

RECLAMATION

Managing Water in the West

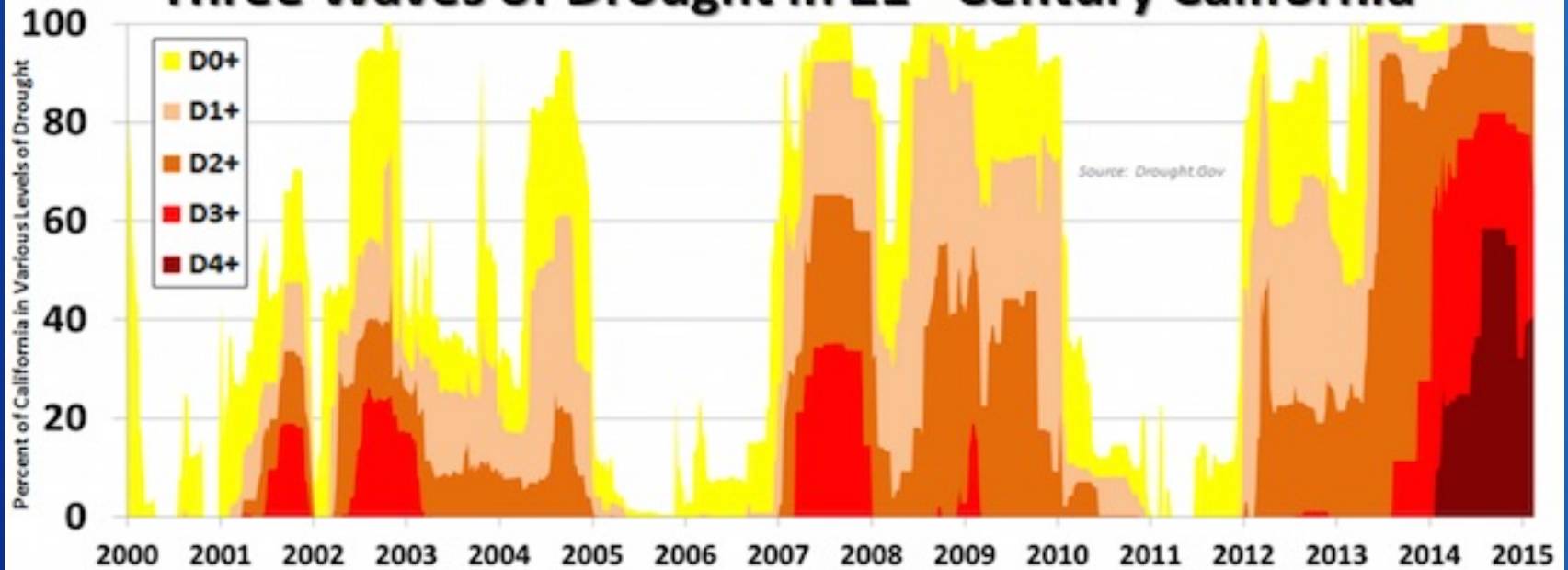
WINTER-RUN CHINOOK SALMON RESPONSES TO DROUGHT: IMPACTS ON POPULATION VIABILITY CRITERIA

Bay Delta Science Conference
November 17, 2017



U.S. Department of the Interior
Bureau of Reclamation

Three Waves of Drought in 21st Century California



weatherunderground



RECLAMATION

Acknowledgements

Barbara Byrne

Chad Dibble

Brett Harvey

Rachel Johnson

Ken Kundargi

Dan Kratville

Bill Poytress

Kevin Reece

Andrew Schultz

Jim Smith

Jeff Stuart

Davis van Rijn

Garwin Yip

IEP
WRCS
PWT



**Brood Year 2013 Winter-run
Chinook Salmon Drought
Operations and Monitoring
Assessment**



March 2015

RECLAMATION

Collaborative Multiagency Technical Effort



**Brood Year 2013 Winter-run
Chinook Salmon Drought
Operations and Monitoring
Assessment**

- Identified hypothesized drought effects
- Assemble monitoring data from Comparative Period (BY 2007-2012)
- Analyze and Synthesize these Impacts
- Recommended Monitoring Improvements



March 2015

RECLAMATION

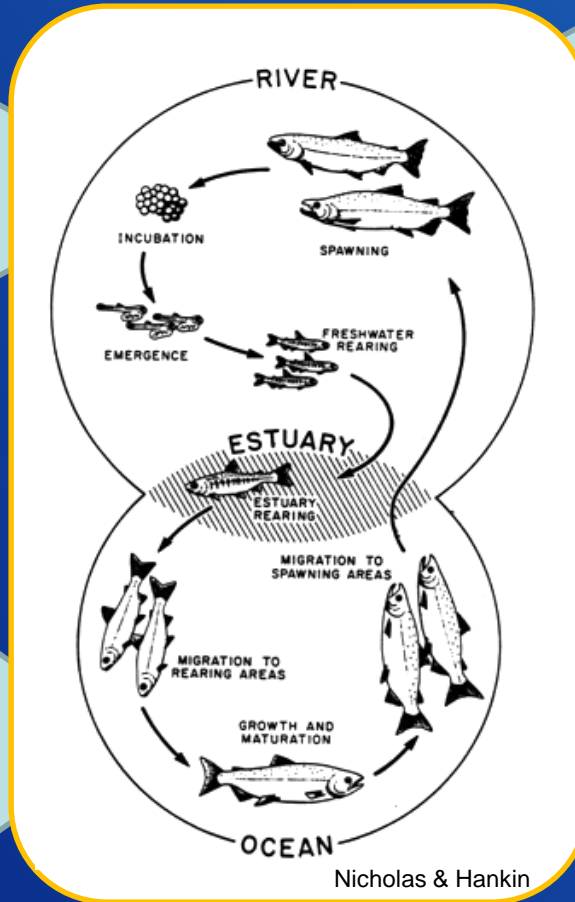
Evaluate Drought Cohort Metrics to Assess Changes in Viability

