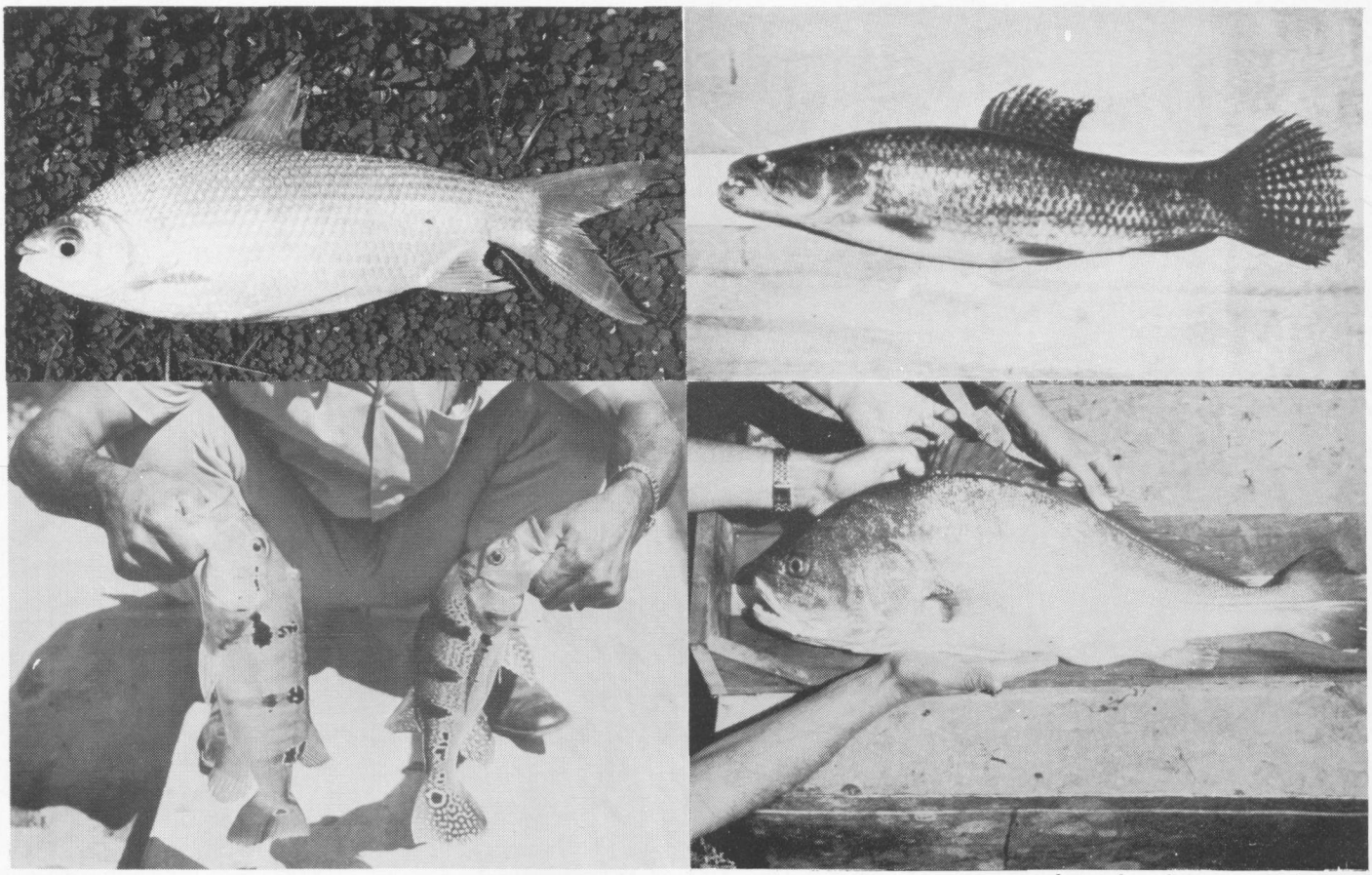
Length-Weight Relationships and Condition Indices of Fishes from Reservoirs of Ceará, Brazil

