

***Atherinella blackburni* (Schultz, 1949) at Itamambuca Beach, Ubatuba, SP: ecological characterization and distribution on the Brazilian coast (Teleostei: Atheriniformes: Atherinopsidae)**

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(With 7 figures)

Abstract

Atherinella blackburni is a silverside species whose occurrence on the Brazilian coast was not properly registered until recently. So far, records of its distribution along the Brazilian shore were limited to Itaparica Island, Bahia State, and Porto Inhaúma, Rio de Janeiro State. In a recent survey of the ichthyofauna of Itamambuca Beach, Ubatuba, São Paulo State, 100 specimens of this species were collected, yielding a considerable source of information regarding its ecology and a new southern limit of its distribution. A detailed survey of an ichthyological collection revealed lots of this species from regions of the Brazilian Northeast, resulting in a northward expansion of the occurrence of *A. blackburni* in Brazilian waters. Besides the populations found on the Brazilian coast, the species also occurs discontinuously in the Atlantic coasts of Costa Rica, Panama and Venezuela. Meristic and morphometric analysis showed overlapped values between Brazilian populations and the ones closer to the Caribbean. An ecological study of *A. blackburni* at Itamambuca Beach revealed that it is a predominantly diurnal species with preference for warm and salty waters, often occurring in sandy-bottom environments. It was more abundant in Summer and Winter, when individuals with smaller values of length and weight also occurred.

Keywords: ecology, marine fish, new occurrence, silverside, West Atlantic.

***Atherinella blackburni* (Schultz, 1949) na praia de Itamambuca, Ubatuba, SP: caracterização ecológica e distribuição na costa brasileira (Teleostei: Atheriniformes: Atherinopsidae)**

Resumo

Atherinella blackburni é uma espécie de peixe-rei cuja ocorrência na costa brasileira não havia sido precisamente registrada até recentemente. Ainda assim, sua distribuição no litoral brasileiro estava restrita à Ilha de Itaparica, Bahia e Porto Inhaúma, Rio de Janeiro. Em um recente levantamento da ictiofauna da Praia de Itamambuca, Ubatuba, São Paulo, foram coletados 100 espécimes desta espécie, originando uma fonte considerável de informações no tocante à sua ecologia e a um novo limite sul de sua distribuição. Um estudo detalhado revelou lotes desta espécie em regiões do nordeste brasileiro em coleção ictiológica, resultando na expansão para o norte da ocorrência de *A. blackburni* em águas brasileiras. Além das populações encontradas na costa brasileira, a espécie também ocorre descontinuamente na costa Atlântica da Costa Rica, Panamá e Venezuela. Análise merística e morfométrica revelou valores sobrepostos entre populações brasileiras e aquelas mais próximas ao Caribe. O estudo ecológico de *A. blackburni* na Praia de Itamambuca evidenciou que é uma espécie predominantemente diurna com preferência por águas quentes e salgadas, freqüente em ambientes com fundo arenoso. Foi mais abundante no verão e inverno, quando indivíduos com menores valores de comprimento e peso também ocorreram.

Palavras-chave: Atlântico ocidental, ecologia, nova ocorrência, peixe marinho, peixe-rei.

1. Introduction

Knowledge of Brazilian marine fishes is not as incomplete as the one of Neotropical freshwater fishes, but much is yet to be done regarding the marine fish fauna on the Brazilian coast (Menezes et al., 2003).

Figueiredo and Menezes (1978) stated that the taxonomy of South American silversides had not been adequately studied and despite of some studies dealing with the taxonomy of higher level taxa in the last 20 years

(Chernoff, 1986; Dyer and Chernoff, 1996; Dyer, 2006), there are still questions to be pursued at the species level (e.g. Malabarba and Dyer, 2002). The silverside species *Atherinella blackburni* (Schultz, 1949) well illustrates this issue.

Atherinella blackburni was originally described in the genus *Coleotropis* based on seven specimens collected in 1925 in the Gulf of Venezuela (Schultz, 1949). Additional collections expanded its area of occurrence, which has a discontinuous distribution between the Caribbean coast of Costa Rica and Porto Inhaúma, Brazil (Gilbert and Caldwell, 1967; Chernoff, 1986; Cervigón, 1991; Aguilera, 1998). The austral limit of the species distribution was registered as the Brazilian Central Coast (Gilbert and Caldwell, 1967), but the exact location of Porto Inhaúma was not explicit. According to J. Williams (pers. comm.), the complete locality of the specimen from Porto Inhaúma is "Bay of Rio, Porto da Inhaúma, Brazil" (22° 52' 19" S and 43° 16' 50" W).

