Supplemental File S1

**KEYLINK: towards a more integrative soil representation for inclusion in ecosystem scale models. II. Model description, implementation and testing.**

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**1: Review of input parameters and carbon pools**

**Respiration**

Due to the lack of the experimental data, it is mostly not possible to distinguish between (1) the standard metabolism and metabolism in the active state; (2) the ecological groups within the taxa.

To convert O2 consumed into carbon respiration losses, for all the animal groups it is assumed that:

(1) Respiratory quotient RQ (volumetric ratio VCO2/VO2) is 1.0, where VO2 – volume of oxygen consumed,VCO2 – volume of carbon dioxide produced; thus 1 mm3 O2 corresponds to 1 mm3 СO2. [This is a simplification, in fact RQ valuescan be lower (sometimes much lower); however, few realistic estimates are available. Possible corrections for some groups, i.e. more realistic RQ values, are indicated in Part 2].

(2) CR = 12VCO2/22.4, where CR – carbon respired (g); VCO2 – volume of CO2 respired (L).

Table S1.1. Respiration rates of soil invertebrates, rough estimates.

An adaptation of available data from 105 literature sources and own measurements by A.V. Uvarov.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Group | T oC | Respiration rates,mm3 O2 g-1 live wt h-1 | Arbitrary ‘mean’, mm3 O2 g-1h-1 | Q10 |
| Nematoda | 20 | 450 – 4600 | 2000 | ~ 3-4 |
| Enchytraeidae | 20 | 100 – 1500 | 500 | ~ 2-3 |
| Lumbricidae | 20 | 40 – 240 | 100 | ~ 2 |
| Isopoda (Oniscoidea) | 20 | 90 – 1600 | 300 | ~ 2.5 |
| Oribatei | 10 | 40 – 480 | 150 | ~ 3.5 |
| Oribatei | 15 | 70 – 700 | 250 | ~ 3 |
| Mesostigmata (Gamasina only) | 10 | 180 – 1600 | 500 | ~ 3-4 |
| Mesostigmata(Gamasina, Uropodina, Trachytina) | 10 | 100 – 1600 | 400 | ~ 3 |
| Araneida | 20 | 20 – 1600 | 250 | ~ 2-3 |
| Diplopoda | 20 | 20 – 900 | 150 | ~ 2 |
| Chilopoda | 20 | 100 – 800 | 250 | ~ 3 |
| Collembola | 10 | 50 – 1300 | 400 | ~ 3 |
| Collembola | 15 | 50 – 2700 | 600 | ~ 3 |
| Carabidae, imago | 15 | 80 – 1300 | 350 | ~ 3 |
| Staphylinidae, imago | 15 | 150 – 850 | 400 | ~ 3-4 |
| Coleoptera, larvae | 15 | 70 –2500 | 550 | ~ 3 |
| Coleoptera, larvae | 20 | 80 –2600 | 750 | ~ 3 |
| Diptera larvae | 20 | 200 – 2200 | 800 | ~ 2-3 |

**C:N ratios**

C:N ratios are an important input for the model. Data can be readily found for many soil animal species. The C:N ratio of root herbivores has been reported to be lower than their food sources. The average C to N ratio of microfauna is about 10 (range between 7.5-12, Anderson *et al*., 1981; Hunt *et al*., 1987). Soil arthropods typically have a C content of about 50% and a N content around 10%, leading to a C:N ratio of about 5. According to Hunt *et al*. (1987), Prostigmata have a C:N = 8. Based on information provided in Pokarzhevskii *et al*. (2003), the C:N ratio of adult Scarabaeid beetles is 5.43 and of Diptera larvae C:N = 4.46. No information is given for the Symphyla, but their relatives, Chilopoda, have a C:N = 4.89. For fungi and bacteria a wide range of values have been found but in general bacteria have a lower C:N ratio. Chertov *et al*. (2017) use an empirical model to calculate local C:N ratio based on the SOM C:N. *Ferris et al*. (1997) provide C:N values for bacterial feeding nematodes, i.e. 5.9, and for the populations of *Escherichia coli* they grew on, i.e. 4.1.

**Table S1.2. Carbon pools in the KEYLINK model.**

Pools of the soil food web represent different functional groups.

|  |  |  |
| --- | --- | --- |
|  | Symbol | C pool |
| 1 | Bb | bacterial biomass |
| 2 | Bf | fungal biomass |
| 3 | Bmyc | mycorrhizal biomass |
| 4 | Bbvores | biomass bacterivores |
| 5 | Bfvores | biomass fungivores |
| 6 | Bdet | biomass detritivores |
| 7 | Beng | biomass engineers |
| 8 | Bhvores | biomass herbivores |
| 9 | Bpred | biomass predators |
| 10 | Lsurf | aboveground litter originating from trees |
| 11 | SOM | total soil organic matter |
| 12 | Broot | biomass roots |
| 13 | R | respiration (CO2) |

**References**

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