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NOVOS MÉTODOS PARA ESTUDAR A ATIVIDADE DE MAMÍFEROS SEMIAQUATICOS

NEW METHODS FOR STUDYING THE ACTIVITY OF SEMIAQUATIC MAMMALS

НОВАЯ МЕТОДИКА ИЗУЧЕНИЯ АКТИВНОСТИ ОКОЛОВОДНЫХ МЛЕКОПИТАЮЩИХ

ANDREYCHEV, Alexey*

National Research Mordovian State University, Department of Zoology, Saransk, Bolshevistskaya street, 68, 430005 Russia

** Correspondence author*
e-mail: andreychev1@rambler.ru

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RESUMO

Um novo método para estudar a atividade de mamíferos semiaquáticos usando gravadores de voz portáteis digitais foi desenvolvido. Anteriormente, mamíferos semiaquáticos foram estudados usando actógrafos e dispositivos de visão noturna. Este método permitirá o registro da atividade diretamente nas tocas. Com o uso de gravadores de voz, tornou-se possível determinar com precisão se o sistema de toca é residencial ou não residencial. Além disso, tornou-se possível identificar os intervalos de tempo do dia, em que os animais se movem mais ou menos ativamente. O teste do novo método foi realizado no Desman russo (*Desmana moschata*). Dificuldades na identificação dos sistemas de escavação da maioria das espécies de mamíferos anfíbios são devidas à ausência de emissões de terra das tocas, como é o caso das escavações subterrâneas. Portanto, para identificar os furos nos quais os gravadores foram instalados, os furos foram sondados usando uma sonda. A ponta de prova é um pino apontado em uma extremidade, e na outra tendo uma alça em forma de T. A tarefa do pesquisador é detectar a entrada do buraco, geralmente debaixo de água. E, em seguida, usando a sonda para determinar a direção do movimento no subsolo. Para isso, uma sonda é perfurada a partir da entrada para perfurar o solo para detectar o vazio do furo (a sonda falha de forma desigual). A uma distância de 2-3 metros do buraco, em alguns casos mais dependendo do comprimento dos buracos, o solo acima do buraco é quebrado na forma de um pequeno poço, com um diâmetro de 10-15 cm. Um gravador de voz digital foi instalado neste poço em uma posição vertical para que o microfone foi direcionado em direção à toca. O ruído do Desman pode ser caracterizado como uma série curta formada como uma sequência de picos curtos contíguos de 15 a 25 segundos com interrupções de 5 segundos, que são formadas por ondas regulares de respiração e seus ruídos de movimento. O ruído do Desman difere nos oscilogramas com amplitude e duração médias. A variedade da audibilidade do seu barulho, por via de regra, é de 1 para 3 minutos.

Palavras-chave: *método, atividade diária, desman russo, Desmana moschata, toca, gravador de voz*

ABSTRACT

A new method for studying the activity of semiaquatic mammals using digital portable voice recorders has been developed. Previously, actographs and night-vision devices were used to study semiaquatic mammals near their burrows. This method allows the mammal activity registration directly in the burrows. The use of voice recorders makes it possible to accurately determine whether the burrow system is inhabited or non-inhabited. In addition, it has become possible to identify the day-night time intervals during which the animals are the most or least active. The new method was tested on the Russian desman (*Desmana moschata*). Therefore, to identify the burrows in which the recorders were to be installed, the burrows were probed. A probe is a pole pointed at one end with a T-shaped handle at the other end. The researcher's task is to detect the entrance to the burrow, usually under water. And then the direction of the underground passage is determined by means of the probe. For this purpose, the ground is pierced to detect the hollows in the burrow with the probe starting from the burrow entrance (the probe falls through unevenly). At a distance of 2–3 meters from the burrow, in some cases largely depending on the burrow length, the ground is dug up above the burrow in the form of a small well, 10–15 cm in diameter. A digital voice recorder was placed vertically in this well, so that the microphone was directed down towards the burrow. Desman noises can be characterized as short series formed as a sequence of contiguous short peaks of 15–25 seconds with 5 second interruptions formed by regular waves of breathing

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and its movement noises. Desman noises differ by mean amplitude and duration on oscillograms. As a rule, the noise audibility ranges from 1 to 3 minutes.

