# Quantifying reader accuracy for thermal mark identification of Pacific salmon through the use of single-blind pre-season test samples.

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- Compare 2 tools used for quality control: blind tests and 2nd reads

- Review the methods used by the Cordova Otolith Laboratory to conduct pre-season blind tests

- Discuss additional applications for blind tests
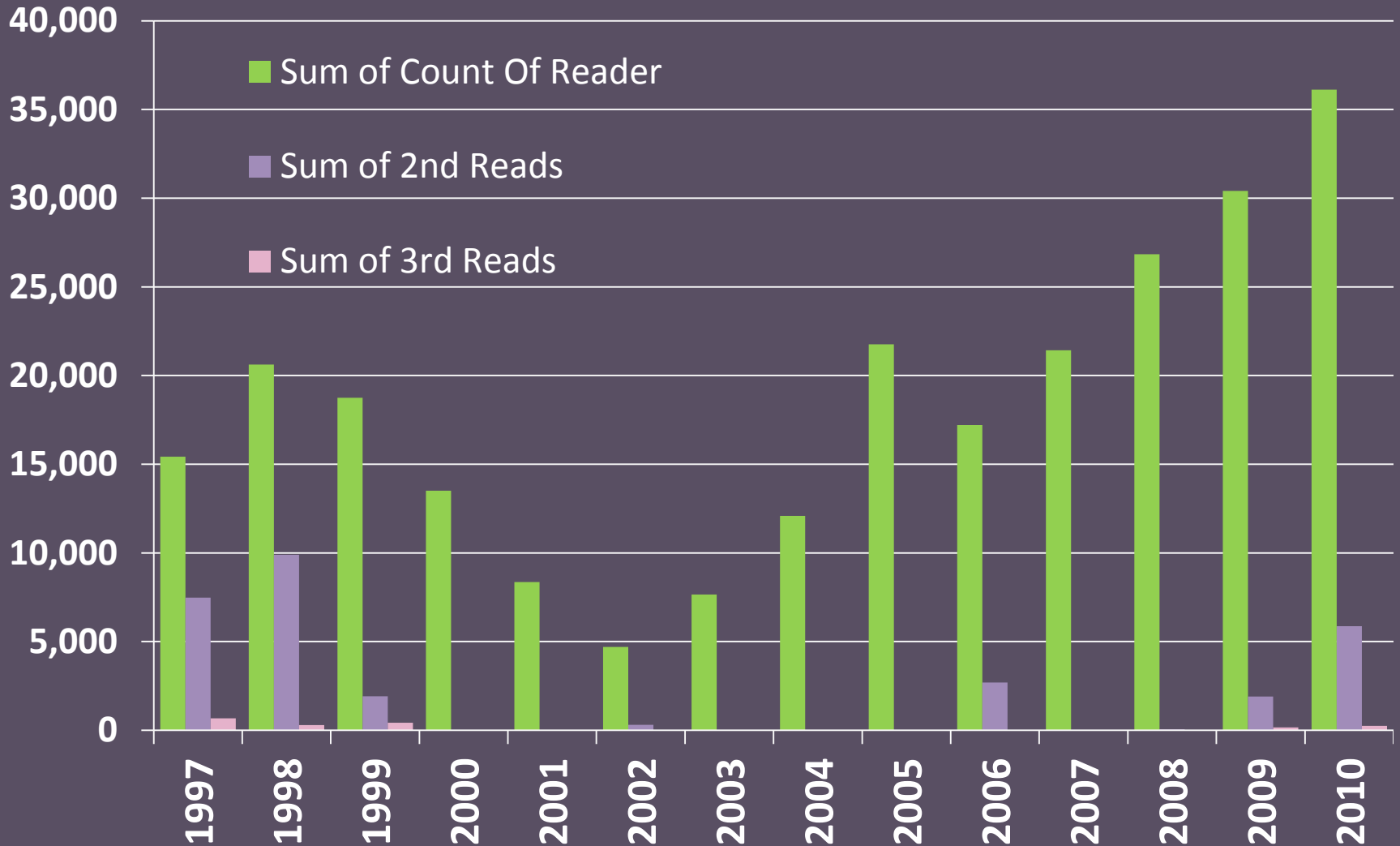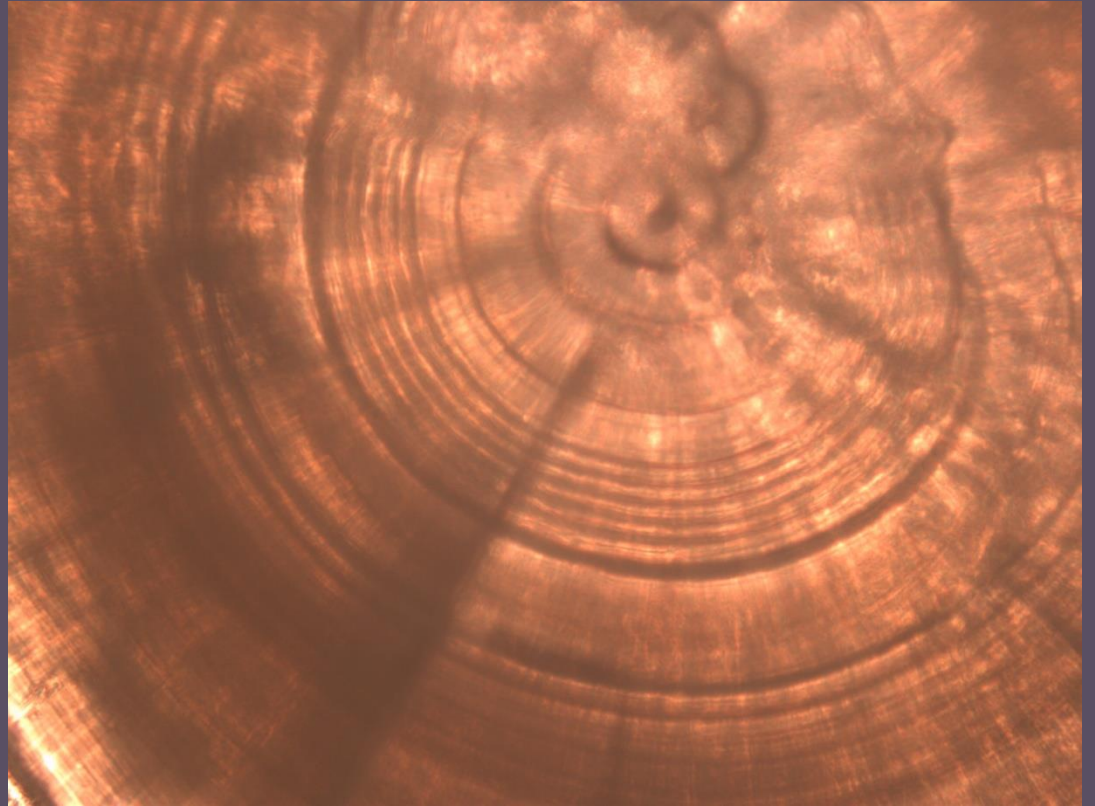
PWS Chum Salmon

