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A PRELIMINARY ANALYSIS TO OBTAIN A SIZE WEIGHT RELATIONSHIP FOR THE MEDITERRANEAN SWORDFISH (*XIPHIAS GLADIUS*)

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SUMMARY

A preliminary analysis of the effect of the size, sex and month variables on weight estimates was carried out using 1006 records of size, weight and sex, obtained by the Spanish fleet targeting swordfish in the Mediterranean. The size (LJFL cm) - weight (RW kg) equations are created by sex and for both sexes combined. The results are compared to the equations traditionally used in these areas.

RESUME

Une analyse préliminaire de l'effet des variables de taille, sexe et mois sur l'estimation du poids a été effectuée en utilisant 1.006 registres de taille, poids, sexe et mois, obtenus à partir de la flottille palangrière espagnole qui vise l'espadon en Méditerranée.

Les équations de taille (LMF cm) - poids (RW kg) sont créées par sexe et sexes combinés. Les résultats sont comparés avec l'équation traditionnelle utilisée dans ces zones.

RESUMEN

Usando 1.006 registros de talla, peso, sexo y mes obtenidos a partir de la actividad de la flota española dirigida al pez espada del Mediterráneo, se realiza un análisis preliminar del efecto de las variables talla, sexo y mes sobre la estimación del peso.

Ecuaciones talla (LJFL cm) - peso (RW kg) son generadas por sexos y sexos combinados. Los resultados son comparados con los de las ecuaciones tradicionalmente usadas para estas mismas áreas.

INTRODUCTION

The size-weight relationships are very important biological parameters for the creation of data bases used in stock evaluations.

Since each fleet has a different way of processing its swordfish catches, in addition to the fact that different terminologies are used depending on the country, there have often been discrepancies and uncertainties in the values of these parameters.

In the case of the Mediterranean swordfish, these uncertainties have been brought to light in recent years by observing the discrepancies between task I and the weight estimates obtained based on task II.

The size-weight equation used for the creation of SWO data bases in the Mediterranean (DE METRIO 1987, MIYAKE, 1990), taken together with a factor for conversion from DW (dressed weight) to RW (round weight), give us the weight values per size category generally higher than the results for the Atlantic, and seem rather unrealistic from an empirical point of view. Later explanations (ICCAT pers. com., ICCAT 1990) related to the weight units used (GW) have partly rectified these major discrepancies.

For the purpose of providing a comparative element, we planned the collection of Size (LJFL)-Weight (RW) data from the catches made by the Spanish fleet targeting swordfish (LL) in the Mediterranean. Although this data collection is still in progress and there will eventually be a greater number of value pairs available, this preliminary analysis has been carried out to shed light on the uncertainties that have arisen around this parameter. We also aim to do comparative analyses, given the importance of this biological parameter in the creation of data bases and future analyses.

METHODS

The analyses were carried out using 1006 entries of size, weight, sex and month, recorded in the port of Alicante in 1990, 1991 and early 1992. The catch was concentrated in the areas covering 5x5 degrees squares 35ºN 00ºE, 35ºN 00ºW, 40ºN 00ºE.

Size (LJFL cm.) was measured with a gauge and classified in one centimeter size categories (to the lowest centimeter).

Weight (RW in kg.) was determined using MOBBA scales having + - 10 gr accuracy for fish weighing under 15 kg. Fish over 15 kg. were weighed using commercial scales having a + - 100 gr. accuracy. Sex (male, female, indefinite) was classified by sight (visu).

To evaluate the possible effect caused by the variables SIZE, MONTH, and SEX on weight, a Generalized Linear Model (GLM) was developed.

Ln Weight= u + LJFLi + Mj + Sk + eijk
u= overall mean.
LJFL= logarithm of effect LJFL.
M = " " " MONTH (from 1 to 12).
S = " " " SEX (male, female).
e = logarithm of the normally distributed error term.

RESULTS.

The results of the preliminary analyses show that out of the 1006 entries available, 810 pertained to males+females. The number of observations is generally well distributed over the months, with the exception of February and July (Table 1). Table 2 provides information on number of observations, ranges, mean values, and standard deviation, classified by sex and month respectively.

The distribution of residuals by month (Figure 1) suggests a suitable arrangement of the residuals, although in May they tend to be positive, whereas in August they tend to be negative. We also carried out residual analyses by size; however, no abnormal patterns were detected.

The results of the GLM (table 3) performed for the known sex recordings (810 entries) suggest that the SEX variable does not appear to have a significant effect on the weight variable, making it possible to develop a general equation representing both sexes combined.

