



Revista de Biología Marina y
Oceanografía

ISSN: 0717-3326

revbiolmar@gmail.com

Universidad de Valparaíso
Chile

Méndez-Abarca, Felipe; Mundaca, Enrique A.
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Revista de Biología Marina y Oceanografía, vol. 51, núm. 2, agosto, 2016, pp. 475-481
Universidad de Valparaíso
Viña del Mar, Chile

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RESEARCH NOTE

Colouration patterns of two species of the genus *Scartichthys* (Blenniidae: Perciformes) in the coastal area of northern Chile

Patrones de coloración de dos especies del género *Scartichthys* (Blenniidae: Perciformes) de la zona costera del norte de Chile

Felipe Méndez-Abarca¹ and Enrique A. Mundaca²

¹Fundación Reino Animal, Cienfuegos S/N, Casilla 6-D, Arica, Chile. felipe.mendez@sag.gob.cl

²Universidad Católica del Maule, Facultad de Ciencias Agrarias y Forestales, Escuela de Agronomía, Casilla 7-D, Curicó, Chile

Abstract. The aim of this study was to report the colouration patterns of live specimens of two Blenniidae species: *Scartichthys gigas* and *S. viridis*, from tide pools in the coastal area of 3 localities of northern Chile. Colouration patterns for *S. gigas* were: the two-bar front head covered/uncovered and the uniform orange-brown, found in specimens associated to kelps, for juveniles; an intermediate juvenile-adult reticulated bar-stained pattern described for the first time and the reticulated pattern for adults. For *S. viridis* the dark-light green pattern is described for juveniles and adults. The findings are discussed in terms of colouration patterns previously described for both species, with emphasis on the importance of using colouration patterns to improve species identification, reduce habitat disturbance and specimen removal from the wild.

Key words: *Scartichthys gigas*, *Scartichthys viridis*, reticulated, intertidal

INTRODUCTION

Blenniidae is a family of benthic fish widely distributed in the coastal waters around the world. Species of this family are abundant in the intertidal zone (Mann 1954, Muñoz & Ojeda 1997, 2000; Ojeda & Muñoz 1999) and share a number of parasite groups (Flores & George-Nascimento 2009). Within this family, the genus *Scartichthys* Jordan & Evermann has 4 species distributed from western Panamá to central Chile (Williams 1990). These species, commonly known as 'borrachilla' ('little drunken one') (Medina *et al.* 2004), have been described as part of the marine fauna in rocky areas of the coastal waters of Chile. The species *S. variolatus* (Cuvier & Valenciennes 1836) can be found exclusively in rocky environments of the oceanic islands of San Felix, San Ambrosio, and Juan Fernandez (William 1990, Dyer & Westneat 2010), whereas *S. crapulatus*, *S. viridis* and *S. gigas*, are considered monophyletic and endemic of the South-Eastern Pacific ocean (Oyarzún & Pequeño 1989). In terms of the distribution of such species, *S. crapulatus* shows a disjoint distribution with reports ranging from the city of Chañaral to the coastal area of the city of Valparaíso (Williams 1990). *Scartichthys viridis* (Valenciennes 1836) was initially reported from Bahía Independencia (Southern Perú) to Valparaíso (Chile) (Chirichigno 1974, Muñoz & Ojeda 2000); although Medina *et al.* (2004) extended its northern distribution range to Panamá and Meléndez & Villalba (1992) to Juan Fernandez Island (Chile). The distribution of *S. gigas* was originally described

from Guayaquil, Ecuador, to Valdivia, Chile (Chirichigno 1974) and subsequently extended to Panamá (Williams 1990, Medina *et al.* 2004).

This genus is primarily herbivorous (Díaz & Muñoz 2010), occasionally supplemented by small invertebrates such as polychaetes, molluscs and crustaceans (Medina *et al.* 2004). In captivity these fish to commercial foods are easily habituated (Méndez-Abarca 2015). These species are well known to the fishermen who often claim to suffer gastric disorders and severe drowsiness after ingesting the fish. Such effects, which are normally short-lived, give these fish the name of 'borrachilla' (the drunken one) (Medina *et al.* 2004).

