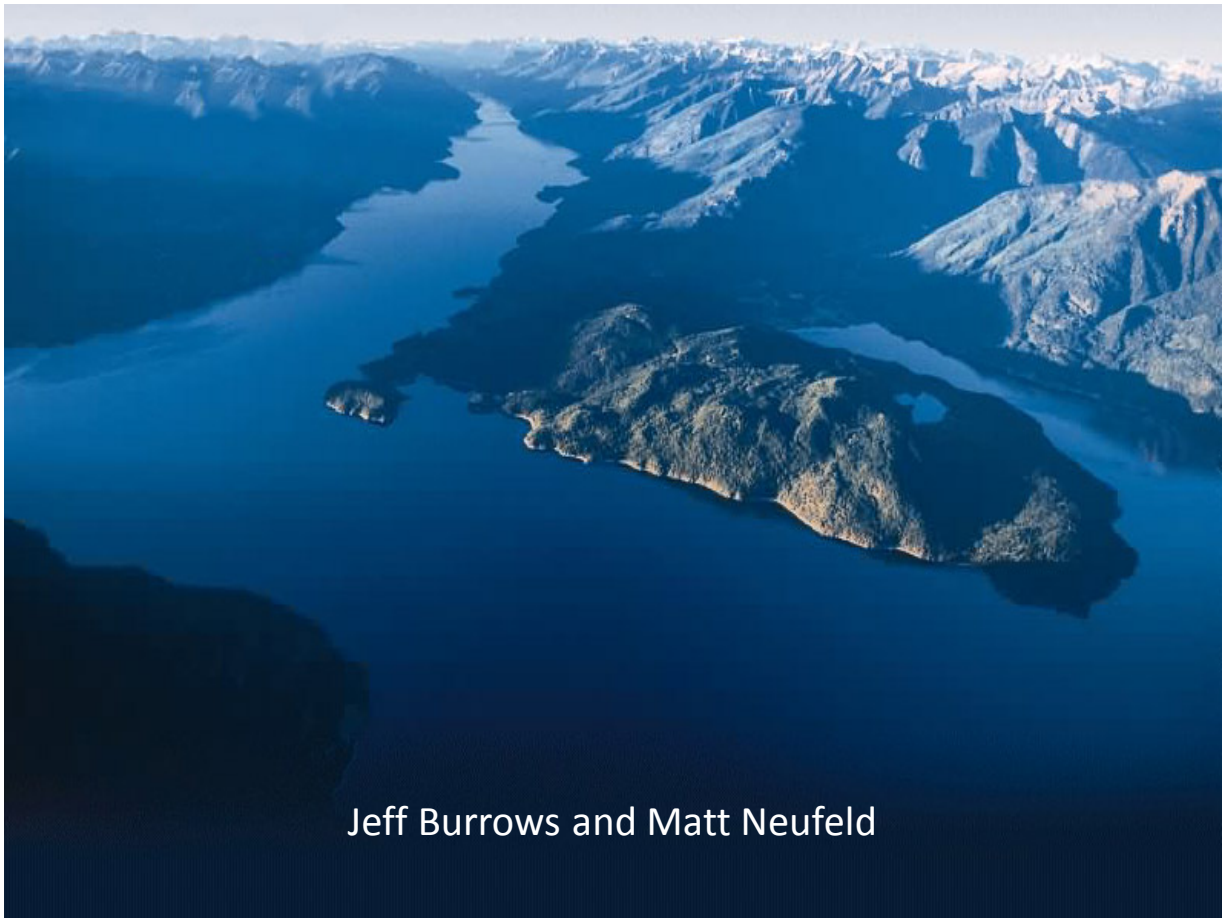
Kootenay Lake Fisheries Update and Proposed 2018 Actions



BC Ministry of Forests Lands and Natural Resource Operations - Fish and Wildlife Branch

Kaslo Legion & Lardeau Valley Halls – September 5-6, 2018

Outline

- Background
  - Kokanee, Bull Trout and Gerrard Rainbow
- 2016 Action Plan Implementation
- 2018 Action Plan Review
- Proposed 2018-19 Actions
- Questions

Kokanee Update

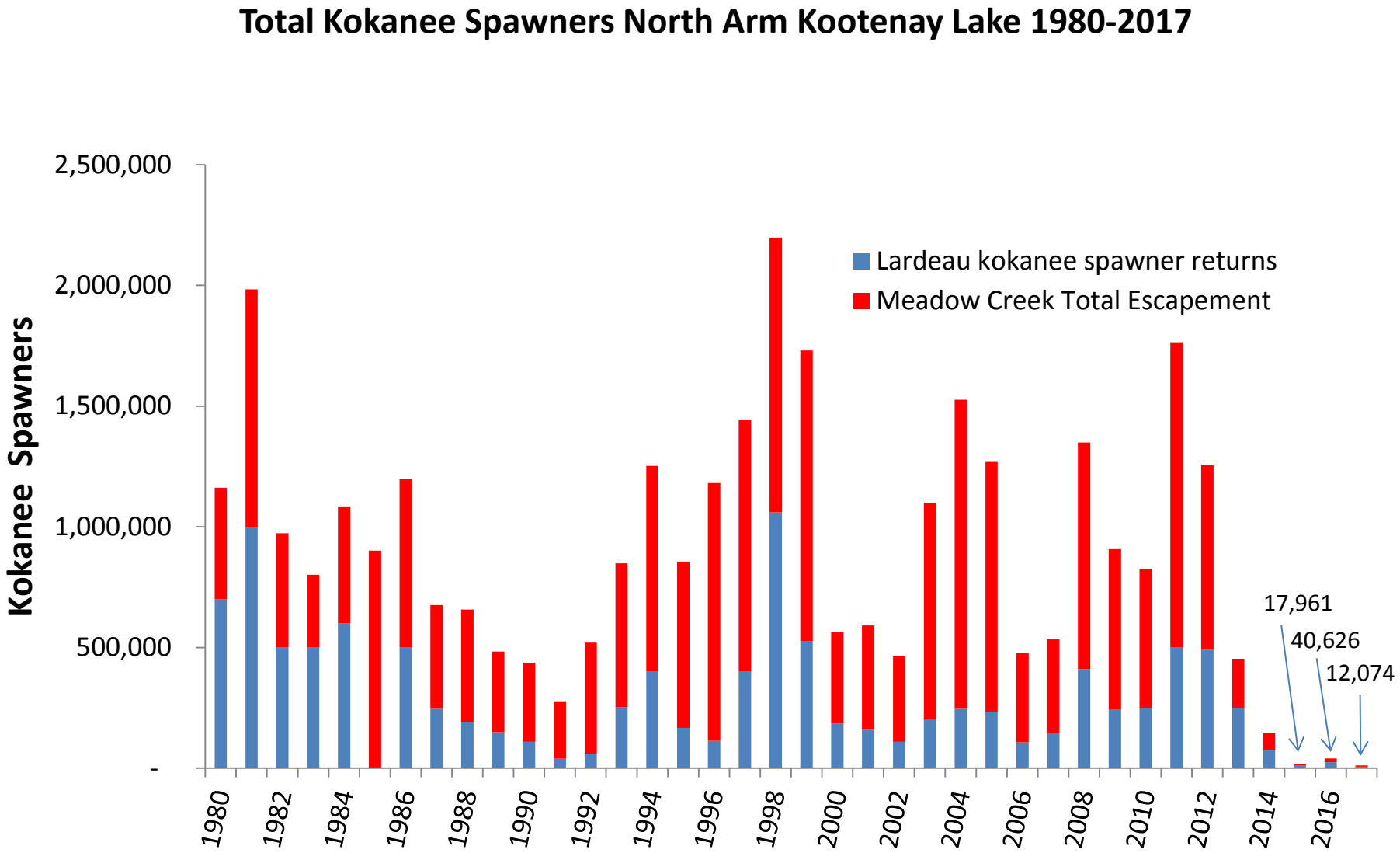
- Kokanee are key:

Jim Lawrence, Cooper Creek

- Kokanee are key:

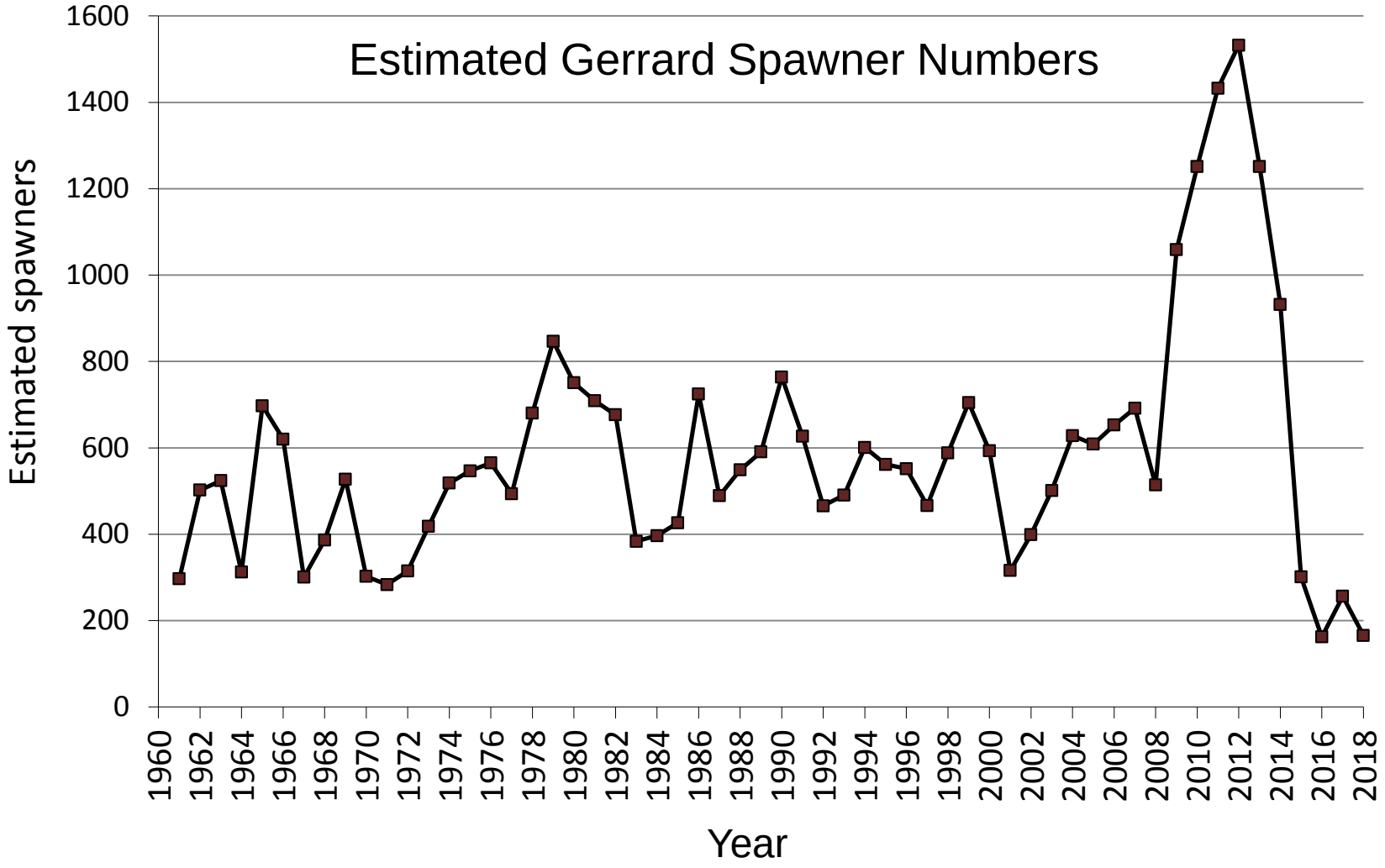
Boots Brown photography, Barry Kovish, JB

