

So, What Does Climate Change Mean for Fishes?

Larry R. Brown

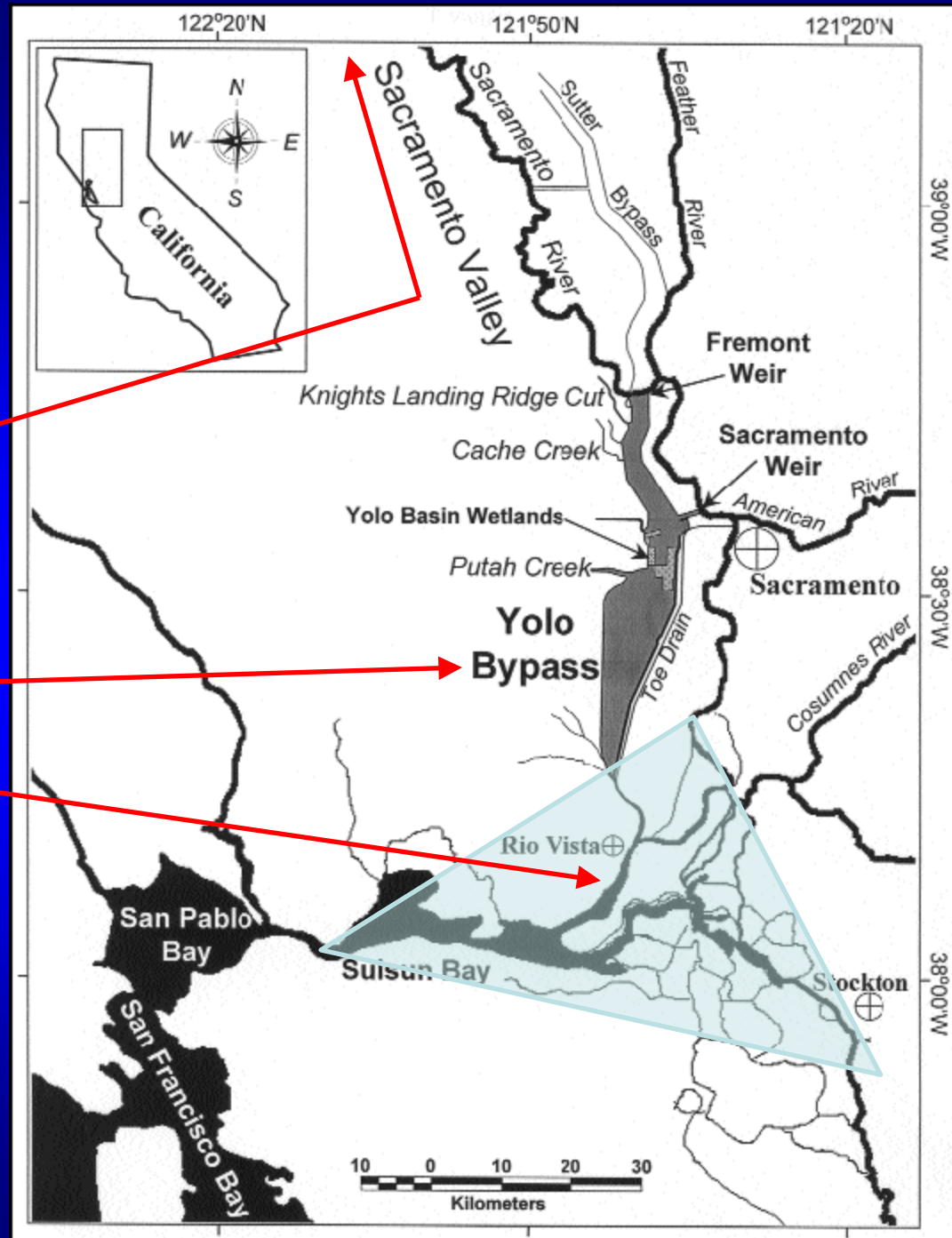
U.S. Geological Survey,
California Water Science Center

