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# When endemic coral-reef fish species serve as models: endemic mimicry patterns in the Marquesas Islands

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## Abstract

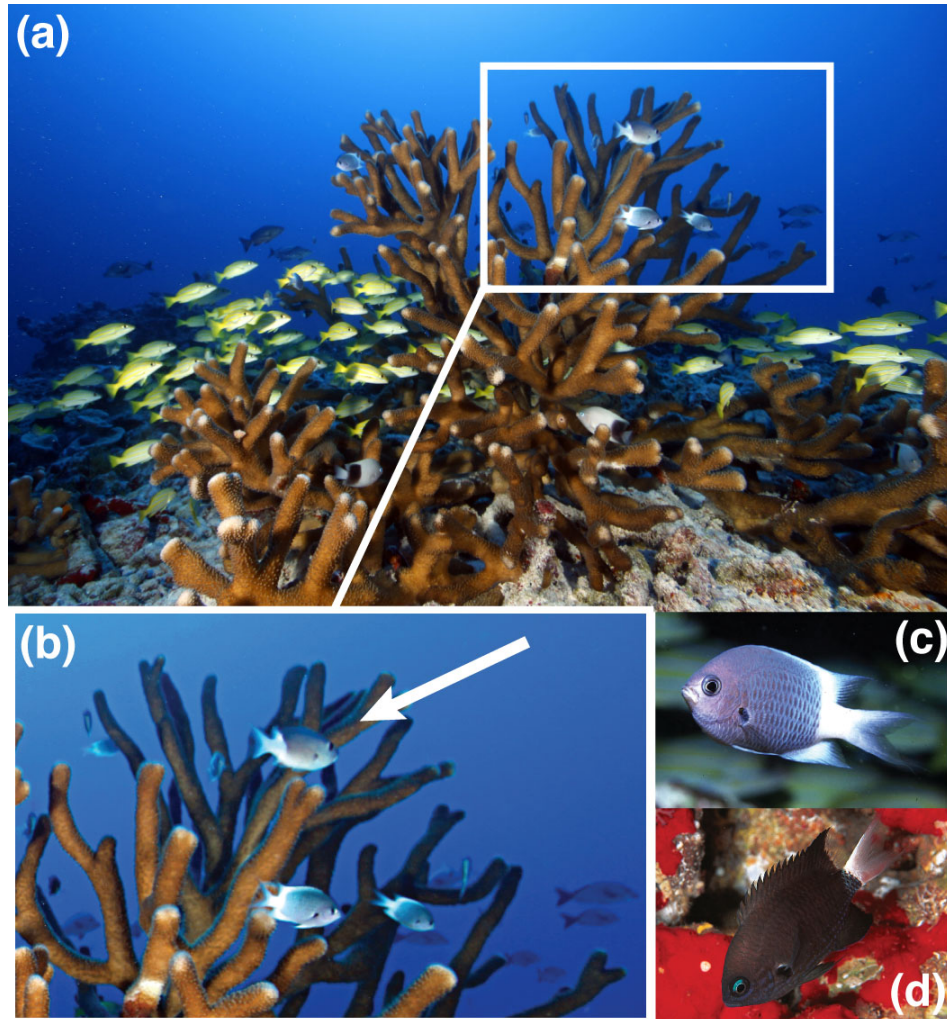
This article documents several cases of widespread species, which usually mimic other widespread species throughout the Indo–Pacific, using endemic Marquesan species as a model and displaying endemic mimicry patterns. This discovery adds a new line of evidence to the uniqueness of the Marquesas Islands, which not only host a high number of endemic reef–fish species, but also endemic mimicry patterns.

Key words: endemism ; *Chromis fatuhivae*; *Coris hewetti*; *Stethojulis marquesensis*; *Pseudanthias regalis*

Extending over 500 km between 7°50' S and 10°35' S latitude and 138°25' W and 140°50' W longitude, the Marquesas Islands are the northeasternmost archipelago of French Polynesia. Isolated by distance and oceanographic features, they also possess unique environmental conditions (Chevalier, 1978; Randall, 2001), all contributing to yield a unique reef fish fauna. The Marquesas Islands are remarkable for hosting a high number of species unique to that locality (endemic species). They rank third in terms

of percentage of endemism in the Pacific (Randall & Earle 2000, Delrieu–Trottin *et al.*, 2015), although only a relatively small portion of the islands have been explored due to the logistical difficulty of assessing the biodiversity in this remote area. An expedition was conducted in November 2011 (Pakaihi i te Moana Expedition) to study the reef fish fauna of every high island and to make the only collections known from Banc Clark and Motu One (submerged atolls) in the Marquesan archipelago. Many additional endemic species (Delrieu–Trottin *et al.*, 2015) were found, and several endemic–based mimicry associations were discovered. This study also discovered several different widespread species, which usually mimic other widespread species throughout the Indo–Pacific, that were using endemic Marquesan species as a model and displaying endemic mimicry patterns.