Kootenay Kokanee Spawner Trends



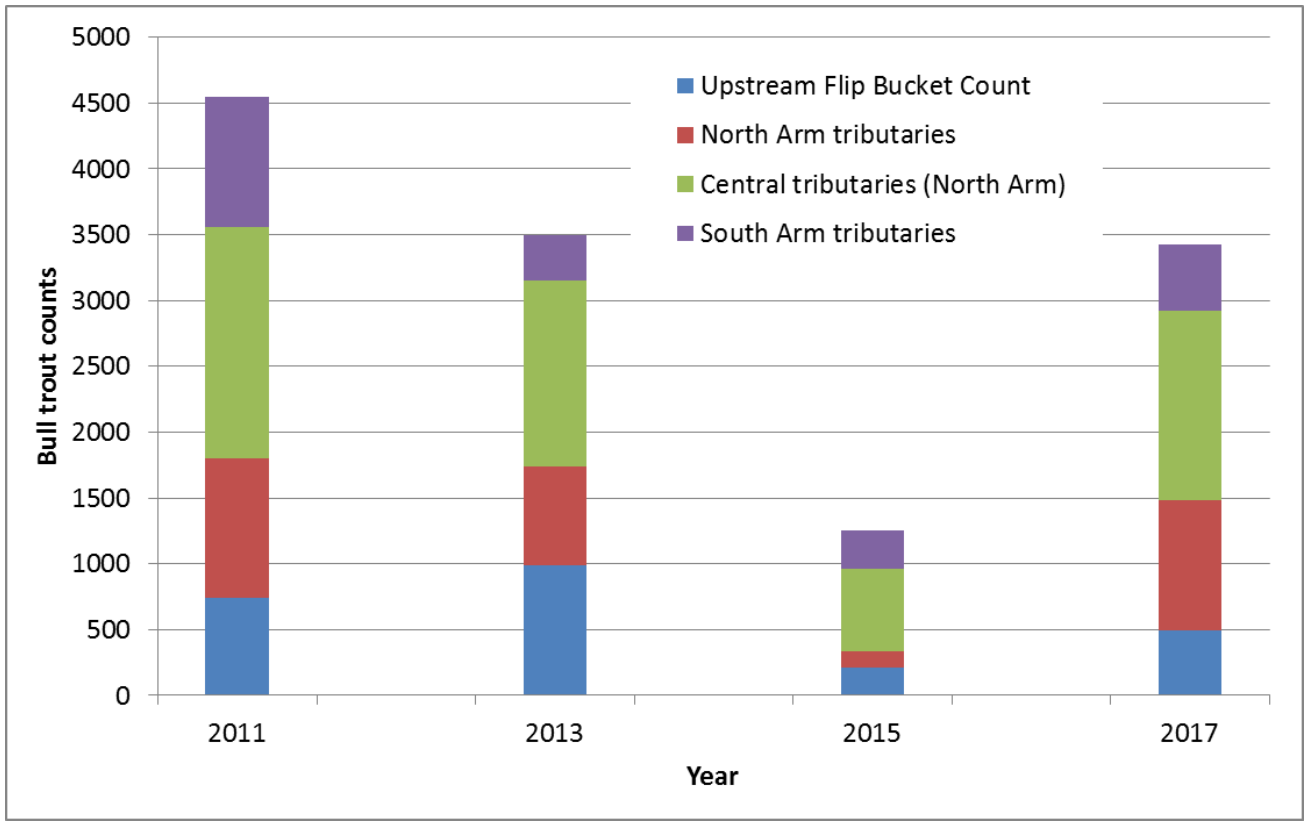
Slide from Basset - 2017

Gerrard Spawner Trends



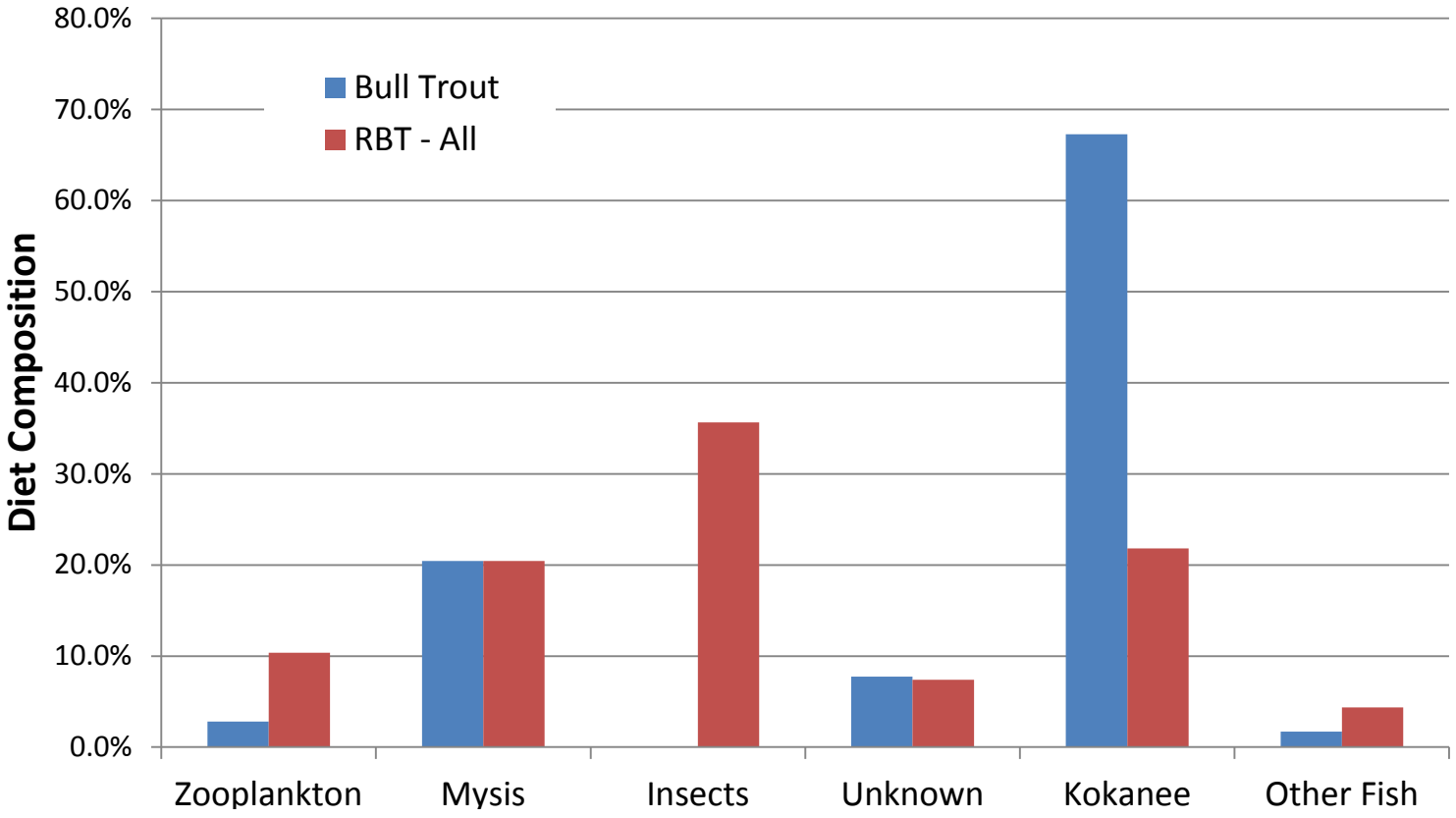
Kootenay Lake Bull Trout Spawner Estimates

- 2017 Bull trout spawner abundance similar to 2013; large increase from 2015
- South Arm tributaries remain a small contributor
- Central and North tributaries strong
  - (Hamill Creek, Kaslo River, Duncan River ~70% of all spawners)



FLNR Nelson data on file – various sources

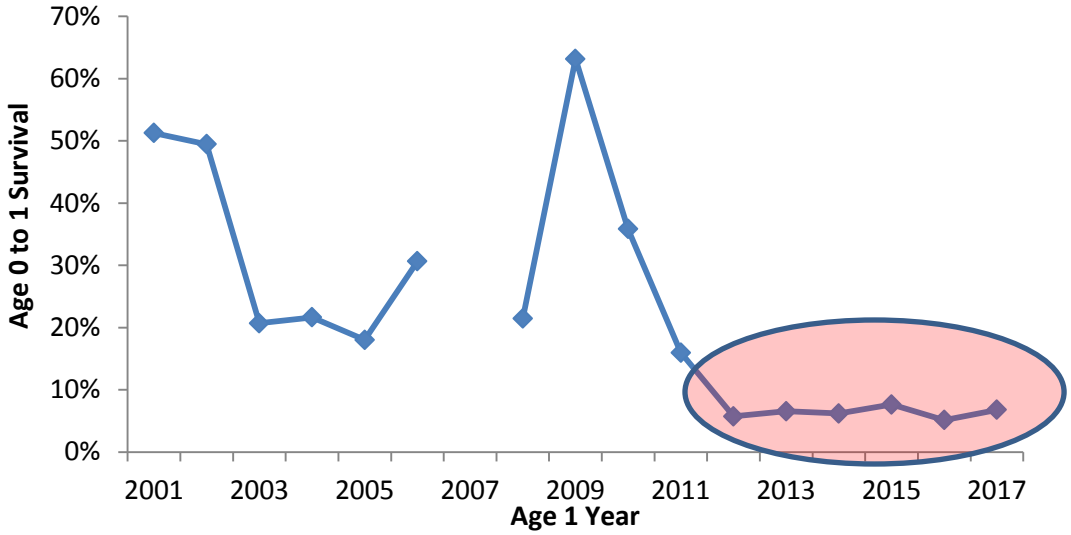
Bull and Rainbow Trout Diet

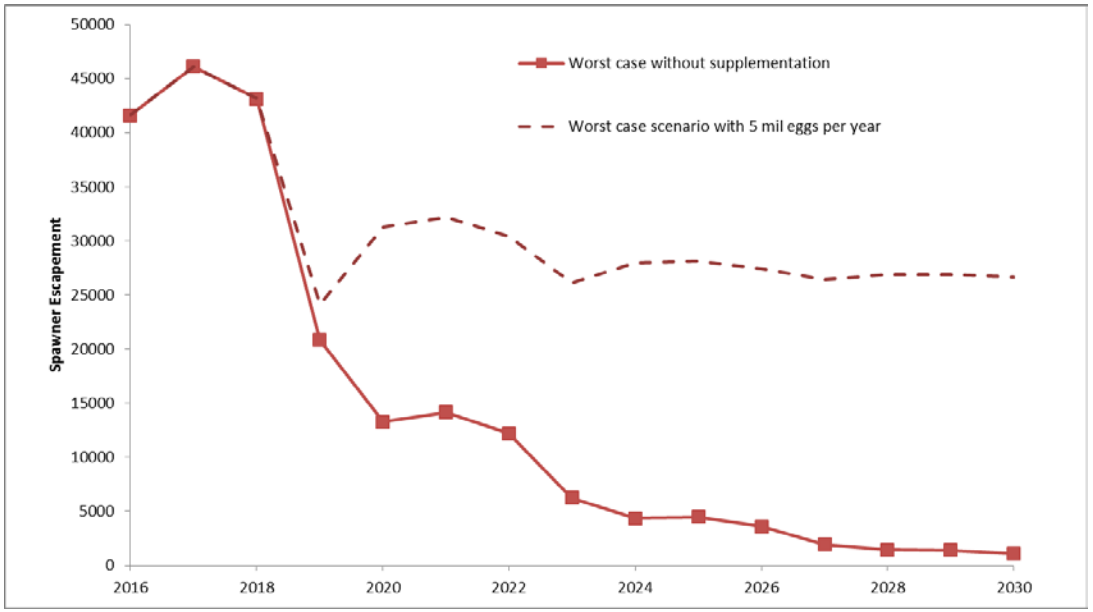


- Bull trout diet has much higher kokanee component
- Predators Kokanee are being consumed in high numbers by predators
- Scaled to in-lake abundance estimates; bull trout eat ~40 tonnes and rainbow trout eat ~60 tonnes of kokanee annually (2016-17);
- Recent spawner numbers **high for bull trout**, **very low for Gerrards**

Kokanee Survival – Forecast Trends

- Kokanee predation by bull trout and rainbow trout continues to be the major factor impacting kokanee survival trends
- Since 2012, young kokanee (age 0-1) survival has been ~5%, not 25%
- 2016 forecast of future kokanee abundance without change – virtual extirpation in 10 years (<2,000 fish)
- Recovery will not occur without a change in survival
- Next snapshot of survival – end of September 2018 (acoustic surveys)





From Askey 2016

Kootenay Lake Action Plan

- Established an advisory team; recommendations implemented - October 2014
- Team constructed an Action Plan – May 2016
- 2016 Plan Implementation began
- 2018 Plan Review – refined actions identified

env.gov.bc.ca/kootenay/fsh/main/mainfish.htm

Action Plan - Levers for Change

- Primary recovery tools available to managers
  - ensure that lake conditions support Kokanee survival through continued nutrient additions
  - supplementation with Kokanee eyed eggs and/or fry (i.e. add kokanee)
  - Predator management actions that support recovery objectives (**conservation** or **reduction** depending on status)
    - sport fishing regulations (conservation or reduction)
    - directed removals (reduction)
    - conservation aquaculture (conservation)

Recovery Implementation – 2015-17

Kokanee Supplementation

- Stocking delivered 2015-17 (> 16 million eggs and fry stocked)
- Stocking was >60% of all kokanee eggs for Kootenay Lake in 2017
- Stocking alone has not yet increased survival rate (likely can't stock enough to satiate predators, or improve school formation and size)

Predator Conservation – Reduce Mortality

Gerrards

- Spawner numbers remained above trigger 50-100 spawners ➔ **no conservation actions triggered**
- ***~160*** *spawners in 2016 and 2018, and* ***~250*** *in 2017*

Bull Trout

- Spawner numbers remained above 50 spawners in Kaslo River and 500 spawners lake-wide ➔ **no conservation actions triggered**
- ***~3,500*** *spawners in 2017*

