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Spawning Peculiarities of Fish from the North-Western Coast of Africa

by

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Spawning peculiarities of many species inhabiting the tropical zone of the Atlantic ocean have been rather insuffciently studied. Thus, up to the present time we have a very tentative idea only of the time of their spawning and the spawning areas.

This report deals chiefly with two problems:-

1. Spawning time of the most numerous fish species occurring in trawl catches from the area of Cape Blanc (23°N-16°N).

2. Diurnal rhythm of fish spawning (on the example of Pagrus ehrenbergii) depending on the hydrographical conditions. These observations were carried out in the area of Los Islands (9°N).

The material was collected by the vessels of AtlantNIRO in the period from 1963 to 1967. Samples for analysis were taken by bottom trawl. The main evidence of spawning was the presence of females with running reproductive products (development stage V). The spawning time of individual species was determined by their annual cycle development of reproductive products.

All the species considered (Table 1) have pelagic eggs and partial spawning.

On the shelf off Cape Blanc spawning of various fish takes place throughout the whole year. However, we can distinguish between two main groups of species according to the times of mass-spawning:-

1. Fish spawning in December-March.

2. Fish spawning in May-September.

The annual cycle of gonad development of members of these groups is given in Figure 1, using Dentex macrophthalmus and Dentex maroccanus as examples.

The first group includes, as a rule, relatively small, schooling and numerous species, such as Trachurus trachurus, Trachurus tricae, Scomber colias, Pagellus acarne, Dentex macrophthalmus, etc.

The second group, except for some small fish (Sardinella aurita, Decapterus rhonchus, Dentex maroccanus), is represented by large but not numerous species (Pagrus pagrus, Pagrus orphus, Dentex filosus, Diagramma mediterraneum). It should be noted that the small fish belonging to the second group inhabit relatively shallow

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waters in contrast to the small fish spawning in December-March. It is very interesting to note that the smallest species (Engraulis hepsetus, Lepidotrigla cadmani) spawn throughout the year. This is probably connected with their extremely short life-span and early maturation.

As is clearly seen from Table 1, spawning in December-March takes place at larger depths, usually at a depth of 100 m. On the other hand, spawning in May-September occurs in more shallow waters. Even such fish as anchovy, which spawns all the year round, spawns in December-March at a higher depth and in May-September at a lower depth.

Spawning of fish usually takes place at sites with considerable temperature gradients because of the water contact with different hydrographical characteristics. Simultaneous spawning of several species is very often observed in the same place. Typical thermal conditions for spawning are given in Figure 2.

Generally, in December-March spawning takes place in the area of the slope not far from the canyons, and in May-September spawning often takes place on the banks, for instance on the Arguin Bank as well as in the estuarine parts of the Senegal River.

Differences in depth and hence in spawning areas in various seasons with regard to the peculiarities of the hydrographical regime can be described as follows.

According to the investigations by K.Ya. Mratov, the Canaries current is in December-March most intense (especially in the middle of the period). At this time it runs parallel to the coastline, forming gyrals on the shelf.

The influence of the equatorial current is rather poor at this time. In the area of the slope, not far from the canyons at a depth of 100-200 metres, zones of mixing are being formed. These conditions are favourable for the spawning of fish.

In May-September the Canaries current becomes less intensive and shifts towards the ocean. In connection with this, the gyrals on the shelf are weakened. The equatorial current is, on the contrary, well developed in this season, and it flows to the north along the shoreline. Besides, during this period the discharge of the Senegal River is highest due to rain on the continent. Thus, the zones of mixing are formed at smaller depths where the spawning occurs.

Diurnal spawning rhythm

The study of the diurnal feeding rhythm of Pagrus ehrenbergii in the area of Los Islands also gave some interesting data on its diurnal spawning, as well as on the diurnal rhythm or the diurnal cycles of the reproductive organs.

Every 9-10th day (new moon period) from September to November 1966, diurnal trawl surveys were carried out in the area not far from the Concoure Deep at a depth of 24-26 metres. One survey was also made in late September. 100 specimens of mature fish were taken from each catch, and the maturity stage of the reproductive products was determined visually.

