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REDUCING THE NOISE LOAD ON WILDLIFE DURING SCIENTIFIC EXPEDITIONS

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Abstract: *Scientific expeditions to the wild are usually carried out by cars that create a negative noise load on the inhabitants of the wild. This study suggests a way to reduce such a noise load by replacing cars with internal combustion engines with electric vehicles. The measurements made it possible to specify the quantitative indicators of reducing the noise load achieved as a result of replacing cars with internal combustion engines with electric vehicles. The article specifies the limitations in the use of electric vehicles during scientific expeditions into the wild, resulting from special conditions, such as impassability and lack of service infrastructure, such as battery charging stations. The data presented in this paper may be of interest both for scientific and environmental organizations, and for government regulatory institutions in the fields of ecology, nature protection and scientific activity.*

Keywords: *expeditions, wildlife, noise, car, electric car.*

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1. INTRODUCTION

Scientific expeditions to the wild are regularly conducted on all continents of the planet, including Antarctica. Currently, in land expeditions, cars with an internal combustion engine are most commonly used as vehicles. The level of traffic noise generated by such cars is in the range of 75-85 dB [1].

The main component of the traffic noise generated by the car occurs as a result of the operation of the internal combustion engine. The hearing distance of such noise reaches several hundred meters, depending on the terrain.

For most inhabitants of the wild, hearing is the main tool for perceiving the surrounding reality, by means of which, in particular, animals learn about potential danger.

Traffic noise is 'alien' to the inhabitants of the wild, and therefore it is a source of concern, which is especially dangerous during the breeding season, as it can lead to a violation of this process.

Also, the negative consequences of traffic noise generated by the expedition cars can be attributed to a decrease in the effectiveness of the expedition itself. So, the noise can make the animals (birds) that are the subject of the study leave their location or change the usual order of their life, which in turn will lead to distortion of the results of the study.

According to the data (Fig. 1), more than 2 thousand scientific expeditions are conducted annually in the world [2-4]. Reducing the noise load during their implementation is an important factor in preserving the ecology in the few regions of the planet with preserved wildlife.

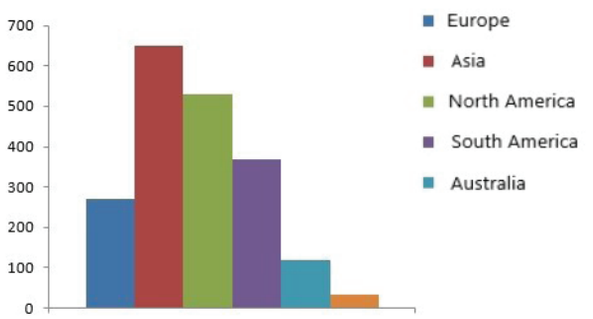

Fig. 1: Statistics on the number of scientific expeditions.

2. USING ELECTRIC VEHICLES AS A WAY TO REDUCE THE NOISE LOAD ON WILDLIFE DURING A SCIENTIFIC EXPEDITION

A promising way to reduce the noise load on wildlife during scientific expeditions is to replace cars with an internal combustion engine used for transporting employees and equipment of the expedition with electric vehicles. Such a change requires specification of quantitative indicators of noise load reduction to justify the effectiveness of this method. In addition, it is necessary to specify the existing restrictions on the use of electric vehicles during scientific expeditions.

The following factors can be attributed to the special conditions of conducting expeditions into the wild that affect the restrictions in the use of electric vehicles:

- impassability, on a significant part of the way;
- lack of stations for charging electric vehicle batteries, on a significant part of the way.

The factors of off-road driving and the lack of charging stations allow us to formulate two requirements that an electric car must meet in order to be able to use it in an expedition.

The off-road factor determines the requirement for the electric vehicle used in terms of increased cross-country ability. Increased cross-country ability is achieved through the use of all-wheel drive and increased ground clearance (the distance between the ground and the lower suspension point of the electric vehicle). Most common, such features are possessed by vehicles of the SUV category.

The factor of the absence of stations for charging the batteries of an electric vehicle determines the requirement for the electric vehicle used, in terms of having the necessary power reserve to reach the destination and return back.

Until recently, the electric vehicles produced were represented by passenger cars with a small ground clearance and a fairly small power reserve of 200-300 km [5-7], which limited the possibility of their use in scientific expeditions into the wild, in off-road conditions and the lack of service infrastructure.

