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Fish biology

A STUDY ON *PAGELLUS COUPEI* DIEUZEIDE FROM  
THE NORTH-WEST AFRICAN REGION

BADANIA NAD *PAGELLUS COUPEI* DIEUZEIDE Z REJONU  
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This work presents investigations of morphological characters, age composition, rate of growth, reproduction and food of *Pagellus coupei* Dieuzeide. It had been ascertained that, in North - West African region, this species forms at least three stocks, i.e. in Rio de Oro, Dakar and Tacoradi region. Worked out is the key to species of *Pagellus* for region discussed.

INTRODUCTION

The North-West African waters present considerably good conditions for production of plankton due to upwelling which appears here on wide regions. The water is rich in food for numerous species of pelagic and bottom fish.

Considerable part of catches here represent the family of sea-bream (Sparidae). With an increase of fishing intensity, the catches of fish belonging to this family, was growing from 83.7 thousands of tons in 1957 to 151.9 thousands of tons in 1966. The yield per unit of fishing effort had gradually been decreasing from 182 kg/h per haul in 1957 to 41 kg/h per haul in 1966 (F A O) 1968).

Participation of breams in Polish fishery for period 1964-1968 tended towards decrease. Polish catches of these fishes expressed in absolute values for the period, proved the decrease from 4.6 thousands of tons to 1.5 thousand of tons.

Considering such circumstances, the more detailed investigations on Sparidae family which still is hardly known, may have great meaning for rational economy of their resources.

The present study relate to biology of one from most frequently encountered in this region representant of Sparidae family, i.e. *Pagellus coupei* Dieuzeide.

## MATERIAL AND METHOD

The work is based on materials collected between 5. December 1968 to 27. February 1970 from region extending from Dakar to Rio de Oro at North-West African coast. Some fish were taken in port from catches of several trawlers type B-23 (Table 1).

T a b l e 1

Number of examined fishes and analysis performed

Analysis	Number of fishes
Measurements of:	
Length	2 952
Weight	1 950
Diameter of eye	63
Preorbital width	62
Examination of stomach content	71
Estimation of stomach filling	804
Taking otoliths for determination of age	930
Taking gonads for determination of fecundity	10
Estimation of gonads maturity	1 031

The length of head, diameter of eye and the width of preorbitals were measured with accuracy of 1 mm (diagram of measurements L é - T r o n g P h â n and K o m p o w s k i, 1972). Diameter of eye and the preorbital width have been expressed in per cent of the head length. Total length was measured with an accuracy of 1 cm, i.e. length class of 20 cm comprised the fish between 20.0 to 20.9 cm. The age was determined according to otoliths and verified according to scales. The back readings of the growth rate were effected by application of microscope with micrometer. The states of gonads were noted according to Maier's eight-degree scale. The food was examined by weighing method and by counting the organisms present in alimentary canal.

## MORPHOLOGICAL CHARACTERS

The body of P. coupei is elongated and the eye is considerably small. Fish is coloured in pink with several small blue spots. The rays of dorsal fin are short; none of them is developed more strongly. Number of scales on lateral line oscillates from 55 to 58. Dorsal fin (D) XII-10, anal fin (A) III-10. Number of rings is constant and amounts to 24.

Pagellus coupei is closely related to P. erythrinus (L), but the first one has smaller height of body.

The investigations on relative size of eye diameter and on the preorbital width proved that these values are changing according to region of fish living (Table 2), and are different for region north of Dakar than in Rio de Oro region. Statistic analysis indicate that the differences are significant and are

not resulting from errors of measurement. Investigations performed by Skornjakov (1963) in Takoradi region (4°00' N) and at Dakar, on ratio between diameter of eye and length of head of this species, proved that this ratio amounted 31.71% and 29.32% respectively. It is apparent that diameter of eye of *P. coupei* is reducing northwards, viz.:

Takoradi	- 31.71
Dakar	- 30.48
Rio de Oro	- 28.24

Diameter of eye and preorbital width expressed in per-cent to head length of *P. coupei*

Morphological characteristic	Region Rio de Oro 23° - 24° N	Region Dakar 16° N
<u>Diameter of eye</u>		
range	24.3-31.9	27.3-31.9
$\bar{x}$	28.24	30.48
	2.3598	1.4916
n	23	40
<u>Preorbital width</u>		
range	15.8-21.0	15.7-20.4
$\bar{x}$	18.24	17.44
n	23	40

Due consideration must be given to fact that investigations of Skornjakov were based on fish length of 13-20 cm, while the present investigations - on fish length of 18-31 cm.

