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# Color variation of a damselfish, *Stegastes flavilatus* (Perciformes: Pomacentridae), from the Pacific coast of Costa Rica and comparison with a sympatric congener

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**Abstract.** This note reports four specimens of the damselfish *Stegastes flavilatus*, captured in the Pacific coast of Costa Rica, with an abnormal coloration pattern. We herein compare morphologically these specimens with "normal" specimens of *S. flavilatus* and other sympatric congener.

**Key words:** color information, distinctive character, reef fish, *Stegastes acapulcoensis*, Tropical Eastern Pacific

**Resumen. Notas sobre un variante cromático de *Stegastes flavilatus* (Perciformes: Pomacentridae), del Pacífico central de Costa Rica y comparación con una especie simpátrica del mismo género.** Esta nota reporta cuatro especímenes de la damisela *Stegastes flavilatus*, capturados en la costa Pacífica de Costa Rica, como variantes cromáticos. Estos especímenes son comparados, morfológicamente, con especímenes "normales" de *S. flavilatus* y *S. acapulcoensis* capturados en la misma zona.

**Parabras clave:** información cromática, carácter distintivo, peces de arrecife, *Stegastes acapulcoensis*, Pacífico Oriental Tropical

Some reef fishes can change color and/or exhibit intraspecific color variation for reasons including sexual selection, camouflage, and evasion of predators, among others. Despite this, coloration patterns are frequently used for species identification in ecological and taxonomic studies (see references of Souza et al. 2011). Therefore, the collection of intra-specific color variation data is very important, especially for ecological studies based on visual censuses.

The genus *Stegastes* Jenyns, 1840 is a diverse group of damselfishes (Pomacentridae) represented by about 40 valid species, with distribution circumglobal in temperate and tropical regions (Froese & Pauly 2015). In the Tropical Eastern Pacific region, eight species of the genus are known and of two these, *Stegastes flavilatus* (Gill, 1862) and *Stegastes acapulcoensis* (Fowler, 1944), are widely distributed on rocky shores (from the Gulf of California to Peru, including oceanic islands) (Robertson & Allen 2015). As noted by Beita-Jiménez & Alvarado (2016), color information at the intra-generic level is an important trait for species determination and has traditionally been considered a conservative character. Color variations have been reported in some species of *Stegastes*, which represented abnormal conditions such as xanthism (Palacios-Salgado & Rojas-Herrera 2012, Beita-Jiménez & Alvarado 2016).

Recently, four specimens of *Stegastes*, of uncertain identification, with dusky bodies and fins, were collected from off Punta Leona on the Pacific coast of Costa Rica (Figure 1A, B). This color pattern was similar to that described for the species *S. acapulcoensis* [i.e., among the species occurring on the Pacific of Costa Rica, sensu Bussing & López (2009)] but the specimens morphologically agreed well with descriptions of the species *S. flavilatus*, which typically have light brown to grey-brown bodies and yellowish fins (Allen 1991, Allen & Robertson 1994, Robertson & Allen 2015). This note reports those specimens as a color variation of *S. flavilatus*, comparing it with "normal" specimens of both species (*S. flavilatus* and *S. acapulcoensis*) captured in the same area, based mainly on the analysis of some meristic and other coloration characters.

Specimens of *S. flavilatus* and *S. acapulcoensis* examined as comparative material in this study were captured, using hook and line, in the Manuel Antonio National Park, Puntarenas, Pacific coast of Costa Rica. All specimens were preserved in 70% ethanol after fixation in 10% formalin. Counts (Table 1) and measurement of standard length (SL) were taken following Allen & Woods (1980).

