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THE DATA PROCESSING SYSTEM OF MEASURING INTERPRETATION OF PURE PINE STANDS OF IA–II YIELD CLASSES

The data processing system of measuring interpretation of pure pine stands of Ia–II yield classes was developed. The database was created, which ensures the completeness and integrity of information, ease of storage and retrieval of data, and automated processing and calculation of mensuration and deciphering characteristics of forest stand of pure pine stands of Ia–II yield classes. Data analysis was performed on a 56 plots. The material was collected during the full-scale inventory of forest stands and measuring interpretation of digital images by using GIS technology. Structuring the received information was conducted, that making it easier to carry out its analysis and processing: to make inquiries, sample, perform mathematical and statistical operations.

Methodology for examination of the interpretive characteristics of pure pine stand is described and the results of the analysis of the relationships between the data obtained from ground-based inventory and measuring interpretation of digital images. Analysis of the results of the research the relationship between mensuration and interpretive characteristics of stand leads to the conclusion that there is a close connection between them. This system involves the performance measurement interpretation of pure pine stands on digital images with the calculation of basic forest indices stand by using regression equations of relationship between mensuration and interpretive characteristics of stand.

Key words: measuring interpretation, system, structural information, pure pine stands, automation, data processing.

Introduction. Modern digital image processing technologies open up new possibilities in the measurement of deciphering remote sensing materials [1]. The crowns of individual trees are quite well highlighted on digital images with high spatial resolution in the image of the forest stand, which allows us to estimate the density of the forest stand, measure the diameter of the crown, canopy cover, the distance between the trees, and on their basis using regression equations of the relationship between interpretive and taxation parameters, regularities of the structure and growth – growing stock.

Using geo-information systems specialists get powerful means of scaling and color correction of digital images, as well as combining the processes of decoding and vectorization of boundaries, which simplifies the technology of forest maps making and allows automating the process of measurements. With the help of GIS tools it is possible in an automated mode to perform the measurement of such indicators as density, composition, the diameter of tree crowns, canopy cover, the average height of the tree stand.

The purpose of this work is to develop a system of data measuring the pure pine stands interpretation of Ia–II yield classes to improve the quality of treatment and accelerate the process of obtaining the basic characteristics of the taxation of the forest stand with the help of modern technologies.

Main part. The data processing system implies a measurement of pure pine stands interpreting digital images with the calculation of the main indicators of taxation of the tree stand using the regression equations of the relationship between the biometrical and interpretive indicators.

To achieve this goal, a database (DB) has been created based on Microsoft Access, the structure of which is represented in the form of related tables. The database contains the information obtained during a full-scale taxation of pure pine stands of Ia–II yield classes on 56-taxatively interpretive plots (TIP), in which the circular sample plots had been laid, as well as the information obtained during the measurement of interpreting stands on digital pictures using a geographic information system Quantum GIS. With the help of queries, algorithms and equations the taxation data of pure pine stands was being processed and a common table of the plots data was formed.

The structuring of the information received at TIP allows to analyze it, process and compare: make inquiries about the forest taxation data of the tree stands, carry out the necessary sampling, sorting, producing mathematical and statistical operations, calculate taxation data of the tree stand when measuring interpreting by calculating them using the regression equations of the relationship, identify deviations and assess the accuracy of interpretation.

The information in the database obtained in full-scale taxation of the forest stand and the measuring interpretation are stored in a separate table. When working with the data from several tables the relations between them were established via the allotment (plot) ID. Queries for search and retrieval of data, and to perform specific calculations were created. For the measurement interpretation

of pure pine stands in digital images methods that make it possible to obtain the basic interpretive figures of the stand were developed.

In the first stage the image processing was being performed, as well as the preparation of digital images for the interpretation, transformation and linking images to the coordinate system, color and brightness transformations, improving of visual differences of objects and improving of the interpretive properties of images.

The next step after pre-interpretation of the images was to carry out measuring of the pure pine stands in the TIP and the determination of their taxation-interpretive parameters.

The calculation of the average diameter of the crowns of the forest stand was carried out with the help of built-in means of geo-information systems for the measurement of lines. The canopy cover of the tree stand in digital pictures was calculated on a straight-line basis. To calculate the average distance between the trees we have chosen a central tree, and from it we draw the lines to the nearest five trees. When determining the density of plants in the GIS we have used the method based on the calculating the number of visible crowns in the canopy of trees per unit of area [2].

All the attribute information on the obtained measurement interpretive indicators in Quantum GIS was exported to Microsoft Access database, where was later used for calculating the taxation indicators for the regression equation correlation (Fig. 1).

The calculation of average taxation and interpretive parameters on each TIP was done automatically by the system of queries in the database (Fig. 2).

