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Fish biology

THE BRONZE BREAM - *PAGELLUS ACARNE* (RISSE) FROM NORTH-  
WEST AFRICAN REGION

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Subject of this work, are the studies on morphological characters, length, age and rate of growth, age composition, reproduction and feeding of *Pagellus acarne* (Risso). It had been ascertained that, in regions investigated (Cap Blanc and Rio de Oro), this species forms at least two separate local stocks which among other features, differ in morphological characters and in rate of growth, in condition and in period of sex changing (hermaphroditism).

INTRODUCTION

Among the bottom fish of North-West African region, considerable part is represented by species belonging to family of Bream (*Sparidae*). An important part of this family represent the Bronze Bream *Pagellus acarne*. Northern boundary of their appearance at Eastern Atlantic are the British Isles. No data is available on their appearance southward of Equator. The genus *Pagellus* plays considerable part in economics. Annual catches of *Pagellus acarne* obtained by Portugal during the years 1964-1966 amounted to more or less 7.000 tons (F.A.O., 1968). French catches of *Pagellus centrodonatus* in 1967 exceeded 6.000 tons (Gueguen, 1969). The biology of genus *Pagellus* has not been yet well recognized. Studies performed on these fishes related mainly to systematics, e.g. Coupé (1952, 1954), or to biology e.g. Alekseev (1969) and Skornjakov (1963 and b, 1969). Only Gueguen (1969) had carried-out relatively wide investigations on *Pagellus centrodonatus* (Delaroche) from Biscay Bay.

This work may contribute towards the studies on biology of species *Pagellus acarne* (Risso), an appearance of which is considerably frequent on waters of North-West African shelf between 16° N to 24° N.

## MATERIAL AND METHODS

The materials for this work had been collected between 5. December 1968 and 27. February 1970 at North-West African coast in region extending from Dakar to Rio de Oro. Partly, the fish had been taken at port from landings of several ships of type B-23 (Table 1).

Table 1

Number of examined fishes and analysis performed

Analysis	Number of fishes
Measurements of:	
Length	2 046
Weight	2 010
Diameter of eye	137
Interorbital distance	142
Preorbital width	139
Examination of stomach content	239
Estimation of stomach filling	1 373
Taking otolithes for determination of age	1 947
Taking gonads for determination of fecundity	22
Estimation of gonads maturity	1 731

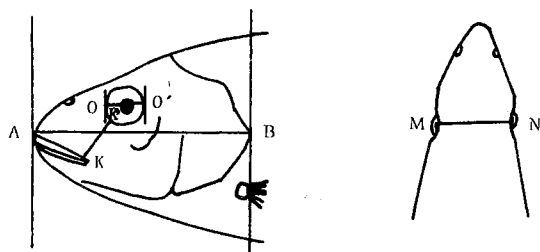


Fig.1. Diagram of morphologic measurements. AB = length of head; KK = pre-orbital width; OO' = diameter of eye; MN = interorbital distance

The length of head, diameter of eye, the interorbital distance and the preorbital width were measured with accuracy of 1 mm (Fig.1). The values obtained were expressed in per-cent of total length. Method of Matsubara (1946) was applied for determination of distribution and differences of the mean arithmetic values. Total length was measured with accuracy of 1 cm, i.e. length class of 20 cm comprised the fish between 20.0 and 20.9

cm. The age was determined according to otoliths, and verified according to scales. The scales were collected from vicinity of dorsal fin starting. Determination of age by otoliths is easy at the individuals below 5 years of age. For older examples, this must be verified according to scales. Period of rings formation on otoliths was determined according to formula:

$$K = \frac{R - r_n}{r_n - r_{n-1}} \cdot 100$$

where: R = radius of otolith

$r_n$  = radius of otolith at age n

$r_{n-1}$  = radius of otolith at age n - 1

K = coefficient for otolith edge.

The back readings for rate of growth were effected by application of microscope with micrometer (Fig.2). The stages of gonads were noted according to eight-stage graduation of Maier. The spawning of *P. acarne* is portional. Eggs comprised by gonads vary in diameter. Should, under such circumstances, be applied the weighing method to calculate the quantity of eggs in gonads, due consideration must be given to fact that all the minor eggs shall disappear after drying. Therefore, the weighing and plankton methods were applied simultaneously. Primarily, complete gonad preserved in Gilson liquid was weighed without surrounding membrane, and thenafter were weighed three samples taken from various parts of gonad. The number of eggs in these samples was calculated by plankton method in Kollwitz camera. For investigation of alimentary content, was applied the weighing method and were counted the organisms present in it. The condition of fish was estimated according to Fulton formula:

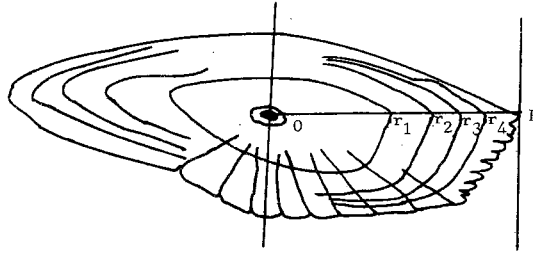


Fig.2. Diagram of otolith measurements.  
Or<sub>1</sub>, Or<sub>2</sub> . . . . OR = otolith radius in particular years of fish life

$$K = \frac{W}{L^3} \cdot 100 ;$$

where: W = weight of fish in g

L = length of fish in cm

K = condition coefficient.

