

BIOLOGY OF THE PYGMY SEA BASS, *SERRANICULUS PUMILIO* (PISCES: SERRANIDAE)

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ABSTRACT

During the period from 1968 to 1971, numerous specimens of *Serraniculus pumilio*, were collected in shallow waters of the northern Gulf of Mexico. This paper presents biological data accumulated from these and other specimens in the fish collection of Florida State University and from scattered literature references regarding the species. The range of *S. pumilio* extends from North Carolina along the continental margin of the western Atlantic Ocean to Guyana, but it apparently does not occur in the West Indies. It has been collected at depths from 1 to 117 m, usually over sand or shell bottoms near coral or rock reefs or accumulations of mollusk shells. Individuals move about considerably, although they spend much time resting on the bottom. *S. pumilio* is a synchronous hermaphrodite, but pairs mate to exchange gametes and self-fertilization probably never occurs. Spawning occurs between March and August or September in the northern Gulf of Mexico. A length-frequency distribution of specimens collected in the northern Gulf is presented to show the growth rate of first year fish. Juveniles (15-20 mm SL) which appear inshore in September reach a size of 50-55 mm by the following June. Most fish move offshore to deeper water for the winter (January and February) and individuals larger than 55 mm apparently never appear inshore. Small crustaceans are the most important food items.

Since the pygmy sea bass, *Serraniculus pumilio*, was described in 1952 by Ginsburg, virtually nothing has been added to our knowledge of the species except for a few brief notes in general surveys of fishes. During a study of reef fishes in the northern Gulf of Mexico from 1968 to 1971, numerous specimens of *Serraniculus* were collected and notes were taken on their biology. The present paper is a synopsis of the information scattered in the literature and the new data accumulated during this study.

The generic allocation of the species used in this paper is tentative. Robins and Starck (1961) briefly discussed the characteristics of the genus *Serraniculus* but did not include the species in their review of the genus *Serranus*. Ginsburg (1952) noted that *Serraniculus* and *Dules* differ from *Serranus* in having six rather

than seven branchiostegal rays, and that *Dules* differs from the other two genera in having the third dorsal spine greatly prolonged. After subsequent study Robins (personal communication) believes that *Serraniculus* is inseparable from *Dules*, but because *Dules* itself is so close to *Serranus*, he recommends no change until a morphological study of a wider range of serranid genera can be completed. According to Robins, *Serraniculus pumilio* and *Dules auriga* are distinct species.

METHODS

During the present study, 106 specimens of *Serraniculus pumilio* [15.8-54.1 mm standard length (SL)] were collected. Most of these (75) were collected at East Pass of Choctawhatchee Bay near Destin, Fla, where biweekly or monthly observations were made between June 1968 and December 1970. Others were collected from St. Andrew Bay near Panama City, from Apalachicola Bay, and from Alligator Harbor, Fla. A

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few were taken short distances offshore from these locations.

Numerous field observations were made while diving, and small groups of specimens (2-3) were maintained and casually observed for a few months in 20-gal aquaria.

Eighty-seven specimens were examined for gonad development. Most were examined superficially using a low-power (10-30 \times) dissecting microscope, and the stage of development of the ovarian portion of the gonad was estimated, following the definitions of Smith (1965) and Moe (1969). Sexual maturity (the presence of Stage 4 oocytes) was determined on the basis of ovarian tissue only, since very small individuals often contained some mature sperm, even though the ovarian tissue was immature. For 22 specimens the gonads were removed, embedded in paraffin, and sectioned. Most specimens had been originally preserved in 10% Formalin² and then transferred to 40% isopropyl alcohol. Gonads to be sectioned were removed from the fish, placed in Bouin's fluid for several days, dehydrated in ethyl alcohol, celloidin-methyl salicylate, and xylene, and then embedded in paraffin. Gonads were sectioned at 10 μ , mounted on microscope slides, and stained. Mallory-Heidenhain stain was used for most slides. This stain was easy to use and yielded good contrast between various tissues within the gonad.

Stomachs of 31 specimens were removed and their contents examined under a low-power dissecting microscope. Food items were identified to major group (usually class or order) and counted. The importance of each group was determined by calculating its frequency based upon the total number of food items counted and upon the number of fish containing each food type.