Basing on keys for fish determination processed previously for discussed region (Perrier, 1924; Fowler, 1936; Skornjakov, 1963b) and supplementing this with observations of Dieuzeide (1960), Maurin (1968) and our data, the below given key had been worked out.

Key to species of *Pagellus* for the North-West African shelf:

1. Scales on occipital region are reaching to middle of eye . . . . . 2
- Scales on occipital region are reaching utmost the back edge of eye . . . . . 4
2. Dark spot at base of pectoral fin, 68-72 scales on 1.l. . . . .  
. . . . . *Pagellus acarne* (Risso, 1826).
- No dark spot at base of pectoral fin, 55-62 scales on 1.l. . . . . 3
3. Straight frontal, 61-62 scales on 1.l., 9 soft rays in anal fin . . . . .  
. . . . . *Pagellus erythrinus* (L., 1758).
- Convex frontal, 55-58 scales on 1.l., body height smaller than at previous species, 10 soft rays in anal fin . . . . .  
. . . . . *Pagellus coupei* Dieuzeide, 1960.
4. 11-12 soft rays in anal fin, 6 or 7 rows of scales on cheek . . . . . 5
- Max. 10 soft rays in anal fin, 5 rows of scales on cheek, 7 vertical streaks on back and sides of body . . . . .  
. . . . . *Pagellus mormyrus* (L., 1758).

5. Dark spot at beginning of 1.1., 7 rows of cheek scales . . . . .  
 . . . . . Pagellus centrodontus (de la Roche, 1809).  
 - No dark spot at beginning of 1.1., 6 rows of cheek scales . . . . .  
 . . . . . Pagellus bogaraveo (Brünnich, 1764).

### LENGTH, AGE AND RATE OF GROWTH

#### Length

Length of P. coupei caught oscillated within 7-35 cm. Average length amounted to 19.3 cm. No distinct differences in length of males and females were noted (Fig. 1). An average length of P. coupei can be related to depth of fishing, e.g. during the period of 23 XII 1969 to 19 I 1970 on depths below 50 m, average length of fish for this species amounted to 10.0 cm; on depths 50-100 m - 17.7 cm