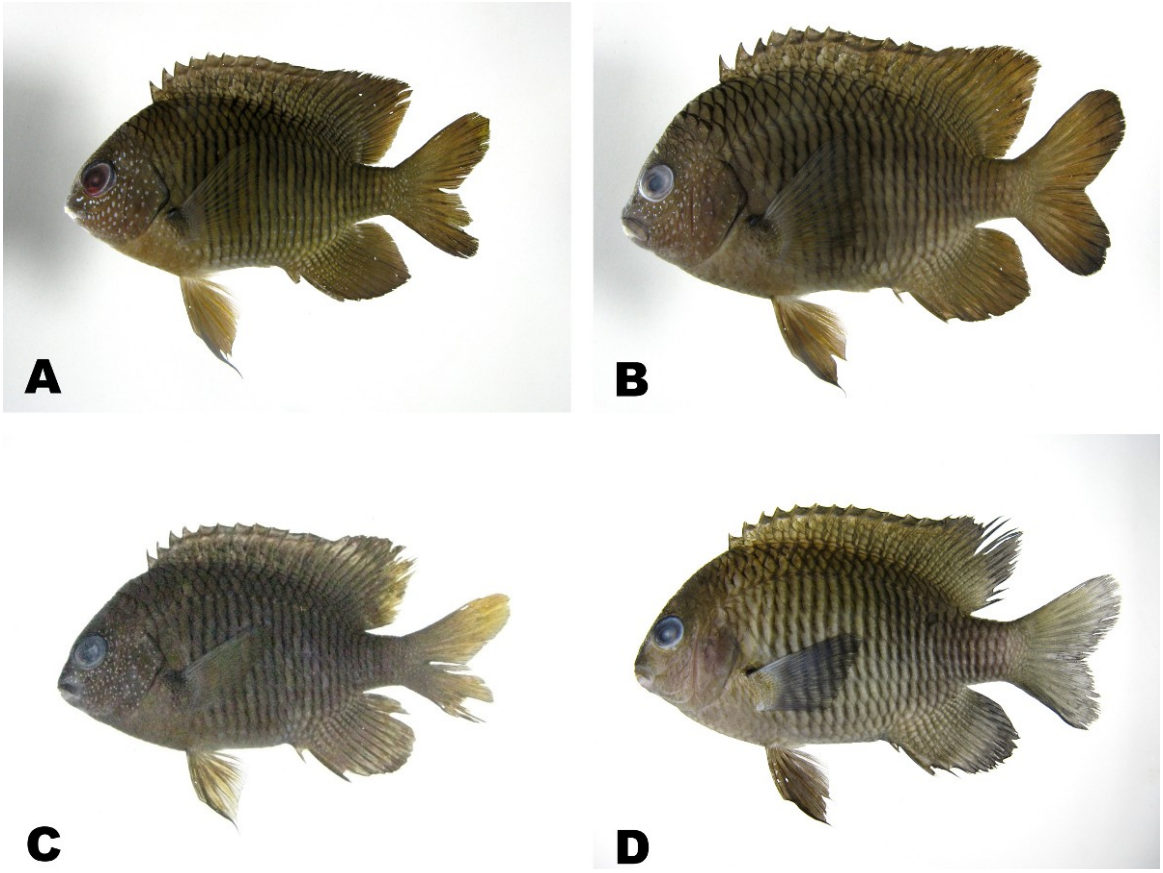


**Figure 1.** Fresh specimens of *Stegastes flavilatus* with dusky fins (A, B), *S. flavilatus* with yellowish fins (C) and *Stegastes acapulcoensis* (D) from the Pacific coast of Costa Rica. A, UCR 2986-2 (photo number, KPM-NR 152413), 62.4 mm SL; B, UCR 3002-4 (KPM-NR 152870), 96.1 mm SL; C, UCR 3090-1 (KPM-NR 164134), 77.4 mm SL; D, UCR 3088-2 (KPM-NR 164130), 78.7 mm SL. Photos by A. Murase (A, B) and R. Sahara (C, D).

**Table 1**. Meristic characters of two species of genus *Stegastes* from Pacific coast of Costa Rica

| Species | *n* | Dorsal-fin soft rays | | | Anal-fin soft rays | | Pectoral-fin rays | | | | | | Pored lateral-line scale | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Left | | | Right | | | Left | | Right | |
| | | 14 | 15 | 16 | 12 | 13 | 21 | 22 | 23 | 21 | 22 | 23 | 19 | 20 | 19 | 20 |
| *S. flavilatus* (with dusky fins) | 4 | 3 | 1 | | 3 | 1 | | 2 | 2 | | 1 | 2 | | 4 | 1 | 3 |
| *S. flavilatus* (with yellowish fins) | 1 | 1 | | | 1 | | | | 1 | | 1 | | | 1 | | 1 |
| *S. acapulcoensis* | 13 | | 12 | 1 | 1 | 12 | 3 | 9 | 1 | 2 | 9 | | 2 | 11 | 2 | 11 |

