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ANALYSIS OF OPHISOPS ELEGANS (MÉNÉTRIES, 1832) AND ITS LIVER

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Abstract

In the lizards *Ophisops elegans*, which are active during the daylight hours, a black layer covers the body cavity to protect their internal organs from the harmful effects of the sun. This layer is absent in newly hatched lizards and develops later. This layer is also used to accumulate heat. This black veil does not form in the lizard *Teniudactilus caspius*, which is mainly active at nights. Population density of *Ophisops elegans* is not high in places with no vegetation. Vegetation also affects *Ophisops elegans* distribution. There is a relationship between this lizard and the presence of vegetation. In lizards exposed to stress, most of the blood is retained in various organs and the amount of circulating blood decreases sharply.

Key words: *Lizard, liver, organs, histology, tissue*

1. Introduction

Ophisops elegans inhabits in Azerbaijan, Turkey, Georgia, Iran, Armenia, Pakistan, Bulgaria, Greece, Cyprus, Libya, Egypt, Syria, Lebanon, Israel, Jordan, Iraq, India and North Africa. This species is included in the list of LC (Least concern). Specifically, it is classified as an unprotected species by the International Union for Conservation of Nature (IUCN) because of its large number in nature. The species Ophisops elegans was scientifically studied by Menetries in 1832 and included in the literature. Wiegmann, three years after Menetries's description of the species, examined a snake-eyed lizard in Syria and named it *Amystes ehrenbergi*. Nowadays, the descriptions given by him are known to belong to the subspecies *Ophisops elegans ehrenbergi*.

2. Materials and Methods

This research was carried out on the basis of a scientific work registered at BSU on April 04, 2021 under the number 3/262. Researches were conducted at the Department of Zoology and physiology of BSU and the Central Scientific Research Laboratory of AMU in 2021-2024. Snake-eyed lizard - Ophisops elegans (Menetries, 1832) spread in the territory of the Azerbaijan widely (Najafov et al., 2014) were used for histological researches. For this purpose, expeditions were organized to various areas. Appropriate methodological methods were used to conduct histological analysis of slides from different organs of lizards. Incisions from the organs tissue of lizards were sampled and fixed in 5-10% formalin [Najafov & Hashimov, 2014, Najafov & Hashimov, 2021]. In preparation of tissue slides, histological incisions were made both longitudinally and transversely. Paraffin-impregnated blocks were prepared from these samples, and 4-5 μm thick incisions were made [Najafov et. al, 2022], using a digital microtome, and transferred to the glass [Hashimov et. al, 2023]. Subsequent histological and cytological studies were performed in the laboratory [Najafov & Hashimov, 2019]. Initially deparaffinized samples of tissues were stained with Giemsa stain, hematoxylin and eosin stain. After the preparation the slide observed under the microscope [Hashimov & Najafov 2023, Najafov & Hashimov, 2023].

3. Results

Temperature, average amount of sunlight, partial pressure, and harsh winter season, amount of rainfall, altitude of the area and density of predators are the main factors affecting the distribution of *Ophisops elegans* species. It is a well-developed free-living lizard with no eyelids. Female individual lays 1-7 eggs [Hashimov, 2022]. Altitude significantly affects the vital characteristics of this lizard. This lizard is widespread in open plains with partially firm soil [Vitt et. al, 2003], arid areas with sparse vegetation. Nevertheless, this lizard can also be found on the edge of forests. The main reason why this lizard is not found in places with dense forest or dense vegetation is its inability to thermoregulate. Lizards unable to receive enough sunlight cannot activate vital enzymes in their body[Najafov & Hashimov, 2014]. In such a situation, producing vitamin "D" in the skin also weakens [Abaszade et. al, 2022]. Vitamin D is vital for the lizard's body [Orudzhev et. al, 2022]. It is of great importance for the assimilation of calcium and phosphate, for the ossification process, the transmission of nerve impulses, and for the tone of skeletal muscles. Food intake is impaired in lizards with vitamin D deficiency. Warmth, the inclination angle of the area less than 25^0, the vegetation (not dense) are important factors for the distribution of this lizard. In Turkey, this lizard is often found in fields, so it is also called field lizard. Population density is not high in places with no vegetation. There is a relationship between this lizard and the presence of vegetation. Vegetation also affects its distribution. Hellmich wrote that in 1969, while conducting research in the east of Turkey, it was also found at an altitude of 2300 meters. It is known to be found in Iran at an altitude of 2500 meters. For this lizard, the amount of quarterly rainfall above the limit of 260-280 mm and below the limit of 35-40 mm is a limiting factor. Annual rainfall of 350-700 mm is optimal for this lizard. The sharpness of the slopes is not a limiting factor for this lizard. We determine that the Bozdagh ridges station of Mingachevir city (height 545m above sea level, 40°46'latitude; 47°05'longitude) has the most favorable conditions of Azerbaijan for the inhabitance of the *Ophisops elegans* lizard from the selected stations in the semi-desert, dry steppe landscape of the Jeyranchol-Ajinohur lowland. This area can be used as a model for the lizard *Ophisops elegans* in the subsequent research of scientists [Berdzenishvili et. al, 2016].