Although the morphological features of this genus have been previously described by Williams (1990), little attention has been given to the colouration patterns observed particularly in the wild. Most of the previous descriptions have been made based on specimens preserved in alcohol, which makes it difficult to find a match between such descriptions and the original colouration patterns. This is because fixed specimens do not retain their original colouration, which tends to fade over time. Most importantly, live specimens exhibit a range of colouration patterns that have not been described so far. In order to address this gap, the objective of this study was to describe the colouration pattern variation of two sympatric species of the genus *Scartichthys* from the coastal areas of northern Chile

through direct observation of live specimens in the field as well as in captivity, to compare it with previous descriptions and to highlight the importance of identifying species in the field.

MATERIALS AND METHODS

A total of 220 specimens of the species *Scartichthys viridis* (n= 112) and *S. gigas* (n= 108), were collected using a bow-net from tide pools located in the Chilean coastal areas of Taltal, Antofagasta Region (25°24'00"S-70°29'00"W); Iquique, Tarapacá Region (20°13'15"S-70°08'35"W) and Arica, Arica & Parinacota Region (18°28'30"S-70°18'15"W). Specimens were identified to species level through the taxonomic keys developed by Williams (1990) and the morphological characters were described as in Medina *et al.* (2004). The specimens were photographed on the spot (both in and out of water). A description of the specimens' colouration was made *in situ*. One specimen of each colouration type was preserved in alcohol for further taxonomic identification. Two specimens of each colouration type were taken into captivity for 30 days and the rest of the specimens were released into the wild.

The specimens taken into captivity were kept in a 250 L aquarium with seawater extracted from the sampling site. Physicochemical parameters were continuously monitored and maintained at an average of 8.1 pH, 36 of salinity and 22°C. The decoration of the aquarium was made out of rocks and sand that were added as floor substrate. Filtration was implemented with a power head of 800 L h⁻¹, in addition to 3 auxiliary heads of unfiltered water to generate continuous currents. Fish were fed following directions in Mendez (2015) for fish of the genus *Scartichthys* in captivity. Their diet consisted of seaweed, cooked vegetables, and chunks of seafood,

Spirulina powder and brine shrimp (*Artemia salina*). Feeding was organised to ensure availability of nutrients during captivity. On Monday and Tuesday fish were fed dehydrated seafood in the form of flakes and they could eat as much as they wanted in 5 min. Wednesday, Thursday and Friday the fish were fed with chunks of seafood (mussels and sea squirt) in the same fashion as on Monday and Tuesday. Saturday, the fish were given boiled spinach leaves which were left in the aquarium for an hour and removed afterwards. On Sunday the fish were fed with live food, which consisted of brine shrimp (*Artemia salina*). The kept specimens were released into the wild after a month of captivity.

RESULTS AND DISCUSSION

The identification of the *Scartichthys* species was performed based on the morphological characters described by Medina *et al.* (2004) and the morphometric features described by Williams (1990). A total of 112 specimens of *S. viridis* with sizes ranging from 2.3 to 23.6 cm, and 108 specimens of *S. gigas* with sizes ranging from 3.5 to 26.4 cm were collected, and the colouration patterns for both species were described (Table 1). The species *S. crapulatus* was not recorded in the study sites.

SCARTICHTHYS VIRIDIS (VALENCIENNES, 1836)

DARK-LIGHT BLUEISH GREEN PATTERN (FIG. 1 A-B)

Central dorsal area ranging from dark to pale green-blueish. Ventral area varies from light green to pale yellow. No stains or body markings were observed in most of the recorded specimens except for a few that showed tiny red spots on the

Table 1. Summary of colouration patterns described for individuals of *S. viridis* and *S. gigas* / Resumen de los patrones de coloración descritos para individuos de *S. viridis* y *S. gigas*

