Migration Characteristics of Juvenile Willamette River Spring Chinook Salmon in the Lower Columbia River and Estuary: Synthesis of Findings from Genetic Stock Identification Studies

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Presentation

Objective

- Provide a compilation and synthesis of results from genetics research in the estuary on migration characteristics for Willamette River spring Chinook salmon

Outline

- Sources
- Caveats
- Results
- Synthesis
- Life History Patterns
- Management Implications

Life History Naming Scheme

- Yearlings = large fish captured in winter and spring
  - E.g., >70 mm in January, >90 mm in March, and >120 mm in May
- Subyearlings = small fish captured in winter and spring
  - Fry < 60 mm
  - Fingerlings > 60 mm
- Subyearlings = any fish captured in July through November

Sources

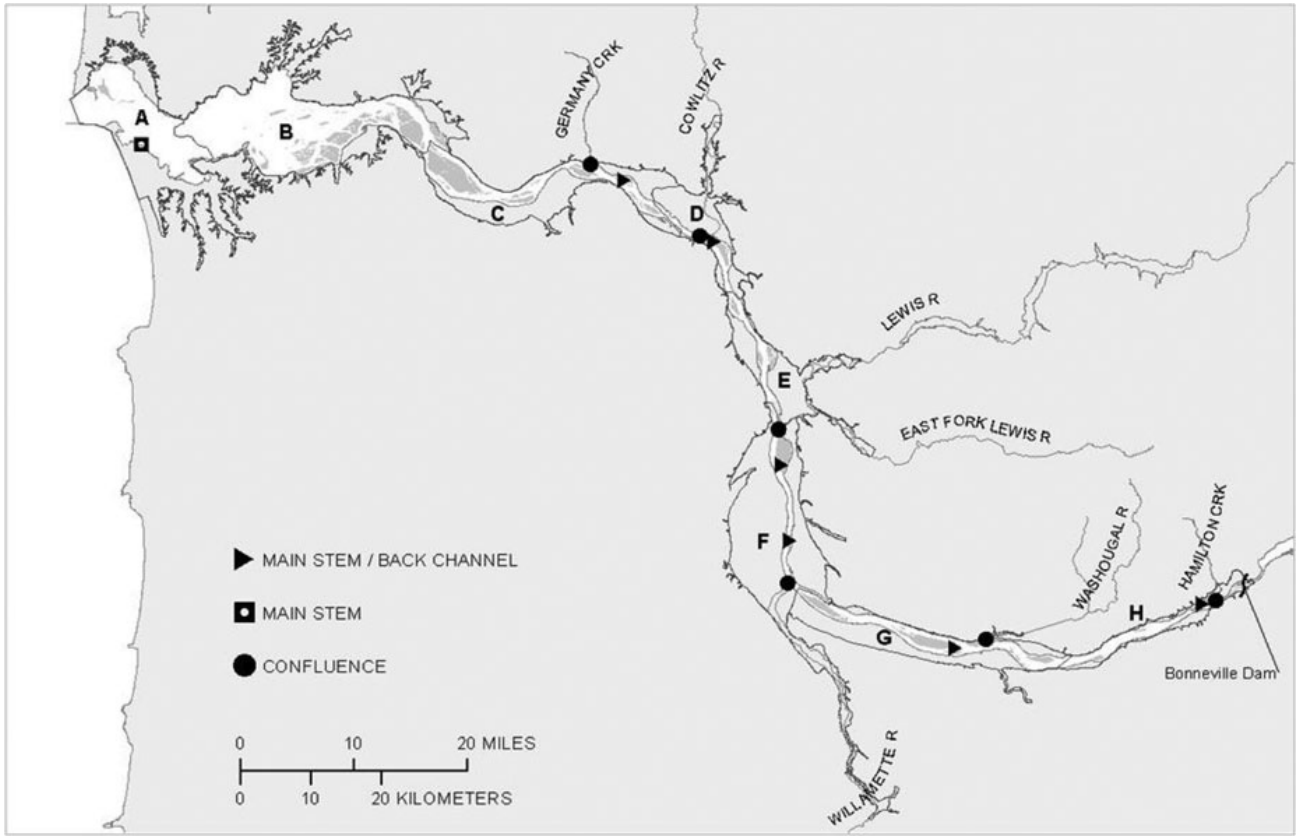
- **Rkm 13-234**: Teel and eight co-authors. 2014. “Genetic Identification of Chinook Salmon in the Columbia River Estuary: Stock-Specific Distributions of Juveniles in Shallow Tidal Freshwater Habitats.” *North American Journal of Fisheries Management* 34:621-641.
- **Rkm 110-141**: Sather, Johnson, Teel, Storch, Skalski, and Cullinan. 2016. “Shallow Tidal Freshwater Habitats of the Columbia River: Spatial and Temporal Variability of Fish Communities and Density, Size, and Genetic Stock Composition of Juvenile Chinook Salmon.” *Transactions of the American Fisheries Society* 145:734-753.
- **Rkm 13-81**: Roegner, McNatt, Teel, and Bottom. 2012. “Distribution, Size, and Origin of Juvenile Chinook Salmon in Shallow-Water Habitats of the Lower Columbia River and Estuary, 2002–2007.” *Marine and Coastal Fisheries* 4:450-472.
- **Rkm 13-17**: Weitkamp, Teel, Liermann, Hinton, Van Doornik, and Bentley. 2015. “Stock-Specific Size and Timing at Ocean Entry of Columbia River Juvenile Chinook Salmon and Steelhead: Implications for Early Ocean Growth.” *Marine and Coastal Fisheries* 7:370-392.
- **Rkm 19**: Roegner, Weitkamp, and Teel. 2016. “Comparative Use of Shallow and Deepwater Habitats by Juvenile Pacific Salmon in the Columbia River Estuary Prior to Ocean Entry.” *Marine and Coastal Fisheries* 8:536-552.

