Editorial

The eight articles in this issue of *Fishbyte*-in-*Naga* cover a variety of topics, countries and resources. However, three of these deal with length-weight relationships (LWR) of the form $W=aL^b$, a topic some may view as not worth writing about much, so some explanation may be in order.

Let us list some of the uses to which LWRs can be put:

i) conversion of length of individual fish to weight, as required, e.g., for visual censuses (see Kulbicki et al.'s paper below);
ii) estimating the mean weight of the fish of a given length class (see Beyer 1987, Fishbyte 5(1):11-13);
iii) conversion of a growth equation for length into a growth equation for weight, i.e., prediction of weight from age, as required, e.g., for yield-per-recruit models;
iv) morphological comparisons between population of the same species, or between species, and related investigations (see Caillouet, p. 30).

Estimating the parameters (a, b) of a LWR is usually straightforward — one weighs 10 small, 10 intermediate and 10 large fish of the same stock, runs the resulting 30 data pairs through a (log) linear regression routine and the job is done. And yet, when practical assessment work needs to be undertaken, or some species need to be compared, it is usually difficult to find the required LWRs in the literature. Why? Because many colleagues believe that estimating LWR requires hundreds of fish to be measured and weighed, missing the fact that measuring a *wide range* of fish sizes is more important for the precise estimation of a and b than the *number* of fish they measure, especially if they are all of intermediate sizes.

Also, there are many colleagues who do not engage in activities such as outlined in (i) to (iv) above and hence do not see the point in estimating LWRs. However, I believe the key problem with LWR is that there is no theory for them.

In science, a theory's role is not only to accommodate (most of) the available facts relevant to a certain set of phenomena, but also to guide research (toward filling remaining gaps), and to provide a basis for expectations (i.e., toward the formulation of testable hypotheses). Thus, while geometry tells us that the parameter b must be equal to 3 (=isometry) if a fish is to maintain its shape as it grows larger, there is no theory that tells us in which case estimated b values can be expected to be below 3 (negative allometry), or above 3 (positive allometry).

Hence, no biological hypothesis is being tested and no advance of one's understanding about anything is made when, for example, a t-test identifies a significant departure from isometry.

The situation is similar with the parameter a of a LWR, which is well defined only in case of isometry, when $b=3$. In this case, a can be interpreted as a "condition factor" (usually a is multiplied by 100 which leads to cf values near unity for trout-shaped, "normal" fish when L is in cm and W in g). Condition factors are expected to vary in the course of a year, to be low when the fish condition is "bad" (e.g., following spawning) and high otherwise. However, in the more frequent case where b is not equal to 3, the values of a cease to be indicators of condition, and tend to vary inversely with b (hence the strong correlation between a and b values in Caillouet, p. 30), not a good attribute if a is to be interpreted in biological terms.

Thus, the field is wide open: who is going to develop a viable theory of (fish) LWR; whose "facts" will be the hundreds of values of a and b presently available (e.g., in FishBase); which will organize these facts, and allow predictions (hypotheses) to be derived? ***D. Pauly***

Length-Weight Relationships of Fish from the Lagoon of New Caledonia

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Abstract

Length-weight relationships of 335 species of fish of New Caledonia, belonging to 65 families of coral reef fishes, were computed (80%) or assembled from the literature (20% of all cases) to facilitate, among other things, estimation of coral reef fish biomass from visual census.

Introduction

Length-weight relationships are — in fisheries research — useful for a number of purposes, notably to estimate biomasses from length-frequency data.

The Institut Français de Recherche Scientifique pour le Développement en Cooperation (ORSTOM) is presently conducting in New Caledonia a project involving the estimation of coral reef fish biomasses, wherein visual census is the main method used to estimate the densities of fish of different species and length. Species-specific length-weight relationships are required for the subsequent estimation of individual fish weights from their lengths, with the weights being added up to obtain total biomasses or standing stock (Kulbicki 1988; Kulbicki et al. 1990).

There is a large literature on length-weight relationship of Indo-Pacific fish, but dealing mainly with soft bottom (i.e., trawled) species, and on pelagic fish. This contribution aims at filling an obvious information gap for coral reef fish, and thus to assist future visual censuses.

Materials and Methods

Fish were caught by a number of methods: rotenone, gill nets and spear fishing for reef fishes; and trawl, gill nets, trammel nets and handline for soft bottom and pelagic fishes. Table 1 indicates the precision of our length and weight measurements, which depends on size.

Table 1. Precision of the length and weight measurements used for estimating length-weight relationships.

Length (cm) Interval	Precision	Weight Precision
0-5	0.5	0.5g
5-10	0.5	1.0g
10-30	1.0	5.0g
30-100	1.0	1-5%
>100	5.0	5%

Fork length (F) was the length taken for most species, but standard length (S) was taken for Anguilliform fish, along with disk width (D) for rays, and total length (T) for sharks. Given our ultimate aim — biomass estimation from visual census data — the sexes were not differentiated, although we are aware that they generally have different length-weight relationships.

