The Science Behind Climate Change Impacts: Bivalves

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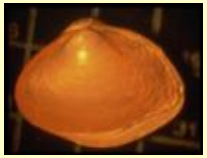
We have two important bivalve species in the system with a third species lurking in nearby reservoirs. All are important for ecosystem function.

We will mostly concentrate on the ones we have now with some exceptions.



Potamocorbula

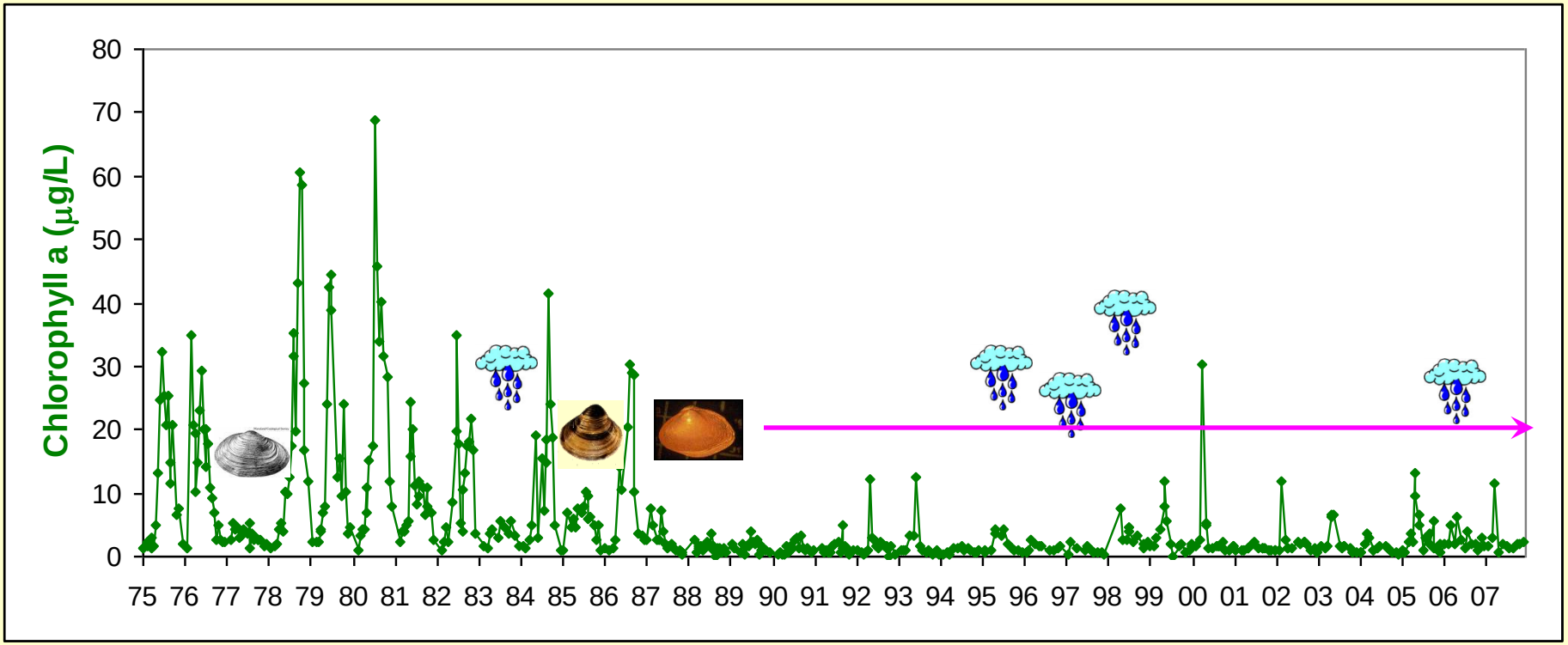
Corbicula

We hope to never see it!

NOAA

Quagga

How important are bivalves in the system? Critical to phytoplankton biomass– what's new is persistence and resilience of one species.



Data from DWR/IEP EMP, DFW, USGS

How important are bivalves in the system? Critical if you are a Se sensitive animal.