The hydrographical regime of this area is characterised by irregular tidal currents with semi-diurnal periods. In September-November, that is in the second half of the rainy period, an alternation of more saline and cold waters with less saline and warmer waters was observed in the near-bottom layer during 24 hours. This is showed in Figures 3, 4, 5 and 6.

As is seen from these Figures, spawning begins at different times of the day: 9th-10th September from 22.30, 29th-30th September and 9th-10th October from 19.00, 9th-10th November from 14.00. It is further seen that spawning begins in the period of inflow of more saline, abyssal waters, resulting in salinity increase and temperature decrease. Fish react keenly to small changes in temperature and salinity, and a temperature deviation of some tenths of a degree can be a "signal" for spawning.

In all the cases considered, however, the spawning began and took place at different values of temperature and salinity. Moreover, the difference between these values was greater than within a period of 24 hours.

A "signal" for spawning is, then, the inflow of more saline and rather cold water as compared with the preceding period.

Figure 7 shows the variation in density of water, the time of spawning is also registered. In three cases out of four the spawning occurred in the period of relatively high water density. The data from the second station are very typical in this respect. Station 4, where the spawning took place in the period of minimum density, was an exception to the rule. However, before the beginning of spawning, some decrease in density is noted. This suggests the existence of maximum density of water at which spawning is possible.

Thus, the beginning of spawning of P. ehrenbergii is observed at different times of the day and is determined by tidal currents. The spawning takes place in the period of maximum inflow. The beginning of spawning depends on the time of inflow of more dense (and more saline and cold) waters.

Spawning, as a rule, takes place in rather dense waters. However, the P. ehrenbergii stays long in more dense waters (density exceeding the optimum values for spawning), and the spawning occurs when density decreases.

Below is a brief review of the diurnal dynamic rhythm of maturity stages (Figure 8). Females with gonads in stage IV spawn during a definite time of the day (stage V), then the gonads turn into the characteristic stage IV-VI (a portion of eggs is spawned) and again they enter the initial stage IV. This probably occurs every 24 hours. Thus, P. ehrenbergii spawns a great number of egg portions during the spawning season because the spawning of a single specimen lasts 4-6 months.

The duration of the individual stages was not different. Spawning (stage V) was always passed very quickly in about two hours. One case only in December when spawning lasted for about 6 hours was an exception to the rule.

The gonads in stage VI-IV (after eggs were spawned) lasted longer at the beginning of the spawning period (September) than later on. Thus, on the first station stage IV-VI was observed during 12-16 hours, on the second during 8-10 hours and on the two last stations during not more than 4-6 hours. This is evidently connected with the fact that at first larger portions of eggs are spawned, and therefore more energy is needed for recovery of the gonads.

Thus, during the spawning period of P. ehrenbergii (4-6 months) the process of spawning occurs every 24 hours, rather small portions of eggs being spawned each time. Consequently, this species deposits a great number of small portions of eggs. Due to this the diurnal cycle or rhythm of gonads is outlined as follows. Fish on the point of egg discharge (maturity stage IV) spawns a portion of eggs at different times of the day according to the hydrographical conditions (maturity stage V). Then, the gonads turn into maturity stage VI-IV and thereafter into stage IV.