Funded by CALFED Science Program
USGS Ecosystems Studies

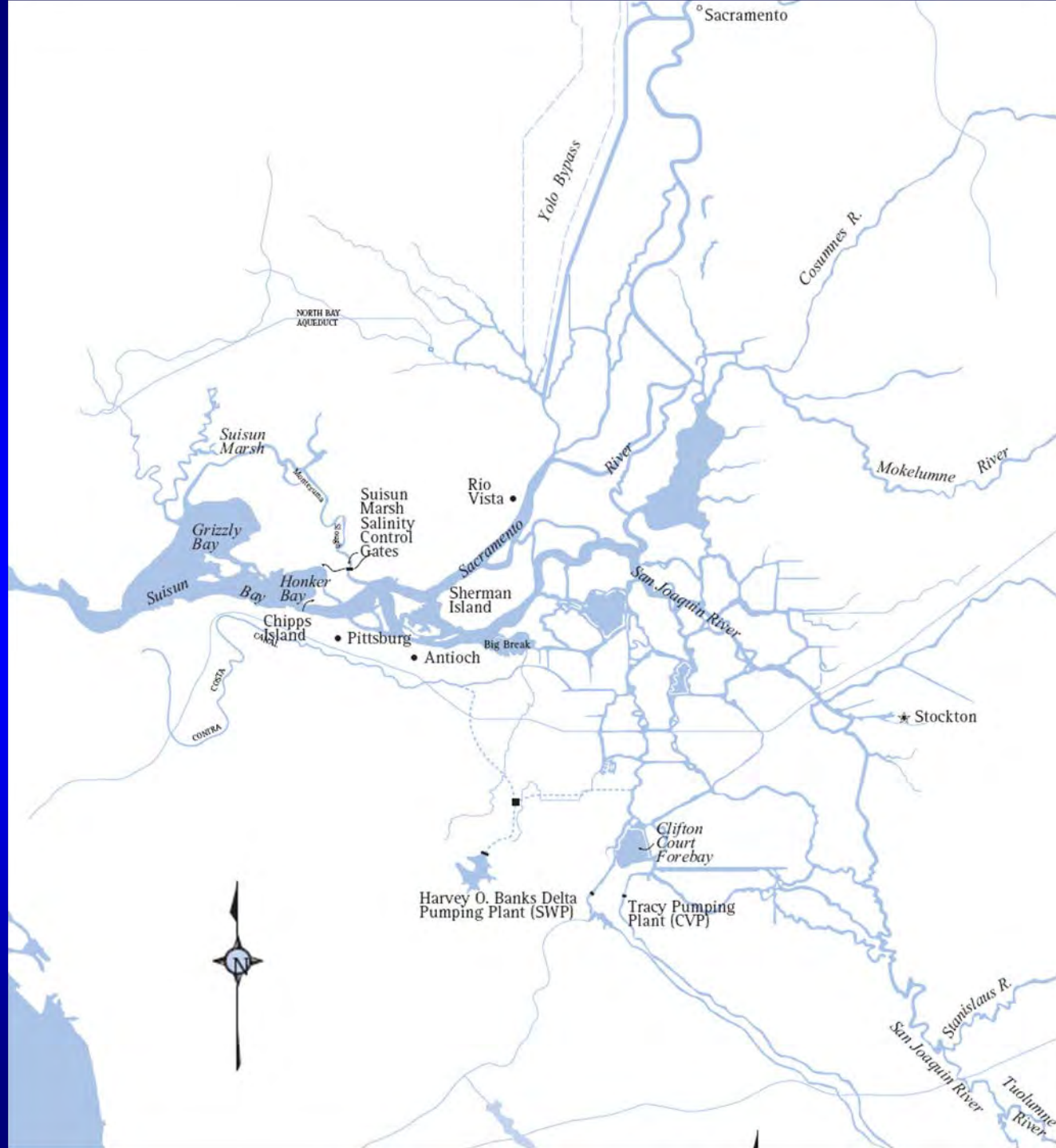


Three Examples:

- Migrant: Winter-run Chinook Salmon
- Floodplains: Sacramento Splittail
- Delta: Delta Smelt



Delta:
Delta
Smelt is a
true delta
species

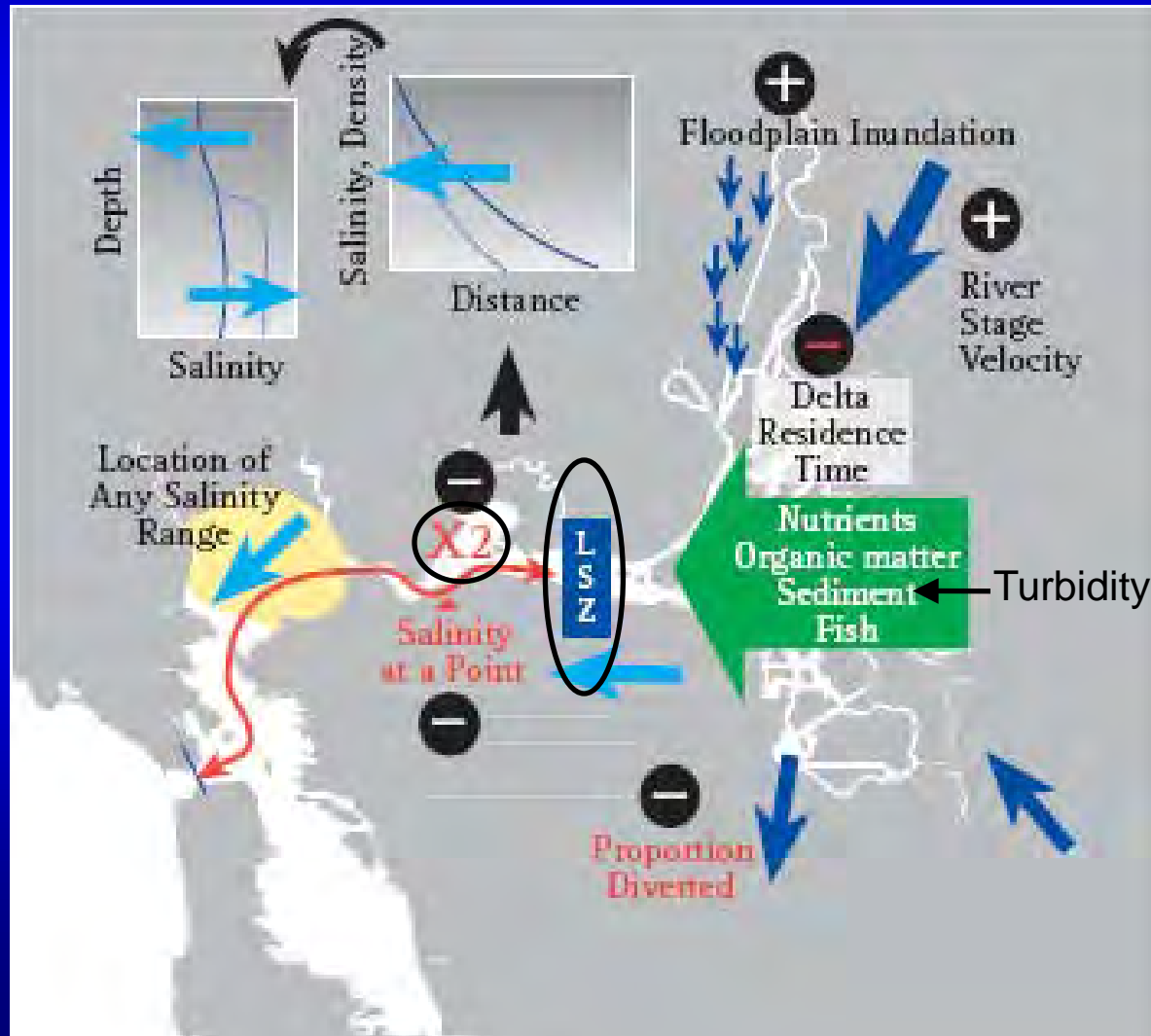


Delta smelt

- State listed as endangered
- Federal threatened: endangered
"warranted but precluded"

