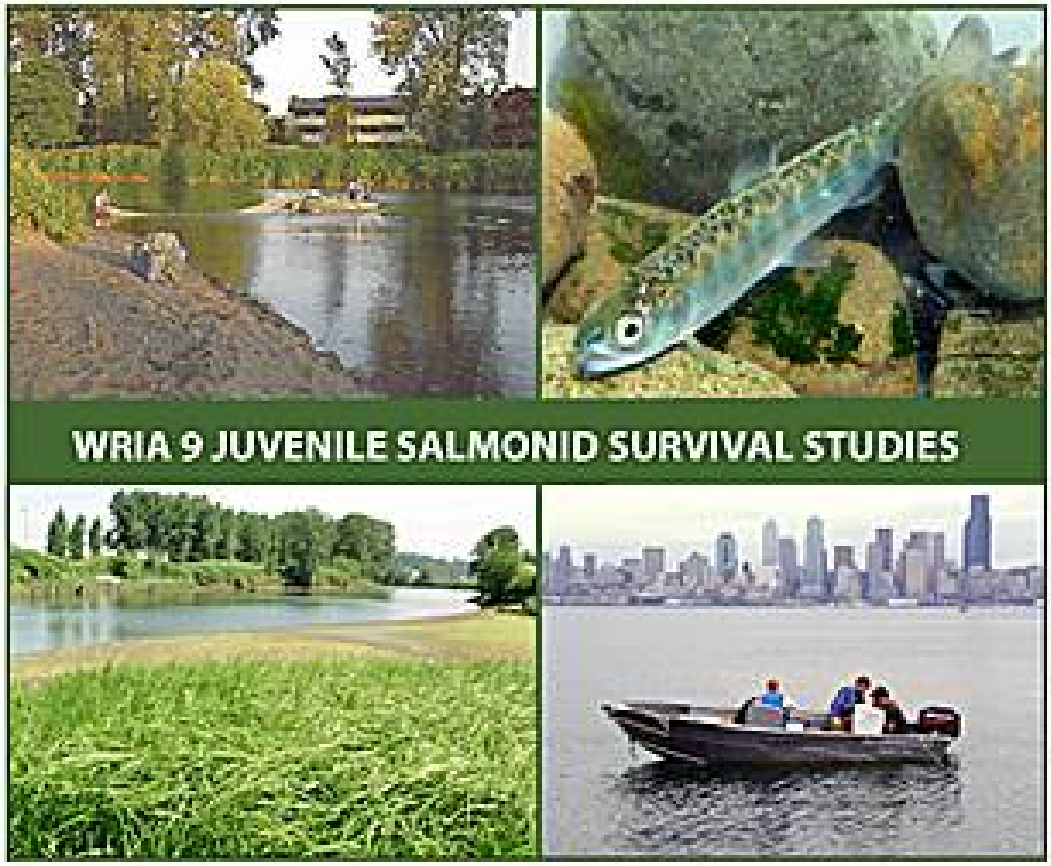
Juvenile Chinook Migration in the Duwamish River



Juvenile Chinook Migration, Growth and Habitat Use in the Lower Green River, Duwamish River and Nearshore of Elliott Bay

2001-2003

Tom Nelson, King County
Greg Ruggerone, NRC
Hwa Kim, King County
Ruth Schaefer, King County

Introduction: WRIA 9 Juvenile Salmonid Survival Studies (JSSS) Objective

- to fill the WRIA Technical Committee identified data gap in the Lower Green River and Duwamish
- used for WRIA recovery efforts (i.e., rehabilitation sites) and for the immediate protection of juvenile Chinook (project timing, etc.)
- Today we focus on the Duwamish

Introduction: Background

- Only 2% of the original 3.5 km^2 of historic Duwamish River mudflats exist today.
- Prior Studies:

  WDFW Report (Bostick 1955), Metro Report (Matsuda 1968), Port (Weitkamp 1980, 1982) USF&W (Meyer 1981), MIT (Warner and Fritz 1995). These studies show Chinook juvenile migration occurring from April-August, with peak in May. Average residence time in the Duwamish is about two weeks.
- 1999 ESA listing, emphasis for wild Chinook recovery
- Green River Hatchery releases about 3 million juveniles/year. In 2000 a program to adipose clip or all hatchery Chinook begins.

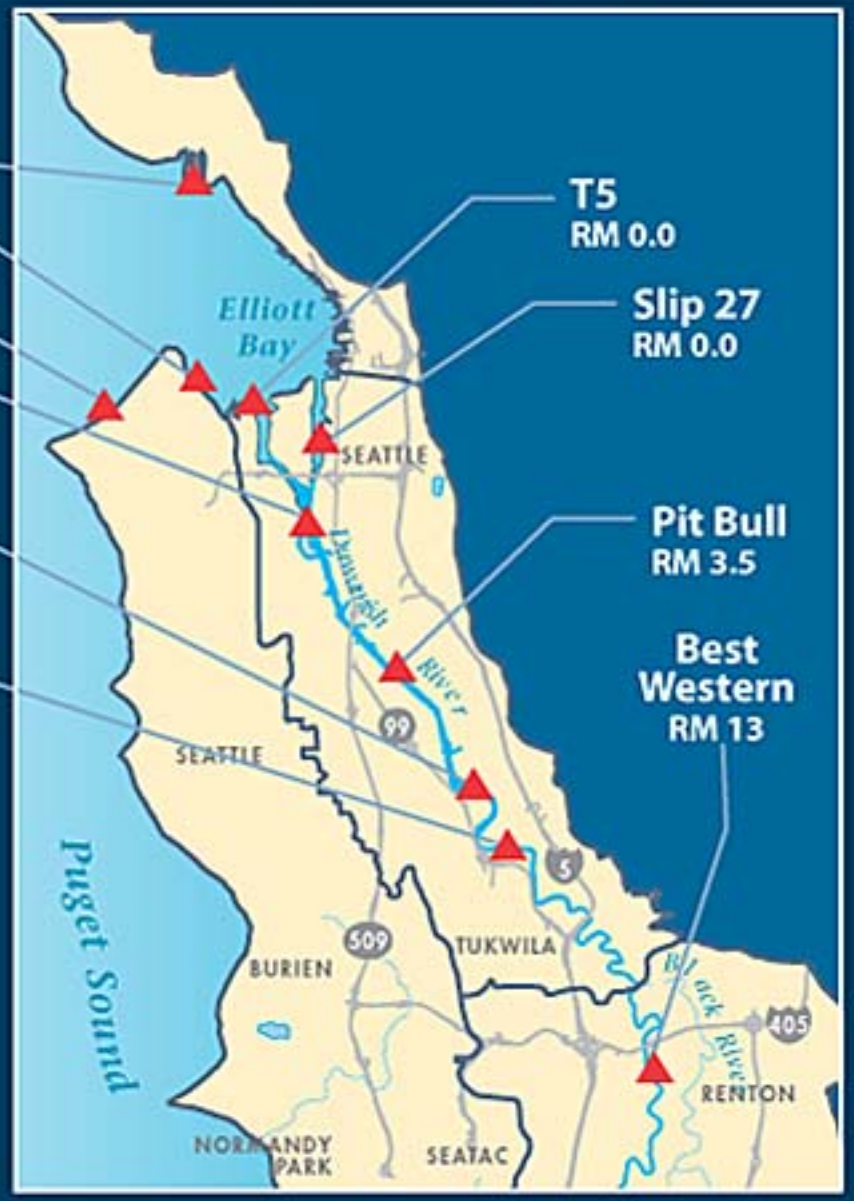
Today's Questions for the Duwamish

- How long do Chinook they stay in the Duwamish?
- Are there any preferred habitats?
- What do they eat while migrating through the Duwamish?
- How is this information useful to the Chinook recovery and other protection efforts?

Methods: Approach

- Separate the system into five habitat reaches.
  (1) Free flowing Green River RM 34.5-13
  (2) Upper Duwamish River RM 13-6.5
- (3) Upper Duwamish estuary RM 6.5-5.5
- (4) Lower Duwamish estuary RM 6.5-0.0
- (5) Elliott Bay nearshore
- Established a series of sampling sites near the reach endpoints
- Monitor the size of fish, relative abundance and speed of migration through the reaches to assess habitat use and wild/hatchery fish interactions.

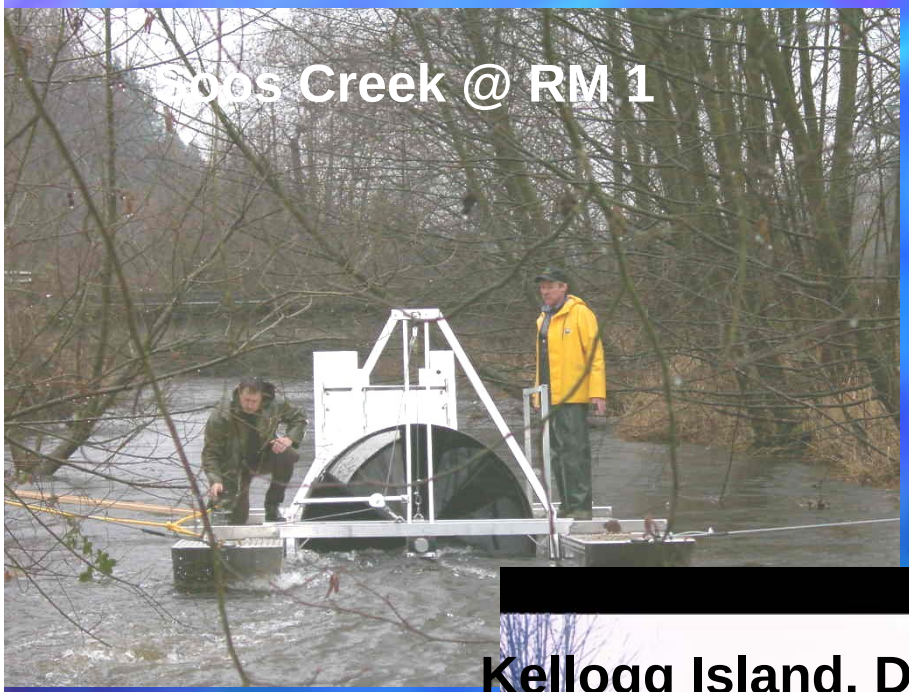
JSSS Monitoring Sites

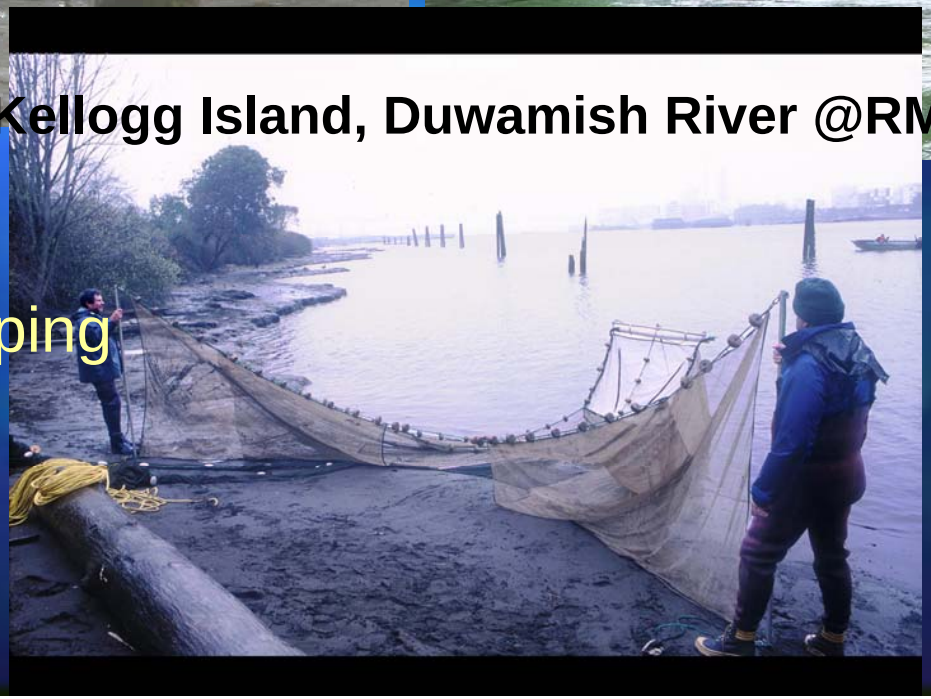


King County
Department of Natural Resources and Parks
Water and Land Resources Division