The increase in the capacity of electric car batteries achieved in recent years has led to the appearance on the market of a number of electric car models belonging to the SUV category, i.e. meeting the requirement for the presence of an all-terrain function [7-10].

Considering the power reserve of electric vehicles of the SUV category, we see that now in some models it has already reached 500-800 km (Tab. 1). From the data in Tab. 2, it follows that electric vehicles from points 1-3 of the table are applicable in expeditions which destination is located at a distance of up to 220-400 km from the last station of the stations for charging electric vehicle batteries. The power reserve of such electric vehicles will allow you to reach your destination and return back.

Points	Vehicles	Power reserve (km)
1	Tesla Model X	545
2	Rivian R1T	640
3	Tesla Cybertruck	800

Tab. 1: Power reserve of electric vehicles of the SUV category

3. SPECIFICATION OF THE QUANTITATIVE INDICATORS OF THE NOISE LOAD REDUCTION WHEN USING ELECTRIC VEHICLES

To specify the quantitative indicators of reducing the noise load as a result of replacing cars with internal combustion engines with electric vehicles, it is firstly necessary to analyze the noise level generated by electric vehicles in the open air. Next, it is necessary to compare the results obtained with the noise level generated by cars with an internal combustion engine. The resulting difference will be an indicator of reducing the noise load when using electric vehicles.

To determine the noise range generated by a moving electric vehicle, portable noise meters were used for measuring (in accordance with the regulatory methodology – 'Regulation No. 51' of the UNECE [15]) the level of the acoustic radiation intensity adjusted according to 'A' scale (Fig. 2).

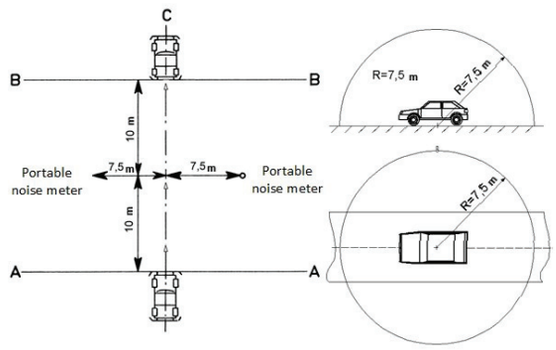

Fig. 2: Electric vehicle noise detection scheme
** When preparing the drawing, the elements of the scheme for measuring the noise from the source were used [1]*

At the same time, the following conditions for determining were set: tests for evaluating are carried out on a measuring section of the road A-B with a length of 20 m; the vehicle in front of the measuring section (up to the A-A line) moves uniformly at a speed of ~30 km/h; the measurement is made when the vehicle passes the middle of the measuring section with noise meters [14, 15] installed at a distance of 7.5 m from its axis; two measurements are made on each side of the vehicle. The maximum sound level, expressed in decibels (dB), is measured at the moment when the vehicle passes between lines A-A and B-B. The resulting value is the measurement result [1].

The experimental measurement was performed using an electric car of the SUV category-Tesla Model X 2018 (without using the function of creating artificial noise).

The obtained measurement results are shown in Tab. 2.

Vehicle	Generated noise level (dB)
Tesla Model X	58

Tab. 2: Noise generated by an electric vehicle

Comparing the obtained data (Tab. 2) with the noise level generated by cars with an internal combustion engine, we see the following difference (Tab. 3). The resulting difference is an indicator of reducing the noise load when using electric vehicles.

Electric vehicle (Tesla Model X)	A car with an internal combustion engine (average indicator)	The difference in the noise level
58	80 dB	22

Tab. 3: Comparison of the noise generation indicators

4. CONCLUSION

In this study, a method for reducing the noise load on wildlife during scientific expeditions is proposed. The method provides the replacement of cars used for transportation of the employees and equipment of the expedition with electric vehicles. Replacing one car with an internal combustion engine of the SUV category with an electric car of the same category allows reducing the noise load by 22 dB at a speed of 30 km/h. The paper specifies the existing restrictions in using electric vehicles in expeditions, including the maximum distance from the destination of the expedition. According to the presented data, the existing electric vehicles of the SUV category are

applicable in expeditions with a destination point of up to 400 km (the distance is measured from the last charging station located on the way of the expedition). Reducing the noise load is also a factor in increasing the effectiveness of scientific expeditions. As a result of reducing the noise load, the probability of wild nature inhabitants (objects of research) leaving their location or changing their usual routine of life is reduced, which reduces the likelihood of distortion of the scientific results obtained by the expedition.

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