Chinook salmon in the Central Valley and how water projects impact them and their habitats

Review of the Long-Term Operations of the Central Valley Project and the State Water Project

31 January 2024, Sacramento CA

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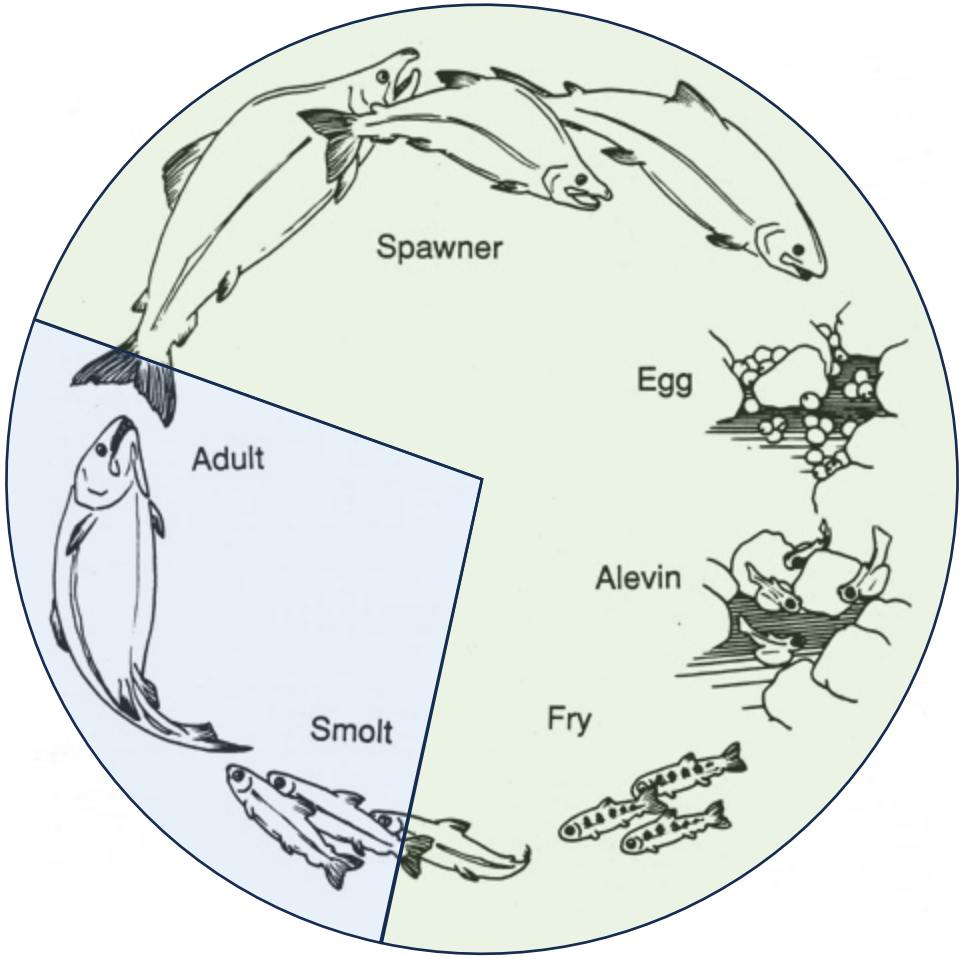
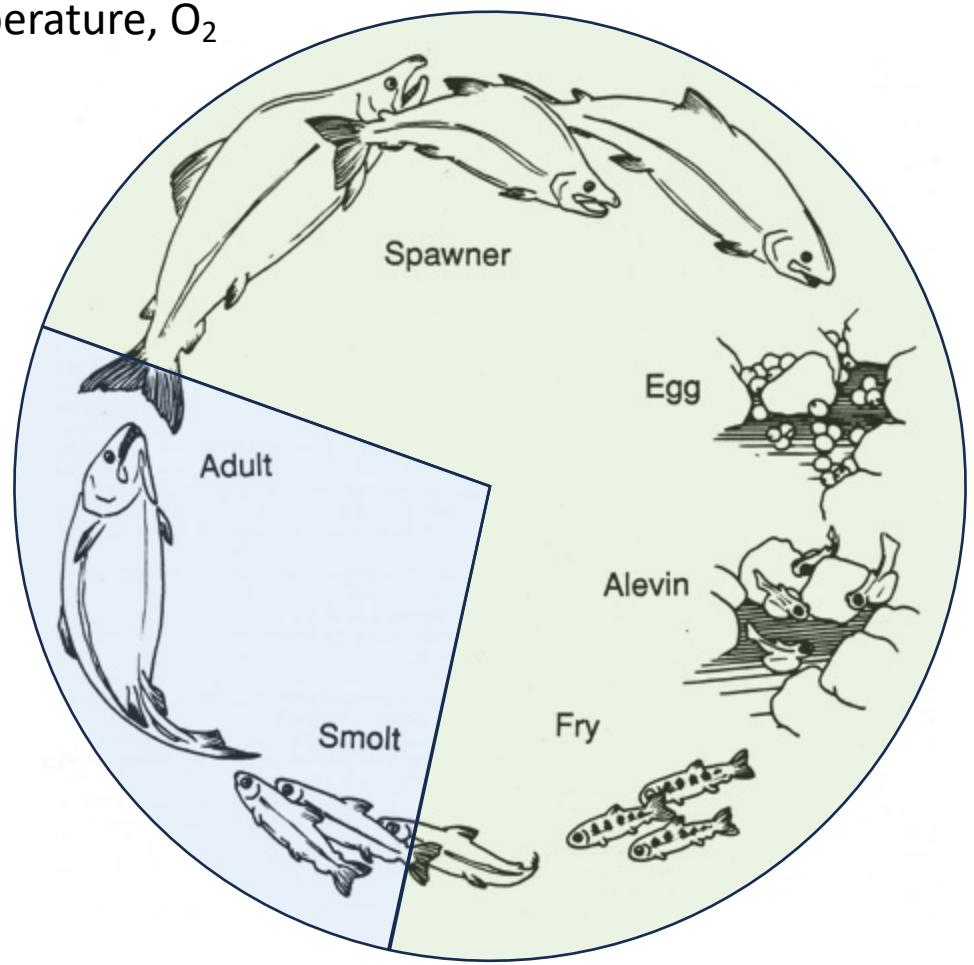
NOAA

Generalized salmon life cycle



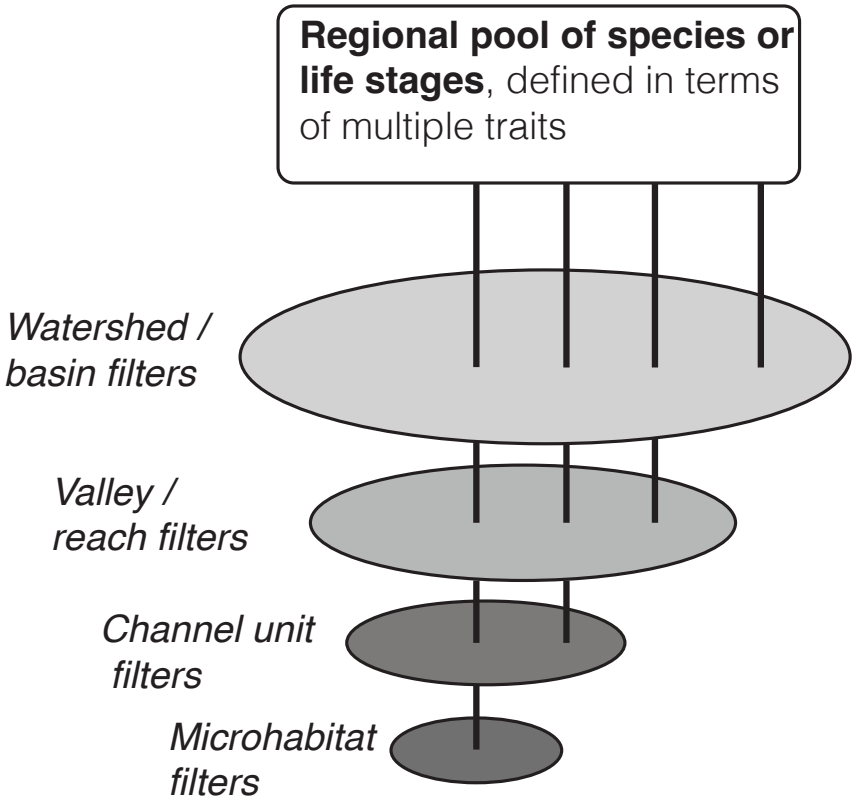
Depth, velocity, substrate, temperature, O_2



