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A systematic review of *Diapoma* (Teleostei: Characiformes: Characidae: Stevardiinae: Diapomini) with descriptions of two new species from southern Brazil

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ABSTRACT

Diapoma *is reviewed and four species are recognized: (1)* Diapoma thauma, *new species, from streams of the rio Jacuí basin, state of Rio Grande do Sul; (2)* D. pyrrhopteryx, *new species collected from the rio Canoas and streams flowing into this basin in the states of Rio Grande do Sul and Santa Catarina, Brazil; (3)* Diapoma terofali, *from streams flowing into rio Uruguay in Uruguay and Rio Grande do Sul, Brazil and streams flowing into rio de la Plata, Argentina; and (4)* Diapoma speculiferum, *from lowland coastal streams in Rio Grande do Sul, Brazil and Uruguay.* Diapoma pyrrhopteryx *possess the posteroventral opercular elongation typical of* D. speculiferum, *type species of the genus, but which is absent in* D. thauma *and* D. terofali. *Nonetheless, all the diapomin species have the caudal pouch organ about equally developed in both sexes and the dorsal portion of the pouch opening bordered by a series of 3 to 8 elongated scales, the two derived features that characterize the group. The two previously described species,* D. speculiferum *and* D. terofali, *are redescribed. Previous hypotheses of relationships among the diapomin genera* Planaltina, Diapoma *and* Acrobrycon *are discussed on the basis of preliminary morphological information. It is proposed that the Diapomini is a monophyletic group. An identification key, information on sexual dimorphism, gonad anatomy, reproductive mode and distribution of the species of* Diapoma *are provided.*

Key-Words: Taxonomy; New species; Characidae; *Diapoma.*

INTRODUCTION

The genus *Diapoma* Cope, 1894 was defined on the basis of unique modifications of the opercular apparatus in *Diapoma speculiferum* Cope, 1894 and included in its own subfamily, the Diapominae, made available by Eigenmann (1910:430). The generic concept of *Diapoma* changed with the inclusion of a species originally described as *Glandulocauda terofali* (Géry, 1964:2), but considered by Weitzman & Fink (1985:103, 109) to share the structures and scale arrangement of the caudal-fin organ as *D. speculiferum.* Those authors also noted the similarity in caudal organ structures among *Diapoma, Planaltina* Böhlke, 1954, and *Acrobrycon* Eigenmann & Pearson, in Pearson, 1924 which led Weitzman *et al.* (1988:383) to include the three genera in the tribe Diapomini, without, however, providing a diagnosis. Burns *et al.* (1995:133, table 1) considered the spherical nuclei of the sperm cells of *Planaltina* and the elongated but relatively short sperm nuclei diameter or length in the species of *Acrobrycon* and *Diapoma* as indicative of a possible relationship among those genera. The Diapomini including the three genera were subsequently

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rediagnosed by Weitzman & Menezes (1998:184). More recently Menezes *et al.* (2003:596) suggested that *Planaltina* might be the sister taxon to *Diapoma* plus *Acrobrycon.*

The idea that Diapomini may not be monophyletic was suggested by Weitzman *et al.* (2005:352) and recent molecular data has further challenged the condition of *Diapoma* as a natural group (Javonillo *et al.* 2010:508). Until more thorough phylogenetic studies including all the involved taxa are undertaken we prefer to maintain *Diapoma* in Diapomini of the subfamily Stevardiinae.

Two species collected in freshwaters of Rio Grande do Sul and Santa Catarina, Brazil, have the same morphological features associated with the caudal organ of the known species of *Diapoma* but differ with respect to other characters and are herein described as new. The two previously known species of the genus are redescribed.

MATERIAL AND METHODS

The procedures for taking counts and measurements follow Menezes *et al.* (2003:559-560) and Menezes & Weitzman (2009:296-297), unless otherwise specified. Meristic data of the species are compared using Tukey box plots and statistical differences evaluated using the Mann-Whitney test (BioEstat 5.0, in Ayres *et al.* (2007). A difference was considered significant when $p \leq 0.05$. Analyses for differences between sexes and in body ratios were demonstrated using regressions and expressed through graphs. In the species descriptions the range of meristic characters is presented first, followed by the mean of the sample and by counts of holotype in parentheses. The procedures for histological analyses are described in Menezes *et al.* (2009:48).

Specimens studied are deposited in Museu de Zoologia, Universidade de São Paulo (MZUSP); Museu de Ciências e Tecnologia, Pontifícia Universidade Católica do Rio Grande do Sul, Porto Alegre (MCP); Museu de Ciências Naturais da Fundação Zoobotânica do Rio Grande do Sul, Porto Alegre (MCN);Departamento de Zoologia, Instituto de Biociências, Universidade Federal do Rio Grande do Sul, Porto Alegre (UFRGS); Academy of Natural Sciences of Philadelphia (ANSP); Field Museum of Natural History, Chicago (FMNH); University of Michigan Museum of Zoology, Ann Arbor (UMMZ); National Museum of Natural History, Smithsonian Institution, Washington, D.C. (USNM). Other abbreviations: SL – Standard length; C&S – clear and stained.

Diapoma Cope, 1894

Diapoma Cope, 1894a:67 (type-species: *Diapoma speculiferum* Cope1894a: by monotypy, compared with *Tetragonopterus*); 1894b:92 (more complete generic description, states "allied to *Hemigrammus*" but no similar characters listed, also states "peculiarly formed operculum displays a tendency towards that of *Corynopoma*" Gill). – Eigenmann, 1914:34 (definition of genus, inclusion in Diapominae and in Glandulocaudinae). – Eigenmann & Myers, 1929:467, 471 (key to glandulocaudine genera and description of genus, placed in Glandulocaudinae). – Gregory & Conrad, 1938:321, 335 (placed in Glandulocaudinae following Eigenmann, Glandulocaudinae placed in Characinae (in part = American Characidae). – Fowler, 1951:412 (listed, placed in family Stevardiidae and subfamily Stevardiinae). – Travassos, 1951:53 (listed, considers *Diapoma* nomenclaturaly valid). – Nelson, 1964:59, 70, 143 (considers caudal pouch indicative of glandulocaudine relationship, discusses elongate opercle as an intermediate "condition" between that of male and female *Corynopoma*). – Fowler, 1975:332 (listed). – Géry, 1977:335, 359, 362 (considered an "allied form" of *Pseudocorynopoma* but in key placed in couplet with *Corynopoma*). Weitzman & Fink, 1985:1, 17, 109, 113 [caudal morphology illustrated, considered *Glandulocauda,* in part, of Géry 1964 (but not that of Eigenmann, 1911) a synonym of *Diapoma,* questions relationships to other glandulocaudines]. – Weitzman *et al.,* 1988:383 (listed, placed in subfamily Glandulocaudinae, tribe Diapomini). – Weitzman & Menezes, 1998:184 (placed in Glandulocaudinae, tribe Diapomini, discuss preliminary relationships). – Weitzman, 2003:224 (placed in subfamily Glandulocaudinae, tribe Diapomini) – Miranda, 2009:8 (placed in Characidae, subfamily Stevardiinae). – Javonillo *et al.,* 2010 (may not be a natural group).

Diagnosis: Diapoma is currently assigned to the tribe Diapomini together with *Planaltina* and *Acrobrycon,* the three genera differing from the remaining members of the Stevardiinae by (1) the presence of a caudal organ nearly equivalent in size and development in both males and females and (2) the presence of multiple series of scales (at least three or more) ventral to the lateral line series and extending posteriorly to form the dorsal border of the pouch opening. *Diapoma* can

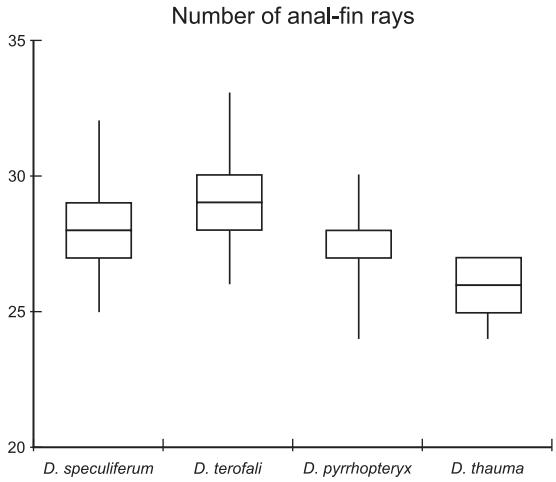

FIGURE 1: Tukey box plot showing statistical distribution of number of anal-fin rays for species of *Diapoma.*

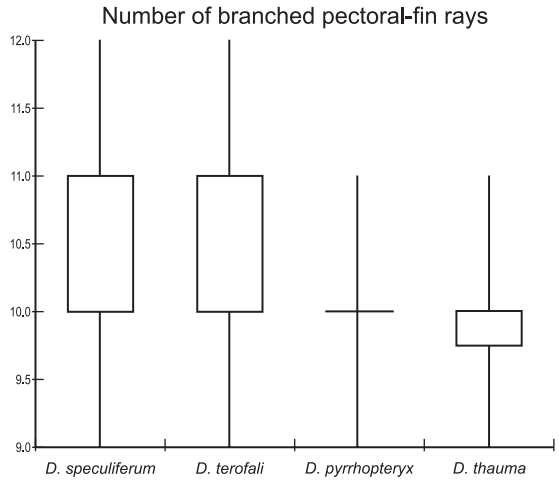

FIGURE 2: Tukey box plots showing statistical distribution of number of pectoral-fin rays for species of *Diapoma.*

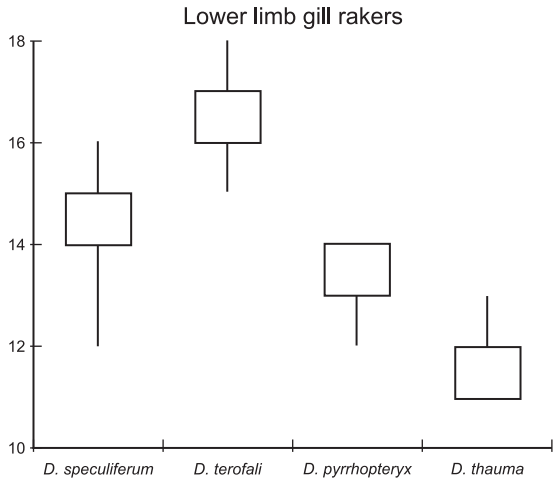

FIGURE 3: Tukey box plots showing statistical distribution of number of lower limb gill rakers for species of *Diapoma.*

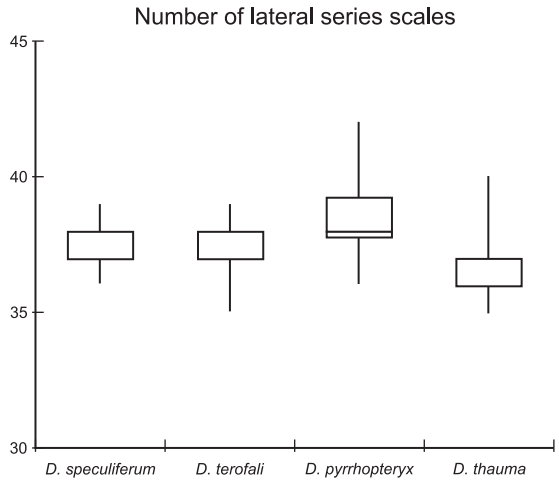

FIGURE 4: Tukey box plots showing statistical distribution of number of lateral series scales for species of *Diapoma.*

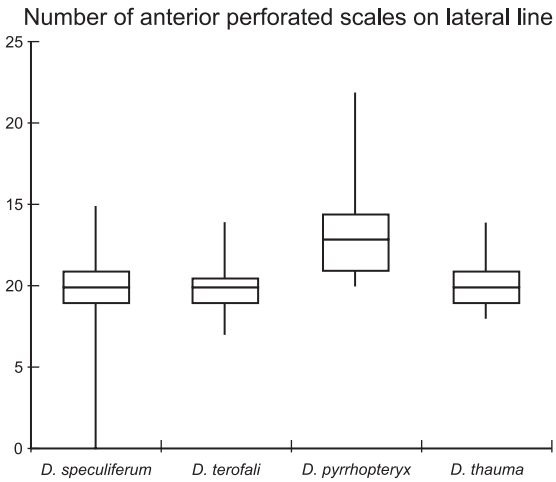

FIGURE 5: Tukey box plots showing statistical distribution of number of anterior perforated scales for species of *Diapoma.*

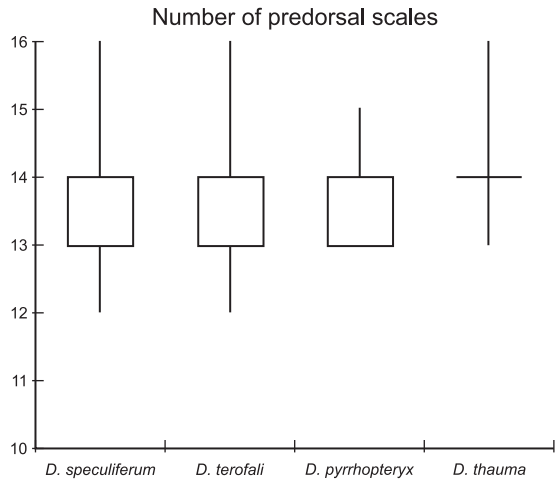

FIGURE 6: Tukey box plots showing statistical distribution of number of predorsal scales for species of *Diapoma.*

be distinguished from *Planaltina* by having the dorsal border of the pouch opening formed by 4 to 8 scales, one of them larger than the others (Fig. 13), a feature also present in *Acrobrycon* (Weitzman & Menezes, 1998, figs. 14 and 15) instead of just the 1 or 2 large scales present along the same border in *Planaltina* (Menezes *et al.,* 2003, figs. 19, 28, and 33). From *Acrobrycon, Diapoma* can be easily distinguished by its interrupted lateral line (Fig. 10), with the short anterior segment having 7 to 22 pored lateral line scales whereas in all the species of *Acrobrycon* the lateral line is complete or nearly so with 51 to 68 pored scales.

