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Mapping Studies of Phytocenoses in Environment Interfaces (as Methodical Approach)

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Abstract

Mapping studies of phytocenoses at environmental interface require a set of approaches and methods providing obtaining of detailed information on vegetation structure and dynamics under contrast environmental conditions. Phytocenoses at environmental interface can be a regional model for indication of current processes and of past changes in vegetation structure under different environmental conditions. Mapping of environmental interface cenoses allows revealing the peculiarities of phytocenoses structure and formation at regional and topological level of plants organization. This is, in turn, an information basis for identification of current processes within zonal vegetation type (environmental zone). In the present article, the results of large-scale mapping of phytocenoses under the conditions of interdependence of development of zonal taiga and extra-zonal steppe at Lake Baikal western coast are presented. We use a study method combination of geobotanical survey with large-scale schematic mapping and vegetation mapping on the base of field deciphering of aerospace pictures made in different years together with phytocenoses monitoring during different seasons and years forming at the interface of zonal forests and extra-zonal steppe.

Keywords

Large-Scale Mapping, Phytocenoses at Environmental Interface, Zonal Vegetation, Extra-Zonal Cenoses

Subject Areas: **Biochemistry**

1. Introduction

Vegetation studies for mapping are a part of geobotanical studies serving simultaneously both as a method and

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as a result. Vegetation studies for mapping determine a selection of classification approach, and this is the essence of studies performed. A rather detailed characteristic of approaches to vegetation classification (without which any cenoses mapping are impossible) is presented in a paper by L. P. Rysin [1] based on the analysis of large amount of researchers' opinions. A choice of any approach in phytocenoses classification depends on the aim of the studies performed. This is confirmed by the opinion of R. V. Kamelin concerning these or those vegetation classification approaches "… if they are performed in any economical activities" [2]. Selection of an approach for vegetation classification resulting in mapping is always individual and is due to the adherence of a researcher to one of existing scientific schools. In our studies, we use a dominant approach in vegetation classification proposed by V. N. Sukachev [3] and developed further by Ye. M. Lavrenko [4] and V. B. Sochava [5]. At a dominant approach, dominant plants are basis of the cenoses. They determine cenoses composition, structure, dynamics, and destructive processes occurring at any external impact and reflect conditions of formation of any concrete community. Ways of endoecogenesis, exoecogenesis in vegetation are always reflected in composition of dominant plants (in many cases edificators) of the synfolia of all cenoses. Besides maximal consideration of ecotopes conditions while using a dominant approach, the taxa establish "… are easily mapped and can be used for planning economic activities with different aims" [1]. And this is just an aim of vegetation studies at any territory where vegetation maps of different scales themselves form a basis geobotanical division into areas and serve as a tool for determination of types and ways of vegetation cover use for human activity.

Baikalian Siberia comprises numerous cenoses reflecting the specifics of structural and dynamic organization of vegetation cover at vast territories. Such communities can serve as a regional model for indication of existing processes and of changes which occur during last centuries. These changes can characterize trends of probable spontaneous dynamics and of anthropogenic destruction of the environment under definite conditions. Phytocenoses of modern habit formed during Late Holocene, will serve as a start point of temporal and spatial changes character. The most important matter is the nature of zonality, extrazonality or environmental genesis determining the zonality and extrazonality in vegetation organization. Nowadays, this is a global problem of modern biogeography and ecology. The importance of vegetation studies for mapping under contrast environmental conditions is in the fact that phytocenoses form under complicate (contrast) environmental conditions resulting from extrazonal effects in the vegetation structures of taiga zone. In our case, this is Western Pre-Baikal Region.

The aim of our studies is to determine (by mapping method) main peculiarities of structural and dynamic organization of cenoses forming under the conditions of mutual development of extrazonal steppe within zonal taiga determining modern trends of their genesis under the conditions of changing climate conditions and of character of anthropogenic impact in the region. The following tasks are solved: 1) to reveal the structure of cenoses forming under the conditions of mutual development of forests and extrazonal steppe; 2) to assess dynamic trends of cenoses at forests and extrazonal steppe interface; 3) to determine main environmental factors resulting in formation of cenoses comprising taiga and steppe plant species; 4) to find out typological composition of cenoses forming at mutual development of forests and extrazonal steppe; 5) to forecast on the base of made vegetation maps the development of cenoses at environmental interface taking into account climatic dynamics and the character of anthropogenic impact in the region.

