Natural forage lands of the Novgorod region

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Abstract. The article discusses the problem of saving and development of nature-created vegetation cover of natural lands, the rational use of which ensures sustainable development of the biosphere and the feed industry. The measures for improvement and rational use of natural hayfields and pastures are suggested, the potential fund of forage lands is identified according to the conducted geobotanical survey. Scientifically grounded recommendations for improvement and rational use of natural hayfields and pastures are developed.

1. Introduction
Floodplain meadows are the main arteries through which the seeds of surviving species spread. In the 80s, these meadows were valuable pastures and hayfields, where up to 75% of roughage was harvested. Geobotanical studies of floodplain meadows are relevant, since the introduction of alien species into floristic complexes and communities can lead to the local species degeneration. The intensive development of animal husbandry in the Novgorod region will inevitably require a solution to the problem of effective feed production [1–3]. Without a solid forage base there are no prospects for animal husbandry intensification in the North-West region of Russia.

Large areas of floodplain meadows are concentrated in the lowlands of lake Ilmen and along the banks of the Msta, Lovat and Shelon rivers. Highly productive meadows with partial flooding located around Ilmen occupy a significant swampy lowland with flat relief [4]. Natural hayfields on these meadows differ in relief, on which the distribution of soil, vegetation, productivity and the need for various agrotechnical measures largely depend [5, 6].

2. Problem statement
Meadows in the North-West region were used for harvesting hay, silage, haylage and pelleted feed for animal husbandry. The productivity of natural forage lands is not high and their botanical composition is unsatisfactory. The vegetation cover is dominated by undersized plant species of little value in terms of food, as well as harmful and poisonous. A large area of meadows and pastures is overgrown with shrubs and small forests. The mismanagement of the meadows in the Volkhov-Ilmen lowland leads to the herbage deterioration and loss of more valuable legumes and cereals. A decrease in yield leads to an increase in hydration.

3. Research questions
In the article, the author searches for an answer to the following issues:
1) To identify the meadow type by soil cover, moisture conditions.
2) To study the species dominance and its constancy in phytocenoses.
3) To conduct geobotanical research and determine the productivity of meadows.
4) To determine the economic use of meadows

4. Purpose of the study
The aim of the study is to examine the horizontal heterogeneity of the vegetation cover, describe the species composition, develop a proposal for increasing their number and further preservation of plant communities in the ecotopes.

5. Research methods
The object of the study was the natural lands of the Priilmenskaya lowland. We studied the plant species composition, plant community structure, and determined the economic use of the meadow [7–9].

To assess the qualitative composition of the herbage, a botanical analysis of average samples was carried out, which were taken when counting each plot simultaneously with the test sheaf. When analyzing the samples, plants were isolated by families and species. Phytocoenological classification was carried out using the dominant approach (dominance of the species and their constancy in phytocenoses) and the floristic level (identification of species that give an idea of the ecological properties of habitats).

6. Findings
The vegetation cover of natural lands is distinguished by its species diversity. Under natural conditions, there are many plant species which form groupings. They are not always identical in terms of species composition, economic value, soil and climatic conditions of growth and development [10].

Natural meadows located in the riverbed part of the Priilmenskaya lowland rivers are filled with flood waters for a week in spring and enrich the soil with minerals in the form of silt. Therefore, on these meadows, there is a layer of alluvial deposits on top, up to 10 cm and more.

The area of the Novgorod region is 55,3 thousand km². Its biggest length is about 385 km from the western part to the east and 250 km from the north to the south.

In the northern part of the region there are marsh massifs: the Gruzinskaya depression in Chudovskoy district, large bogs with peat deposits in the Malovishersky district. In the western and central parts there is a vast swampy Priilmenskaya lowland with a flat relief. Swampy Polistovsko - Lovatsky massif is located in the southern part. The eastern part of the region is located on the Valdai Upland with well-drained soils.

According to the results of the studies carried out from 2010 to 2019, it was found that the floodplain areas located around lake Ilmen and along the channels of the Volkov, Lovat, Msta and Shelon rivers were and remain satisfactorily developed in an agricultural respect.

The soils of these meadows are heterogeneous and differ in agrochemical parameters (table 1).

Table 1. Agrochemical characteristics of soils.

| Meadow location                   | Soil                    | Humus, % | pH in KCl | P2O5 | K2O |
|----------------------------------|-------------------------|----------|-----------|------|-----|
| Floodplain around lake Ilmen     | meadow-boggy            | 3.55     | 3.92      | 12.28| 10.5|
| Floodplain riv. Volkov          | silty-gley              |          |           |      |     |
| Floodplain riv. Lovat           | alluvial meadow, loamy  | 3.37     | 4.79      | 10.0 | 14.2|
| Floodplain riv. Msta            | alluvial meadow, loamy  | 2.19     | 4.84      | 14.6 | 16.7|
| Floodplain around riv. Shelon   | meadow-gley sandy loam  | 1.89     | 5.16      | 8.75 | 6.3 |
|                                  | meadow-gley sandy loam  | 3.48     | 4.17      | 12.7 | 11.9|
The soils of humid habitats have a weakly acidic reaction of the soil solution and are well supplied with nutrients. Dry meadows along the banks of the river Msta are characterized by high acidity and poor availability of phosphorus and potassium mobile forms.