0511_W9sampleMONITOR.ai lpre, sk

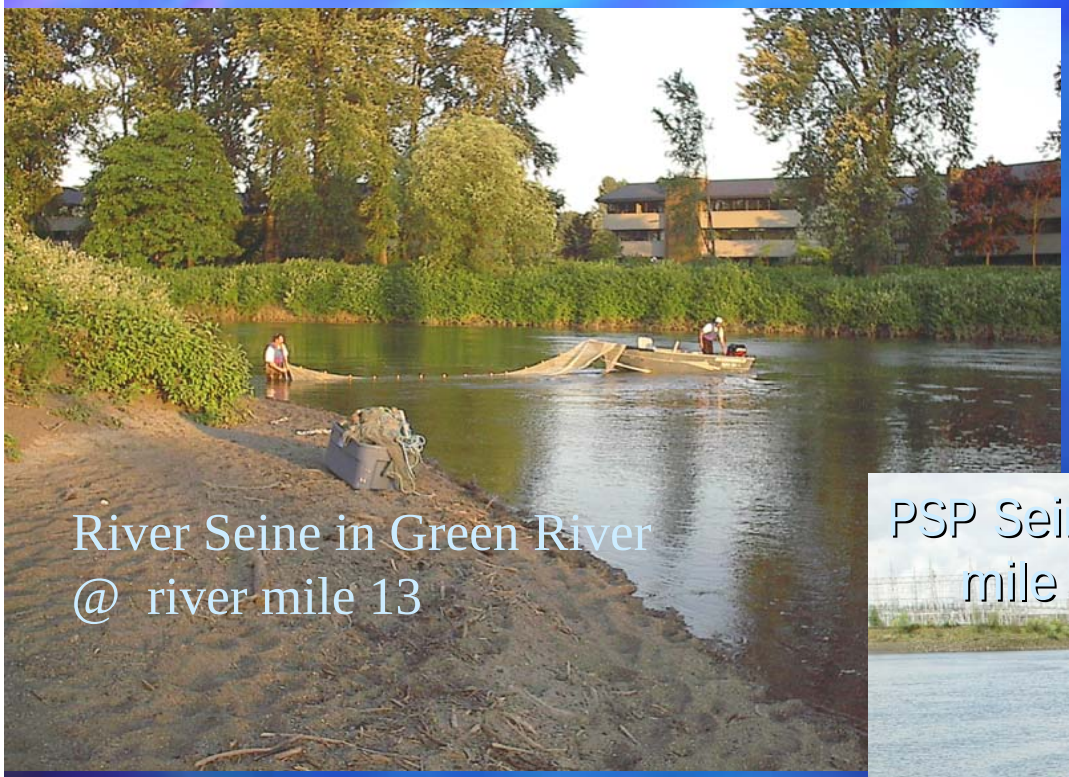
Methods: Fish Collection





168 days of trapping

Methods: Fish Collection

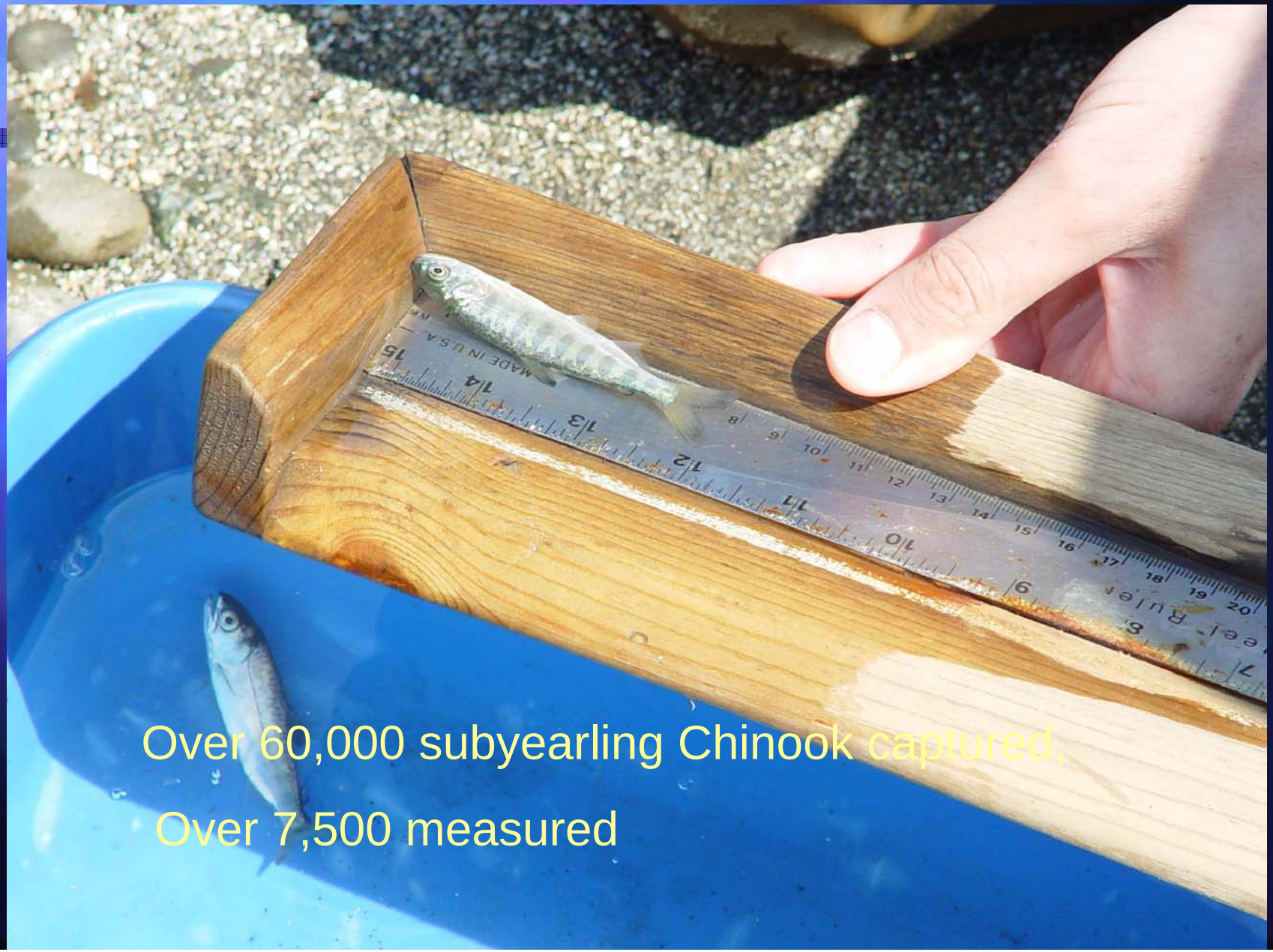


River Seine in Green River @ river mile 13

PSP Seine in Duwamish River @ river mile 5.5 (Turning Basin)

1,150 Seine Sets

Methods: Count & Measure



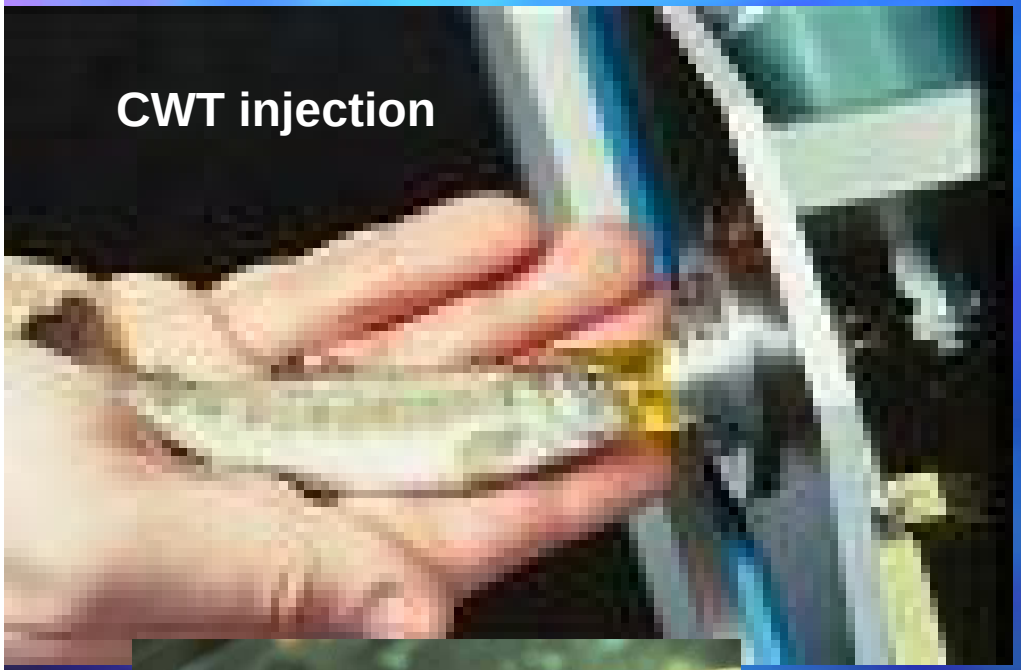
Over 60,000 subyearling Chinook captured,

Over 7,500 measured

Methods: other monitoring tools

Tags	Marks
Coded Wire Tag (cwt)	Adipose fin clip (WDFW program initiated in 2000)
PIT (passive integrated transponder)	Spray applied fluorescent pigment
V6 acoustic tag	

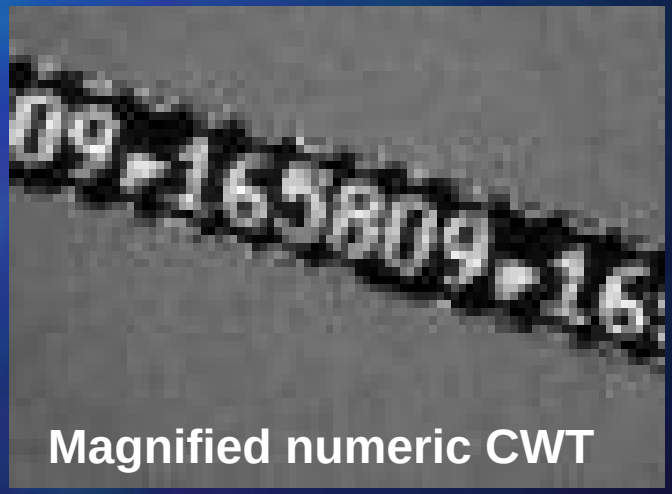
Coded Wire Tag (CWT)



