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BIOLOGY OF *LUTJANUS GRISEUS* (L.) OF THE CUBAGUA ISLAND, VENEZUELA. I. LENGTH-WEIGHT, BODY LENGTH-GUT LENGTH RELATIONSHIPS AND CONDITION FACTOR

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RESUMEN : Las relaciones longitud-peso, longitud-cuerpo, longitud-intestino y el factor de condición de *Lutjanus griseus* se basan en el examen de 263 ejemplares capturados en la Isla de Cubagua. La relación longitud-peso se ha expresado mediante la siguiente ecuación: i) Para las hembras Log W = 7,04 x 10^{-5} + 2,73 Log L, y ii) para los machos Log W = 3,24 x 10^{-5} ± 2,86 Log L. El coeficiente del factor de Condición K promedió 1,5103 en los machos y 1,4853 en las hembras. La longitud del intestino del pez raramente excede a la longitud total del cuerpo, existiendo una relación lineal entre estas dos variables.

ABSTRACT: The length-weight, body-length gut length relationship and condition factor of *Lutjanus griseus* were based on the examination of 263 fish collected from the Cubagua Island. The length weight equation expressed logarithmically is: i) Log W = 3.24 x 10^{-5} ± 2.86 Log L for male and ii) Log W = 7.04 x 10^{-5} + 2.73 Log L for female. The coefficient of Condition factor K was found to be an average of 1.5103 for male and 1.4853 for female fish. Gut length rarely exceeds the total body length and exists a linear relationship between the total body length and the gut length of the fish.

INTRODUCTION

Fishes of the Lutjanidae occur throught the world in tropical and sub-tropical seas and are found from shallow inshore areas to the depth of 350 fathoms. Most species live on or near the bottom and are largely confined to continental shelves and slopes, and to corresponding depths around the islands.

Eight species of the genus *Lutjanus* are reported from the territorial waters of Venezuela (CERviGON, 1966). The catches of these species have been relatively low on both trawlable bottom long line along the 750 miles coast line of Venezuela (CARPENTER & NELSON, 1971). Recent fish trawls exploration by the FAO vessel CALAMAR and the OREGON of the USA are of the s'rnilar conclusions that the areas are not very promising for the snapper (local name "pargo") fishery. Venezuela has already built up a small size fleet of pargo fishery and it is increasing gradually, but most fishing is done with relatively slow and time consuming handling. Nasas, fishing line and underwater har poon are used commonly in the banks around small islands or the rocky coast but catches are not large enough to consider this a major fishery as yet but the Government is exploring the possibilities of a major fishery. The present production of pargo in Venezuela is difficult to ascertain as the published data are contradictory and confusing (NASCIMENTO & RO JAS, 1971; NOVOA *et al,* 1972 and GEMINEZ *et al,* 1975).

Lutjanus griseus is one of the important species that comprises the pargo fishery in Venezuela. It has a size range of 58-520 mm in standard lenght (ANDERSON, 1967) and generally lives at a depth of 4-42 fathoms but 70% of them occur at a depth between 17-27 fathoms (RIVAS, 1970). CARPENTER & NELSON (1971) found the species at a depth between 1-20 fathoms, whereas GINS (1972) reported to fin the species at a depth between 0-27,5 fathoms. This species is available on both sides of the Atlantic ocean with large population in the Gulf of Mexico. Although *L. griseus* is common and important food fish, no work has been done to study its biology. This is the first of the series

of papers on this species which describes the length — weight, body length — intestinal length relations and condition factor of a pargo population collected from the Cubagua Island, Venezuela.

MATERIALS AND METHODS

Specimens for this investigation were collected from the north-west of Cubagua Island from February, 1973 to January, 1974. The details are described in an earlier paper (GUERRA & BASHIRULLAH, in press). Total length and intestinal lengths are measured in mm and weights are taken in gm. Intestinal lengths could not be taken on board always and sometimes had to be kept in a refrigerator for more than one day. There may be some error in measuring the intestine in stored materials as it stretches easily.

ANALYSIS

The body of fish is continually changing in its proportions during its life time and the simple cube law expression ($W=KL^3$, where W = weight, L= lengt and K= constant) does not hold throughout the life of the fish. Many authors have suggested modification to it, but the equation given by LeCren (1951) is wedely used. The equation stands as $W=cL^n$, where c and n are constants, which is also expressed ligarithmicall. Log $W=c + n \text{ Log } L^{(I)}$. The values of c and n are determined empirically.

