In summary, the use of Mission Beach by intertidal crabbers is greatest 1 to 2 h before the low tide. This corresponds to the period when crabs are most readily observable. From the data collected at Mission Beach and aerial survey counts of other Puget Sound beaches, I estimated that about 20,000 crabbers utilized intertidal beaches from April through August 1974. The intertidal Dungeness crab sport fishery is, however, fairly small compared with other marine sport fisheries in Puget Sound.

Acknowledgments

I wish to thank G. Pauley, J. Congleton, C. Woelke, K. Chew, and T. Walker for discussion and critical readings of various stages of the manuscript. Reviewers for the *Fishery Bulletin* helped improve the readability. R. Whitney, as Leader of the Washington Cooperative Fishery Research Unit at the University of Washington, provided encouragement, support, and facilities from the outset of the study. Appreciation is extended to A. Scholz and other members of the Sport Shellfish Section of the Washington State Department of Fisheries, without whose cooperation this study would not have been possible. The study was partially supported by funds from the Washington Department of Fisheries.

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A CONTRIBUTION TO THE BIOLOGY OF THE PUFFERS *SPHOEROIDES TESTUDINEUS* AND *SPHOEROIDES SPENGLERI* FROM BISCAYNE BAY, FLORIDA

The general biology of the checkered puffer, *Sphoeroides testudineus*, and bandtail puffer, *S. spengleri*, is not as well known as that of the northern puffer, *S. maculatus*. For example, Chesapeake Bay populations of the northern puffer have been examined for length-weight relationships by Isaacson (1963) and Laroche and Davis (1973), for age, growth, and reproductive biology by Laroche and Davis (1973), and for fecundity by Merriner and Laroche (1977). None of this information is available on the checkered or bandtail puffer.

Checkered and bandtail puffers have greater geographic ranges and are more southern in distribution than the northern puffer. The checkered puffer is abundant from the Atlantic coast of southern Florida, throughout the Caribbean Islands, Campeche Bay, and along the coasts of Central and South America to Santos, Brazil (Shipp 1974). The bandtail puffer is common in the Caribbean Sea and along the coasts of peninsular Florida, the Bahamas, and Bermuda (Shipp 1974). I report here on growth, reproduction, and the pharyngeal dentition of these two species gathered during a study of their feeding biology (Targett 1978).

The sampling habitat was a shallow seagrass bed along the southwestern shore of Virginia Key in northern Biscayne Bay, Fla. Turtle grass, *Thalassia testudinum*, was the dominant seagrass with small amounts of shoal grass, *Halodule wrightii*, and manatee grass, *Syringodium filiforme*, also present. Monthly collections from September 1973 to December 1974 yielded 414 checkered puffers (15-215 mm SL; 56% females) and 548 bandtail puffers (16-133 mm SL; 49% females). Seawater temperatures ranged from 16.5° to 32.0°C and salinities from 30.5 to 38.5‰.

Standard length-weight relationships (Figures 1, 2) were calculated using functional regressions (Ricker 1973). Checkered puffers grow to a larger size and are heavier than bandtail puffers at a given length. Comparisons of these results with those for northern puffers from Chesapeake Bay (Isaacson 1963; Laroche and Davis 1973) was made possible by the conversion of total length to standard length using the factor: caudal fin length = 20.2% SL (Shipp 1974). Northern puffers grow