Considered was the weight of fish without internal organs.

#### CHARACTERISTICS OF REGION

The fishing grounds are situated on continental shelf of average width 34 to 40 Nm. Characteristic feature for hydrological conditions of this region is cooling effect of Canary Current, due to which the temperatures of shelf

waters vary very widely. Surficial salinity of shelf waters is high and it oscillates within 35.5-36.7% . In spring, together with growing in this region intensity of passat, starts the upwelling, which reaches its peak in plain summer. Owing to strong activity of upwelling which brings to surface deep waters rich in biogenic salts, the pelagic and plankton organisms have in this region favourable conditions for reproduction. Considerably low air temperatures, mild winds, good visibility, negligible clouding and the suitable configuration of bottom promote the exploitation of these waters. Therefore, these regions are known to be good for pelagic and bottom fishing and are exploited by fishing fleets of various countries.

Highest concentration of *P. acarne* were noted between the parallels of 19°00 and 25°00 N. For the period between 23 XII 1969 to 10 II 1970, yield of *P. acarne* on depth of 50-180 m (in average 107-116 m) amounted to 0.8-9,5 kg/h per haul. This represented 0.1 per-cent of total catches.

### MORPHOLOGICAL CHARACTERISTICS

The body of *P. acarne* is elongated, laterally flattened and covered with ctenoid scale. Head is considerably large. Upper and lower jaws are of even length forming the snouth obtuse-shaped. Front teeth are thin and form a sharp brush. Molar teeth are situated at sides of jaws in 2-3 rows. The eyes are large; diameter of eye can be accommodated 3-4 times in length of head. Dorsal fin (D) XII 9-11. Caudal fin (C) - cut-in. Anal fin (A) - III 9-11. Pectoral fins (P) - elongated, sharply tipped with clear dark brown spots at the base of each. Number of scales on lateral line amounts to 68-72. Back is coloured in blood-red with golden shade; the sides and pelvic slightly lighter in colour with silver shade. Number of rings is constant and amounts to 24.

Table 2

Interorbital distance, diameter of eye and preorbital width expressed in per-cent of total length of *P. acarne*

Morphological character	Region Cap Blanc 18°N - 20°N	Region Rio de Oro 23°N - 24°N
<u>Interorbital distance</u>		
range	6.35 - 8.90	6.35 - 9.10
$\bar{x}$	7.73	7.93
$\sigma$	0.4809	0.4895
n	77	65
<u>Diameter of eye</u>		
range	6.55 - 9.50	7.45 - 9.40
$\bar{x}$	7.73	8.18
$\sigma$	0.6720	0.4499
n	73	64
<u>Preorbital width</u>		
range	3.30 - 5.00	3.75 - 5.10
$\bar{x}$	4.25	4.41
$\sigma$	0.3345	0.3039
n	75	64

Relative diameter of eye, interorbital distance and the preorbital width of fish from Cap Blanc region differ from the same characteristics of fish from Rio de Oro region (Table 2). Statistical analysis proved the essentiality of these differences. This leads to assumption, that within the investigated region. this species forms at least two separate local stocks. More detailed evidence for this assumption shall be discussed in further part of this work.

## LENGTH, AGE AND RATE OF GROWTH

### Length

For fishes caught, the length oscillated between 17-35 cm. The individuals of 21-26 cm in length were dominating. According to Coupé (1952), young bronze breams live in shallow waters and therefore no fish below 17 cm is encountered in catches from regions deeper than 80 m. Comparing with ours the results of Coupé's investigations carried out during 1949-1950 in region of Mauretania, no distinct differences in fish length are noted, in spite of speedy growth in fisheries within this period. This may be explained by the facts, that most fishing ships operate on deep waters below 100 m, while *Pagellus acarne* lives mainly on depth between 40-60 m; coast fishing of African countries is still hardly developed.

Average length of females is larger than of males. It does not mean that the rate of growth in females is higher than in males, but must be assigned to fact that at older age the males are changing into females. This phenomenon shall be discussed further in this work.

