

## WRASSES (TELEOSTEI: LABRIDAE) OF THE AZORES

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In the Azores the family Labridae is represented by nine species. Some of these wrasses (*i.e.* *Coris julis* and *Thalassoma pavo*) are among the most abundant rocky shore fish. An identification key, based on single characters, is proposed. Eight species can be observed by scuba diving. The variation in body colour pattern can make their underwater identification difficult. For that reason we present colour photographs of littoral species. Otoliths and jaws are also illustrated. These drawings may assist the identification of stomach contents. Biometric and meristic data did not differ significantly when compared with data from other regions. The Azorean labrid fauna is similar to those of Madeira and the Canary islands. These three archipelagos are secondary assembled with a cluster formed by Mauritania and Gulf of Guinea. Morocco, Mediterranean and Portugal mainland form a compact bunch associated with Gulf of Biscay and British Isles. One species is amphiatlantic.

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Nos Açores a família Labridae está representada por nove espécies. Alguns destes bodiões (*i.e.* *Coris julis* e *Thalassoma pavo*) estão entre as espécies mais abundantes do litoral rochoso. Uma chave dicotômica baseada em caracteres simples é apresentada. Oito espécies podem ser observadas em mergulho subaquático. Devido a apresentarem uma grande variabilidade de padrões de coloração, algumas espécies, quando na natureza, são de difícil reconhecimento. Por isso, apresentam-se fotografias coloridas de algumas das espécies litorais. Otólitos e maxilas de todas as espécies estão ilustrados e ajudarão na identificação dos bodiões nos conteúdos estomacais. Não foram detectadas diferenças significativas entre a biometria e merística dos espécimens por nós observados e a informação bibliográfica disponível para outras regiões. A fauna de labrídeos dos Açores afecta-se principalmente com a da Madeira e Canárias. Uma segunda associação com a Mauritânia e Golfo da Guiné foi obtida. Marrocos, Mediterrâneo e Portugal continental formam um grupo compacto, que por sua vez se associa ao Golfo da Biscaia e Ilhas Britânicas. Uma espécie é anti-atlântica.

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### INTRODUCTION

The family Labridae is an important group of teleosts with a world-wide distribution in tropical, subtropical and temperate waters. They form the second largest family of marine fishes with at

least 60 genera and roughly 500 species (NELSON 1994). A synopsis of the systematic and biology of the European Labridae was presented by QUIGNARD (1966).

In the Azores the family is represented by 9 species. Some wrasses (*i.e.* *Coris julis* and

*Thalassoma pavo*) are among the most abundant fishes in the littoral of the Azores (PATZNER et al. 1992, PATZNER & SANTOS 1993).

Some species have commercial or gastronomic importance and are caught by local fishermen (MARTINS 1982).

There is no detailed review of the Labridae of the Azores. Despite their importance, the bulk of the literature concerning Azorean labrids are mainly checklists, records of their presence or related subjects (e.g. GUIMARÃES 1882; HILGENDORF 1888; REGAN 1903; FOWLER 1936; COLLINS 1954; ALBUQUERQUE 1954-56; QUIGNARD & PRAS 1986; PATZNER et al. 1992; ARRUDA et al. 1992; WIRTZ 1994). Exceptions are the ecological studies of tidal pools where juveniles of *C. trutta* appear (ARRUDA 1979, 1980; SANTOS et al. 1994), RODRIGUES (1995) who deals with data on reproduction and feeding of some labrids and the work of WOOD (1973) who described some underwater ethological observations of *C. julis* and *T. pavo*.

Corrections and standardization of the synonyms and misidentifications were the object of a review of the marine fishes of the Azores (SANTOS et al. in press).

In this paper we present a review of the Labridae occurring in the Azores based on literature, direct field observations and specimens sampled. For each species we give meristic and biometric data, a description of the body colour patterns and some ecological and biological notes. A taxonomic key, fish colour photographs and drawings of some hard structures (otoliths and jaws) are also presented. A discussion of the

biogeography of the Labridae in the eastern North Atlantic is given.

## MATERIAL AND METHODS

Several individuals of each species were collected and studied (Table 1). All fishes were caught in Faial, Pico, S. Jorge and S. Miguel islands. Depending on species habitat and biology, distinct methods of capture were used: handlines for *Acantholabrus palloni*, *Labrus bergylta*, *L. bimaculatus* and *Pseudolepidaplois scrofa*; dipnet for *C. julis*, *Symphodus* (*Crenilabrus*) *mediterraneus* and *T. pavo*; traps for *A. palloni*; spearguns for *C. trutta*, *C. julis*, *L. bergylta*, *P. scrofa* and *S. (C.) mediterraneus*.

Some of the specimens studied were fixed in 4% formaldehyde and preserved in 70% ethanol but the majority, however, were observed fresh.

Several taxonomic keys were used for fish identification namely those by FOWLER (1936), ALBUQUERQUE (1954-56), BLACHE et al. (1970), COLLIGNON & ALONCLE (1973), DELGADO (1981) and QUIGNARD & PRAS (1986).

The following publications were used for the most common vernacular names ICN (1993; Azores: Azo; Madeira: Mad; and Portugal mainland: Por), BRITO (1991; Canaries: Can), WHEELER (1992; U.K.: En), MICHEL et al. (1987; France: Fr) and DELGADO (1981; Spain: Sp).

Biometric measurements and meristic characters were taken according to HUBBS & LAGLER (1964). Measurements were taken with vernier callipers with a 0.01mm accuracy.

Table 1

Number of samples of labrids specimens observed by species, islands where they were caught and fish size range (TL: total length).

Species	Samples	Specimens	Locality (islands)	Size range (TL cm)
<i>A. palloni</i>	4	8	Faial; S. Miguel	21.2 - 34.0
<i>C. trutta</i>	11	64	Faial; S. Jorge	7.0 - 29.5
<i>C. julis</i>	4	13	Faial; S. Jorge; Pico	14.9 - 22.6
<i>L. bergylta</i>	6	13	Faial; S. Jorge; S. Miguel	25.0 - 46.5
<i>L. bimaculatus</i>	3	8	Faial; Pico	29.1 - 41.3
<i>P. scrofa</i>	5	5	Faial; S. Jorge; S. Miguel	1.1 - 68.8
<i>S. (C.) mediterraneus</i>	4	6	Faial; S. Jorge	6.1 - 24.3
<i>T. pavo</i>	2	9	Faial; Pico	10.5 - 20.2
<i>X. novacula</i>	3	3	Faial	19.3 - 20.2

Body colour patterns were described from underwater observations, freshly caught specimens and/or colour photographs and slides.

Data on geographical distribution was taken from BLACHE et al. (1970), COLLIGNON & ALONCLE (1973), WHEELER (1978), DELGADO (1981), FISHER et al. (1987), MICHEL et al. (1987), GOMON & FORSYTH (1990), BRITO (1991) and ICN (1993). Jaccard's coefficient was used as a similarity measure. The Azores was compared biogeographically to the following regions: Madeira (MAD), Canaries (CAN), British Isles (BRT), Gulf of Biscay (GBC), Portugal mainland (POR), Mediterranean (MED), Morocco (MOR), Mauritania (MAU) and Gulf of Guinea (GGN).

## RESULTS

### 1. SPECIES IDENTIFICATION

#### 1.1 Taxonomic key

Nine species of fish belonging to the family Labridae live around the Azores. Despite misidentifications found in literature, all of them are easily recognised. The following taxonomic key was created emphasising some distinctive features that allow an easy identification of specimens of wrasses.

- 1a Anal fin with four to six spines.....2
- 1b Anal fin with three spines.....3
- 2a Dorsal fin with 19-20 spines  
*Acantholabrus palloni*
- 2b Dorsal fin with 16-18 spines  
*Centrolabrus trutta*
- 3a Preoperculum edge smooth.....4
- 3b Preoperculum edge serrated  
*Symphodus (C.) mediterraneus*
- 4a Dorsal fin with more than 16 spines.....8
- 4b Dorsal fin with less than 16 spines.....5
- 5a Head profile close to vertical  
*Xyrichthys novacula*
- 5b Head profile normal.....6
- 6a Pectoral fin with more than 16 rays  
*Pseudolepidaplois scrofa*
- 6b Pectoral fin with less than 14 rays.....7

7a More than 60 scales along lateral line

*Coris julis*

7b Less than 35 scales along lateral line

*Thalassoma pavo*

8a Head shorter or equal to body depth

*Labrus bergylta*

8b Head length longer than body depth

*Labrus bimaculatus*

#### 1.2. Field identification based on colour photos.

Colour patterns of labrids are highly variable, depending on age, sex, reproductive season, habitat, etc. In the Azores it is possible to watch eight species by scuba diving. Some may be difficult to identify by a diver who is not familiar with this group of fishes. The photos represent some of the natural appearance of the species suitable to be observed by scuba diving in Azorean waters (Fig. 1).

