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Reproductive Behavior of the Honeycomb Leatherjacket, *Cantherhines pardalis* (Monacanthidae), at Kashiwajima, Japan

Hiroshi Kawase[1] and Akinobu Nakazono

Department of Fisheries, Faculty of Agriculture,
Kyushu University, 6–10–1 Hakozaki,
Higashi-ku, Fukuoka 812, Japan
[1] Present address: Natural History Museum and Institute,
Chiba, 955–2 Aoba-cho, Chuo-ku, Chiba 260, Japan

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Monacanthid fishes inhabit both temperate and tropical shallow waters. About 95 species are known world wide (Nelson, 1984), including 26 species in Japan (Matsuura, 1984). Among them, *Stephanolepis cirrhifer*, *Thamnaconus modestus* and *Aluterus monoceros* are commercially important species in Japan, their spawning behavior in aquaria, and embryonic, larval and juvenile development, and growth and mortality at the early stage having already been reported (e.g., Takami and Utsunomiya, 1969; Tsukashima et al., 1983; Kitada et al., 1985). However, reproductive behavior and mating systems in the field are not known in these species, having been reported only in two monacanthids, *Oxymonacanthus longirostris* and *Paramonacanthus japonicus* (Barlow, 1987; Nakazono and Kawase, 1993). These reports indicated differences in spawning sites, parental egg-care, and number of eggs per clutch between the two species.

The honeycomb leatherjacket, *Cantherhines pardalis*, which has a dark brown body color with a small but conspicuous white spot on the upper edge of the caudal peduncle, attains 16 cm SL (standard length). It is distributed from Sagami Bay, Japan to the Indo-West Pacific (Matsuura, 1984). At Kashiwajima, southern Shikoku, Japan, a pair of *C. pardalis*, were observed spawning on algae, both parents immediately departing the spawning site without egg care. Such behavior is similar to that of *O. longirostris*, which spawns on toxic algae to avoid egg-predation (Barlow, 1987). This paper describes the spawning behavior of *C. pardalis* and the nature of the algae on which the eggs were deposited, and related ecological features, including aggressive and courtship displays, home range, food preference and egg characteristics.

Materials and Methods

Underwater observations were carried out at a rocky reef off Kashiwajima, southern Shikoku, Japan (32°46′N, 132°37′E) from June 18 to August 17, 1991. Kashiwajima is almost at the northern distribution limit of *Cantherhines pardalis*. Although not rare, the species was infrequent at Kashiwajima, as at Iriomotejima, Kuroshima, Akajima and Sesokojima, Ryukyu Islands, Japan (24–27°N), due to its cryptic and wary nature (Kawase, personal observation; See also Myers, 1989). For the reason given above, *C. pardalis* was followed for as long as possible when encountered during a study on another filefish, *Stephanolepis cirrhifer*, in an area of 40 m × 30 m at 10–13 m depth, and also on the way to and from the study area and the shore (total observation time; 300 min). In the early morning of July 20, a pair of *C. pardalis*, both about 180 mm TL (total length), were observed spawning on algae. The individuals could be discriminated by a split in the dorsal fin, in addition to the female having a swollen abdomen. Detailed observations of the pair were attempted around the spawning site on 10 occasions until August 14, between 0530 h and 0805 h (90 min per day), but the fishes were located on only 5 of these.

Eggs spawned on July 20, 1991 were collected the following day, together with the supporting algae, and fixed in 10% formalin. The embryonic developmental stages were recorded and algal species identified under a binocular microscope. While following *C. pardalis* on August 2, 1991, discharged excrement was collected and fixed in 10% formalin. Two individuals (186 mm and 172 mm TL) were captured on the rocky reef at 5 m depth on July 17, 1993. Both the excrement and stomach contents of the collected fish were examined under a binocular microscope. The two fish were deposited in Natural History Museum and Institute, Chiba.

Results

Displays.—Male *Cantherhines pardalis* exhibited three types of display (Fig. 1). On meeting a second male, each raised the head, expanded the ventral flap and vibrated the first dorsal spine some 3–4 times per second ("vibrating"; Fig. 1a). Subsequently, reciprocal charging and pecking often occurred. "Vibrating" was also performed toward females, probably as a courtship display. A second courtship display was

