BIOLOGICAL PARAMETERS OF BULLET TUNA (*AUXIS ROCHEI*) OBSERVED IN THE SPANISH MEDITERRANEAN FISHERIES

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SUMMARY

Length- weight relationships, sex- ratio by length class and montly trend of gonadosomatic index by length class and sex are reported on this document. Furthermore, it is submitted a growth curve based on modal progression analysis. Present study was financed by EU through project DG-XIV- 96/093.

RÉSUMÉ

Le présent document décrit les rapports longueur-poids, le sex-ratio par classe de taille et la tendance mensuelle de l'indice gonadosomatique par classe de taille et par sexe. Il fournit, en outre, une courbe de croissance basée sur l'analyse de la progression modale. L'étude actuelle a été financée par l'UE par le biais du projet DG-XIV-96/093.

RESUMEN

Se presentan relaciones biométricas de talla-peso, sex-ratio por clase de talla y evolución mensual de los índices gonadosomáticos por clase de talla y sexo. Asimismo, se presenta una curva de crecimiento basada en análisis de progresión modal. El presente trabajo ha sido financiado por la UE a través del proyecto DG-XIV- 96/093

KEYWORDS

Biometrics, Sex ratio, Growth curves, Small tuna

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1. Material and methods

1.1 Basic data

Sampling for size composition was carried out both on board the purse seiners targetting clupeoids in the Mediterranean Sea and in the landing ports covered by the Spanish National Sampling and Information Network. Sampling for studies on biology of reproduction was carried out at the laboratory. For each sampled fish it was recorded data on fishing date, landing port, furcal length (mm), whole weight (g), dressed weight (g), sex and gonad weight (mg).

1.2 Model and specifications

All the biometric relationships in this study were computed following Le Cren's allometric growth equation:

$RW \text{ (or } DW) = a \times FL^{b}$ (Le Cren 1951)

where:

RW = round weight (g); DW = dressed weight (g)
FL = furcal length (cm)

Modal progression analysis was based on length frequency distribution of individuals. Two methods were used in order to decompose length- frequency distribution into age- groups: Bhattacharya´s method (Bhattacharya 1967) and Separation of Normally distributed components- NORMSEP- (Pauly and Caddy 1985). Results from the Bhattacharya´s decomposition were used, in order to refine final result, as initial estimates for NORMSEP (decomposition into age- groups is based on maximum likelihood theory and it is need the expected number of groups in the length frequency distribution as well as previous estimates for each group mean length). Once the mean length and standard deviation for each group was identified, the growth parameters of a von Bertalanffy Growth function - supposing 1st of June as the average birth date for Mediterranean bullet tuna (Bök and Oray 2000) - were estimated.

2. Results

Table 1 and **Figure 1** show the results for the following relationships: round weight (RW g) - furcal length (FL cm), dressed weight (DW g)– furcal length (FL cm) and round weight (RW g)- dressed weight (DW g). The furcal length- round weight relationship was compared to those previously computed by other authors for the same species (Ramos & Alot 1985, Rodríguez Roda 1966 and Yasui 1975). Results are presented in **Figure 2** and it must be noted that no major differences were dectected.

Table 2 and **Figure 3** show mean gonadosomatic index (GSI) by length- class and sex for the months of May, June, July and September. It must be noted that for all the months analyzed the GSI trend is higher for males as compared to females.

Table 3 and **Figure 4** show sex-ratio (proportion of females) by length-class. The obtained values ranged between 0.33 and 0.57. In order to study possible sources for the variation observed in the sex- ratio, a GLM (general linear modelling, Mc Cullagh and Nelder 1989) approach was carried out. Response variable was proportion of females and the model included length- class as explanatory factor. It was assumed a binomial error for the model. **Table 4** shows the results for the fitted model. Based on the results it can be concluded that length- class is not statistically significant.

Table 5 shows parameter estimates, standard errors and t-values for the adjusted von Bertalanffy Growth Curve as well as model goodness of fit statistics. **Figure 5** represents the observed mean length for each age group as well as the predicted means by the von Bertalanffy growth curve.

