A large school of juvenile Chinook salmon swimming in clear blue water. The fish are densely packed and appear to be in motion, with some showing their characteristic silvery scales and dark spots.

Juvenile Production Estimate Calculation for Winter-run Chinook Salmon

Bruce Oppenheim

NMFS

June 26 2014

Background

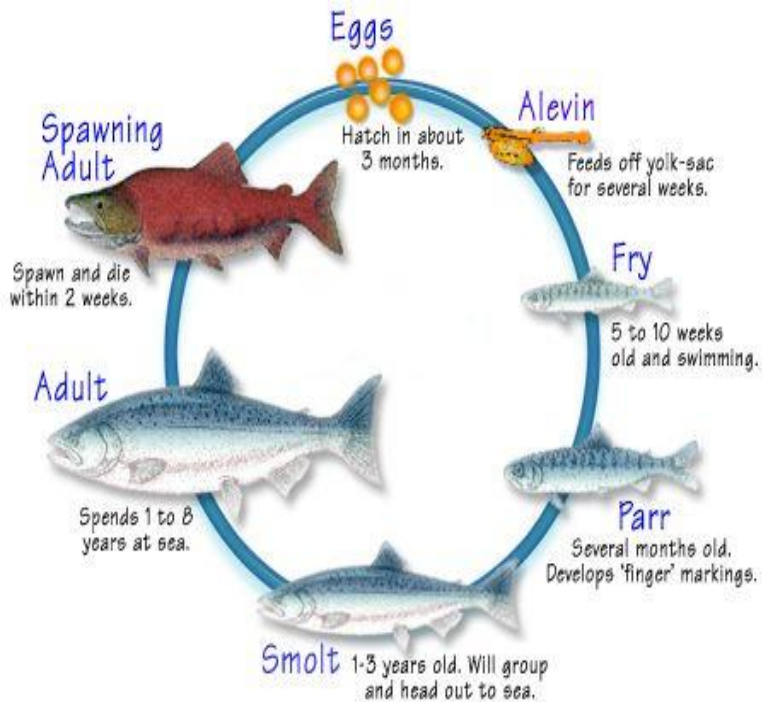
- ▶ Simple spreadsheet model (Excel)
- ▶ Used to determine incidental take limit at the Federal and state pumping facilities in the Delta
- ▶ Developed for the 1995 NMFS Biological Opinion on CVP/SWP operations
- ▶ Reviewed & updated by the IEP Winter-run Project Work Team (WRPWT)
- ▶ Changes with latest science and annual variation in population parameters



