THOMPSON RIVERS UNIVERSITY

BRITISH COLUMBIA | Ministry of Forests, Lands & Natural Resource Operations

Ecology and control of invasive Northern Pike in the Columbia River, Canada

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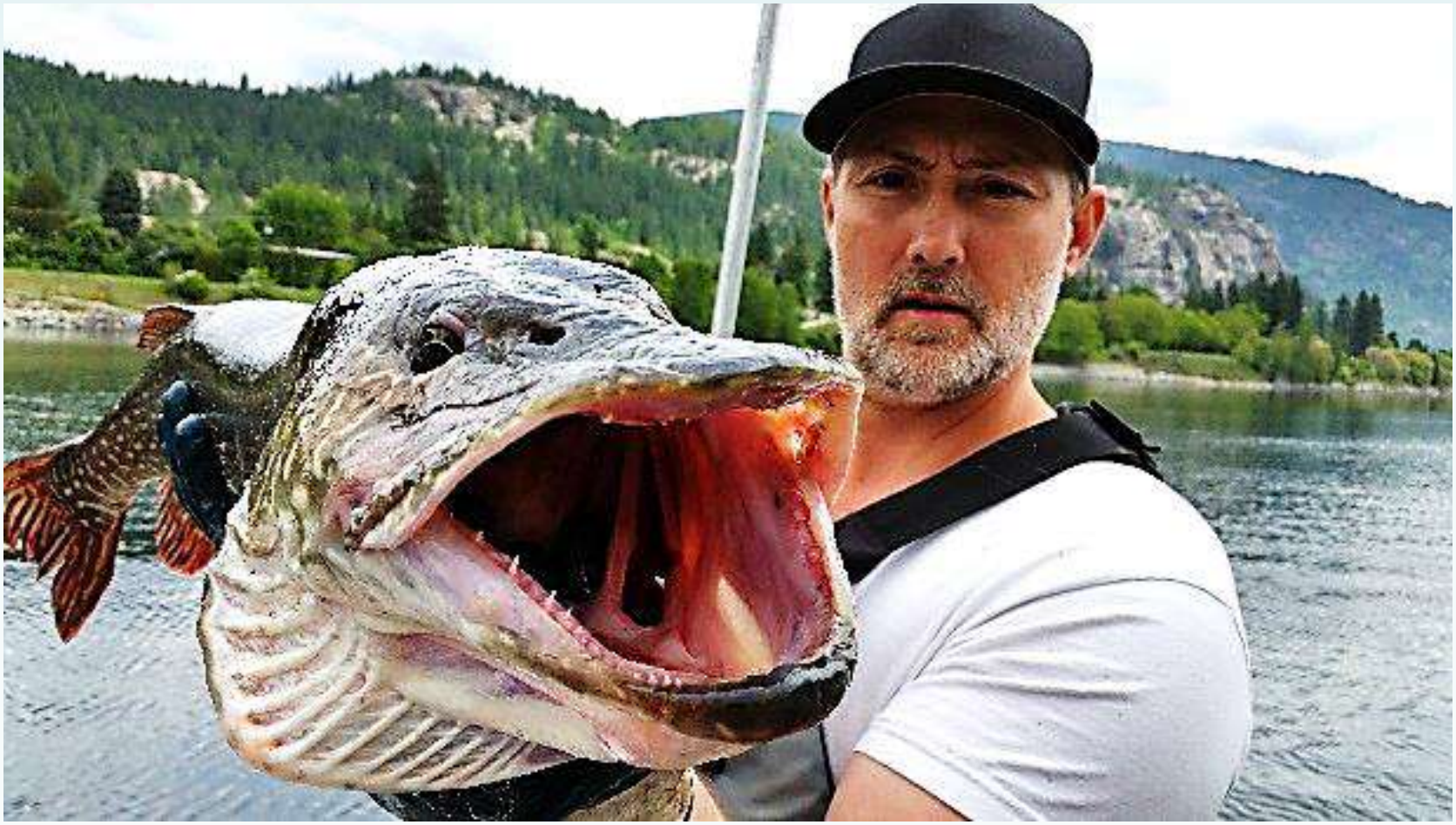
Outline of this talk:

