

Checklist of rocky reef fishes from the Currais Archipelago and Itacolomis Island, Paraná state, Brazil

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ABSTRACT: The ichthyofauna of the rocky substrate of Currais Archipelago and Itacolomis Island (Paraná state, Brazil) was surveyed between October 2008 and August 2009 through visual census, using 40 m² (20x2 m) band transects at an average depth of 6 m. A total of 14,210 individuals (66 species from 33 families) were observed in 336 band transects, covering an area of 13,440 m². *Stegastes fuscus*, *Abudefduf saxatilis*, *Haemulon aurolineatum* and *Malacoctenus delalandii* were the most abundant species. "Carnivore" was the most species-rich category, and "Mobile Invertebrate Feeder" the most abundant. Nine species are added to the list of reef fishes of the Paraná state: *Acanthurus coeruleus*, *Dactylopterus volitans*, *Epinephelus morio*, *Myrichthys breviceps*, *Ophioblennius trinitatis*, *Paraclinus spectator*, *Scorpaena brasiliensis*, and *Selene vomer*.

INTRODUCTION

Reefs are defined as any formation with a consolidated bottom of organic and/or inorganic origin and they are extremely rich in terms of biodiversity and form one of the most complex environments in the coastal marine ecosystem. It is estimated that reefs harbor about 25% of all species of marine fishes currently known (Spalding *et al.* 2001). Fish communities have the highest levels of diversity in reefs, though such diversity may vary according to geographic and morphologic conditions of the ecosystem (Sale 1991). In Brazil, it is estimated that about 520 species inhabit this ecosystem (Hostim-Silva *et al.* 2006). Those species display a plethora of colors, shapes, trophic and reproductive habits, and present a variety of intra- and interspecific associations.

Rocky shore support diverse fish communities despite having lower topographic complexity than coral reefs, and are the main habitat for the reef biota in southern Brazil (Ferreira *et al.* 2001). Consolidated substrates such as those typically present in coastal islands, rocky shores, submerged slabs and calcareous bottoms are uncommon in the coast of Paraná State, southern Brazil. It is possible that the almost complete inexistence of such rock formations in the coast line of Paraná might be related to the relatively large distance of the Serra do Mar, where the rocky formations are found. The Currais Archipelago and Itacolomis Island are ecologically relevant among the marine ecosystems of the Paraná State since they supply suitable conditions for communities whose components are more adapted to living in reef habitats.

Despite its relevance to the marine biota, few studies have been performed to date in these islands (Félix and Harckradt 2008; Félix-Hackradt and Hackradt 2008; Harckradt and Félix-Harckradt 2009). Many studies that deal with the fish fauna have been carried out on the Paraná coast, but the main focus of those studies was usually the ichthyofauna associated with unconsolidated

substrate (*e.g.* Godefroid *et al.* 2001; Vendel *et al.* 2003; Spach *et al.* 2004; Félix *et al.* 2007). In order to contribute to the knowledge of this particular component of the ichthyofauna, a list of the fish species known to occur in the rocky substrates of the Currais Archipelago and Itacolomis Island is provided.

MATERIALS AND METHODS

Study site

The Currais Archipelago (25°44' S, 48°22' W) is composed of three islands separated by 6 nautical miles from the coast. The depth along the archipelago varies from 1.5 to 16 m. Itacolomis Island (25°50' S, 48°24' W) consists of two small rocky islands located approximately 7 nautical miles from the coast, with depths ranging from 3 to 17 m (Figure 1). The inclination of the rocky shores of Currais Archipelago and Itacolomis Islands is moderate, between 45° and 60°. The substrate is composed mostly of small rocks, which are usually covered by macroalgae, *Palythoa* sp., and *Zoanthus* sp.

