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SHORT NOTE

MALICIOUS NEIGHBORS IN LEKS OF SERGEANT MAJOR DAMSELFISH, *ABUDEFDUF VAIGIENSIS*[1]

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Rong-Quen Jan (1991) Malicious neighbors in leks of sergeant major damselfish, *Abudefduf vaigiensis. Bull. Inst. Zool., Academia Sinica* **30**(1): 49-53. Sergeant major damselfish *Abudefduf vaigiensis*, a lekking demersal spawner of which the male is responsible for egg-caring, was used to study whether or not the fish in leks adapted to help care for and protect, each other's embryos like some freshwater fishes. Removal of some members in three leks showed that the neighboring conspecifics were, in all cases, the first to prey on the eggs of nests whose owners were removed. Furthermore, other than some heterospecific egg-predators, the conspecifics also constituted most of the egg-predation pressure to the eggs. Overall, there was no evidence showing individual fish helping others in terms of protecting each other's eggs. On the contrary, these results expose the maliciousness (c.f. spitefulness) of a lekking fish such as *Abudefduf vaigiensis* toward his fellow nesters. Alternative hypotheses of the underlying mechanisms of lek formation are also suggested.

Key words: Lek, Neighbors, Fish behavior, *Abudefduf vaigiensis.*

Lekking, the temporary aggregation of sexually active males for reproduction, occurs in birds, teleosts and a variety of other animals (Bradbury and Gibson, 1983). In teleosts paternal custodial lekking is defined as a lekking system in which the eggs of one or more females are deposited within the male's territory in a nest prepared for that purpose (Loiselle and Barlow, 1978). This mode of lekking is practiced by both freshwater and marine fishes (Loiselle and Barlow, 1978; Thresher, 1984). Loiselle and Barlow (1978) have speculated that the evolution of lekking in teleosts is linked to the dependence upon suitable spawning sites and nest predation. In freshwater teleosts, however, the occurrence of paternal custodial lekking seems to be independent of the availability of a spawning site. Since lekking has been found in environments with either limited or unlimited spawning sites (Dominey, 1981; McKaye, 1984). Yet, evidence that nest predation is a selective force to the formation of a lekking system is supported by the fact that these lekking freshwater teleosts not only defend their own young but also assist in the defence of their neighbors (Dominey, 1981; McKaye, 1984).

In marine teleosts information on the underlying factors of paternal custodial

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lekking is extremely rare despite the fact that this spawning system is practiced widely by some groups of fish, *e.g.* damselfish and wrasse (Moyer and Yogo, 1982; Thresher, 1984). The question of whether or not the availability of sites in the marine environment is limiting remains open (e.g. Barlow 1981). However, like the freshwater environment, the egg-predation pressure on fishes in the marine environment is presumably high (Johanne, 1978). If the pressure of nest predation from heterospecific species is also accounted for in the formation of a lekking spawning system in marine teleosts, then I ask: do the fishes in leks adapt to help each other's embryos like freshwater lekking fishes such as cichlids and bluegill sunfish (Dominey, 1981; McKaye, 1984)?

METHODS

In this study I used sergeant major damselfish, *Abudefduf vaigiensis*, a demersal spawner, as the material. Egg-predation has been found to be the major cause of premature embryo loss of this damselfish (in the form of *Abudefduf saxatilis* or *Abudefduf troschelii* in some waters) (Cummings, 1968: Bahama Islands; Fishelson, 1970: Red Sea; Foster, 1987a and 1987b: Caribbean). Moreover, the majority of *A. vaigiensis* spawn in paternal custodial leks. These characteristics make it suitable material for the present study. Like other lekking birds or fishes, this fish does not defend a territory when it is not breeding. Since males are responsible for both nest-building and egg-caring, they frequently re-occupy, breed and abandon nesting areas throughout the spawning season.

This study was conducted along the northern coast of Taiwan in the summer of 1986. The study area has been previously described elsewhere (Jan, 1989). This area had six main lekking sites, three of which (groups 1, 2 and 3) were chosen for the experiments. The distance between each group was about 60 m. There were 19, 24 and 19 nesting male *Abudefduf vaigiensis* in group 1, group 2 and group 3 respectively before the removals. Five individuals were removed (*i.e.*, speared) from each group. After the removals, fishes which visited the nests and preyed on the eggs were observed and identified. The number of these egg-predators were counted twice, 15 min and 30 min respectively after the the removals. (The length of the time interval, *i.e.*, 15 min, between the two counts was arbitrarily assigned. However, large quantities of eggs were still available in the nest to the predators 30 min after the removal of the nest-owner).

