Marine Biodiversity Records, page 1 of 3. © Marine Biological Association of the United Kingdom, 2011
doi:10.1017/S1755267211000054; Vol. 4; e29; 2011 Published online

A new possible case of mimicry between two Brazilian endemic reef fish

THIAGO C. MENDES[1], RENATA C.B. MAZZEI[2], GABRIEL O. CORREAL[1] AND CARLOS EDUARDO L. FERREIRA[1]

[1]Departamento de Biologia Marinha, Universidade Federal Fluminense, 24001-970, Niterói, RJ, Brazil, [2]Universidade Federal do Rio de Janeiro, Rio de Janeiro, RJ, Brazil

It is proposed herein that the juvenile parrotfish Scarus zelindae *is a mimic of the barber goby* Elacatinus figaro. *Juvenile* S. zelindae *not only resemble* E. figaro *but also present changes in behaviour that helps establish the existence of a mimic–model system. When approached by divers juvenile* S. zelindae *remained stationary at the bottom adopting a site-attached behaviour similar to* E. figaro. *Because of* S. zelindae's *colour similarity and behaviour changes, we propose that juvenile* S. zelindae *may be acting as a mimic to the model* E. figaro *gaining advantage due to the low rate of predation upon cleaner fish.*

Keywords: mimic–model system, Batesian mimicry, cleaning, Scarinae, Gobiidae, *Scarus zelindae*, *Elacatinus figaro*, Arraial do Cabo

Submitted 9 August 2010; accepted 4 January 2011

In general terms, mimicry occurs when a species evolves to closely resemble another and, by doing so, gains some selective advantage (Wickler, 1965). This phenomenon is relatively widespread among reef fish with approximately 60 cases distributed within 16 families (Moland *et al.*, 2005). Four basic types of mimicry have already been proposed for reef fish: Batesian, Müllerian, aggressive and social. However, most cases are anecdotal accounts with only a few studies providing ecological evidence to the existence of mimicry (e.g. Caley & Schluter, 2003; Munday *et al.*, 2003; Côté & Cheney, 2004; Eagle & Jones, 2004; Moland & Jones, 2004).

Some confusion still exists regarding the precise classification of different types of mimicry for many reef fish examples (Randall, 2005) due to their complexities and the presence of more than one selective mechanism involved in most of the cases (Smith-Vaniz *et al.*, 2001; Rainey, 2010). Moreover, since the perception of mimicry has been based only on the human eye perception of colour, and as most fish possess a greater visual acuity than ours (Cheney & Marshall, 2009), recognizing the colours that are transmitted as well as what can be seen by mimics and models may bring essential information on mimicry prevalence among coral reef fish. Thus the number of recognized mimics among reef fish can be overlooked and new mimic–model systems are yet to be described not only in tropical reefs, but also in subtropical waters. Here, we describe a new possible case of mimicry involving the barber goby *Elacatinus figaro* Sazima, Moura & Rosa, 1997 and the juvenile parrotfish *Scarus zelindae* Moura, Figueiredo & Sazima, 2001, two endemic species of the Brazilian province.

The fieldwork was conducted at Arraial do Cabo, southeastern Brazil, between January and April 2010. The records were made basically at two different sites: Forno (between 22°57′59″S and 42°00′27″W) and Maramutá (22°59′30″S and 41°59′50″W). Observations on both species were performed with SCUBA divers during different periods within daylight hours. During the observations, the behaviour of both species was recorded using *ad libitum* sampling (Altmann, 1974) and photographs were taken.

The barber goby *Elacatinus figaro* reaches ~4 cm total length (TL) and presents a dark body with a pale belly and a bright yellow stripe that runs from head to tail (Figure 1A). Similarly, juvenile *S. zelindae* individuals have dark stripes over a yellowish to whitish body (Figure 1B). During the January observations, 3–5 cm (TL) juveniles of *S. zelindae* were continually recorded within the cleaning station of *E. figaro*, usually in pairs (Figure 2A). The same pattern was observed until April, when some juvenile *S. zelindae* had already overgrown *E. figaro* but were still found associating with them (Figure 2B).

Colour or morphological resemblance alone do not guarantee the existence of mimicry (Snyder, 1999). In many cases, the mimic adopts an unusual behaviour to enhance the deception. For example, during its juvenile mimic stage, and in the presence of its model *Centropyge vroliki*, the surgeonfish *Acanthurus pyroferus* adopts a swimming mode typical of the Pomacanthidae (Eagle & Jones, 2004). Similarly, juvenile *S. zelindae* change their swimming pattern when in danger. When approached by divers, juvenile *S. zelindae*, which usually maintain a constant swimming close to the bottom, remained stationary on the bottom presenting the same site-attached mode of *E. figaro*.

Another feature that would help deceive predators is the transparent caudal fin of juvenile *S. zelindae* (Figure 1B). This feature makes the mimic look smaller than its actual size and increases the time it could use mimetic coloration (Moland & Jones, 2004).

