Poster presentation: Preliminary microclimate study of forested karst sinkholes, Nimpkish River area, northern Vancouver Island, British Columbia, Canada

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A preliminary investigation into the microclimatic conditions of forested karst sinkholes was carried out in the Nimpkish River Area of northern Vancouver Island, British Columbia. The 'Karst Management Management Handbook for British Columbia (BC)' best practice guidelines indicates that some forested sinkholes on karst (particularly ones of larger dimensions) likely have their own microclimates, and thus possibly support ecologies with habitats for specific types of flora and fauna. Forestry companies who identify such features are advised to leave a two tree-length reserve area around such sinkholes, plus a surrounding management area if required for windthrow mitigation.

However, in reality little is known about the characteristics of forested sinkholes that generate microclimates in coastal British Columbia, and also what are likely forest stand conditions or attributes that define such a microclimate. Therefore the goals of this project were to firstly determine the nature of the sinkhole microclimates using near-ground air temperature as a proxy indicator for microclimate, and to secondly examine what characteristics of forested sinkholes (such as size, depth, and overall shape) govern their ability to generate a distinct microclimate. An additional goal was to assess how timber harvesting operations might affect sinkhole microclimates, and to determine whether simple field techniques could be developed to monitor these effects.

Two large sinkholes were selected for the study in the Nimpkish River area of northern Vancouver Island – one forested and one where the trees had been clearfelled up to the rim of the sinkhole. The forested sinkhole is approximately 30 m in diameter and 7-10 m deep and is located approximately 75 m from the edge of a clearcut. The 'logged' sinkhole has similar dimensions to the forested sinkhole and is located within a clearcut. Temperature data loggers (LogTag Recorders - Model TRIX-8) were deployed in an array in and around each of the three sinkholes.

Nine of these data loggers were used to monitor the air temperature at each sinkhole – four on the sinkhole rim as defined by the upper slope break (at the north, south, east and west cardinal directions); four on the midslopes (at the north, south, east and west cardinal directions) and one at the drainage focus of the sinkhole. A series of control sites were set up in the surrounding forested and clearcut areas. These data loggers were left in place and set to take measurements at intervals of every ¼ hour from June to December 2006. Three of the warmer days of the summer (June 28, 29 and 30, 2006) were initially chosen for detailed analysis to identify trends and patterns of air temperature changes. Preliminary analyses of the three-day period have indicated that air temperatures for the clearcut control site ranged from 0°C to 35°C, while the forested control site ranged from 4°C to 23°C during the same period. Temperatures at the drainage focus of the logged sinkhole ranged from 2°C to 24°C, while those at the drainage focus of the forested sinkhole ranged from 5°C -15°C. Temperature ranges for the rim and midslopes of the forested sinkhole were somewhat similar to the forested control site. However for the logged sinkhole, the rims had similar temperature ranges to the clearcut control site, while midslopes had slightly lower upper range values compared to the clearcut control site.

From these data it is apparent that the range of air temperatures in the drainage focus of the large forested sinkhole is much narrower than those of the forested control site. The drainage focus is in fact distinctly cooler (by 8°C) than the forested control site during the warmest time of the day (mid-afternoon), while it is slightly warmer (by 1°C) during the coolest times of the day (early morning). It can therefore be reasonably inferred that these temperature differences could lead to distinct microclimatic conditions at the drainage focus, possibly with increased potential for ground moisture

retention and higher ambient relative humidity. In addition to this, it can be speculated that this drainage focus could provide different habitat or ecological niches as compared to the surrounding forest. Interestingly, the air temperatures recorded at the midslopes and rims do not appear to be too dissimilar to the forested cover control site. This may require more investigation. A significantly greater range in temperatures is also apparent between drainage foci of the logged sinkhole and the forested sinkhole (2°C - 24°C and 5°C - 15°C, respectively). This difference provides some indication as to the level of disturbance that surrounding logging activities can have on the microclimates at the base of a sinkhole of this size and shape.

In conclusion, our preliminary findings show that large forested sinkholes do exhibit distinct microclimates that can be measured and defined to some extent using air temperature as a proxy indicator. A key outstanding question is how important is it to preserve these microclimates at the base of these sinkholes, and what size of tree buffer is most suitable or reasonable? It apparent that these sinkhole microclimates are likely important for certain specific fauna and flora, but are they are also probably essential for the karst hydrological and geomorphological functions and processes that occur within and around forested sinkholes. In the larger picture of karst management in coastal British Columbia, this research should be considered only as a first step in evaluating the impacts of forestry activities on forested sinkholes.

Temperature data loggers appear to be a reasonably inexpensive method to monitor microclimatic conditions, and can potentially be used by forest companies to ensure the effectiveness of their karst management strategies for sinkholes with distinct microclimates. This is critical for the new era of the results-based forest practices in BC, where professional reliance and the use of routine-level effectiveness evaluation indicators are becoming more and more important.