Color photographs of the specimens (Figure 1) were taken when fresh (after thawing) to make color comparisons within and between species. All the specimens were deposited at the fish collection of the Museo de Zoología of the Universidad de Costa Rica (UCR). Collection data, by examined lots, are as follows: *S. flavilatus*: UCR 2986-2 (2 specimens, 62.4–69.7 mm SL, collected off the coast between Herradura and Punta Leona, Garabito, Puntarenas, outer part of the Gulf of Nicoya, near rocky and sandy shore, on 22 August 2013, by K. Kase, R. Nishitani and A. Murase), UCR 3002-4 (2 specimens, 96.1–98.2 mm SL, collected off the coast of Punta Leona, Garabito, Puntarenas, outer part of the Gulf of Nicoya, 9°42′16.6″N, 85°19′49.8″W, near rocky and sandy shore, 7–8 m depth, on 20 February 2014, by K. Kase and party), and UCR 3090-1 (1 specimen, 77.4 mm SL, collected in Puerto Escondido Beach, Manuel Antonio National Park, 9°22′59.2″N, 84°08′08.3″W, rock and sand, 1.0–3.5 m depth, on 29 September 2015, by R. Sahara); and *S. acapulcoensis*: UCR 3086-1 (2 specimens, 85.7–92.3 mm SL, collected in Puerto Escondido Beach, Manuel Antonio National Park, 9°23′03.4″N, 84°07′56.0″W, rock and pebble, 0.1–0.3 m depth, on 11 July 2015, by R. Sahara); UCR 3087-1 (4 specimens, 91.8–111.5 mm SL, collected in the same locality and habitat as UCR 3086-1, 0.1–0.5 m depth, on 12 July 2015, by R. Sahara), UCR 3088-2 (3 specimens, 78.7–98.8 mm SL, collected in Gemelas Beach, Manuel Antonio National Park, 9°22′46.5″N, 84°08′23.5″W, rock and sand, 0.5–1.5 m depth, on 13 July 2015, by R. Sahara), UCR 3089-1 (1 specimen, 106.3 mm SL, same locality and habitat as UCR3090-1, on 2 August 2015, by R. Sahara), UCR 3094-2 (1 specimen, 89.9 mm SL, collected in Espadilla South Beach, Manuel Antonio National Park, 9°22′51.2″N, 84°08′53.6″W, gravel and pebble, 1.0–2.0 m depth, on 21 May 2015, by R. Sahara), UCR 3095-3 (1 specimen, 99.7 mm SL, collected in Puerto Escondido Beach, Manuel Antonio National Park, 9°22′59.2″N, 84°08′08.3″W, tidepool with rock and sand bottom, 0.6 m depth, on 19 June 2015, by R. Sahara), and UCR 3097-2 (1 specimen, 78.1 mm SL, same locality and habitat as UCR3095-3, on 20 June 2015, by R. Sahara). Color photographs of each individual were deposited in the Image Database of Fishes at the Kanagawa Prefectural Museum of Natural History, Japan (KPM) as KPM-NR152413, 152412, 152870, 152869, 164134 (*S. flavilatus*), 164125, 164124, 164129–164126, 164130, 164132, 164131, 164133, 164121–164123 (*S. acapulcoensis*) in the same order as the collection numbers and specimen sizes listed above.

Meristic characters of all specimens examined in this study are shown in Table 1. The four specimens of uncertain initial identification (UCR 2986-2 and 3002-4) were finally identified as *S. flavilatus* based on the following key futures, sensu Allen & Woods (1980) and Robertson & Allen (2015): soft dorsal-fin rays 14 (rarely 15); soft anal-fin rays 12; supplementary scale present on opercle; and head with violaceous markings. Although one specimen (UCR 3002-4: 96.1 mm SL) had 13 soft anal-fin rays, and another specimen (UCR 2986-2: 62.4 mm SL) lacked a supplementary scale on the opercle, both specimens were identified as *S.*

*flavilatus* based on the combination of remaining meristic characters listed above, including the presence of violet spots on head. The four specimens of Punta Leona (Figure 1A, B) showed brownish bodies and fins contrasting with that described for *S. flavilatus*: caudal fin, rear part of dorsal and anal fins, pelvic fins, and pectoral fins yellowish (Figure 1C: Allen & Woods 1980, Allen 1991, Allen & Robertson 1994, Robertson & Allen 2015). This dusky coloration in the examined specimens of *S. flavilatus* was the same in live condition (immediately after capture; A. Murase personal communication).