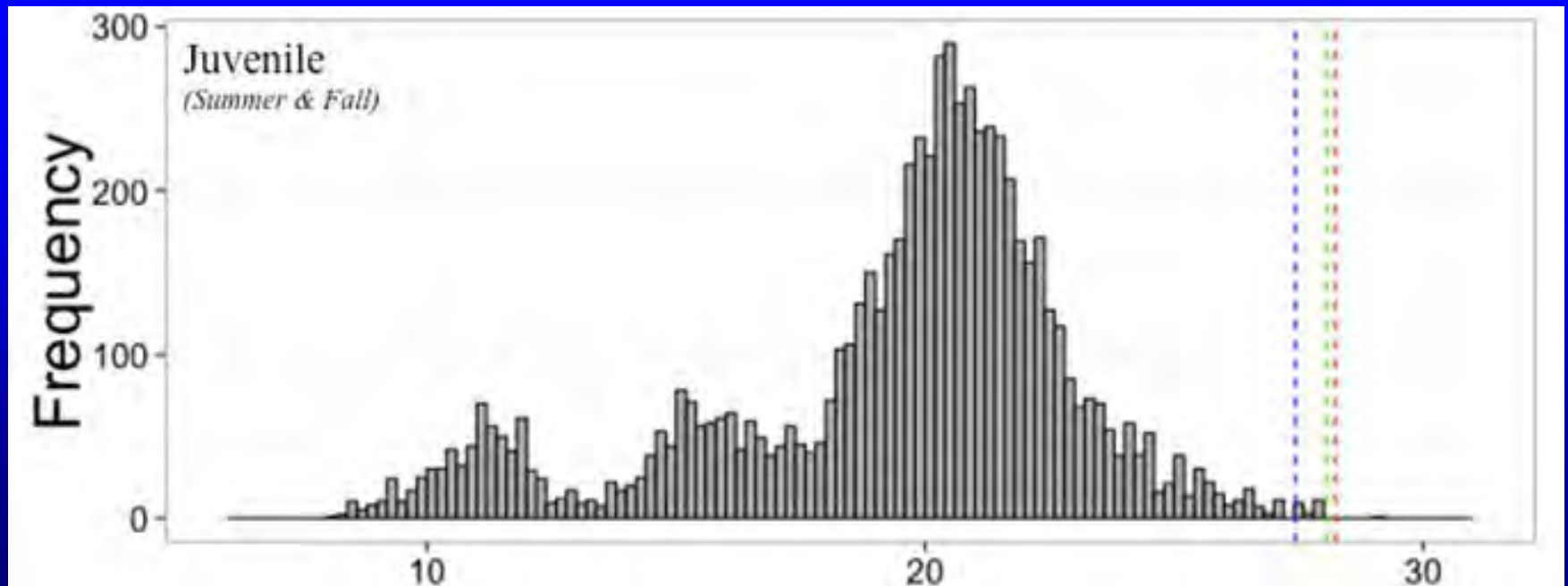


Important physical aspects of Delta Smelt habitat include salinity, turbidity, and temperature



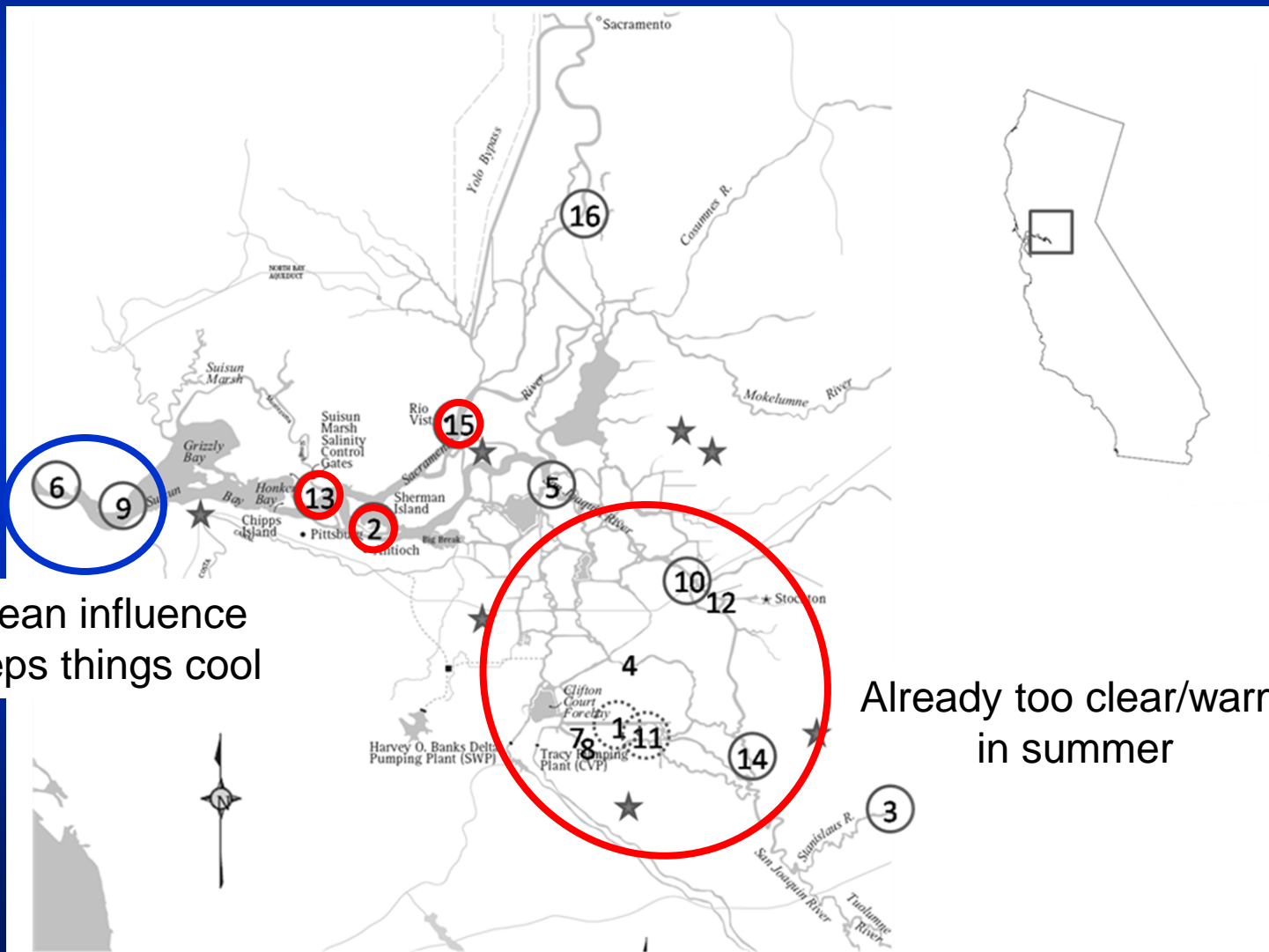
Delta Smelt and Water Temperature

- Studies indicate lethal temperatures from 25°C to 29°C (Swanson et al. 2000, Komoroske et al. in press)
 - Depends on life stage
 - Depends on acclimation temperature
- Avoid water temperatures > 25°C



Models were developed by Wagner et al. (2011)

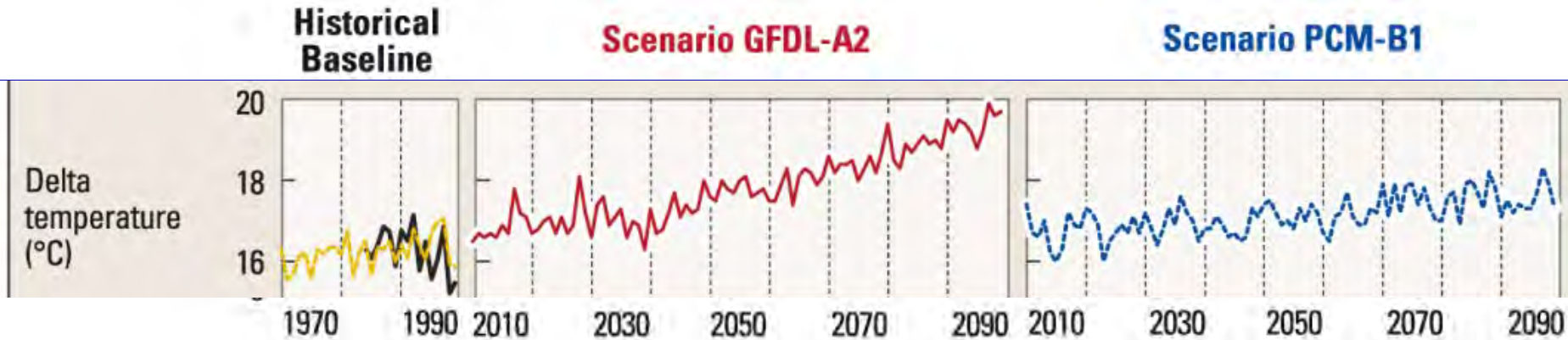
WT = WT day before, air temperature, insolation



