2; Brazil: Santa Catarina, Rio São Bento. **Family Cyprinodontidae: Subfamily Cubanichthyinae:** *Cubanichthys cubensis* (Eigenmann, 1903): USNM 331917, 2; Cuba. **Subfamily Cyprinodontinae: Tribe Aphaniini:** *Aphanius anatoliae* (LEIDENFROST, 1912): UFRJ 8082, 1; Turkey: between Yesilova and Orhanli. *Aphanius dispar* (RÜPPELL, 1829): UFRJ 3302, 2; Kuwait: Al-Khiran; UFRJ 8078, 1; Bahrain: Jirdab. *Aphanius fasciatus* (VALENCIENNES, 1821): UFRJ 4019, 3; Italy: Salina di Ravenia. *Aphanius iberus* (VALENCIENNES, 1846): UFRJ 8083, 1; Spain: San Pedro del Pinatar. †*Aphanius illunensis* GAUDANT (1993): MNHN.P 1986-5-2; Spain: Albacete, Hellín (Upper Miocene). *Aphanius isfahanensis* HRBEK, KEIVANY & COAD, 2006: UFRJ 8079, 1; Iran: Ezhyeh, Zayadeh Rud. *Aphanius mento* (HECKEL, 1843): UFRJ 8075, 1; Turkey: Bor. *Aphanius richardsoni* (BOULENGER, 1907): UFRJ 8077, 1; Israel: Hakikar. *Aphanius splendens* (KOSSWIG & SÖZER, 1945): CAS 168742, 4; Turkey: Toparta Province, Golcuk. *Aphanius sureyanus* NEU, 1937: UFRJ 8080, 1; Turkey: Burdur Lake. *Aphanius villwocki*

HRBEK & WILDEKAMP, 2003: UFRJ 8084, 1; Turkey: Ahiler. *Aphanius vladkovi* COAD, 1988: UFRJ 8086, 1; Iran: Gandoman. †*Brachylebias persicus* PRIEM, 1908: BMNH.P 47933–55; Iran: Tabriz, Khusghoshah (Miocene). †“*Prolebias*” *meridionalis* GAUDANT, 1978: MNHN.P MSQ1-5, 44; France: Haute-Provence, Manosque (Upper Oligocene). **Tribe Cyprinodontini:** *Cualac tessellatus* MILLER, 1956: CAS(SU) 50213, 1; Mexico: San Luis Potosi, La Media Luna. *Cyprinodon elegans* BAIRD & GIRARD, 1853: UFRJ 3900, 2; USA: Texas, San Salomon Springs. *Cyprinodon macrolepis* MILLER, 1976: UFRJ 3901, 2; Mexico: Chihuahua, Jiménez. *Cyprinodon variegatus* LACÉPÈDE, 1803; USA: Massachusetts, Marthas Vineyard. *Floridichthys polyommus* HUBBS, 1936: UFRJ 3425, 4; Mexico: Yucatan, near Río Lagartos. *Garmanella pulchra* HUBBS, 1936: UFRJ 3426, 4; Mexico: Yucatan, lagoon near Río Lagartos. *Jordanella floridae* GOODE & BEAN, 1879: UFRJ 3904, 1; USA: Florida. *Megupsilon aporus* MILLER & WALTERS, 1972: UFRJ 3427, 4; Mexico: Nuevo Leon, El Potosi. **Tribe Orestiini:** †*Carrionellus diumortuus* WHITE, 1927: BMNH. P 14320-14350; Ecuador: Loja (Lower Miocene). *Orestias agassizii* VALENCIENNES, 1846: UFRJ 3048, 1; Bolivia: Copacabana, Lago Titicaca. *Orestias albus* VALENCIENNES, 1846: UFRJ 3894, 1; Peru, Cuzco, Lago Titicaca. *Orestias crawfordi* TCHERNAVIN, 1944: UFRJ 3046, 1; Bolivia: Copacabana, Lago Titicaca. *Orestias gilsoni* TCHERNAVIN, 1944: UFRJ 3054, 5; Bolivia: Copacabana, Lago Titicaca. *Orestias ispi* LAUZANNE, 1981: UFRJ 3044, 5; Bolivia: Copacabana, Lago Titicaca. *Orestias luteus* VALENCIENNES, 1846: UFRJ 3051, 2; Bolivia: Copacabana, Lago Titicaca. *Orestias mulleri* VALEN-

- CIENNES, 1846: UFRJ 3895, 2; Bolivia: Copacabana, Lago Titicaca. **Family Fundulidae:** *Fundulus chrysotus* (GÜNTHER, 1866): UFRJ 8128, 2; USA: Massachusetts, Seminole basin. *Fundulus diaphanus* (LESUEUR, 1817): UFRJ 8127, 2; USA: Massachusetts, Bristol. *Fundulus heteroclitus* (LINNAEUS, 1766): UFRJ 3319, 2; EUA: Massachusetts, Oyster Pond. *Fundulus luciae* (BAIRD, 1855): UFRJ 4108, 2; USA: Kansas, Hateras. *Fundulus majalis* (WALBAUM, 1792): UFRJ 3312, 2; EUA: Massachusetts, Matta poisett. *Fundulus notti* (AGASSIZ, 1854): UFRJ 8129, 2; USA: Georgia, Lake Landon. *Fundulus sciadicus* COPE, 1865: UFRJ 3321, 2; EUA: Nebraska, near Brewster. *Fundulus zebrinus* JORDAN & GILBERT, 1883: UFRJ 8101, 2; USA: Texas. *Leptolucania ommata* (JORDAN, 1884): UFRJ 3314, 1, 19.3 mm SL; USA: Georgia, near Sereven. *Lucania goodei* JORDAN, 1880: UFRJ 3306, 2; USA: Florida, Welaka. *Lucania parva* (BAIRD & GIRARD, 1855): UFRJ 3309, 2; EUA: Massachusetts, Richmond Pond. **Family Goodeidae: Subfamily Empetrichthyinae:** *Crenichthys baileyi* (GILBERT, 1893): UFRJ 3286, 3; EUA: Nevada, near Riorden Ranch. *Empetrichthys pahrump* MILLER, 1948: CAS 47063, 1; USA: Nevada, Pahrump Ranch. *Empetrichthys merriami* GILBERT, 1893: CAS 168745, 1; USA: Nevada, Pahrump. **Subfamily Goodeinae:** *Chapalichthys encaustus* (JORDAN & SNYDER, 1899): UFRJ 3300, 4; Mexico: Jalisco, near Ocotlan. *Characodon lateralis* GÜNTHER, 1866: UFRJ 3304, 4; Mexico: Durango, near Guadalupe Aguilera. *Girardinichthys multiradiatus* (MEEK, 1904): UFRJ 3288, 3; Mexico: Toluca, Río Lerma. *Goodea atripinnis* JORDAN, 1880: UFRJ 3423, 1; Mexico: Jalisco, Ameca. *Ilyodon whitei* (MEEK, 1904): CAS 40793, 2; Mexico: Michoacan, Presa Cupatitzio, Río Balsas drainage. *Skiffia lermæ* MEEK, 