Data collection

Data were collected using underwater visual census (UVC) on strip transects (Floeter *et al.* 2007). Observations were conducted monthly, from October 2008 to August 2009, from 07:00 a.m. to 03:00 p.m. A total of 336 strip transects of 40 m² (20x2 m) each were analyzed, 168 on each site: two in Currais Archipelago and two in Itacolomis Island (Figure 1), using SCUBA gear in depths that ranged from 3 to 9 m. The total area covered in the study was 13,440 m².

Species were identified with the use of keys and descriptions provided by Figueiredo and Menezes (1980), Menezes and Figueiredo (1980, 1985), Randall (1996), Humann and Deloach (2002), Hostim-Silva *et al.* (2006), Craig and Hastings (2007), and Baldwin *et al.* (2009). For the genus *Kyphosus*, the differentiation between the two

species, *K. incisor* and *K. sector*, is possible only with the capture of specimens for counting spines of the dorsal and anal fins; thus the specimens observed were identified until the taxonomic level of genus. The species of reef fishes were grouped in six trophic categories assessed from the literature (Ferreira *et al.* 2004; Randall 1967; Opitz 1996; Floeter *et al.* 2004, 2006; Kuitert 2009), where: CAR = Carnivores (eat a variety of mobile organisms, including invertebrates and fishes), MIF = Mobile Invertebrate Feeders (feed primarily on small benthic mobile invertebrates like mollusks, crustaceans, worms, etc. associated to the hard- or nearby soft-substrate), OMN = Omnivores (feed on a variety of organisms, both animal and vegetal), PLA = Planktivores (feed primarily on macro- and micro-zooplankton), HER = Herbivores (small to large herbivores that include in their diet a rich mass of detritus, turf algae and macroalgae) and SIF = Sessile Invertebrate Feeders (feeds on a array of sessile benthic invertebrates like cnidarians, bryozoans, ascidians and sponges that are mostly associated with hard substrate).

In order to analyze their zoogeographic affinities, the species were classified using the literature (Luiz-Jr *et al.*, 2008) into the following geographic distribution categories: Br = Brazilian province; CE = Central Atlantic (St. Helena and Ascension Islands); CT = Circumtropical, EA= Eastern Atlantic, Pat = Patagonian (occur primarily in the temperate rocky reefs south to Argentina), SCa = Southern Caribbean (coast of Venezuela, Trinidad and Tobago and other islands of the low Lesser Antilles), SE = Southeastern Brazil (endemic from the region that encompass 20° to 27°S), TA = Trans-Atlantic (both sides of the Atlantic Ocean), and WA = Western Atlantic (in the western North and South Atlantic).

RESULTS AND DISCUSSION

Throughout this study, 14,210 individuals of 66 species in 33 families and 8 orders, were observed (Table 1). In the Currais Archipelago, 6,115 specimens (48 species in 30 families) were observed, with an average density of 36.4/40 m². On Itacolomis Island, 8,095 specimens were observed (51 species in 26 families), with an average density of 48.2/40 m².

The families Blenniidae, Carangidae, Epinephelidae, Haemulidae, and Pomacentridae were those with the largest number of species observed (five each). *Stegastes fuscus*, *Malacoctenus delalandii*, *Parablennius marmoratus*, and *Abudefduf saxatilis* were the most frequent species observed during the study (98.8, 86.0, 56.5 and 48.2%, respectively), while *S. fuscus* (n=3,929), *A. saxatilis* (n=2,694), *Haemulon aurolineatum* (n=2,529), *M. delalandii* (n=1,676) were the most numerous (Figure 2).

Most of the individuals observed belong to species whose maximum known TL are around 10 centimeters. Another factor that possibly contributed to this result is the ontogenetic migration of some species, such as *Mycteroperca marginata* (Machado *et al.* 2003). In that species and possibly in others among those identified in this study, smaller individuals are found in shallower depths, whereas the larger ones look for refuges at deeper sites, thus decreasing the competition for space and food.