Key to the species of *Diapoma*

1. Opercular region modified into posterior bony extension primarily involving opercle and subopercle which have their posterior portions prolonged (Figs. 28 and 35) 2
   Opercular region not modified as above (Figs. 11 and 18) 3
2. Snout length 21.3-24.5% of head length (table 4, fig. 27); maxillary teeth pentacuspid (Fig. 37); adipose fin, upper portions of dorsal and caudal fins, posterior portion of pelvic fin, and ventral portion of anal-fin anterior lobe red in live or recently preserved male specimens (Fig. 34).....*D. pyrrhopteryx* sp. nov.
   Snout length 17.0-21.4% of head length (Table 3, fig. 27); maxillary teeth tricuspid (Fig. 29); no red coloration on any fin of live or recently preserved male specimens (Fig. 26) ..... *D. speculiferum*
3. 15-18 gill rakers on lower limb of first gill arch..... *D. terofali*
   11-13 gill rakers on lower limb of first gill arch.....*D. thauma* sp. nov.

Diapoma terofali (Géry, 1964)
Figs. 10-15, Table 1

Glandulocauda terofali Géry, 1964:2 (original description, type locality: Argentina, Provincia Buenos Aires, Canal El Cazador, río Luján). Ringuelet, Aramburu & Aramburu, 1967:156 [description after Géry (1964)]. – Géry, 1977:355, 362 (illustrated and listed). – Miquelarena, Aramburu, Menni & López, 1981:131 (specimens from Argentina, provincia de Corrientes, laguna Iberá and Berisso, provincia de Buenos Aires; meristic and morphometric data). – Miquelarena, 1982:281, 292 (caudal osteology). – Malabarba, 1983:187 (listed; specimens from rio Negro, Bagé and rio Santa Maria, Dom Pedrito, Rio Grande do Sul, Brazil). – López, Casciotta, Miquelarena & Menni, 1984:76, 78 (short descriptions, no new localities). – Miquelarena, 1986:22 (dentition). – Menni, 2004:76 (ecological data).

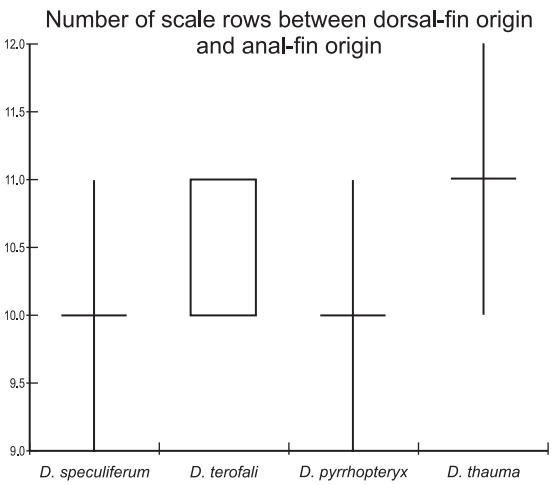

FIGURE 7: Tukey box plots showing statistical distribution of number of longitudinal scale rows between dorsal-fin origin and anal-fin origin for species of *Diapoma.*

Diapoma terofali Weitzman & Fink, 1985:103, 109 (discussion of generic placement, specimens from laguna of arroyo Catalán Chico, Artigas, Uruguay). – Burns *et al.,* 1995:140 (shape of sperm cells). – Weitzman, 2003:224 (maximum length; distribution; remarks and references). – López *et al.,* 2003:21 (listed; distribution, conservation). – Casciotta *et al.,* 2003:83 (laguna Iberiá, Argentina). – Menezes, 2007:38 (listed in catalog; distribution). – Javonillo *et al.,* 2010:500 (listed in table); 2010:509 (listed as member of Stevardiinae).

Specimens examined: Argentina: ANSP 139721, 1 (SL 47.5 mm), Buenos Aires, canal "El Cazador", río Luján, approximately 34°17'S, 58°53'W, paratype; UMMZ 218481, 120 (SL 37-55.5 mm), Los Talas, 20 km SE of La Plata, approximately 34°52'S, 57°53'W. Brazil: MZUSP 28268 (SL 42 mm, male and 38 mm, female, C&S, SL 42 mm, male and 38 mm, female, photographed), USNM 270284 (SL 29.1-46.5 mm), Rio Grande do Sul,

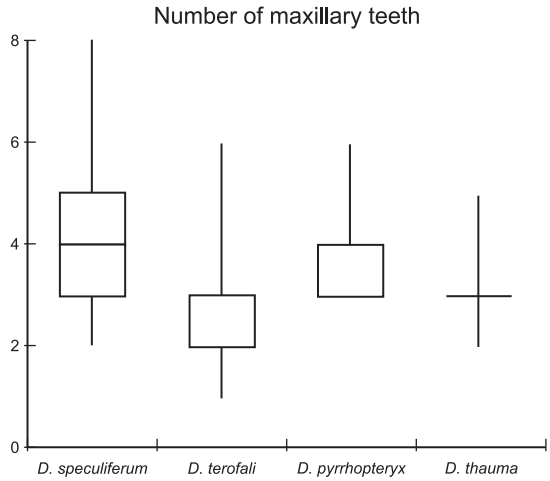

FIGURE 8: Tukey box plots showing statistical distribution of number of maxillary teeth for species of *Diapoma*.

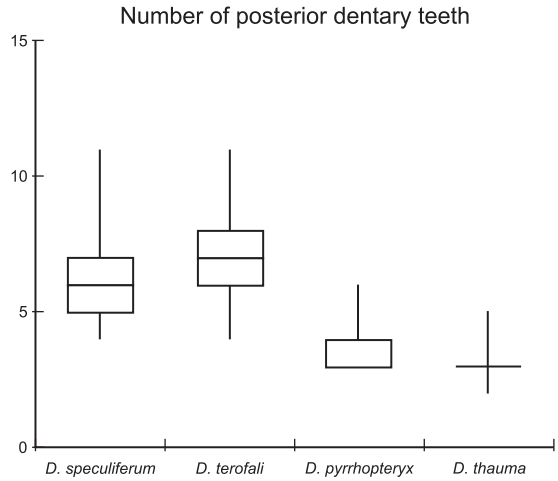

FIGURE 9: Tukey box plots showing statistical distribution of number of posterior dentary teeth for species of *Diapoma*.

rio Santa Maria under bridge on road BR 293, between Dom Pedrito and Santana do Livramento, approximately 30°57'S, 55°05'W; UFRGS 18821, 11 (SL 36.8-41 mm), rio Negro, on road between Bagé and Pinheiro Machado, approximately 31°28'S, 53°48'W. Uruguay: USNM 236275, 2 (37.8 and 39.2 mm), Artigas, laguna of Arroyo Catlán Chico, approximately 30°24'S, 56°28'W; MCP 1531, 7 (SL 30-32.8 mm), Cerro Largo, Estância Arreria, rio Negro, approximately 32°12'S, 54°15'W.

Diagnosis: Diapoma terofali can be readily distinguished from *D. speculiferum* and *D. pyrrhopteryx* by not having the opercle and subopercle prolonged (compare Figs. 11 and 18, with Figs. 28 and 35). It differs from *D. thauma* in the number of gill rakers on the

TABLE 1: Morphometrics of *Diapoma terofali*. Standard length expressed in mm; measurements through head length are percentages of standard length; the last four entries are percentages of head length. Specimens are from ANSP 139721 (Paratype); UMMZ 218481; USNM 236275, 270284; MCP1531; UFRGS 18821. Values of ***p*** in bold indicates significant statistical differences

Characters	Males					Females				*p* value
	Paratype	n	range	mean	SD	n	range	mean	SD	
Standard length	47.50	96	32.0-58.8	45.0		75	30.0-52.0	40.0		
Depth at dorsal-fin origin	36.40	96	29.3-37.5	33.2	1.80	75	29.3-35.0	32.2	1.40	**0.000**
Snout to dorsal-fin origin	54.70	96	52.0-56.3	54.3	0.80	75	52.6-56.8	55.0	0.80	**0.000**
Snout to pectoral-fin origin	26.00	96	25.0-27.6	26.0	0.60	75	24.5-27.6	26.0	0.60	0.259
Snout to pelvic-fin origin	49.00	96	47.0-51.0	48.7	1.00	75	46.7-50.4	48.4	0.90	**0.014**
Snout to anal-fin origin	62.70	96	60.0-65.0	62.4	0.90	75	59.4-65.7	62.3	1.30	0.284
Caudal peduncle depth	12.20	96	10.6-13.3	11.7	0.50	75	10.0-12.6	11.1	0.40	**0.000**
Caudal peduncle length	8.40	96	08.2-11.3	10.0	0.70	75	08.2-11.4	09.7	0.80	0.140
Pectoral-fin length	26.00	96	22.3-26.0	24.3	0.80	75	23.3-26.6	24.6	0.70	0.055
Pelvic-fin length	16.40	96	14.6-18.0	15.8	0.70	75	14.0-16.6	15.5	0.50	**0.008**
Dorsal-fin base length	12.00	96	10.6-13.4	12.0	0.60	75	10.3-13.3	11.5	0.60	**0.000**
Dorsal-fin height	25.20	96	22.1-27.0	24.5	1.10	75	22.1-26.8	24.4	1.10	0.608
Anal-fin base length	36.80	96	31.0-36.6	33.6	1.10	75	30.8-36.0	33.2	1.20	**0.040**
Anal-fin lobe length	22.70	96	19.0-22.2	20.3	0.80	75	19.1-23.2	21.0	1.00	**0.000**
Eye to dorsal-fin origin	44.60	96	40.0-45.0	42.7	1.00	75	40.8-46.4	43.0	1.30	0.181
Dorsal-fin origin to caudal-fin base	49.70	96	48.1-51.8	50.0	1.00	75	45.1-51.7	48.8	1.40	**0.000**
Bony head length	11.40	96	22.4-25.5	24.0	0.60	75	22.5-26.0	24.0	0.60	0.435
Horizontal eye diameter	36.80	96	32.7-42.3	40.0	1.50	75	36.3-42.7	40.1	1.50	**0.012**
Snout length	21.00	96	18.8-23.2	20.8	0.80	75	18.5-22.0	20.3	0.90	**0.000**
Least interorbital width	33.30	96	30.1-35.0	32.4	1.20	75	30.5-35.0	32.3	0.90	0.489
Upper jaw length	45.60	96	43.2-48.0	45.6	1.10	75	43.3-48.4	45.6	1.10	0.699

FIGURE 10: *Diapoma terofali,* MZUSP 28268, adult male above, SL 42.0 mm and adult female below, SL 38.0 mm.

lower limb of first gill arch (15-18 *versus* 11-13 in *D. thauma,* Fig. 3) and in the number of anal-fin rays (26-33 *versus* 24-27, Fig. 1).

Description: Morphometrics presented in Table 1.

Body small (SL 32-58.5 mm), compressed, elongate and moderately deep. Greatest body depth located between snout tip and dorsal-fin origin near vertical through pelvic-fin origin. Dorsal body profile convex from snout tip to origin of dorsal fin, slightly

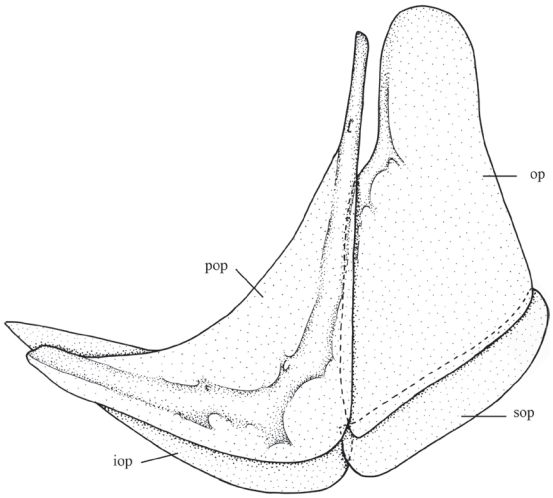

FIGURE 11: *Diapoma terofali,* MZUSP 28268, C&S, sexually active male, SL 42.0 mm, opercular bones, lateral view, left side. OP, opercle; POP, preopercle; IOP, interopercle; SOP, subopercle.