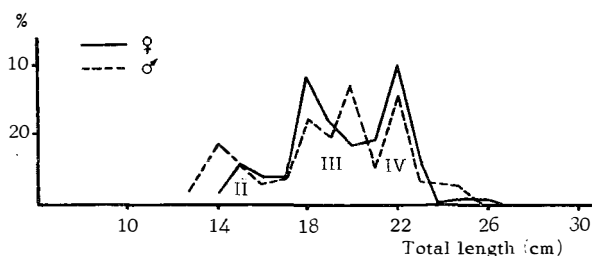


Fig.1. Length distributions curves of P. coupei in February 1970

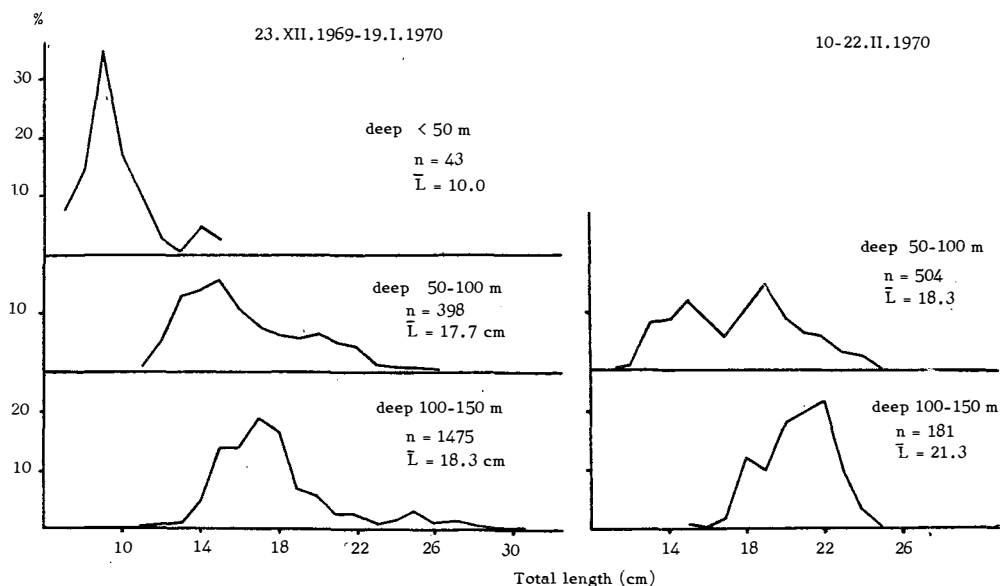


Fig.2. Length oscillation of P. coupei in relation to depth of catch

and on depth 100-150 m - 18.3 cm (Fig.2). It is thus apparent that depending on its size, P. coupei occupies various ecological niches. The fry is living

in more shallow coastal waters and is changing the place for deeper waters in relation to its growth (of course is not exceeding the waters of optimal deep for this species). It may be assumed that, reproduction of P. coupei is taking place in coastal region.

The length distribution curves for P. canariensis from February 1970 catches has some peaks in length-class of 14-15; 18-19 and 22 cm (Fig.1). In determination of age by otoliths, it is evident that these peaks correspond to age-groups II, III and IV respectively.

#### The rings formation on otoliths

Owing to non-sufficient material, the method for determination of rings formation period applied to species P. acarne (L ê - T r o n g P h â n and K o m p o w s k i, 1972), could not be applied in this case. Calculated, was the per cent of specimen with ring forming on otoliths edge from catches of various months and assumed that rings formation prevails on time of the highest percentage. The results (Table 3) proved that majority of fishes had already new formed ring on otolith edges in May. It is apparent that the period of rings formation lasts considerably long time.

Table 3

Period of rings formation on otoliths of P. coupei Dieuzeide in 1970

Month	Per cent of fish with ring on otolith edge	Per cent of fish without ring on otolith edge	n
January	59.0	41.0	448
February	71.5	28.5	115
May	94.6	5.4	203

#### Age and mortality $\ln N$

The stock of P. coupei from region northward of Dakar was composed of 9 age-groups. The percentage of age-groups from 0 to VIII was: 4.7 (0 and I); 35.3; 45.3; 10.7; 2.8; 0.5; 0.4 and 0.2 respectively. This clearly indicates that the catches are based mainly on fishes belonging to II, III and IV age group. Total mortality rate estimated on basis of the above given age composition (Fig.3), amounted for northward region of Dakar in 1970 to value 1.58; total mortality taken by means of Ricker's (1958) tables amounted to 0.7941.

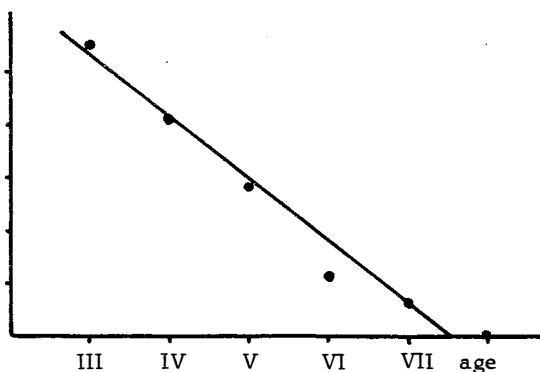


Fig.3. Estimation of total mortality rate of P. coupei based upon age composition of Dakar stock in 1970

### Rate of growth

From measurements of otolith radius of 316 fishes 8-31 cm in length it appears that the relation between the longer otolith radius and total length of fish is nearly directly proportional and is expressed by an equation:  $R = 3.3014 + 2.9995 L$ . The straight obtained from equation crosses the arrangement of coordinates nearly at zero point (Fig.4).