Abundance

- Escapement
- Proportion hatchery

Productivity

- Egg-to-fry survival
- Recruits/
female



Diversity

- Presmolt/
smolts
- Condition

Spatial Structure

- River migration
duration
- Delta rearing
duration

Did changes in abundance during the drought impact risk of extinction?

Criterion	Risk of Extinction		
	High	Moderate	Low
Extinction risk from PVA	> 20% within 20 years – or any ONE of –	> 5% within 100 years – or any ONE of –	< 5% within 100 years – or ALL of –
Population size ^a	$N_e \leq 50$ –or– $N \leq 250$	$50 < N_e \leq 500$ –or– $250 < N \leq 2500$	$N_e > 500$ –or– $N > 2500$
Population decline	Precipitous decline ^b	Chronic decline or depression ^c	No decline apparent or probable
Catastrophe, rate and effect ^d	Order of magnitude decline within one generation	Smaller but significant decline ^e	not apparent
Hatchery influence ^f	High	Moderate	Low

^a Census size N can be used if direct estimates of effective size N_e are not available, assuming $N_e/N = 0.2$.

^b Decline within last two generations to annual run size ≤ 500 spawners, or run size > 500 but declining at $\geq 10\%$ per year. Historically small but stable population not included.

^c Run size has declined to ≤ 500 , but now stable.

^d Catastrophes occurring within the last 10 years.

^e Decline $< 90\%$ but biologically significant.

^f See Figure 1 for assessing hatchery impacts.

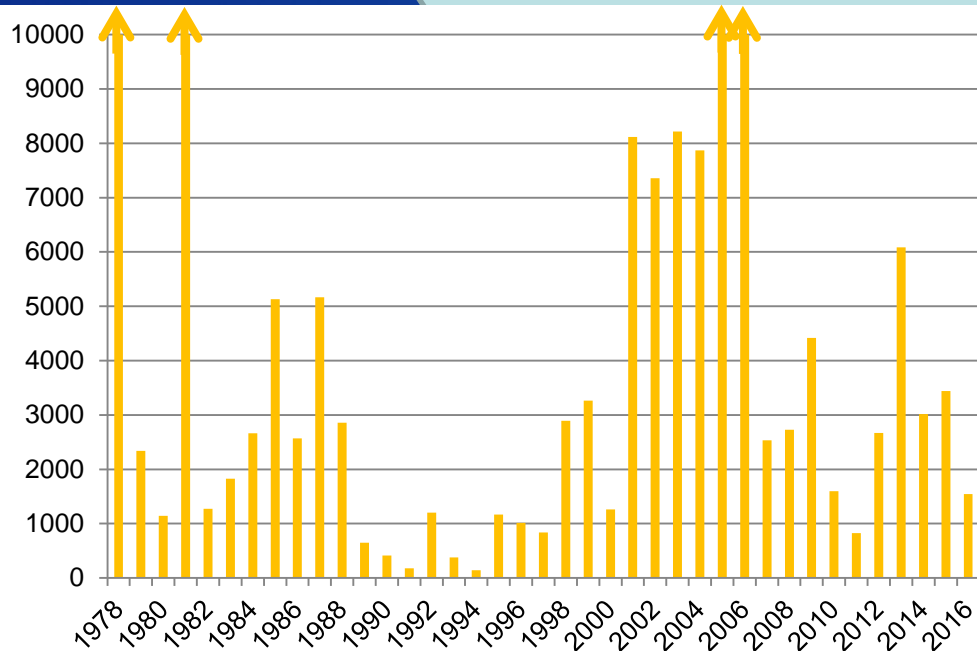
Abundance

<2,500 in 1 gen.

- Moderate Risk

Decline >10%/yr.