The MONTH variable appears to have a moderate but significant effect on the weight variable. Therefore it would be advisable to formulate quarterly equations in future analyses.

Table 4 shows the results of the regressions obtained for the different analyses carried out for sex and combined sexes.

The following constants were obtained for the equation RW= A*(LJFL)**B for the two sexes combined:

M+H+I A= 8.90493 E-07 B= 3.554738 R-square= .9758
UB95%= 3.58933
LB95%= 3.52007

Later, in order to study the distribution of residuals by sex, a new analysis was carried out for males and females separately. Table 4 also shows the results of the constants obtained for each sex.

Residual distribution by sex exhibits, in general, an appropriate pattern. The pattern in males in the month of May is more fitting than in females during this same month, which tend to be positive. In contrast, the residuals for August tend to be negative in both sexes. The behavior of the residuals, which needs further study, might be related to the process of maturation and reproduction of this species in the Mediterranean.

Table 5 presents a comparative list of estimated weights according to some size weight relationships reported (ICCAT, 1990). The relationship obtained here is very similar to the last one carried out with a small number of individuals (MEJUTO et al. 1988) and differs considerably from the estimated values of RW based on the equation traditionally used by the ICCAT (DEMETRIO, 1987), asuming the conversion factor to be RW = GW*1.12.

ACKNOWLEDGEMENTS

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ANALISIS PRELIMINAR LJFL->RW, AREA:MED, FLOTA:LL, ESPAÑA.

SEXO : (M+F+I) M=1 , F=2 , I=9

TABLE OF MES BY SEXO

MES	SEXO			
Frequency	1	2	9	Total
1	42	36	3	81
2	4	14	0	18
3	44	42	26	112
4	23	31	37	91
5	37	50	37	124
6	27	17	0	44
7	21	16	17	54
8	55	59	45	159
9	48	47	2	97
10	30	26	1	57
11	51	53	0	104
12	16	21	28	65
Total	398	412	196	1006

Table 1.- Number of observations by month and sex used in the analyses. Sex 1 = male, Sex 2 = female, Sex 9 = indet.

** PROCESO DE MEDIAS, RANGOS, ETC. **
8:45 Monday, August 31, 1992

MES	N Obs	Variable	N	Minimum	Maximum	Mean	Std Dev
1	81	TALLA	81	82.0000000	166.0000000	123.9876543	20.7216637
		PESO	81	6.1200000	66.0000000	27.4403704	15.4955070
2	18	TALLA	18	115.0000000	178.0000000	144.7777778	18.3929512
		PESO	18	25.4000000	76.4000000	45.1888889	15.6871581
3	112	TALLA	112	67.0000000	191.0000000	117.1607143	28.7071431
		PESO	112	2.7500000	103.8000000	26.5358036	21.0245012
4	91	TALLA	91	62.0000000	162.0000000	100.1208791	23.4931835
		PESO	91	3.0300000	48.4000000	15.2626374	12.2448007
5	124	TALLA	124	70.0000000	229.0000000	124.1854839	43.0088603
		PESO	124	3.2000000	255.0000000	42.2254032	53.8441477
6	44	TALLA	44	88.0000000	237.0000000	130.0227273	32.3264516
		PESO	44	9.1000000	209.8000000	39.4418182	39.0486473
7	54	TALLA	54	74.0000000	179.0000000	108.1111111	23.9312432
		PESO	54	3.5000000	76.8000000	19.8574074	16.2612585
8	159	TALLA	159	74.0000000	193.0000000	116.6226415	24.5933199
		PESO	159	3.3000000	92.6100000	21.5193711	15.9839848
9	97	TALLA	97	78.0000000	178.0000000	119.1649485	22.2428268
		PESO	97	4.7000000	74.3000000	24.1144330	15.5620063
10	57	TALLA	57	111.0000000	180.0000000	141.2807018	12.7709973
		PESO	57	16.5000000	78.5000000	40.9736842	12.0289016
11	104	TALLA	104	90.0000000	163.0000000	119.9134615	16.2797811
		PESO	104	8.2000000	65.4000000	24.3000000	12.1998568
12	65	TALLA	65	64.0000000	155.0000000	108.5076923	31.6643150
		PESO	65	1.7000000	50.0000000	20.9676923	16.1445919

SEXO	N Obs	Variable	N	Minimum	Maximum	Mean	Std Dev
1	398	TALLA	398	83.0000000	226.0000000	123.9045226	20.9683242
		PESO	398	5.8000000	255.0000000	28.6298995	23.8085303
2	412	TALLA	412	86.0000000	237.0000000	131.6868932	25.8206715
		PESO	412	6.8000000	209.8000000	36.1356553	29.1706228
9	196	TALLA	196	62.0000000	146.0000000	81.3775510	11.0514093
		PESO	196	1.7000000	45.2000000	5.8385714	4.8369746

Table 2.- Number of observations, range, mean values and standard deviation of the variables analyzed, by month and sex respectively.

