Towards a Taxonomic Classification of Humus Forms: Third Approximation

The importance of humus form or forest floor as a principal component of terrestrial forest ecosystems has led to the development of a taxonomic classification of humus forms for BC (first approximation: Klinka et al. 1981; second approximation: Green et al. 1993). This classification, as all others, is based on the field-observable (morphological) features because we expect that they reflect differences in the nature and development of humus forms. However, there is a continuing need to test (1) whether humus forms that appear different are in fact different in their physical, chemical, and biotic properties, and (2) the portability of the classification outside the area in which it was developed. As a result of recent studies of the biotic component of humus forms and recent testing of the classification outside British Columbia (Scandinavia, southeastern Russia, and northeastern China), we have recognized several new diagnostic horizons, and hence new taxa. In this pamphlet, we present synopsis of the third approximation of the classification for review and testing. For more detailed information on the background, methodology, and classification of humus forms, the readers should consult Green et al. (1993).

Each humus form is represented by the sequence of organic and mineral horizons that constitute the humus form profile. Identification of a humus form, i.e., giving it a name, requires description of the humus form profile – the identification of master and subordinate horizons. For this reason we have included a description of the horizon designations as well as a synopsis of the classification and a key to the identification of humus forms.

**Horizon designations and definitions**

<table>
<thead>
<tr>
<th>Master horizon</th>
<th>Subordinate horizon</th>
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<tbody>
<tr>
<td><strong>Freely-drained upland horizons</strong></td>
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<tr>
<td><strong>L</strong> (litter); a surface horizon that consists of relatively fresh plant residues readily identifiable as to their origin.</td>
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<tr>
<td><strong>Ln</strong> (new); an L horizon that consists of newly accreted and essentially fresh, non-fragmented plant residues.</td>
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<tr>
<td><strong>Lv</strong> (variative); an L horizon that consists of the plant residues showing initial decay and strong discolouration.</td>
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<tr>
<td><strong>S</strong> (bryophytes); a surface horizon that consists of tissues of living bryophytes (commonly <em>Sphagnum</em> spp.) intermixed to a minor extent with litter.</td>
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<tr>
<td><strong>G</strong> (graminoid); a thin surface horizon that consists of tissues of living graminoids intermixed to various extents with their residues.</td>
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</tr>
<tr>
<td><strong>F</strong> (fermented); an organic horizon in which partly decomposed plant residues predominate; the partial structures of plant residues are macroscopically discernible.</td>
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<tr>
<td><strong>Fm</strong> (mycogeneous); an F horizon in which more or less disintegrated plant residues are aggregated in a compact-matted, banded fabric interwoven by fungal hyphae (mycelia), with a tenacious consistence. If present, faunal droppings are very infrequent and localized.</td>
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<tr>
<td><strong>Fr</strong> (root residues); an F horizon in which fine root residues constitute nearly all fabric; fungal mycelia are infrequent and localized.</td>
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</tr>
<tr>
<td><strong>Frm</strong> (root residue, mycogeneous); an Fm horizon in which fine root residues constitute nearly all fabric; fungal mycelia are common and frequent.</td>
<td></td>
</tr>
<tr>
<td><strong>Fs</strong> (bryophytes); an F horizon that consists of partly disintegrated tissues of <em>Sphagnum</em> spp.; residues are weakly aggregated, fungal mycelia absent or very infrequent and localized.</td>
<td></td>
</tr>
<tr>
<td><strong>Fsm</strong> (bryophytes, mycogeneous); an Fs horizon with fungal mycelia but rarely as common and frequent as in the Fm horizon.</td>
<td></td>
</tr>
<tr>
<td><strong>Fz</strong> (zoogenous); an F horizon in which residues are weakly aggregated with a loose or friable consistence as result fragmentation and comminution by soil fauna; faunal droppings and dropping residues are numerous, fungal mycelia are infrequent and localized.</td>
<td></td>
</tr>
<tr>
<td><strong>Fsz</strong> (bryophytes, zoogenous); an Fz horizon with faunal droppings but rarely as common and frequent as in the Fz horizon.</td>
<td></td>
</tr>
<tr>
<td><strong>Fa</strong> (amphi); an F horizon that has the characteristics of both Fm and Fz horizons; plant residues are aggregated into a weak to moderate, non-compact-matted fabric.</td>
<td></td>
</tr>
<tr>
<td><strong>Fsa</strong> (bryophytes, amphi); an Fs horizon with both fungal mycelia and faunal droppings but rarely as common and frequent as in the Fa horizon.</td>
<td></td>
</tr>
</tbody>
</table>
Freely-drained upland horizons continued

H (humic); an organic horizon in which well decomposed plant residues (fine substances) predominate; the original plant structures are not macroscopically discernible.