Species*	Colouration pattern	Developmental stage	Number of individuals
<i>Scartichthys viridis</i> (n=112)	Dark-light bluish green pattern (Fig. 1 A-B)	Adults and Juveniles	112
<i>Scartichthys gigas</i> (n=108)	Two bar front head covered (Fig. 2 A-B)	Juvenile	32
	Two bar front head uncovered pattern (Figs. 2 C-D)	Juvenile	30
	Uniform orange-brown pattern (Fig. 2 E-F).	Juvenile	12
	Reticulated bar-stained (Fig. 2 G)	Juvenile - adult intermediate stage	11
	Reticulated (Fig. 2 H)	Adult	23

*The species *S. crapulatus* was not recorded in this study

dorsal area and under the lateral line. The presence of such spots matched the description made by Medina *et al.* (2004). Apical area of the body lighter coloured than the dorsal fin. Anal fin dark, with a small, faint spot between each radio. Nasal and nuchal cirrus brownish, also coincident with the description made by Medina *et al.* (2004). There was no obvious variation in the colouration pattern of the body between the juveniles and the adults collected in the field. Williams (1990) describes the general body colouration of individuals belonging to this species as dark brown. From our point of view, however, such colour is the result of being preserved in alcohol rather than their natural colouration pattern of the specimens. In addition, the presence of a diffuse transverse bar, as described by Williams (1990), located in the middle area of the body (observed in living specimens) can also be attributed to alcohol preservation, as it becomes more conspicuous in fixed specimens. The live specimens of *S. viridis* that were taken into captivity kept the colouration pattern described for individuals in the wild. This pattern is present in adults and juveniles.

SCARTICHTHYS GIGAS (STEINDACHNER, 1876)

Juvenile

TWO BAR FRONT HEAD COVERED/UNCOVERED PATTERN (FIG. 2 A-D)

Sixty-two individuals were identified as having two dark black-grey bars running parallel to the body located in central position. The middle bar reaches the head, covering both sides and the front, which resembles a mask (Fig. 2 A-B). Some specimens also exhibited a greyish fading mid-bar that extends towards the anterior region of the body, reaching the upper portion of the head without covering it (Fig. 2 C-D). This mid-bar may also become diffuse towards the caudal peduncle or even fade towards the middle or upper half areas of the caudal fin. Sidebars are flanked on both sides by a variable number of spots with colours ranging from pale red to orange and golden yellow (Fig. 2 C-D).

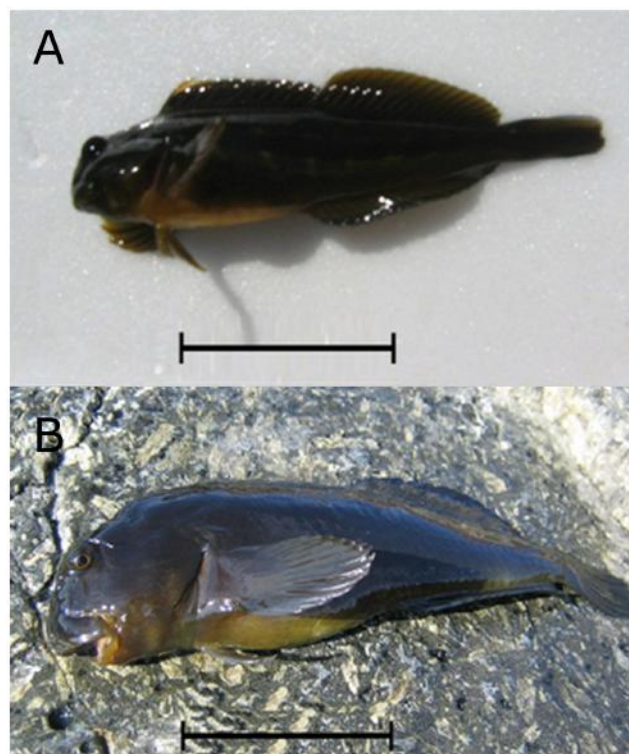


Figure 1. *Scartichthys viridis* colouration pattern varying from (A) dark green to (B) light green bluish. Length of scale bars, A-B= 5 cm / Variación del patrón de coloración de *Scartichthys viridis* de verde oscuro (A) a verde claro azulado (B). Longitud de las barras de escala, A-B= 5 cm