Summary

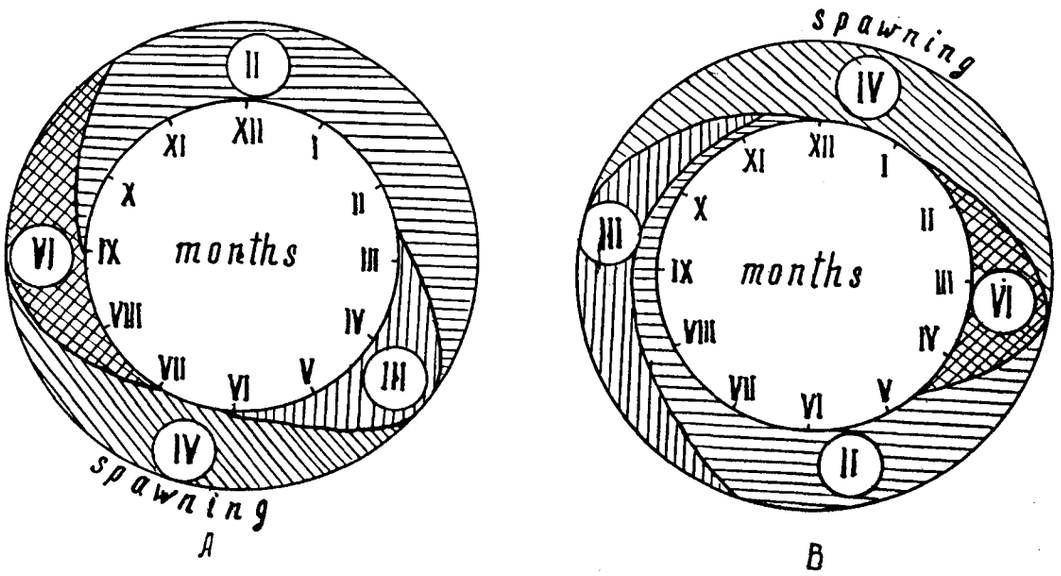
In respect of spawning time the most numerous fish from the area of Cape Blanc can be divided into two groups: fish spawning in December-March and those spawning in May-September. The fish spawning in December-March deposit their eggs at greater depths (100-200 m) than those of the second group (20-50 m). This is connected with hydrographical peculiarities of the area.

It is likely that spawning of the tropical fish (for instance P. ehrenbergii) occurs every 24 hours during the whole spawning period (4-6 months) with a small portion of eggs being laid at each spawning. Therefore, a diurnal cycle or rhythm of the development of sexual products is outlined. The beginning of spawning depends upon the time of inflow of more saline and cold waters. Due to this, spawning was observed at various times of the day.

Table 1. Depth and periods of mass-spawning of some species off the western African coast (16°N - 23°N).

Spawning in December-March	Depth (m)	Spawning in May-September	Depth (m)
Pagellus acarne Risso	100-250	Dentex maroccanus C.V.	60-100
Pagellus caupli Steindachner	90-150	Dentex filosus Val.	15
Dentex macrophthalmus Bloch	100-300	Pagrus pagrus	150
Box salpa Linné	130-140	Pagrus orphus Risso	80-140
Box boops (Linné)	100-120	Cantharus cantharus Linné	30-50
Sargus vulgaris G.St.Hill	100-140	Decapterus rhonchus G.St.Hill	80-170
Trachurus trachurus (Linné)	100-250	Pristipoma bennetti Lowe	17-35
Trachurus tricae Cadenat	60-120	Sardinella aurita Val.	90-170
Decapterus punctatus Agassiz	100-120	Lepidopus caudatus Linné	100
Scomber colias Lowe		Trichiurus lepturus Linné	100
Merluccius senegalensis Cadenat	150-240	Umbrina canariensis Val.	100-120
Saurida parri Norman	120-200	Otolithus senegalensis Val.	20-40
Smaris macrophthalmus	100-160	Lutjanus agennes Bleeker	20-40
Serranus cabrilla (Linné)	100-130	Epinephelus goreensis C.V.	20-50
Trigla lyra Linné	100-150	Mullus barbatus (Linné)	35-40
Trigla lineata C.V.	100-130	Fistularia tabaccaria Linné	40
Lepidotrigla cadmani Regan	100-110	Lepidotrigla cadmani Regan	100
Lichia vadigo Lowe	100	Orcynopsis unicolor G.St.Hill	15-20
Vomer setipinnis Mitchill	60	Pomatomus saltatrix (Linné)	15-20
Eucitharis linguatula Linné	120-140	Diagramma mediterraneum	100-110
Zeus faber Linné	90-200		
Uranoscopus bufo Val.	100-120		
Lirus ovalis C.V.	120-150		
Engraulis hepsetus Cadenat	110-160	Engraulis hepsetus Cadenat	90-110
Sardinella aurita terrasa Lozano Rey	200-250		

Figure 1. Yearly dynamics of development of female gonads of D. macrophthalmus (B) and D. maroccanus (A).



