Behavioral activity of Ursus arctos brown bear in zoo conditions

T A Moiseeva
Department of Zoology and Ecology, Petrozavodsk State University, 33 Lenin Street, Petrozavodsk, 185000, Russia
E-mail: tima3909@rambler.ru

Abstract. The article is devoted to observing the behavior of brown bears in a zoo using time slicing method. For each of the experimental bears, time budgets were determined - a system of indicators characterizing the distribution of time expenditures by types of use, and their detailed analysis was carried out. It is concluded that in the time budgets of the experimental bears, two forms of behavioral activities predominate: circular walking, which is a form of undesirable behavior in bears and at the same time a way of adapting to the conditions of the zoo, means to throw out the accumulated energy, and lying down is a lack of physical activity, which is most pronounced in a young female. Normal forms of locomotor activity typical of brown bears - standing on their hind legs, scratching on the grate - are less represented in zoo bears. Also, using the Shannon index, the diversity of behavior of the experimental bears was assessed. The greater diversity of behavior in the adult male than in the cubs, the authors associate with the greater adaptation of the adult bear to the conditions of the zoo.

One of the main tasks of modern ethology (the science of animal behavior) is to maintain the well-being and full natural behavior of animals in zoos. Bears are a group of carnivorous mammals that tend to exhibit a high level of pathological behavior in captivity, which makes these animals a convenient object for studying the causes of undesirable behavior of wild animals in zoos [1-5].

The purpose of this work is to identify the features of the behavioral activity of brown bears in a zoo.

The material for the study was collected in the summer 2019 on the basis of the Zoolesye Ecopark (Petrozavodsk, Russia).

The objects of the study were 3 brown bears:

- an adult 3-year-old male named Barney;
- two bear cubs of different sex: male Zhenya and female Toptyzhka (they are distinguished by a strip on the back, the male has it).

The behavior of an animal is a continuous stream of events. In order to measure this flow, it must be divided into discrete units or categories, which is achieved in the process of compiling an ethogram. The etogram is a list of motor acts and fixed body positions characteristic of a given animal - behavioral patterns [6]. In the process of preliminary observation of the animals, we identified the behavioral patterns most characteristic of these bears, and on the basis of this we compiled ethograms.
that reflect the entire sequence of behavioral acts in experimental bears, which makes it possible to thoroughly study their behavioral repertoire.

We found that the bears living in the Zoolestye Ecopark are characterized by normal forms of behavior for this animal species, namely:

- No motor activity: sitting, lying, standing, watching;
- Normal physical activity: stands on its hind legs, itches on the grate, sucks and licks the paw, rolls on its back.

We also noted a form of physical activity unusual for bears in the wild - walking in a circle (pacing).

Next, we conducted an experiment to observe the behavior of brown bears in a zoo using the time slicing method. The essence of this method is in “point” or “instant” descriptions of the state of the observed object, produced at regular intervals [6]. We took measurements for 14 days every day in the evening, before feeding the animal, each measurement for 30 minutes, with an interval of 1 minute. Based on the measurement results, 14 registration tables of bear behavior patterns were compiled.

Based on the data obtained for each of the three bears, we have determined time budgets - a system of indicators that characterize the distribution of time expenditures by types of its use. To calculate the time budget, we used the proportion of registrations of the corresponding form of behavior among all 7 registrations (slices). The results are shown in figure 1.

![Figure 1](image)

**Figure 1.** Comparative characteristics of the time budget for all bears.

As you can see in figure 1, most of the time of the adult male brown bear, Barney, is walking in circles. Barney spends 17% of his time on rest, during which he either lies and sucks his paw, or watches. And for about the same amount of time, the male brown bear is engaged in a variety of motor activities: 12% - scratches on the grate, 10% - sits and 9% - stands on its hind legs. However, it is worth noting that circling the brown bear in a zoo is an indicator that the bear lacks physical activity. Probably, constant or rather frequent walking in a circle indicates the bear's desire to find itself in a vast space with the possibility of splashing out its energy.
The largest amount of time a young female bear is on rest and is approximately 36%. The young bear spends 25% of the time on circular walking and a little less, 16% on observations. Basically, the bear watches the visitors of the zoo, is distracted by extraneous sounds, such as crying children or singing birds. 12% comes from rest and 7% from grating. Also, in case of extraneous phenomena, for example, the appearance of visitors, the bear stands on her hind legs, and devotes 1% of her time to this. In our opinion, this may be related to the reaction to the danger. As you know, in cases of danger, brown bears stand on their hind legs. In this case, the appearance of visitors was identified by the she-bear as a source of danger.

