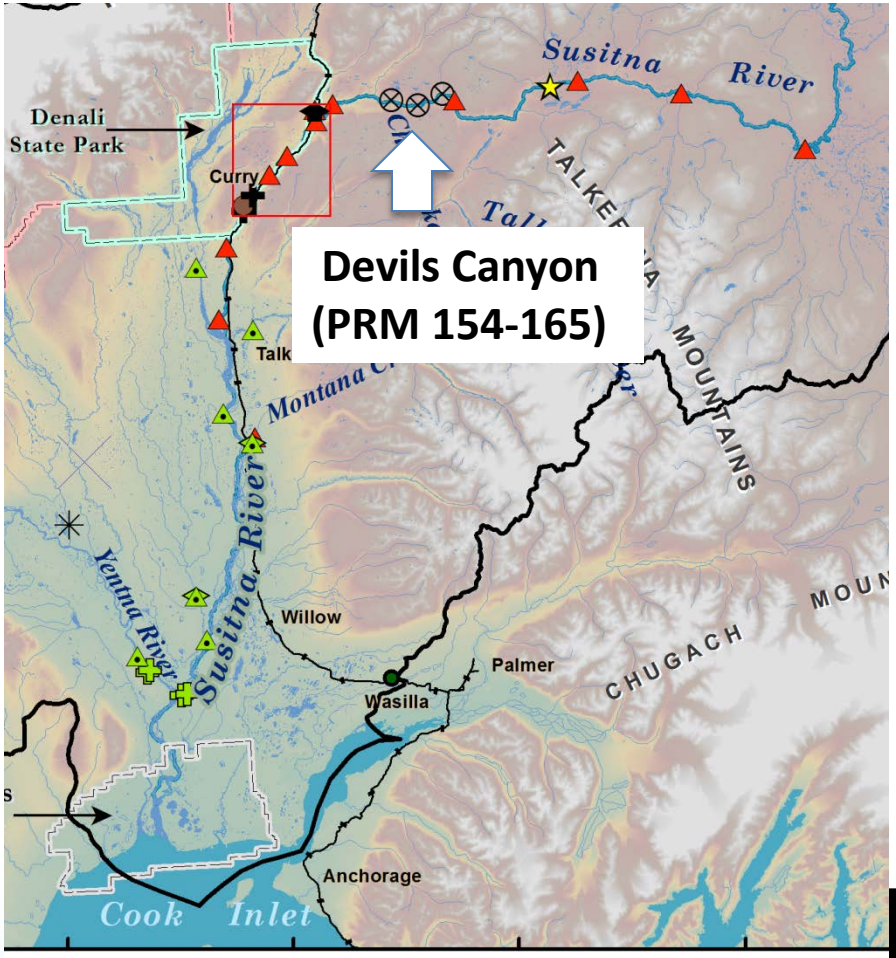
Chinook Salmon above Devils Canyon on the Susitna River: a Sink or Sustaining Population?



