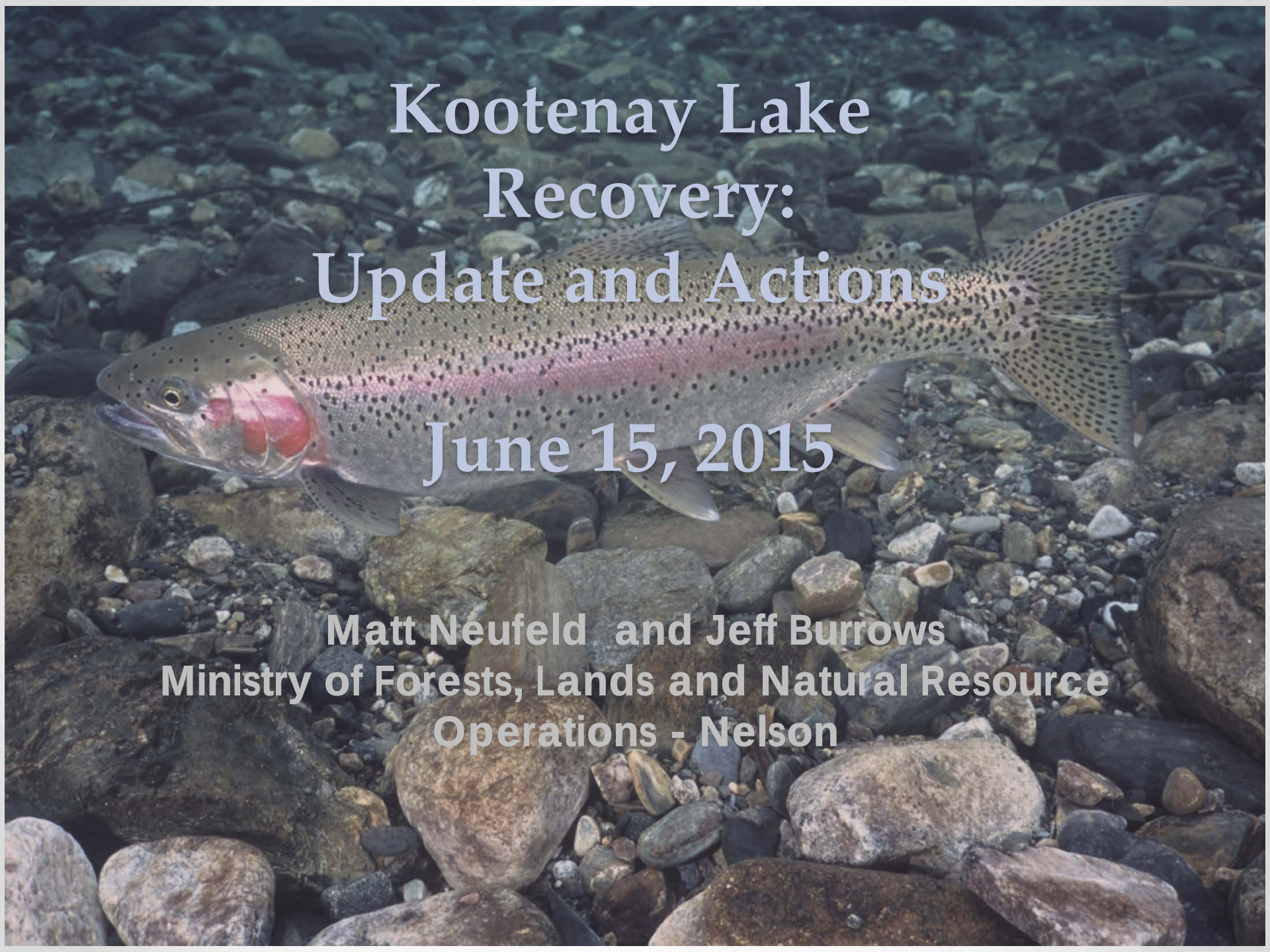


Kootenay Lake Recovery: Update and Actions

June 15, 2015

Matt Neufeld and Jeff Burrows
Ministry of Forests, Lands and Natural Resource Operations - Nelson

Outline

- Recap of Kootenay Lake and February meeting
- Biological and fishery update – new info since February meeting
  - Kokanee fry
  - 2015 Gerrard Spawning
  - Fishery
- Action Update
  - Expert Team and recommendations
  - Actions
  - Monitoring
- Summary, Questions and how to stay informed

Recap of Kootenay Lake Status

- Recent low older Kokanee abundance
- Kokanee fry ~ average abundance
- Recent record high Gerrard trout abundance
- Decreasing Gerrard rainbow trout size and decreasing large trout abundance, degrading condition of trout in fishery
- High abundance of young Gerrard rainbow trout – could increase kokanee recovery time
- Nutrient program continues to produce fish food
- IHN virus remains present – likely not a significant issue currently

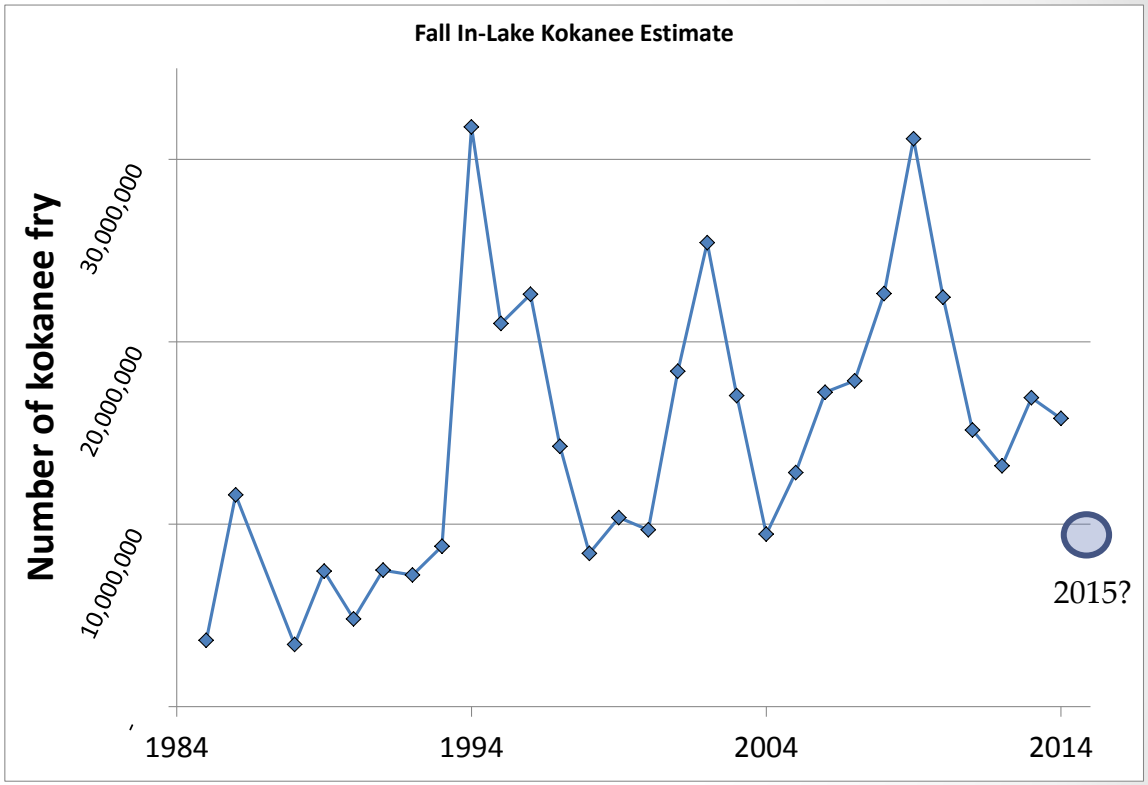
February 2015 - Meeting Outcomes

- Outstanding **written questions** from February Meeting
- Provide a **Sport Fishing Update** on the state of Kootenay Lake
- Form an Expert team, facilitate team meetings and develop an **Expert Team Report** related to Kootenay Lake recovery
- All three are on the Ministry Regional website:
  - www.env.gov.bc.ca/kootenay/fsh/main/mainfish.htm
  - Google "Kootenay Fisheries"

- Ministry **action plan** to speed recovery – summary tonight

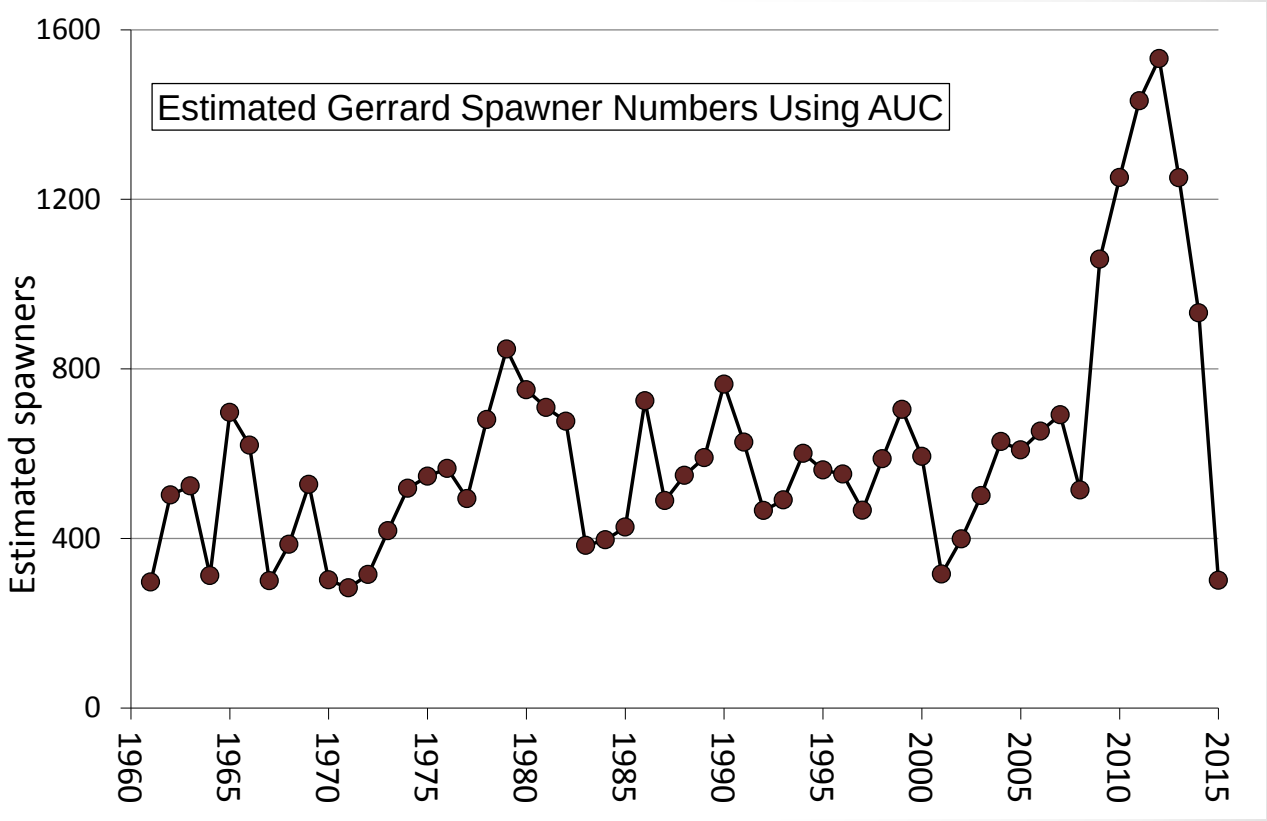
2015 Kokanee Fry Abundance

- Kokanee numbers fluctuate
- Improvements since nutrient restoration
- Fry estimates more than doubled with nutrient restoration and have remained high
- 2014 was post nutrient average and 2015 looking relatively strong
- Egg to fry survival >70%, highest ever recorded
- 7.5 Million fry out of Meadow Creek in 2015, and an additional 3.5 to 5 million expected from Lardeau.
- Likely fall fry estimate of 9 - 10 million (suitable for quick recovery)