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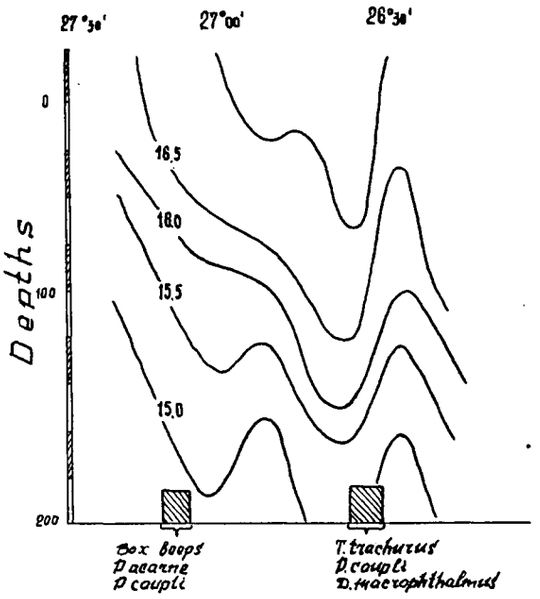

Fig. 2

Characteristic temperature conditions on a fish spawning ground.

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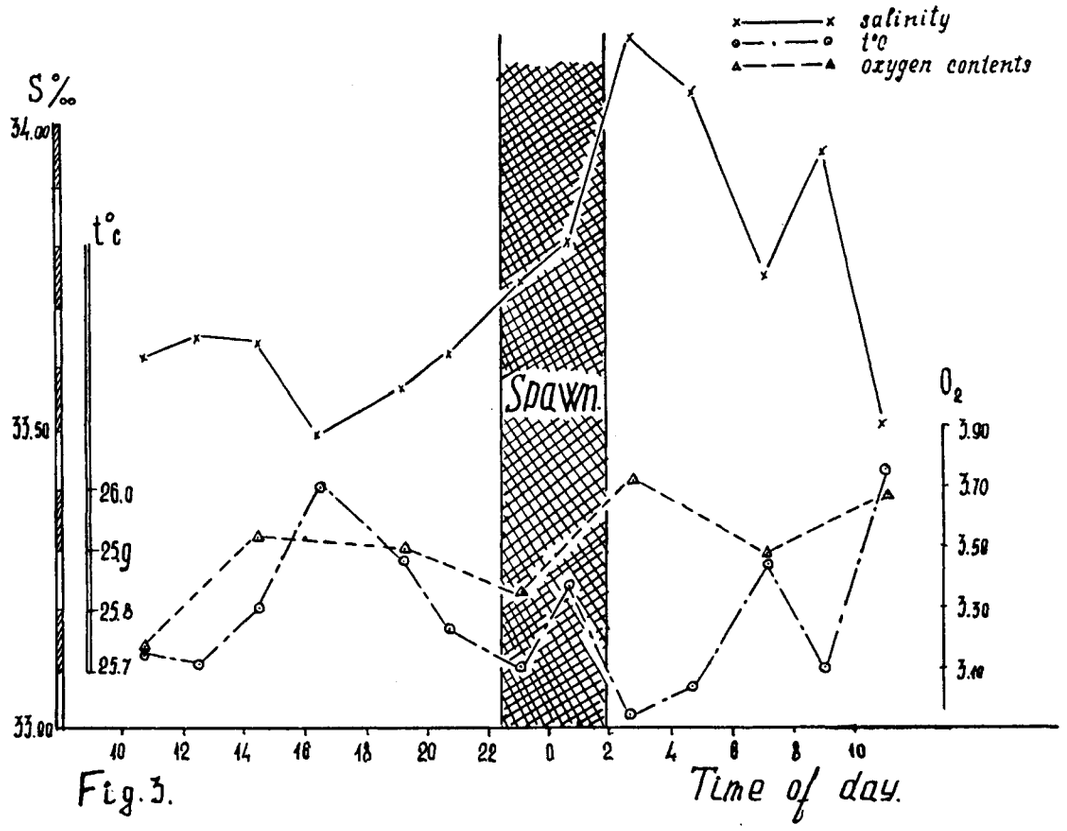

Fig. 3.

Changes of salinity, water temperature and time of spawning of P. ehrenbergii at the 24 hr station on September 9-10, 1966.

