Saving Lake Winnipeg – Philosophies of a biologist

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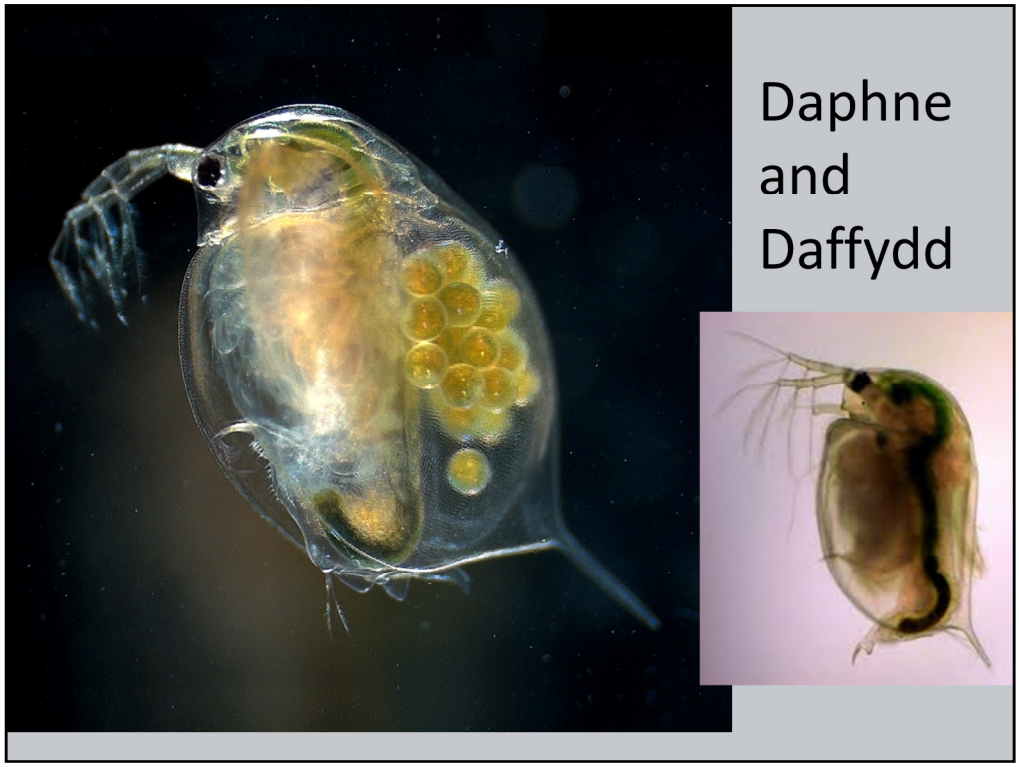
UNIVERSITY OF MANITOBA



I'd like to introduce you to some friends of mine...

A couple of mm long – these creatures are important in the health of any water body

We'll come back to them later

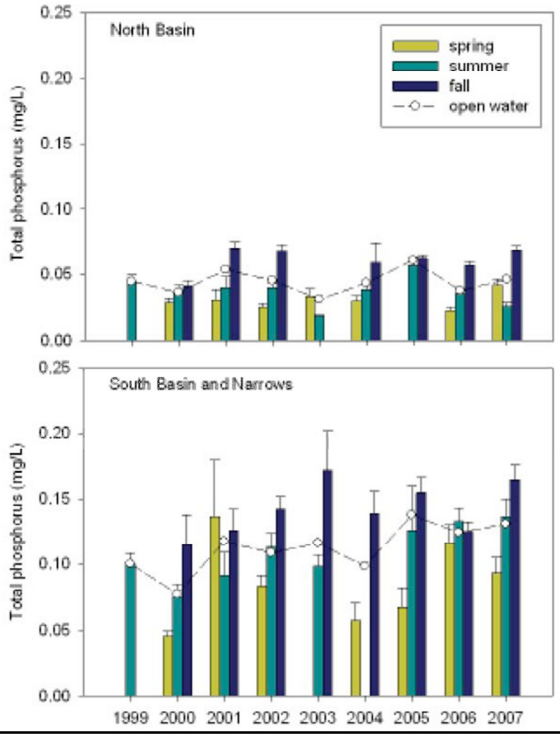
I work for the Watershed Systems Research Program, whose focus is the activities in the Lake Winnipeg Watershed, but today I wanted to give you a broader perspective and consider what is going on in the lake, as well as the watershed.

I will be focused on water quality issues – there won't be any soil science in my talk

And I will introduce you to a range of solutions that have been tried around the world, and could be tried in lakes in the Lake Winnipeg watershed.

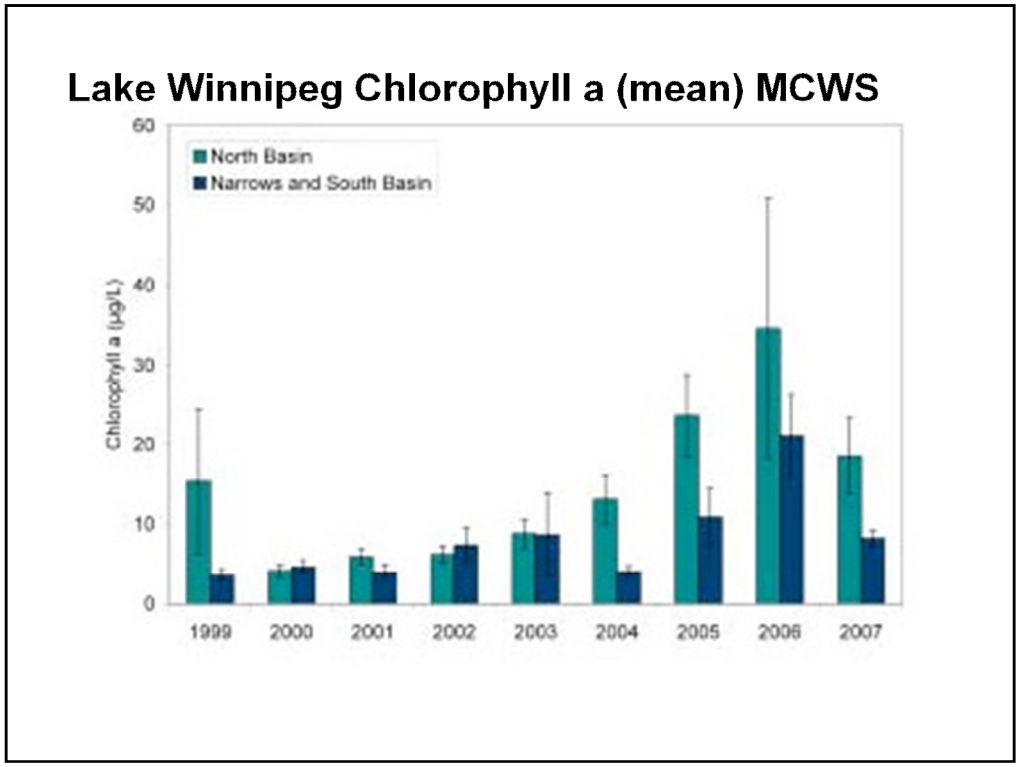
Lake Winnipeg – 10th largest lake in the world, 5th largest in Canada
Lake Winnipeg surface area is 24,514km^2
Lake Winnipeg is 111km wide at its widest point
Lake Winnipeg maximum depth is 36 m
Lake Winnipeg average depth is 12m
Lake Winnipeg shoreline is 1750km long
180-195 open water days each year