The mimic–model relationship between *E. figaro* and *S. zelindae* can be tentatively explained on the basis of

Corresponding author:
T.C. Mendes
Email: tcmendes@gmail.com

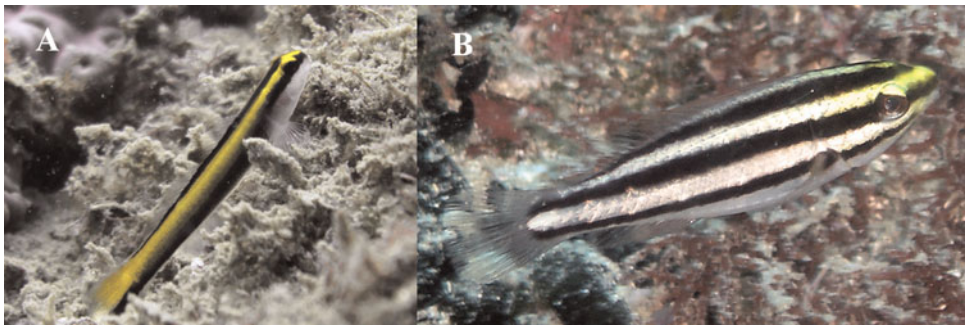

Fig. 1. (A) The barber goby *Elacatinus figaro*; (B) coloration of juvenile individuals of *Scarus zelindae*.

Batesian mimicry. According to Bates (1862), in this type of mimicry a harmless and palatable species closely resemble unpalatable or venomous species usually avoided by predators. Although *E. figaro* does not seem to be unpalatable or venomous, it is largely avoided by predators due to its important role in reef systems as a cleaning species (Grutter, 1999; Côté, 2000; Francini-Filho *et al.*, 2000).

Rates of predation on cleaner fish are extremely low (Côté, 2000). Thus, by mimicking a cleaner model, a mimic may face a lower predation rate during its juvenile stage, which is when reef fish are more susceptible to be preyed upon (Jones & McCormick, 2002). Cleaning stations can be considered 'safe havens', where predators' aggression towards potential prey is decreased (Cheney *et al.*, 2008). Nevertheless, this does not seem to be the case in this study since there was a great number of other juvenile fish (like the closely-related *Sparisoma* spp.) that could be using *E. figaro* cleaning stations as a refuge, but the only species observed finding refuge within the cleaning station was the similar-coloured juvenile *S. zelindae*.

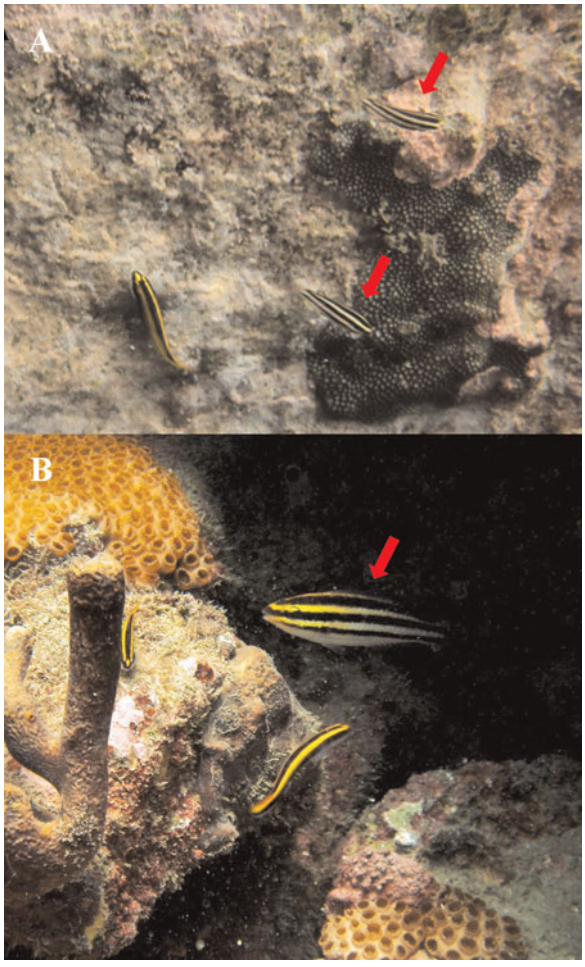

Fig. 2. Different-sized individuals of juvenile *Scarus zelindae* (marked with red arrows) close to the model *Elacatinus figaro*. (A) Two small juvenile individuals of *S. zelindae* and one *E. figaro*; (B) one *S. zelindae* juvenile that overgrew the models but still remained close to two individuals of *E. figaro*.

Mimicry involving cleaning fish has already been described for other species. Examples are the relationships involving the cleaning wrasse *Labroides dimidiatus* and the blennies *Aspidontus taeniatus* and *Plagiotremus rhinorhynchos* (Moland *et al.*, 2005). However, in both cases the mimicry is explained on the basis of aggressive mimicry, in which the mimic gains advantage by deceiving the cleaner's clients in order to feed upon their scales and tissues (Moland & Jones, 2004). Thus this is the first time that a mimic–model relationship involving a cleaner fish is tentatively explained on the basis of Batesian mimicry. This is also the first time that a mimic–model system is proposed between a species of goby as the model and a parrotfish as the mimic (Moland *et al.*, 2005).