Keywords: *method, day-night activity, Russian desman, Desmana moschata, burrow, voice recorder*

АННОТАЦИЯ

Разработан новый метод изучения активности околоводных млекопитающих с использованием цифровых портативных диктофонов. Ранее околоводных млекопитающих изучали с использованием актографов и приборов ночного видения у нор. Данный метод позволят проводить регистрацию активности непосредственно в норах. С применением диктофонов стало возможно точно определять является ли система нор жилой или нежилой. Кроме того, стало возможно выявлять промежутки времени суток, в которые зверьки наиболее или наименее активно перемещаются. Апробация нового метода проведена на русской выхухоли (*Desmana moschata*). Сложности в выявлении норных систем большинства видов амфибионтных млекопитающих обусловлены отсутствием выбросов земли из нор, как это бывает у подземных землероев. Поэтому для выявления нор, в которые устанавливали диктофоны, проводилось прощупывание нор с использованием щупа. Щуп представляет собой штырь заостренный на одном конце, а на другом имеющий Т-образную ручку. Задача исследователя заключается в обнаружении входа в нору, обычно под водой. А затем с помощью щупа определяется направление хода под землей. Для этого щупом начиная от входа прокалывается почва для обнаружения пустоты норы (щуп проваливается неравномерно). На расстоянии 2-3 метров от норы, в некоторых случаях больше в зависимости от протяженности нор, разрывается сверху земля над норой в виде небольшого колодца, диаметром в 10-15 см. В этот колодец устанавливался цифровой диктофон в вертикальном положении, чтобы микрофон был направлен вниз в сторону норы. Шумы выхухоли могут быть охарактеризованы как короткие серии формирующиеся как последовательность сближенных коротких пиков по 15-25 секунд с перерывами в 5 секунд, формирующихся регулярными волнами дыхания и его шумами передвижений. Шумы выхухоли отличаются на осциллограммах средней амплитудой и продолжительностью. Диапазон слышимости ее шумов, как правило, составляет от 1 до 3 минут.

Ключевые слова: *метод, суточная активность, русская выхухоль, Desmana moschata, нора, диктофон*

1. INTRODUCTION

The study of the day-night rhythm of the Russian desman *Desmana moschata* (Linnaeus, 1758) in the wild was carried out in the Khopersky Nature Reserve on Lake Kresty using an actograph. The device was installed in inhabited and fodder burrows from 2:00 pm on October 31 to 2:00 pm on November 2, 1966. The device recorded the entry of animals into the burrows. Entries into or exits from the burrow allowed for the conclusions on the desmans' activity. Two peaks of the desmans' day-night activity were identified. They are associated with the periods of sunrise and sunset (Serdyuk, 1969). Similar results using a night vision device were obtained in Ryazan region in July 1967.

In the Seltsov hunting estate, Vladimir region, the number of burrow entries was recorded by an actograph for 51 days from November 1972 to April 1973. Three seasonal periods of desmans' activity associated with changes in external conditions were identified. The first period is associated with the beginning of freeze-up (November–December) and is characterized by high activity. The second period is associated with strong freeze-up (January–February). The activity of animals decreases during this period. They spend most of their time in burrows. The third period is associated with the end of freeze-up (end of March – beginning of April). It is characterized by increased activity, but less than during the freeze-up period. There are 3 peaks of day-night activity during freeze-up: morning (5.30–7.30 am), afternoon (12.30–2.30 pm), and evening (7.30–9.30 pm). In some cases, the fourth peak is recorded – (11.00 pm – 12.00 am) (Khakhin and Ivanov, 1990). The majority of the known researches on activity of the Russian desmans is got in experimental captive conditions (Barabash-Nikiforov *et al.*, 1964; Nazyrova and Karpov, 2000; Rutovskaya and Kulikov, 2013). This few literature data on the study of the desmans' activity in the burrow, including the monograph by L. P. Borodin (1963), contributed to the purpose of developing a new study method.