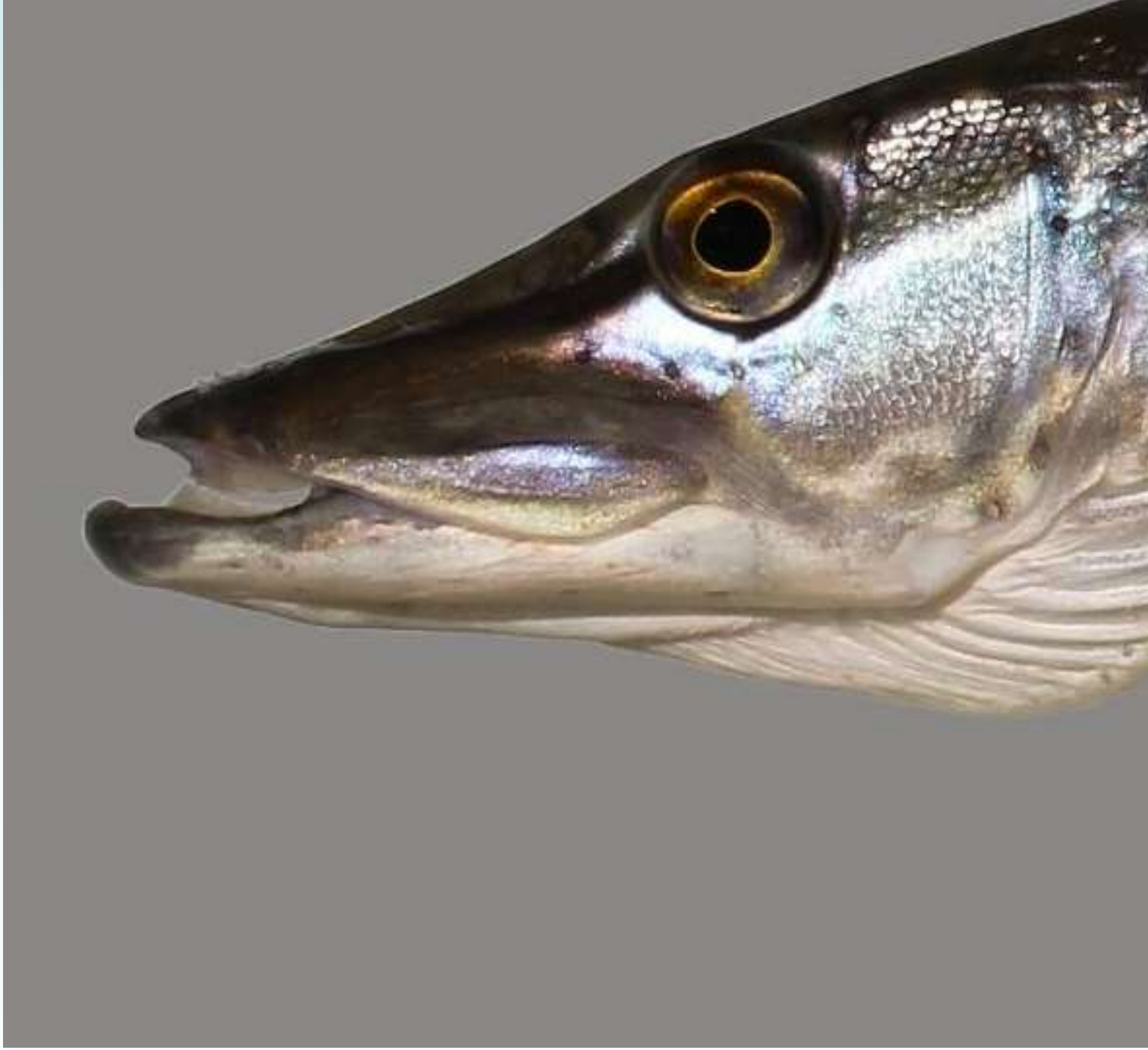
1. Pike biology: feeding, spawning
2. What's the problem? – native salmonids
3. Control: Gill netting and angler incentive programs
4. Results of the gill netting efforts
5. Current research on Northern pike in the Columbia (telemetry, otolith microchemistry, eDNA, cleithra ageing, spawning)
6. Conclusions

Northern Pike biology

- Non-native, invasive species in southeastern BC
- Illegal introductions into US portion of Pend d'Oreille River has led to colonization of Columbia River
- Threaten native fish species through predation, competition, and introduction of disease

Northern pike diets include:





