

March 30, 1955

Age Determination of Whiting

by Albert C. Jensen

The scales of whiting (Merluccius bilinearis) do not feature sharply delineated circuli and annuli as are found in other fishes, e.g., haddock. Thus age determination is not easily accomplished for whiting by the usual scale reading processes. The otoliths of this species, as with many other fishes, are composed of alternating dense and diffuse layers. When examined by transmitted light under a microscope, these layers appear as concentric light and dark ovals. The ovals seem to show up best when the otolith is broken in half and viewed in cross-section. The dense, opaque ovals may then be used to determine the age of the whiting with a fair degree of accuracy; i.e., one oval or annulus for each year of age.

Methods

The otoliths used consisted of 85 pairs taken from a selected sample of whiting. They were caught in Ipswich Bay near Gloucester, Massachusetts on July 27, 1954 during the regular fishing operations of a commercial vessel. The fish were measured, sexed and the otoliths removed on July 28. The otoliths were cleaned of slime and placed in numbered vials along with some scales from the same fish, with a mild carbolic acid solution as a preservative. The fish ranged in length from 13.9 cm. to 63.4 cm. An attempt was made to obtain two or three individuals in each size class.

In the laboratory it was found that the otoliths were easier to work with in a dry condition. Thus, one of each pair of otoliths was placed in a scale envelope numbered to correspond with the vial number. The otoliths were allowed to air dry for two days and then prepared for reading. To do this, each dry otolith was cut in half with a single-edge razor blade.

The cut surface was polished smooth on fine emery cloth and then the piece was put in a cork holder, cut and polished side up. This arrangement is shown in Figure 2.

The polished surface of the otolith was slightly moistened with a 50% solution of glycerine and water to make the diffuse portions more translucent. This facilitated the reading of the otolith. It was then placed with the cork holder on the stage of a binocular microscope under the high power objective. A beam from a small spotlight was directed against the flat side of the otolith while, at the same time, the cut edge was shielded with a hand-held card. The dark opaque areas stood out in contrast against the less dense translucent areas. Only the large "major ovals" (Figure 1) were read. The numerous fine "minor ovals" were ignored.

Results

In the sample of 85 whiting, 53 were females, 21 were males and 11 were apparently immature individuals whose sex could not be determined. With two exceptions, all of the fish 36 cm. or longer were females. They ranged in size from 24.8 cm. to 63.4 cm. The males ranged from 23.9 cm. to 35.3 cm., and the immature fish from 13.9 cm. to 22.9 cm.

The range in ages for all fish was from one through seven years. The females ranged from three years to seven years with the mode at five years. Among the males the age distribution was restricted to two year-classes--three-year olds and four-year olds. Thirteen of the 21 males were three-year old fish. The immature fish were one, two and three years old. Table 1 shows the fish lengths tabulated by age class for the entire sample. These data are broken down for females, males and immature fish in Tables 2, 3 and 4.

The age frequency distribution is shown in Figure 4. No length frequency is shown since this was a size selected sample of fish. However,

a length frequency curve (Figure 5) was drawn for a sample of 212 whiting, randomly selected from the same lot of fish from which the size selected sample was taken. Figure 4 shows the average length plotted against the age class for the entire sample with additional separate curves for the males, females and immature fish.

Conclusion

No attempt has been made to draw any conclusions from the data here presented. This project was undertaken mainly to determine the mechanics of a process to age whiting by means of their otoliths. The study was completed for this particular sample of 85 fish. Further work with whiting aging techniques will originate with the whiting investigation group.

A brief summary follows of the technique used in this study for preparing the otoliths for study.

1. Clean and air dry the otoliths.
2. With a single-edge razor blade "saw" the otolith across the approximate middle.
3. Polish the cut edge of the cross-sectional area by rubbing it on fine sand paper or emery cloth (a small motor driven circular sander would be faster).
4. Mount the otolith, cut and polished side up, in a cork holder or a piece of modeling clay.
5. View the otolith with transmitted light, shielding the polished surface with a small card. The surface may be moistened with a 50% solution of glycerine and water to improve the light transmission.

Table 1. Length for each age class of 85 whiting. Gloucester, Mass., 1954.