wild

1,5H

5,1H
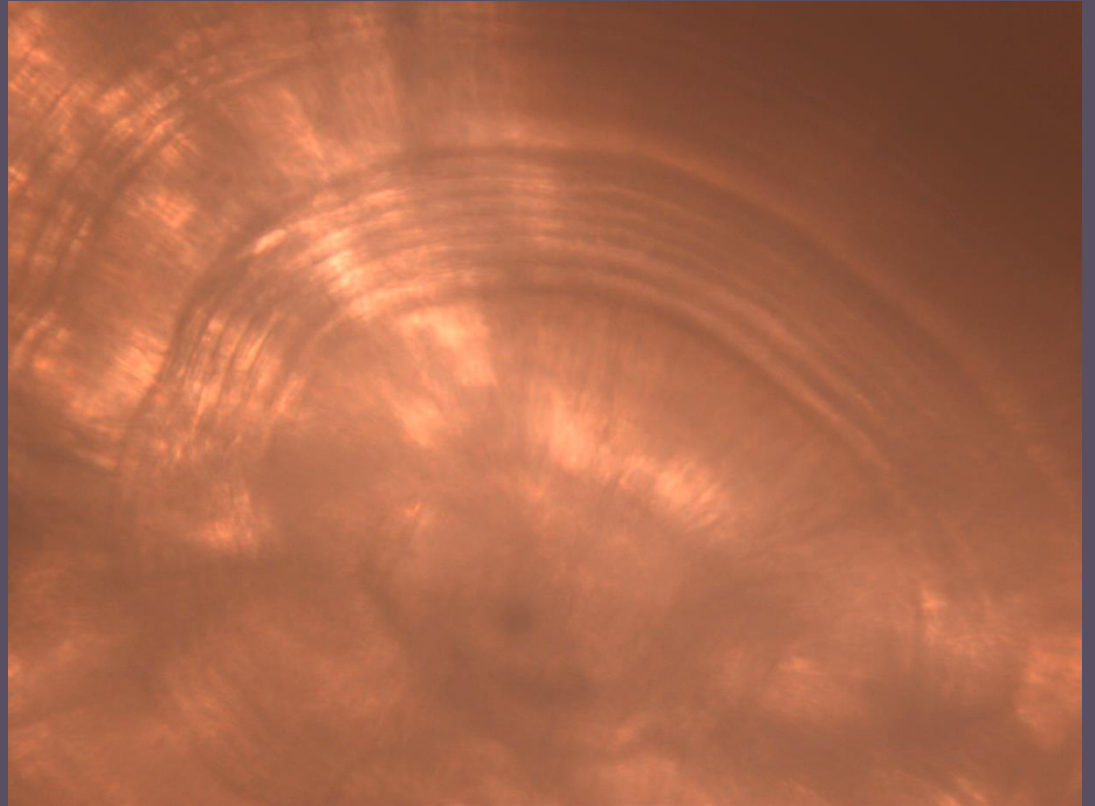
1,2,1,2H

1,2,3H

PWS Chum Salmon

wild

1,5H

5,1H

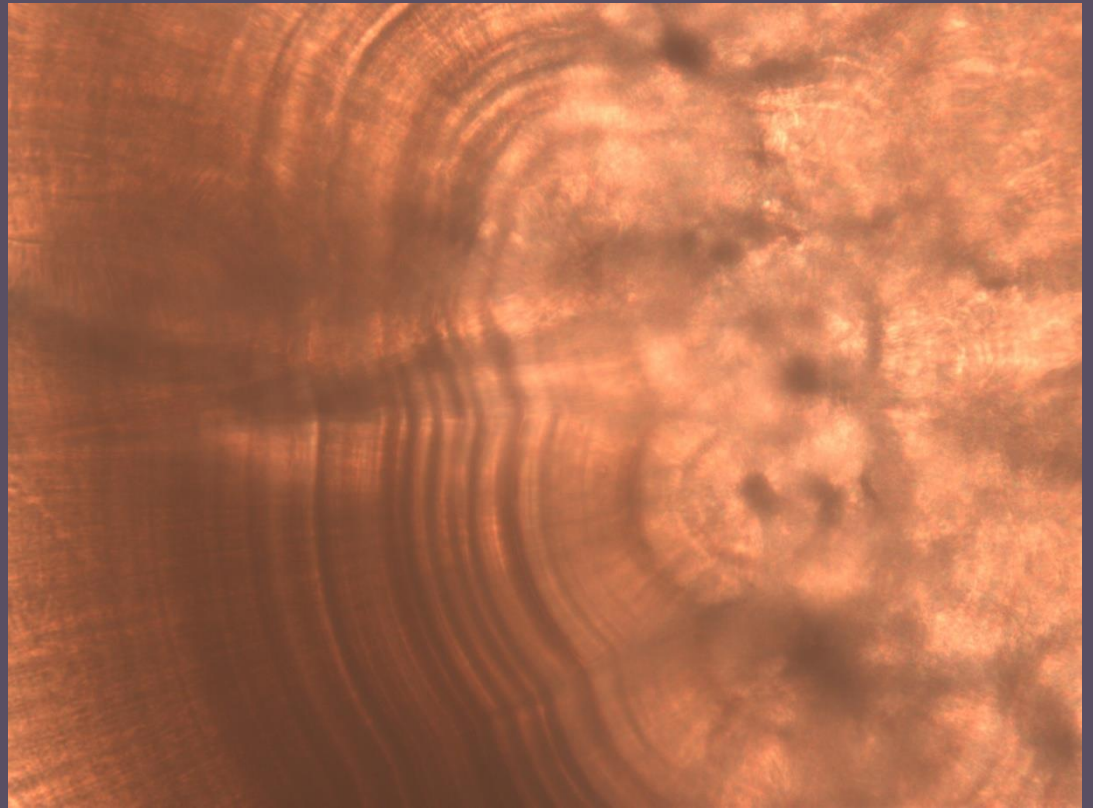1,2,1,2H

1,2,3H

PWS Chum Salmon

wild

1,5H

5,1H

1,2,1,2H

1,2,3H

"While perfect agreement between readers (precision) can occur simultaneously with complete failure in identification (accuracy), the degree of consistency among readers is nevertheless an important parameter."

Joyce, T. L., and D. G. Evans, 1999. Otolith marking of pink salmon in Prince Williams Sound salmon hatcheries, *Exxon Valdez* Oil Spill Restoration Project Final Report (Restoration Project 99188), Alaska Department of Fish and Game, Division of Commercial Fisheries, Cordova and Anchorage, Alaska.

2010 2ⁿᵈ Read Results

	% agreement (sample size)		
	Reader 1	**Reader 3**	**Reader 4**
Reader 1	**95% (296)**	**93% (553)**	**98% (1314)**
Reader 2	**89% (219)**	**94% (89)**	**98% (213)**
Reader 3	**95% (632)**	**97% (117)**	**97% (1390)**
Reader 4	**97% (136)**	**45% (20)**	**98% (485)**

Correct by consensus?

Known hatch code	Reader 1 hatch code	Reader 2 hatch code	Reader 3 hatch code	Reader 4 hatch code
1,5H	5,1H	**1,5H**	5,1H	1,4,1H
1,5H	5,1H	**1,5H**	5,1H	1,4,1H
1,2,3H	**1,2,3H**	1,2,1,2H	1,2,1,2H	1,2,1,2H
3,2n,1H	**3,2n,1H**	Wild	Wild	Wild
1,2,3H	1,2,1,2H	1,2,1,2H	**1,2,3H**	1,2,1,2H
1,5H	5,1H	**1,5H**	5,1H	5,1H
1,5H	Wild	No read	**1,5H**	No read
Wild	No read	**Wild**	No read	No read
1,2,3H	**1,2,3H**	1,2,1,2H	3,2n,1H	3H
5,2H	1,2,1,2H	No read	**5,2H**	No read

Accurate analysis of otoliths

- **Precision**
  - **How close measured values are to each other**

- **Accuracy**
  - **How close measured values are to the true value**

Blind Test Preparation

1. **Fry specimens collected prior to release**

2. **Otoliths mounted to glass slides**

3. **Stored according to marking lot**

