Biomanipulation for lake restoration

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**Biomanipulation definition**

- Adjusting the biological community (often fisheries) to achieve a desired outcome

- Desired outcome includes
  - Reduced phytoplankton blooms (especially cyanobacteria)
  - Less turbid water
  - Submerged plants for stability
  - Removal of pest species
Food chain

Piscivores (fish eaters)

Planktivores (zooplankton eaters)

Herbivores (plant eaters)

Benthivores (bottom feeders)

Zooplankton (phytoplankton eaters)

Phytoplankton

Plants

Water column nutrients
Changes in shallow, nutrient rich lakes

State A

State B
Acting with nutrient management

State A: Clear, plant dominated

State B: Turbid, algae dominated

Nutrient concentrations

Water clarity

Biomanipulation a tool to help force lake back to state A
Enhancing piscivores?

• Few large piscivores (long fin eel, large perch, brown trout, shag)

• Not suited to turbid shallow lake conditions (e.g. visual predators)

• Populations lag behind prey numbers
**Enhancing phytoplankton grazers?**

- Lack large zooplankton? (exotic species?)
- Vegetation refuge OR reduce planktivorous fish?
- Latter looks promising (Lower Karori Reservoir)
- Silver carp not proven......
- Freshwater mussels as biofilters?
Lake Omapere

Role for mussels in clearing of waters?
Lake Omapere mussels at densities that could filter the entire lake volume within 24 hrs

Lake Rotoroa estimated 6 mussels per m² required for volume and area
= at least 3 million!

Not enough information on mussel recruitment
Reducing coarse fish?

- Fishing pressure required? (i.e. extent, ongoing)
- Feasibility of eradication? (rotenone)
- Anecdotal evidence of success
Lake Rotoroa

Vegetation decline (1989)
Limited plant recovery after 9 years
Perch, catfish, rudd, goldfish & tench

1 ha closed off
Fish reduced by 86% (5115 fish, 451 kg)

Enhanced growth & recruitment of un-caught small fish
Transplanted plants did not establish
Lake Rotomanuka

Vegetation decline (late 1990’s)
Rudd, catfish, goldfish

Light for plant growth to 2-4 m, but plants only to <0.3 m

Fish exclosures to test plant establishment with & without fish access
Native pondweeds added inside & outside exclosures

Pondweeds inside grew to surface within 4 months, none survived outside

Plants disappeared when some exclosures were removed

Exclosure plants still growing & seeding
Lake Serpentine South

Few submerged plants
Rudd, catfish and goldfish present

Sonar trace doesn’t detect plants

DOC & EW fishing reduced rudd population *(DOC data)*
Native pondweeds recovered 4-5 years after fishing began

Seasonally surface reaching & seeding

Repeat sonar trace detects dense, tall beds
Lake Wainamu

Vegetation lost between 1995 and 1999
Perch abundant, goldfish and rudd common

Community group guided by ARC starts
intensive netting to improve water quality

9908 exotic fish removed (ARC data)
Water clarity improved after fishing (ARC data)

Submerged plants recolonised over 2005 to 2007

BUT dominated by exotic weed egeria
Changes in shallow, nutrient rich lakes

Native vegetation  Invasion  Exotic vegetation
Enhancing herbivores?

Grass carp can remove submerged vegetation within 2 years

Difficult to remove, live for 15 years+

Still not widely used in lakes
NZ biomanipulation

- Biomanipulation compliments nutrient management
- Fish control might improve water quality & submerged plants recovery
- Mechanisms?
- Biomanipulation outcomes uncertain, no guarantee

Adaptive management to learn from success & failures?
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