- Moderate Risk



Decline

G2: -26% to 88%

G1: -36% to 23%

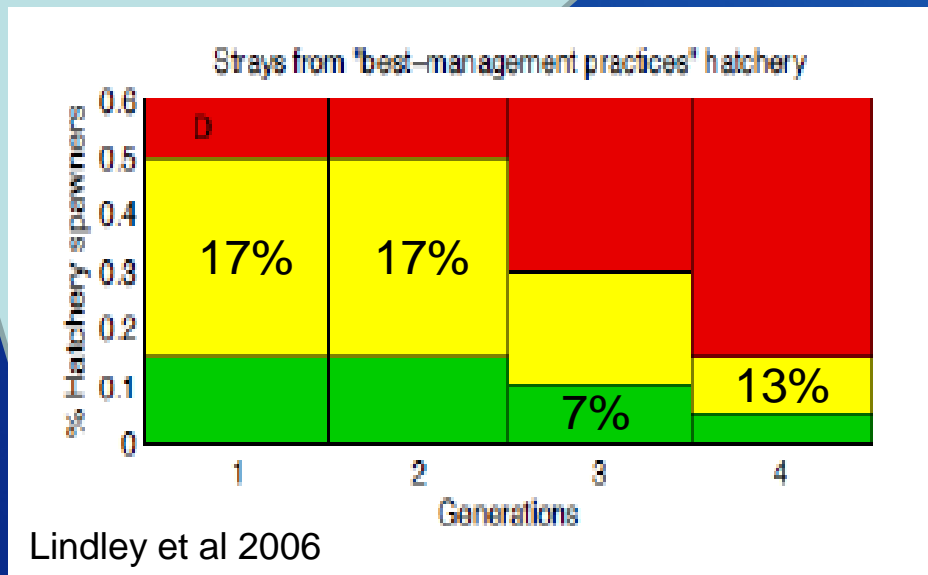
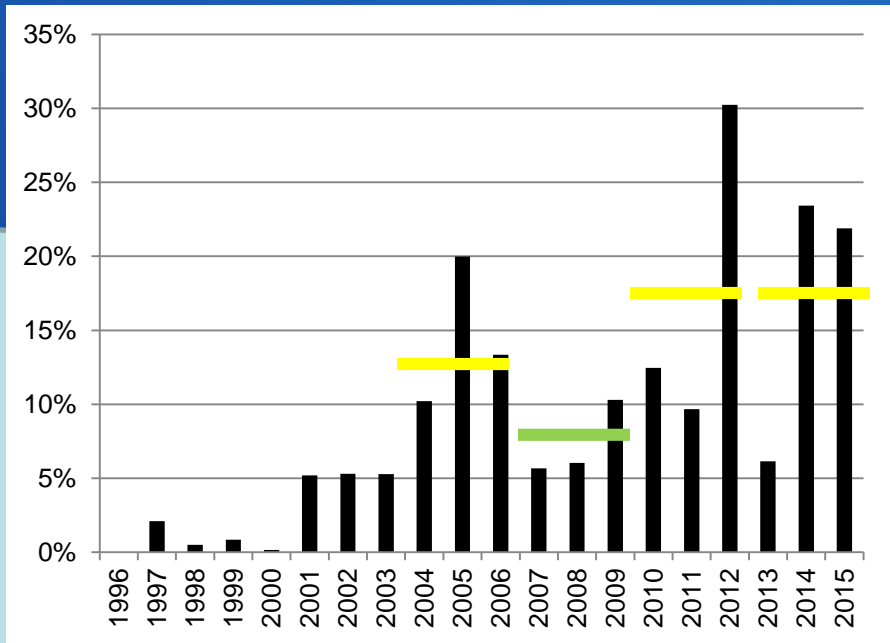
GrandTab 2015, CDFW 2016

RECLAMATION

Abundance

Proportion hatchery

- Moderate Risk



RECLAMATION

Did changes in productivity during the drought impact risk of extinction?

Criterion	Risk of Extinction		
	High	Moderate	Low
Extinction risk from PVA	> 20% within 20 years – or any ONE of –	> 5% within 100 years – or any ONE of –	< 5% within 100 years – or ALL of –
Population size ^a	$N_e \leq 50$ –or– $N \leq 250$	$50 < N_e \leq 500$ –or– $250 < N \leq 2500$	$N_e > 500$ –or– $N > 2500$
Population decline	Precipitous decline ^b	Chronic decline or depression ^c	No decline apparent or probable
Catastrophe, rate and effect ^d	Order of magnitude decline within one generation	Smaller but significant decline ^e	not apparent
Hatchery influence ^f	High	Moderate	Low

^a Census size N can be used if direct estimates of effective size N_e are not available, assuming $N_e/N = 0.2$.

^b Decline within last two generations to annual run size ≤ 500 spawners, or run size > 500 but declining at $\geq 10\%$ per year. Historically small but stable population not included.

^c Run size has declined to ≤ 500 , but now stable.

^d Catastrophes occurring within the last 10 years.