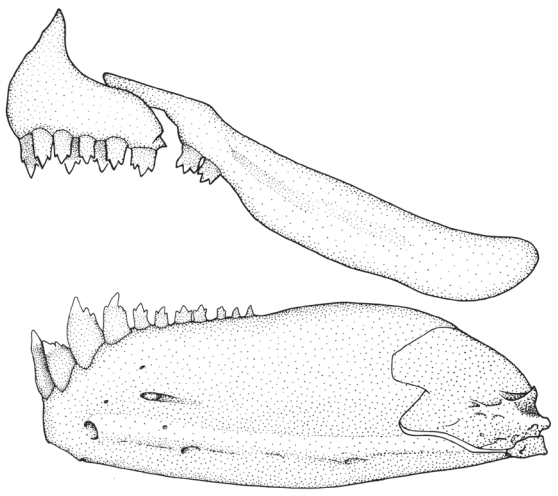

FIGURE 12: *Diapoma terofali,* MZUSP 28268, C&S, sexually active male, SL 42.0 mm, jaws and dentition, lateral view, left side, anterior at left.

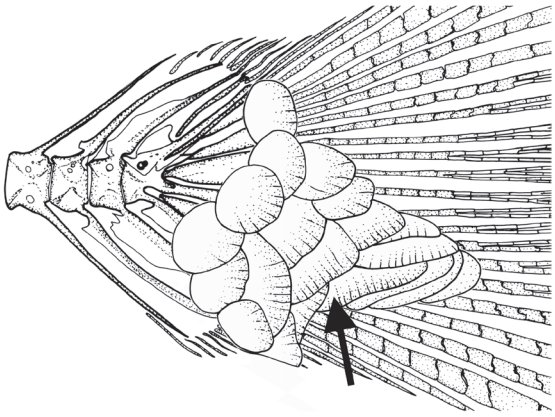

FIGURE 13: *Diapoma terofali,* MZUSP 28268, C&S, sexually active male, SL 42.0 mm; caudal-fin squamation of ventral portion of caudal-fin lobe, lateral view, left side. Arrow indicates larger scale.

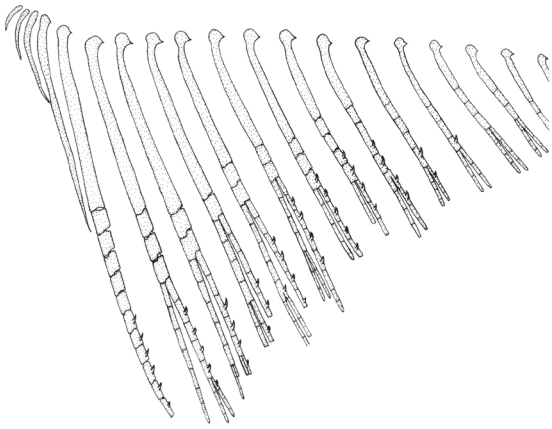

FIGURE 14: *Diapoma terofali,* MZUSP 26268, C&S, sexually active male, SL 42.0 mm; anal-fin rays, lateral view, left side, showing anal-fin hooks.

depressed at nape, nearly straight along dorsal-fin base and slightly concave above caudal peduncle. Snout rounded. Dorsal-fin origin nearer to caudal-fin base than to snout tip. Ventral body profile more convex than dorsal profile, from tip of lower jaw to anal-fin origin, straight along anal-fin base and slightly concave from end of anal-fin base to origin of procurrent caudal-fin rays. Mouth terminal. Mouth gape inclined posteroventrally towards mandibular joint. Maxilla extending posteriorly beyond vertical passing through anterior border of orbit, but not reaching posterior border of pupil, its posterior ventral border convex, posterior dorsal border concave.

Dorsal-fin rays ii, 8 in all specimens, n = 171. Posteriormost ray unbranched in all specimens, n = 171. Adipose fin present. Unbranched anal-fin rays iv or v, usually iv, branched rays 26-33, 28.8, n = 171. Developed anterior anal-fin lobe includes anterior unbranched rays and first 6-7 branched rays. Anal fin of sexually mature males with bilateral hooks on last unbranched and anterior 10-11 branched rays; hooks distributed as shown in figure 17. Pectoral-fin rays i, 9-12, 10.8, n = 171. Posterior tips of longest pectoral-fin rays reaching and in some specimens extending slightly beyond pelvic-fin origin in males, falling short of pelvic-fin origin in females at all sizes, but pectoral fins about same proportional length in both sexes. Pelvic-fin rays i, 6, n = 171. Sexually mature males with hooks on rays of pelvic fin, distributed as shown in Figure 15. Number of hooks per ray varying among males, but usually approximately as shown in Figure 15. Mature male (SL 42 mm) with 8 on fourth, 9 on fifth, and 10 on sixth and 0 on remaining branched and unbranched rays. Tips of longest pelvic-fin rays extending to, or slightly, beyond anal-in origin in adult males and females.

Scales cycloid, with few radii (3-7) along exposed field on body and more numerous (10-12) on enlarged scale bordering pouch opening. Lateral line incomplete, perforated scales on anterior

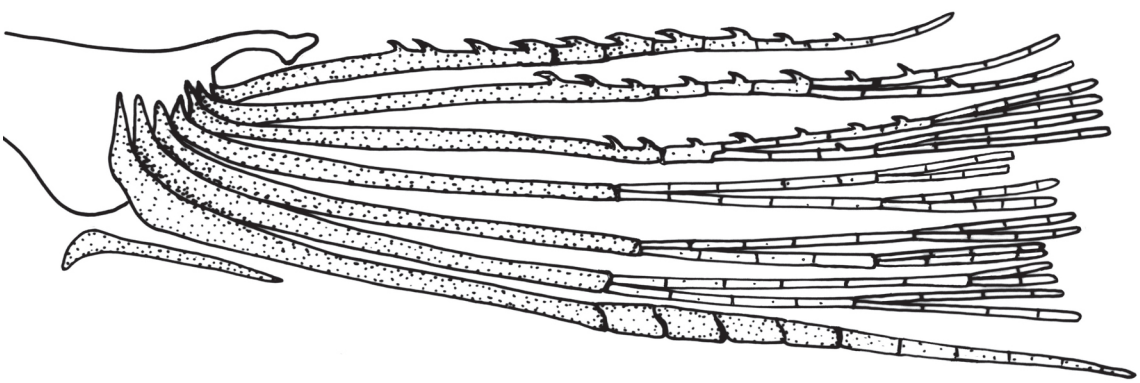

FIGURE 15: *Diapoma terofali,* MZUSP 28268, C&S, sexually active male, SL 42.0 mm; pelvic-fin rays, ventral view, left side, showing pelvic-fin hooks.

segment 7-14, 9.8, n = 135, followed by 17-30, 24 non-perforated scales, n = 135, and shorter posterior segment with 3-8, 4.7, n = 94 in most specimens. Lateral series scales 35-39, 37.1, n = 133. Scales between dorsal-fin origin and anal-fin origin 10-11, 10.6, n = 160. Predorsal scales 13-16, 14, n = 162. Horizontal scale rows around caudal peduncle 14, n = 141. Premaxillary teeth in two distinct rows (Fig. 12), larger teeth pentacuspid, smaller teeth barely tricuspid with barely apparent lateral cusps. Outer row teeth 2-5, 3.8, n = 171. Inner row teeth 4-5, 4.06. Maxillary teeth (Fig. 12) tricuspid anteriorly, bicuspid and smaller posteriorly, 1-6, 3, n = 170. Dentary (Fig. 12) with 4 large anterior pentacuspid or sometimes quadricuspid teeth, n = 171, and 4-11, 6.7, n = 171 smaller tricuspid teeth. Total number of gill rakers 23-27, 25.1, n = 171. Branchiostegal rays 4 in two cleared and stained specimens, with 3 rays originating from anterior ceratohyal and 1 ray from posterior ceratohyal.

Color in alcohol: Males and females with identical color pattern (Fig. 10). Body pale yellow and slightly darker dorsally than ventrally due to presence of dark chromatophores especially on free edges of scales. Ventral part of body silvery. Dorsal part of head,

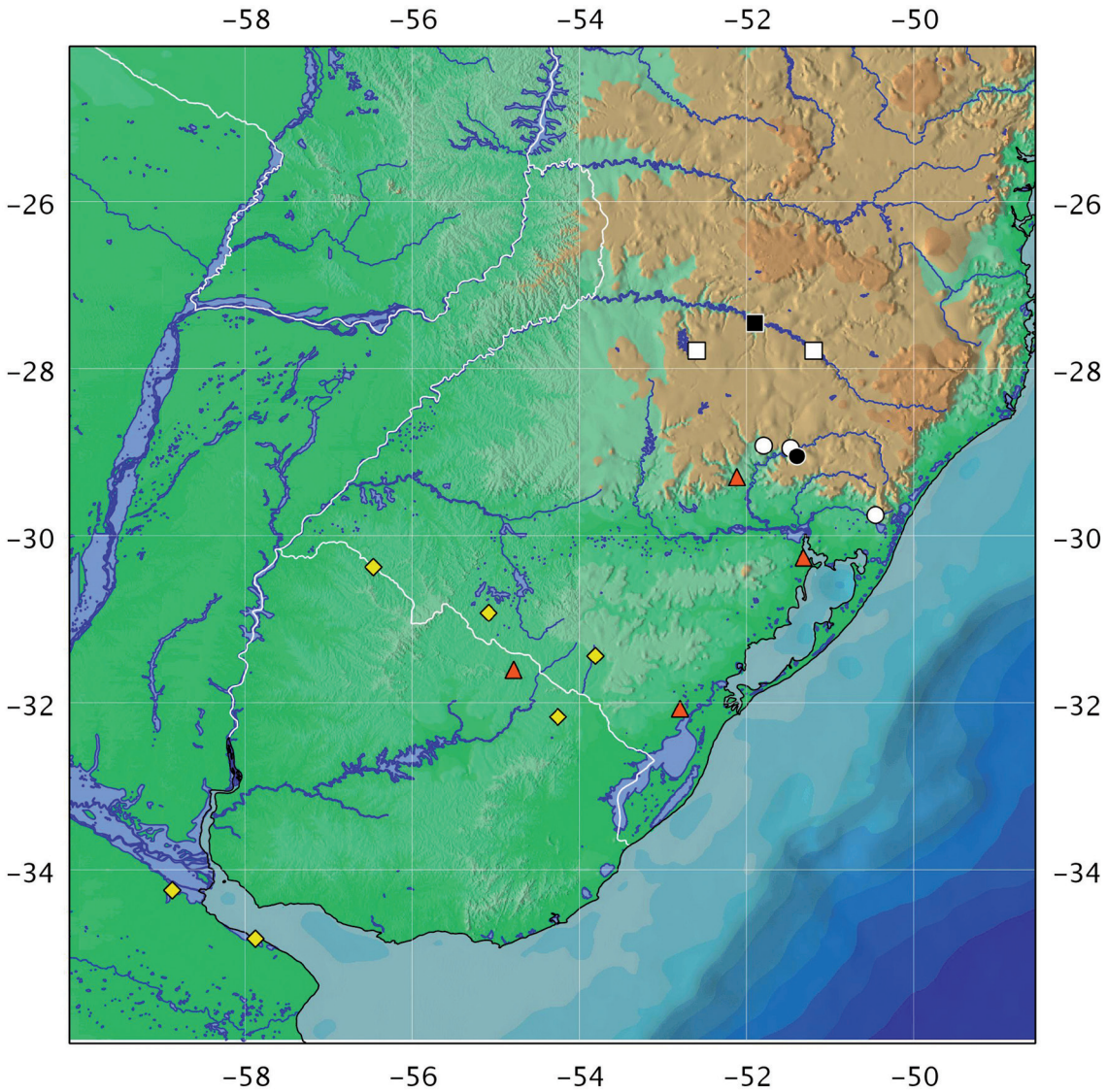

FIGURE 16: Map of southern South America showing collecting sites and type localities (black symbols) of the species of *Diapoma.* Squares, *Diapoma pyrrhopteryx;* triangles, *D. speculiferum;* diamonds, *D. terofali;* circles, *D. thauma.* Some symbols may represent more than one locality.

snout and tip of lower jaw more densely pigmented with dark chromatophores. Faint vertically elongate dark blotch on humeral region. Blotch narrowing ventrally towards short horizontal row of perforated lateral line scales. Anteroventral margin of blotch about four scales distant from posterior edge of upper portion of opercle. Dark lateral body stripe extending from posterior part of dorsal opercular region to caudal-fin base. Stripe mostly obscured by guanine. All fins pale with vestigial dark pigment. Circumorbital bones and opercle silvery with very few scattered dark chromatophores.

