Controls on Osoyoos Lake Limnology and Biological Production

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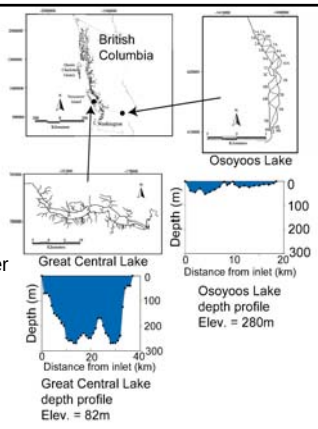
Outline for this talk

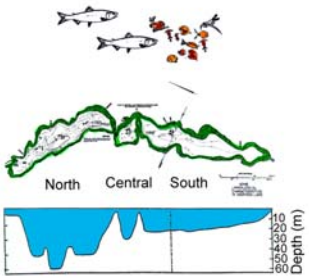
- Identify key features of Osoyoos L. & its landscape.
- Review concept of "bottom up" control of biological processes and water quality in lakes.
- Compare observations from Osoyoos L. with the "bottom p" model.
- Draw conclusions about dominant processes that control species, productivity & water quality.
- Entertain questions.

Key Features of Osoyoos L. & its Landscape

- 3-basin system fed by much larger Okanagan L.
- very shallow (<50m) i.e. larger, GCL & Okanagan lakes have depths > 250m.
- mixes completely twice per yr from surface-to-bottom
- receives inputs from a huge area of the Ok. Watershed
- surrounded by agricultural & urban development

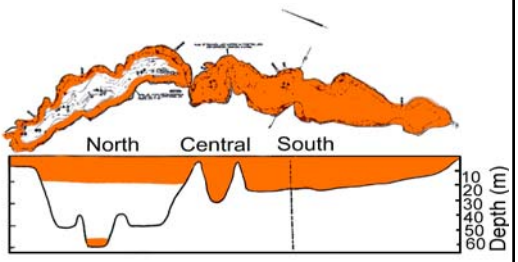


Osoyoos Lake in Winter and Early Spring



- cold and un-stratified
- permanent ice cover infrequent
- relatively low flushing rate
- nutrient rich (total P =10-15 ug.l^{-1}, meso- to eutrophic)
- biological production light limited
- high transparency (> 5 m)
- oxygenated from surface to bottom

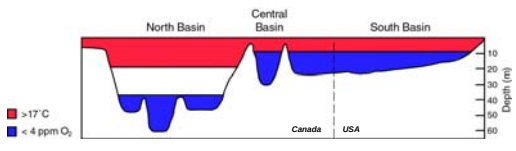
Osoyoos Lake in Summer to Early Fall



- warm (26°C) & stratified (thermocline at 12-16m)
- very high but variable flushing rate
- high production driven by high nutrients (N&P)
- seasonal algal blooms (spring diatom & summer blue-greens)
- low transparency (< 4m)
- deeper, cooler (<15°C) waters often oxygen poor

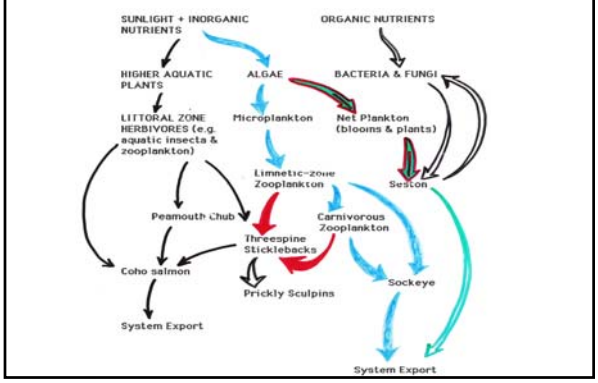
Summer Stratification & Complex Biophysical Events

Temperature and **Oxygen** extremes operate together to restrict the Optimal Water Volume (OWV) of Osoyoos Lake.

