

**SPATIAL STRUCTURE OF PINUS SYLVESTRIS (PINACEAE)  
COENOPOPULATIONS IN THE NORTHERN TAIGA SCOTS  
PINE FORESTS OF KOLA PENINSULA**

© *E. A. Tumakova*,<sup>1</sup> *V. V. Gorshkov*, *N. I. Stavrova*

Komarov Botanical Institute of the Russian Academy of Science, St Petersburg, Russia

<sup>1</sup>E-mail: umkalta@gmail.com

REFERENCES

1. Zaugolnova L. B. 1994. Struktura populyatsiy semennykh rasteniy i problemy ikh monitoringa: Avtoref. dis. ... dokt. biol. nauk [The structure of seed plant populations and the problems of their monitoring: Author's abstract of Doct. Sci. (Biology) Dissertation]. St Petersburg. 90 p. (In Russian)
2. Vincent P. I., Haworth J. M. 1976. The detection of randomness in plant patterns. *J. Biogeogr.* 3 (4): 373–380.
3. Tsvetkov V. F. 1986. The characterization of the territorial distribution of trees in the young Scots pine forests of the Kola Peninsula. *Izvestiya vysshikh uchebnykh zavedenii. Lesnoy zhurnal.* 4: 8–11. (In Russian)
4. Maslov A. A. 1990. Kolichestvennyy analiz gorizontalnoy struktury lesnykh soobshchestv [Quantitative analysis of the horizontal structure of forest communities]. Moscow. 160 p. (In Russian)
5. Pugachevskiy A. V. 1992. Tsenopopulyatsii eli. Struktura, dinamika, faktory regulyatsii [Norway spruce coenopopulations. Structure, dynamics, factors of regulation]. Minsk. 206 p. (In Russian)
6. Ilchukov S. V. 2003. The dynamics of the horizontal structure of derivatives hardwood stands. *Izvestiya vysshikh uchebnykh zavedeniy. Lesnoy zhurnal.* 6: 29–34. (In Russian)
7. Vais A. A. 2009. The horizontal structure of forest stands in Central Siberia. *Nauchnyy Zhurnal KubGAU.* 41 (1): 1–15. (In Russian)
8. Fardeeva M. B. 2014. Ekologicheskie i biomorfologicheskie zakonomernosti prostranstvenno-ontogeneticheskoy strukturyi populyatsiy rasteniy, dinamika i monitoring: Avtoref. dis. ... dokt. biol. nauk [Environmental and biomorphological laws of space-developmental structure of plant populations, dynamics and monitoring: Author's abstract of Doct. Sci. (Biology) Dissertation]. Kazan. 48 p. (In Russian)
9. Proskuryakov M. A. 1971. Laws of formation of the spatial structure of mountain spruce forest stands of the Tien Shan. *Lesovedenie.* 6: 38–42. (In Russian)
10. Proskuryakov M. A. 1983. Gorizontalnaya struktura gornyykh temnokhvoinnykh lesov [Horizontal structure of mountainous coniferous forests]. Alma-Ata. 215 p. (In Russian)
11. Korchagin A. A. 1976. The structure of plant communities. *Polevaya geobotanika.* Leningrad. Vol. 5. 316 p. (In Russian)
12. Tyabera A. P. 1980. Questions of territorial distribution of trees in pine stands. *Izvestiya vysshikh uchebnykh zavedeniy. Lesnoy zhurnal.* 5: 5–8. (In Russian)
13. Askew G. R. 1983. Two methods for evaluating spatial pattern in naturally regenerated loblolly pine stands. *For. Sci.* 29 (3): 514–518.