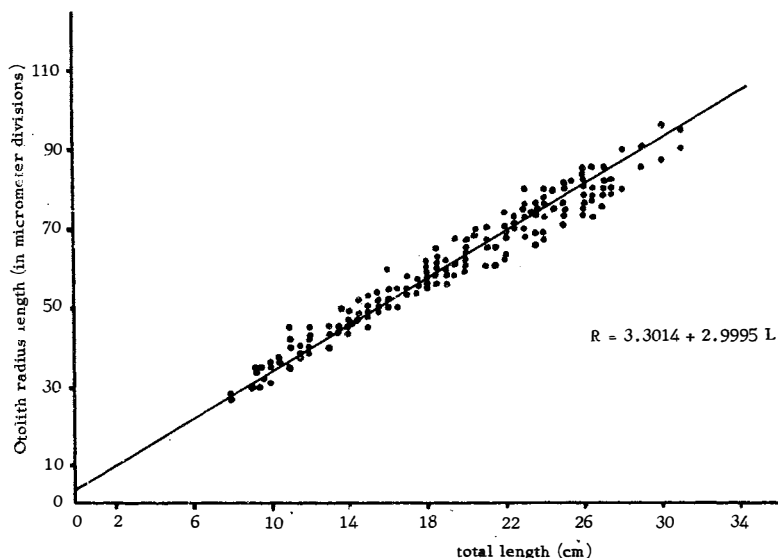


Fig.4. Corelation between total length and length of otolith radius

For these reasons, no corrections were applied at the back reading of growth rate, but applied the method based on direct proportionals. The obtained results are shown on Fig.5. Approximative results were also obtained from direct measurements of length in particular age-groups. The rate of growth for specimen living in Rio de Oro region was higher than of those living in region north of Dakar. The statistical analysis shows that the difference is significant. Skornjakov (1969) ascertained that the rate of growth of P. coupei in Takoradi region was lower than for Dakar region. Such data permits to conclude that P. coupei forms three various stocks in region of Takoradi, Dakar and Rio de Oro. The rate of growth for the specimen of these stocks increase northwards (from Takoradi towards Rio de Oro). Such conclusion is in conformity with the results of the studies of the morphological features. Similar tendency for formation of local stocks, differing, among others, in morphological features, condition and rate of growth, proved P. acarne (Lê - Trong Phê and Kompowski, 1972). In both cases, this may be assigned to small activity which favours an isolation of fishes which belong to Pagellus genus. In contrary to pelagic fish (mackerel, sardinella) these fishes move periodically across the shelf, but not along the shelf.

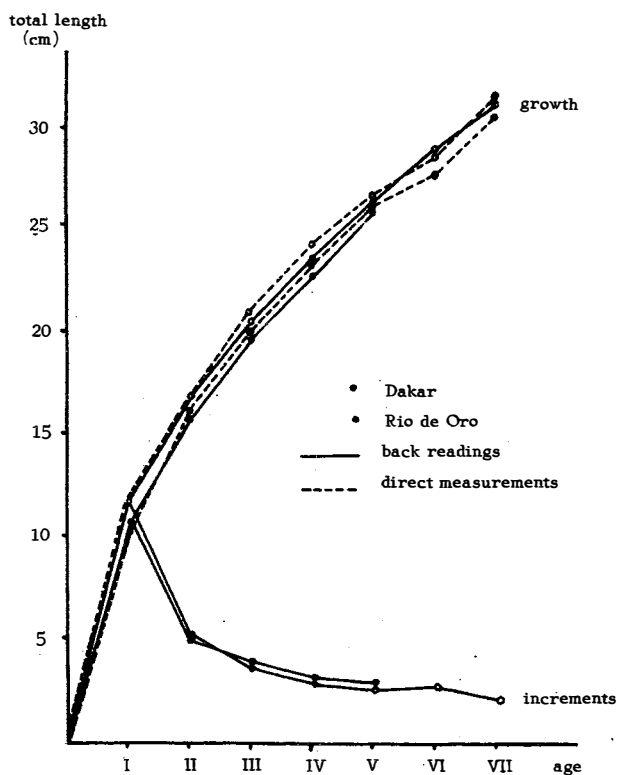


Fig. 5. Rate of growth of *P. coupei* from various region

By measurements of 200 fishes the correlation between length and weight was determined and it may be expressed by formula:  $W = 0.0139L^{2.991}$ . Applying this equation, the fish weight in age-groups I to VII was calculated and it amounts to: 22, 63, 116, 167, 239, 325 and 402 g respectively. It is apparent that the annual weight increments are increasing up to the sixth year of life.