2. Background

While classifying steppes for dividing into areas, Ye. M. Lavrenko [6] deined zonal vegetation as plakors phytocenoses with homogenous composition. He performed division of steppe zone into zones and provinces where steppe zone is considered as a separate phenomenon with characteristic regional heterogeneities in vegetation structure. Studying a problem of division of USSR natural environments into zones, L. S. Berg [7] determined natural zones as regions with dominant development of the same landscapes. He determined tundra, forest, forest-steppe, semidesert, desert and subtropical zones. Here there are quite definite characteristics determining this or that zone. According to V. B. Sochava [8], geographic zonality is the most important characteristic of geographical environment determining environment differentiation with some determined features. In Siberian taiga zone, there occur some steppes area as "steppe islands" of different area, often in intermountain troughs, in riverine valleys, on steep slopes, reaching sometimes tundra boundaries. They do not form environmental zones in the space, like, e.g. forest-steppes or sub-taiga [9]. Southward from North the proportion between taiga and steppe changes in favor of the latter. The occurrence of steppe areas within taiga decreases westward from East.

In difference with zonal forest-steppe and sub-zonal (plakor) sub-taiga, as well as with forest-steppe belt and

belt of low-mountain sub-taiga in the mountains, “steppe islands” are some kind of a succession of vegetation zonal type or of a mountain belt with its specific structure and cenoses genesis. In mountains, relationship between taiga and steppe is characterized by formation of mountain-steppe belt. In the highlands there is a characteristic spatial and vertical stratification of vegetation structure divided into zones and altitudinal belts and reflecting concrete physico-geographical environmental conditions. This fact is doubtless. The doubt is in the same term characterizing different phenomena (or environments). While assessing phytocenoses development and formation, it is necessary to take into account territorial specifics in order to avoid uncertainties in determination of phenomena in each case. It is necessary to make terms concrete: what is forest-steppe or taiga from viewpoint of zonality, altitudinal belts and of extra-zonality. These phenomena determine quite concrete physico-geographical conditions at any territory. Probably, it is necessary to determine information sense of terms characterizing any concrete phenomenon.

There are already many publications characterizing phytocenoses as “ecotones”. However, ecotones in the vegetation structure are determined both under zonal and under under extra-zonal conditions, as well as a forest border. So, this term is inverted; it is used for characteristic both interzonal (or interbelt) and intrazonal (or intrabelt) phytocenoses at territories with different physico-geographical conditions. First the term “ecotone” was used by British and American researchers [10] [11] as a characteristic for transition between two vegetation association. They point out that “ecotone” is a transition between two phytocenoses with higher species diversity in the zones of transition of adjacent territories with different vegetation. A great role of ecotones as buffer cenoses in vegetation organization was taken into account in the studies of V. B. Sochava. He affirmed that in the sites where an ecotone is available, there is an impression of indistinct boundaries between cenoses; however, pointing out of ecotones on the maps eliminates in some way difficulties in boundaries establishment. However, this generates some new questions concerning reflecting of cenoses structure and genesis. Using of term “ecotone” for different physico-geographical conditions (zonal, altitudinal belts, extra-zonal) may not be optimal for classification of phytocenoses at environments interface. Characterization of studied objects of different quality and conditions with the same term cause difficulties in determining of the phenomenon considered. “Forest margin”, “interzonal”, “zonal” or “extra-zonal” ecotones are phenomena of quite different quality defining different environments. Use of any term is always related to degree of knowledge of any studied object, its classification according to a concrete phenomenon. It is possible to solve problem of typization and classification of phytocenoses of environmental interfaces and to determine their informational content using a method of large-scale mapping of phytocenoses at region topology level of vegetation organization.