Alaskan Northern pike containing juvenile salmon

http://akssf.org/

Northern Pike Spawning

- Optimal habitat within grasses and sedges in shallow, sheltered areas

- Occurs following spring freshet when water temperatures reach 8 – 12°C

- Females produce 15,000-60,000 eggs

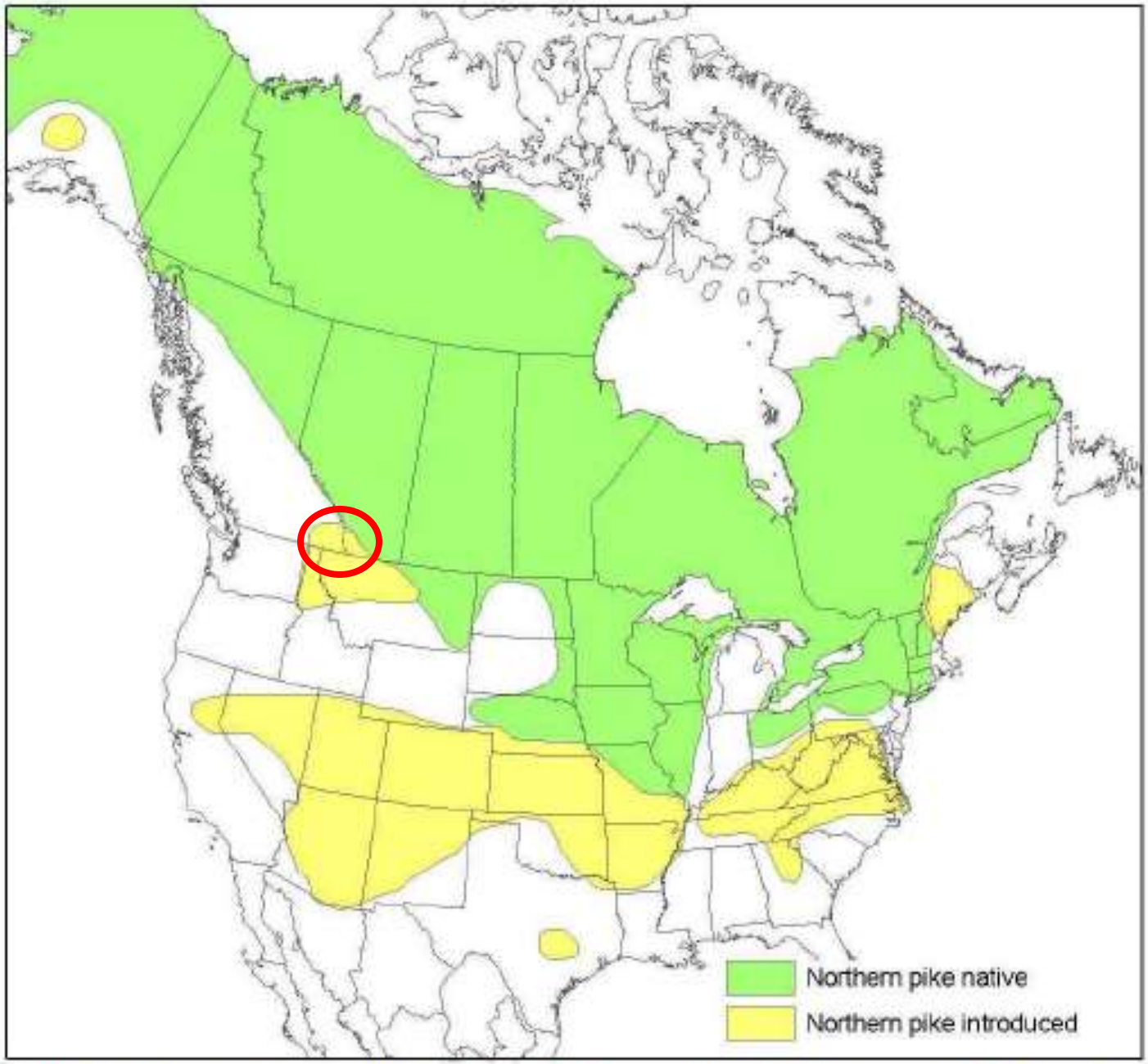
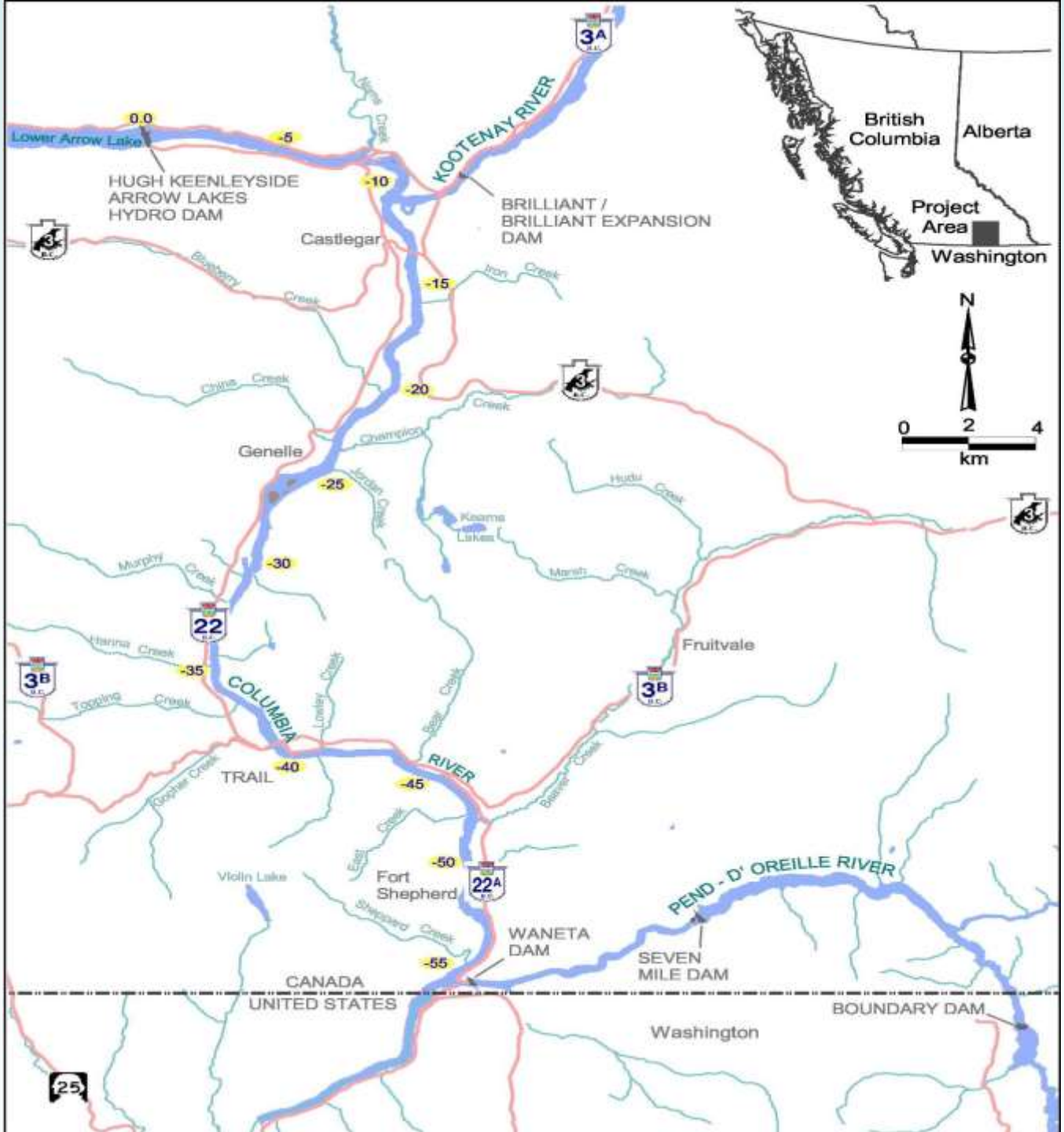


Figure 2. The North American distribution of northern pike from Bradford et al. (2008).