RESULTS

Egg-predators arrived immediately after the removals. In group 1 the predators were composed of two damselfishes, namely, *Stegastes fasciolatus* and *Abudefduf vaigiensis* itself. Fifteen min after the removal, eggs in each nest suffered predation by 2.6 individuals (SD=0.54), among them 46% were neighboring *A. vaigiensis* (Table 1). The average predation pressure at the end of the second 15 min interval was 4 individuals (SD=1), among them 35% were *A. vaigiensis*. There was no significant difference between the egg-predation pressures from conspecific and heterospecific (t=0.45 and 2.12 in the 1st and 2nd 15 min periods respectively, df=8).

In group 2, 7 egg-predators, including the above two damselfishes, appeared after the removals (Table 1). The egg-predation pressure imposed on the unguarded eggs was much higher than in the previous group. At the end of the first 15 min period 12 individuals (SD=4.1) preyed on the eggs and 16 individuals (SD=2.64) at the end of the second 15

Table 1
Numbers of egg-predators found in nests of the three groups of *Abudefduf vaigiensis* 15 min and 30 min after the nest owner was removed

Group 1 (5 among 19 nesters were removed on July 4)

Egg-predators	1st 15 min		2nd 15 min	
	Avg	SD	Avg	SD
Abudefduf vaigiensis	1.2	0.44	1.4	0.54
Stegastes fasciolatus	1.4	0.89	2.6	1.14
Sum	2.6	0.54	4.0	1.00

Group 2 (5 among 24 nesters were removed on July 4)

Egg-predators	1st 15 min		2nd 15 min	
	Avg	SD	Avg	SD
Abudefduf vaigiensis	1.0	0	1.4	0.54
Chaetodon auripes	0.6	0.89	1.0	1.22
Chromis fumea	3.8	1.30	4.4	1.94
Labroides dimidiatus	0.4	0.89	0.4	0.89
Pomacentrus coelestis	4.2	2.77	6.4	2.07
Stegastes fasciolatus	1.6	0.89	2.0	0.70
Stethojulis interrupta	0.4	0.54	0.4	0.54
Sum	12.0	4.06	16.0	2.64

Group 3 (5 among 19 nesters were removed on August 19)

Egg-predators	1st 15 min		2nd 15 min	
	Avg	SD	Avg	SD
Abudefduf vaigiensis	1.6	0.54	1.6	0.54
Stegastes fasciolatus	0.4	0.54	0.8	0.83
Sum	2.0	0.70	2.4	0.54

min period. In this group egg-predation pressure from heterospecifics was higher than from conspecifics.

In group 3, the number of egg-predators was the same as in group 1. But egg-predation pressure from conspecifics was significantly higher than from heterospecifics (t=3.46 and 2.89, in the 1st and 2nd 15-min periods respectively; df=8; both significant at 5%).

Regardless of the differences between total egg-predation pressures shown in the three groups, the first individuals preying upon unguarded eggs were, in all cases, members of the same lek.

DISCUSSION

These results not only show that the lekking *Abudefduf vaigiensis* failed to help others in terms of defending against nest-predation, but also expose the maliciousness (*c.f.* spitefulness) of a lekking fish toward his fellow nesters.

Accordingly, if the strategy of spawning in leks in marine teleosts is underlain by interspecific nest predation, then the gross benefits from lekking should be higher enough to make this strategy adoptable. However, this conclusion is not fully supported by the present results

since the application of lekking seemed independent of heterospecific nest-predation pressure (Table 1). Furthermore, the present results suggest that in some cases, potential nest-predation pressure would possibly increase rather than decrease when the fish spawn in leks in the study area.

Since the exploitation of a suitable substrate for spawning is essential to paternal custodial lekking teleosts, lekking might alternatively be explained either as a tactic adopted to approach this resource (Robertson *et al.*, 1976; Foster, 1985, 1987a) or as a result of the patchy distribution of suitable nesting sites (Loiselle and Barlow, 1978; Bradbury and Gibson, 1983). However, further information is needed to support the above speculations.

