

Identity of the Galaxioid Fishes of the Genus *Aplochiton* Jenyns from Southern Chile

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The genus *Aplochiton* Jenyns is one of two genera in the family Aplochitonidae. There are two species of *Aplochiton* recognised from southern South America and the Falkland Islands and, in addition, one species of *Lovettia* from Tasmania (McDowall, 1971a). A close phylogenetic relationship between *Aplochiton* and *Lovettia* should not be assumed, although both genera clearly belong to the assemblage of galaxiid-aplochitonid fishes that is characteristic of cool southern temperate fresh waters (McDowall, 1969b; Fink, 1984). The relationships between *Aplochiton* and *Lovettia* and their relationships with galaxiids are not well enough understood to justify restructuring of these generic and familial arrangements although some authors present a contrived simplification by placing all genera in Galaxiidae (Nelson, 1972; Rosen, 1974). This does little to clarify relationships.

There are several nominal species of *Aplochiton*, the principle binomina being:

Aplochiton zebra Jenyns, 1842: collected from the Falkland Islands.

Aplochiton taeniatus Jenyns, 1842: collected from Tierra del Fuego.

Aplochiton marinus Eigenmann, 1928: collected from Estero Cutipai, near Valdivia, Chile.

These fishes are poorly known. Their taxonomy was examined by McDowall (1971a) who, somewhat tentatively, treated *A. marinus* as a junior synonym of *A. taeniatus*, although this action has not been accepted by Campos (1973), Bahamonde and Pequeno (1975), or Zama and Cardenas (1984). Neither Campos nor Bahamonde and Pequeno gave reasons for their position but Zama and Cardenas discussed differences in colouration between *A. marinus* and *A. taeniatus*.

Biologically these fishes are also little known. Campos (1969) described the location of spawning, and the development of the eggs of *A. taeniatus* in Lago Llanquihue, a southern Chilean lake. He wrote of accumulations of juveniles in the littoral zone of Lago Llanquihue—possibly an indication of shoaling juvenile stages. This is

consistent with a report of a single elongate, transparent juvenile of an undetermined species of *Aplochiton* from waters around the shores of Lago Villarica in central/southern Chile (McDowall, 1969a). Small juveniles, again of an undetermined species of *Aplochiton* were collected from the sea in southern Chile (Puerto Aysen) by Mr. Akira Zama and reported on briefly (McDowall, 1984).

So little is known of these fishes that the capture of a small series of notably large *Aplochiton* in the vicinity of Puerto Aysen is worth reporting and assists somewhat in clarifying the taxonomic status of these fishes.

Material examined

Aplochiton taeniatus: 2 individuals, HUMZ (Laboratory of Marine Zoology, Hokkaido University) 095682, 095704, 21 January 1982, Fiordo Steele, Chile, 48°13'S, 73°23'W, 361, 326.5 mm SL. 1, SNP(PA) (Servicio Nacional de Pesca (Puerto Aysen)) 76, 1 January 1982, Estero Ventisquero, Chile, 48°15'S, 73°35'W, 271 mm SL. 1, HUMZ 095704, 1 January 1982, Fiordo Ventisquero, Chile, 48°13'S, 327 mm SL. 1, Instituto de la Patagonica 46, 21 September 1977, Estero Veto, Chile, 49°32'S, 74°30'W, 189 mm SL.

A. zebra: 4, HUMZ 095696-9, 1 December 1982, Lago Quetro, Chile, 48°7'S, 73°7'W, 236-284 mm SL.

In addition data from the study of McDowall (1971a) were reconsidered.

Study methods

Study methods adopted were those consistently in use for study of the southern freshwater salmoniform fishes (Galaxiidae, Aplochitonidae etc.) most recently reviewed in McDowall and Frankenberg (1981). These methods, in general, follow Hubbs and Lagler (1958); distinctive features include: measurements taken point to point with needle point dividers to the nearest 0.5 mm; fin ray counts include segmented rays (excluding non-segmented procurrent rays); vertebral counts exclude hypural centra.