March 1978 Research & Development Series No. 18 Contract: AID1152T.O.2

International Center for Aquaculture Agriculture Experiment Station

Auburn University Auburn, Alabama R. Dennis Rouse, Director



TOP LEFT—curimatã (*Prochilodus* sp.), an abundant freshwater fish in northeastern Brazil where it is a popular and traditional food fish; TOP RIGHT—traira (*Hoplias malabaricus*), an endemic predacious fish that is distributed throughout northeastern Brazil; BOTTOM LEFT—tucunaré pinima (*Cichla temensis*) (left) and tucunaré comum (*C. ocellaris*) (right); BOTTOM RIGHT—pescada (*Plagioscion squamosissimus*), a scianid which is a popular freshwater fish in Northeastern Brazil.

PUBLISHED 3/78-1M

Length-Weight Relationships and Condition Indices of Fishes from Reservoirs of Ceara, Brazil

ODILO FREIRE DOURADO and WILLIAM D. DAVIES*

INTRODUCTION

LENGTH-WEIGHT DATA on fishes collected from various locations can be used to calculate typical average weights for fishes of specific lengths. Differences in weight of fishes of similar length is best expressed in terms of a relative condition factor (*4*) which is calculated by dividing an observed weight by a typical average weight for fishes of a certain length.

$$\text{Relative condition (Kn)} = \frac{W}{\hat{W}} \text{ where}$$

W = weight of an individual or the average weight of individuals of a certain length

$\hat{W}$ = the calculated average weight for the same length from the equation $W = aL^b$ where a and b are constants derived from fitting the equation

$$\log W = \log a + b \log L$$

A relative condition (Kn) value greater than one indicates that a fish or fishes of a specific length weigh more than the average weight, or are in better condition. This condition could indicate an aquatic system of greater productivity (*1*), or that the fish populations are structured (predator-prey ratio) to allow rapid growth. The weight per unit length of a fish is greater when it is growing rapidly. A Kn value of less than one indicates that a fish is growing slowly, which may be attributed to overcrowding, parasites, diseases, or low productivity.

Seasonal changes as well as state of sexual maturity may also affect the condition of fish. Godoy (*2*) observed that the weight change per unit of length is greater for female curimatã (*Prochilodus cearensis*) than for males; also the condition index for this species varies between seasons. However, Silva (*5*) determined that the condition of Pescado do Piauí (*Plagioscion squamosissimus*) is not sex related.

*Engenheiro Agronomo Convenio SUDENE/DNOCS/USAID, Centro de Pesquisas Ictiologicas, Fortaleza, Brazil; and Associate Professor, Department of Fisheries and Allied Aquacultures, Agricultural Experiment Station, Auburn University, respectively.

MATERIALS AND METHODS

Total length (2-centimeter groupings) and weights (grams) for fishes representing 20 species were taken from the five major reservoirs in Northeast Brazil listed below:

Reservoir	*Location (city)*	*River drainage*	*No. years sampled*
Pereira de Miranda ..	Pentecoste	Curu	4
Araras	Reriutaba	Acarau	4
Banabuiu	Quixada	Banabuiu	3
Forquilha	Sobral	Acarau	2
Lima Campos	Icó	Salgado	1

Estimated weights were calculated from the linear logarithmic form of the general length-weight equation:

$$\hat{W} = aL^b$$

For several species, one equation did not adequately fit the data over the complete range of lengths; therefore, two and sometimes three equations are occasionally used (see Appendix for details). The length interval for which a single equation was computed was determined at the point where there was a noticeable change in the body conformation or the condition index (*3*). The condition index (K) was calculated as follows:

$$K = \frac{W \times 10^3}{L^3} \text{ where}$$

W = weight in grams

L = total length

Estimated weights are tabulated for each species by 2-centimeter length groups. Also included are the number of individuals in each group, range and average of empirical weights, and the condition index. Species are listed alphabetically by common name.