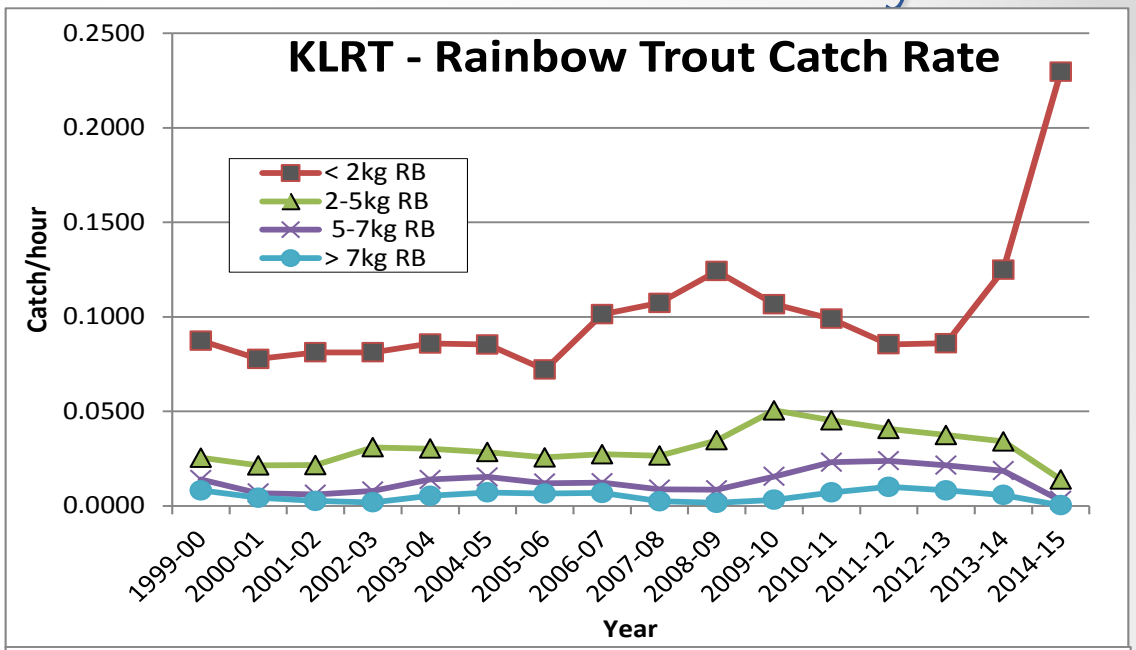
Update - Gerrard Rainbow Trout

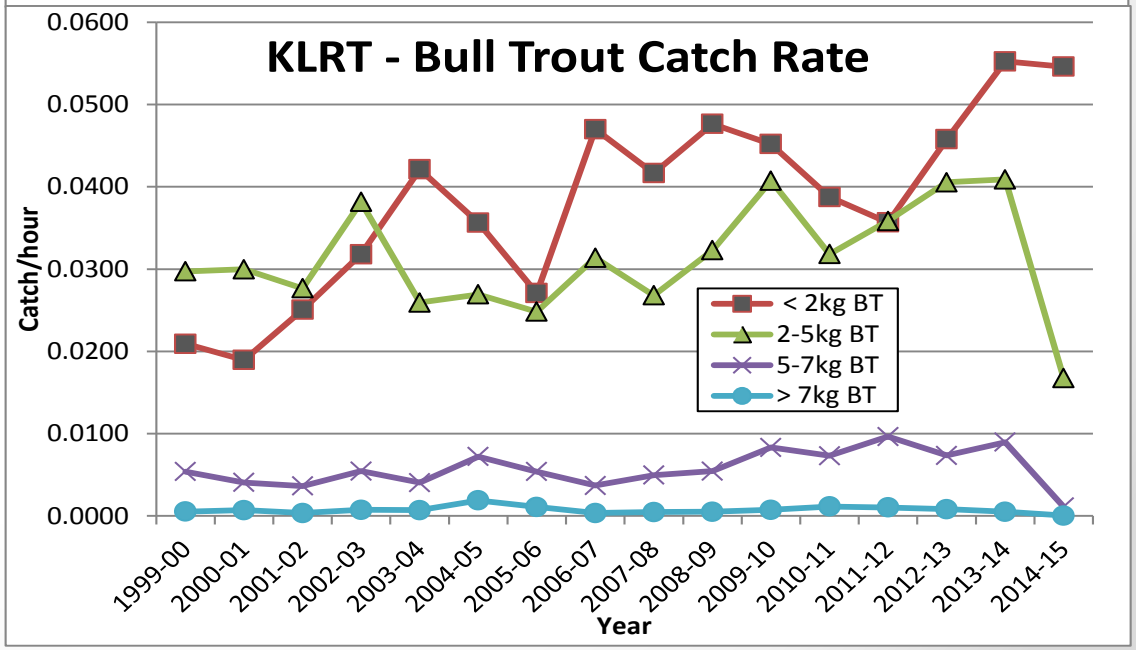
- Spawner estimate in 2015 = 301
- Significant decline from 2014; similarly low in 7 other years since 1960
- Likely high enough to allow continued production of juvenile Gerrards for the next generation
- Although short term impact to angling, a reduction of this magnitude required to help start kokanee recovery



Kootenay Lake Rainbow Trout Survey

- > 50cm rainbow and bull trout catch rates all show decrease in 2014-15
- Small rainbow catch continued increases (~250% higher than average)
- Small bull trout catch level, but very high
- 2014-15 KLRT sales ~5,000
- 2015-16 KLRT sales ~ 75%





Actions - Expert Team

- The Ministry formed a team of fisheries experts comprised of Provincial fish biologists, Freshwater Fisheries Society of BC, the Ktunaxa First Nation, and a BC Wildlife Federation technical expert to discuss all options to speed recovery of kokanee stocks and maintain their numbers.
- Kootenay Lake Fisheries Advisory Team examined **20 actions** to restore a productive and sustainable Gerrard trout fishery.
- Actions considered included options to:
  - 1) as quickly as possible, restore the main lake kokanee population to support a sustainable trophy Gerrard and bull trout fishery, while also providing ecosystem benefits to the lake; and,
  - 2) reduce, on a temporary basis, the predator population, to ensure kokanee recovery.
- Experts prioritized Actions: high, medium, low/long term

Actions – Plan Implementation

- The Ministry will or already has implemented all high and some moderate priority actions identified by the expert team in 2015
- Additional moderate and long term actions in the coming years will only be implemented if needed
- Actions set to implement include short term kokanee supplementation (if spawner abundance drops in 2015) and changes or improvements to the nutrient addition program, spawning channel operations and angling regulations.

Angling Regulation Actions

- Temporary reductions in kokanee harvest and increase in predator harvest has likely benefits for recovery time
- Increases in kokanee survival are required to start recovery

Actions

- **Regulation change**
  - decrease in kokanee quota (0/day) effective April 2015. Could provide 2.5 million extra eggs
  - Daily rainbow quota on the Main Lake increase to 4/day, 1 over 50cm - decreasing juvenile Gerrard abundance has likely benefits for kokanee recovery (50,000 caught in 2014-15, only 16,000 harvested);
  - Reviewing a change to bull trout quota (< 2kg catch very high)

Nutrient Restoration Actions

- Proven performer
- Quick kokanee recovery depends on continued nutrients (food for fish)

- **Action:** Optimization of timing and inputs
  - Increase the length of the nutrient addition period into Fall if environmental conditions are suitable (warm), to increase kokanee overwinter survival
  - Increased monitoring and continued consideration of natural variability and climatic events (flow, temperatures and natural nutrient inputs) will ensure nutrient additions are managed to best move up the food chain.

Kokanee Supplementation Actions

- Temporary infusion of kokanee through supplementation has likely benefits for recovery time, if natural production drops below 2014 levels
- Increases in kokanee survival are required to start recovery

Actions

- **Fry Stocking**
  - 95,000 kokanee fry were stocked in May 2015 into Crawford and Hendryx Creeks (FFSBC, FLNR, Eastshore Freshwater Habitat Society)
  - An additional 500,000 for Spring 2016
- **Eyed Egg Plants**
  - Requested 5 million "eyed" kokanee eggs Fall 2015 and plant to Meadow Creek Spawning Channel and/or suitable Kootenay Lake tributary

Spawning Channel Actions

- We will continue to limit IHN virus at spawning channels where we have some control
  - carcass removal
  - flushing
  - summer drying
  - kokanee testing will continue annually
- Continued improvements to operation and maintenance procedures

Review and Modelling

- Expert team work will continue
  - Review in-season data when available as a trigger for recommendations to the Province around recovery actions;
  - Assist in analysis/modelling to understand predator/prey dynamics in the lake and better inform future management decisions

What else may be done?

Moderate priority:

- Make additional areas of Kootenay Lake fishable by removing angling closures (longer term; 2017-19 synopsis review).
- Change regulation on number of rods that anglers can have in the water at one time – allow 2 or more rods per person (not a Regional decision, will recommend to Provincial Committee).
- Investigate opportunities to increase entrainment of kokanee past Libby Dam (likely no feasible options).
- Test kokanee from trawl samples for IHN virus (exploring potential of historic samples to inform future actions)
- Research feasibility and benefits of Mysid harvest (medium term, necessary to act if mysid abundance increases)

Low priority or long term potential but no immediate benefit to short term recovery:

- Conduct stream habitat improvements to benefit kokanee spawning.
- Conduct mysid harvest if required in future

What are we not doing currently?

Moderate priority:

- Allow guides by Scientific Collection Permit to collect additional Gerrard trout for biological sampling and kokanee predator reduction (not client consumption).
- Remove bull trout in spawning tributaries.

Low priority or long term potential but no immediate benefit:

- Tag Gerrard trout with floy tags, and have a lottery style reward for fish harvested.
- Reduce Kootenay Lake rainbow trout licence to $0.
- Reduce Gerrard trout in Lardeau River or at Gerrard.
- Transplant kokanee fry or eggs from Meadow Creek to another Kootenay tributary.

Monitoring

- How we know our actions are working:
  - Kokanee abundance – spawners and in-lake
  - In-lake kokanee survival (likely first indication of recovery)
  - Fishery results – participation, trout kept and released
  - Gerrard spawner numbers
  - Bull trout spawner numbers
  - Zooplankton and Mysis abundance
  - Meadow Creek spawning channel performance (kokanee size, fecundity, egg to fry survival rates)
  - Looking for improvement in all of these, though with the right timing (kokanee before trout)

Questions and Updates

- **Looking to keep you informed and answer questions as we implement and further develop actions**
  - If you want to know more: answers to common questions, information on current monitoring and updates around ongoing actions are and will be here:
  - www.env.gov.bc.ca/kootenay/fsh/main/mainfish.htm
  - Google “Kootenay Fisheries”

- Contact info
  - Jeff.A.Burrows@gov.bc.ca
  - Matt.Neufeld@gov.bc.ca

How Long Until Recovery?

- Recovery time hard to predict because of uncertainty in predator response
- Best case – Less than one kokanee generation (~2 years)
  - We currently have the building blocks for quick recovery - fry production (15 million in 2014, ~10 million in 2015?) and young Gerrard abundance (highest ever KLRT catch)
  - Potential upturn in kokanee spawners by 2017 and concurrent stabilization in Gerrard catch rate and size
  - Requires an increase in kokanee survival rates, and a corresponding strong reduction in predator abundance (currently underway)
- Worst Case – two kokanee generations or more (8+ years)
  - If predator numbers are slow to drop off and young Gerrards exert additional pressure on depressed kokanee stocks

Other questions

- 2015 contingencies for low flows, temperatures
  - Meadow never a problem
  - West Arm – July fishery closed
  - Less handling
  - Access to tributaries

- Pikeminnow
  - eat some kokanee (up to 50% of diet for the largest fish)
  - part of the fish community that benefits from kokanee
  - unlikely that pikeminnow or other non-game fish are contributing in a significant way to recent kokanee mortality increases
  - There is an unlimited daily quota for non-game fish, but we can't definitively say if additional harvest would be beneficial at a full lake scale.
  - reviewed our fish monitoring (eg trawl) not adequate so we don't know, can review if no turnaround

How you can help

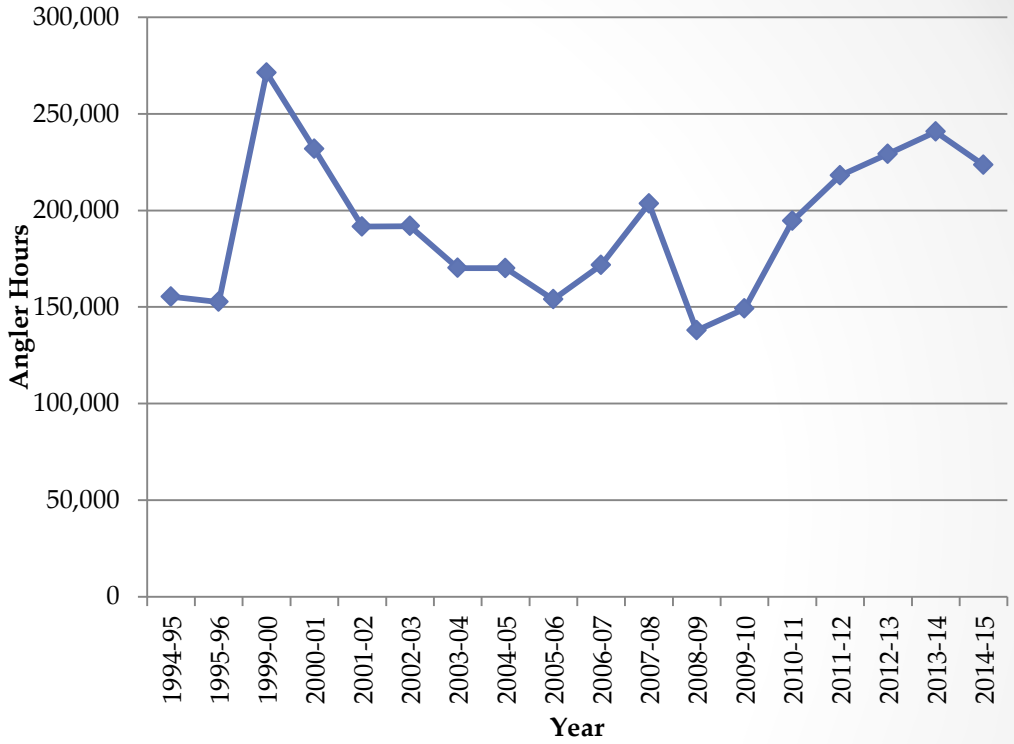
- Stay informed
- Participate in Angling
- Join and help local NGOs

Why not act sooner?