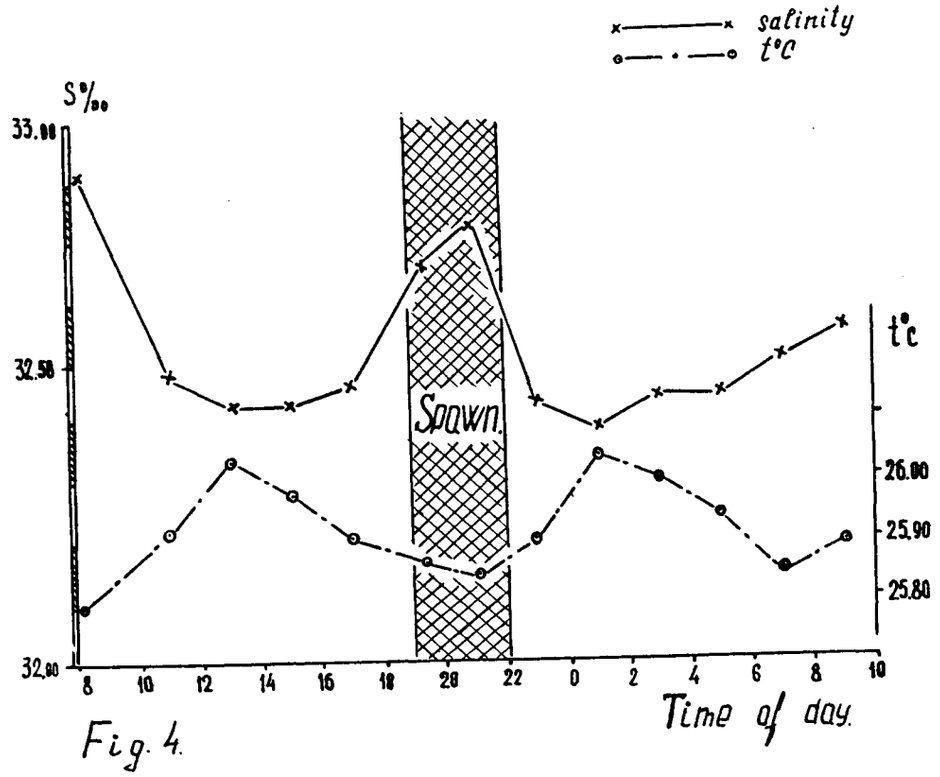

Fig. 4.

Changes of salinity, water temperature and time of spawning of P. ehrenbergii at the 24 hr station on Septenber 29-30, 1966.