LENGTH-WEIGHT RELATIONSHIPS IN CENTIMETERS AND GRAMS OF BODÓ, *PLECOSTOMUS PLECOSTOMUS* LINNAEUS

Length	No. of fish	Range in weight Minimum	Range in weight Maximum	Average empirical weight	Calculated weights standard	Condition index
8	47	5	12	9	8	17.5
10	296	10	13	11	13	11.0
12	126	17	23	18	19	10.4
14	234	24	35	30	27	10.9
16	24	51	58	53	51	12.9
18	24	52	100	68	72	11.6
20	27	79	102	97	98	12.1
22	21	110	136	132	130	12.3
24	33	152	210	170	167	12.2
26	10	180	250	209	211	11.8
28	8	240	300	265	262	12.0
30	6	300	329	318	320	11.7

LENGTH-WEIGHT RELATIONSHIPS IN CENTIMETERS AND GRAMS OF BEIRU, *CHARACIDIUM MARSHI* BREDOR

Length	No. of fish	Range in weight Minimum	Range in weight Maximum	Average empirical weight	Calculated weights standard	Condition index
12	5	25	50	35	34	20.2
14	10	35	60	52	49	18.9
16	14	40	77	59	69	14.4
18	21	50	104	91	94	15.6
20	23	100	150	129	121	16.1
22	3	130	150	148	153	13.8

LENGTH-WEIGHT RELATIONSHIPS IN CENTIMETERS AND GRAMS OF CANGATI, *TRACHYCORYSTES GALEATUS* (LINNAEUS)

Length	No. of fish	Range in weight Minimum	Range in weight Maximum	Average empirical weight	Calculated weights standard	Condition index
12	6	40	46	44	43	25.4
14	8	52	80	60	65	21.8
16	59	70	120	96	92	23.4
18	64	90	200	121	117	20.7
20	19	97	175	145	155	18.1
22	6	200	331	206	199	19.3

LENGTH-WEIGHT RELATIONSHIPS IN CENTIMETERS AND GRAMS OF CURIMATÃ COMUM, *PROCHILODUS CEARENSIS STEINDACHNER*

Length	No. of fish	Range in weight Minimum	Range in weight Maximum	Average empirical weight	Calculated weights standard	Condition index
10	5	15	22	19	17	19.0
12	10	17	36	29	30	16.7
14	9	35	45	44	47	16.0
16	21	45	78	67	71	16.3
18	37	63	120	101	101	17.3
20	72	93	197	143	139	17.8
22	217	100	302	192	185	18.0
24	290	130	298	241	240	17.4
26	277	211	370	290	291	16.4
28	258	248	550	352	348	16.0
30	119	290	600	426	411	15.7
32	57	300	700	434	481	13.2
34	31	320	750	591	558	15.0
36	21	450	920	763	727	16.3
38	19	600	1,000	813	860	14.8
40	10	850	1,300	998	1,008	15.5
42	7	1,000	1,300	1,041	1,172	14.0
44	9	1,200	1,675	1,509	1,354	17.7
46	16	1,290	1,900	1,695	1,555	17.4
48	4	1,500	2,000	1,833	1,774	16.5
50	6	1,800	2,100	1,839	2,013	14.7

LENGTH-WEIGHT RELATIONSHIPS IN CENTIMETERS AND GRAMS OF APAIARI, *ASTRONOTUS OCELLATUS OCELLATUS* SPIX

Length	No. of fish	Range in weight Minimum	Range in weight Maximum	Average empirical weight	Calculated weights standard	Condition index
16	15	76	140	123	122	30.0
18	5	132	172	169	172	28.9
20	24	150	320	239	235	29.8
22	58	256	385	312	311	29.3
24	40	300	540	400	402	28.9
26	45	380	650	473	490	26.9
28	36	450	768	592	550	26.9
30	14	500	800	589	612	21.8

LENGTH-WEIGHT RELATIONSHIPS IN CENTIMETERS AND GRAMS OF ACARÁ COMUM, *CICHLASOMA BIMACULATUS* (LINNAEUS)