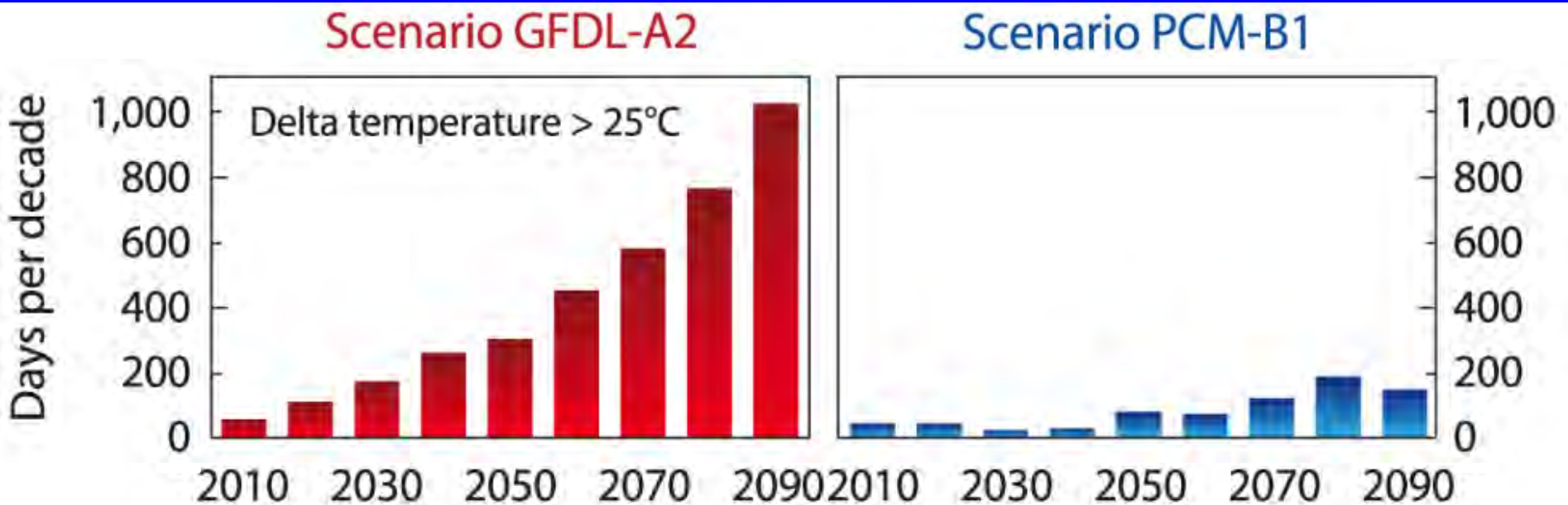
Ocean influence
Keeps things cool

Already too clear/warm
in summer

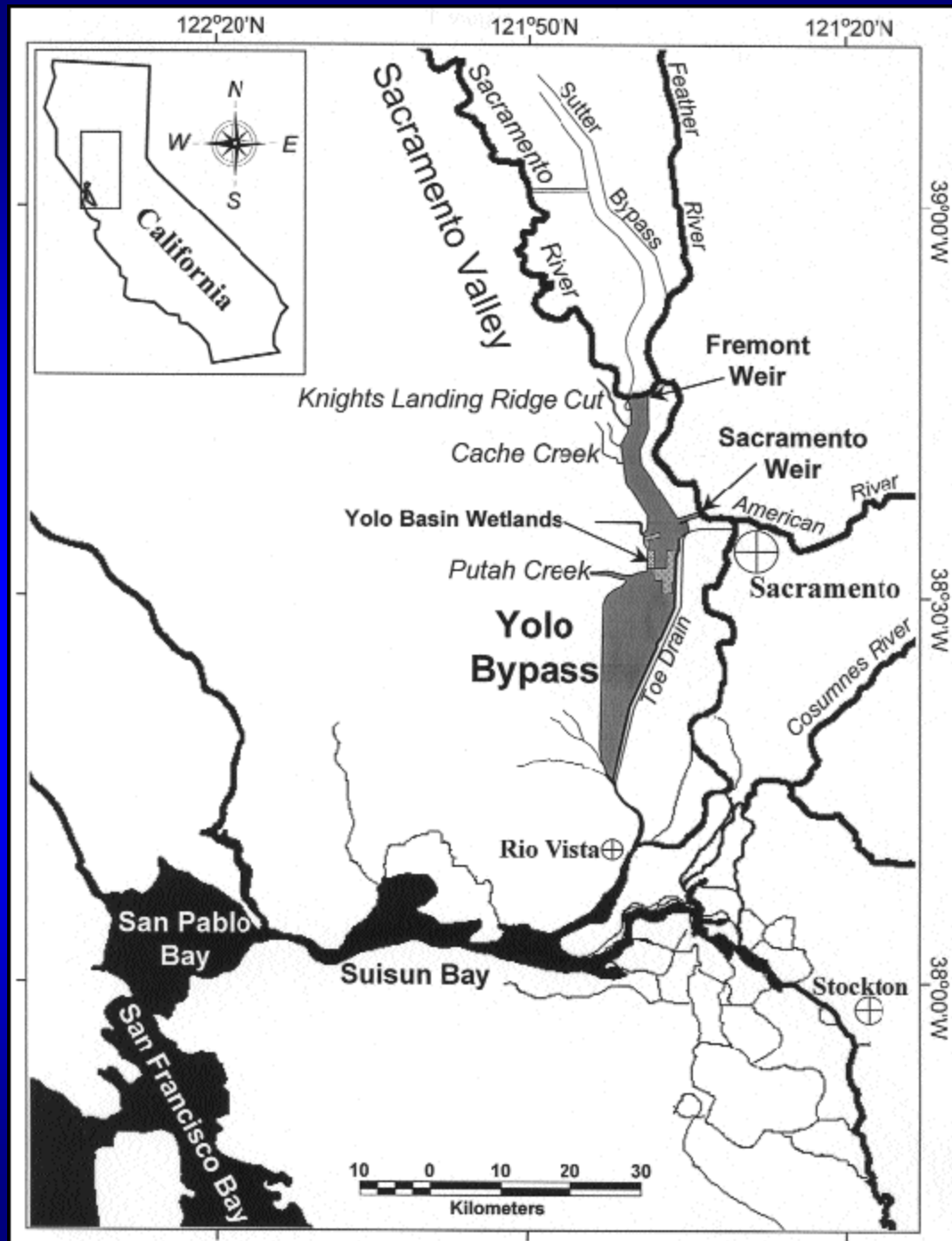
Significant increasing trends in annual average water temperature



