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By L. S. Petrova

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NOTE TO REVISOR

The title as shown in the "Request for Translation" of the Fisheries Research Board is rather misleading:

- 1) Judging by the text, the term "fry" is more appropriate here than "larvae", since all stages of development from hatching up to "fingerling" size are discussed.
- 2) Speaking of "korfo-karaginskaya" sel'd, the author has in mind herring breeding and living in the part of the Bering Sea west of an imaginary line joining Poluostrov*Ozernoi (57°45'N, 163°00'E) and Poluostrov*Govena (60°07'N, 166°30'E), i.e. including Zaliv Korfa and Karaginskii Zaliv.

Karaga Bay mentioned in the FRB title is a small bay (Bukhta Karaga, 59°05'N, 163°00'E - see page 3.).

I am not sure what kind of footnote, if any, should be made in the translated text to clarify this point.

* "peninsula"

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Some data on the biology and distribution of the
fry of the Korf-Karaginskii* herring

L.S. Petrova

Works devoted to the study of the Korf-Karaginskii* herring have been conducted for many years. As the result, the spawning period of its life has been investigated thoroughly, and much information has been accumulated on the feeding and winter periods of the life of mature fish. However, up to present time, no work had been undertaken concerning the early period of the herring's life, i.e. the larval period, although, according to the opinion of many authors (Svetovidov, 1952; Kryzhanovskii, 1956, 1956-a et al.), the numeric strength of a generation of adult herring depends essentially on the survival rate of the larvae.

*Translator's note:

Zaliv Korfa (Gulf) 60° 00' N, 165° 45' E; Karaginskii
Zaliv (Bay) 58° 55' N, 164° 00' E

Some information on the composition of the fry by their dimensions, as well as assumptions concerning their migrations are found in the work of K.I. Panin (1950). Morphological data on different stages of larval development, dealing mainly with the early period, is given in the work of M.Ya. Ievleva (1952).

It is not as yet known, into what regions of the sea are the fry of the Korf-Karaginskii herring population carried by the current; which plankton organisms are vital for their feeding; to what degree do the locations of concentration of the fry coincide with locations of the feed required by them; and how high is the mortality of the fry at various stages of their development. A study of these problems will make possible a high degree of accuracy in the methods of establishing long term forecasts; these are of great importance for proper exploitation of the stock of the Korf-Karaginskii herring.

In 1959-1960, the author and senior laboratory technician V.Ya. Slonovyi made collections of herring fry in the Bays of Uala* and Anapka*, on the 5-11 and 19-25 June respectively. The collections were made from a cutter by means of a roe net (d=80 cm, N 16 gauze). In 1959, the samples were taken from the surface only, in 1960 samples from the surface and total samples were drawn. The water temperature was measured in locations of sampling. All the samples were taken only in day time and during flood tide (Fig.1,2).

*Translator's note:

Zaliv Uala 59° 58' N, 163° 57' E; Zaliv Anapka 60° 00' N,
164° 35' E

Herring of the Korf-Karaginskii population spawns in the Bays of Uala and Anapka, the Gulf of Korf, the Bays of Ossora* Karaga* and Lozhnye Vesti*. As substrate for spawning, herring use Zostera (Panin, 1950), but, as we have observed in 1959-60, they also spawn on Laminaria, Fucus and Rhodophyta. On Laminaria they deposit the roe, as a rule, only on one side and very uniformly, usually in one, less often in two layers, whereas on the Zostera roe is deposited in 3-4 and often 6-7 layers. Thus, in 1959 in the Karaga Bay 50% of the roe was deposited on Fucus; in the Uala Bay, in the area of the Anapka River* and the Il'pyr Peninsula* at a depth of 10 m the greater quantity of roe was noticed on Laminaria.

Herring use the spawning grounds mentioned above to a varying extent in different years, depending on the strength of the population or on hydrometeorological factors during the spawning period.