3. Literature cited

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Table 1. Biometric relationships for bullet tuna (*Auxis rochei*).

log(weight) ~ log(length)

Coefficients:

	Value	Std. Error	t value	Pr(>|t|)
Intercept	-6.1275	0.0545	-112.5032	0.0000
log(length)	3.5614	0.0155	229.2154	0.0000

Residual standard error: 0.08137 on 1062 degrees of freedom
Multiple R-Squared: 0.9802
F-statistic: 52540 on 1 and 1062 degrees of freedom, the p-value is 0

log(dressed_weight) ~ log(length)

Coefficients:

	Value	Std. Error	t value	Pr(>|t|)
Intercept	-5.5116	0.1992	-27.6688	0.0000
log(length)	3.3662	0.0553	60.8654	0.0000

Residual standard error: 0.06808 on 156 degrees of freedom
Multiple R-Squared: 0.9596
F-statistic: 3705 on 1 and 156 degrees of freedom, the p-value is 0

log(weight) ~ log(dressed_weight)*, data = splus3,*

Coefficients:

	Value	Std. Error	t value	Pr(>|t|)
Intercept	-0.2114	0.0741	-2.8538	0.0049
log(dress_wt)	1.0526	0.0112	94.0094	0.0000

Residual standard error: 0.04736 on 156 degrees of freedom
Multiple R-Squared: 0.9827
F-statistic: 8838 on 1 and 156 degrees of freedom, the p-value is 0

Table 2. Bullet tuna (*A. rochei*) mean GSI by length class and sex.

	May		June		July		September	
	males	females	males	females	males	females	males	females
Length- class	*mean IGS*		*mean IGS*		*mean IGS*		*mean IGS*	
31	7.30		10.30				6.30	
32	5.11		8.11				4.11	
33	6.63	2.57	9.63	5.57			5.63	1.57
34	5.56	3.08	8.56	6.08			4.56	2.08
35	6.29	2.15	9.29	5.15			5.29	1.15
36	5.67	2.99	8.67	5.99	10.20	6.22	6.20	3.22
37	5.17				9.17	7.30	6.17	4.30
38	4.67		7.67		8.75	7.64	5.75	4.64
39	5.50				9.71	7.34	6.71	4.34
40	5.91				9.20	5.66	6.20	2.66
41	6.32		9.32		9.35	6.48	6.35	3.48
42	5.30		8.30		8.70	7.30	5.70	4.30
43					7.19	7.42	4.19	4.42
44					9.96		6.96	

Table 3. Bullet tuna (*A. rochei*) sex-ratio by length class and sex.

Length- class	males	females	sex- ratio
32	2	1	0.33
33	8	12	0.60
34	73	74	0.50
35	70	46	0.40
36	10	12	0.55
37	71	70	0.50
38	16	9	0.36
39	30	20	0.40
40	3	4	0.57
41	11	10	0.48
42	2	1	0.33
43	5	3	0.38
44	1	1	0.50

Table 4. GLM results. Sex- ratio by length-class.

fit2.glm<- glm(resp~ length, family=binomial)
summary(fit2.glm)

Coefficients:

	Value	Std. Error	t value
(Intercept)	-5.108256e-001	0.7302967	-6.994768e-001
length33	8.964881e-001	0.7950829	1.127540e+000
length34	5.449586e-001	0.7395871	7.368417e-001
length35	9.466523e-002	0.7424137	1.275101e-001
length36	6.851790e-001	0.7880053	8.695107e-001
length37	4.967409e-001	0.7398773	6.713828e-001
length38	-4.124296e-002	0.7850273	-5.253697e-002
length39	1.135238e-001	0.7577050	1.498259e-001
length40	7.621401e-001	0.8873001	8.589428e-001
length41	4.198538e-001	0.7902092	5.313199e-001
length42	7.407082e-016	1.0327955	7.171877e-016
length43	5.884050e-002	0.8758422	6.718163e-002
length44	5.108256e-001	1.0954451	4.663179e-001

(Dispersion Parameter for Binomial family taken to be 1)

Null Deviance: 17.15829 on 25 degrees of freedom
Residual Deviance: 0.1312185 on 13 degrees of freedom

Analysis of Deviance Table
(Binomial model)
Terms added sequentially (first to last)

	Df	Deviance	Resid. Df	Resid. Dev	Pr(Chi)
NULL	25	17.15829			
Length_Class	12	17.02708	13	0.13122	0.1485817

Table 5. Results for Von Bertalanffy growth curve.