Blind Test Preparation

4. Spreadsheet records specimens

5. Excel to randomize specimens

6. Create 3 sets of 100 specimens

Conducting Blind Test

1. Otoliths ground by most experienced reader
2. Otolith Lab staff each read each specimen
3. Results recorded in spreadsheets
4. Project leader compares results

Caveat: measures mark i.d. ability, not specimen prep. ability

Blind Test Results

Pink Salmon Blind Test Results: Reader 1 (excludes "no read")						
Hatch Code (Reader 1 Response, number of specimens)						
Known Hatch Code	3,3H	4H	6H	8H	Wild	Total
3,3H	22					22
4H		21				21
6H			19			19
8H				23		23
Wild					12	12
Total	22	21	19	23	12	97

Pink Salmon Blind Test Results: Reader 1 (excludes "no read")				
	# correct	# incorrect	Total read	% accuracy
Hatchery/wild	97	0	97	100
Facility	85	0	85	100
Mark	97	0	97	100

Blind Test Results

Pink Salmon Blind Test Results: Reader 4 (excludes "no read")						
Hatch Code (Reader 4 Response, number of specimens)						
Known Hatch Code		3,3H	4H	6H	8H	Wild	Total
	3,3H	18		1	1		22
	4H	1	18		1		21
	6H			16	1		19
	8H				23		23
	Wild					11	12
	Total	19	18	17	26	11	97

Pink Salmon Blind Test Results: Reader 4 (excludes "no read")				
	# correct	**# incorrect**	**Total read**	**% accuracy**
Hatchery/wild	91	0	91	100
Facility	75	5	80	94
Mark	86	5	91	95

Accuracy increases with experience, 2002-2010

Blind Test Results

- Learn what additional training is necessary

- Identify "problem marks" for inseason analysis

- Additional blind tests evaluate training & measure increase in accuracy

- Analysis of specimens is accurate enough to achieve contribution estimates within 10% of the true proportions 95% of the time

Blind Test Benefits

- Increased confidence

- Measured increase in accuracy for readers

- Minimize necessity for 2nd reads

Questions?