Analysing the length of fishes caught in various regions, it had been noted that average length of females from Cap Blanc region amounted to 24.8 cm

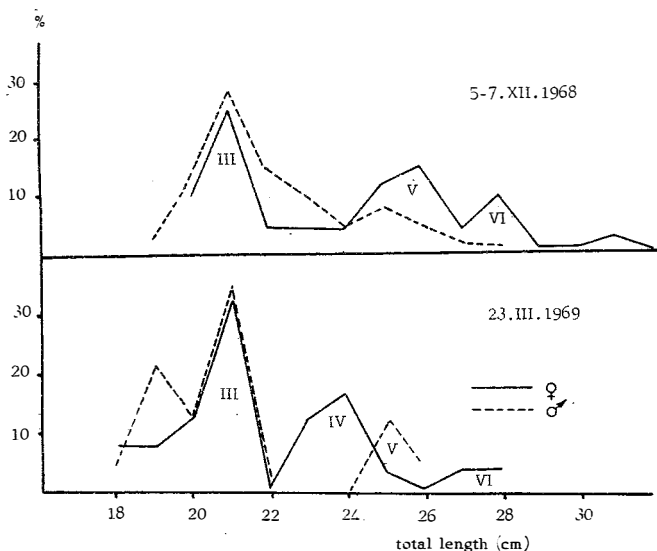


Fig.3. Length distribution curves for *P. acarne*

and of males - 23.2 cm; from Rio de Oro region, females - 23.2 cm and males - 22.4 cm. This proves that average length of fish from Cap Blanc region is by about 1 cm higher than of fish from Rio de Oro region.

The length distribution curves for *P. acarne* from December 1968 and 1969 catches possess several peaks, i.e. in length-class 21; 24-25 and 27-28 cm (Fig.3). In determination of age by otoliths, it is evident that these peaks correspond in sequence to age-groups III, IV, V and VI.

### Formation of rings on otoliths

The formation of rings on otoliths, scales and on other organs of fish from tropical waters presents a problem still hardly known. Skornjakov

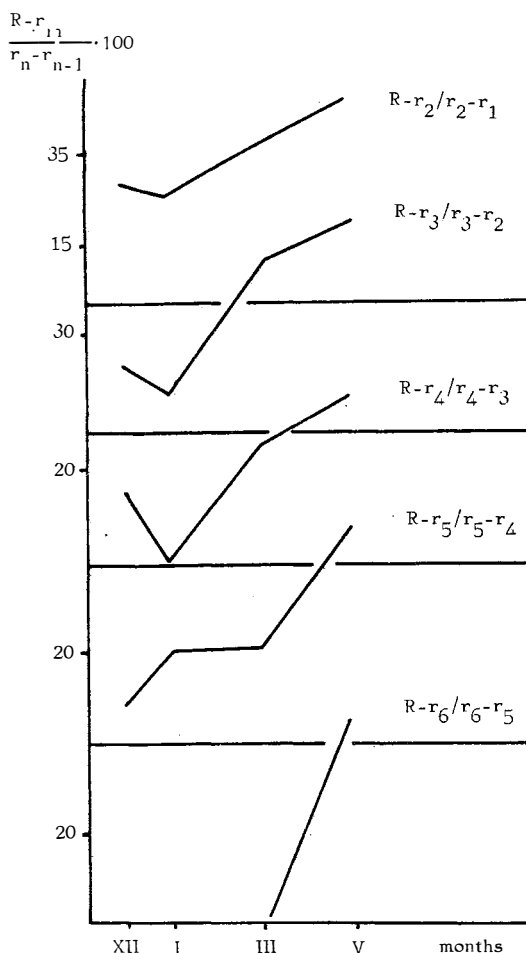


Fig.4. Period of rings formation on otoliths at *P. acarne*

(1963a and 1968) assigns formation of rings at *Pagellus couplei* to rapid changes in salinity of water. He ascertained that on scales of this species from Dakar region, only one ring is forming annually during the period of June to July, i.e. when salinity of water is rapidly decreasing. On scales of *P. couplei* from Takoradi region, two rings are forming in one year, i.e. one in April and May and the second one during December to February, when salinity of water is rapidly increasing.

Lowest values for coefficient of otolith edges at *P. acarne* appear in period of December to February (Fig.4). This period should thus, be considered as a period of rings formation. It is apparent that, the rings are forming earlier at younger fish than at older one. Also, it had been noted that in region investigated, the rings are forming once a year (except for fry ring which appears sometime only). From investigations on *P. couplei* of the same region (Le - Trong Phan and Kompowski, 1971) appears that formation of rings at this species prevails mainly on May. This may raise a question if Skornjakov's hypothesis on influence of salinity changing on rings formation is ju-

stified. Why should the period of rings formation on otoliths of P. acarne and P. coupei be distinctly different, considering that both these species live within the same region?

### Age and mortality

Appearing in stock of P. acarne were 8 age-groups from I to VIII (tab.3).