Nonlinear Regression Model

Formula: Length ~ LINF * (1 - exp(- K * (Age_rel – t0))

Parameters:

	Value	Std. Error	t value
LINF	731.999	1458.69000	0.501819
K	0.447	1.85098	0.241367
t0	-1.020	1.95055	-0.523009

Residual standard error: 7.84606 on 4 degrees of freedom

Correlation of Parameter Estimates:

	LINF	K
K	-0.411	
T0	-0.995	0.998

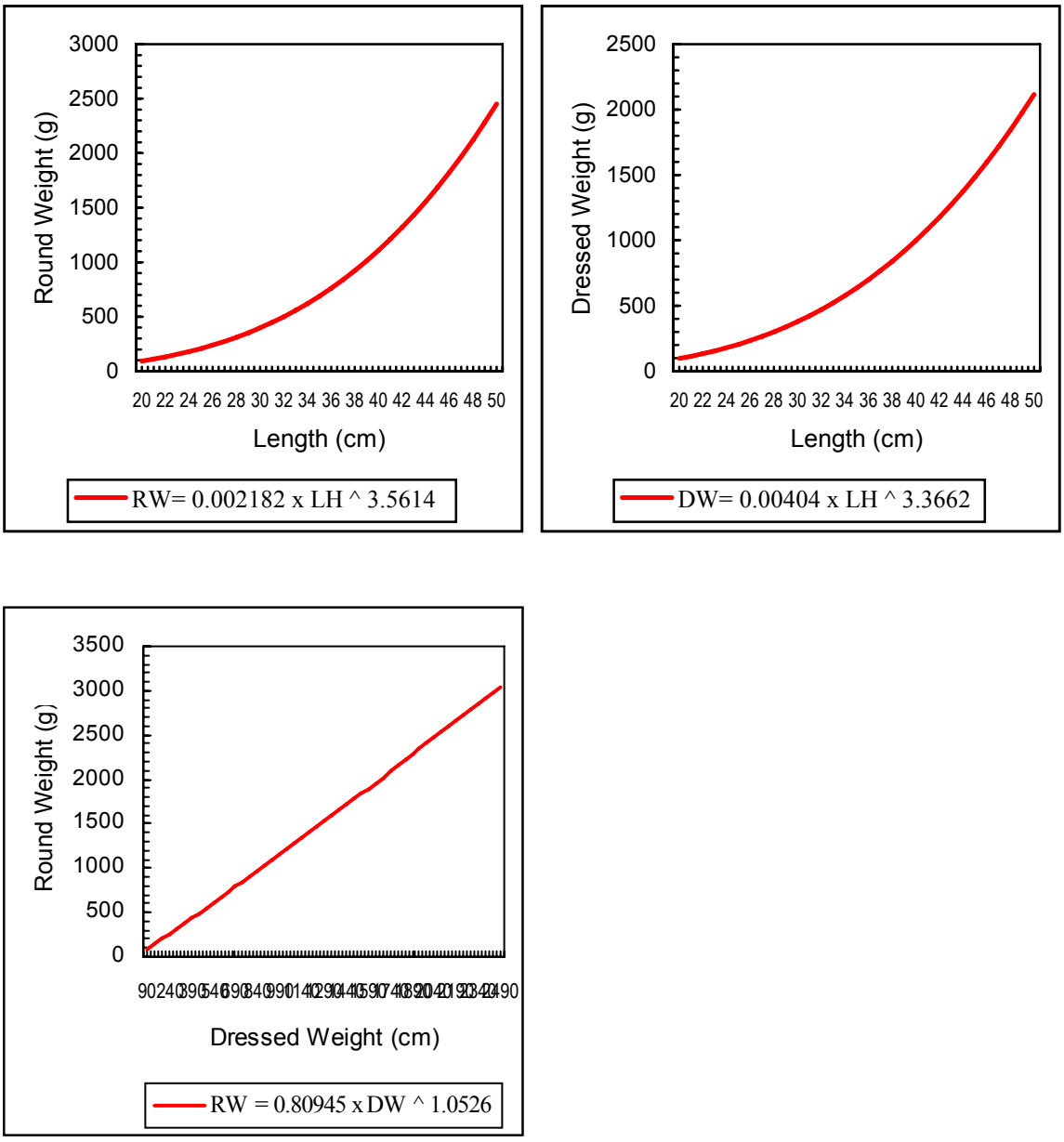
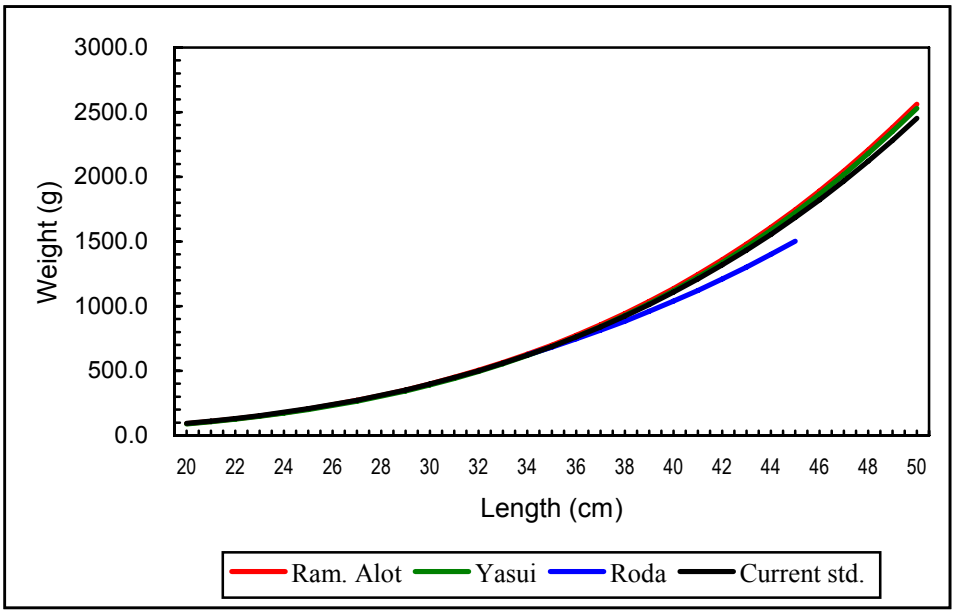


