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BIOPRODUCTIVITY OF BLACK ALDER FORESTS OF UKRAINIAN POLISSYA

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Study of biological productivity of forest is crucial for estimation of terrestrial ecosystems state and dynamics under global change. Models of biological productivity represent dynamics of live biomass and Net Primary Production of forest ecosystems. The assessment of dynamics of biological productivity is an important part of the verified Full Carbon Account of forest.

Actual live biomass of a forest ecosystem is its maximal amount during the growth period for an individual year and total production by live biomass by year as the accumulated value of all phytomass produced by an ecosystem during its life span up to year (*Shvidenko et al., 2007*).

The purpose of the study was to develop models of live biomass fractions and to determine dynamics of bioproductivity of alder stands by site index in Ukrainian Polissya.

Methodology developed at the International Institute for Applied Systems Analysis (*Shvidenko et al., 2007*) was used. The algorithm combines growth models, models of live biomass, and a number of parameters describing the biological production of forest ecosystem (e.g. fine root turnover, foliage lifespan, etc.). The models have been developed in two steps: (1) development of models for estimation of live biomass dynamics, and (2) modeling of Net Primary Production of forest ecosystems.

A special database of live biomass measurements by fractions of alder forests in Ukrainian Polissya is used. The database also contains relevant biometric characteristics of the stands in which the temporary sample plots were established.

Live biomass is defined as organic matter of living plants of ecosystems. Live biomass is not measured by forest inventory directly but is calculated by models. We simulated the ratio (R_{fr}) of live biomass fractions (M_{fr}) to growing

stock (*GS*) as a function of biometric characteristics of forests, which are defined by forest inventory (age, site index and relative stocking):

$$R_{fr} = {}^{M_{fr}}\!/_{GS} = c_0 \cdot A^{C_1} \cdot SI^{C_2} \cdot RS^{C_3} \cdot EXP(C_4 \cdot A + C_5 \cdot RS),$$

where M_{fr} – live biomass fractions, t/ha; *GS* – growing stock volume, m3/ha; *A* – age, years; *SI* – site index; *RS* – relative stocking; and c_0–c_5 are regression coefficients.

This equation was used for quantifying live biomass of four fractions (stem, bark, branches, and foliage). Models of live biomass of roots, understory and green forest floor was used from standard and reference materials (*Tables and models of growth and productivity of forests of major forest forming species of Northern Eurasia, 2008*).

The models are valid for ages from 5 to 100 years. It is shown that the models developed are statistically significant at 0,05 level and adequately describe the experimental data. The accuracy and adequacy with respect to all variables included in equation were examined in the standard way, by calculating multiple statistics of non-linear correlation and analysis of residuals.

Black alder stands stem density is increasing up to 55 years and then decreases. By contrast biomass expansion factor of branches is constantly decreasing. Biomass expansion factor of these fraction are higher in sparse and low productive forests. Most of the forest biomass allocated in stem wood.

The models of live biomass fractions of alder stands (stem wood over bark, bark, wood and bark of branches, foliage) were developed according to the methodology of IIASA. Tables of bioproductivity of black alder forests in Ukrainian Polissya were created based on the obtained models and yield tables for modal alder stands of vegetative origin.

The research will help to reduce uncertainties of estimations of greenhouse gas emissions in Ukraine. Tables and models of bioproductivity will contribute to ecologization of forest management and creation of a solid background for sustainable forest management.