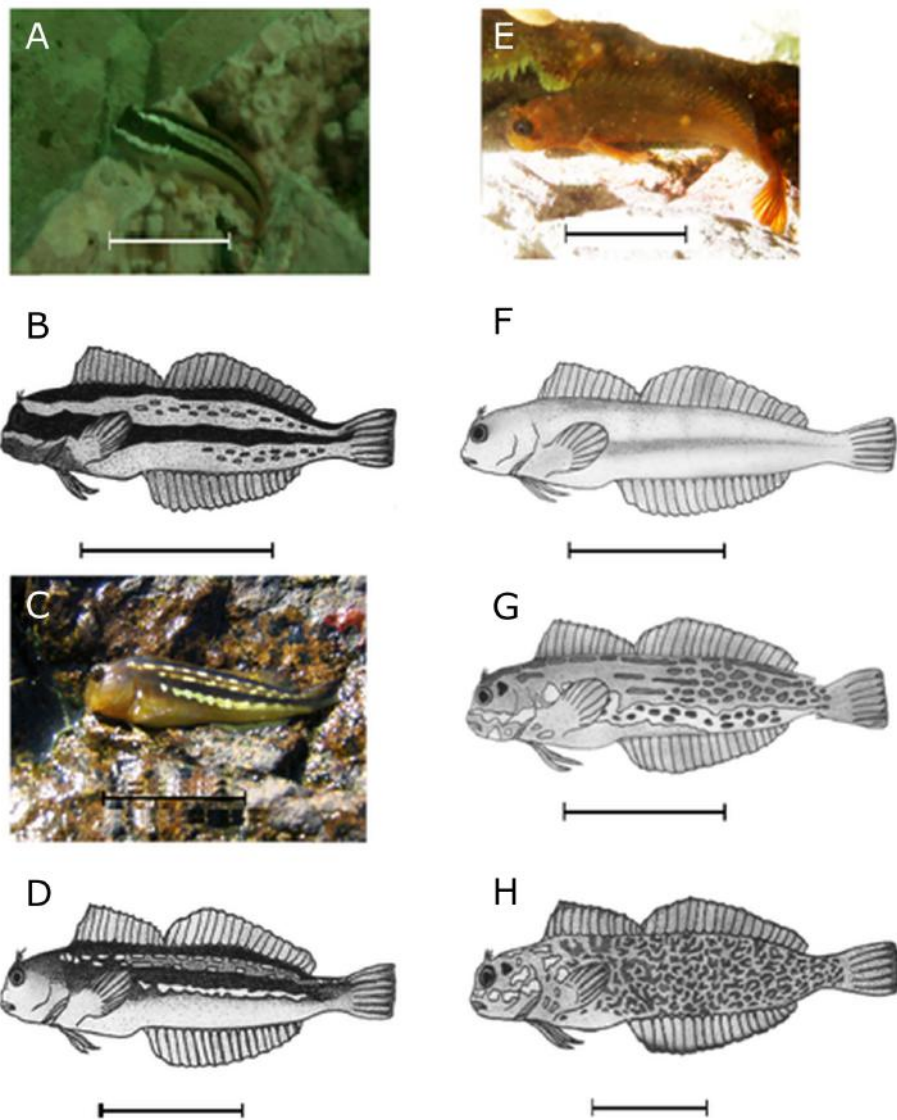


Figure 2. A-B. The 'two bar' colouration pattern of juveniles of *S. gigas* showing front head covered. C-D. Uncovered front head patterns. E. Juvenile of *S. gigas* exhibiting the uniform orange-brown pattern present only in juveniles associated to kelp (*Macrocystis* sp.) forests in the shallow subtidal zone. F. Presence of a faint and diffuse sidebar under stress. G. Details of the reticulated bar-stained pattern of *S. gigas* in an intermediate developmental stage between juvenile and adult. H. Details of the reticulated colouration pattern present in adults of *S. gigas*. Length of scale bar A-F= 2 cm, G-H= 5 cm / A-B. Patrón de coloración de 'dos bandas' observado en juveniles de *S. gigas*, mostrando el patrón 'frente cubierta por banda'. C-D. 'Frente no cubierta por banda'. E. Juveniles de *S. gigas* mostrando patrón de coloración naranja-pardo, presente solo en ejemplares asociados a bosques de huiro (*Macrocystis* sp.) en la zona de submareal somero. F. Aparición de una leve y difusa barra lateral en ejemplares en estado de estrés. G. Detalles del patrón reticulado con manchas presente solo en individuos de *S. gigas* en estado intermedio de desarrollo entre juvenil y adulto. H. Detalle del patrón reticulado presente en adultos de *S. gigas*. Longitud de la barra de escala A-F= 2 cm, G-H= 5 cm

According to Williams (1990), it is possible to observe up to 8 or 10 bars separated by areas of lighter gaps along the body. Such description, however, could have been distorted by the effect of the preserving method, particularly when using alcohol. In general, individuals of *S. gigas* that exhibit darker sidebars covering the frontal area of the head show spots, varying from orange to red, flanking both sides of the dark sidebars. On the other hand, individuals with the frontal area of the head free of a dark bar tend to show bright yellow to whitish spots distributed along the body, dorsal and caudal fin. Such spots were also conspicuous in the fin's rays. In such cases, the bars are located on a background, which varies from pale yellow to darker yellow. Interestingly, this colouration pattern was detected only in juvenile specimens shorter than 12.2 cm.

UNIFORM ORANGE-BROWN PATTERN (FIG. 2 E-F)