3. Research Areas, Methods and Materials

A key site of our studies was the territory of formation of zonal forests and extra-zonal (“island”) steppe in the central part of Lake Baikal western coast (the Talovka R. basing and Little Sea Strait coast). They are determined so in order to reveal structural and spatial vegetation organization of the whole Lake Baikal western coast, which is quite contrast by its physico-geographical conditions.

The studies object are peculiarities of relationship and mutual development of light-coniferous zonal taiga and extra-zonal steppe resulting in formation of phytocenoses comprising plant species from different areas and environments. Geobotaical survey during several years resulted in more than 900 geobotanical descriptions of different periods completed by herbaria. Schematic map and large-scale vegetation map we made helped to reveal peculiarities of spatial stratigraphy of phytocenoses of interfaces of zonal taiga and extra-zonal steppe. For full-scale studies of vegetation under complicate (contrast) physico-geographical conditions of the territory, we needed a series of methods, which would help to reveal a detailed structural and dynamic organization of vegetation under contrast environmental conditions. Large-scale mapping was done using materials of aerospace pictures [12]. During geobotanical mapping, we took into account recommendations presented in [13]. Model sites are established for monitoring of intraseasonal and interseasonal dynamics of phytocenoses. This is aimed to present their dynamical component for making schematic maps and vegetation maps themselves. For cenoses typization, we used concrete principles of vegetation classification presented in [14].

The stages of work were as follows: 1st: typization and classification of phytocenoses reflecting morphologically, ecologically and dynamically zonal (or extra-zonal), regionally typological peculiarities of modern vegetation structure in the studied areae; 2nd: making of large-scale mapping models (schematic maps) of spatial organization of cenoses at the key site taking into account relief structure, edaphic conditions and spatial position

of cenoses in Pre-Baikal mountains system; 3rd: typization and classification of vegetation groups, differing morphologically, ecologically and dynamically from associations reflecting different vegetation types resulting in mapping models (schematic maps); 4th: making a system of model sites (basis) representing all the diversity of the phytocenoses at the studied territory; 5th: revealing of the character of links between components forming a cenosis and determining a phytocenosis as a system; 6th: establishing of parameters determining a concrete cenosis state, which can be used for extrapolation in assessment of similar (close to models) cenoses in other areas; 7th: vegetation mapping itself. We took into account all the aspects of anthropogenic factor impacting structural and dynamic organization of any concrete cenoses.

Geobotanical survey on the base of field deciphering of large-scale aerospace pictures of different years revealed spatial-structural links of phytocenoses, peculiarities and vector of dynamic processes in vegetation, as well as phytoindication features of cenoses (species) resulted in mosaic character and sinusiality of vegetation cover at key sites in the studied area. Before there was a stage of cameral work consisting of making schematic maps on the base of differences in spatial structure of vegetation images on aerospace pictures. While mapping, cenoses typization and classification was done in the following order: a set of descriptions of vegetation area was obtained (forest and steppe cenoses separately) marking on the picture the described sites; descriptions were grouped by similarity of dominant synfolia composition and by horizontal structure; the descriptions were grouped by similarity of cenoses habitat; the classification was done with associations definition. This work results in a large-scale basic inventory (schematic map) of phytocenoses on the key site at Lake Baikal western coast.

4. Results

Large-scale mapping studies of vegetation cover at transitional (interzonal, interaltitudinal belts, intrazonal, non-zonal) territories allowed to reveal structural and dynamic peculiarities of vegetation at regional-topological level of its organization. The notion of zonality or extra-zonality in vegetation was specified by factors series, which determined the vegetation structure at any concrete territory. The intrasystematic links revealed at formation of a cenoses of transitional type (environments interface) allowed determining modern dynamic trends, to reconstruct past vegetation, to forecast potential changes in the cenoses. Mapping analysis of peculiarities of cenoses structure under contrast conditions allowed revealing mechanisms of formation of such cenoses as of sites of formation of species and cenoses diversity at transboundary territories. Mapping presentation of cenoses consisting of different ecobiomorphs and of areal composition of plants species allowed to reveal processes reflecting formation of systems with spatial and genetic peculiarities and to obtain models for monitoring of formation of the environment at regional-topologic level of its organization.