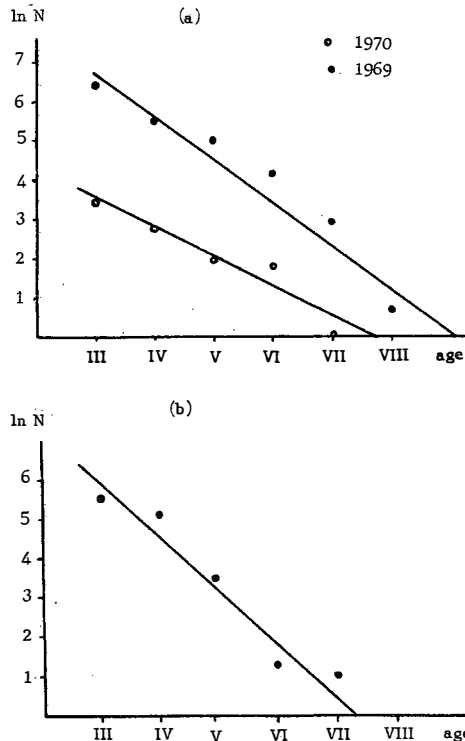
Table 3

Age composition of catches, in per-cent

Region and year	Age group							
	I	II	III	IV	V	VI	VII	VIII
Cap Blanc 1969	0.3	14.1	47.5	20.3	11.5	4.7	1.4	0.2
Cap Blanc 1970	-	8.5	45.5	24.0	11.3	9.8	1.4	-
Rio de Oro 1969	-	16.0	45.5	31.0	5.2	0.7	0.6	-

The exploited stock of P. centrodonatus was composed of 21 age-groups, from II to XXII (Gueguen, 1969). This species is residing mainly at higher geographical latitudes. The species living nearer to equator, such as P. acarne, live shorter. It appears from table 3, that the catches of P. acarne are based primarily on two age-groups, III and IV. Basing on above-presented age composition, total mortality for P. acarne was estimated (Fig.5). For Cap Blanc region, total mortality rate ( $Z = F + M$ ) for years 1969 and 1970 amounted to 1.05 and 0.781, respectively while the total mortality ( $1 - S$ ), to

Fig.5. Estimation of total mortality rate of P. acarne based on age composition of stock in Cap Blanc region, 1969 and 1970 (a) and in Rio de Oro region, 1970 (b)



0.650 and 0.541. For region Rio de Oro, total mortality rate amounted to 1.27 and the total mortality to 0.719.

### Rate of growth

Back calculations for rate of growth of examined fish by method of back reading from otoliths, must be preceded by analysis of interrelation between radius of otolith and length of fish. The results of such analysis indicate that, the relation of otolith longer radius and of fish total length, is similar to straight

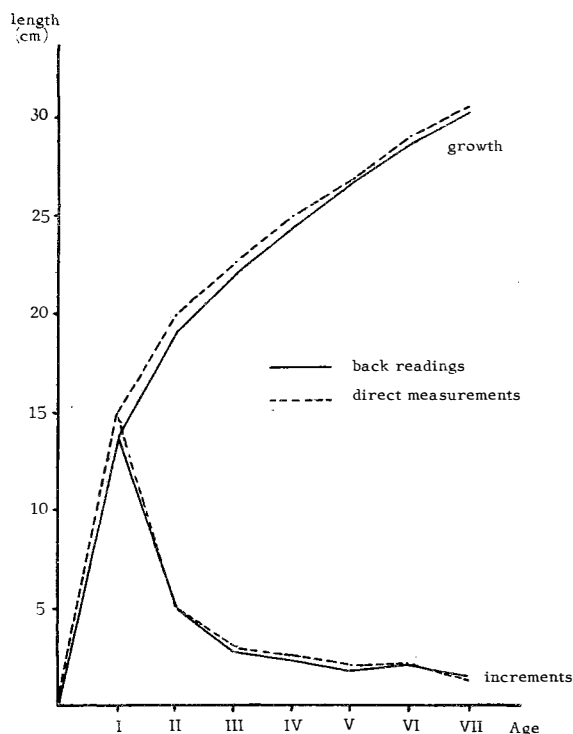


Fig.6. Rate of growth of *P. acarne*

20.0; 22.8; 25.2; 27.0; 29.1 and 31.0 cm. No distinct differences in length obtained by both methods can be noted for any particular age-groups. This confirms that the results may be approved as tenable.

An interrelation between length and weight was determined by least square method, expressed by equation:  $W = 0.0124 L^{3.0865}$ . Applying this equation, weight of fish could be calculated for age-groups from I to VII and it amounts to: 40.0; 103.2; 169.8; 246.4; 324.0; 401.8 and 476.2 g respectively. Contrary to growth of length, the growth of body weight increases during the period from first to sixth year of life.

Basing on rate of growth obtained by back readings, the parameters of von Bertalanffy growth equations were determined and amount to:  $L_{\infty} = 36.0$  cm;  $K = 0.23$ ;  $t_0 = 0.97$  of year (Fig.7).

line which crosses the axis of coordinates arrangement near to zero point. This may be expressed by equation:  $R = 2.196 + 2.786 L$ , where:  $R$  = radius of otolith divisions of eyepiece micrometer and  $L$  = total length of fish. The obtained result justifies an application of direct proportionals for the back readings of growth rate.