CWT injection

CWT

adipose clip

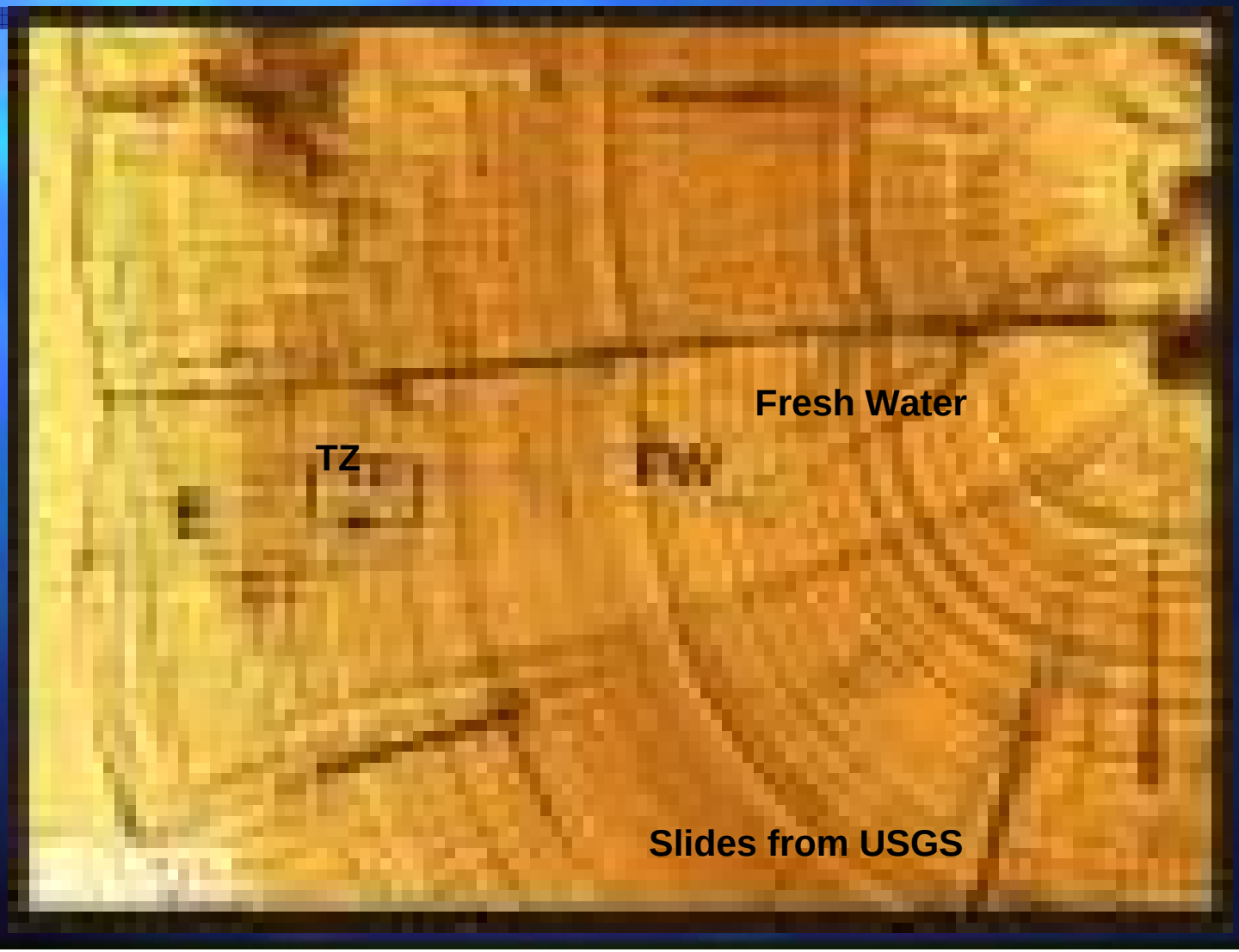


Magnified numeric CWT

Method: Biological Samples
(about 300 each)

Scales	Age, hatchery/wild determination
Otoliths	Age at entry into estuary, growth
Stomach Content	Diet analysis
Whole body	Chemical analysis (PCB)

Otolith

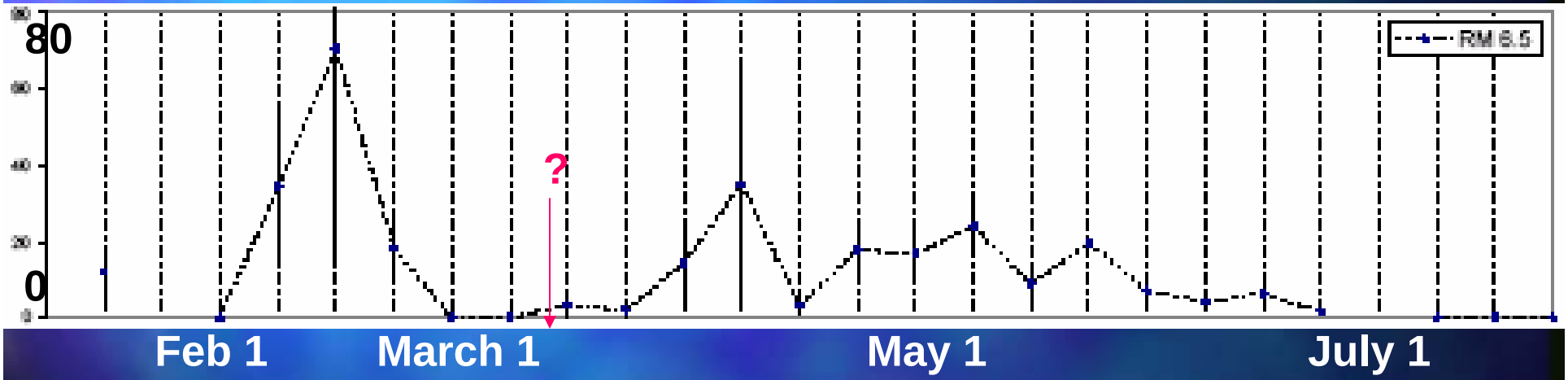


Findings:
Extent of Wild Residence time in the Duwamish

- Chinook fry, one year old and two year old sized fish were found in January. The early fry were found in both 2002 and 2003.
- Wild Chinook were found in the Duwamish into September.

Findings: Wild Chinook were found to have an early (February-March) peak in the Duwamish followed by the fingerling peak in May.

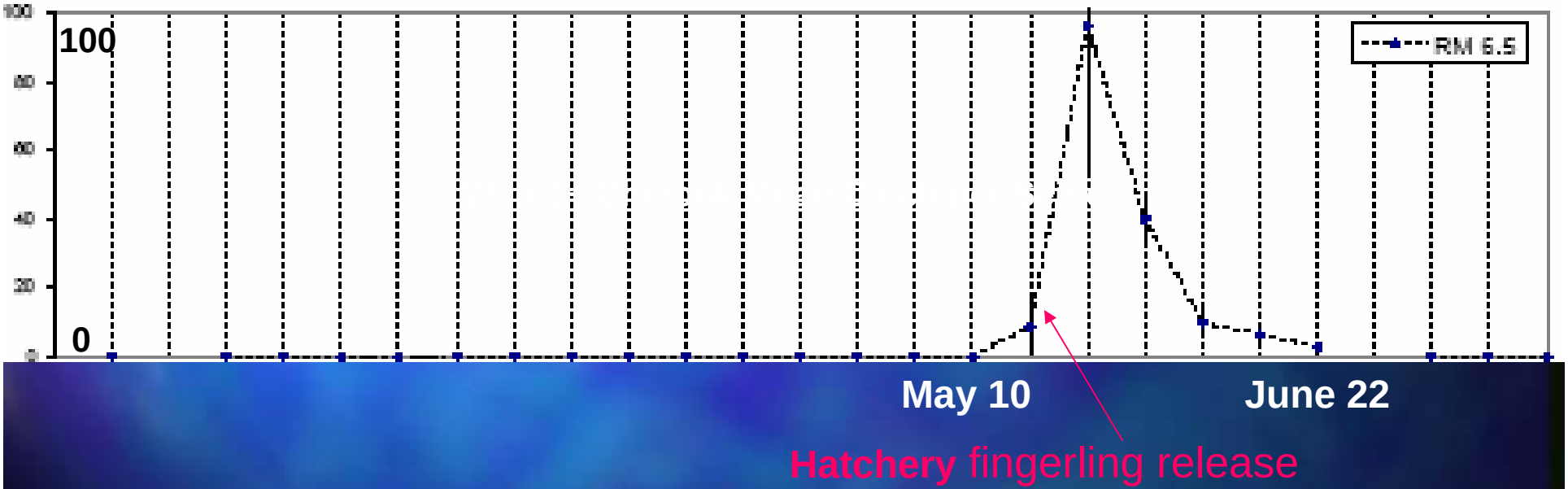
Trimaran Duwamish River Mile 6.5, 2003



Wild 0+ Chinook Mean Catch per Seine

Hatchery Fish Timing

Trimaran Duwamish River Mile 6.5, 2003



Hatchery 0+ Chinook Mean Catch per Seine

JSSS Hatchery Chinook Coded Wire Tag Recoveries Before and After June 20th (2002 and 2003 combined).