Length	No. of fish	Range in weight Minimum	Range in weight Maximum	Average empirical weight	Calculated weights standard	Condition index
4	14,934	1	3	2	2	31.2
6	36,137	4	6	5	6	23.1
8	14,217	10	24	12	13	23.4
10	7,685	20	43	32	25	32.0
12	2,862	28	75	41	42	23.7
14	1,313	45	108	62	65	22.5
16	439	87	137	100	94	24.4
18	149	90	150	117	135	20.0
20	54	135	250	204	187	25.5
22	15	140	273	250	250	23.4
24	2	325	325	325	327	23.5

LENGTH-WEIGHT RELATIONSHIPS IN CENTIMETERS AND GRAMS OF GUARU, *POECILIA VIVIPARA* BLOCH & SCHNEIDER

Length	No. of fish	Range in weight Minimum	Range in weight Maximum	Average empirical weight	Calculated weights standard	Condition index
2	296	0.15	0.50	0.28	0.29	35.0
4	519	1.00	2.00	1.24	1.15	19.3
6	28	1.00	3.00	2.46	2.57	11.3

LENGTH-WEIGHT RELATIONSHIPS IN CENTIMETERS AND GRAMS OF JACUNDÁ, *CRENICICHLAT SAXATILIS ?* (LINNAEUS)

Length	No. of fish	Range in weight Minimum	Range in weight Maximum	Average empirical weight	Calculated weights standard	Condition index
6	35,828	2	3	2	2	9.2
8	16,584	4	8	5	5	9.7
10	6,545	9	13	10	11	10.0
12	3,783	18	30	21	20	12.1
14	1,551	25	48	32	33	11.6
16	898	30	77	51	50	12.4
18	372	50	122	74	73	12.6
20	113	99	145	102	102	12.7
22	52	138	163	141	138	13.2
24	6	166	197	181	183	13.0

LENGTH-WEIGHT RELATIONSHIPS IN CENTIMETERS AND GRAMS OF MUSSUM, *SYNBRANCHUS MARMORATUS* BLOCH

Length	No. of fish	Range in weight		Average empirical weight	Calculated weights standard	Condition index
		Minimum	Maximum			
12	63	1	4	3	2	1.7
14	18	3	5	4	4	1.4
16	18	4	7	5	5	1.2
18	15	5	8	6	7	1.0
20	15	6	11	8	10	1.0
22	5	8	17	11	13	1.0
24	13	8	20	14	16	1.0
26	5	9	21	19	20	1.0
28	20	16	30	25	25	1.1
30	10	28	35	33	30	1.2
32	17	30	38	36	36	1.1
34	11	38	56	48	43	1.2
36	52	47	62	56	51	1.2
38	64	60	70	64	59	1.1
40	51	68	86	84	86	1.3
42	30	80	134	101	102	1.3
46	14	122	180	134	141	1.4
48	6	129	189	181	163	1.6
50	12	135	220	204	188	1.6
52	7	190	240	203	216	1.4
54	5	190	260	254	246	1.6
56	5	231	285	282	280	1.6
58	5	290	305	297	316	1.5

LENGTH-WEIGHT RELATIONSHIPS IN CENTIMETERS AND GRAMS OF PIABUSSU, *CURIMATUS MOROWHANNAE* EIGENMANN

Length	No. of fish	Range in weight		Average empirical weight	Calculated weights standard	Condition index
		Minimum	Maximum			
6	160	1	5	3	4	13.8
8	312	6	17	8	8	15.6
10	217	15	26	19	15	19.0
12	172	20	40	26	25	15.0
14	36	29	52	35	39	12.7

