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ANALYSIS OF REPRODUCTIVE ABILITY OF THE MEDICINAL LEECH (*HIRUDO MEDICINALIS*) BRED UNDER LABORATORY CONDITIONS

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Analysis of Reproductive Ability of the Medicinal Leech (*Hirudo medicinalis*) Bred under Laboratory Conditions. Utevskaya O. M. — The following reproductive characteristics of the medicinal leech, *Hirudo medicinalis L.*, were measured under laboratory conditions: number of deposited cocoons, number of hatchlings per cocoon, weight of hatchlings and increase in weight after the first feed, mortality rate of young leeches. The regression analysis was used to calculate the correlation between characteristics listed above. The negative correlation was found between the number of hatchlings per cocoon and their weight, there is the significant positive correlation between weight of hatchlings after birth and increase in weight after the first feed. No correlation was found between the number of cocoons deposited by a leech and the average number of hatchlings per cocoon and also between the weight after birth and mortality in a period of the first six months after birth.
Key words: *Hirudo medicinalis*, reproductive ability.

Анализ репродуктивной способности медицинской пиявки (*Hirudo medicinalis*), разводимой в лабораторных условиях. Утевская О. М. — Были изучены следующие репродуктивные характеристики медицинской пиявки, разводимой в лабораторных условиях: количество откладываемых коконов, количество молоди в коконах, вес молоди при рождении, прибавка в весе после первого кормления, смертность молоди в течение первых 6 месяцев жизни. Были обнаружены отрицательная корреляция между количеством молодых пиявок в коконе и их весом, а также положительная корреляция между весом молоди при рождении и приростом массы после кормления. Не обнаружилось корреляционных связей между количеством отложенных отдельными пиявками коконов и количеством молоди в этих коконах, а также между весом при рождении и смертностью в течение первых 6 месяцев жизни.
Ключевые слова: *Hirudo medicinalis*, репродуктивная способность.

Introduction. Medicinal leeches, *Hirudo medicinalis L.*, and products obtained from their salivary glands are successfully used for treatment of numerous diseases. Unfortunately, capturing leeches for medical purposes led to their decline. However, the maintenance and breeding of these animals are possible under laboratory conditions. Furthermore, the study of same biological peculiarities inaccessible for observations in wild nature is possible under laboratory conditions, in particular, the study of reproductive ability.

The number of deposited cocoons and the number of hatchlings per cocoon were studied by Sineva (1944) and Zapkuviene (1972a), the growth rate was estimated by Zapkuviene (1972b) and Wilkin & Scofield (1991b), the possibility of the repeated cocoon deposition was established by Shchegolev (1948), the number of reproductive bouts was determined by Davies & McLoughlin (1996). Most likely, the reproductive characteristics are correlated correspondingly to one another, but this problem has been not understood until now. Understanding the relationships between reproductive characteristics is essential for selection of the medicinal leech. In addition, the study of reproductive characteristics will allow to understand the population dynamics in wild and elaborate the appropriate conservation strategy.

The purpose of this work was to study reproductive characteristics of the medicinal leech and determine relationships between them.

Materials and Methods. The medicinal leeches were bred under laboratory conditions.

Leeches were maintained in tap-water at the temperature of 18–22°C. The juvenile leeches were fed every 20–30 days (the first two feeds). The next two feedings were every 60–90 days. The period between the next meals was 4–6 month.

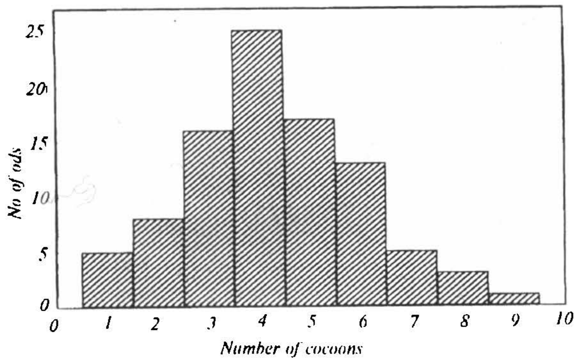

Fig. 1. Distribution of number of cocoons deposited by one leech.