Temperature, depth, food supply, distance from shore

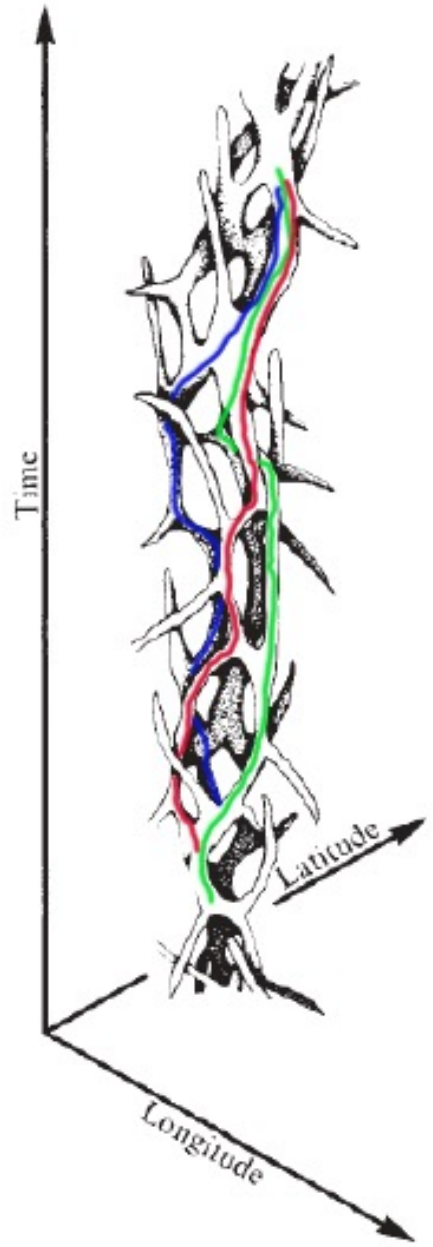
Depth, velocity, temperature, food supply, cover

Habitat: shifting mosaics, templates, filters



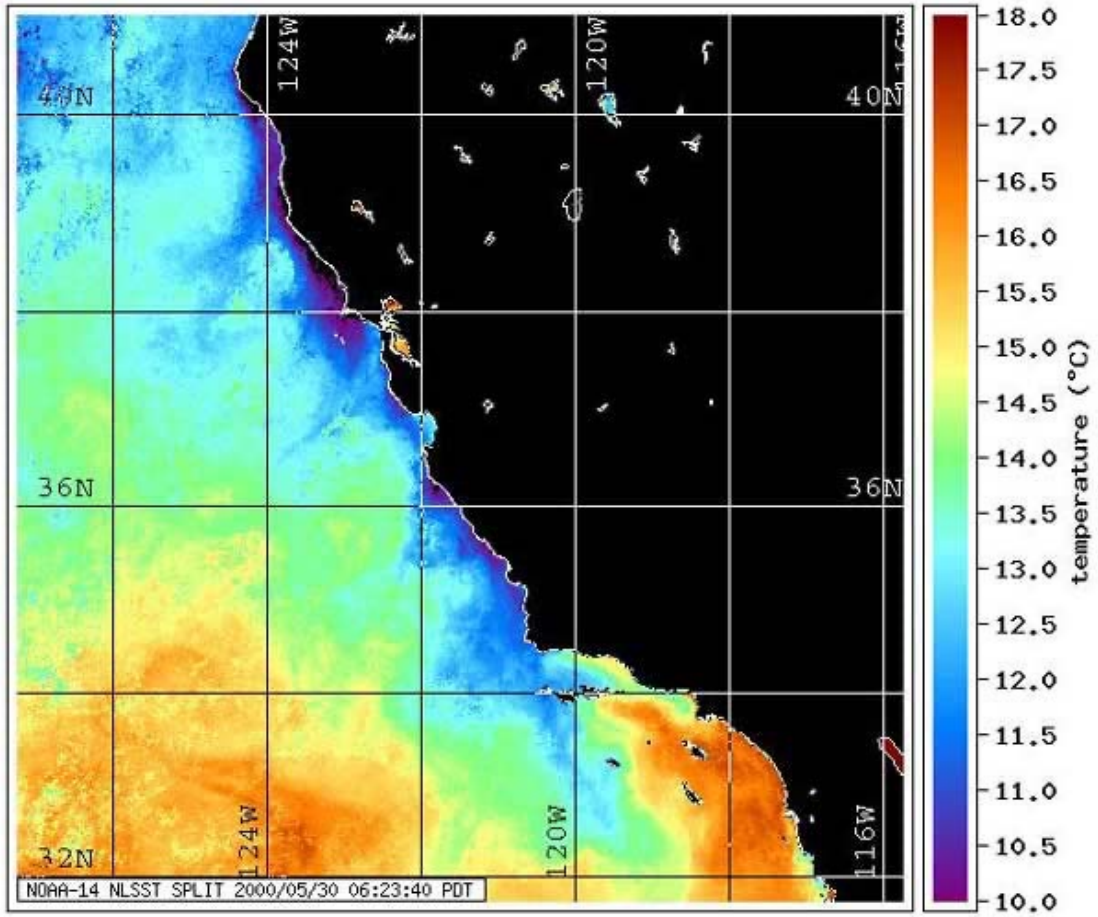
Habitat filters	**Traits of fishes**
Seasonality of flow, temperature extremes, barriers to movement	Life history, migration traits, thermal tolerance
Temperature extremes	Thermal tolerance
Water velocity, depth, substrate composition	Body size, spawning group
Water velocity	Body morphology

Adapted from Poff, JNABS 16: 391 (1997)

