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Response by Potential Prey to Coral Reef Fish Predators

Agonistic behaviour is one of the most interesting and studied interactions among reef fishes. Intra- and inter-specific agonistic encounters between fishes often involve such actions as fin-spreading, tail-beating, mouth-gaping, pendulum movements, and other less equivocal movements (Miller 1978). Lateral displays are one form of behaviour used in intra- and interspecific agonistic encounters and in anti-predator situations between fishes. These displays appear to communicate status and/or threat, sometimes being entirely sufficient to dissuade further encroachment by potential enemies (Chiszar 1978).

This note adds to the growing literature on predator-prey interactions in fishes, specifically those involving prey actively moving to the immediate vicinity of potential predators for purposes of apparent mobbing. I report on lateral displaying and rubbing behaviour exhibited by butterflyfishes (Chaetodontidae), damselfishes (Pomacentridae) and surgeonfishes (Acanthuridae) and directed toward moray eels (Muraenidae) and lizardfishes (Synodontidae).

The nocturnal and diurnal predatory behaviour of moray eels and lizard fishes on other tropical reef fishes, including spinous forms such as butterflyfishes, has been reported by Winn & Bardach (1959), Hobson (1974, 1975) and Burgess (1978).

The interactions described here occurred over coral substrate at various locations in Hanauma Bay, Oahu, Hawaiian Islands on eight separate occasions between 1200 and 1530 hours, and involved nine species of displaying fishes (Table I). In general, after sighting the potential predator, the displaying fish(es) approached it from a distance of up to 3 m. The displayers swam directly towards the potential predator and displayed laterally anywhere from 20 cm in front of it to making direct contact with the predator's head. The displaying fish was oriented approximately perpendicular to the predator's head, which was protruding from a crevice in most cases. The displayer often exhibited tail-beating behaviour, involving slow oscillations of the caudal fin. If contact with the predator's head occurred, it was gentle and made by the caudal fin. During displays, the dorsal fin of the displayer could be either fully or partially erect, or not erect. In cases of close proximity between the displayer and the predator, the former occasionally exhibited rolling or leaning, in which the fish rolled its body with its dorsal spines more or less directed towards the predator. It was not noted whether colour changes accompanied the interactions.

Displays lasted approximately 5–20 s, after which the displaying fish swam a short distance away from the predator and then returned to display one or more times, either in the same or the opposite orientation. In all cases described, the potential prey returned to display at least once more. In some cases the predator left the area following the display.

These displaying fishes may be exhibiting mobbing behaviour. Mobbing may involve one or more animals (Hartley 1950; Hinde 1970), is a reaction to a potential threat, and is not necessarily provoked by hostile actions (Hartley 1950). Mobbing may result in deterring or thwarting a predator's attack (Bertram 1978) and it generally makes nearby individuals of the prey species aware of the presence of the predator (Harvey & Greenwood 1978).

Displaying to potential predators has been briefly described for other reef fishes. Wickler (1961) likened the attacks to those of songbirds on owls. Eibl-Eibesfeldt (1962) observed a school of *Caesio cuning* harass a moray eel, causing it to move some 10 m away along the reef. Maksimov (1970) described 'mobbing' of sharks by tropical fishes as did Fricke (1973) for damselfishes towards barracuda (Sphyracnidae), triggerfish (Balistidae) and octopus. R. W. Abrams, M. D. Abrams and M. W. Schein (personal communication), MacElwain (1977) and possibly Collette & Talbot (1972) noted displaying of reef fishes to other potentially predatory reef fishes. Dubin (1982) hypothesized that similar behaviours exhibited by Atlantic reef fishes towards moray eels and snake eels (Ophichthidae) were stimulating the eels to move away. The behaviour may be functionally analogous to the mobbing response of small birds to predators. Curio et al. (1978) acknowledge that mobbing occurs in fishes, birds and mammals.

Mobbing may cause the predator to move off because of the lowered probability of prey capture in that area, given that most prey individuals are aware of the predator's presence either by spotting it or being alerted by the commotion of the others (Alcock 1979). In two of the eight observations reported here, the potential predator left the immediate area (Table I).

It appears unlikely that the displaying fishes are defending territories because: (a) of the species involved, only the damselfish *Abudefduf abdominalis* is territorial (Reese 1975; Neudecker & Lobel 1982; personal observations); and (b) in over 300 h of observation on *C. miliaris*, *C. ornatissimus*, *C. auriga*, *C. trifasciatus* and *C. unimaculatus*, I have never observed similar displays directed at other fishes.

The function of this behaviour, and whether it constitutes true mobbing, remains unresolved, but this note provides the most detailed account to date of this very interesting interaction among reef fishes.

