

**Reply to Comments by W. C. Yeomans on "Déglaciation de la vallée supérieure de l'Outaouais, le lac Barlow et le sud du lac Ojibway, Québec"**

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[See table of contents](#)

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# REPLY TO COMMENTS BY W.C. YEOMANS ON "DÉGLACIATION DE LA VALLÉE SUPÉRIEURE DE L'OUTAOUAIS, LE LAC BARLOW ET LE SUD DU LAC OJIBWAY, QUÉBEC"

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The discussion by Yeomans apparently results from his misinterpretation of my assessment of *Mysis relicta* as a biological indicator of maximal paleolacustrine transgression. My intention was to stress the fact that the absence of *Mysis relicta* in a given lake does not necessarily discount the occurrence of paleolacustrine transgression (proglacial lake) at this site.

I do not reject *Mysis relicta* or any other biological indicators of paleolacustrine transgression. I believe a careful reading of the section of my paper dealing with this topic will satisfy the reader. On the contrary, the exhaustive work of DADSWELL (1974) demonstrated the good agreement between the distribution of the mysid *Mysis relicta* and the other members of the "deepwater community" (the amphipod *Pontoporeia "affinis"*, and the large copepods *Limnocalanus macrurus* and *Senecella calanoides*) and the extent of proglacial lakes obtained by shoreline measurements and sediment distribution. With the bulk of his discussion aimed at demonstrating the value of *Mysis relicta* as a tolerant indicator species, Yeomans is preaching to the already converted. On the other hand he did not address the main reserves I expressed regarding the use of *Mysis relicta* or other biological indicators: (1) the possible elimination of *Mysis relicta* from certain lakes due to past or present environmental conditions and (2) its absence in the fossil record due to complete morphological destruction of its remains in sediments.

While the presence of *Mysis relicta* in a given lake is a reliable indication of glaciolacustrine transgression at the site, its absence does not constitute positive evidence that the area was not unglaciated. I invoked the possibility that during the relatively long time interval since deglaciation and the arrival of the biological indicators in proglacial lakes (approximately 10 000 years for the area that concerns me), changes in environmental conditions, both physical and chemical, could have led to the disappearance of *Mysis relicta* (or one or more members of the deepwater community) from certain sites. Because the occurrence of these freshwater animals is limited mainly by water temperature and by dissolved oxygen and light transmissivity conditions, I speculated that the warmer and drier climate of the hypsithermal period may have contributed to eliminate *Mysis relicta* from certain lakes where present day conditions are now favourable to its occurrence. Despite the wide range of environmental conditions that *Mysis relicta* can tolerate, it is not indestructible.

The influence of past environmental changes on survival of relict species has been acknowledged by others. DADSWELL (1974, p. 29) reported: "It is probable that when each present-day lake basin separated from the glacial lake, conditions in the new lake were oligotrophic, and it contained populations of all four crustaceans. But lakes change through time from oligotrophic to either eutrophic or dystrophic, and this causes a corresponding change in their profundal community (BRUNDIN, 1958). Consequently, depending on the original depth of the basin and on whatever chemical changes have occurred in the intervening years, one or more of the crustaceans may have become extinct there. Obviously this is the case in our area, since only 33 of 291 possible lakes were found to contain all four crustaceans". *Mysis relicta* is undoubtedly the most tolerant species and was found by DADSWELL in 263 out of 291 localities. Its absence at these 28 localities is not well understood. DADSWELL (1974) suggested that limiting environmental factors could have a multiplication effect that could lead to the extinction or near extinction of a species at a given locality. In Danford Lake, Québec, during the fall, DADSWELL found that even though water temperatures below 18°C occurred as shallow as 8 m, no mysids were found in depths less than 8 m (possibly because of high incipient light) nor deeper than 20 m (because of low oxygen). Such a narrow range of favourable environmental conditions is susceptible to disappear with even slight climatic changes. Assuming the sampling technique to be 100% effective, we must then recognize that certain lakes that we know to be below the maximal glaciolacustrine level and that have water depth, temperature and light conditions favourable to *Mysis relicta* do not contain the mysid.

The fact that *Mysis relicta* is not preserved as a fossil in sediments (TRACY and VALLENTYNE, 1969) lowers its value as a paleolimnological indicator of glaciolacustrine transgression; if its remains had been preserved, its use would be greatly enhanced. Because they are not, we must assume stable environmental conditions since deglaciation, or conditions that have remained within a range compatible with its survival for the lakes where *Mysis relicta* is found today.

A point of importance to this discussion is the usage Yeomans makes of 'maximal' in the expression 'maximal paleolacustrine transgression'. In his reference to lakes in Algonquin Park where *Mysis relicta* was found he

seems to equate the highest level where *Mysis relicta* was found with the level of maximal paleolacustrine inundation (the lacustrine limit). The logic apparently followed here is that this level (381 m), being higher than the highest shoreline (380 m) of Lake Algonquin in this area, must then be the *maximal* water plane. While this may be the case, there is no evidence to associate this water plane (381 m) with the lacustrine limit (the maximal lacustrine level) in this area. The water plane in existence when *Mysis relicta* was introduced in those lakes may have been higher than 381 m. The only unequivocal method known to me to determine a lacustrine limit is to determine the altitude of the level below which sediments have been reworked or removed by wave action (upper washing limit) and above which sediments have not been disturbed by wave action. Good examples of this situation are found at several localities within the basins of proglacial lakes Barlow and Ojibway. It should be clear that although in a given locality biological indicators may suggest a higher ancient water plane than that obtained from strandline evidence, this higher water plane should not be consi-

dered as the lacustrine limit and should not be referred to as maximal.

Finally, I regret that Yeomans interpreted the reserves I expressed about *Mysis relicta* used as a paleolacustrine indicator as an outright rejection of this method. I am also grateful to him for providing me with an opportunity to clarify these reserves. The use of *Mysis relicta* and the other members of the "deep water community" constitutes a valuable complementary tool to geomorphological and geological methods for the reconstruction of paleoenvironments.

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