With the use of actographs and a night vision device, only activity at the entry to the burrow was recorded. With regard to identifying the burrow activity of semiaquatic inhabitants, in particular, the Russian desman, both of the above methods are largely unsuitable. Since the animal can use another entrance or be active inside the burrow. To eliminate these circumstances, a new method of studying the activity of semiaquatic mammals using digital voice recorders was developed. This new method is based on a previously developed method for underground burrowing animals (Andreychev, 2017, 2018) and has been upgraded taking into account the biological peculiarities of the semiaquatic mammals. Initially, the development of the method was carried out to identify new pairs to study the breding success of the Eagle Owl (Andreichev *et al.*, 2016; Andreichev *et al.*, 2017; Lapshin *et al.*, 2018). Subsequently, the method is adapted to study the activity of the steppe marmot (Andreichev and Zhalilov, 2017), as is simpler, than application of the camera traps (Andreychev and Lapshin, 2018). The steppe marmot is a rare species for the region (Andreychev *et al.*, 2015). The voice recorders in the long term can be applied to identification of activity of such rare species for the region as of the forest dormouse (Grigoryeva *et al.*, 2015) and of the Eurasian beaver (Andreychev, 2017). Besides, by means of voice recorders identification of sites of dwelling of birds of prey for further studying of their food is possible (Andreychev *et al.*, 2016; 2019; Andreychev and Lapshin, 2017).

This article describes the method that can be used to study the activity of various semiaquatic inhabitants (desman, beaver, muskrat, and others). The principle of this method is based on recording the noise of animals while they are moving along burrows. Since there is no information on animal noise in burrows in the literature, some explanations are required. According to G. Tembrock's classification (Tembrock, 1963), acoustic signals of mammals are divided into two groups: own voice sounds and non-voice noises not related to the vocal apparatus itself. The second group includes, in particular, the noise generated by the air stream during inhalation and exhalation, mainly by means of nasal cavities (Ilyichyov *et al.,* 1975). In addition, they are overlapped by noises of the animal movements. The method proposed is based on the registration of these noises as a whole.

2. MATERIALS AND METHODS

A description of the method for studying the activity of semiaquatic mammals in burrows should be given, since it has not been previously cited in the literature. Habitat areas should be identified at the preparatory stage. Difficulties in identifying the burrowing systems of most species of amphibious mammals are due to the absence of land emissions from the burrows, as is the case with underground burrowing animals (mole rats, moles). Therefore, to identify the burrows in which the recorders were to be installed, the burrows were probed (Fig. 1). A probe (*5*) is a pole pointed at one end with a T-shaped handle at the other end. The researcher's task is to detect the entrance to the burrow, usually under water. And then the direction of the underground passage is determined by means of the probe. For this purpose, the ground is pierced to detect the hollows (*1*) in the burrow with the probe starting from the burrow entrance (the probe falls through unevenly). At a distance of 2–3 meters from the burrow, in some cases largely depending on the burrow length, the ground is dug up above the burrow in the form of a small well (depression), 10–15 cm in diameter. A digital voice recorder (*4*) was placed vertically in this well, so that the microphone was directed down towards the burrow. The recorder was placed in a 0.5 L mineral water plastic bottle which was used as a container. Pre-cuts were made in the bottle to place the recorder as well as two through cross holes for the spacer bar on which the bottle itself was fastened in the ground. Plastic bottles were used for moisture insulation of voice recorders. The bottles were preliminary cleared of labels and poured with boiled water to eliminate all suspicious odors. After placing the switched-on voice recorders into the wells, they were covered with plates (*3*) and covered with soil and turf (*2*).

Olympus VN-416PC, VN-712PC voice recorders were successfully used. Other alternative models that are similar in technical characteristics may also be used. Voice recorders were powered by alkaline or zinc-carbon AAA batteries, or by an external battery unit, which extended the recording time of the voice recorder. On average, one set of batteries was enough for 80–100 hours of continuous recording. Batteries were replaced with new ones at the end of the battery life.