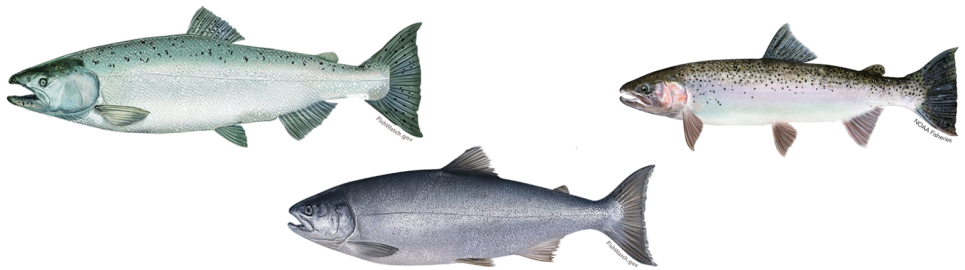


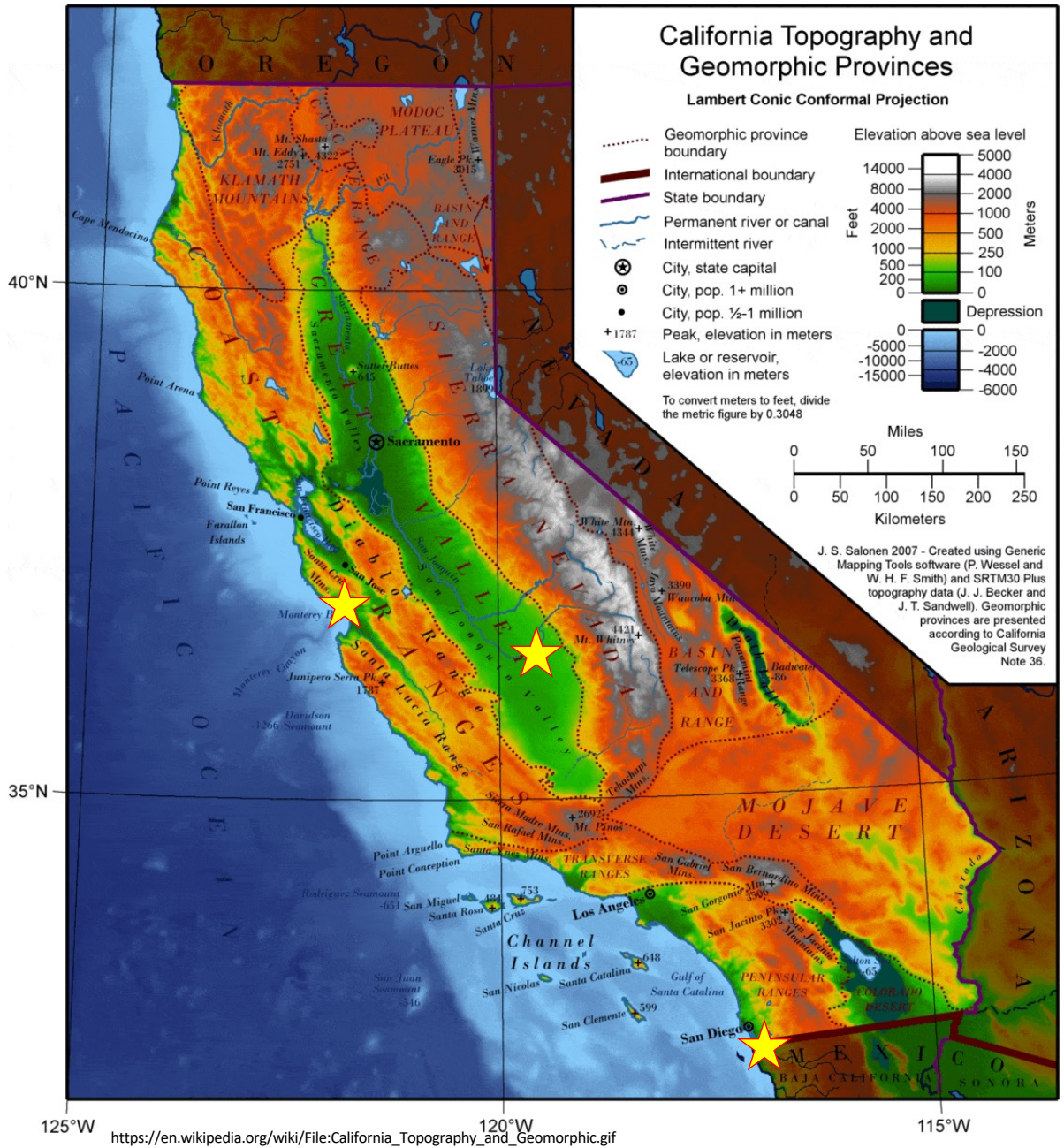
Adapted from Taylor and Taylor, Nature 265:415 (1977)

Oceanographic and geographic setting



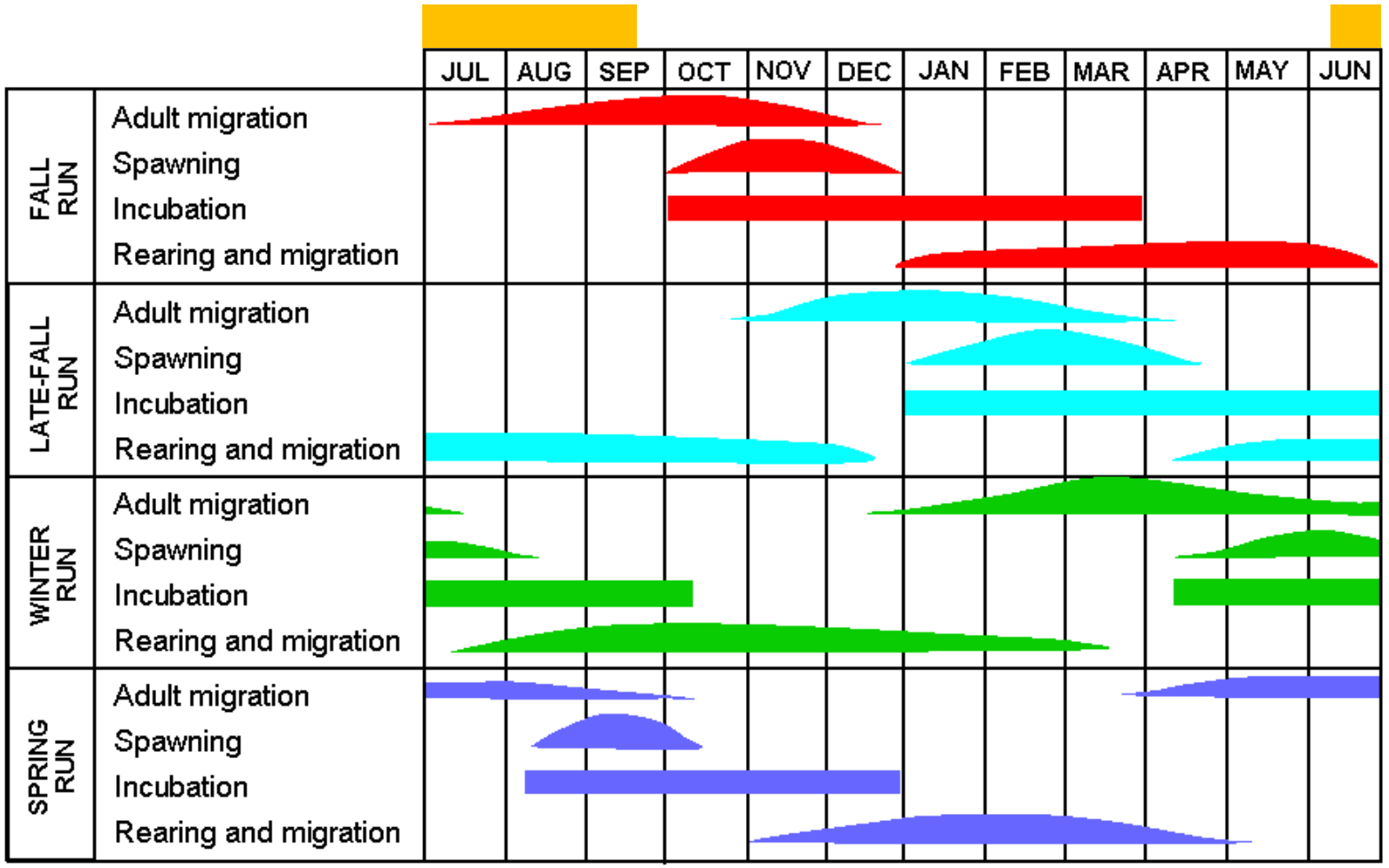
Sanctuary Quest 2002, NOAA/OER - https://oceanexplorer.noaa.gov/explorations/02quest/background/upwelling/media/Fig2_map.html





https://en.wikipedia.org/wiki/File:California_Topography_and_Geomorphic.gif

Life history diversity in CV Chinook salmon



Candidate

Endangered

Threatened

Redrawn from Vogel and Marine, 1991.

