

Original: Fish Division  
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DIVISION OF FISHERIES  
MICHIGAN DEPARTMENT OF CONSERVATION  
COOPERATING WITH THE  
UNIVERSITY OF MICHIGAN

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May 26, 1937

ADDRESS  
UNIVERSITY MUSEUMS  
ANN ARBOR, MICHIGAN

REPORT NO. 419

A TABLE FOR THE CALCULATION OF GROWTH OF THE  
PUMPKINSEED SUNFISH (Eupomotis gibbosus)

The accompanying table of scale radius length and standard body length for the Pumpkinseed Sunfish is derived from the data given in Creaser's paper (Creaser, C.W. 1926, The Structure and Growth of the Scales of Fishes in Relation to the Interpretation of their Life-History, with Special Reference to the Sunfish Eupomotis gibbosus. Univ. of Mich. Mus. of Zool. Misc. Pub. No. 17). The figures of scale radius and standard length given in this paper were averaged by millimeters of body length and then plotted on a large scale on coordinate paper. Through these points an empirical curve was drawn so as to give as good a fit as possible. From this curve the appended table was read off in terms of body length per millimeter of scale radius.

To use the table the following procedure is followed:

1. The scales of the fish are read in the usual manner at any convenient magnification and recorded.
2. The table is entered under the heading "Standard Length" and the tabular scale radius corresponding to the length of the fish under consideration is determined.
3. The actual scale radius is divided into the tabular radius giving a factor F.
4. The length of the radius at each annulus is then multiplied by the factor F to give the corrected annulus measurement.

5. The table is then entered under the head "Scale Radius" using the corrected value for each annulus. The length corresponding to this corrected value of the annulus is then recorded as the calculated length.

A numerical example may make this clearer. The scale readings of a pumpkinseed with a standard length of 77 mm. were as follows:

Scale radius 83 mm.  
 Length of radius at 1st annulus 28 mm.  
 Length of radius at 2d annulus 61 mm.

By reference to the table, it will be seen that the tabular scale radius corresponding to a standard length of 77 mm. is 103 mm.

The tabular radius is divided by the actual radius:

$$\frac{103}{83} = 1.240$$

The length of the radius at each annulus is multiplied by this factor:

$$1.24 \times 28 = 34.7 \text{ (round off to the nearest integer) } = 35$$

$$1.24 \times 61 = 75.6 \qquad \qquad \qquad = 76$$

The table is now entered under the heading "Scale Radius" using the corrected value of the first annulus of 35 mm. Corresponding to this value a standard length of 36.5 is found. This is recorded as the calculated length at the end of the first year. Similarly for the second which gives a calculated length of 62.0 mm.

It is interesting to compare the calculated growth obtained in this manner with those obtained by the more common method of direct proportion.

In three fish the following values were calculated for the length at the end of the first year:

Standard Length	Calculated Length		% B is of A
	A. Table Method	B. Direct Proportion	
73 mm.	41.5 mm.	33.1 mm.	79.7
77 mm.	36.5 mm.	30.2 mm.	82.7
60 mm.	35.2 mm.	27.5 mm.	78.1
Average %			80.2

It will be noted that the values calculated by the direct proportion give values which are on the average only about 80% of what they should be.

INSTITUTE FOR FISHERIES RESEARCH

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Sunfish (Eupomotis gibbosus)