For *P. acarne*, the results of such calculations are presented on Fig.6. Average length of fish in age-groups from I to VII amounts respectively to: 13.7; 18.8; 21.9; 24.6; 26.8; 28.9 and 30.5 cm. Annual growth increments decrease from 13.7 cm in first year to 1.6 cm in seventh year of life. Average length for age-groups from II to VII obtained from direct measurements amounts respectively to:



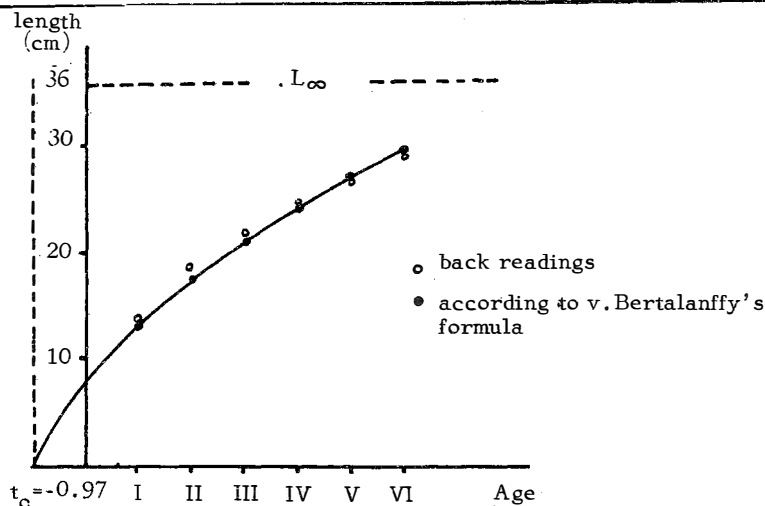


Fig. 7. Curve of growth rate of *P. acarne* obtained according to formula of v. Bertalanffy

#### REPRODUCTION

The *Pagellus* is noted for phenomenon of hermaphroditism. Two types of hermaphroditism of fish are presently recognized, viz.:

- functional, or synchronic
- nonfunctional.

In the gonads of first group are distinguished the testis and ovarian part. Present in the same gonads, are also the maturing spermatozoons and the eggs. Generally, no self-fertilization is taking place at that fish, however it is possible at certain species.

Ovarian and nuclear parts are also distinguished in gonads of second group, but in contrary to first group, both these parts here are not active at the same time.

The genus *Pagellus* may be qualified to the second group; however, such phenomenon may have different occurrence at various species of this genus. At *Pagellus erythrinus* L. (Nikolski, 1965) and at *P. coupei* (Lê-Trong Phâñ and Kompowski, 1972) the ovarian part of gonad (protogynia) is maturing at young age. Such hermaphroditic specimen function as females. At *P. mormyrus* L. (Nikolski, 1965) and at the discussed *P. acarne*, the testis part (protandria) is more developed at young age and such hermaphroditic specimen act primarily as males.

On Fig. 8 are shown the changes in percentage of females and of hermaphroditic specimen<sup>1)</sup> in population of *P. acarne*. In length-class below 17 cm (age 1+), the percentage of "males" amounts to 100. Progressively to growth of fish length, the percentage is decreasing and within the length-class above 29.0 cm, no "males" are noted but entirely the females. It is interesting to note, that a phenomenon of sex change has different nature for both regions discussed. The fish length at which the number of "males" is equal to number

<sup>1)</sup> The hermaphroditic specimen functioning as males shall be further named as "males".

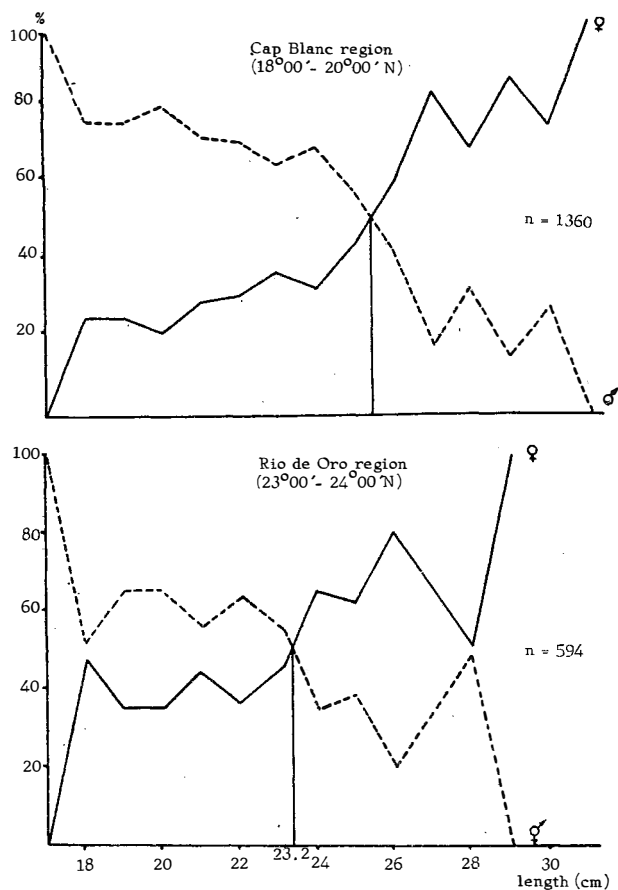


Fig.8. Percentage of changes of females and of hermaphroditic specimen ("males") in particular length-class for years 1968-1969

of females for region Rio de Oro is 23.2 cm and for region Cap Blanc is 25.5 cm. This proves that, the hermaphroditism at Rio de Oro region is taking place earlier than at Cap Blanc region. This supports an assumption that, *P. acarne* forms isolated local stocks in both regions, what already resulted from previous analysis of morphological characteristics. Such assumption complies also with observations effected by Alekseev (1969) for discussed region.

