Northwest **Power** and **Conservation** Council

April 29, 2014

MEMORANDUM

TO: Council Members

FROM: Jim Ruff – Manager, Mainstem Passage and River Operations

SUBJECT: Presentation on NOAA's salmon run forecasting tool and 2014 run forecasts

Background

At the May 7, 2014, Council meeting in Boise, Brian Burke will provide the Council with information about a salmon run forecasting tool developed by NOAA Fisheries, as well as presenting NOAA's 2014 run forecasts. Brian is a Research Fishery Biologist in the Fish Ecology Division of NOAA's Northwest Fisheries Science Center in Seattle.

Presentation Summary

Variable ocean conditions strongly influence salmon population dynamics, and NOAA's Northwest Fisheries Science Center (NWFSC) has compiled a set of ocean indicators, based on long-term ocean surveys, to characterize ocean conditions relative to adult salmon return rates. For most of the 16 years in NOAA's data set, indicators of ocean conditions have shown a relatively high degree of within-year concordance, collectively suggesting good, average, or poor conditions for salmon survival. However, for the past few years, NOAA has seen incongruence among the indicators. In 2013, many of the physical indicators suggested a somewhat poor ocean year for salmon entering the ocean, while the biological indicators suggested a very good entry year. Although these disparities provide opportunities to better understand the ecological dynamics affecting salmon in the marine environment, they can also result in highly variable short term forecasts of salmon survival. In this presentation, Brian will present a summary of ocean conditions in 2013 as well as NOAA's forecasts of adult salmon returns in 2014. He will discuss how these forecasts relate to a better mechanistic understanding of salmon survival, as well as why the importance of particular indicators can vary through time. Finally, Brian will describe some future modeling options and potential collaborations.

w:\jr\ww\2014\5-07-14 bb_noaa run forecasting memo.docx

851 S.W. Sixth Avenue, Suite 1100
Portland, Oregon 97204-1348
www.nwcouncil.org

Steve Crow
Executive Director

503-222-5161
800-452-5161
Fax: 503-820-2370

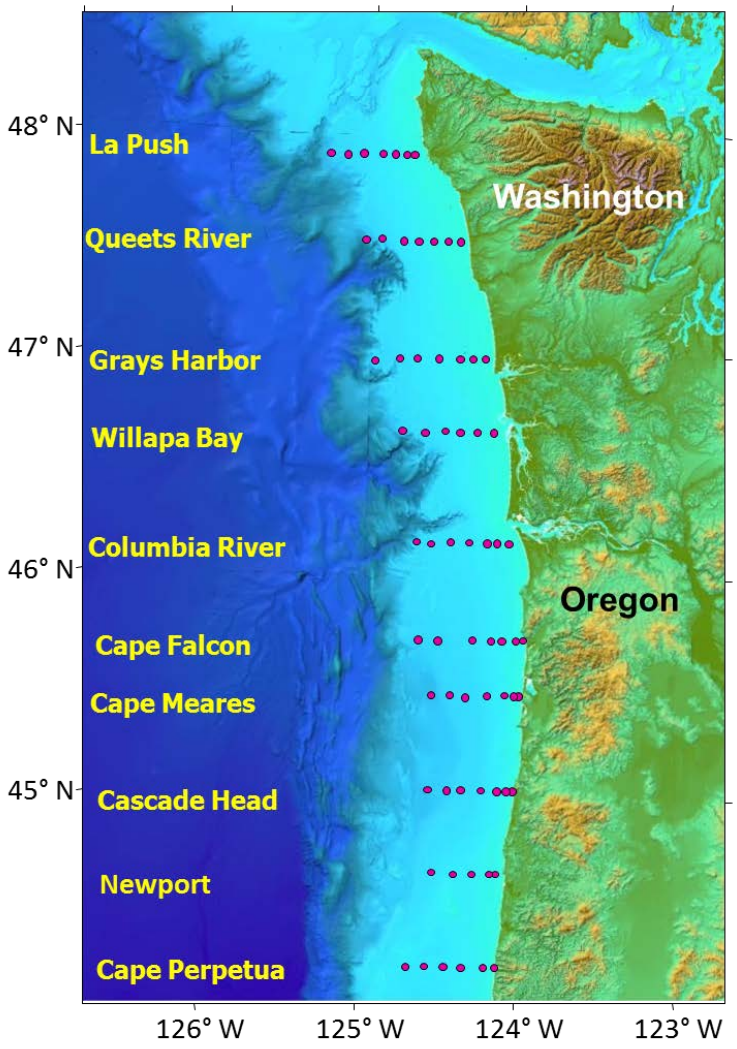
NOAA Fisheries' Ocean Project
and the 2014 run forecast