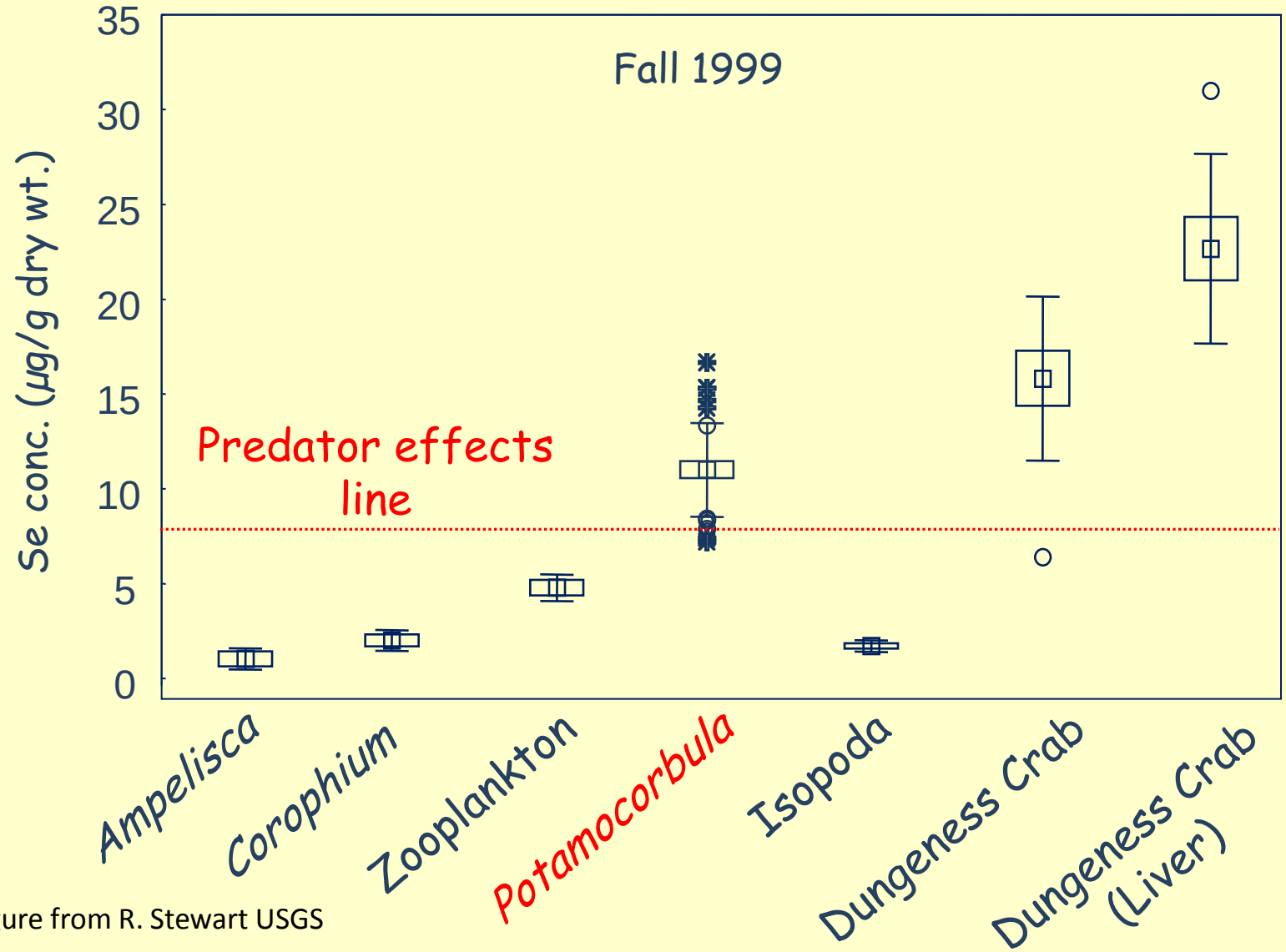


Figure from R. Stewart USGS

A bivalves response to climate change is based on their lack of mobility, their mode of reproduction, and their life history/physiological characteristics.

Adult Survival

Recruit Survival

Growth

The primary factors that limit survival and growth in this system are…

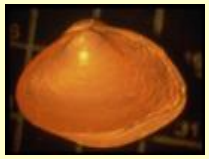
Salinity

Temperature

Food

Important <u>similarities</u> in *Potamocorbula* and *Corbicula* characteristics that determine how climate change affects their function in the ecosystem

Characteristics	*Potamocorbula*	*Corbicula*
Exotic Introduction	1986	1940's
Opportunistic/Disturbance Affinity	Yes	Yes
Filter Feeder-phytoplankton	Yes	Yes
Filter Feeder-zooplankton	Yes	Yes
Fish Prey	Yes	Yes
Physical Habitat Range	Wide	Wide



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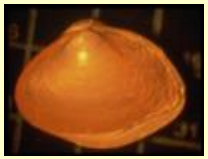
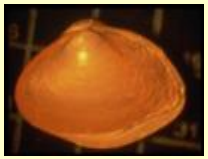
Important differences in *Potamocorbula* and *Corbicula* characteristics will determine how climate change affects their distribution and function in the ecosystem

