Reproductive Behavior of the Wrasse, *Cheilinus bimaculatus* at Makurazaki in Kagoshima, Japan

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Reproductive behavior of wrasse, *Cheilinus bimaculatus*, was studied in a shallow waters at Makurazaki in Kagoshima, southern Japan. Mating system of *C. bimaculatus* was harem. Males established mating territory around the prominent rocks or a thicket of soft corals. Within the territory, there were two or three females. And pair-spawned with a female between 15:00 h – 15:30. One spawning was performed within six seconds. The streaking, sneaking and group spawning were not observed in our observation.

Key words: *Cheilinus bimaculatus*, reproductive behavior, harem, pair-spawning

Introduction

The wrasse (Labridae) is a remarkably large and diverse group of tropical and temperate marine fishes distributed on coral, rocky reefs and sand flats throughout the world. Currently, 57 genera and approximately 500 species are recognized (Nelson, 1994). In the last thirty years, the reproductive ecology of many labrid fishes has been clarified by underwater observation using SCUBA (Thresher, 1984; Yogo, 1987).

The structure of social and mating systems of many labrids can be broadly distinguished between lek-like and harem. In lek-like species, males occupy temporarily territorial sites only during the spawning period, and mate with females which come to the sites to spawn. In harem species, males are permanently territorial and mate almost exclusively with females included within their territories. Generally, two types of spawning behaviors can be distinguished. One is pair spawning, in while a single male mating with a single female at a time, and the other is group spawning, in which a number of males fertilize the eggs of one female.

The small labrid fish, *Cheilinus bimaculatus* Valenciennes was chosen for our study. This species has rounded caudal fin when young, but some of fin rays become filamentous in adults. This species is the smallest member of the genus *Cheilinus*, and is found further north than others. A maximum total length reaches 15 cm (Masuda, Araga and Yoshino, 1975). We observed the reproductive behavior of *C. bimaculatus* in a shallow waters at Makurazaki in Kagoshima, Japan. Its mating system and mating behavior were described. The present study also aimed to clarify time-series reproductive behavior in detail by using underwater video camera, because reproductive behavior expressed sequentially in exact time had seldom attempted. We consider that sequential analysis is important for understanding the reproductive behavior of pelagic egg spawners.

Methods

Our observation was made at the two points at Makurazaki in Kagoshima, called Urajiri and Bohnotsu (Fig. 1). The station at Urajiri was 12 to 15 m deep, and the substrate at the spawning
The reproductive behavior of *Cheilinus bimaculatus* consisted of rocks and boulders about 10 to 15 m offshore. The station at Bohnotsu was 3 to 4 m deep, and the substrate at the spawning site consisted of rocks, corals, and sand about 15 to 20 m offshore. At Urajiri, two harems and at Bohnotsu, one harem were monitored. Sampling and observations were made using SCUBA.

Observations were made between July and August in 1997. During the observation period, each territorial male was observed continuously from 14:00 h to 16:00 h. Reproductive behavior was observed and recorded by an underwater video camera. The sequence of reproductive behavior was analyzed by slow-motion of video cassette recorder (30 frame/sec), frame by frame.

**Results**

**Male mating territories and mating system**

The male of *Cheilinus bimaculatus* established mating territories around prominent rocks (3 to 4 m in diameter, 1.5 to 2.5 m high) or a thicket of soft corals (*Goniopora planulata*, etc.).

The circumference of male territory was about 10 to 15 m. Within the territory, there were two or three females.

The territorial male patrolled slowly about 0.5 to 1 m above the rocks or thickets of soft corals, in wide irregular circles before spawning. The intruding males from outside were not observed.

The females in the territory of the male had small territories around a thicket of soft corals or small rocks. The circumference of female territory was about 1 m.

From the above results, it was shown that the mating system of *C. bimaculatus* was haremic.

**Spawning acts**

Females often swam along crevices or in the thicket of soft corals. About 15:00 h, the patrolling male, being or becoming aware of female, circled above the female clockwise or counterclockwise. While the female looked upward and swam slowly under the male (Fig. 2A). After the male descended to the female, both fish ascended slowly in a spiral movement but both fish were still apart some distance (Fig. 2B). At the end of the spiral movement, both fish came close each other with their body bent. Both fish, the female below the male, swam upward and straight forward (Fig. 2C). They may touch each other momentarily, but usually the female was a little ahead of the male. Finally the male caught up the female which started to move in a more vertical direction very quickly (Fig. 2D). After this, both fish separated and swam rapidly downwards in different directions - the female usually more quickly. A tiny cloud of sperm produced (egg and sperm) marked the place where the fish released their gametes.

In the present study, the spawning behavior of *C. bimaculatus* were observed seven times and three times of that were recorded with UW video.
camera. According to an analysis of video camera records, in the whole process of spawning, male
descending to their releasing gametes were performed within seven seconds. Coming close each
other to releasing gametes were performed within 2.5 seconds. Moving in more vertical direction
and releasing gametes were completed for hardly more than 1/6 to 1/10 of a second (Fig. 2). This
means gametes of the pair are released within a very short period of time and not recorded observa-
tion also showed basically the same sequence of behavior and duration of each behavioral pat-
tern. Sneaking, streaking and group spawning were not observed.