PWS Chum Salmon

wild

1,5H

5,1H

1,2,1,2H

1,2,3H
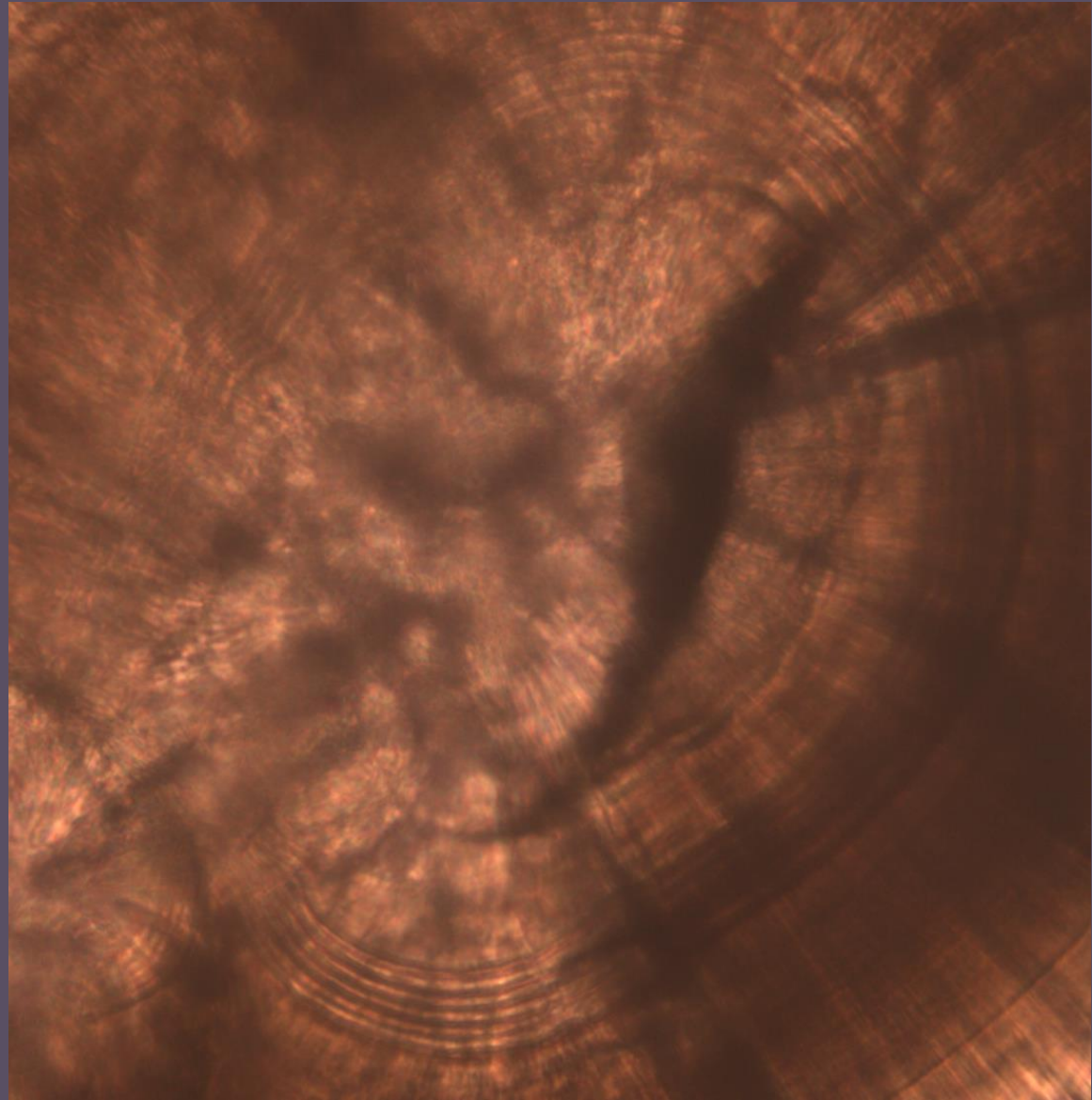
Effective management of Pacific salmon species in Prince William Sound

- Accurate analysis of otoliths
  - Marked/unmarked
  - Marking facility
  - TMID
- Timely analysis of otoliths
  - Stock separation
  - Inseason management

Reader Agreement & Quality Control "2nd Reads" are a common tool

- 1993 Case Study: 83-100% accuracy for 3 readers when otoliths with known marks were planted among samples with unknown mark status

- 1993 Case Study: 2nd reads conducted for 3 samples show 95-98% agreement among readers

- 1998 Juneau/Cordova comparison: 99% agreement among readers; 2nd reads become less frequent

- 2002-2009 2nd reads conducted in Cordova: 99% mark status agreement, 93% mark id agreement

Correct by consensus?

Reader agreement, excludes "no read" (reader 1)			
1st read hatch code	2nd read disagree	2nd read agree	Total specimens read
wild	0	7	7
1,2,1,2H	1	1	2
1,2,2,1H	1	18	19
1,2,3H	6	53	59
1,5H	0	19	19
3,2H2,2	3	62	65
3,2H5	0	58	58
3,2n,1H	3	63	66
5,1H	0	1	1
Total specimens read	14	282	296

Reader agreement, excludes "no read" (reader 4)			
1st read hatch code	2nd read disagree	2nd read agree	Total specimens read
wild	2	104	106
3,2H2,2	1	0	1
3,3H	5	20	25
4H	2	233	235
6H	1	0	1
8H	0	117	117
Total specimens read	11	474	485

Correct by consensus?

