THE FECUNDITY-AGE RELATIONSHIP OF THE SARDINE, *SARDINA PILCHARDUS* (WALB.), IN THE CENTRAL ADRIATIC

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This paper discusses the relation between fecundity and age of sardine from Kaštela Bay at the time they reach the peak of their sexual maturity in November and December 1979 and 1980. This relation is expressed by the formula $F = 7\ 237.785\ A^{1.015}$

Dans ce travail on analyse le rapport de la fécondité et de l'âge de la sardine capturée dans la Baie de Kaštela lors du maximum de sa maturité sexuelle, en novembre et décembre 1979 et 1980. La relation est exprimée par la formule $F = 7\ 237.785\ A^{1.015}$.

Fecundity is a very important factor in assessing the stock size population. The data on fecundity of sardine *Sardina pilchardus* (WALB.) are very scarce. Moreover, there is no data at all on the fecundity of sardine in the Adriatic Sea. Because of that and with respect to a considerable interest of Yugoslav commercial fisheries for this species, we have carried out a study of sardine fecundity.

Four samples with total of 150 specimens of sardine from the commercial catches of the Kaštela Bay were analysed. Only female specimens with ovaries showing the maturity stage just prior to spawning were used (stages V and VI). Ovaries were preserved in modified Gilson's fluid (SIMPSON, 1951) and the number of oocytes determined using volumetric method. Alizarine stained otoliths were used for age determination.

For the relation between fecundity and the age of sardine the equation $F = 7\ 237.785\ A^{1.015}$ was applied where F is absolute fecundity and A is age. The correlation coefficient between fecundity and the age of sardine is highly significant, as well as the

coefficient of determination ($r = 0.991$; $r^2 = 0.982$; $P < 0.001$) which points to a very close connection between fecundity and the age of sardine. Absolute fecundity to age correlation gave a regression coefficient of 1.015 with lower and upper standard error limits of 0.777 and 1.2524, what means that fecundity increases approximately linearly with age.

In studying North Sea herring and shad, HICKLING (1940) and LEHMAN (1953) respectively found an almost linear relation between fecundity and age of these species, too. Linear relation between absolute fecundity and age has also been recorded in Pacific sardine (Mc GREGOR, 1957) as well as in sprat (DE SILVA, 1973). It is possible that fecundity bears a linear relationship to age in a short lived species.

The relation between relative fecundity and age of sardine has also been studied. This relation is given by the formula $F_r = 710.0132\ A^{0.1380}$ where F_r is relative fecundity and A is age of sardine. It has been noticed that relative fecundity of the lower age sardine suddenly increases (up to the 4th year) to be significantly reduced in the higher age sardine (from 5 to 9). This points to insignificant increase in the number of oocytes at the time of naturally lower weight increment rate of the higher age fish.

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REGIME ALIMENTAIRE DE Boops boops (Linné, 1758) ET DE Sarpa salpa (Linné, 1758), POISSONS TELEOSTEENS SPARIDES DU GOLFE DE TUNIS

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Abstract : The alimentary diet study of Boops boops and Sarpa salpa (Pisces Sparidae) in Tunis bay, revealed that the first, is omnivorous (Diploblastica, Polychaeta, Crustacea and vegetables) and the second, herbivorous (marine phanerogames and seaweeds).

INTRODUCTION :

L'étude des valeurs mensuelles de l'indice moyen de nutrition (I.m.n.)* (PORUMB, 1970), de 415 bogues et de 287 saupes, nous a permis de construire les courbes du rythme alimentaire de ces deux espèces dans le golfe de Tunis. L'analyse qualitative du régime alimentaire a été effectuée par le recensement des espèces-proies et la détermination de leur indice de fréquence (F_p)**.

REGIME ALIMENTAIRE DE Boops boops.

L'analyse des valeurs (Tabl.1) et de la courbe du rythme alimentaire (Fig.1) montre deux phases principales au cours de l'année :

- une première phase pendant laquelle le rythme alimentaire subit une chute importante (I.m.n. = 1,43 en Février ; 0,70 en Mars et 1,59 en Avril). Nous avons constaté que cette période correspond à celle qui précède la ponte (Mai-Juin) chez ce poisson dans le golfe de Tunis (ANATO et KTARI-sous-presse).

