Application of Earth Remote Sensing Data in the Practice of Hunting Design

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Abstract. According to the strategy for the development of the hunting economy in the Russian Federation until 2030, one of the principles of sustainable and rational hunting use is the monitoring of the resources used and a reliable assessment of the state of their habitat. The solution of modern problems of classification and typological assessment of the habitat of hunting animals is possible using multispectral satellite imagery, reflecting the whole variety of natural landscapes, types of vegetation and other properties of the earth's surface. The article discusses the features of mapping the habitat of hunting animals using data from remote sensing of the Earth by classifying objects on satellite images according to various criteria corresponding to certain habitats of animals. Methods for interpreting satellite images for determining the categories and classes of the habitat of hunting animals are indicated, the results of a typological assessment of the habitat of hunting animals on the territory of the Priilmensky landscape of the Novgorod region are presented.

1. Introduction
Satellite imagery and geographic information systems technologies are actively used in various areas of engineering design, such as forest management, agriculture and hunting, land management and urban planning. Currently, the development of technologies in the field of the Earth remote sensing (ERS) from space and aerial photography makes it possible to apply new methodological approaches to the determination and assessment of various elements of natural landscapes and their characteristics.

According to the “Strategy for the development of the hunting economy in the Russian Federation until 2030” approved by the order of the Government of the Russian Federation dated July 3, 2014 no.1216-r, one of the fundamental principles of the sustainable and rational use of hunting resources, as well as the preservation of their habitat and biological diversity, is resource management based on their monitoring data. In turn, monitoring and decision-making in the field of hunting is impossible without increasing the information and scientific provision of government bodies, legal entities and individual entrepreneurs of the corresponding profile.

When solving the problems of increasing information and scientific support, the Strategy provides for an inventory of the current state of the habitat of hunting animals on a unified methodological basis, including monitoring using and analyzing data from remote sensing of the Earth's surface and aerial photography of hunting landscapes.

To ensure the rational use and conservation of hunting resources, “Schemes for the placement, use and protection of hunting grounds” (hereinafter referred to as the Scheme) are being developed. One of the key tasks in the design of a hunting area is a qualitative assessment of animal habitats, which requires
the availability of data on the spatial distribution and areal characteristics of classes and categories of elements of the habitat of hunting resources.

2. Objects and methods of research
We have carried out experimental work in the study of the possibility of using ERS and GIS technologies in hunting design; The Priilmensky landscape of the Novgorod region was chosen as the study area. The Priilmensky landscape is a key ornithological territory of Russia, it is included in the “shadow” list of wetlands of international importance. The total area of the studied territory is 122288.59 hectares (excluding the area of the lake Ilmen mirror) and includes, in whole or in part, 9 hunting farms, state natural biological reserves of regional significance "Novgorodsky" and "Vostochno-Illmensky". On the territory of the Priilmensky landscape, all categories and classes of the habitat of hunting resources are represented.

3. Results and discussion
According to the requirements for the structure of the hunting management document, the Scheme identifies 13 categories of the habitat of hunting resources, which include 39 different classes. Such a variety and combination of various natural zones, which include forests, meadows, floodplain complexes, reservoirs, agricultural land, land unsuitable for hunting, etc. complicates the classification of land; this information is not presented on topographic, forest maps [1].

A full-fledged solution of problems of classification and typological assessment in such a volume and with minimization of time costs is possible using multispectral satellite imagery. Multispectral survey data well reflect all the diversity of landscapes, different types of vegetation and other properties of the earth's surface that are important for game animals [2]. However, when analyzing and typological assessment of the territory using data from the Earth remote sensing and spectral imagery, the issues of the methodology for decoding the territory of landscapes with reference to the elements of the habitat of hunting resources have not been sufficiently resolved.

When carrying out hunting management works, specialists are forced to use disaggregated information about the characteristics of the lands. This is especially evident when the territory of the hunting economy is divided into categories and elements of the animal habitat: forest inventory materials, topographic maps and other cartographic bases of various ages are used. Often the information presented on them is irrelevant, discrepancies in areas appear. Generalization of such information is a rather laborious work and there is no guarantee of complete reliability of the final results of hunting management design.

The existing methods of using Earth remote sensing data in hunting management operations are basically a series of specific deciphering actions using a large set of data and applied software. The classification task consists in dividing the space of spectral features into local areas corresponding to one object or class of objects with simultaneous field work and laying control trial plots to check the compliance of the classification and interpretation results with real terrain conditions [2, 3, 4, 5].

The initial data for carrying out work on the identification and typological assessment of the habitat of hunting animals by the method of decoding can be satellite images in various spectral channels from open sources [6]. The ability to import images into the software allows services such as USGS, LandViewer, obtained from the Earth Artificial satellites such as the Landsat, Sentinel, MODIS / NAIP, Terra, Aqua, etc. We can also recommend the navigation software SAS Planeta, geoinformation software ENVI, ArcGIS and QGIS for comprehensive processing of multispectral satellite images. To determine some properties of the Earth's surface, for example, agricultural land and damaged forest areas by windblows and windbreaks, it is possible to effectively use the indicators of vegetation indices [7, 8].

The technology of decoding data of remote sensing of the Earth when mapping elements of the habitat of hunting resources is most often reduced to sequential hierarchical selection from the general array of graphical data of individual classes at several levels of generalization of hunting grounds [9].
Water bodies, transformed and damaged forest areas, territories unsuitable for hunting (settlements, industrial and ruderal complexes) can be attributed to the simplest in the automated process of decoding.

The identification of forests, swamps, floodplain complexes and agricultural land requires a more thorough approach. When determining the listed categories of the habitat of hunting resources, it is necessary to use multi-season images, field survey data and forest inventory materials. In their absence, high-resolution multispectral images (1–5 m) are required. The most informative are the first shortwave infrared, near infrared, red shooting channels [10]. However, decoding of forest communities by methods of controlled and uncontrolled classification of space images pixels is often accompanied by unacceptable errors [11, 12]. To distinguish the “forest” category and determine the areas occupied by woody vegetation, it is advisable to use forest management information through specialized queries or filters in the WinPLP system.

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![Figure 1. A snapshot of the area under study in the near infrared spectrum.](image)

Analyzing the data obtained, the predominant category of the habitat of hunting resources in the study area is agricultural meadows, occupying 31.5%. This is followed by floodplain complexes – 30.6%, of which the largest area is occupied by floodplains with a predominance of meadow vegetation.
(14.5%) and shrub floodplains (13.4%). Floodplains with a predominance of forest vegetation account for 2.7%.

Inland water bodies occupy 9.2%, swamps – 1.1%. Forests in the study area occupy less than a quarter of the total area – 20.1%, with small-leaved forests prevailing. The rest of the area (7.5%) is occupied by transformed and damaged forest areas, settlements and ruderal complexes.

4. Conclusion
As a result of the work carried out, it was concluded that the use of seasonal multispectral images can be effectively used in hunting management design, however, it is necessary to develop a unified method for their interpretation. At the same time, it should be based on typological clusters reflecting the relationship between remote sensing data, aerial photography, multispectral imagery and data from field surveys of the habitat of hunting resources. A unified cluster technique for deciphering various elements of the habitat of hunting grounds will make it possible to reliably and with minimal time expenditures perform a landscape characterization and typological assessment of the grounds, which will provide a basis for an objective design of biotechnical and economic measures aimed at increasing productivity and preventing degradation of the habitat.

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