The parameters a and b of relationships of the form

$$W = a \cdot L^b \quad ...1)$$

were estimated through logarithmic transformation, i.e.,

$$\ln(\text{weight}) = \ln a + b \cdot \ln(\text{length}) \quad ...2)$$

with a and b estimated by ordinary least-squares regressions.

Results and Discussion

Our results identify species following Rivaton et al. (1989) and other sources, and are arranged by families according to Eschmeyer (1990) (Table 2). For each species-a and b values, the number of fish available in the study (N), the correlation coefficient for the log-transformed L-W data pairs (r) — suggesting the presence of outliers when below 0.95, and the length of the smallest (l_{min}) and largest (l_{max})fish measured — are given.

Table 2 combines both our original data ("no data") and those from the literature (see numbers under Ref). As might be seen, the information (beyond a and b) may be incomplete for some of the relationships from the literature, referring mainly to soft bottom and pelagic species loosely associated with coral reefs.

Our original data cover 279 species, representing 30% of the reef fish species of New Caledonia, and 20% of the other lagoon species. Together, these species represent 70% of the biomass in the lagoon of New Caledonia (Kulbicki 1988; Kulbicki et al. 1990, 1992; Kulbicki and Wantiez 1990; Thollot 1992).

Despite the rather comprehensive coverage of Table 2, there is still little information on the small coral reef species which, although they may not be major contributors to total biomass, contribute to the bulk of coral reef fish production.

Table 2. Length-weight relationships of 335 species of fish occurring in New Caledonia, with column headings as defined in the text.

Family/ Species	a	b	N	r	Length type	Length min	Length max	Ref.
Carcharhinidae								
Carcharhinus albimarginatus	3.05E-03	3.243		NA	T			4
Carcharhinus amblyrhynchos	1.97E-02	2.914	17	0.919	T	51	120	
Carcharhinus plumbeus	1.42E-03	3.310		0.984	T			25
Galeocerdo cuvier	6.21E-03	3.160		0.994	T			9
Galeocerdo cuvier	2.62E-03	3.357		0.993	T			25
Sphyrnidae								
Sphyrna lewini	1.27E-02	2.959	13	0.965	T	38	57	
Sphyrna mokarran	1.23E-03	3.240		0.991	T			24
Dasyatidae								
Dasyatis kuhlii	3.56E-02	2.984	63	0.923	D	17	49.5	
Megalopidae								
Megalops cyprinoides	9.67E-02	3.065	42	0.991	F	17	41.5	
Muraenidae								
Thyrsoidea macrura	5.79E-03	2.305	61	0.996	S	22	260	
Muraenesocidae								
Muraenesox bagio	5.26E-03	2.781	17	0.987	S	56	106	
Clupeidae								
Amblygaster clupeoides	3.42E-03	3.180		0.999	F			6
Amblygaster sirm	3.49E-03	3.171		0.999	F			6
Anodontostoma chacunda	1.81E-02	3.048	777	0.996	F	3.5	24	
Dussumieria acuta	2.36E-02	2.631		0.982	F			5
Herklotsichthys quadrimaculatus	1.24E-02	3.005	132	0.919	F	5	10.5	
Nematalosa come	3.05E-02	2.947	92	0.993	F	3.5	24	
Sardinella fijiense	1.67E-02	2.980	54	0.993	F	5.5	15.5	