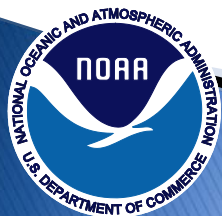
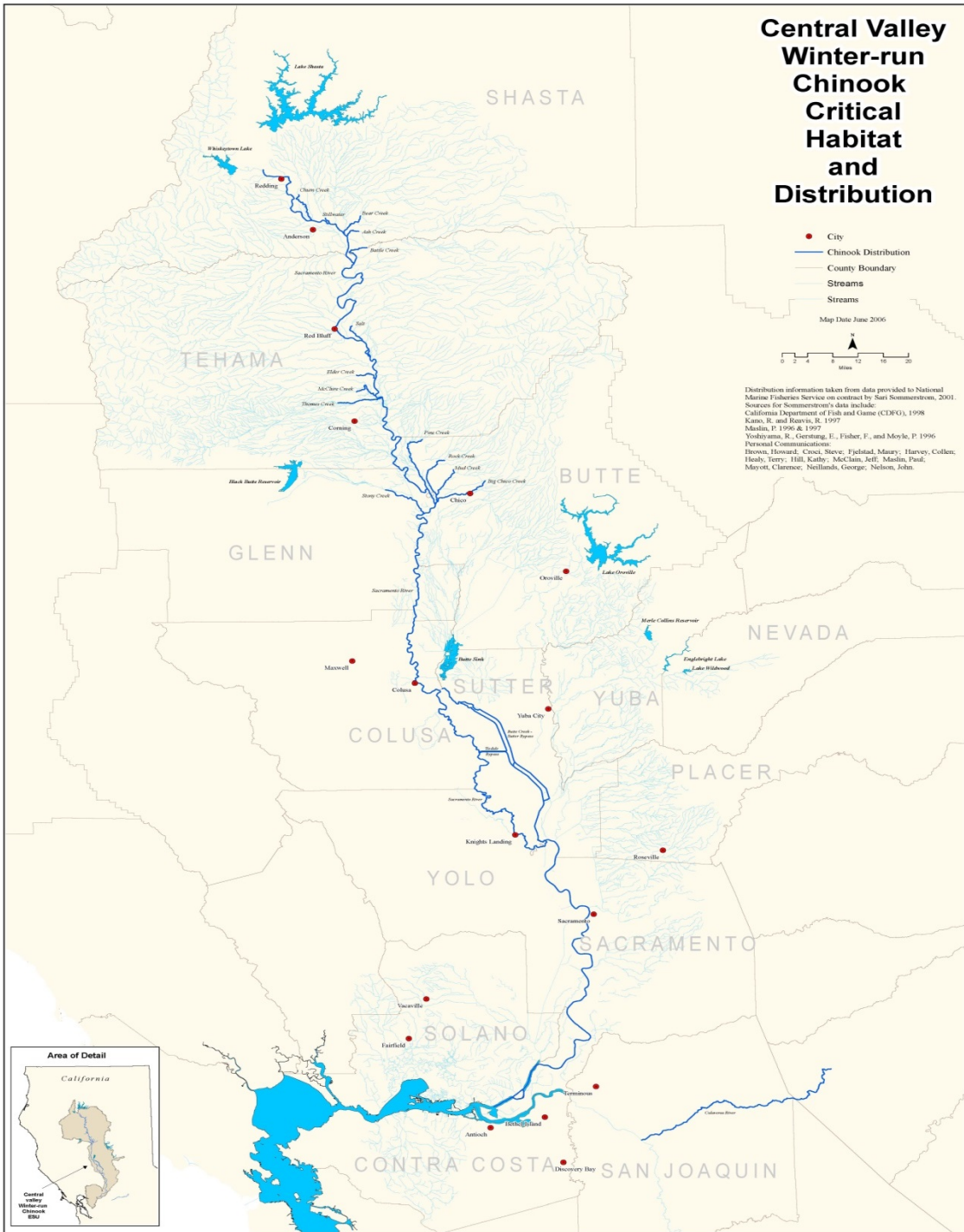
Breakdown of Components

* Modified in 2014

1. Escapement
2. Pre-spawn mortality
3. Fecundity
4. Survival, egg to fry*
5. Survival, fry to smolt*
6. Survival, smolt to Delta*
7. Confidence Intervals

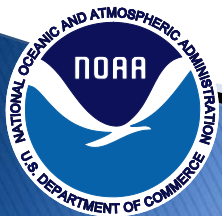


Central Valley Winter-run Chinook Critical Habitat and Distribution



(1) Escapement

- ▶ CDFW official escapement estimate based on carcass, or RBDD ladder counts
- ▶ Varies annually (300–16,000 adults)
- ▶ Sex ratio from Keswick trap
- ▶ 90 % Confidence Intervals added in 2013

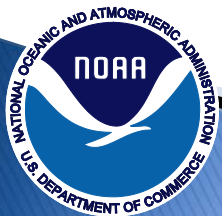


Starts with official CDFW estimate in January

Estimated Total In-river Escapement
(hatchery and natural origin) 2,581

Estimated In-river Escapement
(hatchery origin) 807

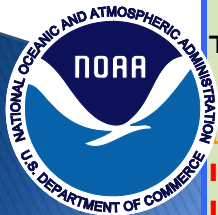
Estimated Number of In-river Adult Females
(hatchery and natural origin) 1,498



Example of JPE from 2012

Version 3 12/19/2012

WINTER RUN CHINOOK SALMON draft Juvenile Production Estimate	Carcass Survey Factors	Carcass Survey Estimate
Total In-river Escapement - <u>1/</u>		2581
Adult Female Estimate - <u>2/</u>	56%	1498
Estimate of Female Spawners - <u>3/</u>	100.00%	1498
Average Fecundity - <u>4/</u>	4518	6767964
Egg Loss Due To Temperature - <u>5/</u>	0	0
Total Viable Eggs		6767964
Estimated Survival - egg to fry (at RBDD) - <u>6/</u>	0.25	1691991
Estimated Survival - fry to smolts in mid-Sac- <u>7/</u> (based on fish coming out of Tehama-Colusa spawning channel)	0.59	998275
Estimated Survival - Smolts to Delta - <u>8/</u> (locations of downstream control: Courtland, Sac, Ryde, Isleton)	0.53625	535325
Total Natural Production Entering Delta		535325
Hatchery Release - <u>9/</u>		180000
Total Hatchery Production Entering Delta	0.53625	96525
Level of Concern for wild fish (1%)		5353
Level of Concern for hatchery fish (0.5%)		483
Incidental Take Level for Natural Production (2%)		10706
Incidental Take level for Hatchery Production (1%)		965