Occurrence of *Atherinella blackburni* on the Brazilian shore was poorly documented to date. Besides the single specimen from Porto Inhaúma (Gilbert and Caldwell, 1967), only Lopes and Oliveira-Silva (2001) registered its occurrence in Brazilian waters, at Itaparica Island, Bahia State (13° 07" S and 38° 45" W), based on 29 specimens. These authors briefly discussed their meristic and morphometric data in relation to values from Venezuelan populations given by Gilbert and Caldwell (1967) and attributed the differences found to intra-specific variation.

Despite the high collection effort in many areas of the Brazilian shore, *Atherinella blackburni* was never among registered species along the coast (e.g., Figueiredo and Menezes, 1978; Giannini and Paiva Filho, 1995; Pessanha et al., 2000; Camargo and Isaac, 2001; Pessanha and Araújo, 2003; Pessanha et al., 2003). Another two species of Atherinopsidae are frequently registered in the Brazilian coast: *Odontesthes bonariensis* and *Atherinella brasiliensis*, the latter being the only congener of *A. blackburni* known in Brazilian waters (Chernoff, 1986; Dyer, 2003).

Several specimens of *Atherinella blackburni* were collected in a recent survey of the ichthyofauna of Itamambuca Beach, Ubatuba, São Paulo State (23° 24' S and 45° 00' W). This study aims to update the data regarding distribution of *A. blackburni* on the Brazilian coast, to compare meristic and morphometric data of specimens collected in Brazil with ones from other localities, to present characters diagnosing *A. blackburni*, and to contribute to the knowledge of its ecology at Itamambuca Beach through a study of its spatial and temporal (diel and seasonal) repartition.

2. Material and Methods

A list of all material examined is attached. The majority of material examined in the present study was collected at Itamambuca Beach (23° 24' S and 45° 00' W) (Figure 1), with permit #42 from IBAMA (Insituto

Brasileiro do Meio Ambiente e dos Recursos Naturais Renováveis), August 15, 2003.

Five points were selected along the beach (Figure 1) and each one was sampled three times in a 50 meter long transect with a beach-seine measuring 9 x 1.5 m, 5 mm of internode distance in the central 3 m-mesh and 15 mm in the two lateral 3 m-mesh. For standardization purposes collections were made monthly, in full moon periods, at morning and night. Total length (Lt, mm) and total weight (Wt, g) was taken from each individual, and then the fishes were fixed in formalin 4%, stored in ethanol 70% and deposited in the ichthyological collection of Museu de Zoologia da Universidade de São Paulo (MZUSP). The identification was made based on the works of Schultz (1949), Gilbert and Caldwell (1967) and Lopes and Oliveira-Silva (2001).

The ecological study included all specimens collected at Itamambuca Beach (n = 100). Additional material was obtained from Enseada Beach (23° 26' 13" S and 45° 04' 08" W), Ubatuba, São Paulo, in April 2005. For the meristic and morphometric analysis, 69 specimens from Itamambuca Beach were used, 9 from Enseada Beach and 19 from the Brazilian Northeast previously deposited in MZUSP (n = 97).

The ecological analysis included relative frequency of numerical abundance and the population structure was based on the average Lt and Wt at the five collection points, in mornings and nights, along the year. Lt and Wt were taken with an ichthyometer and a digital scale of 0.01 g precision, respectively. Temperature and salinity were taken with a thermometer and a refractometer, respectively. Counts and measures followed Schultz (1949), Gilbert and Caldwell (1967) and Lopes and Oliveira-Silva (2001). Measures were taken on the left side of the body, whenever possible, with a digital caliper of 0.01 mm precision. Simple statistical descriptors were obtained for each meristic and morphometric character (i.e., range, average and standard deviation) which were tabled (Table 1) in comparison with data from previous works dealing with this species (Schultz, 1949; Gilbert and Caldwell, 1967; Lopes and Oliveira-Silva, 2001).