*** PROCESO GLM PARA VALORAR EFECTOS ***
8:55 Tuesday, September 1, 1992

General Linear Models Procedure

Dependent Variable: LPESO

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	13	306.54527699	23.58040592	1433.03	0.0
Error	796	13.09811138	0.01645491		
Corrected Total	809	319.64338837			

R-Square	C.V.	Root MSE	LPESO Mean
0.959023	3.929568	0.1282767	3.26439728

Source	DF	Type I SS	Mean Square	F Value	Pr > F
LYALLA	1	304.23955278	304.23955278	18489.28	0.0
MES	11	2.30040244	0.20912749	12.71	0.0001
SEXO	1	0.00532178	0.00532178	0.32	0.5697

Source	DF	Type II SS	Mean Square	F Value	Pr > F
LYALLA	1	253.24030166	253.24030166	15389.95	0.0
MES	11	2.29872641	0.20897513	12.70	0.0001
SEXO	1	0.00532178	0.00532178	0.32	0.5697

Source	DF	Type III SS	Mean Square	F Value	Pr > F
LYALLA	1	253.24030166	253.24030166	15389.95	0.0
MES	11	2.29872641	0.20897513	12.70	0.0001
SEXO	1	0.00532178	0.00532178	0.32	0.5697

Table 3.- GLM results of the effect of size, month and sex on weight.

** PROCESO REGRESSION LJFL->NW **
8:45 Monday, August 31, 1992

Model: MODEL1
Dependent Variable: LPESO ♂+♀

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Prob>F
Model	1	754.41454	754.41454	40462.494	0.0000
Error	1004	18.71936	0.01864		
C Total	1005	773.13390			

Root MSE	0.13655	R-square	0.9758
Dep Mean	2.94728	Adj R-sq	0.9758
C.V.	4.63295		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	T for H0: Parameter=0	Prob > |T|
INTERCEP	1	-13.931491	0.08402051	-165.811	0.0000
LYALLA	1	3.554738	0.01767182	201.153	0.0000

Model: MODEL1
Dependent Variable: LPESO ♂

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Prob>F
Model	1	122.71420	122.71420	6433.936	0.0001
Error	396	7.55289	0.01907		
C Total	397	130.26709			

Root MSE	0.13810	R-square	0.9420
Dep Mean	3.17010	Adj R-sq	0.9419
C.V.	4.35649		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	T for H0: Parameter=0	Prob > |T|
INTERCEP	1	-13.329695	0.20581922	-64.764	0.0001
LYALLA	1	3.433080	0.04280017	80.212	0.0001

Model: MODEL1
Dependent Variable: LPESO ♀

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Prob>F
Model	1	174.57632	174.57632	9127.355	0.0001
Error	410	7.84195	0.01913		
C Total	411	182.41828			