Annual and seasonal mean total phosphorus concentrations (MCWS)

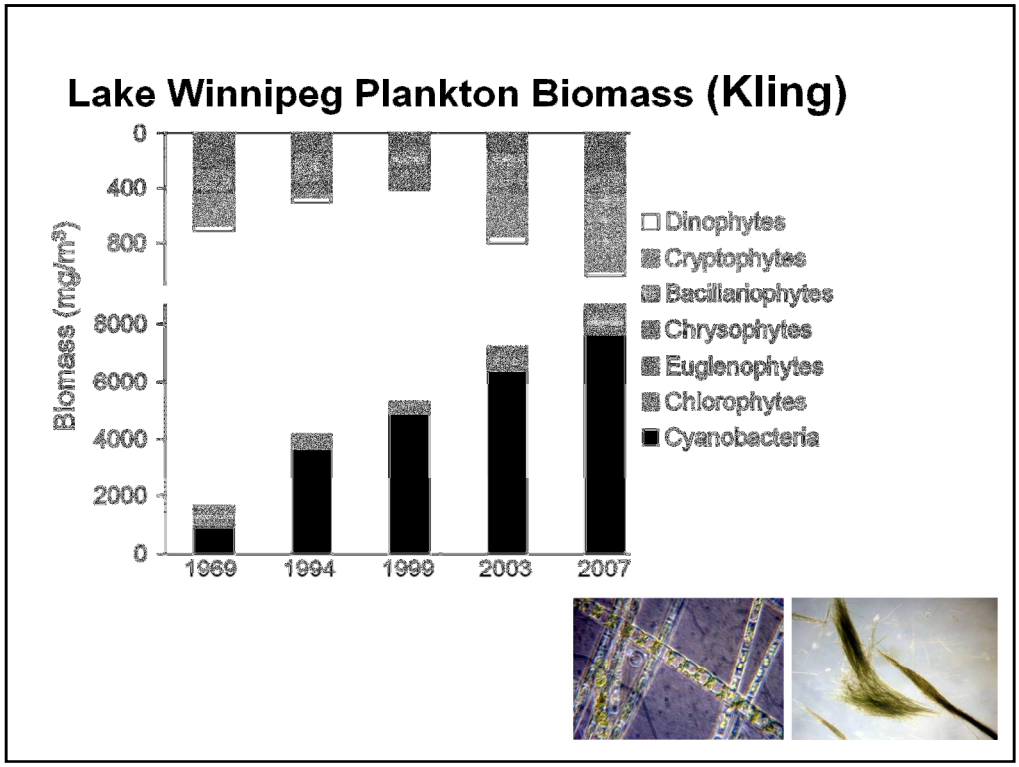


In freshwaters, phosphorus is generally considered to be the limiting factor on algal growth

P in euphotic zone – changes with the seasons

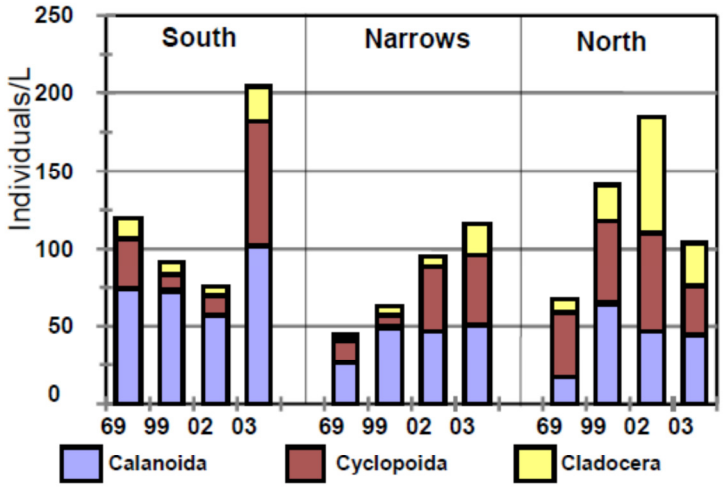


A measure of the algal populations in LW is chlorophyll a – increasing in both the north and south basin



The algal population in Lake Winnipeg has changed – shift to cyanobacteria 'blue-green algae

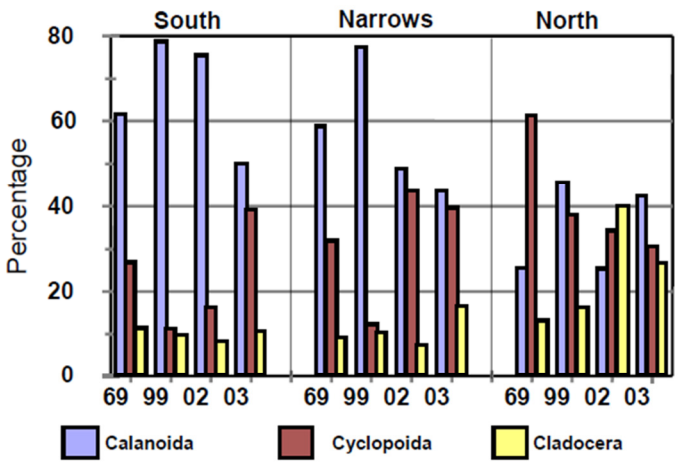
And the quantity of algae have increased as a result of the increased nutrients entering the lake.



Regional, Mid-Summer Abundance of Zooplankton (1969 to 2003)

Salki and Patalas

The zooplankton populations have also grown and the types found have changed in response to the changes in food availability



Regional Zooplankton Summer Community Composition (1969 to 2003)

Salki and Patalas

The south basin is dominated by the Calanoids, whereas the north basin has a more mixed population

