

Wild Fish Conservancy
N O R T H W E S T

Genetic Population Structure of Rainbow Trout in upper Icicle Creek

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Wild Fish Conservancy
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Icicle Research Project

Baseline Data Collection: 2007 - 2010



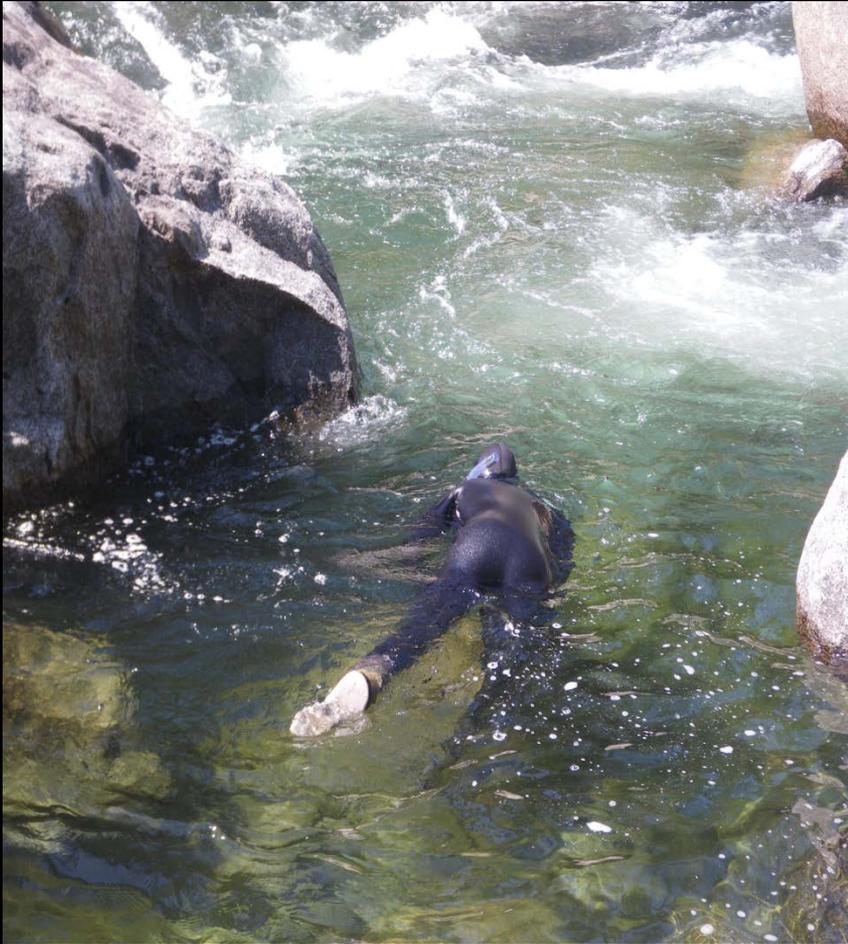
Partners in WFC Icicle Creek Research Project

- NOAA Fisheries, Dr. Gary Winans
- University of Idaho, Dr. Brian Kennedy
- Flathead Lake Biological Station, U. of MT
- Generously supported by the Icicle Fund

Project Objectives

- Establish baseline ecology of upper Icicle Creek rainbow and bull trout populations in advance of anticipated recolonization of upper Icicle by steelhead and migratory bull trout
- Evaluate productivity of upper Icicle for RBT
- Include comparison of ecology of Chiwaukum Creek

Upper Icicle Research: Rainbow



- Fish habitat use
- Fish genetics
- Fish size, growth & diet (gut contents)
- Fish numbers
- Habitat characteristics
- Food web:
 - invertebrates
 - nutrients
 - trophic relations

Upper Icicle Research: Key Questions

- How abundant are rainbow trout ?
- How fast do they grow ?
- Genetics: how many populations? How are they related to Wenatchee steelhead?