SUSITNA-WATANA HYDRO *Clean, reliable energy for the next 100 years.*

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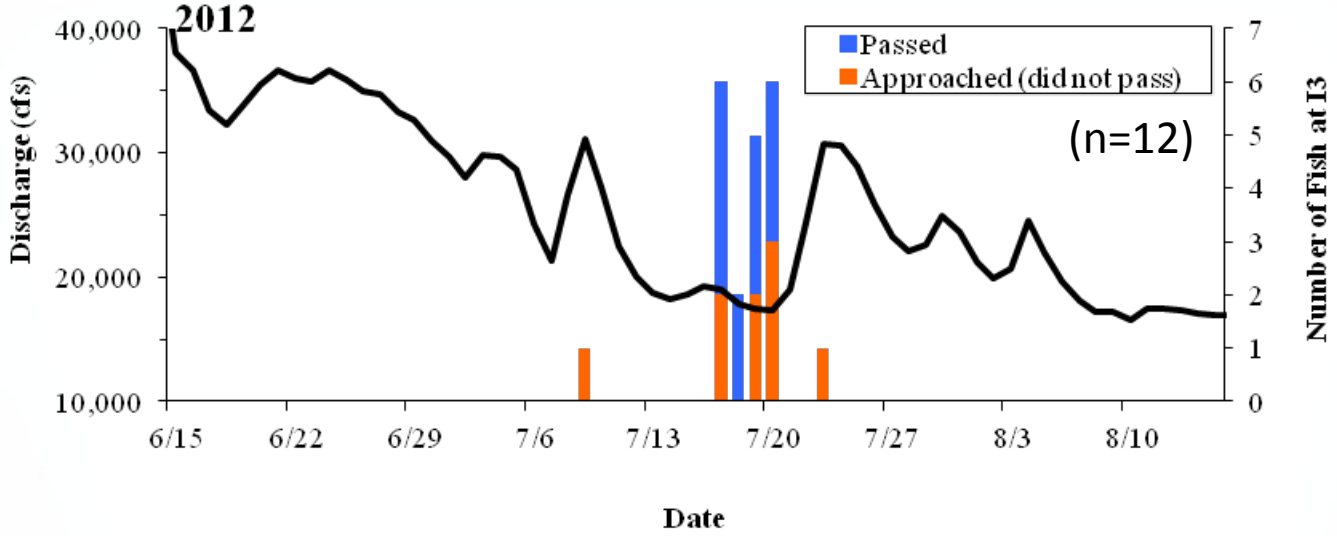
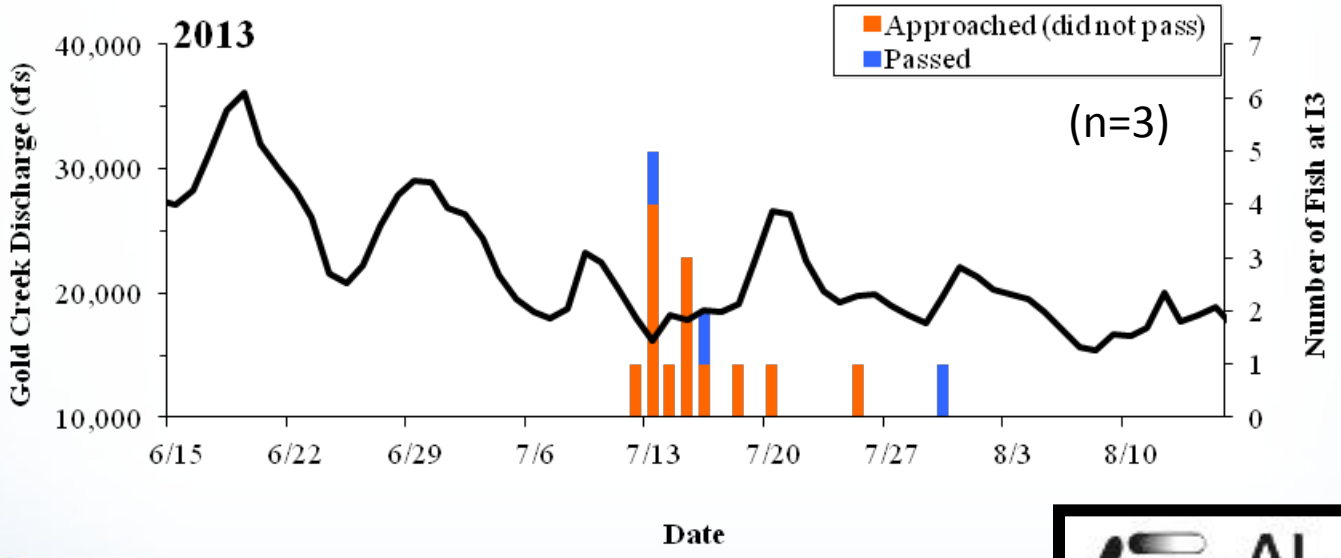
Introduction

- Purpose of presentation:
  - Characterize population
  - State Hypotheses
  - Describe a genetics-based approach to resolve the issue
- Why Relevant:
  - Fish distribution and origin will be considered in the impact assessment of Watana Dam