The studied area is a part of Ol'khon District of Irkutsk Region and comprises major part of Lake Baikal western coast. The territory is characterized by a high contrast in environmental condition with considerable annual and perennial dynamics of the components, mainly precipitation and temperature. It is situated in the area of specially protected territory—Pre-Baikal National Park. Due to this fact, it is especially important to study and to reveal a detailed structural dynamic organization of vegetation as it is the most dynamic environmental component accumulating and reflecting practically all variations in vertical and horizontal environment stratigraphy and its genesis.

The vegetation in the studied area (central part of Lake Baikal western coast, Pre-Ol'khon Region) has complicated cenoses. There are here light-coniferous taiga forests dominated by pine in the southern part of Pre-Ol'khon Region and of Siberian larch at Little Sea Strait of Lake Baikal. Within these areas, steppe cenoses are developed jointly with forest. Practically in the whole territory, larch forest-steppes in grassland of different large (2 - 45 y.o.) occur.

Modern state of vegetation is determined by general landscape and vegetation conditions. The specifics of vegetation cover of the central part of the western coast reflect a definite link with the history of vegetation development in the whole Baikal Region. Main regional structural-typological peculiarities and structural-dynamic features of modern vegetation cover oa the whole Baikal Region and of Lake Baikal western coast are presented on a small-scale (1:1,500,000) geobotanical map [15]. It shows that for the vegetation cover of the studied area, a diversity of cenoses from mountain taiga forests to steppe cenoses is characteristic from floristic, cenotic and dynamic viewpoints.

4.1. A Large-Scale Inventory Schematic Map of Cenoses at the Interface of Zonal Taiga and Extra-Zonal Steppe of the Key Site of Lake Baikal Western Coast (an Example)

The inventory schematic map (an example) of phytocenoses at the interface of zonal taiga and extra-zonal steppe served as a base for determination of key sites aimed to reveal the most typical cenoses of taiga and extra-zonal steppe interface for the central part of Lake Baikal western coast. The inventory schematic map for the Talovka R. basin (the central part of Lake Baikal western coast) served as a base for characteristic of the peculiarities of cenoses formation at taiga and extra-zonal steppe interface in the studied area. The schematic map of cenoses of the key site allowed further classification. The cenoses similar by dominant ecomorphs within synfolia and by habitats type were associated for development a geobotanical map of vegetation itself [16].

It is necessary to notice that we found out among the flora of cenoses of zonal taiga and extra-zonal steppe interface 674 tracheophytes species related to 68 families and 287 genera and 32 mosses species. The ratio of main groups of higher tracheophytes is typical mainly for holarctic floras. The 11 major families (*Poaceae*, *Asteraceae*, *Cyperaceae*, *Rosaceae*, *Fabaceae*, *Ranunculaceae*, *Caryophyllaceae*, *Brassicaceae*, *Apiaceae*, *Scrophulariaceae* and *Lamiaceae*) comprise 431 plant species, these are 67.8% of total amount, and the other а на долю 57 families comprise 243 plants species, these are 32.2% of total amount. Such composition of main families is characteristic for boreal floras and is similar to families set of the flora of the whole East Siberia. The whole holarctic area manifests the dominance of the families *Asteraceae*, *Poaceae*. For boreal floras, *Cyperaceae* are of high importance, *Ranunculaceae* play a considerable role. Continental features in the floras are manifested in a considerable role of the families *Brassicaceae*, *Rosaceae*, *Fabaceae*. A relative abundance of the species of *Caryophyllaceae*, *Scrophulariaceae* increases northward and reaches a maximum in the Arctic part of Siberia. Families set represent the most general peculiarities of flora due to its zonal situation (taiga zone).

The determined geoelement types (areals types) are based on the principles reported by numerous researchers. In sum, 14 geoelement types are determined. The flora of cenoses of taiga and steppe interface on Lake Baikal western coast is dominated by boreal, South-Siberian, Eurasian floras, while species amount of Central Asia and all-Asia floras is not considerable.