Study of
Size-
Related
Properties
of
Rainbow
Trout



Methods: Upper Icicle and Chiwaukum

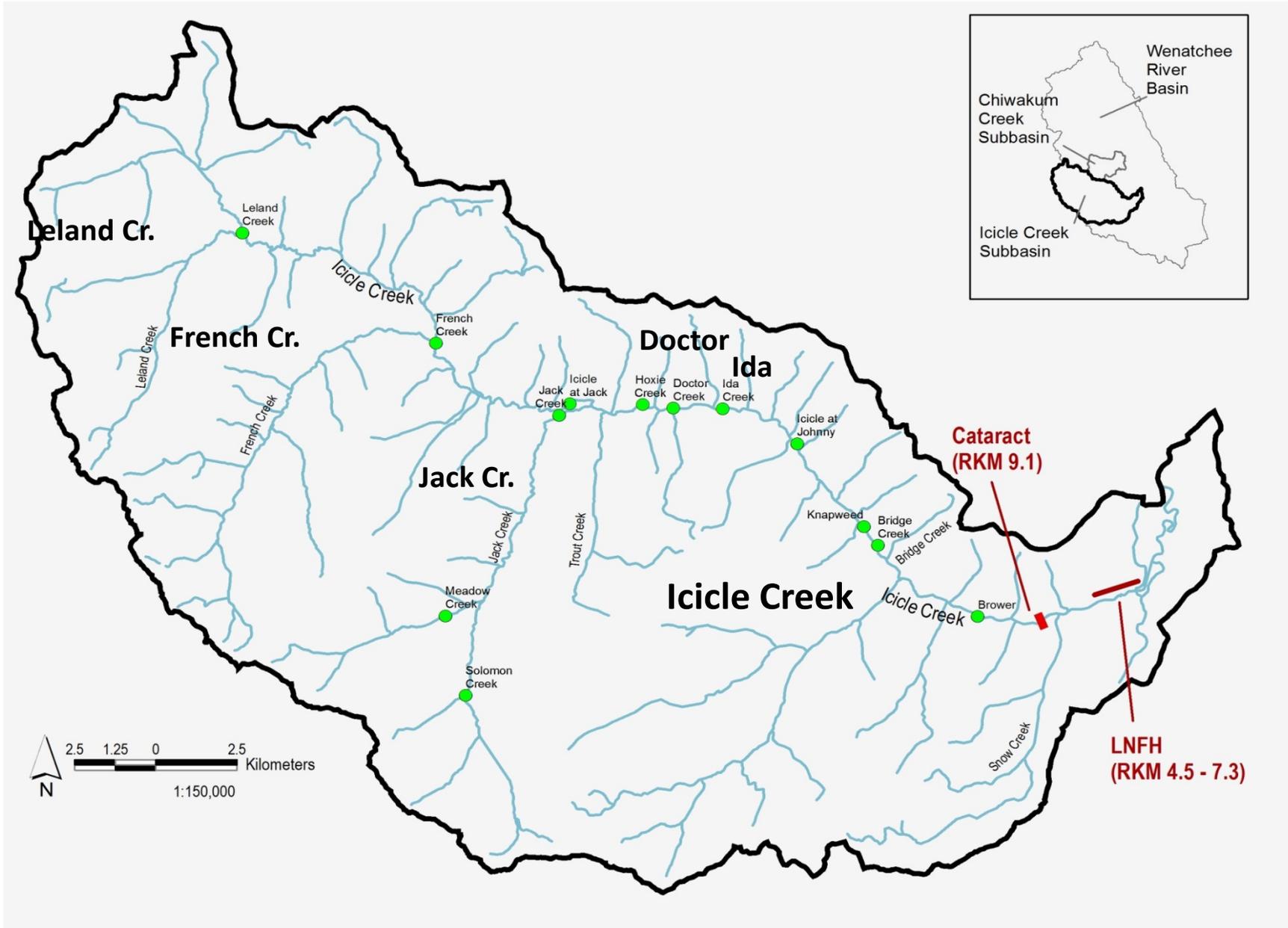
- Repeated sampling at 3 mainstem and one tributary (Jack Cr.) study site:
- Abundance, diet, scale samples, growth rate
- DNA sampling: over 1200 upper Icicle, 260 Chiwaukum Creek
- Annual snorkel counts French Creek to IPID 2007 to 2010

Fish Data Collected at Study Sites

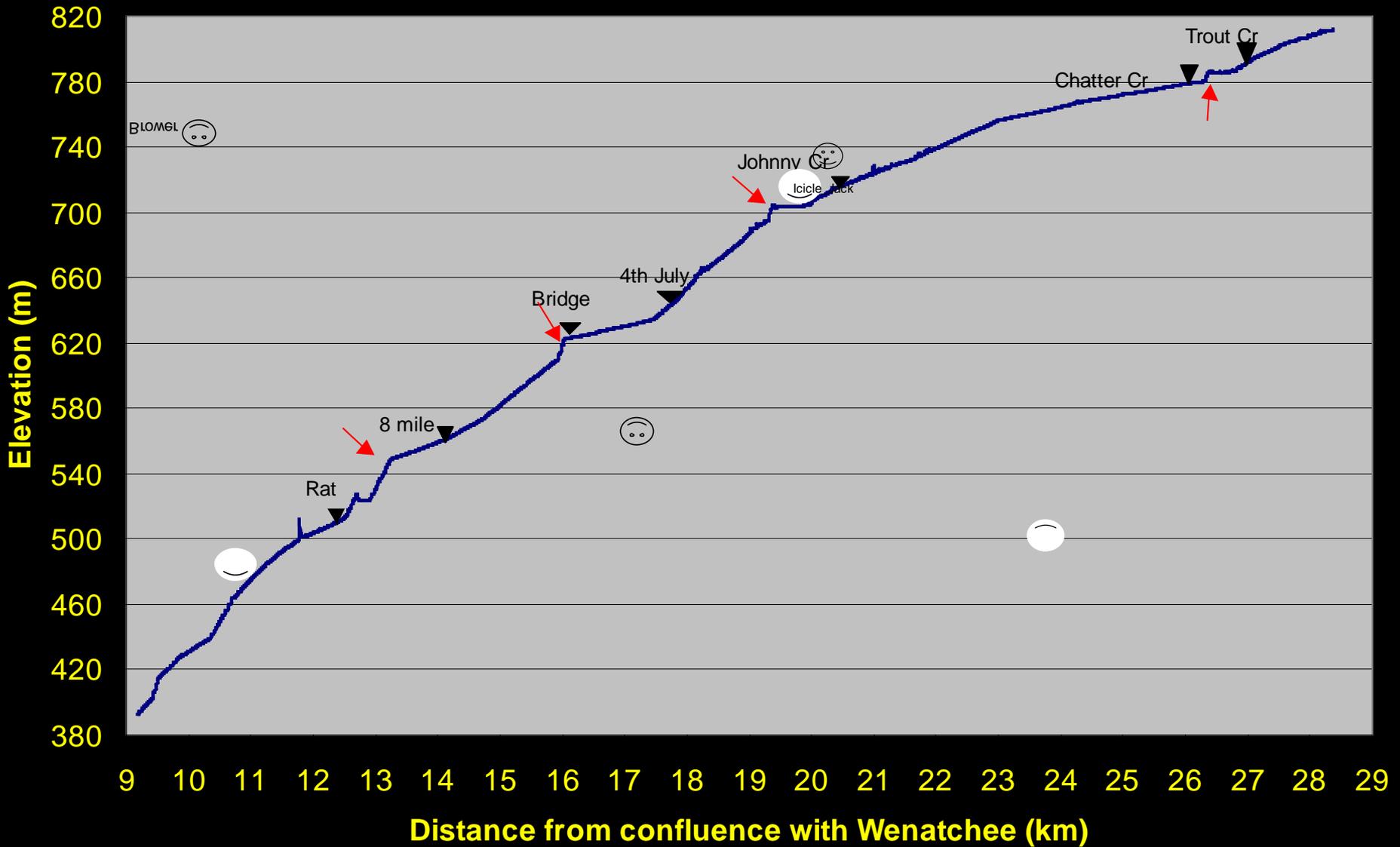
- Length-Weight Measurements
- Scale Samples
- Fin Clip for DNA analysis
- Stomach contents
- Photo
- PIT tagged
- Dorsal Fin Dye Mark