The 66 species identified in this study were grouped in the six trophic categories described above, which can

be used as categories of convenience in studies about interactions between species. About 32% (21 species) are Carnivores. Mobile Invertebrate Feeders is the second largest category, with 26% (17) of the species identified. The other categories are Herbivores, Omnivores, Planktivores, and Sessile Invertebrate Feeders (12, 9, 5, and 2 species, respectively), together contributed with 42% of the species identified. Carnivores are more representative at high latitudes, due to a decrease in herbivores and mobile invertebrate feeders (Ferreira *et al.*, 2004). The diversity of the mobile invertebrate feeders, and the consequently diversified ecomorphological types, make such group prone to be abundant in different environmental conditions (Ferreira *et al.* 2004).

Fifty-nine percent of the species (39) occur throughout the Western Atlantic, 22.7% (15) are Trans-Atlantic, and 10.6% (7) are endemic to the Brazilian coast. Species that occur in the Central-Atlantic and Southeastern Brazil contribute with 6.0% (4) and 1.5% (1), respectively.

Ophioblennius trinitatis, *Selene vomer*, *Dactylopterus volitans*, *Paraclinus spectator*, *Myriichtys breviceps*, *Scorpaena brasiliensis*, *Epinephelus morio* (Figure 3A) and *Acanthurus coeruleus* (Figure 3B) are species known to occur in southern Brazil (Hostim-Silva *et al.*, 2006; A. A. Bertoni, unpubl. data), but during this study they were observed for the first time in association with rocky substrates in the Paraná State and should be added to the regional list provided by Hackradt and Félix-Hackradt (2009).

A juvenile of *Anisotremus virginicus*, which is an optional cleaner during this phase, was observed cleaning an adult of *Chaetodon striatus* for 3 minutes (Figure 4). This interaction represents a cleaning symbiosis in which one species of fish removes parasites and necrotic tissue or mucus from a variety of fish seeking services.

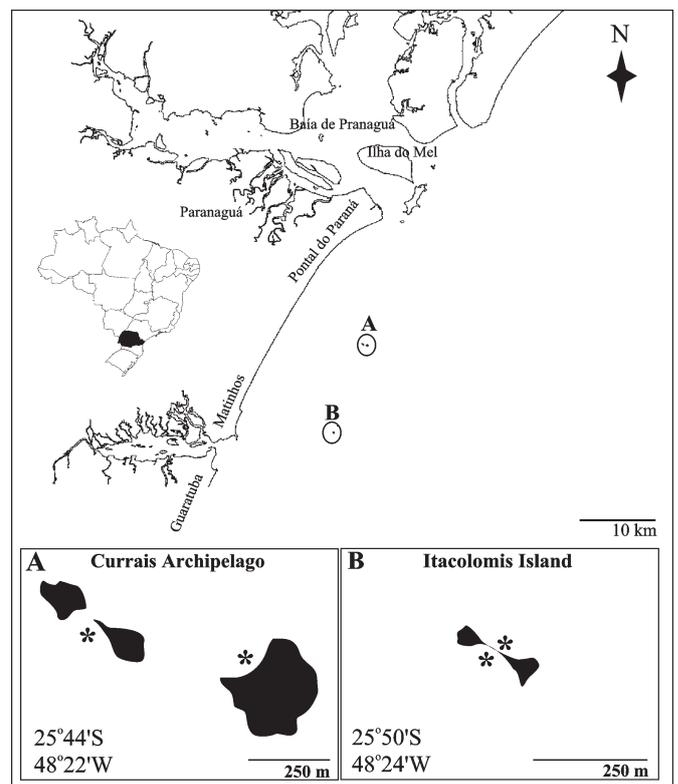


FIGURE 1. Paraná coast. (A) Currais Archipelago and (B) Itacolomis Island.