Lower Arrow Lake
0.0
-5
-10
-15
-20
-25
-30
-35
-40
-45
-50
-55
HUGH KEENLEYSIDE
ARROW LAKES
HYDRO DAM
KOOTENAY RIVER
BRILLIANT /
BRILLIANT EXPANSION
DAM
Castlegar
Genelle
Fruitvale
TRAIL
COLUMBIA
RIVER
Fort
Shepherd
WANETA
DAM
SEVEN
MILE DAM
PEND - D' OREILLE RIVER
BOUNDARY DAM
CANADA
UNITED STATES
Washington
Blueberry Creek
Iron Creek
China Creek
Champion Creek
Jordan Creek
Hudu Creek
Keoma Lakes
Marsh Creek
Murphy Creek
Harina Creek
Topping Creek
Lowley Creek
Bear Creek
Gopher Creek
Violin Lake
East Creek
Shepherd Creek
Beaver Creek
3A
3K
3B
22
22A
25
British
Columbia
Alberta
Project
Area
Washington
N
0
2
4
km

Threatened species:

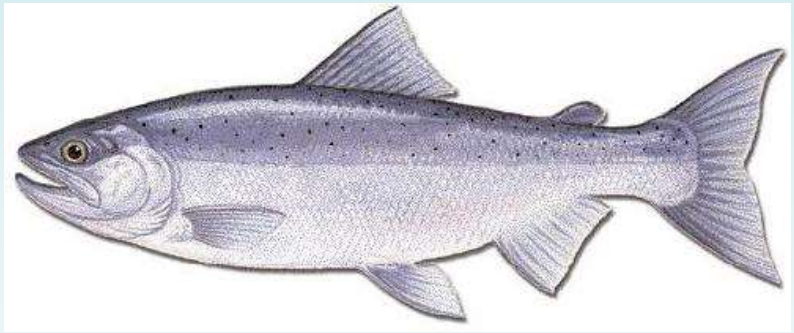
- Potential to significantly impact native salmonids, dace and sculpin species in the Lower Columbia R.

- Impact species-at-risk work being conducted on White Sturgeon (1), Umatilla Dace (2), and Shorthead Sculpin (3)

1)

2)

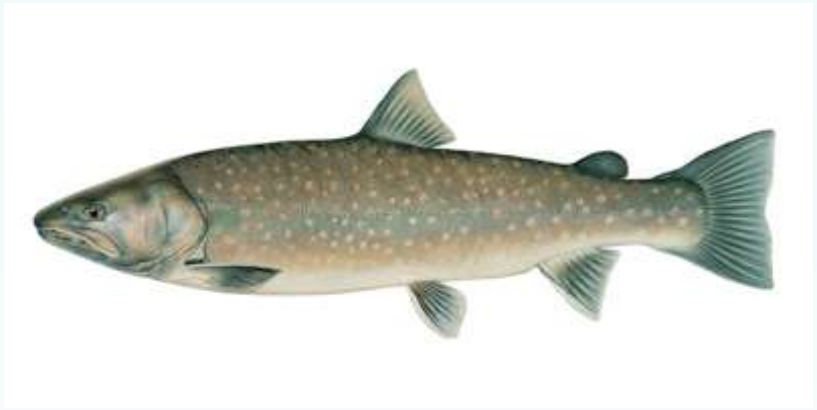
3)



Kokanee
(*Oncorhynchus nerka)*

Mountain Whitefish
(*Prosopium williamsoni)*

Westslope Cutthroat Trout
(*Oncorhynchus clarkii*)



Bull Trout
(*Salvelinus confluentus*)


BC
Okanagan Lake
KELOWNA
PENTICTON
VANCOUVER
Osoyoos Lake
Okanogan
River
SEATTLE
WA
ID
Columbia River
PORTLAND
OR

LCR Pike Suppression Program

- In 2014, MFLNRO and Teck Metals Ltd. implemented the Invasive Northern Pike Suppression Program

- Program includes active removal of pike through gill-netting, and limited PIT tagging

- Gill-netting efforts in 2015 focused in the Robson's Reach area immediately downstream of the Hugh L. Keenleyside Dam

Gill netting in the Robson Reach of the Columbia River, Aug. 2015

Fishing policy in the Columbia River (angler incentive program)

- Regulations were changed from pike fishing being illegal, to fishing allowed, with no catch limits (and anglers encouraged to kill all pike caught)

- In 2014 and 2015 anglers were offered a reward for turning in pike heads (if that head contained a PIT tag)