Discussion

Colin and Bell (1991) reported the spawning behavior of C. bimaculatus at Enewetak Atoll.
This species at Enewetak Atoll was common in the Halimeda meadows at 20 m depth, but was
seldom seen elsewhere. At Makurazaki, C. bima-
culatus was seen on the beds of soft corals. Dur-
ing the observation periods, this species was
frequently seen in or under the thicket of soft
corals, especially around the thicket of Gonio-
pora planulata. The shape of G. planulata is
similar to algae. C. bimaculatus may use algal
beds or thickets of soft corals as hiding places.

Territory size of C. bimaculatus were estima-
ted as about 15 m x 6 m and 15 m x 7 m (90 ~ 105
m²) at Enewetak Atoll (Colin and Bell, 1991). At
Makurazaki, territory size of C. bimaculatus was
smaller than that of at Enewetak Atoll. The
circumference of male territory at Makurazaki
was 10 ~ 15 m (8 ~ 12 m²). Geographical vari-
ation in the mating system has been documented in
Halichoeres maculipinna (Thresher, 1979; Robert-
on, 1981). Territorial sizes and sites may vary
geographically between different areas.

The present study indicated that the mating
system of C. bimaculatus was harem. The
mating system of C. bimaculatus at Enewetak
Atoll (11°40'N) was also haremic (Colin and Bell,
1991). In general, when females live in areas
from which eggs can be rapidly carried off the
reef, females apt to spawn with the territorial
male in whose territory they live. In locations
offering an abundant suitable spawning site, a
harem mating system can be established. The
present study site, abundant spawning sites
must have existed because the low density of C.
bimaculatus and the flow of a current.

According to an analysis of video camera re-
cording, the spawning acts were accomplished
quickly. Especially, gametes were released in a
very short period of time (1/6 ~ 1/10 of a second).
For higher fertilization rate, synchronization of
releasing of eggs and sperms is very important.
And to spawn within a very short period of time
enables sperms and eggs to be packed in a small
volume of water. Packing of sperms and eggs can
attain higher possibility of fertilization. In
spawning of Thalassoma bifasciatum, a few or no
eggs were collected outside the spawned region
or one minute after spawning (Reinboth, 1973). It
is supposed that a ceremony of spawning is ne-
necessary for synchronization and a rapid releasing
of gametes can promote fertilization.

Eggs and mating fish are vulnerable to preda-
tion. Egg predation by five species of pomacen-
trid fishes were described by Moyer (1975) and
Nakazono (1979). And conspicuous sexual dis-
plays of these species probably attracted an atten-
tion of predators. But to avoid danger of predation,
fishes would rather not perform spawning acts or would spawn in dark evening. Though
Parapercis snyderi (Nakazono, Nakatani and
Tsukahara, 1985), Franzia squamipinnis (Yogo,
1985), Novaculichthys taeniourus, Pseudocheli-
linus hexataenia (Colin and Bell, 1991) spawned
at dusk, almost of labrds spawned while sur-
rounding sea water is lighter (Colin and Bell,
1991; Nakazono, 1979; Yogo, 1985). The reason
why labrds spawn at an earlier time than above
species is not known. Though the ceremony is
dangerous, it may be important for synchroniza-
tion to release gametes.

Colonially nesting males of the longer sunfish,
Lepomis megalotis megalotis, are often cucked
by neighbors, but solitarily nesting males are not
(Jennings and Philipp, 1992). In the three–spine
stickleback, Gasterosteus aculeatus, sneaking
occurs more frequently when inter–nest distance
is shorter (Goldschmidt et al., 1992). In C. bima-
culatus, a large territorial male was monopoliz-
ing two to three females. Sneaking, streaking
and group spawning by initial phase male and
non–territorial terminal phase male are common
among labrid fishes (Warner et al., 1975; Warner
and Robertson, 1978; Nakazono, 1979; Hoffman
et al., 1985). But in the present study, sneaking,
streaking and group spawning were not observ-
ed.
References


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日本 鹿児島の 枕崎産 陈列観察 並びに Chelinus bimaculatus의 산란 행동

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陈列観察 並びに Chelinus bimaculatus의 산란 행동을 조사하기 위해 1997년 7월과 8월 두 달 동에 걸쳐 일본 鹿児島の 枕崎에서 수중 관찰 및 video 촬영을 하였다. C. bimaculatus의 mating system은 haremic이었다. 본 실험 수컷은 수중의 키다리 바위 또는 연산호의 덫을 중심으로 밭짓기를 위한 새끼를 형성하였고 자신의 새끼를 내에 2~3마리의 암컷을 거느렸다. 암컷은 수컷의 새끼를 안에서 작은 바위 또는 연산호의 덫을 중심으로 작은 새끼를 형성하였다. 오후 3시부터 3시 30분 사이에 수컷은 자기 새끼를 내의 암컷과 차례차례 산란하였다. 방탄, 방정을 하기 전에 특유의 산란 행동을 하였다. 본 연구에서 streaking, sneaking 및 group spawning은 관찰되지 않았다.