

Influence of catchment characteristics and lake factors on P and N in Finnish Lakes

Kirsikka Niemi, Finnish Environment Institute and University of Helsinki, Finland

The aim of this study is to find cause-effect relationships and create a simple estimation model between nutrients concentration and proportion of fields and water area in the catchment, mean depth and temperature in lake. Results can also be utilised concretely in implementation of Water Framework Directive (WFD).

Between a lake and its catchment is a strong interaction. Yet it is difficult to create a reliable model between them, since different kinds of lakes react in specific way to nutrient load. Here lakes were grouped in to lake types based on Finnish national lake typology. It is shown that among these lake types the intensity of effect between the controlling factors and nutrients of the lakes differ.

Table 1 Finnish lake typology (SA = Surface Area, D = Depth)

Abbreviation	Name	Characteristics
LNh	Large, non-humic lakes	SA > 4,000 ha, color < 30 mg Pt/l
Lh	Large, humic lakes	SA > 4,000 ha, color > 30 mg Pt/l
Nh	Medium and small, non-humic lakes	SA: 50 - 4,000 ha, color < 30 mg Pt/l
Mh	Medium, humic deep lakes	SA: 500 - 4,000 ha, color: 30–90 mg Pt/l, D > 3 m
Smh	Small, humic, deep lakes	SA: 50 - 500 ha, color: 30–90 mg Pt/l, D > 3 m
Hh	Deep, highly humic lakes	Color > 90 mg Pt/l, D > 3 m
SNh	Shallow, non-humic lakes	Color < 30 mg Pt/l, D < 3
Sh	Shallow, humic lakes	Color: 30-90 mg Pt/l, D < 3 m
SHh	Shallow, highly humic lakes	Color > 90 mg Pt/l, D < 3 m
NrCr	Nutrient-rich and CaO-rich lakes	
Nr	Nutrient-rich lakes	
Sd	Lakes with a short detention time	Detention time < 10 days

The explaining variables correlated with each other, which made it difficult to analyse determining factor. For example, on flat areas there is more agriculture area than on land of variable topography, but there the mean depths of lakes are lower too. When it is important to know how the agricultural land influences total phosphorus concentration in lakes the effect of mean depth has to eliminate. Here results are adjusted.

Increase of fields in the catchment increased the total phosphorus (TP) and the total nitrogen (TN) concentrations in all types of lakes. When the proportion of the fields in the catchment increased by 10%, the effect on the nutrients concentration was the strongest in lakes with a short water detention time. There the total phosphorus concentration increased by 30 µg/l and the total nitrogen concentration increased by 350 µg/l. TN/TP-value decreased all other type of lakes except in the Lh and in the NrCr. The influence was strongest in the LNh where TN/TP-value decreased by 610 units. Increase of temperature decreased nutrients concentration in lakes where the nutrients concentrations were highest. Increase in mean depth of the lake and also increase of proportion of the water area in the catchment decreased nutrients concentrations in lakes, especially in nutrient- and CaO-rich lakes. Also TN/TP-value decreased except in those nutrient- and CaO-rich lakes. In the Nr TN/TP-value decreased by 1700 units when the proportion of the water area in the catchment decreased by 10%. Temperature and mean dept affected on TN/TP-value less.