1902: UFRJ 4109, 2; Mexico: Michoacan, El Molino. *Xenotoca eiseni* (RUTTER, 1896): UFRJ 8153, 1; Mexico. *Zoogoneticus quitzeoensis* (BEAN, 1898): UFRJ 3294, 3; Mexico: Michoacan, near Alvaro Obregon. **Family Profundulidae:** *Profundulus candalarius* HUBBS, 1924: UFRJ 3456, 4; Mexico: Chiapas, stream tributary to Río Comitán. *Profundulus guatemalensis* (GÜNTHER, 1866): UFRJ 3446, 2; Guatemala: Pan-Americana Highway, Río Aguacapa drainage. *Profundulus labialis* (GÜNTHER, 1866): UFRJ 3453, 4; Guatemala: Solola, Río Panajachel. **Family Poeciliidae: Subfamily Aplocheilichthyinae:** *Aplocheilichthys spilaulchen* (DUMÉRIL, 1861): UFRJ 4151, 2; Senegal: Marssasoum, Riviere Saungrougrou. Subfamily Poeciliinae: *Alfaro huberi* (FOWLER, 1923): UFRJ 3410, 4; Guatemala: Zacapa, Río Passabien. *Brachyrhaphis cascajalensis* (MEEK & HILDEBRAND, 1913): UFRJ 5545, 2; Panama: Canal Zone, Isla Barro Colorado. *Cnesterodon carnegiei* HASEMAN, 1911: UFRJ 5876, 4; Brazil: Santa Catarina, Cubatão. *Gambusia nicaraguensis* GÜNTHER, 1866: UFRJ 5377, 2; Nicaragua: Felaya, Río Coco. *Girardinus creolus* GARMAN, 1895: UFRJ 5382, 2; Cuba: Pinar del Río, Río Tocotoco. *Heterandria bimaculata* (HECKEL, 1848): *Limia pauciradiata* Rivas, 1980: UFRJ 3412, 4; Haiti: Grand Rivière du Nord. *Micropoecilia branneri* (EIGENMANN, 1894): UFRJ 4615, 4; Brazil: Pará, Santa Izabel. *Micropoecilia minima* (COSTA & SARRAF, 1997): UFRJ 4648, 6; Brazil: Pará, Igarapé Oirem. *Micropoecilia parae* EIGENMANN, 1894: UFRJ 4650, 8; Brazil: Pará, rio Maguary, Belém. *Micropoecilia picta* (REGAN, 1913): UFRJ 3941, 2; Venezuela: Cano Pedernales. *Micropoecilia sarrafae* BRAGANÇA & COSTA, 2011: UFRJ 4614, 4; Brazil: Maranhão, Jandira. *Pamphorichthys araguaensis* COSTA, 1991: UFRJ 1519, 4; Brazil: Goiás, Jussara. *Pamphorichthys hollandi* (HENN, 1916): UFRJ 2176, 7; Brazil: Minas Gerais, Pirapora. *Pamphorichthys minor* (GARMAN, 1895): UFRJ 3914, 8; Brazil: Amazonas, Parintins. *Pamphorichthys scalpridens* (GARMAN, 1895): UFRJ 3913, 8; Brazil: Pará, Santarém. *Phallichthys fairweatheri* ROSEN & BAILEY, 1959: UFRJ 5346; Guatemala: El Paso del Caballo, Río San Pedro de Martín. *Phalloceros anisophallus* LUCINDA, 2008: UFRJ 6105, 6; Brazil: Rio de Janeiro: Paraty, near Tarituba. *Phalloceros harpagos* LUCINDA, 2008: UFRJ 8154, 4; Brazil: Rio de Janeiro, Petrópolis. *Phalloceros leptokeras* LUCINDA, 2008: UFRJ 8155, 4; Brazil: Rio de Janeiro, Terezópolis. *Phalloptychus januaris* (HENSEL, 1868): UFRJ 5107, 6; Brazil: Rio de Janeiro, Ilha do Fundão. *Phallosorynus jucundus* IHERING, 1930: UFRJ 5109, 6; Brazil: São Paulo, Rio Tamanduá, Ribeirão Preto. *Poecilia buttleri* JORDAN, 1889: UFRJ 4053, 3; Mexico: Guamuchil, Río Mocorito. *Poecilia caucana* (STEINDACHNER, 1880): UFRJ 4054, 3; Venezuela: La Guana. *Poecilia chica* MILLER, 1975: Mexico: Jalisco, Arroyo El Pinado. *Poecilia formosa* (GIRARD, 1859): UFRJ 4060, 2; Mexico: Soto La Marina, Río Caballero. *Poecilia gillii* (KNER, 1863): Nicaragua: Río Likus. *Poecilia latipunctata* MEEK, 1904: UFRJ 4055, 3; Mexico: near Llera, Río Tamesi system. *Poecilia maylandi* MEYER, 1983: UFRJ 4088, 3; Mexico: Río Tepalcattepec. *Poecilia petenensis* GÜNTHER, 1866: UFRJ 4049, 3; Mexico: near Champeten. *Poecilia marcellinoi* POESER, 1995: UFRJ 4059, 2; El Salvador: Guija-Lempa, Río Grand. *Poecilia mexicana* STEINDACHNER, 1863: UFRJ 4057, 3; Mexico: near Vila Camacho, Río San Marcos. *Poecilia orri* FOWLER, 1943: UFRJ 4052, 3; Mexico: near Tulum. *Poecilia sphenops* VALENCIENNES, 1846: UFRJ 4050, 3; Mexico: near Casamaloapan. *Poecilia velifera* (REGAN, 1914): UFRJ 4056, 3; Mexico: lagoon near Río Lagartos. *Poecilia vivipara* BLOCH & SCHNEIDER, 1801: UFRJ 3416, 2; Brazil: Espírito Santo, Guarapari. *Poeciliopsis prolifica* MILLER, 1960: UFRJ 5348, 2; Mexico: Sinaloba, Arroyo Sondona. *Priapella compressa* ALVAREZ, 1948: UFRJ 5380, 2; Mexico: near Palenque. *Priapichthys annectens* (REGAN, 1907): UFRJ 5381, 2; Costa Rica: Limon, Los Diamantes. *Tomeurus gracilis* EIGENMANN, 1909: UFRJ 5433, 8; Brazil: Pará, Icoaraci. *Xenodexia ctenolepis* HUBBS, 1950: UFRJ 5347, 2; Guatemala: Quiche, Arroyo Negro. *Xiphophorus hellerii* HECKEL, 1848: UFRJ 3417, 2; Mexico: Veracruz, near Fortín, Río Blanco drainage. **Subfamily Procatopodinae:** *Congopanchax myersi* (POLL, 1952): UFRJ 4153, 2; Zaire: Stanley-Pool. *Fluviphylax obscurus* COSTA, 1996: UFRJ 5374, 2; Brazil: Amazonas, Parintins. *Fluviphylax palikur* COSTA & Le BAIL, 1999: UFRJ 7933, 2; Brazil: Amapá, Vila Nova. *Hylopanchax stictopleuron* (FOWLER, 1949): UFRJ 4106, 1; Central African Republic. *Lacustricola hutereaui* (BOULENGER, 1913): UFRJ 3298, 4; Zambia: Kafue floodplains, Lochinvar Game Reserve. *Lacustricola johnstoni* (GÜNTHER, 1893): UFRJ 3296, 4; Zambia: Kafue floodplains, near Nampongwe lagoon. *Lacustricola maculata* (KLAUSEWITZ, 1957): UFRJ 8138, 2; Tanzania: Pawani, Ruwu River floodplains. *Lamprichthys tanganicus* (BOULENGER, 1898): UFRJ 4249, 2; Zambia: Lake Tanganyika. *Micropanchax pfaffi* (DAGET, 1954): UFRJ 4107, 2;