Basing on the principles of species composition division by features of relation to this or that belt-zonal group, we analyzed the flora of the cenoses of taiga and extra-zonal steppe interface on Lake Baikal western coast. It is shown that among all species, forest-steppe belt zonal group comprises 89 species (related to 22 families), this is 13.17% of all the species (674 ones). The steppe group itself comprises 63 species (related to 15 families), this is 10.04% of total species amount of the cenoses of taiga and extra-zonal steppe interface of Lake Baikal western coast. The presence of this or that species group characteristic for any concrete altitudinal belt (or environment) reflects always the essence and the environment of a phenomenon. Hence, in the studied area there is no clearly manifested belt structure and this is not maybe right to characterize the cenoses of taiga and extra-zonal steppe interface as mountain forest steppe or steppe belt.

Using approaches in plants classification in their relation to the environment, we performed ecotypological, ecomorphological and ecogeographycal analyses of floristic composition of cenoses of taiga and extra-zonal steppe interfaces in the studied area. Among all cenoses species (674 ones) euxerophytes, cryoxerophytes, mesoxerophytes, xeromesophytes make 38% of plant species. Mesophytes species make 52%, respectively. It is to notice that that dominant positions in cenoses of different ecology change often under different climatic conditions. There is a rather large amount of grass cenoses with main xerophytes species with specific habitats conditions, with abrupt seasonal and perennial oscillations of climatic factors, mainly of precipitations, which generated formation of rather stable cenoses under the existing environmental conditions. A large mesophytes diversity (>50%) is due by the effect of taiga element of vegetation cover.

According to ecological-cenotic flora relation in the cenoses of taiga and extra-zonal steppe interface, a considerable fraction of plants species belongs to meadow-forest, medow and forest plants groups (48% of total species composition), while meadow-steppe and steppe groups comprise 42% of species, and meadow-swamp and weed groups—10% of species. Steppe cenoses are widely represented by plants species characteristic for taiga and high mountains (e.g. *Dryas sumneviczii*, rock jasmins *Androsace incana*, *A. lactiflora*. A large fraction of all species composition is not related to the steppe group, this is quite natural under modern environmental conditions and at dynamic tendences of vegetation formation in this region.

Perennial vegetation studies by method of large-scale geobotanic mapping allowed revealing some peculiarities of structure and development of cenoses forming at mutual influence of zonal forests and extra-zonal steppe

cenoses on a territory with limited space.

4.2. A Large-Scale Map of Taiga-Step Cenoses (Epiassociations) of the Key Site of Lake Baikal Western Coast (an Example)

To reveal and to reflect such a complicate of cenotic structure of such cenoses, we used a structural-dynamic principle of vegetation classification [17] used in geobotanical mapping by making maps of different scales. Main classification unit in this case is an epiassociation as a complicate dynamic system including maximally probable cenoses states, which form a plants association for a concrete habitat type. An epiassociation is considered as a syntaxon associating different dynamic states of an association—from serial to radical ones. An epiassociation "… comprises all variable components of the association… different series and ways of development towards the maternal core of the association". We assess an epiassociation as a system reflecting the following parameters: stands age structure, dominants and co-dominants composition in a concrete age goroup, presence or absence of young growth and its composition, presence or absence (dominance) of small-leaved species, a character of natural renewal (depending of effects—fire, cutting, pasturing, haying). For grass (steppe) cenoses in an epiassociation as demutation or renewal series related genetically to forest cenoses, we present a characteristic of stratification, of synfolia dominants and of characteristic species abundance as well as cenosis formation conditions and genesis. For this aim, we classified cenoses as a system of subsequent cenoses typization while accumulating set of cenoses descriptions with similar structure, dynamics and habitat conditions.