The relationship between *E. figaro* and juveniles of *S. zelindae* seems to fulfil all the defining ecological characteristics that should apply in mimic–model systems. However, to establish the real existence of this mimicry, additional field observations and manipulative experiments must be performed to define the relationships of abundance between both species, their distributions along the rocky reefs, and the ecological advantages of the mimic *S. zelindae*.

ACKNOWLEDGEMENTS

We thank Diving Arraial for logistic support and Marcelo and Zé from the boat 'Iceberg'. Financial support was provided by FAPERJ and CNPq with grants to C.E.L.F.

REFERENCES

Altmann J. (1974) Observational study of behavior: sampling methods. *Behaviour* 49, 226–265.

Bates H.W. (1862) Contributions to an insect fauna of the Amazon Valley. Lepidoptera: Heliconidae. *Transactions of the Linnean Society of London* 23, 495–566.

Caley M.J. and Schluter D. (2003) Predators favour mimicry in a tropical reef fish. *Proceedings of the Royal Society B* 270, 667–672.

Cheney K.L., Bshary R. and Grutter A.S. (2008) Cleaner fish cause predators to reduce aggression toward bystanders at cleaning stations. *Behavioral Ecology* 19, 1063–1067.

Cheney K.L. and Marshall N.J. (2009) Mimicry in coral reef fish: how accurate is this deception in terms of color and luminance? *Behavioral Ecology* 20, 459–468.

Côté I.M. (2000) The evolution and ecology of cleaning symbioses in the sea. *Oceanography and Marine Biology: an Annual Review* 38, 311–355.

Côté I.M. and Cheney K.L. (2004) Distance-dependent costs and benefits of aggressive mimicry in a cleaning symbiosis. *Proceedings of the Royal Society* B 271, 2627–2630.

Eagle J.V. and Jones G.P. (2004) Mimicry in coral reef fishes: ecological and behavioural responses of a mimic to its model. *Journal of Zoology* 264, 33–43.

Francini-Filho R.B., Moura R.L. and Sazima I. (2000) Cleaning by the wrasse *Thalasoma noronhanum*, with two records of predation by its grouper client *Cephalopholis fulva*. *Journal of Fish Biology* 56, 802–809.

Grutter A.S. (1999) Cleaner fish do clean. *Nature* 398, 672–673.

Jones G.P. and McCormick M.I. (2002) Numerical and energetic processes in the ecology of coral reef fishes. In Sale P.F. (ed.) *Coral reef fishes: dynamics and diversity in a complex ecosystem*. San Diego, CA Academic Press, pp. 221–339.

Moland E., Eagle J.V. and Jones G.P. (2005) Ecology and evolution of mimicry in coral reef fishes. *Oceanography and Marine Biology: an Annual Review* 43, 445–482.

Moland E. and Jones G.P. (2004) Experimental confirmation of aggressive mimicry by a coral reef fish. *Oecologia* 140, 676–683.

Moura R.L., Figueiredo J.L. and Sazima I. (2001) A new parrotfish (Scaridae) from Brazil, and revalidation of *Sparisoma amplum* (Ranzani, 1842), *Sparisoma frondosum* (Agassiz, 1831), *Sparisoma axillare* (Steindachner, 1878) and *Scarus trispinosus* Valenciennes, 1840. *Bulletin of Marine Science* 68, 505–524.

Munday P.L., Eyre P.J. and Jones G.P. (2003) Ecological mechanisms to coexistence of colour polymorphism in a coral-reef fish: an experimental evaluation. *Oecologia* 137, 519–526.

Rainey M.M. (2010) Evidence of a geographically variable competitive mimicry relationship in coral reef fishes. *Journal of Zoology* 279, 78–85.

Randall J.E. (2005) A review of mimicry in marine fishes. *Zoological Studies* 44, 299–328.

Sazima I., Moura R.L. and Rosa R.S. (1997) *Elacatinus figaro* sp. n. (Perciformes: Gobiidae), a new cleaner goby from the coast of Brazil. *Aqua: Journal of Ichthyology and Aquatic Biology* 2, 33–38.

Smith-Vaniz W.F., Satapoomin U. and Allen G.R. (2001) *Meiacanthus urostigma*, a new fangblenny from the northern Indian Ocean, with discussion and examples of mimicry in species of *Meiacanthus* (Teleostei: Blenniidae: Nemophini). *Aqua: Journal of Ichthyology and Aquatic Biology* 5, 25–43.

Snyder D.B. (1999) Mimicry of initial-phase bluehead wrasse, *Thalassoma bifasciatum* (Labridae) by juvenile tiger grouper, *Mycteroperca tigris* (Serranidae). *Revue Française d'Aquariologie* 26, 17–20.

and

Wickler W. (1965) Mimicry and the evolution of animal communication. *Nature* 208, 519–521.

Correspondence should be addressed to:
T.C. Mendes
Departamento de Biologia Marinha
Universidade Federal Fluminense, 24001-970, Niterói
RJ, Brazil
email: tcmendes@gmail.com