#### 1.3. Identification of species hard structures: jaws and otoliths

Wrasses are prey items of several inshore predators as *Conger conger* (M. J. Gros 1995, pers.com.), *Epinephelus marginatus* (BARREIROS 1995; AZEVEDO et al. 1995), *Seriola rivoliana* (JPB pers. obs.) and *Serranus atricauda* (GOMES 1995). The necessity to identify food items justifies the description of some of the hard structures commonly used for prey identification: otoliths and jaws (Fig. 2 and 3). These bones can be useful for the identification of wrasses species because all are species specific.

### 2. SPECIES DESCRIPTIONS

#### 2.1 *Acantholabrus palloni* (Risso, 1810)

SYNONYMS FOR THE AZORES: None

COMMON NAMES: Bodião do alto (Azo); Truta do alto (Mad); Romero de hondura (Can); Bodião-vidrão (Por); Scale-rayed wrasse (En); Acantholabre (Fr); Tac Rocas (Sp).





Fig. 1. Underwater colour photographs of wrasses (Family Labridae) from the Azores. a: *Centrolabrus trutta* (♂); b: *Coris julis* (♂); c: *Labrus bergylta* (adult); d: *Labrus bimaculatus* (juvenile) and *Coris julis* (♀) (below); e: *Pseudolepidaplois scrofa* (♀); f: *Symphodus* (*Crenilabrus*) *mediterraneus* (♂); g: *Thalassoma pavo* (♀); h: *Xyrichthys novacula* (adult). Photographs a, b, c and e from Ricardo Serrão Santos; d from Frederico Cardigos; f, g and h from Peter Wirtz.

**BIOMETRY:** Body elongated and moderately compressed. Head equal or longer than body depth. Dorsal fin origin posterior to the end of the opercular bone. Eyes big. Snout less than 1/2 of head length. Dorsal length around 1/2 of total length.

**MERISTIC:** Two or three rows of canine-like teeth. The ones of the first row are longer and protruding (7-17/7-12). Upper lip with 4-5 folds. Lateral line with 39-41; 23-26 scales in transverse line; 4-5 scales on cheeks; inter-orbital region scaled. Scale rows extend on to membranes of dorsal, caudal and anal fins. Dorsal fin XIX-XXI + 9-10; anal fin IV-V + 7-8.

**COLOUR:** Pale brownish with undifferentiated clear areas. Each scale with a brown, or light brown, spot. Dark blotches on upper and lower parts of caudal peduncle and at the beginning of the soft dorsal fin. Lateral line darker. About five transverse bands along the upper sides, expanded dorsally towards the head. Belly whitish punctuated with brown specks. Head uniformly brown dorsally and laterally; clear ventrally. Snout with a bluish tone.

**GEOGRAPHICAL DISTRIBUTION:** Eastern Atlantic from southern Norway to Gabon. Azores, Madeira and Canary islands. Western Mediterranean.

**HABITAT AND VERTICAL DISTRIBUTION:** Fish living in bed rocks below 120 m. The lower bathymetric limit unknown.

**REPRODUCTION:** No data.

**FOOD:** Small benthic invertebrates (molluscs and crustaceans).

**LOCAL ABUNDANCE:** Occasionally observed mixed in landings but probably not abundant.

**SIZE:** Up to 34 cm TL.

**INTEREST TO FISHERIES:** None. Some times caught by local fishermen by bottom long-line. The species was caught also by shrimp traps.

## 2.2 *Centrolabrus trutta* (Lowe, 1833)

**SYNONYMS FOR THE AZORES:** *Acantholabrus romerus* by DROUËT (1861).

**COMMON NAMES:** Maracoto, Bodião verde (Azo); Truta verde (Mad); Romero, Barraco (Can).

**BIOMETRY:** Body ovoid and compressed laterally. Head smaller than body depth, deepest between

third and fourth dorsal ray. Dorsal fin origin rising near the posterior margin of the head and measuring slightly less than 1/2 of TL. Eye midway between tip of snout and edge of operculum. Snout conic not reaching 1/2 of head length.

**MERISTIC:** Teeth uniserial, conic and pointed (6-9/4-7). Lips with 4-6 folds. Lateral line with 34-38 scales; 21-27 scales in transverse line, 4-5 on cheeks, 1 behind the eye and 11-13 in the inter-operculum. Dorsal fin XVI-XVIII + 8-10 (rarely 10); anal fin IV-VI (rarely IV) + 7-9 (rarely 7); pectoral fin 13-14.

**COLOUR:** Young (less than 250 mm TL) show an irregular pattern of vertical greenish or brownish stripes (around 6), due to a dark spot on the scales, which are darker on the dorsal zone. These bands expand to both dorsal and anal fins. Longitudinal clearer stripe reaching from the eyes to the caudal fin. Dark blotch on the caudal peduncle between the 7th and 8th caudal rays and below the lateral line. Caudal fin base with a thin transversal stripe. Individuals bigger than 250 mm (TL) become progressively turquoise blue, beginning from the ventral region of the body, head and ventral fins, head, dorsal spines and eventually the whole body.

**GEOGRAPHICAL DISTRIBUTION:** Azores, Madeira, Canaries and possibly Cape Verde islands. Three exceptional records with a question mark from the south of France (QUIGNARD & PRAS 1986).

**HABITAT AND VERTICAL DISTRIBUTION:** Littoral fishes living around boulders and rocks covered with algae. Juveniles can be found in tidepools and in shallow waters over sand. Depths from 0 to 30 m, but most abundant between 2 to 15 m.

**REPRODUCTION:** Late spring and summer (RODRIGUES 1995; our observations). Benthic eggs. Males build nests with algae. Parental care.

**FOOD:** Small invertebrates such as microcrustaceans, molluscs, echinoderms. Algae, fish eggs and small fishes are also ingested.

**LOCAL ABUNDANCE:** Quite frequent; the third most common wrasse between 0 and 20 m. Adults generally isolated or in small groups, but juveniles can form schools with 20 or 30 fish.

**SIZE:** Up to 30 cm TL.

**INTEREST TO FISHERIES:** None.



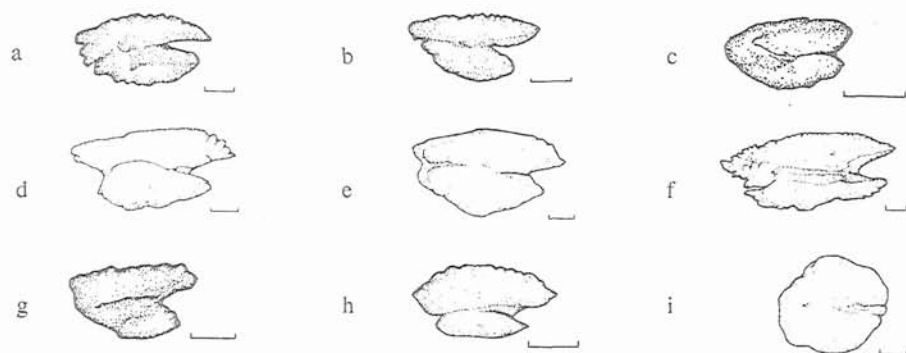


Fig. 2. Right otoliths of the species of labrids recorded for the Azores. a. *Acantholabrus palloni*; b. *Centrolabrus trutta*; c. *Coris julis*; d. *Labrus bergylta*; e. *Labrus binaculatus*; f. *Pseudolepidaplois scrofa*; g. *Symphodus (Crenilabrus) mediterraneus*; h. *Thalassoma pavo*; i. *Xyrichtys novacula*. Scale bar = 1mm. Drawings by JPB.

COMMENTS: This species has been confused with *Symphodus (Crenilabrus) melops*, probably due to a resemblance of colour patterns and body shape. However, the two species are easily distinguishable by the number of anal spines (IV-VI in *C. trutta* and III in *S. (C.) melops*). BARREIROS (1995) reported the occurrence of *C. trutta* in stomach contents of two dusky grouper *Epinephelus marginatus*.

### 2.3 *Coris julis* (Linnaeus, 1758)

SYNONYMS FOR THE AZORES: *Coris giofredi* by REGAN (1903); *C. julis melanura* by ROULE (1919); *Julis azurensis* by FOWLER (1919); *J. speciosa* by DROUËT (1861) and RAMOS (1869); *J. julis* by COLLETT (1896) and ZUGMAYER (1933).

COMMON NAMES: Peixe-rei, Lambaz (male), Torcida (female) (Azo); Peixe-rei (Mad); Carajillo real, Doncella, Señorita (Can); Judia (Por); Rainbow wrasse (En); Girelle (Fr); Julia, Doncella, Gallito de Rey (Sp).