3. Results

3.1. *Atherinella blackburni* (Schultz, 1949) (Figure 2)

- *Coleotropis blackburni* Schultz, 1949 [original description, type-locality: Jacuque Point, Gulf of Venezuela, Venezuela]; Gilbert and Caldwell, 1967 [description and comparison with *C. starski*, occurrence in Costa Rica];
- *Coleotropis colecanos* Caldwell, 1962 [original description, type-locality: Tortuguero, Costa Rica]; and
- *Atherinella blackburni* (Schultz, 1949) – Chernoff (1986) [taxonomic account]; Aguilera, 1998 [list of species of Venezuela]; Lopes and Oliveira-Silva, 2001 [description and occurrence at Itaparica

Island, Brazil]; Dyer, 2003 [list of species of Central and South America].

Diagnosis: *Atherinella blackburni* can be distinguished from its congener *A. brasiliensis* by the presence of a scale-sheath along the anal-fin base (vs. scale-sheath absent in *A. brasiliensis*), more lateral scales in the longitudinal series (44-51, vs. 35-40 in *A. brasiliensis*), a compressed abdomen (vs. rounded in *A. brasiliensis*) and by the color pattern, with white body and the distal margin of the caudal-fin black (vs. light-green body and the distal margin of the caudal-fin red in *A. brasiliensis*). *Atherinella blackburni* may be distinguished from species of *Odontesthes* by possessing less gill rakers on the ventral branch of the first gill arch (14-18, vs. 26-38 in *Odontesthes*) and attaining a smaller body length (102.9 mm, vs. circa of 500 mm in *Odontesthes*).

Geographic Distribution: *Atherinella blackburni* occurs discontinuously in the West Atlantic, on beaches of Costa Rica, Panama, Venezuela and Brazil. In Brazilian waters, the species occurs from Maceió, Alagoas to Ubatuba, São Paulo (Figure 3).

Ecology: In the survey of the ichthyofauna of Itamambuca Beach (Figure 1), 100 individuals of *Atherinella blackburni* were collected during 13 months, measuring from 24 to 129 mm Lt and weighing from 0.33 to 12.67 g Wt.

Water mass to which *Atherinella blackburni* was predominantly associated is characterized by high values of temperature and salinity (Figure 4). The species was collected only at Points 1, 2 and 3, areas with sandy bottom and little or no influence of freshwater from

Rio Itamambuca. Points 4 and 5 were near the mouth of the river and generally had muddy bottom with higher amount of detritus (e.g., shells, plant matter, etc) (Figure 1). Point 2 was the most abundant in number of individuals (Figure 5a), and the smallest specimens occurred in Points 1 and 2 (Figure 6a). The other species in the genus, *A. brasiliensis*, was the second most abundant in this ichthyological survey (unpubl. data) but did not occur together with *A. blackburni* with the exception of a single specimen from Point 3 in January.

Regarding the temporal repartition in a diel context, there was a higher abundance of individuals in the mornings (Figure 5b), when the smallest individuals in Lt and Wt also occurred (Figure 6b). In a seasonal context, *Atherinella blackburni* was captured throughout the year, except for December, being more abundant in Summer and Winter (Figure 7a). Values of average total length and weight did not vary much throughout the year (Figure 7b) but classes of Lt representing young individuals appeared between January and April.

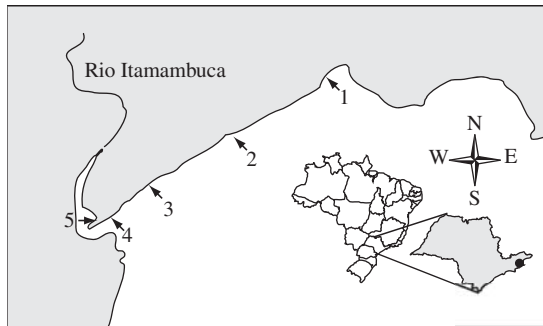


Figure 1. Map with locations of sampling points (numbered 1 to 5) at Itamambuca Beach, Ubatuba, SP (23° 24' S and 45° 00' W). Beach length approximately 1800 meters.



Figure 2. *Atherinella blackburni*. MZUSP 88689, 102.92 mm SL.



Figure 3. Distribution of *Atherinella blackburni* along West Atlantic coast. Some marks represent more than one lot. Square represents the type-locality at Jacuque Point, Gulf of Venezuela, triangles correspond to occurrences registered in literature, and circles to localities registered in the present study.