Meristic and morphometric variation

Systematics of fishes depends heavily on the use of meristic and morphometric variation to clarify variation within and differences between species. The salmoniform fishes, the southern

families like Aplochitonidae and Galaxiidae amongst them, are notoriously difficult in this regard for several distinct reasons. 1. Meristic variation within populations tends to be high. 2. Meristic variation between populations with the same life history strategy is also high. 3. Often there is clinal variation in features such as vertebrae and fin ray numbers. 4. Furthermore, many salmoniforms have alternative life history strategies within species. Many species have both diadromous (sea migratory) and entirely freshwater stocks and sometimes these stocks are sympatric (Campos, 1974; McDowall, 1972, 1979; Northcote and Ward, 1985). The meristic features of diadromous and non-diadromous stocks of a species may be distinctly different, eg. diadromous stocks of *Galaxias maculatus* (Jenyns) may have 57 to 61 vertebrae at the northern extremities of that species' range in New South Wales, Australia (McDowall and Frankenberg, 1981) or up to 60–66 in populations in far southern Chile (McDowall, 1971b). Lacustrine populations have many fewer vertebrae, with 50–53 in northern Australian populations, but up to 54–60 in southern Chile. Similar sorts of variation are described for other galaxiids and also for *Retropinna* (McDowall, 1979). Morphometric features also tend to vary in relation to the above factors, differences between diadromous and non-diadromous stocks being particularly well recognised for characters like head length and eye size. 5. In addition, allometric growth during somatic growth of salmoniform fishes is widely recognised in addition to which there is often exaggeration of some morphological features in relation to the attainment of sexual maturity, especially in males.

All these problems relating to between individual, within and between population, and within and between species variability do or can be expected to apply to *Aplochiton*. In view of the meagre knowledge of the life history strategies of these fishes, resolution of their taxonomy has its difficulties.

McDowall (1971a) has already examined some of these questions for a limited array of *Aplochiton* samples. In *A. zebra*, it was shown that eye size decreases with growth. Vertebral numbers in the samples appeared to be bimodal with number being low (about 57–62) in populations that appeared to be landlocked and high (63–66) in those

that were possibly diadromous. In one sample (Lago Rinihue) vertebral number encompassed both ranges (59–65) suggesting that both diadromous and non-diadromous stocks were present in that lake. Campos (1974) demonstrated a similar broad range in vertebral number for *Galaxias maculatus* (Jenyns) lower in that river system which drains Lago Rinihue (Rio Valdivia-Rio Calle Calle), although his bimodality did not extend that far upstream.

Similar variability was also demonstrated for *A. taeniatus* by McDowall (1971a) who described the following: Eye size decreased and snout length increased with absolute size. Vertebral number was found to be bimodal with some populations at 62–66 and others at 69–73. The lower counts were regarded as being from non-diadromous stocks. Bimodality was also evident in gill raker counts, but this feature subdivided the populations into different subsets than those generated by vertebral count.

On the basis of vertebral count, the Rio Calle Calle stocks (69–73) were different from all others (62–66). Using gill rakers, however, the Rio Calle Calle fish grouped with most other populations (17–23 gill rakers) fish from Lago Todos los Santos had higher counts (26–31) while those from Lago Llanquihue had fish belonging to both subsets (21–23 and 30–34 gill rakers). Thus various characters are varying in different ways between and within populations (in Rio Calle Calle vertebral number is high gill raker number low; in Lago Todos los Santos both are low; in Lago Llanquihue vertebral number is low but gill raker numbers are both high and low).

In view of these sorts of variations, resolution of the taxonomy and the identification of the new series of specimens is not simple. Two plausible scenarios can be envisaged. One is that there is a complex of species (or perhaps subspecies) of *Aplochiton* in the rivers and lakes of Patagonian South America and the Falkland Islands, for which existing material is inadequate to allow resolution. Alternatively there are two (*A. zebra*, *A. taeniatus*) or perhaps three (*A. marinus*) species of *Aplochiton*, which have alternative within-species life history strategies (diadromous and non-diadromous) and that there are morphological differences within species associated with each of the alternate life history strategies. Material available for study and

knowledge of the life histories of *Aplochiton* species do not permit absolute clarification of these hypotheses.

As knowledge of within-species morphological variation related to similarly alternative life history strategies in several species of *Galaxias* (McDowall, 1972) and *Retropinna* (McDowall, 1979; Northcote and Ward, 1985) is entirely consistent with the types of variation discussed above for *Aplochiton* we see no reason to modify the taxonomic arrangement of *Aplochiton* proposed by McDowall (1971a) in which two species *A. zebra* and *A. taeniatus* were recognised and redescribed.

Identification

Material in the present study is easily divided into two taxa (see Table 1).