Brian J. Burke

Northwest Power and Conservation Council Meeting, May 7th, 2014

Supported by:

- Ocean Indicators, 2012 and 2013
- Adult return forecasts
- Why we forecast
- Future directions



Observations

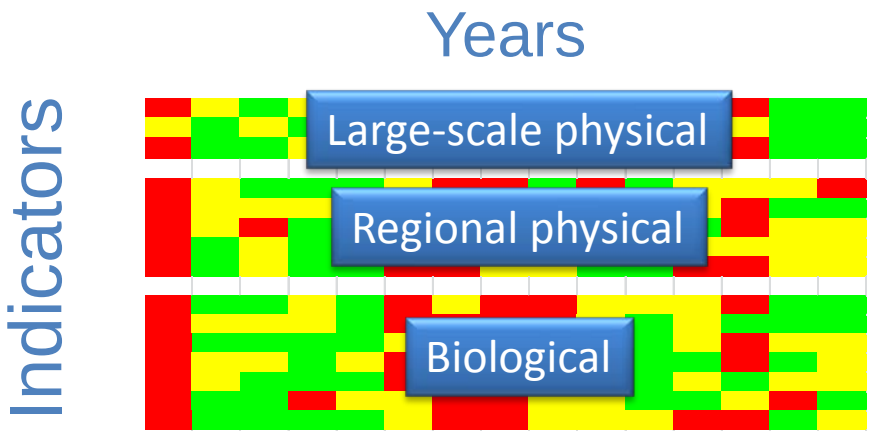
Juvenile salmon sampling:

- May (2006 – 2012)
- June (1998 – present)
- September (1998 – 2012)

Measure physical and biological conditions

Focus on distribution & abundance of juvenile salmonids along with metrics of growth & condition

General Characterization of Ocean Conditions



Good – Fair – Poor

http://www.nwfsc.noaa.gov/oceanconditions

Ecosystem Indicators		1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
PDO (December-March)		15	6	3	11	7	16	10	14	12	9	5	1	13	4	2	8
PDO (May-September)		10	4	6	5	11	15	14	16	12	13	2	9	7	3	1	8
ONI Jan-June		16	2	1	5	12	13	11	14	7	10	3	9	15	4	5	7
46050 SST (May-Sept)		14	8	3	4	1	7	16	13	5	15	2	9	6	10	11	12
NH 05 Upper 20 m T winter prior (Nov-Mar)	*	16	10	7	9	5	13	14	11	12	4	1	8	15	3	2	6
NH 05 Upper 20 m T (May-Sept)	*	13	10	12	4	1	3	16	15	7	8	2	5	11	9	6	14
NH 05 Deep Temperature	*	16	6	8	4	1	9	12	14	10	5	2	7	13	11	3	15
NH 05 Deep Salinity	*	16	3	7	4	5	13	14	8	6	1	2	11	15	10	9	12
Copepod Richness Anomaly	*	16	3	1	7	6	12	11	15	13	10	8	9	14	4	5	2
N. Copepod Biomass Anomaly	*	15	12	7	8	5	14	13	16	9	11	4	10	6	1	2	3
S. Copepod Biomass Anomaly	*	16	3	5	4	2	11	13	15	12	10	1	8	14	9	7	6
Biological Transition	*	16	11	7	3	8	12	10	15	14	4	1	2	13	5	9	6
Winter Ichthyoplankton	*	16	8	2	4	6	15	14	10	13	12	1	9	3	11	7	5
Chinook Juv Catches (June)	*	15	4	5	13	9	11	14	16	10	8	1	6	7	12	3	2
Coho Juv Catches (Sept)	*	11	2	1	4	3	6	12	14	8	9	7	15	13	5	10	NA