Sexual dimorphism, reproductive mode and gonad anatomy: Hooks on the anal and pelvic and fins of males (Figs. 14 and 15) are absent on the same fins of females. Table 1 indicates some statistically significant morphometric differences between males and females (values of ***p*** in bold). However, regression analyses that better express differences in sexual dimorphism in body ratios did not provide any significant differences between sexes concerning the same morphological parameters when graphically treated.

Histological analysis (Burns *et al.,* 1995, Table 3, fig. 3B), indicated the presence of spermatozoa within the ovary and longitudinal sections through the testes revealed that the sperm cells are ovoid.

Distribution: D. terofali is known from streams flowing into rio Uruguay in Uruguay and Rio Grande do Sul, Brazil, and streams flowing into río de La Plata, Buenos Aires, Argentina (Fig. 16).

Diapoma thauma, new species
Figs. 17-24, Table 2

Specimens examined: All specimens from Brazil, Rio Grande do Sul.

Holotype: MCP 44105, male, SL 32 mm, rio das Antas near mouth of rio da Prata basin, 29°04'01"S, 51°22'48"W.

Paratypes: MCP 37900, (SL 26-35), collected with holotype. MCP 23047, 2 (SL 41 and 42 mm), rio Turvo, on road between Vila Flores and Antônio Prado, rio Jacuí basin, 28°52'19"S, 51°26'57"W. MCP 37581, 2 (SLK 34 and 37 mm), rio dos Sinos, beach João Fernandes, about 4 km from Caraá, rio

FIGURE 17: *Diapoma thauma,* MCP 37900, adult male above, SL 32.0 mm and adult female below, SL 41.0 mm.

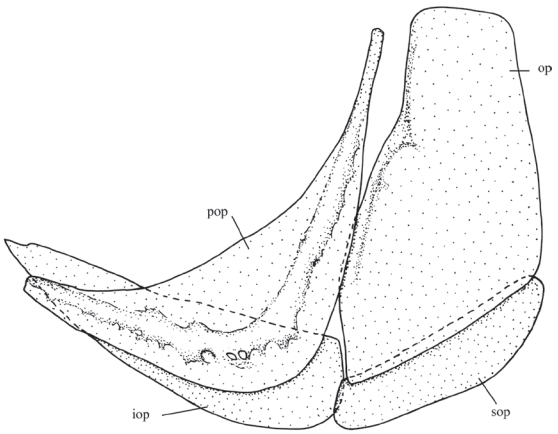

FIGURE 18: *Diapoma thauma,* MZUSP 104077, C&S, sexually active male, SL 35.0 mm; opercular bones, lateral view, left side. OP, opercle; POP, preopercle; IOP, interopercle; SOP, subopercle.

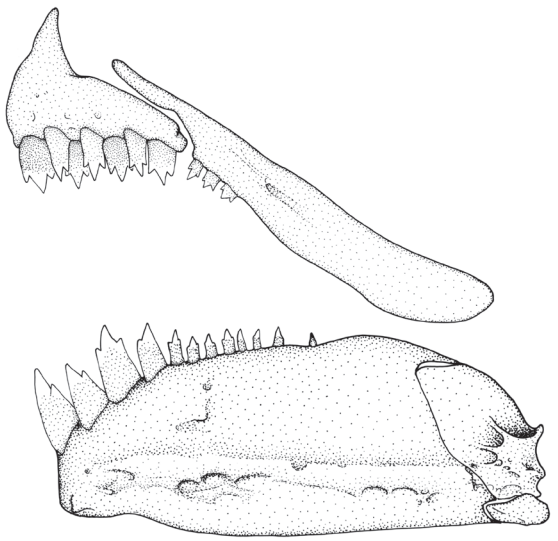

FIGURE 19: *Diapoma thauma,* MZUSP 104077, C&S, sexually active male, SL 35.0 mm; jaws and dentition, lateral view, left side, anterior at left.

Jacuí basin, 29°46'27"S, 50°26'08"W. MCP 41011, 12 (SL 26-45 mm), rio Antas Prata, rio das Antas basin, 28°58'16"S, 51°27'20"W. UFRGS 9708, 24 (21-36 mm), rio Carreiro, Dois Lajeados, 28°56'24"S, 51°46'47"W, MZUSP 104077 (SL 34 and 35 mm, C&S), 28 (SL 22.5-37 mm), rio Carreiro, Dois Lajeados (approximately same coordinates as UFRGS 9708).

Diagnosis: Most similar to *Diapoma terofali,* both species without the opercular extensions present in *D. speculiferum* and *D. pyrrhopteryx,* but easily distinguished from that species by having fewer gill rakers and anal-fin rays, as stated in the diagnosis of *D. terofali.*

Description: Morphometric data presented in Table 2.

Body compressed, elongate, shorter and less deep than that of *D. terofali* (compare respective data on Tables 1 and 2). General body shape, dorsal and ventral body profiles, shape of snout and mouth, position of fin origins and extension of maxilla as described above for *D. terofali.*

Dorsal-fin rays ii, 8 in all specimens, n = 80. Posteriormost ray unbanched in all specimens, n = 80. Adipose fin present. Unbranched anal-fin rays iv or v (one specimen with vi), branched rays 24-27, 25.8 (26), n = 80. Moderately developed anal-fin lobe includes anterior unbranched rays and first 6

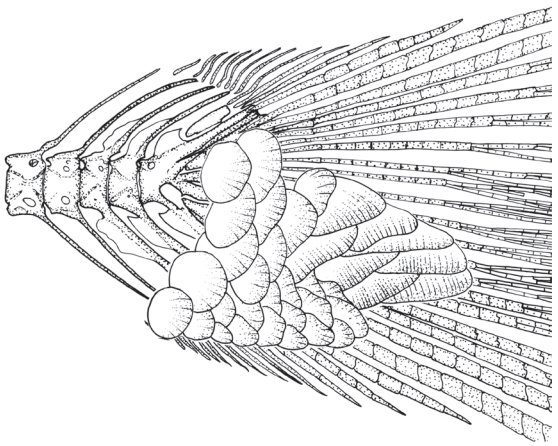

FIGURE 20: *Diapoma thauma,* MZUSP 104077, C&S, sexually active male, SL 35.0 mm; caudal-fin squamation of ventral portion of caudal-fin lobe, lateral view, left side.

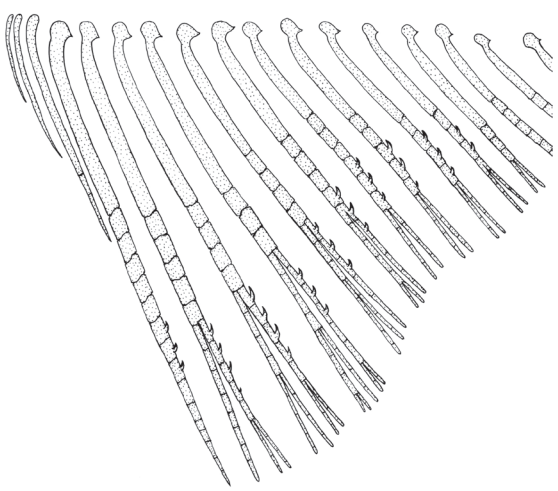

FIGURE 21: *Diapoma thauma,* MZUSP 104077, C&S, sexually active male, SL 35.0 mm; anterior portion of anal-fin rays, lateral view, left side, showing anal-fin hooks.

TABLE 2: Morphometrics of *Diapoma thauma.* Standard length expressed in mm; measurements through head length are percentages of standard length; the last four entries are percentages of head length. Specimens are from MCP 44105 (holotype), 23047, 37581, 37900, 41011; MZUSP 104077, UFRGS 9708. Values of ***p*** in bold indicates significant statistical differences.

Characters	Males					Females				*p* value
	Holotype	n	range	mean	SD	n	range	mean	SD	
Standard length	32.0	40	21.0-45.0	31.80		40	23.0-42.0	30.0		
Depth at dorsal-fin origin	28.1	40	23.8-31.1	27.60	1.50	40	25.0-29.4	26.8	1.10	**0.012**
Snout to dorsal-fin origin	55.6	40	53.3-58.0	56.00	1.00	40	53.5-58.8	56.3	1.20	0.378
Snout to pectoral-fin origin	25.0	40	23.2-27.6	24.80	0.90	40	23.2-26.6	24.8	0.70	0.832
Snout to pelvic-fin origin	46.8	40	44.4-50.0	47.30	1.30	40	45.3-48.7	47.0	1.00	0.324
Snout to anal-fin origin	60.9	40	58.3-63.5	60.30	1.60	40	57.1-63.4	61.1	1.40	**0.026**
Caudal peduncle depth	10.9	40	09.6-11.8	10.80	0.60	40	09.3-10.4	09.8	0.30	**0.000**
Caudal peduncle length	10.3	40	08.1-11.1	9.70	0.60	40	08.8-11.1	09.7	0.60	0.689
Pectoral-fin length	21.8	40	19.2-24.1	22.00	1.00	40	20.0-23.4	21.3	0.80	**0.006**
Pelvic-fin length	15.0	40	13.3-15.6	14.70	0.60	40	13.2-15.7	14.4	0.60	0.068
Dorsal-fin base length	12.5	40	11.0-14.0	12.20	0.80	40	10.0-15.3	12.3	1.10	0.791
Dorsal-fin height	22.8	39	20.0-25.1	23.60	1.10	40	20.7-24.1	22.5	0.90	**0.000**
Anal-fin base length	31.2	40	27.7-34.8	32.00	1.50	40	23.8-33.3	31.6	0.90	0.107
Anal-fin lobe length	20.3	40	17.8-21.0	19.60	0.70	40	17.5-20.8	19.4	0.70	0.142
Eye to dorsal-fin origin	43.7	40	40.0-44.8	42.80	1.00	40	40.7-44.4	42.6	0.90	0.272
Dorsal-fin origin to caudal-fin base	48.4	40	45.1-50.0	47.10	1.10	40	45.3-49.2	47.2	0.90	0.467
Bony head length	25.0	40	23.2-28.5	25.30	0.90	40	24.1-27.1	25.4	0.70	0.464
Horizontal eye diameter	40.0	40	38.4-44.1	41.10	1.50	40	38.8-43.7	41.4	1.20	0.218
Snout length	22.5	40	20.7-24.1	22.60	0.70	40	21.0-23.8	22.5	0.80	0.528
Least interorbital width	28.7	40	28.5-33.3	30.30	1.30	40	28.5-33.3	30.6	1.10	0.254
Upper jaw length	40.0	40	37.3-43.7	41.00	1.40	40	37.3-43.8	40.5	1.60	0.211

or 7 branched rays. Anal fin of males with bilateral hooks on last unbranched ray and first 9-10 branched rays distributed as shown in Figure 21. Cleared and stained specimen (MZUSP 104077, SL 35 mm) has 3 hooks on last unbranched ray, 2 hooks on eighth and nineth branched rays, 3 on first, third, fourth and sixth branched rays and 4 on second and seventh branched rays. Pectoral-fin rays i, 9-11, 9.8 (10), unbranched ray i in all examined specimens. Tip of longest pectoral-fin rays extending to, or slightly beyond, pelvic-fin origin in males, not reaching pelvic-fin origin in females, but no statistical difference between

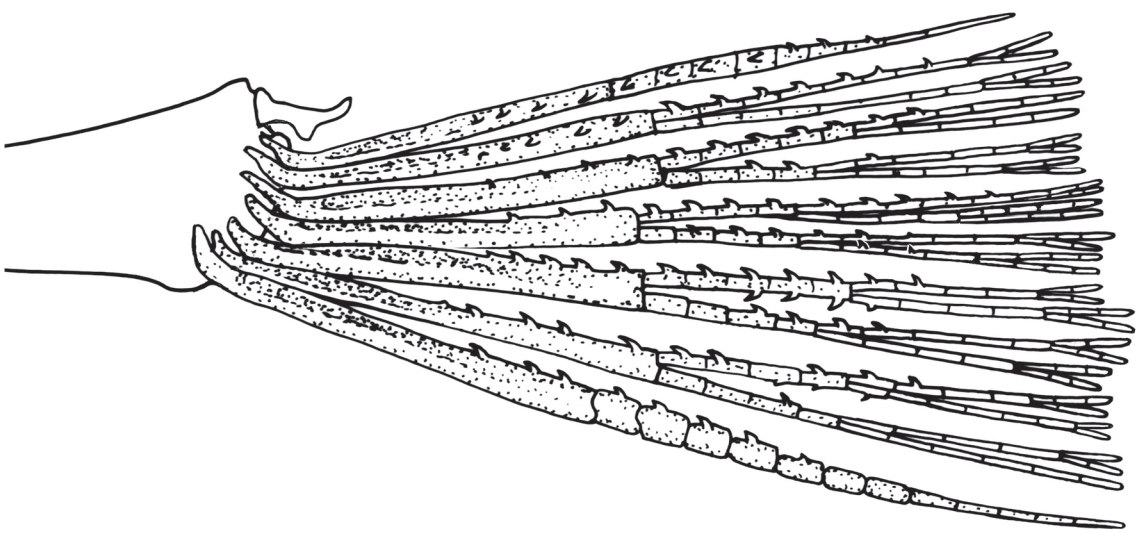

FIGURE 22: *Diapoma thauma,* UFRGS 8956, C&S, sexually active male, SL 35.0 mm; pelvic-fin rays, ventral view, left side, showing pelvic-fin hooks.