Hf (fine); an H horizon that has a very fine granular structure; very small faunal droppings predominate in the fabric.

Hg (granular); an H horizon that has a fine (to medium) granular structure; small faunal droppings predominate in the fabric.

Hh (humic); an H horizon that has a massive (ancient) or weak, coarse, blocky structure; the colour is typically dark gray (black), the material is greasy and stains fingers when rubbed.

Hc (recalcitrant); an H horizon that contains macroscopically recognizable plant residues (roots, bark, and/or wood) imposing yellow, brown, or particularly red colours; fine substances predominate and the material is slightly greasy but does stain fingers when rubbed.

Poorly-drained, waterlogged, wetland horizons

O (organic); a wetland organic horizon

Of (fibric); a surface O horizon that consists of poorly decomposed plant residues readily identifiable as to their origin.

Om (mesic); an O horizon that consists of partly decomposed plant residues at a stage of decomposition intermediate between Of and Oh horizons.

Oh (humic); an O horizon that consists of well decomposed plant residues which for the most part have been transformed into humic materials.

Mineral horizons

A the uppermost mineral horizon that contains < 17% organic C (about 30% organic matter) by weight.

Ah (humic); an Ah horizon enriched with organic matter.

Other designations

w (wood); any organic horizon containing >35% of the volume of solids) of coarse woody debris in various stages of decomposition.

Third Approximation: Synopsis of humus form taxa

<table>
<thead>
<tr>
<th>Order Group</th>
<th>Characteristic humus form profiles ¹</th>
<th>Variation from the Orthic or true form</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Mor</strong></td>
<td></td>
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</tr>
<tr>
<td>Lignomor</td>
<td>L, Fmw or Fsw, Hw</td>
<td>Tenuic, Pachic, Hemic, Humic</td>
</tr>
<tr>
<td>Hemimor</td>
<td>L, Fm, (H)</td>
<td>Tenuic, Pachic</td>
</tr>
<tr>
<td>Rhizomor</td>
<td>L, Frm, (H)</td>
<td>Tenuic, Pachic</td>
</tr>
<tr>
<td>Sphagnomor</td>
<td>S, Fs and/or Fsm, H</td>
<td>Tenuic, Pachic</td>
</tr>
<tr>
<td>Humimor</td>
<td>L, Fm, Hh</td>
<td>Pachic, Hemic, Perhumic</td>
</tr>
<tr>
<td>Resimor</td>
<td>L, Fm, Hc</td>
<td>Pachic, Hemic</td>
</tr>
<tr>
<td>Modernmor</td>
<td>L, Fm and/or Frm, Hf and/or Hg</td>
<td>Hemic, Humic</td>
</tr>
<tr>
<td>Lamimor</td>
<td>L, Fm and/or Frm, Hf and/or Hg and/or Hc</td>
<td>Hemic, Humic</td>
</tr>
<tr>
<td>Fibrimor</td>
<td>S, (F, H), Of, Om, Oh</td>
<td>Hemic, Sapric</td>
</tr>
<tr>
<td>Mesimor</td>
<td>S, (F, H), Of, Om, Oh</td>
<td>Fabric, Sapric</td>
</tr>
<tr>
<td><strong>Moder</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lignomoder</td>
<td>L, Faw and/or Fzw, Hw</td>
<td>Tenuic, Pachic, Hemic, Humic</td>
</tr>
<tr>
<td>Mormoder</td>
<td>L or G, Fa, H</td>
<td>Tenuic, Pachic, Hemic, Humic</td>
</tr>
<tr>
<td>Sphagnomoder</td>
<td>S, Fs and/or Fsa and/or Fsz, H</td>
<td>Hemic, Humic</td>
</tr>
<tr>
<td>Lamimoder</td>
<td>L, Fm, Frm, Fs and/or Fsm, Fa, Fsa, Fz and/or Fsz, H</td>
<td>Hemic, Humic, Sphagno</td>
</tr>
<tr>
<td>Leptomoder</td>
<td>L or G, Fz, H</td>
<td>Tenuic, Pachic, Hemic, Humic</td>
</tr>
<tr>
<td>Mullmoder</td>
<td>L or G, Fa and/or Fz, H, Ah</td>
<td>Hemic, Humic</td>
</tr>
<tr>
<td>Saprimoder</td>
<td>S or G, (Of, Om), Oh</td>
<td>Fabric, Mesic</td>
</tr>
<tr>
<td><strong>Mull</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vemmimull</td>
<td>(L, F), Ahz</td>
<td>Tenuic, Pachic, Ochric, Pellic, Micro, Meso, Micro</td>
</tr>
<tr>
<td>Rhizomull</td>
<td>G, (F), Ahg</td>
<td>Tenuic, Pachic, Ochric, Pellic</td>
</tr>
<tr>
<td>Paramull</td>
<td>(L, F), Ah</td>
<td>Tenuic, Pachic, Ochric, Pellic</td>
</tr>
</tbody>
</table>