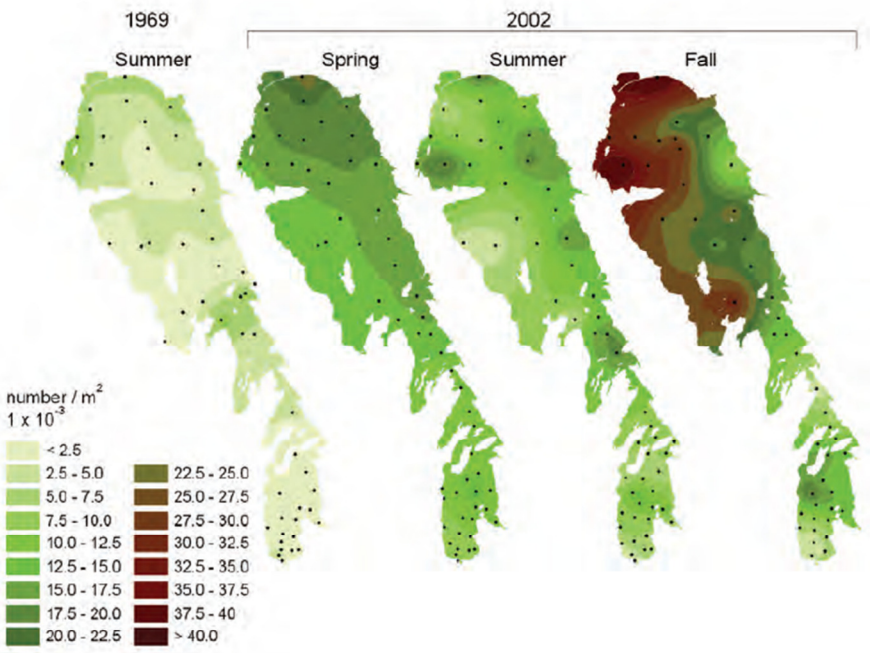


Figure 8.9: *Total density (numbers per m²) of benthic macroinvertebrates in Lake Winnipeg. (Data Source: University of Manitoba, B. Hann)*

And the zoobenthos – the zooplankton living in the bottom sediments have increased, especially in the north basin

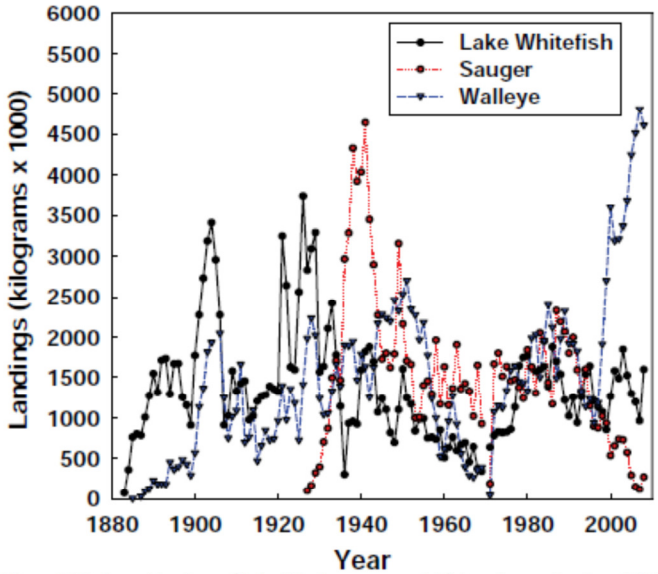
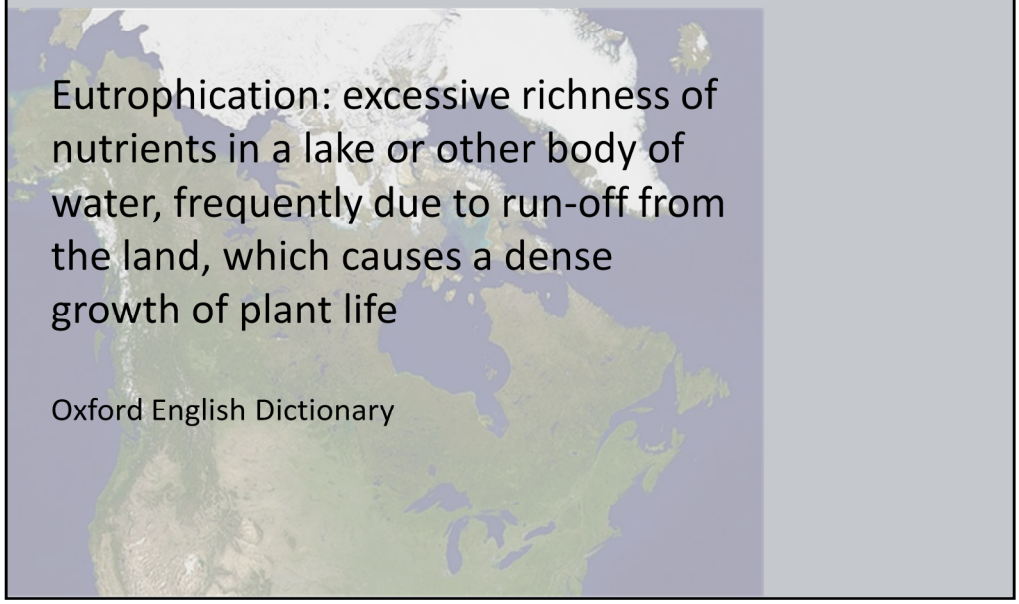


Figure 8.12: Annual landings of Lake Winnipeg commercial fishery by species (kg x 1000). Sauger (Sander canadensis) was not recognized as a species separate from Walleye (Sander vitreus) before 1928. The fishery was closed in 1970 due to high concentrations of mercury in Sauger and Walleye.

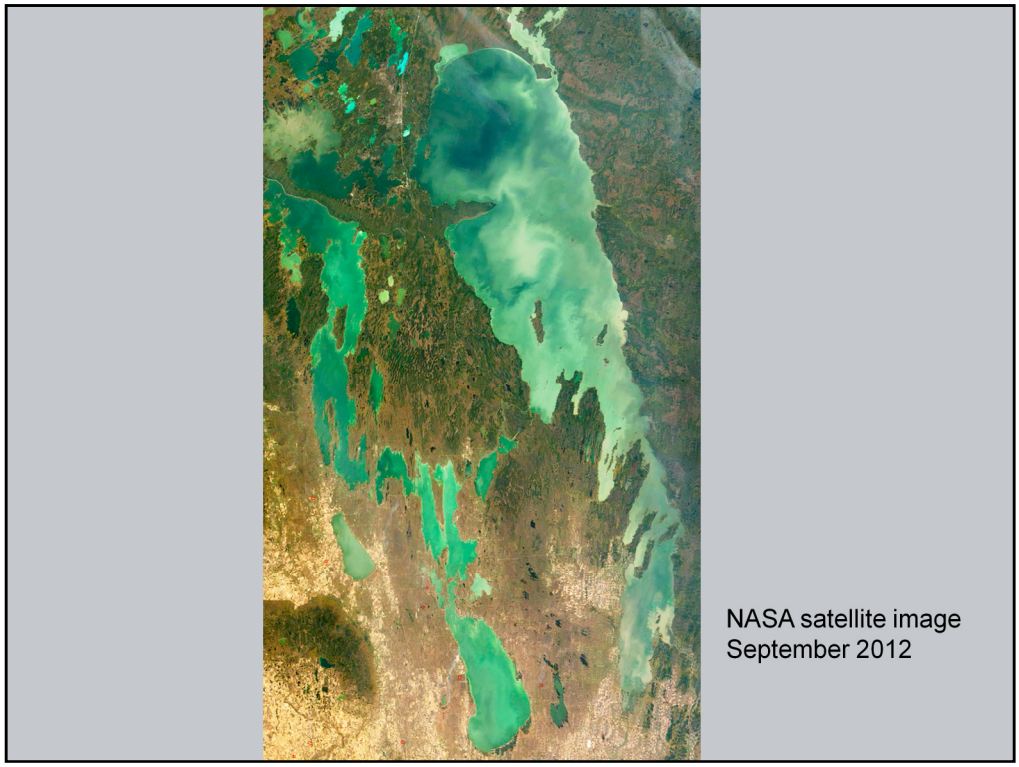
And fish catches show a shift in the fish population.