DISTRIBUTION

Briggs (1958) gave the range of *Serraniculus pumilio* as North Carolina to Florida, and the southwestern Gulf of Mexico in shore areas. Subsequent references (Bullis and Thompson,

1965; Cervigon, 1966) indicate that it occurs along the coast of the western Atlantic Ocean from North Carolina to Guyana. Most collections have come from the Atlantic coast of the southeastern United States and from the eastern Gulf of Mexico as a result of the numerous fisheries surveys in these areas (Reid, 1954; Springer and Bullis, 1956; Springer and Woodburn, 1960; Moe and Martin, 1965; Moe et al., 1966; Starck, 1968; Struhsaker, 1969). The species has also been collected in the western Gulf of Mexico off Texas (Ginsburg, 1952; Hildebrand, 1954) and in Campeche Bay off Mexico (Hildebrand, 1955). More recent collecting by the RV *Oregon* and RV *Pillsbury* off the coast of Colombia indicates that the species is also common in the Caribbean Sea (C. R. Robins, pers. comm.). Two specimens have been taken by the *Pillsbury* from off the coast of Honduras.

Serraniculus is unrecorded from the Bahamas (Böhlke and Chaplin, 1968) and apparently also absent from the other islands of the West Indies. Numerous species of fishes have similar continental distributions in the western Atlantic, while other species are restricted to the coral reef areas of the islands and portions of the Central and South American coast where the continental shelf is narrow. The factors which prevent the distribution of continental species in the islands are not completely understood, but probably include differing ecological conditions, as well as competition from closely related and better adapted island species (Robins, 1971). Physical barriers are undoubtedly not important since many of the species have pelagic larval stages, and some free-swimming species such as *Scomberomorus maculatus* are also absent from most of the West Indies. Ecological parameters which may be important are temperature, bottom type, salinity, and turbidity. Temperature may not be important for *Serraniculus pumilio* since it is distributed well into the tropics, but it is apparently more tolerant of low temperatures than are most of the coral reef fishes. *Serraniculus* may prefer continental sediments rather than coral reef debris, but accurate descriptions of substrates where it has been collected are unavailable. In general, the continental species, including *S. pumilio*, are more tolerant of vary-

² Reference to trade names does not imply endorsement by the National Marine Fisheries Service, NOAA.

ing conditions, but whether they require such changes is unknown. For species such as *S. pumilio*, which are territorial, competition by other species with similar habitat requirements may be important. Two potential competitors of *S. pumilio* are noted in the following section.

HABITAT

Serraniculus pumilio apparently occurs typically at moderate depths (10-70 m) over the continental shelf but may occasionally occur in shallow coastal waters less than 1 m deep. It has been recorded as deep as 117 m (Bullis and Thompson, 1965).

During this study, the species was often common in the shallow waters along the jetties at East Pass of Choctawhatchee Bay in depths of about 1-10 m but was usually absent during January and February. Inshore populations of *Serraniculus* apparently move offshore to deeper water during the winter. The lowest temperatures at which the species was recorded at East Pass were 13°-14°C. Shallowwater temperatures in the northern Gulf often drop below 10°C during the winter, while the temperature in water deeper than about 18 m usually remains above about 15°C. The minimum temperature extreme at which *S. pumilio* can survive may be about 13°C.

Like other small serranids, this species is most common over sand or shell bottoms near irregularities such as coral or rock outcrops. Springer and Woodburn (1960) noted that it was similar in this respect to *Centropristis ocyurus*, another species restricted to the continental shelf. *Serranus tigrinus* and *S. baldwini* (Robins and Starek, 1961) also occupy such habitats at about the same depth range as *Serraniculus pumilio*, but these two species are restricted primarily to coral reef areas of the West Indies where *Serraniculus* is not found.

A few specimens of *Serraniculus* have been collected in grass beds (mostly *Thalassia* and *Syringodium*) at the mouth of Alligator Harbor. However, in such areas, numerous bare patches of sand bottom are present, and there are accumulations of shell debris in places which provide suitable habitat for the species.

Apparently *Serraniculus pumilio* does not have a particularly restricted home range. The number of individuals observed on the East Pass jetties varied considerably, indicating that individuals were often moving into and out of the area. These observations were based upon adults or advanced juveniles; hence recruitment of populations on the jetties resulted from movement of adults, not from the immigration of recently spawned young. The pattern of movement of adults is not known, but more stable populations may occur on the numerous limestone reefs which lie short distances offshore in the area. Accumulations of mollusk shells occur over most of the sandy bottom in the area and small fishes such as *Serraniculus* could use such accumulations for shelter when moving over open bottoms. In this way *Serraniculus* could easily move the few miles from the offshore reefs to the jetties.