2012 ocean year:

- Large-scale physics suggests a good return
- Regional physics and biology mixed

* Collected during NWFSC cruises

Ecosystem Indicators		1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
PDO (December-March)		15	6	3	11	7	16	10	14	12	9	5	1	13	4	2	8
PDO (May-September)		10	4	6	5	11	15	14	16	12	13	2	9	7	3	1	8
ONI Jan-June		16	2	1	5	12	13	11	14	7	10	3	9	15	4	5	7
46050 SST (May-Sept)		14	8	3	4	1	7	16	13	5	15	2	9	6	10	11	12
NH 05 Upper 20 m T winter prior (Nov-Mar)	*	16	10	7	9	5	13	14	11	12	4	1	8	15	3	2	6
NH 05 Upper 20 m T (May-Sept)	*	13	10	12	4	1	3	16	15	7	8	2	5	11	9	6	14
NH 05 Deep Temperature	*	16	6	8	4	1	9	12	14	10	5	2	7	13	11	3	15
NH 05 Deep Salinity	*	16	3	7	4	5	13	14	8	6	1	2	11	15	10	9	12
Copepod Richness Anomaly	*	16	3	1	7	6	12	11	15	13	10	8	9	14	4	5	2
N. Copepod Biomass Anomaly	*	15	12	7	8	5	14	13	16	9	11	4	10	6	1	2	3
S. Copepod Biomass Anomaly	*	16	3	5	4	2	11	13	15	12	10	1	8	14	9	7	6
Biological Transition	*	16	11	7	3	8	12	10	15	14	4	1	2	13	5	9	6
Winter Ichthyoplankton	*	16	8	2	4	6	15	14	10	13	12	1	9	3	11	7	5
Chinook Juv Catches (June)	*	15	4	5	13	9	11	14	16	10	8	1	6	7	12	3	2
Coho Juv Catches (Sept)	*	11	2	1	4	3	6	12	14	8	9	7	15	13	5	10	NA

2012 ocean year:

- Large-scale physics suggests a good year
- Regional physics and biology mixed

2013 ocean year:

- Large-scale physics suggests an average year
- Regional physics suggests a poor year
- Biology suggests a good year