Results of the Columbia Pike Suppression Program

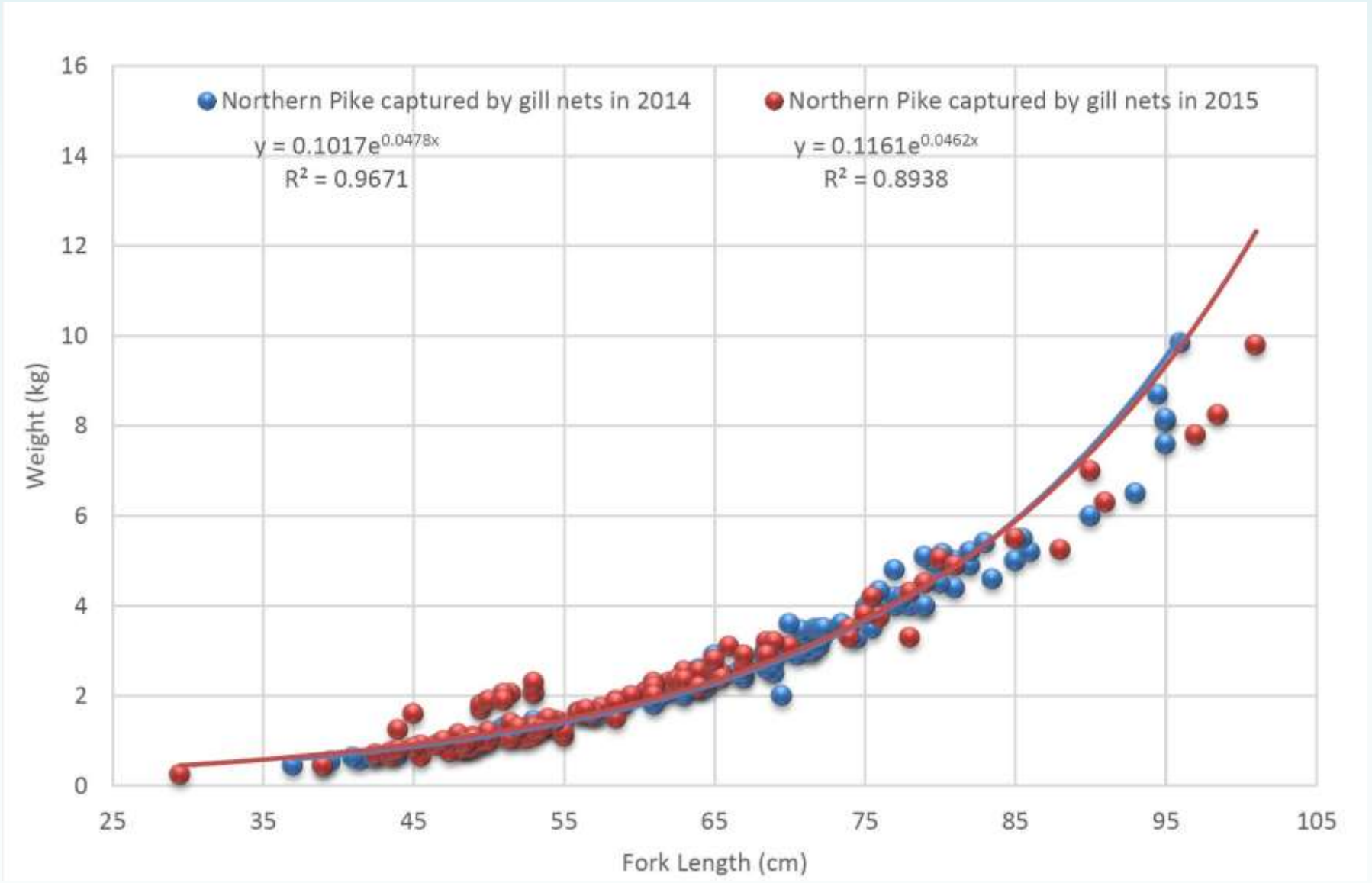
2014: -133 pike were caught, (all in the Robson's Reach part of the river)