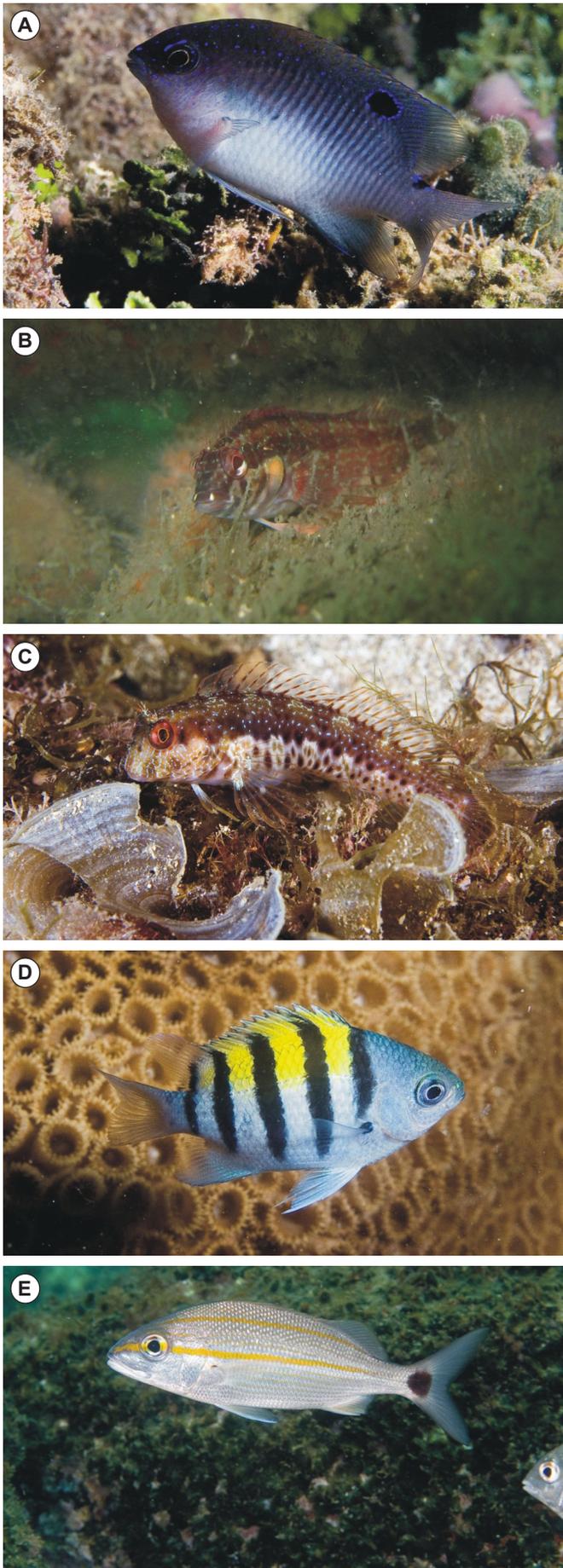


FIGURE 2. Species more frequent and abundant observed in the study: (A) *Stegastes fuscus*; (B) *Malacoctenus delalandii*; (C) *Parablennius marmoratus*; (D) *Abudefduf saxatilis*; and (E) *Haemulon aurolineatum*. Photos A, C, D, and E by Athila Bertoncini. Photo B by Felipe Daros.