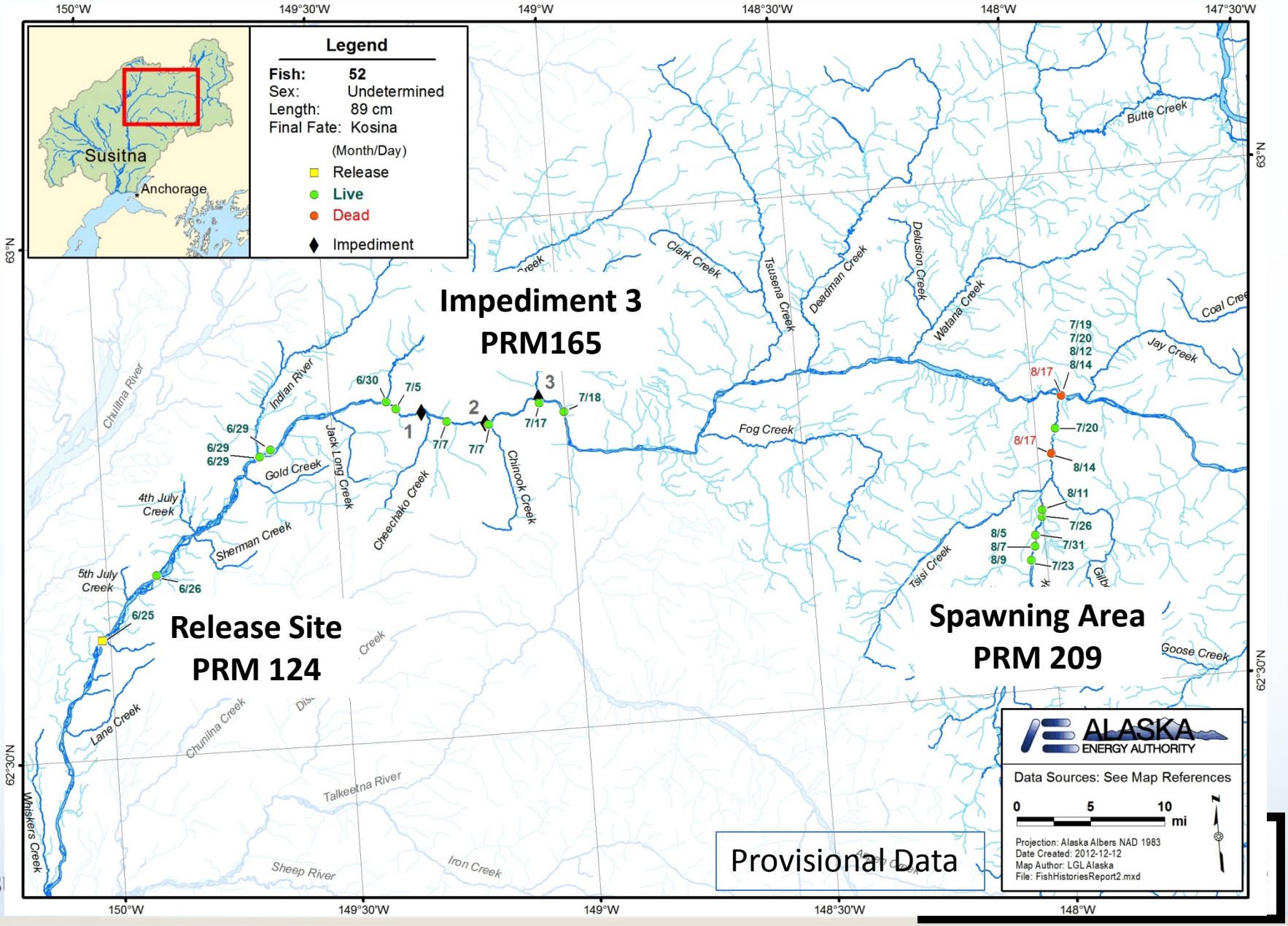
Background

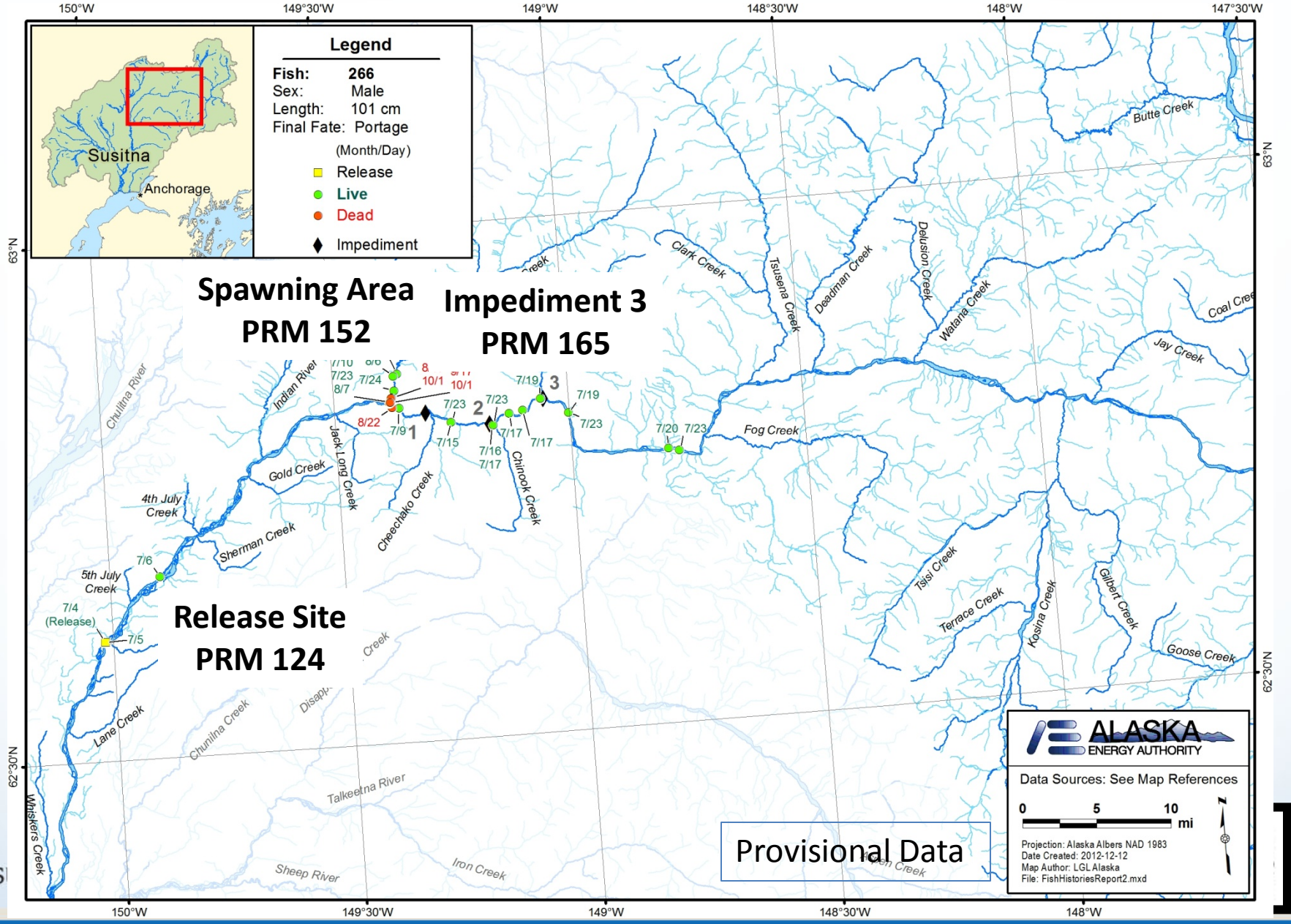
- Radio-tagged Chinook (795 and 1,234) migrated upstream of Devils Canyon (12 and 3) in 2012 and 2013, respectively. Some appeared to spawn there.
- Where does this relatively small population (~100) come from?
  - Sustaining population (Homers): originate from above DC
  - Sink population (Roamers): originate from below DC