Caveats

- Beach seine collections
  - Sample shallow shoreline water
  - Biased against capturing yearling fish (> 90 mm)
- Purse seine collections
  - Sample main channel water
  - Biased against capturing fry (< 60 mm)
- Willamette River spring Chinook stocks have been transferred outside the Willamette R basin, e.g., Sandy River basin
  - Not all WRS Chinook salmon sampled in the estuary came from the Willamette R basin
- The talk emphasizes data from downstream of the Willamette/Columbia confluence
- PIT studies are not included

Teel et al. (2014)

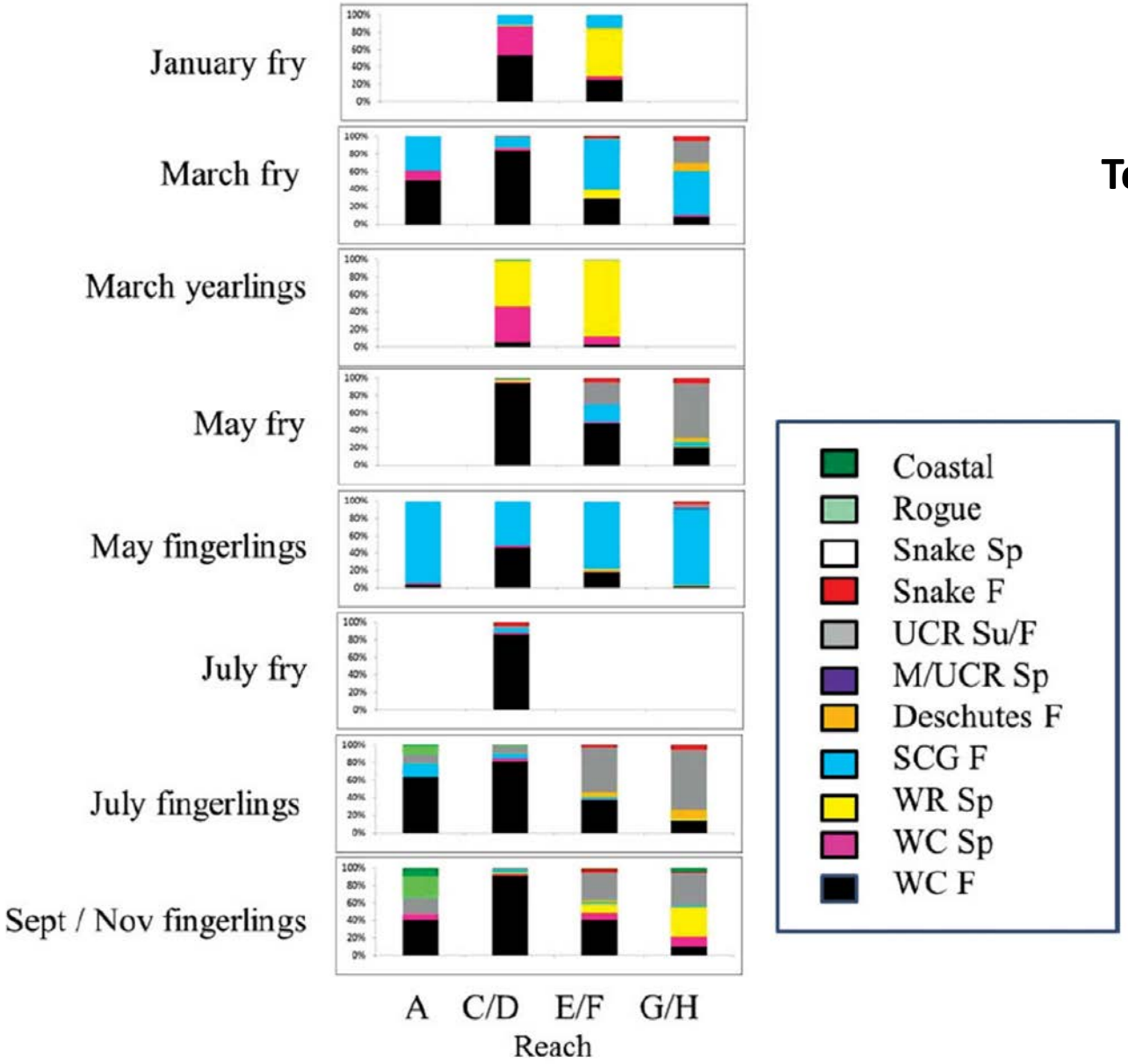
- Beach seine
- Bimonthly sampling, 2010-2012
- Rkm 13-234



From Teel et al. (2014)

TABLE 4. Sample sizes, percentages marked, and estimated percentage composition of the 11 genetic stocks observed in samples of juvenile Chinook Salmon collected at main-stem and back-channel sites in the Columbia River estuary, 2010–2012. Data are shown for all surveys and for each reach. Reach locations are shown in Figure 1; confidence intervals for each estimate are provided in Table A.1.

			Percentage stock composition of Chinook Salmon										
			West Cascade							Snake River			
Estuary reach	*N*	Percent marked	Fall	Spring	Willamette River spring	Spring Creek group fall	Deschutes River fall	Mid and upper Columbia River spring	Upper Columbia summer–fall	Fall	Spring	Rogue River	Coast
All	2,644	28	43	6	8	18	2	0	20	2	0	1	0
A	264	53	39	4	2	39	0	0	7	0	0	7	2
C	423	32	73	11	6	7	0	0	2	1	0	0	1
D	546	23	73	9	6	10	0	0	2	0	0	0	0
E	417	30	30	3	17	23	2	0	24	2	0	0	0
F	368	41	30	3	13	26	2	1	23	2	0	0	0
G	324	19	21	4	13	17	5	1	35	4	0	0	0
H	302	35	3	1	0	20	6	0	62	7	1	0	0