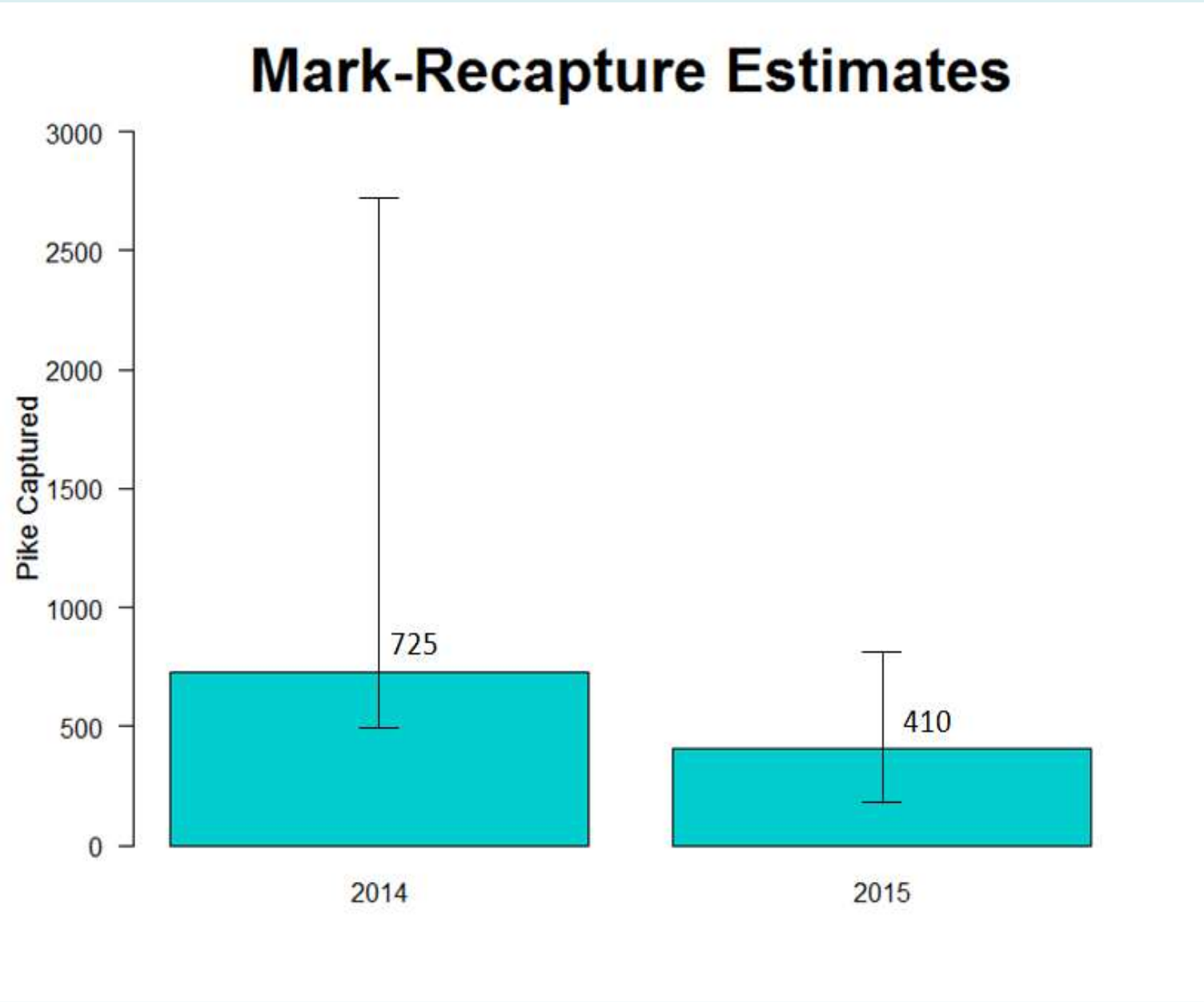
-30 heads from anglers

2015: -116 pike were caught

-11 heads from anglers

Lengths were 15% lower, and weights 33% lower in 2015 than in 2014




Mark-Recapture Estimates
Pike Captured
3000
2500
2000
1500
1000
500
0
725
410
2014
2015

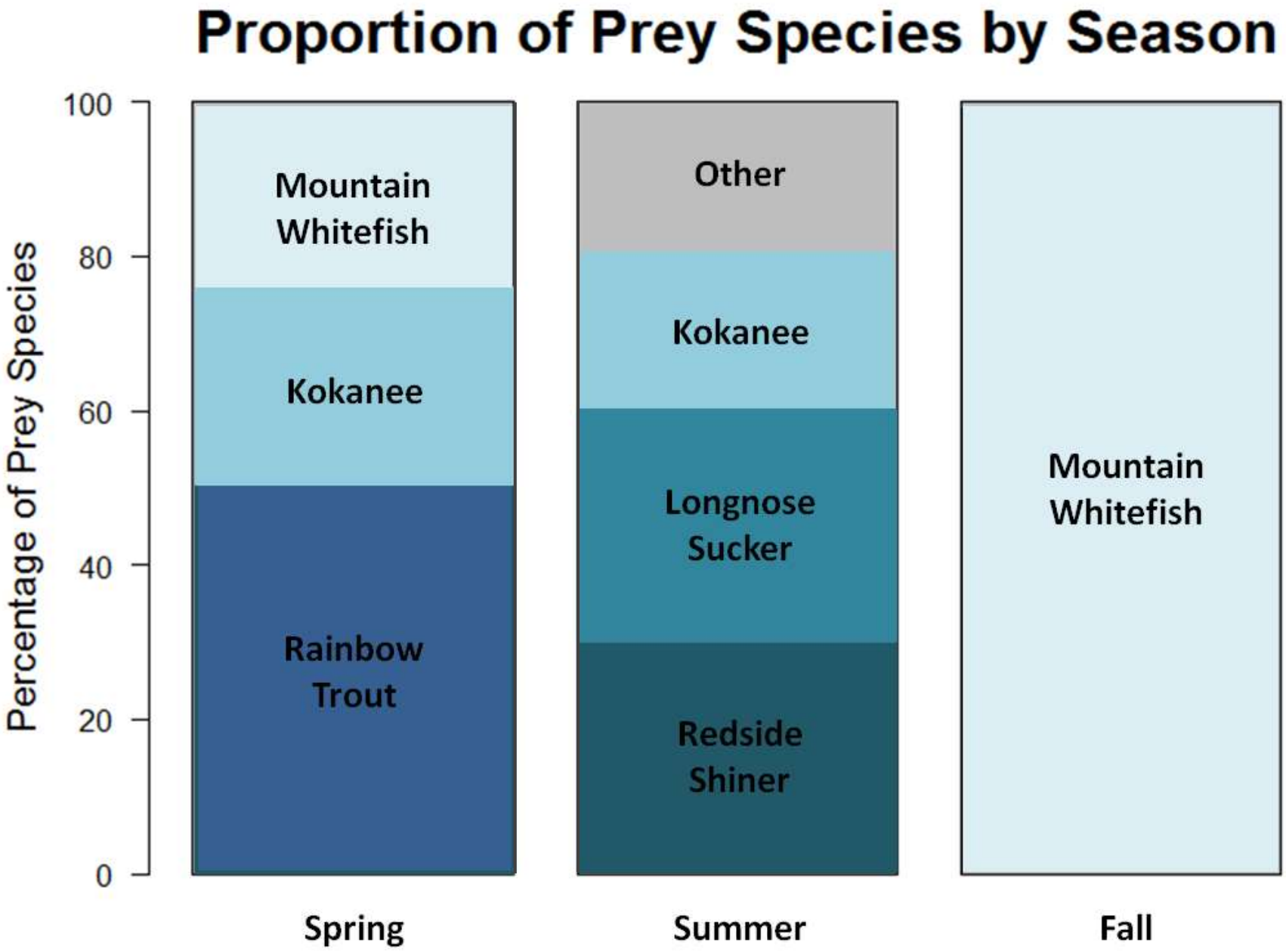
Pike densities, as indicated by CPUE, did not change between years

Year	NP CPUE/hr per net	NP CPUE/8hr net	NP Total	NP Per day (8 nets)
2014	0.19	1.50	133	11.98
2015	0.20	1.62	129*	12.93

*total includes all NP caught by gill-nets. Fish marked and released (11), fish euthanized (116), & fish lost at net (2).

