

Dr. Robert Hinderer
 Manager, Toxicology
 B.F. Goodrich Co.
 6100 Oak Tree Blvd.
 Independence, Ohio
 44131 USA

4 August, 1988

Dear Sir,

I will attempt to answer your questions starting with the first question which you posed (Paragraph 3 in your letter of 21 July, 1988). To improve the clarity of Table 3 in my thesis, I have relabelled it as follows:

TABLE 3: Benthic invertebrate taxa at seven locations in the Welland River. Densities represent the number of organisms in 700 cm². Double values with slash (/) represent the number of deformed specimens/total number counted.

You cited the example from my Table 3 of 5/92 (Sic 15/92) which indicates that at station B on Sept. 1987, there were 92 chironomids (Polypedilus sp.) in 3 Ekman dredges. The total area sampled by the three dredges was 700 cm². Fifteen of these were deformed as judged from my coded samples. Thus at the four replicate sites at Station B, the frequency of deformities for this species was 16%, 8%, 7.7%, and 2.3%. I do not deny that the variance is high, but this is to be expected from benthic invertebrates such as chironomids as their distributions are characteristically patchy (Hare and Carter 1976 and Wiederholm 1984 as cited in the thesis). Accordingly, a simple paired Student's T test was undertaken to determine whether the mean frequency of deformities at station B was significantly higher than the control site (Station A).

For all chironomids which I collected at this station, the combined mean deformity level at Station B was 6.29% with a standard deviation of 1.71 and for station A it was 3.84%, with a standard deviation of 1.32, while at the B.F. Goodrich site (Station D-1) the frequency was 10.9% with a standard deviation of 3.23. This was significantly higher than the frequency of deformities at station A ($P=0.0192$). Thus even though the variance is high, statistical analyses (Paired t value = 3.518, 1 tailed t test probability = 0.0195) confirm the frequency of deformities at B.F. Goodrich were significantly higher than at the control station.

If I assume for the moment that the F test for homogeneity or as you suggested in paragraph four of your letter, the Bartlett's Test for

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homogeneity, was negative indicating that a parametric test is inappropriate, I can carry out a nonparametric test which makes no assumptions about the homogeneity of variance about the mean. Using the nonparametric Wilcoxon signed-rank test gives a Z value of -1.89 which is significant at the 0.05 level ($P = 0.032$).

I believe that this addresses your concern about both my high variance and my lack of homogeneity. If not, I hope you will contact me again to clarify your points.

Your second point, paragraph four, deals with my observations at station B, an area in the Welland River which is impacted by agricultural chemicals such as atrazine. Atrazine and a variety of other pesticides are used on the corn fields adjacent to station B. Station B was the only station at which SOS Chromotest levels for genotoxicity were low while the frequency of chironomid abnormalities were high. After discussing this point with a number of biologists including my professor, I have concluded that many substances released into the water act differently on procaryotes and eucaryotes. Chironomids, which are eucaryotes, display teratogenic effects (birth defects) while prokaryotes do not. When exposed to certain chemicals like PCB's which fail to illicit any effects in procaryotes (Quillardet et al. 1985 as cited in my thesis which I mailed to you via Carl Reid) eukaryotes frequently reveal significantly higher levels of deformities. For this reason, I feel that the frequency of chironomid deformities is a useful screening technique in assessing sediment genotoxicity.

In paragraph six of your letter you referred to a letter which my professor addressed to Carl Reid. In this letter, Dr. Dickman stated that since MOE Reports indicate that 13 kg of Vinyl Chloride Monimer (VCM), a well known carcinogen, was released into the Welland River in 1986 by BF Goodrich, the onus of proof should now rest on BF Goodrich to show why the statistically higher frequency of chironomid abnormalities at the end of its discharge pipe to the Welland River is not due to their release of this mutagen and carcinogen into the natural environment.

I appreciate your concern about this statement as it is your job as the manager of the BF Goodrich toxicology section to see that toxic substances produced at BF Goodrich do not enter the natural environment.

You end your letter by acknowledging that the reduction in benthic invertebrae diversity which I reported for several industrial areas within the Welland River is probably correctly attributed to the discharge by these industries of compounds which stress the natural biota to the point that only the most tolerant taxa can

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survive. Many ecologists look forward to the time when the International Joint Commission recommendation of zero toxic discharge is carried out. Ecologists hope that this will result in the maintenance of high diversity throughout our natural waterways.

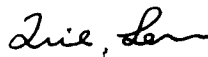
Because my research was supported by the World Wildlife Wetland Toxicology Fund and Environment Canada, I paid special attention to provincially significant (Class One) Wetlands. As you may know, the discharges from the Welland River BF Goodrich Co. enter a provincially significant wetland and hence the low diversity of benthic invertebrates at the end of your company's discharge pipe is a legitimate concern of the Ministry of Natural Resources in Ontario as this agency classified these waters as provincially significant wetlands.

I have also read over your section entitled "Additional Comments" and found many of them quite useful. I will send to you (via Mr. Reid) a copy of my revised thesis. I plan to defend the thesis in Rm. H313 at Brock University on 15 August at 2 P.M. You are welcome to attend this open meeting of my thesis defence.

In closing, I would like to say that I believe I have addressed the main points of your letter of 21 July, 1988 regarding the first draft of my thesis. I sent BF Goodrich my first draft as a good will gesture so that they would have an opportunity to comment on it before these results were made public. I am grateful for your comments as I feel I have profited from them. However I feel that the basic thesis research which I carried out over a two year period, is sound. After the 15th of August I will know if the committee members including an outside expert from Waterloo University, the dean's representative and three members from my own department are in agreement with the thesis findings.

I look forward to any comments which you care to make concerning this letter and my revised thesis.

Sincerely,



Que Lan
Biological Sciences Dept.
Brock University

cc: Mr. Carl Reid

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B.F. Goodrich Canada
P.O. Box 1026
Niagara Falls, Ontario
L2E 6V9
cc: Dr. M. Dickman

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