Known hatch code	Reader 1 hatch code	Reader 2 hatch code	Reader 3 hatch code	Reader 4 hatch code
3,2H2,2	3,2H2	**3,2H2,2**	3,2H2	3,2H2
3,2H2	**3,2H2**	3,2H3	3,2H3	3,2H3
3,2H2	3,2H3	3,2H3	3,2H3	**3,2H2**
3,2H2	**3,2H2**	3,2H3	3,2H3	3,2H3
3,2H2	**3,2H2**	3,2H3	3,2H3	3,2H3

Valdez

CCH

SGH

WNH

Whittier

Cordova

N

PWS Hatchery Release sites Pink salmon

AFK
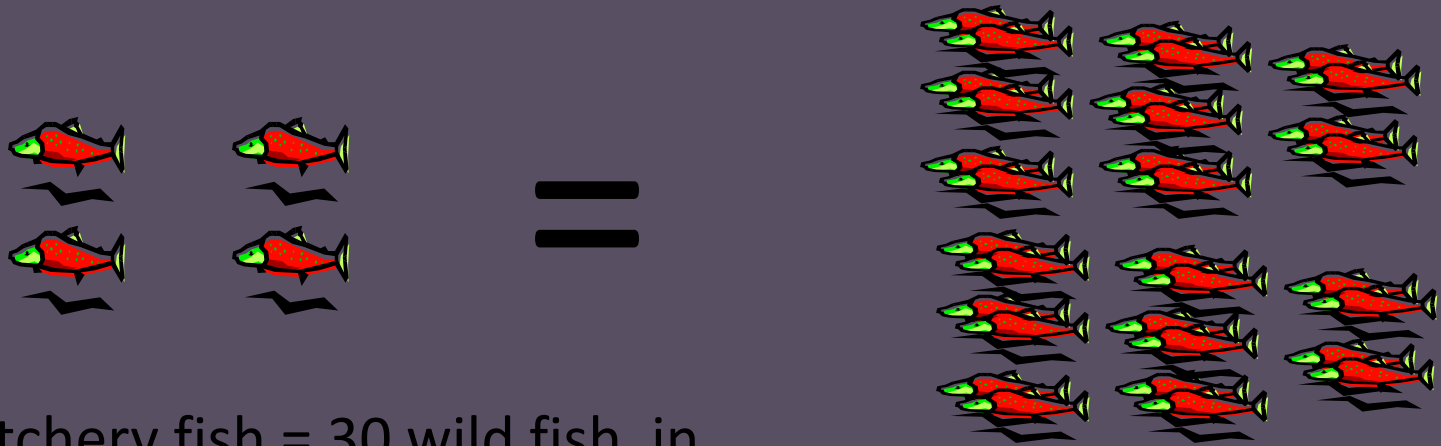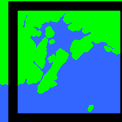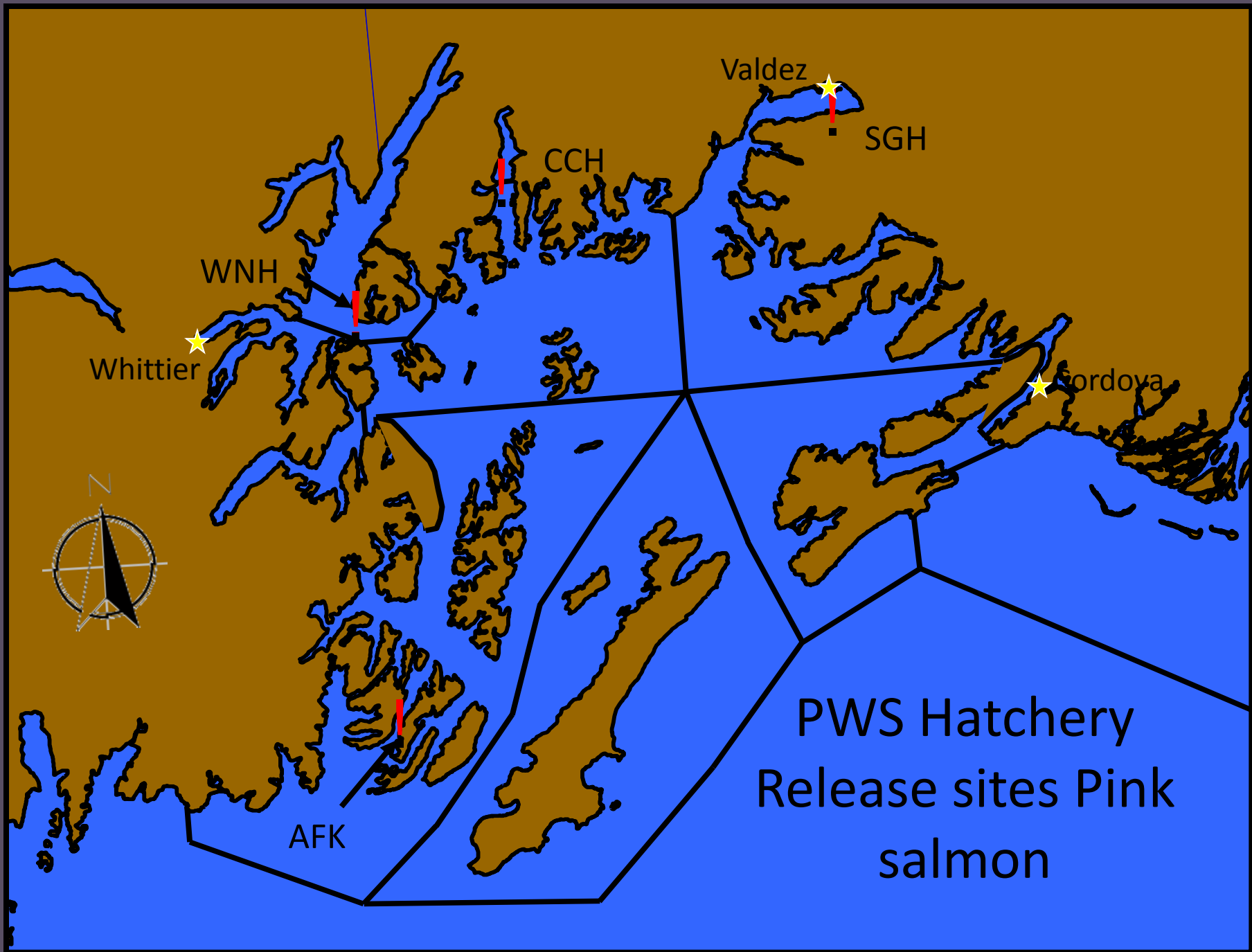
PWS hatchery salmon releases