Differences are quite clear in body depth, shape of the caudal peduncle, the sizes of the dorsal and anal fins, head length and depth, eye diameter, mouth size and other features. The four more slender large-mouthed fish (Fig. 1) are typically heavily covered on the upper sides and back with small round spots, and in some there is a general peppering of small widely spaced melanophores. They have 72–73 vertebrae. When alive the fish

Table 1. Morphometric and meristic variation in *Aplochiton* species (figures given as percentages of denominators in ratios).

	<i>A. zebra</i>		<i>A. taeniatus</i>	
	Range	Mean	Range	Mean
Length to caudal fork (mm)	254–404		292–384	
Number of fish	4		4	
Body depth/standard length	19.7– 20.7	20.30	14.4– 19.2	17.37
Body depth at vent/standard length	14.1– 15.4	14.65	10.2– 13.4	11.9
Length caudal peduncle/standard length	13.0– 13.2	13.07	13.1– 14.9	14.22
Length caudal peduncle/depth peduncle	45.0– 50.0	48.32	36.5– 40.0	37.95
Predorsal length/standard length	56.1– 58.4	56.87	57.8– 61.9	59.45
Preanal length/standard length	76.1– 78.3	77.52	74.4– 79.8	76.80
Predorsal length/preanal length	133.1–139.0	136.27	128.5–129.8	129.05
Length dorsal fin base/standard length	11.0– 13.5	12.25	8.8– 10.4	9.55
Total length dorsal fin/basal length	120.3–133.8	128.00	129.6–138.0	134.37
Length anal fin base/standard length	11.0– 12.7	12.22	8.5– 10.1	9.60
Total length anal fin/basal length	113.2–120.6	121.07	117.7–128.3	123.72
Pectoral fin length/pectoral-pelvic length	32.0– 35.7	33.75	30.5–35.5	31.87
Pelvic fin length/pelvic-anal length	45.1– 51.3	48.85	46.4– 51.6	49.70
Pre-pelvic length/standard length	55.9– 56.5	56.22	56.2– 61.0	58.02
Pectoral-pelvic length/standard length	30.6– 37.3	35.10	33.5– 35.4	34.60
Pelvic-anal length/standard length	21.4– 23.4	22.32	19.6– 21.0	20.15
Head length/standard length	21.0– 21.8	21.35	23.4– 28.4	25.30
Head width/head length	56.1– 60.1	57.47	40.9– 46.4	43.22
Head depth/head length	53.0– 62.9	57.67	42.0– 45.6	44.07
Snout length/head length	33.3– 34.5	33.75	35.2– 39.3	36.90
Postorbital head length/head length	52.2– 54.5	53.42	51.7– 53.9	52.77
Interorbital width/head length	33.9– 35.3	34.52	29.5– 31.4	30.52
Eye diameter/head length	16.5– 18.5	17.75	11.5– 14.5	12.52
Length upper jaw/head length	33.8– 39.8	37.37	50.3– 51.2	50.62
Length lower jaw/head length	33.8– 38.8	36.65	48.0– 48.8	48.27
Width of gape/head length	33.0– 35.3	34.10	23.7– 30.3	26.00
Dorsal fin rays	12–14	13.0	12–13	12.25
Anal fin rays	15–16	15.5	14–16	14.75
Pectoral fin rays	17–19	18.5	17–18	17.75
Gillrakers	21–22	21.5	17–19	18.25
Vertebrae	64–66	65.0	72–73	72.5

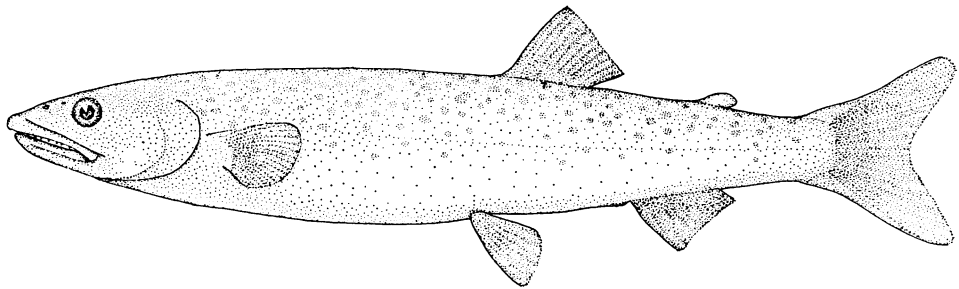


Fig. 1. *Aplochiton taeniatus*, 271 mm SL, Estero Ventisquero, Chile.