The analysis between the taxation parameters of the stand and the canopy was made separately for Ia, I and II yield classes.

The initial data for the calculation of taxation indicators are the average diameter of tree crowns, the distance between the trees, canopy cover and the density of the forest stand. The average diameter of the stand is calculated by the regression models of the yield classes, the function of calculation is as follows:

$$D = f(Dk, l, Ps), \quad (1)$$

where Dk – the average diameter of tree crowns, cm; l – the average distance between trees, m; Ps – the relative fullness of the forest stand.

The average height of the stand is calculated by measuring it in digital images with GIS or stereo using Photomod. If the average height of the stand can not be measured, it is calculated by the regression model of the relationship:

$$H = f(D, N, P), \quad (2)$$

where D – the average diameter of the tree stand, cm; N – the density of the tree stand, piece.

Further, the relative fullness of the stand by the regression model is:

$$P = f(Ps, Dk, l). \quad (3)$$

The total basal area of the forest the stand is calculated by the regression model based on the average diameter of the crown the tree stand, the average height and canopy:

$$G = f(D, H, l, P), \quad (4)$$

where H – the average height of the forest stand, m.

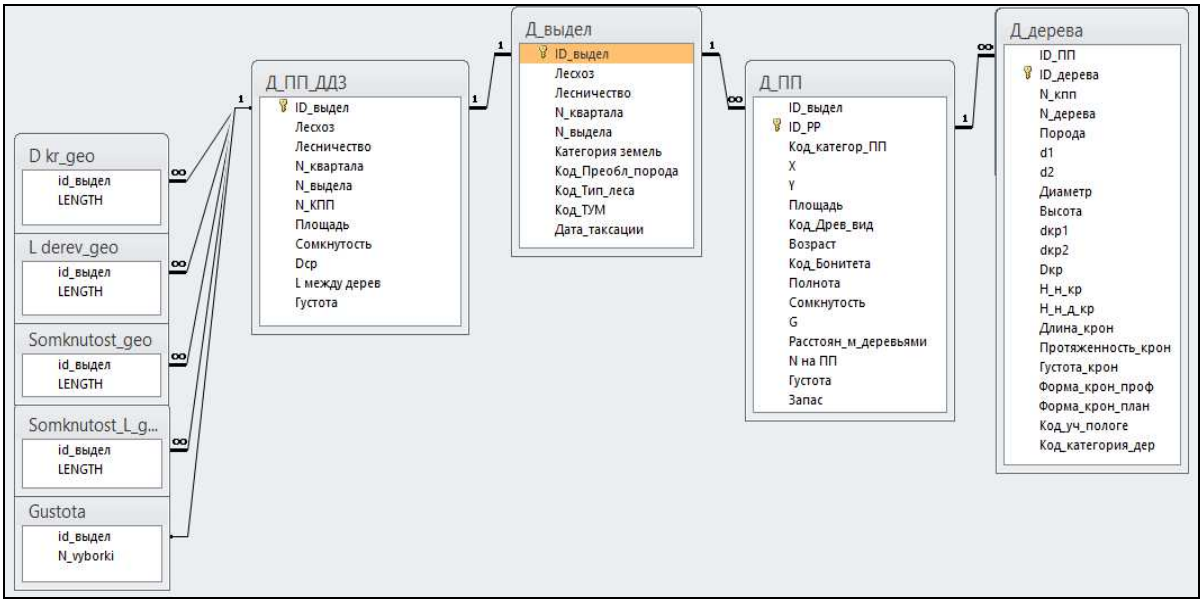

Fig. 1. The structural diagram of the data processing of the measurement interpretation and full-scale taxation of pure pine stands of Ia–II yield classes