Individual variation from general length weight relationship have usually been considered more interesting than the length-weight relationship itself, and have frequently studied under the general name "Condition" (LeCren, 1951). Such changes in condition have usually been analysed by means of a condition factor. This has been calculated by using different formulae. In the present studies, condition factor is analysed by

using i) $K= \frac{100\,W}{L^3}$ (HILE, 1936) and ii) $K= \frac{W}{L^3}$

where, L is length in cm and W is weight in gm.

NIKOLSKY (1963) stated that gut length is related with the type of feeding habit and the length of intestine is always less than 100% of the total length in case of a carnivorous fish. *L. griseus* is a carnivorous fish and the formula $\text{Log } F=\text{Log } a + n \log L^{(II)}$., where F is body length and L is intestinal length, is used to find out the relationship between the body lenght and intestinal length in this fish.

RESULTS

The length-weiht relationship of 89 male fish is expressed graphically by plotting the observed length and weight as dot diagram on arithmetic graph paper resulting an usual curve on approximate eye estimation (Fig. 1), whereas the same data are fed to the computer for the logarithmic form of equation (I) resulting and expected straight line with data grouped and plotted by the computer (Fig. 2). The length-weight equation expressed logarithmically is: Log $W=3.24 \times 10^{-5}+2.86$ Log L. Expressed exponentially the equation is $W=1.0000746\ L^{2.86}$.

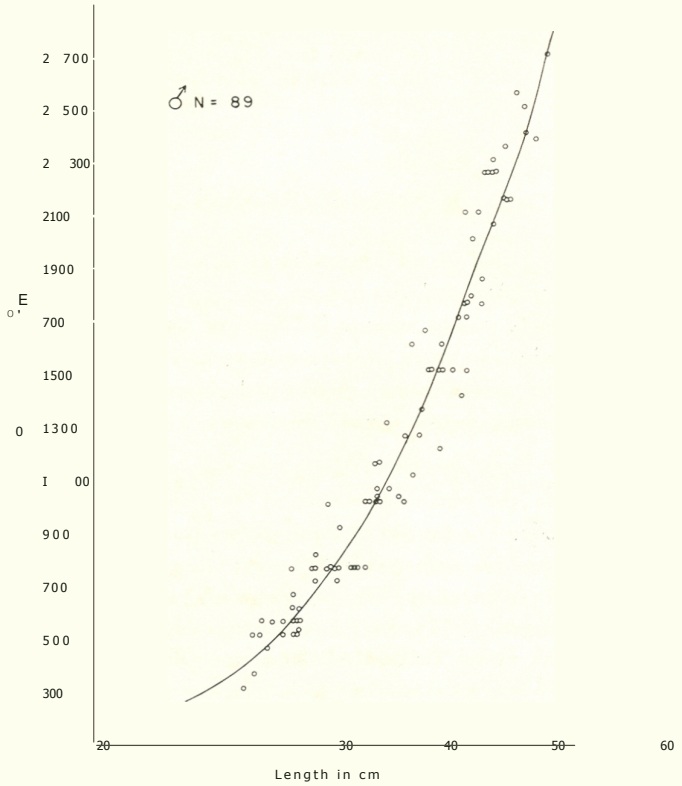

Fig. 1. Length-weight relationship in male *Lutjanus griseus*.

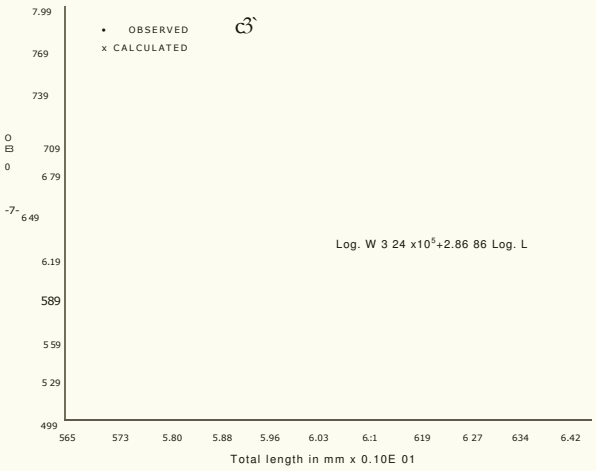

Fig. 2. Length-weight relationship in male *Lutjanus griseus*. Data grouped, computed and plotted by the computer.

Similarly, the weight of 174 female fish are plotted against their corresponding total length in the same manner as in case of male fish (Fig. 3 and 4). The length-weight equation expressed logarithmically is, $W=1.000162\ L^{2.73}$ On putting the values of Log c and n in the equation (I), the corresponding values of Log W for any values of Log L were obtained for both male and female fish.