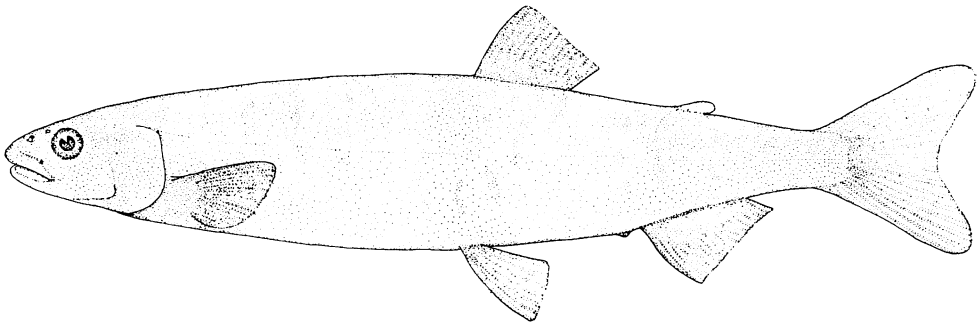


Fig. 2. *Aplochiton zebra*, 284 mm SL, Lago Quetro, Chile.

were bright silvery olive, and darker on the back. These fish are consistent with *A. taeniatus* re-described by McDowall (1971a) from locations at low elevations close to the sea.

The four somewhat (although not much) stouter fish (Fig. 2) have much smaller mouths, are much darker in colour being blotchily black/olive on the back and upper sides with a series of narrow vertical chevron shaped bands across the sides. When alive they were dark black olive on the back, paling to silvery olive on the sides and belly. These fish have 64–66 vertebrae. They are consistent with those re-described by McDowall (1971a) as *A. zebra* again being similar to fish taken from lower elevation localities close to the sea.

In spite of the fact that the specimens presently under discussion are far larger than any previously reported, they would have been identified as *A. taeniatus* and *A. zebra* using McDowall's (1971a) key.

Status of *A. marinus*. Although McDowall (1971a) treated *A. marinus* as a junior synonym of *A. taeniatus*, Campos (1973) and Bahamonde and Pequeno (1975) without comment, listed *A.*

marinus from Chile. Zama and Cardenas (1984) described one specimen (SNP(OA)76 of the present study) as *A. marinus* on the basis that the specimen had distinct dark spots on the body, pointed snout, longer maxillary, smaller eye, slender, well-developed teeth in each jaw. These are all feature characteristics of and described for *A. taeniatus* (McDowall, 1971a) apart from the spotting on the back. McDowall, however, noted that he had seen no freshly captured specimens. The syntypes of *A. marinus* (CAS 51275) do not have spotting on the back now, either, and we do not regard this character as having taxonomic significance in the present analysis.

Allometric growth. Morphometric data from the new specimens are, in general, consistent with those published by McDowall (1971a) for both species except that eye diameter is smaller and snout length greater. These two differences are however consistent with allometric growth patterns previously described for *Aplochiton*. In Figs. 3 and 4 data from the present study (cross) are added to those from McDowall (1971a).

Size. The present collection comprises by far the largest examples of *Aplochiton* on record. To

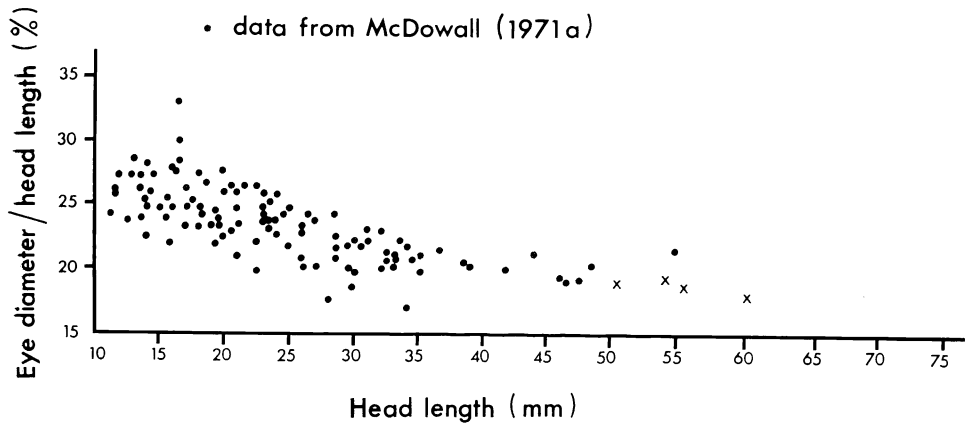


Fig. 3. Variation in eye size with growth in *Aplochiton zebra* (●, from McDowall, 1971a; ×, present study).