	Age Class						
	1	2	3	4	5	6	7
	centimeters						
	13.9	25.2	39.3	49.4	45.0	41.6	44.2
	14.1	22.5	36.1	49.2	57.5	63.4	57.1
		20.1	35.1	53.2	50.3	52.2	
		17.5	35.3	41.4	53.0	52.3	
		16.4	31.7	44.0	56.1	54.2	
		15.0	35.8	37.7	51.0	50.0	
			32.0	43.5	51.3	51.5	
			32.3	43.5	48.5	51.1	
			35.4	41.8	52.3	52.7	
			25.4	33.3	59.5	59.2	
			28.4	46.3	51.2		
			25.0	45.6	42.5		
			36.1	31.7	52.9		
			28.9	30.7	53.0		
			27.3	32.8	52.9		
			25.9	30.7	39.7		
			26.3	38.0	46.0		
			27.0	29.4	39.7		
			24.8	27.4	37.8		
			22.6	22.9	55.8		
			21.5	23.9	55.6		
			19.2		48.0		
N	28.0	116.7	627.0	796.4	1099.6	528.2	101.3
n	2	6	22	21	22	10	2
W	14.0	19.4	28.5	37.2	49.2	52.8	50.6

Table 2. Length for each age class of 53 female whiting. Gloucester, Mass., 1954.

	Age Class						
	1	2	3	4	5	6	7
	centimeters						
		25.2	39.3	49.4	45.0	41.6	44.2
			36.1	49.2	57.5	63.4	57.1
			35.1	53.2	50.3	52.2	
			35.8	41.4	53.0	52.3	
			36.1	44.0	56.1	54.2	
			24.8	37.7	51.0	50.0	
				43.5	51.3	51.5	
				43.5	48.5	51.1	
				41.8	52.3	52.7	
				46.3	59.5	59.2	
				45.6	51.2		
				38.0	42.5		
					52.9		
					53.0		
N		25.2	207.2	533.6	52.2	528.2	101.3
n		1	6	12	39.7	10	2
W		25.2	34.5	44.5	46.0	52.8	50.6
					39.7		
					37.8		
					55.8		
					55.6		
					48.0		

Table 3. Length for each age class for 21 male whiting.
Gloucester, Mass., 1954.

		Age Class						
		1	2	3	4	5	6	7
		centimeters						
				35.3	33.3			
				31.7	31.7			
				32.0	30.7			
				32.2	32.8			
				35.4	30.7			
				25.4	29.4			
				23.4	27.4			
				25.5	23.0			
				28.9				
				27.3				
				25.9				
				26.3				
				27.0				
Σ				381.3	239.9			
\bar{L}				13	8			
\bar{L}				29.3	30.1			

Table 4. Length for each age class of 11 whiting of unknown sex. Gloucester, Mass., 1954.

		Age Class						
		1	2	3	4	5	6	7
		centimeters						
		13.9	22.5	22.6	22.9			
		14.1	20.1	21.5				
			17.5	19.2				
			16.4					
			15.0					
Σ		28.0	91.5	63.3	22.9			
\bar{L}		2	5	3	1			
\bar{L}		14.0	18.3	21.1	22.9			



Figure 1. Diagrammatic sketch of an otolith from a 3-year old whiting showing A: whole otolith and cutting plane, and B: cross-section with major and minor rings.

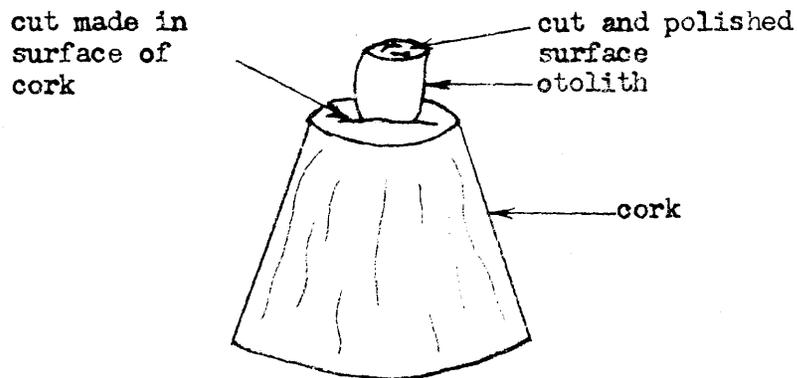


Figure 2. Placement of otolith in cork holder preparatory to reading.