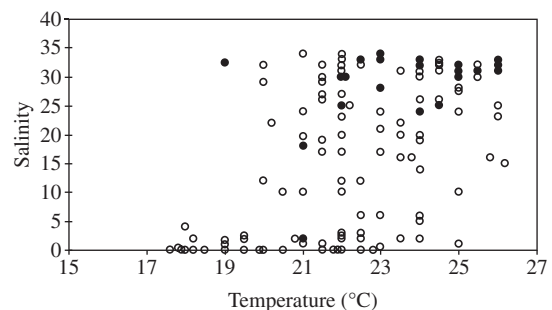


Figure 4. Distribution of temperature and salinity values of the water mass at Itamambuca Beach, Ubatuba, SP. Filled-in circles correspond to points where *Atherinella blackburni* was registered.

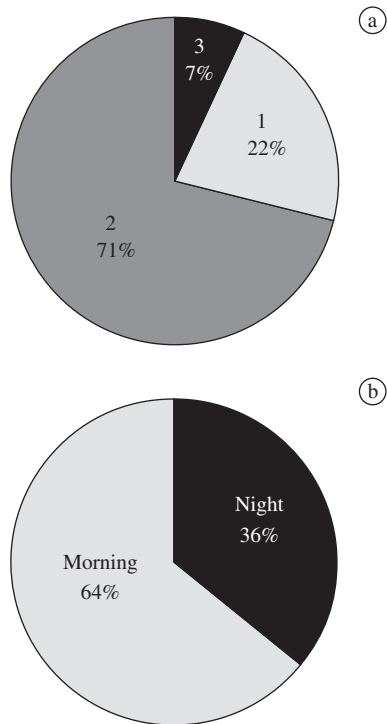


Figure 5. Distributions of relative frequency of individuals of *Atherinella blackburni* collected at Itamambuca Beach, Ubatuba, SP in relation to; a) collection points along the beach (it did not occur in points 4 and 5) and b) periods of the day.

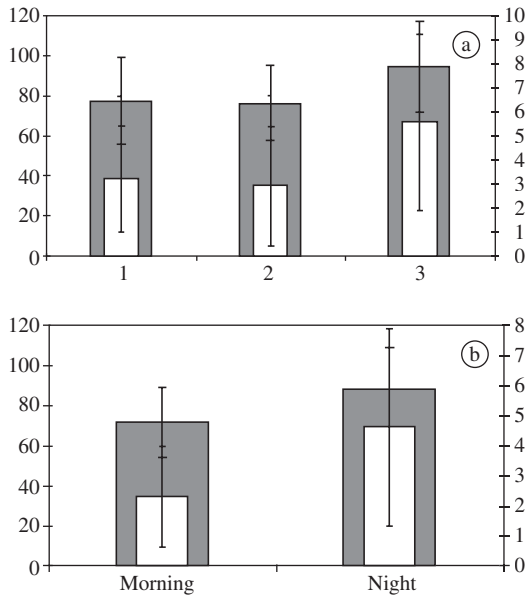


Figure 6. Values of average total length (Lt in mm, main axis, grey columns) and average total weight (Wt in g., secondary axis, white columns) of *Atherinella blackburni*; a) along the collection points; and b) in each diel period at Itamambuca Beach, Ubatuba, SP. Thick standard deviation bars correspond to Lt.

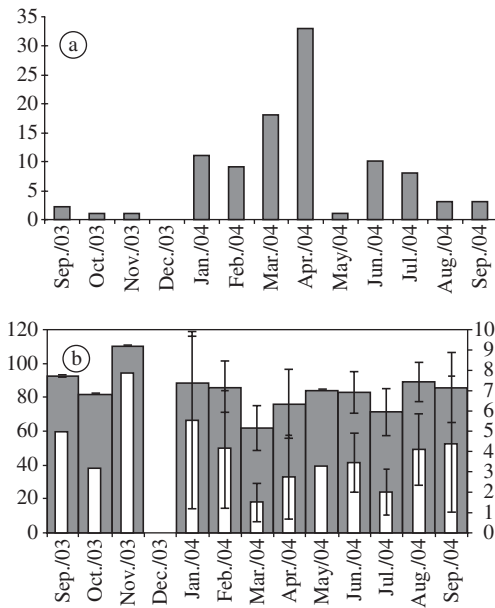


Figure 7. a) Relative numerical abundance of *Atherinella blackburni* throughout the year at Itamambuca Beach, Ubatuba, SP; b) Values of average total length (Lt in mm, main axis, grey columns) and average total weight (Wt in g., secondary axis, white columns) of *A. blackburni* throughout the year at this beach. Thick standard deviation bars correspond to Lt.

