

Fright Posture of the Plesiopid Fish *Callopleleslops altivelis*: An Example of Batesian Mimicry

Abstract. When frightened by a predator, the plesiopid fish, *Callopleleslops altivelis*, adopts a posture and appearance that mimics the head of a noxious moray eel, *Gymnothorax meleagris*. Tests indicate that the mimicry is Batesian and not Müllerian. Unlike the strategy of other reef-fish prey species, which hide when threatened, the *Callopleleslops*'s strategy is one of intimidation.

Although numerous examples of Batesian mimicry in insects have been documented, relatively few examples have been identified in fishes (1). Aquarium and field observations (2) of the Indo-Pacific plesiopid fish, *Callopleleslops altevelis* (Steindachner) (3), suggest that, when frightened, this species adopts a posture and behavior that mimic the appearance of the head region of *Gymnothorax meleagris* (Shaw and Nodder), a noxious and defensively pernicious moray eel (4, 5). The advantage gained by *Callopleleslops* through mimicking a morphologically and phylogenetically dissimilar fish is comparable to the often-cited example of the mimicry of owl eyes by eyespots on butterfly wings.

Batesian mimicry is recognized on the basis of six criteria (6, 7), all of which are satisfied by the *Callopleleslops*-*Gymnothorax* example: (i) a species, the model, is undesirable to predators; (ii) a second species, the mimic, is desirable to predators but has evolved from its ancestral appearance until it resembles the model so closely that potential predators are deceived and leave it alone; (iii) the mimics are less abundant than the models; (iv) the mimics are found at the same place and time as the models; (v) both model and mimic are conspicuous or readily seen by potential predators; and (vi) the predators learn or associate undesirability with the appearance of the model.

The mimic, *Callopleleslops*, is an uncommon species (on the basis of observations by scuba divers and its appearance in rotenone-based collections) and exists well within the range (with respect to both geography and habitat) of the relatively abundant moray model. The mimic is known from the Philippines eastward to Mozambique, including the Seychelles and Grande Comore Island, and lives within the reef coral habitat at depths between approximately 4 and 30 m. The model is known from Hawaii, throughout Oceania, and eastward to the east coast of Africa and the Red Sea, living within the reef between depths of approximately 1 and 30 m. Hobson (4, p. 926) stated that Hawaiian *G. meleagris* "characteristically protrudes its head from crevices during the day and thus is

the moray most often in view on the reef." The model and mimic are similar in coloration, both displaying a dark brown to black background overlaid by numerous white to bluish spots, smaller than the eye in size. The mimic exhibits an obvious ocellus located along the posterior base of the dorsal fin (Fig. 1a), which simulates the eye of the model. The mimic rarely ventures far from the entrance to its rock or coral protection. When pursued by a predator, *Callopleleslops* darts

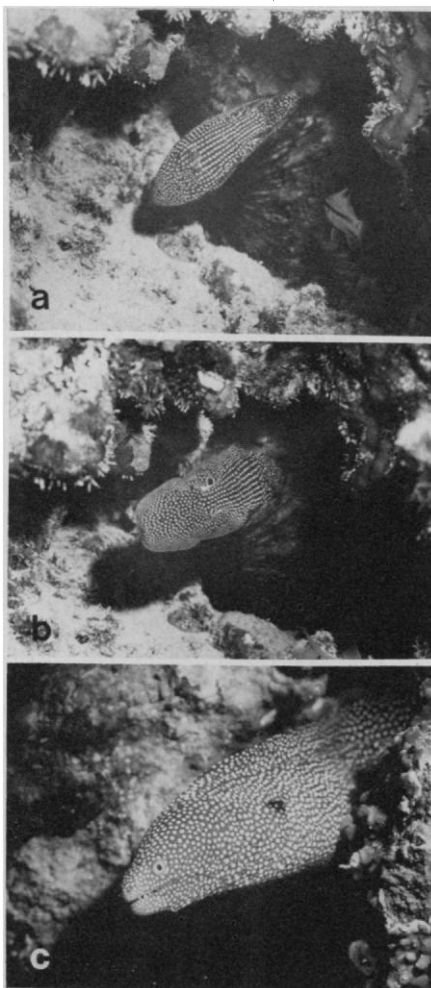


Fig. 1. Field photographs taken at Grande Comore Island, Indian Ocean. [D. Powell] (a) *Callopleleslops altivelis* (total length approximately 15 cm), normal posture. Note the ocellus at the posterior base of the dorsal fin. (b) Intimidation posture. The fish is now facing away from the camera. (c) *Gymnothorax meleagris* (total length approximately 1 m, head length approximately 15 cm), posture when confronted by a diver.

toward its protection and expands its normally relaxed caudal, anal, and dorsal fins, making the ocellus fully visible (Fig. 1b). *Callopleleslops* is then often observed to remain near the opening of its refuge with the hind portion of its body left exposed. In doing so, *Callopleleslops* presumably appears to a predator to be a *Gymnothorax* in a defensive posture (Fig. 1c). When it encounters larger reef fish or a scuba diver, *G. meleagris*, like other species of *Gymnothorax*, usually retracts into the rock or coral substrate but leaves its head and anterior trunk region exposed.