Have to be wary of fish catch data – dependent on fishers going out, reporting landings and the results are very much dependent on the type of gear and how it is used, and that is likely to have changed over time too.

Eutrophication



Lake Winnipeg is considered eutrophic, or even hypereutrophic in some years



NASA satellite image
September 2012

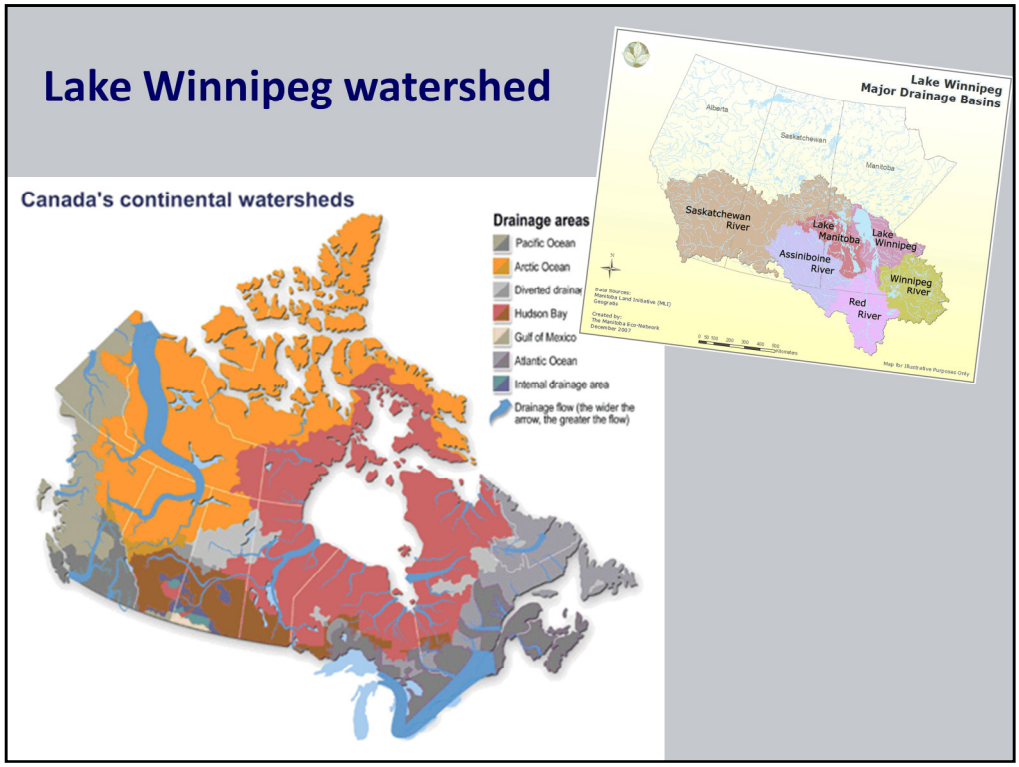
You can see the blooms from space

Government Research scientists raised concerns about the changes in phosphorus concentrations in the lake in 1969, and research at that time from the Experimental Lakes and elsewhere demonstrated the links between changes in algal populations and phosphorus concentrations

In 1974 – the government was being called to take action in press articles

In the late 1990's the Lake Winnipeg Research Consortium began it's program of lake research

In 2003 the Manitoba Government set up the Lake Winnipeg Stewardship Board to make recommendations for action, which they did in 2006



The Lake Winnipeg watershed is part of the Hudson Bay system that flows to the arctic.

The second largest watershed in Canada.

arid to sub-humid climate

runoff dominated by snow-melt

relatively level landscape

home to 7 million people

Drains land from 4 Canadian Provinces and 4 US states, an area of 1,000,000km sq

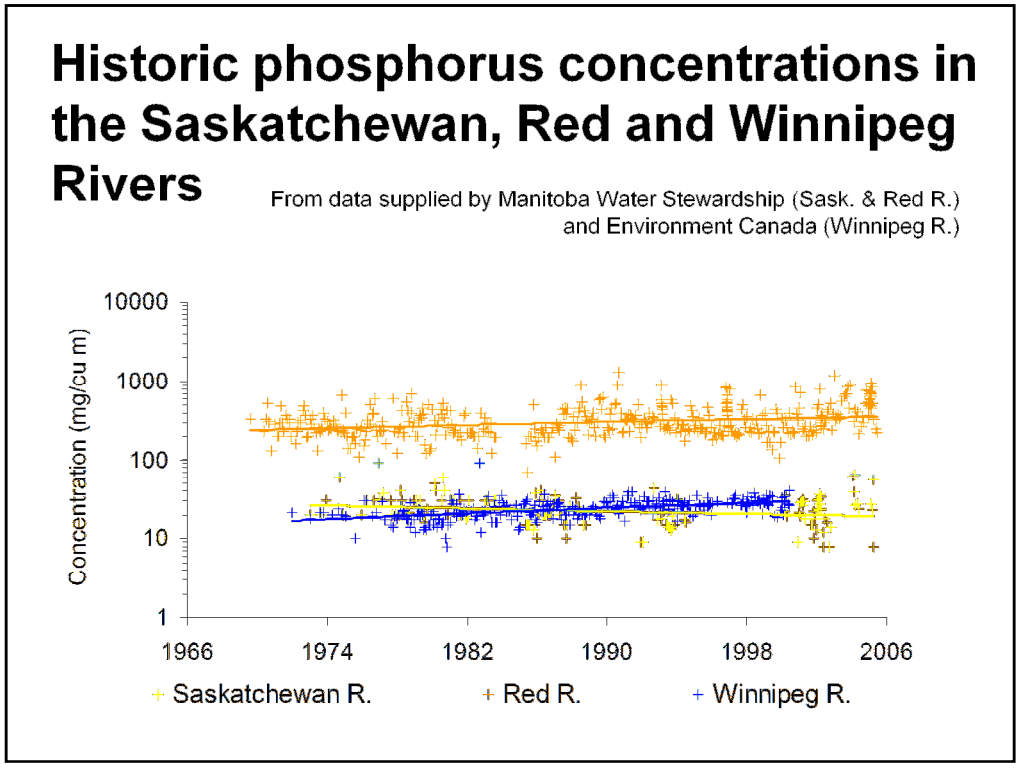
The landscape of the watershed is highly varied.