BEFORE June 20

Seacrest/Alki/Pier 90 & 91

SOOS	13
OTHER	2

T5/Slip 27

SOOS	18
OTHER	3

Kellogg Island

SOOS	40
OTHER	0

Turning Basin/Trimaran

SOOS	34
OTHER	0

Best Western

SOOS	4
OTHER	0

AFTER June 20

Seacrest/Alki/Pier 90 & 91

SOOS	9
OTHER	33

T5/Slip 27

SOOS	21
OTHER	38

Kellogg Island

SOOS	0
OTHER	2

Turning Basin/Trimaran

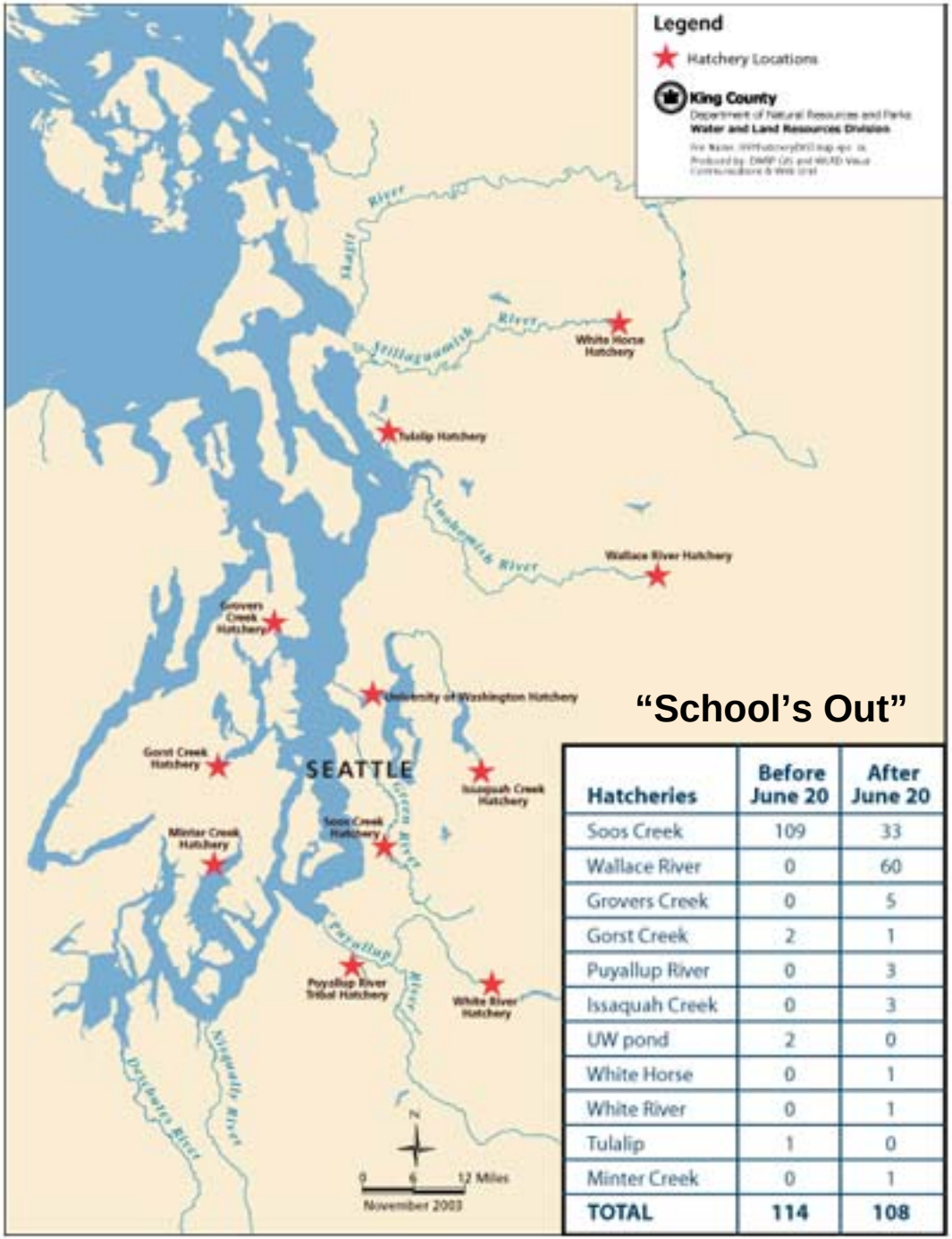
SOOS	2
OTHER	1

Best Western

SOOS	1
OTHER	0

King County
Department of Natural Resources and Parks
Water and Land Resources Division

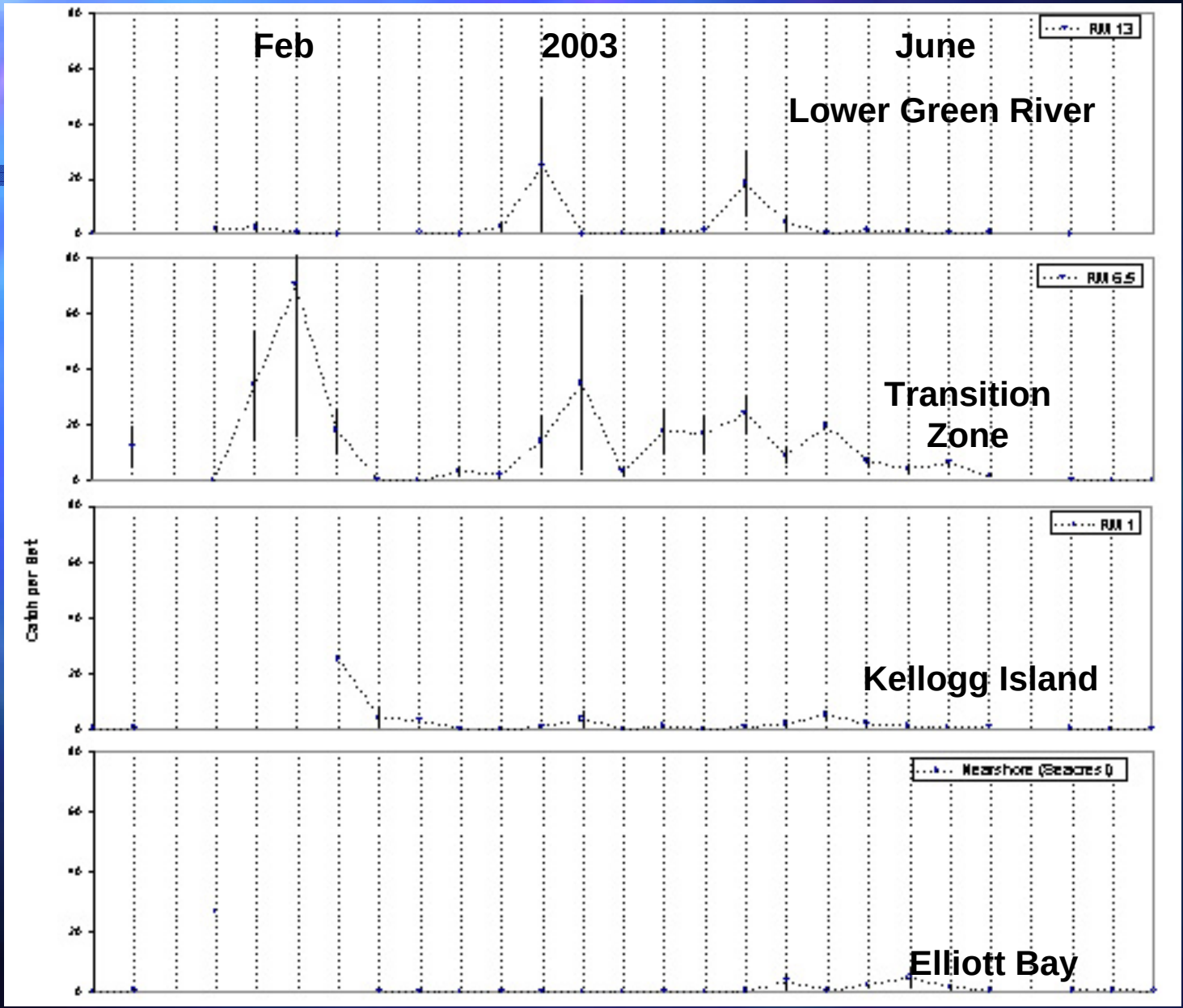
0511_W9sampleCOMPARE.ai lpre, sk



"School's Out"

Hatcheries	Before June 20	After June 20
Soos Creek	109	33
Wallace River	0	60
Grovers Creek	0	5
Gorst Creek	2	1
Puyallup River	0	3
Issaquah Creek	0	3
UW pond	2	0
White Horse	0	1
White River	0	1
Tulalip	1	0
Minter Creek	0	1
TOTAL	**114**	**108**

Findings: Where the Chinook were found.



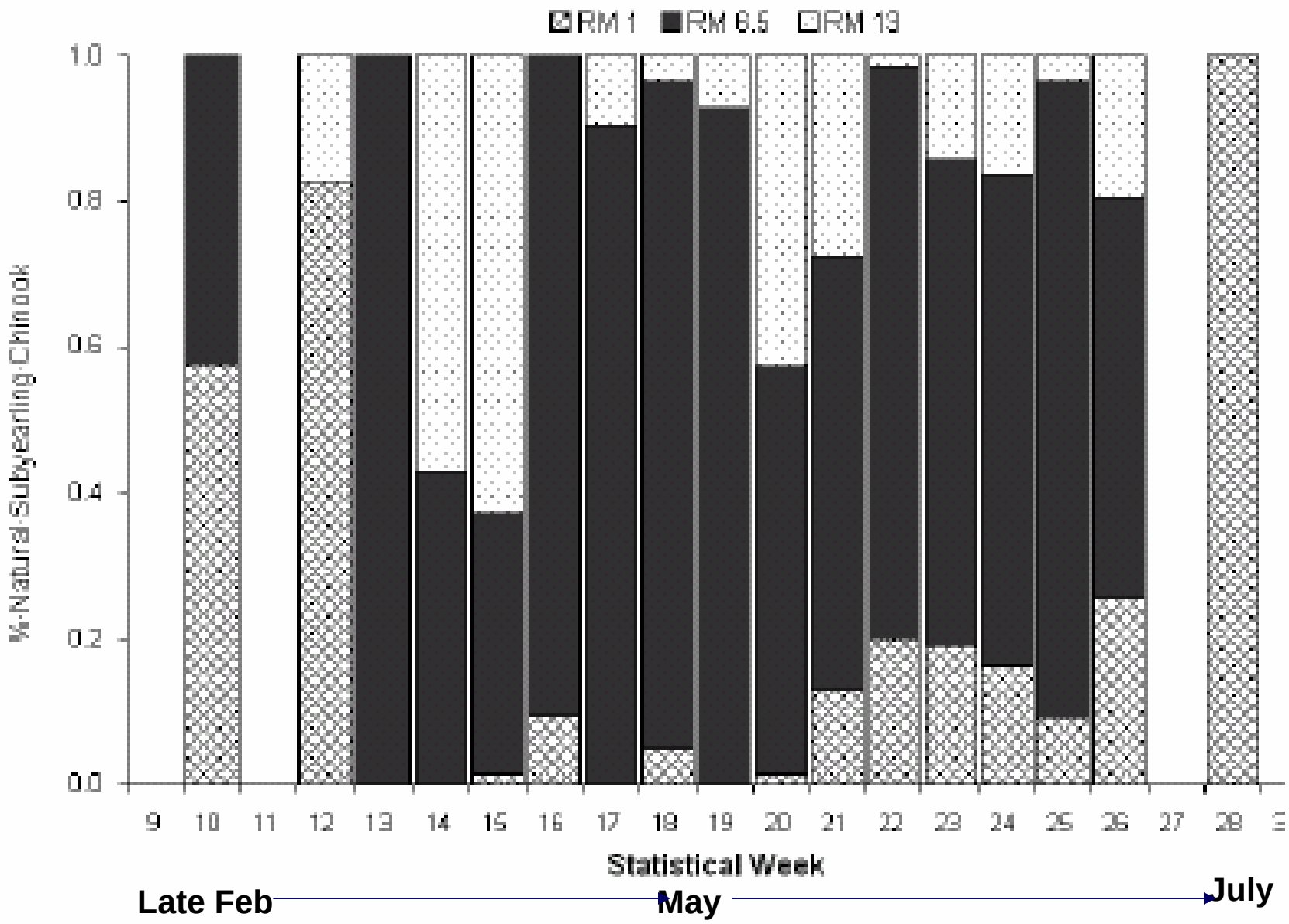


Figure 3-7. Percentage of natural subyearling Chinook salmon (vertical axis) in each of the three (RM 1, RM 6.5, and RM 13) river/estuary index sites, 2003. Only river seine catches used in these figures.