- Guinea: Niholokoba. *Poropanchax normani* (AHL, 1928): UFRJ 8136; Guinea: Koumba river. *Poropanchax rancureli* (DAGET, 1965): UFRJ 8137, 2; Côte d'Ivoire: Dodo River basin. *Procatopus nototaenia* BOULENGER, 1904: UFRJ 4104, 1; Cameroun. *Rhexipanchax lamberti* (DAGET, 1962): UFRJ 4105, 2; Guinea: Dounet, Baang river. *Rhexipanchax schioetzi* (SCHEEL, 1968): UFRJ 699, 1; Cote d'Ivoire: for Tai. *Incertae sedis* poeciliid: †“*Prolebias*” *cephalotes* (AGASSIZ, 1839): BMNH.P.20071, over 40 articulated specimens plus fragments; MNHN.P. AIX-92, 102, 131; France: Aix-en-Provence. **Family Valenciidae:** *Valencia hispanica* (VALENCIENNES, 1846): UFRJ 8112, 1; Spain: Albuixel. AMNH 38432, 1; Spain. *Valencia letourneuxi* (SAUVAGE, 1880): UFRJ 8107, 2; Greece: Pinios. *Incertae sedis* cyprinodontoids: †*Prolebias aymardi* (SAUVAGE, 1869): MNHN.P. PTF 164–175; France: Haute-Loire, Ronzon (Lower Oligocene). †*Prolebias delphinensis* GAUDANT, 1989: MNHN.P.MBR.1, 5, 18, 48–49, 53; France: Drôme, Montbrun-les-Bains (Lower Oligocene). †*Prolebias stenoura* SAUVAGE, 1874: BMNH.P.28491, 30; 57050, 1; 57052-57054, 3; 57056-57074, 21; 57075, 1; MNHN.P. PTF698-748; France: Puy-de-Dôme, Corent (Lower Oligocene). Suborder Aplocheiloidei: **Family Aplocheilidae:** *Aplocheilus blockii* (ARNOLD, 1911): UFRJ 8152, 2; India: near Tenmalai Reservoir. *Aplocheilus dayi* (STEINDACHNER, 1892): UFRJ 8146, 2; Sri Lanka: Elston, Puwakpitiya. *Aplocheilus kirchmayeri* BERKENKAMP & ETZEL, 1986: UFRJ 6270, 2; India. *Aplocheilus lineatus* (VALENCIENNES, 1846): UFRJ 8148, 2; India: Kerala, Achankovil. *Aplocheilus panchax* (HAMILTON, 1822): UFRJ 8143, 2; Sulawesi: Desa Radda, near Mosamba. *Aplocheilus werneri* MEINKEN, 1966: UFRJ 8150, 2; Sri Lanka: Parusella, Nilwala Ganga basin. *Pachypanchax omalonotus* (DUMÉNIL, 1861): UFRJ 6268, 2; Madagascar. *Pachypanchax playfairii* (GÜNTHER, 1866): UFRJ 6559, 1; Seychelles. **Family Nothobranchiidae: Subfamily Epiplatinae:** *Aphyoplatys duboisi* (POLL, 1952): UFRJ 6564, 1; Congo. *Pseudepiplatys annulatus* (BOULENGER, 1915): UFRJ 6554, 1; Sierra Leone. *Epiplatys ansorgii* (BOULENGER, 1911): UFRJ 6271, 2; Gabon. *Epiplatys chaperi* (SAUVAGE, 1882): UFRJ 619, 1; Cote D'Ivoire: Orsom Marigot. *Epiplatys dageti* POLL, 1953: UFRJ 3885, 3; Cote D'Ivoire: Dodo River. *Epiplatys fasciolatus* (GÜNTHER, 1866): UFRJ 1151, 1; Cote D'Ivoire. *Epiplatys mesogramma* HUBER, 1980: UFRJ 3874, 2; Central Africa Republic. *Epiplatys neumanni* BERKENKAMP, 1993: UFRJ 4765, 1; Gabon. *Epiplatys njalaensis* NEUMANN, 1976: UFRJ 6272, 1; Guinea. *Epiplatys sangmelinensis* (AHL, 1928): UFRJ 1152, 1; Cameroon: Nkolkoner, near Yarundé. *Epiplatys steindachneri* (SVENSSON, 1933): UFRJ 4111, 3; Guinea Bissau: between Bissau and Kondara. **Subfamily Nothobranchiinae:** *Aphyosemion aureum* RADDA, 1980: UFRJ 4812, 1; Gabon. *Aphyosemion australe* (RACHOW, 1921): UFRJ 6558, 1; Cameroon. *Aphyosemion calliurum* BOULENGER, 1911: UFRJ 6560; Cameroon. *Aphyosemion franzwerneri* SCHEEL, 1971: UFRJ 8161, 2; Cameroon. *Aphyosemion herzogi* RADDA, 1975: UFRJ 4611, 1; Gabon. *Aphyosemion striatum* (BOULENGER, 1911): UFRJ 6553, 1; Gabon. *Callopanchax occidentalis* (CLAUSEN, 1966): UFRJ 6275, 2; Liberia. *Callopanchax monroviae* (ROLOFF & LADIGES, 1972): UFRJ 6277, 2; Liberia. *Chromaphyosemion cf. bivittatum* (LÖNNBERG, 1895): UFRJ 4835, 2; Gabon. *Fundulopanchax fallax* (AHL, 1935): UFRJ 6610, 2; Cameroon. *Fundulopanchax gardneri* (BOULENGER, 1911): UFRJ 6561, 1; Nigeria. *Fundulopanchax gularis* (BOULENGER, 1902): UFRJ 626, 2; Benin: Cotonou, l'Ouémé basin. *Fundulopanchax moensis* (RADDA, 1970): UFRJ 6267, 1; Cameroon. *Fundulopanchax nigerianus* (CLAUSEN, 1963): UFRJ 6563, 1; Nigeria. *Fundulopanchax scheeli* (RADDA, 1970): UFRJ 6557, 1; Cameroon. *Nimbapanchax petersi* (SAUVAGE, 1882): UFRJ 3907, 2; Cote D'Ivoire: forêt de Banco. *Nothobranchius albimarginatus* WATTERS, WILDEKAMP & COOPER, 1998: UFRJ 6656, 3; Tanzania: Mbezi River