Figure 1. Length- weight relationships for bullet tuna (*Auxis rochei*).



Author	***N***	***a***	***b***
Ramos & Alot 1985	515	1.66000E-03	3.64257
Rodríguez- Roda 1966	744	1.00538E-05	3.12987
Yasyi 1975	not available	1.549E-03	3.65705
Current study	1064	0.002182	3.56144

Figure 2. Length- weight relationships for various authors.

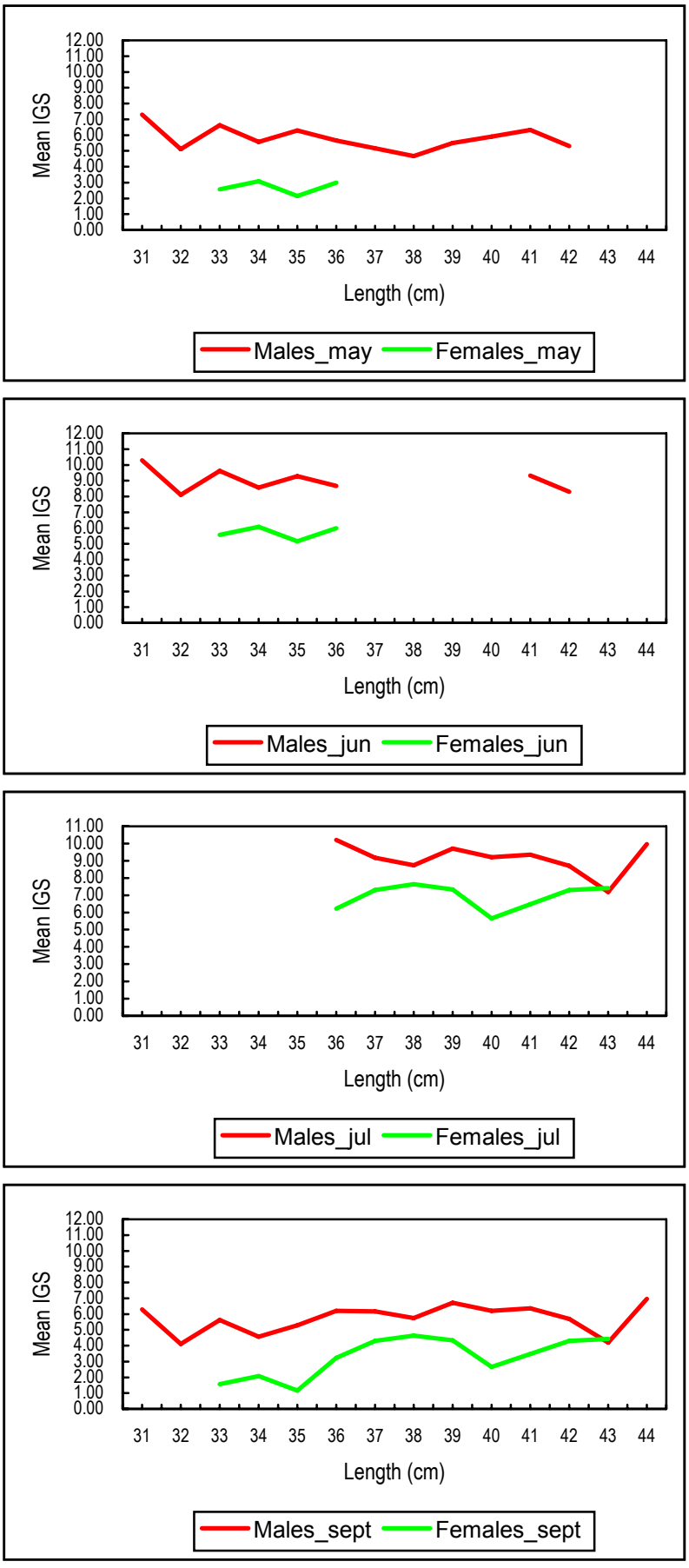


Figure 3. Mean IGS by month and length- class (Auxis rochei).

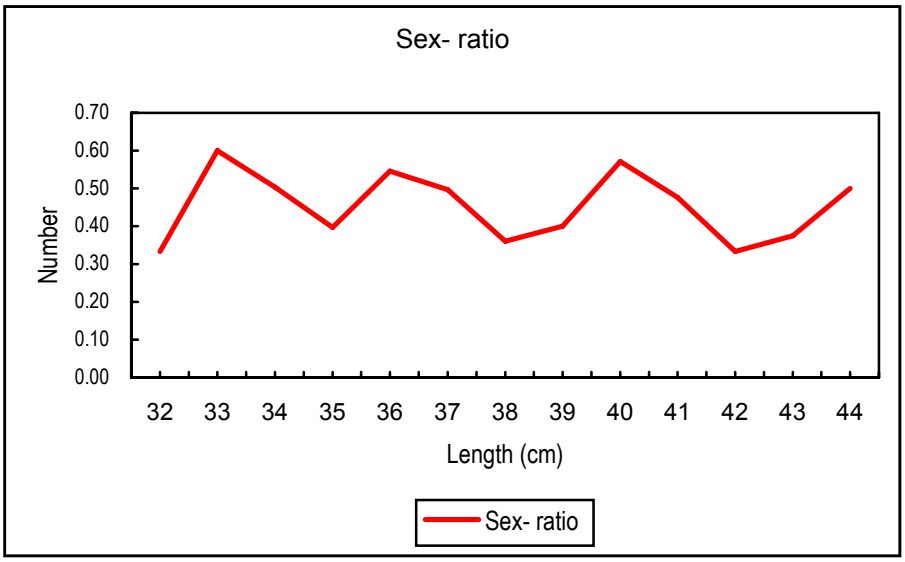


Figure 4. Sex ratio (proportions of females) by length- class.

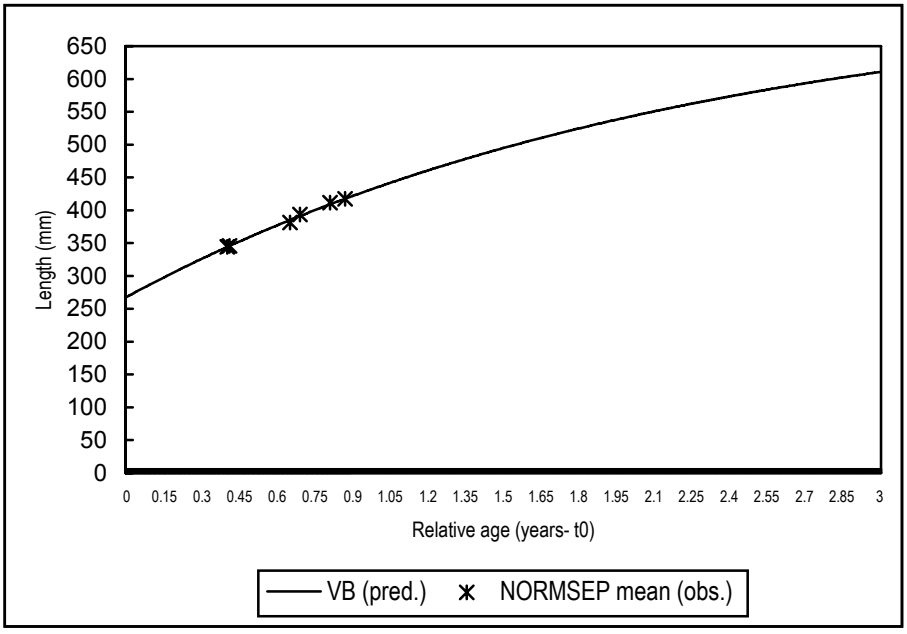


Figure 5. Adjusted von Bertalanffy growth curve.