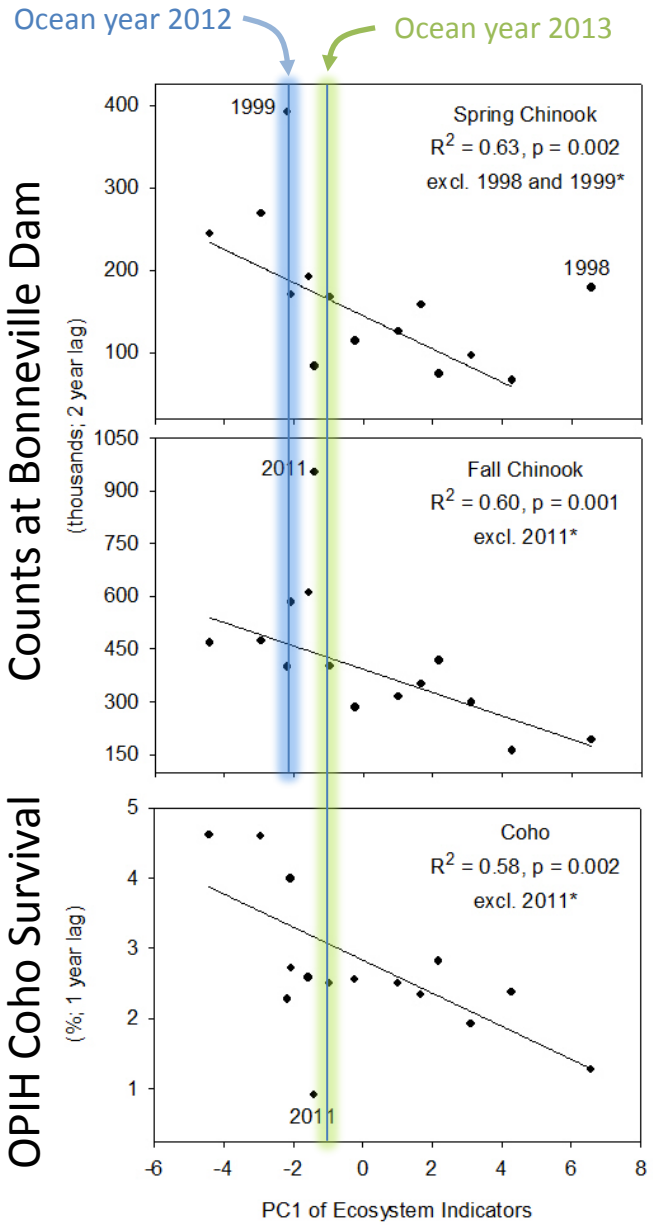
* Collected during NWFSC cruises

- Ocean Indicators, 2012 and 2013
- Adult return forecasts
- Why we forecast
- Future directions

Mixed results for 2013 forecasts

	Adult returns (1000s)	
	Forecast	Observed
Spring Chinook	200 (pred. interval: 102 – 370)	83.3
Fall Chinook	420 (pred. interval: 270 – 680)	953

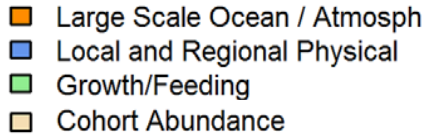
Outlook for adult returns