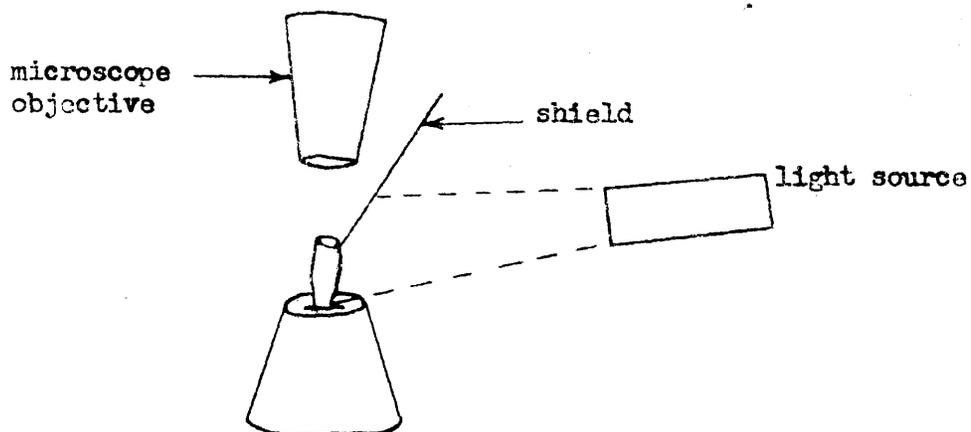


Figure 3. Best results are obtained when viewing otoliths by transmitted light if the light source is on the side opposite the person using the microscope.

Number of Fish

Figure 4. Age Frequency distribution for 85 halibut.
 Gloucester, Mass., 1954.

♂	85 Fish
♀	21 "
sex unknown	59 "
	15 "