According to results of back readings, the rate of growth for *P. coupei* was expressed as an equation of v. Bertalanffy. The parameters of such equation for *P. coupei* from Dakar region amount to:  $L_{\infty} = 39.37$  cm;  $K = 0.18$ ;  $t_0 = -0.81$  year, while from Rio de Oro region,  $L_{\infty} = 40.17$  cm;  $K = 0.19$ ;  $t_0 = -0.63$  year.

## REPRODUCTION

The phenomenon of hermaphroditism exists at *P. coupei* like of *P. acarne* (Lê - Trong Phấn and K o m p o w s k i, 1972). In contrary to *P. acarne*, the hermaphroditism here is of protogynia type, i.e. the young specimen acts as female and thenafter transforms to male. Spawning of *P. coupei* is portional and lasts from May to September. In his investigations.

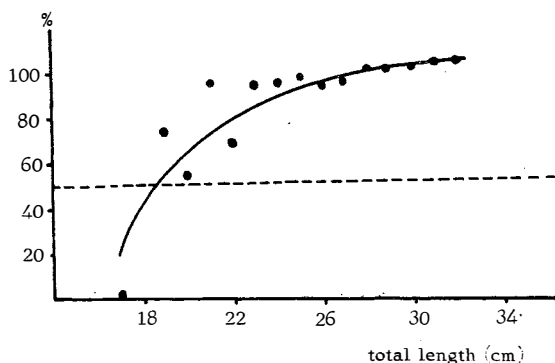


Fig.6. Length composition of spawning population of *P. coupei*

S k o r n j a k o v (1963a) ascertained that spawning of *P. coupei* in Takoradi region is taking place from November to March, i.e. some months earlier than in Dakar - Rio de Oro region. This data and the observations presented in other works (W o ź n i a k, 1965; L ê - T r o n g - P h â n and K o m p o w s k i, 1972) indicate that the fishes from regions nearer to Equator spawn earlier than those from regions of higher geographical latitudes.

The gonads start maturing earlier at males. The percentage of females in catches of various months oscillated from 40.7 to 55, giving the mean value of 48.3. The percentage of males oscillated from 45.0 to 59.3, giving the mean value 51.7 (Table 4).

Table 4

Number ratio of females to males of *P. coupei*

Month	S e x (%)		n
	♀	♂	
V. 1969	55.0	45.0	198
IX. 1969	40.7	59.3	209
I. 1970	49.0	51.0	480
II. 1970	46.5	53.5	140
T o t a l	48.3	51.7	1 027

Generally the number of males was lower than that of females. The gonads of matured females attain the weight of 4 to 27 g. The absolute fecundity oscillated between 60.2-406.8 thousands of eggs. The specimen with ripening sex products were observed in region from 21°00'N to 24°00'N during the spawning period. The investigation results of S k o r n j a k o v (1963a) indicate that the ripening specimen were also appearing in region of Takoradi and Dakar. It is apparent that the fishes spawn at the place of their living, but for reproduction move to more shallow waters where the fry encounters later on better feeding conditions. It may be seen from drawing 6 that among the fish of 19-25 cm in length, percentage of specimen spawning amounts to above 50. All fishes of lengths above 25 cm were already matured. It may be said that the first spawning of this species is taking place at age 1+.



## FEEDING

Percentage of particular groups of food was changing in relation to season of year. In May, fishes were feeding mainly on Amphioxus, which presented at that time 63.9% of stomach content by weight, 84.1% of number of eaten organisms and was appearing in 90% of examined stomachs. On second place were Pisces, Polychaeta and Decapoda (Fig.7).