The casual observations on fresh specimens suggest that there is a significant proportional increase in both depth and girth of larger fish. More data on smaller sizes will be required before a qualitative description of the apparent deviation from the "cube law" can be attempted. The seasonal changes in Condition factor are given in mean weight for the monthly sub-groups for weight on length (Tables 2, 3). The coefficient of

$$\text{Condition, } K=\frac{100\ W}{L^3},$$

was found to average 1.5103 for male and 1.4853 for female samples. The condition factors are plotted for both male and female separately (Fig. 5). For the female, the condition factor are calculated for 174 fish. The condition is fairly constant with the fall in March which rises gradually from April with the maximum in June. The ripe fish from July, however, have lower condition factor and falls to minimum in August. The condition again increases from August to October. It then falls in November and stays almost constant upto January when the fish are either spent or caught immature.

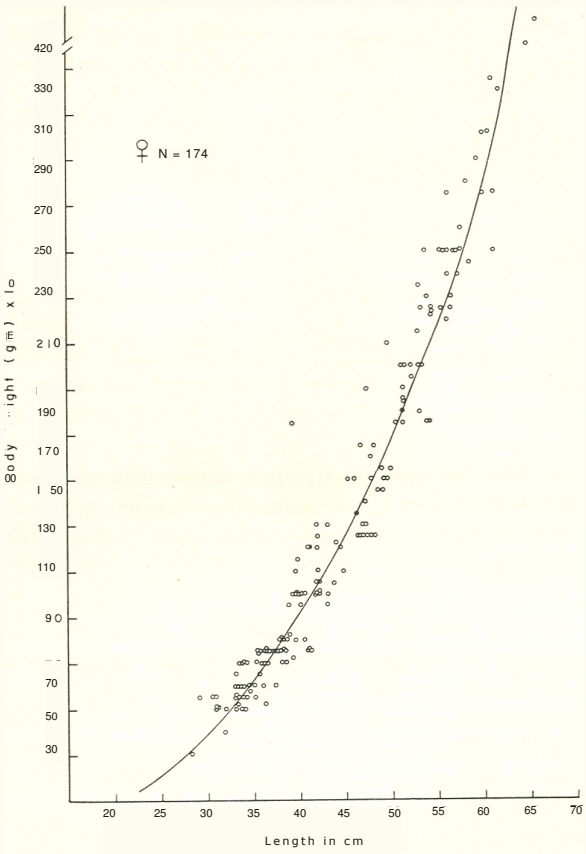

Fig. 3. Length-weight relationship in female *Lutjanus seus.*

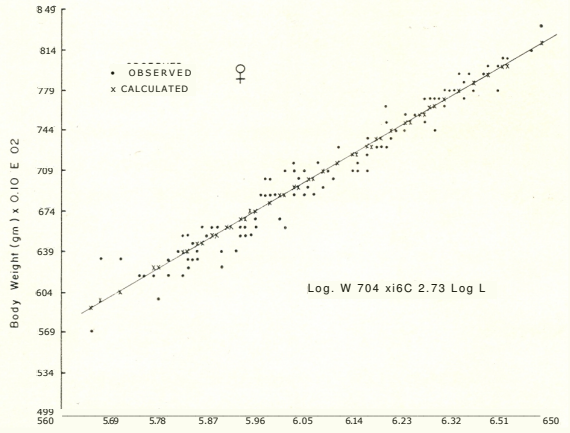

Fig. 4. Length-weight relationship in female *Lutjanus griseus*. Data grouped, computed and plotted by the computer.

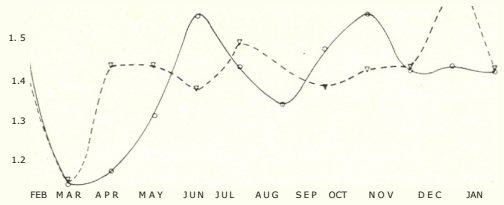

Fig. 5. Seasonal changes in the condition factor of male and female *Lutjanus griseus.*

The males present a picture slightly different from the females. The fall in condition of males in March equals to that of the females which again rises in April and remain fairly constant from April through January, with an exception in December. It seems that the male increases the condition slowly after spawning from September with its peak in December.