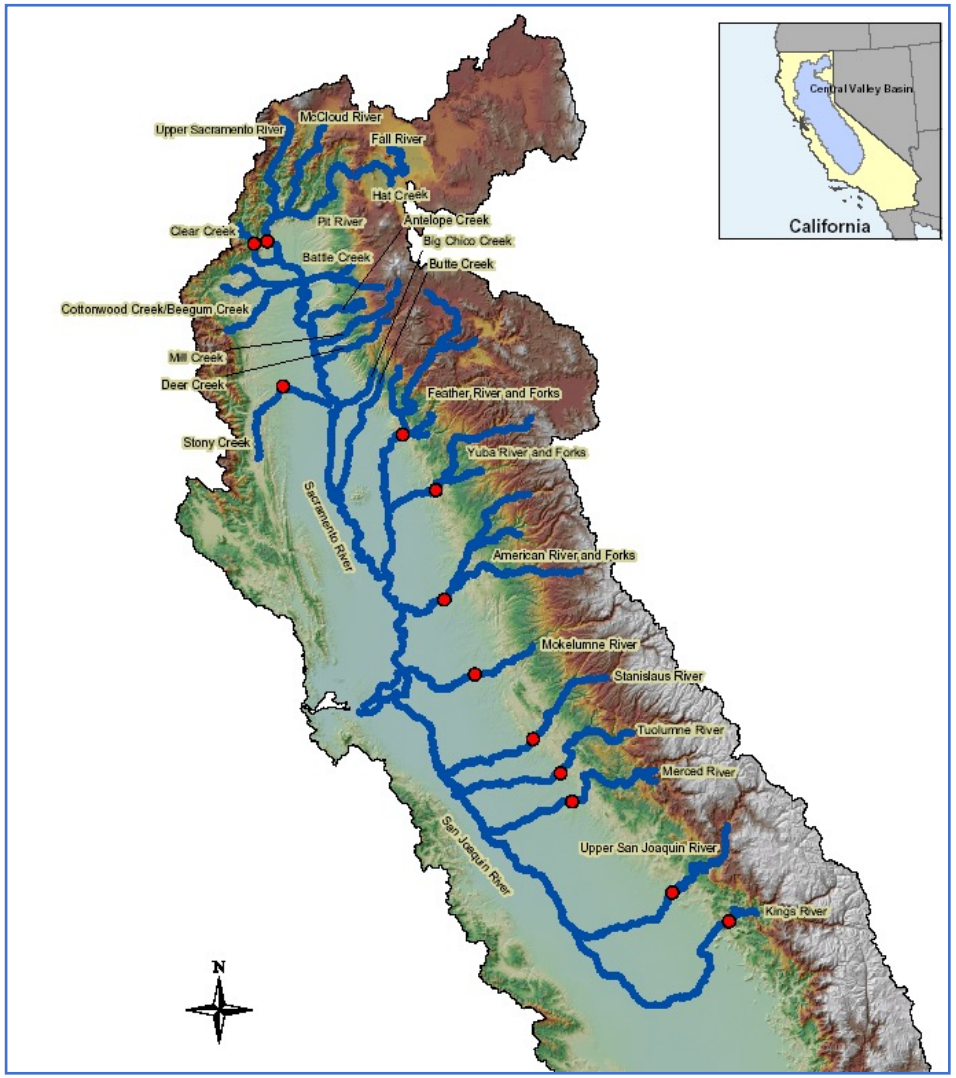
Population structure of Central Valley Chinook salmon ESUs

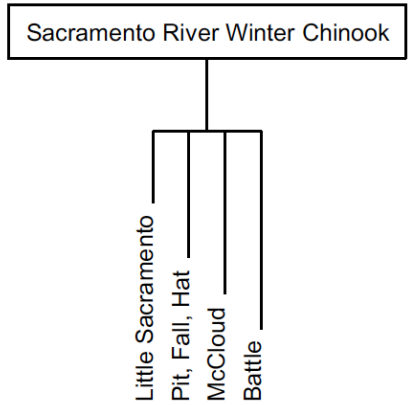
NOAA Technical Memorandum NMFS

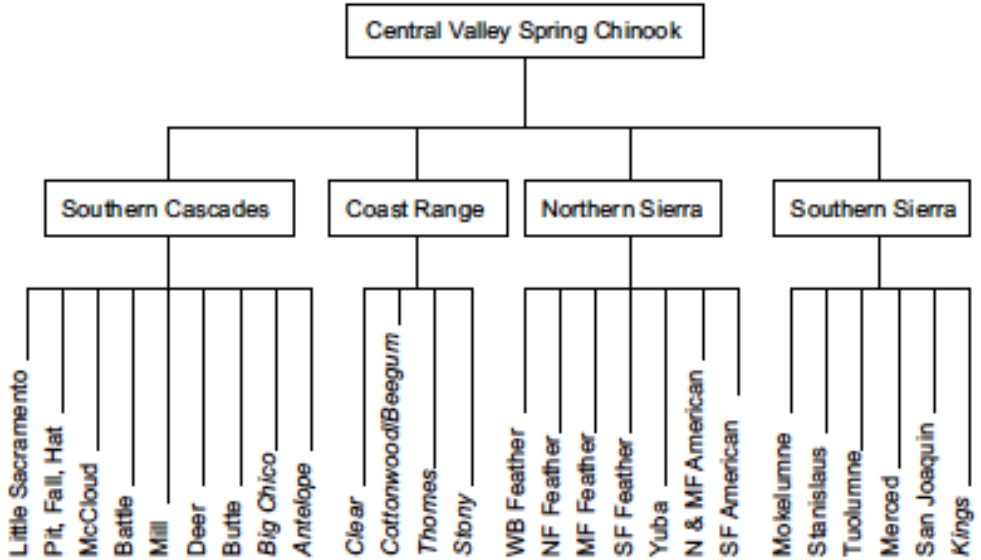
APRIL 2004

POPULATION STRUCTURE OF THREATENED AND ENDANGERED CHINOOK SALMON ESUs IN CALIFORNIA'S CENTRAL VALLEY BASIN

S. T. Lindley[1], R. Schick[1], B. P. May[2], J. J. Anderson[3], S. Greene[4], C. Hanson[5], A. Low[6], D. McEwan[6], R. B. MacFarlane[1], C. Swanson[7], and J. G. Williams[8]







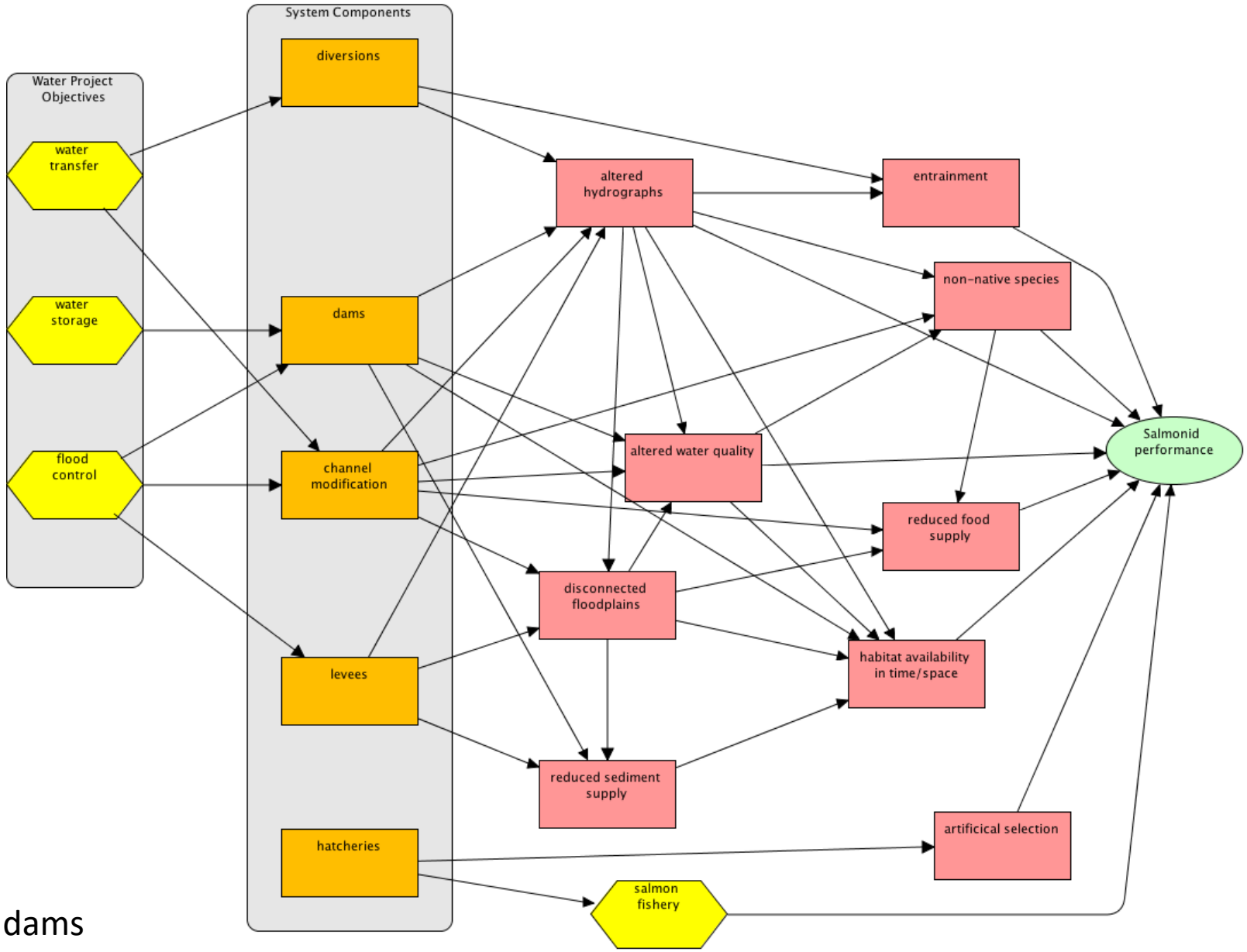
Current Status of CV ESUs: Winter-run Chinook