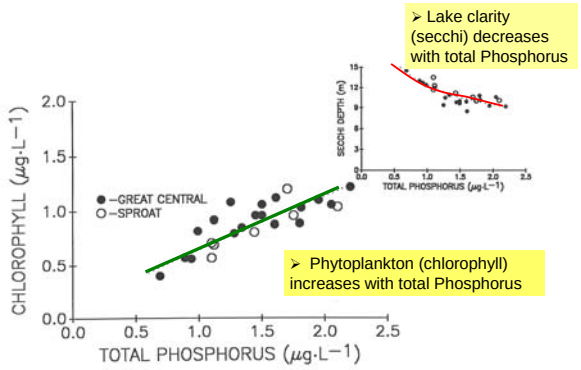


- **South Basin & Central Basins** – highly productive (internal nutrient loading), blooms of phytoplankton lower water quality & induce seasonal hypoxia in deeper waters during stratified periods.
- **North** – deeper and less productive than south and central basins, fewer major algal blooms and O2 depletion in deeper waters less severe.

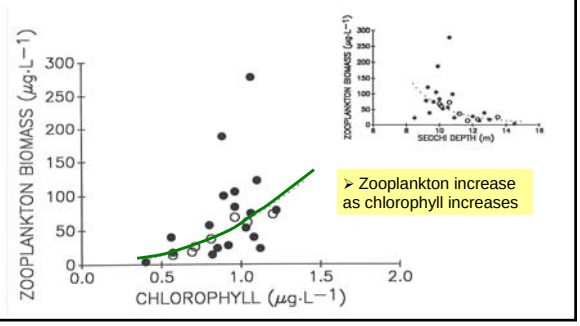
Limnologists often apply bottom‑up control models to explain biological production & water quality of lakes!



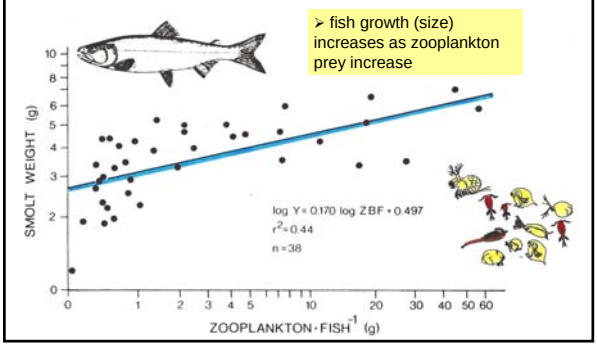
Bottom‑up control by N or P of phytoplankton is commonly observed in BC lakes



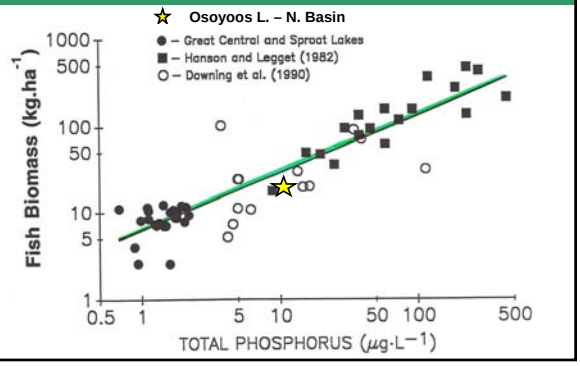
Bottom-up control from phytoplankton to zooplankton is also frequently observed.



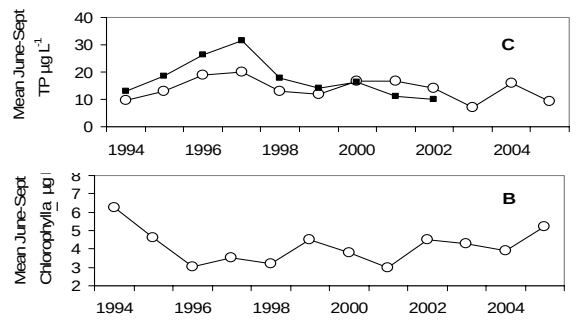
Bottom-up control from zooplankton-to-fish has often been shown in lake fertilization work (e.g. Hyatt & Stockner 1985)