Significant increasing trends in potentially lethal conditions



Floodplains: Sacramento Splittail in Yolo Bypass



Sacramento splittail

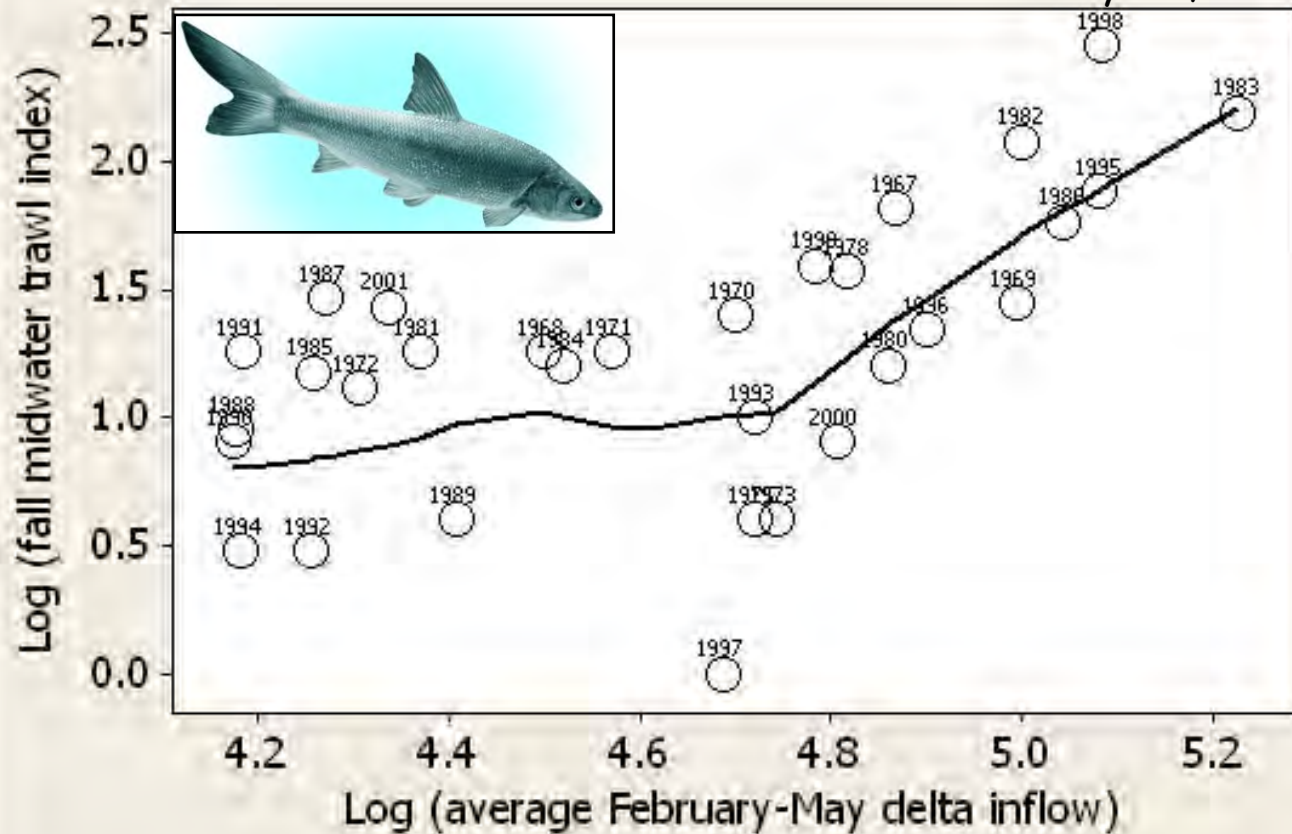
- State species of special concern
- Large minnow
- Tolerant of salinity



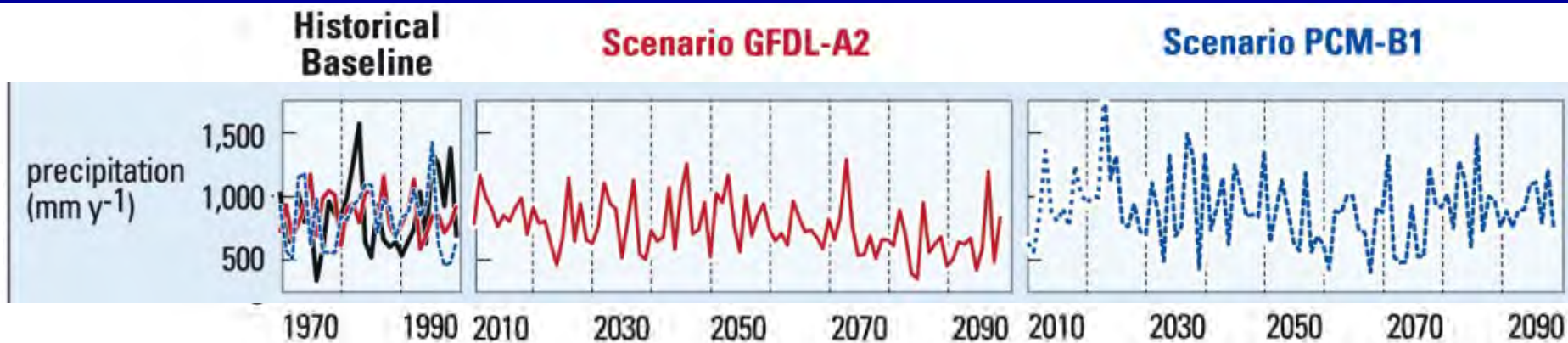
Sacramento Splittail

- Dependent on floodplain for spawning
- Yolo Bypass flooding a major contributor to "good" splittail years
- Approximately 30 days needed for spawning and production of juveniles
- "Flood" defined as flows $> 4,000$ cfs
- Determine timing and duration of floods