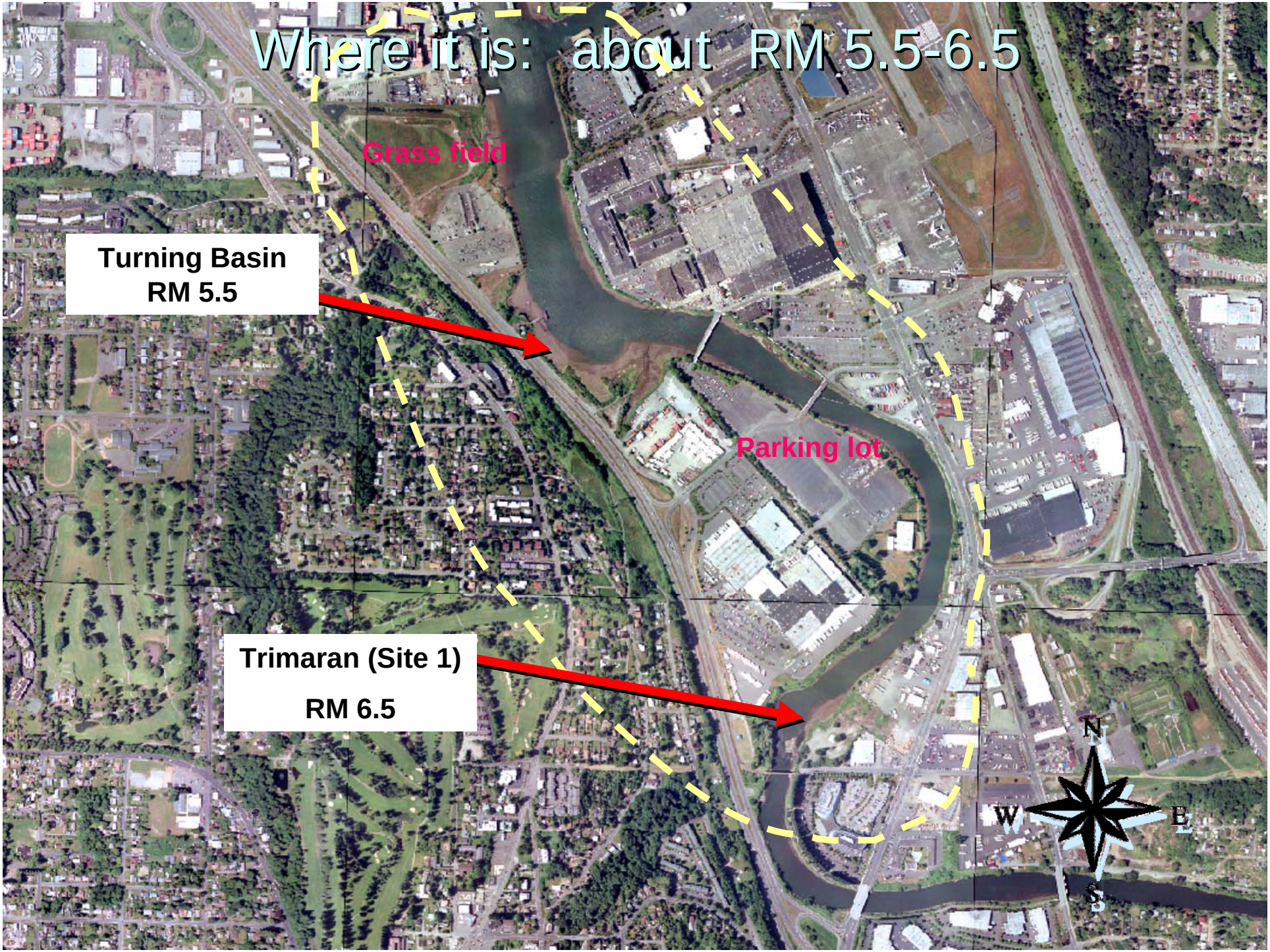
Transition Zone Defined:

Physical Attributes

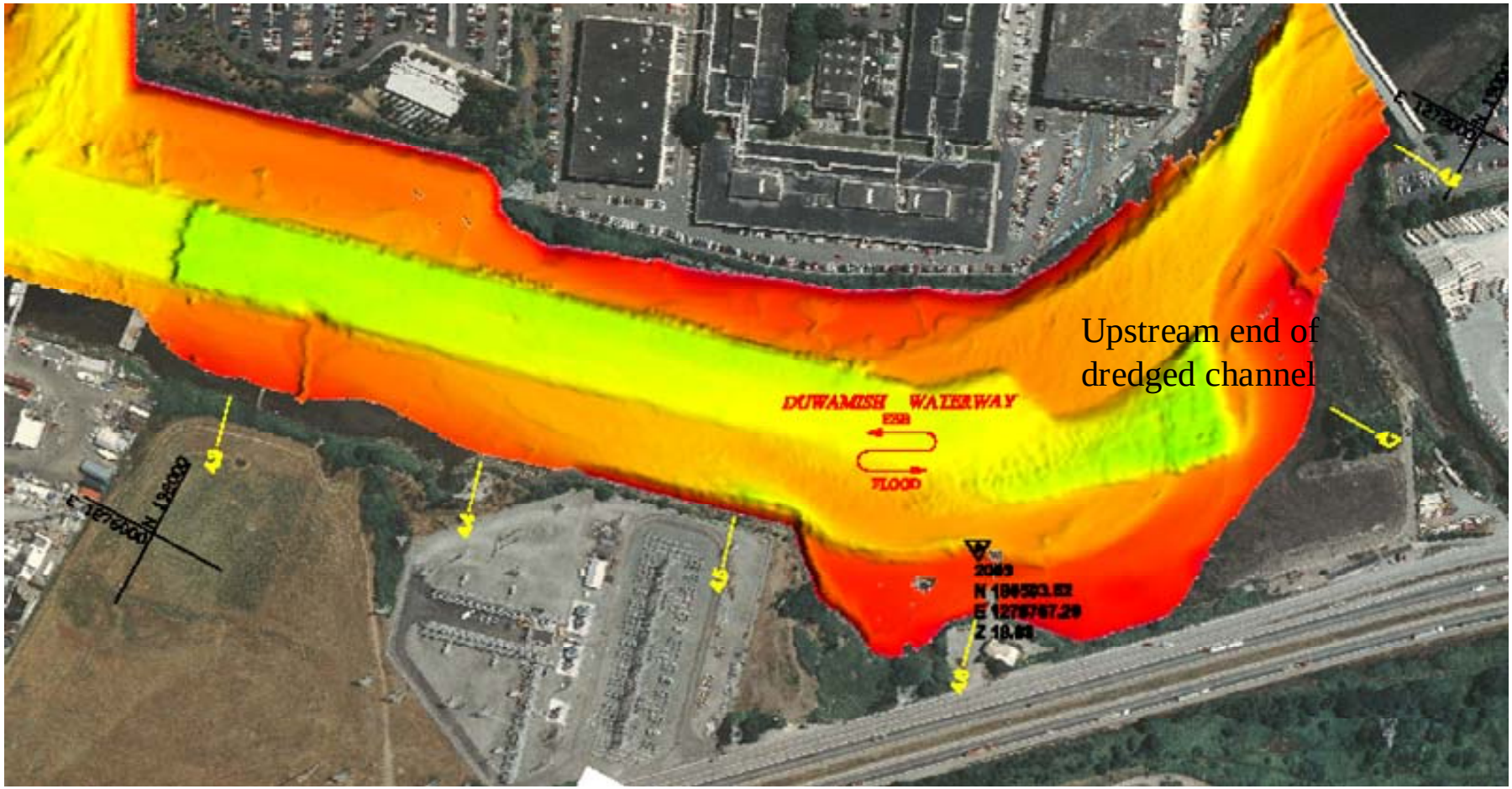
- Fresh initially meets salt water and produces a salinity gradient
- Low velocities
- Shallow water & mudflats

Ecological Attributes

- Area for juvenile salmon to physiologically prepare for salt water
- Less fish predators
- Less energy expenditure
- Food production


Where it is: about RM 5.5-6.5
Grass field
Turning Basin
RM 5.5
Parking lot
Trimaran (Site 1)
RM 6.5
N
W
E
S

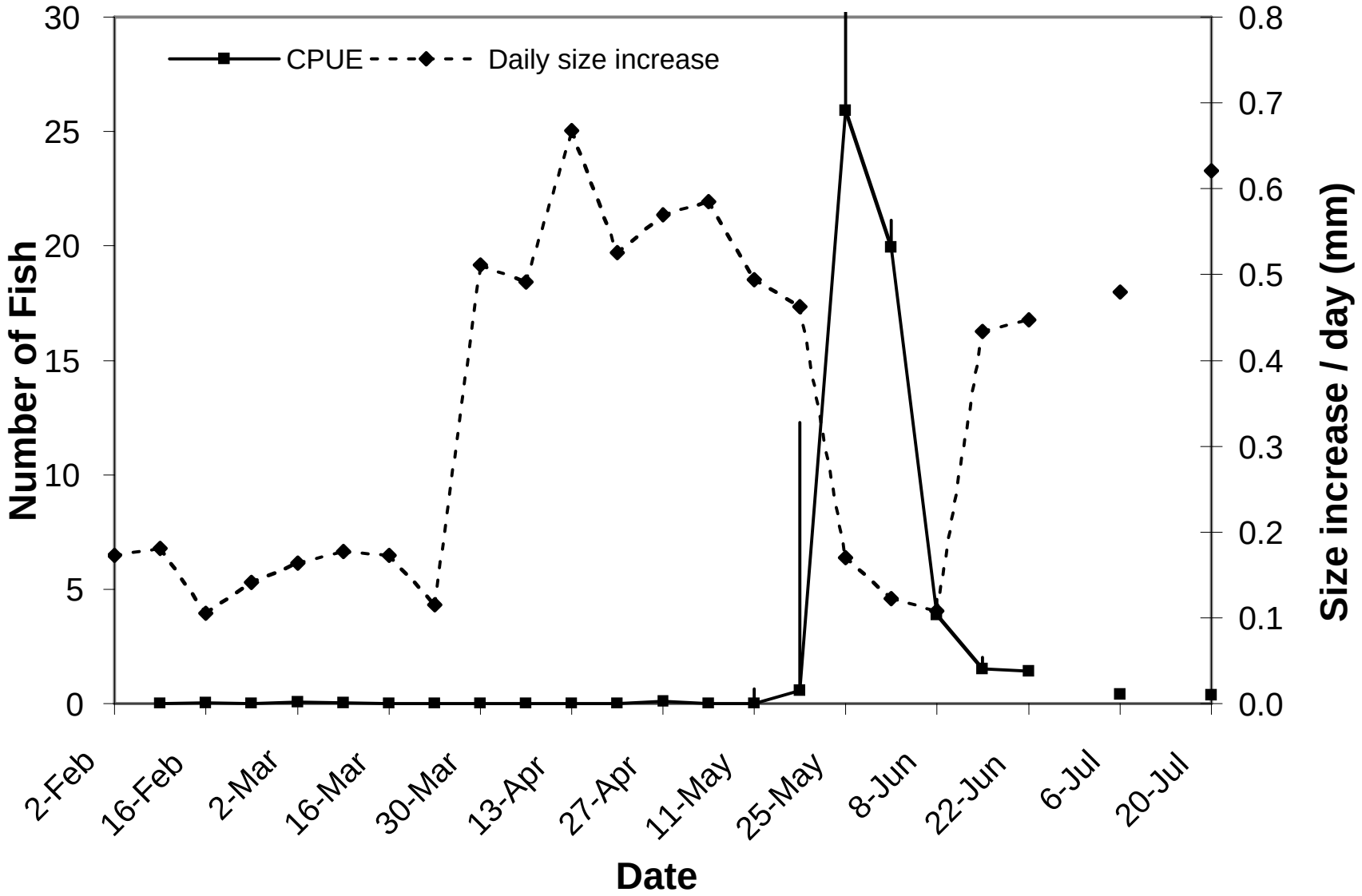
Why is Transition Zone is at the Turning Basin ?