Houghton Lake, Michigan

Body-scale values read from curve

Scale value = length of anterior radius x 50

Scale Radius	Standard Length	Scale Radius	Standard Length	Scale Radius	Standard Length
5 mm.	16.0 mm.	54 mm.	47.5 mm.	102 mm.	76.5 mm.
6	17.0	55	48.0	103	77.0
7	18.0	56	49.0	104	77.5
8	18.5	57	49.5	105	78.0
9	19.0	58	50.0	106	78.5
10	20.0	59	51.0	107	79.0
11	21.0	60	51.5	108	79.5
12	22.0	61	52.0	109	80.0
13	23.0	62	52.7	110	80.5
14	24.0	63	53.5	111	80.7
15	24.5	64	54.0	112	81.2
16	25.0	65	54.5	113	81.7
17	25.5	66	55.5	114	82.0
18	26.5	67	56.0	115	82.3
19	27.0	68	56.5	116	82.7
20	27.5	69	57.5	117	83.0
21	28.0	70	58.0	118	83.0
22	28.5	71	58.7	119	83.2
23	29.0	72	59.2	120	83.7
24	29.7	73	60.0	121	84.0
25	30.2	74	61.0	122	84.2
26	31.0	75	61.5	123	84.5
27	31.5	76	62.0	124	84.7
28	32.0	77	62.7	125	85.0
29	33.0	78	63.5	126	85.5
30	33.2	79	64.0	127	85.7
31	33.7	80	64.5	128	86.0
32	34.5	81	65.0	129	86.5
33	35.0	82	65.5	130	87.0
34	35.5	83	66.2	131	87.5
35	36.5	84	66.7	132	87.7
36	37.0	85	67.2	133	88.2
37	37.5	86	67.7	134	88.5
38	38.0	87	68.2	135	89.0
39	39.0	88	69.0	136	89.5
40	39.5	89	69.5	137	90.0
41	40.0	90	70.0	138	90.5
42	40.5	91	70.5	139	91.0
43	41.0	92	71.0	140	91.7
44	41.5	93	71.5	141	92.2
45	42.0	94	72.0	142	93.0
46	42.7	95	72.5	143	93.5
47	43.2	96	73.0	144	94.0
48	44.0	97	73.5	145	94.7
49	44.5	98	74.0	146	95.5
50	45.0	99	74.5	147	96.0
51	45.7	100	75.2	148	96.5
52	46.2	101	75.7		
53	46.7				

Scale Radius	Standard Length	Scale Radius	Standard Length	Scale Radius	Standard Length
149 mm.	97.0 mm.	202 mm.	129.0 mm.	255 mm.	173.2 mm.
150	98.0	203	130.0	256	174.0
151	99.0	204	130.5	257	174.7
152	99.5	205	131.5	258	175.5
153	100.0	206	132.0	259	176.0
154	101.0	207	132.7	260	177.0
155	100.7	208	133.7	261	178.0
156	102.5	209	134.5	262	178.5
157	103.0	210	135.0	263	179.0
158	103.7	211	136.0	264	180.0
159	104.0	212	137.0	265	181.0
160	104.7	213	137.7	266	181.7
161	105.2	214	138.5	267	182.2
162	105.7	215	139.5	268	183.0
163	106.2	216	140.0	269	183.7
164	106.7	217	141.0	270	184.0
165	107.2	218	141.7	271	185.0
166	107.7	219	142.5	272	185.7
167	108.0	220	143.0	273	186.5
168	108.5	221	144.0	274	187.0
169	109.0	222	145.0	275	188.0
170	109.2	223	146.0	276	
171	109.7	224	147.0	277	
172	110.0	225	148.0	278	
173	110.5	226	149.0	279	
174	111.0	227	149.5	280	
175	111.2	228	150.5	281	
176	111.7	229	151.5	282	
177	112.0	230	152.0	283	
178	112.5	231	153.0		
179	113.0	232	154.0		
180	113.5	233	155.0		
181	114.0	234	156.0		
182	114.5	235	157.0		
183	115.0	236	158.0		
184	115.7	237	158.7		
185	116.5	238	159.5		
186	117.0	239	160.5		
187	117.5	240	161.5		
188	118.5	241	162.0		
189	119.0	242	163.0		
190	120.0	243	164.0		
191	121.0	244	164.5		
192	121.5	245	165.5		
193	122.2	246	166.2		
194	123.0	247	167.0		
195	123.7	248	168.0		
196	124.5	249	168.5		
197	125.5	250	169.5		
198	126.5	251	170.0		
199	127.0	252	171.0		
200	128.0	253	172.0		
201	128.5	254	172.5		