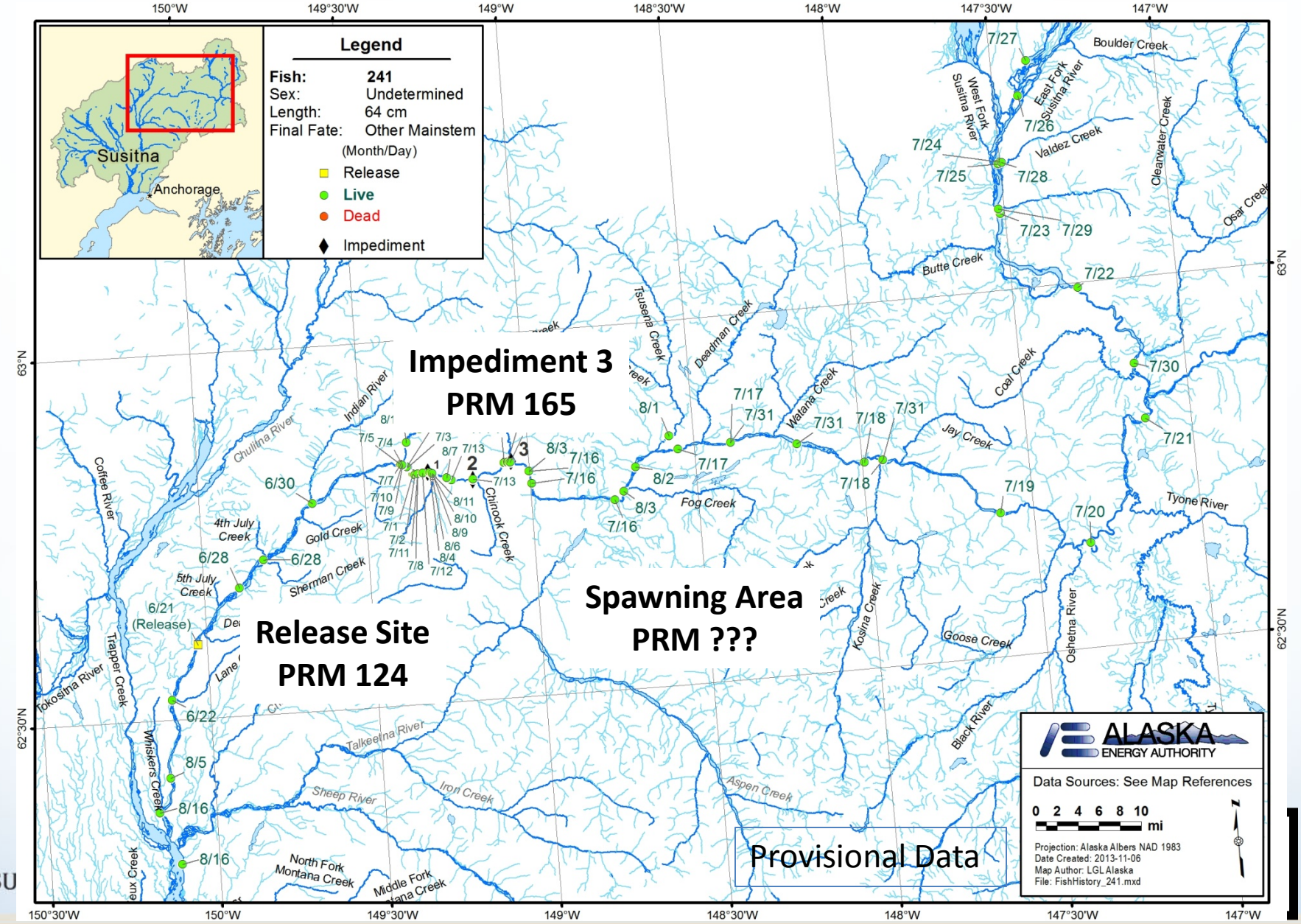

2012
Passed
Approached (did not pass)
(n=12)
Discharge (cfs)
Number of Fish at I3
40,000
30,000
20,000
10,000
7
6
5
4
3
2
1
0
6/15
6/22
6/29
7/6
7/13
7/20
7/27
8/3
8/10
Date


2013
Approached (did not pass)
Passed
(n=3)
Gold Creek Discharge (cfs)
Number of Fish at I3
40,000
30,000
20,000
10,000
7
6
5
4
3
2
1
0
6/15
6/22
6/29
7/6
7/13
7/20
7/27
8/3
8/10
Date

Chinook Salmon that Passed I-3			
Tag Number	First Detection Above I-3	Destination	Returned Downstream of I-3
2012			
52	17-Jul	Kosina Creek	
94	17-Jul	Devil Creek	
359	17-Jul	Portage Creek	X
5005	17-Jul	Kosina Creek	
27	18-Jul	Chinook Creek	X
5019	18-Jul	Kosina Creek	
113	19-Jul	Kosina Creek	
219	19-Jul	Kosina Creek	
266	19-Jul	Portage Creek	X
104	20-Jul	Portage Creek	X
246	20-Jul	Kosina Creek	
257	20-Jul	Portage Creek	X
2013			
395	13 Jul	Tsusena Creek	
241	16 Jul	Unknown	X
272	30 Jul	Devil Creek	