LENGTH-WEIGHT RELATIONSHIPS IN CENTIMETERS AND GRAMS OF PESCADA DO PIAUÍ, *PLAGIOSCION SQUAMOSISSIMUS HECKEL*

Length	No. of fish	Range in weight		Average empirical weight	Calculated weights standard	Condition index
		Minimum	Maximum			
12	7	18	40	23	21	13.3
14	27	22	50	35	34	12.7
16	68	35	98	52	50	12.6
18	137	50	140	70	72	12.0
20	304	65	148	94	98	11.2
22	268	70	256	121	131	11.3
24	250	110	252	168	171	12.1
26	163	120	296	199	217	11.3
28	127	130	311	238	272	10.8
30	92	200	500	327	335	12.1
32	47	330	600	417	406	12.7
34	42	390	604	533	488	13.5
36	35	400	700	590	580	12.6
38	17	450	800	723	683	13.1
40	18	500	1,200	846	797	13.2
46	5	1,100	1,250	1,223	1,196	12.5
48	6	1,200	1,500	1,336	1,385	12.0
50	5	1,250	1,720	1,570	1,594	12.5
52	3	1,670	1,900	1,785	1,824	12.6
54	3	2,060	2,500	2,480	2,077	15.7
66	6	3,800	4,300	4,017	4,143	13.9

LENGTH-WEIGHT RELATIONSHIPS IN CENTIMETERS AND GRAMS OF PESCADA CACUNDA, *PLAGIOSCION SURINAMENSIS* BLEEKER

Length	No. of fish	Range in weight		Average empirical weight	Calculated weights standard	Condition index
		Minimum	Maximum			
10 ...	4	9	9	9	9	9.0
16 ...	42	34	90	46	42	11.2
18 ...	139	44	120	64	62	10.9
20 ...	270	65	132	85	87	10.6
22 ...	171	85	190	117	118	10.9
24 ...	53	126	200	157	157	11.3
26 ...	19	173	250	210	203	11.4
28 ...	18	203	281	248	257	11.2
30 ...	15	256	341	305	321	11.2
32 ...	3	382	443	423	396	12.9

LENGTH-WEIGHT RELATIONSHIPS IN CENTIMETERS AND GRAMS OF PIAU COMUM, *LEPORINUS FRIDERICI* BLOCH

Length	No. of fish	Range in weight		Average empirical weight	Calculated weights standard	Condition index
		Minimum	Maximum			
8 ...	6	7	10	9	8	17.5
10 ...	16	10	24	14	15	14.0
12 ...	42	15	38	24	26	13.8
14 ...	104	31	98	41	41	14.9
16 ...	143	32	100	62	60	15.1
18 ...	150	60	140	89	85	15.2
20 ...	163	87	204	114	115	14.2
22 ...	156	100	290	168	170	15.7
24 ...	166	120	370	223	219	16.1
26 ...	87	200	450	283	276	16.1
28 ...	57	250	520	340	341	15.4
30 ...	26	252	560	385	417	14.2
32 ...	9	353	680	519	502	15.8
34 ...	6	518	700	608	599	15.4

LENGTH-WEIGHT RELATIONSHIPS IN CENTIMETERS AND GRAMS OF PIAU VERDADEIRO, *LEPORINUS SP.*

Length	No. of fish	Range in weight		Average empirical weight	Calculated weights standard	Condition index
		Minimum	Maximum			
22	3	145	159	156	143	14.6
30	4	320	380	345	348	12.7
34	10	380	580	463	499	11.8
36	10	500	700	560	588	12.0
38	12	567	800	701	687	12.7
40	16	640	1,000	798	796	12.4
42	8	700	1,100	854	916	11.5
44	10	760	1,200	969	1,047	11.3
46	12	1,080	1,460	1,244	1,190	12.7
48	7	1,200	1,750	1,342	1,345	12.1
50	7	1,250	1,850	1,520	1,512	12.1
52	5	1,380	2,000	1,840	1,693	13.0
54	3	1,660	2,400	1,900	1,887	12.0
56	6	1,800	2,750	2,175	2,094	12.3

LENGTH-WEIGHT RELATIONSHIPS IN CENTIMETERS AND GRAMS OF PIRAMBEBA, *SERRASALMUS RHOMBEUS* LINNAEUS

Length	No. of fish	Range in weight		Average empirical weight	Calculated weights standard	Condition index
		Minimum	Maximum			
6	3	4	5	4	4	18.5
8	10	6	18	11	10	21.4
10	20	11	26	20	21	20.0
12	49	24	55	39	37	22.5
14	63	40	95	62	59	22.5
16	116	55	150	89	89	21.7
18	87	85	164	123	127	21.0
20	37	120	213	173	176	21.6
22	22	181	277	230	236	21.6

LENGTH-WEIGHT RELATIONSHIPS IN CENTIMETERS AND GRAMS OF PIABA TIRA GOSTO, *ASTYANAX* SP.