Slide courtesy of Fred Goetz, ACOE

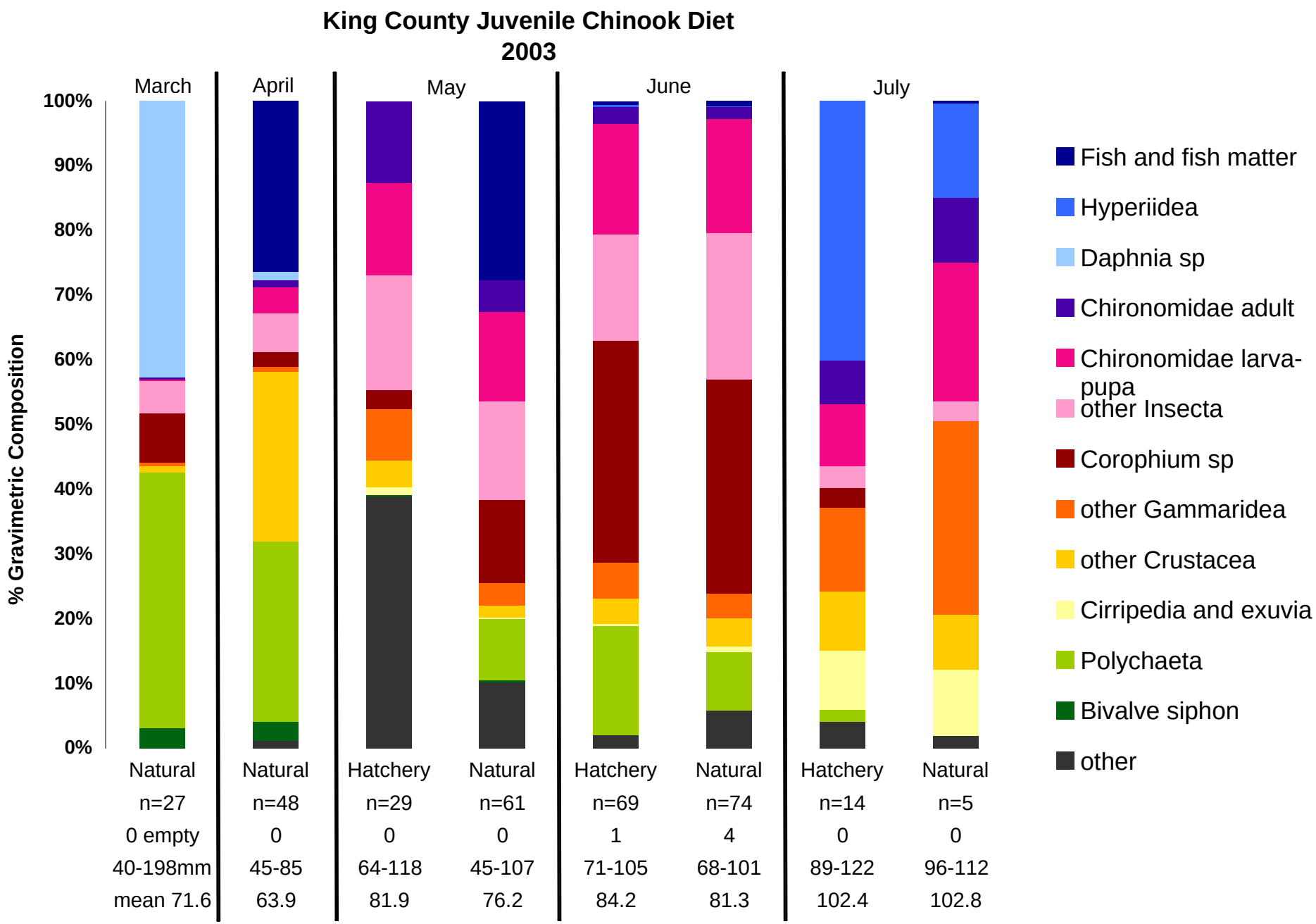
Is the transition zone big enough?

Figure of the change in daily size of wild Chinook in Duwamish as related to Hatchery Chinook Captured.



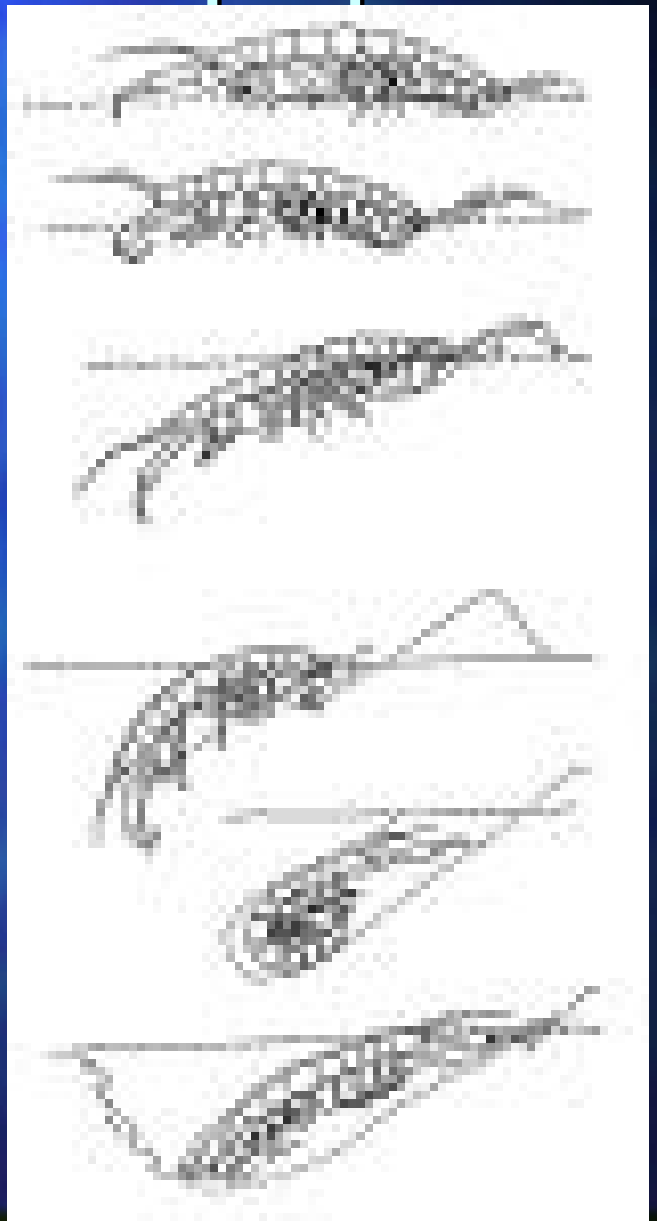
Findings: What they Eat

- Wild and hatchery fish are opportunistic feeders and consume a wide variety of benthic, epibenthic and pelagic invertebrates.
- Overall the three most important prey items were Chironomids, Corophium and Daphnia.


King County Juvenile Chinook Diet
2003
March
April
May
June
July
% Gravimetric Composition
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Natural
n=27
0 empty
40-198mm
mean 71.6
Natural
n=48
0
45-85
63.9
Hatchery
n=29
0
64-118
81.9
Natural
n=61
0
45-107
76.2
Hatchery
n=69
1
71-105
84.2
Natural
n=74
4
68-101
81.3
Hatchery
n=14
0
89-122
102.4
Natural
n=5
0
96-112
102.8
Fish and fish matter
Hyperiidea
Daphnia sp
Chironomidae adult
Chironomidae larva-pupa
other Insecta
Corophium sp
other Gammaridea
other Crustacea
Cirripedia and exuvia
Polychaeta
Bivalve siphon
other

Chironomids: emergent freshwater marsh midge

Corophium: estuarine amphipod



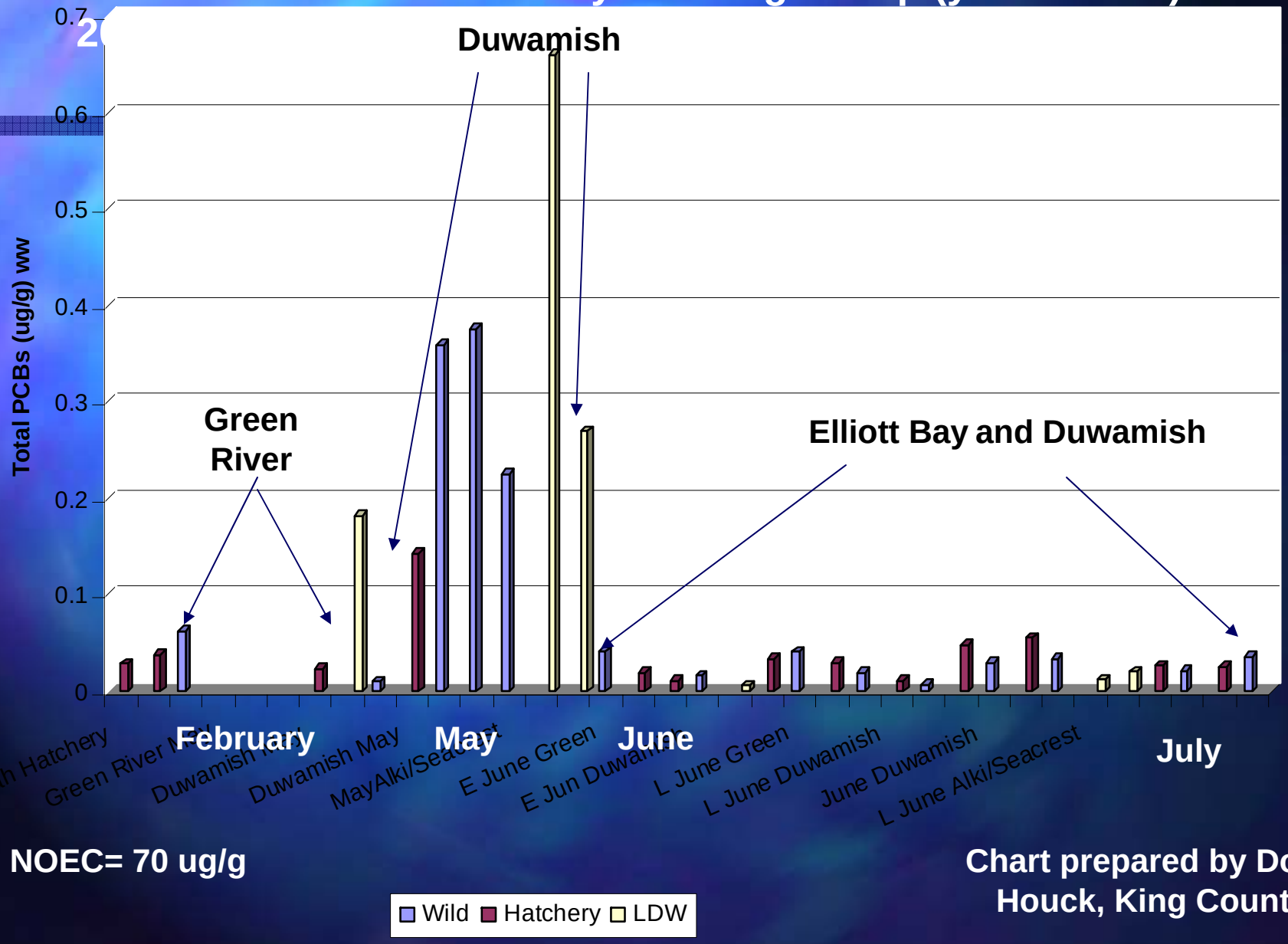
Daphnia: freshwater planktonic

Clam Siphons and Polychaetes

Macoma sp.

