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TRANSFORMATION OF FOREST LIVE COVER UNDER RECREATIONAL LOAD

It is revealed, that the transformation of ground cover under the action of recess occurs with gradual reduction in the portion of participation before coating and variety of typical forest species and by an increase in the portion of meadow and waste plants with the average recreational loads, by exceeding the meadow plants above the forest with the intensive attendance of forest people and the predominance of the waste plants so on of maximum digression. Are established the average indices of coating data of the groups of the plants of ground cover before the stages of digression. Forest growing on the rich soils is characterized as far as a less notable increase in coating cereals, as far as the more significant coating of waste and meadow plants, and also as far as the larger portion of the trampled surface.

Introduction. One of the major factors causing phytocenosis changes is recreational use of forest. It leads to firming and dry-out of upper soil zones, destruction of the forest floor, trampling, breaking and damaging of plants which in their turn result in lower productivity and sustainability of forest stands, succession of tree species, transformation of understory of forest phytocenoses, etc. Stand composition and growth conditions have a considerable effect on visitation and recreational load resistance. In contrast to urban parks, forests are less frequently visited by population. However, isolated densely sited forests or those located close to residential areas are under maximum load as well [1].

The study of transformation of forest live cover was carried out in Minsk suburban forests which suffer from recreational load more than any other suburban forested areas. The subject-matters of the study were pine, spruce, bracken-type and wood sorrel birch forests. To consider the soil cover we used methods common in phytocenology (25 plots of 1 m^2 each).

Main part. Transformation of forest live cover varies depending on growth conditions [1]. Bracken-type pine forests are the most common and popular with population in terms of recreational activities. In the studied undisturbed bracken-type pine forests are dominated by forest stands and marginal tree belts typical of this forest type.

51 species were found out in the forest live cover, 8 moss species and 3 fern species among them (Table). Mosses are dominated by Schreber's moss (*Pleurozium schreberi* (Brid.) Mitt.) and glittering wood-moss (*Hylocomium splendens* (Hedw.). The projective cover of mosses ranges from 10 to 40% depending on stand canopy density and age, its average being about 20%. The projective cover of grass plants makes up not more than 1–2% (more rarely 3%) represented mainly by sheep's fescue grass (*Festuca ovina* L.), common heath grass (*Sieglingia decumbens* (L.) Bernh.), roth reed grass (*Calamagrostis arundinacea* (L.) Roth). Grass-shrub story is dominated by blueberry (*Vaccinium myrtillus* L.), shamrock (*Oxalis acetosella* L.), common bracken (*Pteridium aquilinum* (L.) Kuhn), rock bramble (*Rubus saxatilis* L.). Among wide-spread species are: may lily (*Maianthemum bifolium* (L.) F. W. Schmidt), lily-of-the-valley (*Convallaria majalis* L.), wild strawberry (*Fragaria vesca* L.), spinulose woodfern (*Dryopteris carthusiana* (Vill.) H. P. Fuchs) and common male fern (*Dryopteris filix-mas* (L.) Schott), etc.

Increased load and transfer of the forest stand to the second stage of recreational degradation (low-disturbed) lead to a greater variety of species. A total of 79 species were found out in the forest live cover, 8 mosses and 3 ferns among them. The following species appear or become more abundant: germander speedwell (*Veronica chamaedrys* L.), common avens (*Geum urbanum* L.), common St John's wort (*Hypericum perforatum* L.), golden rod (*Solidago virgaurea* L.), field scabious (*Knautia arvensis* (L.) Coult.), white clover (*Trifolium repens* L.), zigzag clover (*Trifolium medium* L.), colonial bent (*Agrostis tenuis* Sibth.), sheep's fescue grass (*Festuca ovina* L.), Canada bluegrass (*Poa compressa* L.), annual bluegrass (*Poa annua* L.), sweet vernal grass (*Anthoxanthum odoratum* L.), redtop (*Agrostis gigantea* Roth), self-heal (Prunella vulgaris L.), etc.