- La deuxième phase pendant laquelle le rythme alimentaire augmente sensiblement (I.m.n. = 7,09 en Juillet; 6,54 en Août) correspond à celle de post-ponte et de repos sexuel.

L'étude de la fréquence des proies ingérées montre que la bogue a un régime omnivore à tendance planctonophage ; en effet, nous avons noté : 47,45 % de Diplobastiques (Spongiaires 26,27 % et Cnidaires 21,18 %), 23,73 % de Crustacés et 11,02 % d'Annelides polychètes soit au total 82,20 % de proies d'origine animale.
Les végétaux (17,80%) sont accidentellement ingérés avec les proies animales.

REGIME ALIMENTAIRE DE Sarpa salpa.

L'étude des valeurs (Tabl.1) et de la courbe du rythme alimentaire (Fig.1) montre que ce poisson s'alimente de façon irrégulière au cours de l'année. Nous pouvons, cependant, remarquer que l'indice moyen de nutrition atteint son maximum au cours du mois de Décembre (41,35), ce qui correspond à la post-ponte pour cette espèce dans le golfe de Tunis (ANATO et KTARI-sous-presse).

Les divers éléments du contenu oesophago-stomaco-intestinal et leurs indices de fréquence d'observations respectifs, indiquent que ce poisson est essentiellement herbivore ; en effet, les végétaux constituent dans l'ensemble 92,07 % de l'alimentation de la saupe soit 49,51 % de phanérogames marines (Posidonies, Zostères et Cymodocées) et 42,56 % d'Algues. Les animaux (7,93 %), dont la plupart sont des épibiontes des feuilles de Posidonies (Gastéropodes et Lamellibranches) ou ceux des rhizomes (Polychètes), sont des proies accidentelles.

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* $I.m.n. = \frac{\Sigma(Ep - Ev)}{N} \times 100$ avec Ep :Poids plein de l'estomac, E_v : son poids vide et N:nombre total de poissons étudiés par mois.

** $Fp = \frac{n}{N} \times 100$ avec n : nombre d'estomacs contenant la proie "p" et N : nombre total d'estomacs examinés.

Mois		Janv.	Fev.	Mars	Avril	Mai	Juin	Juil.	Août	Sept.	Oct.	Nov.	Déc.
I.m.n.	Boops boops	5,20	1,43	0,70	1,59	3,27	3,39	7,09	6,54	3,04	2,82	3,06	4,56
	Sarpa salpa	27,25	23	35,53	13,97	16,24	6,34	12,74	6,7	13,72	19,08	16,48	41,35
Effectif	Boops boops	5	77	83	49	26	28	23	28	26	34	18	18
	Sarpa salpa	20	13	17	33	17	35	23	20	43	26	21	19

Tableau 1: Suivi mensuel de l'indice moyen de nutrition (I.m.n.) de Boops boops et de Sarpa salpa.