Sardinella melanura	3.58E-02	2.750		0.935	F			21
Spratelloides gracilis	9.50E-03	3.000		0.980	F			8
Spratelloides gracilis	2.27E-03	3.228		0.994	F			6
Engraulidae								
Stolephorus delicatula	2.14E-03	3.287		0.993	F			6
Stolephorus devisi	2.80E-03	3.340		0.990	F			8
Stolephorus devisi	1.40E-03	3.914		0.903	F			12
Stolephorus devisi	1.61E-03	3.328		0.988	F			6
Stolephorus heterolobus	2.40E-03	3.350		0.980	F			8
Stolephorus heterolobus	1.20E-03	3.380		0.994	F			6
Stolephorus indicus	4.10E-03	3.325		0.979	F			5
Stolephorus indicus	3.13E-03	3.159		0.996	F			6
Stolephorus insularis	2.61E-03	3.217		0.994	F			6
Thryssina baelama	2.33E-03	3.317	130	0.967	F	5	11.5	
Chirocentridae								
Chirocentrus dorab	1.12E+02	2.125	17	0.911	F	32.5	62	
Chanidae								
Chanos chanos	2.28E-03	3.354	44	0.994	F	14.5	31	
Synodontidae								
Saurida gracilis	4.59E-03	3.153	57	0.978	F	7	19	
Saurida nebulosa	4.08E-03	3.183	12	0.995	F	8	18.5	
Saurida undosquamis	1.15E-02	2.967	809	0.963	F	6.5	33	
Synodus dermatogennis	2.53E-03	3.307	33	0.984	F	8	16.5	
Synodus hoshinonis	1.32E-03	3.409	45	0.965	F	9	19	
Synodus variegatus	2.68E-03	3.300	20	0.994	F	5	21.5	
Atherinidae								
Atherinomorus lacunosus	8.03E-03	3.090	50	0.968	F	6.5	13	
Hypoatherina ovaloa	2.14E-03	3.270		0.985	F			6
Belonidae								
Strongylura incisa	5.24E-03	2.445	12	0.943	F	36.5	72.5	
Strongylura leiura	3.00E-03	2.515	21	0.846	F	43.5	75	
Strongylura urvilli	2.99E-03	3.298	28	0.991	F	29	73.5	
Tylosurus crocodilus	6.04E-04	3.165	21	0.983	F	29.5	60	
Holocentridae								
Myripristis berndti	2.97E-02	2.988	85	0.995	F	4.5	22.5	
Myripristis kuntee	1.46E-02	3.151	81	0.953	F	6	14	
Myripristis melanostica	2.97E-02	3.007	49	0.994	F	4	19.5	
Myripristis pralinia	2.05E-02	3.069	41	0.996	F	5	15	
Myripristis violacea	5.14E-02	2.903	118	0.992	F	3.5	17	
Neoniphon argenteus	5.32E-02	2.802	57	0.996	F	4.5	16.5	
Neoniphon sammara	4.85E-02	2.822	99	0.995	F	4.5	19	
Sargocentron diadema	3.73E-02	2.890	276	0.990	F	5	15	
Sargocentron microstoma	1.80E-03	3.851		0.989	F			22
Sargocentron rubrum	3.50E-02	2.949	173	0.981	F	8.5	23	
Sargocentron spiniferum	1.70E-02	3.056	32	0.985	F	11.5	31.5	
Fistulariidae								
Fistularia petimba	2.14E-04	3.158	43	0.993	F	19	44	
Scorpaenidae								
Dendrochirus brachypterus	8.05E-03	3.201	32	0.986	F	4	12	
Inimicus didactylus	3.72E-02	2.829	14	0.994	F	6.5	21.5	
Platycephalidae								
Onigicia spinosa	1.52E-02	2.418	26	0.990	F	6	19	
Onigocia macrolepis	7.30E-03	2.584	39	0.988	F	6	17	
Suggrundus staigeri	2.57E-03	3.205	12	0.998	F	19.5	52	
Ambassidae								o
Ambassis interruptus	5.28E-02	2.793	15	0.897	F	5.5	7.5	
Serranidae								
Cephalopholis argus	1.55E-02	3.022	12	0.975	F	25.5	44	
Cephalopholis boenak	1.06E-02	3.081	73	0.993	F	5.5	30.5	
Cephalopholis miniata	6.55E-02	2.757	67	0.928	F	24	45	
Cephalopholis sonnerati	1.36E-02	3.048	62	0.967	F	24	50	
Cephalopholis urodeta	1.38E-02	3.173		0.986	F			16