Length	No. of fish	Range in weight		Average empirical weight	Calculated weights standard	Condition index
		Minimum	Maximum			
4	143	1	2	1	1	15.6
6	1,394	2	4	3	3	13.8
8	576	5	16	6	7	11.7
10	117	10	22	15	12	15.0
12	19	16	25	18	19	10.4

LENGTH-WEIGHT RELATIONSHIPS IN CENTIMETERS AND GRAMS OF SARDINHA, *TRIPORTHEUS ANGULATUS ANGULATUS* SPIX

Length	No. of fish	Range in weight		Average empirical weight	Calculated weights standard	Condition index
		Minimum	Maximum			
12	25	20	30	24	24	13.8
14	87	21	60	33	34	12.0
16	115	35	75	48	45	11.7
18	125	45	103	65	64	11.1
20	101	67	110	90	82	11.2
22	10	88	116	96	101	9.0

LENGTH-WEIGHT RELATIONSHIPS IN CENTIMETERS AND GRAMS OF TIMBIRO, *PTERENGRAULIS ATHERINOIDES* (LINNAEUS)

Length	No. of fish	Range in weight		Average empirical weight	Calculated weights standard	Condition index
		Minimum	Maximum			
8	69	2	5	3	3	5.8
10	73	4	8	6	6	6.0
12	60	8	20	10	11	5.7
14	35	12	28	18	18	6.5
16	37	20	33	27	28	6.5
18	11	35	58	47	40	8.0
20	6	52	66	54	57	6.7

LENGTH-WEIGHT RELATIONSHIPS IN CENTIMETERS AND GRAMS OF TRAIRA, *HOPLIAS MALABARICUS* BLOCH

Length	No. of fish	Range in weight		Average empirical weight	Calculated weights standard	Condition index
		Minimum	Maximum			
16 ...	22	38	60	51	47	12.4
18 ...	20	50	88	63	67	10.8
20 ...	46	60	260	88	92	11.0
22 ...	65	98	310	121	123	11.3
24 ...	83	120	350	167	160	12.0
26 ...	101	150	370	219	204	12.4
28 ...	67	198	400	252	255	11.4
30 ...	46	200	411	316	314	11.7
32 ...	43	290	510	372	381	11.3
34 ...	23	375	600	461	458	11.7
36 ...	6	420	619	502	544	10.7
38 ...	7	420	700	625	640	11.3
40 ...	8	600	1,020	753	747	11.7
44 ...	5	900	1,260	1,000	995	11.7
46 ...	4	1,100	1,290	1,200	1,138	12.3

LENGTH-WEIGHT RELATIONSHIPS IN CENTIMETERS AND GRAMS OF TUCUNARÉ COMUM, *CICHLA OCELLARIS SCHNEIDER*

Length	No. of fish	Range in weight		Average empirical weight	Calculated weights standard	Condition index
		Minimum	Maximum			
8	8	6	10	7	8	13.6
10	12	9	22	13	15	13.0
12	18	20	33	27	25	15.6
14	45	31	48	40	39	14.5
16	65	40	95	58	58	14.1
18	139	45	125	83	82	14.2
20	187	88	163	111	112	13.8
22	153	110	270	157	148	14.7
24	112	153	330	211	192	15.2
26	73	163	380	262	242	14.9
28	78	210	550	339	301	15.4
30	83	300	650	408	369	15.1
32	61	400	810	490	446	14.9
34	33	430	860	582	533	14.8
36	19	500	900	610	631	13.0
38	6	600	940	667	740	12.1
40	5	610	1,000	873	860	13.6
42	3	850	1,100	975	993	13.1
44	4	1,000	1,200	1,075	1,138	12.6
48	3	1,100	1,480	1,280	1,470	11.5

LITERATURE CITED

(1) DENDY, J. S., E. W. SHELL AND E. E. PRATHER. 1966. Relatório Inspeção a Curto Prazo do Açude Pereira de Miranda e da Estação de Piscicultura de Amanari. Mimeo, pp. 19-20. Recife, Pernambuco, Brazil.