	Characteristics	*Potamocorbula*  ≠ *Corbicula* 
Distribution	Salinity Preference- juveniles	≥2
	Salinity Preference - adults	≥0
	Reproduction I	Dioecious
	Reproduction II	2 + Spawn/yr
	Larval Dispersal	Pelagic
Function	Life Span	2-3
	L Water filtered/10 g tissue (20°C)	4000
	Prey for birds	Important
	Selenium Content	High

≤2
≤10
Hermaphrodite
Many Brood/yr
Bedload
3-5
1000
Minor
Medium*

*function of size and predator preference

Increased temperature will affect function; unlikely to kill adults but may alter when animals can be reproductive.



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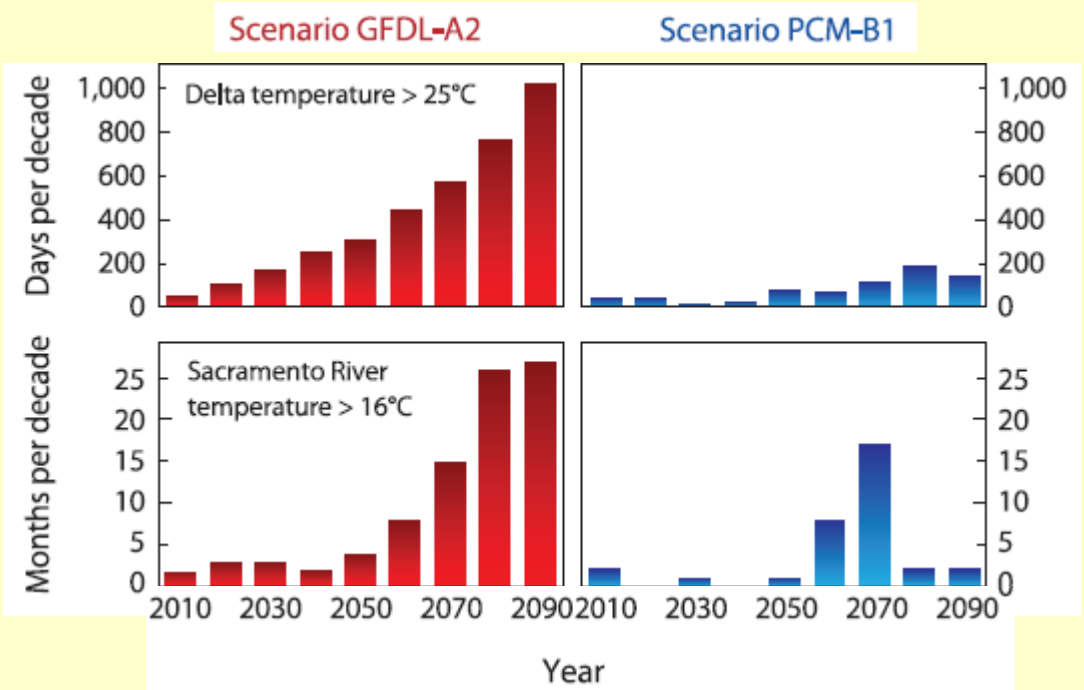
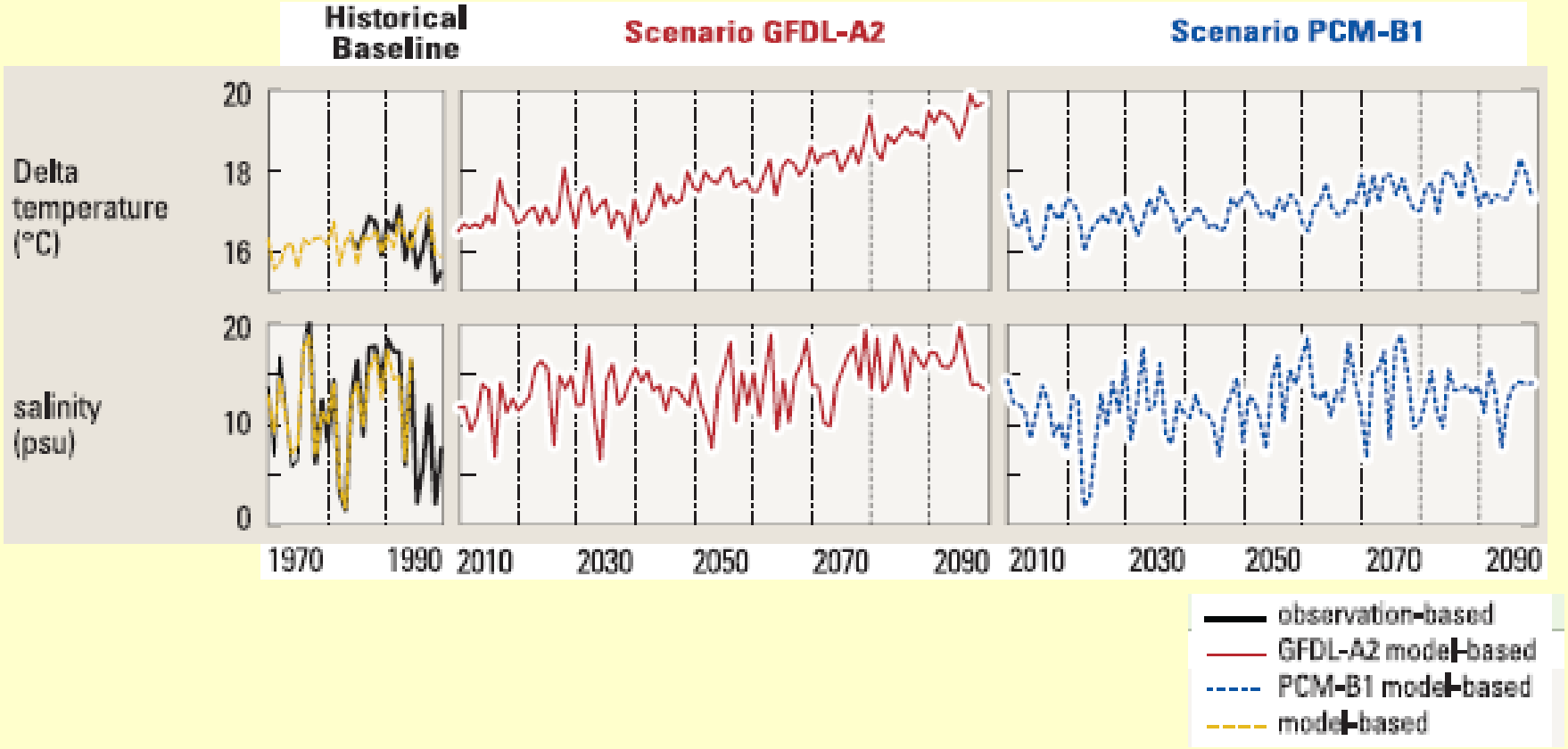
	Potamocorbula	*Corbicula*	*Quagga*
Survival	*2-36˚C*	*2-36˚C*	*2-40˚C*
Reproduction	***6-23˚C??***	*13-30˚C*	*12-24˚C*