Some weed and meadow species are found only rarely. The projective cover of grass plants amounts to 3–6% (more rarely 7–9%), mosses comprise 8–25% (more rarely 30%), forest and marginal tree belt variety of a grassy-shrub story is the same as in undisturbed forests, or can be a little poorer. Occasionally cultivated (introduced) species can be found. The amount of paths becomes bigger, occasional bonfire sites and small meadowed glades appear.

Moderately disturbed stands (3rd stage of recreational degradation) are formed under increasing recreational load. These forest stands contain 73 species in their live cover, 7 mosses and 3 ferns among them. The projective cover of mossy understory (5–20%, more rarely 30%) becomes lower as compared to the 1st and 2nd stages of degradation.

The number of species in bracken-type pine forests by stages of recreational degradation

Story	The number of species by stages of recreational degradation, %				
	1st stage	2nd stage	3rd stage	4th stage	5th stage
Mossy	8	8	7	3	–
Grassy-shrub	43	71	66	58	19
Incl.: ferns	3	3	3	1	–
horsetails	–	–	–	1	–

The cover of forest and marginal tree belt type of a grassy-shrub story also goes down, however together with mosses it is higher than that of grass plants and weeds. The cover of the above mentioned grass plants and sun-loving plants considerably heightens, other species including less common plants and ruderal weeds: couch grass (*Elytrigia repens* (L.) Nevski), common dandelion *Taraxacum officinale* F. H. Wigg.), sheep's sorrel (*Rumex acetosella* L.), creeping bent (*Agrostis stolonifera* L.), meadow fescue (*Festuca pratensis* Huds.), Kentucky bluegrass (*Poa pratensis* L.), cock's foot (*Dactylis glomerata* L.), common plantain (*Plantago major* L.), mugwort (*Artemisia vulgaris* L.), common yarrow (*Achillea millefolium* L.), common polypody (*Clinopodium vulgare* L.), splitlip hempnettle (*Galeopsis bifida* Boenn.), zigzag clover, tall buttercup (*Ranunculus acris* L.), etc. As a whole the projective cover of grass plants ranges from 10 to 20%, occasionally reaching 25–30%. The cover by ruderal weeds is small (0.5–1%, more rarely 2%). Footworn areas are getting larger amounting to 5–10%.

Under continuous moderate loads and increasing loads highly disturbed stands are formed (4th stage of degradation). These phytocenoses include 61 plant species in the live cover, 3 mosses, 1 fern and 1 horsetail among them. The projective cover of grass plants, meadow and ruderal weeds increases and overtops the cover of typical forest and marginal tree belt variety. The grass plants can range from 25–30 to 40–50% (more rarely 60%). The richest projective cover is made up of the following species: colonial bent and redtop (*Agrostis gigantea* Roth), cock's-foot grass, sweet vernal grass, sheep's fescue, etc.

The cover of mosses declines to 2–6, more rarely 10%. The cover of typical forest and marginal belt variety of grasses and shrubs also decreases considerably and makes up 5–10% (more rarely up to 15%). They are usually located on the edges of a stand, in separated forest stands and young stands. Trampled areas can increase dramatically and amount to 25–30% of the total area.

New ruderal weeds, cultivated and meadow plants appear: shepherd's purse (*Capsella bursa-pastoris* (L.) Medikus), meadow horsetail (*Equisetum pratense* Ehrh.), common oberna (*Oberna behen* (L.) Ikonn.), absinth sage (*Artemisia absinthium* L.), etc. The cover can make up 4–5%.

Under continuous heavy load the stands are referred to the 5th stage of degradation. The total variety of species dramatically declines. The live cover includes only 19 plant species. The projective live cover decreases and makes up 30–40% (more rarely 45–60%). It is mainly represented by ruderal weeds and grass plants. The most typical species are the following: annual bluegrass, shamrock, common dandelion, sheepherd's purse, oldmans-pepper, colonial bent, cock's-foot grass, common knotweed (*Polygonum aviculare* L.), etc. The projective cover of grass plants comprises 22%, that of other meadow plants – 7%, that of ruderal weeds – 6%. Trampled areas are very large and amount to 25–30%. Typical forest and marginal belt plants are not found or can rarely be met under some trees as individual species. Their projective cover hardly makes up 1–3%.