floodplains. *Nothobranchius eggersi* SEEGER, 1982: UFRJ 6834, 2; Tanzania, near Kibiti. *Nothobranchius luekei* SEEGER, 1984: UFRJ 6647, 1; Tanzania: Mbezi River floodplains. *Nothobranchius neumanni* (HILGENDORF, 1905): UFRJ 6832, 2; Tanzania: near Kwa Kuchina. *Nothobranchius ocellatus* (SEEGER, 1985): MRAC 91-064-P-0002, 1; Tanzania: near Bagamoyo. *Nothobranchius orthonotus* (PETERS, 1844): UFRJ 6835, 2; Mozambique: between Quelimane and Nicoladala. *Nothobranchius patrizi* (VINCIGUERRA, 1927): UFRJ 6836, 1; Somalia: Hokani. *Nothobranchius ruudwildekampi* COSTA, 2009: UFRJ 6663, 2; Tanzania: Kitonga, near Mbezi River. *Nothobranchius taeniopygus* HILGENDORF, 1891: UFRJ 6833, 2; Tanzania: near Mbuyuni. *Raddaella splendidum* (PELLEGRIN, 1930): UFRJ 3877, 1; Gabon. *Scriptaphyosemion bertholdi* (ROLOFF, 1965): UFRJ 6279, 2; Sierra Leone. *Scriptaphyosemion cauveti* (ROMAND & OZOUF-COSTAZ, 1995): UFRJ 6562, 1; Guinea. *Scriptaphyosemion chaytori* (ROLOFF, 1971): UFRJ 6280, 2; Sierra Leone. *Scriptaphyosemion guignardi* (ROMAND, 1981): UFRJ 4110, 4; Guinea: Dalaba. **Family Rivulidae: Subfamily Cynolebiasinae:** *Austrolebias adloffii* (AHL, 1922): Brazil: Rio Grande do Sul, Gravataí. *Austrolebias affinis* (AMATO, 1986): UFRJ 6160, 8; Uruguay: Tacuarembó, Arroyo Tres Cruces. *Austrolebias alexandri* (CASTELLO & LÓPEZ, 1974): UFRJ 4925, 8; Brazil: Rio Grande do Sul, Uruguaiana. *Austrolebias apaii* COSTA, LAURINO, RECUERO & SALVIA, 2006: UFRJ 6227, 6; Uruguay: Colonia, Carmelo. *Austrolebias arachan* LOUREIRO, AZPÉLICUETA & GARCÍA, 2004: UFRJ 6144, 8; Uruguay: Cerro Largo, Arroyo Chuy. *Austrolebias bellottii* (STEINDACHNER, 1881): UFRJ 4742, 6; Argentina: Buenos Aires, near Arroyo Vivoratá. *Austrolebias carvalhoi* (MYERS, 1947): UFRJ 4967, 4; Brazil: Paraná, União da Vitória. *Austrolebias charrua* (COSTA & CHEFFE, 2001): UFRJ 5024, 4; Brazil: Rio Grande do Sul, Barra do Chuí. *Austrolebias cheradophilus* (VAZ-FERREIRA, SIERRA & SCAGLIA, 1964): UFRJ 6166, 3; Uruguay: Rocha, Ruta 9. *Austrolebias cinereus* (AMATO, 1986): UFRJ 6149, 8; Uruguay: Colonia, Arroyo de las Víboras. *Austrolebias cyaneus* (AMATO, 1987): UFRJ 6741, 7; Brazil: Rio Grande do Sul, Arroio Dom Marcos. *Austrolebias duraznensis* (GARCÍA, SCVORTZOFF & HERNÁNDEZ, 1995): UFRJ 6192, 3; Uruguay: Durazno, Paso de San Borja. *Austrolebias elongatus* (STEINDACHNER, 1881): Uruguay: Soriano, Ruta 96. *Austrolebias gymnoventris* (AMATO, 1986): UFRJ 6164, 2; Uruguay: Rocha, Arroyo India Muerta. *Austrolebias ibicuiensis* (COSTA, 1999): Brazil: Rio Grande do Sul, São Pedrodo Sul. *Austrolebias jaegari* COSTA & CHEFFE, 2002: UFRJ 5430, 6; Brazil: Rio Grande do Sul, Pelotas. *Austrolebias juanlangi* COSTA, CHEFFE, SALVIA & LITZ, 2006: UFRJ 6205, 5; Uruguay: Cerro Largo, Bañados

- Coventos. *Austrolebias litzi* (COSTA, 2006): UFRJ 5029, 6; Brazil: Rio Grande do Sul, Santa Maria. *Austrolebias luteoflammulatus* (VAZ-FERREIRA, SIERRA & SCAGLIA, 1964): UFRJ 6208, 2; Uruguay: Rocha, Arroyo Valizas. *Austrolebias melanoorus* (AMATO, 1986): UFRJ 6162, 4; Uruguay: Tacuarembó, Arroyo Tres Cruces. *Austrolebias minuano* COSTA & CHEFFE, 2001: UFRJ 6176, 2; Brazil: Rio Grande do Sul, Cassino. *Austrolebias nigrofasciatus* COSTA & CHEFFE, 2001: UFRJ 4014, 7; Brazil: Rio Grande do Sul, Pelotas. *Austrolebias patriciae* (HUBER, 1995): UFRJ 6241, 4; Paraguay, Remanso. *Austrolebias paucisquama* FERRER, MALABARBA & COSTA, 2008: UFRJ 6522b, 2; Brazil: Rio Grande do Sul, São Sepé. *Austrolebias periodicus* (COSTA, 1999): UFRJ 4672, 6; Brazil, Rio Grande do Sul, Dom Pedrito. *Austrolebias prognathus* (AMATO, 1986): UFRJ 6188, 3; Uruguay: Rocha, San Luis. *Austrolebias salviai* COSTA, LITZ & LAURINO, 2006: UFRJ 6170, 4; Uruguay: Treinta y Tres, Paso del Dragón. *Austrolebias univentripinnis* COSTA & CHEFFE, 2005: UFRJ 6083, 6; Brazil: Rio Grande do Sul, Telho. *Austrolebias vandenbergi* (HUBER, 1995): UFRJ 3029, 4; Paraguay: Tenente Montania. *Austrolebias varzeae* COSTA, REIS & BEHR, 2004: UFRJ 5432, 2; Brazil: Rio Grande do Sul, Carazinho. *Austrolebias vazferrerai* (BERKENKAMP, ETZEL, REICHERT & SALVIA, 1994): UFRJ 6154, 2; Uruguay: Tacuarembó, Ruta 26. *Austrolebias viarius* (VAZ-FERREIRA, SIERRA & SCAGLIA, 1964): UFRJ 6215, 6; Uruguay: Rocha, Ruta 9. *Austrolebias wolterstorffi* (AHL, 1924): UFRJ 4973, 4; Brazil: Rio Grande do Sul, Porto Alegre. *Campellolebias brucei* Vaz-FERREIRA & SIERRA, 1974: UFRJ 4494, 6; Brazil: Santa Catarina, near Esplanada. *Campellolebias chrysolineatus* COSTA, LACERDA & BRASIL, 