BIOMETRY: Body elongated, fusiform and compressed. Head length longer than body depth and near  $\frac{1}{5}$  of TL. Head longer than high. Snout length between  $\frac{1}{3}$  and  $\frac{1}{4}$  of the head. Dorsal fin rising near the posterior margin of the head and longer than  $\frac{1}{2}$  of TL.

MERISTIC: Teeth uniserial (9-14/11-14). The anterior ones more developed than the others on both jaws. A hidden canine posteriorly on both sides

of the upper jaw. Lips with 4-6 folds. Lateral line with 70-76 scales; 41/2-61/2 scales above lateral line and 25-28 below it; cheeks scaleless. Dorsal fin IX + 12; anal fin III + 12-13; pectoral fin 13.

COLOUR: Males, juveniles and females show considerable differences in colouration. Juveniles and females with a series of longitudinal lines. Above the lateral line they have a dark line and below a strong pinkish stripe and a yellow band, with greyish punctuations on each scale, its origin at the pectoral fin base. Another pink line appears ventrally. Belly light pink becoming yellowish posteriorly. Head with the same pattern but with a blue and black spot on the posterior gill cover. Dorsal fin anteriorly orange becoming yellow at the margin. Anal fin with the same colour pattern as the dorsal fin. Blue spot on the pectoral insertion. Pectorals with pink rays. Caudal fin yellow, black and pink. Males dorsally dark green and black posterior to the anus region. Anteriorly, they can be either green, violet or greyish blue just at the pectoral. Posteriorly, this band expands to the caudal fin and a yellow colour becomes evident. Belly orange or yellow and light pink. Operculum with a blue spot. Head dorsally pink, green and violet with lips red and pink. Green ring surrounding the eyes. Blue and black spot at the pectoral insertion. Anal with longitudinal yellow, blue, orange and pink stripes from the margin to the body. Dorsal fin pinkish with the first three spines black and orange at the margin.

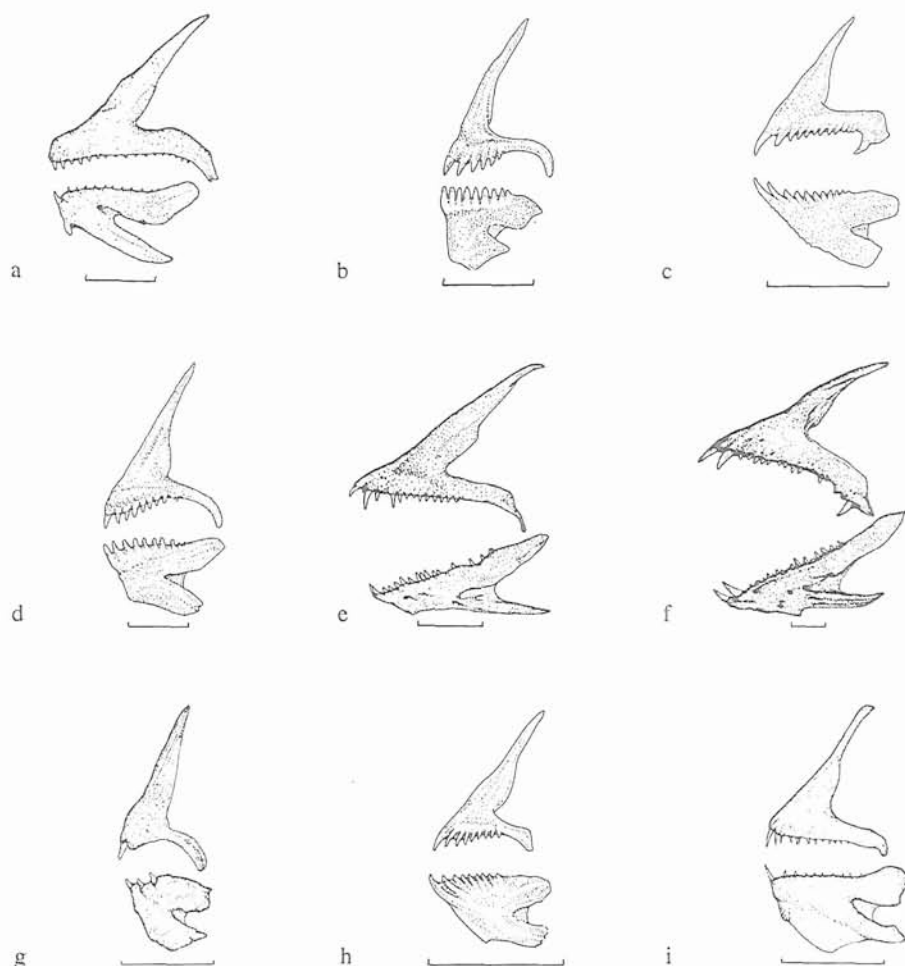


Fig. 3. Jaws of labrid species recorded for the Azores. a. *Acantholabrus palloni*; b. *Centrolabrus trutta*; c. *Coris julis*; d. *Labrus bergylta*; e. *Labrus bimaculatus*; f. *Pseudolepidaplois scrofa*; g. *Symphodus (Crenilabrus) mediterraneus*; h. *Thalassoma pavo*; i. *Xyrichthys novacula*. Scale bar = 1cm. Drawings by JPB and L. Gallagher.

**GEOGRAPHICAL DISTRIBUTION:** From Sweden and British Isles to Gabon. Azores, Madeira and Canaries. Mediterranean and southern Black Sea.

**HABITAT AND VERTICAL DISTRIBUTION:** Littoral inshore fish living on rocky bottoms or around boulders with or without sand. Depths from 0 to 100 m.

**REPRODUCTION:** According to RODRIGUES (1995) *C. julis* reproduce during the spring and summer. Pelagic eggs. Hermaphroditism protogynic.

**FOOD:** Small benthic invertebrates such as amphipods, isopods and gastropods. Algae have also been found in stomachs (RODRIGUES 1995).

**LOCAL ABUNDANCE:** The most common wrasse at depths between 15 and 30 m. Juveniles and females form schools up to 50 individuals. Males often solitary but they may also form small schools.

**SIZE:** Up to 23 cm TL.

**INTEREST TO FISHERIES:** Highly appreciated by local population. Frequently caught on a

subsistence basis in all islands, mainly during the winter months. A small target commercial fishery exists on S. Miguel island.

COMMENTS: A large school of males was observed in a shallow seamount off the coast of Pico island (Baixa do Canal) on 21st June, 1995. This was our first observation of such a concentration. This species hide under rocks and crevices during night (see WOOD 1973).

#### 2.4 *Labrus bergylta* Ascanius, 1767

SYNONYMS FOR THE AZORES: *Labrus bergylta* by FOWLER (1936) and COLLINS (1954); *L. maculatus* by VAILLANT (1919).

COMMON NAMES: Bodião vermelho (Azo); Truta vermelha (Mad); Romero capitán, Bullón real, Empedrado (Can); Bodião reticulado, Burrinho manso (Por); Ballan wrasse (En); Grande vieille (Fr); Maragota, Durdo (Sp).

BIOMETRY: Body oblong, compressed with strong caudal peduncle. Head length shorter or equal to body depth. Snout not reaching  $\frac{1}{2}$  of head length. Predorsal length smaller than  $\frac{1}{3}$  of TL. Depth of soft dorsal fin slightly longer than its length. Length of dorsal fin less than  $\frac{1}{2}$  of TL.

MERISTIC: Juveniles with one row of teeth. A second row with 2-3 small teeth is often present in adults. First row with canine-like teeth (8-11/7-10). Front teeth longer than all the others, more evident in adults. Lips with 6-8 folds. Lateral line with 41-45 scales; transverse line with 24-28 scales; 6-8 scales on cheeks; 1-3 on the interoperculum; inter-orbital region scaleless. Gill rakers 18-20. Dorsal fin XIX + 11-12; anal fin III + 9-11; pectoral fin 13-14.

COLOUR: The colour patterns of these wrasses are highly variable. However, the body, head and fins are usually reddish. Darker on the dorsal body region where each scale shows a bluish spot, more obvious in the posterior region. Head dorsally uniform red. Ventral region of the body with reddish spots becoming clearer anteriorly to the pelvic insertion. Some specimens have gold reflections in the dorsal region and pink ones in the ventral zone, while others show a longitudinal clearer stripe along the median region of the body. Upper lip light red or orange. Dorsal fin reddish with bluish spots more evident in the soft part.

Base of the fins greyish blue. Eyes red, blue and yellow.

GEOGRAPHICAL DISTRIBUTION: From Norway to Morocco. Azores, Madeira and Canary Islands. South-western Mediterranean.

