

One or both of the following all-day workshops are being offered by Gertrud K. Nürnberg at the NALMS meetings.

Internal phosphorus loading I: Its effect on lake water quality, its determination, quantification and prediction, and remediation options

Internal phosphorus loading as phosphorus (P) released from anoxic sediment surfaces often represents the main summer P load to lakes. Because of its high biological availability, the lack of dilution, and the timing, it can have an immense effect on summer water quality of a lake, reservoir, or pond. However, depending on the stratification of the lake, it is not always easy to determine the quantity of internal load (especially in polymictic lakes), and it may be difficult to estimate the ultimate effect it may have on surface water quality (especially in stratified lakes).

This workshop presents a way of sorting out the different possibilities so that internal load can be quantified in polymictic, as well as stratified lakes. In particular, five different methods will be presented to determine internal load, depending on lake characteristics and data availability. Such quantification can be done in a step-wise fashion, where missing data may be predicted by subsidiary models. (For example, anoxia as anoxic factor may be predicted from lake TP concentration and combined with release rates, predictable from sediment TP concentration, to arrive at an internal load estimate).

After the quantification of internal load the participant will learn how to combine it with external load in a simple mass balance model to predict seasonal phosphorus concentration. Knowing this, other water quality characteristics (algal biomass, bloom frequencies, Secchi disk transparency, and hypolimnetic anoxia) can be arrived at. Applications regarding lake quality assessment, nutrient criteria, and total maximum daily load (TMDL) computations will be discussed.

The next step is remediation. The basic planning of remediation, with emphasis on hypolimnetic withdrawal and alum additions, will be presented. There will be ample time available for interactions and discussions with the audience.

Each workshop topic will follow this structure to simplify understanding:

1. Theoretical description
2. Presentation of case studies covering US, Canadian, and European lake assessment and restoration projects
3. Occasional demonstration with modeling spreadsheets (on computer)
4. Discussion with attendees

Comprehensive handouts and reference list to cover theory and case studies.

Internal phosphorus loading II: Hands-on applications of the theoretical concepts and models presented in the introductory workshop, Internal phosphorus loading I.

This workshop is meant to augment the more theoretical workshop on internal P load. Potential attendees are expected to know the basic modeling approach for internal load as taught in the first workshop. Ideally, they would have taken *Internal load I* at one point (see description of Workshop) or at least would be familiar with the models and concepts described in the NALMS-EPA Manual on *Managing Lakes and Reservoirs*), Chapter 5, and other publications by G. Nürnberg as listed in the publication list.

The workshop will be structured according to the following outline. 1. *Fine-tuning*: Introduction and exchange with participants to tailor material and choice of case studies to their needs and experience. 2. & 3. *The Meat*: Determination of internal load in stratified and in mixed lakes and reservoirs. 4. *Tricks of the trade*: Possible ways of modeling internal load when data are poor or unavailable. 5. *Putting it all together*: Applications in the real world with emphasis on restoration attempts. 6. Examples from the audience. If prepared in advance under consultation and exchange with GN, some case studies could be used for illumination in sections 2 to 5. 7. *Last but not least*: Discussion with participants, including their stories and experiences, summary and fare-well.

Comprehensive handouts will be provided, including simple spreadsheet modeling examples and publications on disk.

Attendees are encouraged to bring laptop computers with CD drives, but this is not essential. I would use *Powerpoint* and a projection system so that I can show on-screen programs and calculations from my laptop. They could be reproduced and done simultaneously by participants on their own laptops.

The interested attendee may read in preparation Nürnberg G.K. (1998) *Prediction of annual and seasonal phosphorus concentrations in stratified and polymictic lakes. Limnology and Oceanography*: 43, 1544-1552, and Nürnberg, G.K.(2005) *Quantification of internal phosphorus loading in polymictic lakes. Verhandlungen International Verein. Limnology (Proceedings of SIL)*. 29, 623-62 and other papers as listed in the publication list.