BEHAVIOR

Springer and Woodburn (1960) described *Serraniculus pumilio* as sedentary, but individuals apparently move about considerably. The fish rests on the bottom using its pelvic fins as props and moves about in short "hops" over the bottom. It appears to be territorial and protects its temporary abode (near a large shell, rock, or coral ledge) from intrusion by other fishes. The size of the area defended is not known, but when two or more individuals were placed in a 20-gal aquarium, one became dominant and forced the other fish to remain off the bottom, even when several rock piles were provided as hiding places.

During agonistic displays, *Serraniculus* spreads its dorsal and caudal fins and gill covers, and presents the lateral side of the body to the opponent (Figure 1). During these displays, the dark and light bands on the side of the body become more distinct and series of small, pale spots are clearly visible along the rays of the dorsal and caudal fins. These displays are followed by the fish beating the side of its opponent with its caudal fin and the posterior part of its body. When one individual proves subordinate, it retreats with its dorsal fin depressed and usu-

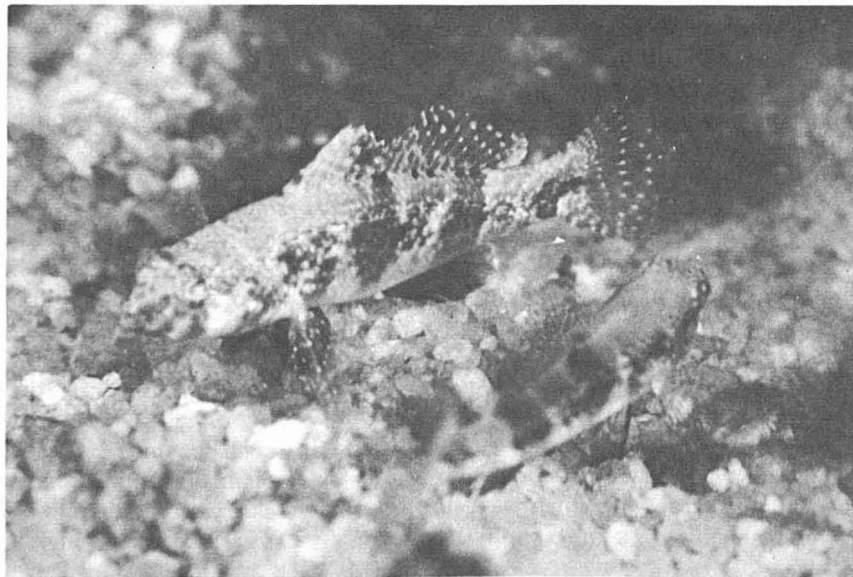


FIGURE 1.—Agonistic display of aquarium-held *Serraniculus pumilio*.

ally with the victor in pursuit. Quite similar agonistic behavior involving fin-spreading and tail-beating has been described in *Serranus scriba* (Kirchshofer, 1954). Subsequently, the subordinate individuals in an aquarium remained in precarious positions in the corners of the aquarium some distance above the bottom. When these fish left such positions, except during periods of feeding, they were soon attacked by the dominant individual and returned to their "sanctuaries" near the surface of the water.

Once, agonistic behavior was observed between two fish on the East Pass jetties, but in this case the retreating individual had its dorsal fin greatly expanded.

REPRODUCTION AND DEVELOPMENT

Microscopic examination of sectioned gonads (Figure 2) proves that *Serraniculus pumilio* is a synchronous hermaphrodite, as Ginsburg (1952) originally supposed. His statement that the testicular tissue is "interspersed with the masses of ripe roe" is misleading, however. The gonads of *Serraniculus* are identical to those of *Serranus* in that the testicular portion is well separated from the ovarian tissue and is re-

stricted to narrow bands which lie along the ventral surface of each gonad (Reinboth, 1962; Smith, 1965).

The smallest and the largest specimens examined had both ovarian and testicular tissue in the gonad and many were seen with both mature eggs and sperm present. As with *Serranus*, internal self-fertilization is undoubtedly impossible since separate ducts are present to carry eggs and sperm. Clark (1959, 1965) found that under aquarium conditions, *Serranus subligarius* could fertilize its own eggs, but mates with another individual and exchanges gametes under normal conditions. Reinboth (1962) also induced self-fertilization in *Serranus scriba* but suggested that paired spawning normally occurs. The same is probably true for *Serraniculus*.