Millions of Fish

Release Year

Legend:
- Chum
- Pink
- Coho
- Sockeye
- Chinook

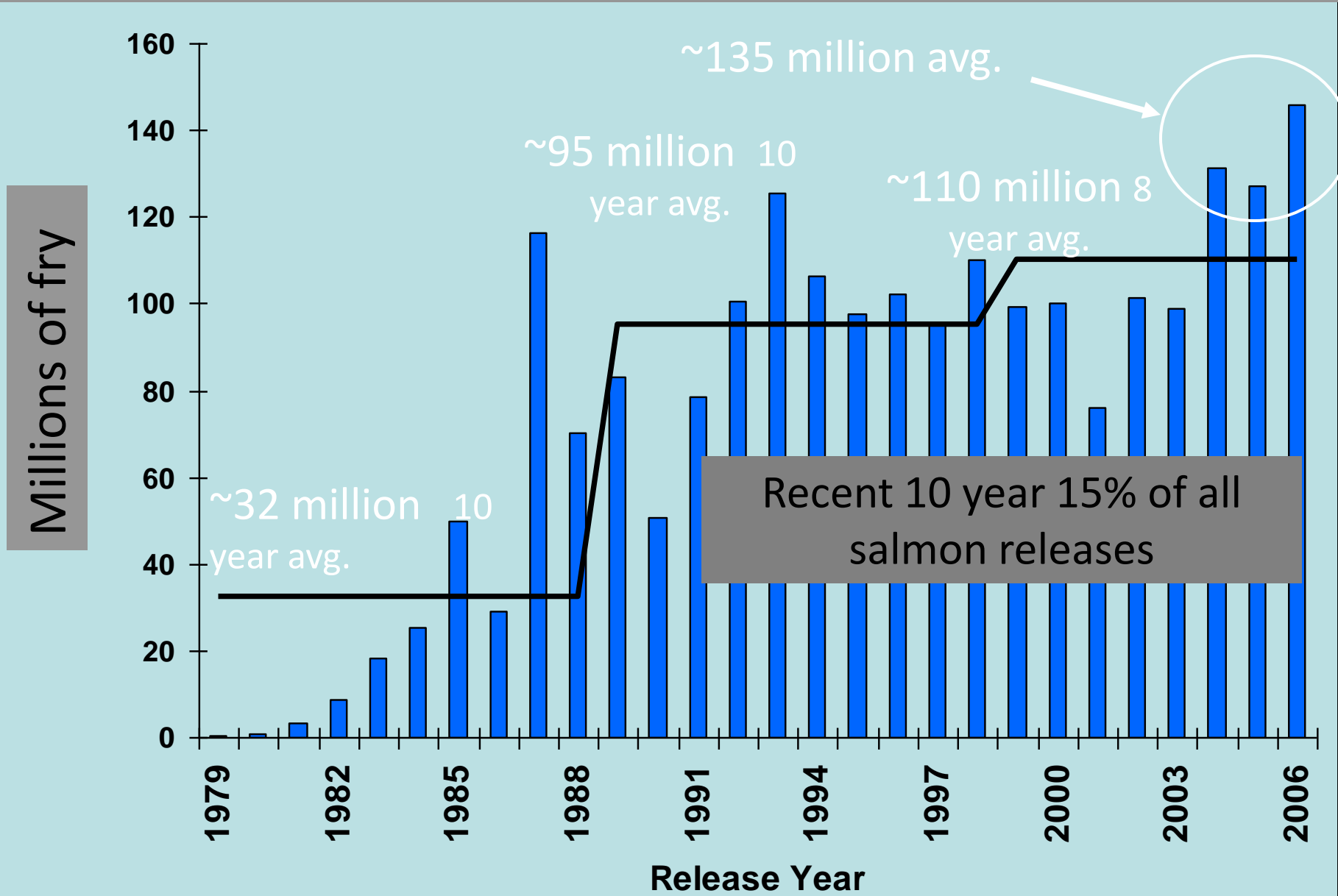~47 million
