Length, weight, spawning, and fecundity of the tilefish, *Lopholatilus chamaeleonticeps*, from New Jersey waters

by

Wallace W. Morse

U. S. Department of Commerce
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Northeast Fisheries Center
Sandy Hook Laboratory
Highlands, New Jersey 07732

Report No. SHL 81-02 (January)

Abstract

Life history aspects of tilefish, Lopholatilus chamaeleonticeps, occurring off New Jersey were studied from 1971 to 1973. Length-weight relationship was described by the equation log W = -2.20 + 3.19 (log L), where W is the fish weight (g) and L is total length (mm). Males attained a larger size than females and sexual maturity was reached at approximately 600-650 mm by females and 650-700 mm by males. Spawning occurred from March through August. Fecundity (F) was related to total length (L) and weight (W) by the equations F = -15,020,043 + 26,865 L and F = -996,471 + 887 W.

Introduction

The tilefish, Lopholatilus chamaeleonticeps, occurs from Nova Scotia to Florida on the Atlantic coast, in the Gulf of Mexico, and off Venezuela to Guyana and Surinam (Dooley 1978). They inhabit a relatively narrow (45 km) depth zone between 76 and 540 m along the continental shelf and slope where temperatures range between 8° and 17°C (Goode 1884, Bigelow and Schroeder 1953, Nelson and Carpenter 1968, Dooley 1978). Centers of abundance are apparently in depths of 120-200 m and at temperatures from 10°-15°C (Bigelow and Schroeder 1953, Dooley 1978). A small, but locally important, commercial and recreational fishery for tilefish has developed off the mid-Atlantic coast in recent years. Approximately 1,000 metric tons are landed annually with about 70% being landed in New Jersey.

Relatively little is known about the life history of the tilefish. They were first discovered in 1879 off New England; however, in 1882 a massive fish kill (over 1.5 billion fish) reduced their numbers to such an extent (Collins 1884) that Lucus (1891) reported them extinct. The fish kill was apparently caused by thermal shock from a sudden drop in water temperature. By the early 1890's they were again plentiful.

Bigelow and Schroeder (1953) reported they spawn in July and August and Dooley (1978) observed ripe females in February, March, June, and July. Preserved eggs measured 1.25 mm and had a 0.2 mm oil droplet (Eigenmann 1902). Dooley (1978) suggested protogynous sex reversal in smaller specimens.

The purpose of this study was to define the length-weight relationship, spawning season, and fecundity of tilefish occurring in mid-Atlantic waters.

Materials and Methods

Tilefish were collected from recreational rod and reel and commercial longline catches in the vicinity of Hudson Canyon during 1971-1973. Catches were made approximately 145 km east of Beach Haven Inlet, New Jersey in 110 to 185 m of water. All fish were measured (mm TL), weighed (g), sexed and sexual maturity was determined. A sample of 16 females collected April 4, 1973 was used for fecundity estimation.

The ovaries were removed, weighed (g), slit open, and placed in Gilson's fluid as modified by Simpson (1951). The ovaries remained in Gilson's fluid for approximately 2 months during which time they were occasionally agitated to facilitate the breakdown of the ovarian tissue. The contents of the jars were poured through 1.5-mm mesh screen which permitted the eggs to pass through but retained larger pieces of tissue. Repeated washing and decanting removed suspended matter including the minute eggs destined to be spawned in following years.

Subsamples were obtained by placing the eggs in a large beaker with a known volume of water, stirring randomly and pipetting a 10-ml aliquot. All opaque eggs ($\geq$0.15 mm) were counted using a dissecting microscope. The mean of three subsamples was used to calculate the total number of eggs contained in the ovaries. To test the inherent variability in this sampling method, 13 subsamples were taken from the same ovary. The standard deviation of these was 56 and the coefficient of variation was 7.88%. By using means of three subsamples, the standard deviation was reduced to 29.6 and the coefficient of variation to 4.16%.

Results and Discussion

Preliminary observations of the length and weight of tilefish indicated they are curvilinearly related and the relationship could be adequately expressed by the equation $W = aL^b$, where W is weight and L is total length. Therefore, all data were transformed to logarithms ($\log_{10}$) and the equation becomes $\log_{10} W = a + b (\log_{10} L)$.