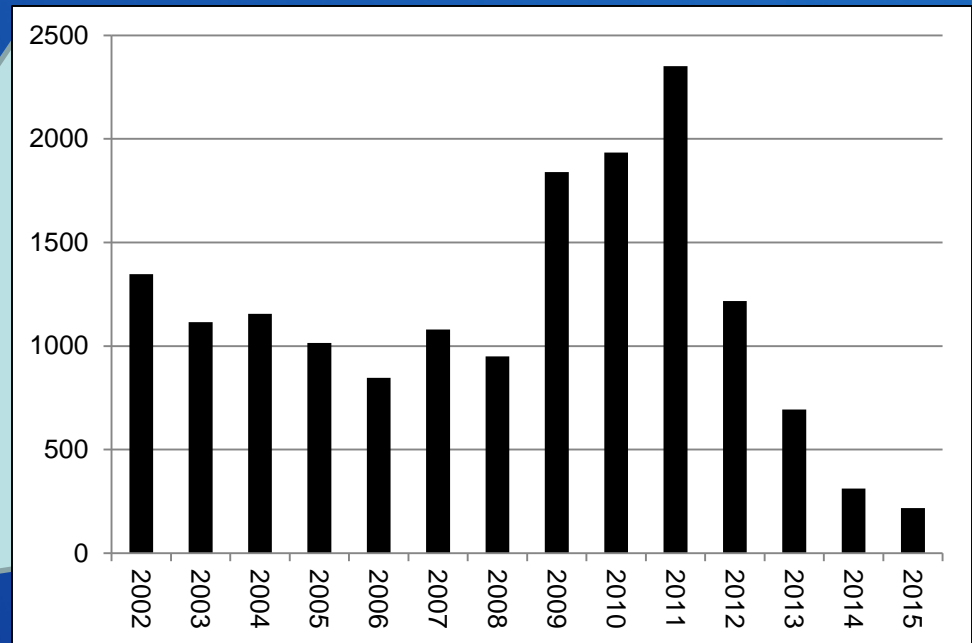
^e Decline $< 90\%$ but biologically significant.

^f See Figure 1 for assessing hatchery impacts.

Productivity

- Recruits/
female
- **High Risk**

Recruits/female

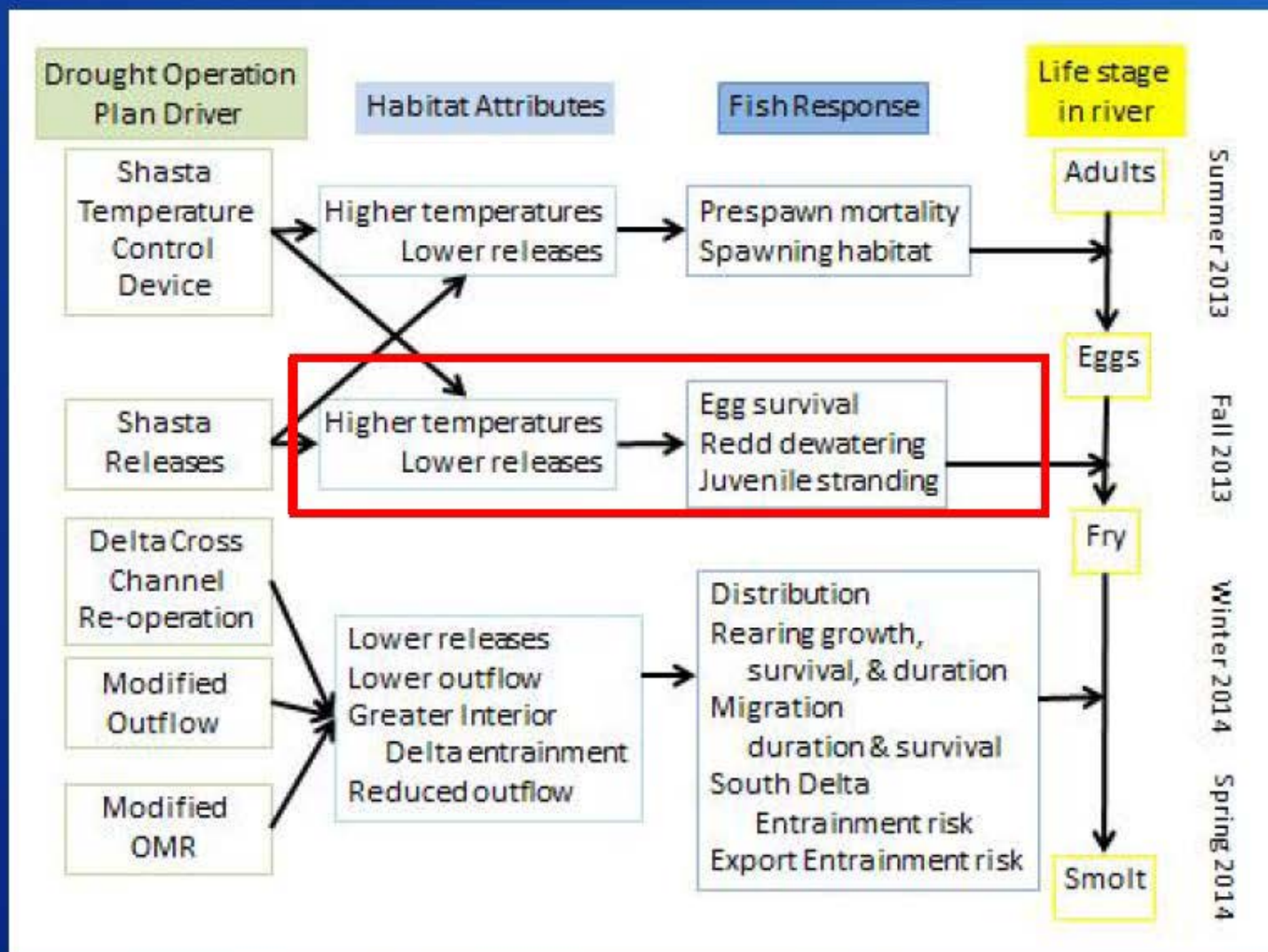


USFWS 2014, B. Poytress pers comm, CDFW 2016

	BY 2003-12	G3 (BY07-09)	G2(BY 10-12)	G1 (BY13-15)
Recruits/ female	Av. = 1350	Av.=1290	Av.=1834	Av.=408
Max. Decline during generation	+48% to -93%	-14%, No decline	93%	240%