4. Discussion

Atherinella blackburni was described in detail in previous studies (Schultz, 1949; Gilbert and Caldwell, 1967; Cervigón, 1991; Lopes and Oliveira-Silva, 2001), therefore it is not redescribed in the present study. Instead, an updated diagnosis for this species in Brazilian waters was provided to aid in its identification. A table is made available (Table 1) with meristic and morphometric values comparing data of the present work with those from the literature.

The present study extended the records of the occurrence of *Atherinella blackburni* on the Brazilian coast, previously restricted to Porto Inhaúma, Rio de Janeiro (Gilbert and Caldwell, 1967) and to Itaparica Island, Bahia (Lopes and Oliveira-Silva, 2001). Additional material from beaches of Ubatuba and the discovery of specimens from the shores of Alagoas and Bahia States demonstrated that the real distribution of *A. blackburni* on the Brazilian coast is wider than what was previously registered. Additional collections and the use of more precise characters to identify the species may further expand records of the occurrence of *Atherinella blackburni* on the Brazilian shore.

Meristic and morphometric analysis revealed an increase in range of many values, probably due to the higher number of specimens sampled in this study in relation to previous works (Schultz, 1949; Gilbert and Caldwell, 1967; Lopes and Oliveira-Silva, 2001). Values presented in these previous works fall within the ranges obtained in the present study (Table 1), not corroborating the intra-specific variations suggested by Lopes and Oliveira-Silva (2001). The only discrepant data given by Lopes and

Table 1. Meristic and morphometric data of *Atherinella blackburni* obtained in the present study and information from literature. Measures 10-26 are expressed as proportions of Standard Length, followed by average and standard deviation between parentheses.

Variable	N	Values	Lopes and Oliveira-Silva (2001), N = 29	Types (Schultz, 1949), N = 7	Gilbert and Caldwell (1967), N = 37
1. Number of pre-dorsal scales	93	24-29	22-32	-	23-28
2. Number of scales of peduncle	97	14-16	06-10	-	14-16
3. Number of lateral scales	97	44-51	-	44-48	43-50
4. Number of dorsal-fin rays	97	II-IV, ii + 7-9	III-IV, i + 8-10	III, ii + 7-8	III-IV, 7-10
5. Number of pectoral-fin rays	97	i + 9-15	12-13	i + 12-13	-
6. Number of pelvic-fin rays	95	i + 4-5	i + 5	-	-
7. Number of anal-fin rays	95	i-ii + 18-25	i + 19-24	ii + 21-23	20-26
8. Number of caudal-fin rays	96	i + 14-16 + i	16-23	-	-
9. Number of gill rakers	92	14-18	-	16-17	-
10. Higher body height	97	14.95-21.93 (17.38; 1.26)	15.12-21.32	18.90-21.20	16.30-20.70
11. Caudal peduncle height	97	5.77-9.94 (8.83; 0.55)	7.94-10.45	9.56-9.88	8.70-10.40
12. Distance from snout to first dorsal-fin origin	96	52.40-63.92 (55.87; 1.58)	52.61-62.67	57.80-58.00	53.20-60.90
13. Distance from snout to second dorsal-fin origin	96	64.12-73.04 (69.95; 1.54)	-	70.20-72.40	-
14. Distance from snout to pectoral-fin origin	96	20.63-25.37 (23.20; 0.92)	-	21.80-22.90	-
15. Distance from snout to pelvic-fin origin	96	27.08-54.28 (36.54; 2.66)	32.11-40.52	36.00-37.10	33.70-38.00
16. Distance from snout to anal-fin origin	96	47.77-57.25 (52.63; 1.69)	49.96-58.93	52.00-53.20	47.00-55.20
17. Distance from pelvic-fin origin to anal-fin origin	96	12.50-23.31 (17.94; 1.95)	-	15.50-17.30	-
18. Distance from first dorsal-fin origin to second dorsal-fin origin	96	10.53-17.61 (14.56; 1.30)	11.97-17.62	12.90-15.20	11.80-16.30
19. Pos-orbital head length	96	6.59-10.40 (8.09; 0.86)	7.85-10.85	9.56-10.00	8.30-9.30
20. Anal-fin length	94	27.28-39.40 (31.93; 1.97)	23.92-31.46	31.30-33.80	30.20-38.00
21. Head length	96	18.46-23.36 (20.76; 1.08)	20.39-25.00	22.10-22.20	19.80-23.90
22. Head width	96	8.44-17.30 (9.47; 0.93)	8.88-10.47	9.78-11.30	9.70-12.40
23. Head height	96	9.30-24.24 (13.93; 1.29)	12.35-22.00	-	13.20-16.30
24. Interorbital distance	96	3.10-8.37 (6.56; 0.59)	6.04-8.85	6.95-7.56	6.50-7.80
25. Orbital diameter	96	4.91-25.29 (7.38; 1.97)	5.13-9.02	5.85-6.89	5.70-7.60
26. Lower jaw length	96	5.21-9.45 (7.34; 0.70)	5.78-9.68	-	-