Diet Analysis

- Only 37% of pike contained food
- 55% were native salmonid species (rainbow trout, mountain whitefish, and kokanee)
- Remainder consisted of dace spp., sculpin spp., redside shiner, longnose sucker, northern pikeminnow, northern pike, and invertebrates


Proportion of Prey Species by Season
Percentage of Prey Species
100
80
60
40
20
0
Mountain Whitefish
Kokanee
Rainbow Trout
Other
Kokanee
Longnose Sucker
Redside Shiner
Mountain Whitefish
Spring
Summer
Fall

TRU Research Objectives

- Determine life history of pike in Columbia and Pend d'Oreille Rivers
- Locate spawning sites and source populations for Columbia River population
- Determine the risk of passage of Northern Pike into other areas and tributaries of the Columbia, and sample eDNA

Juvenile Studies

- To date attempts to capture juvenile Northern Pike in the Columbia have been unsuccessful

- Our telemetry research will aim to locate spawning areas to target for juvenile capture

- The Okanogan Nation Alliance will be conducting a juvenile study in 2016 using this information

Acoustic Telemetry

- Northern Pike will be tracked with acoustic transmitters to locate crucial habitat

- 15 pre-spawn mature Northern Pike will be surgically tagged and monitored over the 2016/2017 seasons

Transponding Hydrophone

VR100 Receiver

Otoliths

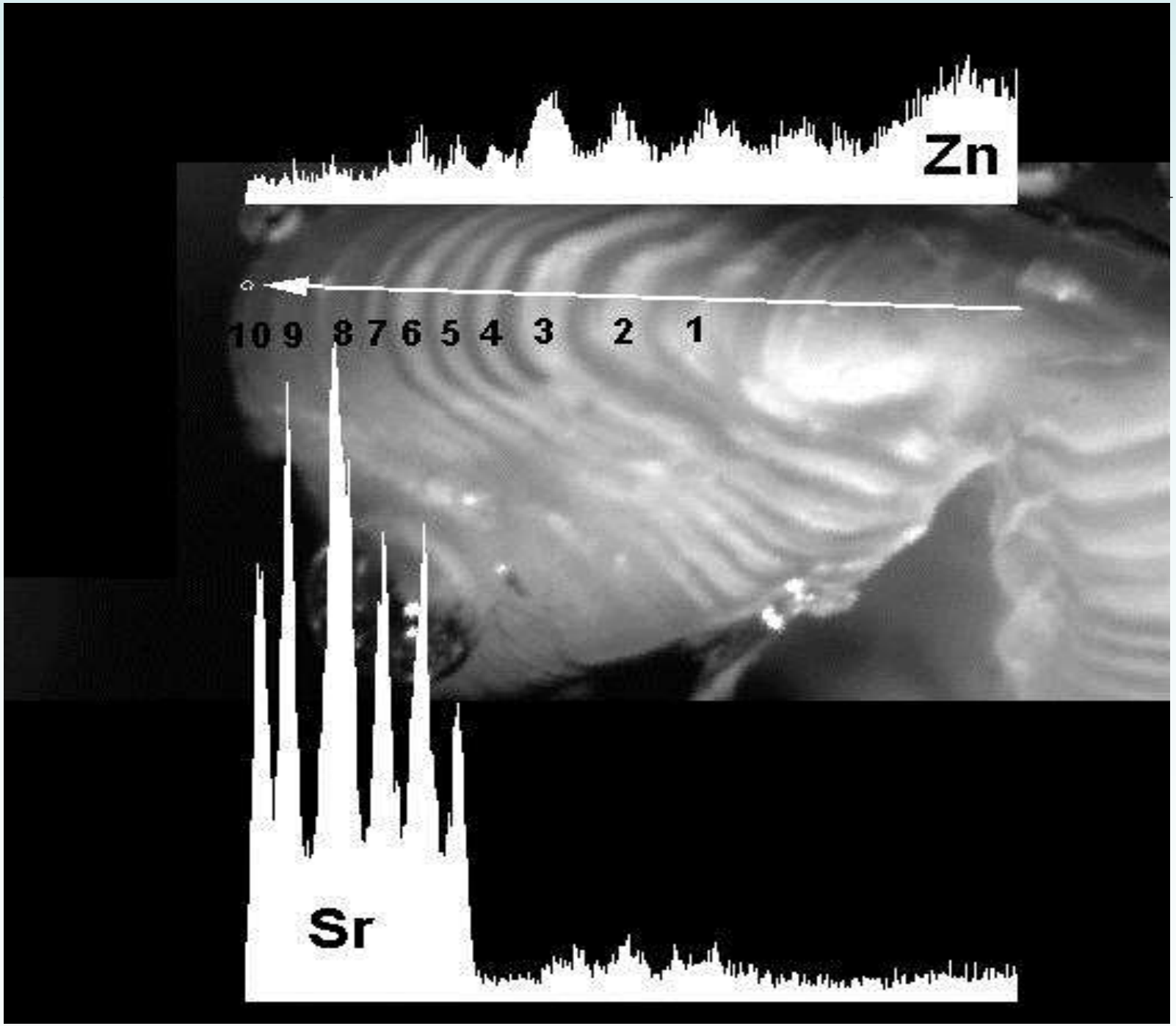
- Paired calcified structures in the inner ear of all bony fish