The histological structure of the liver [Darevsky, 1989] is one of the organs most affected by external influences. This is due to its high functionality. The lizard's liver is the largest of the digestive glands and is a dark brown organ. Its right lobe is larger than the left one. Capillaries observed in the liver are the largest diameter capillaries. A large number of capillaries are observed in the liver. Blood from most of the small intestine comes through the hepatic portal vein and passes through the liver. Only complex lipids (chylomicrons) from the substances excreted from the intestine pass to the lymphatic capillaries and are transported to the blood through the lymphatic system. In the embryonic period, the liver performs a hematopoietic function, and in the postembryonic period, it may be of various importance, such as cleaning harmful products of metabolism, being involved in metabolism, preparing auxiliary substances for digestive enzymes, and storing various substances and vitamins. When the blood passes through the liver, proteins with various functions join it and it is freed from chemicals that are destructive to the organism. The hepatic artery and the hepatic portal vein enter the liver. Hepatic vein, lymphatic vessels and right-left channels leave the liver. These vessels and ducts originate from the liver follicles. Hemosiderin and ferritin accumulate in the liver because of the breakdown of erythrocytes. These substances are delivered to the hematopoietic organs through special carriers. The liver is also involved in the synthesis of substances that make up the blood plasma. For example: fibrinogen, albumin proteins.

The liver is covered with Glisson's capsule, which is a thin layer of connective tissue. It is composed of fibrous connective tissue. The components of this connective tissue also enter the liver. The arteries, veins, and lymphatics that enter the liver are located within a tree root-like network formed by these connective tissue components. But the veins coming out of the liver lack that connective tissue. Blood and lymphatic vessels, bile ducts and nerves pass through the hilum, located at the bottom of the liver. The capsule covering the liver consists of two layers that are firmly connected to each other. The outer layer of the capsule is the serous, and the inner one is fibrous. Although the outer serous layer covers only surface of the liver, the collagens of the inner fibrous layer extend to the sinusoids. In the lizards under the study, it is not possible to observe the formation of lobules inside the parenchyma tissue of the internal collagens of the capsule with a light microscope. Masson's trichrome is the dye we use to study collagen fibers. In this case, collagens are dyed blue, muscles red, and nuclei black.

The hepatic artery and the veins called the hepatic portal vein enter the liver and branch internally. Since the bile duct is always observed next to the veins, these structures together are called the triad. Apart from these vessels, there are also lymphatic vessels in the liver. Arteries in the triad have a smaller diameter than that of veins. In the wall of the veins of the triad, the smooth muscles very poorly developed, but in the parts of these veins before the branching, normally developed smooth muscles can be observed. Blood capillaries branch off from the veins of the triad and form a network called sinusoids within the veins. The blood in the sinusoids moves from the periphery of the veins to the central vein. The diameter of sinusoids can be in the range of 0.05-25 μm. Typically, up to half of the blood capillaries in the lizard's other organs are too narrow in diameter to enable only plasma to flow. However, such a situation is not observed in the sinusoids of the liver. Since the diameter of the sinusoids is large, the speed of the blood flow here is also low. Blood can be stored in the liver of stressed lizards. In stressed lizards, most of the blood is stored in various organs and the amount of circulating blood drops sharply. When we cut the head of a stressed lizard to take blood, we notice that very little blood was injected into the head. The chemical composition of the blood flowing in the capillary vessels of the liver also differs from other organs and has a mixed character. When we observe the livers of lizards by stationaries, the diameter of sinusoids is determined to decrease as the height above sea level increases, but the number of sinusoids per unit area increases. We also analyze the liver of lizards using the EPR method [Huseynov et. al, 2021, Ismayilova et. al, 2021, Yarbasi et. al, 2011].