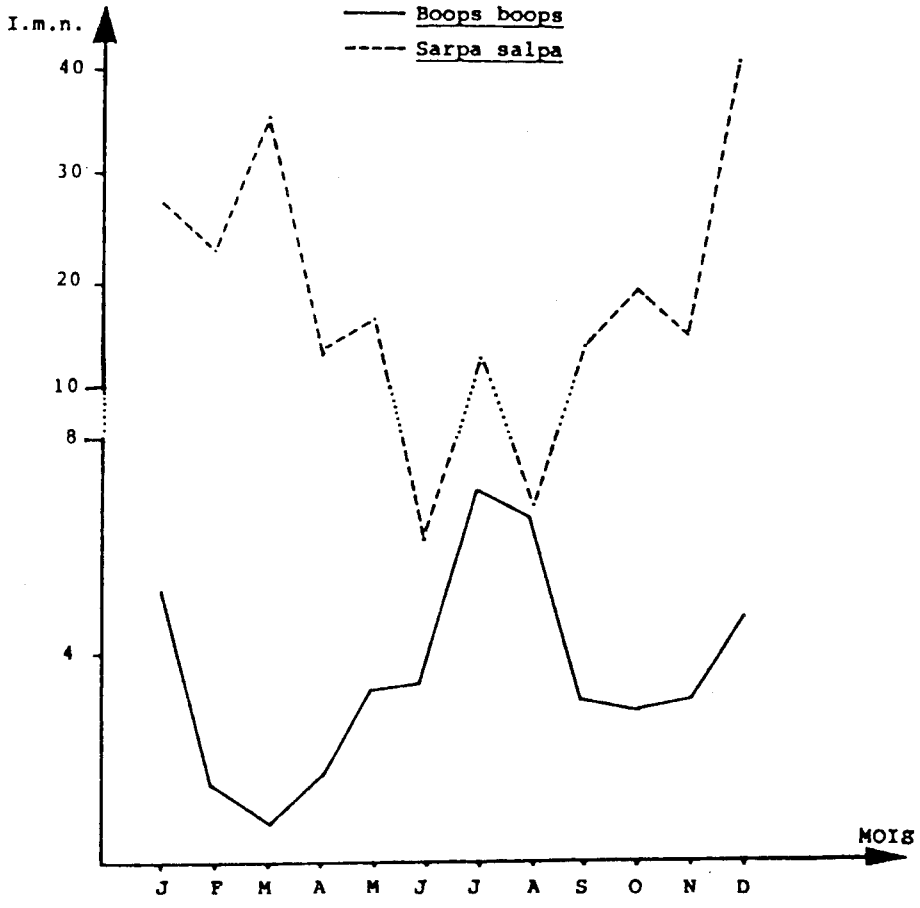

Fig.1: Courbes du rythme alimentaire (R.A.).

ABOUT THE CATCH,THE DIET,THE REPRODUCTION,THE SIZE FREQUENCY AND DISTRIBUTION OF *Pagellus acarne* (RISSO 1826) IN THE STRAITS OF MESSINA AREA.

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SUMMARY-For its importance on the economy of the littoral fishery in the Straits of Messina Area,some features on *Pagellus acarne* biology have been studied.It results to be more abundant in the Tyrrhenian Sea than in the Jonian Sea,its feeding is based on 6 Phyla animals among which fish and crustaceans result more abundant,and the reproduction occurs in June-September period.

RÉSUMÉ-*Pagellus acarne* est une des espèces plus capturée par la petite pêche dans le Detroit de Messine,représentant à elle seule le 21% du poids de la pêche totale.A la suite de travaux intéressant âge et croissance,cette recherche se propose de contribuer à la connaissance des autres aspects biologiques de l'espèce dans la zone.Les données de capture montrent une présence majeure dans les stations Tyrrhéniennes,et une particulièrement les exmplaires de plus grandes dimensions.L'étude du cuntenu de l'estomac révèle dans le régime de l'espèce 6 Phyla animals variables dans les stations mais constants dans les périodes.Des poissons et crustacés constituent la base de l'alimentation.La période reproductive va da jullet à septembre avec une ponte majeure en août et septembre.La sexratio montre 57% de mâle contre 42.5% de femmèles.

INTRODUCTION-*Pagellus acarne* represents one of the most fished species, in the range of the littoral fishery,in the Straits of Messina Area, making up in fact the 21% in weight of the whole catch.

This species was already treated by the Author in two preceeding papers,in which 8 classes of age were identified,and were calculated; the von Bertalanffy's growth equations :

♀ ($L_\infty = 29.78$ $K = 0.3203$ $t_o = -0.2625$), ♂ ($L_\infty = 26.23$ $K = 0.4187$ $t_o = -0.2217$) ;

the size-weight relationship: $W = 0.0092\ TL^{3.076}$;

and the first sexual maturity,which coincident with the 2nd year of age.

At present,it is thought convenient to complete the study on bronze bream treating further features of its biology.

DESCRIPTION OF THE AREA AND METHODS-600 specimens coming from 4 sampling stations in the Straits of Messina Area (fig 1)have been examined. The stations were different among them also for depth and nature of the bottom (Tab I).