Susitna
Anchorage
Legend
Fish: 52
Sex: Undetermined
Length: 89 cm
Final Fate: Kosina
(Month/Day)
Release
Live
Dead
Impediment
Impediment 3
PRM165
Release Site
PRM 124
Spawning Area
PRM 209
Provisional Data
ALASKA ENERGY AUTHORITY
Data Sources: See Map References
Projection: Alaska Albers NAD 1983
Date Created: 2012-12-12
Map Author: LGL Alaska
File: FishHistoriesReport2.mxd
Indian River
Gold Creek
Jack Long Creek
Cheechako Creek
Chinook Creek
Sherman Creek
4th July Creek
5th July Creek
Lane Creek
Chunilna Creek
Talkeetna River
Sheep River
Iron Creek
Whiskers Creek
Clark Creek
Tsusena Creek
Deadman Creek
Delusion Creek
Watana Creek
Fog Creek
Jay Creek
Butte Creek
Tsisi Creek
Goose Creek
6/30
7/5
7/18
7/17
7/7
6/29
6/26
6/25
7/19
7/20
8/12
8/14
8/17
8/11
7/26
7/31
7/23
8/5
8/7
8/9
150°W
149°30'W
149°W
148°30'W
148°W
147°30'W
63°N
62°30'N


Legend
Fish: 266
Sex: Male
Length: 101 cm
Final Fate: Portage
(Month/Day)
Release
Live
Dead
Impediment
Susitna
Anchorage
Spawning Area
PRM 152
Impediment 3
PRM 165
Release Site
PRM 124
Provisional Data
ALASKA ENERGY AUTHORITY
Data Sources: See Map References
0 5 10 mi
Projection: Alaska Albers NAD 1983
Date Created: 2012-12-12
Map Author: LGL Alaska
File: FishHistoriesReport2.mxd
Indian River
Gold Creek
Jack Long Creek
Cheechako Creek
Chinook Creek
Fog Creek
Clark Creek
Tsusena Creek
Deadman Creek
Delusion Creek
Watana Creek
Butte Creek
Jay Creek
Tsisi Creek
Terrace Creek
Kosina Creek
Gilbert Creek
Goose Creek
4th July Creek
5th July Creek
Sherman Creek
Lane Creek
Whiskers Creek
Chunilna Creek
Talkeetna River
Sheep River
Iron Creek
150°W
149°30'W
149°W
148°30'W
148°W
147°30'W
63°N
62°30'N


Legend
Fish: 241
Sex: Undetermined
Length: 64 cm
Final Fate: Other Mainstem
(Month/Day)
Release
Live
Dead
Impediment
Susitna
Anchorage
Impediment 3
PRM 165
Spawning Area
PRM ???
Release Site
PRM 124
Provisional Data
ALASKA ENERGY AUTHORITY
Data Sources: See Map References
0 2 4 6 8 10 mi
Projection: Alaska Albers NAD 1983
Date Created: 2013-11-06
Map Author: LGL Alaska
File: FishHistory_241.mxd
Boulder Creek
East Fork Susitna River
West Fork Susitna River
Valdez Creek
Clearwater Creek
Butte Creek
Deadman Creek
Tsusena Creek
Watana Creek
Coal Creek
Jay Creek
Fog Creek
Chinook Creek
Indian River
Chulitna River
Coffee River
4th July Creek
Gold Creek
Sherman Creek
5th July Creek
Trapper Creek
Tokositna River
Whiskers Creek
Talkeetna River
Sheep River
Iron Creek
Aspen Creek
Kosina Creek
Goose Creek
Oshetna River
Tyone River
Black River
North Fork Montana Creek
Middle Fork Montana Creek
150°W
149°30'W
149°W
148°30'W
148°W
147°30'W
147°W
63°N
62°30'N

What we know

- Chinook salmon successfully spawn above DC
  - Adults
  - Juveniles
- Few Chinook salmon make it through all the impediments in some years
- Home to natal “sites”
- Spawn and die

Hypotheses about Chinook salmon above Devils Canyon

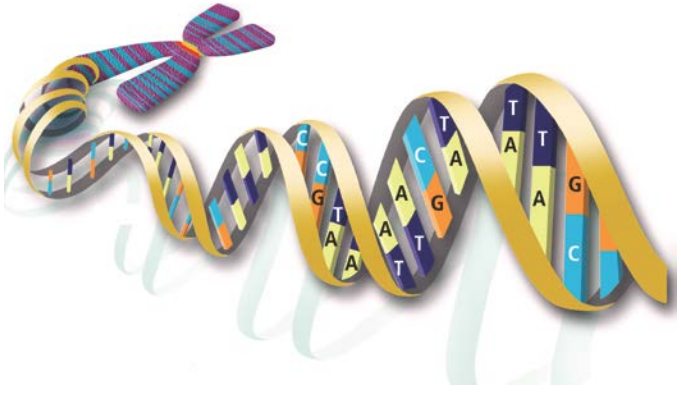
H1: Self-sustaining population(s)

