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Reproductive Behavior of Moray Eels at Miyake-jima, Japan

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In his comprehensive review of reproduction in reef fishes, Thresher (in press) noted that reproductive behavior of moray eels (Muraenidae) is not well-documented, and that spawning has not been reported. In the summer of 1980, we observed both the spawning of *Gymnothorax kidako* and interactions between four individuals of *Uropterygius necturus* which may have included spawning. *U. necturus* and its synonyms *U. knighti* and *U. reidi* are a wide ranging trans-Pacific species (McCosker and Moyer, MS). Both observations were at Miyake-jima (34°05′N, 139°30′E), one of the Izu Islands of southern Japan. Although we have only these limited records, we are reporting them here due to the paucity of information on the reproductive behavior of eels and the difficulty of further observations. Morays are extremely secretive, wary of divers, and may spawn infrequently. Brock (1972) reports that females of *Gymnothorax javanicus* appear to spawn only once a year.

Results

Gymnothorax kidako. Spawning was observed at 16: 30 h, 15 Aug 1980, at a depth of 12 m. Using SCUBA, we had just crossed over a boulder en route to a study site, when we saw two large *G. kidako* lying together on the cobble substrate immediately adjacent to a piece of broken pipe, four meters in length and 20 cm in diameter. Both eels appeared to be about 90 cm in total length. They were pressed laterally together with the posterior 1/3 of their bodies loosely entwined. Suddenly, they pressed their abdomens together and the eel closest to the pipe turned rapidly to the left, entering a hole in the pipe. Simultaneously, the other eel turned sharply to the right and dashed 60～80 cm away from the pipe. As their bodies separated, a large cloud of gametes appeared. There was no upward dash. The eggs were spherical, buoyant, transparent, and large (an estimated 2 mm in diameter). They were not collected. Neither moray made any attempt to defend the spawn, although one of them watched us closely as we examined the eggs. Spawning occurred exactly 121 minutes before sunset (18: 31 h) and four days after the new moon (11 Aug 1980). Although in an area of moderate offshore currents, there was no noticeable current at the time of spawning. The water temperature was 26°C. No sexual dimorphism was observed, and we were unable to distinguish male from female.

Uropterygius necturus. At 19: 03 h, 29 July 1980, we observed four dark-colored eels, each about 25 cm in total length, at a depth of 2.5 m within 3 m of the rocky shore. The heads of the four eels appeared to be touching. They moved forward very quickly over a substrate of black volcanic rubble and rocks, their bodies rapidly waving, with caudal fins continuously passing back-and-forth, around and between each other. They continued to move very close to the substrate, without any upward rush. Their heads frequently disappeared under rocks, tails still visible and thrashing. This continued for about 30 s before one eel separated from the group. About a second later another left and the other two disappeared in the darkness. No gametes were observed. The action took place 15 min after sunset (18: 48 h) and one day after the full moon (28 July 1980). The water temperature was 23.5°C. A specimen of an identical eel was taken at the same site on 20 Aug 1980 and sent to Dr. John E. McCosker, Steinhart Aquarium, who identified it as *U. necturus*.

Discussion

Gymnothorax kidako. From the above observations and those of others, it is possible to construct a hypothetical spawning sequence for *G. kidako*. N. Yamamoto (personal communication) observed and photographed what appeared to be the early stages of courtship of *G. kidako* at a depth of 12 m in Sagami Bay, Japan, in 1978 (Fig. 1). The eels approached each other on a flat substrate near the base of a cliff. They rose upright in the water, their tails on the substrate, and faced each other. After a moment, one of the eels moved its head behind the other, as if to wrap its body around the other eel. A close approach by the observer frightened them and they departed in different