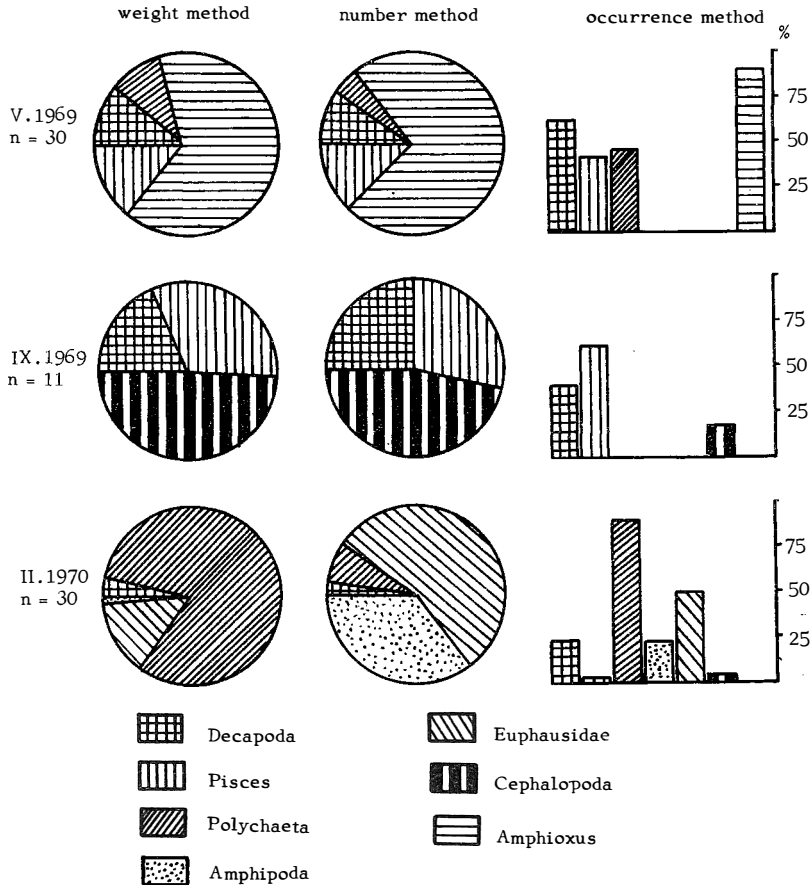


Fig.7. Composition of food of *P. coupei* for various seasons of year

Different composition of food was in September. No Amphioxus and Polychaeta was found, but it appeared a new component - Cephalopoda. This group is taking considerable part in food and it presented at that time 48.5% of food weight. Appearing also beyond Cephalopoda were: Pisces - 32.5% and Decapoda - 19.0%.

Cephalopoda and Pisces were not present in food in February; appearing instead were Euphausiidae, Amphipoda and Ophiuroidea. Main food of this month comprised Euphausiidae and Polychaeta, which presented respectively 12.4 and 82.4% of stomach content by weight and 53.4 and 5.8% of number of eaten organisms.

It is apparent that Decapoda, Cephalopoda, Pisces, Amphioxus and Polychaeta are the essential components of food, but each of them dominates in different annual season.

Analysis of degree to which alimentary tracts are filled, lead to conclusion that intensive feeding of fish prevailed in summer period and less intense for winter period. Any internal changes of physiological condition during spawning period, has no distinct influence of feeding of P. coupei. Intensive feeding is also taking place during spawning period, what is supported by fact that some specimen with ripening sex products were found with strongly filled alimentary tracts.

### CATCHES

The greatest abundance of the P. coupei may be found in regions of Rio de Oro, Dakar, of Guinea and Sierra Leone. Yield of catches of this species during 23.XII.1969-10.II.1970 on depths 50-180 m (in average 107-116 m) amounted to 9.9-41.7 kg/h of haul; i.e. 0.4-1.6% of total catches. Such relatively small yield may be explained by fact that this species is living primarily on smaller depths within the territorial waters which are not accessible for Polish fishing fleet. This is supported by data of M a s s u t i (1967), who noted that P. coupei forms the large concentrations in coastal region of Guinea and Sierra Leone at depth of 40-50 m. Average yield from here amounted to about 60 kg/h per haul, what presented about 20% of total catches. In one haul at Dakar region on depth 46-48 m, yield of P. coupei amounted even to 210 kg/h per haul.

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BADANIA NAD PAGELLUS COUPEI DIEUZEIDE  
Z REJONU PÓŁNOCNO-ZACHODNIEJ AFRYKI

S t r e s z c z e n i e

*Pagellus coupei* Dieuzeide, gatunek o słabo dotychczas poznanej biologii, należy do rodziny Sparidae, która odgrywa ważną rolę w rybołówstwie rejonu północno-zachodniej Afryki.

Materiały zebrano w okresie XII 1968-III 1970. Pochodziły one z połowów polskich trawlerów na szelfie północno-zachodniej Afryki, między równoleżnikami  $16^{\circ}$  i  $24^{\circ}$ N.