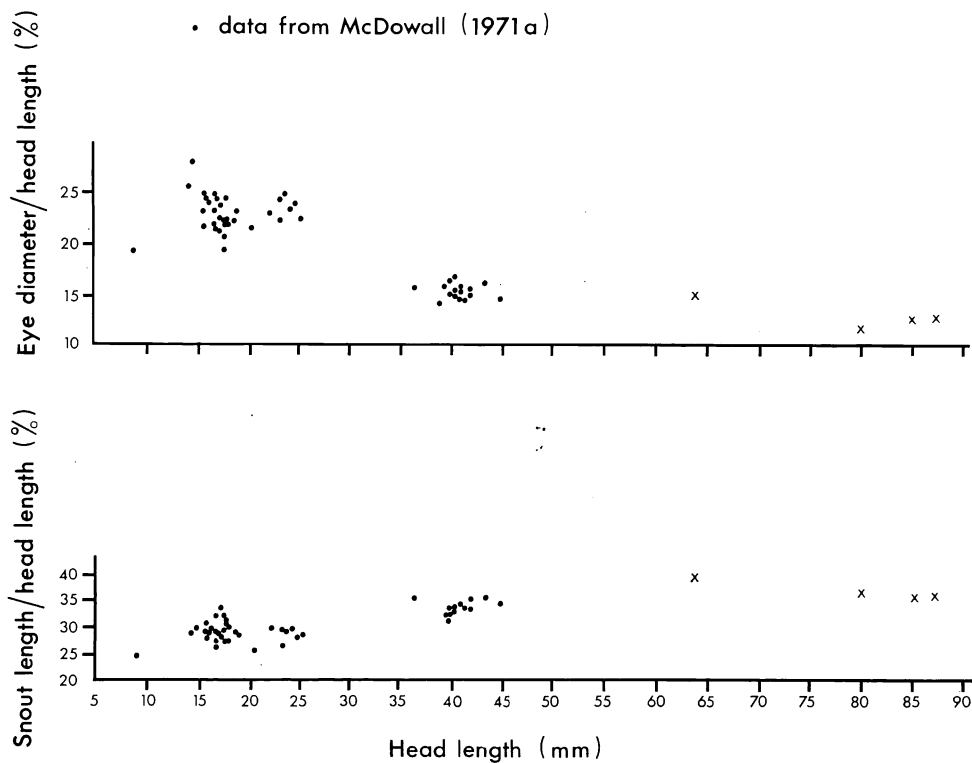


Fig. 4. Variation in eye and snout size with growth in *Aplochiton taeniatus* (●, from McDowall, 1971a; ×, present study).

1971, there were records of *A. taeniatus* up to 240 mm LCF (Ringuelet et al., 1967) and of *A. zebra* to 240 mm LCF (McDowall, 1971a). The present collection raises maximum sizes of these species to 384 mm LCF for *A. taeniatus* and 304 mm for *A. zebra*.

Geographical distribution. The earlier study by McDowall (1971a) showed two major large disjunct areas of distribution for *A. zebra* and *A. taeniatus*, viz. a northern area between about Valdivia and Puerto Montt (39–42°S) and a far southern area, roughly between Puerto Natales