In determining the period of spawning, it is useful to apply the coefficient of maturity.

$$(\text{coefficient of maturity} = \frac{\text{weight of gonads} \cdot 100}{\text{weight of fish}})$$

Average value of this coefficient amounted to: 4.32 in December 1968; 3.49 in January; 1.89 in March; 0.40 in May and 0.96 in September 1969. Highest value of coefficient was noted for December and smallest one for May.

Table 4

Stage of gonads at *Pagellus acarne* in particular months

Month	Sex	Gonad maturity stage (%)								n
		I	II	III	IV	V	VI	VII	VIII	
XII 1968	♀		1,2	8,9	38,0	44,3		7,6		79
	♂		1,2	24,5	20,3	20,3	11,6	21,5	0,6	163
I 1969	♀				47.0	31.0		22.0		32
	♂			18.0	21.5	25.2	6.0	29.3		167
III 1969	♀		1.0			1.0		59.5	38.5	101
	♂		1.0				1.0	51.0	47.0	79
V 1969	♀	1.3	23.0	0.6				2.1	73.0	151
	♂	7.5	84.2	1.7				0.8	5.8	120
IX 1969	♀		28.9	70.2	0.6				0.3	327
	♂	0.2	72.5	26.7				0.4	0.2	431
XII 1969	♀					22.0	78.0			9
	♂				10.0	70.0	20.0			10
I 1970	♀					9.0	82.0	9.0		11
	♂					25.0	75.0			16
II 1970	♀					5.0	42.0	53.0		19
	♂						16.6	83.4		18

The observations on coefficient of maturity and on state of gonads (tab.4) indicate that spawning of *P. acarne* in discussed region is taking place from November till March, with higher concentrations prevailing mainly on period from December to February. In regions situated towards North, the spawning may last still longer; this, among others, is apparent from investigations of Woźniak (1965). The gonads of males mature earlier than those of females. With those last, three groups of eggs could be distinguished simultaneously: first of diameter below 0.16 mm, second from 0.16 to 0.36 mm and third 0.36-0.80 mm. This proves that spawning of *P. acarne* is repeated and the spawn had been laid at least three times.

The repeated nature of spawning seriously obstructed the study on fecundity. This was overcame by application of weighing-plankton method (see Material and Method). The absolute fecundity varied within 85-536 thousands of eggs (Fig.9) and in average amounted to 244 thousands. During spawning period, the ripening fish was noted at every place wherever ships were fishing between the latitudes 17°00' and 24°00' N. This shows that, spawning places of *P. acarne* are very wide. It may be assumed that, a fish spawns at place of its living. It had been noted that *P. acarne* is sexually maturing considerable early. For length of 19.0 cm, the matured specimen represent already

37.0 per-cent. In other words, for the first time are reproducing the specimen at age 1 + ("males").