14. Griбанov V. Ya. 1984. The spatial structure of pine and larch stands. In: Produktivnost lesnykh fitotsenozov. Krasnoyarsk. P. 44—49. (In Russian)
15. Kuuluvainen T., Rouvinen S. 2000. Post-fire understory regeneration in a boreal *Pinus sylvestris* forest sites with different fire histories. J. Veg. Sci. 11 (6): 801—812.
16. Kuuluvainen T., Juntunen P. 1998. Properties and importance of tree regeneration microhabitats in a small wind throw gap in a boreal *Pinus sylvestris* dominated forest. J. Veg. Sci. 9 (4): 551—562.
17. Suktsessionnye protsessy v zapovednikakh Rossii i problemy sokhraneniya biologicheskogo raznoobraziya [Succession processes in the reserves of Russia and the conservation of biological diversity]. 1999. St Petersburg. 549 p. (In Russian)
18. Siren G. 1955. The development of spruce forest on raw humus sites in northern Finland and its ecology. Acta Forest. Fennica. 62: 1—363.
19. Voronova V. S. 1959. Natural regeneration under the canopy of spruce forests. Trudy Karelskogo filiala AN SSSR. 16: 30—37. (In Russian)
20. Ipatov V. S., Tarkhova T. N. 1975. Quantitative analysis of cenotic effects in the placement of trees on the territory. Botanicheskiy zhurnal. 60 (9): 1237—1250. (In Russian)
21. Faktory regulyatsii ekosistem elovykh lesov [Factors of regulation of Norway spruce forest ecosystems]. 1983. Leningrad. 318 p. (In Russian)
22. Leemans R. 1991. Canopy gaps and establishment patterns of spruce (*Picea abies* L. Karst.) in two old-growth coniferous forests in central Sweden. Vegetatio. 93: 157—165.
23. Kuuluvainen T., Hokkanen T., Pukkala T. 1993. Factors related to seedlings growth in a boreal Scots pine stand: a spatial analysis of a vegetation-soil system. Can. J. For. Res. 23: 2101—2109.
24. Yastrebov A. B., Poznanskaya V. A. 1993. Analysis of the impact of stand on the regrowth in pine forests of Karelia. Botanicheskiy zhurnal. 78 (4): 123—133. (In Russian)
25. Kuuluvainen T. 1994. Gap disturbance, ground microtopography, and the regeneration dynamics of boreal coniferous forest in Finland: a review. Ann. Zool. Fennici. 31: 35—51.
26. Lundqvist L., Nilson K. 2007. Regeneration dynamics in an uneven-aged virgin Norway spruce forest in northern Sweden. Scand. J. For. Res. 22 (4): 304—309.
27. Nikonov V. V. 1987. Pochvoobrazovanie na severnom predele sosnovykh biogeotsenozov [Soil formation at the northern limit of pine biogeocenosis]. Leningrad. 142 p. (In Russian)
28. Pereverzev V. N. 2004. Lesnye pochvy Kolskogo poluostrova [Forest soils of the Kola Peninsula]. Moskva, 232 p. (In Russian)
29. Stavrova N. I. 2012. Struktura populyatsiy osnovnykh lesoobrazuyushchikh vidov na Yevropeyskom severe Rossii: Avtoref. dis. ... dokt. biol. nauk [Structure of the populations of the main forest species in northern European Russia: Author's abstract of Doct. Sci. (Biology) Dissertation]. St. Petersburg. 39 p. (In Russian)
30. Chudnyy A. V. 1976. On location of trees in Scots pine populations. Lesovedenie. 5: 63—69. (In Russian)
31. Buzykin A. I., Gavrikov V. L., Sekretenko O. P., Khlebopros R. G. 1985. Analiz struktury drevesnykh tsenozov [Structure analysis of wood cenoses]. Novosibirsk. 89 p. (In Russian)
32. Vasilenko N. A. 2008. Samoorganizatsiya drevesnykh tsenozov [Self-organization of wood cenoses]. Vladivostok. 171 p. (In Russian)
33. Sannikov S. N., Sannikova N. S. 1985. Ekologiya estestvennogo vozobnovleniya sosny obyknovlennoi pod pologom lesa [Ecology of Scots pine natural regeneration under the forest canopy]. Moscow. 149 p. (In Russian)
34. Gordina N. P. 1985. Prostranstvennaya struktura i produktivnost sosnyakov Nizhnego Eniseya [The spatial structure and productivity of pine forests of the Lower Yenisei]. Krasnoyarsk. 128 p. (In Russian)

35. Zlobin Yu. A. 1972. The number and placement of the undergrowth in the areas of renewal. *Botanicheskiy zhurnal*. 57 (6): 632—634. (In Russian)
36. Repnevskiy V. V. 1961. Natural regeneration of Scots pine in different types of cuttings of the Kola Peninsula. *Lesa Kol'skogo poluostrova i ikh vozobnovlenie*. Moscow. P. 137—176. (In Russian)
37. Repnevskiy V. V. 1963. Natural regeneration in Scots pine forests of the Murmansk region. *Lesnoe khozyaistvo*. 9: 11—16. (In Russian)
38. Kuuluvainen T., Pukkala T. 1989. Effect of Scots pine seed trees on the density of ground vegetation and tree seedlings. *Silva Fennica*. 23 (2): 159—167.
39. Sannikov S. N., Sannikova N. S., Petrova I. V. 2004. *Estestvennoe lesovozobnovlenie v Zapadnoi Sibiri (ekologo-geograficheskiy ocherk) [Natural reforestation in Western Siberia (ecological and geographical essay)]*. Ekaterinburg. 198 p. (In Russian)
40. Sannikov S. N., Sannikova N. S., Petrova I. V. 2012. *Ocherki po teorii lesnoy populyatsionnoy biologii [Essays on the theory of forest population biology]*. Ekaterinburg. 272 p. (In Russian)
41. Molchanov A. A., Preobrazhenskiy I. F. 1957. *Lesa i lesnoe khozyaistvo Arkhangel'skoi oblasti [Forests and forestry of Arkhangelsk region]*. Moscow. 238 p. (In Russian)
42. Sannikov S. N. 1992. *Ekologiya i geografiya estestvennogo vozobnovleniya sosny obyknovlennoy [Ecology and Geography of Scots pine natural regeneration]*. Moscow. 263 p. (In Russian)
43. Ipatov V. S., Golubitskaya I. N. 1987. Influence of ground cover on Scots pine renewal in moss-lichen pine forests. *Vestnik Leningradskogo gosudarstvennogo universiteta. Seriya Biologiya*. 17 (3): 38—45. (In Russian)
44. Steijlen I., Nilsson M.-Ch., Zackrisson O. 1995. Seed regeneration of Scots pine in boreal forests stands dominated by lichen and feather moss. *Can. J. For. Res.* 25: 713—723.