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Methodology of Ecological Evaluation and Regulation of Soil Degradation on the Basis of Equation for the Soil State Function

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Procedures of determining threshold concentrations of stressors on ecosystem components (for example, maximum permissible concentration (MPC)) include experimental study of responses to impacts. Full curves of the response of living organisms and populations have, as a rule, graphics in the form of a deformed bell and, in the absence of theoretical models, are interpreted either, using experimental or statistical models, which reduces the information content of experimental data. More preferably to use a theoretical model, free of the drawbacks of empirical models: $q = C/z^b$∗exp(-K/z), (1)

where q - is a measurable response of living organisms on exposure to the stressor, the concentration of which is equal to z, C - the constant of integration that makes sense of coefficient, which is scaling the value q , $b-$the coefficient of velocity of growth with the increase of z, K – the coefficient of velocity decrease q with increasing z.

The coefficients $C, b, K$of equation (1) find by fitting the model (1) to the experimental data by methods of non-linear regression using an available software package. The algorithm involves the introduction into the program of approximate values of the coefficients. These approximate values calculated by analytical formulas, obtained from (1):

ln$C = (c_3 * a_1 * b_2 - c_3 * b_1 * a_2 - c_1 * a_3 * b_2 - c_2 * a_1 * b_3 + c_2 * b_1 * a_3 + c_1 * a_2 * b_3)/(b_2 * a_1 - b_1 * a_2 - a_3 * b_2 - b_3 * a_1 + b_1 * a_3 + a_2 * b_3)$, (2)

$b = (c_2 * a_1 - c_1 * a_2 + (a_2 - a_1) * \ln C)/(b_2 * a_1 - b_1 * a_2)$, (3)

$K = (c_1 - b * b_1 - \ln C)/a_1$, (4)

where $a_i = -1/z_i, b_i = -\ln z_i, c_i = \ln q_i, q_i-$the current value of the response of living organisms to the impact of the stressor at a concentration of z_i . For the calculations three pairs of representative values are chosen from the experimental data, and substituted into equation (2) - (6).

Using the obtained constants C, b, K, values of q_i are calculated, using equation (1), for all $z_i$from the table and the average relative deviation of calculated values $q_i$from measured , *delta* is found. The definition of constants is repeated with different pairs of representative values $q_i$and z_i, achieving the minimum value of the average relative deviation *delta*. For the evaluation of the true values adopt those b and K, which correspond to the smallest value of *delta*.They are used to calculate the abscissa of the maximum point of the dose-response curve, based on the theoretical formula, obtained from the analysis of the first derivative *dq/dz*:

$z_{max} = K/b$(5)

and the abscissa of the inflection point of the graph (to the right of the maximum) according to the theoretical formula, obtained from the analysis of the second derivative d^2q/dz^2:

$z_{inf}=(K*b+K+(b+1)^{1/2})/(b^2 + b)$ (6)

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