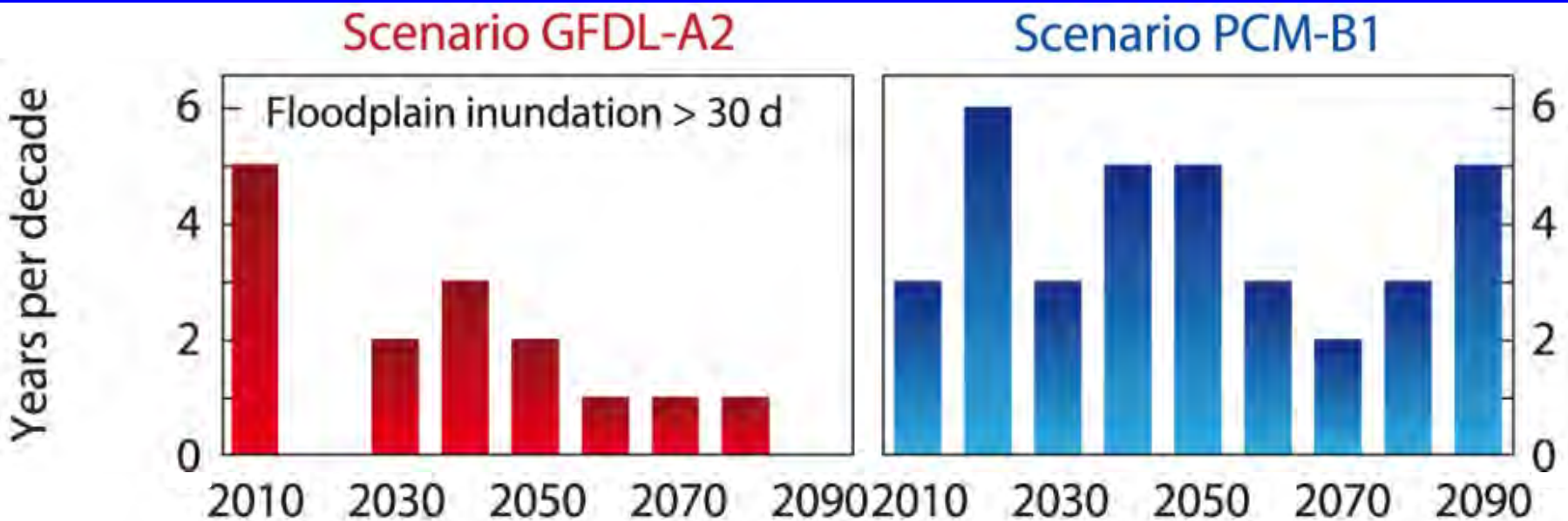
Source: Fred Feyrer, USBR



Significant decline in precipitation only in warmer scenario



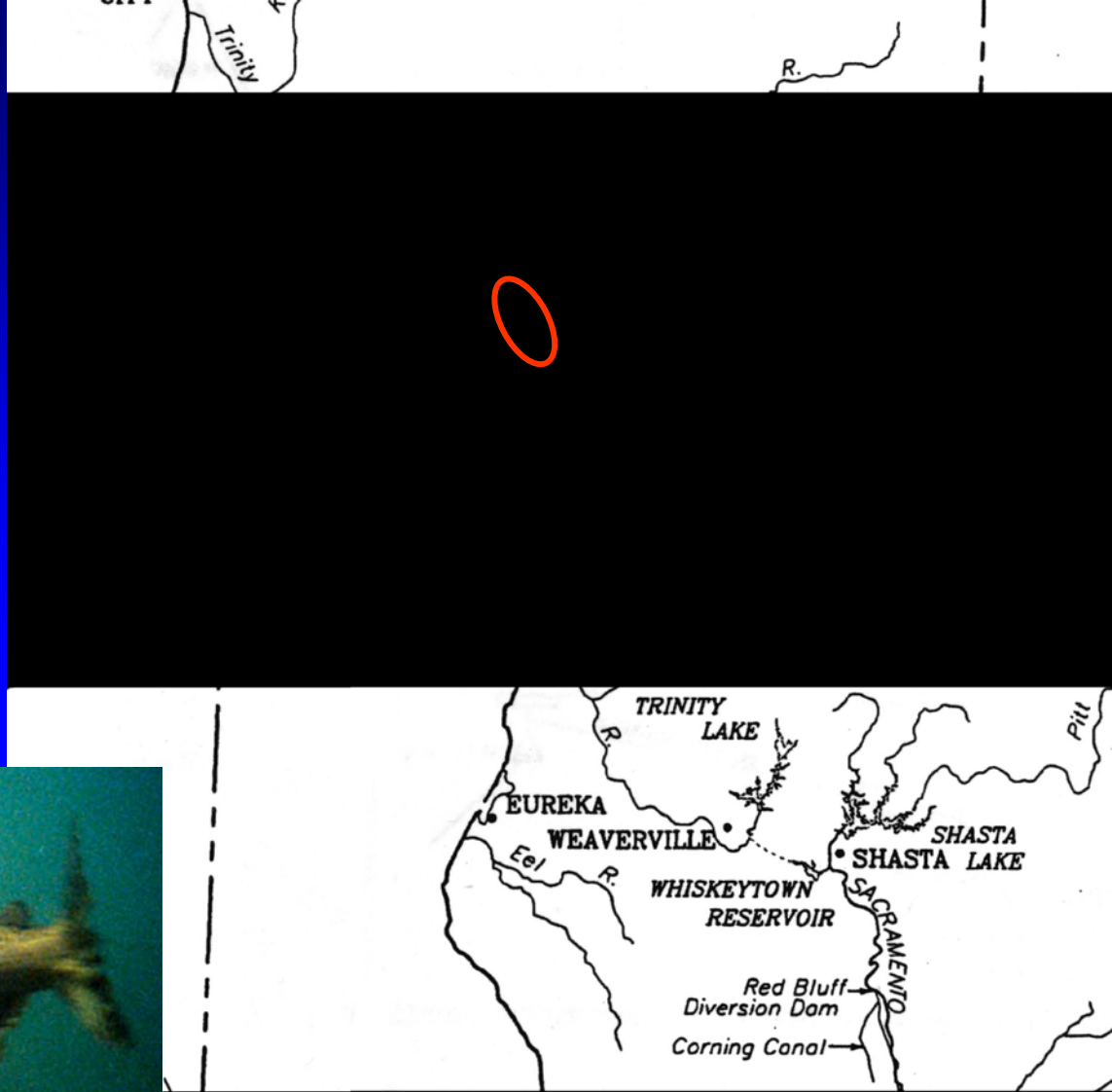
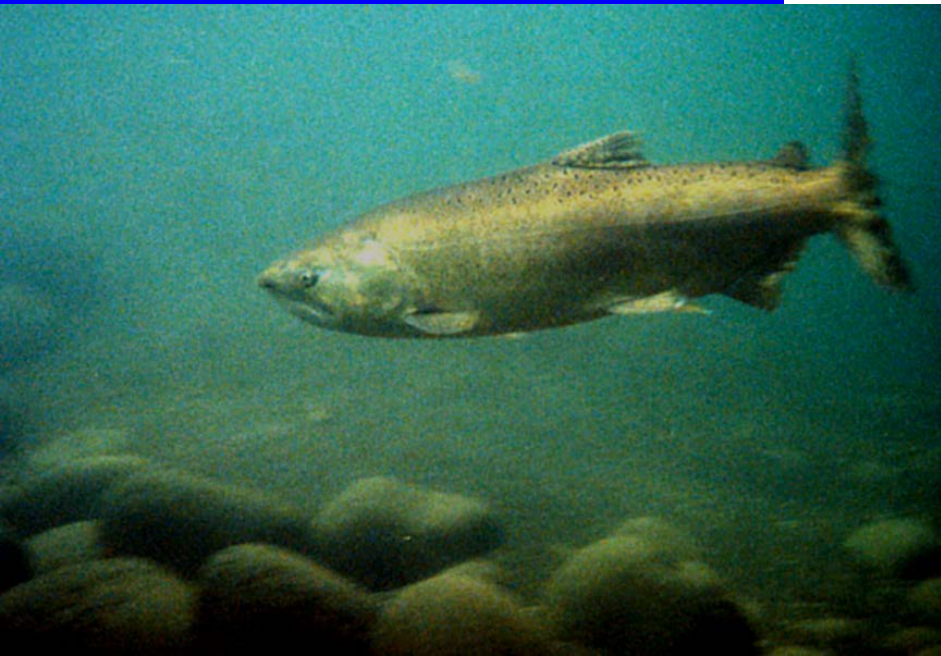
Significant decline in Yolo Bypass flooding only in warmer scenario



