Temporal Spawning Patterns of Several Surgeonfishes and Wrasses in American Samoa

P. G. CRAIG

ABSTRACT: Three coral reef surgeonfishes (Acanthurus guttatus, A. triostegus, A. lineatus) and two wrasses (Thalassoma quinquemaculatum, T. hardwickii) spawned year-round in American Samoa. Spawning occurred in or adjacent to the channel draining the fringing reef at specific times of day: dawn (A. lineatus), daylight (T. quinquemaculatum, T. hardwickii), or dusk (A. guttatus, A. triostegus), and spawning time tracked seasonal changes in day length. Egg predation was high for the surgeonfishes, but predation by piscivores appeared to be low.

MATERIALS AND METHODS

American Samoa (14° S, 170° W) consists of several small volcanic islands in the central South Pacific. Observations of spawning were made on the fringing coral reef at Asafo village on Tutuila Island. The reef flat there was 250 m wide, dropped abruptly to a depth of 3–6 m, and descended gradually thereafter to 20 m. A single channel drained the reef flat. Nearshore water temperatures were measured seaward of the reef flat at a depth of 0.3 m (n = 295 daily measurements). Sunrise and sunset times were obtained from the NOAA weather station in American Samoa. During 1991–1995, approximately 35 snorkeling surveys were made on nearshore portions of this reef at various times of day. For the surgeonfishes, I made observations during all months of the year at known spawning locations; observations of the wrasses were opportunistic encounters. Confirmation of spawning was determined by the upward rush of fish, culminating in the production of visible milt clouds. Observations were generally made at mid to high tide; no attempt was made to assess tidal or lunar effects. Data are summarized by plotting multiple-year spawning records over a single annual cycle. Spawning times listed for dawn spawners tended to be at the end of their spawning period, whereas the reverse occurred for dusk spawners. Because the full duration of each spawning period was not monitored, observed rates of predation were minimum estimates.

RESULTS

Two variables that commonly influence the time when fish spawn, water tempera-
Acanthurus guttatus, a nonterritorial surgeonfish, migrated to a specific ("traditional") area in the outer reef channel and spawned above several large coral blocks in waters 4–7 m deep. Groups of 56–500 fish began spawning near sunset, and the time of spawning tracked seasonal changes in sunlight (Figure 2). Spawners had pale/silver sides with faint bars and dots, dark edges on dorsal and ventral body, and bright yellow on pelvic fins and a portion of the caudal fin. Egg predators (primarily the snapper Macolor niger Forskål) fed on the eggs during at least 57% of observed spawning periods on 22 dates. Two attacks on the spawners were observed, once each by a dogtooth tuna (Gymnosarda unicolor Ruppell) and a bluelip trevally (Caranx melampygus Cuvier).

Acanthurus tristegus also spawned near sunset (Figure 2) in large groups (200–2000) along the reef top adjacent to the reef channel and along the outer channel floor. Water depths were 0.8–5.6 m. Spawning color was as described by Robertson (1983). Egg predators (M. niger) were observed feeding on the eggs during at least 64% of observed spawning periods on 28 dates. Eighteen attacks on the spawners were observed, 17 by bluelip trevally and one by an unidentified fish.

Acanthurus lineatus, a territorial surgeonfish, migrated to dawn to a "traditional" site that partially overlapped the spawning site used by A. guttatus in the outer portion of the reef outlet channel. Groups of 56–200 fish began spawning at least 5–15 min before sunrise (Figure 2) in water depths of 3–5 m. Spawning color was as described by Robertson (1983). Typically 10–30 egg predators (M. niger) hovered nearby and fed on the eggs during all spawning periods observed on 27 dates. One attack was observed on the spawners, apparently by Lujanus bokar Forskål.

Thalassoma quinquenotatum spawned throughout the daytime (Figure 2) on the shallow reef flat adjacent to the channel (water depth 0.7–1 m). Almost all were group spawners consisting of 10–20 small fish (8–10 cm). Multiple spawnings were observed on each of 49 dates. No predators or egg predators were seen. On three occasions,
Pair spawnings were observed between a small fish and a larger terminal-phase fish at the edge of the reef flat. On one of the latter occasions, a juvenile *M. niger* fed on the eggs. *Thalassoma hardwickii* probably spawned year-round (Figure 2). On 13 dates, group spawnings of 10–40 fish were observed during daytime hours on the reef flat near the inner channel (water depth 0.7–1 m). No predators or egg predators were seen during spawnings.

**Discussion**

It has long been noted that tropical fishes spawn over an extended season compared with fishes from higher latitudes (e.g., Qasim 1956). Year-round spawning, as observed in Samoa, has been documented or inferred for a number of other tropical fishes (Randall 1964a, Randall and Randall 1963, Myrberg 1972, Munro et al. 1973, Warner et al. 1973).

Despite such prolonged breeding, Russell et al. (1977) emphasized that most spawning effort by tropical fishes occurs during a seasonal period. This holds true for at least one of the fishes described in this paper: *A. linea- tur* spawns primarily during the austral spring and summer months of September–February (Craig et al. 1997), even though some spawning occurred monthly. Similarly, *A. triostegus* in Hawaii has a seasonal spawning peak although some year-round spawning occurs (Randall 1961a). Although a seasonal spawning peak may be tailored to a particular time that is favorable for either adult spawners or the survival of their young, year-round spawning seems to be a “bet-hedging” strategy to cope with losses of young caused by environmental vagaries (Robertson 1990, 1991).

The time of day that spawning occurred in this study was similar to that reported elsewhere for the same species. *Acanthurus lineatus* spawned at dawn in Palau (Johannes 1981, Robertson 1983); *A. triostegus* spawned at dusk in the Society Islands (Randall 1961b); *T. quinqueloculatum* and *T. hamanticus* were daytime spawners in the Marshall Islands (Colin and Bell 1991). For one of these species, the herbivorous and strongly territorial *A. lineatus* (Craig 1996), the time of day when it spawned is thought to be a strategy to minimize loss of food from its territory (Robertson 1963, 1991; Kalda 1988); that is, if a herbivorous territorial fish must leave its territory unguarded when it spawns, it would be best to do so in the morning when herbivorous conspecifics typically have low feeding rates.

In all, the Samoan spawning data fit well into what was predicted based on literature from distant tropical areas: spawning occurred over an extended time period, at specific times of day, often at "traditional" sites where there was a seaward current away from the reef. In addition, the surgeonfishes adopted specialized spawning coloration, egg predation was high at some sites, and the only dwarf-spawning species was one that defended feeding territories.

**LITERATURE CITED**


of laboratory and field behavior. Anim. Behav. Monogr. 5:189-283.