To exclude the possibility that the mimicry is Müllerian rather than Batesian (8), I conducted preliminary experiments to detect the presence of any toxic, nonpalatable substances associated with *Callopleleslops* (9). I tasted the skin of a living *Callopleleslops* (total length, 14 cm) in order to detect the presence of a grammistin-like toxin (10); there was no unpleasant bitter taste or stinging sensation. The same stressed *Callopleleslops* was placed in 600 ml of distilled water for 2 minutes; two goldfish (*Carassius auratus*, Cyprinidae) were subsequently added. Neither goldfish showed ill effects after 2 hours. The *Callopleleslops* was then placed in a 2-liter saltwater tank for 2 hours with two subadult Sergeant Major damselfishes (*Abudefduf troschelii*, Pomacentridae); again, the test fish showed no ill effects. Therefore, a Müllerian explanation of this mimicry seems unlikely.

Alternative interpretations exist for the function of the ocellated eyespot along the *Callopleleslops* dorsal fin. Supportive of the hypothesis that this is an instance of Batesian mimicry is the premise that it completes the image which intimidates predators through mimicry of the predator's own enemies (11, 12). Another interpretation would suggest that the eyespot deflects the attack to an area of the body less vulnerable than the true eye, which is, in fact, hidden among the spots on the head. Similar false eyespots are commonly located along the wings of butterflies and moths and the median fins of marine butterflyfishes (Chaetodontidae). An examination of 12 specimens (13) of *Callopleleslops* did not reveal the ocellus to have been a significant site for attack and injury. A final function of the eyespot could be that it, like the eyespots of certain butterflies or moths (6, 12, 14), startles predators when it rapidly appears. In the aquarium, when a *Callopleleslops* is frightened its subsequent fin erection noticeably startles its tankmates (such as butterflyfishes, damselfishes, and angelfishes, none of which are large

enough to act as predators). In the absence of evidence from other sources, it seems most likely that the ocellus functions as a component of Batesian mimicry rather than as a deflective target, but it may also startle a predator.

On the basis of field and aquarium observations, it is apparent that, when threatened, most reef-fish prey species take shelter in the reef and await the eventual departure of the predator. What then would be the selective advantage to a prey species to pose in a vulnerable location rather than to flee and hide? The strategy of the mimic appears to be one of intimidation. Rather than flee into the refuge of the reef when it encounters a predator, *Calloplepsiops* simulates the abundant and aggressive moray, frightening away a predator and thereby reducing the time spent by *Calloplepsiops* in less productive activities.

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References and Notes

1. W. Wickler, *Mimicry in Plants and Animals* (McGraw-Hill, New York, 1968); J. Randall and H. Randall, *Bull. Mar. Sci. Gulf Caribb.* **10**, 444 (1960); J. Randall and A. Emery, *Zoologica* **56**, 115 (1971).
2. Aquarium observations are based on six specimens, presumably collected in the Philippines, of *Calloplepsiops* that have been in captivity since December 1973. I made field observations