Splittail Results

- Sustained flooding of Yolo Bypass becomes less common in more extreme scenario
- Implies less flooding in entire system so reduced Splittail spawning habitat

Winter-run Chinook Salmon (endangered)

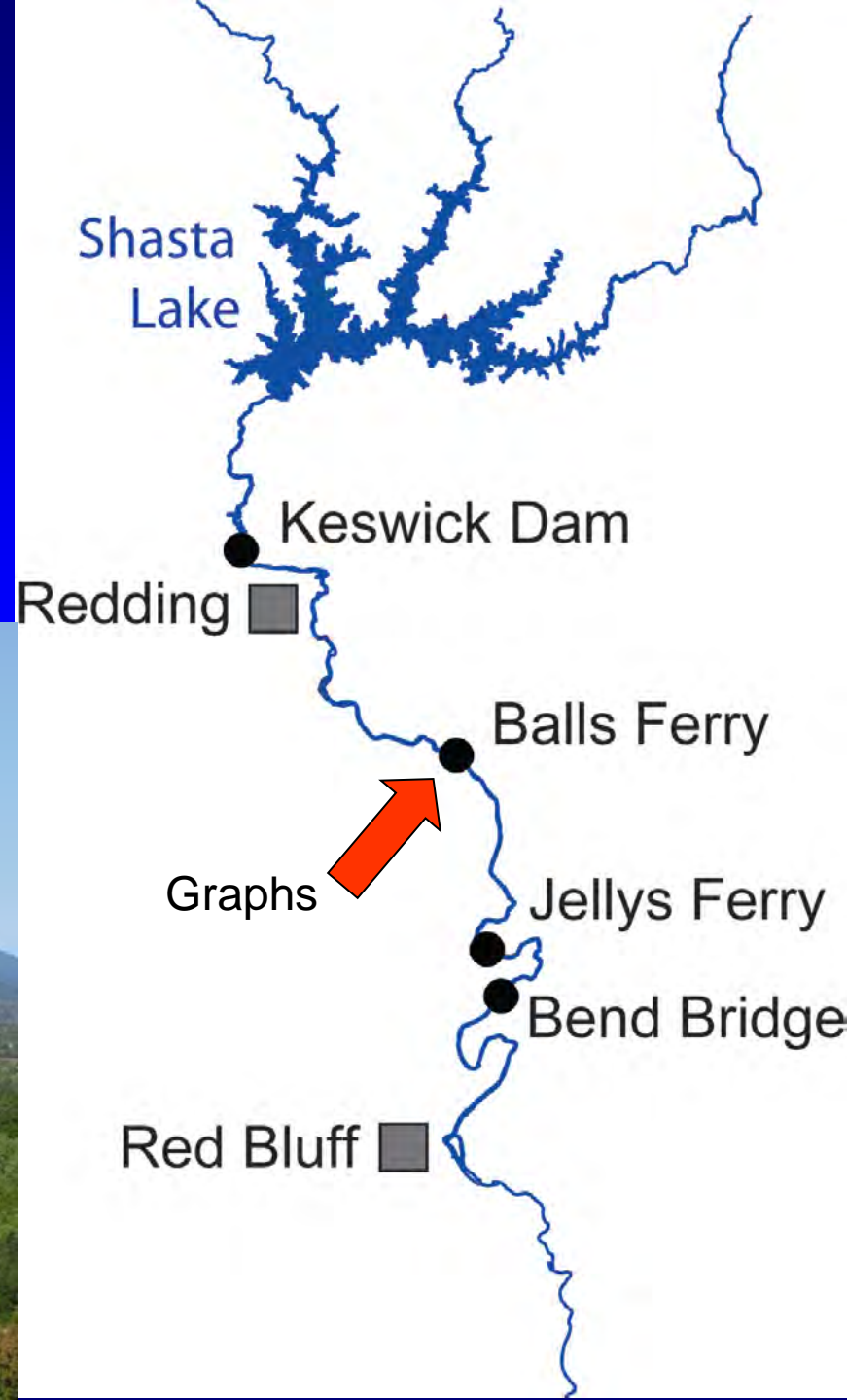


Winter-run Chinook salmon egg and pre-emergent fry survival

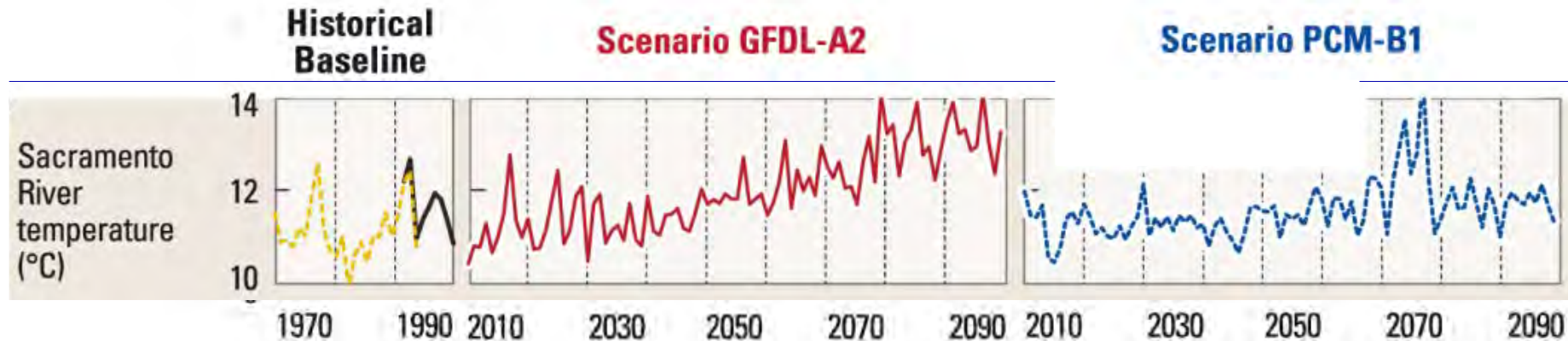
- Effect of temperature:
 - 13.3°C (56°F), 100% survival
 - 15.5°C (60°F), 20% egg survival, 50% pre-emergent fry survival = 10% total survival
 - >16.0°C (61°F), little if any survival
- Time period for presentation May-October