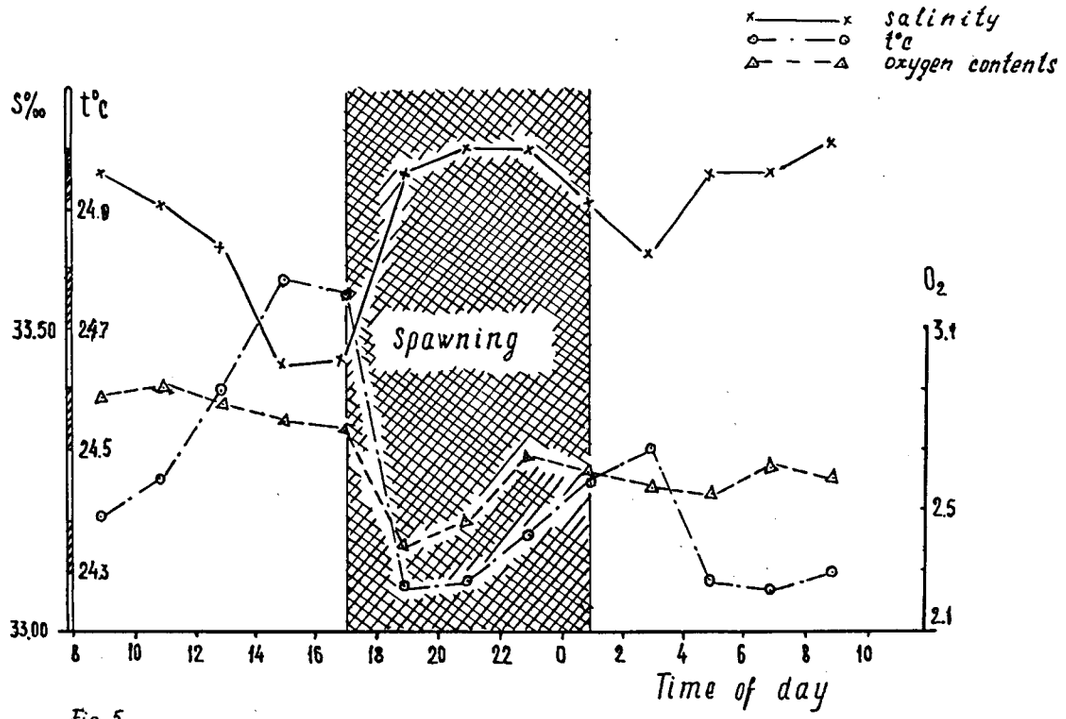

Fig. 5

Changes of salinity, water temperature and time of spawning of P. ehrenbergii at the 24 hr station on October 9-10, 1966.

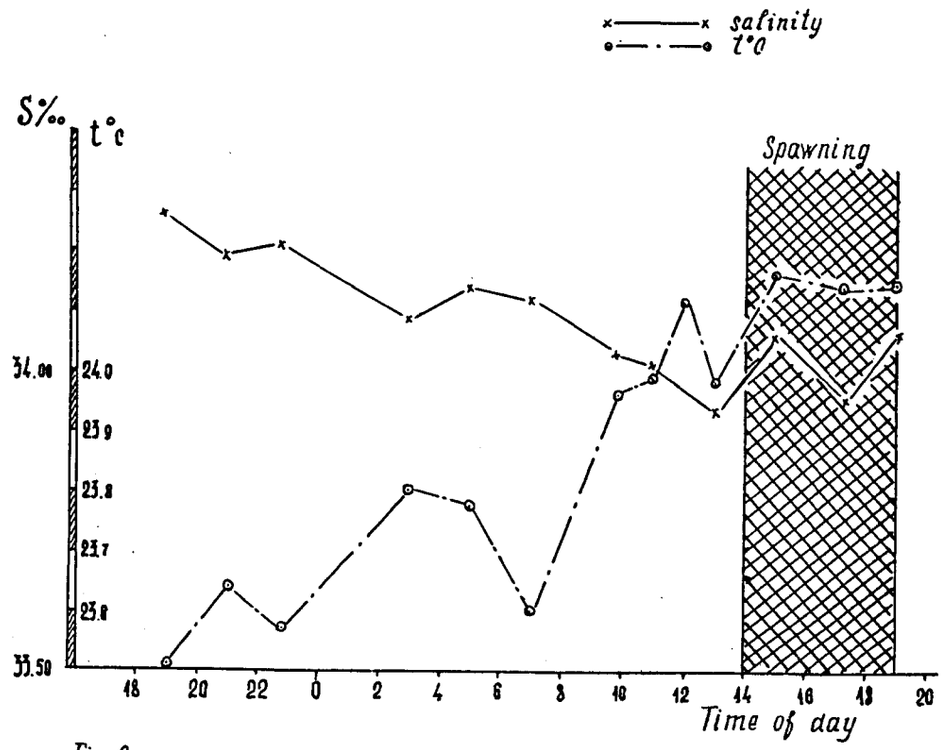

Fig. 6

Changes of salinity, water temperature and time of spawning of P. ehrenbergii at the 24 hr station on November 9-10, 1966.