- Kokanee and Gerrard rainbow trout numbers have fluctuated significantly over the last 50 years, sometimes high and sometimes low.
- In fall 2011, kokanee numbers were nearly the highest ever recorded, and in spring 2012, Gerrard numbers were the highest ever recorded at the spawning grounds.
- At the time, this was good news for anglers and Gerrards which consume kokanee.
- Kokanee spawner numbers started to decline in 2012, as did Gerrards in 2013.
- This trend was part of what would be expected given previous cycles in population abundance for both fish.
- Questionnaire lags fishery by > 1 y, fishery anecdotes led to concerns late 2013, through 2014
- Although declines in abundance were underway in 2012, it was not until 2014 that both data on Gerrard spawner abundance (June 2014), kokanee spawners (October 2014), and in lake kokanee abundance (January 2015) were lower than what would have been expected given previous lows in predator prey cycles.
- Addressing virtually immediately

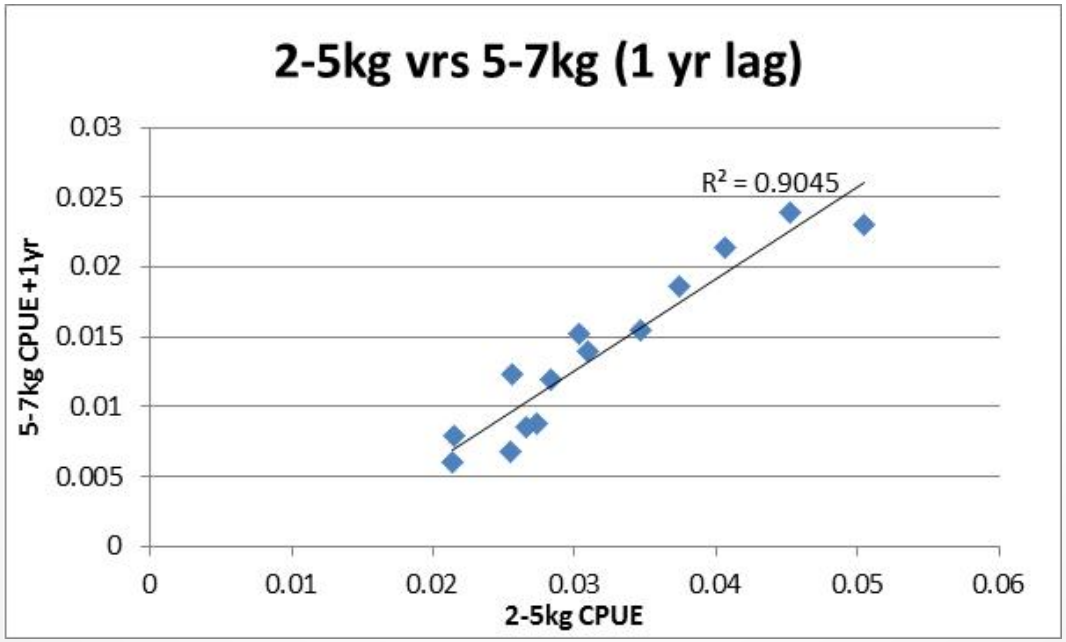
Kootenay Lake Rainbow Trout License Sales

- 2014-15 sales high (~5,000),
- 2014-15 effort remained high, likely drop in 2015
- 2015-16 sales ~75%??
- Angler harvest low despite high effort (~13%; harvest likely not driving current change in abundance)



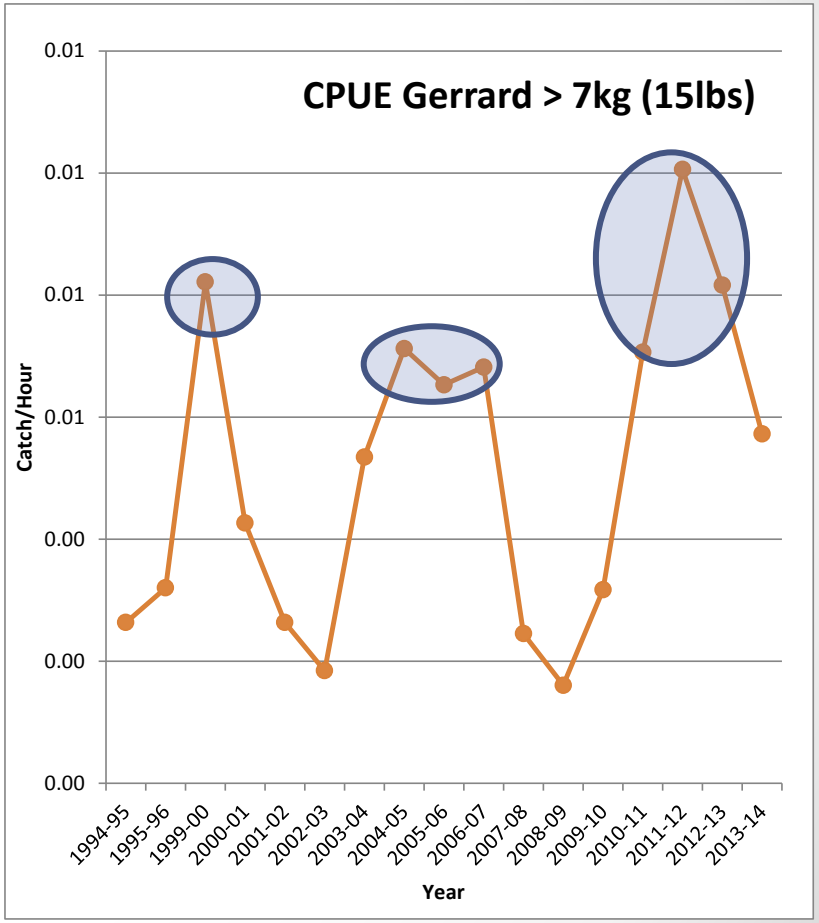
KLRT Creel Survey Comparison

- KLRT vs Creel: effort estimates – **within 0.5% of each other** (Creel 46,053; KLRT 46,311angler days)
- >50cm BT and RB catch and harvest – **1.5 to 2x higher in KLRT** – likely reflects survey bias that is well recognized including anglers that do not report if they did not catch, recollection bias as creel completed on day of catch (with harvest in hand) and survey up to 1.5yrs latter, anglers reporting boat catch not personal catch and other (creel survey a valuable reference point to correct for survey bias)
- Year to year predictive power is internally consistent - KLRT catch rates by size class in one year predict future catch rates of larger fish, so useful index of abundance and fishery performance



Where are the Really Big Fish (>25 lbs)

- Was happening well before current pred:prey mismatch
- Catch data not suitable to differentiate big (>15lbs) vs very big (>25lbs).
- Peaks in the past (small numbers) but not since mid 2000's.
  1. Natural mortality plus angler harvest removal at high enough rate for none to make it to > 25 lbs (need to get >8yrs old).
  2. Large fish corresponded in past with Gerrard peaks, but latest peak 2x past peaks, so competition with each other may have been strong enough to limit size
  3. Adequate prey size not available for the very biggest (energetics poor if kokanee size is small for very largest fish?).
  4. Genetic Selection – anglers preferentially remove the largest fish
  5. Combination of some of the above.



Worms in Fish

- Worms reported by anglers are "**broad fish tapeworm**", native to Kootenay Lake
- Larvae infect both freshwater and marine fishes, and are **always present** in the Kootenay Lake rainbow population at some level.
- There is **no practical way of controlling parasites** in wild fish populations. For anglers, the key consideration is care in the preparation of your catch prior to consumption.
- Tapeworm eggs are excreted in the feces of **animals hosting the adult tapeworm (fish-eating birds or mammals)**, develop in water into larvae that work their way through the food chain and eventually into fish.
- **Heavy infestations of these larval tapeworms could kill some fish**, especially those an already weakened condition, such as older fish, malnourished fish, or post-spawning migrants that are just returning to the lake.
- **Parasite loads fluctuate**. Although more trout appear to be affected by these parasites now than in the recent past, some anglers and retired fish biologists recall relatively high levels of parasites in past decades.
- We don't know for sure why these parasites are more common at some times, but this cycle is common in other populations

Impact of Proposed Regulation Changes

Gerrard Rainbow Trout

- annual small rainbow catch is 10,000-15,000 fish, and only 25-30% harvested
- **Anglers can help:** there is potential to reduce the young Gerrard population by as much as 10,000 fish in one year if all fish were kept.
- For perspective, total production of 1 year old Gerrards annually is ~20,000, which decreases by the time they enter the fishery. **Anglers catch and could keep almost one entire year class of juveniles in one year.**

Kokanee

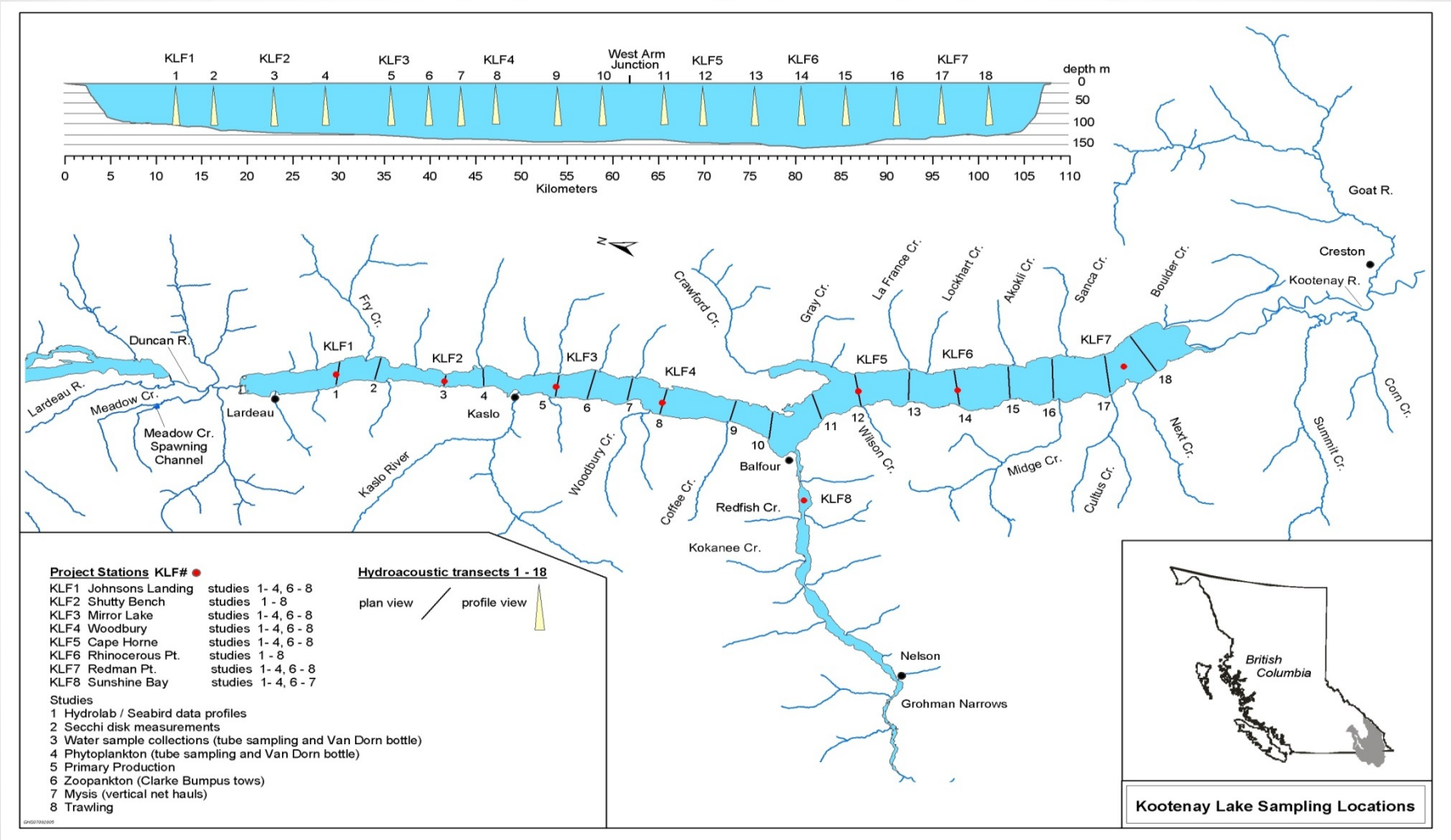
- measurable increase in egg numbers from 0 harvest. The estimated gain could be ~10% or more in 2015.