Hepatocytes and sinusoidal endothelial cells, which are gathered around the veins, together are considered the main structural unit of lobules. Unlike the human liver, these lobules also contain melano-macrophages. In lizards, the network of thin fibers extending from the central canal to hepatocytes and endothelial cells develops very weakly. The adjacent side walls of the endothelial cells of the sinusoids in the liver of the lizard also contain micropores. Kupffer cells locate between the endothelial cells. The blood coming through the sinusoids accumulates in the central vein, which in turn accumulates in the sublobular veins. There are fewer sinusoids towards the periphery of the liver. But in the center of the liver, a dense capillary network is visible. Lizards do not have bile ducts near the sublobular veins. The sublobular veins and central veins in lizards are always open because they must constantly receive blood. It is due to the fact that these vessels are tightly connected to the surrounding tissue and almost no muscles of the thigh are found in their wall. The wall of the veins of the central nervous system of the lizard has the same structure, and the muscles of the jaw are not found inside. Endothelial cells covering the inner wall of these veins are large sized and form depressions and protrusions. The endothelium is covered by a basement membrane, which is connected to fibrous connective tissue.

Inside the liver, hepatocytes, Kupffer cells, stellate (ITO cells) fat-storing cells and endothelial cells of the liver predominate. The main structural and functional unit of the liver is hepatocyte cells. They make up to 70% of the cells observed in the liver. These cells generate ribbon-like structures located next to each other. Sinusoids are the reason for the ribbon-like structures. Most of the hepatocytes are polyhedral epithelial cells of relatively large size, round-like shape, with a large nucleus. Although most of the hepatocytes of the lizard have one nucleus, there are also those with two or more nuclei. In most of these cells, the nuclei are displaced to the periphery, and their shape is round or partially elliptical. In the lizards we study, hepatocytes produce small interconnected groups. These cells store glycogen, vitamin B12, folic acid, pigments and iron. They are involved in the transformation and transportation of substances and prepare bile. In lizards leaving their shelter mainly during the day, glycogen synthesis in the liver increases in the evening, however bile production increases during the day.

Liver sinusoids are low-pressure blood capillaries. They take blood from the terminal arteries and portal veins and slowly transport it towards the central veins. The cavity of sinusoids is called sinusoidal lumen and this cavity is mainly covered by endothelial cells. Endothelial cells may include Kupffer cells and T-lymphocytes. Perisinusoidal area (Disse area) locates between endothelial cells of sinusoids and hepatocytes. Kupffer cells, which perform a protective function, are of monocytic origin and are local macrophages of the liver. When needed, these cells can enter the bloodstream and become free macrophages. Fat-storing stellate cells, pit cells (natural killers of the liver) and mesenchymal stem cells (MSC) are also observed in the Disse area. Drops of lipid origin are also observed in the cytoplasm of stellate cells. The mitochondria in these cells are very few. They also store fat-soluble vitamins. Microvilli of hepatocytes are connected to the interior of sinusoids and ensure absorption of plasma substances by hepatocytes. Pit cells are the natural killers of the liver and have specific granules. These cells originate in the red bone marrow and reach the liver through the blood. Pit cells are involved in the destruction of cells damaged by cancer and viruses. Ito cells (stellar cells) are of mesenchymal origin located in the perisinusoidal space (Disse area) of liver lobules. These cells turn into myofibroblast-like cells when a pathological condition occurs, synthesize a large amount of collagens outside the cell, and cause collagenization of the area. Ito cells are also actively involved in liver regeneration.

4. Discusion

As a result of our research, we can conclude that there is a population living at an altitude of 1500 meters. Foreign literature (Anderson, 1999) writes that they are found at an altitude of 2500 meters. Taking into account the density and number dynamics of the observed lizards, the optimum height for this species is determined to be 500-800 meters. The analysis of the populations living in areas higher than 1200 meters shows that the average height of the individuals found in the populations upsurges as the altitude increases. It is observed mostly in male individuals. The biological lifespan of these lizards is longer in high-altitude lizard populations. When we study the populations living at an altitude of 500-700 meters and above 1200 meters, it is found that the age of sexual maturity for males and females of this species is three years. That is, individuals of this species reach sexual maturity by the age of three. LAGs (lines of arrested growth) are used to determine this age. These lines, observed in the bones (skeletochronology), which are detected in some mammals as well as in cold-blooded animals, provide complete information about the age of the animal. Knowing the habitat optimums of this lizard, it is possible to determine the potential distribution areas of this species.

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