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Versatile indices for quantifying of soil quality indicators

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Environmental impacts are differently reflected by ecological variables suggested as indicators of soil quality (ISQ). Control values of such indicators in undisturbed soils differ from each other in a large scale. That is why the development of mathematical indices allowing the comparison of different ISQ is necessary for quantification of degradation and rehabilitation processes in soils. Several new indices and quotients have been suggested recently for assessment of ecosystem sustainability (resistance and resilience) showing the necessity of universal index for ecological monitoring (Herbert et al., 1999; Wardle et al., 2000; Griffiths et al., 2001; Orwin, Wardle, 2004).

We suggested two indices allowing the estimation of both degradation and rehabilitation processes in soils. The benefits of different quotients are combined while some shortcomings are avoided in our indices. Suggested indices fit the following criteria:

1. The modulus values of indices increase monotonically with decrease of resistance and resilience ability of soil.

2. If the control value of ISQ increased or decreased by the factor of N after disturbance, the index value increases or decreases by the same factor.

3. Index lively reflects both the increase and decrease of ISQ after disturbance by positive and negative values which do not tend to infinity.

4. Index values are standardized against control values of ISQ.

The advantages of our indices are the following:

- our indices uniquely determine whether the values of ISQ increased or decreased after disturbance;

- if the control values of comparing ISQ have been changed after disturbance by the same factor but in the opposite directions (increased and decreased), the absolute values of index are equal but inverse in sign (+ or -);

- if the control values of comparing ISQ have been increased and decreased after disturbance by N units, the values of index are inverse in sign and not equal. This is the most important attribute of our index overcoming the problem of dissymmetry of ISQ response to disturbance. The dissymmetry of ISQ response means that the minimal values of ISQ are usually limited by zero while the maximal values are theoretically unlimited. Thus, the decrease of ecological parameter by N units after disturbance may response stronger effect compared to increase of these parameters by N units.

Our indices are standardized against control values of different ISQ. Hence, the index takes the same absolute values under equivalent changes of ISQ (in percent) even at high differences in control values between the compared ISQ.

The convenience and versatility of our indices have been checked on experimental data of microbial activity in soils at different levels of soil quality.

References:

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