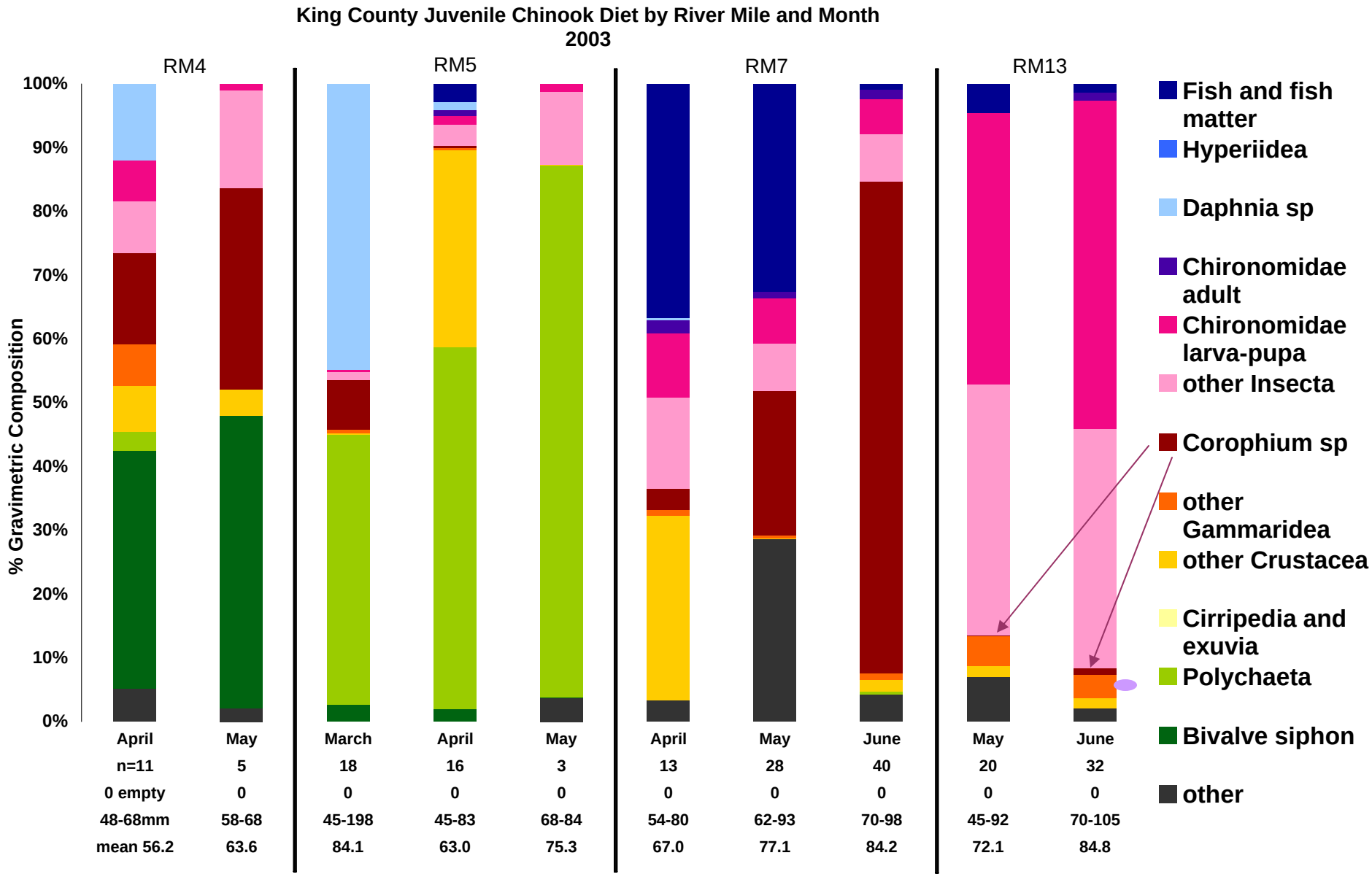
Platynereis bicanaliculata

Green-Duwamish River Juvenile Chinook Total PCB concentration from King County Lab (red and blue bars) and Lower Duwamish Waterway Working Group (yellow bars) in 2



NOEC= 70 ug/g

Chart prepared by Doug Houck, King County


King County Juvenile Chinook Diet by River Mile and Month
2003
RM4
RM5
RM7
RM13
% Gravimetric Composition
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
April
n=11
0 empty
48-68mm
mean 56.2
May
5
0
58-68
63.6
March
18
0
45-198
84.1
April
16
0
45-83
63.0
May
3
0
68-84
75.3
April
13
0
54-80
67.0
May
28
0
62-93
77.1
June
40
0
70-98
84.2
May
20
0
45-92
72.1
June
32
0
70-105
84.8
Fish and fish matter
Hyperiidea
Daphnia sp
Chironomidae adult
Chironomidae larva-pupa
other Insecta
Corophium sp
other Gammaridea
other Crustacea
Cirripedia and exuvia
Polychaeta
Bivalve siphon
other

Summary: Importance of Information to Chinook Recovery and Protection

- Residence Time Expansion

  Wild Chinook are now known to enter the Duwamish in January and exit in August. Two migration peaks occur and are representative of two life history types of Chinook. The fry peak in late February to early March and the fingerlings peak in late May. Maintaining varied life history types are important to maintain a resilient and viable population.

  Recommendations:

  1. avoid direct impact from projects (i.e. dredging) by providing appropriate work windows.
  2. Chemical uptake (i.e., CSO discharges, non point, contaminated sediments) by juveniles may be of more concern than previously thought due to the expanded residence time. Find sources of pollution and clean it up.

Summary: Importance of Information to Chinook Recovery and Protection

- Transition Zone is a WRIA Priority

  Identifies a discrete habitat, the Transition Zone (about Duwamish River Mile 4.5 to 6.5) that is very important for Chinook survival.

  Recommendations:

  1. restore mudflat habitat by excavating out old fill.
  2. Move the dredging location downstream and allow as much of existing Turning Basin to refill with clean sediment as is reasonable.
  3. Limit the hatchery salmon competition with wild Chinook by implementing new hatchery practices and schedules for release.

What's Next

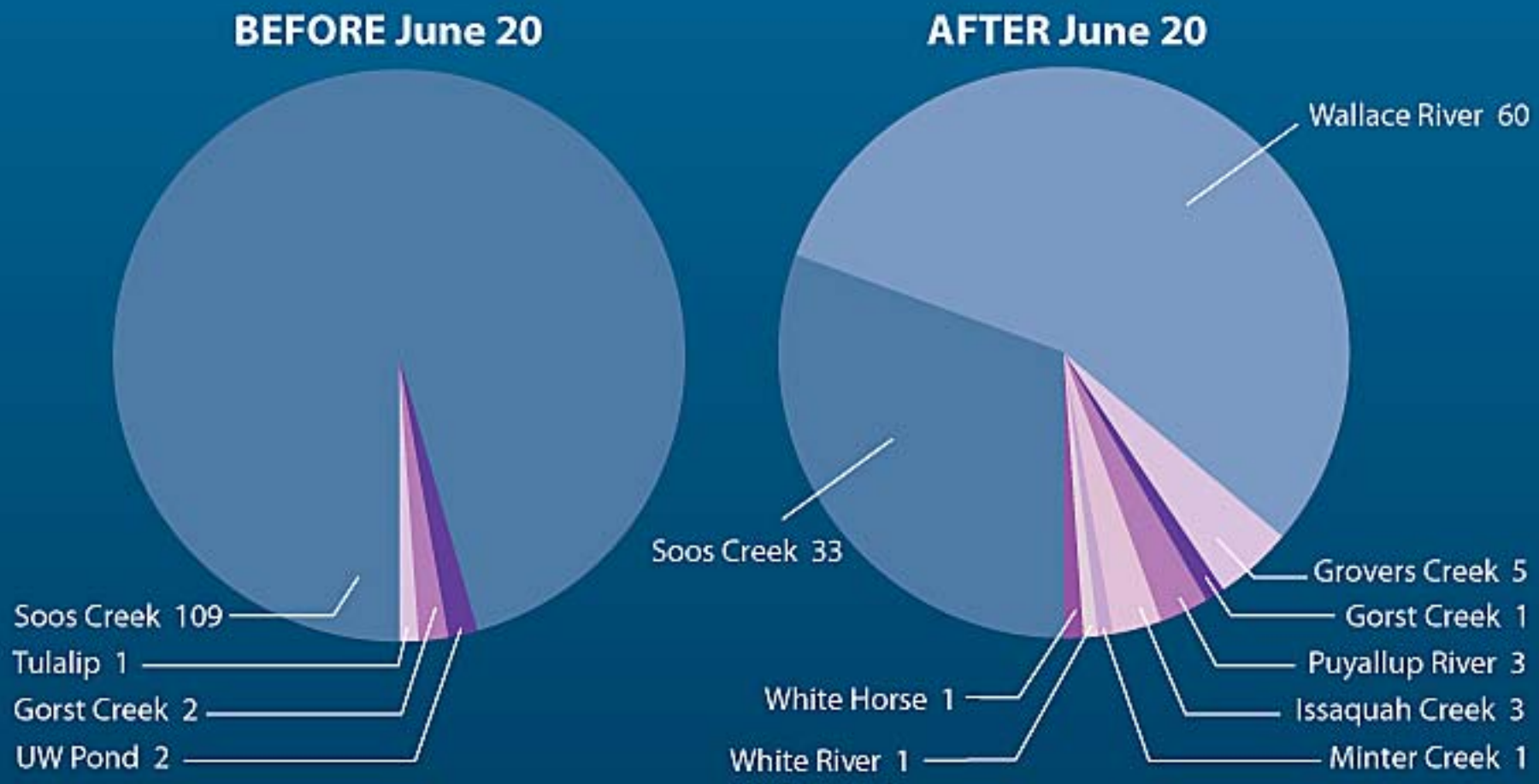
- Otoliths could answer questions about Chinook duration and growth in the Duwamish. Funds are currently being sought for analyzing 2003 and 2005 collections.
- This could result in information leading to answers regarding early fry survival, hatchery origin, life history types, as well as more precise residency and growth estimates.