continued

Table 2, continued

Family/ Species	a	b	N	r	Length type	Length min	Length max	Ref.
Epinephelus areolatus	1.54E-02	2.977	139	0.991	F	6	42.5	
Epinephelus caeruleopunctatus	2.57E-02	2.913	26	0.997	F	3.5	69	
Epinephelus cyanopodus	1.24E-02	3.052	132	0.970	F	19.5	76	
Epinephelus fasciatus	3.22E-02	2.868	93	0.989	F	10	33	
Epinephelus fuscoguttatus	2.34E-02	2.891		0.968	F			18
Epinephelus macrospilos	1.48E-02	2.996	35	0.995	F	11	41	
Epinephelus maculatus	2.55E-02	2.899	569	0.970	F	6.5	60.5	
Epinephelus malabaricus	1.37E-02	3.006	162	0.998	F	8.5	101	
Epinephelus merra	2.57E-02	2.890	79	0.991	F	6	24	
Epinephelus microdon	2.57E-02	2.923	59	0.975	F	17.5	61	
Epinephelus rivulatus	2.83E-02	2.892	110	0.970	F	16	36.5	
Epinephelus suillus	9.27E-03	3.069	26	0.997	F	6.5	111	
Plectropomus leopardus	9.23E-03	3.078	117	0.991	F	24	91	
Pseudanthias hypselosoma	1.27E-02	3.085	35	0.990	F	5	9.5	
Variola louti	1.34E-02	3.036	31	0.983	F	22	66	
Pseudochromidae								
Pseudochromis purpurascens	1.18E-02	3.028	20	0.973	F	4	7.5	
Terapontidae								
Therapon jarbua	9.19E-03	3.156	74	0.989	F	2	23	
Kuhliidae								
Kuhlia marginata	1.01E-02	3.121	58	0.995	F	4	17.5	
Priacanthidae								
Priacanthus hamrur	3.92E-02	2.828	41	0.996	F	4.5	38	
Apogonidae								
Apogon angustatus	2.30E-02	2.976	39	0.959	F	4.5	9	
Apogon aureus	3.58E-03	3.378	89	0.990	F	6.2	12	
Apogon cyanosoma	1.23E-02	2.546	12	0.941	F	4	6.5	
Apogon ellioti	3.62E-02	2.832	22	0.973	F	5.5	13	
Apogon fraenatus	4.10E-02	2.271	218	0.829	F	1	11	
Apogon fuscus	1.24E-02	2.604	35	0.987	F	4	10	
Apogon hyalosoma	4.13E-03	3.347	74	0.985	F	6	15	
Apogon kallopterus	8.66E-03	3.178	29	0.955	F	6	10.5	
Apogon lateralis	3.55E-02	2.857	172	0.972	F	3.5	8.5	
Apogon lineolatus	1.74E-02	2.991	11	0.901	F	6	7.5	
Archamia fucata	5.38E-03	3.260	30	0.948	F	6	8.5	
Archamia zosterophora	6.28E-03	2.697	22	0.876	F	5.5	7.5	
Cheilodipterus lachneri	1.09E-03	3.577	51	0.963	F	6	12.5	
Cheilodipterus quinquelineatus	1.36E-02	3.044	81	0.985	F	3.5	11	
Cheilodipterus subulatus	5.29E-04	3.717	11	0.995	F	9	13.5	
Fowleria marmorata	3.66E-04	3.942	11	0.947	F	4	7.5	
Sillaginidae								
Sillago ciliata	1.84E-03	3.303	182	0.988	F	15.5	31	
Sillago sihama	4.34E-03	3.130	273	0.992	F	3.5	29	
Echeneidae								
Echeneis naucrates	4.68E-04	3.304	125	0.976	F	32	84.5	
Carangidae								
Alepes djeddaba	1.69E-02	2.761		0.918	F			5
Atule mate	3.54E-02	2.822	56	0.984	F	10	26.5	
Carangoides chrysophrys	3.57E-02	2.890	90	0.995	F	12.5	60	
Carangoides ferdau	4.14E-02	2.850		0.990	F			21
Carangoides orthogrammus	2.81E-02	2.910	26	0.995	F	28	61	
Carangoides uii	1.60E-02	2.630	12	0.993	F	12	22.5	
Caranx ignobilis	6.44E-03	3.216	77	0.997	F	7	76	
Caranx lugubris	1.05E-02	3.087		NA	F			4
Caranx lugubris	1.99E-02	3.001		NA	F			19
Caranx melampygus	2.15E-02	2.982	26	0.997	F	5.5	26	
Caranx papuensis	1.99E-02	2.999	119	0.995	F	6.5	64	
Caranx sexfasciatus	3.18E-02	2.930		0.998	F			21
Decapterus russelli	6.40E-03	3.142	16	0.991	F	11.5	30	
Elagatis bipinnulata	1.35E-02	2.920		1.000	F			21
Elagatis bipinnulata	2.34E-02	2.240		NA	F			29
Gnathanodon speciosus	1.93E-02	3.002	17	0.999	F	4	74.5	
Megalaspis cordyla	7.00E-03	3.084		0.979	F			5
Megalaspis cordyla	1.58E-02	2.990		0.994	F			21
Pseudocaranx dentex	1.70E-02	3.007		NA	F			29,30
Scomberoides commersoni	2.95E-02	2.809	47	0.995	F	19	100	
Scomberoides lysan	1.49E-02	2.896	14	0.995	F	11.5	55.5	
Scomberoides tol	3.41E-02	2.726	187	0.992	F	3.5	23	
Selar crumenophthalmus	1.94E-02	2.983	34	0.966	F	18	27.5	
Seriola dumerili	2.21E-05	2.940		NA	F			29,30
Leiognathidae								
Gazza minuta	5.42E-02	2.831	247	0.993	F	2.5	21	
Leiognathus bindus	6.85E-0	2.190	120	0.890	F	3	9	
Leiognathus equulus	3.23E-02	2.953	581	0.995	F	2.5	20	
Leiognathus fasciatus	1.94E-02	3.054	87	0.994	F	5	15.5	
Leiognathus leuciscus	3.06E-03	3.422	94	0.973	F	5	9	
Leiognathus rivulatus	9.03E-02	2.653	43	0.955	F	6	10	
Leiognathus splendens	5.94E-02	2.812	206	0.978	F	4.5	11	
Secutor insidiator	2.45E-02	2.715		0.970	F			5
Secutor insidiator	1.87E-02	3.080		0.924	F			21
Secutor ruconius	1.46E-0	2.563	25	0.928	F	3.5	6.5	
Lutjanidae								
Aphareus rutilans	1.54E-02	2.961		NA	F			19
Aphareus rutilans	3.60E-03	3.311		NA	F			4
Aprion virescens	3.51E-02	2.869	64	0.985	F	22.5	88	
Lutjanus adetii	2.55E-03	3.335	106	0.995	F	18.5	46	
Lutjanus argentimaculatus	6.40E-02	2.761	329	0.991	F	5.5	64	
Lutjanus bohar	1.75E-02	3.019	154	0.987	F	4	75	
Lutjanus fulviflammus	2.57E-02	2.936	319	0.992	F	5.5	32.5	
Lutjanus fulvus	2.75E-02	2.937	292	0.996	F	4	31	