Cenoses forming at zonal taiga and extra-zonal steppes interface are to be called taiga-steppe ones. By their structure and dynamics, they form an epiassociation for a concrete habitat. Making of a large-scale (1:25,000) map oa taiga-steppe cenoses (epiassociatins) for a key site (as an example) allowed to reveal all the diversity of spatial structure and the peculiarities of vertical organization of cenoses forming at mutual development and mutual effects of light-conifeorous taiga and of extra-zonal steppes of the central part of Lake Baikal western coast. For cenoses typization and classification, a dominant approach was used taking into account ecomorphological features and geosystematic analysis of structural dynamic of features of cenoses associated into epitaxa. A large set of cenoses of different structure, which form a complicated system of light-coniferous (taiga) and steppe cenoses is revealed. The base of vegetation of the studied area is formed by epiassociations of taiga steppe pine ones, larch-pine ones and larch ones with presence of pines in association with steppe cenoses as demutation-renewal series of forest cenoses.

The legend to the map of taiga-steppe cenoses (epiassociations) of the key site of Lake Baikal western coast (the central part of Lake Baikal western coast) presents age structure of stands of the association, dominants and co-dominants composition in a concrete age group, presence or absence of young growth and its composition, dominance or non-dominance of small-leave species, renewal depending on the effects (fire, cutting, pasture, haying), presence or absence of demutation-renewal grass cenoses, components of structural-dynamic and genetic factors. All these factors form one united association. Epiassociations are strongly associated with concrete sites—slopes of different exposition and steepness, watersheds of definite morphostructure, aprons of slopes of different expositions, notches and riverine valleys.

E.g. an epiassociation of pine trees with larch and of larch and pine trees and rhododendrons (Daurian rhododendron) with duschekia (*Duschekia fruticosa*) in cowberry mesophytic forests on watersheds saddles (No. 1, for example) includes the following cenoses: birch-pine young growth on burn-out places; aspen-birch forests aged up to 40 y.o.; birch-aspen forests aged up to 40 y.o.; larch-pine forests with birch and aspen without young growth aged up to 40 y.o.; aspen-larch forests with birch without young growth aged up to 40 y.o.; pine forests with birch without young пкцер aged up to 60 y.o.; pine forests with birch aged up to 80 y.o.; pine-larch forests with birch and aspen without young growth aged up to 80); pine-larch forests with birch and aspen and young growth of pine, larch and birch aged up to 100 y.o. and more. This epiassociation includes all the possible dynamic components of a forest cenosis forming under concrete conditions—on watershed saddle. Here we present characteristics composition of synfolia dominants, their age structure, character of young growth and renewal together with steppe cenoses, which are demutation renewal series of taiga-steppe epiassociations.

Epiassociation of pines with larch (No 6, for example), of petrophytic minor-species with *Carex macroura*, meadowsweet and some mosses, mesophytic forests on eroded slope includes pine forests with larch (stand aged up to 40 y.o.) and with larch and pine young growth; pine forests with larch (stand aged up to 80 y.o.) with large and pine young growth; grasses with dominant fairway crested grass and sage-leaf mullein in the cenoses of

demutation-renewal series of pine forests with larch; pine forests with larch (stand aged up to 80 y.o.) with larch, pine and birch young growth; grasses with dominant *Carex duriuscula* and *Poa botryoides* in the cenosis of demutation series of pine forests with larch. We present species and age parameters of stands forming epiassociations, which, together with grasses cenoses, form an epiassociation of a definite habitat. The development character reflects tendencies of forest formation with decrease of sites with grasses cenoses. Here pine young growth without forest canopy is found out.

Epiassociation of fir and larch forests with pines and willows (*Salix taraikensis* and *Salix pyrolifolia*), tall grasses (*Cacalia hastata*, *Carum carvi*, *Trollius asiatica*, *Equisetum pratense*, *Veratrum lobelianum*) on low terraces about the flood plain of the Talovka R. includes larch and birch forests (*Betula pendula*) with aspen without young growth (aged up to 40 y.o.); birch and aspen swamped forests with willows and carex (*Carex coriophora* and *Carex pamirensis* subsp. *dichroa*) (aged up to 60 y.o.); grasses cenoses with dominant *Agrostis mongolica*, *Alopecurus pratensis*, *Carex enervis*, *Carum carvi*, *Veratrum lobelianum*, *Eryophorum russeolum*, *Trollius kytmanovii* used for haying; larch forests with fir and birch with larch and birch young gross with willows and blackcurrant (*Ribes nigrum*) considered as initial ones for such habitats; swamped grasses cenoses with dominant *Festuca rubra*, *Agrostis mongolica*, *Poa pratensis*, *Rhinanthus vernalis* and *Eryophorum russeolum* used often for haying and related genetically to fir-larch forests in the Talovka R. valley.