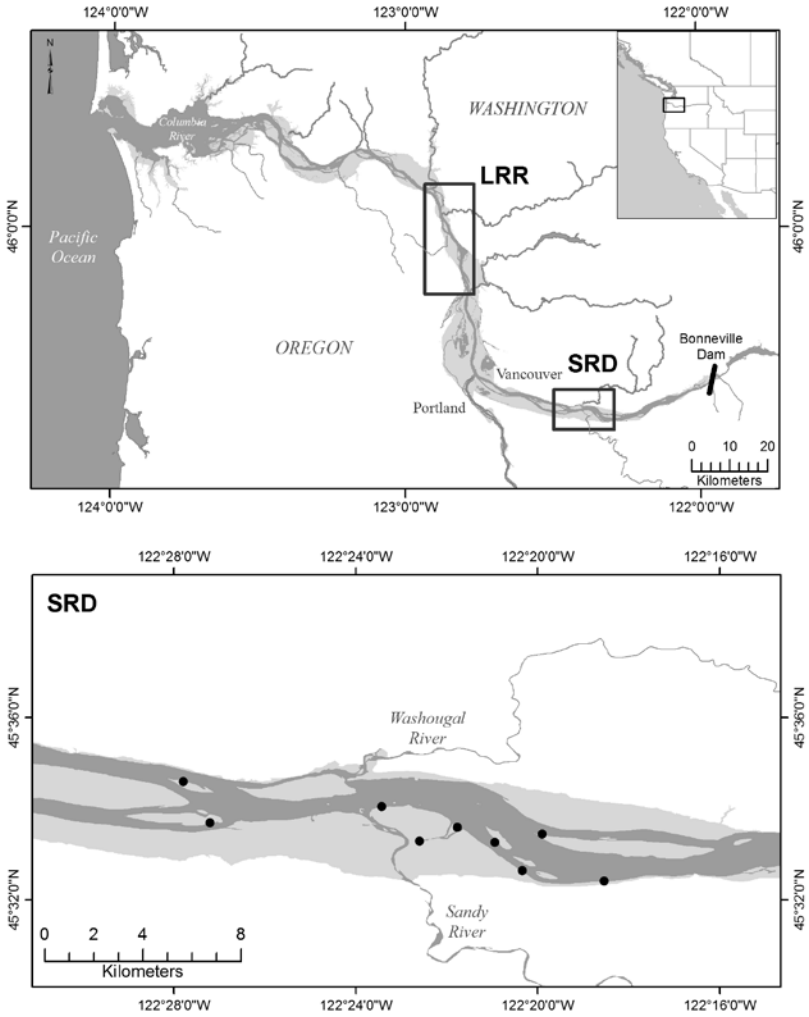


(from Teel et al. 2014)

FIGURE 5. Stacked histograms of stock compositions (percentages) of Chinook Salmon juveniles collected at main-stem and back-channel sites in the Columbia River estuary. Samples are grouped by month, life history type, and hydrogeomorphic reach. Genetic stocks are West Cascade fall (WC F), West Cascade spring (WC Sp), Willamette River spring (WR Sp), Deschutes fall (Deschutes F), mid and upper Columbia River spring (M/UCR Sp), upper Columbia River summer–fall (UCR Su/F), Snake River fall (Snake F), Snake River spring (Snake Sp), Rogue River (Rogue), and Washington–Oregon coastal (Coast). Sample sizes and stock composition estimates are given in Table A.3; reach locations are shown in Figure 1.

Sather et al. (2016)

- Beach seine
- Seasonal sampling, Feb, May, Jul, Nov 2009-2012
- Lower river reach (LRR) Rkm 110-141



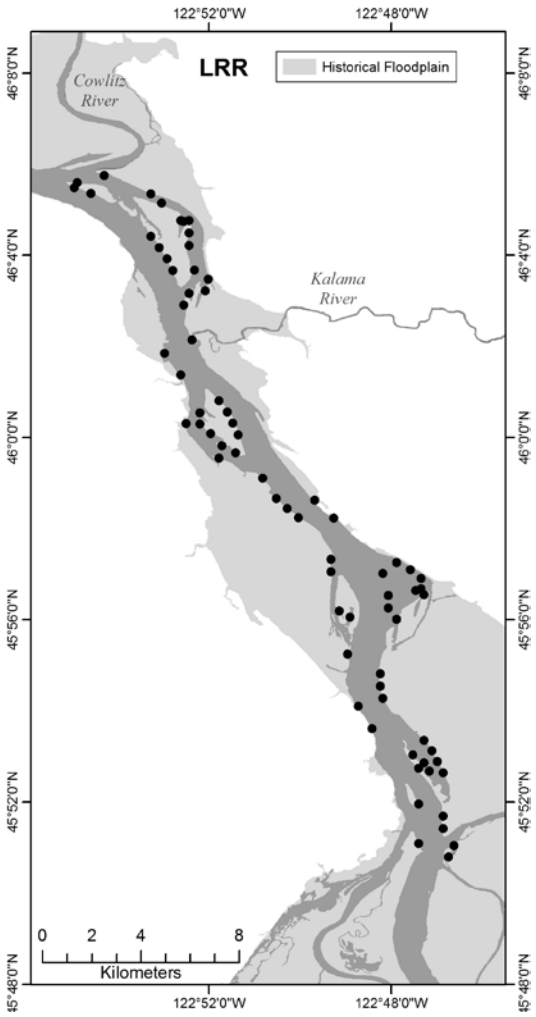


TABLE 3. Sample sizes and estimated percent composition of seven genetic stocks of unmarked juvenile Chinook Salmon sampled from Sandy River delta and lower river reach sites in the lower Columbia River and estuary, 2007–2012. All estimates for mid- and upper Columbia River spring, and introduced Rogue River stocks were less than 1% and are not shown.

Season	*N*	West Cascade Fall	West Cascade Spring	Willamette River spring	Spring Creek group fall	Deschutes River fall	Upper Columbia summer/fall	Snake River fall
Sandy River delta								
All	1,706	13	2	9	35	3	34	3
Winter	568	5	4	10	74	1	5	1
Spring	848	18	1	3	20	6	48	4
Summer	199	12	0	11	1	1	68	7
Fall	91	13	14	63	2	1	4	2
Lower river reach								
All	1,193	73	5	2	6	1	11	2
Winter	388	71	8	5	15	0	0	0
Spring	357	68	2	0	6	2	18	5
Summer	360	74	3	1	0	2	19	0
Fall	88	88	4	2	4	0	2	1