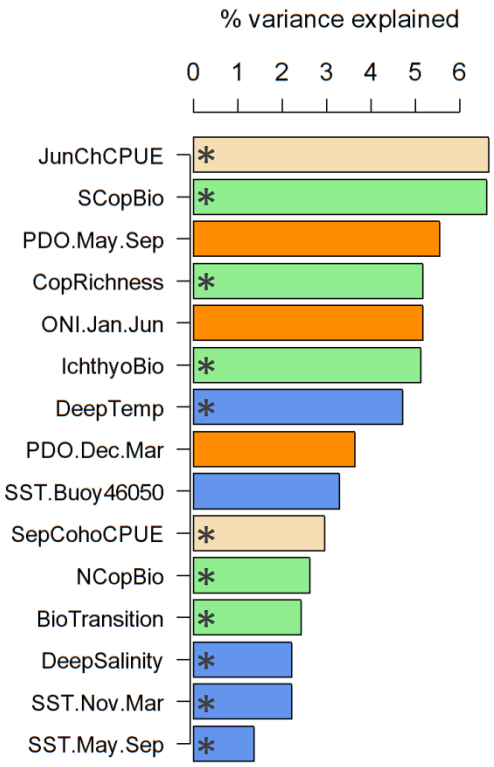
	2014	2015
Spring Chinook	200 K (pred. interval: 88 – 455)	155 K (pred. interval: 68 – 340)
Fall Chinook	470 K (pred. interval: 280 – 760)	401 K (pred. interval: 245 – 655)
Coho	2.8% (pred. interval: 1.8 – 4.4%)	

- Ocean Indicators, 2012 and 2013
- Adult return forecasts
- Why we forecast
- Future directions

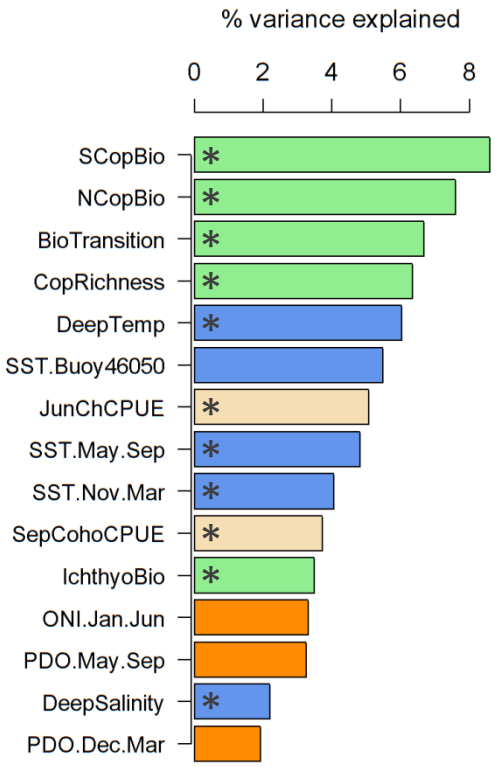
Variable importance differs among runs/species