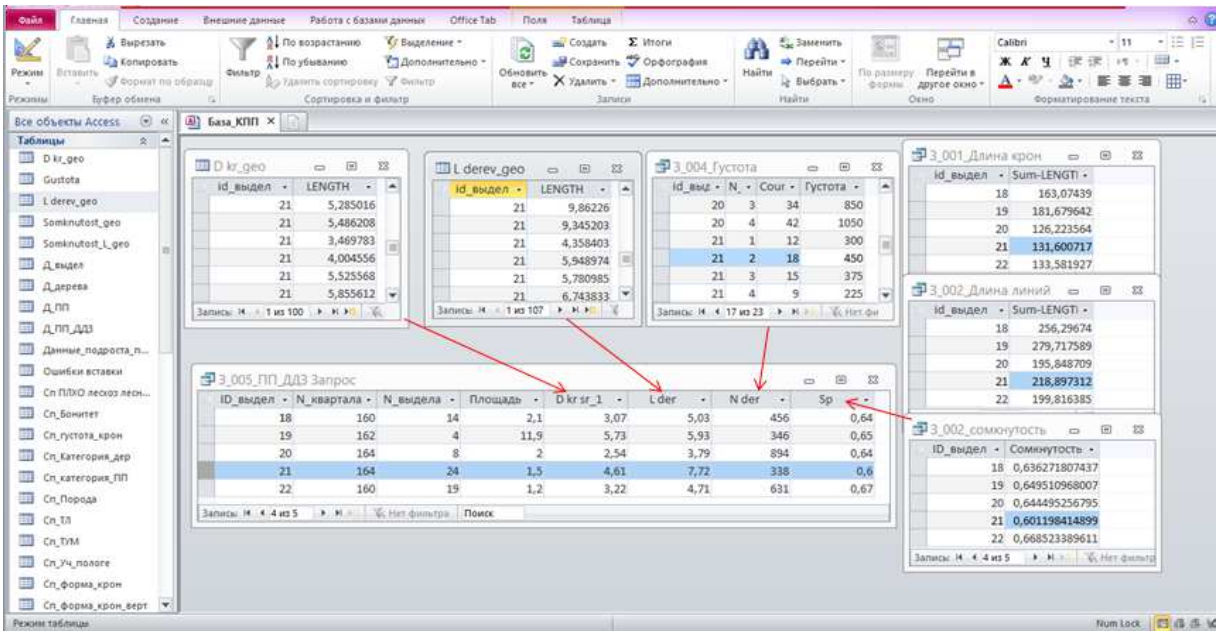

Fig. 2. Data processing of the measurement interpretation of pine forest stands using Microsoft Access

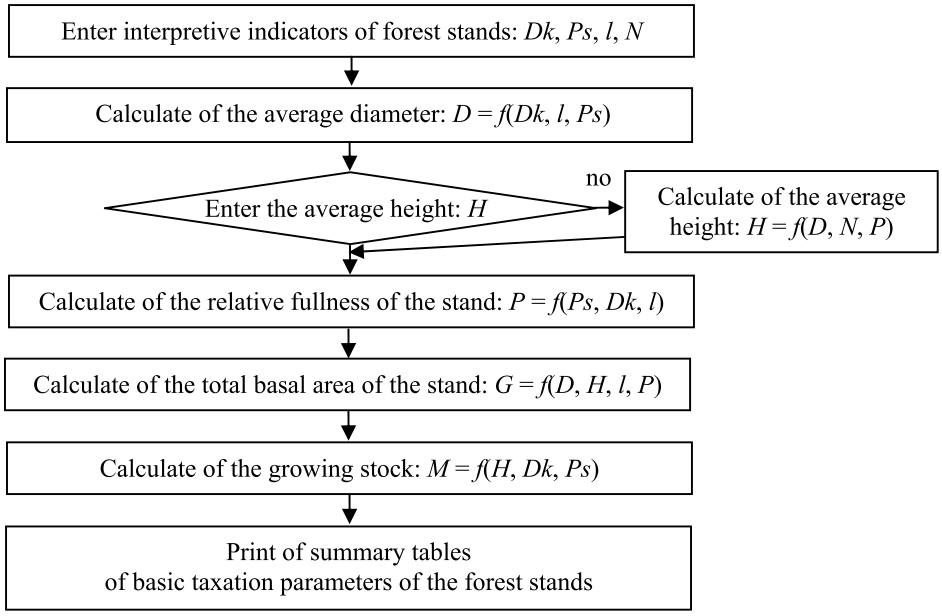

Fig. 3. The flowchart of calculating the basic taxation-interpretive indicators of the tree stand

The growing stock is calculated by the regression model of the relationship between the average diameter of the crown of the forest stand, average height, canopy cover and stock:

$$M = f(H, Dk, Ps). \quad (5)$$

The structural diagram of the measurement system of interpretation is shown in Fig. 3, it includes all of the above steps to produce the ultimate taxation characteristics of tree stands.

To assess the accuracy of the measurement using the interpretation system query and making a report a comparative analysis of the data obtained from full-scale taxation of pure piny forest stands Ia–II yield classes and the picture within the interpretive taxation-interpretive allotments was carried out.

Conclusion. The developed system of the data processing the measurement interpretation of pure pine forest stands of Ia–II yield classes allows us to obtain the necessary information by performing interpretation of the measurement of tree stands in digital images using the GIS technologies. This system, developed on the basis of Microsoft Access, accelerates and improves the quality of the data processing.

The calculation of taxation-interpretive indicators of pure pine forest stands of Ia–II yield classes in the database is done with the help of the regression equations of the relationship between them.

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