1979-1982

~528 million
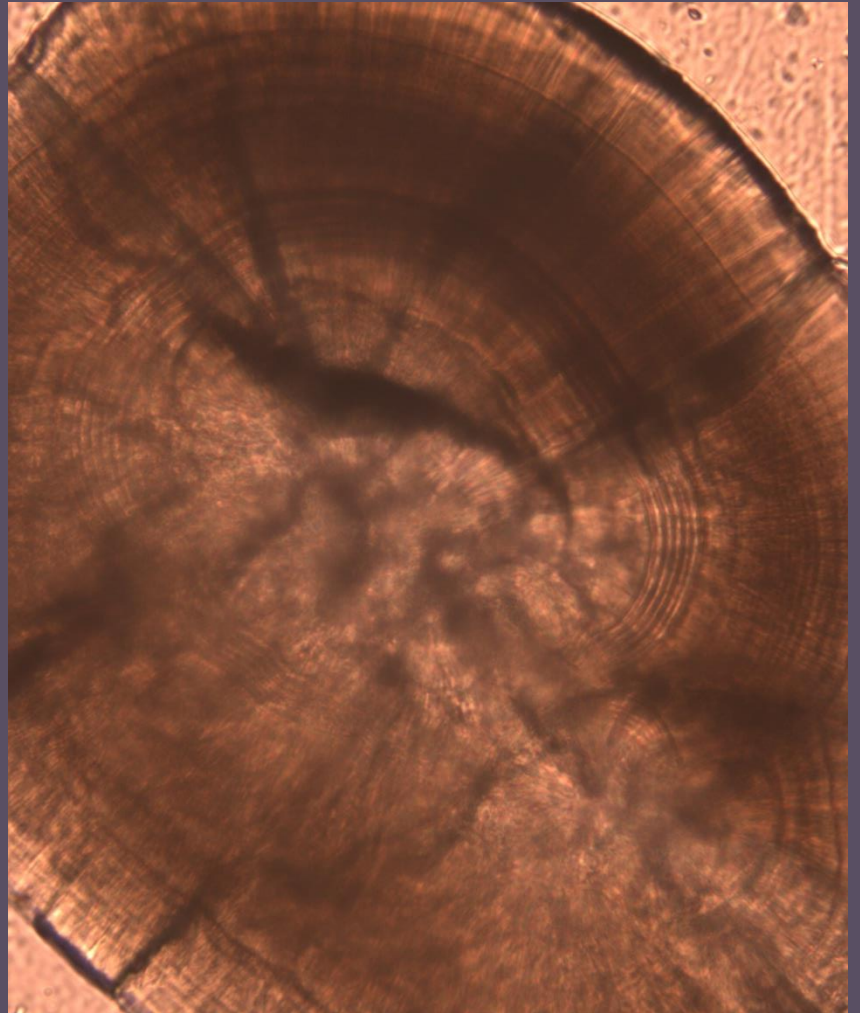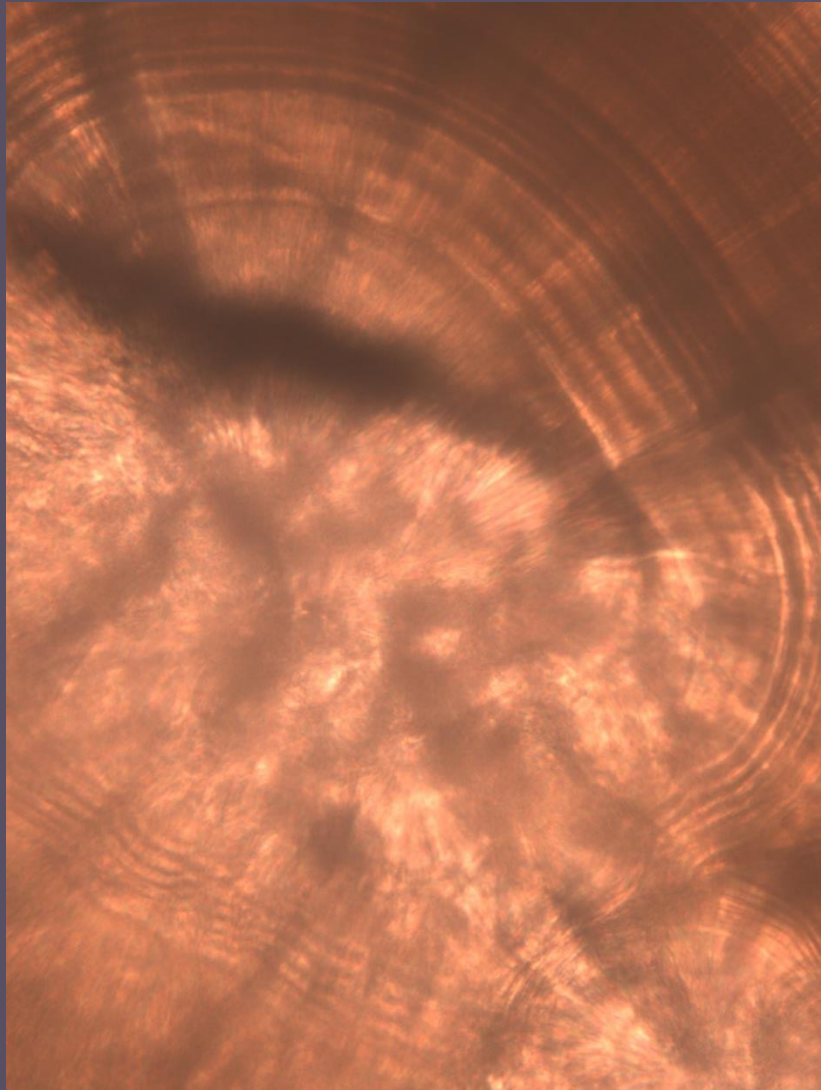1984-1993