(2) GODOY, M. P. DE. 1959. Age Growth, Sexual Maturity, Behavior, Migration, Tagging and Transplantation of the Curimatã (*Prochilodus scrofa* Steindachner, 1881) of the Mogiguassu River, São Paulo State, Brazil. Anais da Academia Brasileira de Ciências, Rio de Janeiro. Vol. 31, No. 3, pp. 447-477.

(3) LAGLER, F. L. 1969. Freshwater Fishery Biology. W. M. C. Brown Company Publishers, Dubuque, Iowa. 2nd edition, pp. 159-165.

(4) LECREN, E. B. 1951. The Length-Weight Relationships and Seasonal Cycle in Gonad Weight and Condition in the Perch, *Perca fluviatilis*. J. Animal Ecol. 20(2):201-219.

(5) SILVA, J. W. B. 1969. Sobre o Comprimento e o Peso de Pescada do Piauí, *Plagioscion squamosissimus* Heckel, No Açude Pereira de Miranda (Pentecoste, Ceará, Brazil), Bol. DNOCS, Série Fomento e Produção, Fortaleza. Vol. 27, No. 1, pp. 59-60.

APPENDIX

Estimated Parameters of Length-Weight Equations

Common name	*Scientific name*	*Length interval*	*Log (a)*	*b*
Apaiari	*Astronotus ocellatus ocellatus* Spix	16-24	-1.460	2.945
		26-30	0.496	1.550
Acara Comum	*Cichlasoma bimaculatus* (Linnaeus)	04-14	-1.488	2.879
		16-24	-1.721	3.068
Bodó	*Plecostomus plecostomus* Linnaeus	08-14	-1.119	2.223
		16-30	-1.805	2.918
Beiru	*Characidium marshi* Bredor	12-16	-0.197	1.641
		18-22	-1.081	2.433
Cangati	*Trachycorystes galeatus* (Linnaeus)	12-16	-1.258	2.677
		18-22	-1.236	2.633
Curimatã comum	*Prochilodus cearensis* Steindachner	10-24	-1.775	3.011
		26-34	-0.977	2.431
		36-50	-1.963	3.100
Guaru	*Poecilia vivipara* Bloch and Schñeider	02-06	-1.127	1.977
Jacundá	*Crenicichlat saxatilis*? (Linnaeus)	06-24	-2.146	3.193
Mussum	*Synbranchus marmoratus* Bloch	12-38	-2.682	2.818
		40-58	-3.655	3.490
Piabussu	*Curimatus morowhannae* Eigenmann	06-14	-1.633	2.816
Pescada do Piauí	*Plagioscion squamosissimus* Heckel	12-40	-1.932	3.017
		46-66	-2.644	3.441
Pescada cacunda	*Plagioscion surinamensis* Bleeker	10-32	-2.249	3.220
Piau comum	*Leporinus friderici* Bloch	08-20	-1.718	2.904
		22-34	-1.654	2.893
Piau verdadeiro	*Leporinus elongatus*	22-56	-1.702	2.873
Pirambeba	*Serrasalmus rhombeus* Linnaeus	06-22	-1.761	3.080
Piaba tira gosto	*Astyanax* sp.	04-12	-1.393	2.473
Sardinha	*Triportheus angulatus angulatus* Spix	12-16	-0.959	2.170
		18-22	-1.032	2.262
Timbiro	*Pterengraulis atherinoides* (Linnaeus)	08-20	-2.427	3.213
Traira	*Hoplias malabaricus* Bloch	16-46	-1.955	3.014
Tucunaré comum	*Cichla ocellaris* Schneider	08-48	-1.774	2.939