continued

Table 2. continued

Family/ Species	a	b	N	r	Length type	Length min	Length max	Ref.
Lutjanus gibbus	2.10E-02	2.996	319	0.979	F	15.5	72	
Lutjanus kasmira	7.23E-03	3.166	78	0.989	F	4	34.5	
Lutjanus lutjanus	2.02E-02	2.964	52	0.994	F	8.5	18.5	
Lutjanus quinquelineatus	2.44E-02	2.959	524	0.969	F	5.5	23	
Lutjanus russelli	3.27E-02	2.850	173	0.976	F	9.5	29	
Lutjanus sebae	6.41E-03	3.187	14	0.998	F	24.5	77	
Lutjanus vitta	1.72E-02	2.985	687	0.983	F	6	38.5	
Symphorus nematophorus	3.50E-02	2.896	19	0.992	F	44.5	92	
Caesionidae								
Caesio caerulaurea	1.58E-02	3.046	28	0.994	F	8.5	15.5	
Pterocaesio digramma	4.14E-03	3.283	82	0.991	F	8	15.5	
Pterocaesio trilineata	9.60E-03	3.112	93	0.987	F	6	14	
Gerreidae								
Gerres filamentosus	2.86E-02	2.968	386	0.991	F	5	23	
Gerres ovatus	2.45E-02	2.986	1068	0.992	F	3	19	
Gerres oyena	5.87E-03	3.273	313	0.976	F	4	19	
Haemulidae								
Diagramma pictus	1.55E-02	2.982	398	0.993	F	7	75	
Plectorhinchus gibbosus	8.27E-02	2.719	16	0.962	F	7	34.5	
Plectorhinchus goldmanni	4.62E-03	3.219	14	0.979	F	29.5	40	
Plectorhinchus obscurus	4.27E-02	2.853	29	0.994	F	17.5	55.5	
Plectorhinchus picus	1.35E-02	3.030	16	0.990	F	36	54.5	
Pomadasys argenteus	2.11E-02	2.954	986	0.998	F	4	43	
Sparidae								
Acanthopagrus berda	2.23E-02	3.024	332	0.994	F	5	36	
Lethrinidae								
Gnathodentex aurolineatus	2.29E-02	2.982	43	0.981	F	8.5	19	
Gymnocranius japonicus	2.88E-02	2.959	256	0.994	F	10	49	
Gymnocranius lethrinoides	3.26E-02	2.931	112	0.999	F	9	48	
Gymnocranius rivulatus	4.88E-02	2.858	100	0.991	F	16	67.5	
Lethrinus harak	1.54E-02	3.043	71	0.988	F	6	31.5	
Lethrinus lentjan	2.06E-02	2.982	46	0.988	F	7.5	44	
Lethrinus mahsena	1.88E-02	3.029	732	0.971	F	11	56.5	
Lethrinus miniatus	4.48E-02	2.926		0.996	F			17
Lethrinus nebulosus	2.65E-02	2.943	1867	0.989	F	8	69.5	
Lethrinus nematacanthus	3.45E-02	2.863	749	0.985	F	8.5	21.5	
Lethrinus olivaceus	3.29E-02	2.728		NA	F			4
Lethrinus olivaceus	6.62E-02	2.780	88	0.995	F	22.5	72.5	
Lethrinus ramak	4.29E-02	2.835	22	0.974	F	12.5	28.5	
Lethrinus rubrioperculatus	1.69E-02	3.018	453	0.982	F	16.5	39.5	
Lethrinus semicinctus	3.98E-02	2.813	95	0.958	F	10	17.5	
Lethrinus xanthochilus	3.78E-02	2.872	30	0.995	F	22	62.5	
Monotaxis grandoculis	2.59E-02	2.989	44	0.999	F	4	44	
Nemipteridae								
Nemipterus peroni	6.99E-03	3.167	590	0.966	F	11.5	27	
Scolopsis bilineatus	1.02E-02	3.148	34	0.994	F	6.5	19	
Scolopsis temporalis	3.74E-02	2.846	561	0.978	F	7	21	
Mullidae								
Mulloides flavolineatus	1.86E-03	3.436	27	0.963	F	10	13.5	
Parupeneus barberinus	1.23E-02	3.081	16	0.997	F	13.5	41	
Parupeneus dispilurus	6.20E-03	3.240	39	0.996	F	8	24.5	
Parupeneus indicus	1.18E-02	3.094	83	0.996	F	6	36	
Parupeneus pleurospilos	2.34E-02	2.977	520	0.973	F	5.5	23.5	
Parupeneus signatus	2.16E-02	2.574	19	0.915	F	16	29.5	
Upeneus moluccensis	1.63E-02	3.021	956	0.975	F	6.5	17	
Upeneus sulphureus	2.01E-02	2.984	38	0.948	F	11	17	
Upeneus tragula	1.69E-02	2.991	379	0.987	F	3.5	24	
Upeneus vittatus	3.66E-03	3.326	366	0.991	F	6	23.5	
Drepanidae								
Drepane punctata	5.09E-03	3.321	12	0.977	F	28	35.5	
Ephippidae								
Platax orbicularis	4.50E-02	2.975	14	0.999	F	4.5	50	
Monodactylidae								
Monodactylus argenteus	4.00E-02	2.921	259	0.993	F	2	18.5	
Scatophagidae								
Scatophagus argus	4.94E-02	2.906	63	0.999	F	5	36	
Chaetodontidae								
Chaetodon auriga	2.30E-02	3.040	59	0.986	F	8	18.5	
Chaetodon citrinellus	3.42E-02	2.949	28	0.978	F	4	9	
Chaetodon flavirostris	1.29E-02	3.195	39	0.984	F	7	16.5	
Chaetodon melannotus	6.15E-02	2.856	19	0.990	F	5	12.5	
Chaetodon mertensii	6.56E-03	3.809	13	0.988	F	7	10	
Chaetodon pelewensis	4.29E-02	2.917	15	0.984	F	5	9	
Chaetodon plebeius	1.02E+01	2.179	20	0.978	F	2	9.5	
Chaetodon trifasciatus	4.30E-02	2.922	39	0.978	F	4	10.5	
Heniochus acuminatus	2.35E-02	3.062	76	0.989	F	3.5	17.5	
Heniochus chrysostomus	6.24E-03	3.352	12	0.987	F	5	14	
Heniochus monoceros	1.73E-02	3.115	14	0.986	F	9	21	
Pomacanthidae								
Centropyge bispinosus	7.71E-02	2.243	100	0.965	F	2	11.5	
Centropyge tibicen	1.47E-02	2.648	55	0.970	F	2	10	
Pomacentridae								
Amblyglyphidodon curacao	5.37E-02	2.886	14	0.954	F	7	9.5	
Amphiprion tricinctus	7.23E-02	2.813	13	0.984	F	5.5	12	
Chromis caerulea	2.99E-01	2.408	106	0.940	F	2	7	
Chromis chrysura	8.62E-03	3.320	46	0.969	F	7.5	12	
Chromis fumea	1.07E-02	3.238	46	0.982	F	4.5	9	
Chromis iomelas	3.78E-02	2.918	23	0.982	F	3.5	8	
Chromis lepidolepis	1.81E+00	1.994	16	0.856	F	5	6.5	
Chromis retrofasciata	9.00E-02	2.773	14	0.797	F	3	4.5	
Chromis ternatensis	5.54E-02	2.889	30	0.921	F	5	7.5	
Chrysiptera cyanea	2.11E-02	2.443	14	0.878	F	4	6	