Shield and boreal forest in the east – the Winnipeg River watershed

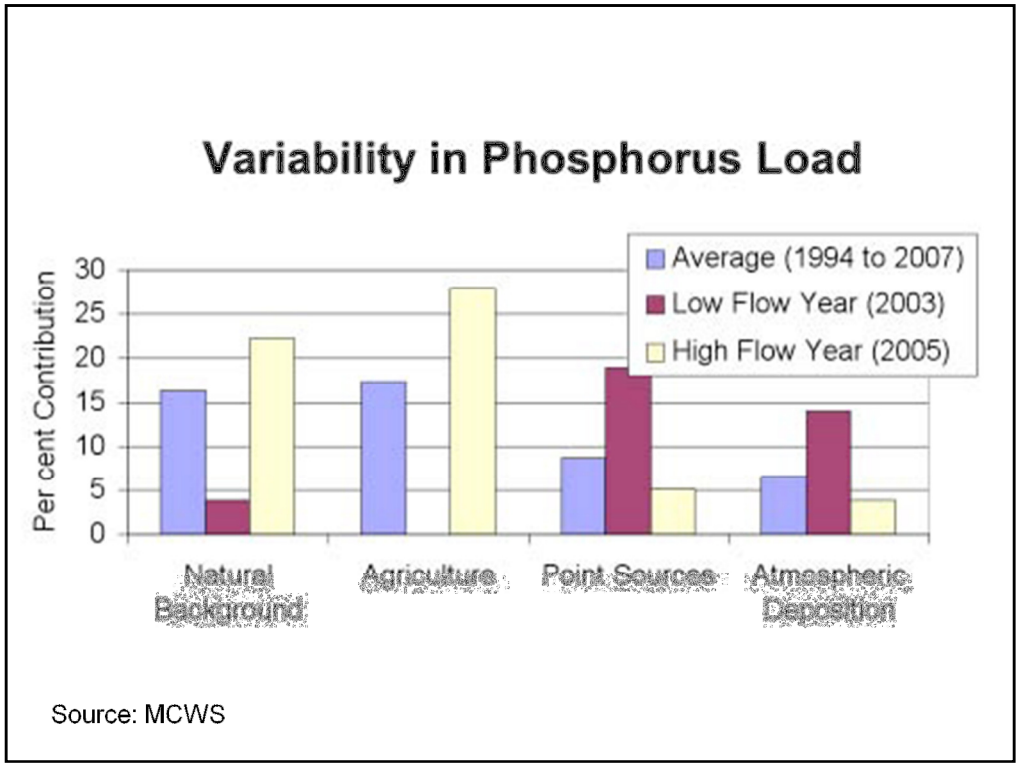
Highly drained, flat meandering Red River that follows the former Lake Agassiz plain

The potholes of much of the River Assiniboine watershed

And the mountains and prairie of the Assiniboine and Saskatchewan River watersheds

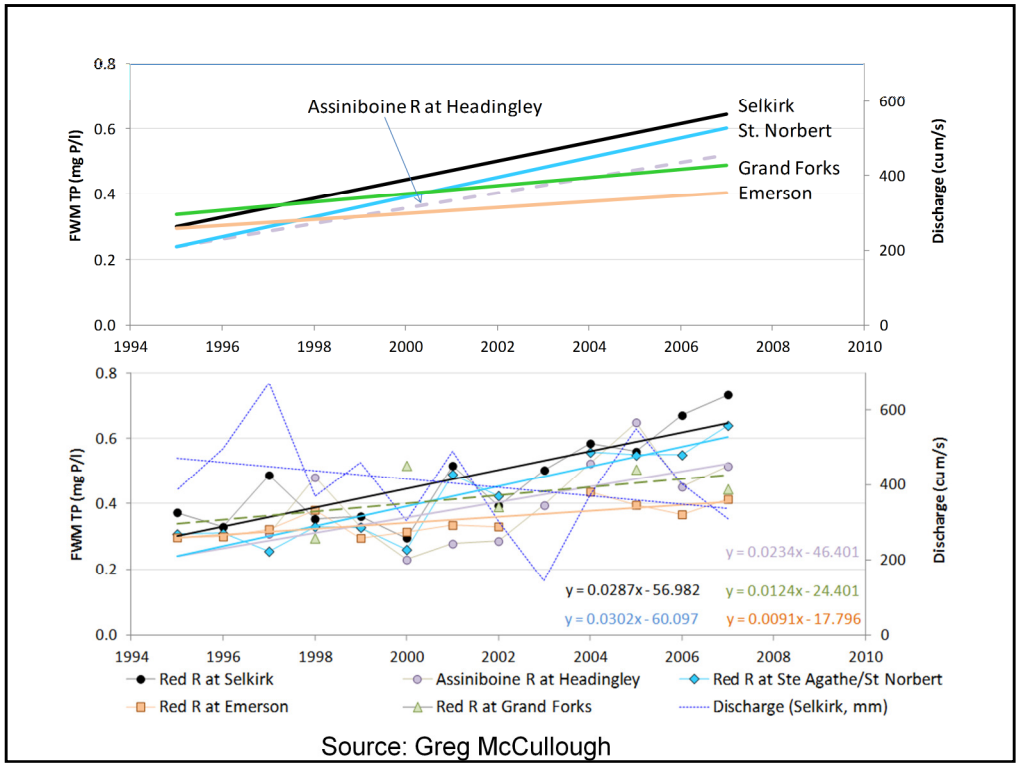


Phosphorus concentrations in the rivers flowing to Lake Winnipeg have been increasing since the 1970's



The estimated contribution of different sources are shown in this graph from MCWS

You can see here, that in high flow years, the contribution of Phosphorus is significantly higher.