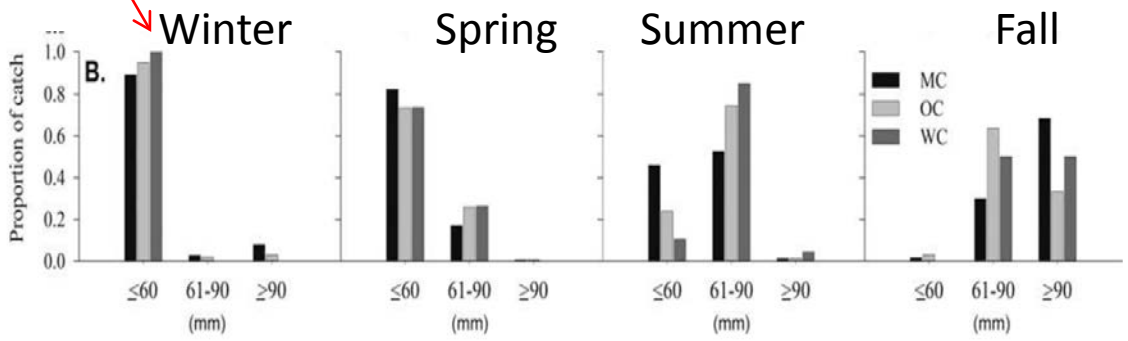
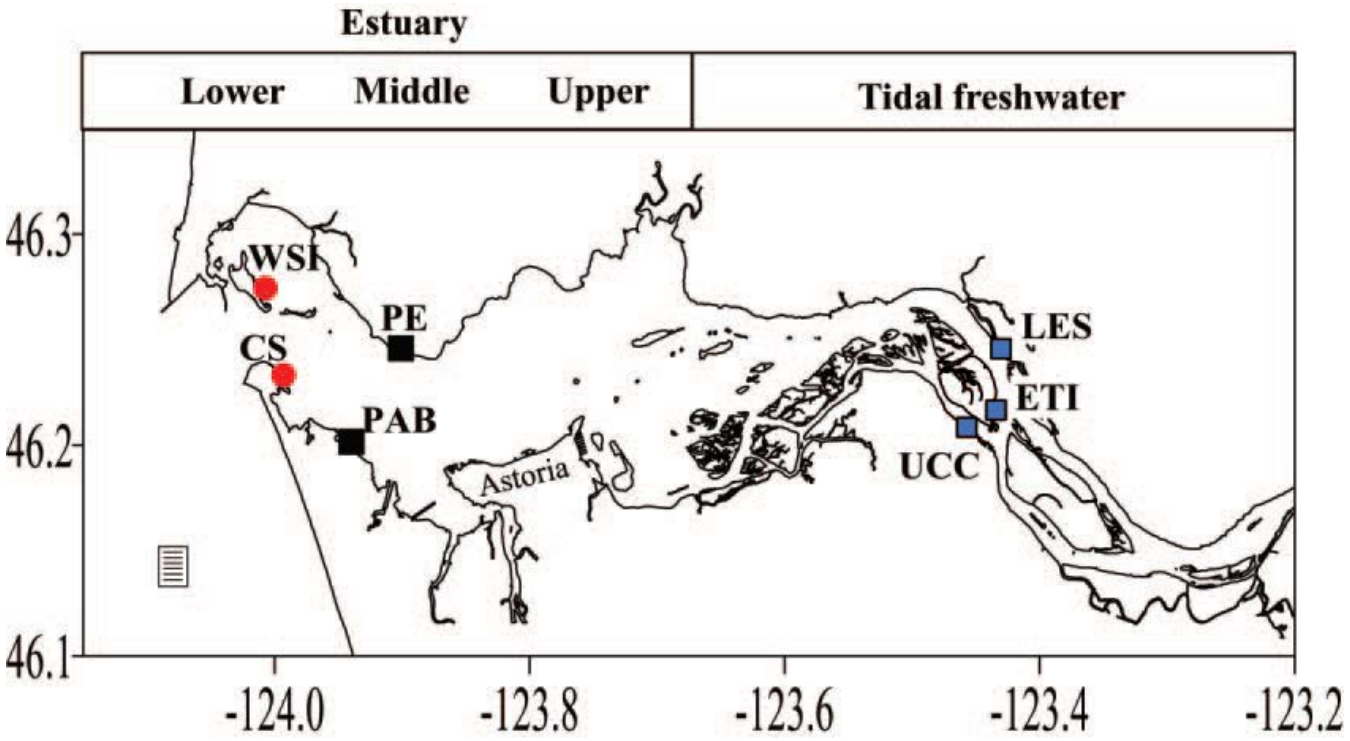


FIGURE 6. Proportion of unmarked Chinook Salmon by size-class (mm) and season of capture from the (A) Sandy River delta and (B) lower river reach (habitat strata: MC = main channel; OC = off-channel; WC = wetland channel). Proportions are segregated among the three distinct size-classes that were used to differentiate juvenile life history characteristics of Chinook Salmon (see Johnson et al. 2014).

(from Sather et al. 2016)

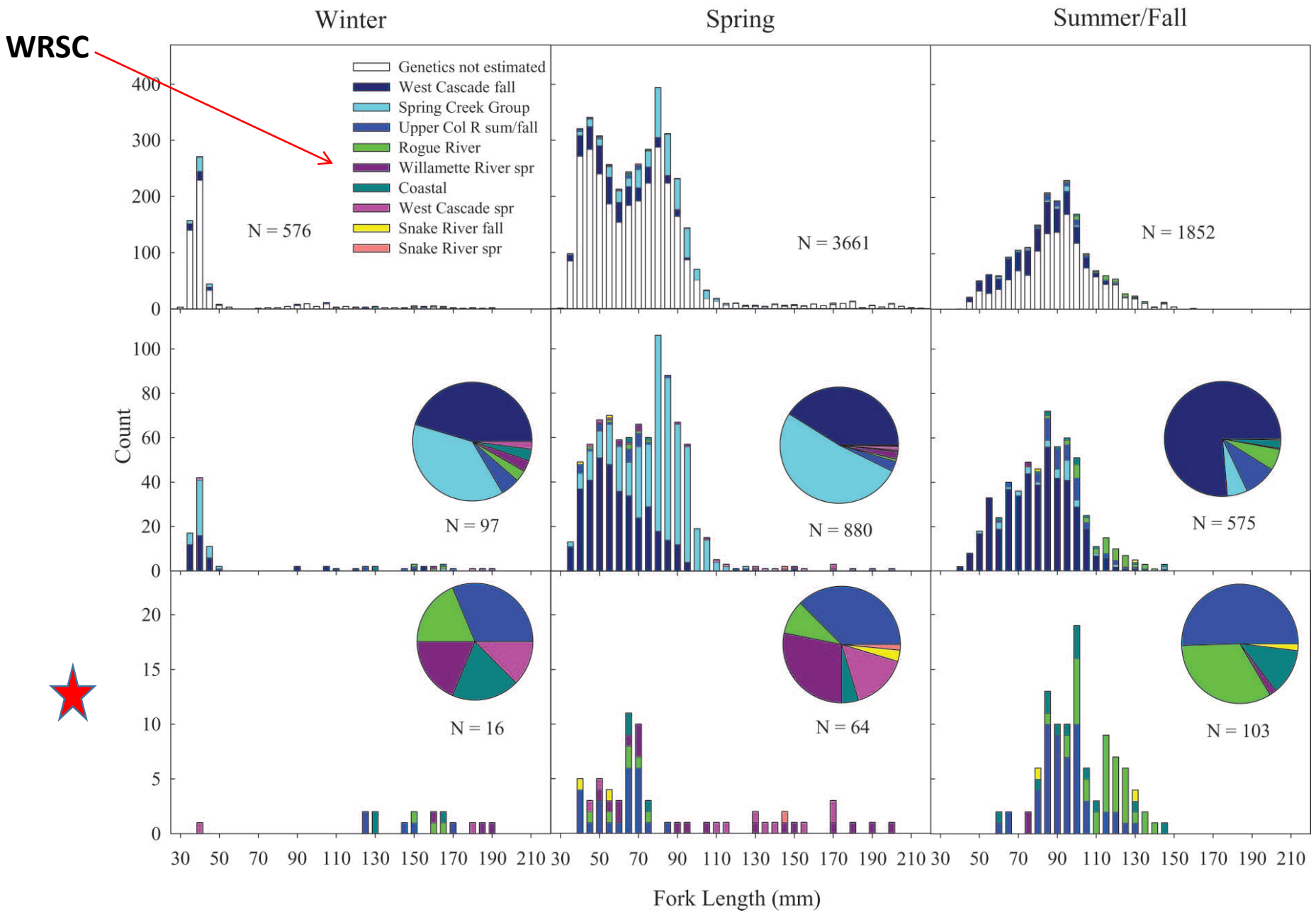
Roegner et al. (2012)