1989: UFRJ 5211, 3; Brazil: Santa Catarina, Araquari. *Campellolebias dorsimaculatus* COSTA, LACERDA & BRASIL, 1989: UFRJ 6310, 3; Brazil: São Paulo, Icapara. *Campellolebias intermedius* COSTA & DE LUCA, 2006: UFRJ 6315, 4; Brazil: São Paulo, Juiquiá. *Cynolebias albipunctatus* COSTA & BRASIL: UFRJ 5806, 6; Brazil: Bahia, Juazeiro. *Cynolebias altus* COSTA, 2001: UFRJ 5132, 3; Brazil: Bahia, Ibotirama. *Cynolebias attenuatus* COSTA, 2001: UFRJ 4779, 2; Brazil: Bahia, Bom Jesus da Lapa. *Cynolebias gibbus* COSTA, 2001: UFRJ 5133, 2; Brazil: Bahia, Sítio do Mato. *Cynolebias gilbertoi* COSTA, 1998: UFRJ 4471, 2; Brazil: Bahia, Bom Jesus da Lapa. *Cynolebias griseus* COSTA, Lacerda & Brasil, 1990: UFRJ 150, 2; Brazil: Goiás, Nova Roma. *Cynolebias itapicuruensis* COSTA, 2001: UFRJ 5119, 3; Brazil: Bahia, Capim Grosso. *Cynolebias leptocephalus* COSTA & BRASIL, 1993: UFRJ 2122, 1; Brasil: Bahia, Guanambi. *Cynolebias microphthalmus* COSTA & BRASIL, 1995: UFRJ 5125, 3; Brazil: Ceará, Limoeiro do Norte. *Cynolebias parnaibensis* COSTA, RAMOS, ALEXANDRE & RAMOS, 2010: UFRJ 6735, 3; Brazil: Piauí, Jacobina do Piauí. *Cynolebias perforatus* COSTA & BRASIL, 1991: UFRJ 2077, 2; Brazil: Minas Gerais, São Francisco. *Cynolebias vazabarrisensis* COSTA, 2001: UFRJ 4467, 2; Brazil: Bahia, Bendegó. *Cynopoecilus fulgens* COSTA, 2002: UFRJ 5230, 5; Brazil: Rio Grande do Sul, Rio Grande. *Cynopoecilus intimus* COSTA, 2002: UFRJ 4490, 6; Brazil, Rio Grande do Sul, Santa Maria. *Cynopoecilus melanotaenia* (REGAN, 1912): UFRJ 5019, 3; Brazil: Rio Grande do Sul, Quinta. *Cynopoecilus multipapillatus* COSTA, 2002: UFRJ 5233, 8; Brazil: Rio Grande do Sul, Lagoa Fortaleza. *Cynopoecilus nigrovittatus* COSTA, 2002: UFRJ 5231, 6; Brazil: Rio Grande do Sul, Montenegro. *Hypsolebias adornatus* (COSTA, 2000): UFRJ 4807, 8; Brazil: Bahia, Sítio do Mato. *Hypsolebias alternatus* (COSTA & BRASIL, 1994): Brazil: Minas Gerais, Brasilândia. *Hypsolebias antenori* (TULIPANO, 1973): UFRJ 4880, 8; Brazil, Ceará, Limoeiro do Norte. *Hypsolebias auratus* (COSTA & NIELSEN, 2000): UFRJ 4667, 10; Brazil: Minas Gerais, Rio Taboca. *Hypsolebias brunoi* (COSTA, 2003): UFRJ 5412, 8; Brazil, Goiás, Ribeirão Canabrava. *Hypsolebias delucaii* (COSTA, 2003): UFRJ 5427, 3; Brazil: Minas Gerais, Urucuia. *Hypsolebias fasciatus* (COSTA & BRASIL, 2006): UFRJ 6341, 4; Brazil: Minas Gerais, Unaí. *Hypsolebias flagellatus* (COSTA, 2003): Brazil: Bahia, Bom Jesus da Lapa. *Hypsolebias flammeus* (COSTA, 1989): UFRJ 2116, 4; Brazil: Goiás, Rio Paranã floodplains. *Hypsolebias flavicaudatus* (COSTA & BRASIL): UFRJ 4565, 2; Brazil: Pernambuco, Lagoa Grande. *Hypsolebias fulminantis* (COSTA & BRASIL, 1993): UFRJ 5864, 4; Brazil: Bahia, Guanambi. *Hypsolebias ghisolfii* (COSTA, CYRINO & NIELSEN, 1996): UFRJ 3808, 1; Brazil: Bahia, Guanambi. *Hypsolebias gibberatus* (COSTA & BRASIL, 2006): UFRJ 6375, 6; Brazil: Minas Gerais, Unaí. *Hypsolebias guanambi* COSTA & AMORIM, 2011: UFRJ 6862, 4; Brazil: Bahia, Guanambi. *Hypsolebias hellneri* (BERKENKAMP, 1993): UFRJ 2080, 4; Brazil: Minas Gerais, São Francisco. *Hypsolebias igneus* (COSTA, 2000): Brazil: Bahia, Igarité. *Hypsolebias janaubensis* (COSTA, 2006): UFRJ 5410, 6; Brazil: Minas Gerais, Janaúba. *Hypsolebias longignatus* (COSTA, 2008): UFRJ 6616, 4; Brazil: Ceará, Aquiraz. *Hypsolebias macaubensis* (COSTA & SUZART, 2006): UFRJ 6106, 12; Brazil: Bahia, Macaúbas. *Hypsolebias magnificus* (COSTA & BRASIL, 1991): UFRJ 4958, 3; Brazil: Minas Gerais, Gado Bravo. *Hypsolebias marginatus* (COSTA & BRASIL, 1996): UFRJ 3537, 4; Brazil: Goiás, Barro Alto. *Hypsolebias mediopapillatus* (COSTA, 2006): UFRJ 5407, 3; Brazil: Bahia, Pindaí. *Hypsolebias multiradiatus* (COSTA & BRASIL, 1994): UFRJ 2075, 6; Brazil: Tocantins, Brejinho de Nazaré. *Hypsolebias nielseni* (COSTA, 2005): UFRJ 6062, 5; Brazil: Minas Gerais, Pirapora. *Hypsolebias notatus* (COSTA, LACERDA & BRASIL, 1990): UFRJ 6108, 4; Brazil: Goiás, Flores de Goiás. *Hypsolebias nudiorbitatus* COSTA, 2011: UFRJ 6838, 3; Brazil: Bahia, Filadélfia. *Hypsolebias ocellatus* (COSTA, NIELSEN & DE LUCA, 2001): UFRJ 5098, 8; Brazil: Minas Gerais, Itaobim. *Hypsolebias picturatus* (COSTA, 2000): UFRJ 5054, 7; Brazil: Bahia, Volta das Pedras. *Hypsolebias radiosus* (COSTA & BRASIL, 2004): UFRJ 6019, 6; Brazil: Goiás, Formosa. *Hypsolebias rufus* (COSTA, NIELSEN & DE LUCA, 2001): UFRJ 5113, 4; Brazil: Minas Gerais, Ibiá. *Hypsolebias similis* (COSTA & HELLNER, 1999): UFRJ 4147, 5; Brazil: Minas Gerais, Urucuia. *Hypsolebias stellatus* (COSTA & BRASIL, 1994): UFRJ 5126, 8; Brasil: Minas Gerais, São Francisco. *Hypsolebias trilineatus* (COSTA & BRASIL, 1994): UFRJ 4670, 10; Brazil: Minas Gerais, Brasilândia. *Hypsolebias virgulatus* (COSTA & BRASIL, 2006): UFRJ 6338, 6; Brazil: Minas Gerais, Unaí. *Leptolebias aureoguttatus* (CRUZ, 1974): UFRJ 6332, 5; Brazil: Paraná, Praia do Leste. *Leptolebias citrinipinnis* (COSTA, LACERDA & TANIZAKI, 1988): UFRJ 3679, 3; Brazil: Rio de Janeiro, Barra de Maricá. *Leptolebias itanhaensis* COSTA, 2008: UFRJ 5219, 8; Brazil: São Paulo, Itanhaém. *Leptolebias*