No pressing conservation concerns…

Predator Management Actions – Reduce Predator Abundance

Rainbow Trout:

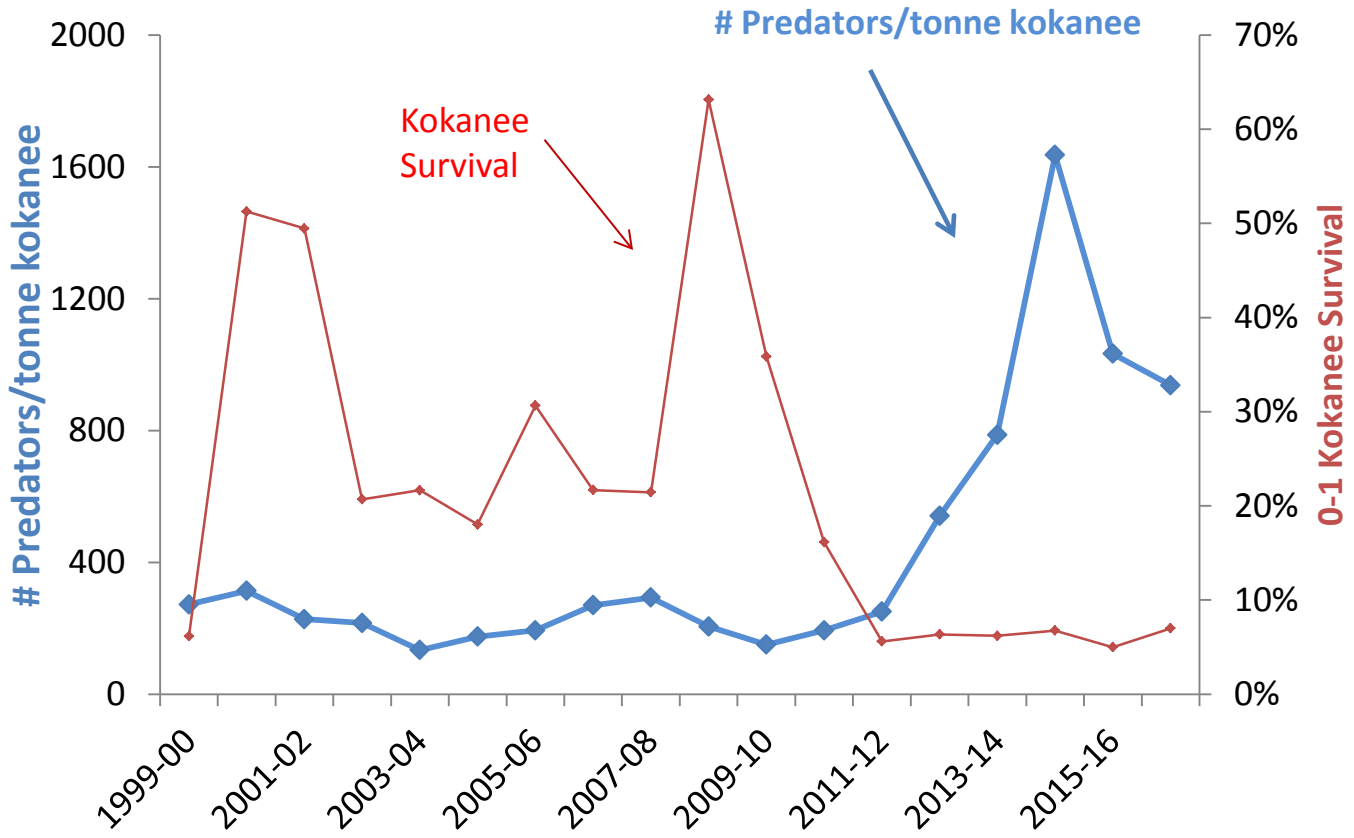
- Daily quota increase (to 4/day in 2015 and then 5/day in 2018; still only 1 > 50 cm)
- Harvest rate increased ~14% between 2015 and 2017 (regulations and outreach combined)
- But angling effort declines resulted in decreased overall harvest (9,000 to 4,000 in the same period)

Bull Trout

- Regional biologists recommended an increase to 2/d (only 1 > 50cm) in 2015, management decision not to proceed (stakeholder opposition)
- Daily quota increase to 2/day (only 1 > 50 cm) in 2018

Recovery – no early sign of progress

- In spite of interventions:
  - Increased kokanee supply at capacity over the last 3 years (stocked >16 million eggs)
  - Reduced predator numbers through angling regulation changes only



2018 Action Plan Review
Proposed New Actions

2018 Action Plan Review

- Kootenay Lake Advisory Team meeting and data review in May 2018
- No significant changes to Actions or triggers for Action proposed
- Recent data on diet and abundance resulted in a recommendation by the Kootenay Lake Advisory Team to consider additional options for predator reduction
- Action plan (2016) identified predator management, but detail lacking for reductions (conservation actions thought more likely in the near future, at the time)
- 2018 meeting provided guidance on reduction actions to implement

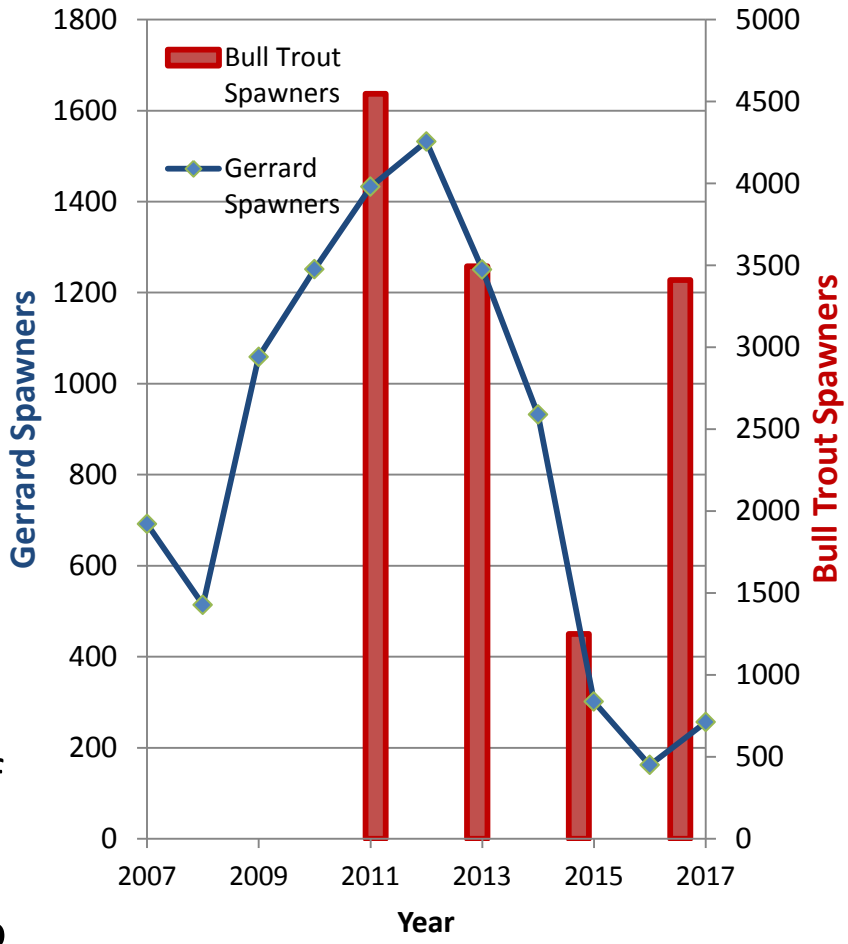
Predator Reduction Advice

Rainbow Trout

- There is risk to additional directed rainbow trout reduction (beyond the current angling regulation changes in effect for daily quota)
- Spawner numbers for the entire Gerrard population is currently only **~160 adults**

Bull Trout

- Bull trout are less abundant in the lake (rear to age 2-4 in tributaries); however, their spawning populations are currently very strong **(~3500 in 2017**) and geographically diverse.
- Data from the Kaslo River shows ~50% of the spawners in 2017 were surplus to production needs; therefore short term bull trout reductions come at little risk to future bull trout supply.



Bull Trout Reduction Proposed

- Short term reduction to allow kokanee survival increase
- Low risk (surplus spawners, lots of juveniles already rearing in tributaries and the lake).
- Planned Actions:
  - Post-spawner removals
    - Kaslo and Hamill Creek
    - via kelt fence
  - Pre-spawner removals
    - Duncan Dam
    - 2017 window lost
  - Angling Regulation changes
    - increase in lake quota
    - proposed north end opening
    - proposed Duncan River harvest

Kelt Fence Details

- Two weeks operation – last two weeks in September
- 50 to 65% of spawners encountered will be removed on the way back to the lake
- Fish from removals we will use for scientific sampling, first nations food/social/ceremonial purposes, local food banks, bear research
- Fish we return alive to the streams we will tag to provide data in the future on survival, abundance, movement and spawning frequency
- We anticipate only one year of kelt fence operation (2018), unless biological data suggests more is required to improve kokanee survival. Short term action.

Anglers Can Help!

- ~50% of bull trout and rainbow trout caught on Kootenay Lake are still released by anglers
- Anglers can help – retain bull trout and rainbow trout caught in Kootenay Lake (reductions will benefit kokanee)
- Additional angling opportunities (lake and/or tributaries) will be options next year if kokanee survival does not increase

Summary and Acknowledgements

1. Background – Kokanee collapse, Bull Trout and Gerrard Rainbow status
2. 2016 Action Plan Implementation
3. 2018 Action Plan Review
4. Proposed 2018-19 Actions

People

- 25 technical expert contributors
- Staff and contractors delivering suite of Recovery Actions
- Public patience

Funding

- Freshwater Fisheries Society of BC
- Fish and Wildlife Compensation Program
- Habitat Conservation Trust Foundation
- BC Ministry of FLNRO
- Kootenai Tribe of Idaho
- BC Hydro - WLR

Questions and Discussion

Find the Plan and other Info @

env.gov.bc.ca/kootenay/fsh/main/mainfish.htm

Or Google Search: Kootenay Fisheries

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Jeff Burrows	Senior Fish Biologist	FLNR, Nelson
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Dr. Trevor Davies	Stock Assessment Specialist	FLNR, Victoria
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Dr. Will Warnock	Senior Aquatic Biologist	Ktunaxa Nation Council, Cranbrook
Tyler Weir	Large Lake Ecosystem Specialist	FLNR, Victoria
Observer		
Michael Zimmer	Biologist	Okanagan Nation Alliance Fisheries Dept, Castlegar
Tia Scott	Administration	FLNR, Nelson

What is our authority to remove fish?

Fisheries Act (Canada) Fishery (General) Regulations S. 52

- “52 Despite any provisions of any of the Regulations listed in subsection 3(4), the Minister may issue a licence if fishing for experimental, scientific, educational, aquatic invasive species control or public display purposes would be in keeping with the proper management and control of fisheries.”

Licence issuance delegated to Regional Director-General (Pacific) Fisheries and Oceans Canada – currently Rebecca Reid - through March 2023.

> “This Licence is issued to the Ministry of Forests, Lands, Natural Resource Operations and Rural Development, and permits any officer of the Ministry to fish for scientific purposes in the non-tidal waters of the Province of British Columbia. For the purpose of this Licence, an "officer" means a person who is (a) a conservation officer or constable, the director, and assistant director, a regional manager of the fish and/or wildlife program of the Ministry or a biologist or biological technician in the Ministry, or (b) an employee of the Ministry designated by name or position as an officer.”

What about people not identified in that licence from Fisheries and Oceans (e.g. contractors)

They will have a scientific collection permit, which we (FLNR) issue pursuant to Wildlife Act (BC) Scientific collection and angling regulation 125/90

In short fisheries management work including reducing bull trout populations outside of the sport fishing regulations, has been, is and will be legal.