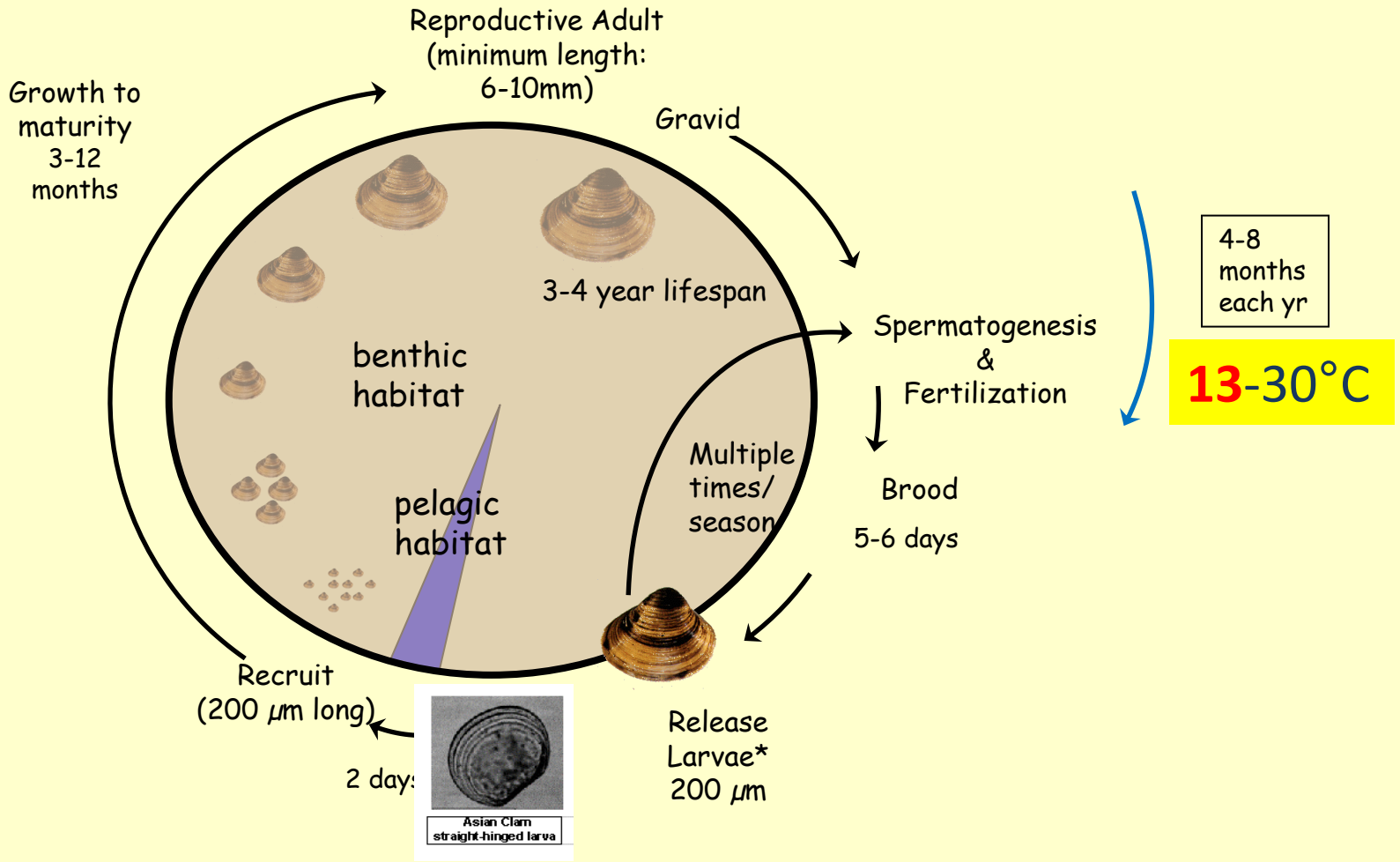
http://www.fws.gov/answest/qzap/qzap_appendices.pdf