(2) Prespawn mortality

- ▶ Number of females that die prior to spawning
- ▶ Estimated from carcass survey data
- ▶ Typically very low for winter-run (1–2%)
- ▶ Subtract from total females
- ▶ Subtract temperature effect on eggs (assumes 100% mortality below compliance point)



(3) Fecundity

- ▶ Number of eggs/female
- ▶ Derived annually from hatchery returns
- ▶ Small sample size $n = < 50$
- ▶ Depends on female size (e.g., 4,000–5800)
- ▶ Historically, used 3,859 from literature



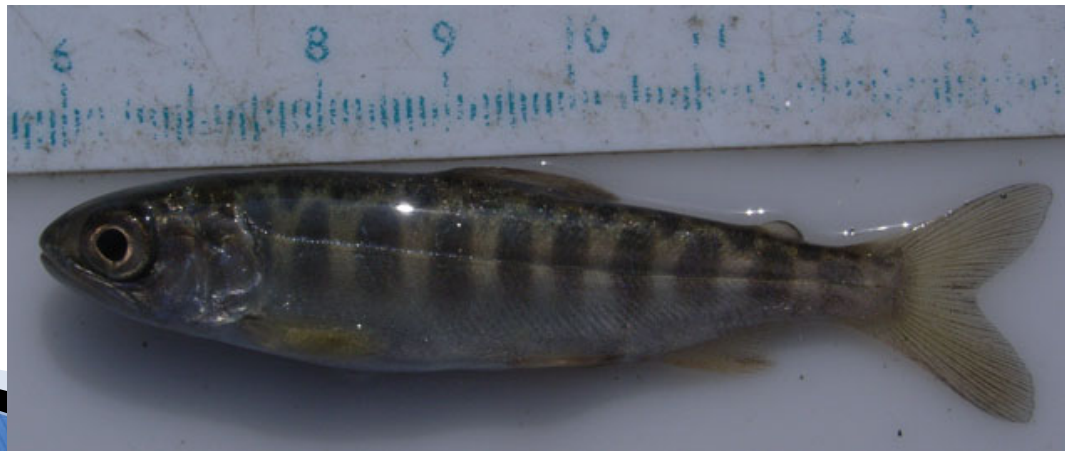
(4) Survival – Egg to Fry (25%)

- ▶ Early life–stages (egg, alevin, & fry)
- ▶ Spatially = spawning grounds to RBDD
- ▶ Temporally = 3–4 months (May–September)
- ▶ Size = <34 mm
- ▶ Derived from RBDD data



(5) Survival – Fry to Smolt (59%)

- ▶ Early life–stages (fry, parr, pre–smolt)
- ▶ Spatially = RBDD to Colusa (mid Sac. R)
- ▶ Temporally = 4–6 months of age (Sept.–Nov)
- ▶ Size = 35–60 mm
- ▶ Derived from fall–run survival at Tehama–Colusa Spawning Channel (1972–1985)