- leitaoi* (CRUZ & PEIXOTO, 1992): UFRJ 171, 1; Brazil: Bahia, Mucuri. *Leptolebias marmoratus* (LADIGES, 1934): Brazil: Rio de Janeiro, Nova Iguaçu. *Nematolebias papilliferus* COSTA, 2002: UFRJ 4652, 2; Brazil: Rio de Janeiro, Inoã. *Nematolebias whitei* (MYERS, 1942): UFRJ 3159, 2; Brazil: Rio de Janeiro, Rio das Ostras. *Notholebias cruzi* (COSTA, 1988): UFRJ 5287, 3; Brazil: Rio de Janeiro, Barra de São João. *Notholebias fractifasciatus* (COSTA, 1988): UFRJ 6452, 8; Brazil: Rio de Janeiro, Inoã. *Notholebias minums* (MYERS, 1942): UFRJ 6576, 10; Brazil: Rio de Janeiro, Seropédica. *Ophthalmolebias bokermanni* (CARVALHO & CRUZ, 1987): UFRJ 3162, 1; Brazil: Bahia, Itabuna. *Ophthalmolebias constanciae* (MYERS, 1942): UFRJ 5809, 2; Brazil: Rio de Janeiro, Barra de São João. *Ophthalmolebias ilheusensis* (COSTA & LIMA, 2010): Brazil: Bahia, Ilhéus. *Ophthalmolebias perpendicularis* (COSTA, NIELSEN & DE LUCA, 2001): UFRJ 5145, 5; Brazil: Bahia, near Ribeirão do Salto. *Ophthalmolebias rosaceus* (COSTA, NIELSEN & DE LUCA, 2001): Brazil: Bahia, Itapetinga. *Ophthalmolebias suzarti* (COSTA, 2004): UFRJ 5811, 2; Brazil: Bahia, Canavieiras. *Simpsonichthys boitoni* CARVALHO, 1959: UFRJ 6350, 4; Brazil: Distrito Federal, Ribeirão Guará. *Simpsonichthys nigromaculatus* COSTA, 2007: UFRJ 6469, 3; Brazil: Goiás, Chapadão do Céu. *Simpsonichthys parallelus* COSTA, 2000: UFRJ 4839, 4; Brazil: Goiás, Parque Nacional das Emas. *Simpsonichthys punctulatus* COSTA & BRASIL, 2007: UFRJ 6480, 5; Brazil: Goiás, Formosa. *Simpsonichthys santanae* SHIBATA & GARAVELLO, 1992: Brazil: Distrito Federal, Ribeirão Santana floodplains. *Simpsonichthys zonatus* COSTA & BRASIL, 1990: UFRJ 2123, 3; Brazil: Minas Gerais, Garapuava. *Spectrolebias chacoensis* (AMATO, 1986): Paraguay: Chaco, San Juan. *Spectrolebias costae* (BAKER, 1990): UFRJ 3350, 4; Brazil: Mato Grosso, road to Cocalinho. *Spectrolebias filamentosus* COSTA, BARRERA & SARMIENTO, 1997: UFRJ 3990, 4; Bolivia: Santa Cruz, near Río San Pablo. *Spectrolebias inaequipinnatus* (COSTA & BRASIL, 2008): Brazil: Maranhão, Cidelândia. *Spectrolebias semiocellatus* COSTA & NIELSEN, 1997: Brazil: Tocantins, Formoso do Araguaia. *Xenurolebias myersi* (CARVALHO, 1971): UFRJ 3161, 3; Brazil: Bahia, Mucuri. Subfamily Rivulinae: *Anablepsoides amanan* (COSTA & LAZZAROTO, 2008): Brazil: Amazonas, Igarapé do Baré. *Anablepsoides amphoreus* (HUBER, 1979): UFRJ 4606, 3; Suriname: Tofelberg. *Anablepsoides bahianus* (HUBER, 1990): UFRJ 4602, 2; Brazil: Bahia, Busca-Vida. *Anablepsoides beniensis* (MYERS, 1927): UFRJ 5885, 4; Brazil: Rondônia, between Mutum-Paraná and Abunã. *Anablepsoides cajariensis* (COSTA & DE LUCA, 2011): Brazil: Amapá, Vila Cajari. *Anablepsoides cearensis* (COSTA & VONO, 2009): UFRJ 6638, 3; Brazil: Ceará, São Gonçalo do Amarante. *Anablepsoides cryptocallus* (SEEGERS, 1980): UFRJ 2126, 1; Martinica: Ravine Vilaine. *Anablepsoides derhami* (FELS & HUBER, 1985): UFRJ 392, 2; Peru: Tingo Maria. *Anablepsoides stagnatus* (EIGENMANN, 1909): UFRJ 4605, 4; Suriname: Wageningen. *Anablepsoides tocantinensis* (COSTA, 2010): UFRJ 6683, 4; Brazil: Tocantins, Sampaio. *Anablepsoides urophthalmus* (GÜNTHER, 1866): UFRJ 6674, 3; Brazil: Pará, Mosqueiro. *Anablepsoides xinguensis* (COSTA, 2010): UFRJ 6266, 2; Brazil: Pará, Altamira. *Aphyolebias boticarioi* COSTA, 2004: UFRJ 5988, 5; Brazil: Acre, Porto Acre. *Aphyolebias claudiae* COSTA, 2003: UFRJ 5470, 3; Bolivia: Santa Cruz, near Río San Pablo. *Aphyolebias manuensis* COSTA, 2003: UFRJ 5545, 2; Peru: Madre de Dios, Río Providencia. *Aphyolebias obliquus* (COSTA, SARMIENTO & BARRERA, 1996): UFRJ 3035, 2; Bolivia: Beni, Río Mamoré basin. *Aphyolebias schindleri* COSTA, 2003: Peru: Amazonas, Río Oroba. *Atlantirivulus depressus* (COSTA, 1991): UFRJ 2118, 1; Brazil: Bahia, Porto Seguro. *Atlantirivulus haraldsioli* (BERKENKAMP, 1984): UFRJ 6295, 2; Brazil: Santa Catarina, Joinville. *Atlantirivulus