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Table 2. continued

Family/ Species	a	b	N	r	Length type	Length min	Length max	Ref.
Dascyllus aruanus	1.36E-02	2.686	91	0.955	F	2.5	6.5	
Neopomacentrus taeniurus	3.95E-02	2.263	78	0.809	F	1.5	5	
Pomacentrus amboinensis	2.15E-02	2.550	116	0.980	F	2.5	10.5	
Pomacentrus lepidogenys	4.42E-02	2.936	28	0.972	F	5	8	
Pomacentrus melanopterus	6.57E-03	3.312	13	0.989	F	4	9.5	
Pomacentrus pavo	6.75E-02	2.753	153	0.981	F	2.5	9.5	
Pomacentrus philippinus	1.13E-02	2.681	85	0.873	F	3.5	10	
Pomacentrus popei	1.89E-02	2.612	68	0.962	F	3	8	
Pomacentrus simsiang	1.22E-02	2.683	28	0.942	F	5	7.5	
Pomacentrus vaiuli	1.63E-02	2.603	74	0.976	F	2.5	8.5	
Pristotis jerdoni	3.73E-02	2.890	50	0.970	F	7	10	
Stegastes nigricans	8.08E-02	2.351	150	0.904	F	2.5	12.5	
Cirrhitidae								
Cirrhitichthys falco	2.45E-02	2.901	13	0.952	F	4.5	8	
Mugilidae								
Liza macrolepis	1.82E-02	2.963	989	0.993	F	6	29	
Liza melinoptera	2.04E-02	2.938	1123	0.986	F	4	35.5	
Mugil cephalus	1.01E-02	3.064	247	0.997	F	6.5	48.5	
Valamugil buchanani	1.04E-02	3.050	717	0.997	F	7	60	
Valamugil engeli	3.99E-03	3.231	308	0.994	F	6.5	26	
Valamugil seheli	3.68E-03	3.250	38	0.996	F	11.5	43.5	
Polynemidae								
Polydactylus microstoma	2.06E-02	2.981	136	0.982	F	10.5	24.5	
Labridae								
Bodianus perditio	2.07E-02	3.001	259	0.984	F	24	73	
Cheilinus bimaculatus	2.85E-02	2.354	25	0.970	F	5	11	
Cheilinus chlorourus	6.20E-02	2.778	11	0.996	F	10.5	32	
Choerodon graphicus	8.95E-03	3.153	35	0.993	F	22	51.5	
Elops machnata	1.23E-02	2.930	49	0.992	F	19.5	81.5	
Halichoeres trimaculatus	4.81E-02	2.740	12	0.994	F	3.5	16	
Labroides dimidiatus	4.30E-03	3.179	23	0.971	F	4.5	10	
Thalassoma lunare	4.26E-02	2.745	54	0.991	F	3.5	20	
Thalassoma lutescens	1.03E-02	3.077	15	0.994	F	4.5	16.5	
Scaridae								
Calotomus carolinus	1.22E-02	3.167		0.997	F			22
Scarus altipinnis	2.33E-02	2.980		0.993	F			22
Scarus fasciatus	1.50E-02	3.068	13	0.998	F	12.5	41.5	
Scarus ghobban	1.41E-02	3.061	210	0.947	F	7	49.5	
Scarus gibbus	3.88E-02	2.897	20	0.998	F	4	53	22
Scarus psittacus	1.44E-02	3.163		0.990	F			22
Scarus rubroviolaceus	1.36E-02	3.109		0.994	F			22
Scarus schlegeli	4.35E-02	2.865	59	0.982	F	4.5	37	
Scarus sordidus	3.19E-02	2.927	124	0.998	F	3.5	37	
Pinguipedidae								
Parapercis cylindrica	4.91E-02	2.718	23	0.874	F	3.5	14	
Parapercis polyophthalma	8.50E-03	3.159		0.979	F			17
Blenniidae								
Ecsenius bicolor	1.86E-02	2.324	33	0.937	F	4	8	
Callionymidae								
Synchiropus rameus	9.00E-02	2.036	13	0.920	F	10	16	
Eleotridae								
Butis amboinensis	3.70E-02	2.626	25	0.930	F	4.5	8.5	
Gobiidae								
Ctenotrypauchen microcephalus	3.78E-02	2.070	23	0.898	F	4.5	11.5	
Istigobius decoratus	4.68E-02	2.687	12	0.987	F	5.5	11	
Oxyurichthys papuensis	3.63E-02	2.727	12	0.968	F	8	14	
Priolepis cincta	4.58E-02	2.719	13	0.951	F	3.5	7	
Trypauchen vagina	6.87E-03	2.844		NA	F			1
Siganidae								
Siganus argenteus	1.06E-02	3.095	14	0.990	F	10	32	
Siganus canaliculatus	1.58E-02	3.010	448	0.990	F	3	29.5	
Siganus corallinus	4.71E-02	2.940		NA	F			11
Siganus doliatus	2.24E-02	2.988	20	0.995	F	6	22.5	
Siganus lineatus	2.86E-02	2.948	907	0.990	F	5.5	35	
Siganus spinus	5.50E-03	2.880		0.996	F			28
