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## DEVELOPMENT OF THE STRUCTURE OF THE GEOSPATIAL DATABASE FOR BEEKEEPING

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**I. DOMINA,**

*National University of Life and Environmental Sciences of Ukraine*

*E-mail: i\_diomina@nubip.edu.ua*

**Abstract.** *The work draws attention to the importance of beekeeping for providing the population of Ukraine with food and the importance of providing pollination services. Since pollination is necessary to obtain many foods grown by farmers. The methods of collecting information of Remote Monitoring of the Earth, by means of which the operative approach to the definition of possible locations of apiaries is carried out, are mentioned. It is determined that the use of geographic information technologies, the accumulation of useful data for beekeeping and the correct way to store them in the database is a necessary condition for the development of beekeeping. The main purpose is to develop a model of geographic information database that will store information about land (areas) safe and dangerous for bees. The necessity of such a database is substantiated, its constituent parts (land plots, safe zones with fodder base of beekeeping, buffer zones around dangerous objects, annual and perennial vegetation) are defined and described. The paper also gives examples of similar geoinformation databases of the European Union, the purpose of which is to monitor the forest stands of Europe (The Forest Information System for Europe). An example of application of the developed database in the country is presented and the direction of development with the help of geoinformation technologies is determined.*

**Keywords:** *Geospatial database, fodder base of beekeeping.*

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### **Introduction.**

According to the United Nations FAO (Food and Agriculture Organization of the United Nations), climate change, anthropogenic intervention in nature, changes in land use, monoculture and pesticide use have led to large-scale extinction of pollinating insects [1].

About 75 percent of the yield of fruit and seed crops consumed by humans depends on honey bees [1].

The development of beekeeping is a necessary condition for maintaining food security in the country [2].

An important part of bee food is annual crops and forest plantations. Unfortunately, we do not have a single crop rotation registration system. Just as there is no single source of information about the location of trees with pollen in forest areas. The lack of automated collection and storage of spatial information on the location of the fodder base of beekeeping makes it impossible to effectively develop this area.

To improve the situation, it is necessary to study new modern approaches. Which will provide operational mapping and analysis of the location of land suitable for beekeeping [3].

This approach could be to use a geospatial database as part of GIS technology to gather information on the location of areas with honey plants and bee-threatening objects. Storing this data in a single system and using it will ensure yield growth and interaction between farmers and beekeepers.

### ***Analysis of recent researches and publications.***

In works [4], [5] the methods of using geospatial systems and the assessment of their capabilities in decision-making on land use planning were studied.

In [6], [7] the prerequisites for the effective functioning of the beekeeping industry and the optimization of bee food supply are considered.

The monograph [8] describes the methodology of database development in geographic information systems.

The article [9] presented the results of a study of the effectiveness of the planned pollination of gardens by bees.

Methodical recommendations [2] contain materials on the effective use of bees for pollination of orchards and berries. In addition, the author touches on the topic of providing pollination services.

In the previous article [10] the following issues were revealed: search of fodder base of beekeeping with the help of remote sensing data; automation of finding the optimal location of plots for the needs of beekeeping. The model of creating a geoimage of areas suitable for the apiary was built. However, the method of storing the obtained geospatial information was not provided.

Example of a modern geospatial database system is the European FISE system, which provides continuous monitoring of Europe's forest stands. [11][12].

### ***Objectives of the article.***

The aim of the work is to build a model of a geospatial database, which will contain information about the location of land plots with honey vegetation, its types and remoteness to objects dangerous to bees.

### ***Materials and methods.***

To achieve the goal of the study, the structure of the geospatial database for beekeeping was developed in the form of a model, which is based on a unified modeling language (UML).

In the course of work on the development of the structure of the geospatial data base, data from previous work were selected as a basis [10], where operational approaches to detecting honey-bearing vegetation using Remote Sensing of the Earth were considered. The program "Dia" was used. The main research methods were: analysis of the characteristics of geospatial information, synthesis and object-oriented design.

***The main materials.*** Prompt provision of up-to-date information on the fodder base of beekeeping and areas dangerous for bees is a necessary condition for sustainable management and development of this area.

Geoinformation technologies are an important tool in solving this problem. The accumulation of data is accompanied by the problem of their preservation. All information should be stored in a single system with easy access to it.

It was decided to develop the structure of a geospatial database for beekeeping.

