# Dissertation Literature Review

Background + Expected Trend

1. Water quality of Loch Leven: response to enrichment, restoration and climate change (Data from 1968-2007)

DOI: 10.1007/s10750-011-0923-x

Abstract

* Seasonal changes in temperature and rainfall may have positive and negative impacts on water quality
* Warmer spring temperatures appear to have a positive effect on Daphnia densities = reduced ChlA concentration in springs = improvement in water clarity in May and June
* Negative relationships between summer rainfall and ChlA concentrations
  + 3 wettest summers have low ChlA concentrations & driest summers having high concentration

Introduction (Background)

* Over the last few decades, efforts have been made to restore enriched systems, **largely through reductions in point sources of nutrients entering lakes**
* Attempts to restore the lakes are often hindered by **internal loading from nutrients that have stockpiled in the lake’s sediments**
* It is often assumed that rising temperatures will lead to a deterioration in water quality – stimulating plankton growth (particularly cyanobacteria)
  + However, changes in bacteria also affect the growth and reproduction of zooplankton grazers
* Other climate parameters, such as rainfall may have confounding influences as well

Site details

* Loch received phosphorous rich effluent from woollen mill
* Progressively reduced from a peak in the 1960s and 1970s – the mill ceased using P-based materials in 1989
* Sewage works were also a major source – tertiary treatment and effluent diversion measures were introduced at these works in the 1990s
* TP risen to 20tP/year by 1985 🡪 reduced to 8tP/y by 1995 and remained at this level in 2005
* Since 1995, diffuse nutrient loads from agricultural have also been targeted through the introduction of buffer strips – impact currently unclear
* **SITE SPECIFIC CHLA TARGETS FOR LOCH LEVEN WOULD BE 11μg/L FOR THE G/M BOUNDARY AND 22 μg/L FOR THE M/P BOUNDARY**

Results

* Highly significant trends were observed between ChlA and TP concentrations, as well as ChlA and SD
  + There is some evidence of levelling off at low TP concentrations (less than 7022 μg/L

Discussion

* This highlights how significant Daphnia grazing is to the water quality of the Loch

1. The sensitivity of phytoplankton in Loch Leven (U.K.) to changes in nutrient load and water temperature

DOI: 10.1111/j.1365-2427.2007.01865.x

Summary

* Temperature changes had little effect
* Increasing only phosphorus load caused a large increase in *Anabaena* abundance and total ChlA concentration
* The opposite was recorded when nitrate load was changed as well, with *Anabaena* increasing its biomass under reduced nutrient scenarios
* Key factor – nitrogen availability – *Anabaena* is a nitrogen fixer
  + Can exploit the P resources of Loch Leven under limiting nitrogen availability – allowing it to dominate under most of the scenarios apart from those supplying extra N to the lake

1. Exploring nutrient and light limitation of algal production in a shallow turbid reservoir

DOI: 10.1016/j.envpol.2020.116210

Summary

* Nutrient variability, rather than mixing or light, is the primary driver of algal blooms in a shallow eutrophic reservoir

1. Contrasting roles of water chemistry, lake morphology, land-use, climate and spatial processes in driving phytoplankton richness in the Danish landscape

DOI: 10.1007/s10750-011-0996-6

Abstract

* Lake water chemistry was the strongest predictor of phytoplankton richness for all groups
* Climate and land-use in catchments contributed only little to the explained variation in phytoplankton richness
* Total nitrogen played a more important role for phytoplankton richness than total phosphorus

1. Nutrients and Saltwater Exchange as Drivers of Environmental Change in a Danish Brackish Coastal Lake over the Past 100 Years

DOI: 10.3390/w15061116

Abstract

* Lake recovery over the last 20 years has been driven by a reduction in TN and TP loading from the catchment and shows improvements in the lake water clarity and, recently, in macrophyte cover.
* Reduced salinity after 2004 has also changed the composition of the dominant macrophyte community within the lake.
* The low N:P ratio indicates that in summer, the lake is predominately N-limited, likely explaining why previous management, mainly focusing on TP reduction measures, had a modest effect on the water quality of the lake.

1. Impact of zooplankton grazing on phytoplankton in north temperate coastal lakes: changes along gradients in salinity and nutrients

DOI: 10.1007/s10750-022-05017-1

Abstract

* Zooplankton grazing at similar nutrient levels is generally regarded as lower in brackish than in freshwater lakes.
* Grazing was low in 11 of the 12 lakes, even when they were dominated by edible phytoplankton and nutrient addition led to a major increase in phytoplankton biomass.
* Grazing was significant in most of the mesocosms, particularly at high nutrient levels and salinities of 8‰ or below where *Daphnia* dominated.
* Grazing in summer was generally low in the majority of the lakes, which we attribute to high predation on zooplankton.