The increase in the temperature minimums is also important for reproduction – as baseline temperature increases so does the minimum temperature

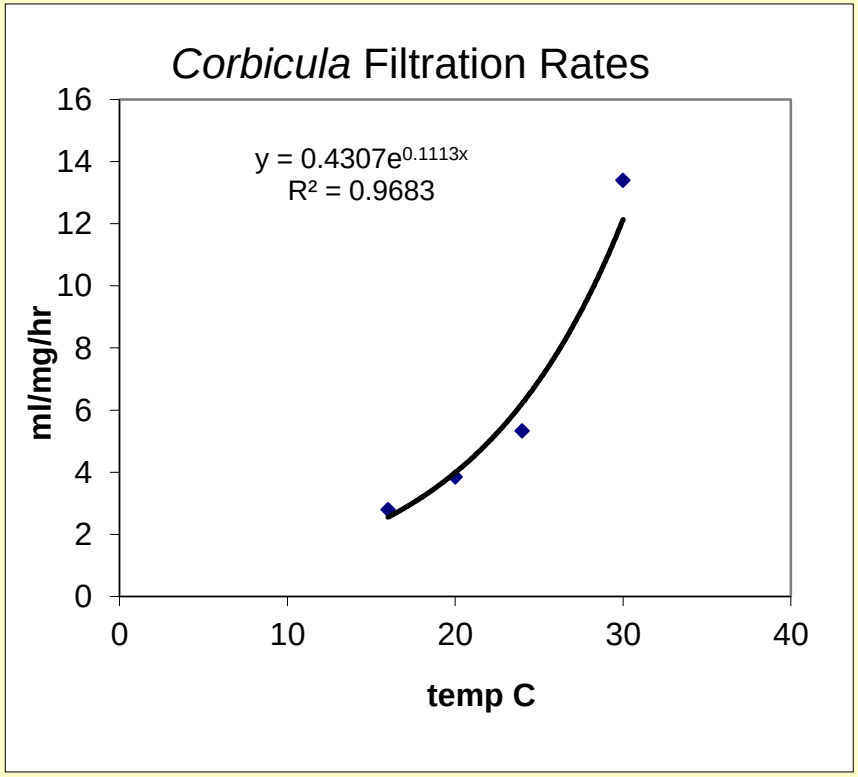


The period of reproductive activity may increase for *Corbicula* with the limiting minimum temperature being less common.