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Table 1. Summary of Reported Interactions Involving Apparent Mobbing of Potential Predators by Various Reef Fishes

Predator species	Prey species	No. of individuals laterally displaying	Prey obviously paired	Predator-prey distance during lateral display		Approx. duration of lateral display	No. of approaches of prey	Comments
				max.	min.			
<i>Gymnothorax meleagris</i> (TL=90 cm)*	<i>Chaetodon fremblii</i> (TL=13 cm)	1	yes	10 cm	touching	5-10 s	2	Predator swam approx. 5 m away to another hole in reef following display
<i>Gymnothorax eurostus</i> (TL=90 cm, D=5 cm)†	<i>Chaetodon utimaculatus</i> (TL=10 cm)	2	yes	2.5 cm	touching	10-20 s	> 2	Butterflyfishes continued feeding nearby after displaying
<i>Gymnothorax meleagris</i> (TL=60 cm)	<i>Chaetodon trifasciatus</i> (TL=13 cm)	2	yes	7.5 cm	5 cm	?	> 2	Eel moved out of rocks into open sandy area
	<i>Forcipiger flavissimus</i> (TL=10 cm)	2	?	?	?	?	> 2	These plus above displayed after eel moved out from cover. Eel tried numerous times to force itself into holes in reef that were too small. Eventually it found hole 1 m from original site
<i>Muraenidae</i> sp. ‡ (D=5 cm)	<i>Chaetodon auriga</i> (TL=15 cm)	1	yes	10 cm	5 cm	5-10 s	2	
<i>Gymnothorax meleagris</i> (TL=120 cm, D=10 cm)	<i>Chaetodon ornatissimus</i> (TL=15 cm)	2	yes	20 cm	15 cm	?	3	
<i>Muraenidae</i> sp. ‡ (D=4 cm)	<i>Chaetodon auriga</i> (TL=15 cm)	1	yes	2.5 cm	touching	10 s	~ 2	
<i>Muraenidae</i> sp. ‡ (TL=60 cm)	<i>Acanthurus nigrofasciatus</i>	1	?	5 cm	?	10-15 s	2	Presented caudal spine area in front of eel
<i>Synodontidae</i> sp. ‡ (<i>Saurida gracilis</i> ?) (TL=35 cm)	<i>Chaetodon militaris</i> (TL=10 cm)	2-3	no	?	15 cm	?	> 2	Lizard fish scared out into open by author
	<i>Chaetodon fremblii</i> (TL=12.5 cm)	2	?	?	15 cm	?	> 2	<i>Abudefduf</i> swam down 3 m from foraging above to display. At any one point 2-3 fish were around lizard fish. Predator did not leave area
	<i>Abudefduf abdominalis</i> (TL=15 cm)	~ 3	no	?	15 cm	?	> 2	

*TL = approximate total length.

†D = approximate lateral diameter of predator.

‡ Unidentified species.

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Note on Terminology in Animal Behaviour, with Special Reference to Slavery in Ants

Recent articles by Estep & Bruce (1981) and Gowaty (1982) challenge the use of so-called 'anthropocentric'

and 'emotionally charged' words in descriptions of animal behaviour. These authors argue that to apply such 'human labels' to 'lower animals' is not only inappropriate, but sensationalistic. In this respect, Estep & Bruce list seven 'human metaphors or analogies' (incest, homosexuality, prostitution, adultery, slavery, orgasm and rape) and Gowaty refers to six 'sexual terms used in sociobiology' (rape, coy, cuckoldry, adultery, homosexual and harem). Furthermore, these authors indicate that their lists are not all-inclusive. Indeed, if one accepts their general arguments, any word which carries any emotional, social, ethical or cultural connotation when applied to humans is reprehensible when used in reference to non-human animals. I protest against the sweeping nature of this criticism, and suggest that the definitions of the terms listed by these authors are neither so restrictive nor so inherently human that they cannot be applied to other animals.

In principle, I believe all of the above words can be objectively and functionally defined, and could be used to describe the behaviour of non-human animals under certain circumstances. None of these words necessarily embody human emotion or conscious thought, and are therefore not strictly anthropomorphic. Indeed, behaviour which is mediated by emotion and conscious choice in humans might be quite similar to evolved behaviour patterns and preferences mediated by other means in other animals. Certainly, these words possess emotional connotations when used in a human context; but such connotations are apart from the denotations of the words and are largely a matter of personal bias. When such words are used to describe behaviour in diverse groups of animals, one should not assume that all of the connotations and ramifications in one case should necessarily apply in other cases. Clearly, it is the definition of the word which should limit what is expected. Furthermore, if due heed is paid to the denotative requirements of such words, then any charge of linguistic irresponsibility or sensationalism is groundless.

Superficially, it may be difficult to imagine how any form of non-human behaviour could fulfil the definitions of the words listed by Estep & Bruce and Gowaty. Nonetheless, even these words may be found to be quite appropriate once the details of the phenomena to which they have been applied are examined. For example, Estep & Bruce include the word 'slavery' on their list of objectionable terms but offer no specific complaints and cite no references in which they claim abuse. However, this term has been used to describe a form of social parasitism which occurs among certain ant species, and this usage has such a long history that both 'slave ant' and 'slave-making ant' are now included in dictionaries (e.g. Gove 1976). Typically, slave-making ants attack other ant colonies in what are referred to as slave raids. They kill or drive away the adults of such colonies and appropriate their brood. This captured brood is reared in the slave-maker nest, and workers which eclose from it join the slave-maker colony. Such alien ants (slaves) function as workers within the slave-maker colony: they forage for food, feed the brood and their adult nestmates, defend the nest, and may even join the slave-makers on slave raids. However, slaves merely help support the slave-maker colony, and it is the slave-makers which reap the reproductive benefits. Slavery in ants is polyphyletic, and may occur either intra- or interspecifically, and be either facultative or obligatory (Wilson 1971; Stuart & Alloway 1982).