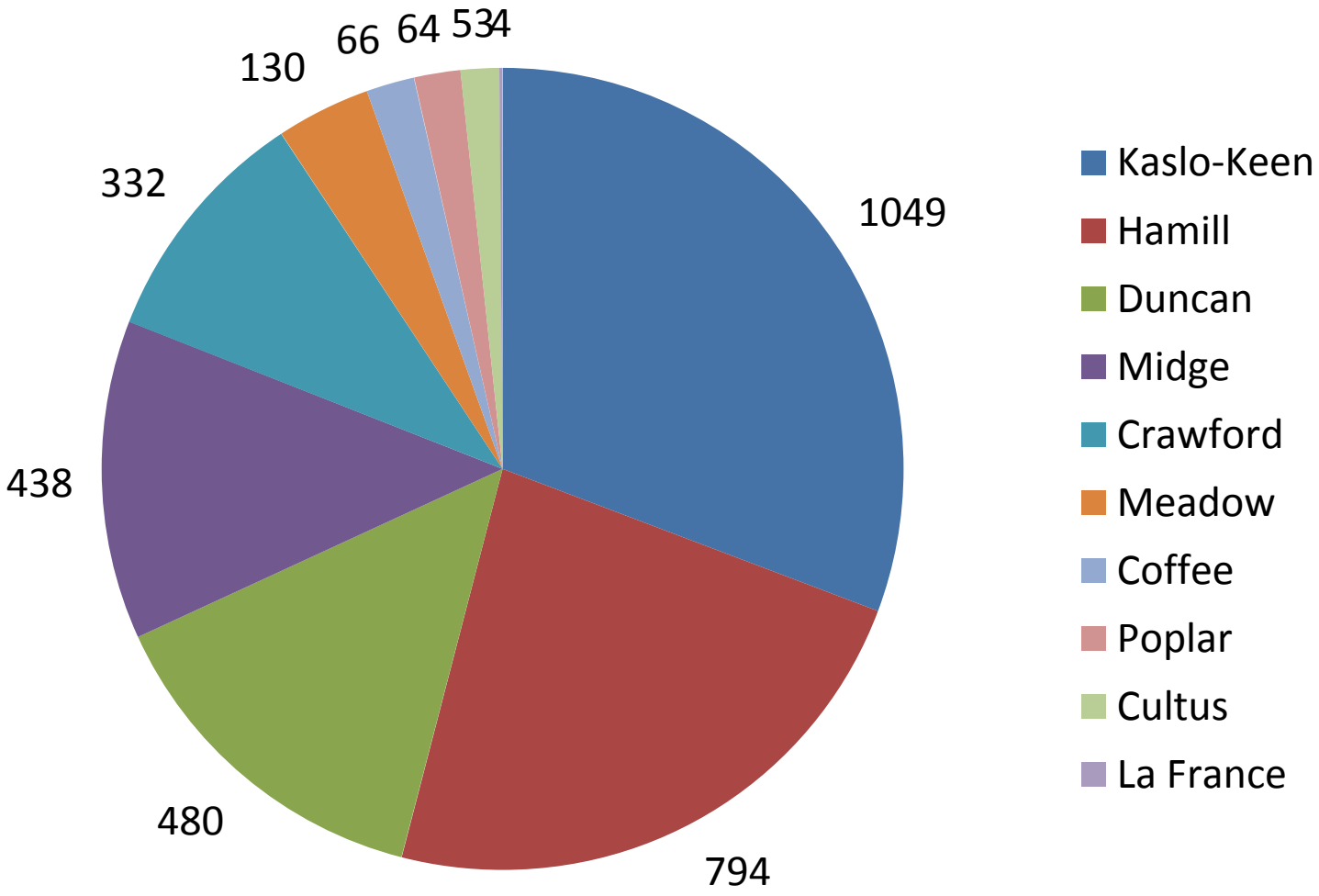
Single species management is not the solution?

- Kokanee are a keystone species – many species are reliant on kokanee
- Nutrient addition, spawning channels (& disease management), kokanee supplementation, sport fishing all part of management, and in synergy directed at multiple species
- Inaction on bull trout is an option with consequences to every species now and in future including bull trout
- Bull trout action is one of several practical ecosystem levers we are working with not a lone action (kokanee supplementation, nutrient program, angling regulations)

This is only about fishing and money

- Action plan does identify trophy fishing as the main objective
- However kokanee are keystone spp with profound consequences for all food web participants (from plankton to bears)
- While Fishing is fun, and Money matters to some, our main priority is conservation which is severely at risk for many spp when a keystone is not present

Bull trout spawners by stream 2017



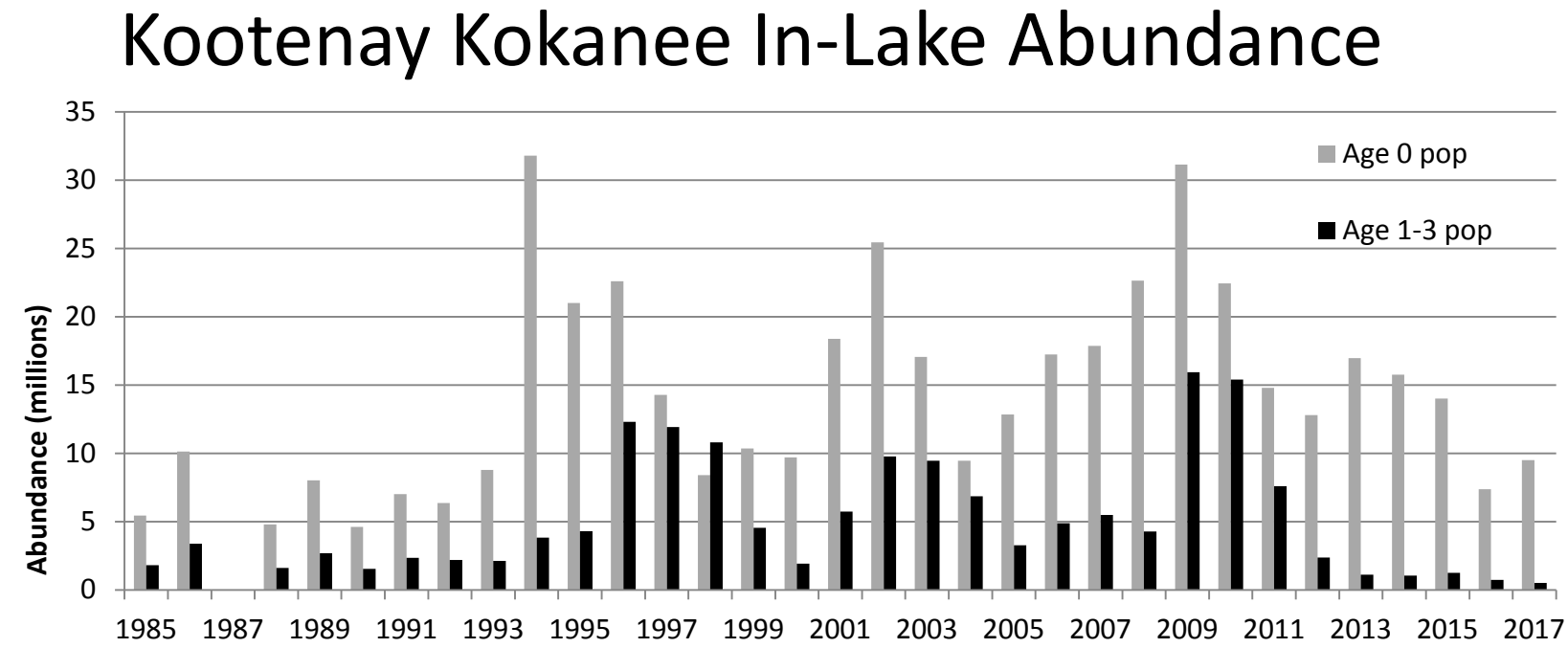


Figure 5. Acoustic abundance trends for age 0 and age 1-3+ kokanee from fall surveys of Kootenay Lake. 2017 data are preliminary.

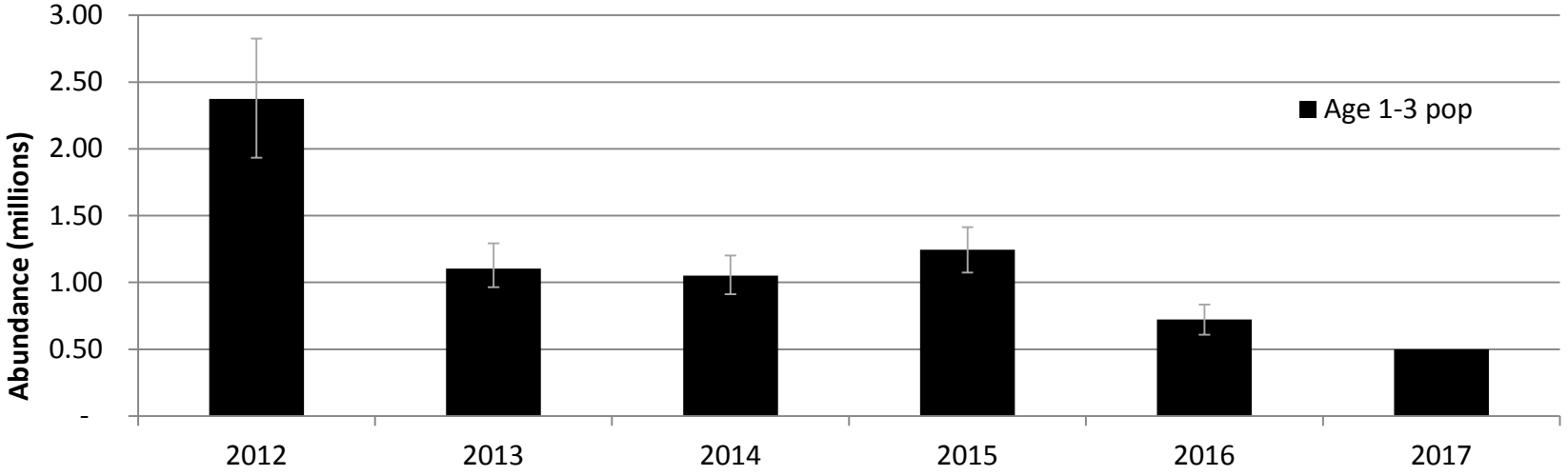
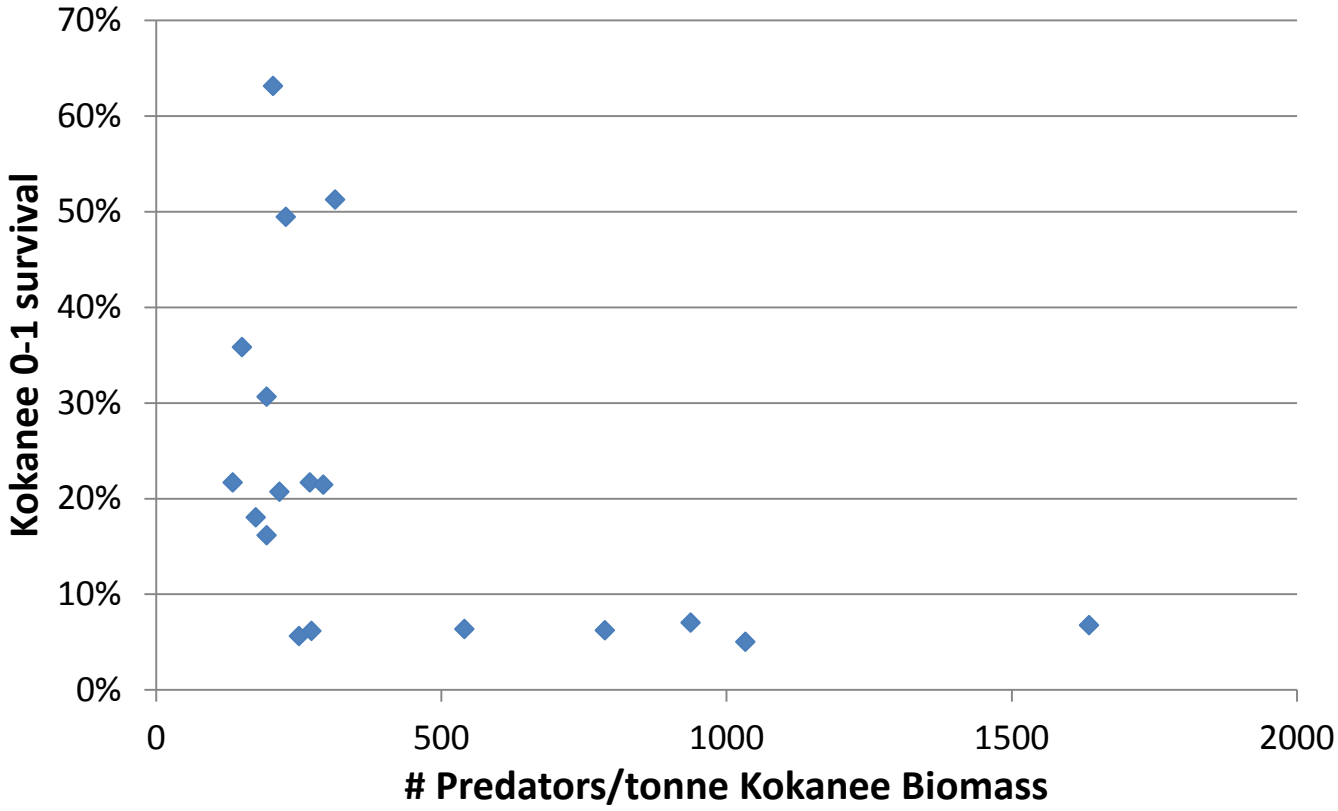
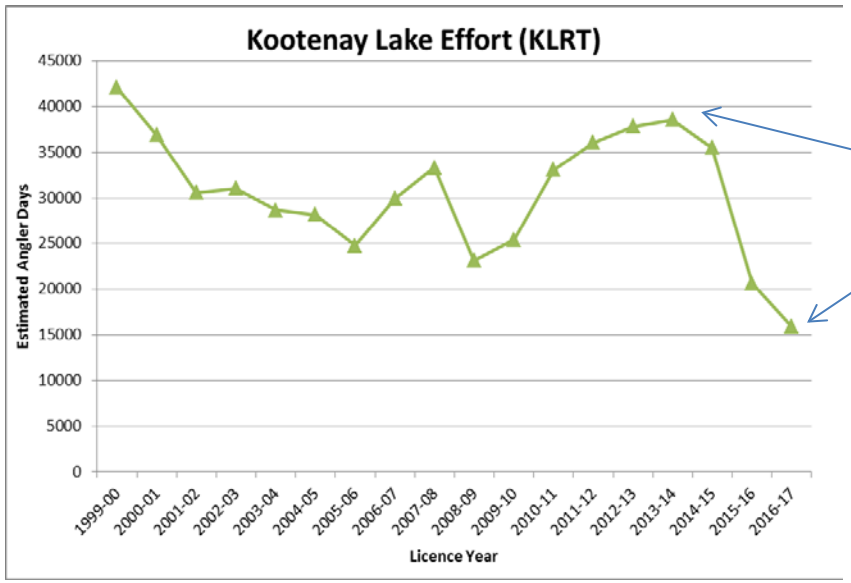


Figure 6. Acoustic abundance trends for age 1-3+ kokanee from fall surveys of Kootenay Lake from 2012 to 2017. 2017 data are preliminary.