Regression equations by the method of least squares were determined for males and females and an analysis of covariance (Snedecor 1956) applied to test for possible sex related differences in length-weight relationships. No significant differences ($P = 0.01$) were found and all data were pooled and a common regression equation and the coefficient of determination (r^2) calculated. For 141 observations:

$$\log W = -2.20 + 3.19 (\log L) \quad r^2 = 0.96$$

The largest fish sampled was a 1,090 mm male weighing 18.2 kg. The largest female was 932 mm and weighed 14.5 kg. The mean weights for males and females were 12.0 kg and 7.5 kg respectively. This observed difference in mean weight and the predominance of males for fish >900 mm probably reflects a real difference in the population structure. Dooley (1978) reported a similar finding by H. C. Mears who observed 20 specimens 635-900 mm were all females, while 16 fish 900-1,090 mm were all males. Additional sampling over a greater part of its range is needed to adequately document this difference.

Sexual maturity observations indicated females mature between 600 and 650 mm and males mature between 650 and 700 mm (Table 1). The smallest mature female and male were 631 and 683 mm respectively, and the largest immature female and male were 647 mm and 696 mm respectively.

Examinations of tilefish ovaries revealed spawning occurs at least six months of the year. Females in the ripe and running ripe condition were found from March through August while no ripe fish were found during January, September, or October. Collins (1884) and Bigelow and Schroeder (1953) reported ripe females in July and August and Dooley (1978) observed ripe females in February, March, June, and July.

Fecundity estimates for 16 fish ranged from about 1.9 to 7.8 million eggs for fish between 631-809 mm and 3.5-9.0 kg. Preliminary plots of length and weight versus fecundity indicated fecundity increased linearly with both length and weight. Therefore, linear regression equations were calculated by the method of least squares relating fecundity (F) to total length in mm (L) and weight in g (W). The respective equations were:

$$F = -15{,}020{,}043 + 26{,}865\ L \qquad r^2 = 0.68$$

$$F = -996{,}471 + 887\ W \qquad r^2 = 0.61$$

Variations in fecundity were found more closely associated with length though an analysis of variance indicated both relationships were highly significant ($P < 0.01$). The fecundity estimates indicated tilefish have a high reproductive potential with a mean egg production of 727 per gram of fish weight.

Table 1. Number of mature and immature male and female tilefish examined from the Hudson Canyon area during 1971-1973 by 50-mm length intervals.

Length Interval (mm)	Females		Males	
	Immature	Mature	Immature	Mature
<250	3			
250-299	9		1	
300-349	4		6	
350-399	5		5	
400-449	9		14	
450-499	3		4	
500-549	1		3	
550-599	2		1	
600-649	1	2	5	
650-699		11	1	2
700-749		5		1
750-799		4		-
800-849		4		2
850-899		5		4
900-949		3		7
950-999				7
1000-1049				4
1050-1099				2

Literature Cited

Bigelow, H. B., and W. C. Schroeder. 1953. Fishes of the Gulf of Maine. U. S. Fish. Bull. 53: 1-577.

Collins, J. W. 1884. History of the tile-fish. Rep. U. S. Comm. Fish. for 1882, App. B, p. 237-294.

Dooley, J. K. 1978. Systematics and biology of the tilefishes (Perciformes: Branchiostegidae and Malacanthidae), with descriptions of two new species. U. S. Dep. Commer., NOAA Tech. Rep. NMFS Circ. 411, 78 p.

Eigenmann, C. H. 1902. The egg and development of the conger eel. U. S. Fish. Bull. 21: 37-44.

Goode, G. B. 1884. The fisheries and fisheries industries of the United States, Sect. 1. Natural history of useful aquatic animals. U. S. Gov. Printing Office, Wash., D. C. pp. 360-361.

Lucus, F. A. 1891. Animals recently extinct or threatened with extermination as represented in the collections of the U. S. National Museum. Rep. U. S. Nat. Mus. ending June 30, 1889: 647-649.

Nelson, W. R., and J. S. Carpenter. 1968. Bottom longline explorations in the Gulf of Mexico. A report on "Oregon II's" first cruise. Commer. Fish. Rev. 39(10): 57-62.

Simpson, A. C. 1951. The fecundity of the plaice. Fish. Invest. Minist. Agric. Fish. (G. B.), Ser. 2, 17(5): 1-27.

Snedecor, G. W. 1956. Statistical Methods (fifth edition). Iowa State Coll. Press, Ames, Iowa. 534 p.

Acknowledgments

I wish to thank Bruce Freeman who provided information presented here and S. J. Wilk for his reviews and comments. Special thanks to Ms. M. Montone for her assistance and typing of this manuscript.