Although the coloration pattern described for these specimens of *S. flavilatus* (dusky bodies and fins) is similar to that described for their sympatric congener *S. acapulcoensis* (Figure 1D) in external view, some differences can be noted: body and fins brownish (vs. grayish in *S. acapulcoensis*); vivid violet spots present on head (vs. absent); gill membrane black edged (vs. no black edged) in both fixed and fresh specimens (Figure 2). The color of the caudal fin differs between the two forms of *S. flavilatus*, and in comparison with *S. acapulcoensis*, in both preserved and fresh conditions: entirely brown in the dusky form of *S. flavilatus* in preserved specimens (almost the same color when fresh: Figure 3A), vs. distally light grayish and subtransparent in the yellowish ("normal") form of *S. flavilatus* in preserved specimens (yellowish when fresh: Figure 3B), vs. entirely light grayish and subtransparent in *S. acapulcoensis* in preserved specimens (almost the same color when fresh: Figure. 3C). Although a hybrid of fishes generally has intermediate coloration of two similar species (Marie et al. 2007, Hobbs et al. 2009, Miyazaki et al. 2015), the color comparison concluded that the dusky form of *S. flavilatus*, not sharing characteristic features with *S. acapulcoensis*, could not be a hybrid between the two species.

Intraspecific color variation is not rare amongst reef fishes and there are various causal factors including ontogenetic development, environmental pressures, and/or intra-/interspecific interactions, among others (Leclercq et al. 2010). Intraspecific color variation in the genus *Stegastes* are known as abnormalities, which could be caused by genetic factors (for xanthism see, for example,

