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MODERN TENDENCIES OF CHANGES OF METHODOLOGICAL APPROACHES TO STUDYING OF THE RESTORATION NATURAL VEGETATION IN POST-MINING AREAS

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The study of the dynamics of natural vegetation on post-mining sites is of great theoretical and applied importance [17]. We can get better forecasts of natural vegetation recovery using these studies. This allows us to choose more efficient and reliable methods of reclamation [7, 9]. Post-mining objects are universal test sites for the study of ecosystem dynamics in different edaphic, orographic, microclimatic and anthropogenic conditions [4, 15]. We can observe primary autogenic succession in the area of immediate mining when they are carried out or stopped. We can also observe secondary autogenic succession in dumps or fallow lands around mines and quarries. This allows us to study the dynamics of ecosystems as safely as possible for biota [3]. Also, we get the opportunity to change quickly from theoretical research to practical tasks of reclamation and restoration [1].

The main problem with ecosystem restoration projects is the gap between research and the practice of restoration ecology [11, 12, 13]. Scientists and practitioners talk about the gap between theoretical and applied activities [14]. There are several ways to solve this problem. We can support scientifically specific projects, break the project into several stages and do unified research directly on sites that need restoration. Support for direct projects by teams of scientists is frequent. However, the number of scientists for such work is much smaller than the number of projects. Differentiation of the project into stages requires a lot of time and resources. This approach will consist of a series of basic research (development of the theory of ecosystem dynamics), theoretical research (modeling of specific successions) and applied research (development and support of specific recovery algorithms).

A unified approach is the solution of all levels of theoretical problems directly on the object of recovery. This combination allows us to simultaneously build theoretical models and adjust recovery algorithms. The objects of the unified approach are abandoned agricultural lands disturbed by the recreation of the territory, mining and post-mining objects. If we try to implement a unified method now, we will not get an effective result. This method requires modernization. We need to involve experts from different fields of science to study the restoration of vegetation at post-

mining sites. It is known that the dynamics of vegetation is influenced by the environment. We have to do standard geobotanical descriptions and at the same time geological analysis and surveying [6]. We need to have these results at once to adjust the study area for different teams. Substrate and terrain are important for site selection for geobotanical description [2]. Laboratory analysis of samples takes a long time. So instead of one expedition to the site, we will have to do several, repeating the same work several times. This will lead to excessive financial and time losses for researchers. Failure to do so will increase the likelihood of errors [5].

We can solve this problem with multispectral and hyperspectral imaging [8, 10]. The first is used to remotely create a three-dimensional map of the object's vegetation. We use a quadcopter for this. We will establish a series of standard geobotanical descriptions in each relatively homogeneous area. We have to choose the exact place to describe. The place for the description is determined by the characteristics of the geological substrate. To bypass long-term laboratory tests of samples, we can use their hyperspectral imaging [16]. It is desirable for us to be able to conduct it in the field. If you work out the features of the methodology and create large databases, the study of vegetation restoration at the post-mining site will be able to conduct a small group of ecologists in a short time.

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