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REFERENCES

Barlow, G.W. (1981) Patterns of parental investment, dispersal and size among coral-reef fishes. *Environ. Biol. Fish.* **6**: 65-85.

Bradbury, W.B. and R.M. Gibson (1983) Leks and mate choice. *In*: *Mate Choice* (P. Bateson, ed.). Cambridge University Press, Cambridge, London, New York, New Rochelle, Melborune, Sydney. pp. 109-138.

Cummings, W.C. (1968) Reproductive habits of the sergeant major, *Abudefduf saxatilis*, (Pisces, Pomacentridae) with comparative notes on four other damselfishes. Ph.D. dissertation. University of Miami, Coral Gables. Florida. 172 pp.

Dominey, W.J. (1981) Anti-predator function of bluegill sunfish nesting colonies. *Nature* **290**: 586-588.

Fishelson, L. (1970) Behaviour and ecology of a population of *Abudefduf saxatilis* (Pomacentridae, Teleostei). *Anim. Behav.* **18**: 225-237.

Foster, S.A. (1985) Group foraging by a coral reef fish: a mechanism for gaining access to defended resources. *Anim. Behav.* **33**: 782-792.

Foster, S.A. (1987a) Acquisition of a defended resource: a benefit of group foraging for the neotropical wrasse, *Thalassoma lucasanum*. *Environ. Biol. Fish.* **19**: 215-222.

Foster, S.A. (1987b) Diel and lunar patterns of reproduction in the Caribbean and Pacific sergeant major damselfishes *Abudefduf saxatilis* and *A. troschelii*. *Mar. Biol.* **95**: 333-343.

Jan, R.Q. (1989) Aspects of reproductive ecology of damselfishes (Pomacentridae, Teleostei), with emphasis on substrate utilisation. Ph.D. dissertation, University of York, UK. 244 pp.

Johannes, R.E. (1978) Reproductive strategies of coastal marine fishes in the tropics. *Environ. Biol. Fish.* **3**: 65-84.

Loiselle, P.V. and G.W. Barlow (1978) *Do fishes lek like birds*? *In*: Contrasts in Behavior (E.S. Reese and F.J. Lightner, eds.). Wiley-Interscience NY. pp. 31-75.

McKay, K.R. (1984) *Behavioural aspects of cichlid reproductive strategies*: *patterns of territoriality and brood defense in Central American substratum spawners and African month brooders*. *In*: Fish Reproduction: Strategies and Tactics (G.W. Potts and R.J. Wootton, eds.). Academic Press. pp. 245-273.

Moyer, J.T. and Y. Yogo (1982) The lek-like system of *Halichoeres melanochir* (Pisces: Labridae) at Miyake-jima, Japan. *Z. Tierpsychol.*, **60**: 209-226.

Robertson, D.R., H.P.A. Sweatman, E.A. Fletcher and M.G. Cleland (1976) Schooling as a mechanism for circumventing the territoriality of competitors. *Ecology* **57**: 1208-1220.

Thresher, R.E. (1984) *Reproduction in Reef Fishes*. TFE Publications, Neptune City, New Jersey. 399 pp.

條紋雀鯛產卵羣集內的惡鄰居

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條紋雀鯛 *Abudefduf vaigiensis* 產附著性卵，產卵時聚集成羣，產卵之後，雄魚留在巢中，保護孵化中的卵塊。我以此雀鯛來探討其產卵羣內的個體是不是會如一些淡水魚類，會相互扶持，照顧彼此的卵。

經自三個產卵聚集內除掉部分護巢的個體，之後發現會有一些魚類來吃失去保護的巢中的卵塊。而隔壁的同種個體（也就是產卵聚集內的鄰居）往往是這些魚卵的主要掠食者；不但如此，這些同種的個體並且都是在護巢者消失之後第一個到達巢內並開始掠食卵塊的。此項結果顯示在產卵羣集內條紋雀鯛與其鄰居之間是互具惡意的，遑論相互扶持、照顧彼此的卵。文中並且就海水魚類產卵羣集的其他可能形成原因加以討論。