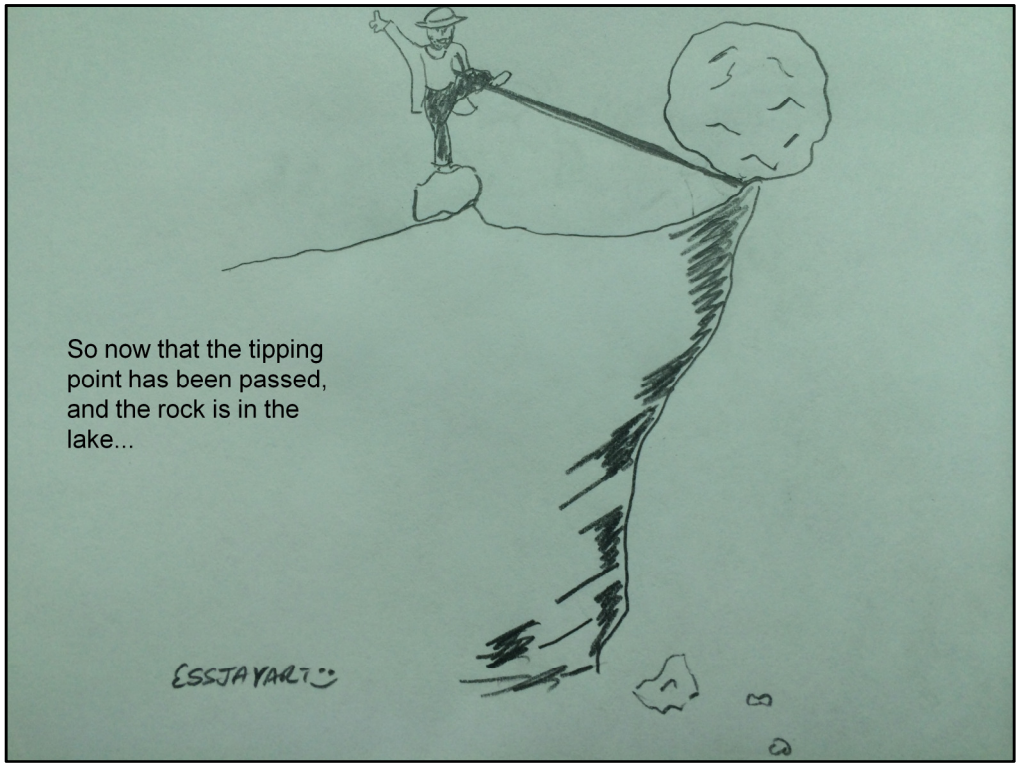
Source: Greg McCullough

And Greg McCullough has made clear link between flow and nutrient phosphorus. Flood events contribute significantly to the loss of phosphorus from land to water.

And as these graphs show – there has been a substantial increase in the flow entering the Lake from the Red River

What's the cause – well that's the problem!

Phosphorus lost from agricultural land, natural areas and from areas where people live are all causing phosphorus to increase


So now that the tipping point has been passed, and the rock is in the lake...
ESSJAYART

Restoring Lake Winnipeg

- Management of external nutrients (from the watershed)

-Turn the clock back to a time when the nutrient loadings were lower and set a target
- Implement a regime of nutrient reductions from man-made sources

The watershed program and a number of researchers from UofM are involved in evaluating beneficial management practices in agromanitoba to reduce the losses of nutrients from farmland

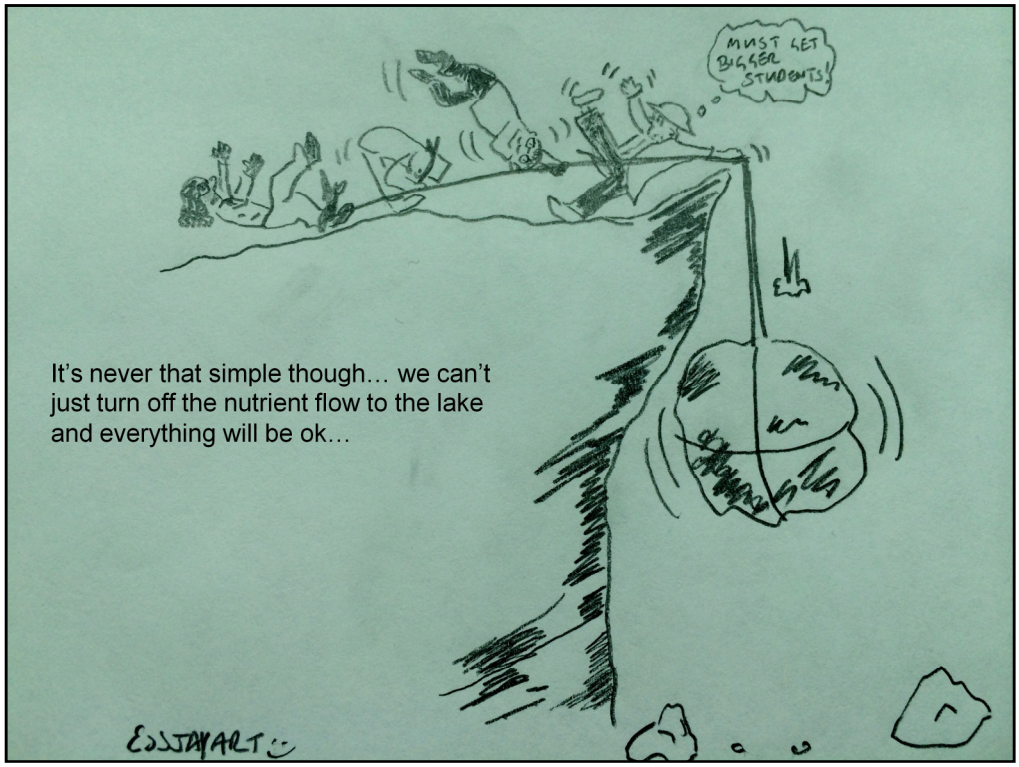
Reducing inputs – nutrient management, planting nutrient efficient crops, the 4 R's approach

Zero tillage

Riparian buffers

Water retention systems

Research is showing that it is not so easy to reduce the losses of phosphorus



Its not so easy

By the time we've put in place the systems to get the rock back up the cliff, things have changed – a tree has grown where the rock came from, the rock has changed shape etc.