The method of catch has been the trammel net for the adult speci-

mens;instead,the young have been sampled with beach seine.

The degree of development of gonads has been fixed on the basis of the scale suggested by FAO manuals.

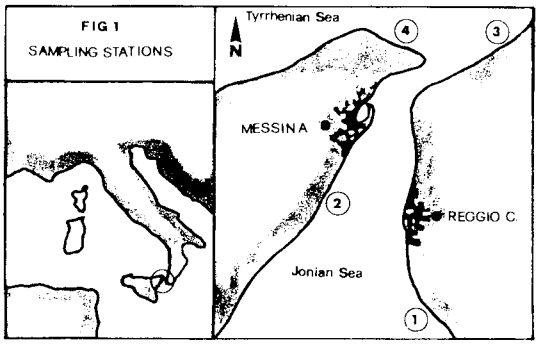
DISTIBUTION OF CATCHES-The effectuated samplings have given variable results either for the sampling stations or for the periods.

These catch differences emerge from the graphs of fig 2 and fig 3 which show as the species is rather mostly present in the Tyrrhenian stations than in the Jonian ones.

FEEDING-The analyses of stomach contents have revealed in the diet of the species the presence of 6 Phyla animals,changeable in the stations but constant in the periods.

The presence of algae (stat 2) confirms the possible vegetarian diet,and strange it appears,instead,the presence of sand in individuals in the same station (Tab II).Among the Crustacea Isopods appear prevailing, among the Echinodermata are prevailing Ophiuridea,and same for Bivalva among the Mollusca.The main basis of their diet is made up of Crustacea and fish .The presence of Echinodermata,Anellida and Coelenterata is instead to be attributed to their abundance in some stations.In fig 4 is synthetized the situation in percentage.

SEXUAL MATURITY AND REPRODUCTION-Notwithstanding reproduction is often influenced by environing conditions,the data got in the several years of samoling have revealed themselves constant:thus the resumntive



STATION	ZONE	DEPTH	BOTTOM NATURE
①	C^PO DELL'ARMI	196–262 ft	detritus–muddy
②	GALATI	262–328 ft	sand–rocky
③	FAVAZZINA	229–328 ft	detritus–muddy
④	CASABIANCA	164–262 ft	mud–sandy

TABLE I : DEPTH AND BOTTOMS IN THE STATIONES

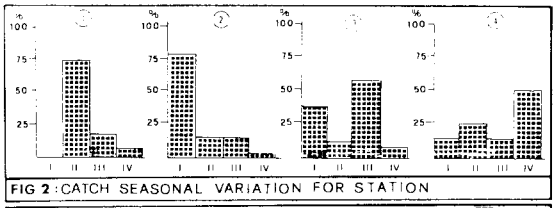


FIG 2 : CATCH SEASONAL VARIATION FOR STATION

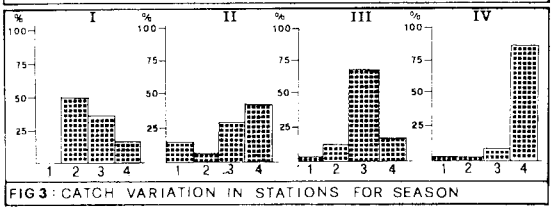


FIG 3 : CATCH VARIATION IN STATIONS FOR SEASON

STATION	①				②				③				④			
FOOD \ PERIOD	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV
SAND						+	+									
ALGAE						+	+	+								
COELENTERATA					20	5										
ANELLIDA	20	15	15	15												
CRUSTACEA	40	45	40	35	40	20	30	25	40	35	20	45	30	30	20	30
MOLLUSCA		5				30	40	40	20	15	15	10	10		10	5
ECHINODERMATA					20	5	20	15			5					
PISCES	40	35	40	50	20	30	10	20	40	50	60	45	60	70	70	65

TABLE II : TABLE OF STOMACH CONTETS IN PERCENTAGE

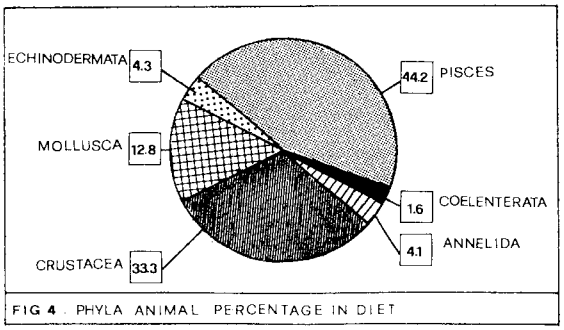


FIG 4 : PHYLA ANIMAL PERCENTAGE IN DIET

Tab III has been set down.