HABITAT AND VERTICAL DISTRIBUTION: Near rocks, boulders or rocky/sandy bottoms with algae cover. Juveniles tend to remain in shallower waters. Depths from 0 to 80 m. More frequent in depths above 15 m.

REPRODUCTION: Winter. Eggs benthic in nests. Parental care.

FOOD: Small invertebrates such as equinoderms, molluscs and crustaceans.

LOCAL ABUNDANCE: The fifth most common wrasse in littoral rocky shores. Usually solitary but they can form small groups of 2-3 individuals. Males appear to be more solitary.

SIZE: To 45 cm TL.

INTEREST TO FISHERIES: A traditional winter fishery directed to the species exist in all islands.

COMMENTS: *Labrus merula* is a related species cited for the Azores by several authors (e.g. HILGENDORF 1888, SAMPAIO 1904, FOWLER 1936, RIBEIRO 1936, ALBUQUERQUE 1954-56, MICHEL et al. 1987). However, we never found it and do not confirm its occurrence in the Azores presuming that the citations of this species are misidentifications for *L. bergylta* (see SANTOS et al. in press).

#### 2.5 *Labrus bimaculatus* Linnaeus, 1758

SYNONYMS FOR THE AZORES: *Labrus maculatus* by VAILLANT (1919); *L. mixtus* by GUIMARÃES (1882), HILGENDORF (1888), REGAN (1903), WOOD & WILLIAMS (1974), WOOD (1973) and WHEELER (1978).

COMMON NAMES: Peixe-rei-do-alto, Canário (Azo); Bodião-canário (Por); Cuckoo wrasse (En); Coquette (Fr); Gayano, Pastenaga (Sp).

BIOMETRY: Body elongated and slightly compressed laterally. Head longer than body depth, usually longer than  $\frac{2}{3}$  of the head height. Dorsal fin origin near the posterior margin of the head. Dorsal fin length smaller than  $\frac{1}{2}$  of TL.

MERISTIC: Teeth conical, well separated and more pointed on the pre-maxilla (12-19/11-14). Often two rows anteriorly in jaws, the second row



having smaller more numerous teeth which are not equally distributed. Four anterior teeth higher and canine-like. Lips with 6-8 folds. Lateral line with 46-50 scales; transverse line with 32-38 scales and  $7\frac{1}{2}$ - $8\frac{1}{2}$  above lateral line; 8-9 scales on cheeks. Dorsal fin XVII-XIX + 13-14; anal fin III + 12-13; pectoral fin 15-16.

**COLOUR:** Different colour patterns in juveniles, females and males. Young and females are bright orange, becoming paler ventrally. Two prominent dark blotches under the soft dorsal region plus a third blotch at the upper caudal peduncle. More blotches (1-3) may appear along dorsal fin base. Dorsal, anal and caudal fins are margined with greyish blue. Snout and dorsal part of the head with grey-blue patches. Males are blue and yellow, the head being blue with yellow stripes and blotches and a yellow ring around the eyes. They also present a large blue longitudinal stripe that begins at the region of pectorals insertion. Spiny dorsal fin is blue and soft part yellow. Pectorals, pelvics and caudal fins bordered by a semi-lunate blue band.

**GEOGRAPHICAL DISTRIBUTION:** From Norway to Senegal. Iceland, Greenland. Azores, Madeira and Canaries. Mediterranean but absent from the Black Sea.

**HABITAT AND VERTICAL DISTRIBUTION:** Inshore waters on bed rock. Depths from 10 to 200 m. More abundant below 80 m.

**REPRODUCTION:** Juveniles (ca. 5 cm TL) observed during late August and September.

**FOOD:** Juveniles have been seen grazing on benthic organisms in rocky substratum. Benthic invertebrates.

**LOCAL ABUNDANCE:** No data.

**SIZE:** To 41 cm TL.

**INTEREST TO FISHERIES:** Occasionally caught by local fishermen.

**COMMENTS:** In the Azores, this species seems to live deeper compared with other places where it occurs. Only recently we have observed a few juvenile individuals at shallower depths (15 m and below), around Faial island.

## 2.6 *Pseudolepidaplois scrofa* (Valenciennes, 1839)

**SYNONYMS FOR THE AZORES:** *Bodianus scrofa* by GOMON & FORSYTH (1990), DOOLEY et al.

(1985) and ARRUDA et al. (1992); *B. speciosus* by MARTINS (1982); *Cossyphus scrofa* by HILGENDORF (1888); *Crenilabrus caninus* by COLLINS (1954); *Diastodon speciosus* by COLLINS (1954), ALBUQUERQUE (1954-1956), WOOD & WILLIAMS (1974), HARMELIN & HARMELIN-VIVIEN (1979), RÊ (1979), SALDANHA (1980), INIP (1985) and DIAS (1991); *Trochocopus scrofa* by GUIMARÃES (1884).

**COMMON NAMES:** Peixe cão, Gaio, Viola (Azo); Peixe cão (Mad); Pejeeperro (Can).

**BIOMETRY:** Body elongated and compressed. Head length almost equal to body depth. Dorsal fin raising at the posterior level of the head. Eye diameter comprised 7 to 8 times in head length. Dorsal fin base around 40% of TL. Interorbital and snout scaleless.

**MERISTIC:** Canine-like teeth (20-22/13-14) and 1 hind canine; 7 folds in lips. Lateral line with 44-48 scales; transverse line with 28-30 scales. Dorsal fin XII + 10-11; anal fin III + 12-13; pectoral fin 16-17.

**COLOUR:** Distinct sexual dimorphism. Males: Body uniform pinkish to reddish, sometimes with a stronger longitudinal red stripe alongside the flanks. Narrow yellow lines on snout and posteriorly to the eyes. Pectoral fin red. Caudal fin yellow on dorsal and ventral rays, bluish (live specimens) to reddish in the middle rays, black ridges between them. Dorsal fin red and pinkish with narrow yellow lines alongside spines and rays and with a blue blotch on the first 5 spines. Anal and pelvic fins red. Blue circle along the anus. Females: Head and dorsal part of the body red; belly yellow until the posterior limit of anal fin; head yellow ventrally; preoperculum with darker stripes; dark striped blotch stretching from the anus until the middle of the body, anus blue and black; pectoral rays orange; first three rays of pelvic fins yellow, the others whitish; anal fin yellow with black dots until the 6th ray; first three external rays of caudal fin red, the others yellow and interradyal spaces black; dorsal spines margined with red, interradyal membranes yellow; dorsal rays yellow and interradyal dark green anteriorly and black on the last three rays; oval blue blotch until the 5<sup>th</sup> spine; posterior margin of operculum dark green; "U" shaped dark

green list between anterior nostrils; posterior margin of body scales dark. Juveniles: Body dark with whitish spots across the whole body forming an irregular pattern which is more clear ventrally. Dorsal fin white posteriorly and darker anteriorly. Caudal fin whitish with some black radial lines. The remaining fins are uniformly clear. A "U" shaped white band between anterior nostrils.

**GEOGRAPHICAL DISTRIBUTION:** Azores, Madeira, Canaries and Cape Verde islands. BLACHE et al. (1970) cite the species for the African tropical Atlantic, without any remarks. LLORIS et al. (1991) cite the occurrence of this species from the African coast adjacent to the Canaries.

**HABITAT AND VERTICAL DISTRIBUTION:** On rocky bottoms or in large caves. Frequently found near shallow seamounts. Depths from 15 to 150 metres.

**REPRODUCTION:** Juveniles seen in July and August.

**FOOD:** Invertebrates (e.g. gastropods, bivalves, sea urchins and decapods).

**LOCAL ABUNDANCE:** Rare near the coast, more frequently observed by scuba diving in summer. Solitary or in groups of 2 or 3 individuals (one male and females).

**SIZE:** Normally up to 70 cm but it can reach 90 cm TL.

**INTEREST TO FISHERIES:** Occasionally caught as bycatch of demersal fisheries. Caught by speargun divers.

**COMMENTS:** This is the largest wrasse occurring in the Azores. Juveniles occur at depths below 15 m, generally in pairs or triplets. Juveniles exhibit a characteristic colour pattern and the body proportions are quite different from the adults. One specimen (101 mm TL) was caught by Norberto Serpa at Pedrinha, Sta. Maria Island, on the 11th of July 1996, where several individuals were observed. WIRTZ (1994) took a photograph that "... shows what is probably the so far undescribed juvenile colour of the species." The surmise of the author is here confirmed.

## 2.7 *Symphodus (Crenilabrus) mediterraneus* (Linnaeus, 1758)

**SYNONYMS FOR THE AZORES:** *Crenilabrus mediterraneus* by VAILLANT (1919), ZUGMAYER

(1933), COLLINS (1954) and ALBUQUERQUE (1954-1956); *C. (Symphodus) mediterraneus* by WOOD & WILLIAMS (1974); *S. mediterraneus* by FOWLER (1936), COLLIGNON & ALONCLE (1973), HARMELIN & HARMELIN-VIVIEN (1979), RÉ (1990) and WIRTZ (1994).