janeiroensis* (COSTA, 1990): UFRJ 130, 2; Brazil: Rio de Janeiro, Magé. *Atlantirivulus lazzarotoi* (COSTA, 2007): UFRJ 7213, 4; Brazil: Rio de Janeiro, Angra dos Reis. *Atlantirivulus luelingi* (BERKENKAMP, 1984): UFRJ 127, 5; Brazil, Santa Catarina, Araquari. *Atlantirivulus simplicis* (COSTA, 2004): UFRJ 5942, 5; Brazil: Rio de Janeiro, Paraty. *Atlantirivulus unaensis* (COSTA & DE LUCA, 2009): UFRJ 6597, 3; Brazil: Bahia, Una. *Austrofundulus limnaeus* SCHULTZ, 1949: UFRJ 3912, 2; Venezuela, Zulia. *Austrofundulus transilis* MYERS, 1932: UFRJ 6121, 4; Venezuela: Portuguesa, near Papelón. *Cynodonichthys tenuis* MEEK, 1904: UFRJ 4601, 2; Guatemala: Passion, Río Samococa. *Gnatholebias hoignei* (THOMERSON, 1974): UFRJ 6117, 5; Venezuela: Portuguesa, near Papelón. *Gnatholebias zonatus* (MYERS, 1935): Venezuela: Río Orinoco basin. *Kryptolebias brasiliensis* (VALENCIENNES, 1821): UFRJ 5332, 6; Brazil: Rio de Janeiro, Citrolândia. *Kryptolebias gracilis* COSTA, 2007: UFRJ 6345, 2; Brazil: Rio de Janeiro, Sampaio Correia. *Kryptolebias hermaphroditus* COSTA, 2011: UFRJ 6234, 4; Brazil: Rio de Janeiro, Guaratiba. *Kryptolebias ocellatus* (HENSEL, 1868): UFRJ 6236, 6; Brazil: Rio de Janeiro, Guaratiba. *Laimosemion amanapira* (COSTA, 2004): UFRJ 5931, 1; Brazil: Amazonas, São Gabriel da Cachoeira. *Laimosemion cladophorus* (HUBER, 1991): UFRJ 4810, 3; French Guiana, Montagne des Chevaux. *Laimosemion dibaphus* (MYERS, 1927): UFRJ 6284, 6; Brazil: Pará, Santarém. *Laimosemion mahdiaensis* (SUIJKER & COLLIER, 2006): Guiana, Mahdia. *Laimosemion romeri* (COSTA, 2003): UFRJ 5448, 4; Brazil: Amazonas, Rio Uaupés. *Laimosemion uakti* (COSTA, 2004): UFRJ 5931, 1; Brazil: Amazonas, São Gabriel da Cachoeira. *Laimosemion uatuman* (COSTA, 2004): UFRJ 6024, 2; Brazil: Amazonas, Balbina. *Laimosemion strigatus* (REGAN, 1912): UFRJ 6251, 4; Brazil: Pará, Primavera. *Llanolebias stellifer* (THOMERSON & TURNER, 1973): UFRJ 245, 5; Venezuela: Cojedes, near El Pao. *Maratecoara lacortei* (LAZARA, 1991): UFRJ 6406, 8; Brazil: Tocantins, Rio Formoso. *Maratecoara formosa* COSTA & BRASIL, 1995: UFRJ 2111, 4; Brazil: Tocantins, Brejinho de Nazaré. *Maratecoara splendida* COSTA, 2007: UFRJ 6433, 4; Brazil: Tocantins, Rio Canabrava. *Melanorivulus apiamici* (COSTA, 1989): UFRJ 5972, 3; Brazil: Mato Grosso do Sul, Nova Porto Quinze. *Melanorivulus bororo* (COSTA, 2008): UFRJ 6502, 3; Brazil: Mato Grosso, Arenópolis. *Melanorivulus crixas* (COSTA, 2007): UFRJ 6460, 5; Brazil: Goiás, Nova Crixás. *Melanorivulus cyanopterus* (COSTA, 2005): UFRJ 5914, 5; Brazil: Mato Grosso, Jaciara. *Melanorivulus dapazi* (COSTA, 2005): UFRJ 5921, 3; Brazil: Mato Grosso do Sul, Rio Comprido. *Melanorivulus decoratus* (COSTA, 1989): UFRJ 2135, 3; Brazil: Bahia, Ibiraba. *Melanorivulus egens* (COSTA, 2005): Brazil: Mato Grosso do Sul, Canapuã. *Melanorivulus faucireticulatus* (COSTA, 2008): UFRJ 6549, 3; Brazil: Goiás, Perolândia. *Melanorivulus formo-*

- sensis* (COSTA, 2008): UFRJ 6545, 4; Brazil: Goiás, Chapadão do Céu. *Melanorivulus giarettai* (COSTA, 2008): UFRJ 6491, 4; Brazil: Minas Gerais, Nova Ponte. *Melanorivulus illuminatus* (COSTA, 2007): UFRJ 6466, 4; Brazil: Goiás, Montividiu. *Melanorivulus javahe* (COSTA, 2007): UFRJ 2100, 4; Brazil: Goiás, São Miguel do Araguaia. *Melanorivulus karaja* (COSTA, 2007): UFRJ 6487, 2; Brazil: Tocantins, Rio Dueré. *Melanorivulus kayabi* (COSTA, 2008): UFRJ 6535, 4; Brazil: Mato Grosso, Nova Mutum. *Melanorivulus kayapo* (COSTA, 2006): UFRJ 6382, 5; Brazil: Goiás, Rio Bonito. *Melanorivulus litteratus* (COSTA, 2005): UFRJ 5958, 6; Brazil: Mato Grosso, Córrego do Sapo. *Melanorivulus megaroni* (COSTA, 2010): UFRJ 2109, 5; Brazil: Mato Grosso, Rio Xingu. *Melanorivulus modestus* (COSTA, 1991): UFRJ 2103, 5; Brazil: Mato Grosso, Rio Mutum drainage. *Melanorivulus paracatuensis* (COSTA, 2003): UFRJ 2291, 2; Brazil: Minas Gerais, Brasilândia. *Melanorivulus paresi* (COSTA, 2008): UFRJ 6507, 4; Brazil: Mato Grosso, Progresso. *Melanorivulus parnaibensis* (COSTA, 2003): UFRJ 5449, 4; Brazil: Piauí, Rio Parnaíba. *Melanorivulus pictus* (COSTA, 1989): UFRJ 5959, 2; Brazil: Distrito Federal, Planaltina. *Melanorivulus pinima* (COSTA, 1989): UFRJ 2279, 4; Brazil: Goiás, Rio Claro drainage. *Melanorivulus planaltinus* (COSTA & BRASIL, 2008): UFRJ 6499, 4; Brazil: Goiás, Planaltina de Goiás. *Melanorivulus punctatus* (BOULENGER, 1895): UFRJ 2110, 4; Brazil: Mato Grosso do Sul, Aquidauana. *Melanorivulus rossoi* (COSTA, 2005): UFRJ 5978, 4; Brazil: Mato Grosso