Transformation of the live cover of bracken-type birch forests and mossy pine forests is similar to that of bracken-type pine forests described above.

Wood sorrel forested areas are seldom used for recreational purposes therefore only the 2nd and the 3rd stages of degradation were registered for this type. Transformation of the live cover in such forests is characterized by a smaller increase in grass plants and other typical species and by a more significant increase of ruderal weeds and meadow plants. An important indicator of degradation is the proportion of trampled areas which is considerably larger than similar areas in bracken-type forests.

Special characteristics of transformation in the live cover of wood sorrel spruce forests are given below. The studied undisturbed wood sorrel spruce forests are dominated by typical mosses (plagiomnium moss (*Plagiomnium affine* (Blandow ex Funck) T. Kop.) and toothed plagiomnium moss (*Plagiomnium cuspidatum* (Hedw.) T. Kop.), common smoothcap moss (*Atrichum undulatum* (Hedw.) Beauv.), glittering wood-moss, rockmoss (*Brachythecium oedipodium* (Mitt.) Jaeg.) and flaccid brachythecium moss (*Brachythecium salebrosum* (Web. Et Mohr.) Schimp.) etc.) and grass-shrub plants (wood sorrel, bugle (*Ajuga reptans* L.), common blueberry, ground elder (*Aegopodium podagraria* L.), yellow archangel (*Galeobdolon*

luteum Huds.) etc.). The projective cover of mosses averages 20–30%, sometimes amounting to 45–50%. The projective cover of grass plants is insignificant and does not exceed 1%, its typical species being wood millet (*Milium effusum* L.), reed grass, Geyer's oniongrass (*Melica nutans* L.) and creeping soft grass (*Holcus mollis* L.). Trampled areas hardly amount to 1–2%.

In low-disturbed stands the projective cover of grass plants becomes a little higher (up to 1–2%) with new species appearing (cock's-foot grass, annual bluegrass, colonial bent and creeping bent). The cover of mosses can either become lower or remain the same. Some meadow plants and ruderal weeds are found (chickweed (*Stellaria media* (L.) Vill.), coltsfoot (*Tussilago farfara* L.), dog-mint, healall, etc.). Their projective cover makes up 1–2%. The proportion of path, bonfire sites and trampled areas increases covering up to 4–7%.

In moderately disturbed wood sorrel spruce forests the grass plants cover increases to 3–5%. The cover of mosses ranges from 10 to 15–20%. Trampled areas can constitute 15–25%.

Wood sorrel pine and birch forests are represented only by the 1st and 2nd stages of recreational degradation. Transformation of the forest live cover is similar to that of spruce forests under low recreational loads.

In the studies undisturbed wood sorrel pine forests the projective moss cover can amount to 15–20%. The projective cover of grass plants is inconsiderable and does not exceed 1%. Trampled areas are small as well making up only 1–2%.

Low-disturbed forest stands have 2–4% of the projective grass plants cover. The projective cover of mosses is the same. The projective cover of meadow plants and ruderal weeds is 2–3%. Trampled areas comprise 4–7%.

Transformation of the forest live cover in low-disturbed wood sorrel birch forests is similar to that of wood sorrel pine forests for all of the parameters listed. There are differences in flora species composition.

Conclusion. Transformation of the forest live cover under recreational load is characterized by a gradual decrease of typical forests and marginal belt species in the projective cover and species diversity. The proportion of meadow plants and ruderal weeds increases in the stands of the 3rd degradation stage, meadow plants dominate over forest plants in the stands of the 4th degradation stage with weed species dominating in the 5th stage of degradation. The fixed average parameters of the projective cover of the above plant groups by the degradation stages are quite accurate indicators of the recreational degradation stages. Transformation of the live cover in the wood sorrel forests shows a lower increase in grass plants, a higher cover of meadow plants and ruderal weeds and increased trampled areas as compared to similar indicators of bracken-type forests.

References

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