The meadow around Lake Ilmen is confined to places with difficult runoff. The soils are characterized by increased moisture, and they gradually become waterlogged. The unfavorable water-air regime of soils had a significant impact on the floristic composition and meadow phytocenosis productivity. The lack of mowing and grazing of farm animals contributed to a sharp decline in the herbage of canary grass (*Phalaroides arundinacea* L.), caused by slender sedge species (*Carex acuta* L.), aquatic sedge (*Carex aquatilis* Wahlb.) and other harmful and poisonous plants. In terms of species composition, forbs dominate and is represented by Siberian hogweed (*Heracleum sibiricum* L.), horse sorrel (*Rumex confertus* Willd.), rough sow thistle (*Sonchus asper* L), angelica (*Angelica archangelica* L.), yellow basil (*Thalictrum flavum* L.), common meadowsweet (*Filipendula vulgaris* Moench.) (table 2). In spring, a large amount of water and, accordingly, nutrients stagnate. The soils of these areas are rich in humus, enriched in calcium, and have a slightly acidic reaction of the soil solution. Groundwater is close to the soil surface. In the 90s, this meadow was used for haymaking for 20 years, the annual yield was in the range of 12.3–14.8 centners/ha of dry weight. Over the past 10 years, there has been no haymaking. Degeneration of the herbage occurred due to the high degree of stiffness and bushiness. Without radical improvement of these meadows, the process of waterlogging will increase annually.

### Table 2. Species composition of floodplain meadows.

| Families     | Floodplain of Ilmen | Ilmen clint | Floodplain of Volkhov | Floodplain of Lovat | Floodplain of Msta | Floodplain of Shelon |
|--------------|---------------------|-------------|-----------------------|---------------------|-------------------|----------------------|
| Cereals      | 1                   | 5           | 4                     | 2                   | 3                 | 3                    |
| Legumes      |                     |             |                       |                     |                   |                      |
| Sedge        | 2                   |             |                       |                     |                   |                      |
| Buckwheat    | 1                   |             |                       |                     |                   |                      |
| Sunflower    | 1                   |             |                       |                     |                   |                      |
| Parsley      | 1                   |             |                       |                     |                   |                      |
| Buttercup    |                     |             |                       |                     |                   |                      |
| Asteraceae   | 1                   |             |                       |                     |                   |                      |
| Rose         | 1                   |             |                       |                     |                   |                      |
| Madder       |                     |             |                       |                     |                   |                      |

White-grass meadows are widespread on Ilmensky clint in the Starorussky district, on podzolic soils poor in organic matter. Low-yielding herbs grow: fine bent grass (*Agrostis tenuis* Sibth.), meadow fescue grass (*Festuca pratensis* Huds.), crested dogtail (*Cynosurus cristatus* L.), sweet vernal grass (*Anthoxanthum odoratum* L.), with high share of matweed (*Nardus stricta* L.). The mismanagement of the meadow led to the deterioration of the herbage, the loss of leguminous plants and the growth of matweed.

In the meadows formed on richer calcareous soils in the village of Korystyn, the species diversity is represented by meadow fescue (*Festuca pratensis* Huds.), timothy grass (*Phleum pratense* L.), cock’s foot grass (*Dactylis glomerata* L.), red clover (*Trifolium pratense* L.), meadow pea (*Lathyrus pratensis* L.), tufted vetch (*Vicia cracca* L.), sickle alfalfa (*Medicago falcata* L.). Forbs are dominated by: brown knapweed (*Centauréa jacéa* L.), hawkweed (*Pilosella officinarum* L.), silvery cinquefoil (*Potentilla argentea* L.). The meadow is economically used as a pasture.

At the source of the Volkhov the floodplain is well developed. The floodplain meadows are periodically flooded. Meadow vegetation depends on the duration of flooding and the thickness of the slit deposit. In the 80s, technical measures were taken to improve crops and the meadows were widely used for haymaking. The following species prevailed in the herbage: tufted hair grass (*Deschampsia cespitosa* L.), meadow foxtail grass (*Alopecurus pratensis* L.), dog bent (*Agrostis canina* L.) and black bent (*A. gigantea* Roth), fox sedge (*Carex vulpina* L.) and grass-like sedge (*C. cespitosa* L.). Currently,
there is no economic use of the meadow, the herbage is represented by moisture-loving species: meadowsweet (Filipendula ulmaria L.), common rush (Juncus effusus L.), European globe flower (Trollius europaeus L.), cow lily (Caltha palustris L.). The herbage of Volkov-Ilmen lowlands is of low quality, the dry mass yield is about 10 c/ha. There is a degradation of the vegetation cover and the absence of cultural and technical measures to restore valuable species in the herbage.