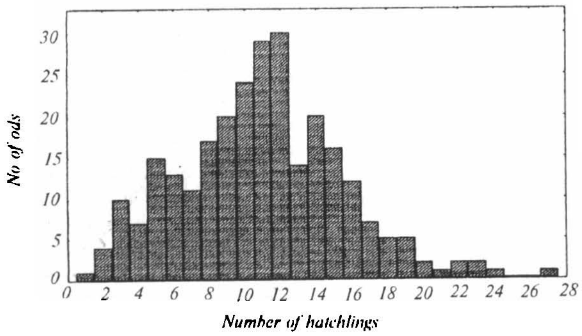

Fig. 2. Distribution of number of hatchlings per cocoon.

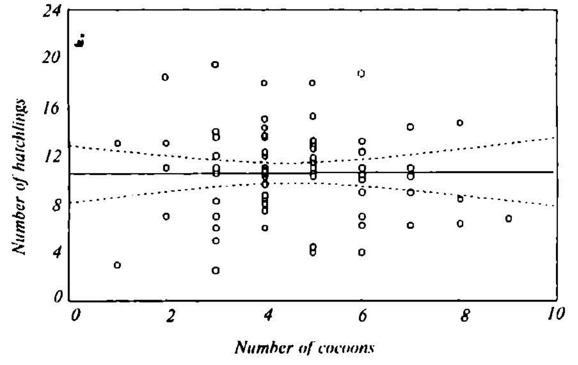

Fig. 3. Regression between number of cocoons deposited by a leech and average number of hatchlings per cocoon (correlation coefficient is 0.01).

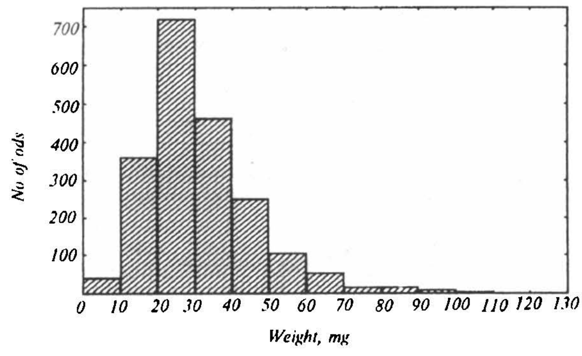

Fig. 4. Distribution of weight of hatchlings.

For the reproduction, the pairs of mature adults were put into containers with water for a month. A temperature of 25°C was maintained. After copulation, leeches were put individually into the containers with peat at 25°C for the cocoon deposition.

The cocoons laid during two months were collected and the posterity of each leech was studied. The following characteristics were considered: number of cocoons laid by each leech (for 93 leeches), number of hatchlings per each cocoon (for 269 cocoons) and their number after 6 months, weight of hatchlings after birth (for 2932 hatchlings) and after the first feeding (for 53 hatchlings).

Correlation between these characteristics was estimated by means of regression analysis. For this purpose, the programme STATISTICA 5.0 for WINDOWS was used.

Results. Of 139 leeches taken for the experiment, only 93 (66.9 %) laid 400 cocoons, others died or did not breed. The number of cocoons laid by one leech varied from 1 to 9 (Fig. 1); on the average 4.3 cocoons per leech were obtained. Of 400 deposited cocoons, 131 (32.75 %) did not develop, perhaps because of unfertilization or anomalous embryogenesis. 2932 leeches hatched from 269 cocoons (67.25 %).

The number of hatchlings per cocoon varied from 2 to 26 (Fig. 2), on the average 10.9 hatchlings per cocoon. The correlation coefficient between the number of cocoons laid by a leech and the average number of hatchlings per cocoon was 0.01. It means that there was no correlation between the listed characteristics (Fig. 3).