One particular photograph taken during the expedition led to this discovery [Fig. 1(a)]. The photo depicts the underwater landscape of Banc Clark, a remote submerged atoll at the northernmost point of the Marquesas archipelago that was explored for the first time by the scientific expedition. The photograph shows *Chromis fatuhivae* Randall 2001, a rare, endemic and iconic species from the Marquesas Islands, living far away from its previously known geographic distribution [Fig. 1 (a), (b), (c)]. This species was named for its type locality Fatu–Hiva, the southernmost island of the Marquesas where it was thought to be restricted (Randall, 2001; Randall, 2005a). In addition to the expanded range, the underwater photograph reveals, more interestingly, a previously unknown mimetic association linked to the endemic *Chromis*. Hidden among the *C. fatuhivae*, a juvenile *Lutjanus bohar* (Forsskal 1775) can be seen mimicking the endemic damselfishes [Fig. 1 (a), (b), indicated by the arrow]. *Lutjanus bohar* is a species whose juveniles extensively use mimicry to approach its prey and hunt more efficiently [aggressive mimicry (Wickler, 1965)], but also to benefit from the defensive strategy of schooling (social mimicry, sensu Randall 2005b). This species is known to mimic and school with several harmless damselfish species of the genus *Chromis* throughout its Indo–Pacific geographic distribution: *Chromis ternatensis* (Bleeker 1856) in Indonesia; *C. margaritifera* Fowler 1946 in Fiji; *C. iomelas* Jordan & Seale 1906 in the Tuamotu Archipelago (French Polynesia); and *C. flavomaculata* Kamohara 1960, *C. weberi* Fowler & Bean 1928, *C. lepidolepis* Bleeker 1877, and *C. notata* (Temminck & Schlegel 1843) in Japan (Russell *et al.*, 1976; Moyer, 1977; Randall, 2005b). None of these widespread damselfish species occur in the waters of the Marquesas Islands where *L. bohar* is abundant (Randall & Earle, 2000, Delrieu–Trottin *et al.*, 2015). Hence, this study provides the first report of a case of mimicry by *L. bohar* of *Chromis fatuhivae*. The strategy to mimic an a priori rare species seems odd from an evolutionary point of view, but it seems probable that *C. fatuhivae* is actually

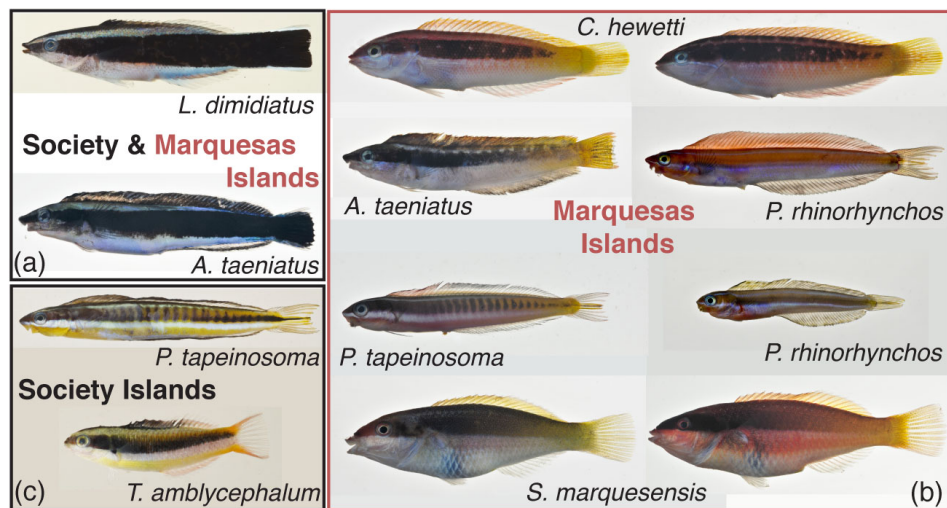


**Figure 1:** Banc Clark underwater landscape. (a) Coral head with the juvenile *Lutjanus bohar* [arrow in (b)] mimics mingling with the endemic *Chromis fatuhivae*. (c) *Chromis fatuhivae*. (d) *Chromis abrupta*. Photographs credits: (a) and (b): Yann Hubert, (c): Luiz A. Rocha, (d) Philippe Bacchet.

not rare in the Marquesas and its presumed rarity is a sampling artifact based on inadequate knowledge and limited sampling of its preferential habitat. In this study it was found not only at its type locality (Fatu–Hiva), but also to be common 500 km away at the submerged atoll Banc Clark, the northernmost point of the Marquesas Islands where the photograph was taken. Moreover, at Tuamotu Archipelago *L. bohar* is known to mimic *C. margaritifer*, a damselfish replaced in the Marquesas by its sister species *C. abrupta* Randall 2001 [Fig. 1 (d)] which is very abundant in Marquesan waters. *Lutjanus bohar* may also mimic this other white–tailed damselfish species in Marquesan waters.