Osoyoos Lake's position fits well within a global data-set re: bottom-up control from nutrients to fish (Hyatt & Rankin 1999)

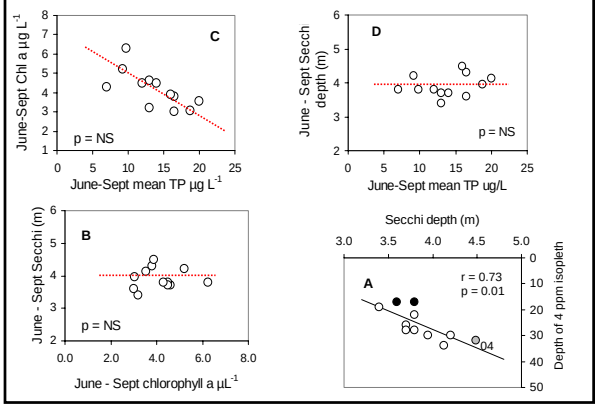


What do phosphorus & chlorophyll (1994–2005) measures tell us about Osoyoos Lake's current state ?

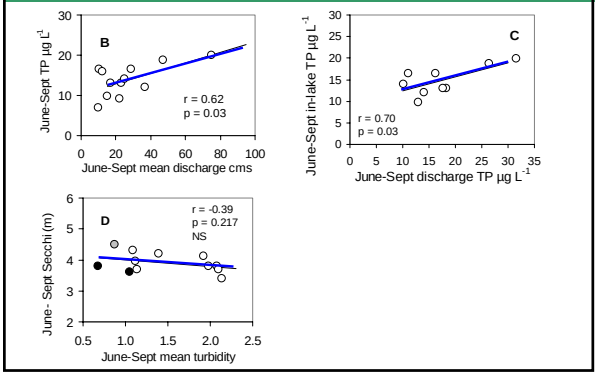


GS-averages for phosphorus & chlorophyll (1994-2005) suggest Osoyoos is meso-to-eutrophic and less productive with higher water quality than in 1970s.

But Osyoos results don't fit "bottom up" models well !



Ok. River summer discharge appears to exert significant control over in lake biophysical processes !

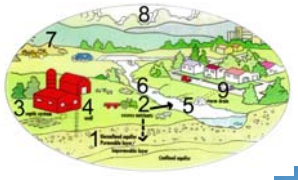


Seasonal water releases from Okanagan L. Dam at Penticton have a potent influence on Osoyoos Lake water quality and biological processes.

Conclusions

- Osoyoos L. exhibits high nutrient levels & productivity relative to most other lakes in either the Okanagan or B.C. in general.
- Bottom-up control models don't fully explain biological processes and water quality changes because of the overriding importance of upstream discharge & lake flushing.
- Upstream factors (flow regulation at Penticton, point & non-point source nutrient inputs) may dominate Osoyoos Lake conditions due to its small volume & position at the bottom of a large chain of lakes surrounded by farms and cities.
- Regulation of Osoyoos Lake level & discharge at Zosel Dam has significant downstream effects but effects on water quality & biological processes upstream in Osoyoos Lake are subtle.

Many of the Key Factors that Control Water Quality Processes in Osoyoos L. are Out-of-Sight & Out of Mind?



Aquatic ecosystems in the Okanagan are subjected to "disturbance regimes" (physical, chemical, biological) that are increasingly influenced by activities associated with local & global human population growth.

1. Groundwater supplies (quantity and quality)
2. Nutrients (influence on biota)
3-4. Contaminants (organophosphates, PCB's, DDT, heavy metals, etc.)
5. Surface water supplies (quantity and quality)
6. Invisible barriers: temperature, O_2, NH_3
7. Landfills & waste (775 kg.person.yr)
8. Atmospheric pollutants (e.g. nitrous oxides, sulphates, polycyclic aromatic hydrocarbons
9. Storm runoff and sediments from urban and agricultural development

Thanks for Your Attention ! Questions ?