Root MSE	0.13830	R-square	0.9570
Dep Mean	3.35569	Adj R-sq	0.9569
C.V.	4.12158		

Parameter Estimates

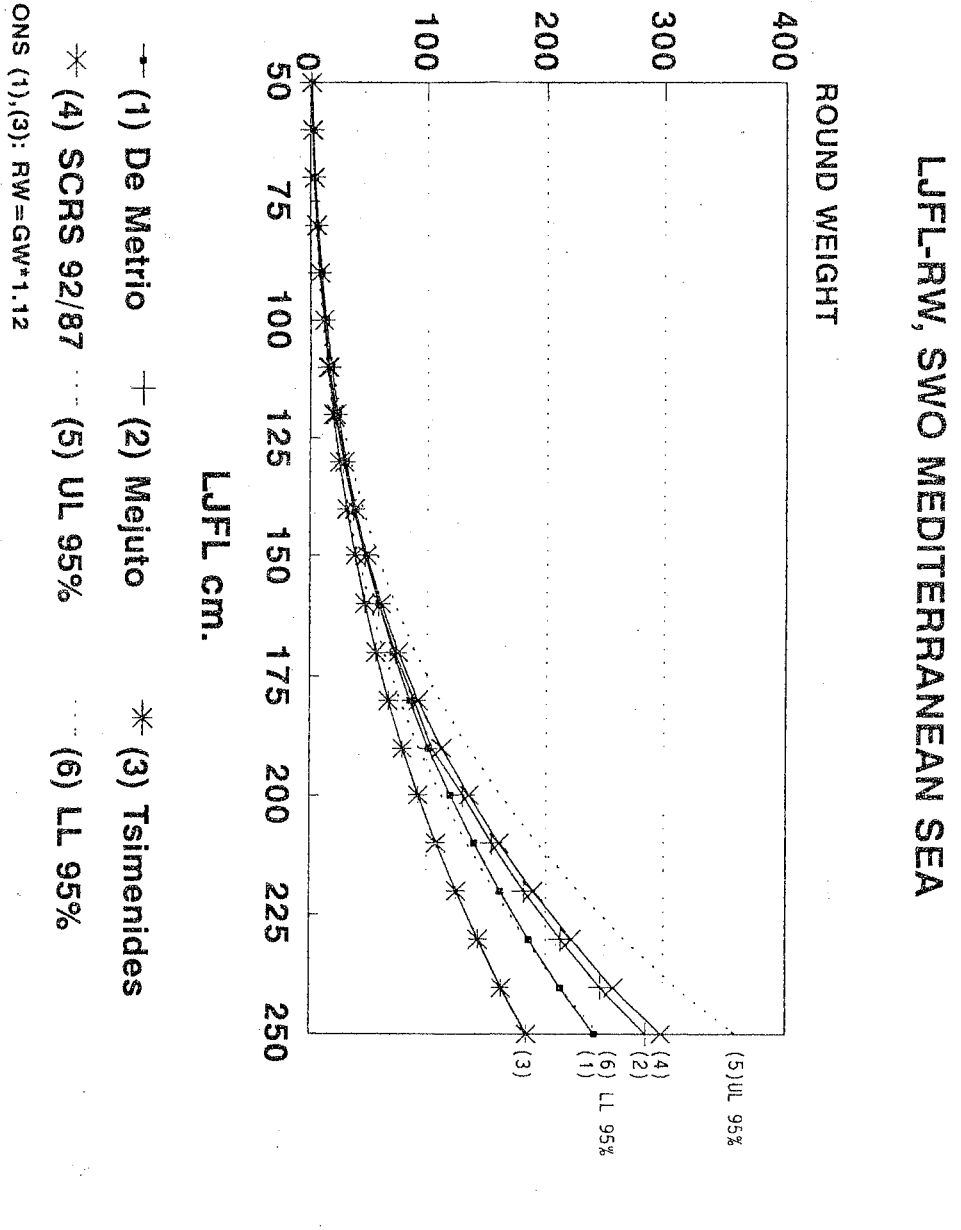
Variable	DF	Parameter Estimate	Standard Error	T for H0: Parameter=0	Prob > |T|
INTERCEP	1	-13.248644	0.17393811	-76.172	0.0001
LYALLA	1	3.415063	0.03574590	95.537	0.0001

Table 4.- Results of the regression analyses obtained by sex and the sexes combined.

(1) GW A= 5.701 E-06 B=3.16 (De Metrio, 1987). RW= GW*1.12
(2) RW A= 9.617 E-07 B=3.533 (Mejuto et al.1988).
(3) GW A= 7.504 E-06 B=3.06 (Tsimenides & Tserpes, 1989).
RW=GW*1.12
(4) RW A= 8.905 E-07 B=3.555 (actual).
(5) RW UL 95% (3) B=3.589
(6) RW LL 95% (3) B=3.520

LJFL	(1)	(2)	(3)	(4)	(5)	(6)
50	1.49	.97	1.33	.98	1.12	.85
60	2.65	1.84	2.33	1.87	2.15	1.62
70	4.32	3.17	3.74	3.23	3.73	2.78
80	6.59	5.09	5.62	5.19	6.03	4.45
90	9.56	7.72	8.06	7.89	9.21	6.74
100	13.34	11.19	11.53	11.47	13.43	9.77
110	18.03	15.68	14.90	16.10	18.92	13.67
120	23.73	21.32	19.44	21.93	25.85	18.56
130	30.56	28.29	24.85	29.15	34.46	24.59
140	38.63	36.75	31.17	37.94	44.96	31.93
150	48.04	46.90	38.50	48.49	57.59	40.70
160	58.91	58.91	46.90	60.99	72.60	51.08
170	71.35	72.98	56.46	75.66	90.25	63.24
180	85.47	89.31	67.25	92.71	110.80	77.33
190	101.40	104.11	79.35	112.36	134.53	93.54
200	119.24	129.59	92.84	134.83	161.72	112.05
210	139.12	153.97	107.80	160.37	192.68	133.04
220	161.15	181.48	124.28	189.21	227.70	156.72
230	185.45	212.34	142.39	221.60	267.08	183.26
240	212.15	246.79	162.19	257.80	311.17	212.88
250	241.36	285.08	183.77	298.06	360.27	245.78

Table 5.- Estimated round weight for different length-weight relationships.