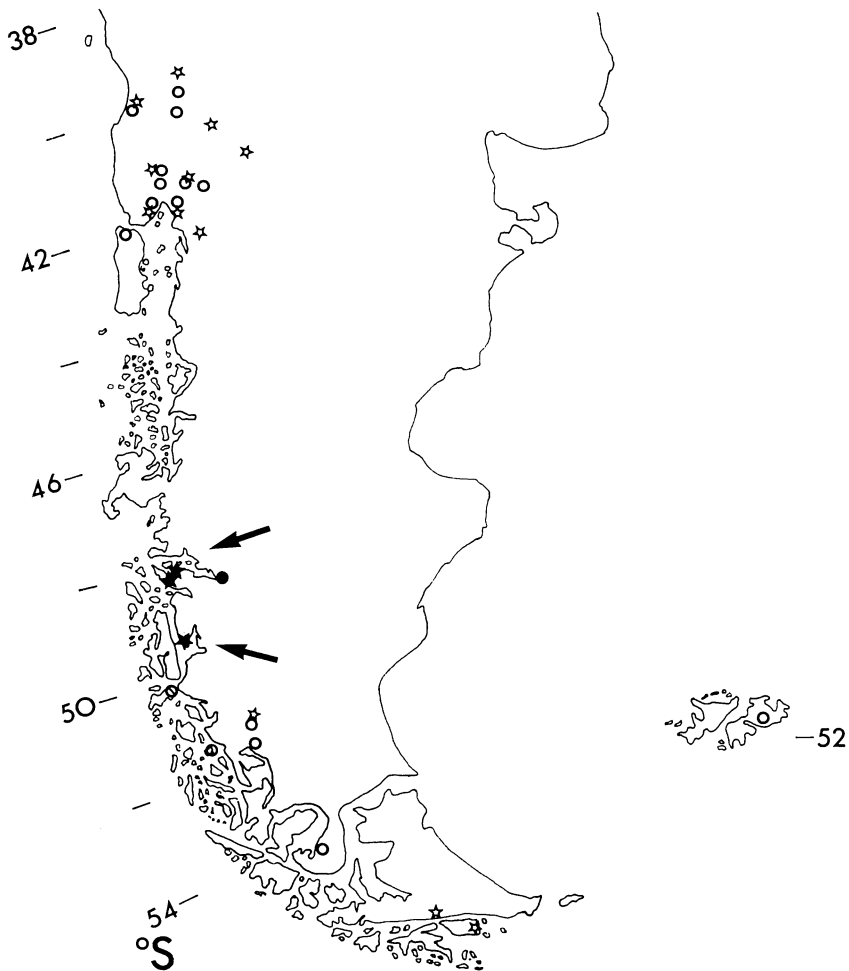


Fig. 5. Distribution of *Aplochiton zebra* and *A. taeniatus*. Open symbols: from McDowall, 1971a; closed symbols: present study. Circles: *A. zebra*; stars: *A. taeniatus*. Arrows indicate general area from which additional material in present study originated.

and Ushuaia at the far tip of South America (50°–56°S). *A. zebra* was also reported from the Falkland Islands. Two major areas of absence are those between latitudes 42 and 50°S along the Chilean (western) coastline, as well as the entire Argentinian (eastern) coastline of Patagonia.

The present specimens and those reported on by Zama and Cardenas (1984) provide localities between these two disjunct areas in Chile (48–49°S) and it can probably safely be suggested that both species are present along the entire Chilean coastline. (There has been virtually no systematic collection of fishes in this remote and inaccessible area.)

Distribution maps for *Galaxias maculatus* and *G. platei* show similar huge gaps in known occurrence in this same areas (McDowall, 1971b) but Zama and Cardenas (1984) again show their presence at Aysen and vicinity, at intermediate latitudes. Lack of records clearly is due to lack of collection. Absence of *Aplochiton* along the Atlantic coast of Patagonia is consistent in all known collections (although *G. maculatus* and *G. platei* both occur there). This distributional gap seems more likely to be real.

Life history strategy. McDowall (1971a, 1984) has suggested that the life histories of at least some populations of *Aplochiton* are diadromous.

The reports of small juveniles from the sea (McDowall, 1984) indicate this and suggest that amphidromy is involved (Myers, 1949; McDowall, 1987). The finding of these very large adults of both *A. zebra* and *A. taeniatus*, in localities close to the sea, and their high vertebral counts offers circumstantial support for this hypothesis. The lake spawning population of *A. taeniatus* which Campos (1969) studied is interpreted as a lake limited stock of that species.

Acknowledgments

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チリ南部の *Aplochiton* 属の分類

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以前には分布が確認されていなかったチリ南部から Aplochitonidae の *Aplochiton zebra* Jenyns と *A. taeniatus* Jenyns の 2 種を報告する。本研究に用いられた最大の標本は以前に知られていた最大の個体 (両種ともに 240 mm LCF) よりはるかに大きく、*A. zebra* で 304 mm LCF, *A. taeniatus* で 384 mm LCF であった。魚体の大きさ、海に極めて近い所からとれていること、脊椎骨数が多いことなどから彼らは両側回遊型のライフサイクルをもっているものと考えられる。

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