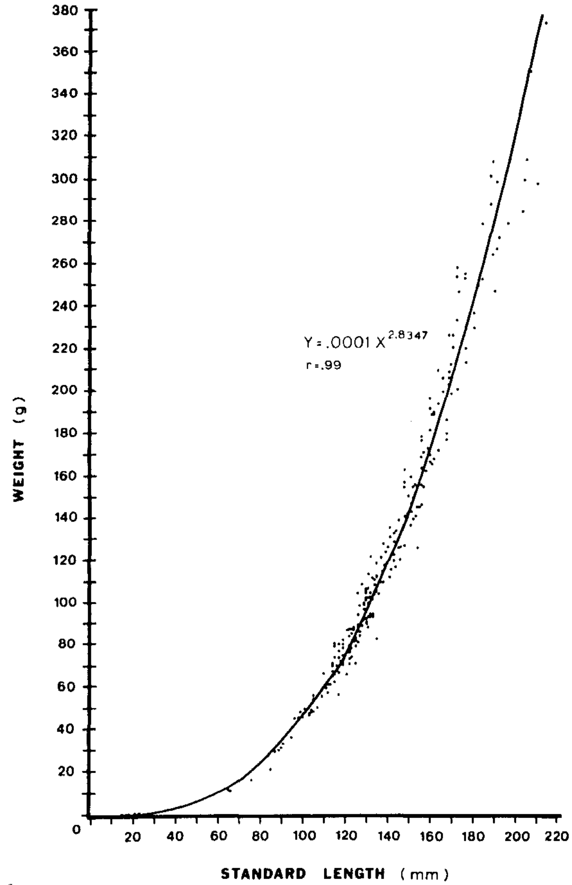

FIGURE 1.—Standard length-weight relationship for 250 checkered puffers from Biscayne Bay, Fla. Functional regression parameters derived by least squares fit to log transformed data, where variance about regression was S_{yx}^2 = 0.0014.

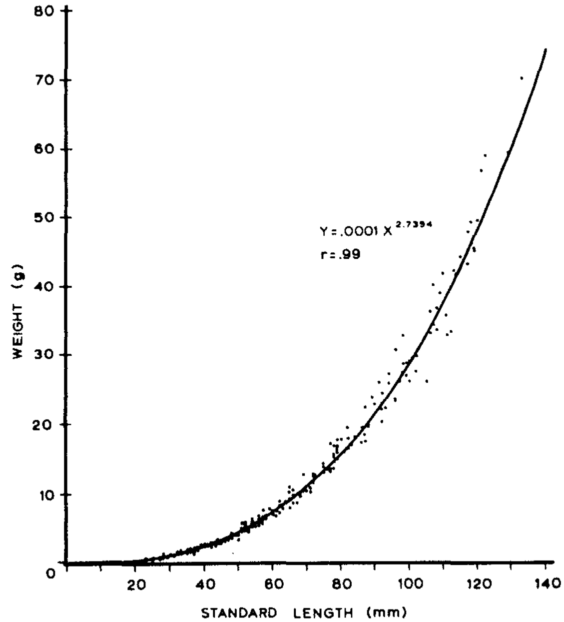

FIGURE 2.—Standard length-weight relationship for 250 bandtail puffers from Biscayne Bay, Fla. Functional regression parameters derived by least squares fit to log transformed data, where variance about regression was S_{yx}^2 = 0.0018.

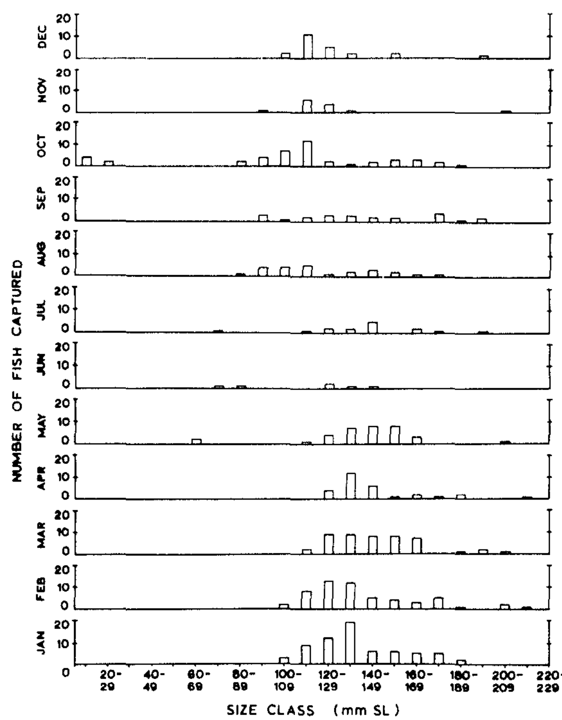

FIGURE 3.—Monthly standard length-frequency distributions for checkered puffers from Biscayne Bay, Fla., during 1974.

to a greater maximum size than either checkered or bandtail puffers and are approximately the same weight at a given length as checkered puffers.