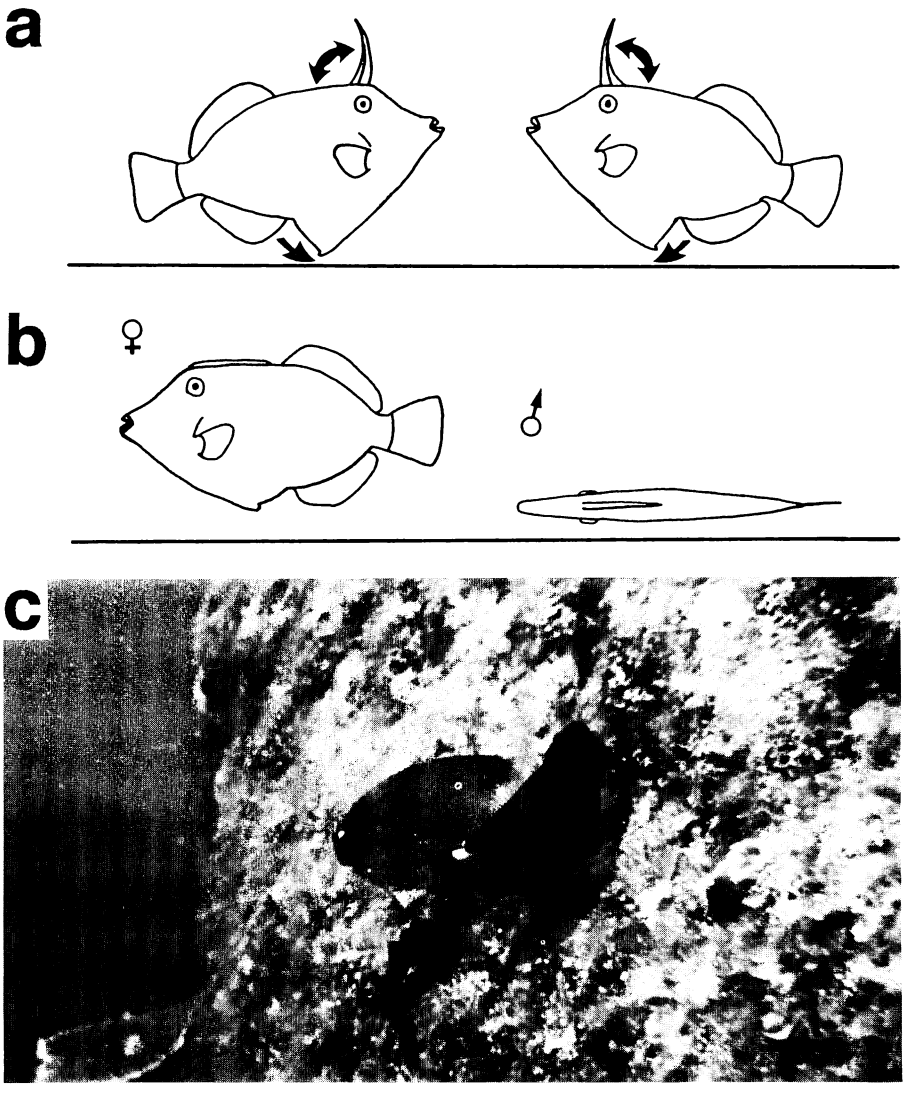

Fig. 1. Three types of display of male *Cantherhines pardalis*. a) Aggressive display of two males ("vibrating"); b) courtship display of a male following a female ("lying"); c) male (*left*) nuzzling the face of his partner ("nuzzle"), while the female (*right*) thrusting her snout into tufts of algae ("thrust") before spawning.

"lying" (Fig. 1b); wherein a male followed a female with his body in a horizontal position, at the same time changing his usual dark brown body color to white, with a conspicuous honeycomb pattern. The third courtship display observed was "nuzzle" (Fig. 1c); wherein a male pecked at the face and side of the body of a female, while she thrust her snout repeatedly into tufts of algae covering the rock surface ("thrust"). Male "nuzzle" and female "thrust" were observed before spawning.

Spawning.—On July 20, a male was observed following a female at 0615 h, she wandering back and forth over an area of about 30 m × 20 m. The male exhibited "nuzzle," coinciding with the female "thrust" on the algae at several sites, often returning to the same site. When a second male appeared at 0618 h, the two males exhibited "vibrating" and fought intensely for a minute until the intruding male retreated. Spawning occurred at 0622 h, at one of the sites of 11 m deep where the female had earlier

exhibited "thrust." The male and the female touched abdomens, the male then slanting his body, and released gametes. Mating lasted only 2–3 seconds. Both fish left the site immediately, with no parental care being apparent. The male initially followed the female, but they separated at 0625 h.

