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MODEL OF TREES WIND STABILITY WITH EFFECT OF INTERACTIONS BETWEEN NEIGHBOURS

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Abstract

This paper the theoretical analysis of trees wind stability with effect of interactions between neighbours is considered. The wind stability of tree and stand are depended from the interactions between neighbours and the presence of cooperative effects. Besides for description the influence of interaction between trees on the wind stability of stands two types of stand characteristics are considered. The first one is vertical parameter that characterized the projection stand on vertical plane. And the second ones are horizontal parameters that characterized the projection on horizontal plane. The characteristics each have concept and parameters which to described peculiarities of wind stability.

The effect of horizontal and vertical characteristics of tree interaction with neighbouring trees we have considered with taking into account competitive and cooperative effects by using the function of partial ecological utility. The function of partial ecological utility of tree is showing the probability of tree survives. Using the field's data the corroboration of the theoretical dependence for the probability of windthrown tree to the number of neighbouring trees and the relative height of tree over the stand canopy was got. The independence of these cooperative effects from the place and conditions vegetation was shown.

Key words: forest stand, windthrown, stability, modeling

References

Alexander, R.A. Minimizing windfall around clearcuttings in spruce-fir forests / R.A. Alexander // Forest Science. - 1964. - № 10. - P. 130-142.

Canham, C.D. Interspecific variation in susceptibility to windthrow as a function of tree size and storm severity for northern temperate tree species / C.D. Canham, M.J. Papaik, E.F. Latty // Canadian Journal of Forest Research. -2001. - № 31. - P. 1-10.

Coates, K.D. Windthrow damage 2 years after partial-cutting at the Date Creek silvicultural systems study in the Interior Cedar-Hemlock forests of northwestern British Columbia / K.D. Coates // Canadian Journal of Forest Research. - 1997. - № 27. - P.1695-1701.

Dunham, R.A. Crown, stem and wood properties of wind-damaged and undamaged Sitka spruce / R.A. Dunham, A.D. Cameron // Forest Ecology and Management. - 2000. - № 135. - P. 73-81.

Everham, E.M. Forest damage and recovery from catastrophic wind / E.M. Everham, N.V.L. Brokaw // Botanical Review. - 1996. - № 62. - P. 113-185.

Gardiner, B.A. Management of forests to reduce the risk of abiotic damage - a review with particular reference to the effects of strong winds / B.A. Gardiner, C.P. Quine // Forest Ecology and Management. - 2000. - № 135. - P. 261-277.

Holmes, S.R. An analysis of windthrow along clearcut boundaries in the Tsitika watershed / S.R. Holmes // B. A. Thesis. University of British Columbia, 1985. - 104 p.

Huggard, D.J. Windthrow following four harvest treatments in an Engelmann spruce - subalpine fir forest in southern interior British Columbia, Canada / D.J. Huggard, W. Klennar, A. Vyse // Canadian Journal of Forest Research. - 1999. - № 29. - P. 1547-1556.

Mitchell, S.J. Empirical modelling of cutblock edge windthrow on Vancouver Island, Canada, using stand level information / S.J. Mitchell, T. Hailemariam, Y. Kulis // Forest Ecology and Management. - 2001. - №154. - P.117-130.

Peltola, H. A mechanistic model for calculating windthrow and stem breakage of Scots pines at stand edges/ H. Peltola, S. Kellomäki // Silva Fennica. -1993. - № 27. - P. 99-111.

Peterson, C.J. Within-stand variation in windthrow in southern boreal forests of Minnesota: Is it predictable? / C.J. Peterson // Canadian Journal of Forest Research. - 2004. - № 34. - P. 365-375.

Smith, V.G. Mechanical stability of black spruce in the clay belt region of northern Ontario / V.G. Smith, M. Watts, D.F. James // Canadian Journal of Forest Research. - 1987. - № 17. - P. 1080-1091.

Veblen, T.T. Subalpine forest damage from a severe windstorm in northern Colorado / T.T. Veblen, D. Kulakowski, K.S. Elsenhart, W.L. Baker // Canadian Journal of Forest Research. - 2001. - № 31. - P. 2089-2097.

Wang, Y. Relationships between tree slenderness coefficients and tree or stand characteristics for major species in boreal mixed wood forests / Y. Wang, S.J. Titus, V.M. LeMay // Canadian Journal of Forest Research. - 1998. - № 28. - P. 1171-1183.

Waring, R.H. Forest ecosystems: concepts and management / R.H. Waring, W.H. Schlesinger // Academic Press, New York, 1985.

Zakharov, Yu.V. A mathematical model of tree root forms and estimation of effects on decreasing windfall risk / Yu.V. Zakharov, V.G. Soukhovolsky // "Disturbance in boreal forest ecosystem: human impacts and natural processes". Proc. Intern. Boreal Forest Research Association 1997 annual meeting. St. Paul, MN: U.S. Dept. of Agriculture, 2000. - P. 211-218.

Захаров, Ю.В. Модели устойчивости деревьев и насаждений к воздействию ветра / Ю.В. Захаров, В.Г. Суховольский // Лесоведение. - 2004. - №2. - С. 61-67.

Захаров, Ю.В. Упруго закрепленный стержень и колонна на упругом основании под действием поперечной на-

грузки: модели двух предельных случаев ветроустойчивости дерева / Ю.В. Захаров, Н.В. Филенкова, В.Г. Суховольский // Вестник КрасГУ. «Физико-математические науки». - 2006. - № 1. - С. 16-20.

Захаров, Ю.В. Влияние взаимного расположения деревьев на ветроустойчивость одноярусных древесных насаждений / Ю.В. Захаров, Н.В. Филенкова, В.Г. Суховольский А// Хвойные бореальной зоны. - 2006. - №3. - С 119-125.

Калинин, М.И. Формирование корневой системы деревьев / М.И. Калинин - М.: Лесная пром-сть, 1983. - 152 с.

Суховольский, В.Г. Экономика живого: Оптимизационный подход к описанию процессов в экологических сообществах и системах / В.Г. Суховольский - Новосибирск: Наука, 2004. - 140 с.