The banks of the Lovat River are gentle, located in the Priilmenskaya lowland. Wet meadows are flooded every year. The grass stand is dominated by tufted hair grass (Deschampsia cespitosa L.), browntop (Agrostis capillaris L.), admixture of sedges and herbs: European goldenrod (Solidago virgaurea L.), Hieracium umbellatum L. and tormentil (Potentilla erecta L.). These lands are of little use for haymaking and pasture use. The process of waterlogging and overgrowing with shrub vegetation takes place intensively.

The variety of Shelon meadows in the Soletsky district depends on the granulometric composition of soils, the degree of their moisture and the terrain. These are dry meadows, but once every 12 years, in a long spring and at a large amount of precipitation, moisture stagnation is noted, especially in low areas. In the herbage on this site, the following types of cereals are dominant: timothy grass (Phleum pratense L.), meadow foxtail (Alopecurus pratensis L.), meadow fescue (Festuca pratensis Huds.), and among legumes – meadow clover (Trifolium pratense L.) and hybrid clover (Trifolium hybridum L.), bird’s foot trefoil (Lotus corniculatus L.), sickle alfalfa (Medicago falcata L.), craw pea (Lathyrus pratensis L.), tufted vetch (Vicia cracca L.). Forbs are presented by northern bedstraw (Galium boreale L.), golden (Galium verum L.) and hedge (Galium mollugo L.).

These meadows are used as pastures sometimes alternating with mowing. To preserve the species composition, it is necessary to re-sow valuable grasses in the sod, and to clean from shrubs. It is possible to significantly increase the productivity of meadows by applying fertilizers. When sowing, perennial plants capable of vegetative and seed propagation should be included in the sod. Among cereal grasses, quitches reproduce vegetatively: awnless brome (Bromus inermis L.), meadow grass (Poa pratensis L.), meadow foxtail (Alopecurus pratensis L.), red fescue (Festuca rubra L.) and meadow fescue (F. pratensis Huds.). Among legumes, rhizome forms of yellow alfalfa (Medicago falcata L.) and white clover (Trifolium repens L.). Without the above measures, they are prone to overgrowing with shrubs, and the process of waterlogging gradually occurs.

Meadows of Msta in Borovvichsky district are typical dry lands. Meadows with xerophilous species are formed on the Opechensky Posad site: mountain clover (Trifolium montana L.) hop clover (Medicago lupulina L.), creeping trefoil (Trifolium repens L.), and bird’s foot trefoil.

Rare species grow in the area of the Bobrovsky mountains on a finely contoured meadow: purple milk vetch (Astragalus danicus Retz.) and suckering weed monocline of sickle alfalfa (Medicago falcata L.).

On the right bank of the riv. Msta near vil. Egl formed the so-called craw pea meadows with valuable herbage consisting of craw pea (Lathyrus pratensis L.), sickle alfalfa (Medicago falcata L.) and a rare species – kidney vetch (Anthyllis macrocephala Wend). There is a small share of such cereals as browntop (Agrostis capillaris L.), red fescue (Festuca rubra L.) and meadow fescue (F. pratensis Huds.). This plot can be used for mowing. It is possible to significantly increase the productivity of meadows by applying mineral fertilizers. With the application of mineral fertilizers N 45 P45R60, the increase in dry matter yield was 14.7 c/ha.

We have found that natural forage lands occupy a significant area in the Novgorod region. The main disadvantages of these lands are low yields due to their irrational use, complicated area pattern which hinders the use of technology, due to which significant areas of hayfields remain unused. It is possible to increase the productivity of these lands through land reclamation and the use of fertilizers. On lands with degenerated grass, as well as on heavily bogged and bushy areas, it is necessary to carry out a radical improvement.

On bushy meadows, if the herbage contains about 40% of cereals and legumes that are valuable for forage, it is necessary to create cultivated pastures by means of surface improvement. First of all, the improvement must be carried out on meadows that are free of shrubs and do not require draining, the
payback period is two years. It is necessary to improve bushy meadows, hillock meadows and, in the last turn, the lands requiring draining. The payback period in this case is from 5 to 6 years.

7. Conclusion
To plan measures for the improvement and rational use of natural hayfields and pastures, to identify the potential fund of forage lands, it is necessary to conduct a geobotanical survey. These studies will make it possible to assess the change in the botanical composition of the herbage by individual years, depending on meteorological conditions and the struggle for existence between species. This will allow to develop scientifically grounded recommendations for improvement and rational use of natural hayfields and pastures.

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