70%
60%
50%
40%
30%
20%
10%
0%
Kokanee 0-1 survival
0
500
1000
1500
2000
Predators/tonne Kokanee Biomass

Fishery Trends – KLRT Creel

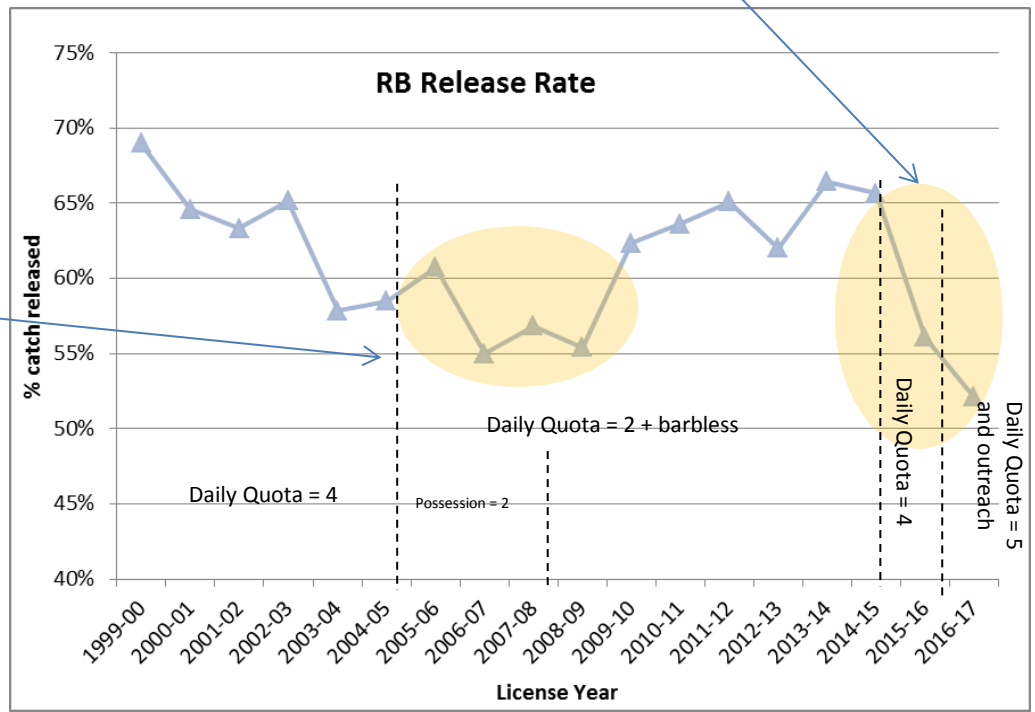


Effort Declines – 40,000 to 15,000 angler days

Recent outreach/daily quota increase = more harvest

No strong evidence for daily quota changes affecting exploitation

Fits with CPUE data: ~1 RB per rod day average



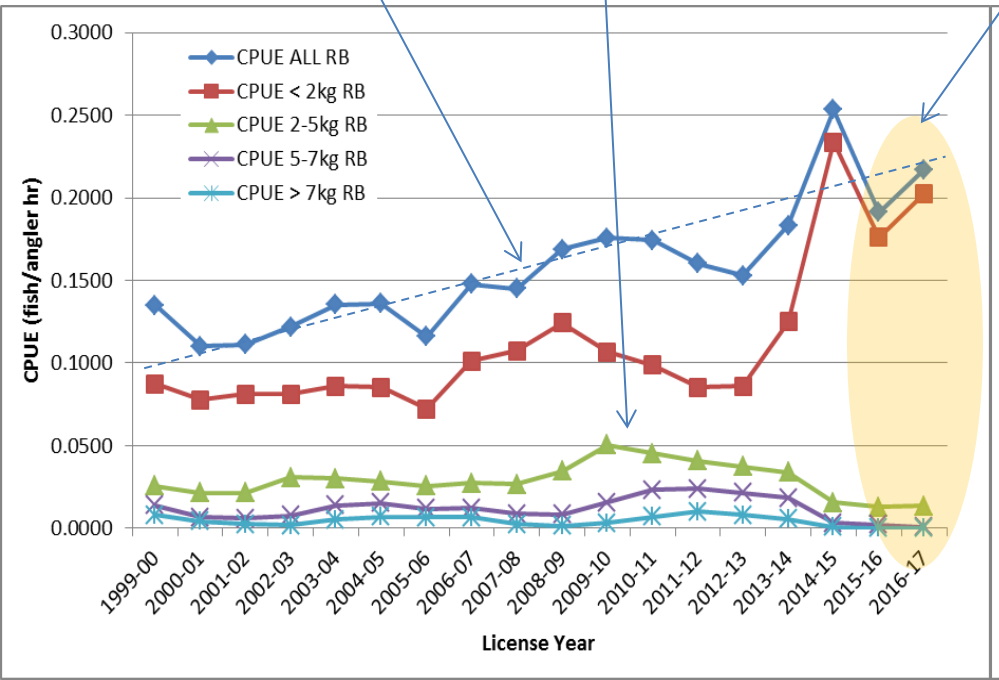
Rainbow Trout Catch Trends (KLRT)

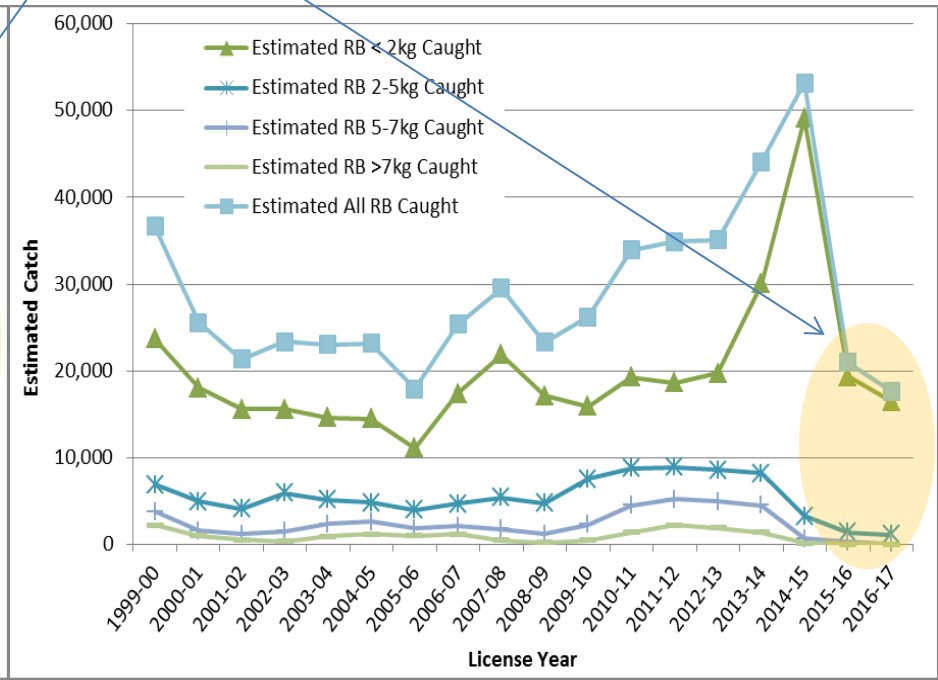
Large size classes now gone

general RB CPUE increase over time?

Recent departure between CPUE and catch trends

Catch now all small





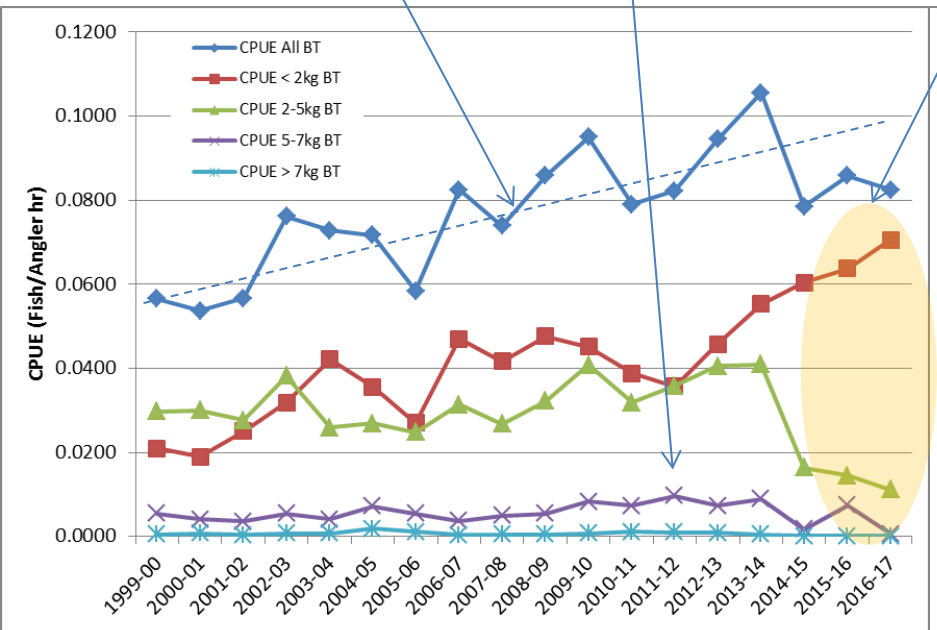
Bull Trout Catch Trends (KLRT)

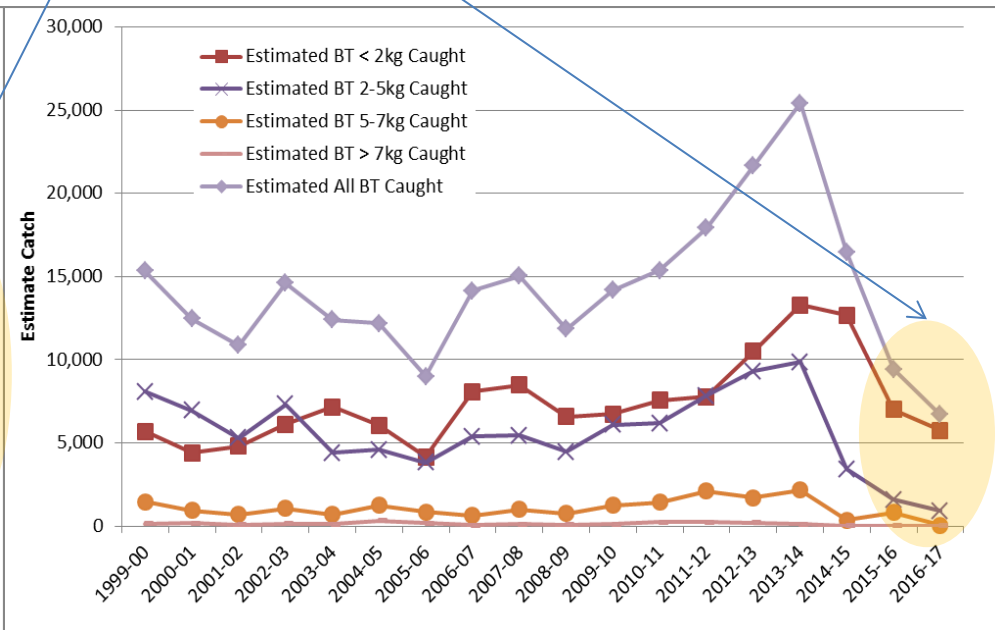
general BT CPUE increase over time?