¹ Diagnostic horizons are printed in bold fonts; less commonly occurring, non-diagnostic horizons are given in parentheses.
Explanation of adjectives used to designate variations from the Orthic (true) variation that is thought to typify a humus form group

<table>
<thead>
<tr>
<th>Adjective</th>
<th>Connotation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pachic</td>
<td>Relatively thick humus forms.</td>
</tr>
<tr>
<td>Tenuic</td>
<td>Relatively thin humus forms.</td>
</tr>
<tr>
<td>Hemic</td>
<td>F horizons predominate in the humus form profile.</td>
</tr>
<tr>
<td>Humic</td>
<td>H horizons predominate in the humus form profile.</td>
</tr>
<tr>
<td>Perhumic</td>
<td>Humimors that have a black, massive (ancient) Hh horizon.</td>
</tr>
<tr>
<td>Sphagno</td>
<td>Laminoders that have Fs and/or Fsm and Fsa and/or Fsz horizon.</td>
</tr>
<tr>
<td>Fibric</td>
<td>Mesimors (Saprimoders) and Hydro humus forms that have a well developed Of horizon.</td>
</tr>
<tr>
<td>Mesic</td>
<td>Fibrimors (Saprimoders) and Hydro humus forms that have a well developed Om horizon</td>
</tr>
<tr>
<td>Sapric</td>
<td>Fibrimors, Mesimors, and Hydro humus forms that have a well developed Oh horizon.</td>
</tr>
<tr>
<td>Ochric</td>
<td>Mulls that have light coloured Ah horizons (moist colour value &gt;3).</td>
</tr>
<tr>
<td>Pellic</td>
<td>Mulls that have dark coloured Ah horizons (most colour value ≤3).</td>
</tr>
<tr>
<td>Macro</td>
<td>Mulls that have granular aggregates &gt;5 mm.</td>
</tr>
<tr>
<td>Meso</td>
<td>Mulls that have granular aggregates &gt;1 mm but ≤5 mm.</td>
</tr>
<tr>
<td>Micro</td>
<td>Mulls that have granular aggregates ≤1 mm.</td>
</tr>
</tbody>
</table>

Key to humus form groups

1a Growing-season water table is absent, or if present, is >40 cm deep; soil is mineral but not gleysolic, or upland organic (Folisol) ................................................................. 2

1b Growing-season water table is present and ≤ 40 cm deep; soil is organic; if water table is absent, soil is gleysolic ............................................................................................................. 16

2a Ah horizon ≥2 cm thick is absent, if present, thickness of F and H horizons is >Ah horizon ................................................................. 3

2b Ah horizon ≥2 cm thick is present and thickness of F and H horizons is <Ah horizon ................................................................. 15

3a F horizon includes mycogeneous (Fm and/or Frm) horizons, other F horizons, if present, are either ≤2 cm thick or ≤25% of thickness of F horizon ........................................................................ 4

3b F horizon includes sphagnum mycogeneous (Fs and/or Fsm) horizons; other F horizons, if present, are either ≤2 cm thick or ≤25% of thickness of F horizon ........................................................................ 9