In 1959 the spawning ground in the area of the Peschanaya* River was filled with roe and in 1960 the same situation occurred in the area of the Al'khovayam* River. In those same years all spawning sites in the Uala Bay were well used. When conducting the work of determination of spawning sites and of the

*Translator's note:

Bukhta Ossora 59°13'N, 163°08'E; Bukhta Karaga 59°05'N, 163°00'E; Guba Lozhnykh Vestei 58°59'N, 163°50'E; Anapka River 60°01'N, 163°55'E; Poluostrov Il'pyr 59°52'N, 164°09'E; Peschanaya River most probably in Anapka Bay near the locality Peschanoe, approx. 59°58'N, 164°43'E; Alkhovayam River 60°03'N, 164°35'E

density of deposited roe, it has been found that in the last two years 80% of all roe was deposited in the Bays of Uala and Anapka. In 1960 the area of spawning grounds in these bays,

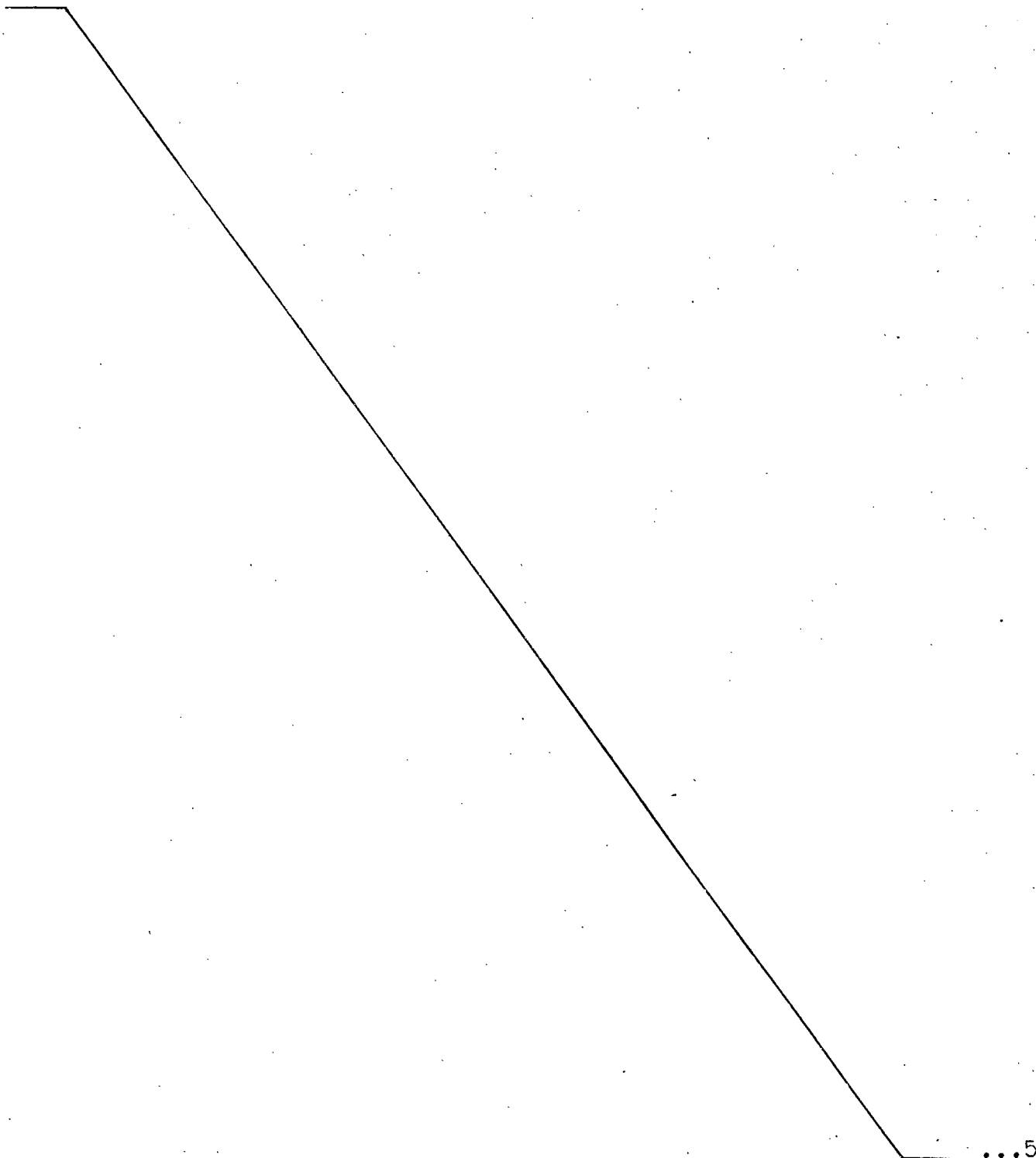


Fig.1 Distribution of herring fry in the Bays of Uala and Anapka in June 1959
 1- very little; 2- little; 3- medium; 4- many; 5- very many; 1-86 - station numbers