~718 million
1994-2006
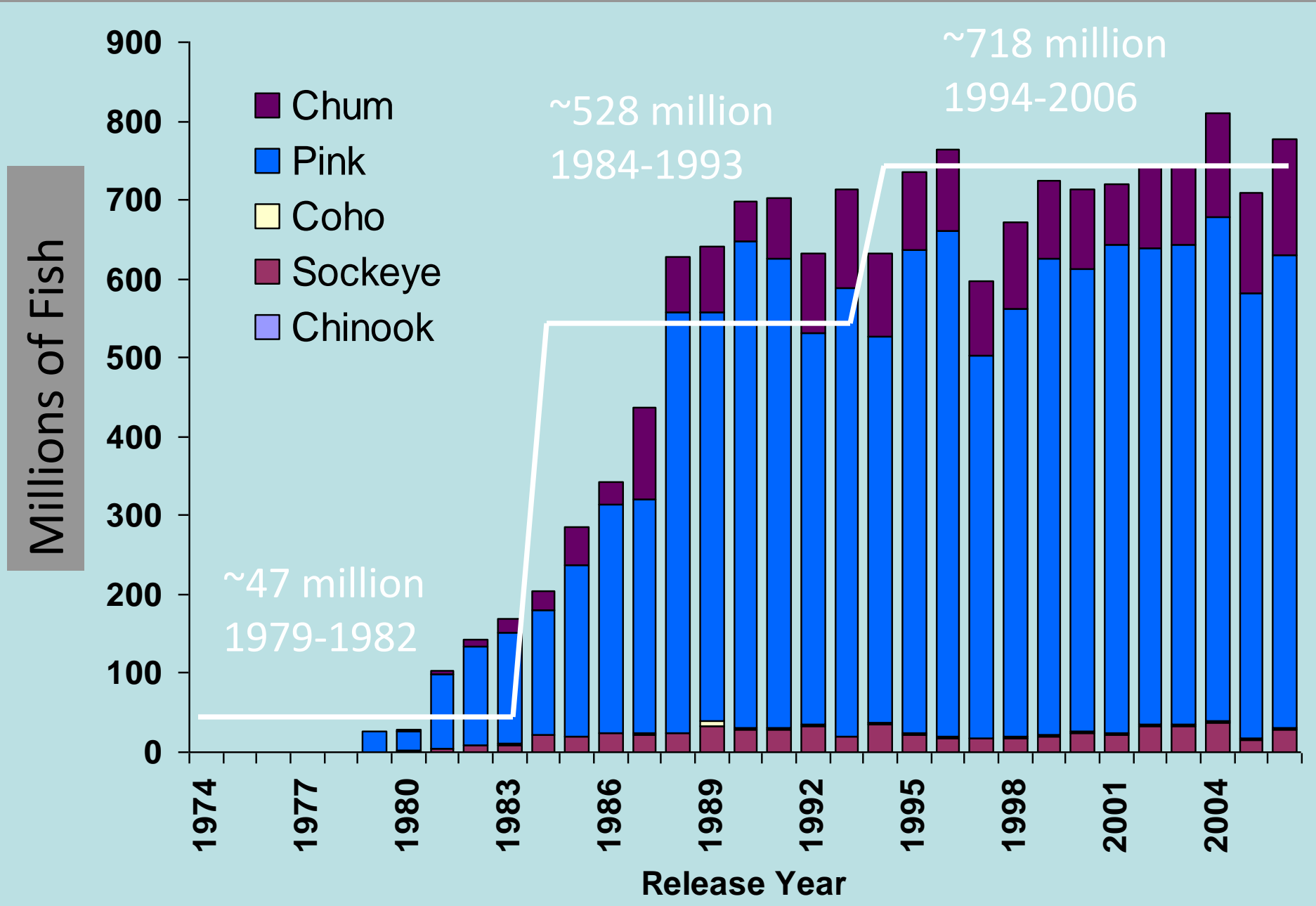
PWS hatchery pink salmon fry releases
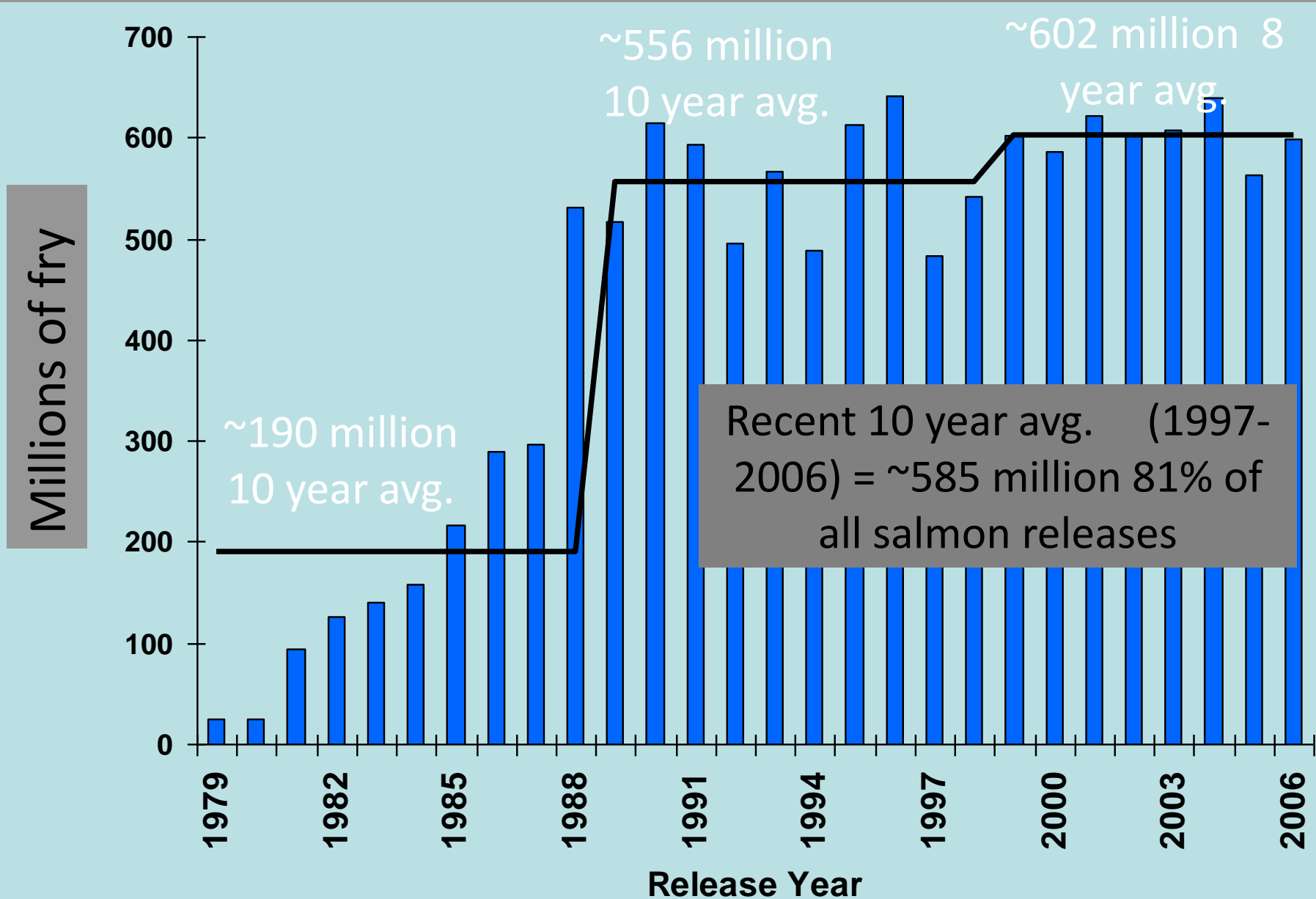
PWS hatchery chum salmon fry releases

PWS Chum Salmon

1,5H

5,1H

1,2,1,2H

1,2,3H

wild