	Viability assessment		
	2010	2015	2020
Population Size	Low risk	Low risk	Low risk
Population Decline	Low risk	Moderate risk	Low risk
Catastrophe, rate, and effect	Low risk	Low risk	Low risk
Hatchery Influence	Low risk	Moderate risk	High risk

Current Status of CV ESUs: Spring-run Chinook

	Extinction risk		
	Viability assessment year		
Population	2010	2015	2020
Mill Creek	High	Moderate	High
Deer Creek	High	Moderate	High
Butte Creek	Low	Low	Low
Battle Creek	High	Moderate	High
Clear Creek	High	Moderate	High
Feather River Hatchery	High	High	High

How do the water projects affect salmon*?



* Below the impassable dams

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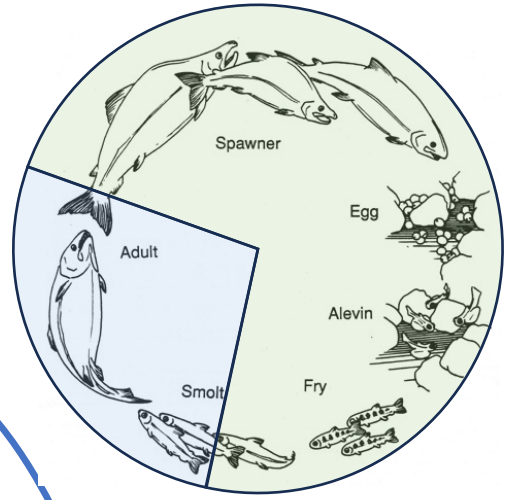