Assumed potential harvest under 15/d limit = 10,000KO		
limit	harvest	number of extra eggs to MC
0	0	2,500,000
2	6125	968,750
5	9125	218,750
15	10000	0

Nutrients – why not stop South Arm?

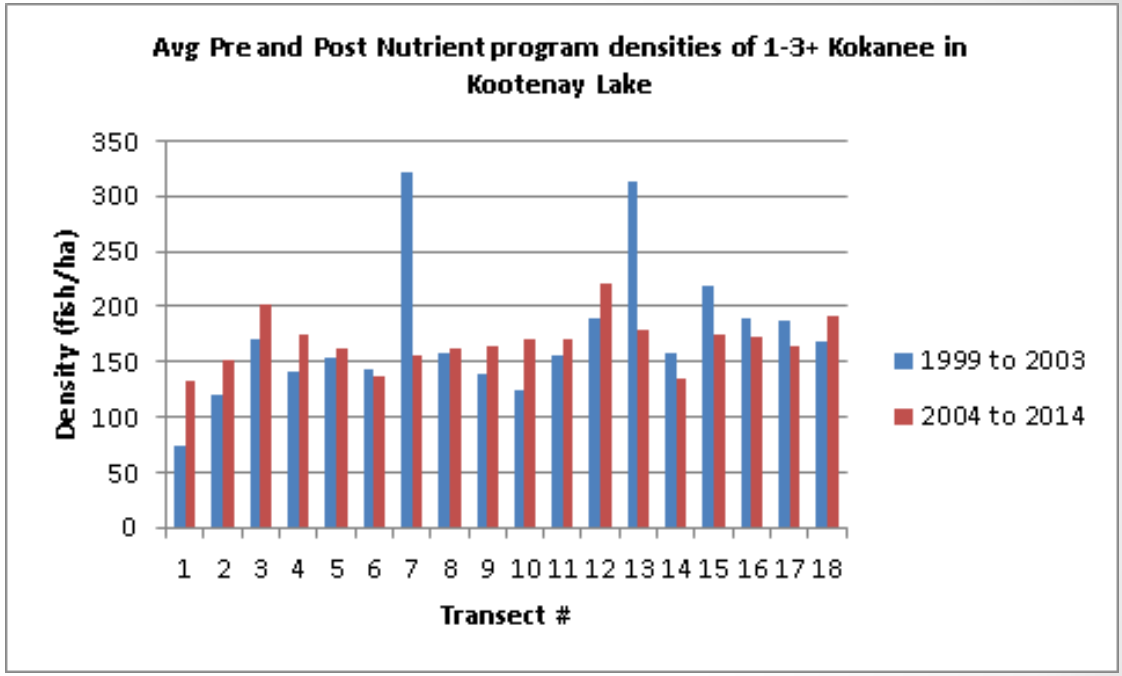
- Following slides
- North and south results prove food increase
- Currently not too much…..compare to Cominco

Kokanee Distribution

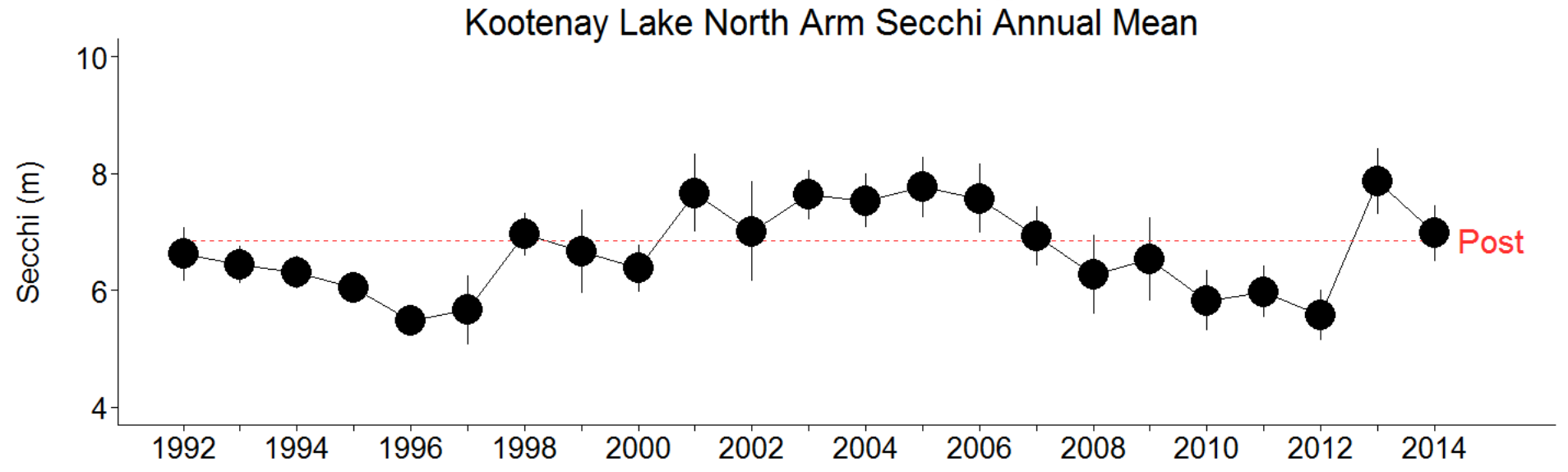


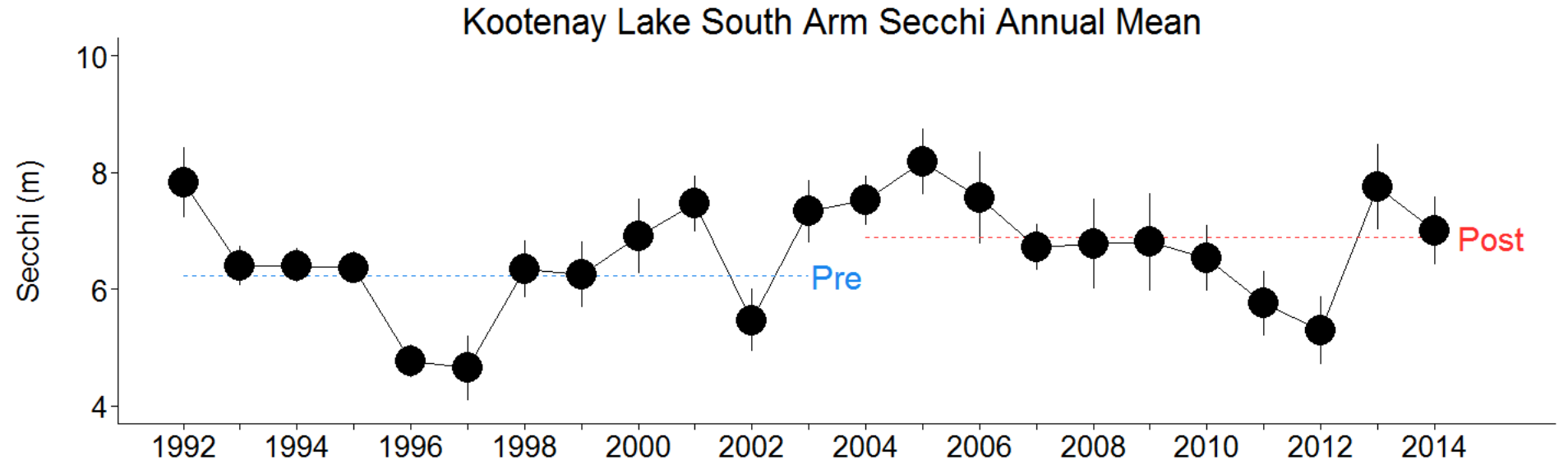
Kokanee Distribution

- Density of kokanee higher after south arm nutrients
- No significant change in distribution, with high densities at all transects in both the north and south arms