The map of taiga-stepe associations of the key site (as an example) of the studied area (the central part of Lake Baikal western coast) includes all dynamic and demutation components of forest and grass cenoses forming under modern contrast environmental conditions, but related genetically and having a common development vector. At this key site with dominant pine and larch in the stand, the cenoses structure is complicate due to their spatial heterogeneity. Epiassociation of larches with green mosses, carex and motley grasses include often some cedars aged 2 - 27 y.o., but they occur not only on the key sites but also in the vegetation structure of the whole studied area. In epiassociations of stepped larch forests with different habitat types, an important role bolongs often to mosses characteristic for a polydominant dark- and light-coniferous taiga. Here larch young growth up to 17 y.o. Is developed, stand of different age and crown density is characteristic everywhere, including more "steppe" part in the studied area. Often, pines and larches aged 2 - 17 y.o. Form separate cenoses out of stands canopy. By age, larches aged 2 - 30 y.o. Dominate with several trees aged 60 - 100 y.o. Soil cover of larch forests in this area is rather complicate. Here, together with steppe plants, there are meadow-forest (taiga) plant species with mosses characteristic for polydominant dark- and light-coniferous taiga. They form a particular synusial cenoses structure. Such cenoses are considered as paragenesis in vegetation structure and represent nowadays a stage of renewal dynamics of forest (taiga) type in the Pre-Baikal Region.

5. Discussions

Actual decrease of sites with steppe cenoses, especially in the zone of forsts and extra-zonal steppe interface, is confirmed by perennial observations of spatial variability of taiga-steppe epiassociations. There are tendencies of steppes foresting, especially at inter-ridge, inter-slope and graded sites of their formation. At all the studied territory there occurs active entrance of mesophytes into steppe cenoses, projective cover and bioproductivity of steppe cenoses increased. The stratification of soil cover of taiga-steppe epiassociations is manifested more clearly. Meadow-forest plants species become there dominant independently on their habitats. We found out in taiga-steppe associations of zones of taiga and steppe interface a spatial increase of mosses synusiae characteristic for dark- and light-coniferous polydominant taiga. An especial feature of spatial variations of vegetation cenostructure on the western coast is tendencies to very active entrance of tree ecobiomorphs into steppe communities, and not only in the interface zone. Clumps of different ages form—from sprouts to trees aged 25 - 30 y.o. Before we found out single *Pinus sylvestris* and *Larix sibirica* aged 40-50 y.o. In the steppes. The processes of general mesophytting of species composition and if steppes foresting occur on the whole Lake Baikal western coast. The genesis of regional vegetation during the Holocene, modern dynamic tendencies in the cenoses, as well as decrease and localization of anthropogenic effects allow to suppose the beginning of stage of formation of forest (taiga) vegetation type here as a special form of light-coniferous taiga invariant characteristic only for this part of the Pre-Baikal region. This defined spatial dynamics of light-coniferous forests and steppe cenoses from viewpoint of territories they occupy. According to last studies, rather considerable changes occurred on Lake Baikal western coast during last 4 ky. They concerned composition and structure of regional vegetation with periods of forest area increase and relative increase of grass one at definite stages. Variation in the ratio of

steppe and forest vegetation suggests a vector decrease of climate aridity, but during last 2 ky, some short-time of its increase were manifested up to 1500, ca. 900 and 200 years BP. Probably, just at two last stages xerophytic vegetation formed in the Pre-Ol'khon region, moreover, this processes were stronger by anthropogenic effects as well.