Unlike a young female, the bear cub spends most of the time on movement, namely, circular walking, which is 35% of the total time budget. However, it's worth noting that rest accounts for 24% when the bear rests. In the absence of physical activity, it is also worth highlighting 17% - sitting and 11% - watching. These motor actions can also indicate the stage of rest. 8% of the time the bear spends on getting up on its hind legs, 4% - on licking and sucking the paws, and only 1% on scratching on the grate.

The measurement results were processed statistically, with the results of each session (one continuous observation) taken as a unit of analysis.

To compare the time budgets of the studied animals, we used the Mann-Whitney U-test, which is most often used in such studies of animal behavioral activities, a statistical criterion that is known to be used to assess the differences between two independent samples in terms of the level of any quantitative trait. This criterion is a nonparametric criterion, therefore, unlike, for example, the Student's t-test, it does not require the presence of a normal distribution of the compared populations.

The results shown in figure 6, where it can be seen that the greatest amount of normal activity, which should include circular walking, standing on its hind legs, scratching on the lattice - in a young male brown bear, in aggregate, all these motor actions make up 68%, followed by Barney, whose normal activity is 63%, and then a young female brown bear, whose normal activity is 33%.

Based on the results obtained using the U-test, we can say that the differences between the behavioral patterns of lying, standing on their hind legs, and scratching on the grate are significant between the cubs. When comparing the behavioral patterns of Barney and the bear cub, significant differences were obtained only in circular walking, which is an undesirable (pathological) activity for bears, and their adaptation to keeping in a zoo. It should be noted here that from the point of view of animal psychology, circular walking is an indicator of the need for a release of energy. This is probably why all the brown bears we studied have the highest rate of circling walking. However, the rest index is even higher in the young female, which allows us to speak about the greater activity of males than females. The bulk of Barney and the young male's total time budget falls on physical activity. The young female has a rest.

To assess the diversity of behavior, we used the Shannon diversity index. This index is commonly used for assessing species diversity in ecological research; however, it can also be used to assess a variety of behaviors. The index is calculated by the formula: \[ H = L \left[ \pi_i \times \log \left( \frac{1}{\pi_i} \right) \right] \], where \( \pi_i \) is the share of this form of behavior in the time budget. The results are presented in figure 2, which shows that Barney's behavioral diversity is greater than that of the cubs; and the male bear is slightly larger than that of the female. Most likely, this is due to the fact that Barney arrived at the zoo at the age of 1 year in 2017, that is, he has been living in captivity for 3 years, and the cubs were born on the territory of the Three Bears zoo complex (Karelia) in January 2019, in the eco-park "Zoolosesye" do not live long.

Based on the research carried out, we formulated the following conclusions:

1. In time budgets, all bears have two forms of behavioral activity:
   - Circular walking, which is a form of undesirable behavior of bears and at the same time a way of adaptation to the conditions of the zoo, a means of throwing out the accumulated energy;
   - Lying down - lack of physical activity, most pronounced in a young female.

Normal forms of locomotor activity typical of brown bears - standing on their hind legs, scratching on the grate - are less represented in zoo bears.
We also note that the bulk of the total time budget for Barney and the young male is spent on physical activity, while the young female is on rest, which may support the assumption of some gender difference in the behavioral activity of bears kept in zoos.

![Figure 2. Comparison of Bear Behavior Diversity by Shannon Diversity Indices.](image)

2. The variety of behavior of an adult male bear is greater than that of cubs; and the male bear is slightly larger than that of the female. This is probably due to a longer stay of an adult bear in the zoo and is associated with better adaptation to captive conditions than in cubs. This can also explain the reliably more than that of the bear cub, the presence in his budget of the time of a circular walk.

3. Our research was approved and supported by the zoo staff and assessed as a possible basis for work to improve the living conditions of animals kept in captivity.

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