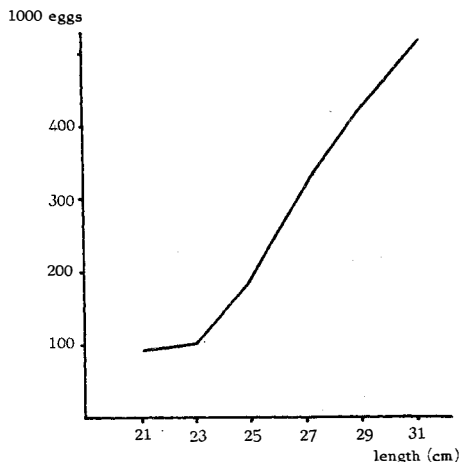


Fig.9. Relation of fecundity to length of females of *P. acarne*

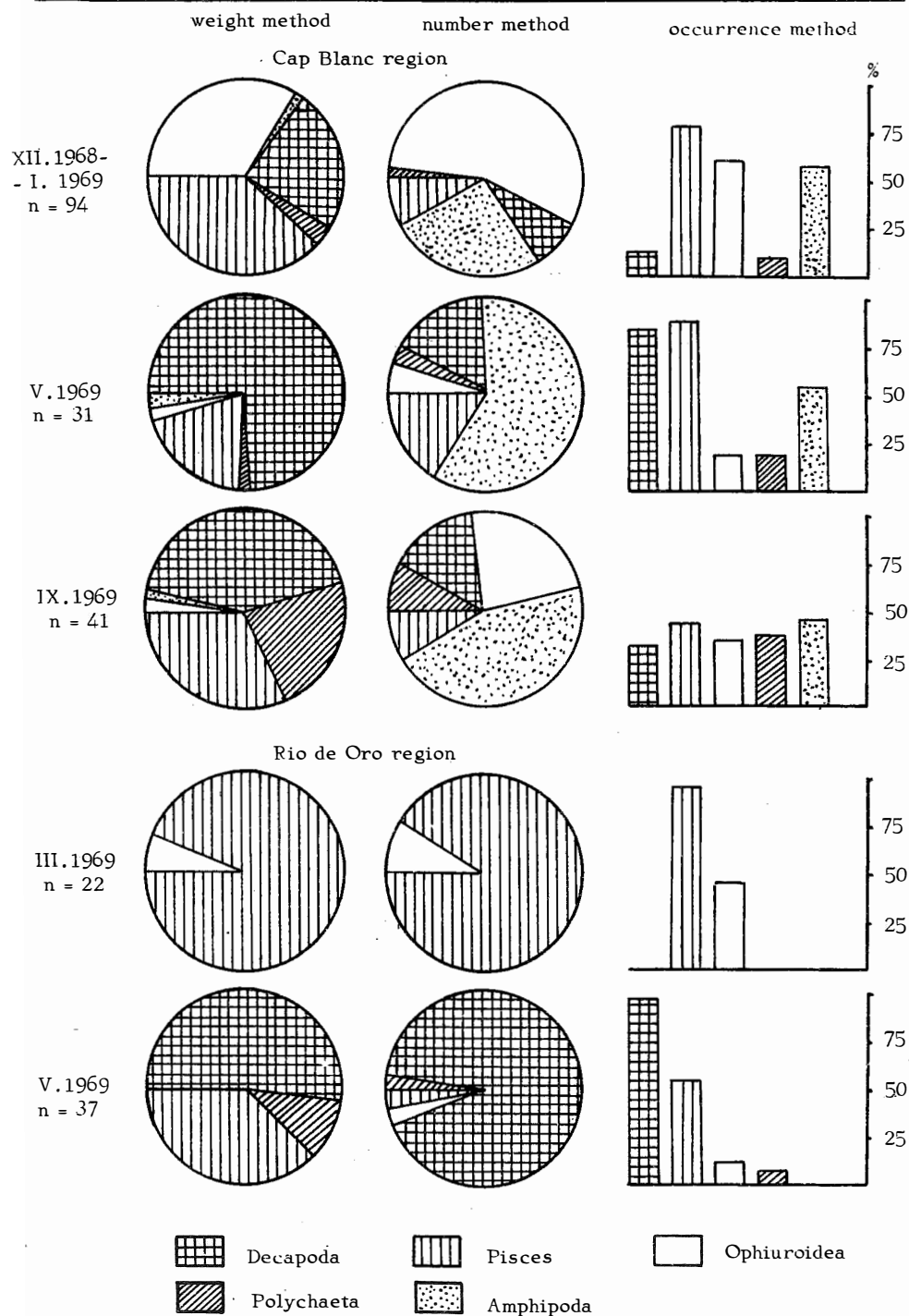
#### FEEDING

From data presented on drawing 10 appears that, the composition of food at Cap Blanc region had been changing in relation to annual season. In winter, in alimentary tracks dominated *Ophiuroidea*, *Pisces* and *Decapoda*; in spring, only two groups - *Pisces* and *Decapoda*. In summer the fish feed on *Decapoda*, *Pisces* and *Polychaeta*. Thus, the main food for *P. acarne* of this region were *Decapoda* and *Pisces*, while *Ophiuroidea* and *Polychaeta* were appearing in notable quantity at certain seasons only as additional food.

Generally taking, the food composition of fish from Rio de Oro region is similar to this of Cap Blanc region. However, certain components which were not noted in Rio de Oro region, or were appearing in negligible quantities, were noted in Cap Blanc region (Fig.10).

In stomachs of younger fish from both regions, Amphipoda was noted more frequently and in higher quantity than in stomachs of older fish. The observations on degree of filling of alimentary tracts, indicate that *P. acarne* are feeding intensively during May - September. Intensity of feeding is considerably lower during the remaining part of year and particularly during the spawning, but even at the ripening specimen, presence of food in stomach was noted. It must be supplemented, that, period of intensive feeding is in conjunction with an increase of water temperature.

Relative to seasonal changes of feeding intensity, are the changes of Fulton's coefficient of condition; the lowest value, of this coefficient appeared for March - 1.31 and the highest, 3.47, for May. The condition of fish caught in region of Cap Blanc was better than of fish from Rio de Oro region. The mean value of condition coefficient for both regions amounted to 1.512 and 1.286 respectively. This phenomenon is caused by higher biological pro-

Fig.10. Composition of food of *P. acarne* at various seasons of year

ductivity of waters in Cap Blanc region, where the intensive upwelling is taking place during the spring and summer. This is further evidence to support the assumption that, separate local stocks of P. acarne are appearing in both regions discussed.