*http://el.erdc.usace.army.mil/zebra/zmis/zmishelp4/distinguishing_between_dreissenid_species.htm

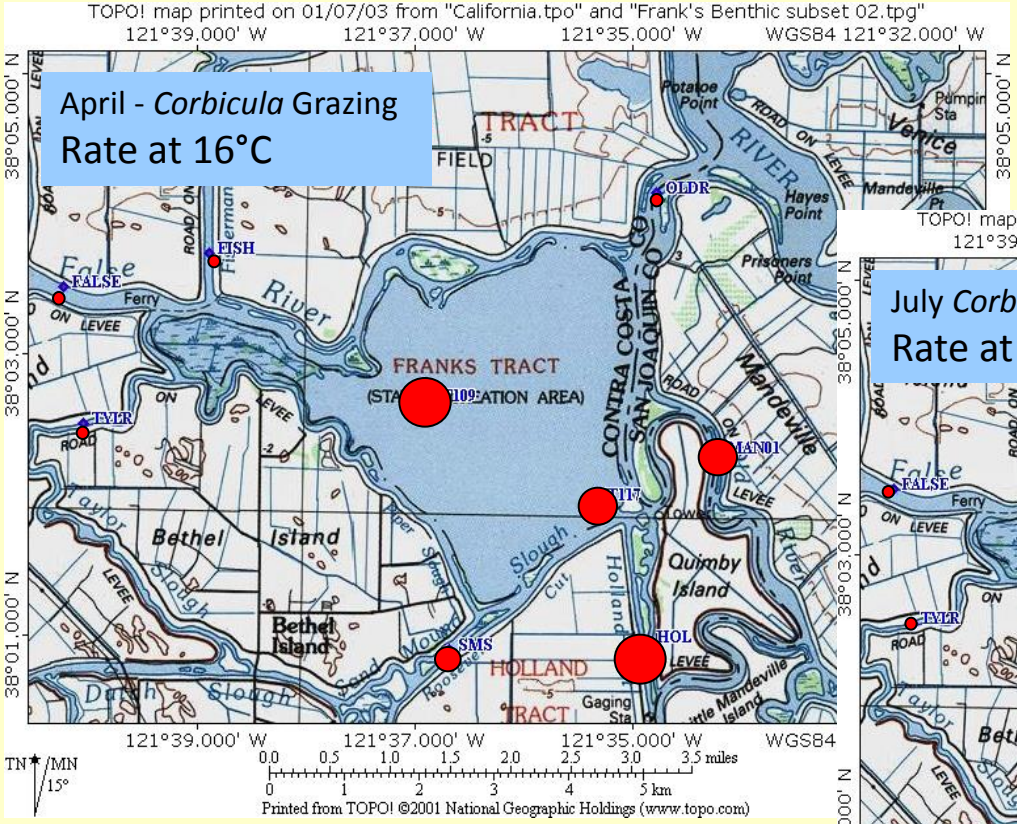
For a similar clam population biomass, grazing rate for both species will increase with an increase in temperature.