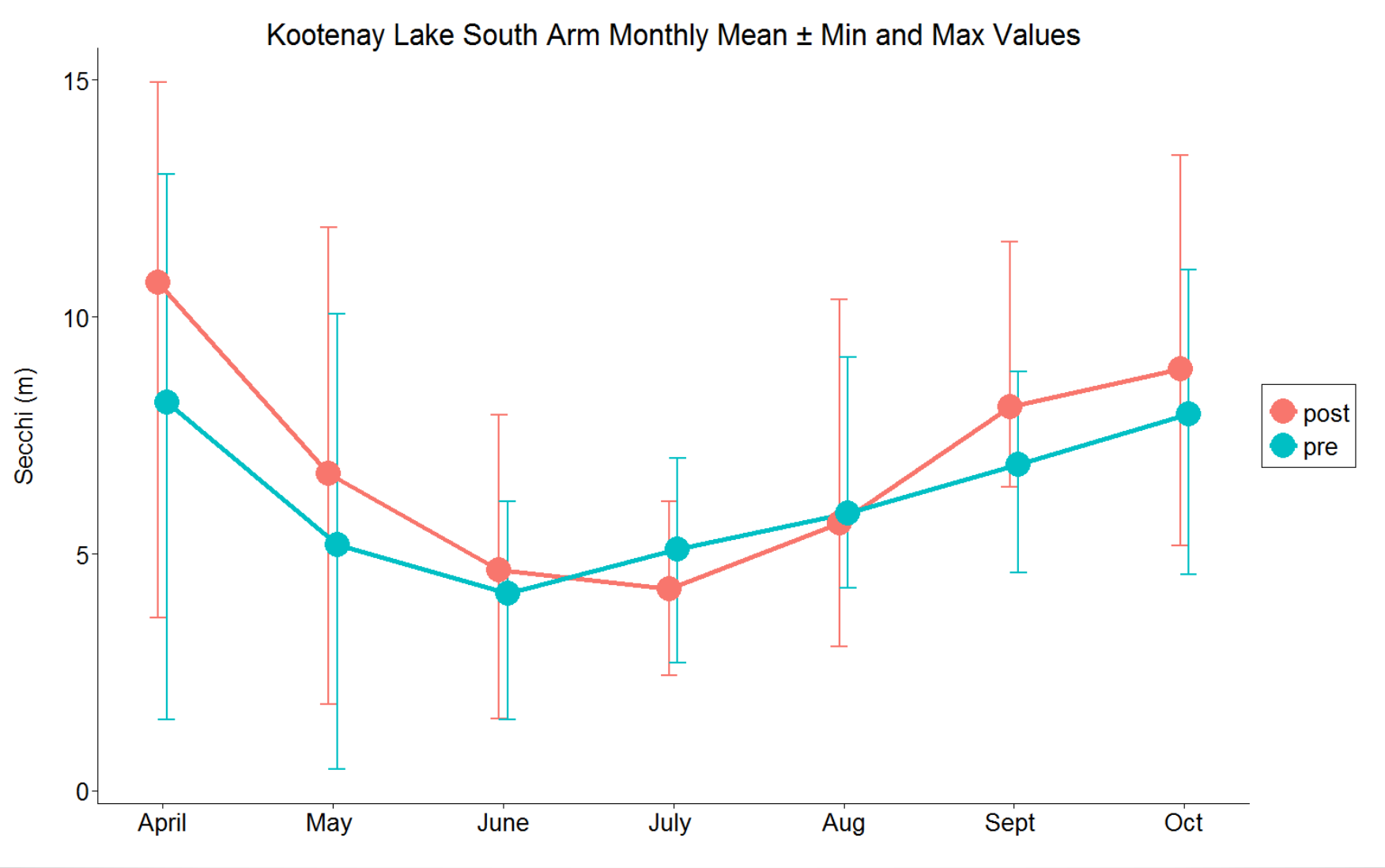


Secchi – measure of transparency

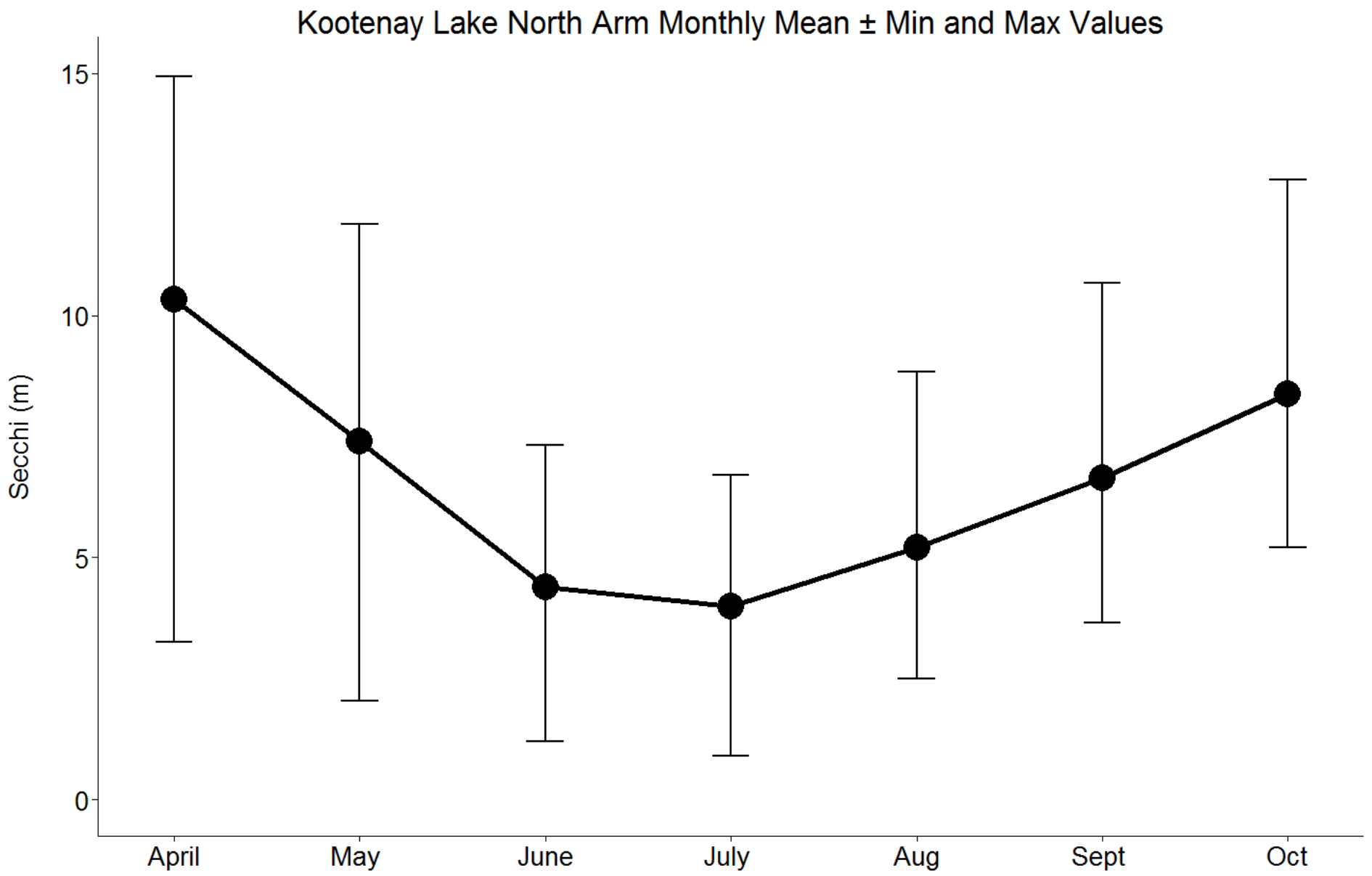




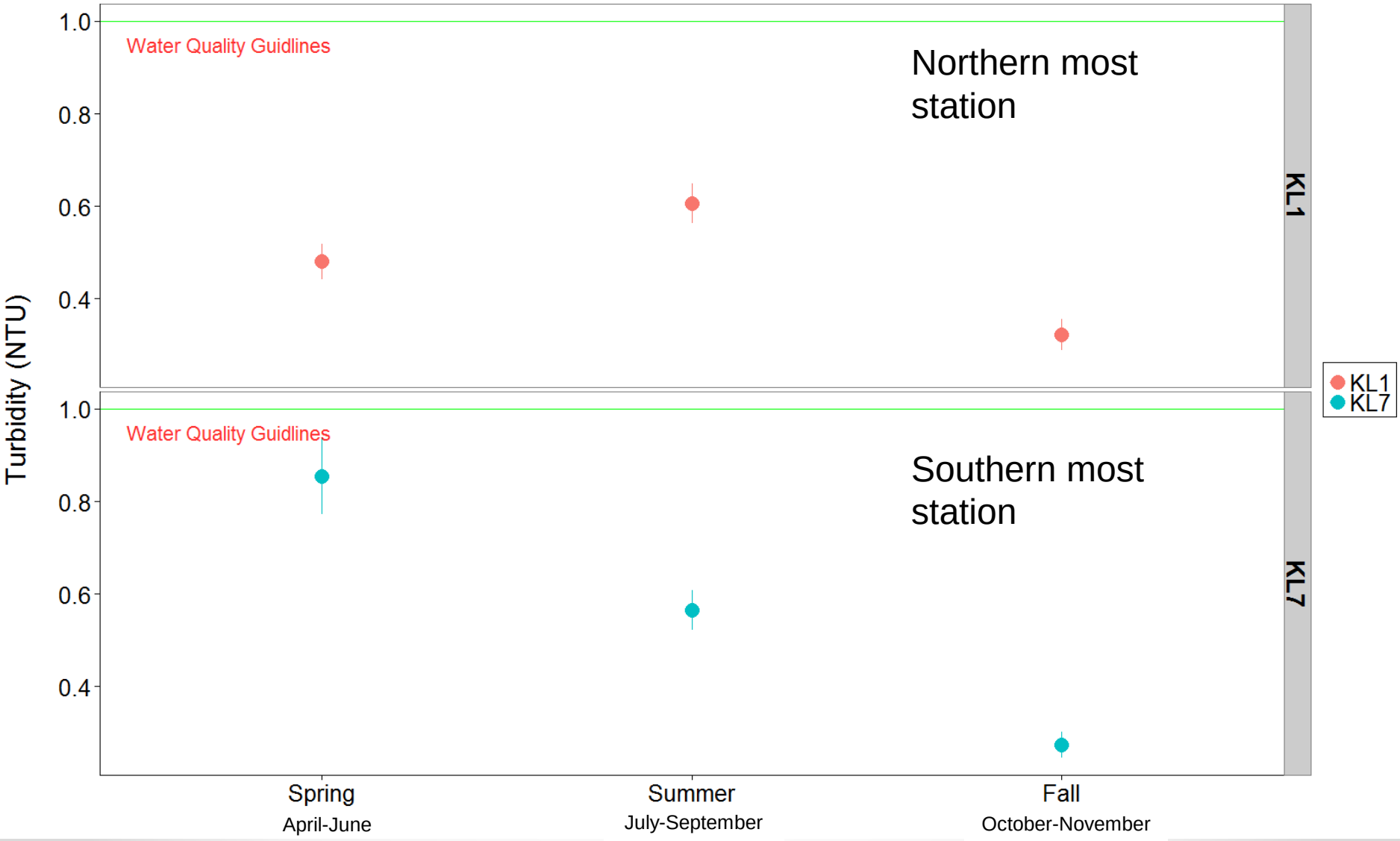
South Arm Secchi



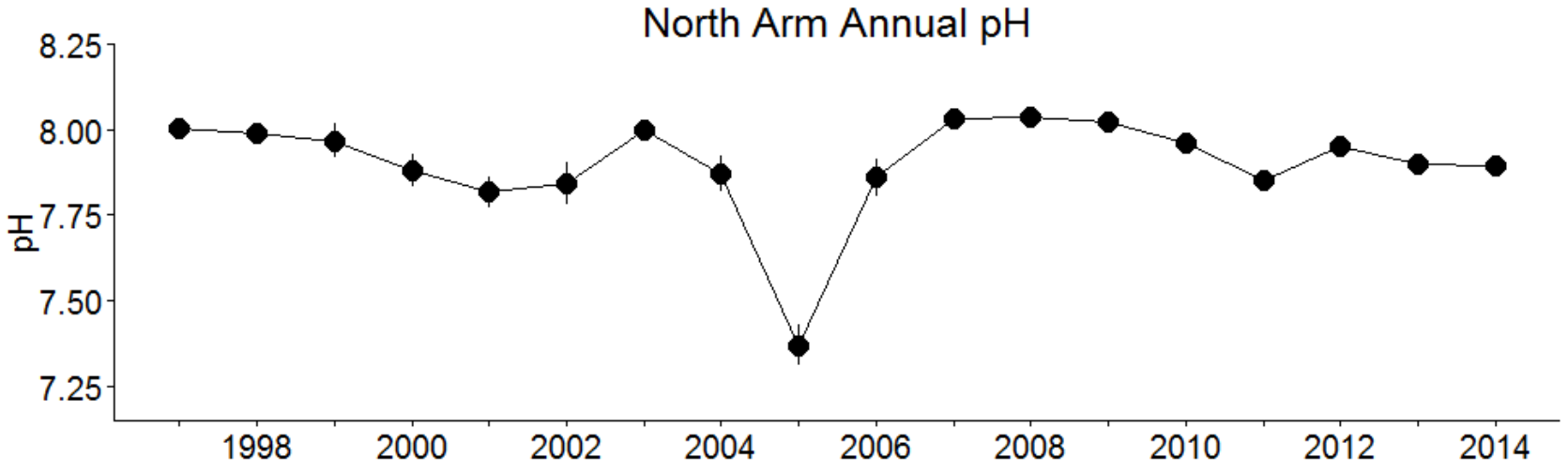
North Arm Secchi

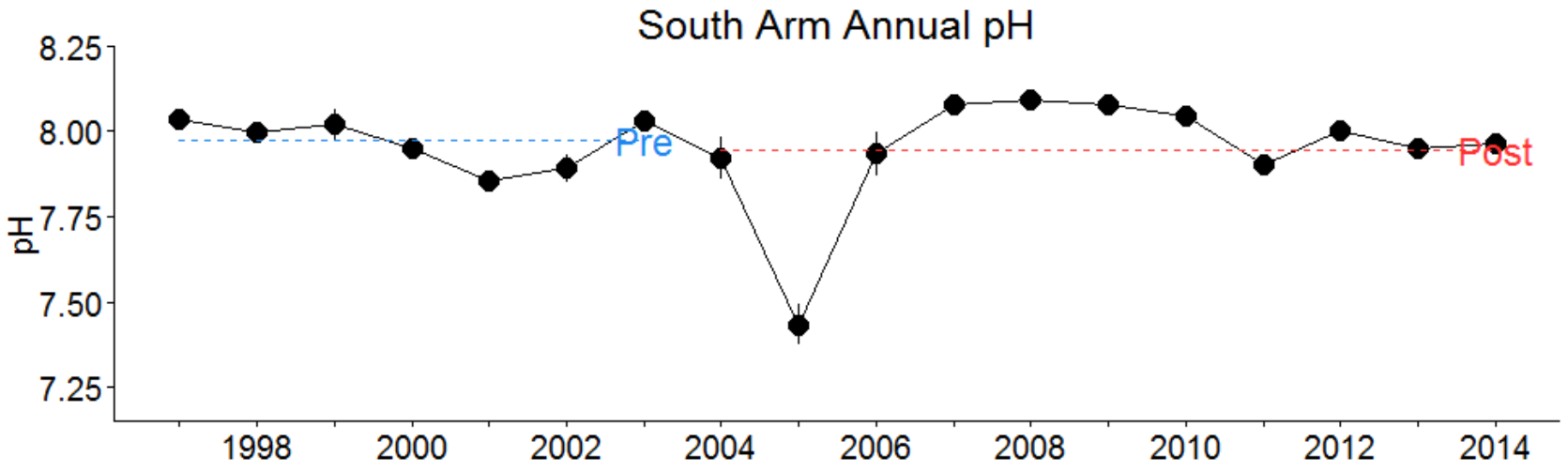


Turbidity

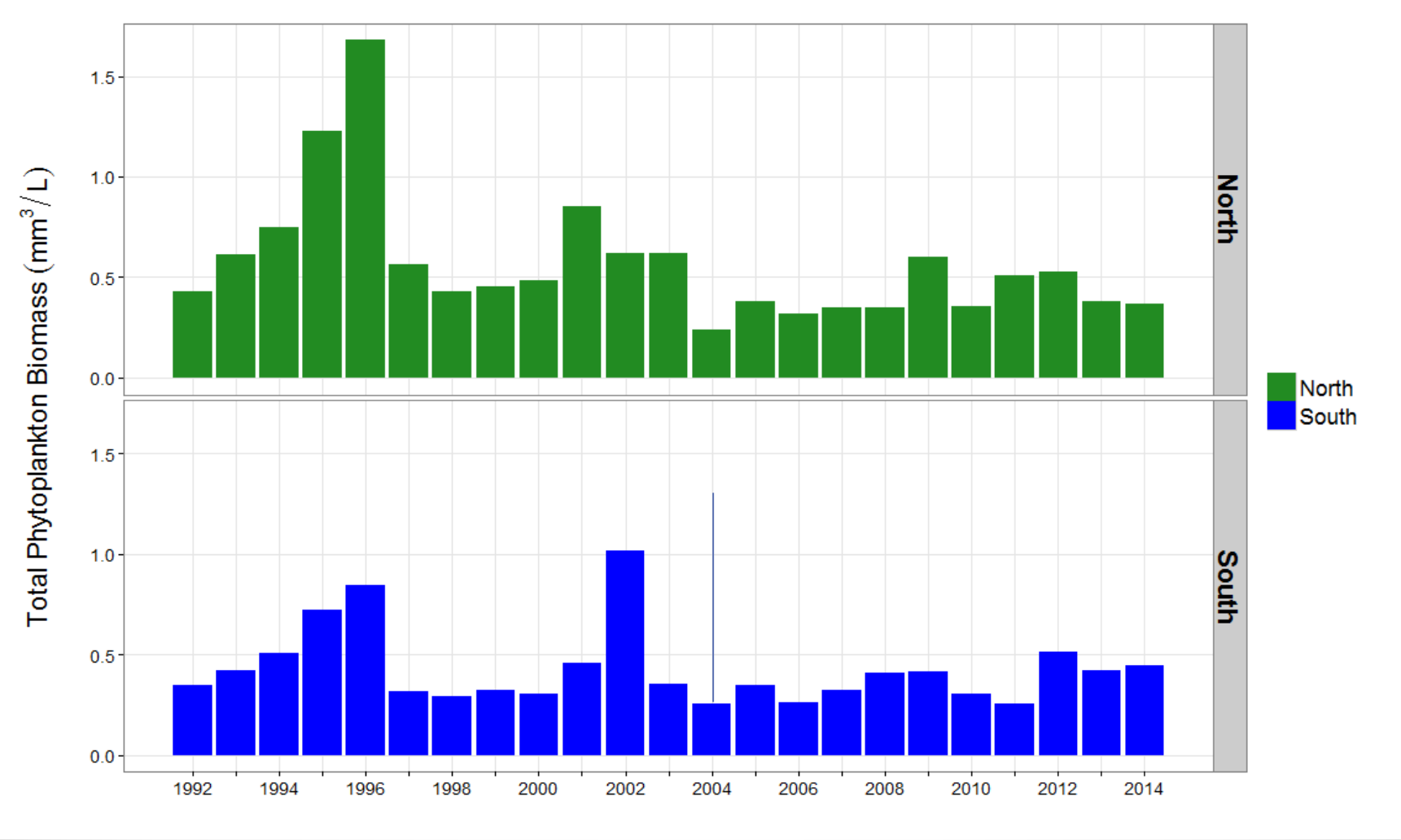

Turbidity (NTU)
1.0
0.8
0.6
0.4
Water Quality Guidlines