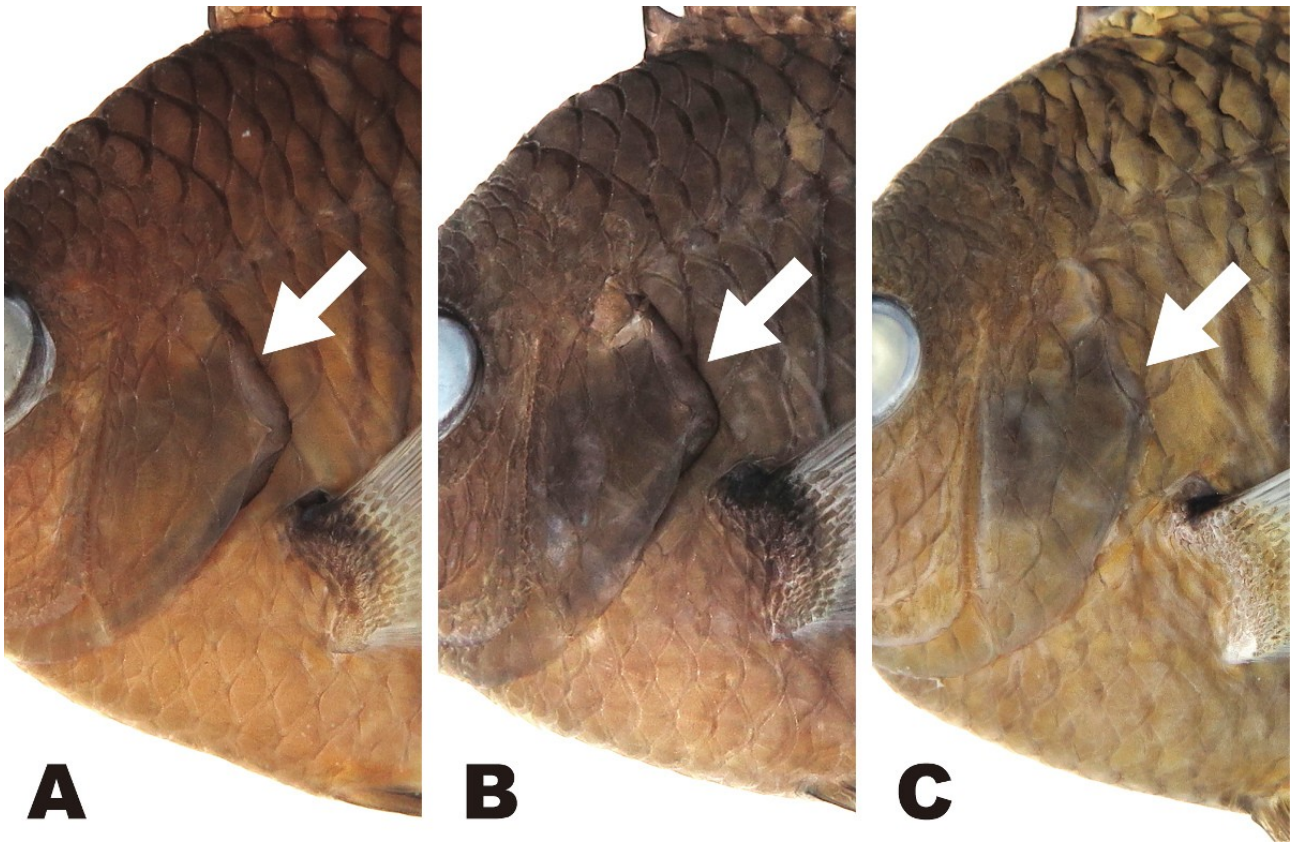


**Figure 2.** Comparison of gill membrane color in two species of the genus *Stegastes* in preserved condition. A, *Stegastes flavilatus* with dusky fins, UCR 2986-2, 62.4 mm SL; B, *S. flavilatus* with yellowish fins, UCR 3090-1, 77.4 mm SL; C, *Stegastes acapulcoensis*, UCR 3088-2, 78.7 mm SL. Arrows indicate position of gill membrane.

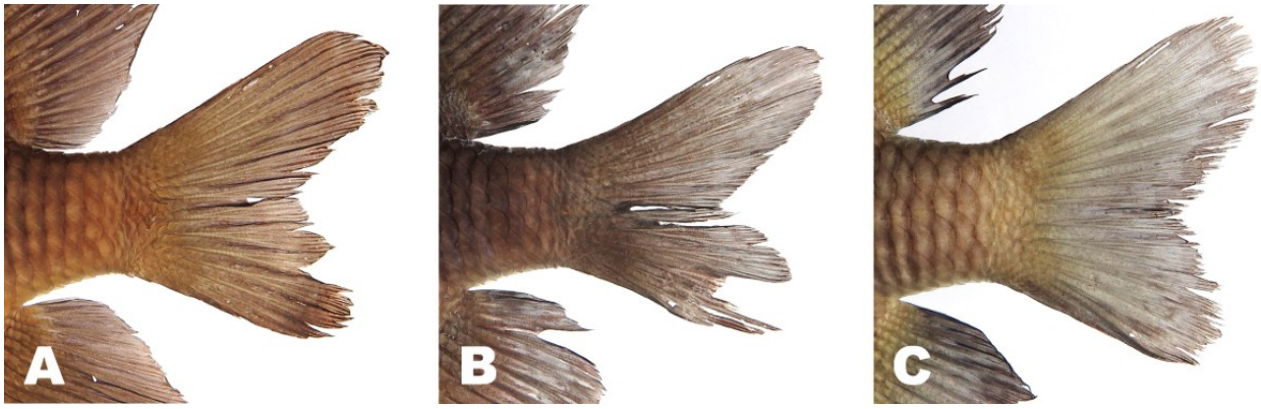


**Figure 3.** Comparison of caudal-fin coloration of two species of the genus *Stegastes* in preserved condition. A, *Stegastes flavilatus* with dusky fins, UCR 2986-2, 62.4 mm SL; B, *S. flavilatus* with yellowish fins, UCR 3090-1, 77.4 mm SL; C, *Stegastes acapulcoensis*, UCR 3088-2, 78.7 mm SL.

Palacios-Salgado & Rojas-Herrera 2012 and Beita-Jiménez & Alvarado 2016), nutritional deficiencies, water quality, and stress and/or social interactions (Souza et al. 2011). The color variation of *S. flavilatus* found in the present study appears to be neither an anomalous phenomenon (as reported previously for other members of the genus), based on the frequency of occurrence in the one area (4 individuals of the same color captured in a year), nor related to ontogeny, as 2 specimens (62.4–69.7 mm SL: Figure 1A) bear brownish fins the same as larger specimens (96.1–98.2 mm SL: Figure. 1B), despite being smaller than the specimen with the yellowish tail (Figure 1C).

Souza et al. (2011) reported intraspecific color variation in *Stegastes variabilis* (Castelnau, 1855) between populations from different sites and depths, and stated that the variation could be caused by the environmental distinctiveness of the sites. Although similar environmental variation is possible in the case of *S. flavilatus*, further ecological and/or genetic evidence is needed to determine factors affecting intraspecific coloration variation in the genus.

*Stegastes flavilatus* is a relatively poorly studied species, in ecological terms, even though it is one of main members of some reef fish assemblages in tropical eastern Pacific waters (e.g. Aburto-Oropeza & Balart 2001, Dominici-Arosemena & Wolff 2006). Unidentified individuals of *Stegastes* represented in previous visual censuses on reef fish assemblages from the Pacific coast of Costa Rica (Phillips & Perez-Cruet 1984, Myers et al. 2011) might be the dusky form of *S. flavilatus*. Information from the present study will aid the identification of *Stegastes* species in future studies using visual techniques.

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