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MORLESZ KRWISTY - *Pagellus acarne* (Risso)  
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#### S t r e s z c z e n i e

Praca poświęcona jest badaniom nad biologią stosunkowo często spotykanego w wodach północno-zachodniej Afryki, a słabo jeszcze poznanego gatunku.

ku - Pagellus acarne (Risso). Materiały pochodziły z połowów polskich trawlerów dokonanych na szelfie północno-zachodniej Afryki od  $16^{\circ}$  do  $24^{\circ}$  N. Największe skupiska tego gatunku występują pomiędzy równoleżnikami  $19^{\circ}$  i  $25^{\circ}$  N, na głębokościach 40-180 m. Stosunek szerokości międzyocnej, średnicy oka i szerokości kości łzowej do długości całkowitej był odmienny u P. acarne z rejonu Cap Blanc niż u P. Acarne z rejonu Rio de Oro. Różnica ta była statystycznie istotna. Połowy P. acarne opierają się głównie na III i IV grupie wieku. Średnia długość łowionych P. acarne wzrasta wraz z głębokością i wynosi najczęściej 21-26 cm. Współczynnik śmiertelności całkowitej ( $Z = M + F$ ) wynosił w rejonie Cap Blanc 1,05 (1969) i 0,781 (1970 r.) a w rejonie Rio de Oro 1,27. Zależność między długością całkowitą (l.t.) i długością dłuższego promienia otolithu jest zbliżona do prostoliniowej, co pozwala stosować metodę Dahl-Lea przy odczytach wstecznych. Średnia długość w grupach wieku od I do VII wynosi 13,7; 18,8; 21,9; 24,6; 26,8 i 30,5 cm. Roczne przyrosty ciężaru zwiększają się do siódmego roku życia. Parametry równania wzrostowego v. Bertalaffy'ego wynoszą  $L_{\infty} = 36,0$  cm;  $K = 0,23$ ;  $t_0 = -0,97$  roku. P. acarne jest obojnakiem, obojnactwo to jest typu protandrii. Zmiana płci z samców na samice w rejonie Rio de Oro występuje u ryb mniejszej długości niż w rejonie Cap Blanc. Rozród odbywa się zimą. Tarliska są rozległe, położone w płytkich wodach przybrzeżnych. Tarło jest porcyjne. Głównym pokarmem P. acarne są Decapoda i Pisces; dodatkowym Ophiuroidea i Polychaeta. W opisywanym rejonie P. acarne tworzy co najmniej dwa odrębne stada lokalne (Cap Blanc i Rio de Oro), różniące się m. inn. cechami morfologicznymi, kondycją i szybkością wzrostu.

#### ИССЛЕДОВАНИЯ НАД PAGELLUS COUPEI DIEUZEIDE ИЗ СЕВЕРО-ЗАПАДНОГО РАЙОНА АФРИКИ

##### Р е з ю м е

Pagellus coupei, рыба, биология которой до сих пор ещё мало изучена, относится к семейству Sparidae, играющему важную роль в рыболовстве северо-западного района Африки.

Материалы собирались в период с декабря 1968 до марта 1970 годов. Происходили они из уловов польских траулеров на северо-западном шельфе Африки между  $16^{\circ}$  и  $24^{\circ}$  северной широты.

Самые большие скопления P. coupei наблюдались на глубинах 30-150 м, главным образом в районе Рио-де-Оро, Сенегала, Гвинеи и Сьерра-Леоне. Среднее отношение диаметра глаза и ширины лакримальной кости к длине головы было разным у особей, вылавливаемых в районе Дакара и в районе Рио-де-Оро. Эти различия были статистически существенными. Лов основывался, главным образом, на рыбах II, III и IV возрастных групп; средняя их длина увеличивалась вместе с увеличением глубины, составляя в среднем 19,3 см. Коэффициент общей смертности составлял в районе Дакара 1,58. Скорость роста особей из района Рио-де-Оро была более высокой, чем в районе Дакара. Статистический анализ указывает на существенность этой разницы. Прирост

веса *P.soupei* увеличивается до шестого года жизни. Параметры уравнения фон Берталаффи для района Дакара имеют следующие величины:  $L_{\infty} = 39,37$  см;  $K = 0,18$ ;  $t_0 = -0,81$  года, а для района Рио-де-Оро:  $L_{\infty} = 40,17$  см;  $K = 0,19$ ;  $t_0 = -0,63$  года.

*P.soupei* является гермафродитом. Гермафродитизм его имеет характер протерогинии. Размножение происходит в период с мая по сентябрь на обширных нерестилищах в мелководных прибрежных районах. Основным кормом исследованного вида являются Decapoda, Cephalopoda, Pisces, Amphioxus и Polychaeta - каждый из этих компонентов корма доминирует в разное время года. В рассматриваемом районе *P.soupei* образует по крайней мере два отдельных местных стада - в районе Дакара и второе в районе Рио-де-Оро; третье такое стадо обитает в районе Такоради.

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