Additional Information on Impact of Waterbody Fertilization on Fish Production[1]

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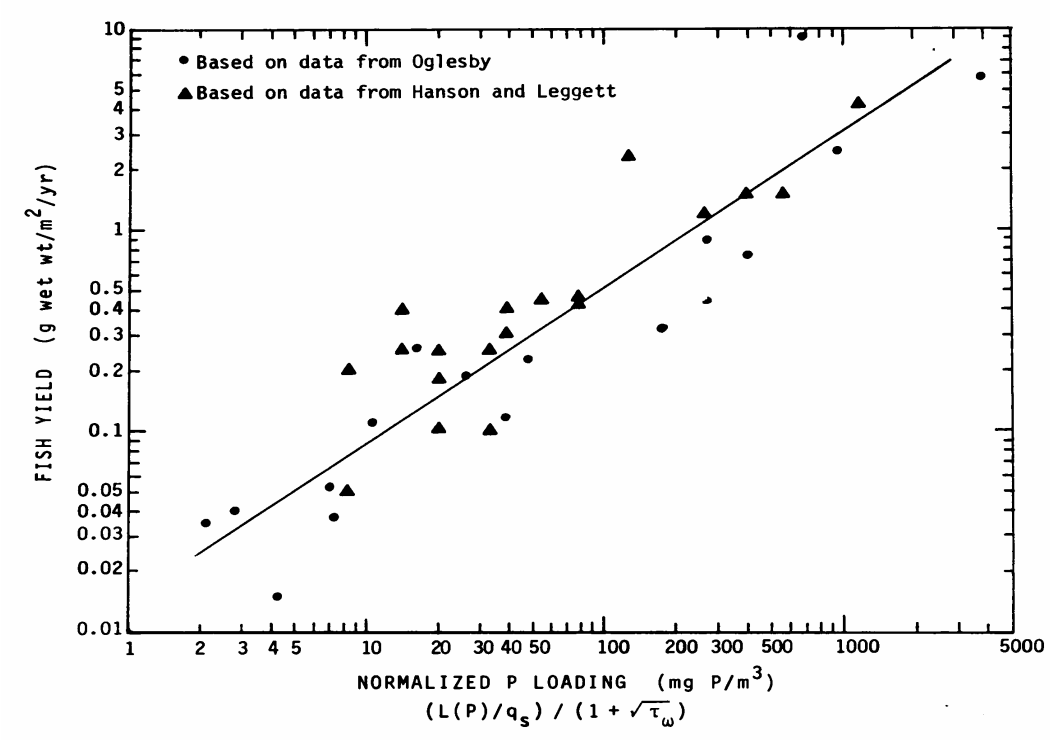
The October 2003 SCOPE NEWSLETTER presented a summary of several papers published in the proceedings of the first international conference on nutrients in salmonid ecosystems, American Fisheries Society, Bethesda, MD USA. The impact of fertilization of waterbodies on fish production and characteristics has long been of interest to the authors. A decade ago they reported a summary quantification of how fertilization of waterbodies improves fish production in terms of total fish biomass; this relationship is shown in Figure 1.

Figure 1 - Relationship between Normalized P Load and Fish Yield
(From Lee and Jones, 1991)



Key to Figure:

L(P) = Areal annual phosphorus loading (mg $P/m^2/yr$)

m^2 = surface area of the waterbody

q_S = waterbody mean depth/hydraulic residence time
mean depth is the waterbody volume divided by its surface area

T_ω = hydraulic residence time (waterbody filling time)

1. Published in *Scope Newsletter* by CEEP Bruxelles, Belgium
Available from http://www.ceep-phosphates.org/scope/frm_prev.htm

As Lee and Jones (1991) discussed, moderate levels of fertilization can improve fish production of lakes, impoundments and ponds. However, fertilization, especially at high levels, can be adverse to the production of desirable forms of fish. In highly fertilized waterbodies that stratify, the oxygen demand in the hypolimnia (created by the decomposition of algae that had grown in the surface waters and settled to the bottom) can be sufficient to deplete the oxygen there. Since desirable coldwater fish (such as the salmonids, trout, etc.) normally inhabit the hypolimnion during the summer in temperate waterbodies, these more desirable fish cannot survive in highly eutrophic waterbodies because of a lack of oxygen in the cooler hypolimnetic waters. Thus, while there may be increased overall fish production in highly eutrophic waterbodies as shown in Figure 1, the populations of rough fish, such as carp, which can tolerate lower dissolved oxygen levels, often dominate the increased fish production characteristic of excessively fertile waterbodies. The relationship shown in Figure 1 applies to waterbodies with surplus nitrogen available for algal growth.

The abscissa in Figure 1 is the Vollenweider normalized phosphorus loading term, which is the phosphorus load normalized by the waterbody's mean depth and hydraulic residence time. This term is approximately equal to the annual average phosphorus concentration in the waterbody's water column. Additional information on the Vollenweider OECD Eutrophication Study results is available from Jones and Lee (1986).

References:

Jones, R. A. and Lee, G. F., "Eutrophication Modeling for Water Quality Management: An Update of the Vollenweider-OECD Model," World Health Organization's *Water Quality Bulletin* 11(2):67-74, 118 (1986). Available at http://www.gfredlee.com/voll_oecd.html

Lee, G. F. and Jones, R. A., "Effects of Eutrophication on Fisheries," Reviews in Aquatic Sciences, 5:287-305, CRC Press, Boca Raton, FL (1991). Available at http://gfredlee.com/pexfert2.htm