Project Support

- King County DNR
- King Conservation District Grant (100K)
- Port of Seattle (Taylor Associates)
- City of Seattle
- WDFW (Hatchery and Research Divisions)
- US Army Corps of Engineers, Fred Goetz
- City of Kent
- NMFS
- Washington Conservation Crews
- Kurt Fresh NOAA
- Doris Small WDFW
- Mike Wilson WDFW Soos Creek Hatchery
- Pete Topping, WDFW

- Abel Eckhardt
- Melissa Boles
- Jim Lissa
- Jim Brennan,
- Hans Berge
- Jennifer Vanderhoff, KC
- Jim Shannon, Taylor Associates
- Volunteers: Nancy Gleason
- UW WET Lab, Jeff Cordell, Vasilia Stamatiou, Alex Von Saunder, Daniele Potter
- Doug Houck WTD
- Nancy Musgrove

WRIA 9 JSSS CWT Recoveries from various hatcheries in the Puget Sound



Wallace River, Grovers Creek, Puyallup River, Issaquah Creek, White Horse, White River, and Minter Creek 0

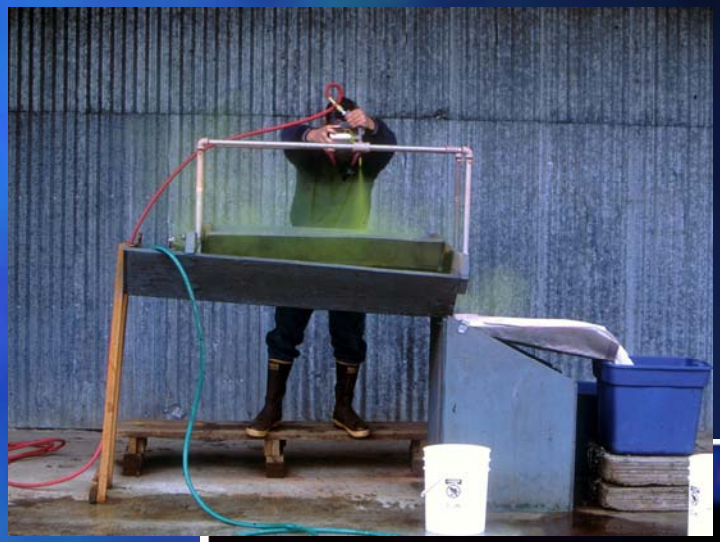
UW Pond and Tulalip 0

King County
Department of Natural Resources and Parks
Water and Land Resources Division

0511_W9sampleCHART_2.eps lpre, sk

Findings:
Wild Chinook Fry Migration Speed to the Duwamish

- Through flourescent pigment marking and recapture, wild fry were shown to migrate to estuary from Soos Creek (RM 33) as fast within the first 24 hours, the majority were captured within first 48 hours.



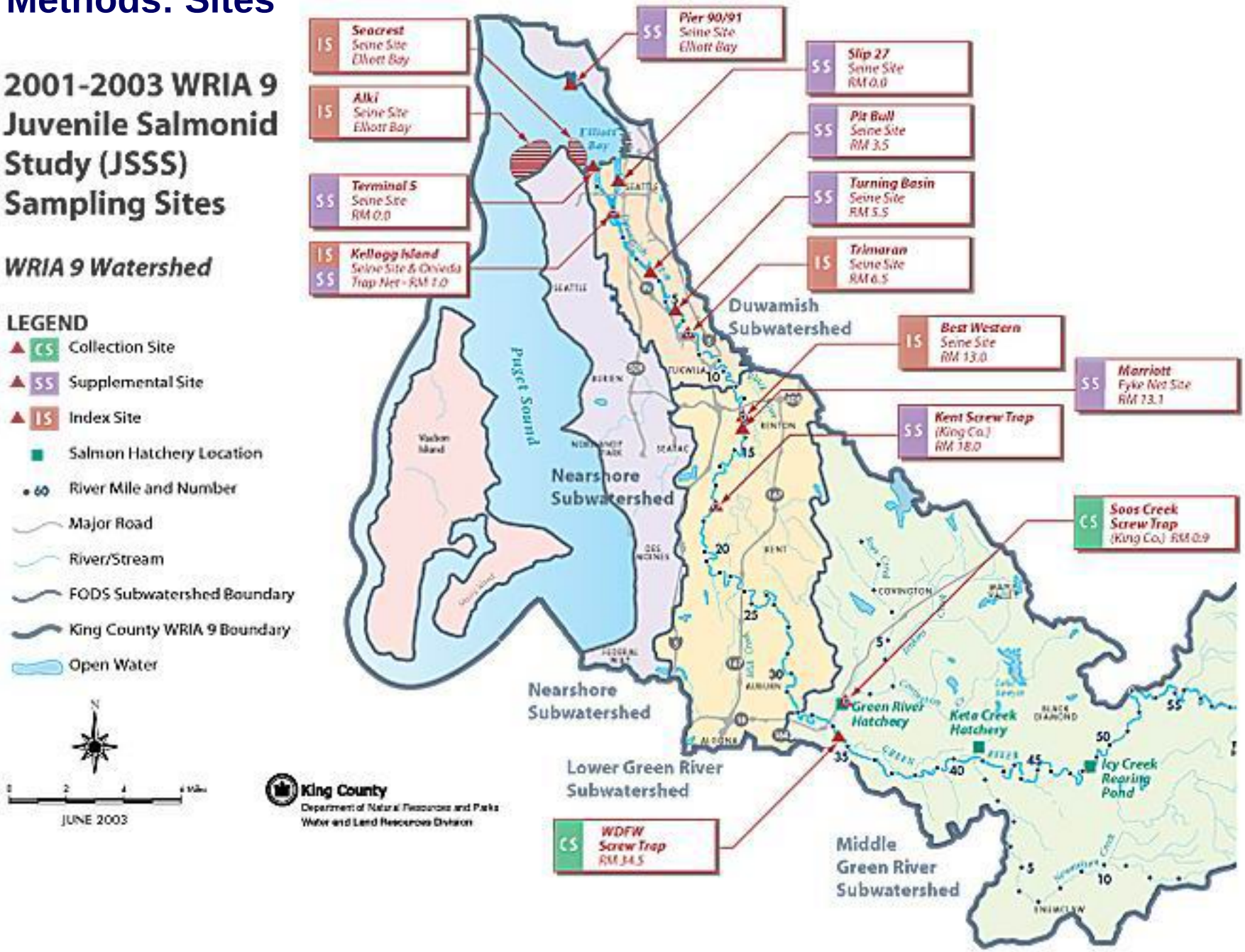
Findings:
Wild Chinook Fingerling Migration Speed to the Duwamish

- In 2003, Wild fingerlings from the Middle Green were assumed to migrate quickly (within one week) to the Duwamish by observing closely related peak catches at RM 34.5, 18 and 6.5.

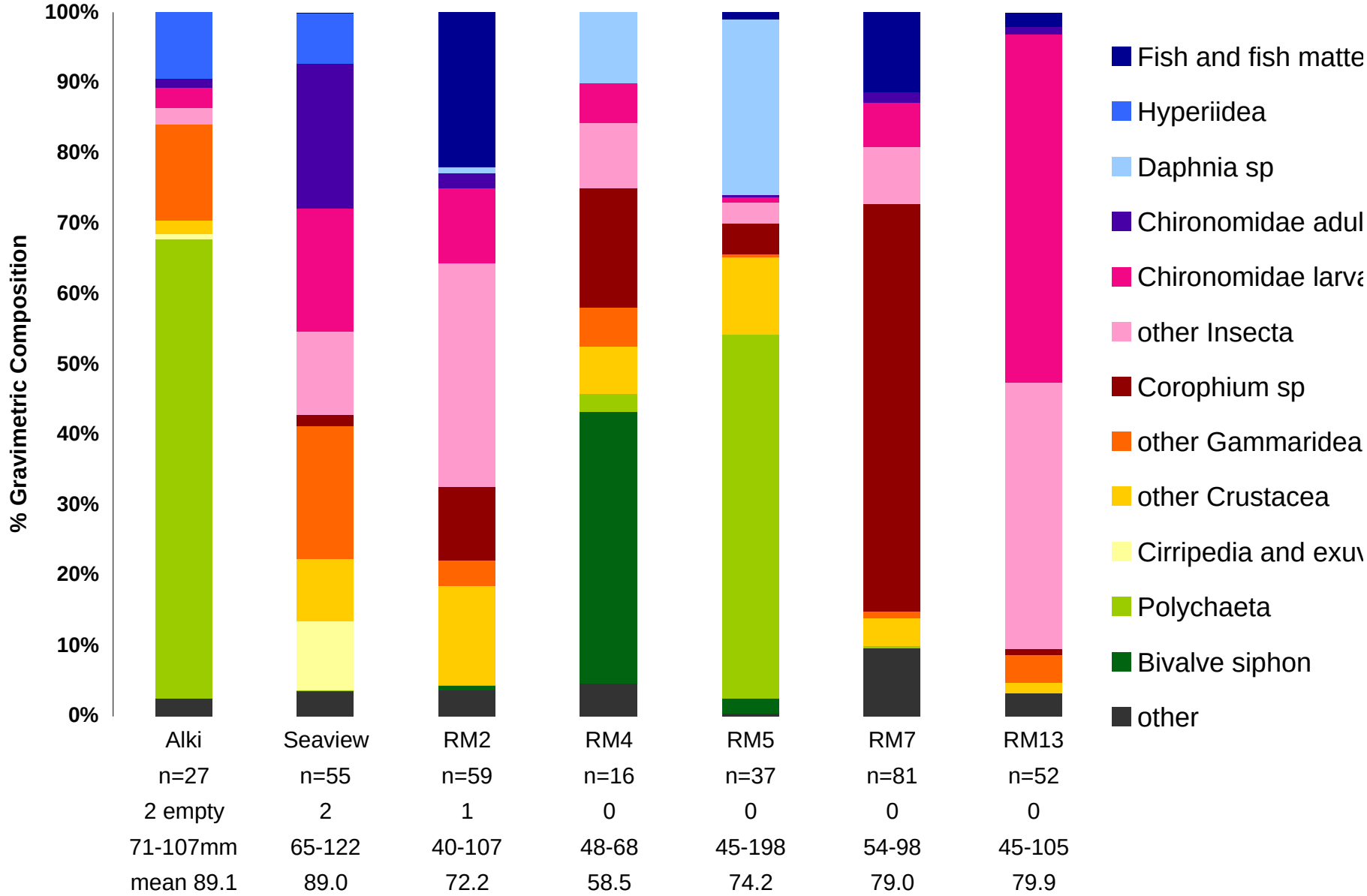
Methods: Sites

2001-2003 WRIA 9 Juvenile Salmonid Study (JSSS) Sampling Sites

WRIA 9 Watershed



King County Juvenile Chinook Diet by River Mile 2003



Summary: Importance of Information to Chinook Recovery and Protection

- Coded wire tag recovery analysis shows the Chinook move abruptly out of the natal estuary and rapidly throughout the Puget Sound Nearshore (School's Out Affect) in mid-June. This information should lead recovery resources towards the best possible projects on a Puget Sound-wide basis. The best nearshore project for Duwamish River/ WRIA 9 fish may lie in another WRIA.