Oliveira-Silva (2001) is the number of scales around the caudal peduncle, and this may be due to a different method these authors might have used to count them (Table 1).

Abundance of small individuals in the months of Summer and Fall indicates that this is the time of year when recruitment occurred. Higher abundance of individuals collected in the mornings may be due to various factors. Patterns of diel activity, according to Reebbs (2002), may be extremely plastic and factors such as vulnerability to predators, changes in feeding habits, competition, among others, may be responsible for the choice of which period of the day fish show higher or lower activity patterns.

The ecological evaluation of *Atherinella blackburni* showed that the species has preference for waters with high temperature and high salinity values (Figure 4) and a sandy bottom. Therefore, it is less generalist than its congener *A. brasiliensis*, a silverside fish quite common on the Brazilian shore, occurring predominantly in low salinity waters and muddy bottoms, mainly in coastal river mouths (Figueiredo and Menezes, 1978). Environments subject to influence of freshwater and with muddy bottoms seem to restrict *A. blackburni* occurrence. This ecological repartition between both species of *Atherinella* was observed in the present study and has been documented before (Cervigón, 1991; Lopes and Oliveira-Silva, 2001).

Discontinuity of the occurrence area of *Atherinella blackburni* on the Atlantic coast of Central and South America (Chernoff, 1986) (Figure 3) must be further investigated. Based on current knowledge about the ecological features and the species distribution, it is possible to infer that the stocks of populations composed of young and adult individuals may be restricted to sandy beaches along its occurrence area, but the same cannot be affirmed for eggs and larvae without a wider study. Hence, it is suggested that further investigations should be conducted in order to enlighten questions regarding the discontinuous occurrence of *A. blackburni* on the West Atlantic coast.

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Attachment

List of material examined, organized in alphabetical order of Brazilian states. For each lot, there is the catalog number at Museu de Zoologia da Universidade de São Paulo (MZUSP) followed by number of specimens in each lot, range of standard length in millimeters and locality. Lots with the same locality were grouped.

Alagoas: MZUSP 67169, 3, 42.30-66.54, Avenida Beach in front of AABB; MZUSP 67481, 5, 66.44-77.20, Sobral Beach, Maceió; MZUSP 67484, 5, 26.95-54.60; MZUSP 79894, 4, 38.21-71.88, Avenida Beach, Maceió.

Bahia: MZUSP 67505, 3, 55.01-66.34, Molhado e Molhadinho Beach, Ilhéus. São Paulo: MZUSP 88686, 2, 75.08-75.18; MZUSP 88687, 1, 66.26; MZUSP 88688, 1, 86.80; MZUSP 88689, 11, 36.40-102.92; MZUSP 88690, 9, 57.12-94.40; MZUSP 88691, 18, 47.69-69.28; MZUSP 88692, 33, 61.20-98.71; MZUSP 88693, 1, 66.27; MZUSP 88694, 10, 44.84-81.16; MZUSP 88695, 8, 38.27-71.65; MZUSP 88696, 3, 59.15-83.62; MZUSP 88697, 3, 52.33-91.67, Itamambuca Beach, Ubatuba; MZUSP 88698, 9, 27.70-61.94, Enseada Beach, Ubatuba.