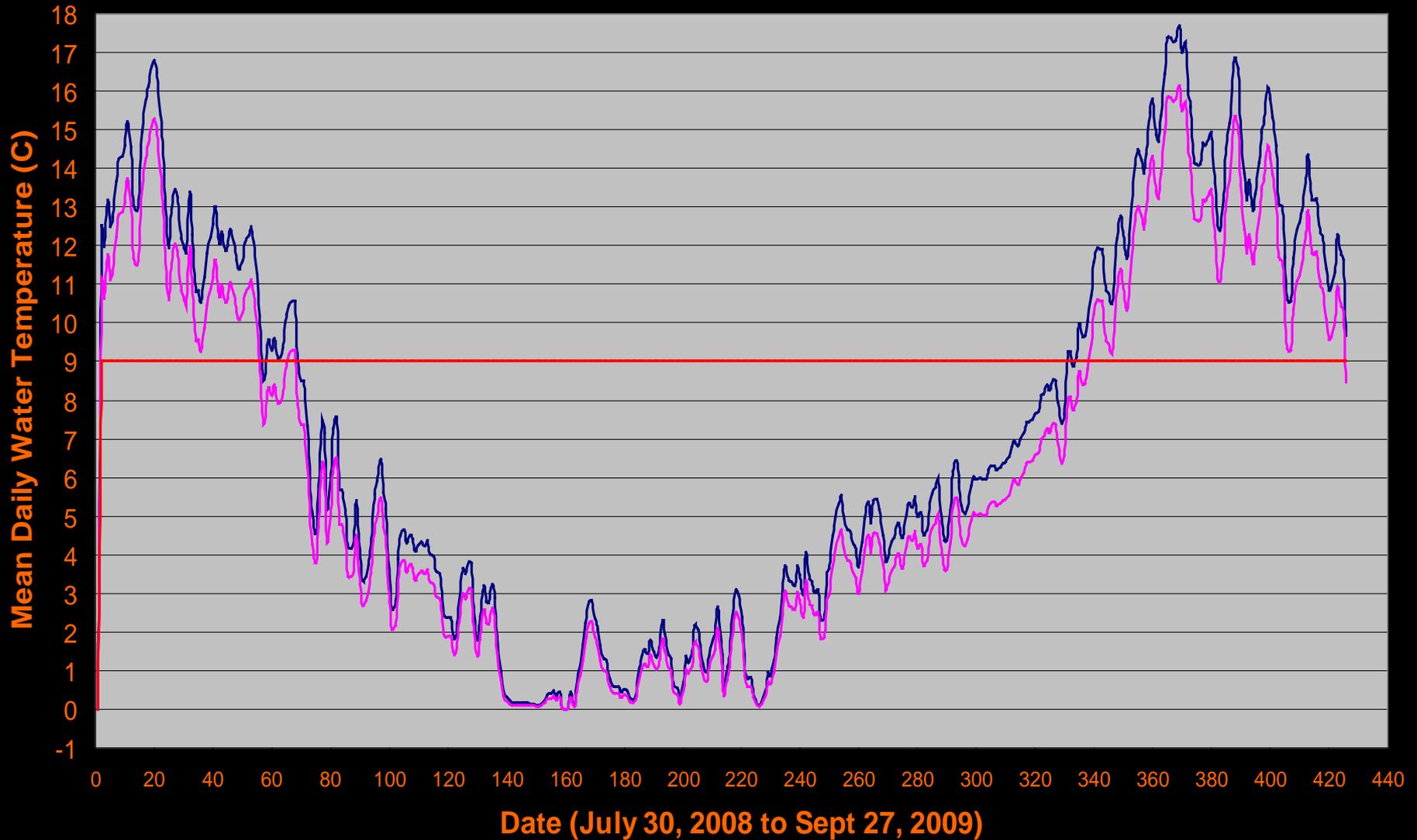


Elevation Profile RM6 - RM18





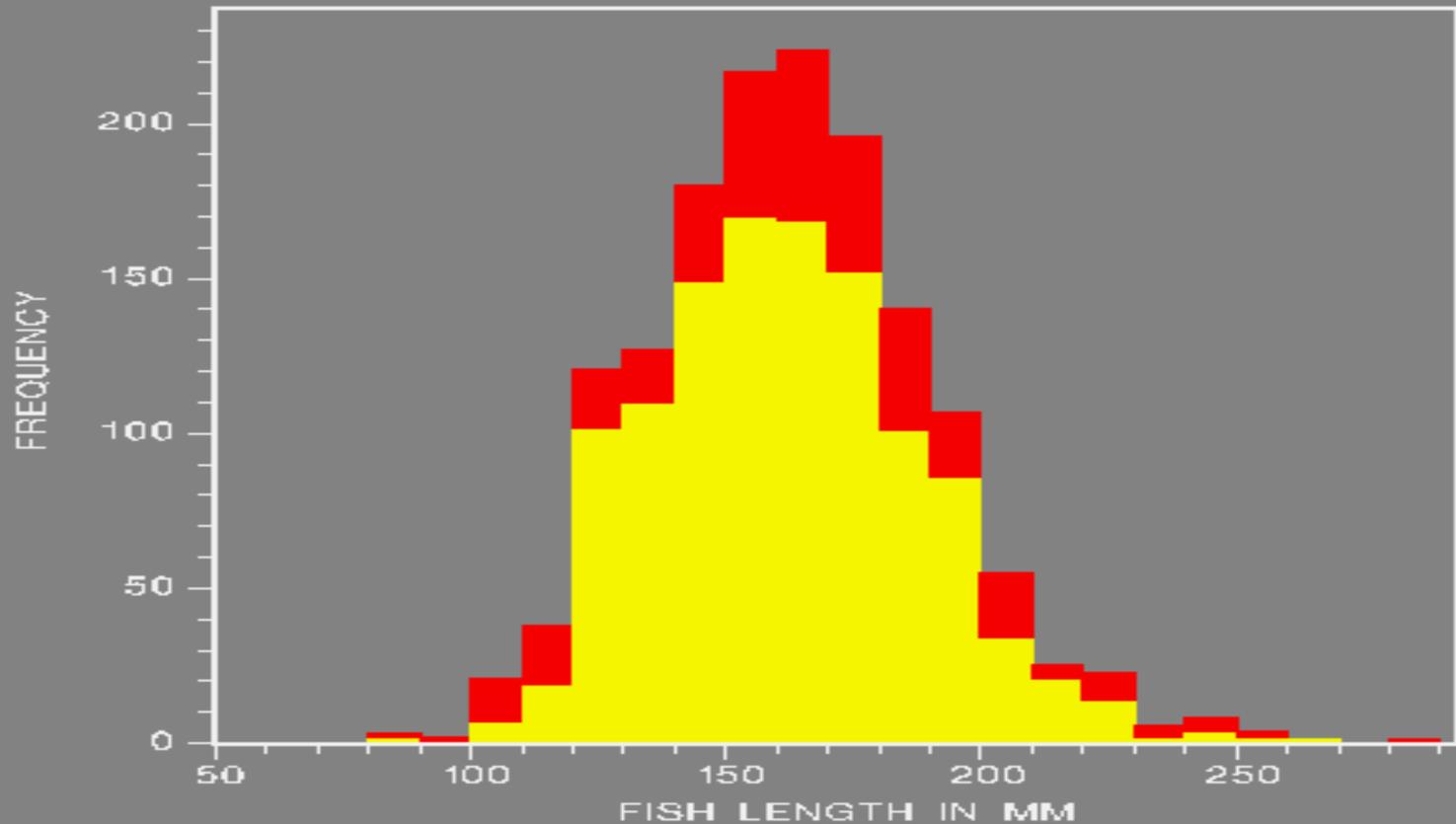
Water Temp Rkm 11 and 29



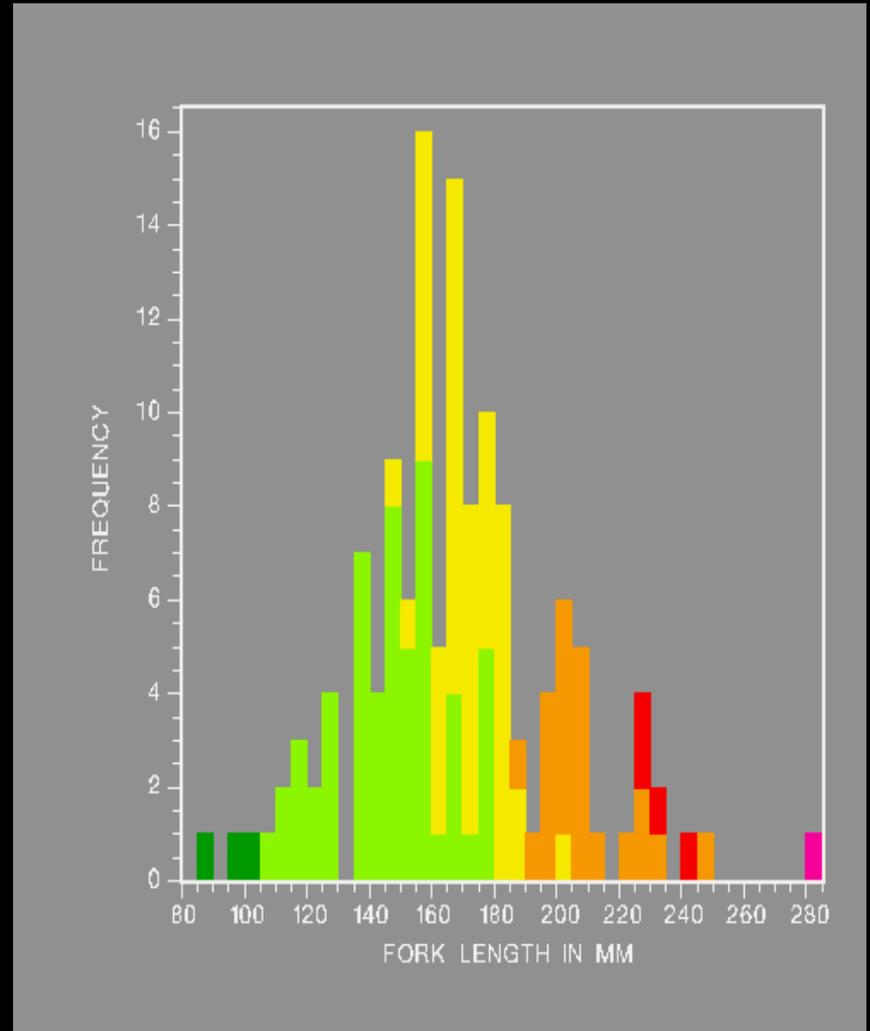
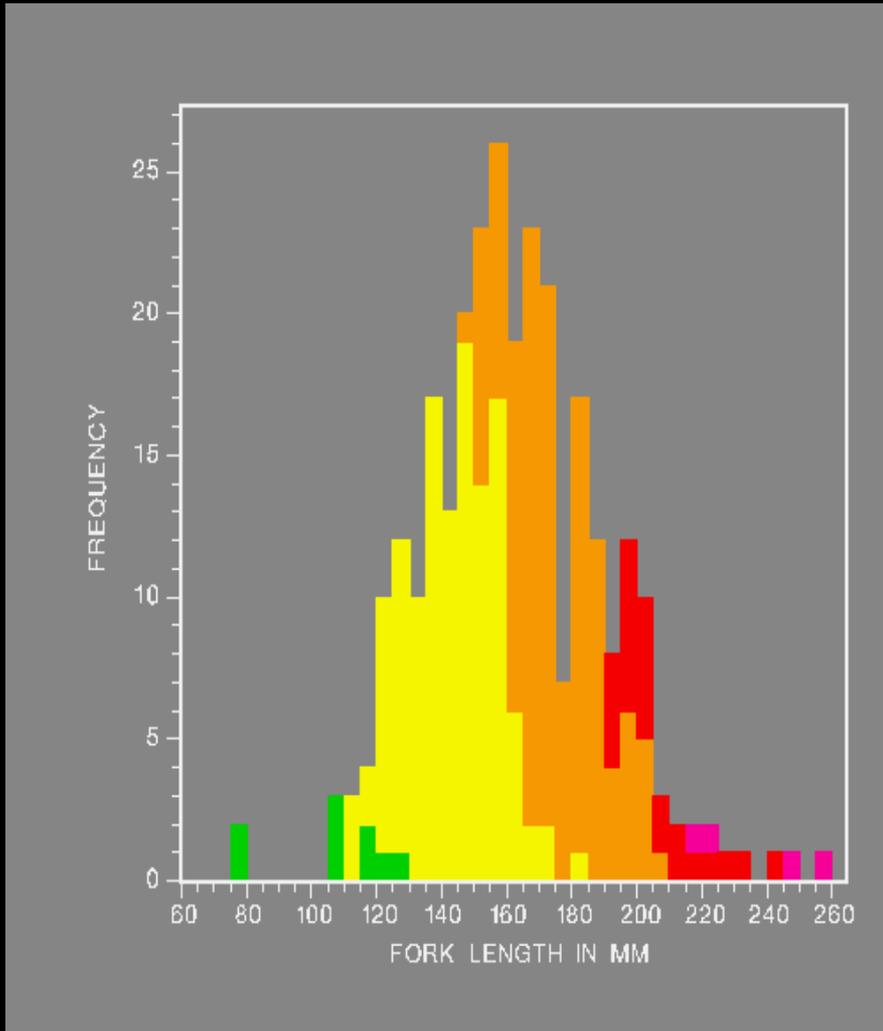