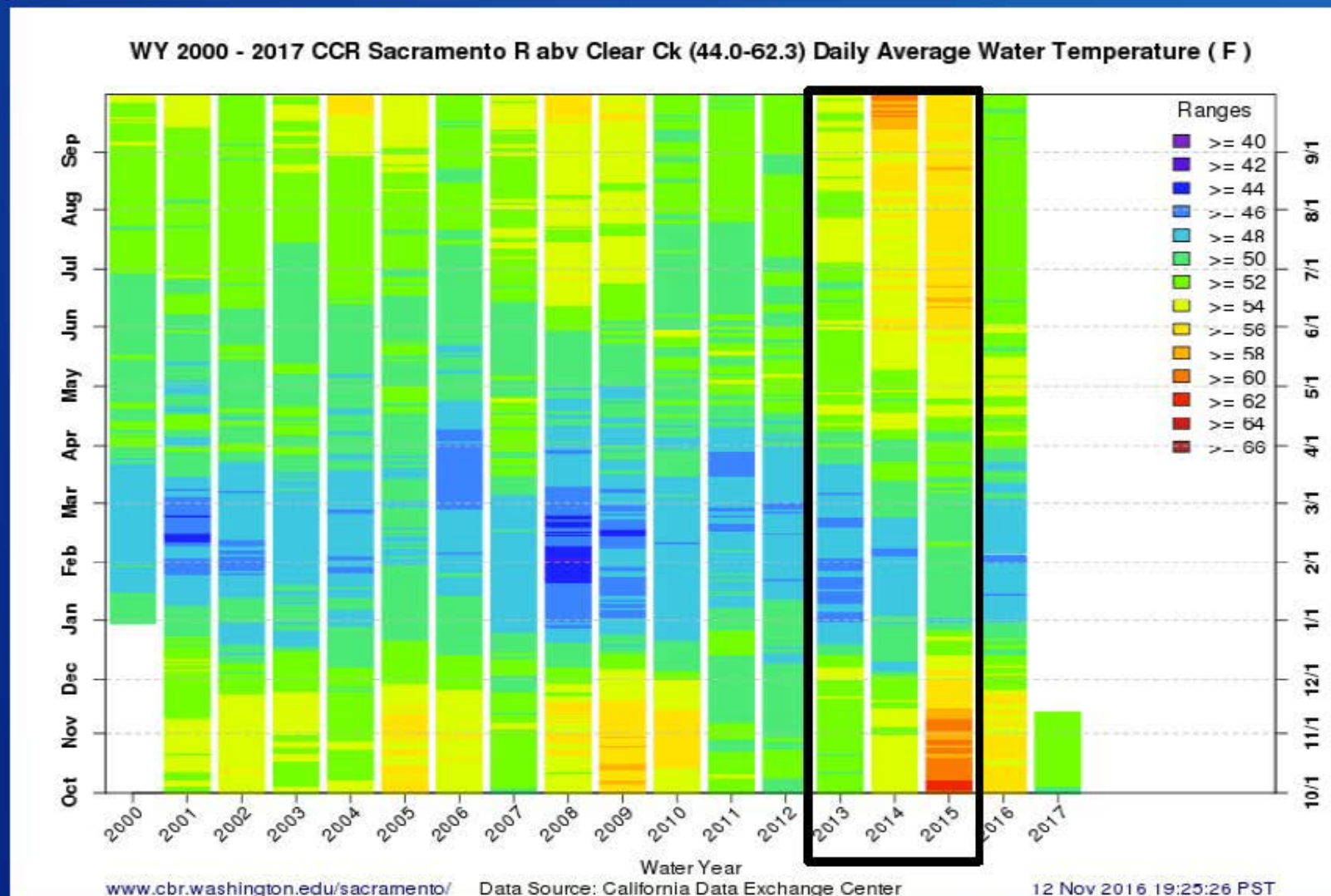
RECLAMATION

Higher temperatures impacted egg survival



RECLAMATION

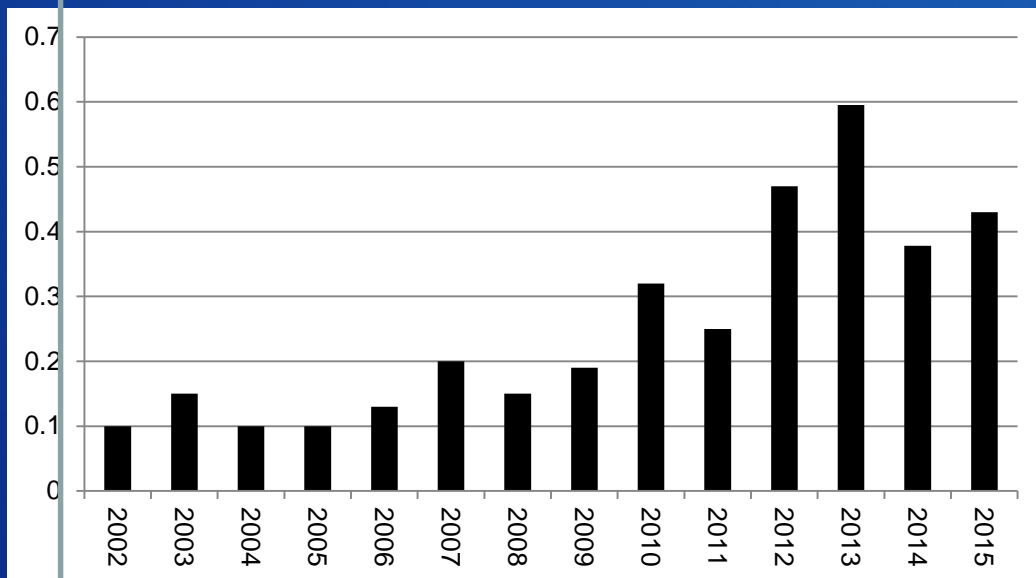
Higher temperatures impacted egg survival



SacPAS

RECLAMATION

% Presmolt and smolt



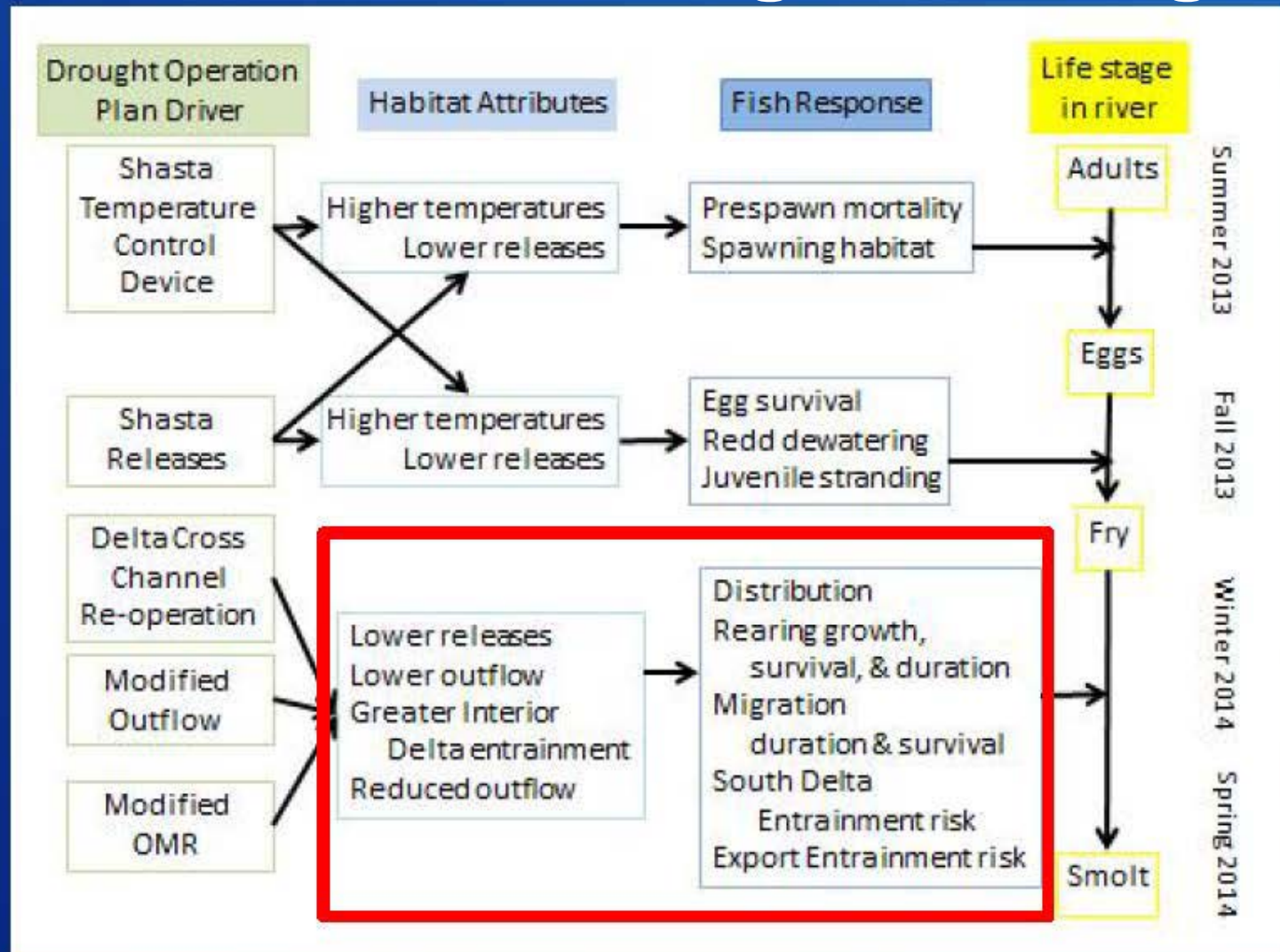
USFWS 2014, B. Poytress pers comm

- Diversity
- Condition Metrics
- Low/
Moderate risk

	BY 2003-12	BY 2013	BY 2014	BY 2015
% presmolt /smolt	Av. = 20% (10% to 47%)	59%	38%	43%
Salmonid Disease State (Foott 2013,2014,2015)	Not monitored	Spring: Low-Mod prevalence (7-64%)	Spring: Moderate prevalence (63-77%)	Fall: High prevalence (80-82%)