3. RESULTS AND DISCUSSION:

The activity of animals should be monitored using voice recorders in different parts of the reservoir. The choice of installation locations for recording devices was determined using the OziExplorer software. To check the sensitivity of microphones to record the noise of animals, several recorders were placed in one burrow. In this case, one recorder was placed directly at the burrow entrance and the rest were placed a few meters away from the burrow entrance. For convenience of the further processing of audio recordings obtained from voice recorders from one burrow system, the recorders were switched on simultaneously. This made it possible to clearly identify the time intervals in which the animal moved past each recorder. Practice showed that the noises of animals were heard on all voice recorders. However, the recorders that were placed farther from the entrance recorded only the noises of the animals themselves, excluding extraneous noises, such as the wind noise. Therefore, it has been concluded that it is better to place a voice recorder not at the burrow entrance, but directly in the burrow system at some distance from the entrance. For easy re-detection of previously placed voice recorders in the field, a GPS navigator was used.

Office processing of the audio recordings obtained should be carried out using AIMP 1.75 (2007) and AUDACITY 2.1.1 (2015). This software allows for identification and subsequent listening to the noises of moving mammals along the burrow by frequency characteristics in visual mode. Alternative software, in particular, SONY SOUND FORGE AUDIO STUDIO 7.0 (2003), can be used to convert audio files from WMA to WAV and divide them into short sections for easy analysis in AUDACITY.

Desman noises can be characterized as short series formed as a sequence of contiguous short peaks of 15–25 seconds with 5 second interruptions formed by regular waves of breathing and its movement noises (Fig. 2). Desman noises differ by mean amplitude and duration on oscillograms. As a rule, the noise audibility ranges from 1 to 3 minutes.

In the future, the proposed method can help obtain outcomes for phases of activity of the hard-to-explore semiaquatic species, which will be of undoubted significance in comparative terms.

The method was successfully tested on the Russian desman in 2018 within the territory of the Republic of Mordovia. The method testing revealed the following advantages:

1. Possibility to obtain the most detailed information about day-night and seasonal activity in the burrows.

2. Minimization of disturbance by a researcher; the natural structure of the burrows is not damaged.

3. Possibility to conduct studies over a long period.

4. Large coverage of the study area.

5. Convenient schedule for the researcher.

6. Possibility to identify inhabited or non-inhabited burrows without direct capturing.

7. Minimum time to detect the burrow

population, which may take up to 24 hours, even in seasons of low activity of animals.