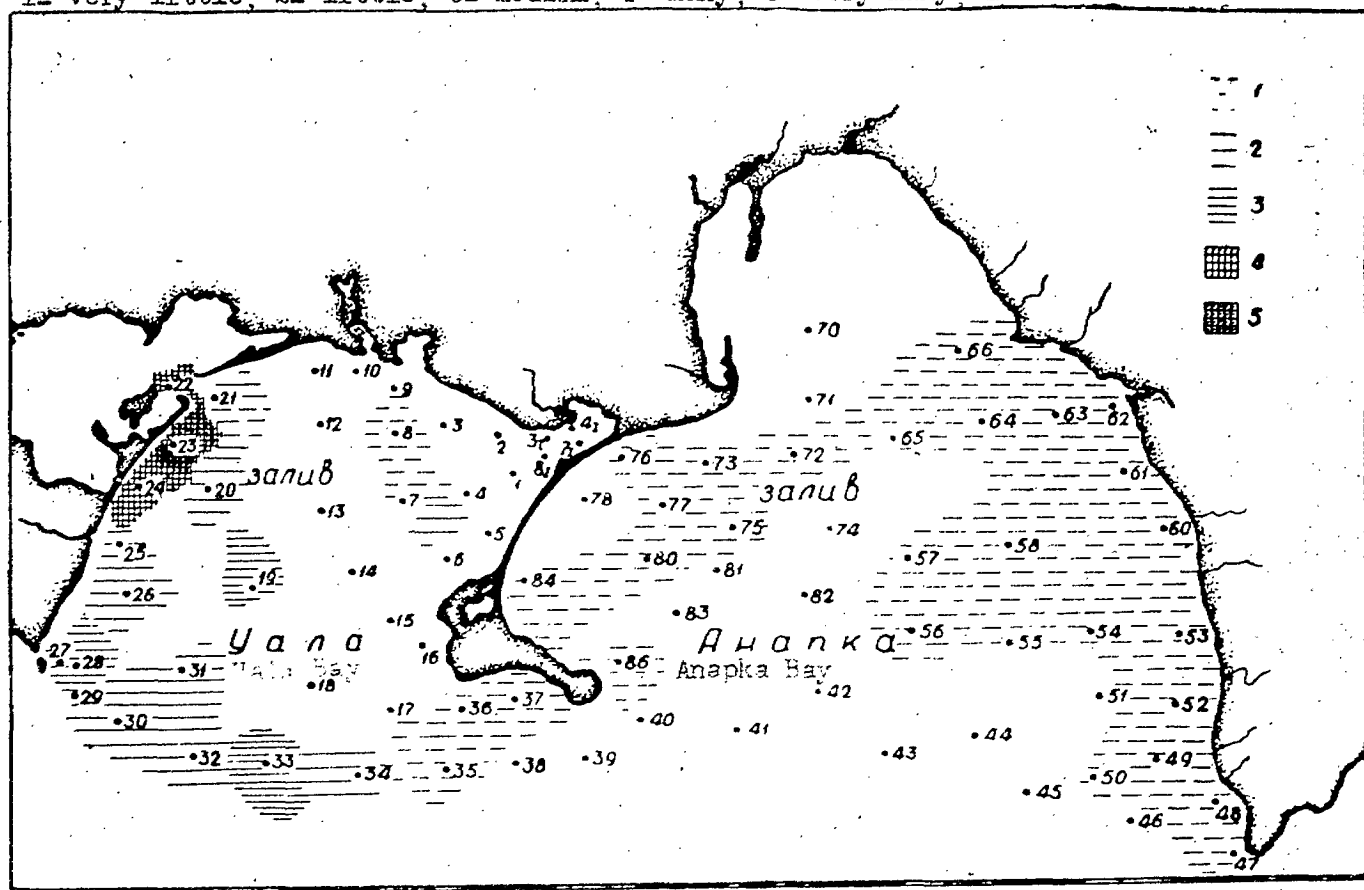


Рис. 1. Распределение личинок сельди в заливах Уала и Анапка в июне 1959 года
 1 — очень мало; 2 — мало; 3 — среднее; 4 — много; 5 — очень много; 1-86 — номера станций.