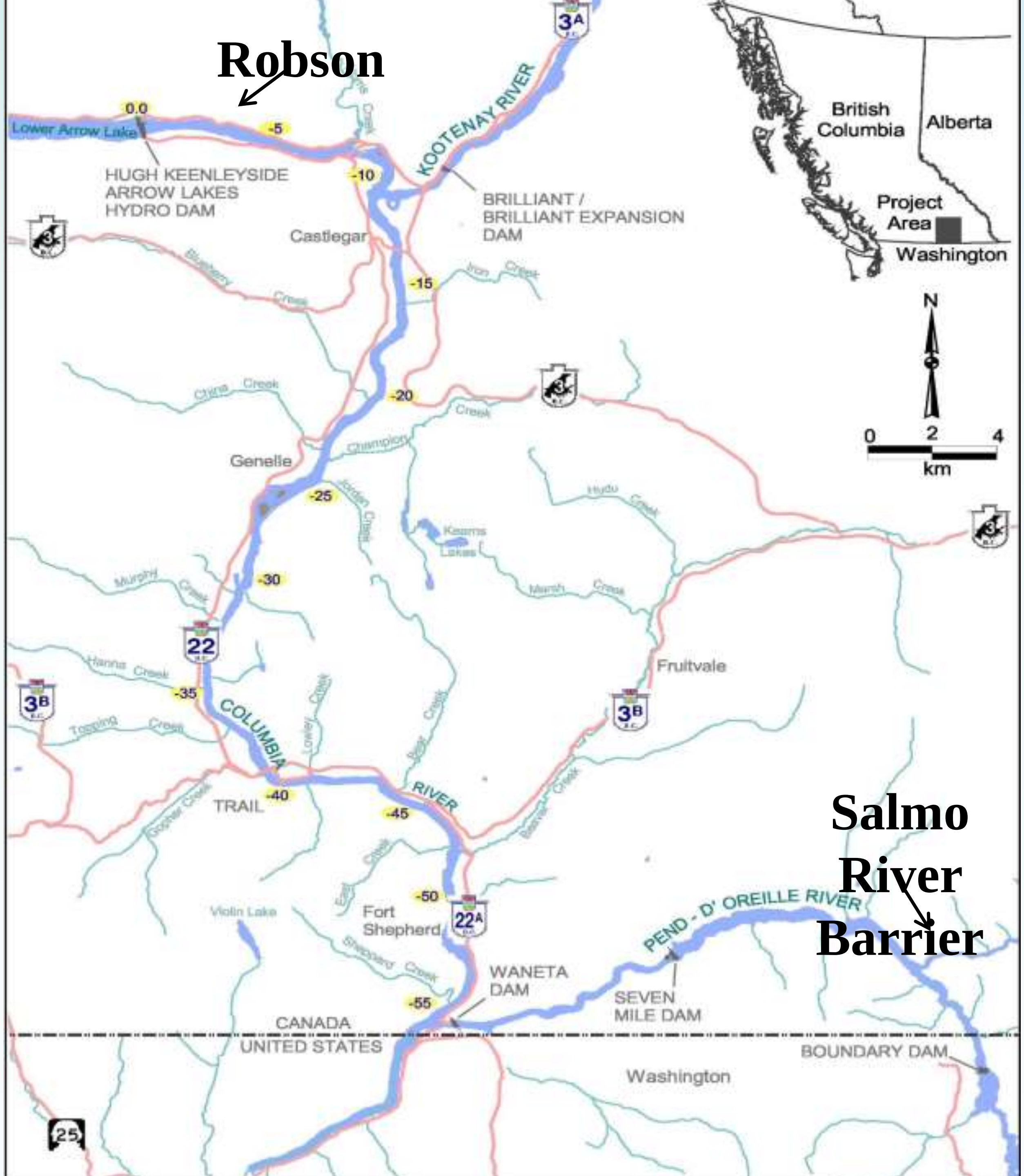
- Formed by continuous deposition of $CaCO_3$ and trace elements from the environment

- Elements within the matrix are retained throughout the life of the fish

Otolith Microchemistry

- Differences in water chemistry between areas can leave elemental “signatures” within the otolith matrix
- Elements can be measured (laser ablation inductively coupled plasma mass spectrometry) and compared to regional water chemistry to determine the geographic life history of individual fish
- This information will help determine where the fish have been, including their natal water body


Zn
10 9 8 7 6 5 4 3 2 1
Sr


Robson
Salmo River Barrier
Lower Arrow Lake
0.0
-5
-10
-15
-20
-25
-30
-35
-40
-45
-50
-55
HUGH KEENLEYSIDE ARROW LAKES HYDRO DAM
KOOTENAY RIVER
BRILLIANT / BRILLIANT EXPANSION DAM
Castlegar
Genelle
Fruitvale
TRAIL
COLUMBIA
RIVER
Fort Shepherd
WANETA DAM
SEVEN MILE DAM
PEND - D' OREILLE RIVER
BOUNDARY DAM
CANADA
UNITED STATES
Washington
British Columbia
Alberta
Project Area
Washington
N
0
2
4
km
3A
22
22A
3B
25

Hugh L. Keenleyside Dam

- Last physical barrier before Arrow Lakes
- Northern Pike have colonized Robson's Reach directly upstream of dam
- Dam contains a navigational lock that allows daily access of commercial and pleasure craft

HLK Dam Navigational Lock

Salmo River

- Largest Canadian tributary of the Pend d'Oreille River

- Provides recreational fisheries for rainbow trout, bull trout (Blue listed), mountain whitefish, cutthroat trout, and eastern brook trout

Salmo River Fish Barrier

Barrier during low discharge. Note the full height of the barrier (≈1.5m) is exposed.

Barrier during high discharge. Note the barrier is submerged and inner bank is flooded

Environmental DNA Detection

- eDNA is an attractive non-invasive surveillance technique for monitoring rare or invasive species
- DNA sampled directly from environmental sample such as water, DNA isolated and identified to determine species present in sample
- We aim to test the efficacy and limitations of eDNA detection to monitor the presence and spread of northern pike in the Columbia River

Conclusions

1. Pike are eating salmonids in the Columbia River, and could move downstream

2. A control program using gill netting is reducing numbers, but the pike population is still large

3. Research this summer aims to provide spawning locations, age of fish, and the geographical history of pike in the Columbia River system

Thank-you, and suggestions