Largest size classes now gone

Recent departure between CPUE and catch trends

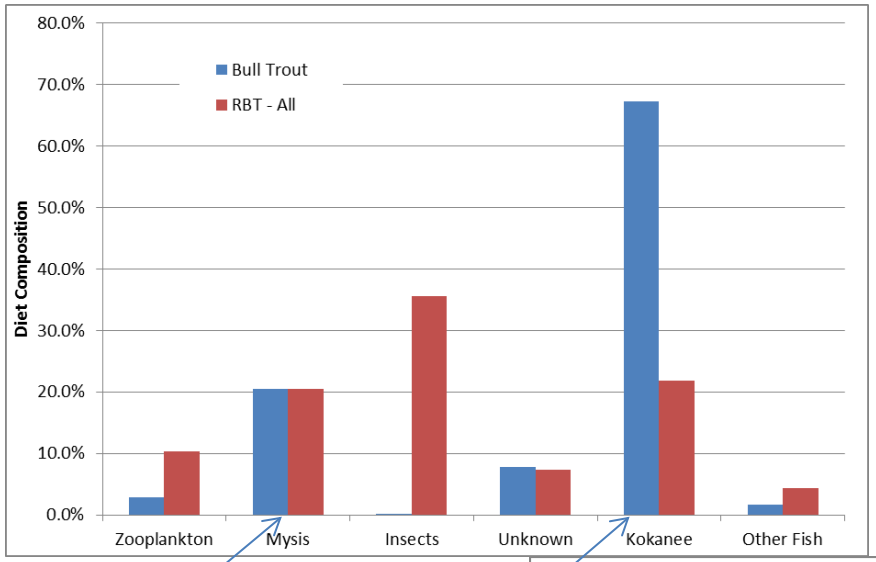
Catch now all small





Piscivore Monitoring (2015-17)

Diet Composition - % composition by mass



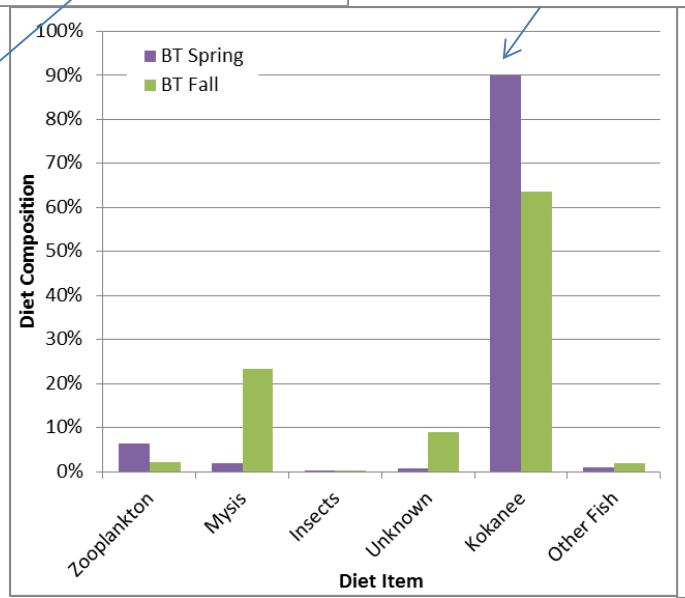
Seasonal shifts in diet apparent

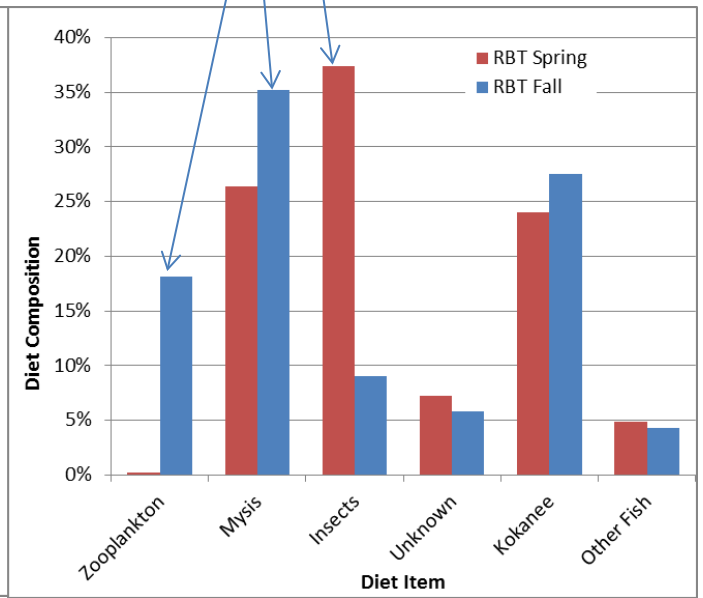
Kokanee - BT in spring: May 2018 (13 in one 2Kg fish, 92 in 11 fish)

Insects for RB in spring, mysis/zooplankton in Fall

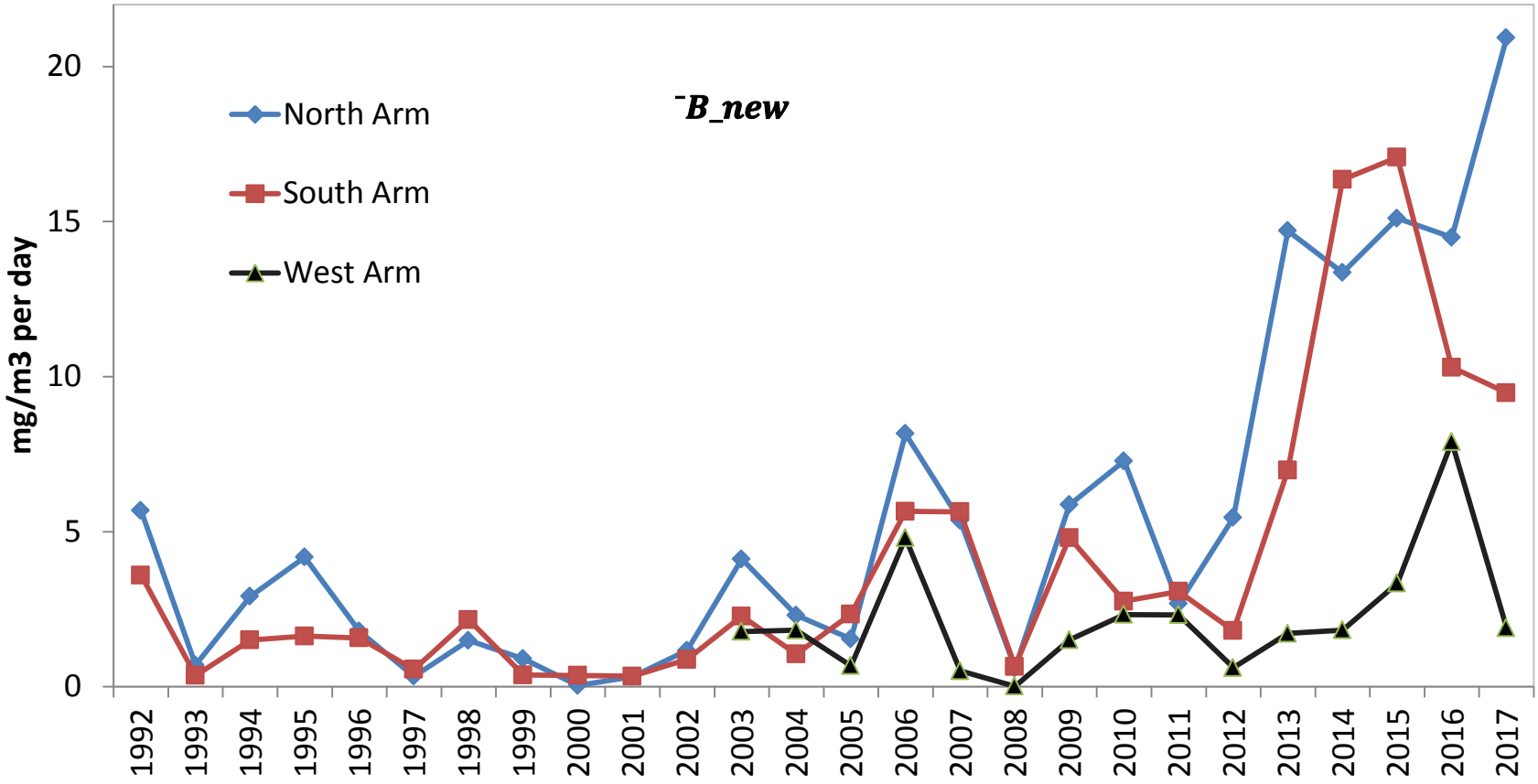
Mysis consumption

Kokanee most significant portion of BT diet; Insects most significant portion of RB diet