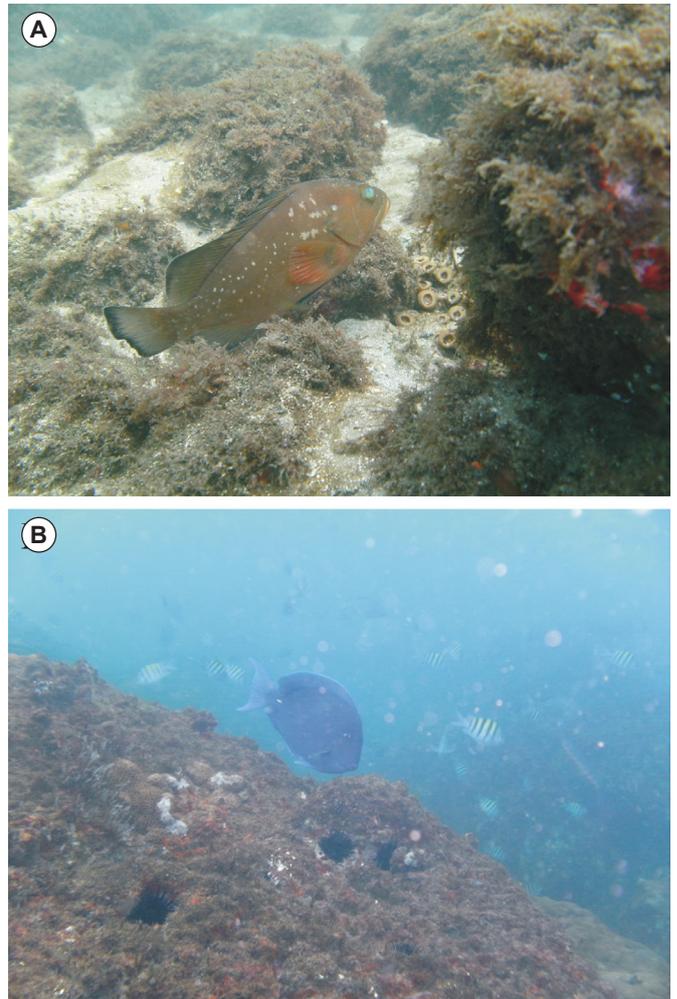


FIGURE 3. *Epinephelus morio* (A) in the Currais Archipelago and *Acanthurus coeruleus* (B) in the Itacolomis Island. Photos by Felipe Daros.

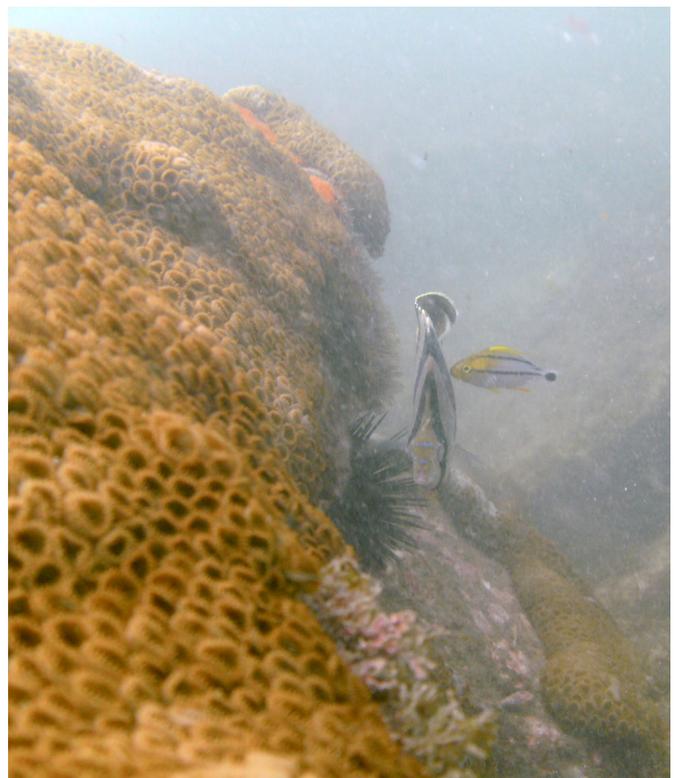


FIGURE 4. Cleaning station observed in the Currais Archipelago. *Anisotremus virginicus* and *Chaetodon striatus*. Photo by Felipe Daros.

TABLE 1. Abundance of species of fishes in the Currais Archipelago and Itacolomis Island. Classification follows Nelson (2006). Trophic categories: CAR, carnivore; HER, herbivore; ONI, omnivore; MIF, mobile invertebrate feeder; SIF, sessile invertebrate feeder; PLA, planktivore. Geographic range: Br, Brazilian province; CE, Central Atlantic; CT, Circumtropical; EA, Eastern Atlantic; Pat, Patagonian; SCA, Southern Caribbean; SE, Southeastern Brazil; TA, Trans-Atlantic; WA, Western Atlantic.