3c F horizon includes amphimorphic and/or zoogeneous (Fa and/or Fz horizons), other F horizons, if present, are either ≤2 cm thick or ≤25% of thickness of F horizon ........................................................................ 10

3d F horizon includes sphagnum amphimorphic and/or zoogeneous (Fsa and/or Fsz horizons), other F horizons, if present, are either ≤2 cm thick or ≤25% of thickness of F horizon ........................................................................ 13

3e F horizon includes both mycogeneous and amphimorphic or zoogeneous horizons with each set of horizons >2 cm thick or >25% of thickness of F horizon ........................................................................ 14

4a Decaying wood comprises >35% volume in humus form profile .................................................................................................................. Lignomor

4b Decaying wood comprises ≤35% volume in humus form profile .................................................................................................................. 5

5a H horizon is absent, or if present, is either ≤2 cm thick or ≤25% of thickness of F and H horizons ................................................................. 6

5b H horizon >2 cm thick is present and >25% of thickness of F and H horizons ................................................................. 7

6a Thickness of Fm horizon is >Frm horizon .................................................................................................................. Hemimor

6b Thickness of Fm horizon is ≤Frm horizon .................................................................................................................. Resimor

7a Hf and/or Hg horizons are present; other H horizons, if present, are either ≤2 cm thick or ≤25% of thickness of H horizon .................................................................................................................. Modernmor

7b Hh and/or Hr horizons are present; other H horizons, if present, are either ≤2 cm thick or ≤25% of thickness of H horizon .................................................................................................................. 8

7c H horizon is comprised by both sets of horizons (Hf and/or Hg and Hh and/or Hr) with each set of horizons >2 cm thick or >25% of thickness of H horizon .................................................................................. Laminor

8a Thickness of Hh horizon is >Hc horizon .................................................................................................................. Humimor

8b Thickness of Hh horizon is ≤Hc horizon .................................................................................................................. Rhodomor
Decaying wood comprises >35% volume in humus form profile .............................................. Lignomor
Decaying wood comprises ≤35% volume in humus form profile .............................................. Sphagnetromor

Decaying wood has >35% volume in humus form profile ......................................................... Lignomoder
Decaying wood has ≤35% volume in humus form profile ......................................................... 11

Ah horizon ≥2 cm thick is present, thickness of F and H horizons is >Ah horizon ................. Mullmoder
Ah horizon is absent or, if present, is <2 cm thick ................................................................. 12

Thickness of Fa horizon is >Fz horizon ................................................................................ Marmomoder
Thickness of Fa horizon is ≤Fz horizon .............................................................................. Leptomoder

Decaying wood has >35% volume in humus form profile ......................................................... Lignomoder
Decaying wood has ≤35% volume in humus form profile ......................................................... Sphagnetromoder

Decaying wood has >35% volume in humus form profile ......................................................... Lignomoder
Decaying wood has ≤35% volume in humus form profile ......................................................... Lamimoder

Granular (earthworm casts), zoogeneous Ah horizon is present ........................................ Vermimull
Sward or turf, rhizogenous Ah horizon is present ................................................................. Rhizomull
Ah horizon formed by infiltration, or accumulation of organic materials by mechanical intermixing (colluvial, eolian, cryoturbation or silvoturbation) ........................................ Paramull

Soil has an organic layer >40 cm thick or ≤40 cm thick if a lithic, paralithic, permafrost or fragmental layer is present (recognize wetland organic horizons) ........................................... 17
Soil is mineral (organic layer is ≤40 cm thick), (recognize upland organic (LFH) horizons) Return to couplet number 2 and add the prefix Hydro to the identified group ........................................ 2

Thickness of upland organic (L,F,H) horizons is >O horizon Return to couplet number 2 and add the prefix Hydro to the identified group ........................................ 2
Thickness of upland organic (L,F,H) horizons is ≤O horizon ................................................... 18
Oh horizon is absent, or if present, thickness of other O horizons is >Oh horizon .................... 19
Oh horizon is present and thickness of other O horizons, if present, is ≤Oh horizon ............. Sapromoder

Thickness of Oh horizon is ≤O horizon ................................................................................ Fibrimor
Thickness of Oh horizon is ≤O horizon ................................................................................ Mesimoder

Reference