Frequently Asked Questions

ONLINE MEETING SUPPLEMENTARY INFORMATION

MINISTRY OF FORESTS, LANDS, NATURAL RESOURCE OPERATIONS AND RURAL DEVELOPMENT

FISH AND AQUATIC HABITAT SECTION– NELSON, B.C.

MARCH 11, 2022

Predators and Kokanee Collapse

Rainbow trout and bull trout are not the only kokanee predators in Kootenay Lake. Other predators include cormorants, yellow perch, largemouth bass, bears and osprey. What is the impact of these predators on kokanee, and would predator control measures make a difference for kokanee recovery?

- Pikeminnow: the juvenile kokanee survival bottleneck is in the deeper parts of the lake (offshore pelagic zone), and we have almost no evidence of pikeminnow physically overlapping with juvenile kokanee in these areas.
  - Our guide-caught data shows very few pikeminnow captured in the pelagic zone, no kokanee found in stomachs;
  - Diet study on Kootenay Lake: 106 pikeminnow sampled, 1 kokanee in stomach (McGregor *et al.,* 2018); and
  - There are no daily quota limits on pikeminnow angling.
- Perch: not broadly distributed in Kootenay Lake, not enough present to be biologically significant, habitat does not overlap with juvenile kokanee (not in pelagic habitat).
- Largemouth bass: not broadly distributed in Kootenay Lake, not enough present to be biologically significant, habitat does not overlap with juvenile kokanee (not in pelagic habitat).
- Can't rule out other predators as a contributing factor, there is no current monitoring for these species, but:

<u>High bull trout and rainbow trout consumption explains the sustained collapse of kokanee without including additional factors.</u>

Predator Abundance Outburst

Why was there an outburst of predator abundance that drove the kokanee collapse?

- This isn't fully understood, but likely a combination of things. Some hypotheses include:
  - Changes in fishing regulations (i.e., increased release rates)
  - Predator recruitment may have been low in ~2000-2003, followed by a very strong age class that was produced by the spawners in 2004.
    - Mobbs Creek historically deposited sediment on Gerrard nests which reduced survival; this hasn't occurred since 2003
  - Kokanee fry supply to the lake was very high in the mid-2000s
  - The abundant age classes of kokanee had excellent growing conditions due to favorable climate. These abundant, well fed kokanee in turn could feed the abundant age class of Gerrards.
  - Commencement of south end of Kootenay Lake fertilization (i.e., nitrogen additions began in south end as a trial in 2004) could have improved growing conditions for kokanee, but also rainbow trout and bull trout
  - These hypotheses are unlikely to be mutually exclusive; it's likely that all factors were perfectly timed to result in an increase in predator abundance and growth.

Kokanee Collapse in Lake Pend Oreille

How does this compare to the kokanee collapse in Lake Pend Oreille?

- Ministry biologists in Nelson are consulting regularly with Idaho Fish and Game on recovery approach.
- Kokanee never "collapsed" in Lake Pend Oreille. Abundance was reduced, but not as severely as in Kootenay Lake.
- Managers prevented collapse by supressing an invasive Lake Trout population from expanding.
- Lake Trout are not native and no caution is needed in suppression.
- Lake Trout suppression can be achieved by netting spawning adults and juveniles deep where kokanee and native predators don't live, using commercial scale netting efforts.
- Kokanee recovery may have as much to do with an unexplained natural Mysis collapse as the predator suppression (Corsi *et al.,* 2019, Dux *et al.,* 2019).
- Ongoing annual stocking in Lake Pend Oreille, but not primarily from external sources; however, stocking has not triggered fishery recovery alone in any similar predator pit examples we are aware of.
- It took 8 years for adult kokanee recovery in Lake Pend Oreille (note that it's been 8 years from initial kokanee collapse in Kootenay Lake to present)

Disease and Parasites

Has disease (e.g., Infectious Haematopoetic Necrosis [IHN] virus) played a role in collapse? Can you do anything about it?