The body weight of hatchlings varied from 2 to 122 mg (Fig. 4), on the average 32 mg. The negative correlation between the number of hatchlings per cocoon and their average weight was found (Fig. 5), the correlation coefficient was – 0.4.

The large increase in the body weight took place after the first feeding. It varied from 2 to 5 times in accordance with the weight after birth. The significant correlation was found between the weight of hatchlings and increase in weight after feeding (Fig. 6), the correlation coefficient was 0.69.

However, it turned out that there was no dependence between the weight after birth and viability (Fig. 7). Correlation coefficient between the weight after birth and 6-month mortality was 0.09.

The mortality of leeches during 6 months after birth was considerable (about 30 %). The maximum mortality (about 22 %) was observed in the first two months of life (Fig. 8). According to our observations, the reasons of mortality were the following: the inability of leeches to find and to assimilate food, lack of oxygen, diseases and others.

Discussion. It follows from our investigation, that an average 21.1 hatchlings were born from each adult in a breeding period under favourable laboratory conditions. Taking into consideration absence of parental care, we would say that fecundity of the medicinal leech is low. Furthermore, *H. medicinalis* reaches sexual maturity in a long time. According to Sineva (1944) mature leech may reach in 12–18 months under laboratory conditions. Zapkuviene (1972b) used leeches over 1.5 g in weight for breeding and reported that this size may be reached in 6–12 months. Davies & McLoughlin (1996) found out that it takes 9.5 months to reach reproductive maturity of *Hirudo medicinalis* in a laboratory. However, this period may be much longer in natural populations; the development of poikilothermal leeches depends heavily on the environmental conditions. Young leeches cannot breed for at least a year, before the next summer coming. During this period, they are exposed to unfavourable natural factors which cause significant mortality. According to our data, the total mortality under favourable laboratory conditions for the first six months of life was about 30 %, in nature it is, undoubtedly, higher.

Low fecundity is compensated by long life and repeated breeding during several years. The possibility of repeated breeding of the

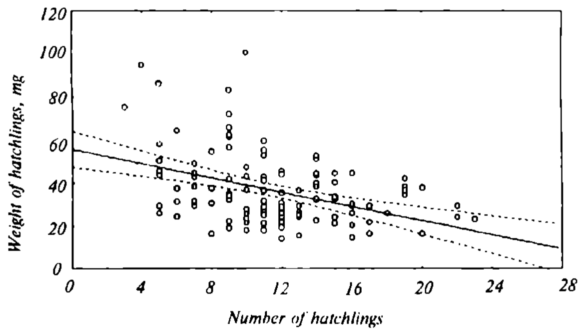

Fig. 5. Regression between number of hatchlings per cocoon and their weight (correlation coefficient is 0.4).

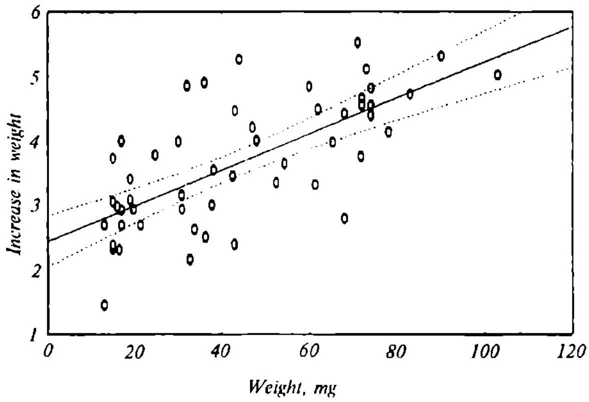

Fig. 6. Regression between weight of hatchlings and increase in weight after the first feed (correlation coefficient is 0.69).