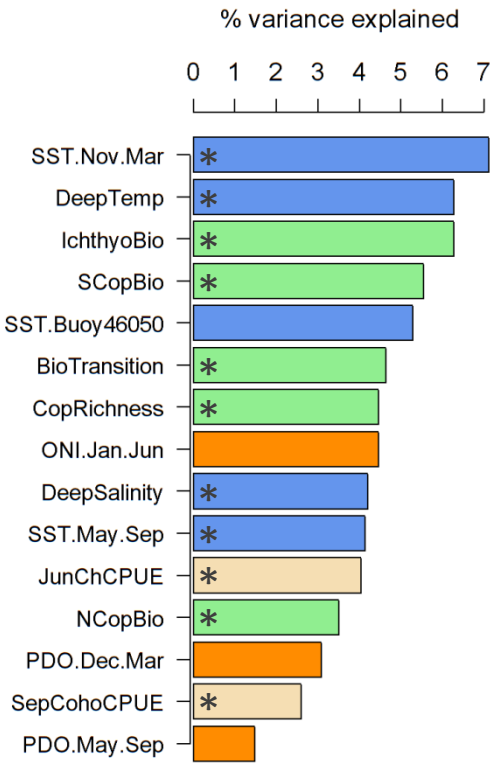
Spring Chinook



Fall Chinook

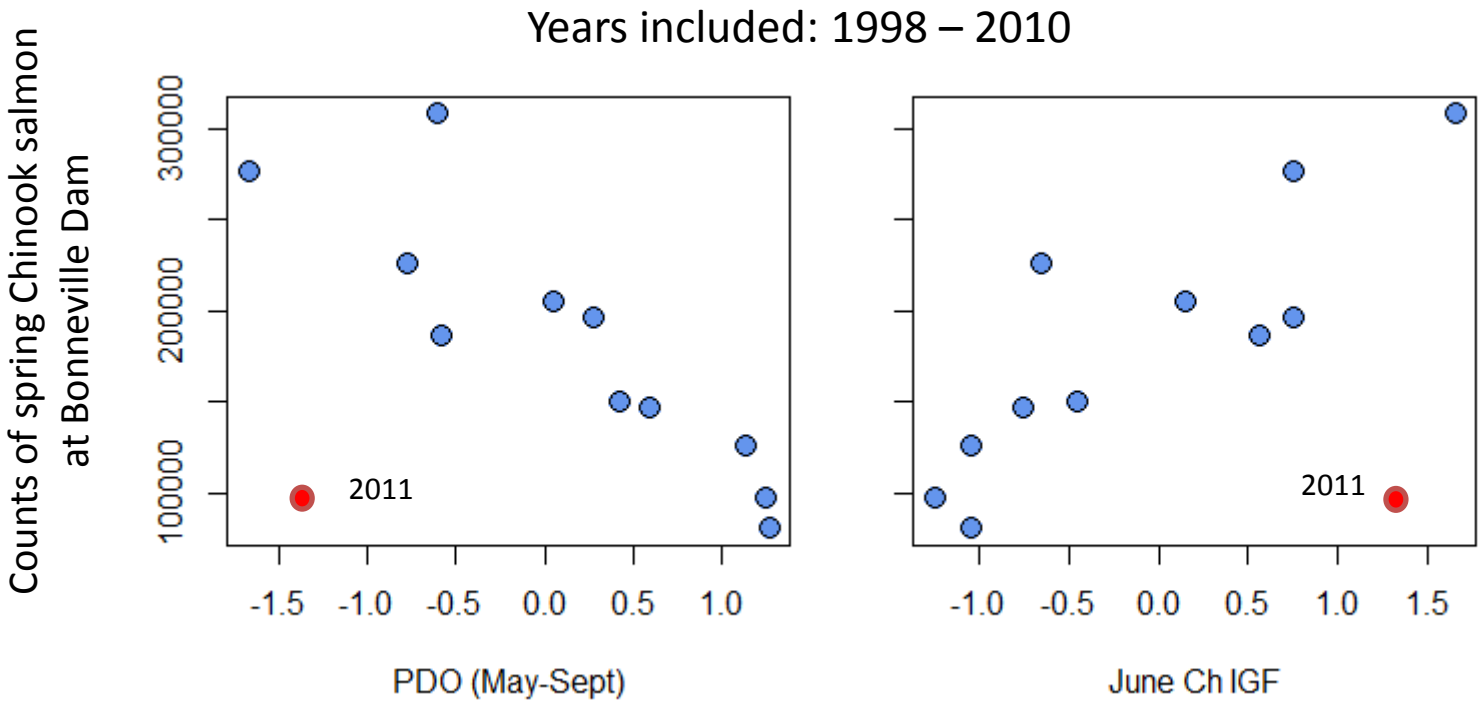


Coho



* Collected during NWFSC cruises

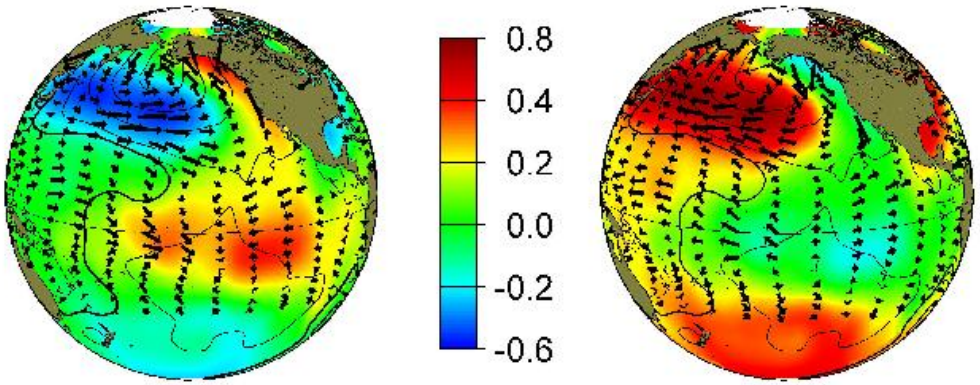
We learn best when models fail

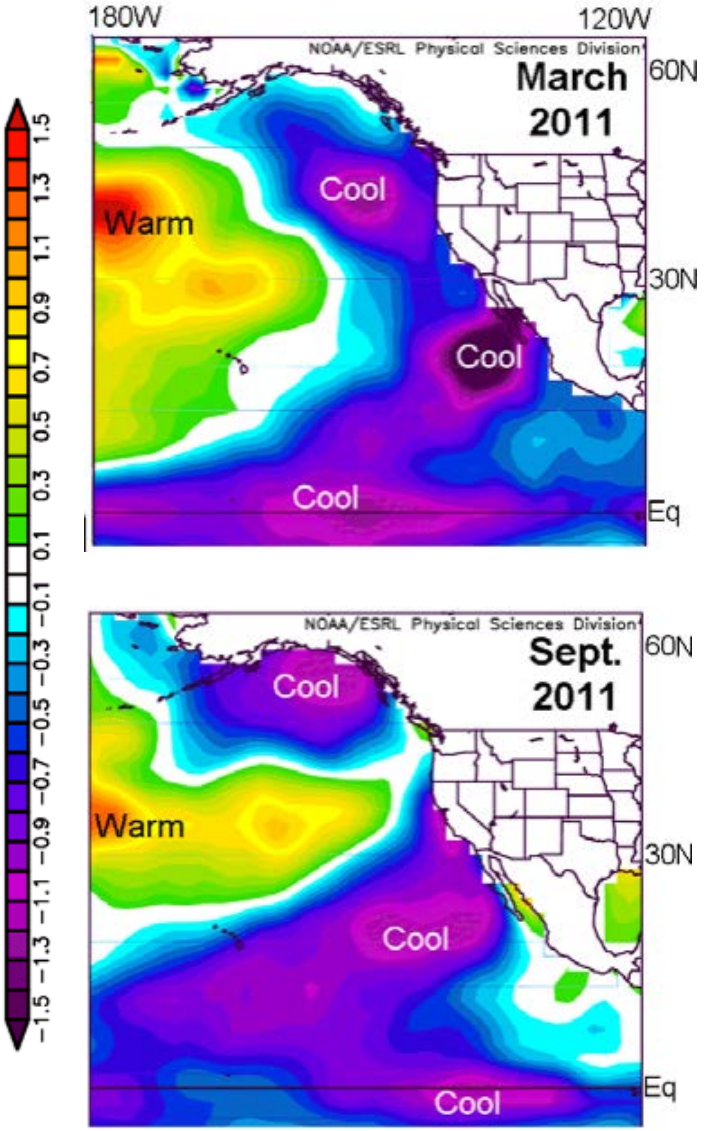