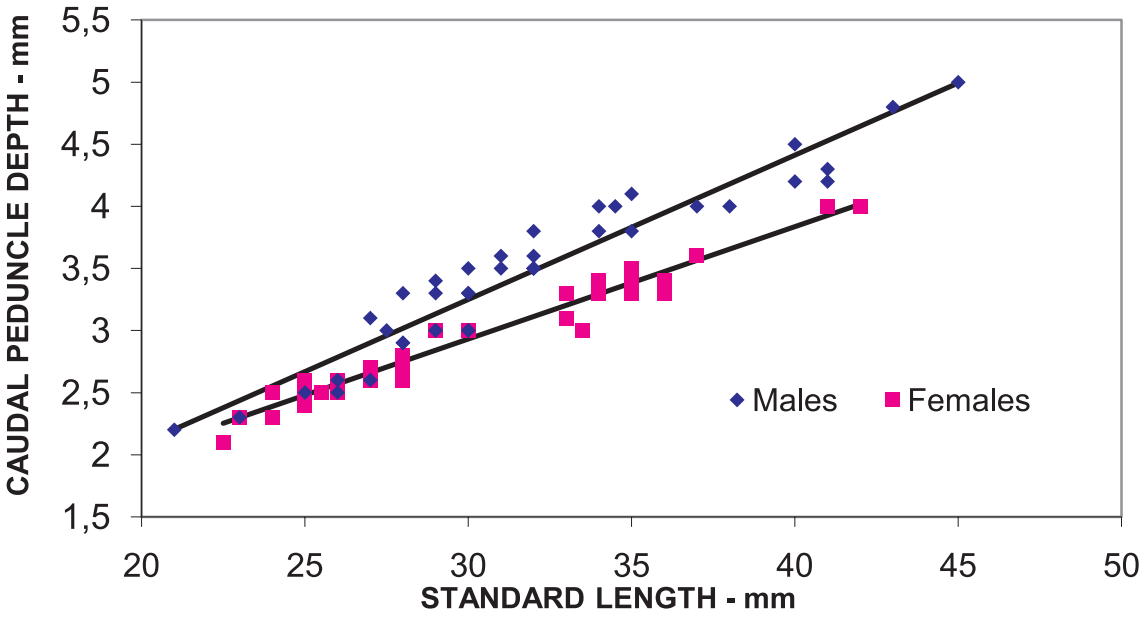

FIGURE 23: Caudal peduncle depth as a function of standard length for *Diapoma thauma.*

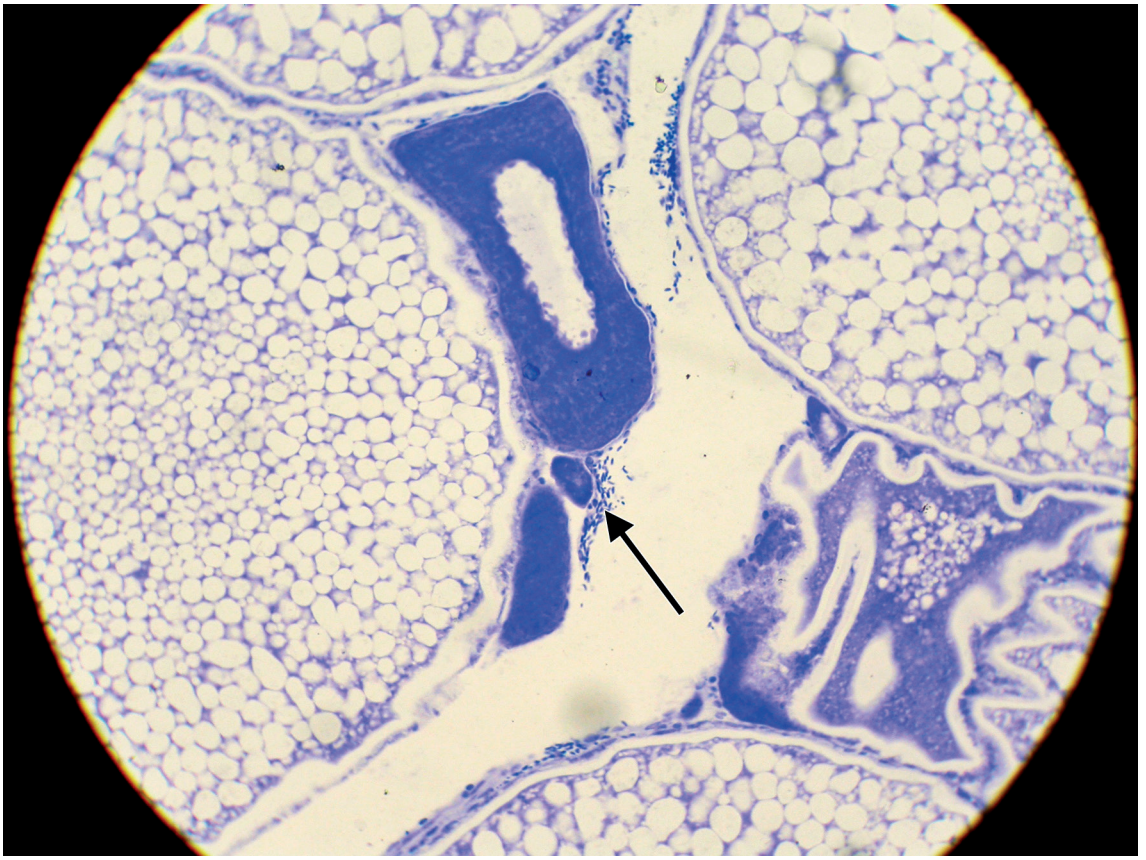

FIGURE 24: *Diapoma thauma,* MCN 18903; histological section of ovary of adult female; arrow points to spermatozoa.

FIGURE 25: *Diapoma speculiferum,* USNM 221155, adult male above, SL 45.1 mm and adult female below, SL 47.5 mm.

FIGURE 26: *Diapoma speculiferum,* USNM 221152, male, SL 32.3 mm. Photographed in life.

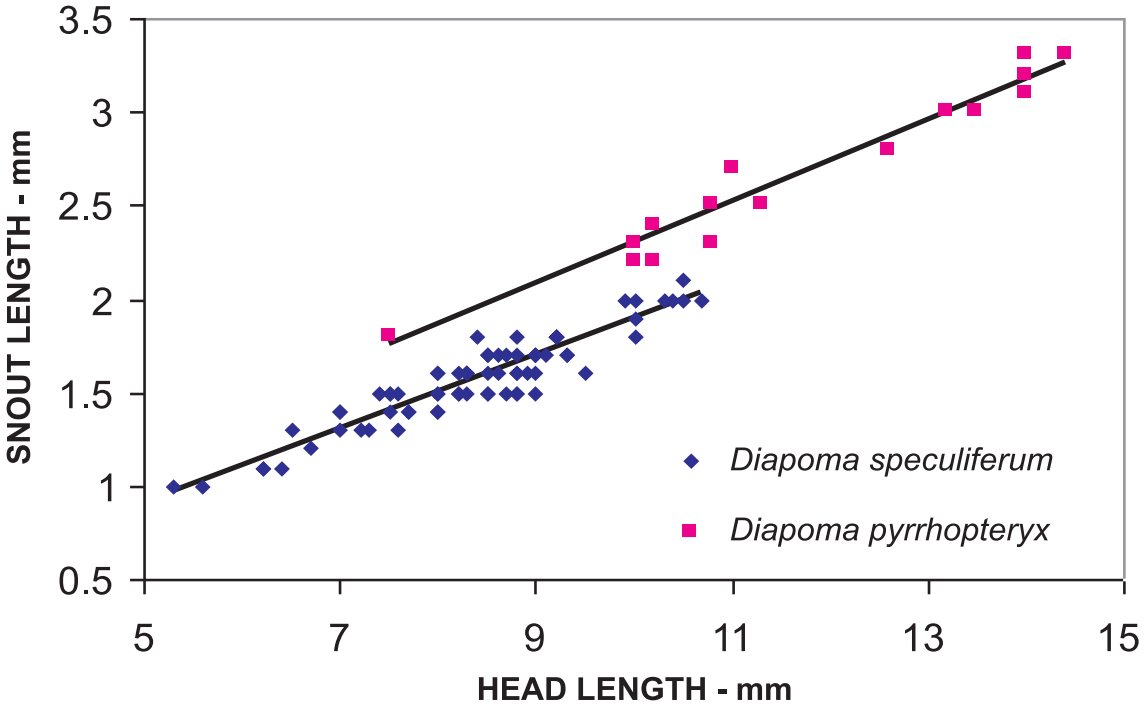

FIGURE 27: Snout length as a function of head length for *Diapoma speculiferum* and *D. pyrrhopteryx*.

sexes in length of pectoral fin. Pelvic-fin rays i, 6, n = 80. Sexually mature males with hooks on pelvic fin rays, distributed as shown in figure 22. The same specimen with 8 hooks on first unbranched ray, 13 on first, 20 on second, 17 on third, 14 on fourth, 12 on fifth branched rays and 11 on sixth unbranched ray. Distal tip of longest pelvic-fin rays extending slightly beyond anal-fin origin in adult males, barely reaching anal-fin origin in adult females.

Scales cycloid with few radii (3-5) on exposed field on body and radii more numerous (10-15) on enlarged scales bordering pouch opening. Lateral line incomplete, anterior segment with 8-14, 10.1 (9), n = 46 pored scales and 23-30, 26 (28), n = 46 non-perforated scales. Lateral series scales 35-40, 37 (37), n = 46. Horizontal scale rows between dorsal-fin origin and anal-fin origin 10-12, 11 (11), n = 63. Predorsal scales 13-16, 14 (14), n = 79. Horizontal scale rows around caudal peduncle 13-15, 14 (14), n = 46. Premaxillary teeth in two rows (Fig. 19), outer row with 2-5, 3.7 (4) tricuspid teeth, n = 80, inner row with 4-6, 4.4 (4) tricuspid or quadricuspid teeth, n = 80. Maxillary (Fig. 19) with 2-5, 3.1 (3) tricuspid teeth, n = 80. Dentary (Fig. 19) with 4-5, 4.2 (4) tricuspid to quadricuspid teeth, n = 80 and 5-11, 7.4 (8) smaller tricuspid teeth, n = 80. Total number of gill rakers on first gill arch 16-19, 17.4 (17), n = 80. Branchiostegal rays 4 in two cleared and stained specimens, 3 originating from anterior ceratohyal and 1 from posterior ceratohyal.

Color in alcohol: Nearly identical to that of *D. terofali* described above, but with dark humeral blotch and lateral body stripe more conspicuous (Fig. 17). Anteroventral margin of humeral blotch about 2 scales distant from posterior edge of upper portion of opercle.

Sexual dimorphism, reproductive mode and gonad anatomy: Anal- and pelvic- fin hooks (Figs. 21 and 22) present in males only. Some morphometric differences between males and females (Table 2) are statistically significant (values of ***p*** in bold), but upon regression analysis caudal-peduncle depth was the only character to show significant difference between sexes (Fig. 23).

Histological sections through ovary of a female (MCP 23047) indicated presence of ovoid spermatozoa (Fig. 24).

Distribution: This species has been collected to date in tributaries of the rio Jacuí basin, northwest of Porto Alegre, Rio Grande do Sul, Brazil (Fig. 16)

Etymology: The name *thauma* is from the Greek meaning wonder, or marvel with reference to the beauty of the fish when alive.

Remarks: Specimens used for histological sections of gonads (MCN 18903) from rio dos Sinos, Caraá, Rio Grande do Sul, (approximately 29°45'S, 50°26'W) have all the morphological features of the specimens on which the species description is based.

