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Hydrology and Earth System Sciences
Discussions

Interactive comment on "Regional and local patterns in depth to water table, hydrochemistry, and peat properties of bogs and their laggs in coastal British Columbia" *by* S. A. Howie and H. J. van Meerveld

Anonymous Referee #2

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The objective of the study, as stated at the end of the Introduction, was to improve understanding of the environmental gradients across bog margins and to determine whether these gradients are consistent for bogs throughout coastal British Colombia (BC). The authors' purpose was to support restoration planning for local bogs, with special reference to re-establishing appropriate lagg conditions which are expected to vary between previously defined wetland regions. The problem was addressed by studying 17 radial transects starting on the mire expanse and extending towards the margin on 13 bogs in two climatic zones on the west coast of BC. At a default number

of five points per transect, measurements were made of (a) depth to water table (from the bog surface), (b) peat characteristics (thickness, humification, ash content) and (c) pore water chemistry (pH, EC, acidity, DOC and some cation concentrations). Transect topography was also surveyed so that hydraulic gradients could be determined. Clear radial trends in e.g. hydrochemistry, such as those reported by other authors, were not detected. However, some radial patterns in the measured attributes were identified 'when all bogs in a region were analysed together, but not for all bogs individually'. For example, although "there was a significant correlation between pH and location on the transect for only 5 of the 17 transects" (P3160/L9), it is concluded (P3165/L10–11) that "clear gradients were identified across the bog expanse–bog margin transition, particularly for ... pH". However, consideration of the outcomes of the 'lumped' data analyses leads overall to the conclusion (P3166/L9–12) that there is substantial variation in the measured attributes between both sites and regions within BC, such that the only valid template sites for restoration projects will be located close to the bog that is to be restored. Whilst the work does improve knowledge of the measured characteristics within the geographical region studied, this conclusion hardly amounts to a significant advance in international peatland science.

The Introduction goes into some detail on the characteristics and function of the lagg, which is described (Page 3145/Line 20 et seq. and P3146/L13 et seq., although the logical place is rather earlier, perhaps at P3145/L6–7) as "the transition zone at the bog margin where water from the bog and the surrounding mineral soil mix and form a vegetative ecotone" and "an integral part of the hydrological system of a raised bog because it supports the water mound of the bog and buffers the bog from surrounding minerotrophic water". This is more or less my understanding of the lagg and its functions, within the catenary sequence mire expanse–rand–lagg as described by Swedish researchers several decades ago. However, I miss a clear account of the working definition of lagg that was applied in placing the sampling stations, in terms of lagg morphology/function as well as in relation to the various landscape settings of the bogs themselves. The latter is touched upon in places, e.g. P3155/L3–4 where 'flat'

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and ‘slope’ bog types (according to a local/Canadian classification system?) are mentioned but not explained in terms of classifications (e.g. hydrogenetic types) that would be more familiar to an international audience. I wonder if the variety of bog-edge topographies to which unclear trends in water table depth are attributed in Section 4.1.1 might have been conceptually tamed by invoking even the simple distinction between ‘confined’ and ‘unconfined’ mire margins as described by P.D. Hulme in 1980 (Scottish Geographical Magazine, 96, 46–50). Lagg morphology is not mentioned as a factor that should be considered in the context of peatland restoration until the Conclusion (P3166/L13–14).

In Methods we are told that the transect stations were selected on the basis of ‘vegetative characteristics’ alone. The first point of each transect (BG) was placed ‘inside the bog’ (presumably on the mire expanse), the second and third (R1/R2) on the rand (marginal slope), the fourth (LG) in the lagg and the fifth (MN) ‘outside the bog’ i.e. on mineral ground(?). Referring to Figure 2, which shows the morphology of example mire margins, I am puzzled as to how the working definitions of lagg that were applied (on the basis of ‘vegetative characteristics’ alone) relate to the lagg function. For Surrey Bend (Fig. 2D), the LG site is indeed in a (confined) depression at the edge of the peat body, where water draining from both the bog and the adjacent rising mineral ground will converge/mix and the water level will define the hydrological boundary of the water mound within the bog. For Tow Hill Bog (Figs. 2A), the LG and MN transect stations appear to be on the (morphological) rand and thus isolated from the influence of water that has drained from mineral ground. For Blaney Bog (Fig. 2C), I wonder why the lagg function is not attributed to the ‘fen creek’ (P3154/L19) or ‘large fen’ (P3156/L13) into which a 1.5 m thick peat layer extends beyond the downslope MN transect station (which appears to be on peat). Finally, although the labelling is too small to read, I suspect that the illustrated edge of Burns Bog (Fig. 2B) is artificially confined such that the hydrological boundary of the dome is set by water draining from the bog collecting behind a marginal bund distal to both the LG and MN stations.