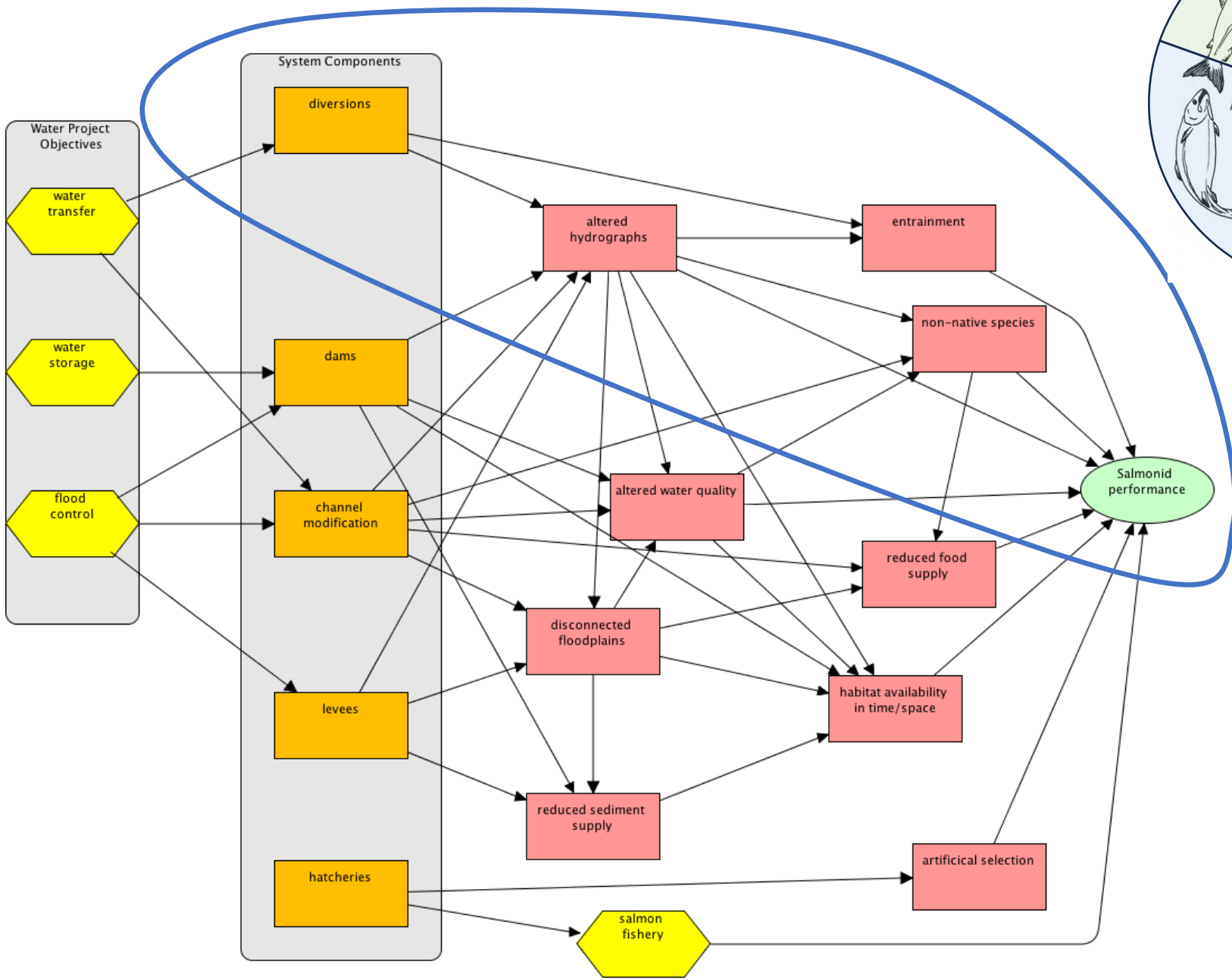

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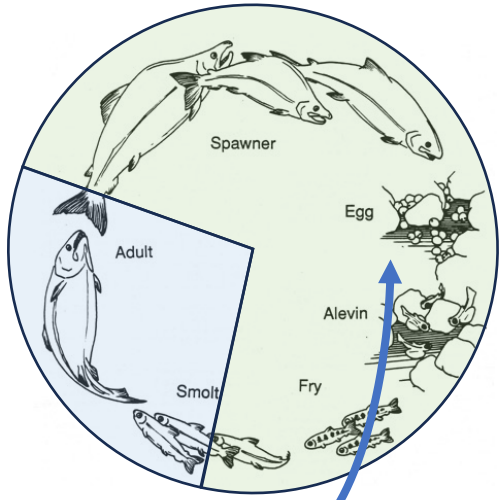
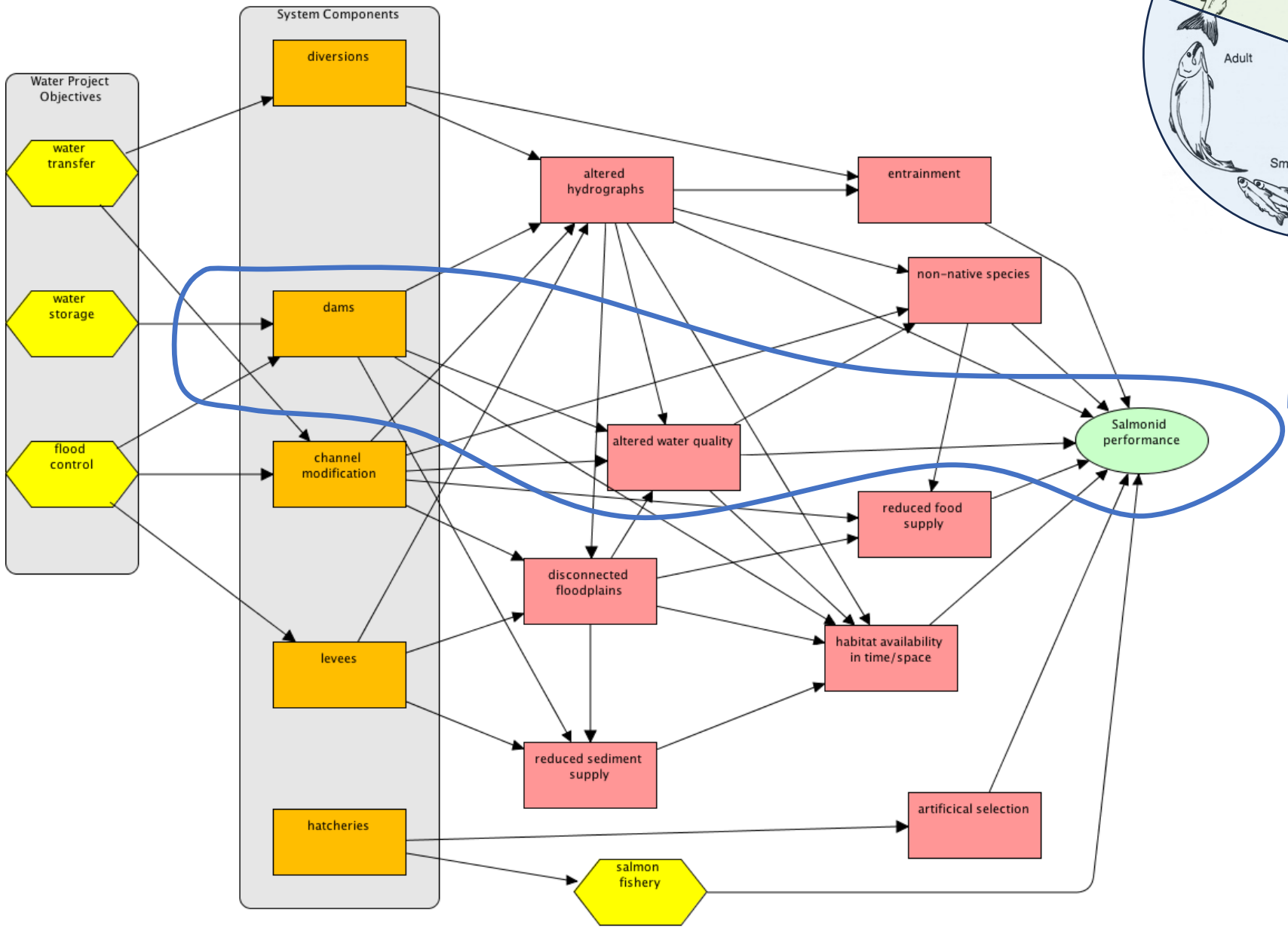




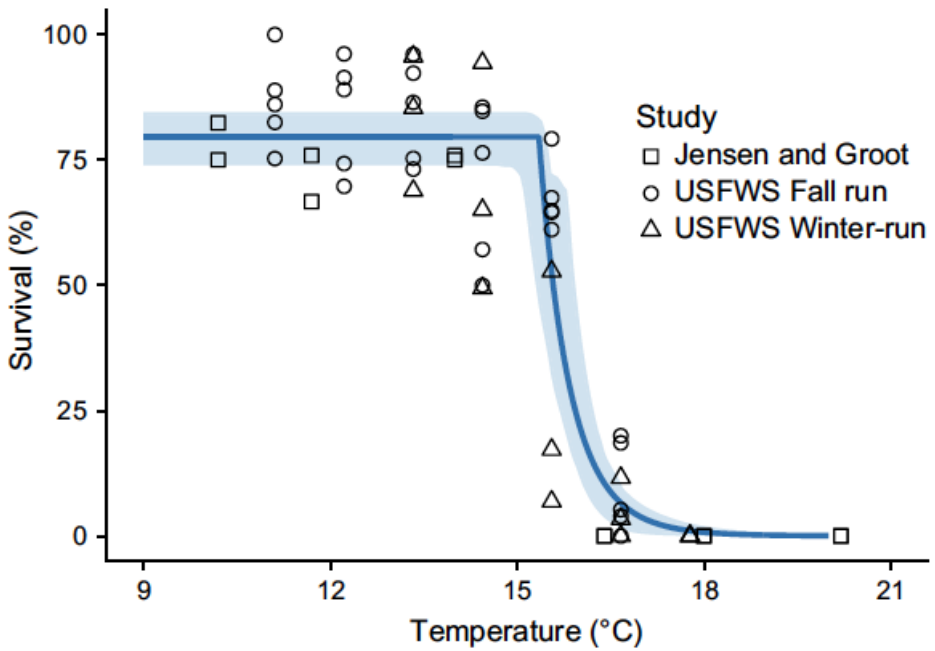
Temperature Dependent Egg Mortality

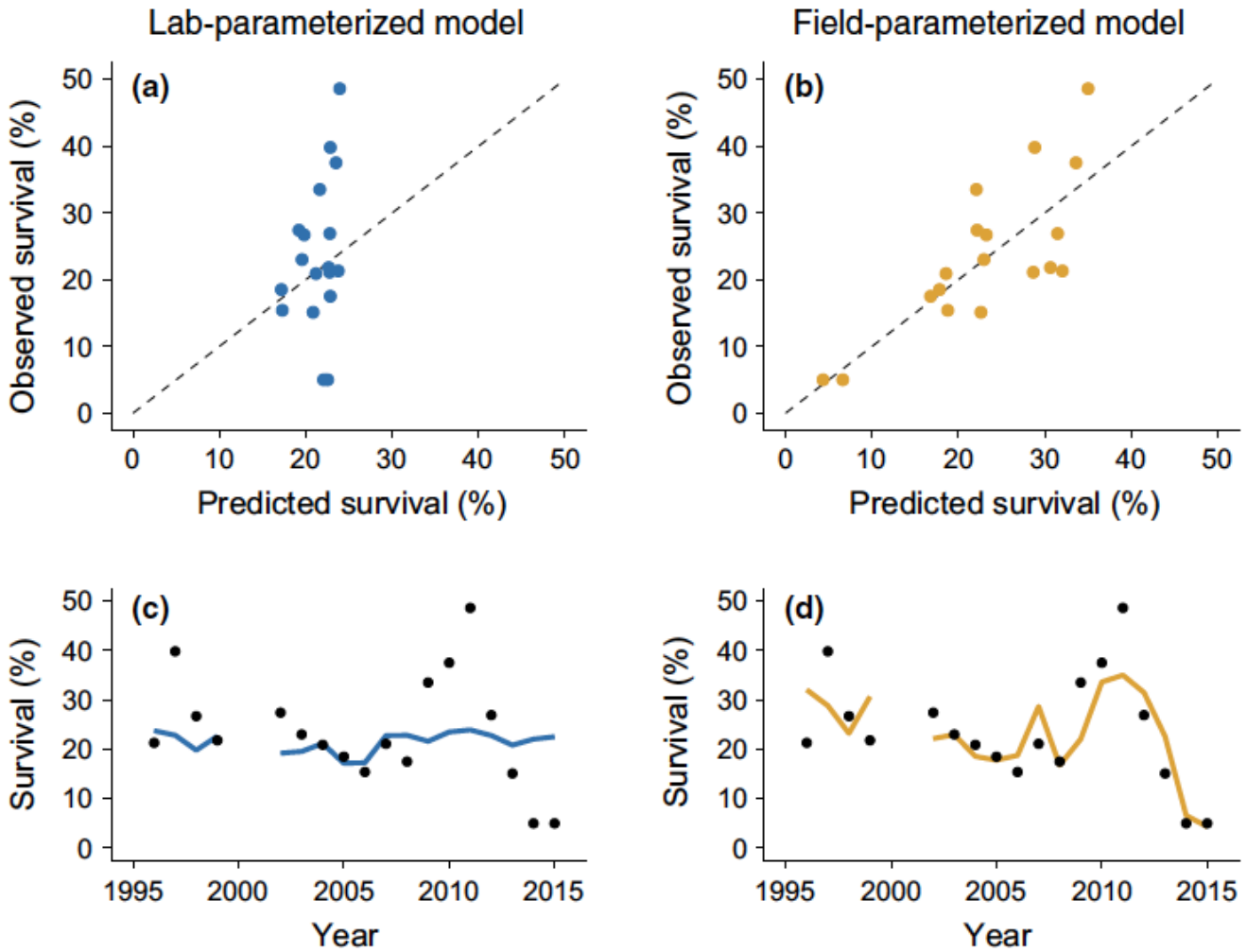
ECOLOGY LETTERS
Ecology Letters, (2017) **20**: 50–59 doi: 10.1111/ele.12705