Basically, the intestinal length of *L. griseus* does not exceed the total body length but in some cases intestinal length exceeds the body length (Table 1), which may be due to the error of measurements. Intestinal length and body length maintains linear relationship i.e intestinal length increases along with the increase of the body length. The equation (II) is applied and expressed logarithmically, the result is Log F= 76.5+0.953 Log L, where F=body length and L=intestinal length. Fig. 6 represents the dot diagram of both male and female, whereas the Fig. 7 is computed and plotted by the computer for male. The value of sigma of the same analysis in case of female fish is turned out to be very high and therefore ommitted.

TABLE 1. TOTAL LENGTH, BODY WEIGHT AND INTESTINAL LENGTH OF *LUTL1NUS GRISEUS,* 1973-74 (F=FEMALE AND M=MALE)

Month	Sex	Number	Total length (cm)		Body weight (gm)		Intestinal length	
			Mean	Range	Mean	Range	Mean	Range
February	F	34	46.78	34.0-60,0	1601.47	500-2750	38.82	13.5-83.0
	M	16	42.41	29.3-53.2	1184.37	300-2230	27.133	13.0-57.0
March	F	9	43.77	32.6-54.1	1044.44	400-1750	31.67	30.0-63.0
	M	6	44.83	39.4-54.3	1133.33	750-2150	55.50	28.0-48.0
April	F	6	40.55	34.7-48.0	841.66	600-1250	36.50	25.0-49.0
	M	4	47.25	34.0-54.3	1612.50	550-2150	40.50	28.0-48.0
May	F	6	36.53	33.6-39.9	684.16	550-1000	20.50	13.0-24.0
	M	6	45.12	34.0-56.0	1400.00	350-2400	28.20	17.0-42.0
June	F	7	39.96	34.8-56.0	1051.42	520-2500	27.50	13.0-46.0
	M	11	45.67	34.6-58.0	1394.54	500-2750	32.14	16.0-49.5
July	F	20	47.73	32.2-66.0	1655.00	500-3400	38.50	16.0-63.0
	M	17	41.94	31.5-53.9	1165.64	550-2300	37.68	20.0-55.0
August	F	15	49.21	35.4-62.0	1708.70	750-3200	37.73	21.0-63.0
	M	0						
September	F	23	43.93	30.2-66.8	1318.26	550-2800	34.91	14.0-64.0
	M	2	52.85	50.5-55.2	2150.00	1750-2550	32.50	30.0-35.0
October	F	16	40.23	30.3-66.0	1073.43	500-4200	32.25	16.0-71.0
	M	9	42.89	34.5-56.4	1191.66	525-2500	38.44	20.0-55 0
November	F	16	43.91	28.8-61.1	1279.37	300-2750	33.03	13.0-58 0
	M	6	43.97	33.6-56.9	1290.33	550-2370	22.00	17.0-31.0

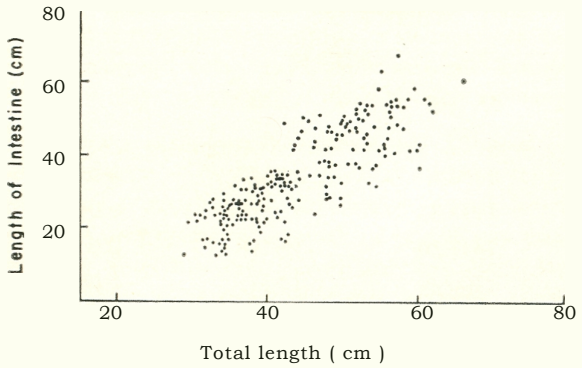

Fig. 6. Dot diagram of body length and intestinal length relationship of both male and female of *Lutjanus griseus.*

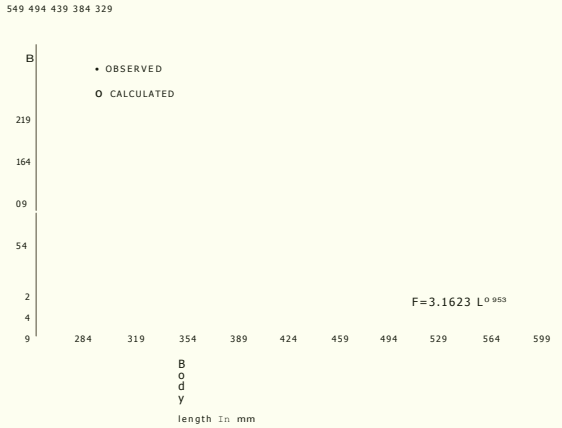

Fig. 7. Body length-intestinal length relationship of male *Lutjanus griseus.* Data grouped, computed and plotted by the computer.