Checkered puffers decreased in abundance in June and July due to a drop in numbers of 120-169 mm SL fish (Figure 3). (Some individuals may have left the seagrass bed as early as April and May, since a greater effort was needed to catch checkered puffers at that time.) Males and females decreased equally in abundance. The group leaving the seagrass bed may have been going elsewhere to spawn since their departure corresponded with the time of capture of ripe individuals. Some ripe checkered puffers were captured in April and May; and by August, September, and the beginning of October the few adults caught were all ripe. Furthermore, Christensen (1965) found evidence that checkered puffers from Jupiter Inlet, Fla., spawned in low salinity waters during the fall. He found young fish (≤10 mm SL) from early November through December in waters having salinities generally <20‰. He also observed that young and juveniles were abundant in the upper reaches of the Loxahatchee River (which flows into Jupiter Inlet) during winter and spring, rarely being found elsewhere. Thus, the checkered puffers leaving the seagrass bed in the present study may have been going to spawn in lower salinity waters found along portions of western Biscayne Bay or in the Miami River. This would explain why no checkered puffers <25 mm SL were captured, except for six in October. Most young likely remain in brackish water areas and move into higher salinity habitats only at larger sizes the following year. The 80-119 mm SL group appearing in August probably composed the 1-yr-old fish moving into the seagrass bed.

The checkered puffer spawning season, beginning in the spring and concentrated during summer and early fall in Biscayne Bay, occurs slightly later than the spring and summer spawning of the southern puffer, *S. nephelus*, at Cedar Key, Fla. (Reid 1954). The northern puffer in Chesapeake Bay has been reported to spawn during May by Hildebrand and Schroeder (1928) and during late May, June, and July by Laroche and Davis (1973).

Fecundity analysis, using the gravimetric technique, was done on nine checkered puffer females ranging from 127 to 178 mm SL (99-256 g). Only yolky eggs, with nuclei obscured, were counted. Regression analyses of fecundity-standard length and fecundity-body weight were done using functional regressions (Ricker 1973). Total fecundity increased exponentially as a function of body length (Figure 4) and linearly as a function of body weight (Fecundity = 1,431.81 [Body wt in grams] − 45,704.97; r = 0.96). Over the size range examined, relative fecundity averaged 1,146 eggs/g body wt. These fecundity values are greater than those found by Merriner and Laroche (1977) for northern puffers in Chesapeake Bay. Of the six checkered puffers <25 mm SL, two (15 and 23 mm SL) were males and the sex of the rest (17, 17, 18, and 21 mm SL) was undeterminable. Thus, it was not possible to estimate the body size at which eggs become discernible.

The age structure of the checkered puffer population can be inferred from the monthly length-frequency distributions (Figure 3). The 80-119 mm SL group appearing in August is likely 1-yr-old fish which grow to 120-189 mm SL by the end of their second year. A comparison of the growth of checkered puffers in this population with results from the work of Laroche and Davis (1973) on northern puffers from Chesapeake Bay shows that the checkered puffers reach a smaller size at the end of each year of life and are shorter lived than the northern puffers.