H2: Strays from below-canyon populations

H3: Some combination of the two

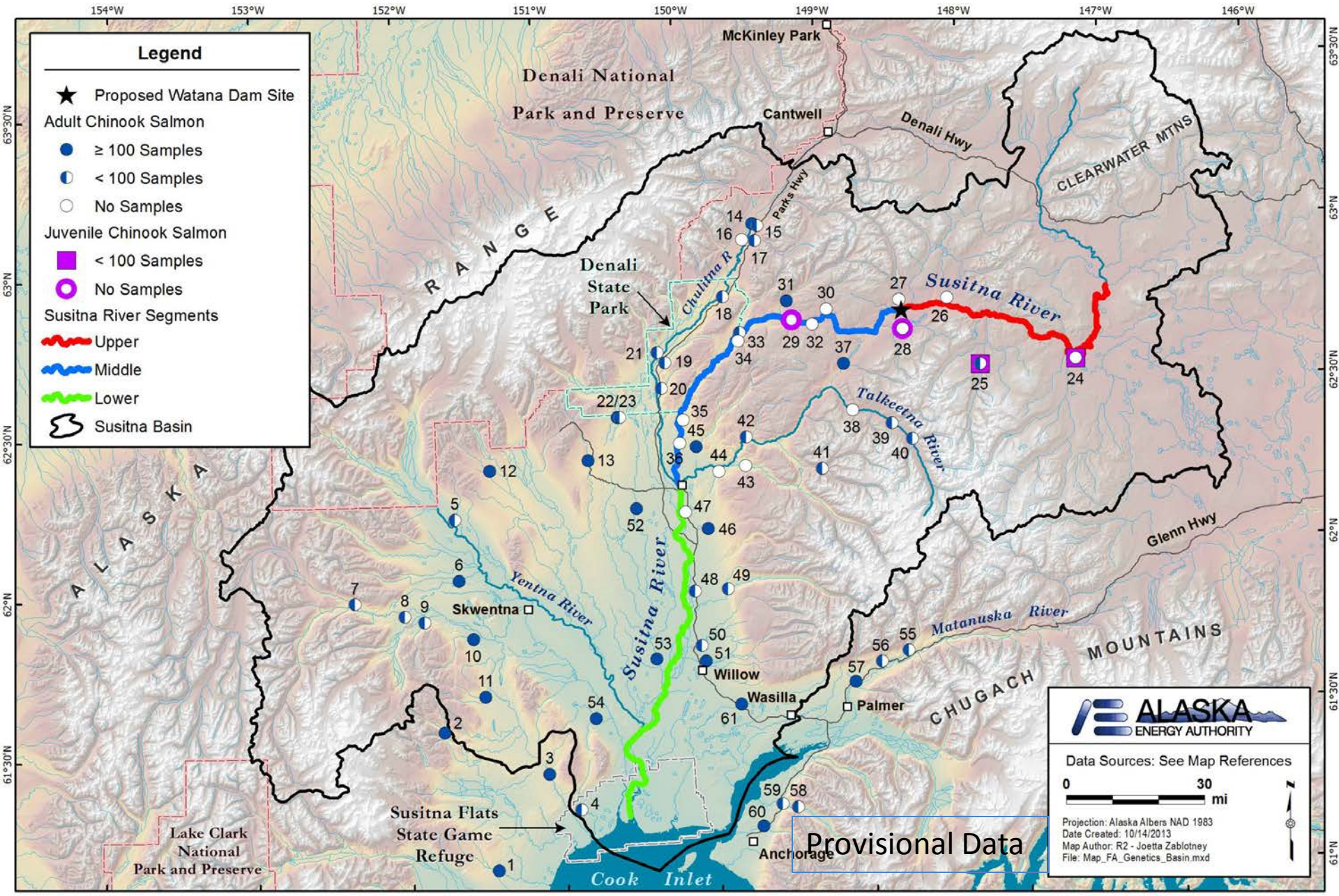
How to test among hypotheses?

- Tag the juveniles
  - Logistically difficult
  - Limited # of generations – what happened during times when we have not been looking?
- Identify physical/behavioral differences
  - Confounded with environment
  - Common garden experiments
    - Logistically difficult
- Genetic data – but how?