The close following of the female by the male, as well as male "nuzzle" and female "thrust," was also observed around the spawning site from 0630 h to 0735 h on July 23 and from 0650 h to 0800 h on August 14. However, on both days the female had not spawned by the conclusion of the observations, at which time "nuzzle" and "thrust" were continuing. The female was often repelled by the territorial damselfishes, *Chromis fumera* and *C. weberi*, during her "thrust" at several sites.

Home range.—During incidental observations of the pair on 6 days (200 min), the home ranges of the male and female overlapped within an area of about 50 m × 40 m at 8–15 m depth, although they were not always swimming together.

Eggs.—The eggs of *Cantherhines pardalis*, collected 25 hr after spawning, were spherical in shape, 0.53 ±0.01 mm ($\bar{x}\pm$SD, $n=10$) in diameter and had 3–5 oil globules, 0.078–0.117 mm in diameter. The embryonic body had a pair of optic vesicles and 20 myomeres at a water temperature of 23.7°C. The eggs were demersal and adhesive, being scattered on the algae. The number of the eggs was only 40, probably because of loss during collection. The algae species on which the eggs were deposited were all members of Dictyotaceae (brown algae), i.e., *Dictyota dichotoma*, *Dictyota* sp., *Dictyopteris* sp., and an unidentified species.

Food preference.—*Cantherhines pardalis* pecked at algae covering the rock surface in the daytime. Excrement and stomach contents examined comprised mainly algae, especially red algae. The following 16 algal genera (12 families) were recorded: *Galaxaura*, *Gelidium*, *Jania*, *Callophyllis*, *Plocamium*, *Hypnea*, *Gracilaria*, *Ceramium*, *Acrosorium*, *Polysiphonia*, *Symphyocladia* and *Leveillea* (Rhodophycophyta), *Dictyota* and *Padina* (Phaeophycophyta), *Ulva* and *Enteromorpha* (Chlorophycophyta). A smaller amount of sponges, scuds and barnacles was also included.

Discussion

The pre-spawning behavior and spawning site of *Cantherhines pardalis* had two aspects in common with those of *Oxymonacanthus longirostris*, studied by Barlow (1987). Firstly, females of both species wandered back and forth thrusting their snout repeatedly into tufts of algae ("thrust") at several sites before spawning. Barlow (1987) suggested that female *O. longirostris* were testing the suitability of the algae for eggs, including such aspects as texture, depth, chemical nature and the presence of other eggs. When female *C. pardalis* exhibited "thrust," she was often repelled by territorial damselfishes. Occupation of areas within the algae by such territorial fishes may limit available spawning sites for *C. pardalis*, thereby resulting in female wandering.

Secondly, both *O. longirostris* and *C. pardalis* spawned on toxic algae. *O. longirostris* spawns on some species of toxic blue green-algae, probably to prevent egg predation (Barlow, 1987). Eggs of *C. pardalis* were attached to brown algae (Dictyotaceae). Several species of Dictyotaceae, such as *Dictyota dichotoma* and *Dictyopteris divaricata*, are known to be toxic and thus avoided by sea urchins, ear shells and herbivorous fishes (Hay et al., 1987; Shiraishi et al., 1991). Prostrate thalli of several species of *Dictyota* and *Dictyopteris* have a tendency to form a monospecific community covering the surface of rocks, such algal communities being commonly seen at Kashiwajima. It is likely that *C. pardalis* spawns selectively on such algal communities in order to prevent egg predation. Spawning on dictyotaceous algae may also be advantageous for preventing egg disturbance by conspecifics, because a smaller amount of dictyotaceous algae was found in *C. pardalis* excrement and stomach contents.

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高知県柏島におけるアミメウマヅラハギの繁殖行動

川瀬裕司・中園明信

1991年6月から8月に，高知県柏島でアミメウマヅラハギ *Cantherhines pardalis* の潜水観察を行った．本種は藻食性で，主に紅藻を摂餌していた．雄は，腹部皮膜を広げると同時に，第1背鰭棘を立てすぼめする誇示行動を示した．産卵間近の雌は，岩の表面をマット状に覆っている細かい海藻に吻を出し入れする動作を数ヵ所で行った．産卵はそれらのうちの1ヵ所で観察され，雌雄のペアで2, 3秒のうちに行われた．産卵後に，親による卵保護は見られなかった．卵は球形で直径 0.53 mm の沈性粘着卵であり，毒性の報告されているアミジグサ科の褐藻に付着していた．本種はこのような産卵場所を選ぶことにより，卵の捕食を防いでいる可能性が示唆された．

(〒812 福岡市東区箱崎 6-10-1　九州大学農学部水産学第二講座；川瀬　現住所：〒260 千葉市中央区青葉町955-2　千葉県立中央博物館)