RECLAMATION

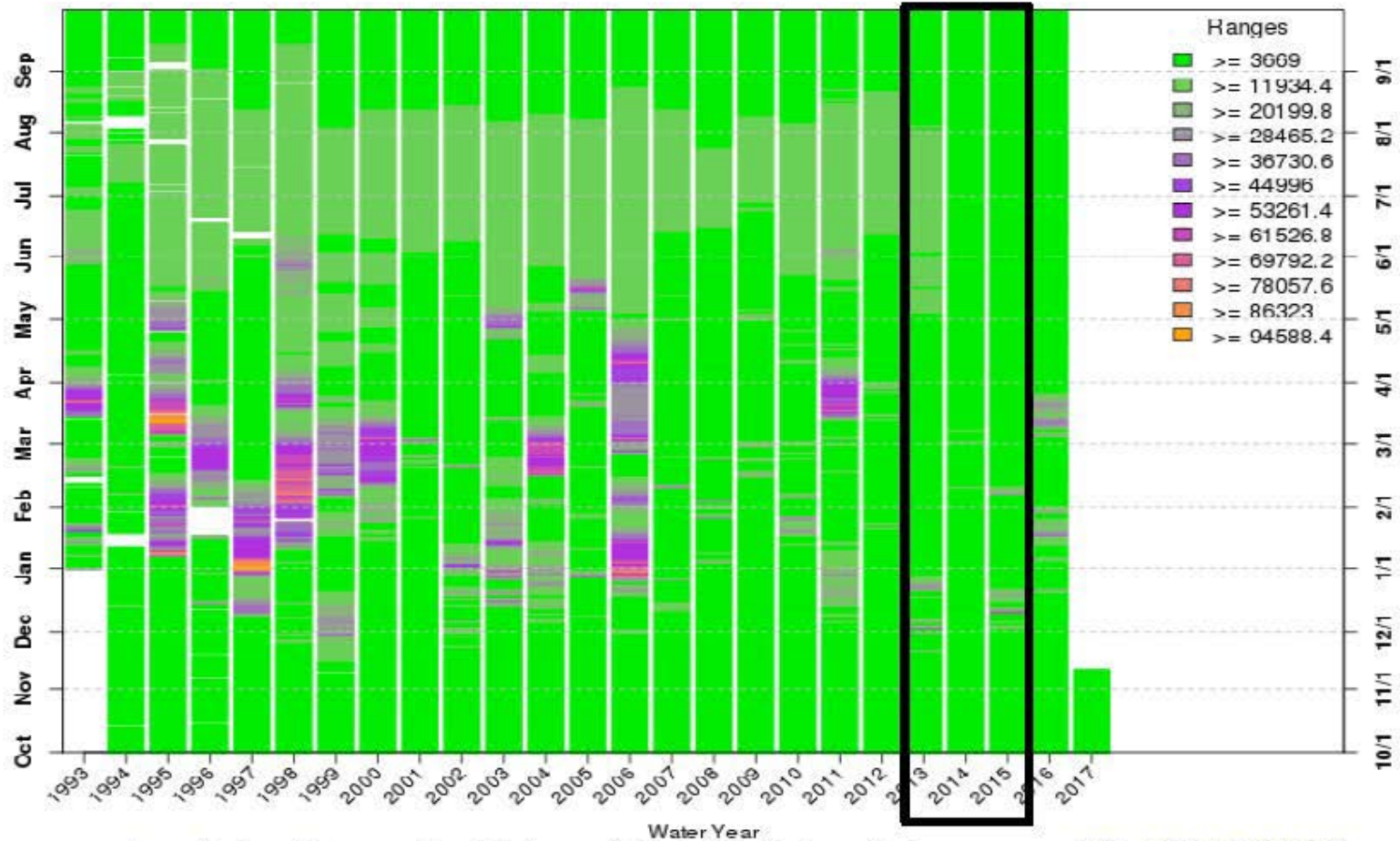
Did changes in life history diversity and condition occur during the drought?