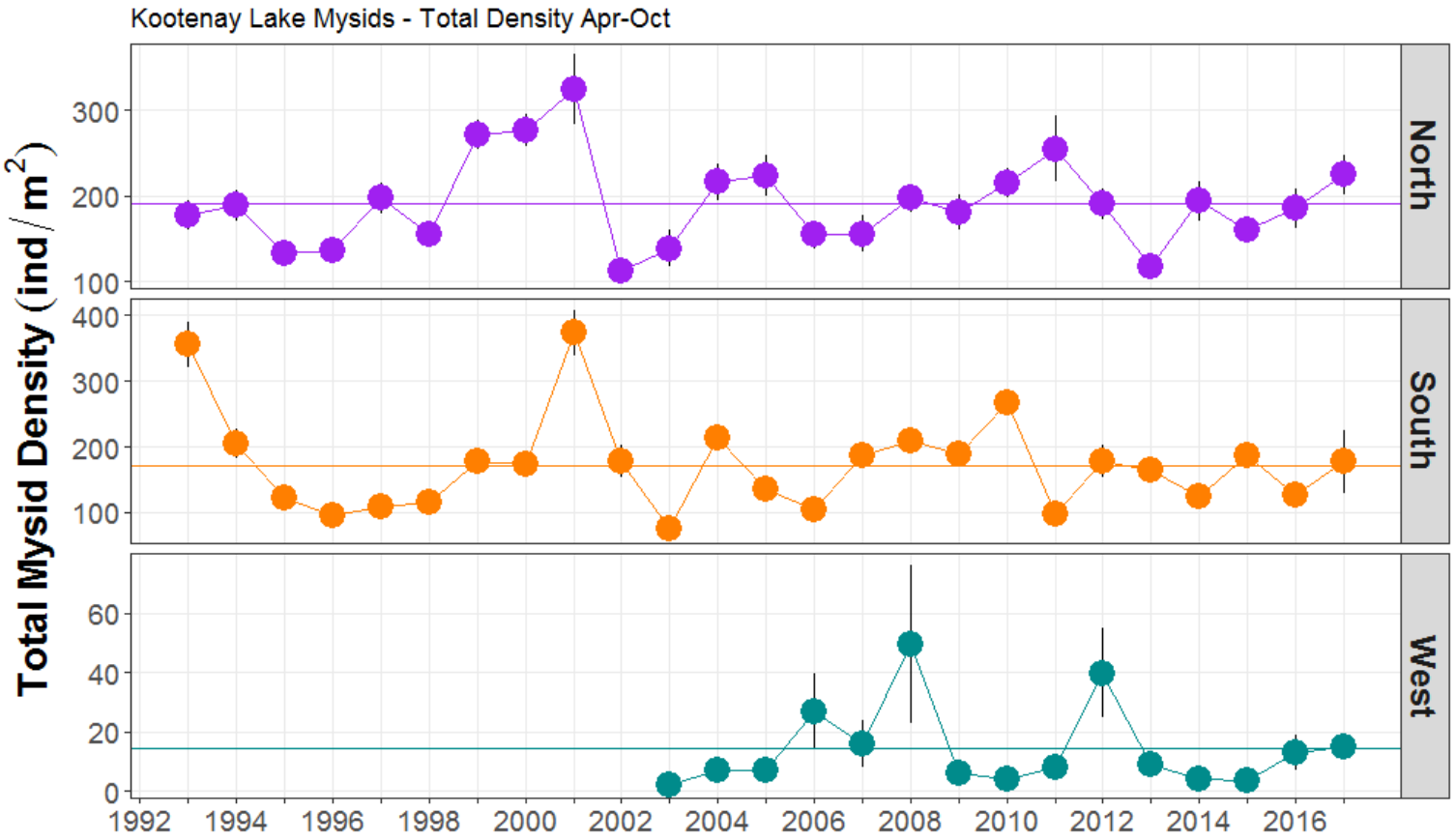


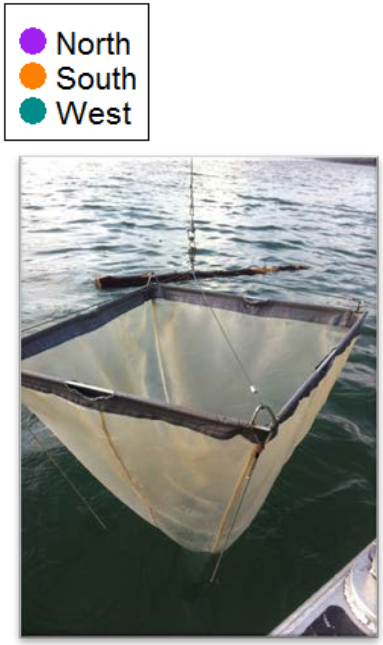
Zooplankton production - *Daphnia*



Kootenay Lake Results

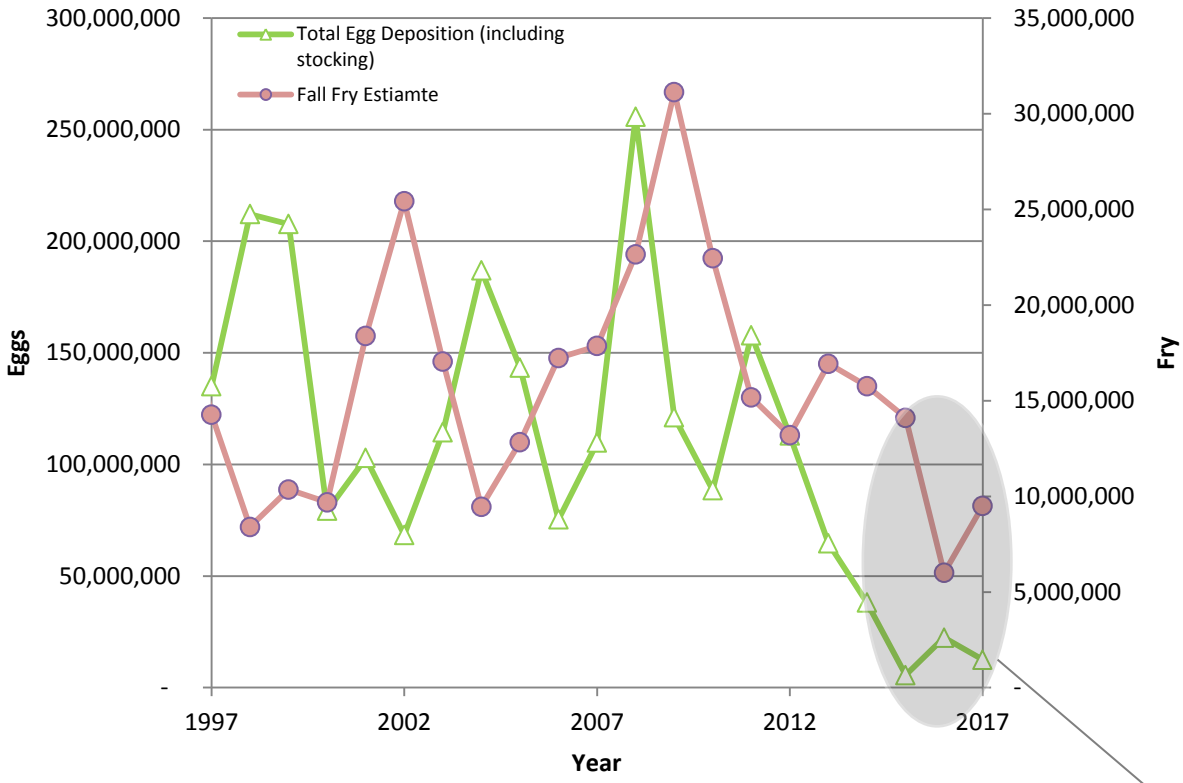
Mysids 1992-2017





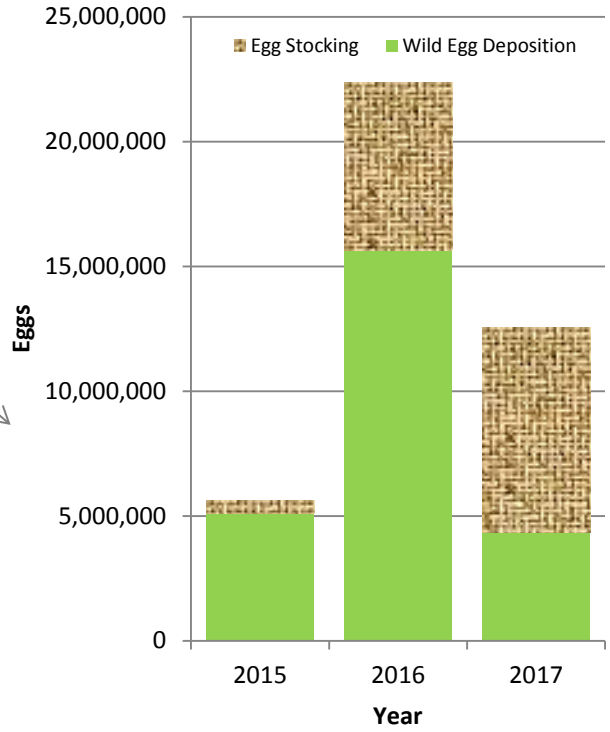
North
South
West

Action Update – Kokanee Supplementation



- Egg deposition crash (roughly tracks escapement) - Fry supply decreases, but not well outside historic lows (supply is OK?).

- Supplementation (egg stocking) significant contributor to overall egg supply (30-60% of all eggs) in the past two years



2016-2017 Final Report

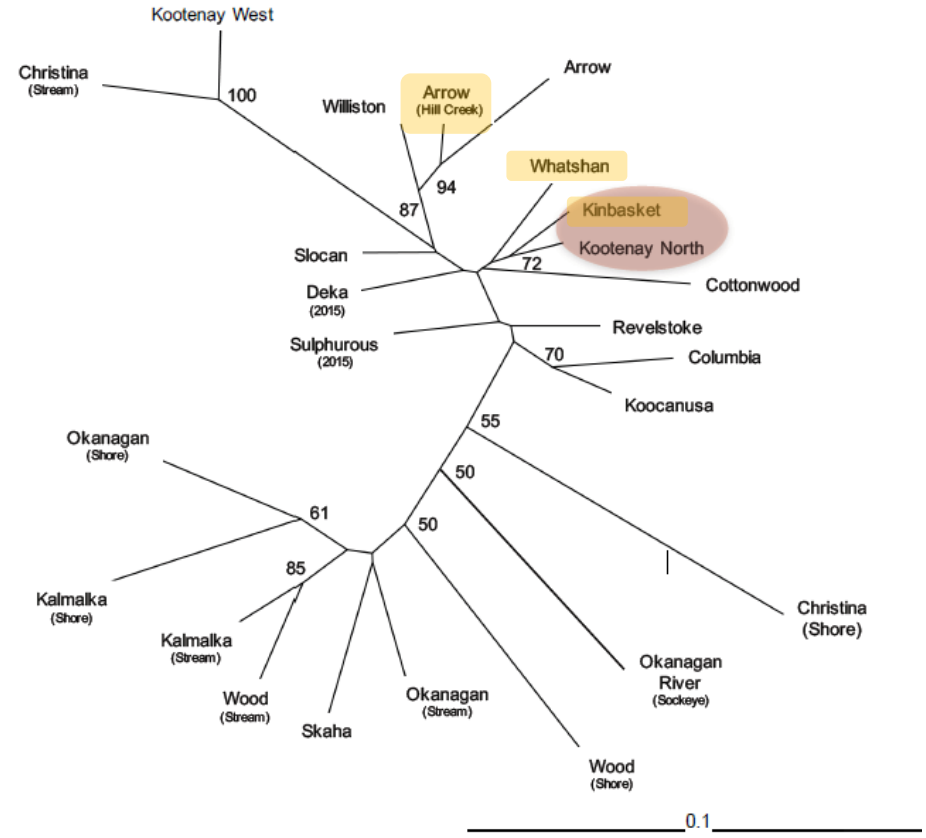


Figure 1. Unrooted neighbor-joining tree based on pairwise Cavalli-Sforza & Edwards (1967) chord distance. Nodes supported by >50 bootstrap values are indicated.

Table 3. Among-site differentiation between Kootenay Lake Meadow Creek and all other sites samples. Samples added this year indicated in *italics*.

Lake/River	Sampling Location	Kootenay Lake - Meadow Creek		
		F_{ST}[a]	*p*-value	significance[b]
Arrow Reservoir	*Burton Creek*	*0.1335*	*0.0006*	*
Arrow Reservoir	*Deer Creek*	*0.1382*	*0.0006*	*
Arrow Reservoir	*Drimmie Creek*	*0.1163*	*0.0006*	*
Arrow Reservoir	Hill Creek	0.0570	0.0002	*
Arrow Reservoir	*Mosquito Creek*	*0.1296*	*0.0006*	*
Arrow Reservoir	*Taite Creek*	*0.1126*	*0.0006*	*
Christina Lake	Sanders Creek	0.1280	0.0002	*
Christina Lake	Shore	0.2097	0.0002	*
Columbia River	Norns Creek	0.0732	0.0002	*
Cottonwood Lake	-	0.0653	0.0002	*
Deka Lake (2015)	Interior Plateau	0.0080	0.0044	NS
Kinbasket Reservoir	All[c]	0.0016	0.4211	NS
Kinbasket Reservoir	Bush Trawl	-0.0070	0.6605	NS
Kinbasket Reservoir	Columbia River	0.0065	0.2022	NS
Kinbasket Reservoir	Main Trawl	0.0053	0.4136	NS
Kinbasket Reservoir	Wood Trawl	0.0124	0.0437	NS
Koocanusa Reservoir	Lussier River	0.0481	0.0002	*
Koocanusa Reservoir	Norbury Creek	0.0428	0.0002	*
Kootenay Lake	*Crawford Creek*	*0.0104*	*0.6057*	NS
Kootenay Lake	*Goat River*	*0.0000*	*0.6640*	NS
Kootenay Lake	Lardeau River	0.0041	0.3111	NS
Kootenay Lake	Lower Duncan River	0.0009	0.7820	NS
Kootenay Lake	*Midge Creek*	*0.0920*	*0.0006*	*
Kootenay Lake	West Arm - Fisheries	0.1118	0.0002	*
Kootenay Lake	West Arm - Kokanee Creek	0.1503	0.0002	*
Kootenay	West Arm - Shore	0.1493	0.0002	*
Revelstoke Reservoir	*In Lake*	*0.0283*	*0.0006*	*
Revelstoke Reservoir	*Standard Creek*	*0.0201*	*0.0006*	*
Slocan Lake	Bonanza Creek	0.0352	0.0002	*
Slocan Lake	Wilson Creek	0.0270	0.0002	*
Sulphurous Lake (2015)	Interior Plateau	0.0252	0.0002	*
Whatshan Reservoir	Arrow Watershed	0.0097	0.0103	NS
Willistin Reservoir	Osolinka River	0.0544	0.0002	*

[a] Weir and Cockerham (1984) unbiased estimator of F_{ST} (θ)

[b] Indicative adjusted nominal level (5%) for multiple comparisons is : 0.000198

[c] Given small sample sizes of trawls, Kinbasket reservoir analyzed with all samples pooled and unpooled

Bull Trout Spawners – Potential Surplus/Production Needs

Kaslo and Keen				All Kootenay Lake Tribs		
2017 redds	477					
2017 spawners	1049	Surplus (n)	Surplus (%)	3421	Surplus (n)	Surplus (%)
Spawners required for 5 redd/km	387	662	63%	1262	2159	63%
Spawners required for 7.5 redd/km	581	469	45%	1893	1528	45%
Spawners required for 10 redd/km	774	275	26%	2525	896	26%

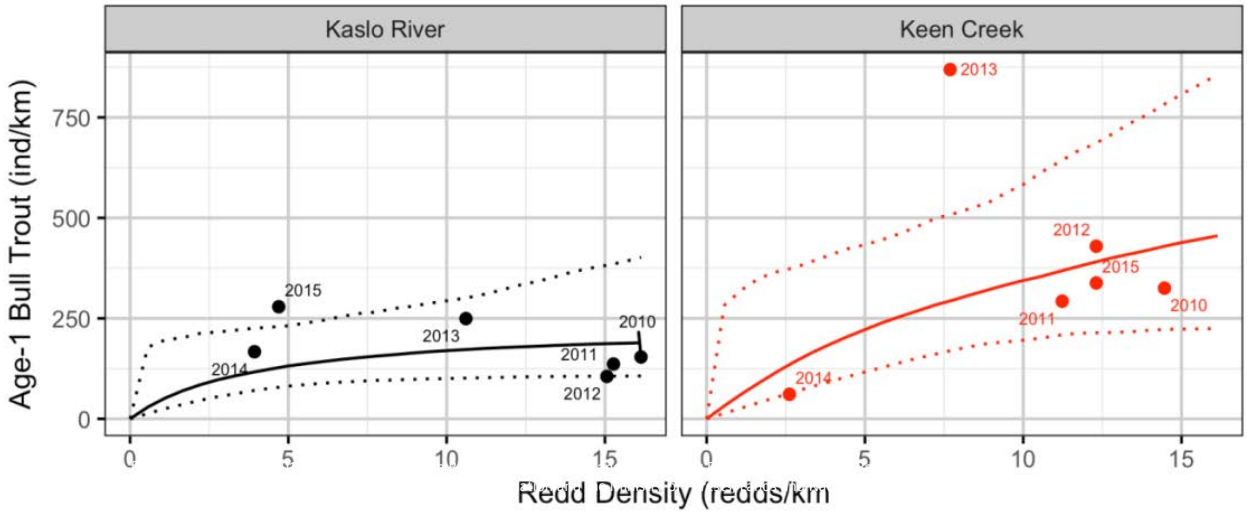


Figure from - Andrusak, G.F. 2018. Draft Kootenay Lake Bull Trout Productivity and Capacity for Defining Management Reference Points-CAT # 17-4-465-2017. Prepared for the Habitat Conservation Trust Foundation and the Ministry of Forests, Lands and Natural Resource Operations, Nelson, BC. January 2018. 32 pp+

Reconstructing Predator Abundance

Numbers at Age in 2011 (Andrusak et al.)