Key Research Results

- Upper Icicle is relatively productive of RBT: fish reach steelhead smolt size within 2 to 3 years
- Average counts of RBT 4 to 12 inches between French Cr. and IPID (27 kilometers): 13000 or 480/km.
- Individual fish condition is high
- Results for Chiwaukum are similar

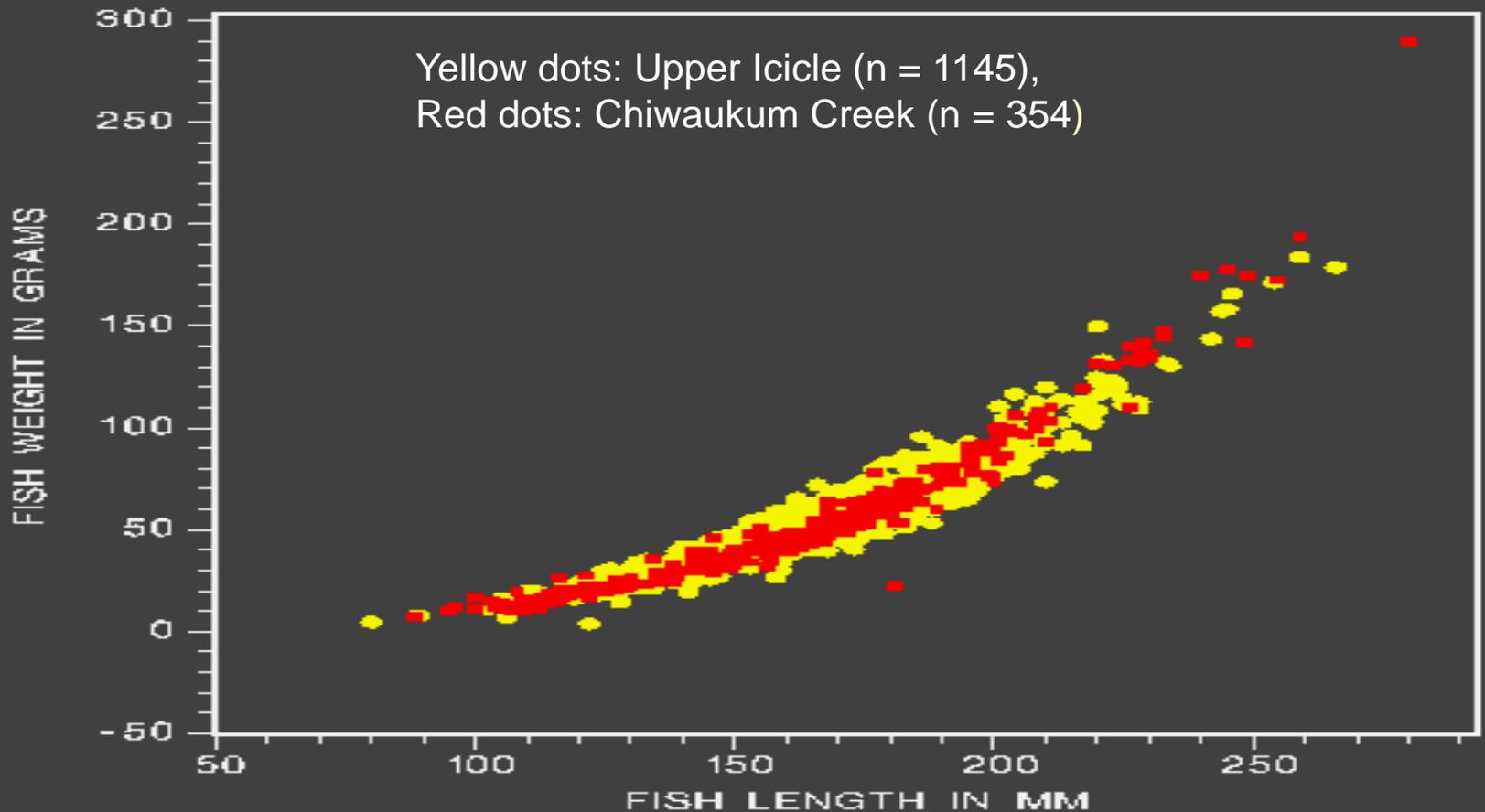
Fork Lengths of RBT sampled 07 to 09 in Icicle (n = 1145, yellow) and Chiwaukum (n = 354 red)