The geospatial database provides interoperability [13] of the data considered in the previous study [10]: analy-

sis of the distance to the fodder base of beekeeping and objects near which beekeeping is prohibited. This information should be accumulated in one place, characterize specific land plots and be publicly available.

The base should collect data on flowering time, location, quantitative and qualitative characteristics of crops and forest plantations belonging to the fodder base of beekeeping. Remote sensing data should be updated automatically from open sources.

Description of the components of the developed scheme:

Land plot - territory on which the apiary can or cannot be located. It has area, geometry, exact location and unique code;

Purpose of land plot is one of the basic characteristics of any land plot, which determines its legal regime; [14] [15]

Remote sensing materials - Earth remote sensing data is the main operational source of geoinformation data and the main source of information support in the current state. With the help of remote

sensing data it becomes possible to quickly find sites for the location of apiaries;

Dangerous objects - for the location of apiaries it is necessary to comply with the requirements of sanitary norms and rules. The location of apiaries near industrial facilities, roads, power lines, airports, farms and similar facilities is impossible; Buffer zones - used to place apiaries at a safe distance from industrial facilities;

Plants - to ensure the fodder base of beekeeping, honey vegetation is searched among the vegetation cover. Plants can be divided into annuals and perennials. Annuals are mostly agricultural crops, perennials are forest crops;

Safe zones - land plots containing honey plants and together with the buffer zone (not more than 2 kilometers) around them. They are the optimal areas for apiaries near the fodder base of beekeeping.

The figure below (Fig. 1) shows a diagram of the interaction of the components of the future geospatial database using a class diagram in UML.

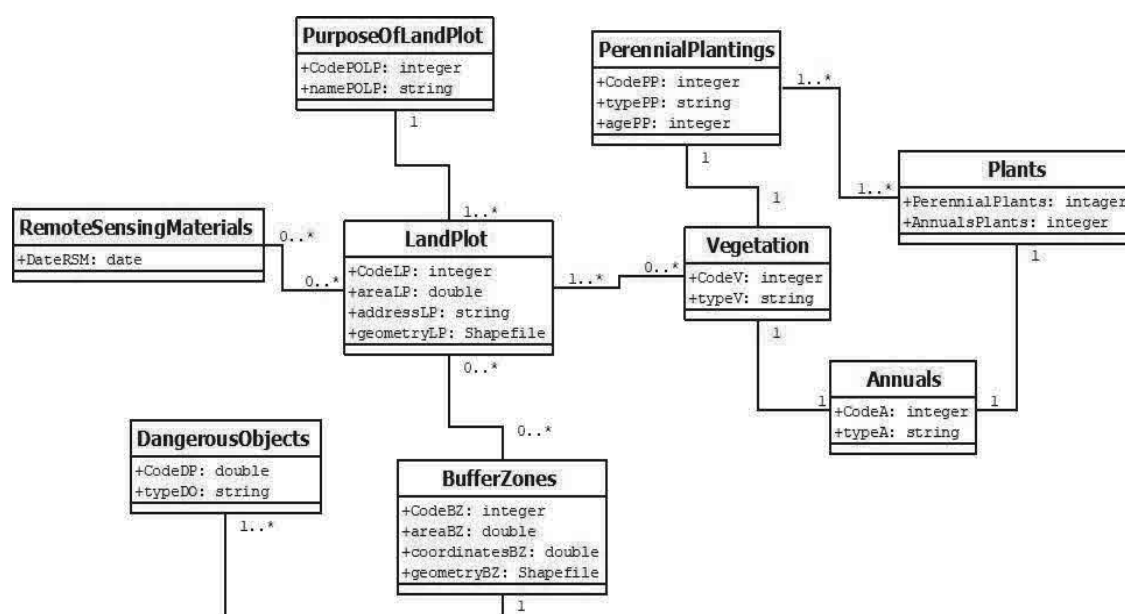


Figure 1 - The scheme of interaction of the components of the geospatial database for the needs of beekeeping is presented using a class diagram in UML

One of the options for implementing this project of a geospatial database at the state level is to introduce it into the National Structure of Geospatial Data [13].

To do this, it is necessary to ensure the introduction of up-to-date sustainable information from such resources as “Public cadastral map” [16] with verticalized land plots. In addition, it is necessary to create global vector layers with dangerous objects [3] and perennial vegetation, which is necessary for the calculation of buffer and safe zones.