- Beach seine
- Monthly from January 2002 through September 2007
- Rkm 13-81

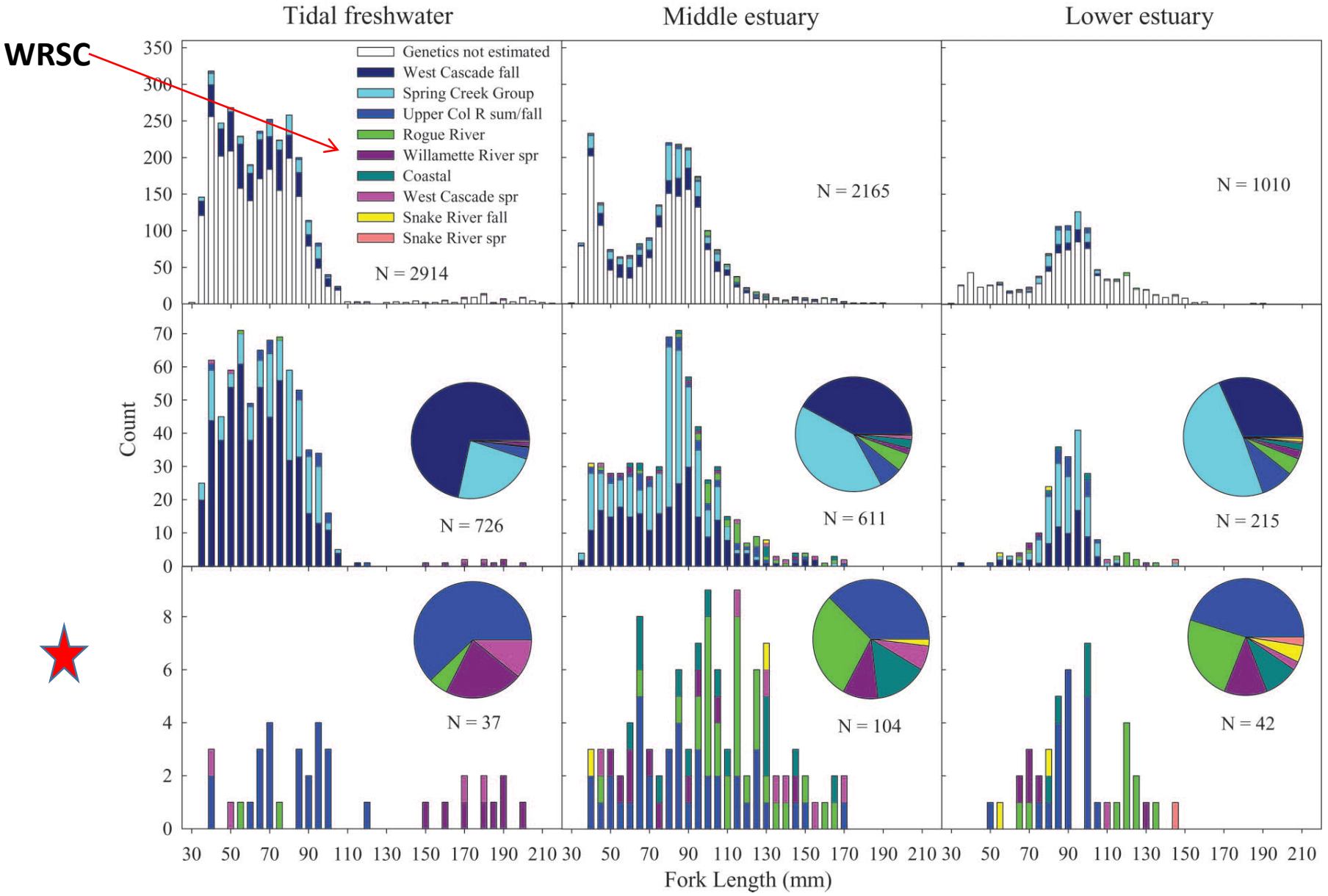


Legend:

- Blue squares are tidal freshwater sites
- Black square are middle estuary sites
- Red dots are lower estuary sites