Icicle (left) and Chiwaukum (right) Age and Fork Length. Icicle ages 1 – 5 . Chiwaukum ages 1 - 6



Upper Icicle and Chiwaukum *O. mykiss* samples length-weight 2007 - 2009



Genetic Results

- There is significant genetic diversity among rainbow within the upper Icicle
- Upper Icicle rainbow are native and distinct from steelhead, but the lower population group shows some relationship to Wenatchee steelhead

- Upper Icicle contains (at least) 3 distinct native RBT gene pools/populations: Mainstem above Chatter Gorge to Leland Cr., Jack Creek, mainstem below Chatter Gorge
- Genetic effective population sizes (estimated from the DNA samples) are significant:
- Harmonic mean N_e : Lower Jack Cr. study site – 124, Icicle-at-Jack Cr. site – 235, Icicle-at-Johnny Cr. site – 532, Icicle-at-Brower – 340, Chiwaukum: 62
- No hatchery rainbow trout genes (Goldendale or Spokane strains)

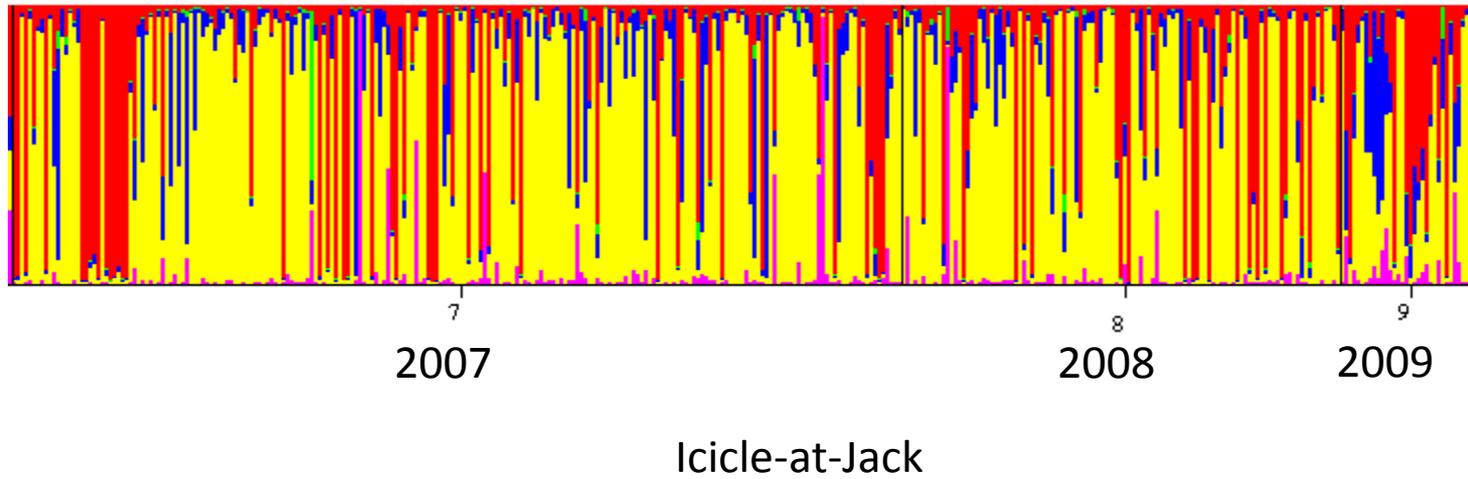
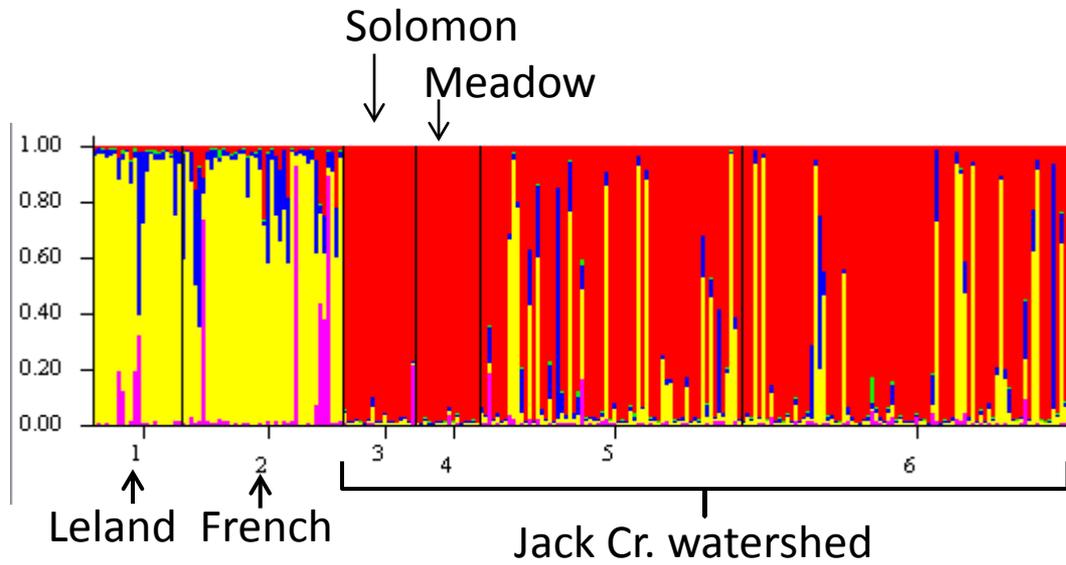
Genetic diversity between Icicle populations and Wenatchee steelhead