LIST OF SPECIES	CURRAIS (N)	ITACOLOMIS (N)	TROPHIC CATEGORIES	GEOGRAPHIC RANGE
CHONDRICHTHYES				
Myliobatiformes				
Myliobatidae				
<i>Aetobatus narinari</i> (Euphrasen, 1790)		1	CAR	CT
ACTINOPTERYGII				
ANGUILLIFORMES				
Muraenidae				
<i>Gymnothorax funebris</i> Ranzani, 1839	1	2	CAR	WA
<i>Gymnothorax moringa</i> (Cuvier, 1829)	5	2	CAR	WA+CE
<i>Gymnothorax vicinus</i> (Castelnau, 1855)	1	4	CAR	TA
Ophichthidae				
<i>Myrichthys breviceps</i> (Richardson, 1848)	1		MIF	WA
Synodontidae				
<i>Synodus synodus</i> (Linnaeus, 1758)		*	CAR	TA
BERYCIFORMES				
Holocentridae				
<i>Holocentrus adscensionis</i> (Osbeck, 1765)	26	75	MIF	TA
GASTEROSTEIFORMES				
Sygnathidae				
<i>Micrognathus crinitus</i> (Jenyns, 1842)	1		MIF	WA
Fistulariidae				
<i>Fistularia tabacaria</i> Linnaeus, 1758	1		CAR	TA
SCORPAENIFORMES				
Dactylopteridae				
<i>Dactylopterus volitans</i> (Linnaeus, 1758)	*		MIF	TA
Scorpaenidae				
<i>Scorpaena brasiliensis</i> Cuvier, 1829		2	CAR	WA
PERCIFORMES				
Serranidae				
<i>Diplectrum radiale</i> (Quoy and Gaimand, 1824)	1		CAR	WA
<i>Serranus flaviventris</i> (Cuvier, 1829)	110	56	MIF	WA
Epinephelidae				
<i>Epinephelus morio</i> (Valenciennes, 1828)	*		CAR	WA
<i>Hyporthodus niveatus</i> (Valenciennes, 1828)	1	4	CAR	WA
<i>Mycteroperca acutirostris</i> (Valenciennes, 1828)	37	14	CAR	WA
<i>Mycteroperca bonaci</i> (Poey, 1860)	1		CAR	WA
<i>Mycteroperca marginata</i> (Lowe, 1834)	7	16	CAR	SE+Pat+EA
Priacanthidae				
<i>Priacanthus arenatus</i> Cuvier, 1829	*		CAR	TA
Carangidae				
<i>Carangoides crysos</i> (Mitchill, 1815)	1	6	CAR	TA
<i>Caranx latus</i> Agassiz, 1831		1	CAR	TA
<i>Chloroscombrus chrysurus</i> (Linnaeus, 1766)	8	20	PLA	TA
<i>Pseudocaranx dentex</i> (Bloch and Schemmeider, 1801)	115	49	PLA	CT
<i>Selene vomer</i> (Linnaeus, 1758)		1	CAR	WA
Lutjanidae				
<i>Lutjanus analis</i> (Cuvier, 1828)	2		CAR	WA
Haemulidae				
<i>Anisotremus surinamensis</i> (Bloch, 1791)	27	31	MIF	WA
<i>Anisotremus virginicus</i> (Linnaeus, 1758)	135	103	MIF	WA
<i>Haemulon aurolineatum</i> Cuvier, 1830	1745	784	PLA	WA
<i>Haemulon stendachneri</i> (Jordan and Gilbert, 1882)	5	1	MIF	WA
<i>Orthopristis ruber</i> (Cuvier, 1830)	22	4	MIF	WA
Sparidae				
<i>Archosargus probatocephalus</i> (Walbaum, 1792)		1	OMNI	WA

TABLE 1. CONTINUED.