PDO does not capture local dynamics

Warm year

Cold year





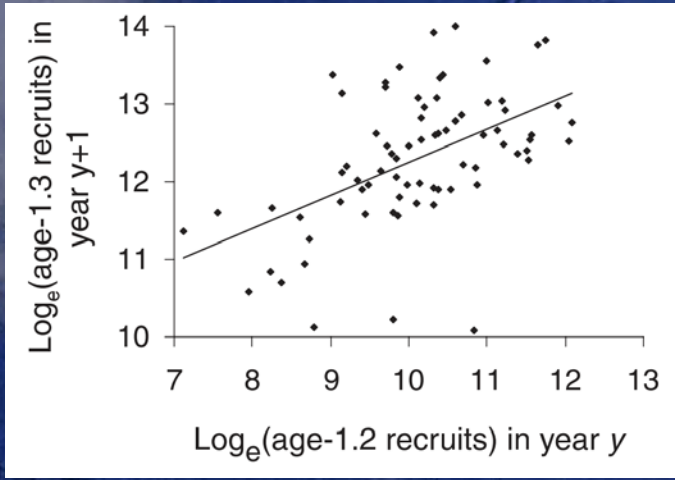
DFO State of the Pacific Ocean 2011 report
(http://www.dfo-mpo.gc.ca/Csas-sccs/publications/resdocs-docrech/2012/2012_072-eng.pdf)