Chinook	J	J	A	S	O	N	D	J	F	M	A	M
Winter	Spawning						Adult migration					
		Emergence										
				Outmigration								

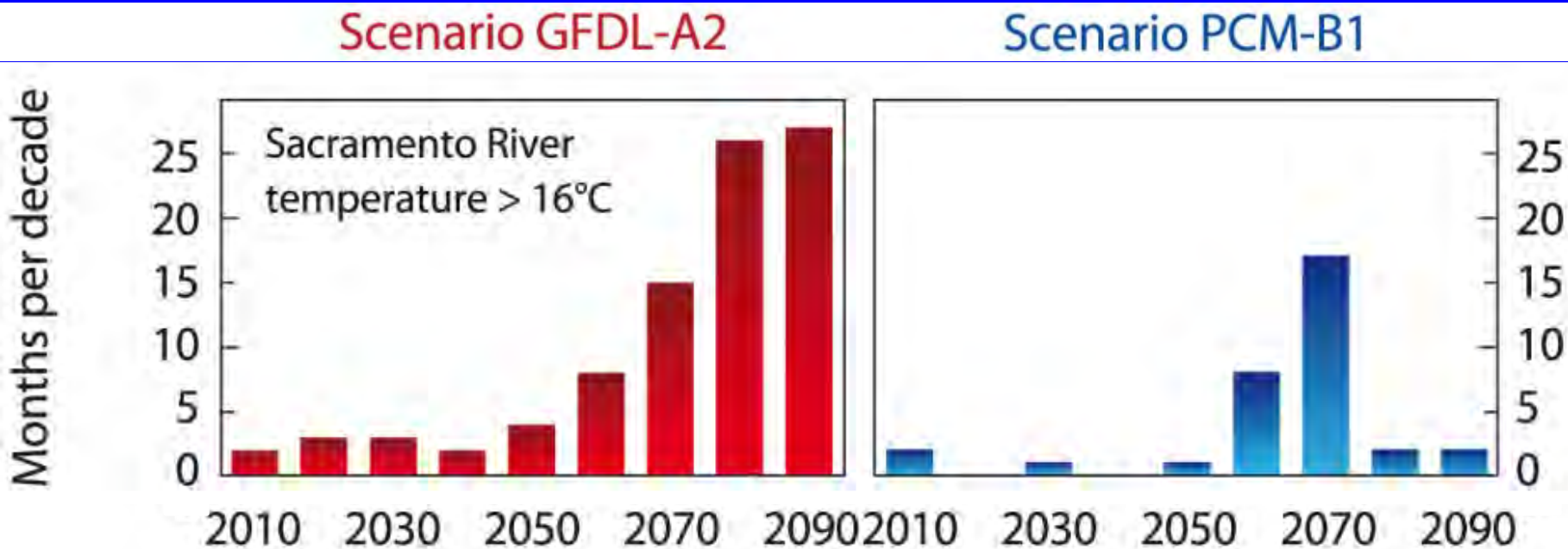
Temperature
monitoring points
covering the majority
of spawning habitat



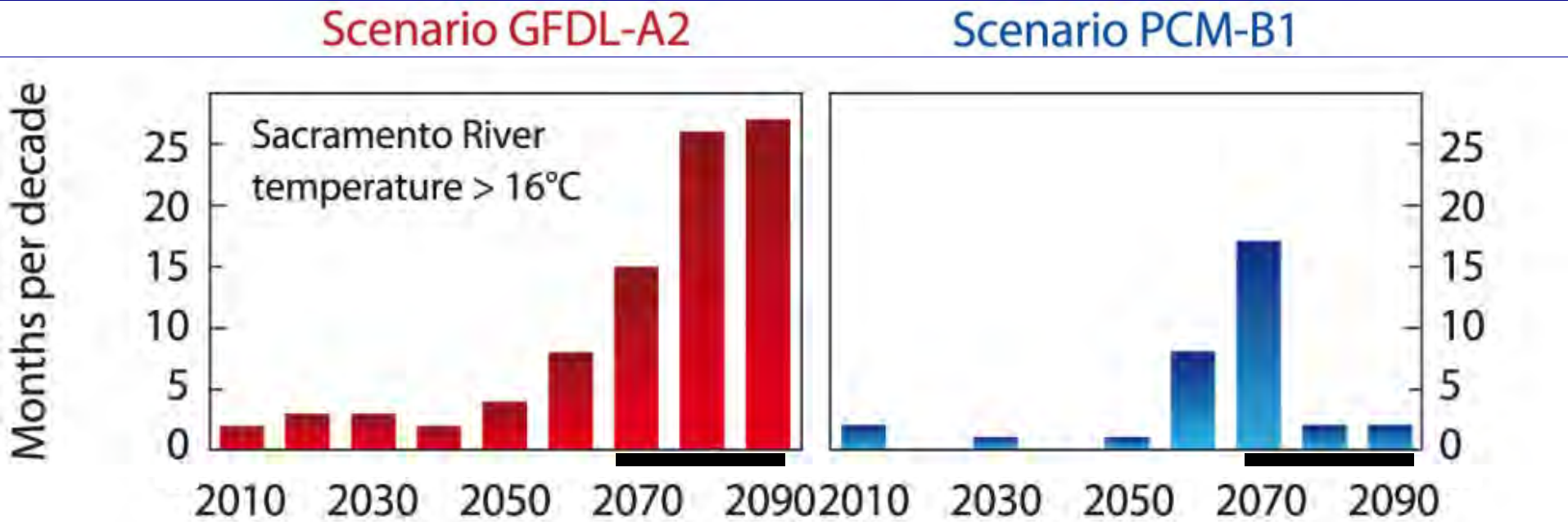
Significant increasing trends in water temperature



Significant increasing trends in lethal conditions



Significant increasing trends in lethal conditions



Poor survival in Aug, Sep, and Oct of most years

Poor survival in Sep and Oct of about 40% of years

- Management of winter-run Chinook salmon will become more challenging as climate warms

This is a really depressing talk!



But...we need to think about
these issues!



REMEMBER these are scenarios NOT predictions!

- Please do not leave thinking any of these species are doomed
- Many modeling assumptions
- Models can be improved and management strategies evaluated (CASCaDE II)