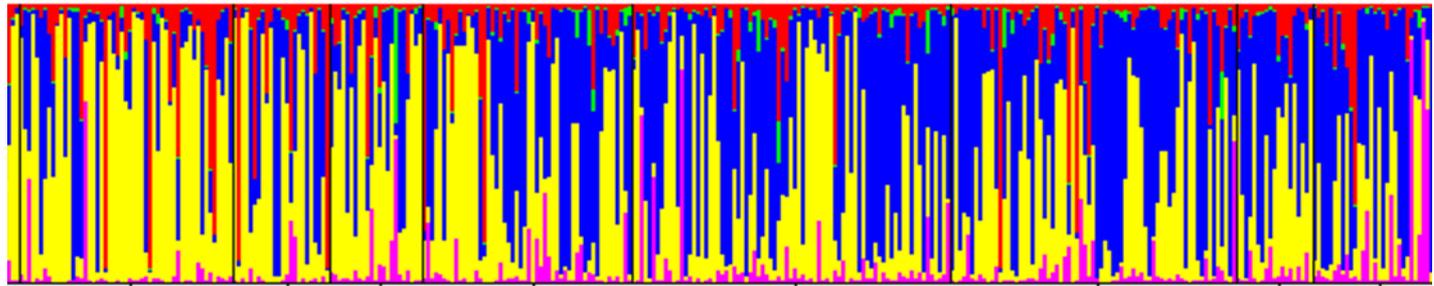
- Average Fst Values:
- Icicle resident and hatchery strains: 0.202
- Average among Icicle resident trout: 0.027
- Leland-French v Brower: 0.024
- Upper Jack Cr. v Brower: 0.089
- Upper Jack v Leland-French: 0.128
- Icicle resident trout and steelhead: 0.053
- Brower v Chiwaukum: 0.034



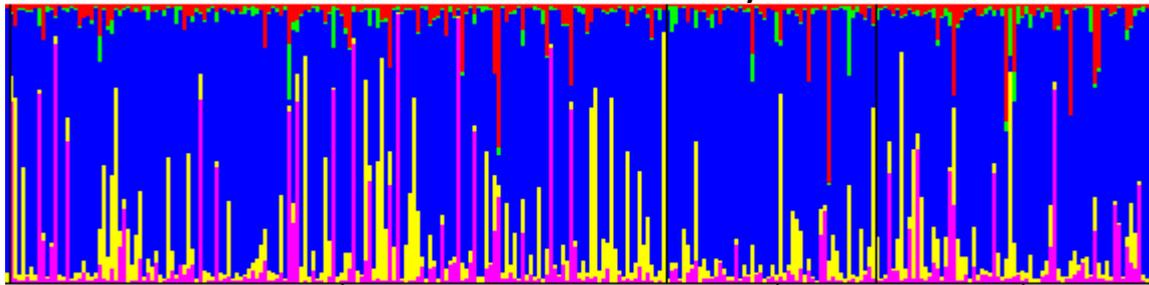
Gene flow between Icicle populations (and Wenatchee steelhead?)

- We used the program STRUCTURE to estimate the number of populations (distinct gene pools) within the upper Icicle samples and to estimate recent gene flow between these populations and (possibly) steelhead
- Structure will estimate both the total number of independent populations in a sample and admixture of genes from different populations within individuals
- We used the standard threshold level of 20% to identify admixed individuals

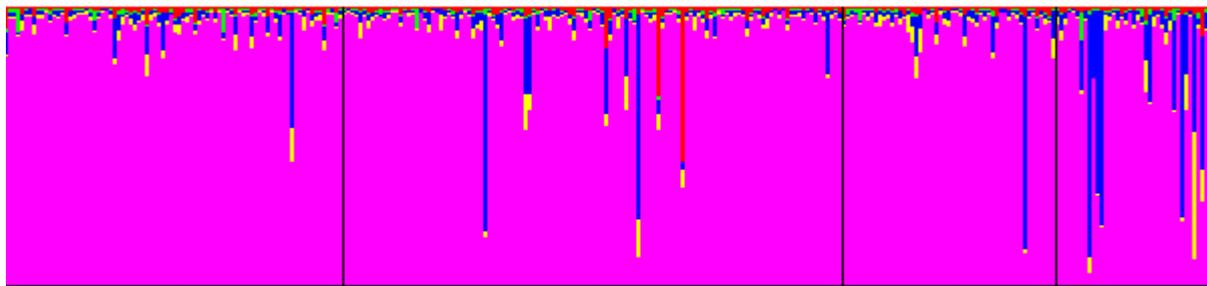




10 11 12 13 14 15 16 17
Doctor Hoxie Ida | 2007 2008 2009 | Bridge
Johnny Knapweed