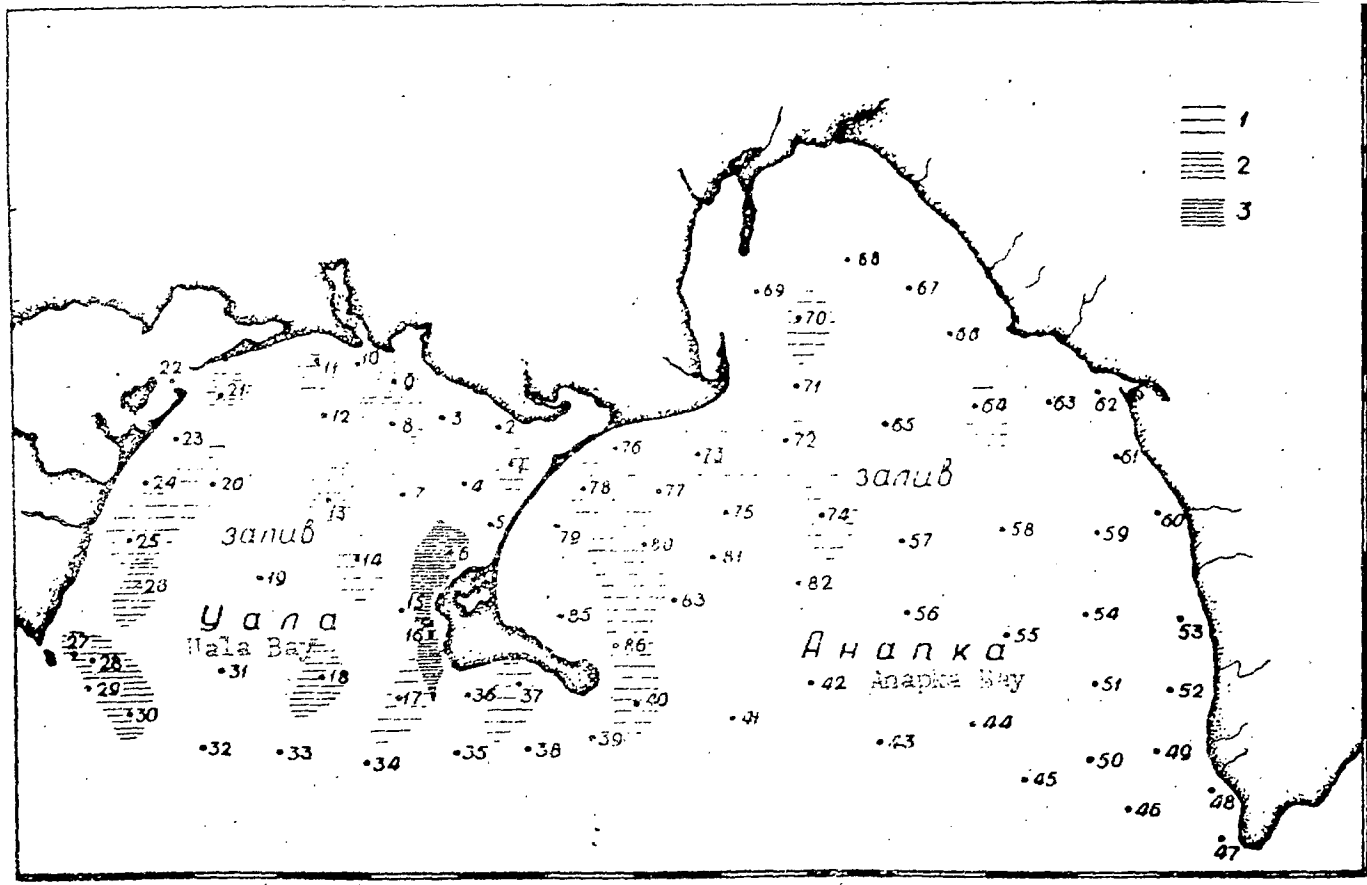


Рис. 2. Распределение личинок сельди в заливах Уала и Анапка в июне 1960 года:
 1 — очень мало; 2 — мало; 3 — среднее; 1-86 — номера станций.

Fig.2. Distribution of herring fry in the Bays of Uala and Anapka in June 1960:

1- very little; 2 - little; 3- average; 1-86 station numbers

seeded with roe, amounted to 23,590,000 m², while the area 324 of all the other sites of spawning was about 2,000 m². Therefore, when choosing the region for the study of fry distribution, we limited ourselves particularly to these bays.

In 1959 and 1960 the conditions for development of roe on the spawning grounds in the Uala and Anapka Bays were relatively equal. The spawning of herring took place in the first days of May. The water temperature at the spawning grounds was from 0.5 to 1.5°C at the beginning of embryonic development, 4.5°C during the development of the roe (sometimes it dropped to 1-1.5°C) and 10-11°C during the time of hatching of the larvae.

It should be noted that such water temperatures, particularly at the beginning of the embryonic development, are too low for herring of the Korf-Karaginskii population. It has been established in observations over many years that stable temperatures not lower than 3-4 C° (Panin, 1950) are required for a normal process of spawning and initial embryonic development. S.G. Kryzhanovskii, N.N. Disler and A.N. Smirnova (1953) attach great importance to the influence of water temperature on embryonic development. According to their data, the embryos of perch, which usually breed at a temperature of 10-15°C, placed in water cooled to 3°C and later transferred again into normal temperature, produced abnormal forms and perished.

When determining the density of the deposited roe, the percentage destroyed was computed for each spawning

ground (the determination was conducted on fixed material by counting eggs which became white). In those years, an increased mortality of roe was observed on all the spawning grounds. As has been mentioned earlier, the main cause of the loss could have been low water temperature at the beginning of embryonic development and sharp fluctuations of temperature during its later stages.

Very high losses of roe were observed in the Uala Bay in 1959 and 1960 (Table 1). Thus, in the region of the Shilka* Island a 100% loss of roe occurred in the stage of beginning segmentation. In other spawning sites, the loss of roe was somewhat lower. In 1960 more roe perished on all the spawning grounds than in 1959.

Roe on Zostera which is the main substrate, was frequently laid in 6-7 layers. In addition, the embryonic development of roe during those years coincided with great fluctuations of the water level on the spawning grounds, connected with tidal phenomena. Many spawning grounds became dry for 2-3 hours.