Northern most station
KL1
Water Quality Guidlines
Southern most station
KL7
KL1
KL7
Spring
April-June
Summer
July-September
Fall
October-November

pH

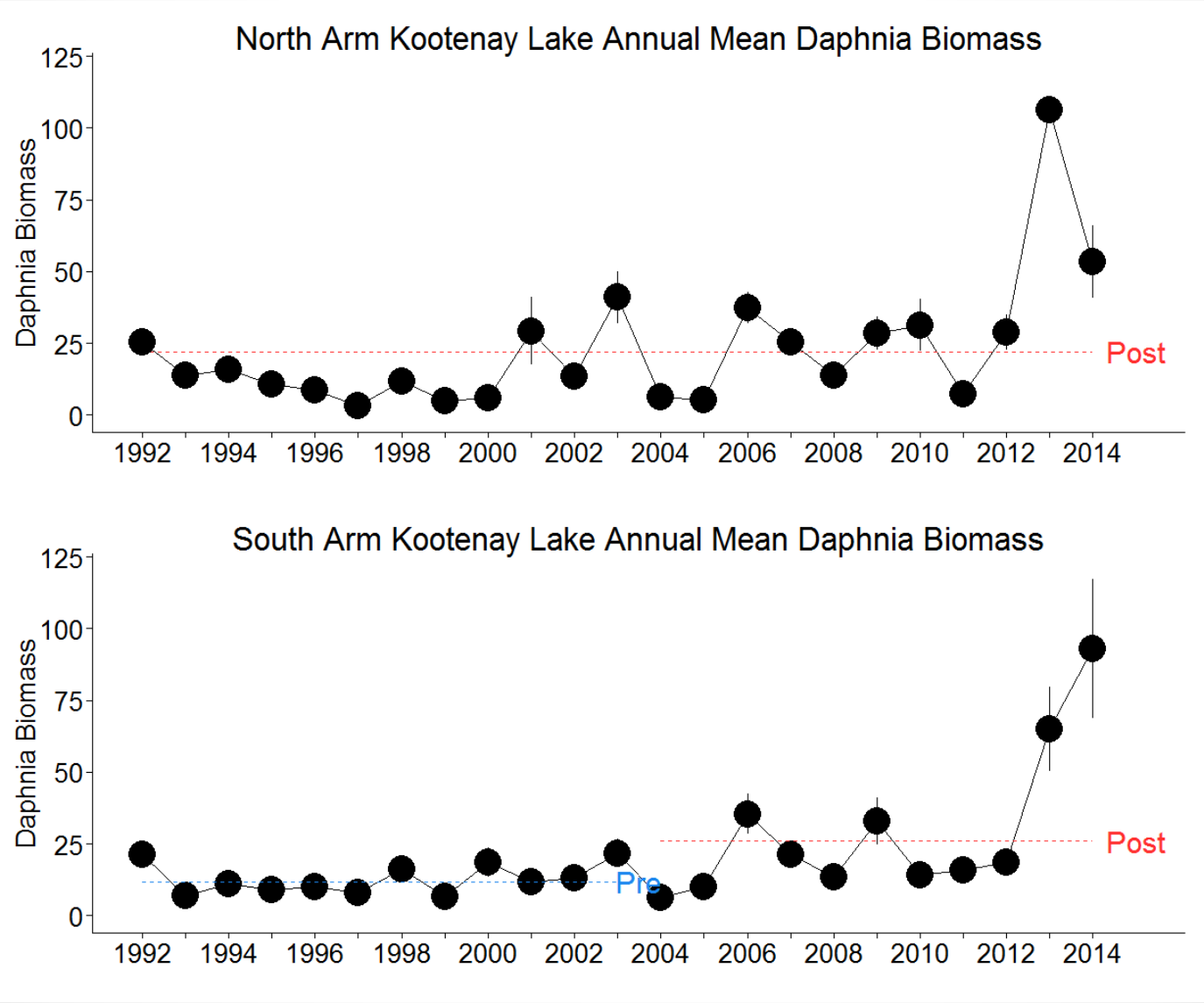

North Arm Annual pH
pH
8.25
8.00
7.75
7.50
7.25
1998
2000
2002
2004
2006
2008
2010
2012
2014


South Arm Annual pH
pH
8.25
8.00
7.75
7.50
7.25
Pre
Post
1998
2000
2002
2004
2006
2008
2010
2012
2014