8. Possibility to study the activity of animals directly in the nesting chambers.

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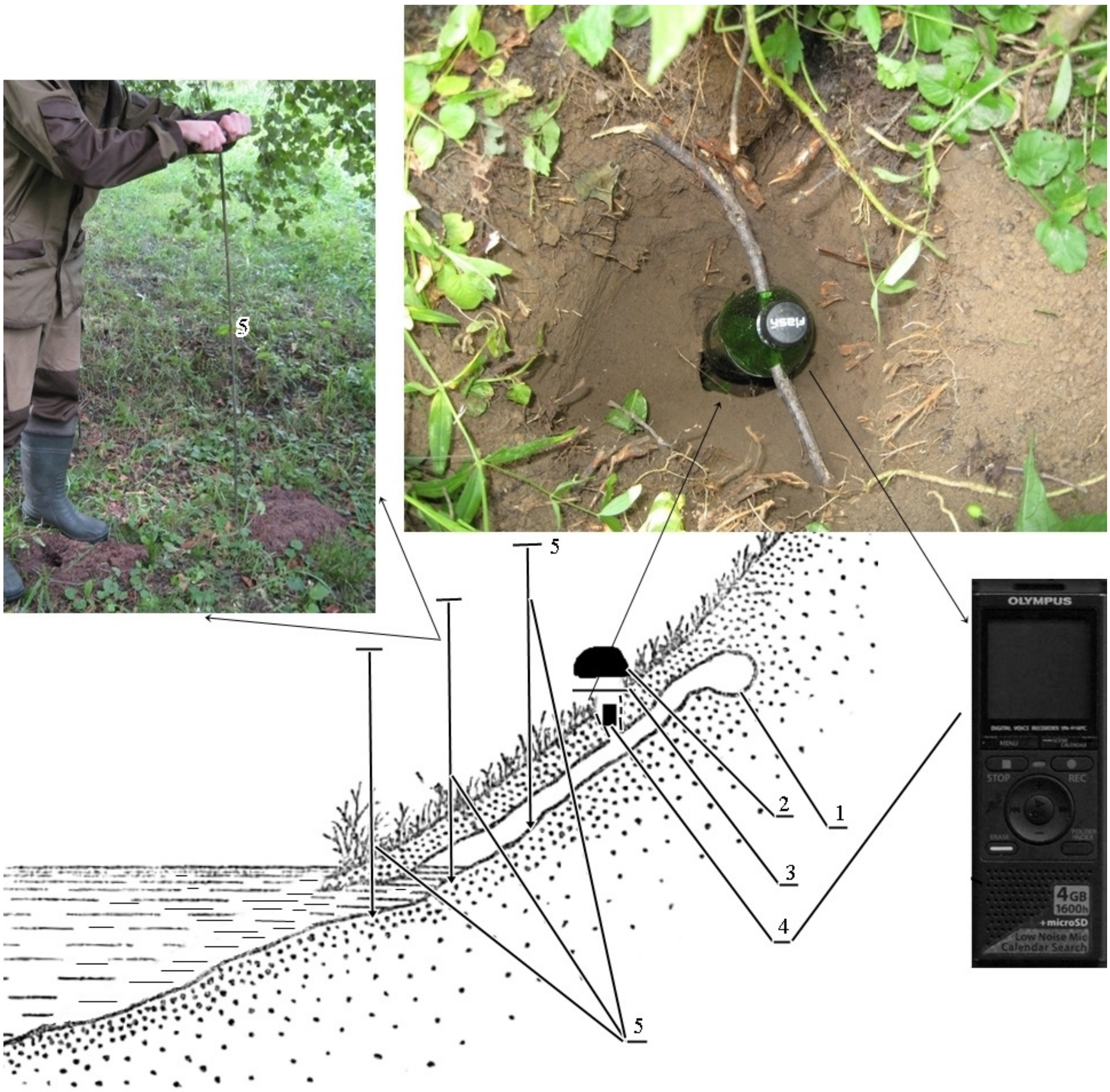

Figure 1. The diagram of installation of a voice recorders of the Russian desman in the burrow (1 - hollows, 2 – soil, 3 – plates, 4 – voice recorder, 5 – probe)

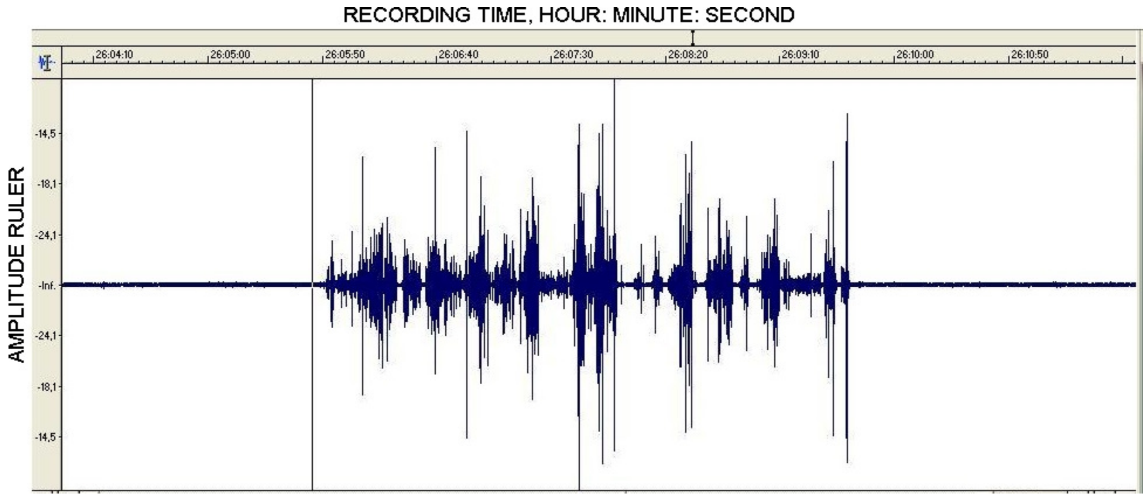

Figure 2. The oscillogram of Desman noises in the burrow

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