Two Complimentary Approaches

Bering Sea

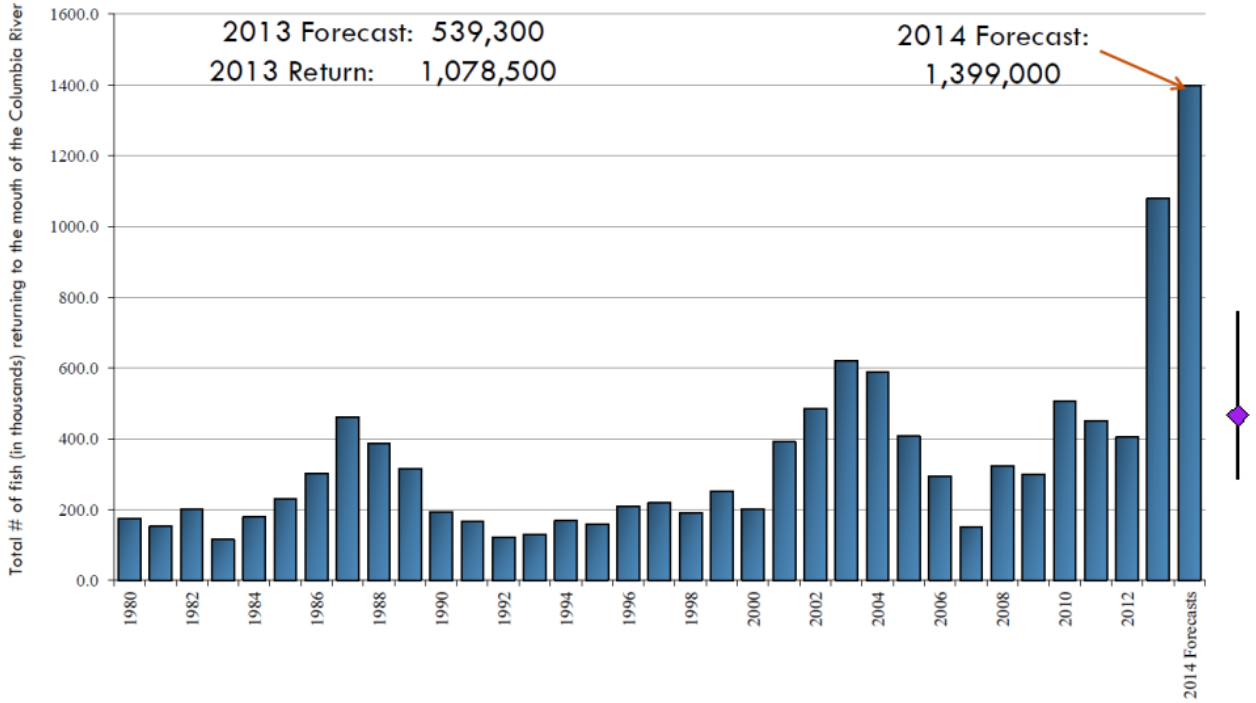
Gulf of Alaska

Yearling Chinook



Holt and Peterman, 2004. CJFAS

Upriver Fall Chinook

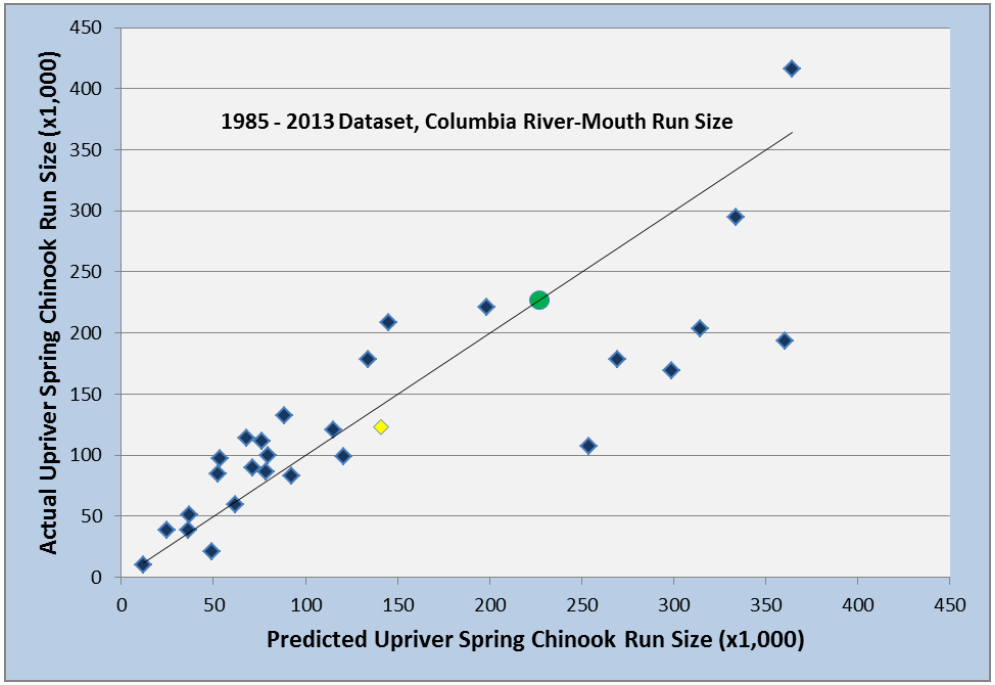


NOAA Forecast:
461 K fish to Bonneville Dam
(pred. interval: 280-760K)

From Bill Tweit ’s talk to the NWPCC, March 4th, 2014

- Ocean Indicators, 2012 and 2013
- Adult return forecasts
- Why we forecast
- Future directions

- Hybrid sibling regressions
  - Combine sibling regression with environmental conditions
  - Incorporate age-structured cohort data (sensu TAC)
  - Forecast SAR (as opposed to counts at Bonneville Dam)
  - Stock-specific



From Ed Schriever's talk to the NWPCC, March 4th, 2014

Spring Chinook salmon life cycle model