Taiga-steppe communities of Lake Baikal western coast are a stage of coniferous forests formation on the lake coast territory at modern stage of vegetation cover development and are indicators of vector of environmental dynamics in the whole region. Presence of forest communities—pine and larch stand among steppes in central area of the coast with inclusion of such plants as *Bergenia crassifolia*, *Linnaea borealis*, *Pyrola rotundifolia*, *Iris ruthenica*, *Maianthemum bifolium* characteristic for polydominant dark- and light-coniferous taiga and availability of mosses synusiae common for dark-coniferous forests among stepped ones consisting of forest cenoses of *Pinus sylvestris*, *Larix sibirica* indicate some peculiarities in the structure, dynamics and genesis of regional vegetation.

In the zone of uninterrupted forest and steppe cenoses interface, considerable changes in their vertical and spatial structures were revealed. So, simultaneously with formation of stable young growth of *Pinus sylvestris*, *Larix sibirica* in stands of forest (taiga) cenoses, we find out an active entrance of tree ecobiomorphs into grass (steppe) cenoses as clumps or separate groups of young growth aged under 17 y.o. During last years, we found out young growth of pine and larch among grass (steppe) cenoses based of such xerophytes as *Artemisia commutata*, *Heteropappus altaicus*, *Phlomis tuberosa*, *Poa botryoides*, *Agropyron cristatum*. Soil cover of light-coniferous forests are impacted everywhere by increase of forest plants species with increase of synusiae consisting of *Drepanocladus uncinatus*, *Mnium cuspidatum*, *Dicranum polysetum*, *Rhytidium rugosum* and *Vaccinium vitis-idaea*. Dominant positions in grass stands belong more and more to *Astragalus versicolor*, *Galium verum*, *Aster alpinus*, *Lupinaster pentaphyllus*, *Potentilla tanacetifolia*, *Campanula glomerata*, while steppe graminoids such as *Festuca lenensis*, *Koeleria cristata*, *Poa botryoides*, *Agropyron cristatum* are less abundant and form a stage of cenoses dynamics during a vegetation period. Presence of young growth and strouts of pine and larch in grass steppe cenoses suggest tendencies to increase of tree ecobiomorphs due to temperature increase and to re-distribution of mean annual precipitations by seasons in the Pre-Baikal region during last 30 - 50 years. Simultaneously with decrease of areas of steppe cenoses, moss synusia increase on forests soil cover. These mosses are characteristic for polydominant dark- and light-coniferous taiga.

6. Conclusion

Structural-dynamic peculiarities of phytocenoses in the central part of Lake Baikal western coast (the Pre-Ol'khon Region) revealed by method of large-scale mapping allow suggesting processes of taiga formation at the place of stepped pine forests, rare larch forests and extra-zonal steppe cenoses formed in Late Holocene under anthropogenic effects in the region during last decades. Under the conditions of extra-zonality of western coast steppe where plant species of Central Asia and Asia floras are ca. 1/10 of total species composition, we can suggest that modern taiga-steppe cenoses in the studied area are a stage of renewal dynamics and of development of taiga forest zone. Further formation of taiga-steppe communities from the viewpoint of structural variations on the background of fluctuations of mean annual precipitations and of mean annual winter temperatures will result in formation of forest with small area occupied by xerophytic-petrophytic grasses groups on stony eroded slopes and on stony crests. Light-coniferous forests of the studied area together with steppe communities are its in phytocytogenesis. Main environmental factor resulting in spatial stratigraphy of vegetation cover in the studied area is position of a concrete cenoses in mountain system of the Western Pre-Baikal region. This is reflected in the vegetation structure, mainly in young growth, undergrowth and soil cover for forests and in floristic composition of grass (steppe) cenoses. Expository of mountain slopes is determined only by degree of stands density and abundance of young growth for forests as well as abundance of this or that plant species among grass (steppe) cenoses. There forms actively among steppe areas forest cenoses with rather stable renewal, often with synusiae of mosses characteristic for polydominant dark- and light-coniferous taiga. Under the conditions of extra-zonal steppe, of non-manifested mountain-steppe and mountain-forest-steppe belts in the studyied area, particular "taiga-steppe" cenoses are formed, which reflect paragenesis in the structure of regional vegetation. By the character of their development, they are a stage of renewal (at different development periods—destructive) dynamics of Pre-Baikalian forests and manifest a complicate structure and ambiguous genesis of vegetation in the Pre-Baikalian taiga zone.

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