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Further questions about how well the LG stations represent locations within functional laggs arise at various points in the text, as noted below. (a) One of the Burns Bog transects crossed the line of a road, and two of the LG stations lay downslope of this (P3150/L15–17). Is it possible that the road interrupts the natural flow pattern of water movement from the bog into the lagg and, if so, how closely would the measurements of (at least) water level, water table depth and water chemistry reflect the natural situation? (b) Indeed, three of the four Fraser Lowland bogs are reported (P3149/L29 et seq.) to have been subject to past disturbance (peat mining, sewer and road construction). What will data from such sites tell us that will be useful in determining objectives for restoration? (c) Because the water sampling technique could not be applied in the ('too rocky') adjacent mineral soil, some MN samples came from wet, partly organic soil at the margin of the bog (P3156/L10–12). Is this not more likely to be the functional lagg? (d) The absolute water table altitude/elevation increased towards the lagg in 6 out of 16 transects (P3154 L24–25). Does this mean that the hydraulic gradient would promote seepage into the 'bog' in around one-third of the studied sites, in which case are these sites actually bogs (by definition exclusively rain-fed) at all? There is a suggestion (P3161/L23–25) that the pertinent hydraulic gradients may reverse seasonally (which is feasible), but no hard data to support this.

Perhaps clearer trends that would provide more useful targets for lagg restoration would emerge if the data were grouped for analysis on the basis of 'function' and 'naturalness' in addition to 'vegetative' criteria. But perhaps sample sizes would then be too small. Indeed, I find myself wondering if the work began as a straightforward investigation of how the various peat and water attributes varied between vegetation types; and the realisation of relevance to lagg function and restoration science dawned as it progressed, but too late to modify the sampling strategy. I am left with a feeling of 'missed opportunity' to research an important and neglected aspect of peatland science, and wonder if more observation and 'maturation of ideas' time would benefit the quality of an eventual publication. On the other hand, perhaps a shorter report of the data already collected could be produced now as a prelude to a rigorous investigation of lagg characteristics.

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A couple of other questions about the science also occurred to me. First, the discussion of relationships between bog radius and dome height on pages 3158–9 perhaps begs the question of whether we can expect these attributes to correlate as reported by others in a 'lumped data' analysis, given that the most areally extensive (Fraser Lowland) bogs sampled here seem to have been preferentially subject to disturbance including peat extraction (P3149/L28–30), which might be expected to directly (artificially) reduce dome height. Secondly, the second footnote to Table 2 suggests that, despite some precautions (P3151/L8–11), the experimental design was not completely 'immunised' against the well-known hazards of determining water table position in 'piezometers' (literally 'pressure meters', not actually used as such in this study) when they are deployed within (catotelm) peat; which arise from their potentially long response times as well as the possible presence of vertical hydraulic gradients. Especially as the 'piezometers' were actually used as collectors for water samples, from which water was necessarily removed during site visits, one wonders how faithfully the water table data reflect the true position of the water table; and why the simple 'fix' of installing a dedictated dipwell (with walls slotted/screened along their entire lengths) in the vicinity of each 'piezometer' could not have been exercised.

Overall, this manuscript comes over as rather a 'hotch-potch' of half-explored ideas that does not add much to existing knowledge. It is, however, generally well written and I have relatively few comments about presentation. My personal preference is to see (as required by other journals) a dedicated Results section that reports the new data collected separately from their Discussion in the context of other work; this might help to improve clarity. Perhaps the Conclusion could be shortened (if it is needed at all), as part of it simply summarises Results. The word 'parameters' is misused in several places (e.g: P3147/L1 substitute 'factors'; P3152/L9 are most of them actually ion concentrations? – certainly variables anyway; P3153/L24 substitute 'variables'; P3161/L1 substitute 'attributes'). I do not know if this journal accepts 'Americanized' spellings and grammar, but some are present e.g. a smattering of word endings (a) with 'ize' (including 'characterized' P3148/L2; 'minimize' P3152/L28) and (b) without

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'al' ('geographic' P3162/L23); and use of the word 'likely' in place of 'probably' e.g. "is likely because/due to" and "likely result in" at P3155/L10, P3157/L13 and P3163/L17. Finally, an unnecessary comma is frequently inserted between the penultimate item of a list and the connecting 'and' (e.g. P3150/L7 "Shorepine Bog, Burns Bog, and Blaney Bog" should be written "Shorepine Bog, Burns Bog and Blaney Bog").

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 10, 3143, 2013.