Specimens with this colouration pattern were observed mainly associated to subtidal kelps (*Macrocystis* sp.), where they tend to rest and apparently mimic the kelps' colouration to become less conspicuous. The individuals associated to kelps also showed different behaviour. Thus, males tend to be more aggressive and territorial towards other individuals of the same species, individuals of *S. viridis* and even other fish species. Similar behaviour was also observed in individuals with this colouration pattern kept in captivity. No specimen showing this type of colouration was larger than 8.1 cm long, with observed sizes ranging from 2.7 to 8.1 cm. Although most of these specimens taken into captivity kept their general colouration pattern, some showed 2 transversal bars along the body when transported in plastic bags and put into the aquarium.

Juvenile-Adult Intermediate Colouration

RETICULATED BAR-STAINED PATTERN (FIG. 2 G)

This colouration pattern is very similar to the adult reticulated pattern, but differs in the irregularity of the reticulation design, the presence of semi-cylindrical reddish stains and the presence of a large and irregular whitish-yellow bar running from the medium area of the head, crossing the entire body and fading towards the tail without reaching the caudal fin. Eighteen, out of the thirty-four specimens found to have a reticulated colouration pattern, exhibited the bar-stained pattern. The body size of the observed specimens ranged from 13.6 to 17.1 cm. The presence of the fading bar and reddish stains, plus the sizes of the recorded specimens confirms that this pattern represents an intermediate stage between juveniles and adults.

Adult

RETICULATED PATTERN (FIG. 2 H)

Thirty-four specimens exhibited this pattern consisting of a number of reddish to dark brown reticulated spots distributed along the body. Only in a few cases these spots occurred together with large milky-white to light-brown patches located in the ventral area of the body. Those stains are arranged in a reticulated pattern on a background that can vary from light brown to dark brown and green, or even have intermediate tones. The colouration of the fins can vary, with reddish patches on the apical region of the dorsal fin, which can also sometimes have slight traces of light blue shades. This pattern is also common in the anal fin of the specimens. There are also specimens that do not show this colouration pattern in their fins, which can be replaced by black or dark grey patches. This pattern could be observed only in specimens over 18.4 cm long, which suggests the reticulated colouration pattern is an adult feature. These results are coincident with Williams' (1990), who also noticed such reticulation. All collected specimens had a dark spot behind the eye and another at the beginning of the dorsal fin, as described by Cohen (1956) and Medina *et al.* (2004).