1. Assessing multiple stressor effects to inform climate change management responses in three European catchments

DOI: 10.1080/20442041.2020.1827891

Abstract

* In all catchments, indicators of nutrient enrichment were identified as the primary stressor, with climate change-sensitive indicators causing secondary effects
* Loch Leven: additive, total phosphorus [TP] × precipitation; Pinios: additive, nitrate × dissolved oxygen; Lepsämänjoki: synergistic, TP × summer water temperature
* The intensity of which varied between catchments and along the nutrient stressor gradient

1. Long-term variation and regulation of internal phosphorus loading in Loch Leven

DOI: 10.1007/978-94-007-4333-5\_4

* The paper summarizes the historical changes in external phosphorus loads to Loch Leven, Scotland, UK, from 1905 to 2005, and the impacts of these changes on the lake's ecosystem and the various ecosystem services it provides.
* Management interventions to enhance one ecosystem service at Loch Leven often had unintended negative consequences on other ecosystem services provided by the lake.
* Attempts to enhance the fishery through stocking may have had detrimental effects on algal control and biodiversity.
* Reducing nutrient and pesticide pollution improved water quality and ecosystem services like macrophyte growth and biodiversity, but recovery was slow due to internal nutrient loading.

Conclusion

* Improvements in water column TP concentration during the recovery period appear to have resulted from two different processes.
* First, a gradual decline in TP was observed over the 20-year period.
* Second, a more instantaneous decline in TP was observed in 2007.
* Correlation analysis suggests that one important driver of this variation in Loch Leven between 1989 and 2008 was the magnitude of internal loading.
* Variability in the magnitude of internal loading during the recovery period appeared to be regulated mainly by climate change variables (i.e. wind and temperature) and, to a lesser extent, indicators of water clarity (i.e. Secchi depth), rather than TP concentrations in the sediment.

1. Making waves. Bridging theory and practice towards multiple stressor management in freshwater ecosystems

DOI: 10.1016/j.watres.2021.116981

Abstract

* Despite advances in conceptual understanding, single-stressor abatement approaches remain common in the management of fresh waters, even though they can produce unexpected ecological responses when multiple stressors interact.
* Those critical limitations include that (i) monitoring schemes fall short of accounting for theory on relationships between multiple-stressor interactions and ecological responses, (ii) current empirical modelling approaches neglect the prevalence and intensity of multiple-stressor interactions, and (iii) mechanisms of stressor interactions are often poorly understood.

1. Which factors affect phytoplankton biomass in shallow eutrophic lakes

DOI: 10.1007/s10750-013-1525-6

Results

* We found a significant (P < 0.05) but weak relationship between TN and Chl-a (Table 2), while the TP–Chl-a relationship was not significant.
  + We note that the TP–Chl-a relationship was significant in the lower (TP ~ 0–400 μl−1) range (P < 0.05; R 2 = 0.3009)
  + Inorganic nitrogen forms show high within-year variation, therefore, it was not surprising that NO3 ions showed no correlation with phytoplankton biomass. The reason is that inorganic forms of nitrogen are strongly involved in microbial processes in aquatic environment.
* The pH also showed strong and highly significant linear relationships with phytoplankton biomass with relatively high proportions of variance explained (Table 2). However, the pH was not included in the predictive models, because it cannot be considered an explanatory variable for Chl-a.

Discussion

* Although the TP–Chl-*a* relationship was not significant over the entire concentration range we cannot say that TP has no impact on the phytoplankton biomass in shallow eutrophic systems.
* The maximum carrying capacity of phytoplankton biomass is related to the nutrient content even in the case of eutrophic lakes.

1. Response of planktonic diversity and stability to environmental drivers in a shallow eutrophic lake

DOI: 10.1016/j.ecolind.2022.109560

Abstract

* The findings showed that the plankton community was the least diverse in winter and the most stable during the spring-to-summer transition.
* For phytoplankton community composition, physical and chemical parameters, followed by light, had the greatest influence.
* Further analysis showed that phytoplankton were influenced primarily by nutrients, water depth, and pH.
  + Structural equation modelling showed that light had minimal direct effect on the plankton and affected the plankton indirectly through changes in total nitrogen and NO3-N.

Introduction (Good to read in detail probably)

* Determining the key factors of phytoplankton species diversity and community stability in shallow lakes is challenging because different predictors may be interrelated
  + Different driving factors have varying degrees of impact on diversity and stability.

1. Analysis of environmental drivers influencing interspecific variations and associations among bloom-forming cyanobacteria in large, shallow eutrophic lakes

DOI: 10.1016/j.hal.2019.02.002

Abstract

* Previous studies indicate that dual nitrogen (N) and phosphorus (P) reduction is needed to control cyanobacterial blooms
* However, N limitation may cause replacement of non-N2-fixing by N2-fixing taxa
* The results illustrate that the community composition of cyanobacteria is primarily driven by physical factors and the zooplankton community, and their interactions