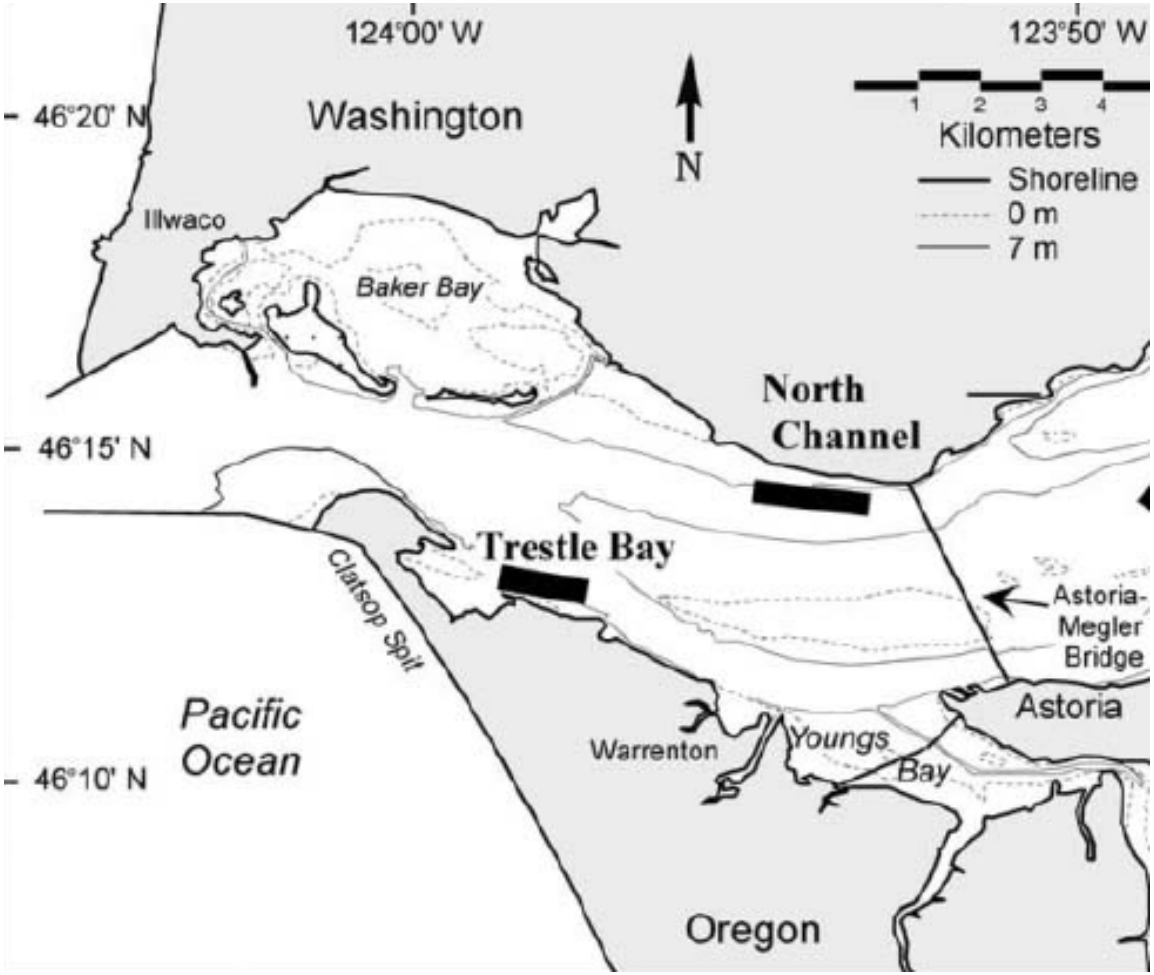
(from Roegner et al. 2012)

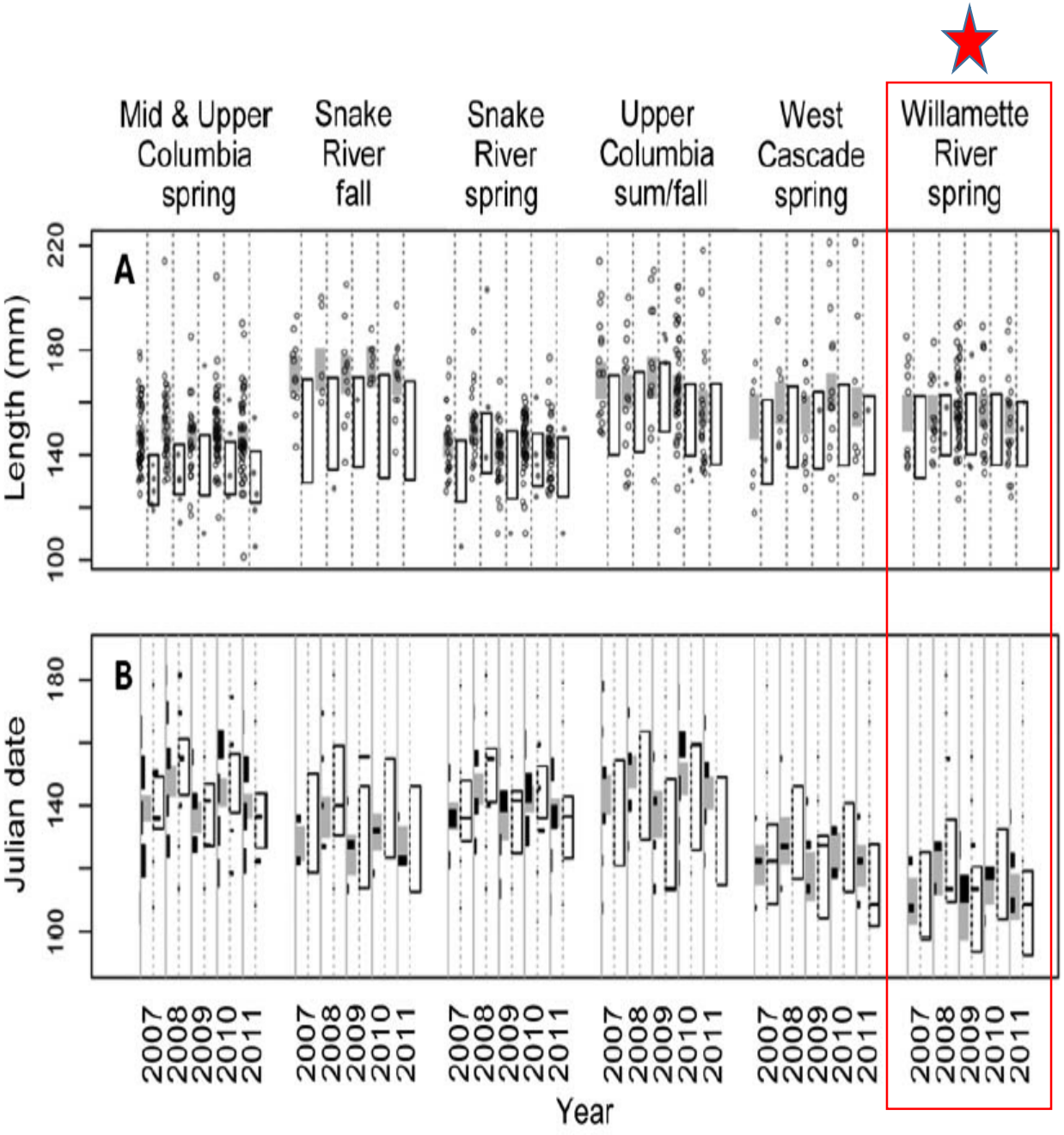


(from Roegner et al. 2012)

Weitkamp et al. (2015)

- Purse seine
- Bi-weekly, mid-April to late June or early July, 2007-2011
- Rkm 13 and 17