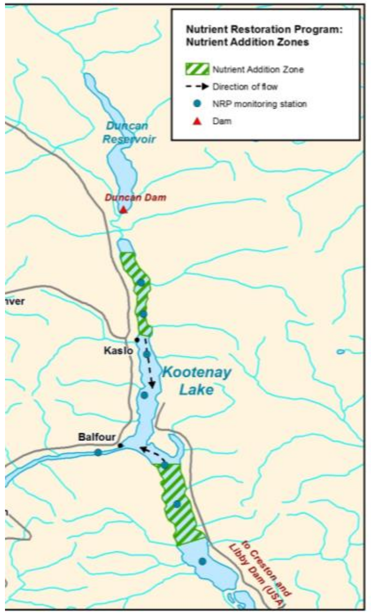
- IHN was highly prevalent in Kokanee samples from the Meadow Creek Spawning Channel in 2013
- There is evidence that IHN kills salmonids in hatcheries (Traxler and Rankin, 1989)
- Addressed it through drying channel (kills virus), pitching carcasses, monitoring annually, literature review (vaccine- immersion vax had no impact; must administer individually [Corbeil *et al*. 2000])– expectation that salmonids will adapt/evolve herd immunity
- It is rare, but has been associated with in-lake mortality of Kokanee (e.g., Cowichan Lake) (Traxler 1986)

Have parasites (e.g., flatworms and nematodes) played a role in collapse?

- Parasite infection rates vary through time, fish seem to tolerate high parasite burden
- Natural occurrence, known outbreaks in past that have not precipitated any abundance issues
- Public Health Guidelines: if you cook fish properly they’re still edible even with parasites

What’s the deal with the Nutrient Restoration Program?

- North Arm and South Arm nutrient program is still occurring. North Arm receives nutrient additions of phosphorus and nitrogen and the South Arm receives nitrogen only.
- Objective to restore lost upstream nutrients and promote food production for kokanee to move up the food chain.
- Weekly applications occur during daylight in April to Aug/Sept. Currently via tug and barge on Kootenay Lake.
- Nutrient addition zone in the
  - North Arm is between Bulmer Creek and Campbell Creek
  - South Arm is between Wilson Creek and Akokli Creek.
- Two products are added to the lake
  - 10-34-0 also called Liquid Ammonium Phosphate is the blend which contains phosphorus and nitrogen. It is 10% nitrogen and 34% phosphate (P_2O_5).
  - 28-0-0 also called urea ammonium nitrate. It is 28% nitrogen.
- 2018 NRP FAQ link: https://fwcp.ca/app/uploads/2018/06/Info-Sheet-Columbia-Region-Nutrient-Restoration-Program-FAQ-Jul-1-2018.pdf



	North Arm		South Arm
Year	Tonnes of Nitrogen	Tonnes of Phosphorus	Tonnes of Nitrogen
1992	207	47	
1993	207	47	
1994	207	47	
1995	207	47	
1996	207	47	
1997	112	30	
1998	93	23	
1999	93	23	
2000	112	30	
2001	207	47	
2002	207	47	
2003	241	47	
2004	244	38	124
2005	247	44	234
2006	248	45	257
2007	247	46	245
2008	242	46	265
2009	241	45	265
2010	230	43	265
2011	171	35	257
2012	140	24	192
2013	208	33	258
2014	205	26	247
2015	213	32	267
2016	228	39	265
2017	223	40	267
2018	222	37	118
2019	234	40	196
2020	231	41	196
2021	180	36	196

FAQ References

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McGregor, A., B. Beckwith, M. Neufeld, S. Stephenson, and V.Evans. 2018. Diet composition of Northern Pikeminnow (*Ptychocheilus oregonesis*) and comepetition with other piscivorous fish in Kootenay Lake, British Columbia. School of Environment and Geomatics, Selkirk College.

Traxler, G.S. 1986. An epizootic of infectious haematopoietic necrosis in 2-year-old kokanee, *Oncorhynchus nerka* (Walbaum) at Lake Cowichan, British Columbia. *Journal of Fish Diseases* **9**: 545-549.

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