Studies on the physical features of species of the genus *Scartichthys* have revealed the association of morphological and physiological parameters (*e.g.*, RNA:DNA ratios in muscle tissues) to environmental conditions (Pulgar *et al.* 2011). Intraspecific variations of colouration patterns, however, have not been given especial attention until now. In most cases, colouration patterns have been described as part of the diagnostic characters of the species (*e.g.*, Williams 1990, Medina *et al.* 2004) and have been carried out mainly using preserved specimens with the subsequent effects of the preserving method on the colouration pattern. This study represents a novel contribution to the knowledge of the colouration patterns of two species of the genus *Scartichthys* as observed in their natural environment. For the species *S. viridis* no differentiation between juveniles and adults was found, with all specimens showing similar colour pattern. Such pattern was described as dark-light green pattern due to the variations that can be observed among individuals. In the light of the results of this study, it seems that the original colouration pattern described for the species by Williams (1990) differs from what was here recorded in the field mainly due to the effect of the preserving method used on the individuals to describe the species. For this reason, the dark-light green pattern is proposed in this study as a more valid pattern to refer to the species, particularly when observing them in the wild.

For the species *S. gigas*, Williams (1990) identified two main colouration patterns: 8 to 10 irregular dark brown bars along the body for juveniles and a similar pattern for adults with the body and head breaking into a reticulated design. As previously mentioned, the dark brown pattern and the variable number of bars crossing the body described by Williams (1990) seem to be a misrepresentation resulting from the preservation method. Instead, here the existence of two well-differentiated patterns for juveniles is proposed: a two bar front head covered/uncovered pattern (which is the most commonly observed pattern in the wild) and the uniform orange-brown pattern (which is a variation exhibited by juvenile individuals associated to *Macrocystis* sp. kelps). The patterns described for juveniles, in this study, as 'two bar front head covered/uncovered' were also reported by Cohen (1956), who describes them as dark bands that run the length of the fish in the species *Salaria* (*Scartichthys*) *eques*. In this case the author recognised the patterns as belonging to *S. gigas* and utilises such description to propose *S. eques* as an invalid species and a synonymy of *S. gigas*.

Based on the measures of the recorded individuals, an intermediate pattern between juvenile and adult stages was found: the reticulated bar-stained pattern, which differs from the adult pattern in the irregularity of the reticulation. As for the adult stage, coincidences were found with the original description made by Williams (1990). In terms of pattern changes, it seems that keeping specimens of *S. gigas* in captivity could trigger colouration changes, although the mechanisms that regulate this particular response remain unknown. Also, all observed specimens slightly differ in their colouration pattern, which suggests that this species' colouration pattern is highly variable among individuals. Such observations are coincident with reports made by Abel (1993) on the variability of some Mediterranean blennies that tend to change their colouration in response to the environment. Based on our observations of the colouration pattern and behaviour, we could hypothesise that some male juveniles of *S. gigas* adapt their colouration to the kelp dominated environment in order to establish reproductive territories before reaching sexual maturity.

Along with the widespread use of modern and affordable technology (e.g., video and photographic cameras), our study represents a valuable tool for identifying species of the genus *Scartichthys* on the spot. Finally, it is expected that providing the tools to identify specimens in the field can minimise the risk of habitat disturbance and reduce unwanted impacts on the population by avoiding the collection of large numbers of specimens for laboratory identification.

ACKNOWLEDGMENTS

We would like to thank Lorena Avilés Arredondo for the fish drawings, Miguel Santos Carrasco for supporting us with specimen photography and to the Fundación Reino Animal for providing the necessary funds to acquire materials, carry out field trips and laboratory work.

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Received 3 June 2015 and accepted 19 May 2016

Editor: F. Patricio Ojeda