Diapoma speculiferum Cope, 1894
Figs. 28-32, Table 3

Diapoma speculiferum Cope, 1894a:67 [original description, type locality: Brazil, Rio Grande do Sul, rio Jacuhy (= rio Jacuí)]; 1894b:92: more complete description of holotype). – Fowler, 1906:334 (redescription of holotype of *D. speculiferum*). – Eigenmann, 1910:438 (listed); 1914:38 (listed Eigenmann, 1921: plate 61, figure 4 (drawing of holotype). – Eigenmann & Myers, 1929:471 (redescription of species based on holotype). – Myers, 1942:91 (notes on specimens from río Cebollati, departments of Rocha and Minas, Uruguay; elongate opercles recorded for both males and females). – Fowler, 1951:412 (listed with synonymy. – Vaz-Ferreira, 1969:33: brief description, figure after Fowler, 1951), – Fowler, 1975:332 (listed). – Géry, 1977:359 (diagnosed in key). – Malabarba, 1983:187 (listed, specimens from arroyo dos Ratos, São Jerônimo and Santo Antônio da Patrulha, Rio Grande do Sul, Brazil. – Böhlke, 1984:54 (listed). – Weitzman & Fink, 1985:17, 96, 103, 109, 116 (additional locality records from rio Jacuí system, caudal morphology, caudal pump function, relationships, note on ecology). – Malabarba, 1989:134 (listed). – Burns *et al.,* 1995:140-141 (shape of sperm cells). – Malabarba & Weitzman, 2000:279 (sperm cells elongated). – Weitzman, 2003:224 (maximum length; distribution; remarks and references. – Menezes, 2007:38 (listed in catalog; distribution). – Javonillo *et al.,* 2010:500 (listed in table); 2010:509 (listed as member of Stevardiinae).

Specimens examined: Brazil: MCP 7979, 70 (SL 21.6-42.5), Rio Grande do Sul, Barra do Ribeiro, açude dos Garcia, km 56 on road BR 116, approximately 30°17'S, 51°18'W; MZUSP 14720, 1 (SL 42.2 mm), rio Fão in Vila do Fão, município de Lajeado; MZUSP 14715, 4 (SL 26.2-34.2), USNM 221151, 9 (SL 27.5-32.7 mm), 221157, 3 (SL 21-32 mm) 221160, 13 (SL 21-32.7 mm), Marquês de Souza, município de Lajeado rio Forqueta,

TABLE 3: Morphometrics of *Diapoma speculiferum.* Standard length expressed in mm; measurements through head length are percentages of standard length; the last four entries are percentages of head length. Specimens are from MZUSP 14715, 14717, 14720; MCP 7979; USNM 221151, 221154-55, 221157, 221160; FMNH 70496. Value of ***p*** in bold indicates significant statistical differences.

Characters	Males				Females				*p* value
	n	range	mean	SD	n	range	mean	SD	
Standard length	73	21.0-42.0	32,60	4,5	63	21.0-42.5	31.70	4.5	
Depth at dorsal-fin origin	73	25.2-32.8	28,60	1,5	63	25.3-31.7	28.60	1.5	0.349
Snout to dorsal-fin origin	73	53.0-57.9	55,00	1,1	63	53.2-57.7	55.30	1.2	0.060
Snout to pectoral-fin origin	73	24.2-27.5	25,50	0,9	63	23.8-27.2	25.30	0.9	0.396
Snout to pelvic-fin origin	73	45.0-49.6	46,70	1,0	63	44.1-49.4	46.70	1.3	0.785
Snout to anal-fin origin	73	52.8-62.6	60,10	1,3	63	57.7-63.6	60.50	1.2	0.111
Caudal peduncle depth	73	09.0-12.0	10,70	0,6	63	09.1-11.2	10.00	0.5	**0.000**
Caudal peduncle length	73	08.3-11.0	9,60	0,6	63	08.2-11.7	10.00	0.9	0.148
Pectoral-fin length	73	21.1-25.6	23,30	0,9	63	21.4-24.4	23.00	0.7	**0.036**
Pelvic-fin length	73	14.2-17.1	15,60	0,8	63	13.3-16.2	14.80	0.6	**0.000**
Dorsal-fin base length	73	10.4-12.8	11,70	0,6	63	09.4-12.6	11.00	0.7	**0.000**
Dorsal-fin height	73	20.8-25.8	23,60	1,1	63	21.2-24.7	23.00	1.0	**0.003**
Anal-fin base length	73	31.4-35.8	33,80	0,9	63	30.3-35.0	33.10	1.1	**0.005**
Anal-fin lobe length	73	19.3-23.7	20,50	1,1	63	18.0-21.6	20.30	0.8	0.444
Eye to dorsal-fin origin	73	39.7-43.9	41,80	0,8	63	39.5-44.1	42.30	1.1	**0.002**
Dorsal-fin origin to caudal-fin base	73	44.1-50.7	47,50	1,4	63	44.0-49.6	46.70	1.5	**0.000**
Bony head length	73	24.1-27.3	25,70	0,7	63	23.6-26.3	25.00	0.6	**0.000**
Horizontal eye diameter	73	34.3-39.0	36,60	1,2	63	35.0-41.8	38.20	1.6	**0.000**
Snout length	73	17.0-21.4	18,80	1,0	63	17.0-21.2	19.10	1.0	0.080
Least interorbital width	73	27.7-31.8	30,00	0,8	63	28.4-32.9	31.20	1.0	**0.000**
Upper jaw length	73	38.8-44.1	41,80	1,3	63	39.7-44.8	43.20	1.2	**0.000**

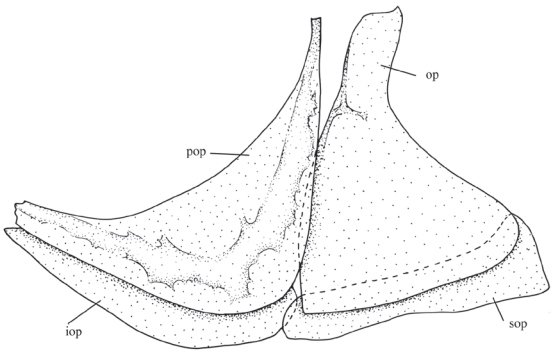

FIGURE 28: *Diapoma speculiferum,* MZUSP 28247, C&S, sexually active male, SL 33.5 mm; opercular bones, lateral view, left side. OP, opercle; POP, preopercle; IOP, interopercle; SOP, subopercle.

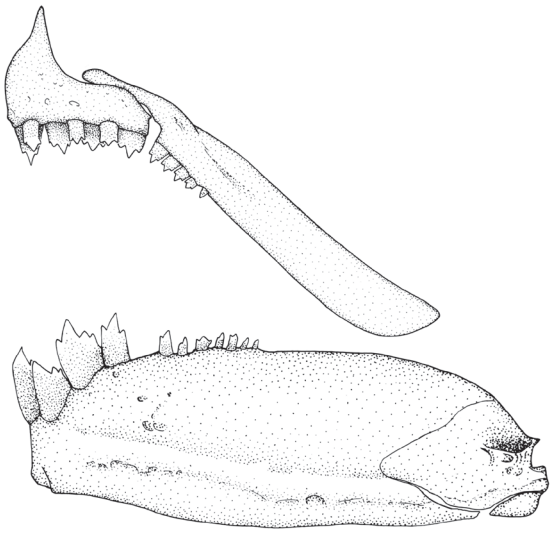

FIGURE 29: *Diapoma speculiferum,* MZUSP 28247, C&S, sexually active male, SL 33.5 mm; jaws and dentition, lateral view, left side, anterior at left.

approximately 29°19'S, 52°06'W; MZUSP 14717, USNM 221154, 17 (SL 21-33 mm), arroio Grande, muncípio de Arroio Grande, stream 1 km from city, where crosses under road BR 116, between Pelotas and Jaguarão, approximately 32°06'S, 52°47'W. Uruguay: USNM 221155, FMNH 70496, 30 (SL 27-42 mm), Arroyo Blanco, Rivera, approximately 31°38'S, 54°47'W.

Diagnosis: D. speculiferum can be easily differentiated from its congeners, except *D. pyrrhopteryx* by the posterior prolongation of the operculum in both sexes consisting of a triangular extension of the posteroventral field of the opercle and a posteriorly broadened posterior region of the subopercle (Fig. 28 and 35). The greatest horizontal length of the bony opercle is about three fourths of its total vertical length in adult males of about 32-38 mm SL. *Diapoma pyrrhopteryx* has the same opercular modifications, but its adipose fin, upper portion of the dorsal, posterior portions of the pelvic and caudal fins, and the ventral part of the anal fin are red in live or recently preserved males (Fig. 34) contrasting with the pale fins of live or recently preserved male specimens of *D. speculiferum* (Fig. 26). Additionally *D. pyrrhopteryx* has the maxillary teeth pentacuspid (Fig. 37) and the snout longer (Fig. 27) whereas in *D. speculiferum* the maxillary teeth are tricuspid (Fig. 29) and the snout shorter (Fig. 27).

Description: Morphometrics presented in Table 3.

Body comparatively small (SL 21-42.5 mm). General body shape, dorsal and ventral body profiles, mouth shape, position of fin origins and extension of

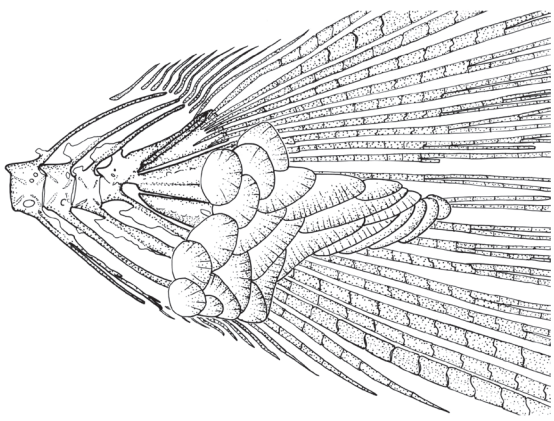

FIGURE 30: *Diapoma speculiferum,* MZUSP 28247, C&S, sexually active male, SL 33.5 mm; caudal-fin squamation of ventral portion of caudal-fin lobe, lateral view, left side.

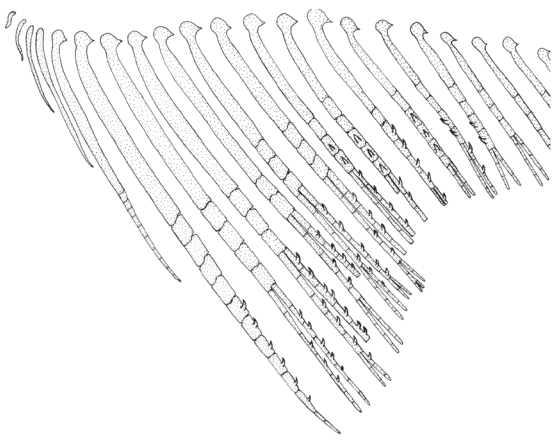

FIGURE 31: *Diapoma speculiferum,* MZUSP 28247, C&S, sexually active male, SL 33.5 mm; anterior portion of anal fin, lateral view, left side, showing anal-fin hooks.

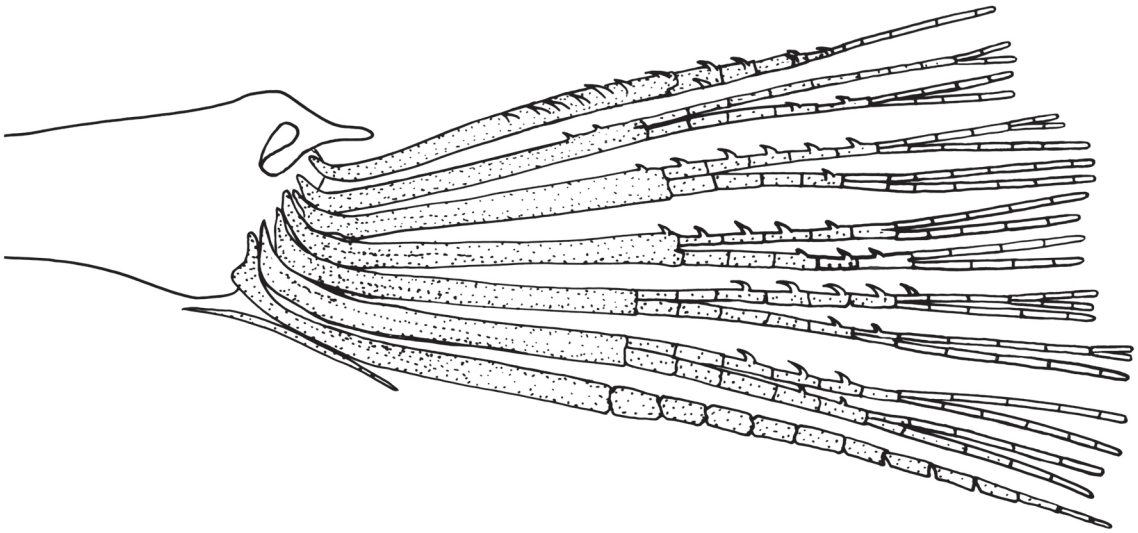

FIGURE 32: *Diapoma speculiferum,* MZUSP 28247, C&S, sexually active male, SL 33.5 mm; pelvic-fin rays, ventral view, left side, showing pelvic-fin hooks.

maxilla identical to those of *D. terofali* and *D. thauma* described above. Posterior of head, however, very different from these two species due to bony and fleshy extension of gill cover in *D. speculiferum.* Dorsal region of opercle vertically oriented, its apical portion flat, narrowing to a blunt end, posteroventral opercular region prolonged, triangular shaped, subopercle posteriorly broadened (Fig. 28). Opercular process extending slightly beyond to anterior base of pectoral fin.