On 10 May 1968, several pairs of *Serraniculus pumilio* apparently involved in reproductive behavior were seen on the sand bottom at the base of the St. Andrew Bay jetties, on the Gulf side of the west jetty in water about 2 m deep. The water temperature was 23°C. Pairs would move slowly about in close proximity with one individual following behind the other. The trailing individual would repeatedly nudge the anal region of its mate. Clark (1959) noted such nudg-

ing behavior in spawning *Serranus*. Although no spawning clasps were observed, six specimens were collected, and subsequent examination revealed that all had large numbers of ovulated eggs within the lumen of their gonads. These specimens were 41.7-48.6 mm SL.

Based upon examination of gonads of preserved specimens, *Serraniculus pumilio* spawns between March and August or September. The number of small individuals collected during these months is limited, so the size at which maturity of the ovarian tissue is reached was not determined. There is some indication that it may be about 40 mm SL. Seven specimens (34.1-41.2 mm) collected in March were immature, while two (43.0 and 44.2 mm) were mature. One specimen (36.6 mm) collected in April had mostly immature gonads but had a few Stage 4 oocytes. Twelve specimens (40.6-49.5 mm) collected in May were mature, while two (40.5 and 40.8 mm) were mostly immature, with only a few Stage 4 oocytes. A few individuals as small as 23 mm SL contained mature sperm, even though the ovarian tissue was immature, but it is not known whether such individuals could successfully spawn as males. Reinboth (1962) noted a similar condition in

Serranus scriba and *S. cabrilla*, in which the testicular portion of the gonads matured earlier in the annual reproductive cycle and also at a smaller size. He speculated that *S. scriba* in their first year of sexual maturity (120-140 mm body length) function only as males and that the ovarian tissue matures only in fish over 160 mm in length. He did not demonstrate actual spawning in such first-year males, however.

All 38 specimens (15.8-48.8 mm SL) collected in February, September, October, November, and December had immature gonads, although one specimen (42.7 mm) collected in October had a few mature oocytes in the posterior region of its gonad. All specimens larger than 43.0 mm collected from March through August had mature gonads. Specimens with ovulated eggs were collected in May, June, and July.

Nothing is known of the embryonic and larval development of *Serraniculus pumilio*. The eggs of *Serranus* are buoyant (Clark, 1959) and eggs and larvae of *Epinephelus* (family Serranidae) are pelagic (Moe, 1969), but it is not known if the same condition exists in *Serraniculus*. The smallest individual collected during this study (15.8 mm SL) has the general body shape and pigmentation of adults.

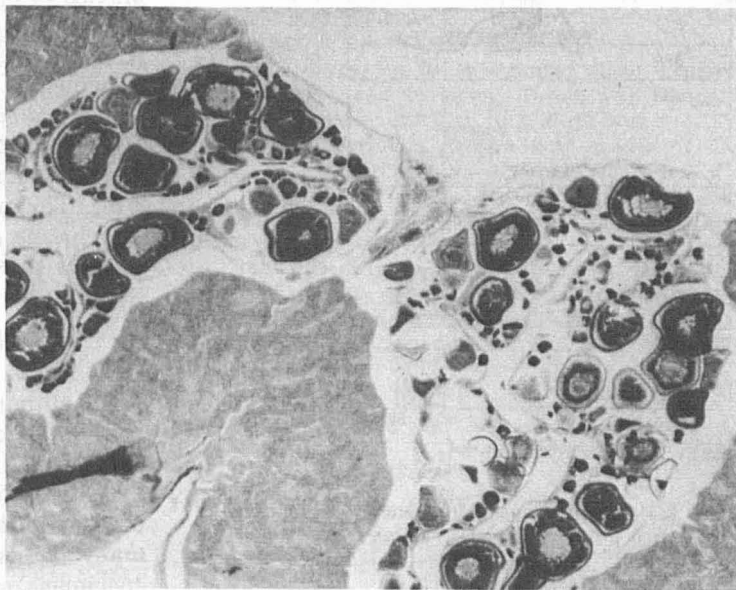


FIGURE 2.—Cross section through the basal (posterior) portion of the gonads of *Serraniculus pumilio* showing mature ovarian and testicular tissues.