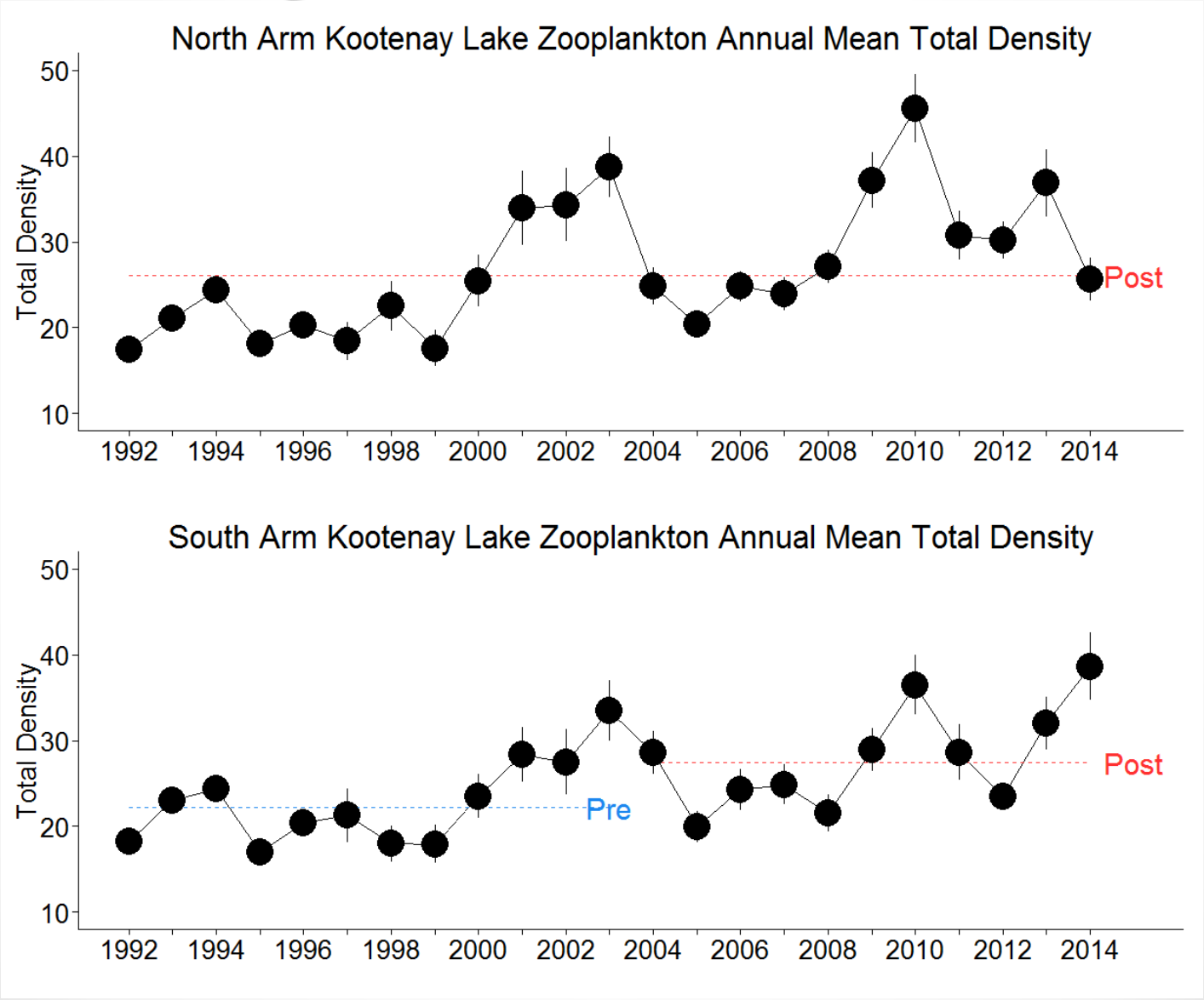
Phytoplankton



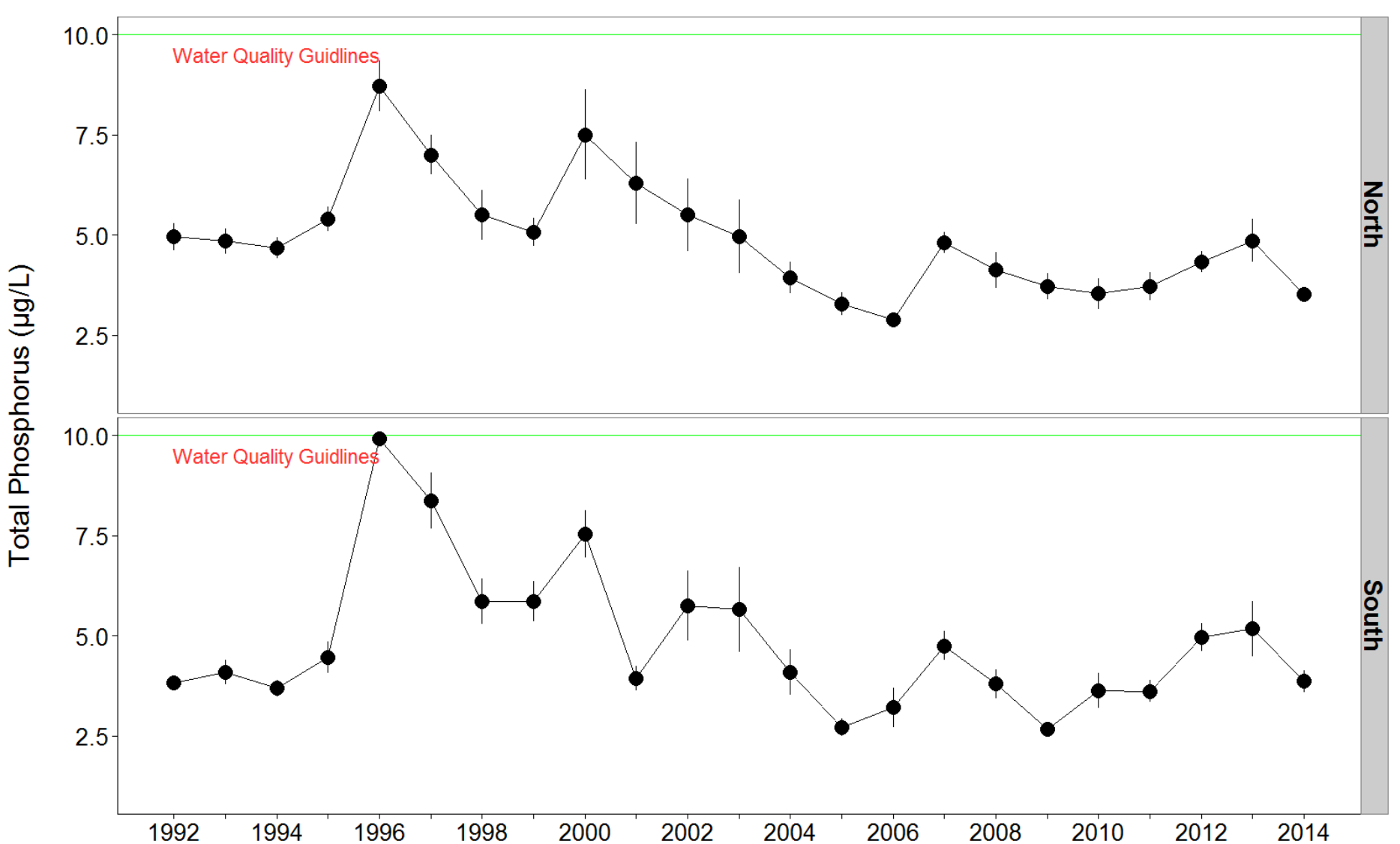
Zooplankton – Adult Kokanee Food *Daphnia*



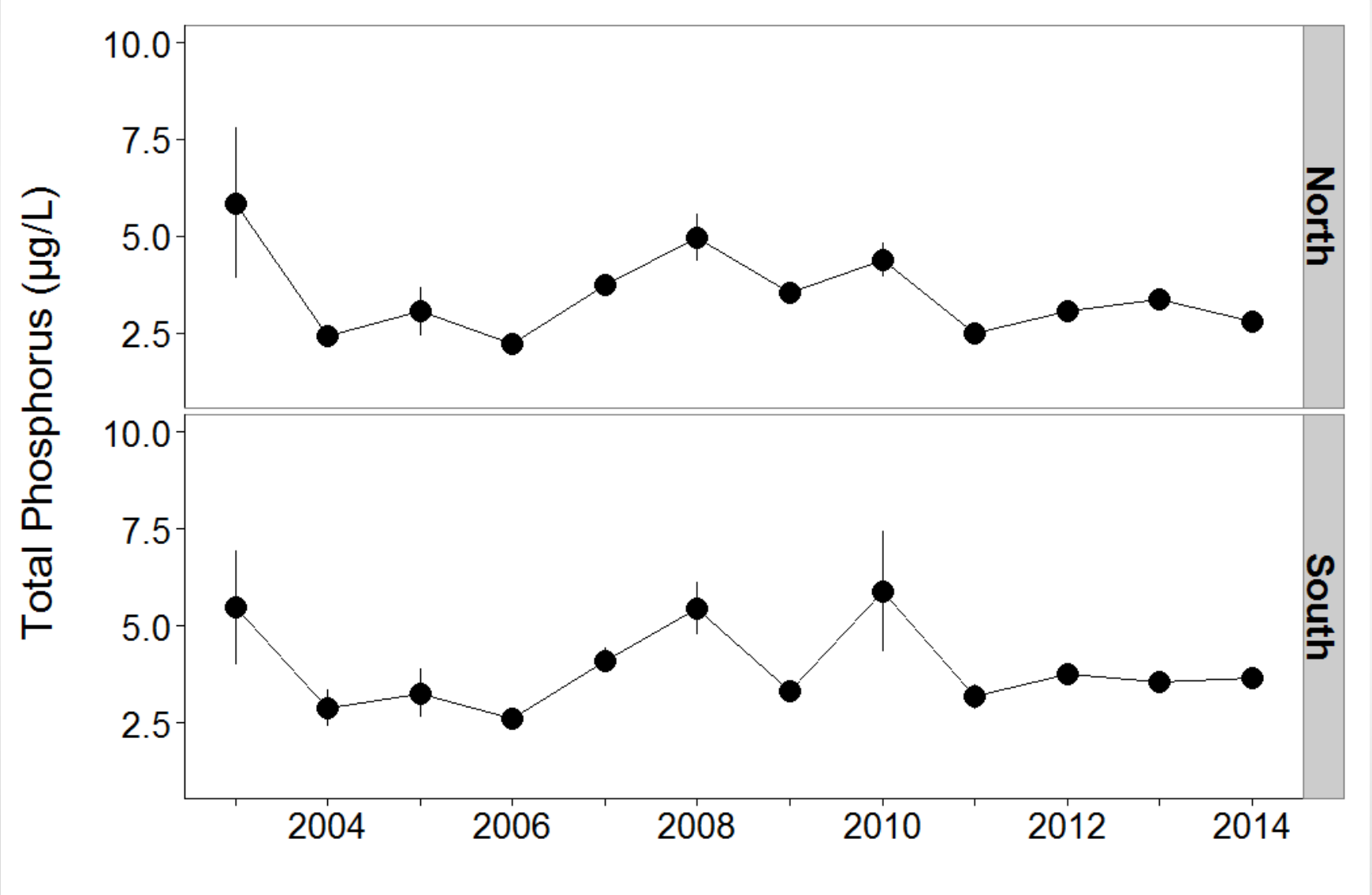
Zooplankton – Kokanee Food Total Density