Zanclidae								
Zanclus cornutus	1.72E+02	3.171		0.907	F			17
Acanthuridae								
Acanthurus blochii	1.99E-02	3.054	75	0.992	F	6.5	37	
Acanthurus dussumieri	1.10E-02	2.761	85	0.982	F	2.5	51.5	
Acanthurus gahm	1.20E-02	3.163	19	0.995	F	11.5	22.5	
Acanthurus lineatus	1.92E-02	3.072		0.977	F			22
Acanthurus mata	3.06E-02	2.945	48	0.990	F	10	29.5	
Acanthurus nigricans	6.70E-02	2.669		0.905	F			22
Acanthurus nigricauda	8.00E-02	2.610		0.910	F			7
Acanthurus nigrofuscus	3.12E-02	2.977	107	0.991	F	4.5	17.5	
Acanthurus nigrofuscus	9.60E-02	2.520		0.980	F			7
Acanthurus olivaceus	7.00E-03	3.398		0.947	F			22
Acanthurus triostegus	5.20E-02	2.394	20	0.977	F	6.5	16.5	
Acanthurus xanthopterus	8.64E-03	2.769	29	0.921	F	8	57	
Ctenochaetus striatus	2.78E-02	2.997	111	0.994	F	5	21	
Naso brevirostris	1.02E-02	3.128	29	0.985	F	2	31.5	
Naso lituratus	4.97E-02	2.839		0.934	F			22
Naso unicornis	2.22E-02	2.988	56	0.989	F	18.5	60	
Zebrasoma scopas	7.25E-02	2.812	55	0.994	F	4	15	
Zebrasoma veliferum	4.71E-02	2.857	36	0.989	F	4	26.5	
Sphyraenidae								
Sphyraena barracuda	1.32E-02	2.874	197	0.978	F	19	59.5	
Sphyraena flavicauda	1.95E-03	3.192	16	0.991	F	23	35.5	
Sphyraena forsteri	1.11E-02	2.914	77	0.966	F	8.5	58	
Sphyraena jello	2.50E-03	3.245		0.982	F			5
Sphyraena novaehollandiae	1.02E-02	2.464	23	0.987	F	19	28	
Sphyraena obtusata	1.25E-02	2.472	23	0.898	F	19	26.5	
Sphyraena putnamiae	1.28E-02	2.866	178	0.994	F	20	104	
Sphyraena waittei	1.61E-02	2.808	34	0.992	F	19	31	
Trichiuridae								
Trichiurus lepturus	1.50E-04	3.427		0.968	F			5
Trichiurus lepturus	1.93E-04	3.417		NA	F			3
Scombridae								
Gymnosarda unicolor	1.05E-02	3.065		NA	F			19
Gymnosarda unicolor	4.09E-02	2.800		NA	F			4
Rastrelliger kanagurta	3.19E-03	3.205		0.999	F			2,6
Rastrelliger kanagurta	1.44E-03	3.377		NA	F			23,26
Bothidae								
Asterorhombus intermedius	1.78E-03	3.407	59	0.914	F	7	12.5	
Bothus pantherinus	1.29E-03	3.475	21	0.963	F	8	18	
Engyprosopon grandisquama	3.48E-02	2.786	101	0.982	F	5.5	11.5	
Grammatobothus polyophthalmus	4.68E-02	2.717	39	0.969	F	11	20.5	
Balistidae								
Abalistes stellatus	1.10E-02	2.712	56	0.920	F	14	55	
Melichthys vidua	5.80E-02	3.554		0.958	F			22
Pseudobalistes fuscus	1.05E+01	2.410	35	0.975	F	26	57	
Rhinecanthus aculeatus	1.79E-02	3.100		0.953	F			22
Rhinecanthus rectangulus	3.55E-02	2.875		0.940	F			22
Sufflamen chrysopterus	1.53E-02	3.152		0.961	F			22
Sufflamen fraenatus	3.50E-02	2.947	86	0.970	F	19	36.5	
Monacanthidae								
Cantherines dumerili	4.06E-02	2.792		0.961	F			21
Paramonacanthus japonicus	1.87E-02	2.474	48	0.918	F	5	17	
Pseudalutarius nasicornis	1.44E-02	2.978	209	0.955	F	8	13.5	
Ostraciidae								
Lactoria cornuta	5.37E-02	2.709	15	0.925	F	20.5	30	
Ostracion cubicus	2.62E-02	2.588	18	0.999	F	2.5	41	
Tetrosomus gibbosus	1.61E+01	2.229	23	0.970	F	5	26	
Tetraodontidae								
Arothron hispidus	9.01E-02	2.801	14	0.998	F	6.5	46	
Arothron manillensis	9.27E-03	2.704	38	0.989	F	3.5	33	
Arothron stellatus	2.05E-02	2.665	21	0.998	F	5	75	
Canthigaster valentini	4.40E-02	2.290	29	0.894	F	2	8	
Lagocephalus sceleratus	2.41E-02	2.905	62	0.996	F	9	71.5	
Diodontidae								
Diodon hystrix	1.29E+01	2.345	22	0.946	F	28	75	