Dorsal-fin rays ii, 8 in all specimens, n = 136. Adipose fin present. Anal-fin rays iv or v, branched rays 25-32, 28.1, n = 136. Posteriomost ray unbranched in all specimens, n = 136. Moderately developed anal-fin lobe including anterior unbranched rays and 6 or 7 branched rays. Anal fin of males with bilateral hooks on last unbranched ray and anterior 11 branched rays, distributed as in Fig. 31. Pectoral-fin rays i, 9-12 (anterior unbranched ray i, in all specimens), 10.4, n = 136. Posterior tip of longest pectoral-fin rays not reaching or just extending to pelvic-fin origin in mature males. Pelvic-fin rays i, 6, n = 136, last pelvic-fin ray unbranched, but counted as branched. Sexually mature males with hooks on pelvic-fin rays as shown in Fig. 32. A mature male (MZUSP 28247, 33.5 mm SL) with 4 hooks on last unbranched ray, 5 on first, 7 on second, 8 on third, 7 on fourth, 5 on fifth and 12 on sixth branched rays. Distal tip of longest pelvic-fin rays extending slightly beyond anal-fin origin in males and females.

Scales cycloid, with few radii (3-7) along exposed field on body and radii more numerous (15-20) on enlarged scale bordering pouch opening. Lateral line incomplete, anterior segment with 8-13, 10, n = 113 perforated scales, followed by 14-30, 25.3, n = 113 non-perforated scales. Some specimens with additional posterior short segment represented by 3-13, 6.2, n = 34 perforated scales. Lateral series scales 36-39, 37.3, n = 113. Predorsal scales 12-16, 13.8, n = 127. Horizontal scale rows from dorsal-fin origin to anal-fin origin 9-11, 10, n = 129. Horizontal scale rows around caudal peduncle 14, n = 79.

Premaxillary teeth in two rows (Fig. 29), outer row with 2-5, 3.6, n = 136 tricuspid teeth, inner row with 4-5, 4.1, n = 136 pentacuspid teeth. Maxillary (Fig. 29) with 2-8, 4.2, n = 136 tricuspid teeth. Dentary (Fig. 29) with 4, n = 136 anterior quadricuspid to pentacuspid teeth and 4-11, 6, n = 136 posterior tricuspid teeth, some of which with barely apparent cusps. Total number of gill rakers on first gill arch 12-16, 14.4, n = 135. Branchiostegal rays 4 in two cleared and stained specimens, 3 rays originating from anterior ceratohyal and 1 ray from posterior ceratohyal.

Color in alcohol: General body color as described above for *D. terofali.* Dark humeral blotch extending ventrally to fourth perforated lateral line scale, its anterior margin separated by 3 scales from upper portion of opercle. Lateral dark stripe inconspicuous but with a very conspicuous black line of chromatophores along stripe, inserted more deeply into musculature along stripe (Fig. 25). Line extending from anterior margin of dark blotch to caudal-fin base. Fleshy extension of bony opercle and subopercle heavily pigmented with dark chromatophores surrounded by marginal clear

area; pigmentation especially conspicuous in mature males and females. Other specimens have only scattered dark chromatophores so that opercle and subopercle are mostly silvery.

Color in life: Specimen photographed in life (USNM 221115, SL 32.3 mm) with body silvery dark humeral blotch and lateral body stripe conspicuous. Fins pale to yellowish.

Sexual dimorphism, reproductive mode and gonad anatomy: As in other species, pelvic- and anal-fin hooks are present only in males. Several morphometric characters appeared to differ statistically between males and females when treated as proportions of standard length or head length (Table 3, values of ***p*** in bold). However, when compared through regression analysis, the same data of males and females completely overlapped. Opercular extensions are about equally developed in both sexes and when tested through regression analysis, head length (measured from tip of snout to tip of opercle) of males and females revealed no significant statistical differences. In *D. speculiferum* spermatozoa were also found in the ovary of a female and ovoid sperm cells in the testes of a male, with the sperm nuclei slightly more elongate than those of *D. terofali* (Burns *et al.,* 1995, table 3).

Distribution: D. speculiferum occurs in lowland coastal streams in Rio Grande do Sul, Brazil, and Uruguay (Fig. 16).

Diapoma pyrrhopteryx, new species
Figs. 33-39, Table 4

Specimens examined: All specimens from Brazil.

Holotype: MCP 44104, male, SL 51 mm, rio do Peixe, tributary of rio Uruguai, Concórdia, Santa Catarina, 27°28'S, 51°53'W.

Paratypes: MCP 12982, 8 (SL 38-49 mm), collected with holotype; MCP 13368, 8 (SL 25-56 mm), rio Pelotas, tributary of rio Uruguai, Anita Garibaldi, Rio Grande do Sul, 27°47'51"S, 51°16'42"W; MCP 44141, 22 (SL 29-56 mm), MZUSP 104323, 2 (C&S), rio Canoas, tributary of rio Uruguai, road between Tupitinga and Celso Ramos, Santa Catarina, 27°35'11"S, 51°22'48"W.

TABLE 4: Morphometrics of *Diapoma pyrrhopteryx*. Standard length expressed in mm; measurements through head length are percentages of standard length; the last four entries are percentages of head length. Specimens are from MCP 44104 (holotype), 44141, 12982, 13368, MZUSP 104323. Values of ***p*** in bold indicates significant statistical differences.

Characters	Males					Females				*p* value
	Holotype	n	range	mean	SD	n	range	mean	SD	
Standard length	51.0	19	29.0-56.0	44.70		22	30.0-49.0	38.10		
Depth at dorsal-fin origin	32.5	19	26.2-32.5	30.20	1.70	22	25.1-31.0	27.70	1.9	**0.000**
Snout to dorsal-fin origin	56.1	19	54.4-59.2	56.00	1.20	22	55.1-57.1	56.10	0.6	0.266
Snout to pectoral-fin origin	26.4	19	23.6-26.4	25.20	0.90	22	23.5-26.0	24.50	0.6	**0.017**
Snout to pelvic-fin origin	49.0	19	44.8-50.5	47.50	1.50	22	45.4-48.0	46.80	0.7	0.186
Snout to anal-fin origin	61.7	19	59.5-65.0	61.70	1.40	22	58.2-63.6	61.70	1.4	0.637
Caudal peduncle depth	11.7	19	09.0-12.1	11.20	0.70	22	09.0-11.3	10.10	0.7	**0.000**
Caudal peduncle length	9.8	19	09.0-11.2	9.80	0.70	22	09.3-11.8	10.00	0.7	0.480
Pectoral-fin length	23.5	19	20.7-25.2	23.20	1.00	22	19.3-25.0	22.30	1.3	0.086
Pelvic-fin length	16.0	19	13.8-16.8	15.40	0.80	22	11.8-15.7	14.10	1.3	**0.000**
Dorsal-fin base length	12.1	19	11.3-12.6	11.80	0.40	21	10.8-12.7	11.80	0.5	0.967
Dorsal-fin height	24.1	19	22.0-25.0	23.70	0.90	20	20.4-25.4	22.40	1.5	**0.004**
Anal-fin base length	35.3	19	30.7-35.3	32.80	1.10	22	30.3-34.6	32.10	1.1	0.094
Anal-fin lobe length	20.6	19	17.0-21.8	20.00	1.00	22	17.8-21.4	19.60	1	0.234
Eye to dorsal-fin origin	43.7	19	41.0-44.3	42.60	1.00	22	39.2-44.5	42.50	1.3	0.927
Dorsal-fin origin to caudal-fin base	50.2	19	45.4-50.1	47.20	1.20	22	45.4-48.5	46.70	1.1	0.200
Bony head length	26.4	19	25.0-27.2	26.20	0.60	22	24.5-26.7	25.60	0.7	**0.019**
Horizontal eye diameter	37.0	19	34.7-40.0	37.40	1.60	22	37.3-41.7	40.00	1.2	**0.000**
Snout length	22.2	19	21.3-24.5	23.00	1.00	22	22.0-24.5	23.50	0.7	**0.049**
Least interorbital width	29.6	19	26.4-30.0	28.00	1.20	22	27.2-33.3	30.00	1.7	**0.000**
Upper jaw length	45.2	19	41.0-46.4	44.60	1.80	22	39.4-44.4	42.40	1.6	**0.000**

FIGURE 33: *Diapoma pyrrhopteryx,* MCP 44104, adult male above, SL 51.0 mm, and MCP 13368, adult female below, SL 44.0 mm.

Diagnosis: Diapoma pyrrhopteryx is morphologically most similar to *D. speculiferum,* both species sharing the posterior elongation of opercle and subopercle. This feature distinguishes it from *D. terofali* and *D. thauma. Diapoma pyrrhopteryx* differs from *D. speculiferum* in the presence of red fins in live males (*versus* fins pale to yellowish in live males of *D. speculiferum*), the longer snout, 21.3-24.5% of head length, Fig. 27 (*versus,* 17-21.4% of head length, in *D. speculiferum*) and the maxillary teeth pentacuspid, Fig. 37 (*versus* maxillary teeth tricuspid in *D. speculiferum,* Fig. 29).

Description: Morphometrics presented in Table 4.

Body comparatively large (SL 29-56 mm), larger than that of *D. speculiferum.* General body and head shapes, dorsal and ventral body profiles, mouth shape, position of fin origins and extension of maxilla as in *D. speculiferum.*

Dorsal fin ii, 8 in all specimens, n = 41. Posteriormost ray unbranched in all specimens, n = 41. Adipose fin present. Unbranched anal-fin rays iv or v, usually iv, branched rays 24-30 (29), 36.4, n = 41. Well-developed anal-fin lobe including anterior unbranched rays and 9-10 branched rays. Anal fin of males with bilateral hooks on last unbranched ray and anterior 10 branched rays, distributed as in Fig. 38. Pectoral-fin rays i, 9-11 (11), 10 (unbranched pectoral-fin ray i, in all specimens), n = 41. Posterior tip of longest pectoral-fin rays extending slightly beyond pelvic-fin origin in all specimens. Pelvic-fin rays i, 6, n = 41, last pelvic-fin rays unbranched but counted as branched. Sexually mature males with hooks on pelvic

FIGURE 34: *Diapoma pyrrhopteryx,* MCP 44377. Color pictures of adult male, above, SL 72.5 mm and adult female below, SL 65.4 mm.

fin, distributed as in fig. 39. A mature male (MZUSP 104323, SL 52 mm) has 7 hooks on fifth, 3 on sixth and no hooks on remaining branched or unbranched rays. Distal tip of longest pelvic-fin rays falling slightly short or just extending to origin of anal fin.

Scales cycloid, with few radii (5-10) on exposed field on body and more numerous (20-30) on enlarged scale bordering pouch opening. Lateral line incomplete, with 10-22 (11), 13.4, n = 35 perforated scales on anterior segment, followed by 1-20 (18), 11.8, n = 41 non-perforated scales and a posterior segment with 6-26 (6), 13.5, n = 35 perforated scales in most specimens. Lateral series scales 36-42 (37), 38.45, n = 36. Predorsal scales 13-15 (13), 13.7,

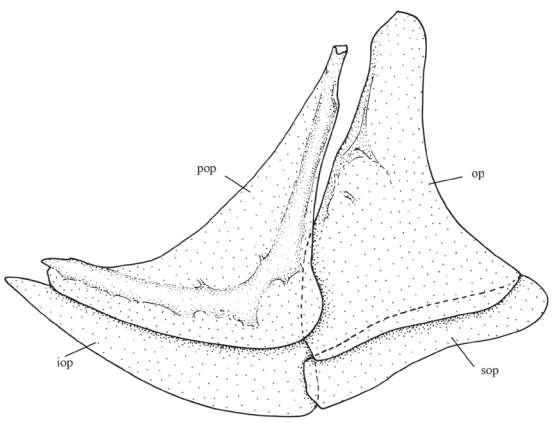

FIGURE 35: *Diapoma pyrrhopteryx,* MZUSP 104323, C&S, sexually active male, SL 52.0 mm; opercular bones, lateral view, left side. OP, opercle; POP, preopercle; IOP, interopercle; SOP, subopercle.