Preservation of this data and open access to them: will provide up-to-date information to the beekeeping industry, facilitate the work of beekeepers, help prevent bee morbidity and death, establish relationships between apiaries and farms, allow spatial and temporal analysis in future research on beekeeping.

### ***Conclusions.***

The study reflects the development of the structure of the geospatial database to collect information on the location of safe for bees areas with honey vegetation.

A basic set of classes of the geospatial database has been established, which includes: land plot, land use purpose, remote sensing materials of the Earth, bee-dangerous objects, buffer zones around dangerous objects, perennial and annual honey plants and zones around them. A list of attributes and data types for each class is set.

The geospatial database model structures the information for creating land suitability maps for apiaries, which are necessary for effective beekeeping management. It is necessary to have stable information resources in this area. Prompt provision of up-to-date information on the fodder base of bee-

keeping and areas dangerous for bees is a necessary condition for sustainable management and development. With the help of the developed geoinformation database, it is possible to facilitate the work of beekeepers, save thousands of bee families and increase the yield of crops that need pollination.

Prospects for further research lies in the ways of development of this database of geoinformation data in Ukraine. And development of ways to implement systems for storage and accumulation of information on agriculture. That will promote the development of beekeeping through a strategic plan for crop rotation.

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- Дьоміна І.І.**  
**РОЗРОБЛЕННЯ СТРУКТУРИ БАЗИ ГЕОПРОСТОРОВИХ ДАНИХ ДЛЯ ПОТРЕБ БДЖІЛЬНИЦТВА**  
<https://doi.org/10.31548/zemleustriy2020.04.07>  
**Анотація.** Робота звертає увагу на важливість бджільництва для забезпечення населення України продовольством, так як опилення є необхідним для отримання багатьох харчових продуктів і не тільки. Згадується спосіб збору інформації за допомогою Дистанційного моніторингу Землі, за допомогою якого здійснюється оперативний підхід у визначенні можливих місць розташування пасік. Виявляються основні проблеми накопичення великої кількості даних, а саме способи зберігання геопросторових даних. Основною метою даної роботи є розробка моделі геоінформаційної бази даних, що буде зберігати в собі інформацію про земельні ділянки (території) безпечні та небезпечні для бджіл. Обґрунтовано необхідність такої бази даних, визначено і описано її складові частини (земельні ділянки, безпечні зони з кормовою базою бджільництва, буферні зони навколо небезпечних об'єктів, однорічна та багаторічна рослинність). Також в роботі дано приклади подібної геоінформаційних баз даних Європейського союзу, метою якої є моніторинг лісових насаджень Європи (The Forest Information System for Europe). Представлено приклад застосування розроблюваної бази даних в масштабах країни та визначено напрямки розвитку за допомогою геоінформаційних технологій.
- Ключові слова.** База геопросторових даних, кормова база бджільництва.
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- Дёмина И.И.**  
**РАЗРАБОТКА СТРУКТУРЫ БАЗЫ ГЕОПРОСТРАНСТВЕННЫХ ДАННЫХ ДЛЯ НУЖД ПЧЁЛОВОДСТВА**

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**Аннотація.** Работа обращает внимание на важность пчеловодства для обеспечения населения Украины продовольствием, так как опыление необходимо для получения многих пищевых продуктов и не только. Упоминается способ сбора информации с помощью Дистанционного мониторинга Земли, с помощью которого осуществляется оперативный подход в определение возможных мест расположения пасек. Выявляются основные проблемы накопления большого количества данных, а именно способы хранения геопространственных данных. Основной целью этой работы является разработка модели геоинформационной базы данных, которая будет сохранять информацию о земельных

участка (территориях) безопасных и опасных для пчел. Обоснована необходимость такой базы данных, определена и описана ее структура (земельные участки, безопасные зоны где находится корм для пчёл, буферные зоны вокруг опасных объектов, однолетняя и многолетняя растительность). Также в работе даны примеры подобной геоинформационной базы данных Европейского союза, целью которой является мониторинг лесов Европы (The Forest Information System for Europe). Представлены пример применения разрабатываемой базы данных в масштабах страны и определено направление развития с помощью геоинформационных технологий.

**Ключевые слова.** База геопространственных данных, кормовая база пчеловодства.