MORPHOLOGICAL CHANGES OF ORGANS DURING ONTOGENY OF MOOSE (*ALCES ALCES*) COMPARED TO DOMESTICATED RUMINANTS

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ABSTRACT: The ontogenesis of body mass, the skeleton, organs of the alimentary tract, and the endocrine system of moose (*Alces alces*), cattle, sheep, and goats were studied in the Ivanovo region using morphological and ontogenetic methods. We noted that changes in the rates of growth and development of body mass and some organs were connected with their functional characteristics in different periods of development. Histological studies showed that decline in growth rate of all the organs were accompanied by an increase in complexity in their structural organization. Moose had earlier formation of thyroid and adrenal glands, thymus, ossification centers in the skeleton, and of characteristic structures in the organs of the alimentary tract in comparison with domestic animals.

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Comparative ontogenesis of body mass, skeleton, alimentary tract, and endocrine system of moose (*Alces alces*) and other ruminants are given in the report. Characteristics, similarity, and differences in moose, goat, and cattle development are revealed.

MATERIALS AND METHODS

The material for moose research was taken both from dead animals and those specially shot in the Ivanovo region. Shooting of moose was conducted systematically during the last 2–3 days of every month for the purpose of age selection, focusing in particular on development of fetuses.

When defining the age of moose we considered the season of their collection and estimates of age derived from the tooth wear. Six regions of Ivanovo district provided the material for cattle, sheep, and goats. Sex and mass of all animals were recorded. Internal organs were taken from dead animals. The skeleton was cleaned of soft tissue. Materials were not allowed to dry because that would have changed their mass. Bones and internal organs were weighed. The volume, linear dimensions, and mass of bones and internal organs were measured prior to fixing in alcohol–ether for further investigation. Histological preparations were made by encasing samples in paraffin prior to slicing. Microscopic sections were stained by haematoxylin–eosin.

RESULTS AND DISCUSSION

Observations over several decades in Ivanovo region let us draw the following conclusions. The number of moose in our district is increasing every year. Moose are recorded in every region. Moose in our region have become accustomed to the presence of humans. Sometimes they come to settlements, parks, and even industrial areas. Meeting moose in the forest is a common occurrence.

In our region adult moose are 180–200 centimeters in height, 180–190 centimeters in length, and have a mass of 400–450 kg.

Thus the moose in Ivanovo district are very massive animals. Sexual maturity is achieved when moose are 1.5 years old. The rut occurs mainly in September, but in some cases mating may take place in October. Duration of the rut is related to the fatness of moose at that time. According to our observations, pregnancy of moose females lasts 7.5 months. Young moose are usually born in May. Moose females have few outward signs of pregnancy. They usually bear two calves (86%) and young individuals bear only one. Moose twins are usually of different sexes (67%), and seldom are of the same sex (33%). Unisexual twins are usually males rather than females. Hair covering of young animals, 2.5 months of age, has a bright red color and is abundantly smeared with oils. When young moose are 2.5 months old they begin to shed hair. Shedding of hair begins in the area of the ulna, knee–joint, and surface of the abdomen, then it spreads to the sides of the body. Shedding ends when young moose are 4 months old and hair covering has the appearance of an adult.

In studying age characteristics, we ascertained that moose growth takes place primarily within one period of great intensity and then declines. In fetus development, growth is high during the first half of pregnancy and decreases by the time of birth. In the postnatal period, increased growth takes place from birth until 2 months (sheep), 3 months (cattle), or 6 months (moose). Increase of mass during the first 6 months of life is 10–fold in moose compared with a 5–fold increase in cattle, and moose of that age are 41% of adult mass, whereas cattle are 28% of their adult mass. Growth subsequently decreases gradually until adult size is reached. It should be mentioned that the period from birth to 6 months of age in moose must be used as much as possible for creation of favorable conditions for the purpose of growth and development. Fetus development of moose occurs quicker than that of cattle and is comparable to the development of sheep and goats, having shorter terms.

Moose and cattle fetuses aged 3 months have different attributes. For example, moose have more height at the shoulder, a longer helix, and a shorter tail. At 5 months, the moose fetus has a body covered with short hair (cattle achieve this only during the eighth month of fetal development). On the basis of comparative studies of body formation in moose ontogenesis, we believe that moose grow quicker after birth than they do during fetal development.

Skeletal growth takes place with the same regularity as body formation. We noted that the growth of the peripheral skeleton of moose prevails over axial growth during development of the fetus but after birth this pattern reverses. The appearance of centers of ossification occurs in moose in the same pattern as in cattle. The main difference is that centers of ossification in moose occur earlier than in cattle, but the age coincides with sheep and goats.

The process of ossification of wrist bones differs in moose and sheep. In moose, ossification occurs from medial to lateral, and in cattle and sheep it occurs from lateral to medial. Hence, it appears that a great load in moose falls on medial bones of the wrist rather than on lateral bones, and in cattle and sheep it is the opposite. Differences in patterns of ossification of wrist bones thus depend on characteristics of locomotion, which evolved in connection with different life history requirements.

Summarizing the results of alimentary tract research in ontogenesis of moose, cattle, sheep, and goats, we drew the following conclusions. Stomach and intestine grow irregularly. On the whole they grow rapidly in moose and cattle through the fourth month of fetal development (in sheep, 2–3 months). An intensified growth of the

alimentary tract occurs in moose fetuses but that growth takes place after birth in cattle.

Growth of the stomach and intestines in moose basically ends at 1.5 months of age whereas in cattle it is still in progress. Stomach chambers of these animals grow simultaneously but unequally. The reticulum and omasum of cattle, sheep, and goats grow in the same way as the stomach as a whole, with great intensity in the postnatal period, but the abomasum grows more quickly, especially in volume, during fetal development. Only the rumen in moose grows more intensively after birth, but the reticulum and omasum grow rapidly during fetal development. Intestines as a whole grow more rapidly during fetal development. The rumen and large intestine are better developed in adult moose in comparison with cattle, sheep, and goats, which in turn have greater development of the abomasum, omasum, and small intestine.

Endocrine system formation occurs earlier in moose than cattle, sheep, and goats. Fetuses aged 2–2.5 months showed formation of thyroid, thymus, and adrenal glands. The first signs of their functioning were detected at 3–3.5 months of fetal age. The first signs of thymus involution – an indicator of sexual maturity – were documented in a 1–month–old moose.