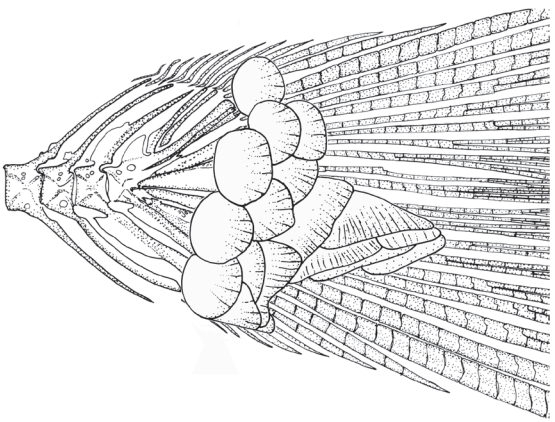

FIGURE 36: *Diapoma pyrrhopteryx,* MZUSP 104323, C&S, caudal-fin squamation of ventral portion of caudal-fin lobe, lateral view, left side.

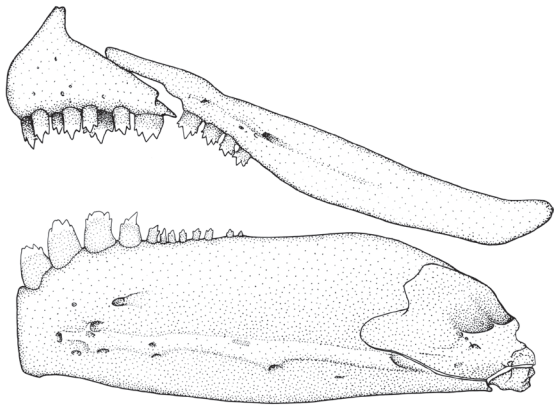

FIGURE 37: *Diapoma pyrrhopteryx,* MZUSP 104323, C&S, sexually active male, SL 52.0 mm jaws and dentition, lateral view, left side, anterior at left.

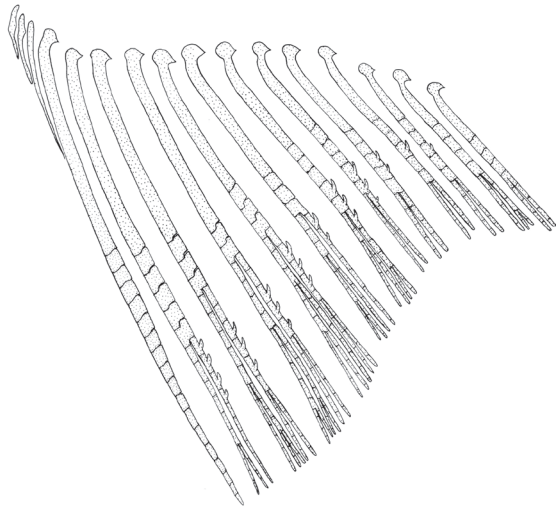

FIGURE 38: *Diapoma pyrrhopteryx,* MZUSP 104323, C&S, sexually active male, SL 52.0 mm; anterior portion of anal fin, lateral view, left side, showing anal-fin hooks.

n = 41. Horizontal scale rows from dorsal-fin origin to anal-fin origin 9-11(10), 10, n = 41. Horizontal scale rows around caudal peduncle 13-14(14), 13.9, n = 35.

Premaxillay teeth in two rows (Fig. 37), outer row with 2-5(4), n = 35, n = 41 tricuspid teeth, inner row with 4-5(4), 4.3, n = 41 pentacuspid teeth. Maxillary (Fig. 37) with 3-6(5), 4, n = 41 anterior quadricuspid to pentacuspid teeth. Dentary (Fig. 37) with 4-5(5), 4.3, n = 41 anterior quadricuspid to pentacuspid teeth and 4-10 (7), n = 41 tricuspid teeth, posteriormost teeth with vestigial cusps. Total number of gill rakers on first gill arch 12-14 (14), 13.4, n = 40. Branchiostegal rays in two cleared and stained specimens 4, 3 originating from anterior ceratohyal and 1 rays from posterior ceratohyal.

Color in alcohol: Identical to that of *D. speculiferum* as described above. Lateral body stripe mostly obscured by guanine with black line along its length inconspicuous.

Color in life: A male specimen (Fig. 34) preserved soon after capture (MCP 44377) had body silvery with upper part of dorsal-fin red mixed with yellow and separated from its basal dark portion by a whitish longitudinal stripe. Uppermost and lowermost caudal-fin rays red. Marginal posterior portion of caudal fin pale to yellowish and remaining area of fin with scattered dark chromatophores. Adipose fin red. Anteroventral portion of anal fin red, and contrasting

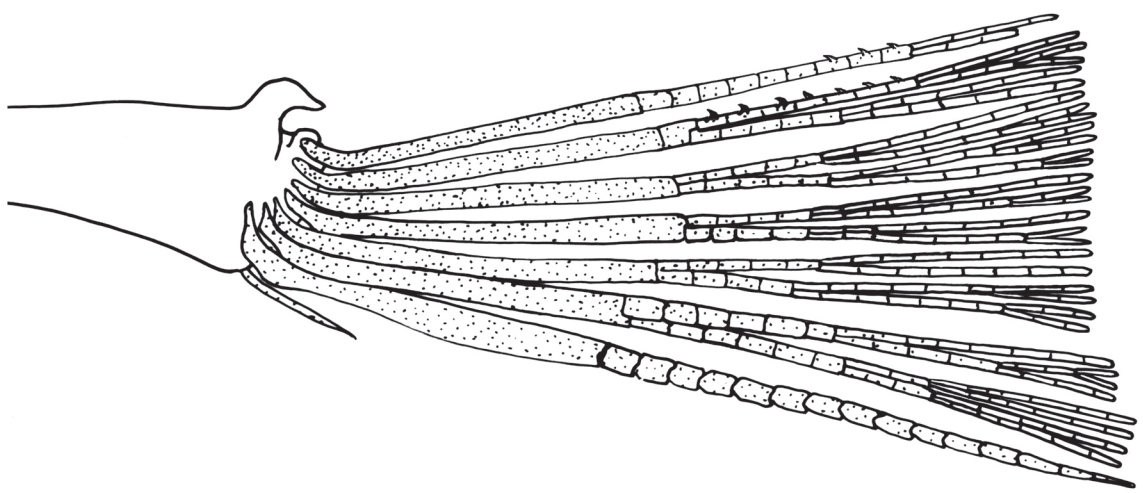

FIGURE 39: *Diapoma pyrrhopteryx,* MZUSP 104323, C&S, sexually active male, SL 52.0 mm; pelvic-fin rays, ventral view, left side, showing pelvic-fin hooks.

with remaining portion of anterior whitish area of lobe. Remaining portion of anal-fin area yellow and marginal posterior area of fin dark. Posterior two thirds of pelvic fin red mixed with yellow, anterior third whitish. Posterior portion of pectoral fin yellowish, with upper posterior marginal portion of fin with red chromatophores. Very conspicuous dark humeral blotch present along with dark blotch on caudal peduncle, extending posteriorly to anterior portion of median caudal-fin rays. Female from the same lot (Fig. 34) had body pale with yellowish areas especially distributed over dorsal part of body. All fins yellowish especially adipose, upper part of dorsal, dorsal and ventral rays of caudal and posterior part of anal fins. Humeral dark blotch, dark blotch on caudal peduncle and lateral body stripe inconspicuous.

Sexual dimorphism, reproductive mode and gonad anatomy: Pelvic- and anal-fin hooks are present only in males of *D. pyrrhopteryx,* but their number and arrangement on both fins are different from those in *D. speculiferum* (compare Figs. 31 and 32 with Figs. 38 and 39). Several morphometric characters in table 4 show significant statistical differences between males and females (values of ***p*** in bold), but when submitted to regression analysis none of them revealed significant differences between sexes. As in *D. speculiferum* no significant statistical differences was detected in opercular extensions of males and females. Histological sections could not be done through the ovary of mature females of this species.

Distribution: This species has been collected to date in the rio Canoas basin or tributaries flowing into this basin that belongs to the rio Uruguay basin in Rio Grande do Sul, Brazil (Fig. 16).

Etymology: The species name, *pyrrhopteryx,* from the Greek words "pyrrho" meaning red and "pteryx" meaning fin is in reference to the red fin colors of the fish when alive.

Remarks: Specimens (MCP 44377, 2, 65.4 mm, and 72.5 mm SL) from rio Passo Fundo, tributary of rio Uruguai, Rio Grande do Sul, (approximately 27°48'S, 52°35'W) used to get color pictures have all the morphological features of the type specimens.

DISCUSSION

The two new species herein described share with the other two previously known species of *Diapoma* two characters that we hypothesize as synapomorphies for the tribe Diapomini together with the genera *Planaltina* and *Acrobrycon:* (1) the presence of a caudal pouch dorsally bordered by a series of 3 to 8 or 9 scales delimiting the pouch opening and (2) the male and female caudal organs approximately of the same size. They also have elongated albeit still relatively short sperm nuclei diameter such as found in *Diapoma* and *Acrobrycon* instead of the nearly spherical sperm nuclei (aquasperm) of *Planaltina* (Burns *et al.,* 1995), indicating that *Diapoma* is more closely related to *Acrobrycon* than to *Planaltina.* The gill gland, reported to be present in two species of *Planaltina* (Menezes *et al.,* 2003:570), is absent in the species of *Diapoma* as revealed by histological sections through the gills of the four species herein included.

The presence of an epithelium along some of the anal- and pelvic-fin rays of *Planaltina myersi* and *P. glandipedis* usually thicker in mature males than in mature females is also present in all the *Diapoma* species included herein. Abundant club cells are present in this epithelium (Menezes *et al.,* 2003), but light micrographs through the anal and pelvic fins of these species (K. Ferreira, *personal communication*) revealed that not only club cells, but mucous cells are also found in several layers giving to the epithelium a typical stratified structure. Whether or not Diapomini is a monophyletic group is beyond the purpose of this paper and will require a more extensive phylogenetic analysis of characters. A recent phylogenetic analysis of the relationships among all the stevardiin genera (Ferreira *et al., in press*) based on the study of morphological and histological characters indicated, however, that *Planaltina, Diapoma* and *Acrobrycon* are, more closely related to each other than to any other genus of the subfamily. This contradicts the findings of Javonillo *et al.* (2010) using molecular data from a number of characid genera, suggesting that Diapomini would not be monophyletic without the inclusion of *Cyanocharax alburnus,* a non-inseminating species currently included in clade A characids. At this point the question of phylogenetic relationships is not discussed any further. We prefer to use the current concept of the Diapomini that considers the group to be monophyletic and *Diapoma* as more closely related to *Acrobrycon* than to *Planaltina.*

Within *Diapoma, D. pyrrhopteryx* seems to be closest to *D. speculiferum* than to *D. terofali* and *D. thauma,* based on the opercular modifications shared by the former and absent in the latter, but again this hypothesis must be tested through a more extensive analysis of characters.

RESUMO

Diapoma *é revisto e quatro espécies, são reconhecidas: (1)* Diapoma thauma, *espécie nova, de riachos bacia do rio Jacuí no estado do Rio Grande do Sul; (2)* D. pyrrhopteryx, *espécie nova, coletada no rio Canoas e riachos que desembocam nesta bacia hidrográfica nos estados do Rio Grande do Sul e Santa Catarina, Brasil; (3)* Diapoma terofali, *de riachos que desembocam no rio Uruguai, Uruguai e Rio Grande do Sul, Brasil e riachos pertencentes à bacia do rio de La Plata, Argentina; e (4)* Diapoma speculiferum, *de rios costeiros de planície no Rio Grande do Sul, Brasil e Uruguai.* Diapoma pyrrhopteryx *possui o alongamento da parte póstero-ventral do opérculo, típico de* D. speculiferum, *espécie tipo do gênero, mas que está ausente em* D. thauma *e* D. terofali. *Entretanto, todas as espécies têm o órgão caudal em forma de bolsa quase igualmente desenvolvido tanto em machos como em fêmeas e porção dorsal da abertura do órgão margeada por uma série de 3 a 8 escamas alongadas, que representam as duas características exclusivas do grupo. As duas espécies previamente descritas,* D. speculiferum *e* D. terofali *são redescritas. Hipóteses prévias de relações filogenéticas entre os gêneros de Diapomini,* Planaltina, Diapoma *e* Acrobrycon *são discutidas com base em informações morfológicas preliminares. É proposto que o grupo a que pertencem, Diapomini, é monofilético. Uma chave para identificação, informação sobre dimorfismo sexual, anatomia das gônadas, modo de reprodução e distribuição geográfica das espécies são incluídos.*

Palavras-Chave: Taxonomia; Novas espécies; Characidae; *Diapoma*.

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