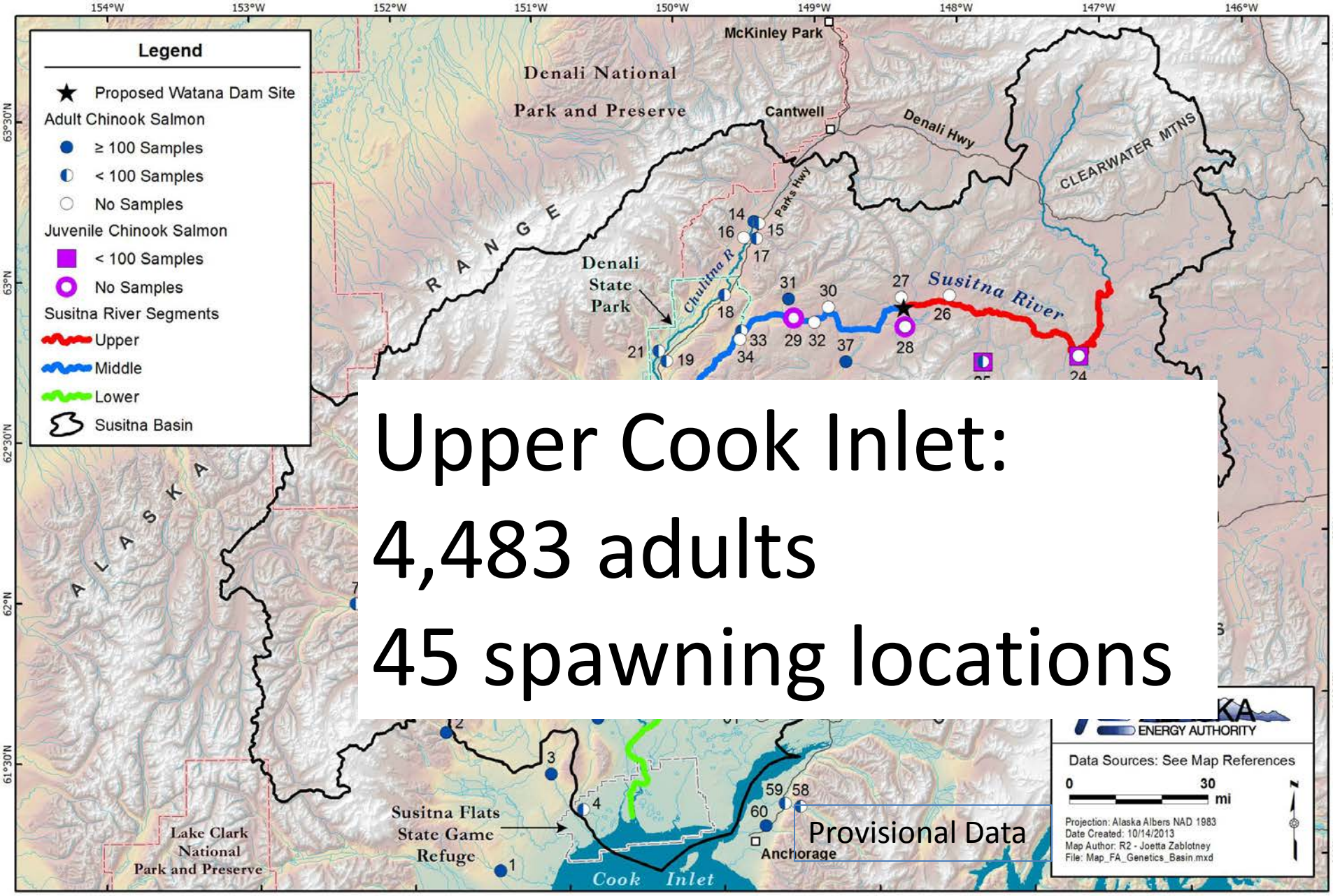


First, we collect tissues from Chinook salmon

Chinook salmon genetic collections



Chinook salmon genetic collections

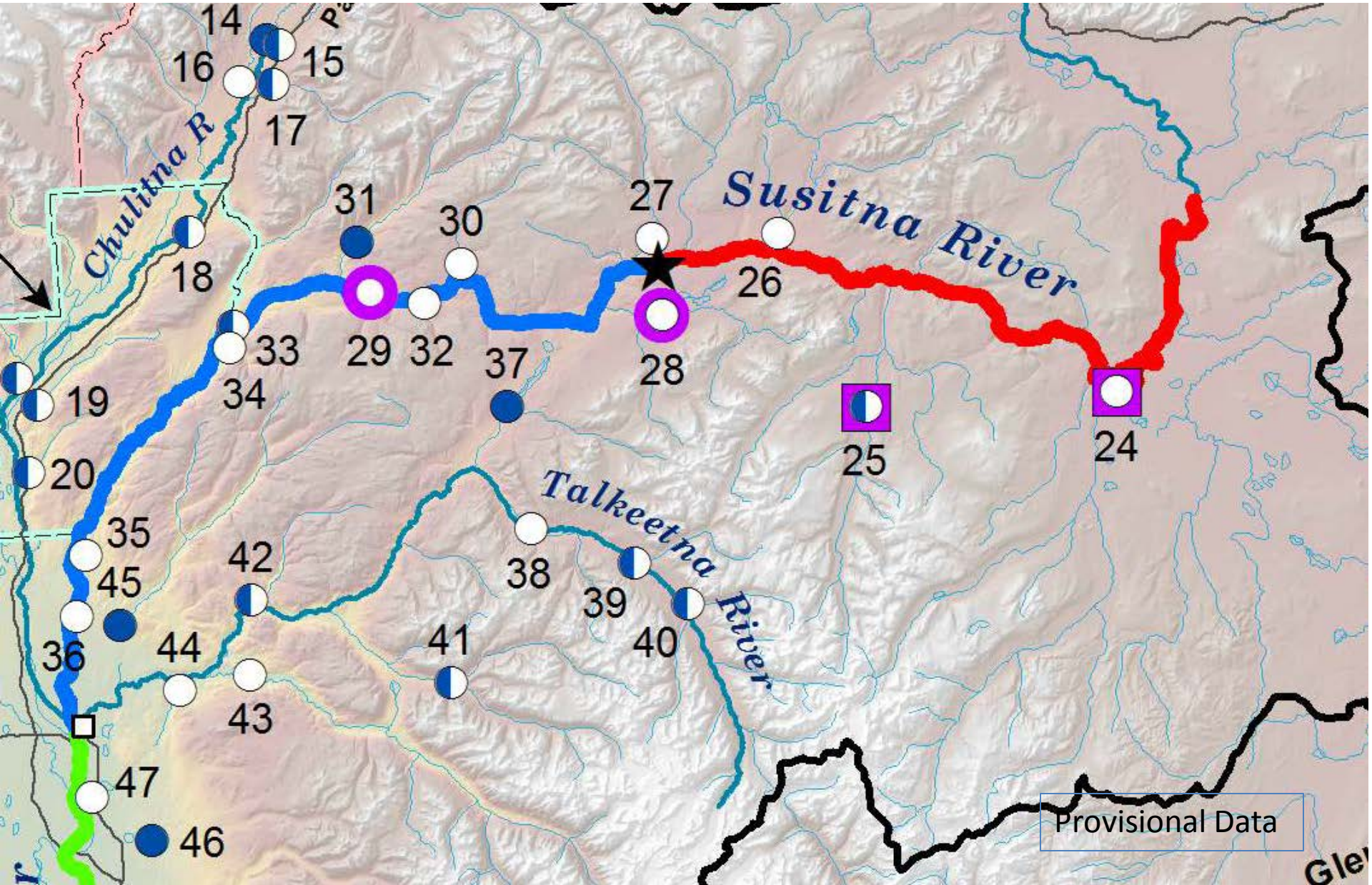


Upper Cook Inlet:

4,483 adults

45 spawning locations

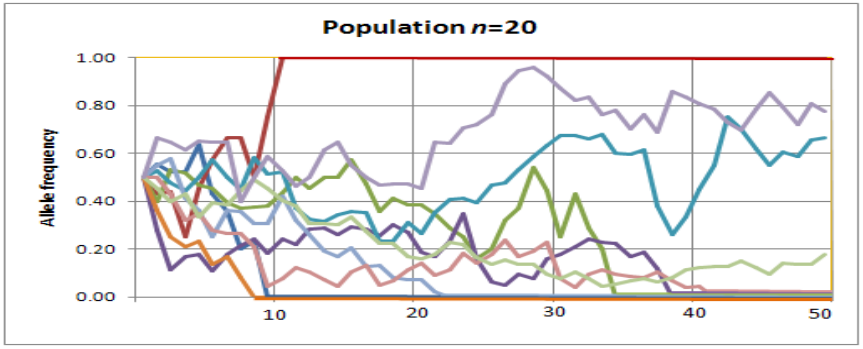
Chinook salmon genetic collections

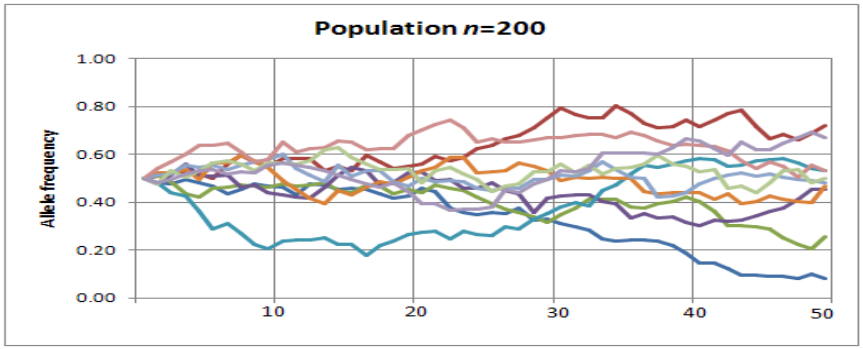


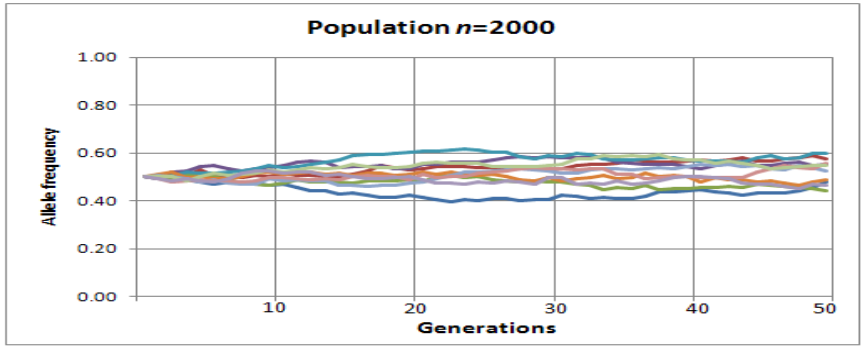
Chinook salmon genetic collections

Next, we apply population genetics concepts

- Genetic Drift
- Migration







Population genetics concepts

- Genetic Drift
  - Caused by:
    - Restricted gene flow among populations
    - Chance that genes pass across generations
  - Affected by:
    - Population size
    - Time (generations)
  - Results in:
    - Loss of variation within populations
    - Divergence among populations
- Migration
  - Opposite cause, affect, results

Hypotheses about Chinook salmon above Devils Canyon

H1: Self-sustaining population(s)

- Percentages divergent from below-canyon populations
- Missing gene types for some genes
- Percentages trending across time

H2: All strays from below-canyon populations

- Percentages similar to below-canyon populations
- Most gene types present
- Percentages trending across time

H3: Some combination of the two

- Percentages similar or divergent to below-canyon populations, depending on year
- Most gene types present
- Percentages variable across time

When will we report?

- Last field season: 2014
- Report due in February, 2015