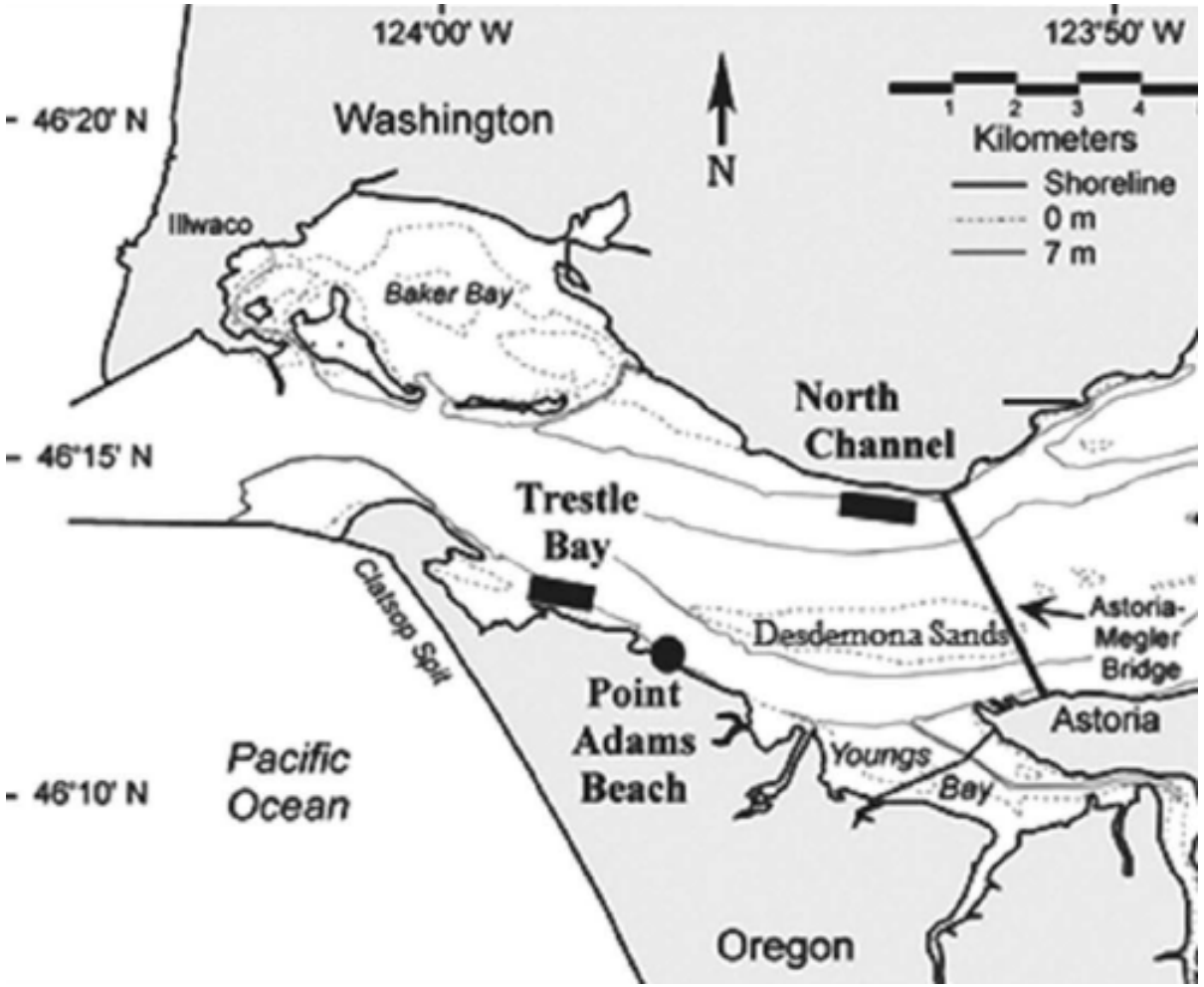


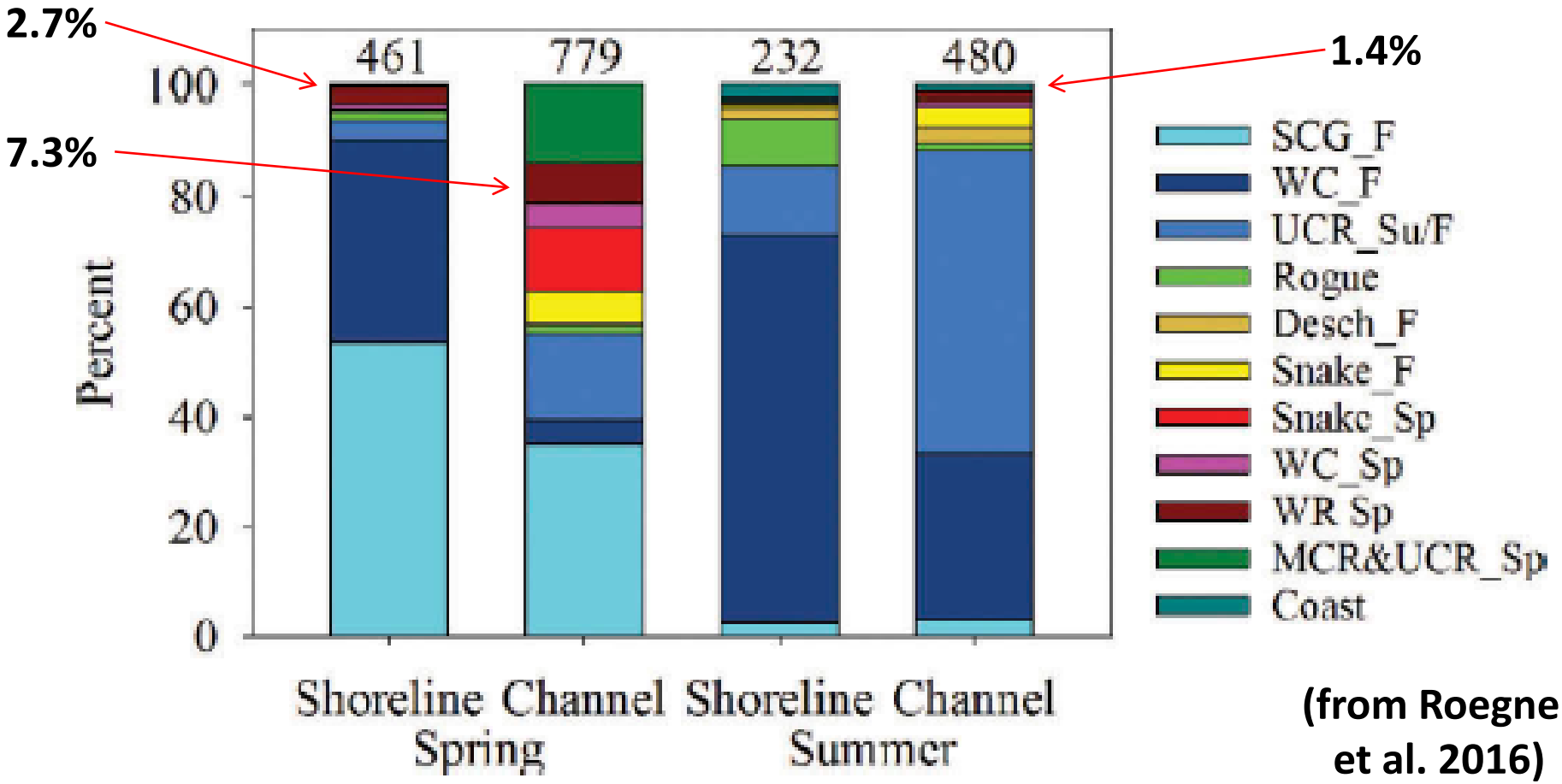


(from Weitkamp et al. 2015)