- along the western coast of Grande Comore Island, Indian Ocean, during February and March 1975.
3. *Calloplepsiops altivelis* (Steindachner) was described as *Plesiops altivelis* and includes *Barrosia barrosi* Smith in its synonymy.
4. E. Hobson, *Fish. Bull.* **72**, 915 (1974).
5. R. Hiatt and D. Strasburg, *Ecol. Monogr.* **30**, 65 (1960).
6. C. Rettenmeyer, *Annu. Rev. Entomol.* **15**, 43 (1970).
7. The necessity and importance of certain of the listed characters, particularly items (iii) and (iv), is debatable.
8. Müllerian mimicry is based on the premises that (i) two or more species are unpalatable, (ii) if two or more species are indistinguishable by predators, they will be captured in proportion to their abundance, and items (iv) to (vi) of the Batesian mimicry criteria (6).
9. Because of the scarcity of *Calloplepsiops*, the simple but conclusive experiment of feeding a series of *Calloplepsiops* to various predators was not attempted.
10. J. E. Randall, K. Aida, T. Hibiya, N. Mitsuura, H. Kamiya, and Y. Hashimoto [*Publ. Seto Mar. Biol. Lab.* **19**, 157 (1971)] outlined the procedure for identifying the presence of skin toxins and discovered them to be present throughout the family Grammistidae. Ichthyologists consider the Grammistidae and Plesiopidae to be related families within the suborder Percoidae [see, for example, P. H. Greenwood, D. E. Rosen, S. Weitzman, G. S. Myers, *Bull. Am. Mus. Nat. Hist.* **131**, 341 (1966)].
11. E. Poulton, *The Colours of Animals* (International Scientific Series, LXVIII, London, 1890); H. Cott, *Adaptive Coloration in Animals* (Meuthen, London, 1940).
12. A. Blest, *Behaviour* **11**, 209 (1957).
13. Six specimens from Steinhart Aquarium and preserved specimens from the fish collections of the California Academy of Sciences, National Museum of Natural History, and J. L. B. Smith Institute of Ichthyology.
14. A. Blest, *Zoologica* **49**, 161 (1964).
15. Comoran fieldwork supported by a grant from the C. H. Breeden Foundation. I thank R. MacPherson for insight, P. Ehrlich and G. Barlow for advice, and T. McHugh/Photo Researchers and D. Powell for photographs.

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The Development of Language-Like Communication Without a Language Model

Abstract. Deaf children who are unable to acquire oral language naturally and who are not exposed to a standard manual language can spontaneously develop a structured sign system that has many of the properties of natural spoken language. This communication system appears to be largely the invention of the child himself rather than of the caretakers.

Must a child experience language in order to learn language? Clearly some experience with language is necessary for the child to learn the established language of his particular community. The child of English-speaking parents learns English and not Hopi, while the child of Hopi-speaking parents learns Hopi, not English. But what if a child is exposed to no conventional language at all? Surely such a child, lacking a specific model to imitate, could not learn the conventional language of his culture. But might he elaborate a structured, albeit idiosyncratic, language nevertheless?

We have observed a group of children who lack specific linguistic input but who otherwise have normal home environments. Our subjects are deaf children

of normal intelligence whose hearing losses prevent them from acquiring oral language naturally in the home. These children's hearing parents have decided against exposing them to a manual sign language in order to concentrate on oral education (1). At the point at which we studied these subjects, their oral education program had not produced significant learning; they had acquired few, if any, spoken-language items that they could use regularly in their daily activities.

Six deaf children of hearing parents (two girls and four boys), ranging in age from 17 to 49 months at the first interview, were visited in their homes by two experimenters for 1 to 2 hours at intervals of approximately 6 to 8 weeks. The

experimenters provided a standard set of toys for the child to play with during the interview and videotaped the informal interaction of mother, experimenter, child, and toys. Each videotaped session was coded by one of the experimenters or a research assistant. Selected samples were coded by both experimenters in order to calculate reliability scores on the coding categories.

The videotaped sessions were used to develop a coding system (2). (i) Instances of communicative gestures were designated in the stream of motor behavior (3). In a randomly selected sample of videotape, 82 percent of the gestures identified by either of two coders were identified and similarly described by both coders. (ii) On the basis of physical criteria, these gestures were broken down into single units analogous to words or signs and into multisign units analogous to phrases (4). Of the gestures identified by both coders, there was 95 percent agreement on sign boundary assignment and 85 percent agreement on phrase boundary assignment. (iii) By the method of "rich interpretation" (5), referential designates (such as Santa Claus or twist) were assigned to all word signs, and semantic elements, cases, and predicates (such as agent or act) (6) were assigned to the individual signs in all multisign phrases. Of the gestures identified by both coders, there was 98 percent agreement on reference assignment and 96 percent agreement on semantic element assignment.

Using these descriptive categories, we found that each of our deaf subjects developed a structured communication system that incorporates properties found in all child languages (7). They developed a lexicon of signs to refer to objects, people, and actions, and they combined signs into phrases that express semantic relations in an ordered way.

Lexicon. The children developed two types of signs to refer to objects and actions (8). First, they used deictic signs, typically pointing gestures which, like proforms in English (such as "this" or "there"), effectively allow the child to make reference to any object or person in the present. However, as is the case with proforms, context is necessary to interpret these signs. During the study, David, Donald, Dennis, Chris, Kathy, and Tracy produced, respectively, 4854, 1806, 309, 401, 1218, and 366 deictic signs, representing 52, 62, 49, 41, 52, and 52 percent of the signs each child produced.

The children produced a second type of sign, characterizing signs, which are motor-iconic signs that specify actions,