RECLAMATION

Warm temperatures- faster growth Lower flows- longer rearing

WY 1993 - 2017 BND Sacramento R at Bend Bridge (3669.0-102854.0) Daily Average Flow (CFS)



www.cbr.washington.edu/sacramento/

Data Source: California Data Exchange Center

12 Nov 2016 19:34:15 PST

SacPAS

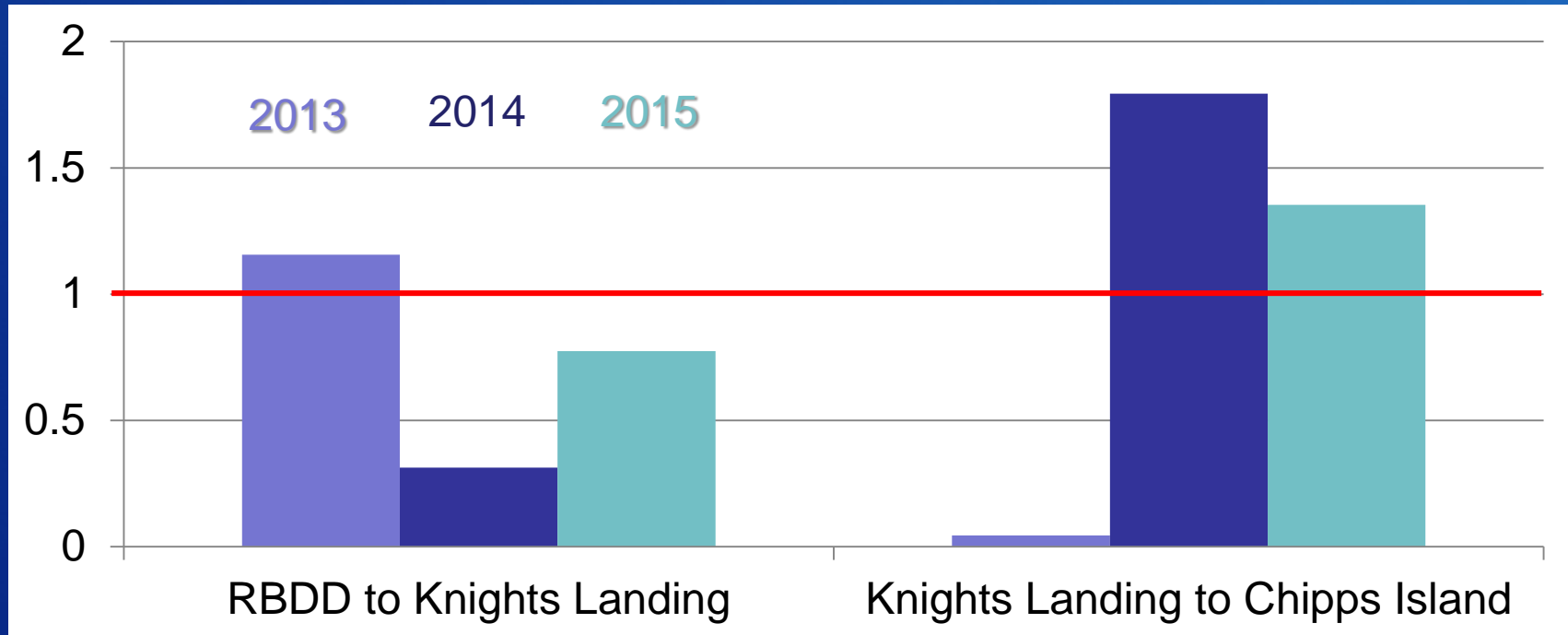
RECLAMATION

WRCS drought cohorts reared above RBDD longer

Juvenile Winter Chinook Migration Timing Characteristics, Red Bluff Diversion Dam

Brood Year	Passage Dates							Middle 80% Days	Run Size
	First	5%	10%	50%	90%	95%	Last		
2015	2015-7-6	2015-9-1	2015-9-11	2015-10-6	2015-12-11	2015-12-15	2016-4-28	92	328411
2014	2014-7-7	2014-8-27	2014-8-30	2014-9-27	2014-11-19	2014-12-2	2015-5-21	82	272227
2013	2013-7-9	2013-9-9	2013-9-16	2013-10-28	2014-1-16	2014-2-10	2014-5-8	123	1416704
2012	2012-7-16	2012-9-11	2012-9-17	2012-10-20	2012-11-22	2012-12-13	2013-5-4	67	1186292
2011	2011-8-3	2011-9-15	2011-9-19	2011-10-7	2011-12-1	2011-12-13	2012-4-18	74	742344

BY13-15 spatial structure metrics Compared to BY07-12 average



BY 13 :
Reared longer in lower river
Quickly migrated through
Delta

BY 14 & 15:
Reared shorter in lower river
Slowly migrated through Delta

Reduction in Viability Due to Drought

Abundance – Increased Risk due to reductions during drought years for generational metrics

Productivity- Increased Risk due to order of magnitude decline during drought years for cohort metrics

Diversity- Increased Risk due to cohort metrics

Spatial Structure- Greater variation in rearing and migration metrics, hypothesized to be related to drought conditions

RECLAMATION

Reduced Winter-run Viability Impacting Fish and Water Management

RPA Adjustment Process

Adjusted Temperature Management Planning and Implementation Process

- Salmon in the Spotlight
- Salmon Action Plan
- CVPIA
- IEP



- Upper Sacramento River restoration
- Adaptive Resource Management
- New Monitoring

Reinitiation of Consultation on CVP/SWP

RECLAMATION