GROWTH

A length-frequency distribution (Figure 3) of *S. pumilio* occurring in inshore waters indicates that all belong to the same year class and that no second year fish occur inshore. Small fish which were apparently spawned in the summer appear inshore in September, and some may remain throughout the winter. Most probably move to deeper water as the temperature drops

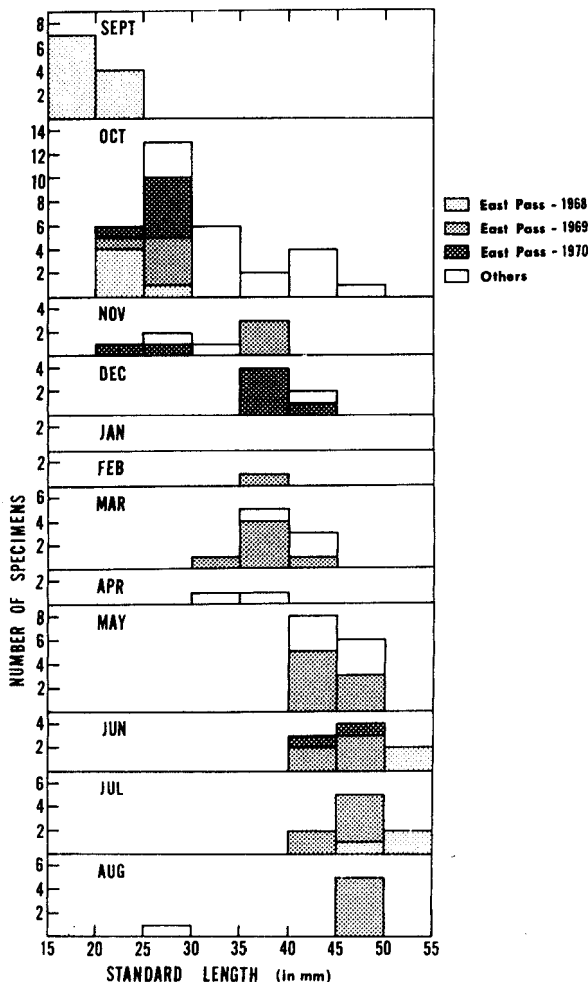


FIGURE 3.—Monthly length-frequency distributions of *Serraniculus pumilio* collected inshore at East Pass, Choctawhatchee Bay, Fla., and at other locations in the northern Gulf of Mexico.

and move inshore again in March. No adults were found after August. The largest specimen collected during this study (54.1 mm) is considerably smaller than the maximum size attained (80 mm SL—Ginsburg, 1952) so possibly the larger, second year fish remain offshore in deeper water.

FOOD HABITS AND PREDATION

Thirty-one specimens were examined for stomach contents, but two were empty. Results of stomach analyses are shown in Table 1. *S. pumilio* feeds predominantly upon crustaceans, which made up 91% of the total number of food items. Numerically, amphipods are the most common group, but shrimps and crabs comprise a larger volume of the stomach contents when present and may be the most important food items. *Serraniculus* appears to be an indiscriminate carnivore, feeding upon any small organism which it discovers, but showing preference for small crustaceans.

The extent of predation by other fishes on *S. pumilio* is not known. It seems strange that D. S. Jordan never found this species in his extensive studies of the stomach contents of snappers and groupers taken in the northern Gulf of Mexico (Jordan, 1884, 1886; Jordan and Gilbert, 1882, 1883; Jordan and Swain, 1885). Stephen A. Bortone (personal communication) found one specimen in the stomach of a *Lagodon rhomboides* collected in Apalachee Bay, 11 October 1969, about 2 miles south of the St. Marks lighthouse, Wakulla County, Fla., at a depth of about 3 m. The general cryptic coloration and sedentary habits of the pygmy sea bass may conceal it from most predators.

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TABLE 1.—Food habits of *Serraniculus pumilio* based on stomach analysis of 29 specimens (15.8-54.1 mm SL) collected in inshore waters of the northern Gulf of Mexico, 1968-71.

Food types	Number of items	Percent of total number	Number of fish containing each	Percent frequency of occurrence
Crustacea	262	91.0	28	96.5
Amphipods	110	38.2	17	58.6
Caprellid amphipods	12	4.2	6	20.7
Isopods	32	11.1	8	27.6
Copepods	20	6.9	7	24.1
Tanaidaceans	4	1.4	3	10.3
Cumaceans	1	0.3	1	3.4
Shrimps (adults)	18	6.2	10	34.5
Shrimp zoea (?)	23	8.0	7	24.1
Crabs (adults)	21	7.3	9	31.0
Crab megalops	14	4.9	2	6.9
Unidentified crustacean	7	2.4	5	17.2
Polychaetes	9	3.1	9	31.0
Unidentified wormlike organisms	13	4.5	1	3.4
Gastropods	1	0.3	1	3.4
Algae	(1 mass)	0.3	1	3.4
Fishes	2	0.7	2	6.9

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