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On Comparing Groups of Fishes Based on Length-Weight Relationships

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Abstract

F. Torres, Jr., in a 1991 *Fishbyte* article, presented length-weight relationships derived from 122 graphs in van der Elst's *1981 A guide to the common sea fishes of southern Africa*. This author analyzes Torres's tabulated results to determine whether or not *a*, *b*, lna, L_{max} and $\ln L_{max}$ were correlated. Highly significant ($P < 0.01$) negative correlations between *b* and lna ($r = -0.868$) and between lna and $\ln L_{max}$ ($r = -0.276$) were detected. Thus, Torres's mean of *b* for this sample of 122 species may have been influenced not only by the species composition of the sample, but also by the range in size of individuals of each species.

Introduction

For each of 122 species from 93 genera and 44 families of marine fishes, Torres (1991) extracted four weight (W, in kg) and length (L, in cm) data pairs from L-W graphs presented by van der Elst (1981). Using least-squares regression, of the form $\log_{10}W = \log_{10}a + b\log_{10}L$, to fit the L-W relationship, Torres (1991) estimated b and a for each species, then tabulated these estimates along with the maximum size (L_{max}, in cm) of each species. He conducted a Student's t-test to compare the mean $\bar{b} = 2.88$, of this sample of 122 species with 3, the average *b* reported for different multispecies samples of fishes by Carlander (1969) and Cinco (1982). Coincidentally, 3 also is the expected value of *b* when growth in W and L is isometric (Beyer 1987; Cone 1989; Beyer 1991).

Using Torres's (1991) tabulated results for his 122-species sample of marine fishes, I examined the frequency distributions of *b*, *a*, lna, L_{max} and $\ln L_{max}$, to determine which if any were normal. I then examined all possible bivariate, product-moment correlations among *b*, *a*, lna, L_{max} and $\ln L_{max}$ to determine if any were significant.

Materials and Methods

I extracted *b*, *a* and L_{max} data for each of the 122 species of marine fishes from Torres's (1991) tabulation, and conducted univariate analyses of *b*, *a*, lna, L_{max} and $\ln L_{max}$. I then conducted product-moment correlation analyses to examine all bivariate relationships among b, a, lna, L_{max} and $\ln L_{max}$.

Results and Discussion

Descriptive statistics for *b*, *a*, lna, L_{max} and $\ln L_{max}$ are presented in Table 1. The distributions of b, lna and $\ln L_{max}$ were normal, as indicated by high values of the Shapiro-Wilk statistic (Shapiro and Wilk 1965), *W*, and skewness and kurtosis coefficients approaching 0, but the distributions of