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Comparison of Methods for Counting Hoofed Animal Density in Sikhote-Alin

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ABSTRACT

During four months in the winter period of 2002–2003, a census of four species of hoofed animals (red deer, sika deer, roe deer, and musk deer) was conducted in the study areas of the Sikhote-Alin Reserve and the surrounding area, including the territory of the planned Reserve Tavayza. The census was conducted on a monthly basis at two sites in the pine and broadleaved forest (nature Reserve and surrounding area) and at three sites in the oak and broadleaved forest. A total of 40 counts were made. Five fieldworkers were working at each site for two days. During the first day, the fieldworkers counted daily hoof prints and removed them. During the second day, newly appearing hoof prints were counted. In addition to the usual counting of crossings of hoofed animals, the number of individual animals was counted, as well. Thus, the census was conducted by two methods: counting of hoof prints in the tracks and counting of individual animals in a certain area. The results of these surveys were organized into a database which shows the relative density of hoofed animals (number of crossings of hoof prints per 10 km of the route) and absolute density of hoofed animals (number of individuals per km^2). The analysis of absolute density of hoofed animals in different habitats and its correlation with the number of hoof prints per 10 km was performed.

Introduction

To assess the state of the population of hoofed animals, it is first necessary to determine the spatial distribution and abundance of the species under study. Among the main parameters are population size and density. Determining the abundance of animals is an important issue.

The resulting information is essential for areas where wildlife is protected, as well as for hunting farms where the resources from hoofed animals are used. Winter route counting of hoof prints of large mammals are traditionally used in all protected areas and hunting farms in Russia. However, there are different methods of counting of hoof prints and different ways of calculating the density of a species. Because of this, the obtained density values vary significantly.

Materials and Methods

A census of hoofed animals with the purpose of determining the density of their populations was conducted in the Terney area of Primorsky Krai during the winter of 2002–2003. Five study areas were selected, two were in oak forests at an unprotected territory of

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the planned Reserve Tavayza (Vtoroy stream, tributary of Skrytaya River, Serebryanka River basin, Russkaya River which flows into the Sea of Japan). One site was selected in a valley forest at an unprotected territory of the same nature reserve (Signalnaya River, tributary of Zabolochennaya River), and another one was located in a pine forest at an unprotected territory along the Nechet stream (tributary of Tayozhnaya river). The final-territory was in a pine forest at the territory of the Sikhote-Alin Reserve also along the Nechet stream. The average size of the study area was 9 km^2 each. Five fieldworkers taking parallel routes were engaged in field work. Terrain was taken into account during route plotting. The census was conducted monthly in December through March for two consecutive days in each study area, and the number of animals was determined for each day of the counting. In addition to determining the number of animals in the study area, the fieldworkers counted all of the crossings of hoof prints in their routes, using the same method that is used during the traditional winter route counting.

On the first day, the fieldworkers counted daily hoof prints and removed them. On the second day, newly appearing hoof prints were counted. Each study area was divided into routes for five fieldworkers in such a way that the distance between the routes was approximately 250 m. The routes were plotted in parallel to each other where it was possible due to terrain. In other cases, circular routes were plotted in fan-shape fashion.

Each fieldworker was given a copy of the map at a scale of 1: 25,000 with the plotted route. The fieldworkers counted hoofed animals on the route by two methods: a) by counting all hoof print crossings as is performed during the winter route counting and b) by calculating the number of individuals by their hoof prints and indicating the direction of their movement as is done during areal counting. Additionally, during the first and the second days, the fieldworkers tracked small segments of the path to determine: a) the direction in which the animals left the path i.e., inside or outside of the area under study, and b) if different hoof prints belonged to a single individual. In addition to the records, the fieldworkers marked animal routes on the map. As a result, the entire area was divided into study corridors by study routes.

During data analysis, the number of animals that were inside each study strip was counted separately, and then the data were summarized for the entire study area. As a result, we had all of the animals' paths mapped out. Analysing the direction of the paths, we determined the number of individuals in the study strip. When determining the number of individuals, the following was taken into account: a) the path of a hoof print tracked by the fieldworker, b) the number of individuals and the freshness of the hoof print, c) the location of hoof prints of this animal on the next day, and d) the distance of oppositely directed paths from one another (at a distance smaller than the diameter of the daily hoof print these prints were considered as belonging to the same animal). The hoof print of a startled animal was equivalent to a visual contact and counted as an animal inside the study area at the time of registration.

The differences of this method from that used for animal census in the study areas at hunting farms are as follows: a) hoof print crossings are calculated as during the winter route counting, b) a differentiated approach to calculation of the animals with an equal number of incoming and outgoing hoof prints, and c) taking into account the daily print path determined by additional tracking during the first or the second day of the study. Thus, two indicators of animal abundance were obtained for each study area.

1. The number of hoof print crossings per 10 km of the route (winter route counting indicator): $\frac{S \times 10}{m}$.
   S — being the total number of crossings on the route, m — length of the route in kilometres.
2. The number of individuals in a given area: N.

A total of 40 surveys were conducted in the study areas, with the total length of the route taken into account being 1314.4 km. Calculations of the density of animals in the study areas were performed by three methods: a) by the method adopted at hunting farms in which the difference of the incoming and outgoing hoof prints is calculated (Rusanov, 1973) by the differential method used by our group, which is based on the method of double-checking and tracking of hoof prints of individual animals to determine the paths of incoming and outgoing prints, taking into consideration the location of the animals on the second day of the study, and c) traditional winter route counting method, using the well-known Formozov's formula (1932), with corrections from Malyshev (1936) and Pereleshin (1950) to convert the relative indicator of the winter route accounting the absolute density:

$$Z = \frac{1,57 \cdot S}{d\ m}.$$

Z — being the total density per 1 km^2, S — the number of hoof prints, m — route length in km, d — the length of the daily path in km.

The data were analysed using standard statistical methods (Rokitsky, 1973). The computer program STATISTICA for Windows 5.0 (StatSoft, Inc., 1999, Tulsa, Oklahoma, USA) was also used.

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Comparison of Two Methods of Calculation of Hoofed Animals

Five species of hoofed animals were registered in the following study areas: roe deer *Capreolus pygargus* Pallas, 1771; red deer *Cervus elaphus* L., 1758; sika deer *Cervus nippon* Temminck, 1838; musk deer *Moschus moschiferus* L., 1758; and boar *Sus scrofa* L., 1758. Hoof prints of boar were spotted only in two study areas in the pine forest due to low abundance of the animal during this winter. Therefore, the results concerning boar were excluded from the analysis.