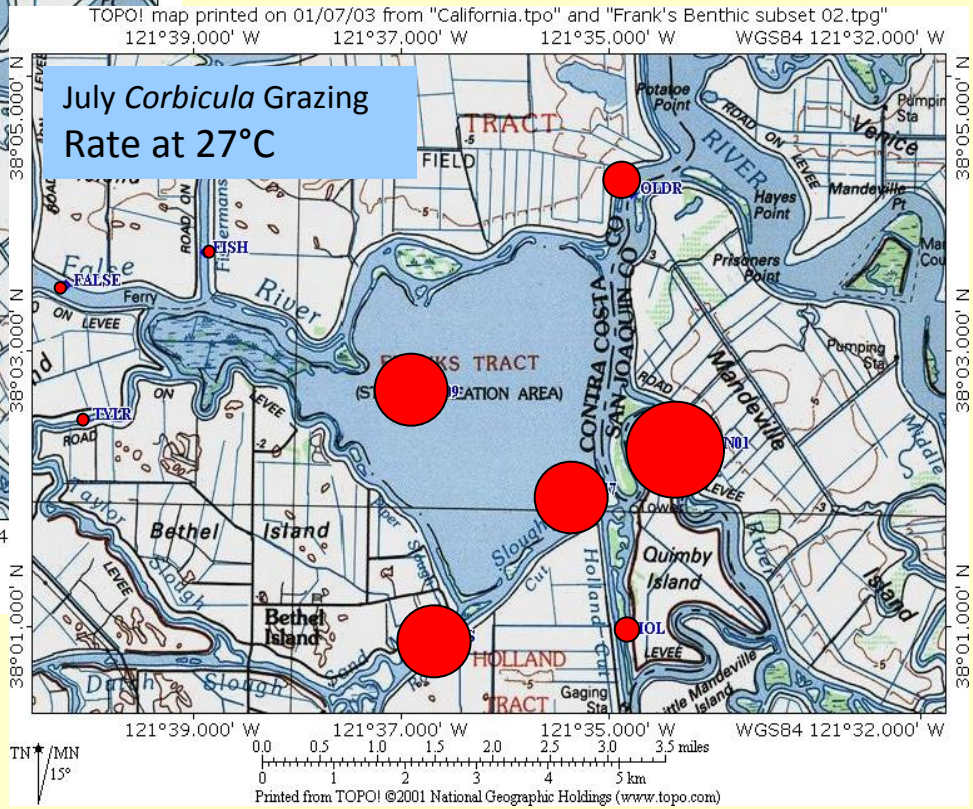


Based on Foe and Knight 1985

Think of it as a clam panting

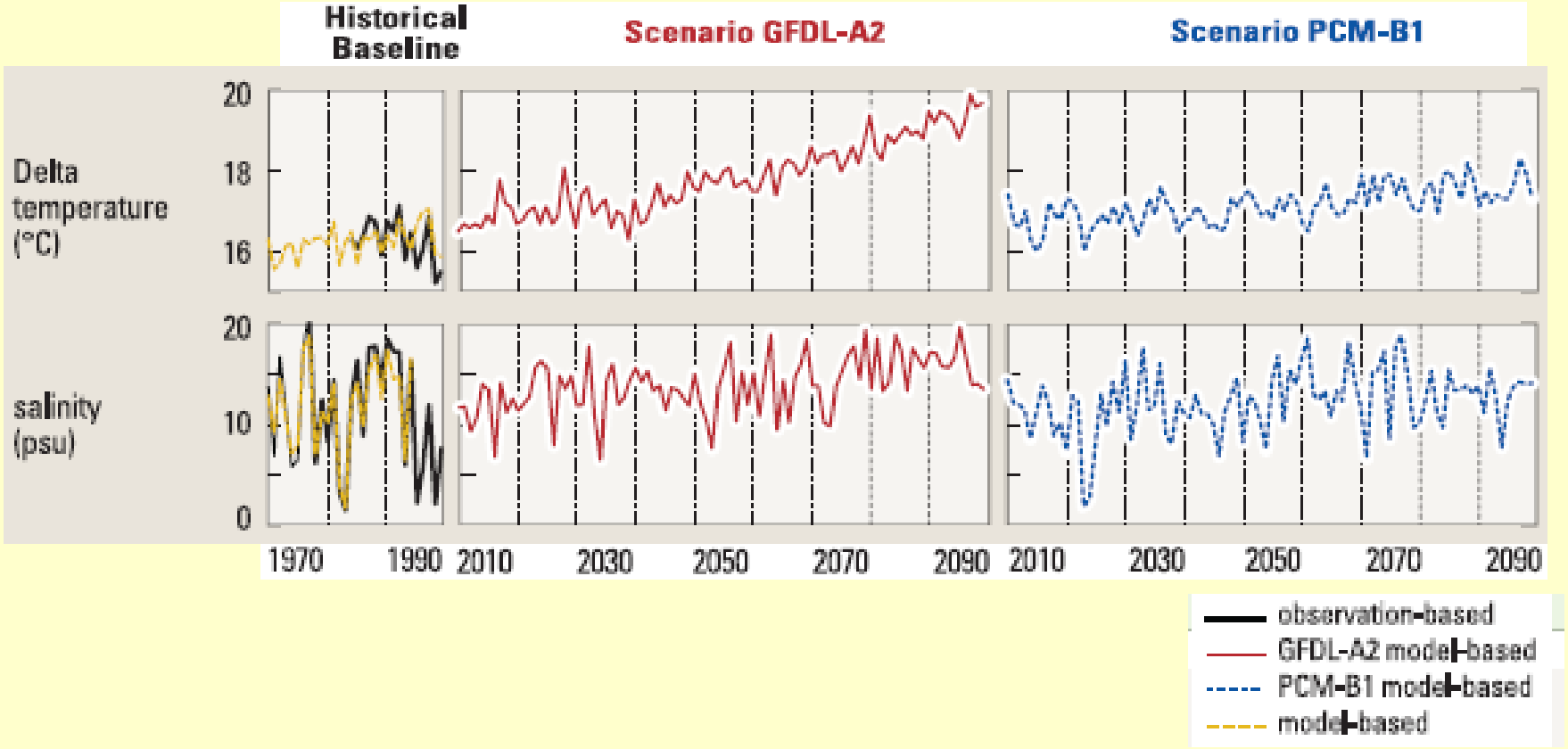
We have observed grazing rate increases due to large temperature changes in spite of small biomass change



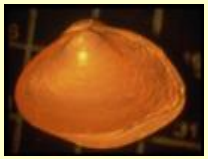


20 10 5 2.5 1 <.5 m/d

An increase salinity in these scenarios, largely due to sea level rise, is a critical factor in determining clam distribution.