DISCUSSION

The value will be exactly 3.0 when the growth is isometric in the length-weight relationship of fish (RICKER, 1963). In reviewing the literature it was observed that not too many fish are "ideal" as the values are either lower or higher than 3.0. The value of n for *Lutjanus griseus* is found to be less than 3.0 which is comparable to earlier works of the same genus (CAMBER, 1955; DAWSON, 1963). This may be due to the fact that weight is affected by the time of the year, stomach contents, stage of maturity or even the occurrence of parasites. Besides, there are sometimes marked differences in weight of fish of the same size during the different periods of the year. DAWSON (1963) found n=2.60513 for *L. blackfordi* and CAMBER (1955) calculated n to be 2.917 and 2.915 for the male and female respectively of *L. aya,* whereas CROKER (1962) observed n=2.7261 for *L. griseus* in Florida. The value of n of the same species is calculated to be 2.86 for male and 2.73 for female and closely comparable with the former results.

The value of K in *Lutjanus griseus* were calculated by using two different formulae (Tables 2, 3). The K is almost the same in both the formulae with only variation in number of decimals. The formula, $K = \frac{100\,W}{L^3}$ (RILE, 1936) as recommended by LECREN (1951) seems to be easier for calculation. The value of K in both male and female are very close with only variation during the different period of the year. The differences in condition factor in *L. griseus* may be interpreted to different biological factors, such as, environmental condition, food availibility and the reproductive maturity. LECREN (1951) discussed three major factors for the variation of the condition factor e.g. 1) length, ii) selection in sampling and iii) environment, food supply and degree of parasitization. In view of these different factors, condition aftcor can easily be affected.

Every species of fish is generally adapted to feed on a particular food but the fish gradually changes its diet when it grows. Along with it, length, structure and function of intestine also change. According to NIKOLSKY (1963) the length of digestive tract is closely related to the type of food habit. The length of intestine of carnivore fish is less than 100% of the body length. *L. griseus,* a carnivorous fish, generally agrees with the above statement of NIKOLSKY in principale, but in some cases of the present studies, the intestinal length exceeded the total body length. This may be due to measuring error as the intestine may easily be stretched out. DAS & MOITRA (1958) concluded that the ratio of the gut length and body length can be expressed as the angle subtended by the gut length body length ratio, is constant for each species. SAXENA & CHITRAY (1964) could not reach the same observation in *Clarius batrachus,* an omnivore. They did not find any correlation between the gut length and body length.

TABLE 2. MEAN MONTHLY CONDITION FACTOR OF MALE *LUTJANUS GRISEUS*

Month	Number	Mean Leuger cm	L^3	Weigth gm	$K=\frac{100\ W}{L^3}$	$K=\frac{W}{L^3}$
February	16	42.41	76278.97	1184.37	1.5527	0.0155
March	6	44.83	90096.15	1133.33	1.2579	0.0126
April	4	47.25	105488.58	1612.50	1.5286	0.0153
May	6	45.12	91855.95	1400,00	1.5241	0.0015
June	11	45.67	95256.15	1394.54	1.4640	0.0146
July	17	41.94	73770.93	1167.64	1.5280	0.0158
August						
September	2	25.85	147616.25	2150.00	1.4565	0.0146
October	9	42.89	78898.39	1191.66	1.5104	0.015-
November	6	43.97	85009.88	1290.33	1.5179	0.0152
December	5	36.08	46967.73	800.00	1.7033	0.0170
January	7	46.04	97590.14	1478.57	1.5151	0.0152
					1.5103	0.0139

TABLE 3. MEAN MONTHLY CONDITION FACTOR OF FEMALE *LUTJANUS GRISEUS*

Month	Mean Number Length	Mean Length cm	L'	Weigth gm	$K=\frac{100\ W}{L^3}$	$K.=\frac{W}{L^3}$
February	34	46.78	102371.87	1601.47	1.5644	0.0156
March	9	43.77	83855.13	1044.44	1.2455	0.0012
April	6	40.55	66676.47 .	841.66	1.2623	0.0126
May	6	36.53	48747.13	684.16	1.4035	0.0140
June	7	39.96	63808.19	1051.42	1.6478	0.0165
July	20	47.73	108736.24	1655.00	1.5220	0.0152
August	15	49.21	119168.12	1708.00	1.4333	0.0143
September	23	43.93	84778.09	1318.26	1.5550	0.0155
October	16	40.23	65110.36	1073.43	1.6486	0.0165
November	16	43.91	84662.35	1279.37	1.5111	0.0151
December	5	46.12	98099.75	1490.00	1.5189	0.0152
January	17	40.72	67518.58	1020.58	1.5116	0.0151
					1.4853	0.0139

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