The reproductive period occurs from July to October with a spawning maximum in August and September;however the male seems to be fluent for a longer period.

SEX-RATIO AND SEXUAL DISTRIBUTION FOR SIZE AND AGE-The sex-ratio,calculated by the total sampled specimens,states 57.5% of males and as against 42.5% of females.

Considering the protadrycal hermaphroditism to which the species goes towards,and the growth difference between the two sexes,it has been proceeded in the elaboration,in fig 5,in which the percentage composition in length of the two sexes in the 8 classes of age is represented; from this the growth difference and the hermaphroditism condition are pointed out further on.

For the distribution of the sexes for size,instead,separate histiograms are needed,in as much as they vary remarkably with the sampling stations (fig 6).A single graph has no meaning.

This variability is imputable to movings of the individuals during their growth if not to real and proper migrations for size in relation to their several feeding exigences.

MONTH	JAN		APR		MAY		JUN		JULY		AUG		SEP		OCT		DEC	
	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀
I	40	70	32	29	11	6	9	7	8	3	6	2	18	15	31	33	68	89
II	60	30	28	51	33	22	2											
III			19	9	20	49	8	10										
IV			16	11	16	14	48	19	9	14	1							
V			5		18	9	26	53	41	13	9	8						
VI					2		4	11	32	61	52	37	18	14	10			
VII							3		9	6	30	52	53	45	20	20	1	
VIII									1	3	2	1	11	26	39	47	18	4

MATURITY STAGES

TABLE III : ANNUAL PROCEEDING OF GONAD MATURATION (in percentage)

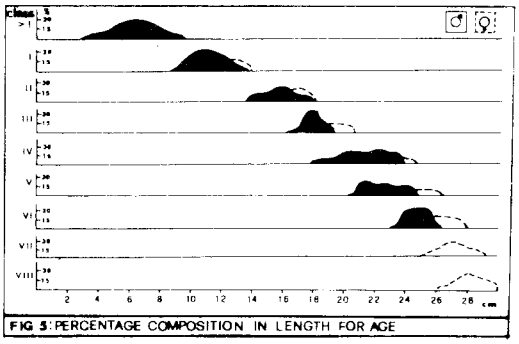


FIG 5: PERCENTAGE COMPOSITION IN LENGTH FOR AGE

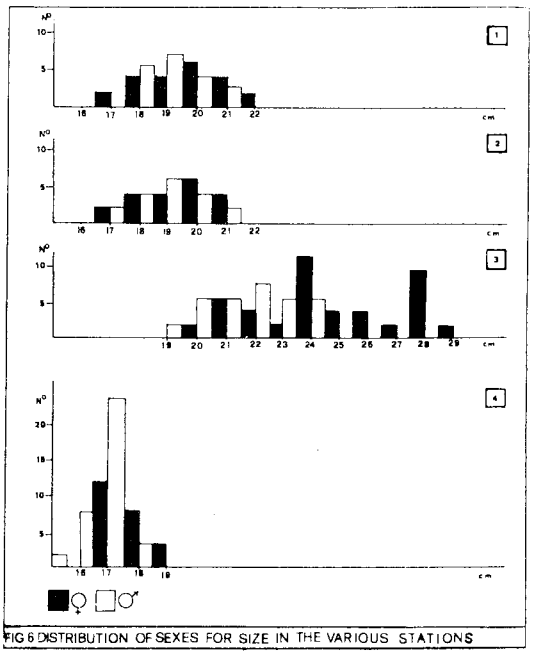


FIG 6 DISTRIBUTION OF SEXES FOR SIZE IN THE VARIOUS STATIONS