** PROCESO REGRESSION LJFL->RW ** 11
8:45 Monday, August 31, 1992

FREQUENCY OF STUD1 GROUPED BY MES

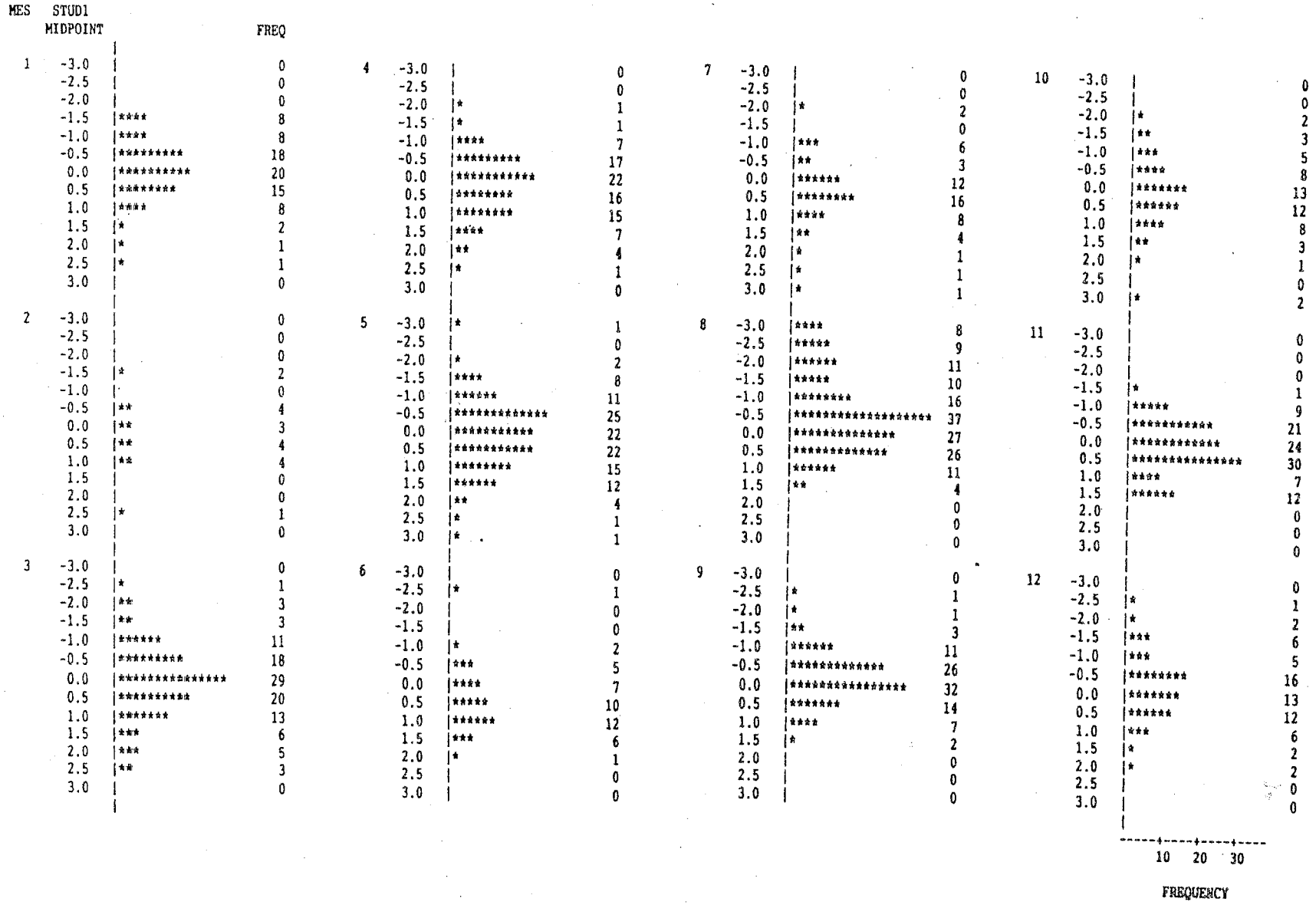


Figure 1.- Histograms (%) of residuals by month.