**COMMON NAMES:** Costureira, Trombetão (Azo); Trombetão (Mad); Bodião do Mediterrâneo (Por); Axillary wrasse (En); Crénilabre méditerranéen (Fr); Vaqueta, Porcellana (Sp).

**BIOMETRY:** Body moderately oblong. Head length smaller than body depth but bigger than its height. Eyes large. Dorsal fin origin before the end of the opercular bone. Dorsal fin longer than 1/3 of TL.

**MERISTIC:** Teeth (1/3-5). No folds in lips. Lateral line with 34-38 scales; 1 scale behind the eye. Dorsal fin XVII + 9; anal fin III + 9.

**COLOUR:** Pronounced sexual dimorphism. Both sexes present typical dark blotches on the pectoral insertion and on the upper caudal peduncle. Females and juveniles with 6 reddish vertical irregular bands, darker dorsally, which continue to both dorsal and anal fins. Belly pale. Caudal fin base with a vertical red line. Head dorsally dark red with lighter lips. Females with a urogenital blue papilla. Males more conspicuously coloured. Pectoral fins yellow, the others being electric blue on their basis. Pectoral base blotch surrounded by a yellow ring. Eyes yellow. Blue lines over the head, along lateral line and on the snout.

**GEOGRAPHICAL DISTRIBUTION:** From the north of Portugal to Morocco. Azores, Madeira and Canaries. Mediterranean and Marmara Seas.

**HABITAT AND VERTICAL DISTRIBUTION:** Littoral fish living close to boulders with or without sand and in rocky bottoms. Depths from 1 to 50 m (more common below 10 m).

**REPRODUCTION:** During summer. Territorial males show an exuberant coloration. They build more than one nest, several metres apart, courting 2-3 females simultaneously. Nests are built with algae in small depressions on the top of rocks. They transport the algae in the mouth. Hermaphroditism protogynic.

**FOOD:** Small invertebrates.

**LOCAL ABUNDANCE:** Common. In some restricted areas it is more abundant than *C. trutta*.

**SIZE:** To 25 cm TL.

## 2.8 *Thalassoma pavo* Linnaeus, 1758

SYNONYMS FOR THE AZORES: *Julis pavo* by DROUËT (1861), RAMOS (1869), HILGENDORF (1888), REGAN (1903), VAILLANT (1919), NOBRE (1924, 1930), ALBUQUERQUE (1954-1956) and ZUGMAYER (1933).

COMMON NAMES: Rainha (Azo); Peixe verde (Mad); Pejeverde, Guelde (Can); Bodião verde (Por); Ornate wrasse (En); Paon (Fr); Pez verdoso, Fadrí, Fredi (Sp).

BIOMETRY: Body slightly elongated and compressed. Body depth almost equal to head length. Head depth about  $\frac{3}{4}$  of its length. Eye diameter less than  $\frac{1}{6}$  of head length. Pre-dorsal length slightly longer than head. Anal fin longer than  $\frac{1}{2}$  of dorsal fin.

MERISTIC: Two front teeth in both jaws curved and larger than the others (9-13/10-13). Some individuals have an anterior second row of small teeth. Upper lip with 6-8 folds; inferior lip with 3-4 folds. Gill rakers 16-17. Lateral line with 27-31 scales; transverse line with 31/2-12-14 scales; cheeks scaleless. Dorsal fin VIII + 13; anal fin III + 11; pectoral fin 14.

COLOUR: Accentuated sexual dimorphism. Females and juveniles yellowish with vertical green stripes due to the pigmentation of scale margins. The anterior region of the dorsal is light grey. Five blue transverse bands finishing at the pectoral level. Dark blotch within the second and third blue bands. Ventral region greyish blue from the head to the caudal peduncle or to the anal fin. Dorsal fin with longitudinal stripes (reddish, blue and brown) with the margin of the three first spines green and the others blue. Anal fin greyish blue, blue and red with green longitudinal stripes. Caudal with brown and blue rays. Dark patch on the pectoral insertion. Head with 5-6 irregular blue lines rising from the eyes. Males show a similar colour but lack the five blue bands and have a large vertical blue band behind the pectoral fin, bordered by two reddish narrower bands. First dorsal spines are blue and green with a prominent reddish spot. Head with a blue tonality darker than that of females.

GEOGRAPHICAL DISTRIBUTION: From Portugal to Gabon. Azores, Madeira and Canaries. Mediterranean.

HABITAT AND VERTICAL DISTRIBUTION: Littoral fish surrounding boulders with or without sand. During daytime they swim generally at 10 to 30 cm from the substratum. Individuals bury themselves in sand or fine gravel during the night. Depths from 0 to 50. Also present in large tidal pools.

REPRODUCTION: In the Azores the reproductive period is between May and September (RODRIGUES 1995). Pelagic eggs. Hermaphroditism protogynic.

FOOD: Small invertebrates such as crustaceans, molluscs, echinoderms and polychaetes. Also an active predator of benthic eggs.

LOCAL ABUNDANCE: The most abundant species in rocky littoral bottoms. At depths between 15 m and 30 m *C. julis* is slightly more abundant. Juveniles and females form schools with 2 to 100 fish while males are solitary, associated in small groups or amongst the females and juveniles.

INTEREST TO FISHERIES: Highly appreciated as food by local population. Frequently caught (with *C. julis*), on a subsistence basis in all islands, mainly during the winter months. A target fishery exist on S. Miguel island.

SIZE: Up to 20 cm TL.

COMMENTS: Fish of this species were observed in cleaning behaviour on *Boops boops* (JPB pers. obs.). This behaviour has been reported for *T. pavo* in other areas e.g. in the Mediterranean and Canary Islands but for the Azorean population it has been rarely observed (see VAN TASSELL et al. (1994) for an update of the cleaning behaviour).

## 2.9 *Xyrichtys novacula* (Linnaeus, 1758)

SYNONYMS FOR THE AZORES: *Novacula cultrata* by HILGENDORF (1888) and REGAN (1903); *Xyrichtys novacula* by COLLINS (1954).

COMMON NAMES: Bodião da areia (Azo); Peixe papagaio (Mad); Pejepeine, Baqueta (Can); Mordedor (Por); Cleaver wrasse, Pearly razorfish (En); Rason (Fr); Raó, Galán (Sp).

BIOMETRY: Body highly compressed laterally. Body depth greater than head length. Head higher than longer with an anterior profile almost vertical. Snout short. Dorsal length more than  $\frac{1}{2}$  of TL.

MERISTIC: Jaws (10-13/9-10) with two curved



canine-like teeth anteriorly. Lateral line with 20 + 7-20 + 9 scales; transverse line with 16-17 scales; 2 scales on cheeks. Dorsal fin IX-X + 12; anal fin III + 11; pectoral fin 11.

COLOUR: Pinkish. One bluish vertical line per vertical row of scales. Blue lines also present over the head. Dorsal and anal fins with small bluish spots or lines. Males are more reddish than females and juveniles.

GEOGRAPHICAL DISTRIBUTION: Both sides of the Atlantic. In the eastern Atlantic from Portugal to the Gulf of Guinea and the Mediterranean. Madeira, Canaries and Santa Helena.

HABITAT AND VERTICAL DISTRIBUTION: Sandy bottoms. All specimens sampled were found at depths ranging between 8 to 10 m.

REPRODUCTION: No data.

FOOD: All specimens sampled had mainly shells of the bivalve *Ervillia castanea* in the stomach.

LOCAL ABUNDANCE: The apparently rare occurrence of this species is due to the fact that its

habitat and behaviour make observations difficult since they burrow quickly under the sand when a diver approaches.

SIZE: Sampled up to 20 cm.

### 3. BIOGEOGRAPHY OF THE NORTHEASTERN ATLANTIC AND MEDITERRANEAN LABRIDAE

Twenty four species of Labridae are reported for the north-eastern Atlantic including the Mediterranean sea. Wrasse diversity is low in the northern and southern boundaries of the area considered (8 species in British Isles and 5 at the Equator) reaching a maximum (19 species) at Mediterranean (Fig 4). Figure 5 shows the latitudinal distribution of the 9 species occurring in the Azores. The average latitudinal distribution range calculated for Azorean species is higher (40°) than the average value found for all the wrasses present in the north-east Atlantic (23°).