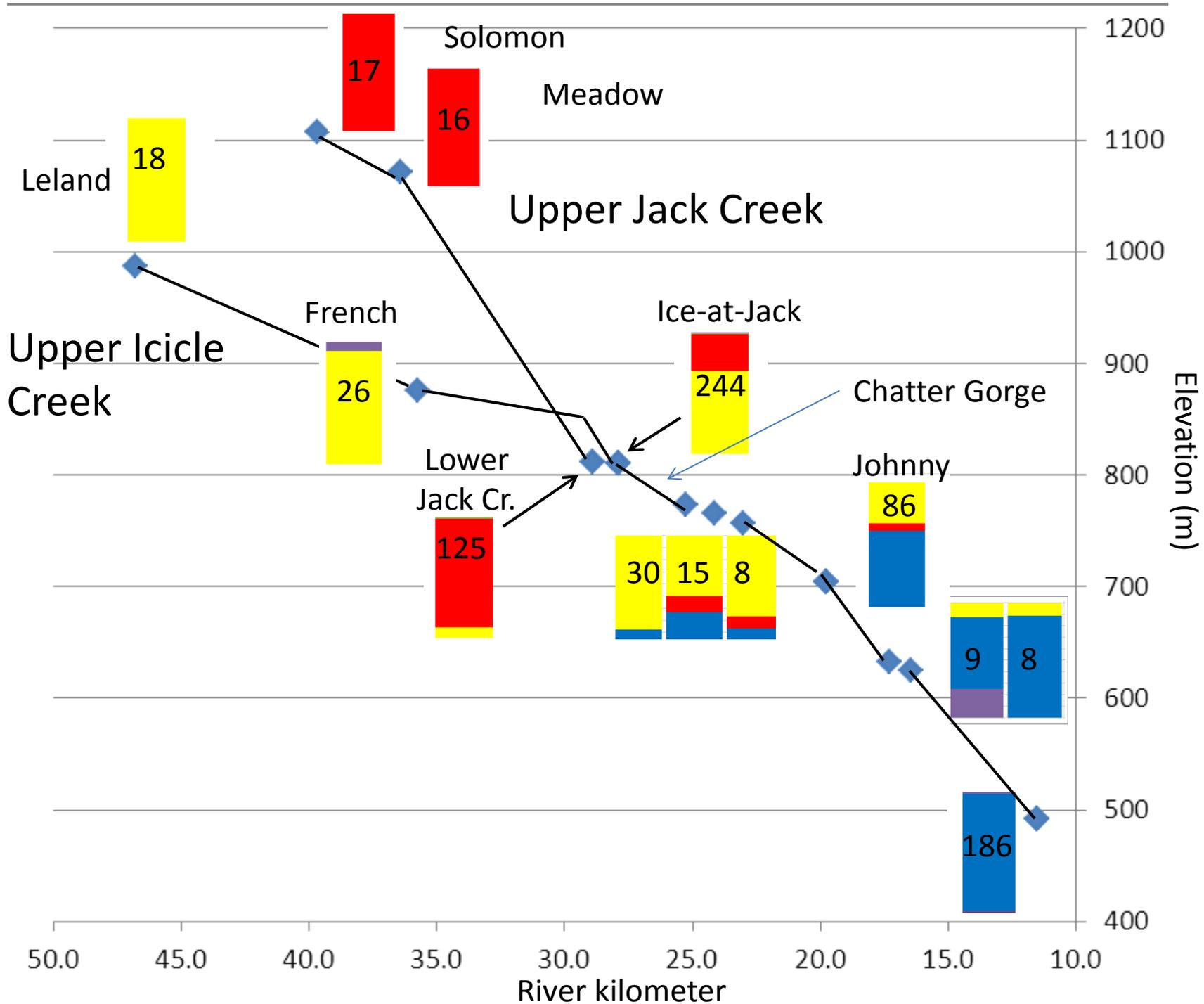


18 19 20
2007 2008 2009
Brower



21 22 23 24

Steelhead



Summary



- Upper Icicle Creek is relatively productive for rainbow trout
- Abundance averages 700 to 1200 fish 4 to 12 inches per linear stream mile (total abundance 12000 to 20000)
- Most reach steelhead smolt size (160 to 180 mm, 6 to 7 inches) in 2 or 3 years

Relation of Icicle RBT to steelhead and movement

- Wenatchee steelhead (including Chiwaukum) are genetically distinct from Icicle RBT
- However, Icicle-at-Brower fish have some genetic similarities with steelhead
- Movement: there is genetic evidence that Icicle rainbow can migrate upstream from above IPID to Chatter Gorge Falls!



Monitoring Recolonization

- Should passage improvements at LNFH enable steelhead to begin regularly recolonizing upper Icicle our large genetic baseline will enable us to detect this with high probability and relatively few samples.
- Accuracy will be further increased by expanding the baseline to include SNP loci

Future Research

- Analyze our tissue samples using a regional SNP panel developed for upper Columbia *O. mykiss*
- Steelhead in Chiwaukum Creek, abundance and ecology. Use genetics to estimate annual numbers of spawners
- Testing for adaptive differences between upper Icicle RBT populations: common rearing experiments, new genetic tools (SNPs, RADs).

Thank You for Your Attention!