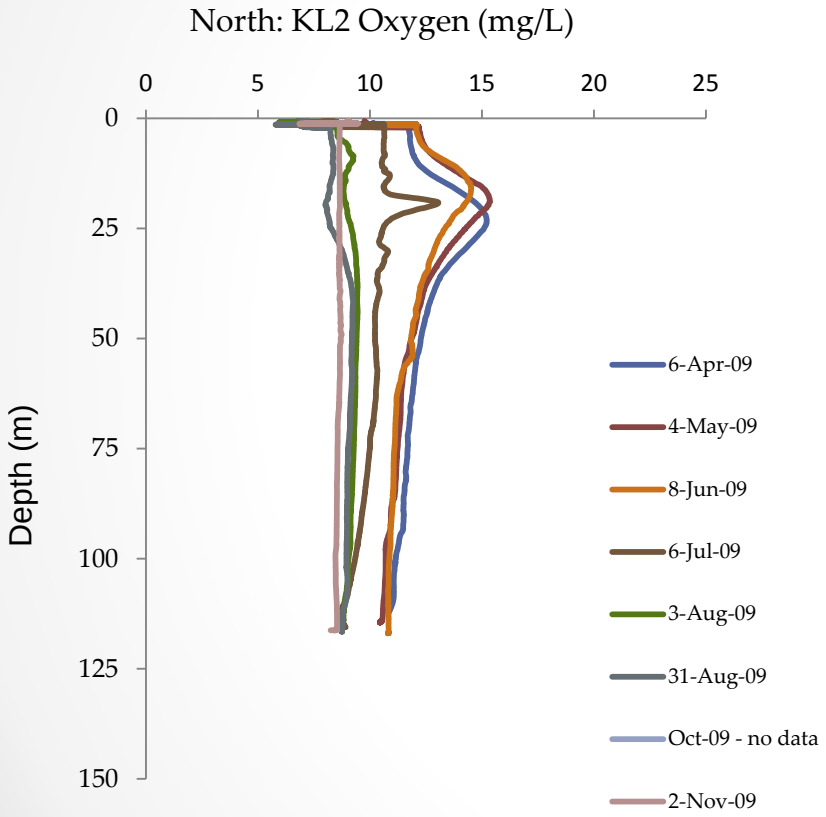
Phosphorus – Top 20 meters

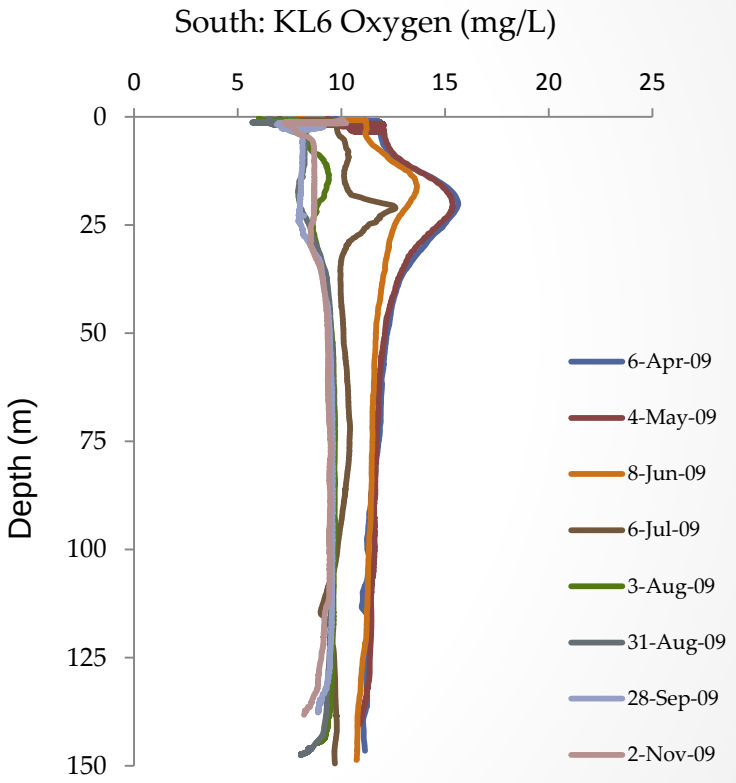


Phosphorus - Bottom

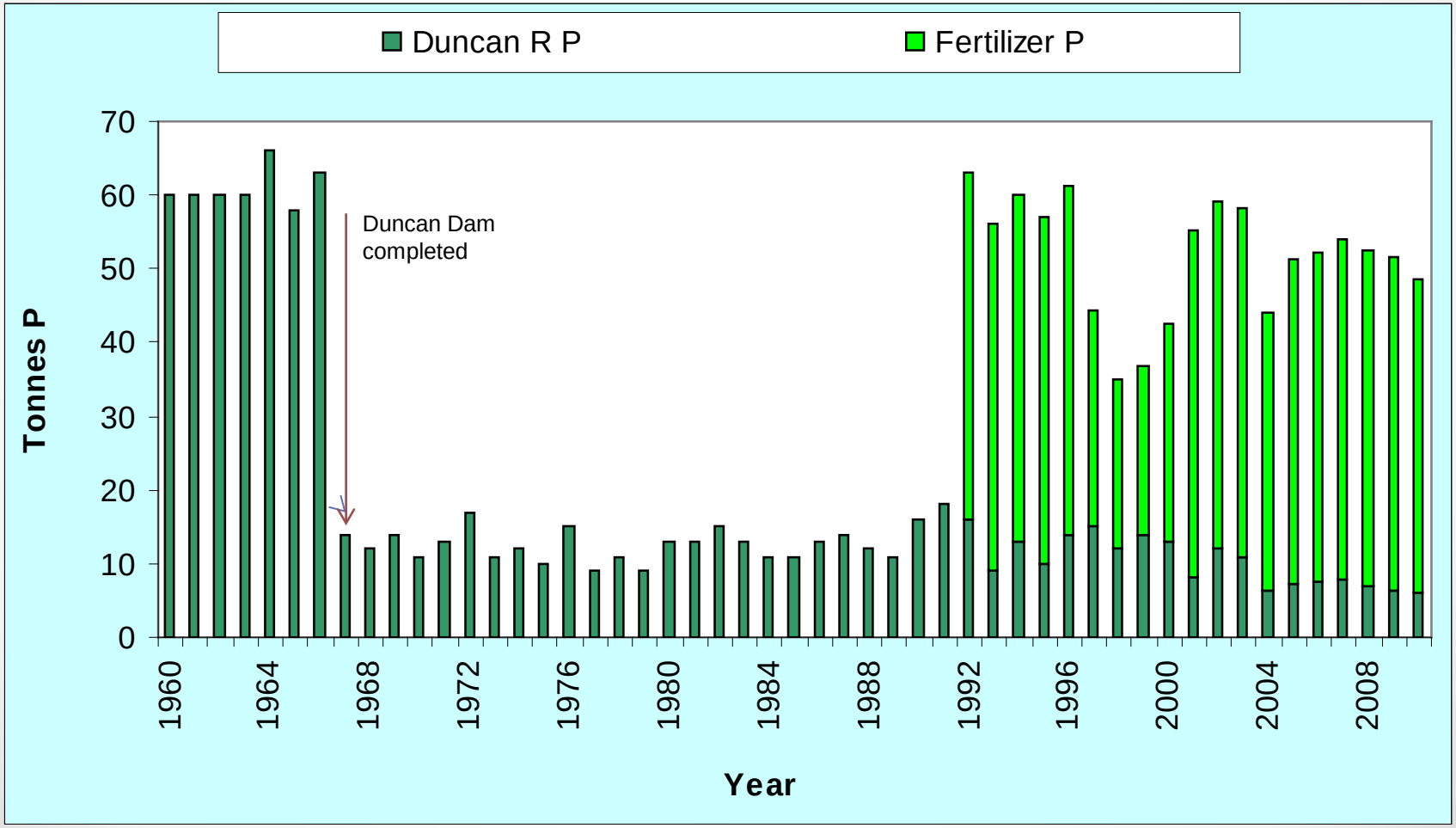


Oxygen Profile in a higher phytoplankton year

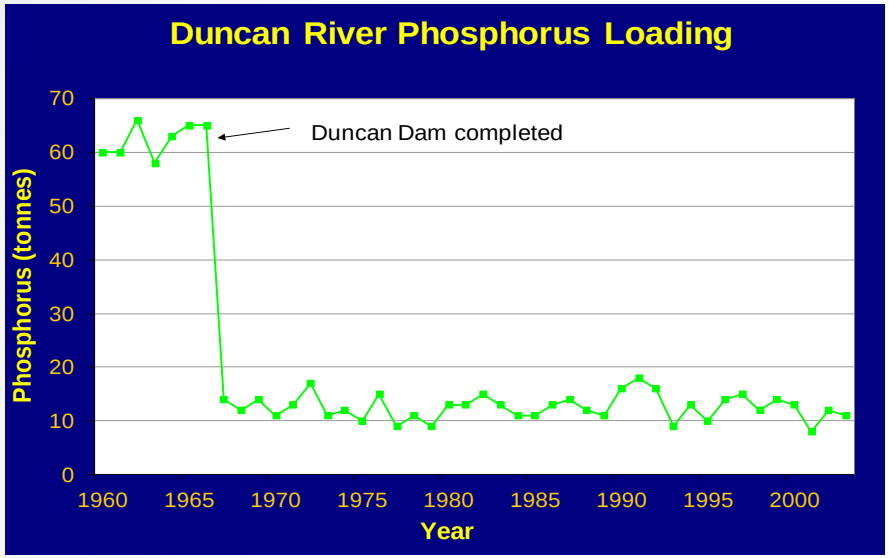


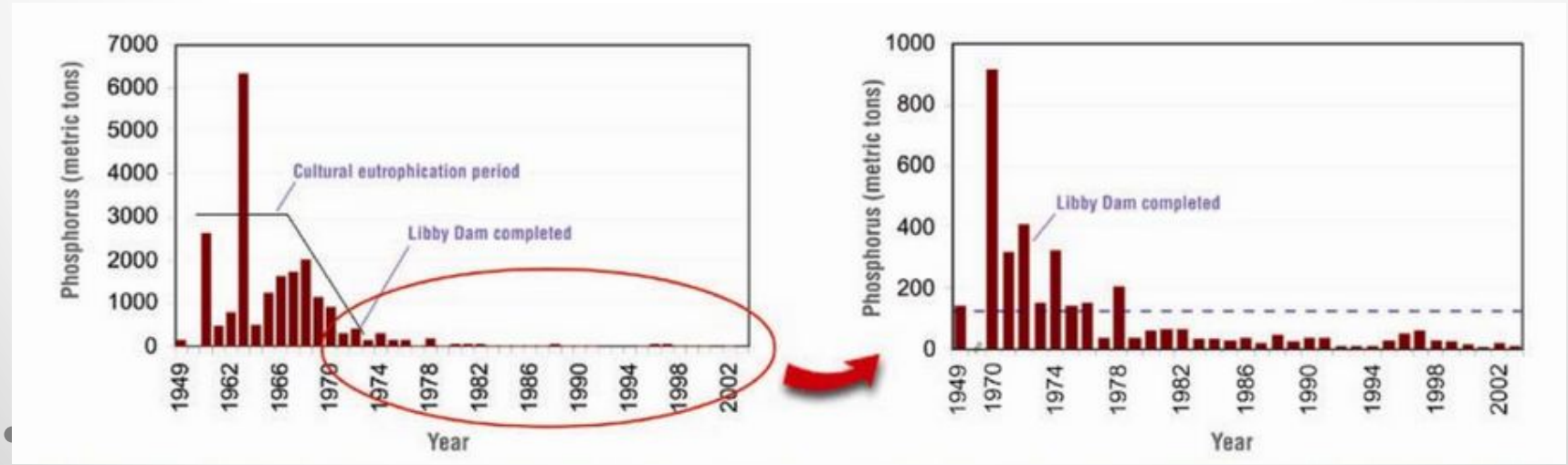


Phosphorus loading

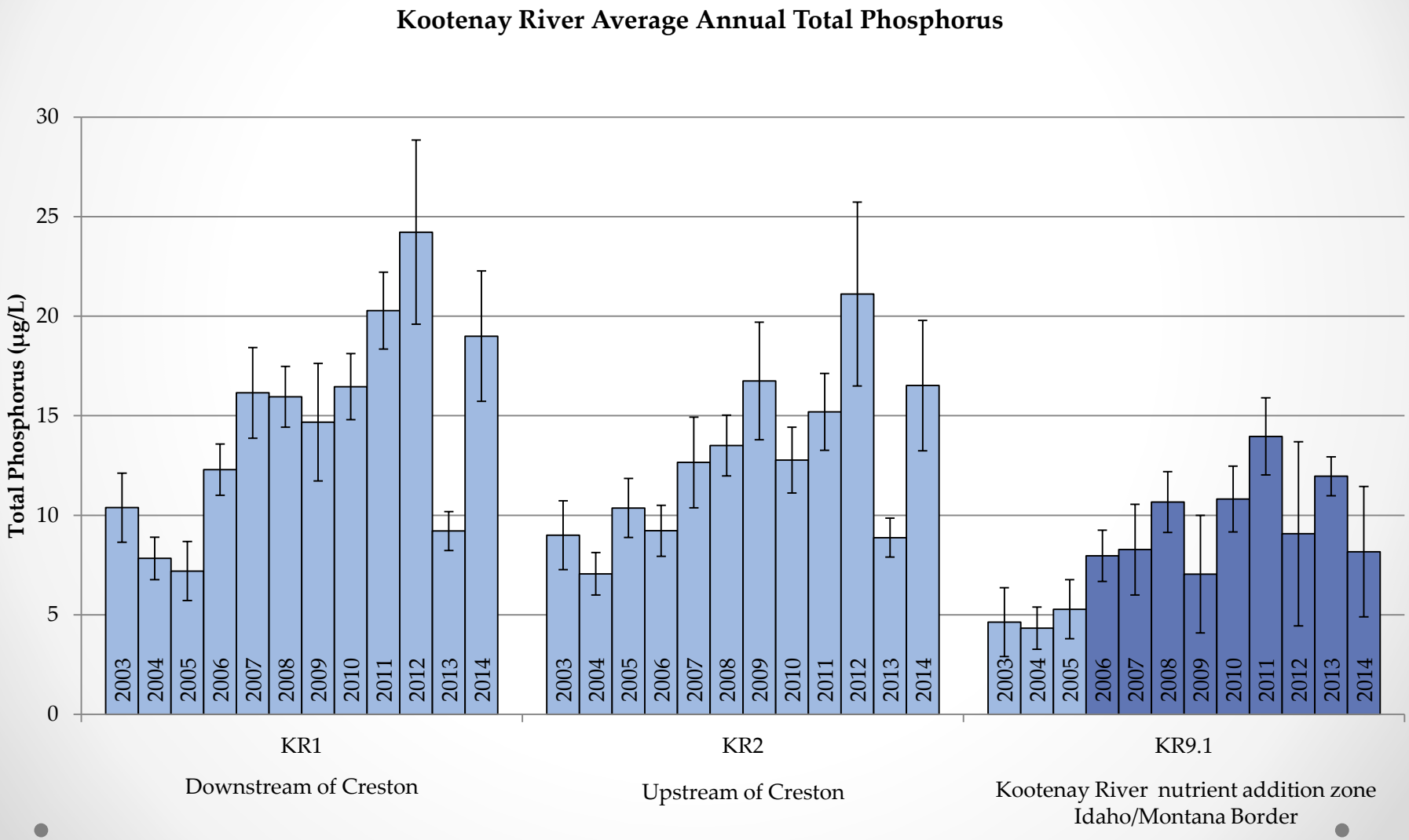


Phosphorus loading

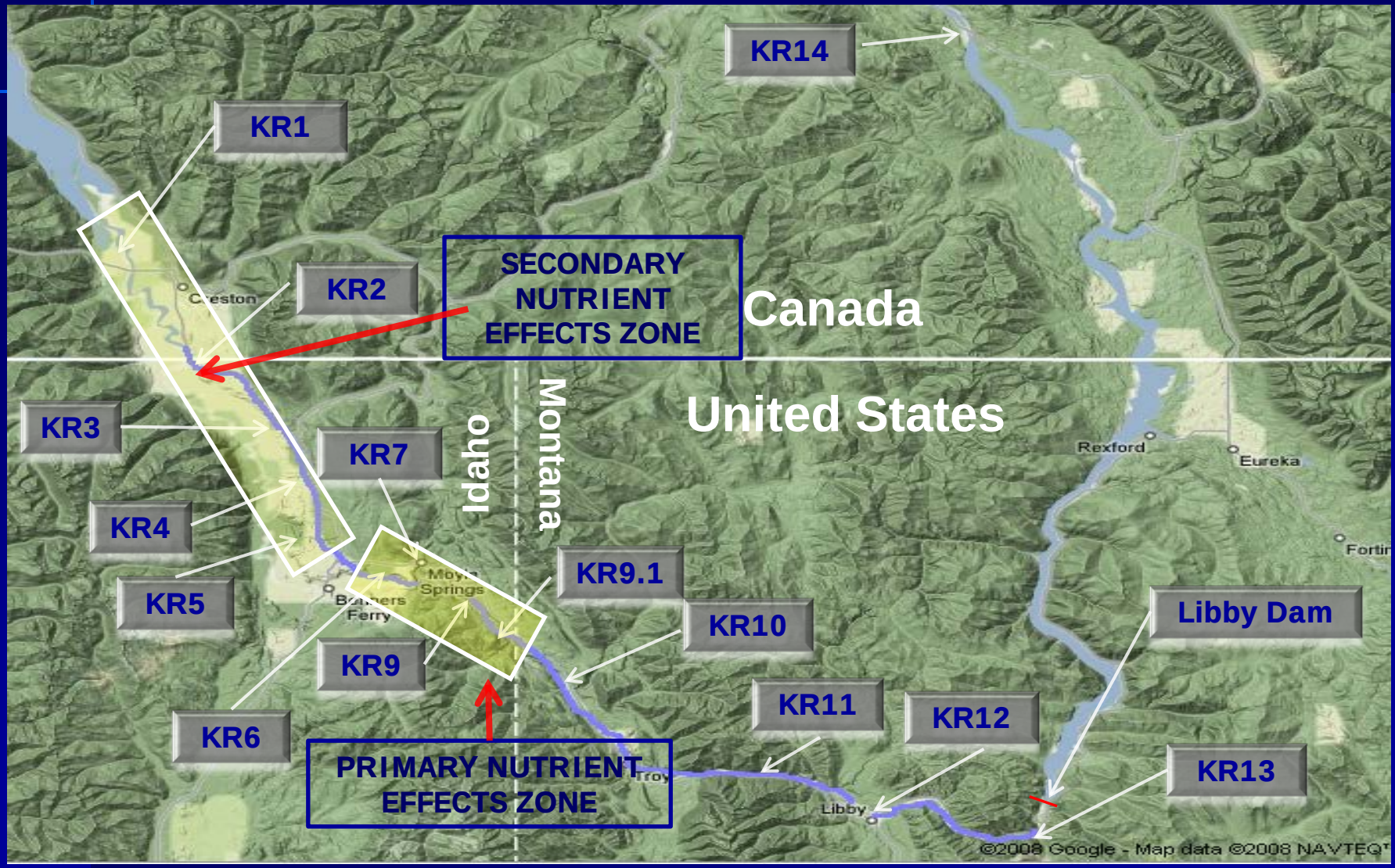




Phosphorus loading in Kootenay River



Kootenai(y) River Nutrient Addition Bio-Monitoring Sites



Nutrient addition Zones