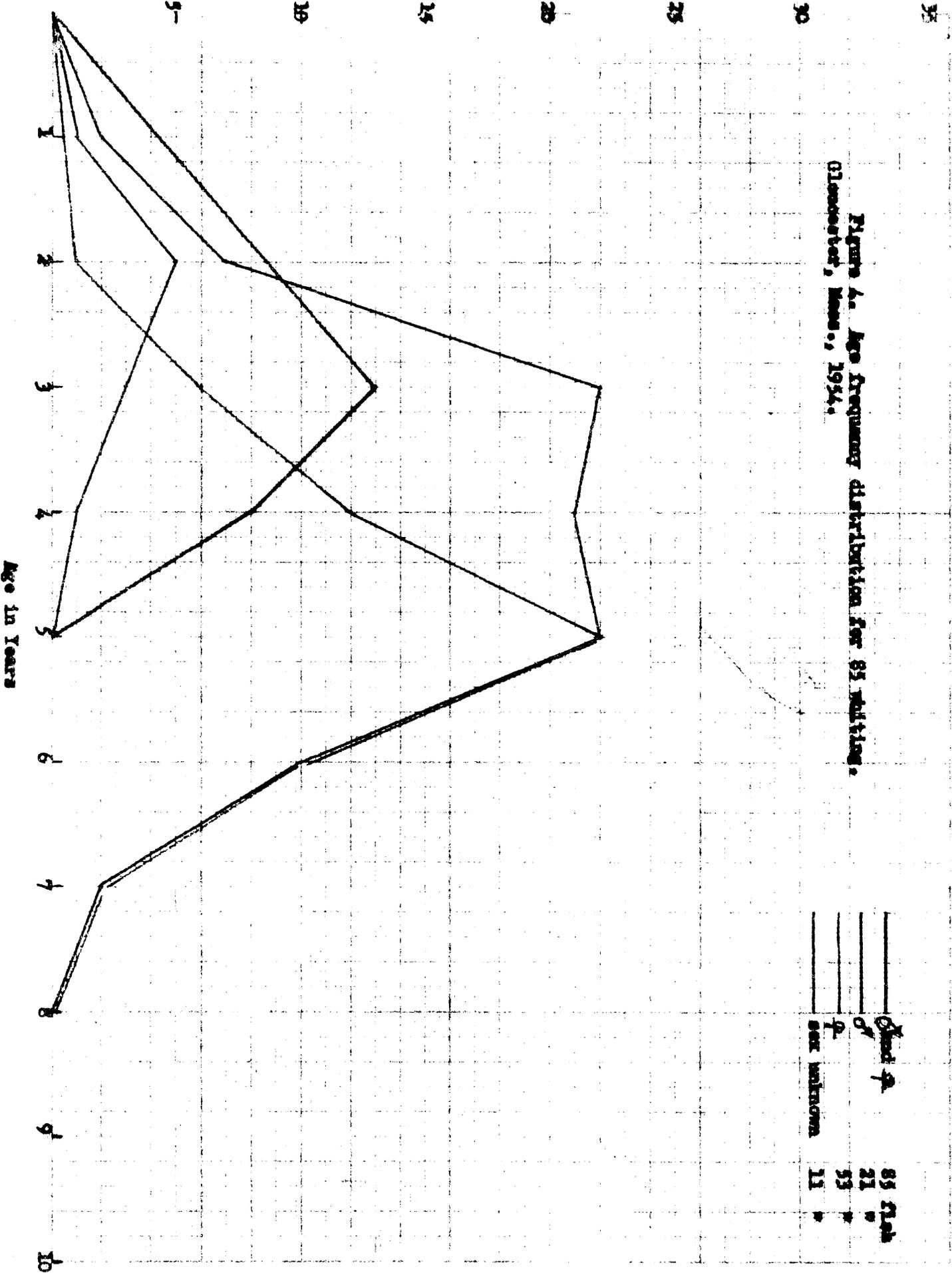
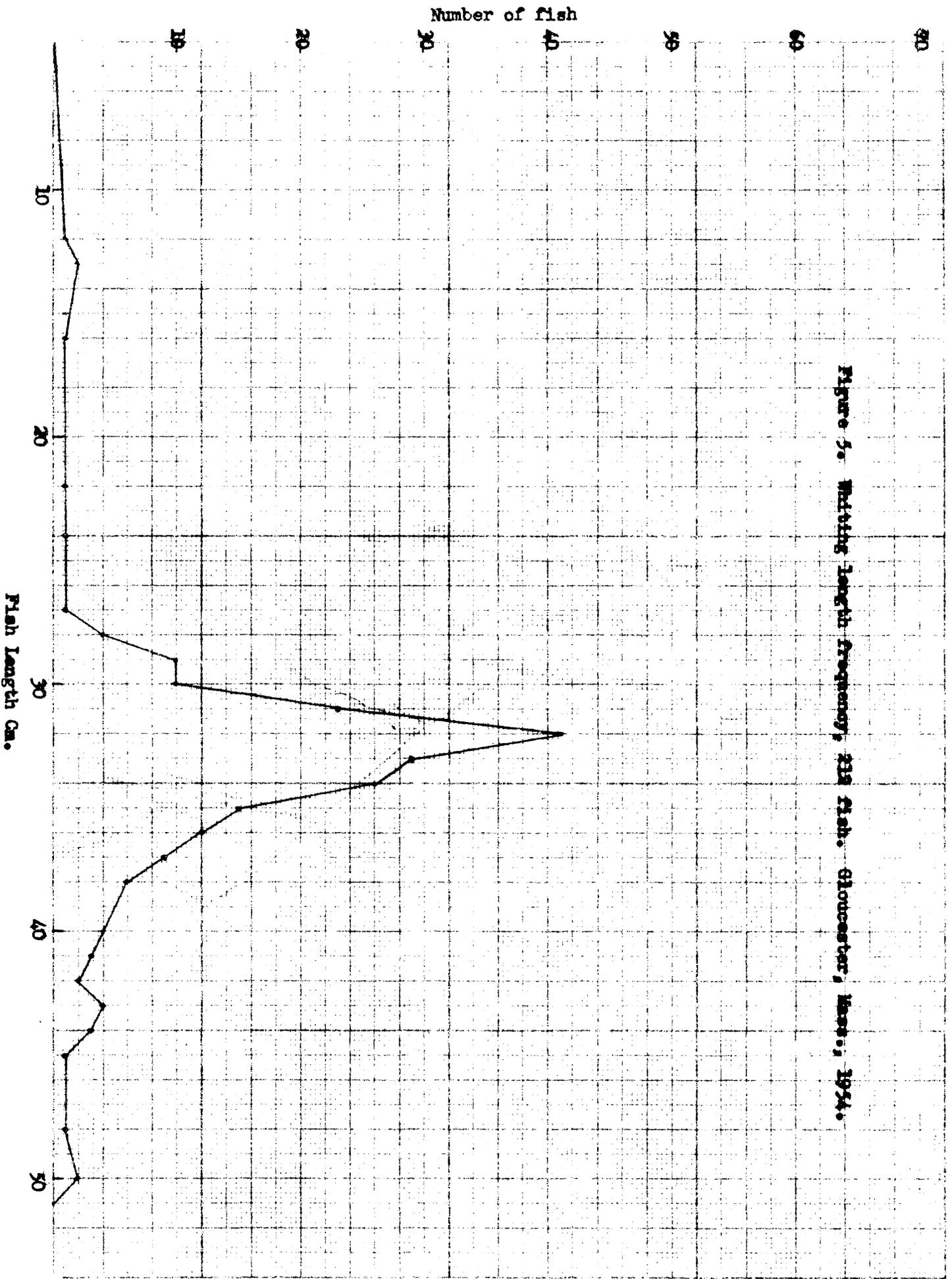
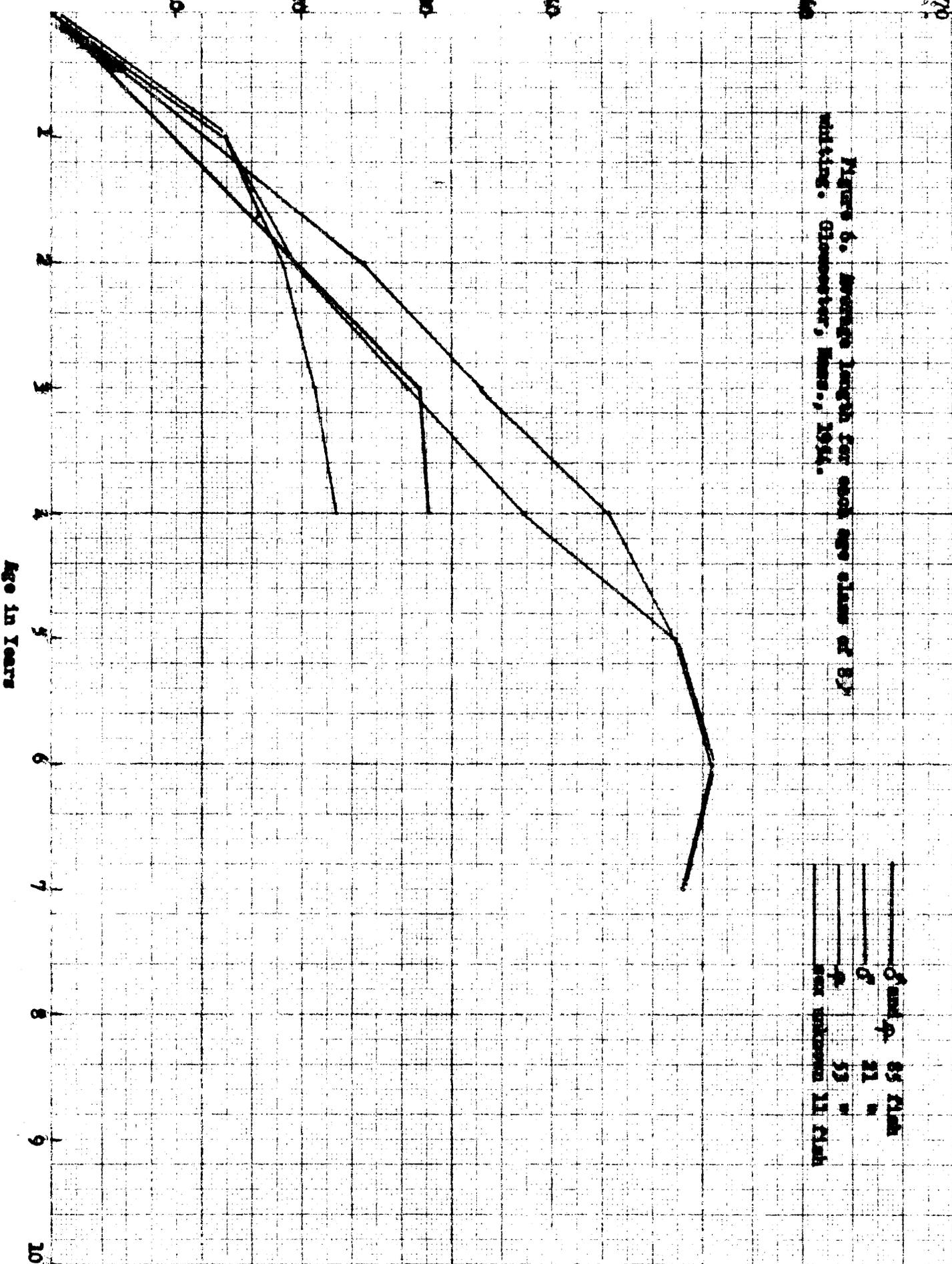


Figure 5. Matching Length Frequency, 232 Fish. Gloucester, Mass., 1954.



Average length in cm.

Figure 6. Average length for each age class of B.J. mullus. Gloucester, Mass., 1954.



— 85 FLW
 — 53 FLW
 — 21 FLW