do Sul, Campo Grande. *Melanorivulus rubromarginatus* (COSTA, 2007): UFRJ 6477, 4; Brazil: Goiás, Rio Espingarda. *Melanorivulus rutilicaudus* (COSTA, 2005): Brazil: Goiás, Serranópolis. *Melanorivulus salmonicaudus* (COSTA, 2007): UFRJ 6482, 6; Brazil: Goiás, Córrego Dom Bil. *Melanorivulus scalaris* (COSTA, 2005): UFRJ 5970, 4; Brazil: Mato Grosso do Sul, Costa Rica. *Melanorivulus schuncki* (COSTA & DE LUCA, 2011): UFRJ 6768, 6; Brazil: Amapá, Vila Nova. *Melanorivulus violaceus* (COSTA, 1991): UFRJ 2106, 7; Brazil: Mato Grosso, Primavera do Leste. *Melanorivulus vittatus* (COSTA, 1989): UFRJ 5964, 4; Brazil: Goiás, Aparecida do Rio Doce. *Micromoema xiphophora* (THOMERSON & TAPHORN, 1992): UFRJ 3165, 1; Venezuela: Amazonas, Orinoco basin. *Millerichthys robustus* (MILLER & HUBBS, 1974): UFRJ 4598, 2; Mexico: Veracruz, near Jesus Carranza. *Moema apurinan* COSTA, 2004: UFRJ 5982, 7; Brazil: Acre, Porto Acre. *Moema hellneri* COSTA, 2003: UFRJ 4594, 2; Peru: Bella Vista, Napo. *Moema heterostigma* COSTA, 2003: UFRJ 5518, 3; Brazil: Mato Grosso, Porto Cercado. *Moema nudifrontata* COSTA, 2003: UFRJ 283, 1; Brazil: Roraima, Ilha do Carneiro. *Moema ortegai* COSTA, 2003: UFRJ 5446, 1; Peru: Madre de Dios, Tambopata. *Moema piriana* COSTA, 1989: UFRJ 316, 2; Brazil: Pará, Primavera. *Neofundulus ornatipectus* MYERS, 1935: UFRJ 2113, 1; Brazil: Mato Grosso do Sul, Uquidabá. *Neofundulus paraguayensis* (EIGENMANN & KENNEDY, 1903): UFRJ 3648, 4; Brazil: Mato Grosso do Sul, Boiadeiro road. *Neofundulus parvipinnis* COSTA, 1988: UFRJ 267, 1; Brazil: Mato Grosso, Cuiabá. *Papiliolebias bitteri* (COSTA, 1989): Paraguay: Chaco, San Juan. *Pituna brevirostrata* COSTA, 2007: UFRJ 6429, 5; Brazil: Goiás, Goiânia. *Pituna obliquose-riata* COSTA, 2007: UFRJ 3545, 3; Brazil: Mato Grosso, Rio das Mortes. *Pituna poranga* COSTA, 1989: UFRJ 3564, 4; Brazil: Tocantins, Barreira do Piqui. *Pituna schindleri* COSTA, 2007: UFRJ 5547, 8; Brazil: Piauí, Campo Maior. *Pituna xinguensis* COSTA & NIELSEN, 2007: Brazil: Pará, Altamira. *Plesiolebias altamira* COSTA & NIELSEN, 2007: UFRJ 6371, 3; Brazil: Pará, Altamira. *Plesiolebias filamentosus* COSTA & BRASIL, 2007: UFRJ 6368, 3; Brazil: Tocantins, Sampaio. *Plesiolebias fragilis* COSTA, 2007: UFRJ 5049, 8; Brazil: Tocantins, Ilha do Bananal. *Plesiolebias glaucopterus* (COSTA & LACERDA, 1988): UFRJ 120, 2; Brazil: Mato Grosso, road Poconé-Porto Cercado. *Plesiolebias lacerdai* COSTA, 1989: UFRJ 121, 2; Brazil: Mato Grosso, Rio das Mortes. *Prorivulus auriferus* COSTA, LIMA & SUZART, 2004: UFRJ 5934, 3; Brazil: Bahia, Valença. *Pterolebias longipinnis* GARMAN, 1895: UFRJ 5883, 6; Brazil: Rondônia, Guajará-Mirim. *Pterolebias phasianus* COSTA, 1988: UFRJ 3673, 4; Brazil: Mato Grosso, Cáceres. *Rachovia brevis* (Regan, 1912): UFRJ 295, 1; Venezuela. *Rachovia maculipinnis* (RADDA, 1964): UFRJ 6119, 4; Venezuela: Portuguesa, near Papelón. *Renova oscari* THOMERSON & TAPHORN, 1995: UFRJ 3164, 1; Venezuela: Amazonas, Orinoco basin. *Rivulus cylindraceus* POEY: UFRJ 7655, 2; Cuba. *Terranatos dolichopterus* (WEITZMAN & WOURMS, 1967): UFRJ 3911, 3; Venezuela: Cojedes, 40 km S of El Pao. *Trigonectes balzanii* (PERUGIA, 1891): UFRJ 3671, 6; Brazil: Mato Grosso, Santo Antônio do Leverger. *Trigonectes rubromarginatus* COSTA, 1990: UFRJ 274, 1; Brazil: Mato Grosso, road to Cocalinho. *Trigonectes strigabundus* MYERS, 1927: UFRJ 2114, 2; Brazil: Tocantins, Porto Nacional. **Order Atheriniformes: Family Atherinidae: Craterocephalus honoriae** (OGILBY, 1912): UFRJ 4165, 2; Australia. **Family Atherinopsidae: Atherinella brasiliensis** (QUOY & GAIMARD, 1825): UFRJ 3163, 1; Brazil: Saquarema, Jaconé lagoon. **Family Melanotaeniidae: Melanotaenia affinis** (WEBER, 1907): UFRJ 4167, 2; Papua New Guinea. *Melanotaenia duboulayi* (CASTELNAU, 1878): UFRJ 4157, 2; Australia: Glenrugh, Iallamud Jan Creek. **Family Pseudomugilidae: Pseudomugil gertrudae** WEBER, 1911: Papua New Guinea: Bensbuch. **Order Beloniformes: Family Adrianichthyidae: Oryzias matanensis** (AURICH, 1935): UFRJ 8094, 2; Indonesia: Sulawesi, Lake Matano. *Xenopoeilus sarasinorum* (POPTA, 1905): UFRJ 8095, 2; Indonesia: Sulawesi, Lake Lindu. **Family Exocoetidae: Hirundichthys rondeletii** (VALENCIENNES, 1847): UFRJ 7350, 1; Brazil: Espírito Santo coast. **Family Hemiramphidae: Hyporhamphus unifasciatus** (RANZANI, 1841): UFRJ 4115, 1; Brazil: Rio de Janeiro. **Order Mugiliformes: Family Mugilidae: Mugil curema** VALENCIENNES, 1836: UFRJ 8114, 2; Brazil: Amapá, Calçoene.