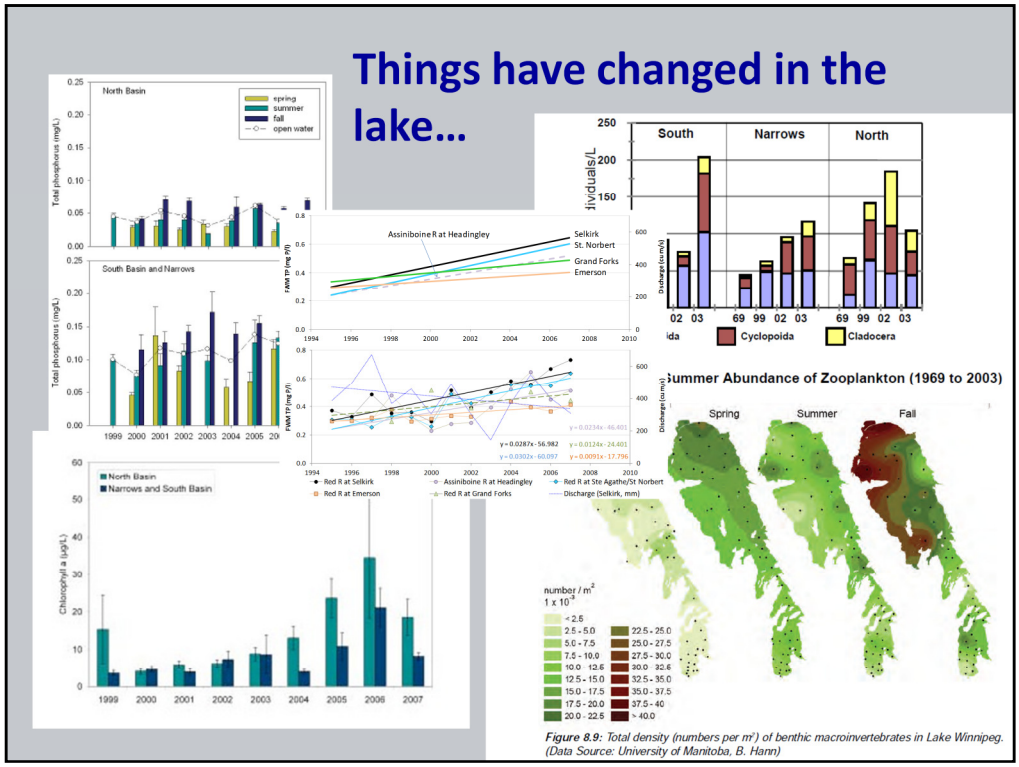


Figure 8.9: Total density (numbers per m²) of benthic macroinvertebrates in Lake Winnipeg. (Data Source: University of Manitoba, B. Hann)

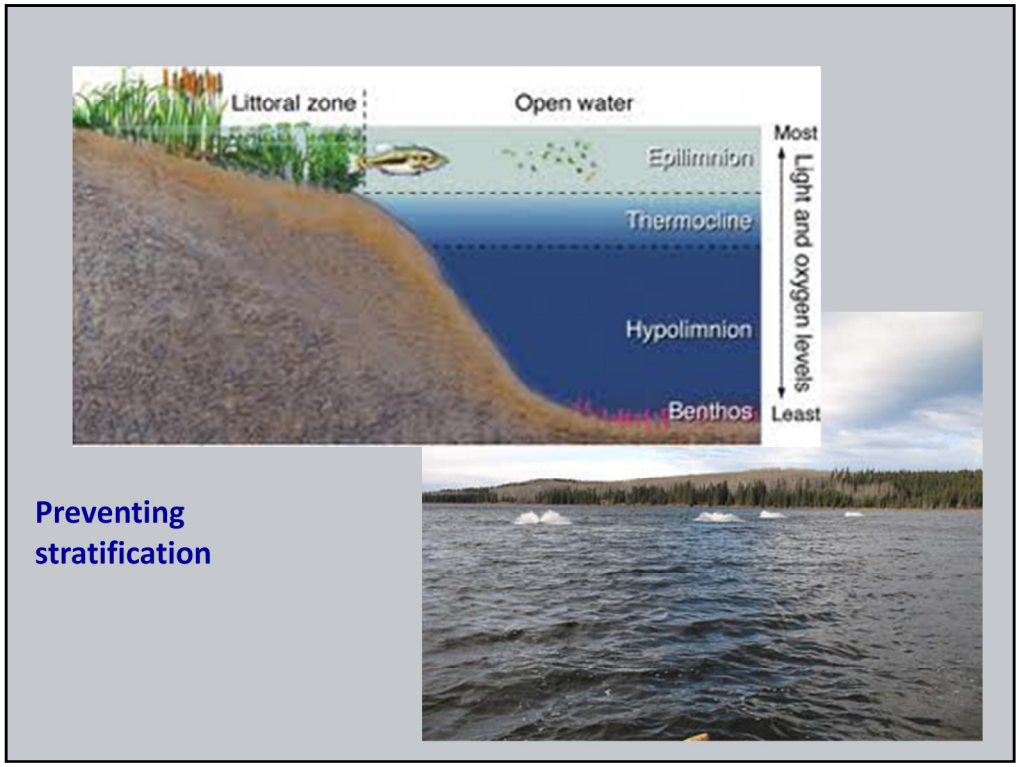
As we have seen, things have changed in the lake

Restoring Lake Winnipeg

• Management of physical and chemical conditions for sediment-water exchange

- Keeping the phosphorus in the sediments
- removing the p-laden sediments

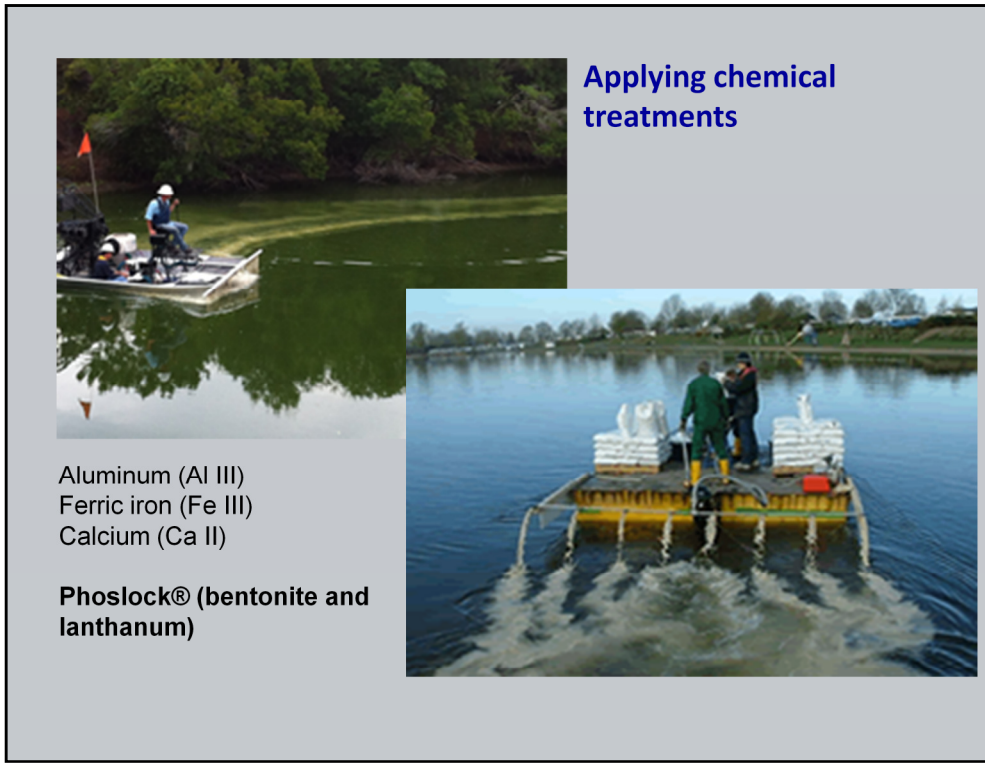
Tricky in a large lake…



Preventing stratification

Lake Winnipeg is generally turbid and well mixed, especially in the south basin

But there have been times in the North Basin when stratification has been observed



There are a variety of chemical treatments that can be applied in water to lock up phosphorus. They have been used in water treatment for many decades where their use is fairly simple.

In lakes, it is more complex.

Aluminum, iron and calcium have all been applied in lakes

But the current trend is Phoslock – and there is a plan to apply this compound in Lake Simcoe in Ontario to deal with the blooms there.