All of the species that were collected during the census of the reef fish fauna were photographed to record fresh colour. By reviewing the photographic records for other potential mimetic associations involving endemic species, colour photographs were retrieved for a similar case in the Marquesas Islands, first reported by Randall (2005b) involving an endemic model with the cleaner wrasse mimic, the blennioid *Aspidontus taeniatus* Quoy & Gaimard 1834. Throughout the Indo–Pacific, this blenny mimics *Labroides dimidiatus* (Valenciennes 1839) [Fig. 2 (a)] and uses mimicry to approach fishes and feed on pieces of fin or flesh from their potential clients instead of cleaning them (Russell *et al.*, 1976; Kuwamura, 1983). In the Marquesas Islands, *A. taeniatus* can display two colour patterns, the classic colour pattern mimicking *L. dimidiatus* which is also present in the Marquesas Islands [Fig. 2 (a)] and another pattern mimicking the female of the Marquesan endemic wrasse, *Coris hewetti* Randall 1999 (Randall, 2005b) [Fig. 2 (b)]. In this latter pattern, the whitish areas become yellow posteriorly on the body and the caudal fin and the dark stripe on the anterior two–thirds of the body are flanked with a series of white dots along the upper margin, mimicking the female of the endemic wrasse, which is also involved in cleaning (Randall, 2005b).

The photographic records of this study also indicated previously unreported cases of endemic mimicry patterns, involving two other widespread species mimicking an endemic species and another possible endemic model species. *Plagiotremus tapeinosoma* (Bleeker 1857) usually mimics the initial phase of *Thalassoma amblycephalum* (Bleeker 1856) in the Pacific (Russell *et al.*, 1976) [Fig. 2 (c)]; both species are present in the Marquesas Islands. In the current study it became apparent that *P. tapeinosoma* can also mimic *C. hewetti* in the Marquesas Islands [Fig. 2 (b)]. Moreover, *Plagiotremus rhinorhynchos* (Bleeker 1852), known as opportunistically mimicking *L. dimidiatus* (Ct & Cheney, 2005) may also mimic *C. hewetti* in the Marquesas Islands [Fig. 2 (b)]. The current study showed that the female of the endemic Marquesan wrasse, *Stethojulis marquesensis* Randall 2000, also displays a similar colour pattern to that of *P. tapeinosoma*, *P. rhinorhynchos*, *C. hewetti* and *A. taeniatus*; all forming a mimicry ring (i.e., mimetic



**Figure 2:** Mimics and their models. (a) *Aspidontus taeniatus* mimicking *Labroides dimidiatus*. (b) Mimicry ring involving the endemic *Coris hewetti* and *Stethojulis marquesensis* and their mimics: *Aspidontus taeniatus*, *Plagiotremus rhinorhynchos* and *Plagiotremus tapeinosoma*. (c) *Plagiotremus tapeinosoma* mimicking *Thalassoma amblycephalum*.



**Figure 3:** (b) *Pseudanthias regalis* and (a) its mimic *Ecsenius midas*.

relationships between multiple species). Because this complex mimicry case was only discovered from photographs rather than in-situ observations, the function of the complex is unknown. *Stethojulis marquesensis* may display this colour as a cleaning signal or for protective mimicry as cleaner species are less vulnerable to predation.

Finally, the blenniid *Ecsenius midas* Starck 1969 along with the damselfish *Lepidozygus tapeinosoma* (Bleeker 1856) are known to form feeding aggregations with and to mimic two anthiine species, *Pseudanthias dispar* (Herre 1955) and *Pseudanthias bartlettorum* (Randall & Lubbock 1981) in the Line Islands and Phoenix Islands (Randall & McCosker, 1993). Both are absent in the Marquesas Islands, and only the endemic *Pseudanthias regalis* (Randall & Lubbock 1981) displays a similar colour pattern among the anthiine species present, characterized by the bright yellow above and bright pink below. In 2003, Luiz Rocha (pers. comm.) observed *E. midas* mimicking and schooling with the Marquesan endemic *Pseudanthias regalis*; an illustration of that mimicry case is provided here (Fig. 3).

Mimicry is quite common in the marine environment and Randall reviews around a hundred cases (Randall, 2005b). However, the Marquesas seem to host an unusually high number of unique mimicry associations, involving endemic reef-fish species. This discovery adds a new line of evidence to the uniqueness of the Marquesas Islands, which not only host a high number of endemic reef-fish species, but also endemic mimicry patterns that may be an engine for speciation processes.

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