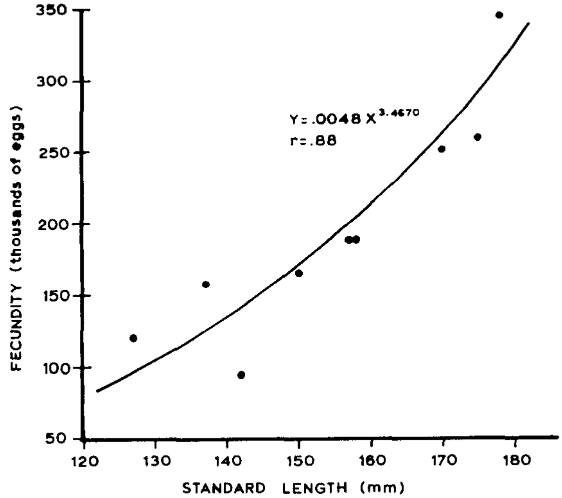

FIGURE 4.—Total fecundity-standard length relationship for nine checkered puffers from Biscayne Bay, Fla. Functional regression parameters derived by least squares fit to log transformed data, where variance about regression was $S_{yx}^2 = 0.0078$.

Eggs became discernible, by microscope, in bandtail puffers at 25-30 mm SL. Spawning season, however, was not easily determined. No ripe or nearly ripe bandtail puffers were caught despite the fact that this species was abundant throughout the year and the full size range (to approximately 160 mm TL (Shipp 1974)) was captured. At least one fish <30 mm SL was collected every month except September, November, and December, although most were captured during March through June. This implies that bandtail puffers have a long spawning season, concentrated in the late fall and early winter, and spawn elsewhere with the young moving into the seagrass bed shortly after hatching.

Both checkered and bandtail puffers feed mainly on crabs, bivalves, and gastropods (Targett 1978). They use their beaklike jaws (paired premaxillary and dentary bones) to break the shelled prey. Two specimens of both species were cleared and stained, revealing that they have similar pharyngeal dentition. Three pairs of dorsal pharyngeal tooth plates are present, associated with the pharyngobranchial elements of branchial arches I, II, and III, with one tooth plate of each pair being located on either side of the dorsal midline. Each tooth plate is slightly curved with a posteriorly directed dentigerous surface. In the 126- and 137-mm SL checkered puffers, the four tooth plates in the anterior two pairs were each 4 mm long and those in the posterior pair were each 3 mm long. In the 108- and 118-mm SL bandtail puffers, the four tooth plates in the anterior two pairs were each 3 mm long and those in the posterior pair were each 2 mm long. The dorsal pharyngeal tooth plates of both puffer species bear upon the pair of ventrally located, and nondentigerous, fifth ceratobranchial (lower pharyngeal) bones. The pharyngeal tooth apparatuses likely function to pull flesh from and to further grind and break crab and mollusc shells. The smooth puffer, *Lagocephalus laevigatus*, also has strong beaklike jaw teeth but has dentigerous tooth plates associated with the pharyngobranchial elements of only the II and III branchial arches (Tyler 1962). In general, fishes in the Order Plectognathi have very strong jaw teeth and comparatively weak pharyngeal dentition (Al-Hussaini 1947).

Acknowledgments

I thank the many people who helped with the seining of fishes. I also thank Hugh H. DeWitt, Jon G. Stanley, and Nancy M. Targett for their helpful comments on the manuscript.

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CORRELATES OF MATURITY IN THE COMMON DOLPHIN, *DELPHINUS DELPHIS*

Maturity of the gonads in mammals is closely related to other aspects of physical development. Therefore, a simple method for estimating an individual's proximity to sexual maturity would be to evaluate appropriate morphometric data. However, the morphometrics traditionally collected on cetaceans are less than ideal for this task.

Studies on cetacean growth patterns have typically used data collected in a cross-sectional manner and have used large samples which included all age-classes. Unfortunately, individual rates and patterns are indistinct when values are averaged using this method (Sinclair 1973). If a large change in growth or development takes place over a short period of time and the beginning of this change does not occur at exactly the same age in each individual, the data acquired from a group of individuals will imply that the change takes place at a slower rate and over a greater period of time than is actually the case for an individual.

The present study used parameters which indicated the proximity of an individual to its own mature condition, not the average mature condi-