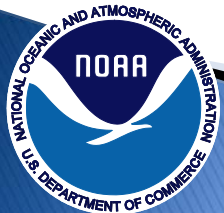
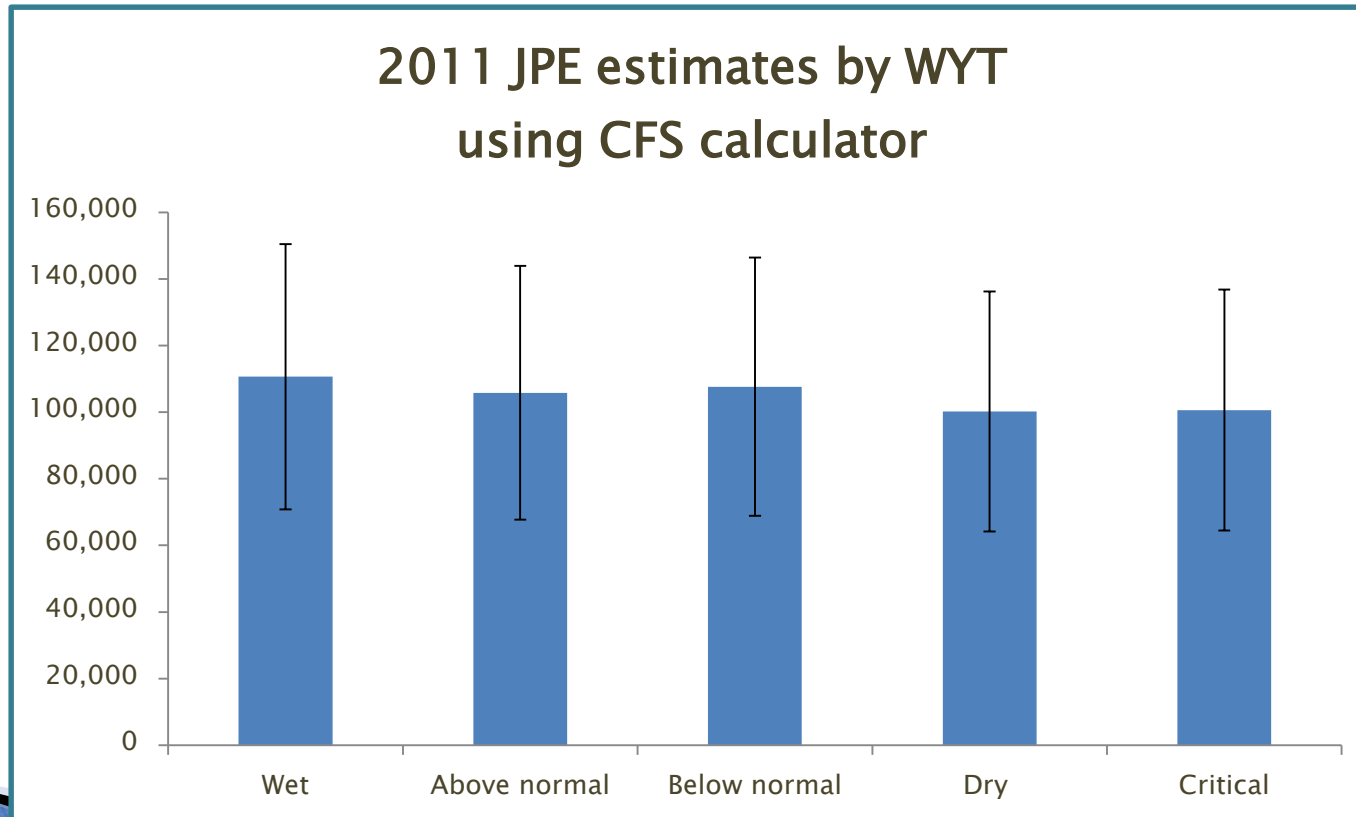
(6) Survival –Smolt to Delta (53%)

- ▶ Early life–stages (pre–smolt to smolt)
- ▶ Spatially = Colusa to Delta (at Hwy 80 Bridge)
- ▶ Temporally = 6–8 months of age (Nov–Jan)
- ▶ Size = 61–120 mm
- ▶ Based on 8 years of paired CWT late–fall run Chinook salmon releases from Battle Creek and Delta 1994–2001 (Chippis Island data)



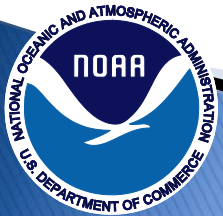
(7) Confidence interval submodel

- ▶ 95 % CI's from CFS model since 2010
- ▶ Wide range on error bars



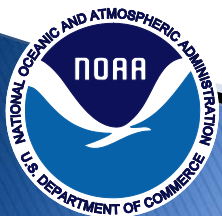
Modifications in 2013

- ▶ Incorporate recent data from 6 years of acoustic tag studies
- ▶ Consideration of:
 - Surrogacy
 - Water year type



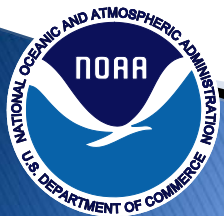
Data necessary for a JPE calculation

- ▶ Escapement (including sex ratio)
- ▶ Pre-spawn mortality
- ▶ Fecundity
- ▶ Survival estimates, such as:
 - Egg to fry
 - Fry to smolt
 - Smolt to Delta



Ideas for use of a spring-run JPE in San Joaquin Restoration Program

- ▶ Trap juveniles -estimate JPE, similar to RBDD
- ▶ Mark juveniles to identify at pumps
- ▶ Develop SJR specific length criteria
- ▶ Use JPE to evaluate program success
- ▶ Time constraint- likely 3 years to gather data (e.g., escapement and survival studies)



Questions ?