LETTER

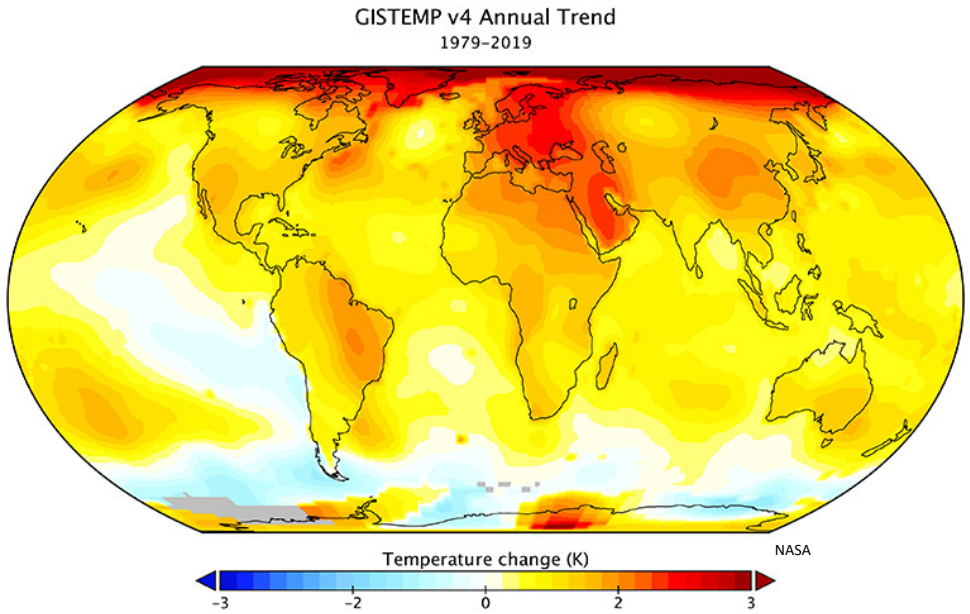
Phenomenological vs. biophysical models of thermal stress in aquatic eggs

Benjamin T. Martin,[1,2]* Andrew Pike,[1,2] Sara N. John,[1,2] Natnael Hamda,[1,2] Jason Roberts,[3] Steven T. Lindley[2] and Eric M. Danner[2]





Other stressors



NASA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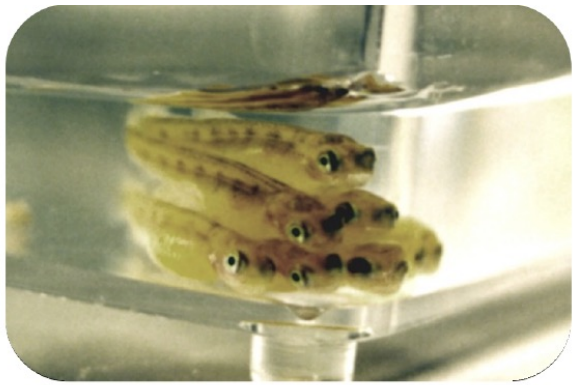
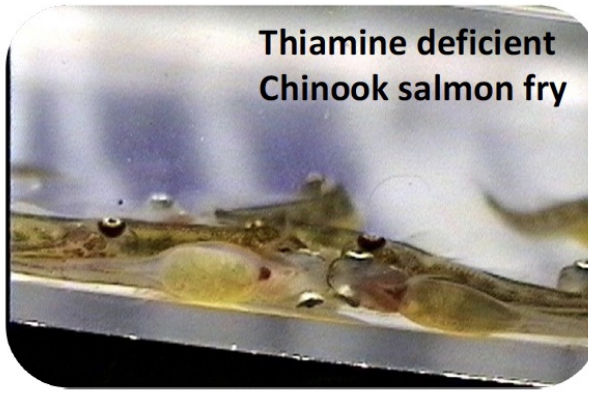
NOAA