Roegner et al. (2016)

- Purse and beach seines 2010-2012
- Purse seine
  - Rkm 13 and 17
  - Biweekly mid-April to late June
- Beach seine
  - Rkm 19
  - Biweekly February-July, monthly thereafter





(from Roegner et al. 2016)

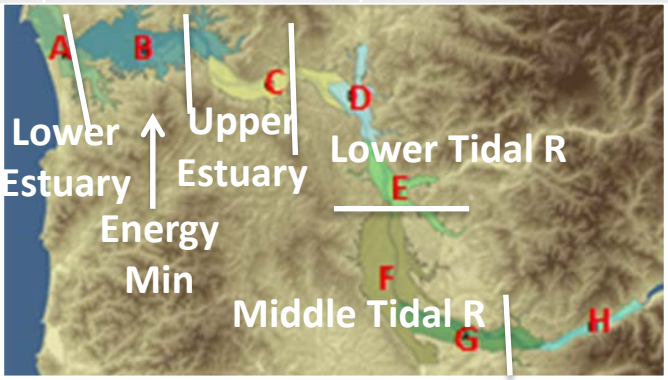
FIGURE 7. Genetic stock composition of Chinook Salmon that were sampled from channel and shoreline habitats of the Columbia River estuary during spring (April–June) and summer (July–October) of 2010–2012. The number of fish that were used to estimate stock proportions is shown above each bar. Codes for the genetic groups are defined in Table 4..

Synthesis

	Lower Estuary (Rkm 5-21)	Energy Minimum (Rkm 21-39)	Upper Estuary (Rkm 39-87)	Lower Tidal River (Rkm 87-139)	Middle Tidal River (Rkm 139-196)
Winter (Dec-Feb)	Not sampled	Yearlings	Yearlings	Fry	Fry
Spring (Mar-May)	Fry, fingerlings, yearlings	Fry, fingerlings, yearlings	Fry, fingerlings, yearlings	Yearlings	Yearlings
Summer (Jun-Aug)	Subyearlings	Few or no WRSC	Few or no WRSC	Subyearlings	Few or no WRSC
Fall (Sep-Nov)	Not sampled	Few or no WRSC	Few or no WRSC	Subyearlings	Subyearlings

Definitions

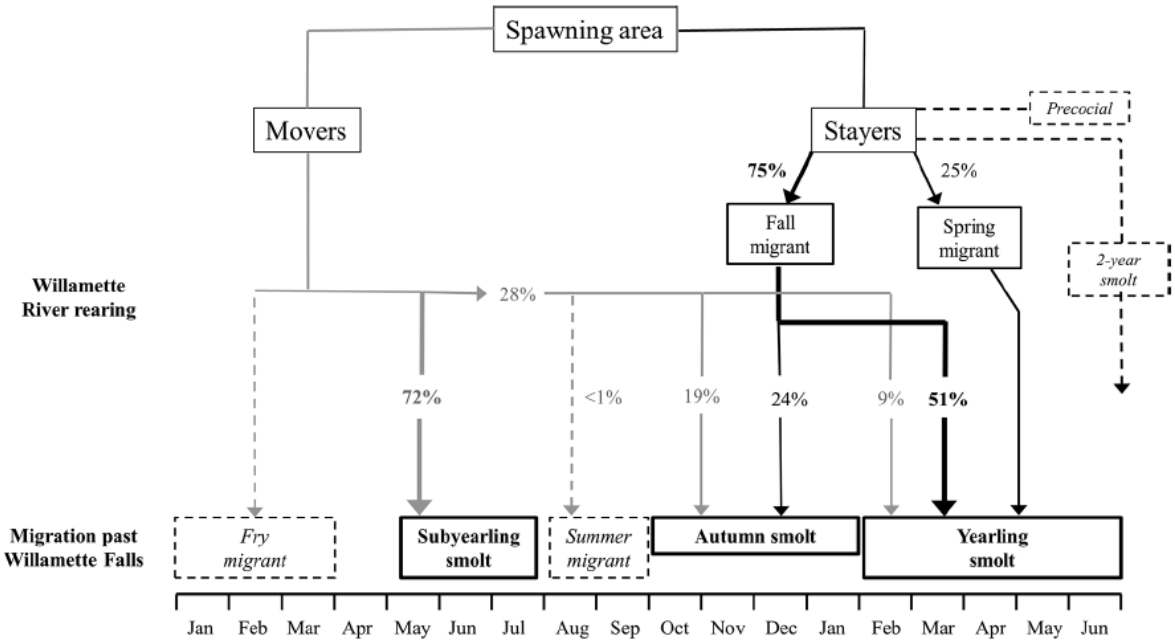
- Yearlings = large fish captured in winter and spring
- Subyearlings = small fish captured in winter and spring: Fry < 60 mm and Fingerlings > 60 mm
- Subyearlings = any fish captured in July through November



Zonation based on Jay et al. (2016)

Life History Patterns

- Life history patterns for Willamette spring Chinook salmon that would be expected to be observed in the LCRE include (Schroeder et al. 2016):
  - Fry outmigration in winter
  - Subyearling and yearling smolt outmigration in late winter, spring, and early summer
  - Subyearling outmigration in late fall and winter ("autumn" smolts)
- These patterns were reflected in the results from the estuary summarized herein



(from Schroeder et al. 2016; figure 5)

Management Implications

- Habitat restoration in the estuary will benefit Willamette River spring Chinook (WRSC) salmon.
- A holistic approach incorporating life history diversity will aid recovery of WRSC salmon.
- Management actions in the Columbia River hydrosystem above Bonneville Dam will affect environmental flows in the estuary, which in turn will affect habitats for WRSC salmon.
  - New FCRPS BiOp
  - CRSO EIS alternatives
  - Columbia River Treaty

Thank you

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