Table 1

Losses of roe in the stage of beginning segmentation (in %)

Year	Uala* Bay	Anapka* Bay	Area of Shilka* Island	Karaga* Bay	Ossora* Bay	Lozhnye Vesti* Bay	General average (weighted average)
1959	18.0	-	-	7.5	4.6	8.2	9.3
1960	42.0	13.0	100.0	8.0	-	28.0	33.9

*Translator's note:

Ostrov Shilka 59°52'N, 163°42'E (not shown on map 1:1,000,000 for Uala, Anapka, Karaga, Ossora, Lozhnye Vesti Bays see footnote p. 2 and 3.

L.A. Galkina (1959) calculates for the Gizhiginskaya Guba* population a loss of roe during the period of embryonic development as 30%.

According to her data, almost all the roe in the lower layers of the deposit perished and had a damaging effect on the development of the adjacent eggs.

It has been established during investigation of the spawning grounds that mass hatching of larvae in those years occurred on May 26, on the 26th day of development.

Immediately after hatching, the larvae of herring have an elongated transparent body bordered by a high fin fold. There are no rudiments of odd fins; in the paired pectoral fins, fin rays cannot be distinguished. The yolk sac is large, of oval shape. The head of the larva is slightly bent towards the surface of the sac. The eyes are large and pigmented. The length of the larvae at the moment of hatching is 7 mm. During the day, the larvae remain in the upper layers of the water. 325

In larvae from 13.5 to 18.5 mm the fin fold is considerably reduced; a well developed back fin forms in its dorsal part (fin rays are showing through). A thickening can be noticed in the place of the future anal fin. A fold of the hypural bone is observed in the area of the tail fin. In many larvae, 14.0-18.5 mm long, a dark green mass could be seen at the end of the intestinal tract (indicating beginning of feeding).

*Translator's note:

Gizhiginskaya Guba 61° 30'N, 158° 00'E

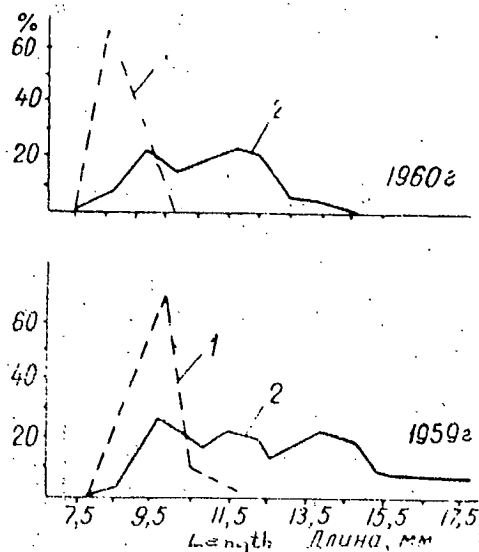


Fig.3. Classification by dimensions of fry in the samples of 1959 and 1960
 1 - with yolk sac; 2 - without yolk sac.

Since the hatching of all larvae did not occur at the same time, the length of the body in our samples varied from 7 to 18.5 mm (Fig.3). On the basis of curves of classification by dimensions, we can assume that in the years under consideration there were several peaks of hatching. This is very possible, because mass spawning was widespread and took place during a period of 20 days. Larvae with yolk sac and without it were observed in the samples. In 1959 larvae with yolk sac amounted to 14%, in 1960 to 10% of the catch. The average dimensions of the larvae were 11.0 and 11.8 mm correspondingly.

The smaller numbers of larvae with yolk sac and their larger dimensions in 1960 can be explained by the fact that times of sample collection in those years differed by almost

15 days, the periods of mass spawning being comparable.

The dimensions of the larvae with yolk sac varied from 7 to 11 mm, however their numbers were sharply reduced after reaching the length of 10 mm. Larvae 12 mm long had no traces of the yolk sack whatsoever. According to a description by M.Ya.Ievleva (1952), in small herrings developing in June 1949 the yolk sac was reduced earlier i.e. at the length of 8 mm. It should be also mentioned that in the hatching of the larvae in 1949 the length of the body was smaller (5 mm). Statements that fish of a greater body length have correspondingly bigger offspring (Meien, 1940; Toom, 1958), do not agree with our data, since in 1949 the average size of the parent fish equalled 34 cm, and in the years 1959 and 1960 it was 28.5 and 29.0 cm correspondingly. It is possible that in the given case the thermal regime at the spawning sites at the time of embryonic development had a negative influence. In May and June 1949 the water temperature was 2-3°C lower than in the years under study.