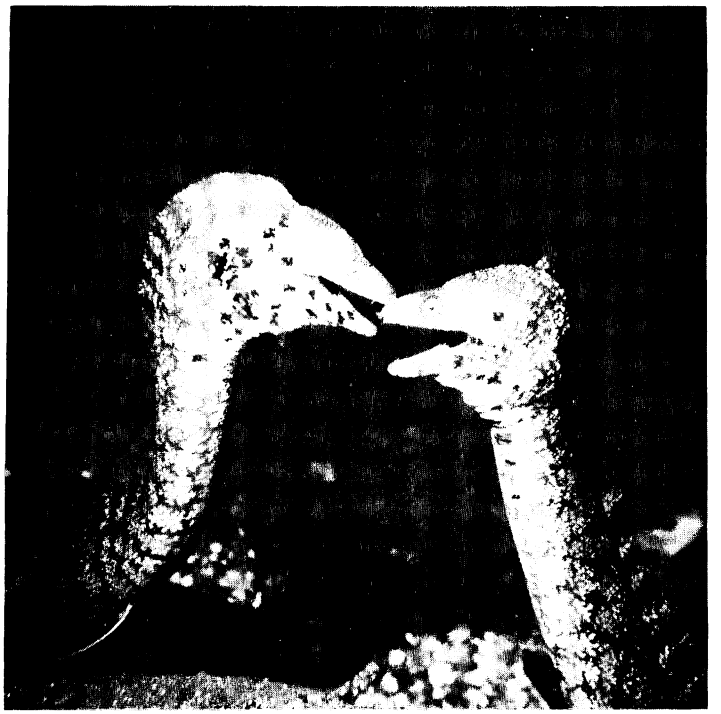

Fig. 1. Pair of *Gymnothorax kidako* in courtship at a depth of 12 m, Sagami Bay, Japan. From color transparency by Noriaki Yamamoto.

directions. Brock (1972) observed a pair of *Gymnothorax javanicus* entwined around each other and flat on the substrate. Waves of motion passed down their bodies. During our observation of *G. kidako*, the bodies were only partially entwined, but in close contact. Just prior to spawning, the eels pushed their abdomens together. These observations in the order presented represent a probable spawning sequence, i.e. the eels approach each other, rise up face to face, entwine their bodies, return to the substrate with bodies still entwined, and, after some time, spawn, with abdomens pressed together. The length of time from initial approach to spawning is, of course, unknown. Fricke (1970) reported that males and females of the garden eel *Gorgasia sillneri* remained entwined in an upright position for more than nine hours before spawning.

Uropterygius necturus. In at least two species of eels, males are known to bite the female at the base of the head prior to spawning. Deraniyagala (1930) reported that a male of the ophichthid *Leiuranus semicinctus* grasped a female dorsally just behind the head and subsequently released sperm when disturbed, although the pair did not spawn. C. Ferraris and R. Steene (personal communications) observed and Steene photographed group spawning in a moray tentatively identified as *Gymnothorax brunneus*. Observations were at sunset at a depth of two meters in the Philippines. Just prior to spawning, several males grasped the single female dorsally at the base of the head. Spawning occurred after a short upward dash. Detailed observations, with a description of the species involved will subsequently be published by Ferraris.

Based on the observations of Deraniyagala, Ferraris and Steene, it is possible that we observed *U. necturus* just prior to spawning, with three males grasping the female just behind the head. Whether spawning followed could not be determined due to darkness 15 min after sunset.

Acknowledgments

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三宅島でのウツボ類の産卵行動

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1980年8月15日16時30分，三宅島の水深12mの地点で全長約90cmの2尾のウツボ *Gymnothorax kidako* が産卵しているのを観察した．両者は尾部をゆるくからませていたが，突然腹部を押しつけ合ってから離れた．その瞬間精子による水の白濁が観察された．卵は直径約2mmの丸い浮性卵で，親魚による卵の保護は観察されなかった．1980年7月29日19時30分には，岸近くの水深2.5mの地点で，全長約25cmの *Uropterygius necturus* 4尾が群がって行動しているのを観察した．これは産卵直前の行動と思われた．