Największe skupiska *P. coupei* występowały na głębokościach 30-150 m, głównie w rejonie Rio de Oro, Senegalu, Gwinei i Sierra Leone. Średni stosunek średnicy oka i szerokości kości łzowej do długości głowy był odmienny u osobników łowionych w rejonie Dakaru i Rio de Oro. Były to różnice statystycznie istotne. Połowy opierały się głównie na rybach z II, III i IV grupy wieku; średnia ich długość zwiększała się wraz ze wzrostem głębokości, wynosząc przeciętnie 19,3 cm. Współczynnik śmiertelności całkowitej wynosił w rejonie Dakaru 1,58. Szybkość wzrostu osobników z rejonu Rio de Oro była wyższa niż w rejonie Dakaru. Analiza statystyczna wskazuje na istotność tej różnicy. Przyrosty ciężaru *P. coupei* zwiększają się do szóstego roku życia. Parametry równania v. Bertalanffy'ego dla rejonu Dakaru mają wartości:  $L_{\infty} = 39,37$  cm;  $K = 0,18$ ;  $t_0 = -0,81$  roku, a dla rejonu Rio de Oro  $L_{\infty} = 40,17$  cm;  $K = 0,19$ ;  $t_0 = -0,63$  roku. *P. coupei* jest obojnakiem. Obojnactwo to ma charakter protogynii. Rozród odbywa się w okresie od maja do września na rozległych tarliskach w płytkich rejonach przybrzeżnych. Podstawą pokarmu omawianego gatunku są Decapoda, Cephalopoda, Pisces, Amphioxus i Polychaeta - każdy z tych komponentów dominuje w innym okresie roku. W omawianym rejonie *P. coupei* tworzy co najmniej dwa

odrębne lokalne stada - Dakaru i Rio de Oro; trzecie takie stado występuje w rejonie Takoradi.

ПАГЕЛЬ ДЛИННОРЫЛЫЙ - *PAGELLUS ACARNE* (RISSE) из  
РАЙОНА СЕВЕРО-ЗАПАДНОЙ АФРИКИ

Р е з ю м е

Работа посвящена исследованиям биологии сравнительно часто встречающегося в водах северо-западной Африки, но мало ещё изученного, вида - *Pagellus acarne* (Risso). Материалы для исследований были взяты из уловов польских траулеров на шельфе северо-западной Африки от  $16^{\circ}$  до  $24^{\circ}$  северной широты. Самые большие скопления этого вида встречаются между параллелями  $19^{\circ}$  и  $25^{\circ}$  северной широты на глубине 40 - 180 м. Отношение межглазничного пространства, диаметра глаза и ширины лакримальной кости к общей длине было неодинаковым у *P. acarne* из района Кап-Блан и у этого же вида из района Рио-де-Оро. Разница эта была статистически существенной. Лов *P. acarne* основывается главным образом на III и IV возрастных группах. Средняя длина вылавливаемого *P. acarne* увеличивается вместе с глубиной и составляет чаще всего 21 - 26 см. Коэффициент общей смертности ( $Z = F + M$ ) составлял в районе Кап-Блан 1,05 (1969) и 0,781 (1970 г.), а в районе Рио-де-Оро - 1,27. Зависимость между общей длиной ( $L_t$ ) и длиной самого длинного луча отодита приближается к прямопропорциональной, что позволяет применять метод Дааль-Лея при обратных вычислениях роста. Средняя длина в возрастных группах от I до VII составляет 13,7; 18,8; 21,9; 24,6; 26,8; 30,5 см. Годовой прирост веса увеличивается до седьмого года жизни. Параметры возрастного уравнения фон Берталаффи составляют;  $L_{\infty} = 36,0$  см;  $K = 0,23$ ;  $t_0 = -0,97$  года. *P. acarne* является гермафродитом, гермафродитизм его относится к типу протандри. Изменение пола, т.е. переход из самца в самку, в районе Рио-де-Оро наблюдается у рыб меньшей длины, чем в районе Кап-Блан. Размножение происходит зимой. Нерестилища обширны, расположены в мелких прибрежных водах. Нерест является порционным. Основным кормом *P. acarne* являются *Decapoda* и *Pisces*; дополнительным - *Ophiuroidea* и *Polychaeta*. В рассматриваемом районе *P. acarne* образует по крайней мере два отдельных местных стада (Кап-Блан и Рио-де-Оро), отличающиеся друг от друга морфологическими признаками, упитанностью и скоростью роста.

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