It is known from literature data that the quantity of deposited roe which survived is still not an indication of abundance of the future generation. A.N. Svetovidov (1952) and S.G. Kryzhanovskii (1956) note that the quantity of the fish fry which has survived is the main index of the pro- ductivity of a generation.

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The majority of authors assume that transition to active feeding is one of the decisive stages in the life of the fry of fish, in the course of which the highest mortality

is observed. It has been established that the strength of a generation of the Danube herring depends on the timeliness of development of the plankton on which the fry feeds (Vladimirov, 1953). The timeliness and density of the feed plankton for the young generation of Clupea harengus mebras in the Baltic Sea also determines its numbers (Rannak, 1958). However, Farris (1960) states that the mortality of the fry of pelagic fish approaches maximum up to resorption of the yolk sac and later decreases. He does not consider the beginning of active feeding to be a "critical" period in the life of fish fry.

According to our data, it is difficult to form an opinion as to the critical period in the life of herring fry.

For that purpose, special observations are necessary, combined with a study of the basic food, the salinity, the oxygen regime and the currents.

On the basis of absence of herring fry in collections from the coastal areas of the Uala* and Anapka* Bays in the second half of June. K.I. Panin (1950) put forward the assumption that herring fry, carried by tidal currents away from the spawning sites, get into the main flow zone of the steady current from the Olyutorskii** Bay, moving south along the eastern

Translator's note:

* see footnote on page 2.

** Olyutorskii Zaliv 60°15'N, 168°30'E

shore of the Kamchatka Peninsula. Thus, he proposed that, soon after hatching, the fry are carried into the areas of the Avachinskaya Guba*, and Kronotskii Zaliv*.

Because of lack of sufficient material we cannot present a pattern of migration of the fry in late stages of development.

In 1959, at the beginning of May, in the southern part of the Korf Gulf**two and three year-old fish were caught in large quantities at a depth of 35-40 m, using a herring trawl for varying depth. In September 1959, in the north-eastern part of the Karaginskii Bay south of Il'pyr Peninsula*** at a depth of 29-30 m, fingerlings of herring were fished (unpublished data by V.G. Prokhorov).

The absence of fry in the catches of K.I. Panin can be explained by the fact that he conducted surface fishing in areas very close to the spawning sites, while the fry does not stay long within the range of the spawning sites and soon move with the ebb current into the open spaces of the bay. Apart from that, on the basis of observations of the Sakhalin herring, many authors reached the conclusion that during the day, when starting active feeding, the fry stay in their mass in the layer of water with dispersed light (5-10 m), where feed is most abundant (Darda, 1960).

According to data of I.S. Pokrovskaya (1957), when

Translator's notes:

* Avachinskaya Guba (Bay) 52°56'N, 158°36'E; Kronotskii Zaliv 54°12'N, 160°36'E

** See footnote on page 1.

*** See footnote on page 3.

moving to active feeding, the fry meet in large quantities at the surface twice in 24 hrs, i.e. at 8 o'clock in the morning and at 8 o'clock in the evening. The herring fry of the Korf-Karaginskii population of that age, apparently, also dive into deeper layers of water.

It is necessary to mention that in the Uala Bay*, where spawning grounds extend along the whole shoreline, fry are not dispersed uniformly, but in a kind of separate groupings (see Fig.1,2). There are very few fry in the central part of the bay.

In the Anapka Bay*, in 1959 and 1960, the fry were dispersed uniformly, in spite of the fact that in 1959 spawning took place only in the middle part of the bay, at the eastern shore (in the area of the Peschanaya River*). Such distribution in the early stages indicates good mixing of the water by the tidal currents.

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