Parameter	Estimate
Total > age 4	67,590
Age 1	126,600
Age 2	82,310
Age 3	53,920
Age 4	35,590
Age 5	16,920
Age 6	8,151
Age 7	3,979
Age 8	1,968
Age 9	985

KLRT Catch Time Series 2010-2011

	< 2kg RB	2-5kg RB	5-7kg RB	> 7kg RB	Sum
RB Catch	19,249	8,793	4,487	1,375	33,904

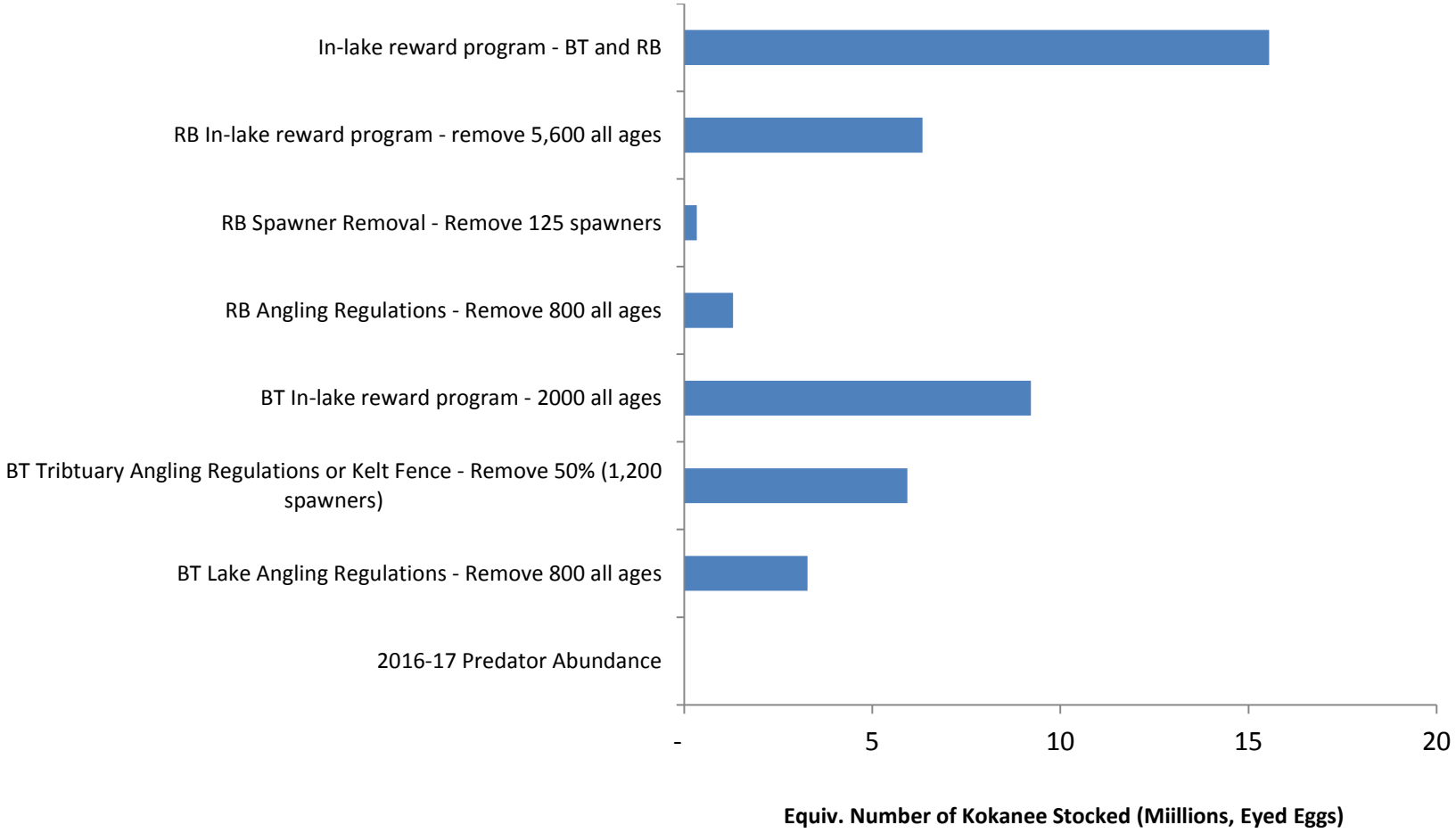
- Assumptions about vulnerability to angling at age: RB - 50% Age 3, 100% Age 4+

  → Total Vulnerable Population = 93,568

BT - 50% Age 4, 100% Age 5+

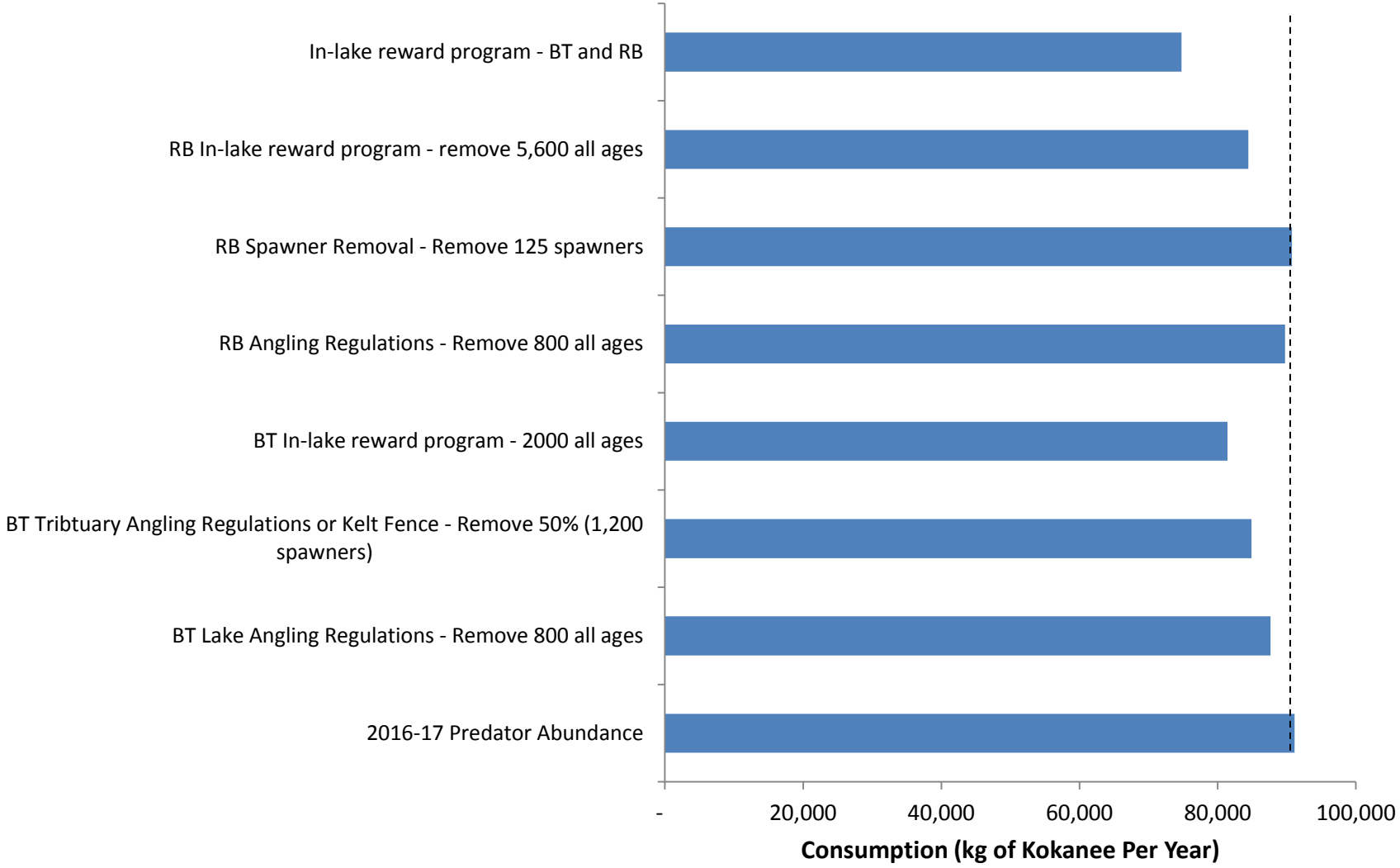
- Catch is an index of abundance → $C = qN$

Predator Management Options– Potential Kokanee Benefit

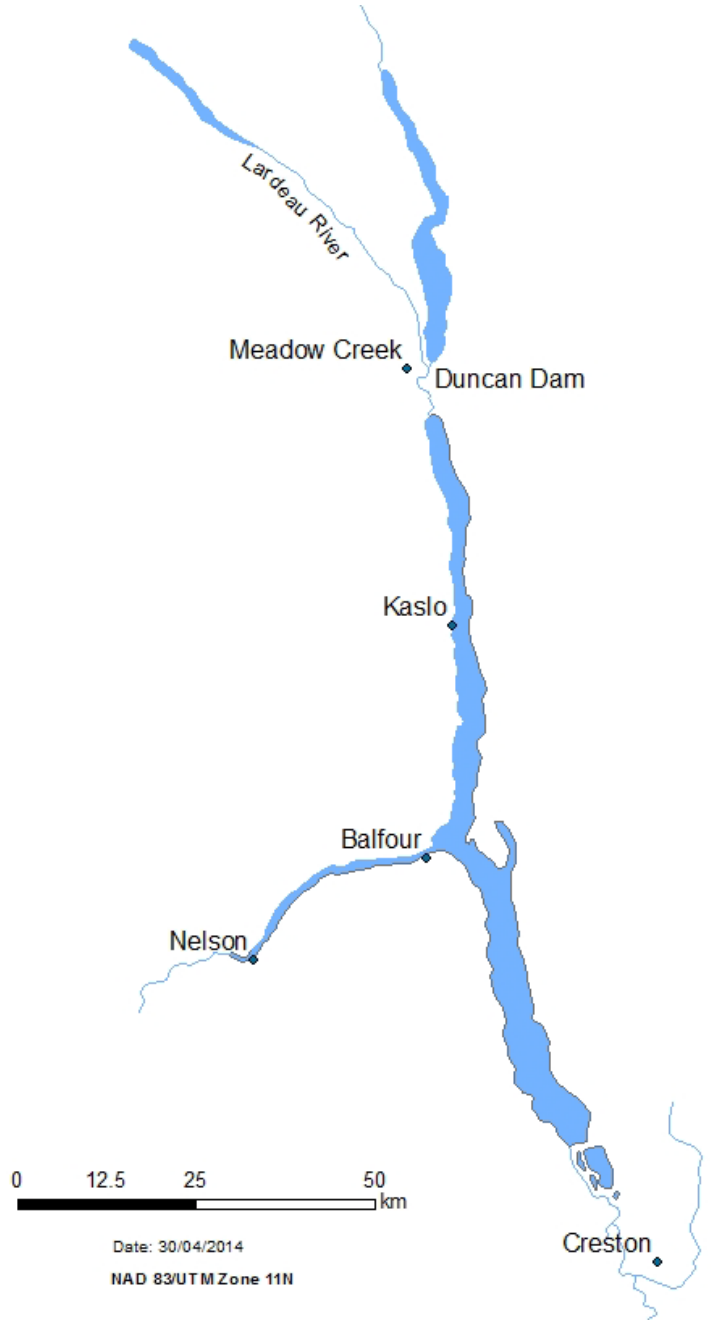


Assumes 35% EE to Fall Fry Survival: might be an underestimate

Predator Management Options – Total KO consumption change



Main Lake vs West Arm



Current Angling Regulation Proposals

- Duncan River harvest opportunities
  - Regulation proposal to open the Duncan River to angling starting in Fall 2018; daily quota=2
- North Arm of Kootenay Lake geographic closure change
  - Regulation proposal to remove the north end of Kootenay Lake geographic seasonal closure to all angling; open with rainbow trout release to avoid spawning Gerrard mortality