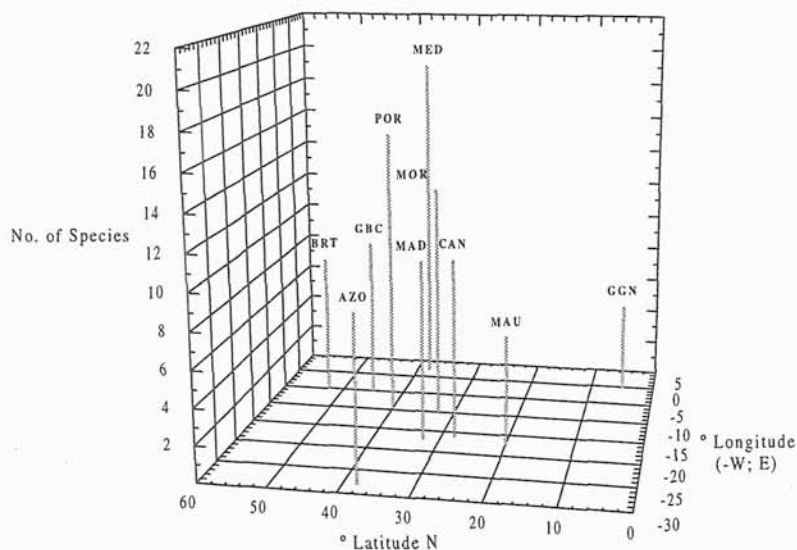


Fig. 4. Number of species of Labridae reported for selected areas of the north-east Atlantic. (AZO - Azores; MAD - Madeira; CAN - Canaries; BRT - British Isles; GBC - Gulf of Biscay; POR - Portugal mainland; MED - Mediterranean; MOR - Morocco; MAU - Mauritania; GGN - Gulf of Guinea).

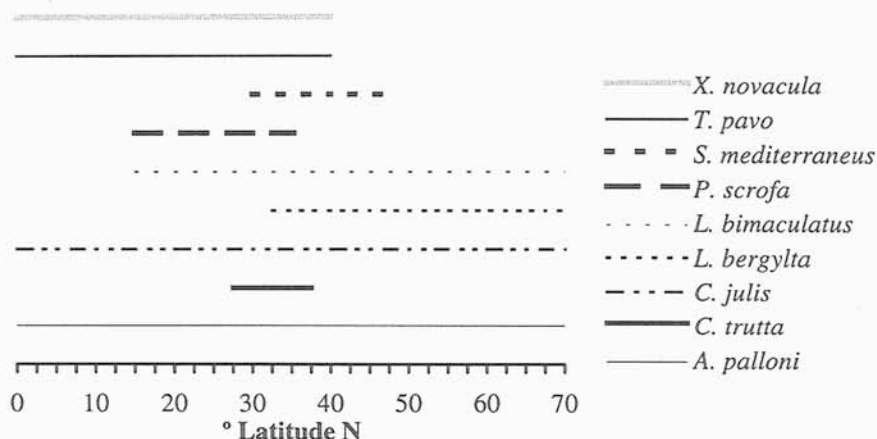


Fig. 5. Latitudinal distribution of labrid species present in the Azorean waters.

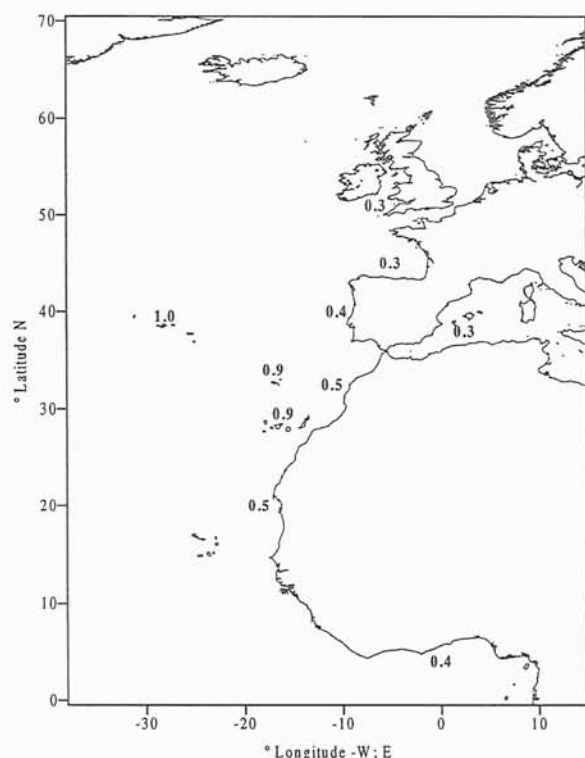


Fig. 6. Jaccard's coefficient as a similarity index concerning labrids of the Azores and other areas of the north-east Atlantic (Madeira, Canaries, British Isles, Gulf of Biscay, Portugal mainland, Mediterranean, Morocco, Mauritania and Gulf of Guinea).

All species recorded for the Azores are also present in Madeira and the Canaries. However, *Lapanella fasciata* (as *Ctenolabrus iris* by MAUL (1948)) which occurs in these more southern archipelagos, has not been reported for the Azores. Except for *C. trutta* (and probably *P. scrofa*) which is endemic of the Macaronesia, the remaining species also inhabit the shores of Europe and/or Africa.

As expected, the Atlantic islands show a marked affinity. This similarity is represented by a high value of the Jaccard's coefficient calculated between the Azores and Madeira/Canaries. An intermediate value of the index was determined between the Azores and the shores of Morocco and Mauritania and the lowest values when Mediterranean, the Gulf of Biscay and the British Isles were considered (Fig. 6). The cluster analysis indicates a compact group between the three archipelagos which are secondary associated with Mauritania and the Gulf of Guinea. The Mediterranean, Portugal and Morocco are assembled together and linked to the Gulf of Biscay and British Isles (Fig. 7).

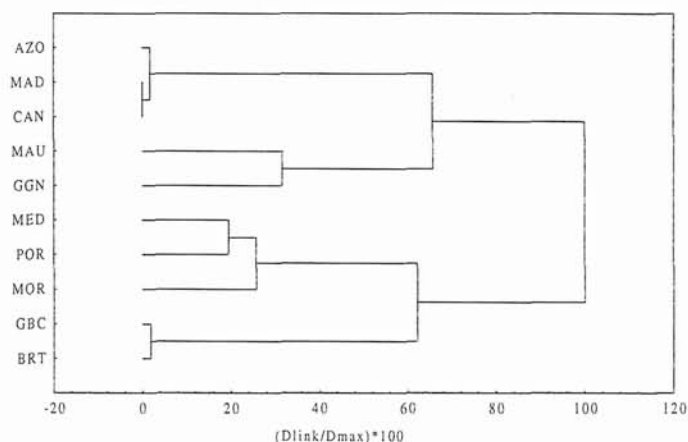


Fig. 7. Cluster analysis based on the Jaccard's coefficient calculated using the Labridae fauna of selected area of the northeast Atlantic (AZO - Azores; MAD - Madeira; CAN - Canaries; BRT - British Isles; GBC - Gulf of Biscay; POR - Portugal mainland; MED - Mediterranean; MOR - Morocco; MAU - Mauritania; GGN - Gulf of Guinea).

The only amphiatlantic species is *X. novacula* (Linnaeus, 1758) commonly named in the western Atlantic as *Hemipteronotus novacula* (Linnaeus, 1758).

## DISCUSSION

Labridae constitutes an important family of inshore fish in the Azores. Some species, as *C. julis* and *T. pavo*, are amongst the most abundant fish in the littoral of the islands (PATZNER & SANTOS 1993). Despite the few information available these two species seem also to be quite abundant in Madeira (ANDRADE & ALBUQUERQUE 1995). In Canary Islands the ornate wrasse, *T. pavo*, is by far the most abundant fish nearshore but *C. julis* is not very common (BORTONE et al. 1991). Efforts should be made to evaluate the ecological role of these species in the structure and dynamic of the Azorean littoral ecosystem as well as compilation of consistent biological data to define their life cycles in the area.

## SPECIES IDENTIFICATION AND DESCRIPTION

The taxonomic key proposed for the identification of the labrids of the Azores, is based on single

characters. It was established to allow a ready identification.

No marked differences were found between the morphometry, meristic or colour pattern of our specimens and others from different regions. Those detected (e.g. one extra soft ray in the anal fin of *L. bimaculatus* or the presence of a ventral dark blotch on the caudal peduncle of *A. palloni*) are not powerful enough to define or split populations. However, it would be pertinent to evaluate the level of genetic variation and/or separation within the Azorean "populations" and between these populations and those from elsewhere.