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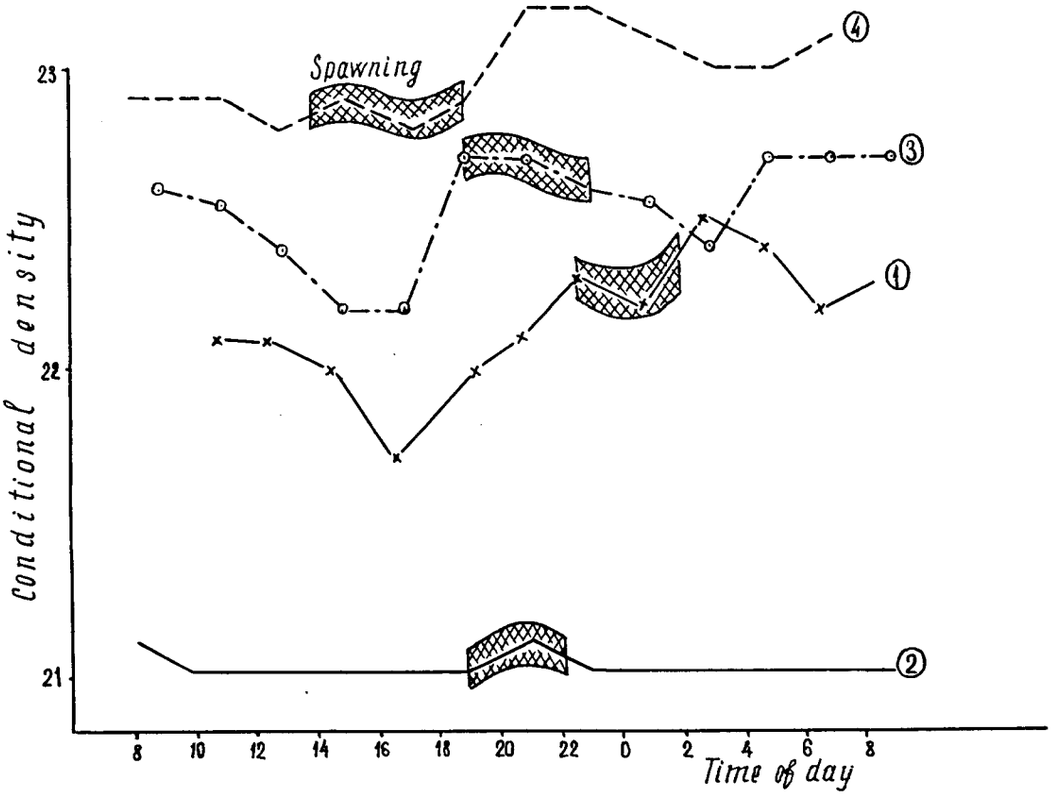

Fig. 7

Changes of density conditions and time of spawning at the 24 hr stations:

1 - on September 9-10, 1966
2 - on September 29-30, 1966
3 - on October 9-10, 1966
4 - on November 9-10, 1966.

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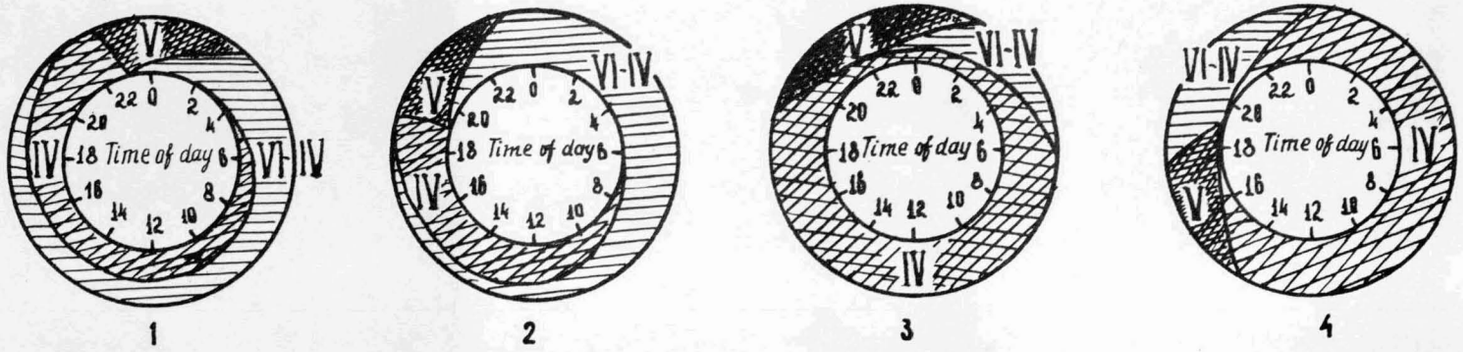

Fig. 8

Diurnal rhythm of gonad condition of female P. ehrenbergii:

1 - on September 9-10, 1966
2 - on September 29-30, 1966
3 - on October 9-10, 1966
4 - on November 9-10, 1966.