USGS





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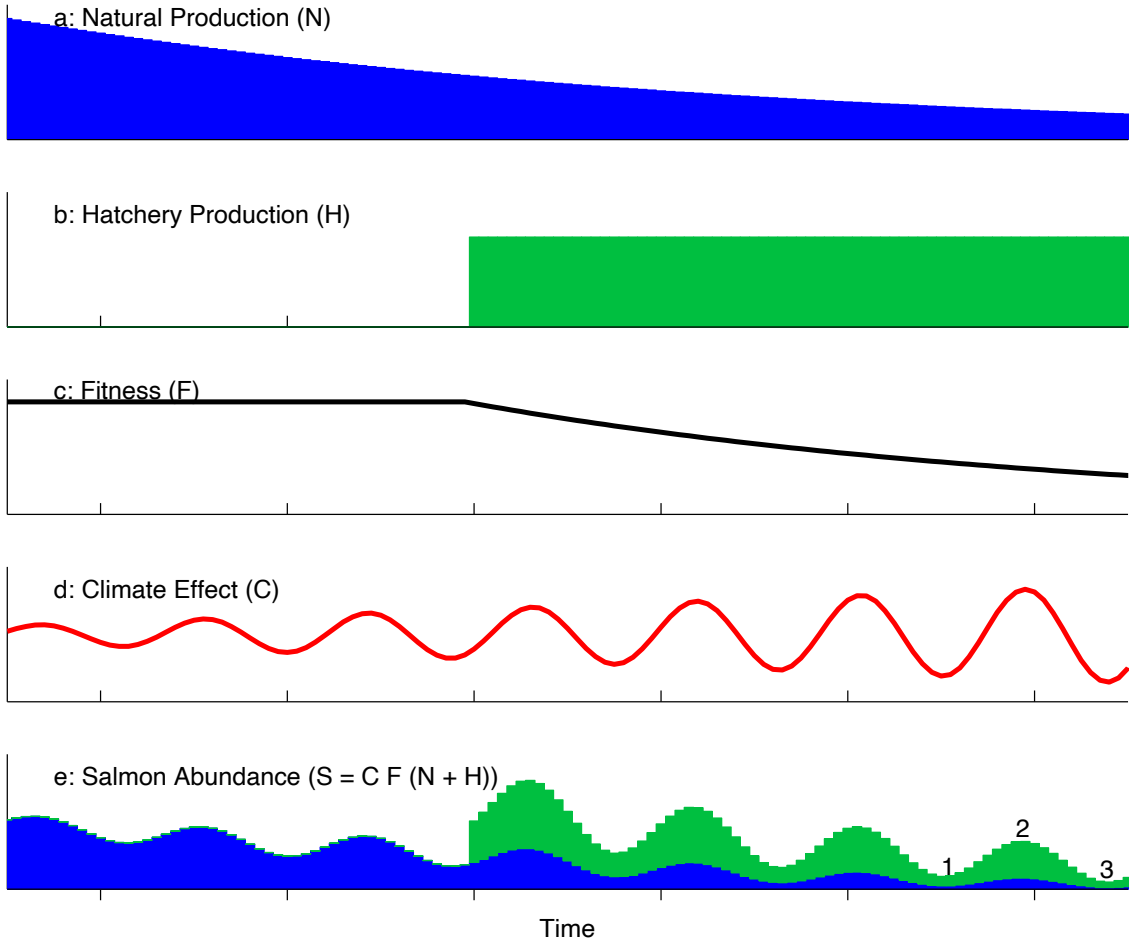
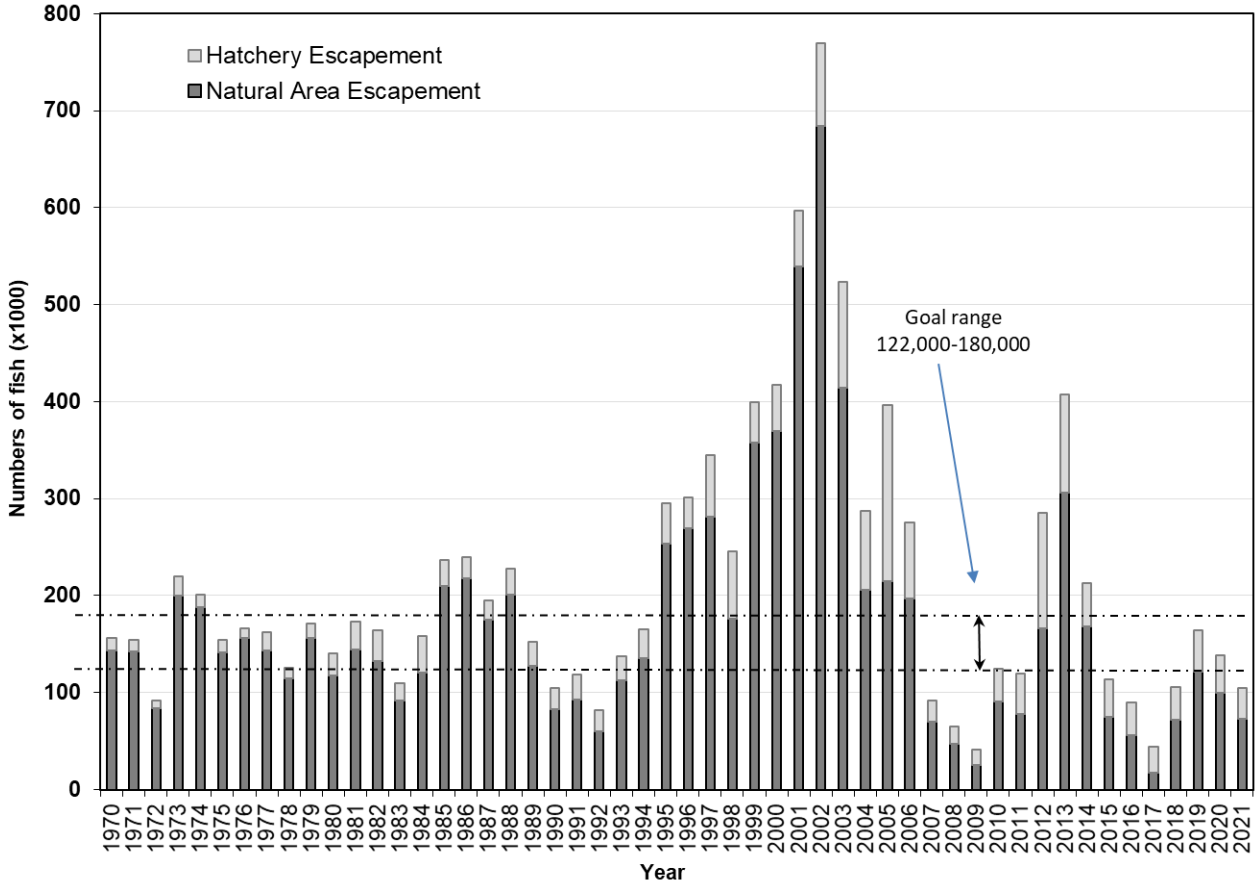
EPA

A conceptual model of salmon declines

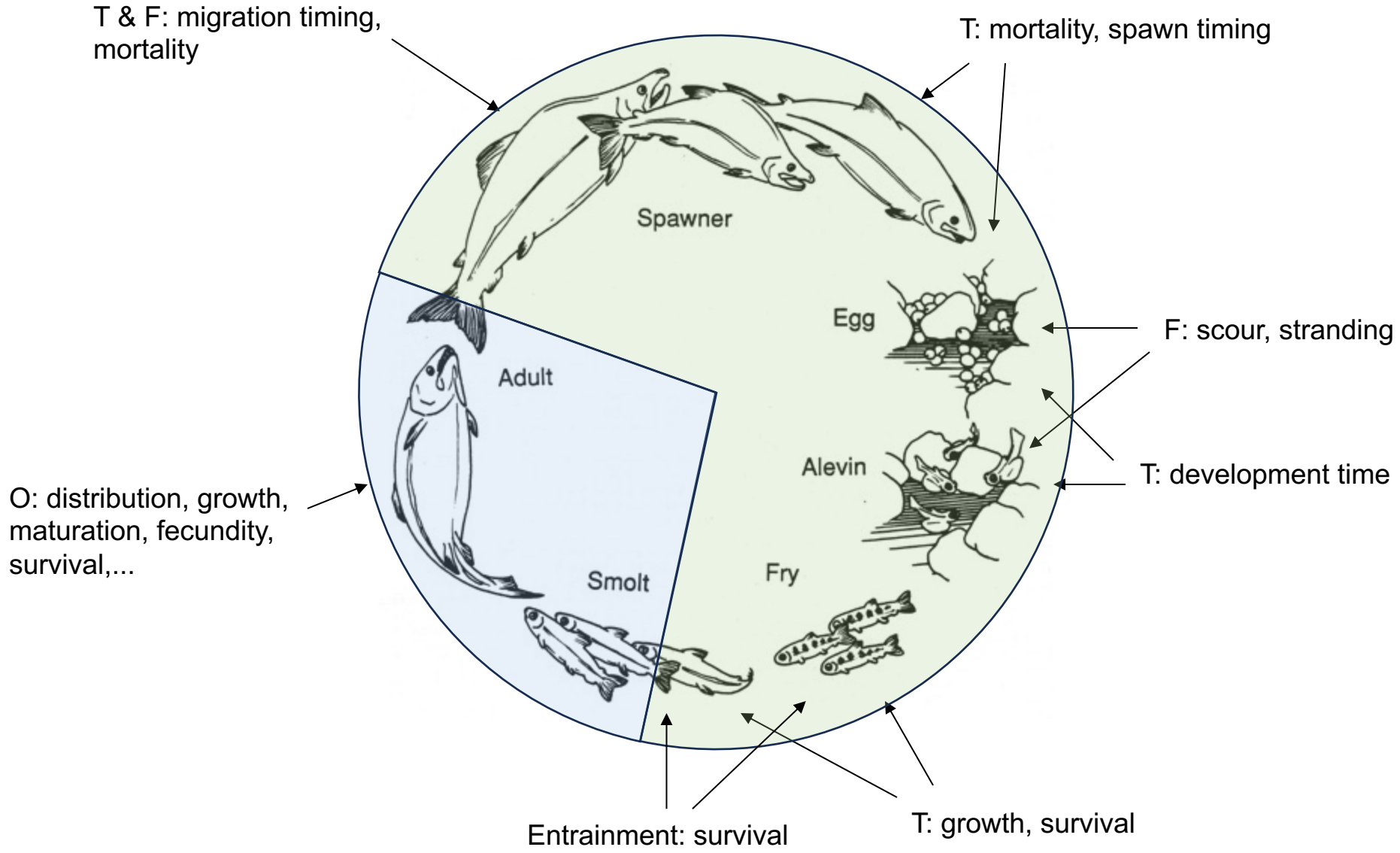




PFMC 2022

Summary:

- CV salmon are currently in poor shape
- Water project facilities and operations reduce the capacity of nature to produce salmon
- Multi-year droughts exacerbate the problems and challenges


T & F: migration timing, mortality
T: mortality, spawn timing
Spawner
Egg
F: scour, stranding
Alevin
T: development time
Adult
O: distribution, growth, maturation, fecundity, survival,...
Smolt
Fry
Entrainment: survival
T: growth, survival