With their multicoloured body pattern this family are interesting fishes for aquaria (see MICHEL et al. 1987) as well as for scuba divers and underwater photographers (see WIRTZ 1994). However, to identify visually these species is sometimes difficult and some species can be confused. Recent misidentifications have probably been caused by the diversity of colour patterns of some species or to the resemblance with other species that do not occur in the area (e.g. *Centrolabrus trutta* with *Symphodus melops* or *Labrus bergylta* with *L. merula*). Also, variations of the terminal colour pattern of some species from different regions have been described, e.g. *C. julis* Atlantic type and



Mediterranean type by WOOD & WILLIAMS (1974) and LAURENT & LEJEUNE (1988).

Since wrasses are among the most abundant littoral fishes, they represent a higher biomass available for the subsequent trophic level. Despite inadequate efforts in the study of feeding ecology of littoral species, several predators are known to include labrids in their diet. The understanding of the trophic web of this interchangeable ecosystem (oceanic *versus* littoral) is of major importance.

#### BIOGEOGRAPHY OF THE NORTHEASTERN ATLANTIC AND MEDITERRANEAN LABRIDAE

Only two species of wrasses are endemic of the north-eastern Atlantic islands. All the others also occur in the continental shores of Europe and/or Africa. The small endemism of these archipelagos suggest a recent (re)colonisation (BRIGGS 1974). The concepts supporting the colonisation pathways of the Azores are based on the actual system of ocean circulation and are discussed by SANTOS et al. (1995, in press).

The strong resemblance found between the Macaronesian archipelagos was expected. Also, the important ichthyogeographic affinities of the Azorean coastal fishes with the north-western coast of Africa has been reported by SANTOS et al. (1995). Despite the inaccuracy of the checklists used by LLORIS et al. (1991) they found a high influence of Equato-Guinean species in the fish fauna of the area studied (Macaronesia). However, it should be noted that seven species occurring in the Azores (all minus the two endemics of the oceanic archipelagos) are present also in mainland Portugal. The high diversity of wrasses present in the Mediterranean and the adjacent regions (Portugal and Morocco) and the low diversity reported for the African coast (except Morocco) may mask the true affinity of the Azores with these regions.

The wrasses occurring in the Azores show an average latitudinal distribution greater than those from the north-east Atlantic coasts. This fact supports the idea that the Azores were colonised by species with a wide distribution range and great capacity for dispersal (see SANTOS et al. 1995)

In the Canary Islands *P. scrofa* and *L. bergylta* are included in Red List as, endangered (C) and vulnerable (V), respectively (BACALLADO et al. 1989). Azorean labrids are not included in Red Book of Portuguese marine fish (ICN 1993).

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#### REFERENCES

- ANDRADE, C.A.P. & F.M.M. ALBUQUERQUE 1995. Fish assemblages associated with bottom habitats on the south coast of Madeira. Proceedings of the 1<sup>st</sup> Symposium of "Fauna & Flora of the Atlantic Islands". *Boletim do Museu Municipal do Funchal*. Suplemento 4, Parte A: 9-22.
- ALBUQUERQUE, R.M. 1954-1956. Peixes de Portugal e Ilhas Adjacentes - Chaves para a sua determinação. *Portugaliae Acta Biologica* (B), Vol. V: 1-1164.
- ARRUDA, L.M. 1979. On the study of a sample of fish captured in the tidal range at Azores. *Boletim da Sociedade Portuguesa de Ciências Naturais* 19: 5-36.
- ARRUDA, L.M. 1980. On the adjustment of the Motomura's model to populations of intertidal fish on the Portuguese and Azorean coasts. *Arquivos do Museu Bocage*. 2<sup>a</sup> Série 7(19) 19: 339-348.
- ARRUDA, L.M., J.N. AZEVEDO, P. C. HEEMSTRA & A. I. NETO 1992. Checklist of the fishes on the "Santa Maria and Formigas 1990: Scientific expedition". *Arquivos do Museu Bocage Nova Série* 2(12): 263-273.
- AZEVEDO, J.N., J.B. RODRIGUES, M. MENDIZABAL & L.M. ARRUDA 1995. Study of a sample of dusky grouper, *Epinephelus marginatus* (Lowe, 1934), caught in a tide pool at Lages do Pico, Azores. Proceedings of the 1<sup>st</sup> Symposium of "Fauna &

- Flora of the Atlantic Islands". *Boletim do Museu Municipal do Funchal*. Suplemento 4, Parte A: 55-64.
- BACALLADO, J.J., T. CRUZ, A. BRITO, J. BARQUIM & M. CARRILLO 1989. *Reservas Marinas de Canarias*. Cosejería de Agricultura y Pesca. Gobierno de Canarias, 200 pp.
- BARREIROS, J.P. 1995. Aspectos do comportamento e da reprodução do mero *Epinephelus marginatus* (Lowe, 1834), nos Açores. Provas de Aptidão Pedagógica e Capacidade Científica. Departamento de Ciências Agrárias, Universidade dos Açores, Angra do Heroísmo, 95pp.
- BLACHE, J., J. CADENAT & A. STAUCH 1970. Clés de détermination des poissons de mer signalés dans l'Atlantique oriental (entre le 20° parallèle nord et le 15° parallèle sud). *Faune tropicale* Vol. XVIII. Office de la Recherche Scientifique et Technique Outre Mer, 479pp.
- BORTONE, S.A., J. VAN TASSELL, A. BRITO, J.M. FALCÓN & C.M. BUNDRICK 1991. A visual assessment of the inshore fishes and fishery resources off El Hierro, Canary Islands: A baseline survey. *Scientia Marina* 55(3): 529-541.
- BRIGGS, J. C. 1974. *Marine Zoogeography*. McGraw-Hill Book Company, xi + 475 pp.
- BRITO, A. 1991. *Catálogo de los Peces de las Islas Canarias*. Francisco Lemus, La Laguna, 230pp.
- COLLETT, R. 1896. Poissons provenant des campagnes du yacht L'Hirondelle (1885-1888). *Résultats des Campagnes Scientifiques Accomplies sur son Yacht par Albert Ier Prince Souverain du Monaco*, Fascicule X, Imprimerie du Monaco: 1-198 (+ 6 plates).
- COLLIGNON, J. & H. ALONCLE 1973. Catalogue raisonné des poissons des mers marocaines. *Bulletin de l'Institut des Pêches Maritimes*. 2ème partie 21: 1-267.
- COLLINS, B.L. 1954. Lista de peixes dos mares dos Açores. *Açoreana* 2(5): 1-40.
- DELGADO, F.S. 1981. Contribucion al conocimiento de los labridos (Familia Labridae) de las costas ibéricas. Parte I: descripción de las especies. *Boletín del Instituto Español de Oceanografía*, 6(3) 303:19-57
- DIAS, M.L. 1991. Pesca exploratória com palangre em águas dos grupos central e oriental do Arquipélago dos Açores (1979-1983). *Relatórios Técnicos e Científicos do INIP*, Lisboa (46) Novembro 1991. 26pp.
- DOOLEY, J.K., J.V. TASSELL & A. BRITO 1985. An Annotated Checklist of the Shorefishes of the Canary Islands. *American Museum Novitates* 2824: 1-49.
- DROUËT, H. 1861. *Éléments de la Faune Açoréenne*. J. B. Baillié & Fils, Paris: 245pp.
- FOWLER, H.W. 1919. The fishes of the United States Eclipse expedition to west Africa. *Proceedings of the United States National Museum* 56: 195-292.
- FOWLER, H.W. 1936. The marine fishes of west Africa, based on the collection of the American Museum Congo Expedition 1909-15. *Bulletin of the American Museum of Natural History* 70(1-2): 1-1493.
- FISHER, W., M.L. BAUCHOT, & M. SCHNEIDER 1987. Fiches FAO d'identification des espèces pour les besoins de la pêche. (Révision 1) Méditerranée et mer Noire. Zone de pêche 37. 2:761-1530.
- GOMES, T.M. 1995. Ecologia Alimentar de *Serranus atricauda* (Günther 1874) dos Açores. Relatório de Licenciatura, Universidade do Algarve. 64 pp + 6 anexos.
- GOMON M.F. & P. FORSYTH 1990. Labridae. Pp: 868-882 in: QUÉRO, J.C., J.C. HUREAU, C. KARRER, A. POST and L. SALDANHA (Eds). Check-list of the eastern tropical Atlantic (CLOFETA), vol II Unesco, JNCTI, Lisboa
- GUIMARÃES, A.R.P. 1882. Lista dos peixes da Ilha da Madeira, Açores e das possessões portuguesas d'Africa, que existem no museu de Lisboa (Suplemento). *Jornal de Sciencias Mathematicas, Physicas e Naturaes* 9(23): 30-39.
- GUIMARÃES, A.R.P. 1884. Lista dos peixes da Ilha da Madeira, Açores e das possessões portuguesas d'Africa, que existem no museu de Lisboa (Segundo suplemento). *Jornal de Sciencias Mathematicas, Physicas e Naturaes* 9(37): 11-28.
- HARMELIN, J.-G. & M. HARMELIN-VIVIEN 1979. Rapport Préliminaire. Pp.: 1-4 in Saldanha, L. (coord.). Mission Bio-Océanographique 1979 aux Açores: Missão Bio-Oceanográfica Açores 79. Julho/Agosto 1979. Faculdade de Ciências de Lisboa.
- HILGENDORF, F. 1888. Die Fische der Azoren. Pp: 205-213 in H. Simroth (Ed.) *Zur Kenntniss der Azorenfauna*. *Archiv für Naturgeschichte* 1(3): 179-234.
- HUBBS, C.L. & K.F. LAGLER 1964. Fishes of the Great Lakes region. *Bulletin of Cranbrook Institute of Science* 26: 1-213 [19-26].
- ICN 1993. *Livro Vermelho dos Vertebrados de Portugal*. Vol. III - Peixes Marinhos e Estuarinos. Secretaria de Estado do Ambiente e do Consumidor. ICN, Lisboa, 146pp.
- INIP 1985. Programa de apoio às pescas nos Açores. Cruzeiros 020150480, 02180780, 020290581 e 020310781. *Relatórios INIP*, Lisboa (42) 1985:

- LAURENT, L. & P. LEJEUNE 1988. Coexistence en Méditerranée de deux livrées terminales différentes chez la girelle *Coris julis* (Pisces, Labridae). *Cybiu* 12(1): 91-95.
- LLORIS, D., J. RUCABADO & H. FIGUEROA 1991. Biogeography of the Macaronesian ichthyofauna (The Azores, Madeira, the Canary islands, Cape Verde and the African enclave). *Boletim do Museu Municipal do Funchal* 43(234): 191-241.
- MARTINS, H.R. 1982. Nomenclatura de peixes de valor comercial dos Açores. *Açoreana*, 6(2): 127-129.
- MAUL, G.E. 1948. Lista sistemática dos peixes da Madeira. Pp. 135-159 in NORONHA, A.C. & A.A. SARMENTO. *Vertebrados da Madeira*. Peixes. Vol. 2, Junta Geral do Distrito Autónomo do Funchal. 181pp.
- MICHEL, C., P. LEJEUNE & J. VOSS 1987. Biologie et comportement des labridés européens (labres, crenilabres, rouquiers, vielles, girelles). *Revue Française d'Aquariologie Herpétologie* 14(1/2): 1-80.
- NELSON, J.S. 1994. *Fishes of the World* (3rd. edition). John Wiley & Sons, Inc., New York. xvii + 600pp.
- NOBRE, A. 1924. Contribuições para a fauna dos Açores. *Anais do Instituto de Zoologia da Universidade do Porto* 1: 41-90.
- NOBRE, A. 1930. *Materiais para o Estudo da Fauna dos Açores*. Companhia Editora do Minho. 108pp.
- PATZNER, R.A. & R.S. SANTOS 1993. Ecology of rocky littoral fishes of the Azores. *Courier Forschungsinstitut Senckenberg* 159: 423-427.
- PATZNER, R.A., R.S. SANTOS, P. RÉ & R.D.M. NASH 1992. Littoral fishes of the Azores: An annotated checklist of fishes observed during the "Expedition Azores 1989". *Arquipélago. Life and Earth Sciences* 10: 101-111.
- QUINGNARD J.P. 1966. Recherches sur les Labridae (Poissons Téléostéens Perciformes) des côtes européennes - Systematique et Biologie. *Naturalia Monspeliensis*. (Série Zoologie) 5: 7-247
- QUINGNARD J.P. & A. PRAS 1986 Labridae. Pp. 919-942 in WHITEHEAD, P.J.P., M.-L. BAUCHOT, J.-C. HUREAU, J. NIELSEN & E. TORTONESE (Eds) *Fishes of the North-east Atlantic and the Mediterranean* (FNAM). Vol. II. UNESCO, Paris.
- RAMOS, A.G. 1869. *Noticia do Archipelago dos Açores e do que ha de mais importante na sua Historia Natural*. Angra do Heroísmo. Typ. Terceirense (1ª Edição): 150pp. [2ª edition: 1871, same title. Lisboa, Typographia Universal: 229 pp.]
- RÉ, P. 1979. Lista das espécies de peixes observadas e capturadas. 2pp in: L. Saldanha (coord.). *Missão Bio-Oceanográfica Açores 79*. Julho/Agosto 1979. Faculdade de Ciências de Lisboa.
- RÉ, P. 1990. Ecologia dos peixes litorais. Pp. 127-151 in: *Expedição Açores/89. Ecologia e Taxonomia do Litoral Marinho dos Açores. Relatório Preliminar. Parte I, Vol. 1*. Universidade dos Açores, Departamento de Oceanografia e Pescas, Horta, Açores. 177pp.
- REGAN, C.T. 1903. On a collection of fishes from the Azores. *Annals and Magazine of Natural History*. Ser. 7(12): 344-348.
- RIBEIRO, L.S., 1936. Notas sobre a pesca e os pescadores na Ilha Terceira. *Açoreana* 1(3): 147-169.
- RODRIGUES J.B. 1995. Biologia de espécies de peixes litorais dos Açores. Família Labridae: *Centrolabrus trutta* (Lowe, 1834), *Coris julis* (L. 1758), *Symphodus mediterraneus* (L. 1758) e *Thalassoma pavo* (L. 1758). Relatório de Licenciatura, Universidade dos Açores. 57 pp + 2 anexos.
- ROULE, L. 1919. Poissons provenant des campagnes du yacht *PRINCESS-ALICE* (1891-1913) et du yacht *HIRONDELLE II* (1914). *Résultats des Campagnes Scientifiques Accomplies sur son Yacht par Albert Ier Prince Souverain du Monaco* 52. 190pp. + erratum + 7 plates.
- SALDANHA, L. 1980. *Fauna submarina Atlântica - Portugal continental, Açores, Madeira*. Europa-América, 203pp.
- SAMPAIO, A. S. 1904. *Memoria sobre a Ilha Terceira*. Imprensa Municipal, Angra do Heroísmo. ix + 876 pp.
- SANTOS, R.S., R.D.M. NASH & S.J. HAWKINS 1994. Fish assemblages on intertidal shores of the island of Faial, Azores. *Arquipélago. Life and Marine Sciences* 12A: 87-100.
- SANTOS, R.S., S.J. HAWKINS, L.R. MONTEIRO, M. ALVES & E.J. ISIDRO 1995. Marine research, resources and conservation in the Azores. *Aquatic Conservation: Marine and Freshwater Ecosystems* 5(4): 311-354.
- SANTOS, R.S., F.M. PORTEIRO & J.P. BARREIROS in press. Marine fishes of the Azores: Annotated checklist and bibliography. *Arquipélago. Life and Marine Sciences*, Supplement 1.
- VAILLANT, L. 1919. Appendice. Liste des espèces déterminées par M. le Professeur Léon Vaillant. Pp. 129- 135 in ROULE, L. (Ed.). *Poissons provenant des campagnes du yacht PRINCESS-ALICE* (1891-1913) et du yacht *HIRONDELLE II* (1914). *Résultats des Campagnes Scientifiques Accomplies sur son Yacht par Albert Ier Prince Souverain du Monaco* 52.
- VAN TASSEL, J.L., A. BRITO & S.A. BORTONE 1994. Cleaning behaviour among marine fishes and



- invertebrates in the Canary Islands. *Cybium* 18(2):117-127.
- WHEELER, A. 1978. *Key to the Fishes of Northern Europe*. Frederick Warne (Publ.), London, xix + 380pp.
- WHEELER, A. 1992. A list of common and scientific names of fishes of the British Isles. *Journal of Fish Biology*, Supplement A. iii + 37pp.
- WIRTZ, P. 1994. *Underwater Guide. Madeira, Canary Islands, Azores - Fish*. Verlag Stephanie Nagelschmid, Stuttgart, 159pp.
- WOOD, C. (Coord.) 1973. Açores Expedition 1972. Final Report, University of London Sub Aqua Club, Exul Sub Aqua Club, London: ii + 78pp
- WOOD, E. & B. WILLIAMS 1974. Collection of inshore fishes & ecological notes. Pp. 55-69 in: Açores Expedition 1973. Report of Exul Sub Aqua Club Scientific Diving Expedition to Sao Miguel, Azores, August 1973. London.
- ZUGMAYER, E. 1933. Liste complémentaire des déterminations faites par M. Zugmayer. Appendice Pp. 73-85 in: ROULE & ANGEL (EDS). Poissons provenant des campagnes du Prince Albert Ier de Monaco. Résultats des Campagnes Scientifiques Accomplies sur son Yacht par Albert Ier Prince Souverain du Monaco 86.

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