LIST OF SPECIES	CURRAIS (N)	ITACOLOMIS (N)	TROPHIC CATEGORIES	GEOGRAPHIC RANGE
<i>Diplodus argenteus</i> (Valenciennes, 1830)	23	45	MIF	WA
Sciaenidae				
<i>Odontoscion dentex</i> (Cuvier, 1830)	381	361	CAR	WA
<i>Pareques acuminatus</i> (Bloch and Schemneider, 1801)	52	77	MIF	WA
Mullidae				
<i>Pseudupeneus maculatus</i> (Bloch, 1793)	46	19	MIF	WA
Pemppheridae				
<i>Pempheris schomburgkii</i> Muller and Troschel, 1848	6	11	PLA	WA
Kyphosidae				
<i>Kyphosus</i> sp.	10	130	HER	TA
Chaetodontidae				
<i>Chaetodon striatus</i> Linnaeus, 1758	95	26	SIF	WA
Pomacanthidae				
<i>Pomacanthus paru</i> (Bloch, 1787)	4	2	OMNI	WA
Pomacentridae				
<i>Abudefduf saxatilis</i> (Linnaeus, 1758)	797	1897	OMNI	CT
<i>Chromis multilineata</i> (Guichenot, 1853)		2	PLA	TA
<i>Stegastes fuscus</i> (Cuvier, 1830)	1521	2408	HER	BR
<i>Stegastes pictus</i> (Castelnau, 1855)	*		HER	BR+SCa
<i>Stegastes variabilis</i> (Castelnau, 1855)	4	4	HER	WA
Labridae				
<i>Bodianus rufus</i> (Linnaeus, 1758)		4	MIF	WA
<i>Halichoeres poeyi</i> (Steindachner, 1867)	6	2	MIF	WA
Scaridae				
<i>Sparisoma amplum</i> (Ranzani, 1841)		1	HER	BR
<i>Sparisoma axillare</i> (Steindachner, 1878)	11	9	HER	BR
<i>Sparisoma frondosum</i> (Agassiz, 1831)	5	4	HER	BR+SCa
<i>Sparisoma radians</i> (Valenciennes, 1840)		1	HER	WA
Blenniidae				
<i>Hypsoblennius invemar</i> Smith-Vaniz and Acero-P., 1980		3	OMNI	WA
<i>Ophioblennius trinitatis</i> Miranda Ribeiro, 1919		1	HER	BR
<i>Parablennius marmoratus</i> (Poey, 1876)	121	306	OMNI	WA
<i>Parablennius pilicornis</i> (Cuvier, 1829)	8	35	OMNI	TA
<i>Scartella cristata</i> (Linnaeus, 1758)	4	5	OMNI	CT
Labrisomidae				
<i>Labrisomus nuchipinnis</i> (Quoy and Gaimard, 1824)	2	20	CAR	TA
<i>Malacoctenus delalandii</i> (Valenciennes, 1836)	354	1322	MIF	WA
<i>Paraclinus spectator</i> Guimarães and Bacellar, 2002	3		MIF	BR
Gobiidae				
<i>Coryphopterus glaucofraenum</i> Gill, 1863	348	26	PLA	WA
Ephippidae				
<i>Chaetodipterus faber</i> (Broussonet, 1782)	5		OMNI	WA
Acanthuridae				
<i>Acanthurus bahianus</i> Castelnau, 1855	10		HER	WA
<i>Acanthurus chirurgus</i> (Bloch, 1787)	5	184	HER	TA
<i>Acanthurus coeruleus</i> Bloch and Schneider, 1801		*	HER	WA
Scombridae				
<i>Scomberomorus brasiliensis</i> Collette, Russo and Zavala-Camin, 1978	4	2	CAR	WA
TETRAODONTIFORMES				
Monacanthidae				
<i>Stephanolepis hispidus</i> (Linnaeus, 1766)	1	1	OMNI	TA
Tetraodontidae				
<i>Sphoeroides spengleri</i> (Bloch, 1785)	36	10	SIF	WA

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