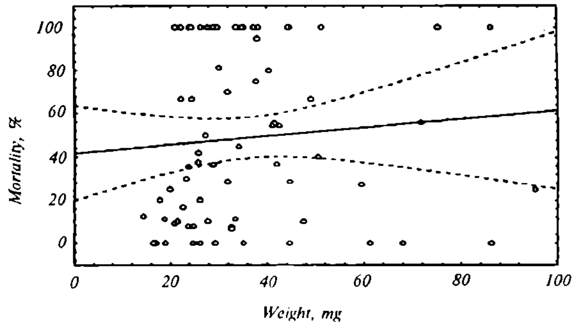

Fig. 7. Regression between weight of hatchlings and their mortality (correlation coefficient is 0.09).

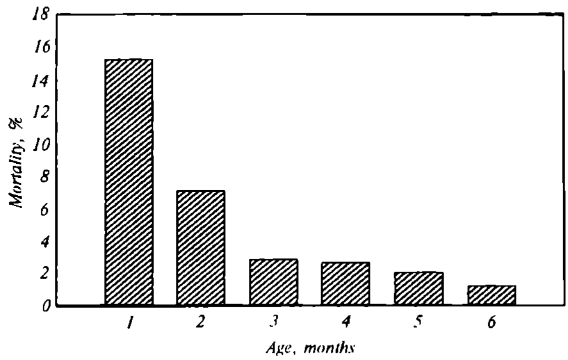

Fig. 8. Dependence of mortality on the age of leeches.

medicinal leech was suggested by Shchegolev's four-years studies (1948). The number of bouts of reproduction ranges from two to nine (Davies & McLoughlin, 1996). Wilkin et al. (1991b) carried out field studies with marked mature medicinal leeches during 2 years, and laboratory observations for more than 3 years (Wilkin & Scofield, 1991a). A part of leeches involved in our investigations had the age of more than 4 years.

Low fecundity is the cause of slow restoration of a natural population after destruction of its greater part; population is incapable to grow rapidly. For instance, the regular capture is an effective method widely used against the tsetse fly (*Glossina* sp.) which gives 8 larvas per a female at most and mosquito *Phlebotomus pappatasii* Scop. which lays 70–80 eggs, but such capture have no influence on the number of malaria mosquito *Anopheles maculipennis* Meig. which gives about 2000 eggs (Beklemishev, 1970). For this reason, the intensive capture of medicinal leeches and the general destruction of their habitats are serious threats for natural populations.

Considering absence of correlation between the number of deposited cocoons and the number of leeches per cocoon, it is likely that the total fecundity of a leech depends heavily on the number of deposited cocoons. The last parameter is defined by the size and, consequently, resources of the maternal organism (Zapkuviene, 1972a).

The wide range of body weight (from 2 to 120 mg) is dueto different cache for leeches in the embryo. It is known that size of hatchlings is determined by relationship between the size of a cocoon and the number of eggs in it (Zapkuviene, 1972 a). Our investigations have verified the occurrence of the negative correlation between the number of hatchlings per cocoon and their average weight. It means that the smaller is the number of leeches per cocoon, the greater is their weight, and conversely.

As a rule, the big juveniles are more competitive, they are able to assimilate food and to stand stresses better than small ones. It has been showed in this paper that the larger is a leech, the greater is increase in weight after the feeding and, consequently, the higher is the growth rate. Such fact was noted by Zapkuviene (1972b) who reported that the differences in size of hatchlings did not decline during the following development but became more conspicuous. The rapid growth results in sexual maturation in a short time. Thus, the possibility of early reproduction is an advantage of big juveniles in comparisonwith small juveniles which have a numerical superiority.

However, it turned out that the leech size after birth does not exert influence on the viability. It should be noted, that data for laboratory population which was mantained under favourable conditions without intraspecific competition may not be true for natural populations. Perhaps, under natural conditions big hatchlings have an advantage in rate of movement, search of food and ability for long starvation.

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