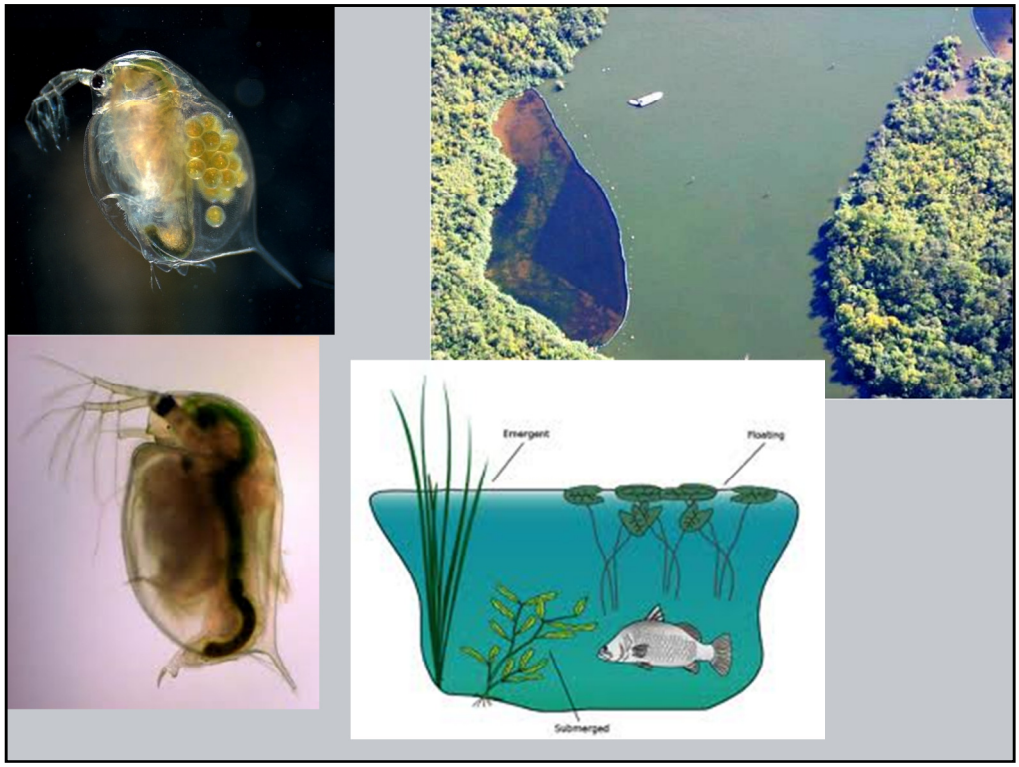
Restoring Lake Winnipeg

- Management of biological processes

- Using the natural populations to control the algal growth

Another option is to use the natural biological systems.

There is some work on this area, led by IISD



Remember these?

Given the right conditions, these gals can keep a lake clear.

What are the right conditions?

Well, they are pretty adaptable and can withstand a range of temperatures, light conditions and even turbidity.

But what they really need are a mix of plant species – emergent and sub-emergent plants to hide from fish,

Floating plants that shade the light from the surface and slow the growth of phytoplankton species such that zooplankton can keep up.

Some potential options

Encouraging shoreline macrophyte communities – reedbeds

Installing floating communities

Removing planktivorous fish – which covers most fish species at some point in their life cycle – top right shows a fish exclusion zone on Barton Broad in UK

Could you do this in Lake Winnipeg?

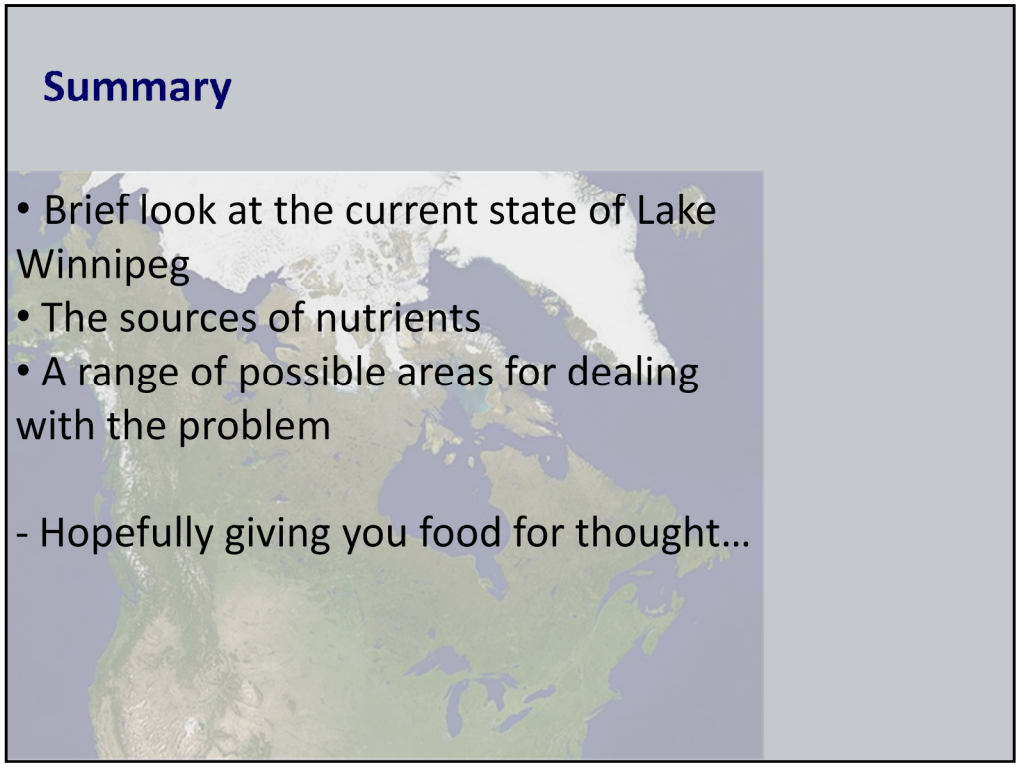
The Netley-Libau project – promotes the use of the natural marshy areas to take up nutrients, and by harvesting the cattails that grow there, the nutrients are permanently removed.

Promoting the growth of shoreline plants around water bodies, will improve water quality during the summer – the plants take up nutrients, and also provide refuges for zooplankton and invertebrates that feed on the algae

Floating reed islands have had some success in Europe – they can be deployed where it is too deep for the marginal plants to establish. Coir mats hold lots of plants whose roots are in the water taking up nutrients. The mats themselves shade the area from light, limiting algal growth and they provide refuges for zooplankton and small fish.

How long would it take?

- Managing external nutrient inputs – decades to hundreds of years
- Managing sediments – decades
- Managing biological processes – a few years



So I have given you a background to the issues in Lake Winnipeg and its watershed

I've given a brief outline of the range of possible solutions.

Like most things, solving the problem is best done in combination

But in all cases, its going to take time – a lot of time for some aspects

So we need to be patient

For more information

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