As salinity increases *Potamocorbula* will move upstream as will *Corbicula*.



NOAA

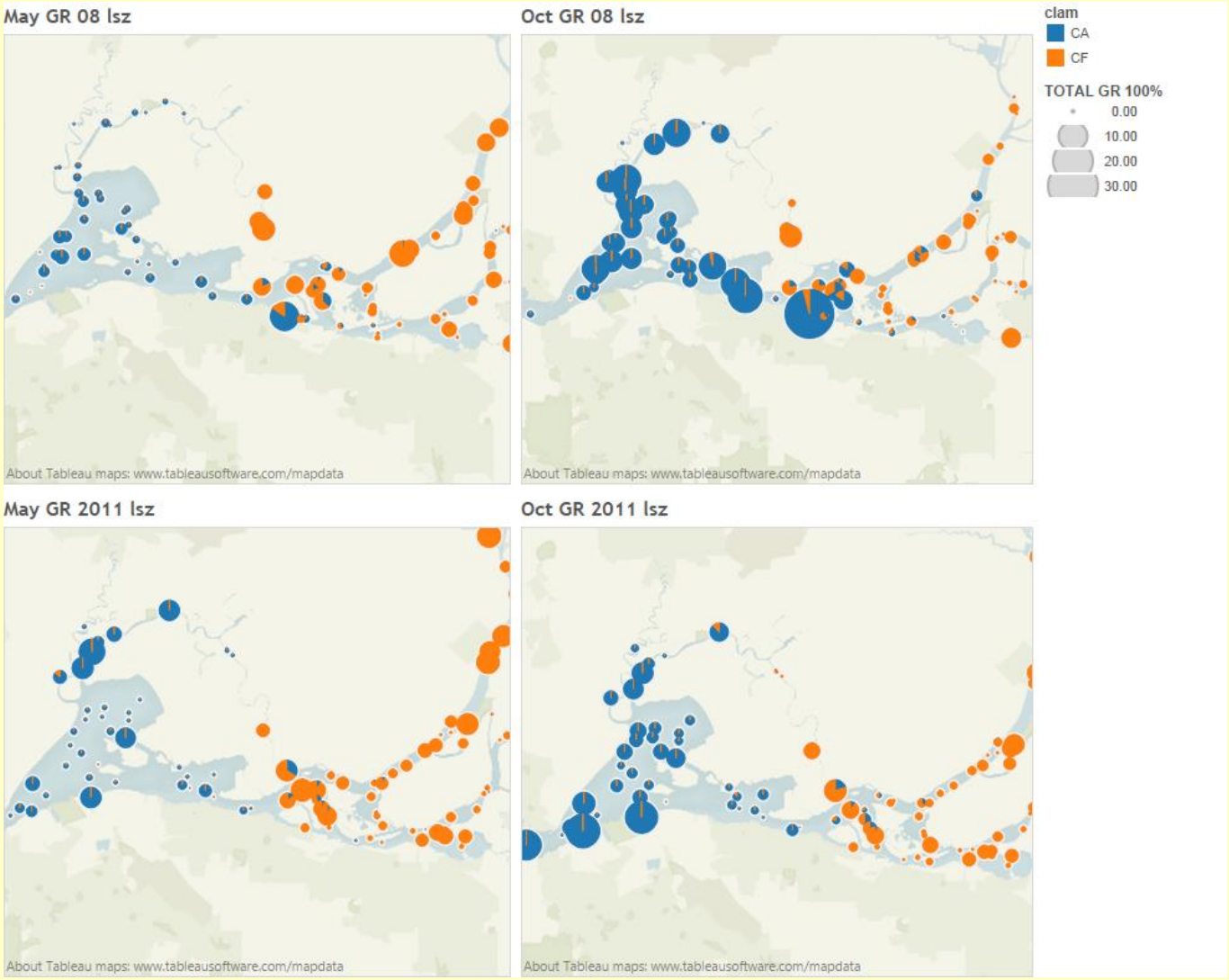
	Potamocorbula	*Corbicula*	*Quagga*
Survival	*0-35?*	*0-14*	*0-12*
Reproduction	*5-25*	*<2*	*0-2*

http://www.fws.gov/answest/qzap/qzap_appendices.pdf

We have observed downstream movement of the overlap zone in wet years when compared to dry years.

Dry after Dry year

Wet after Normal year

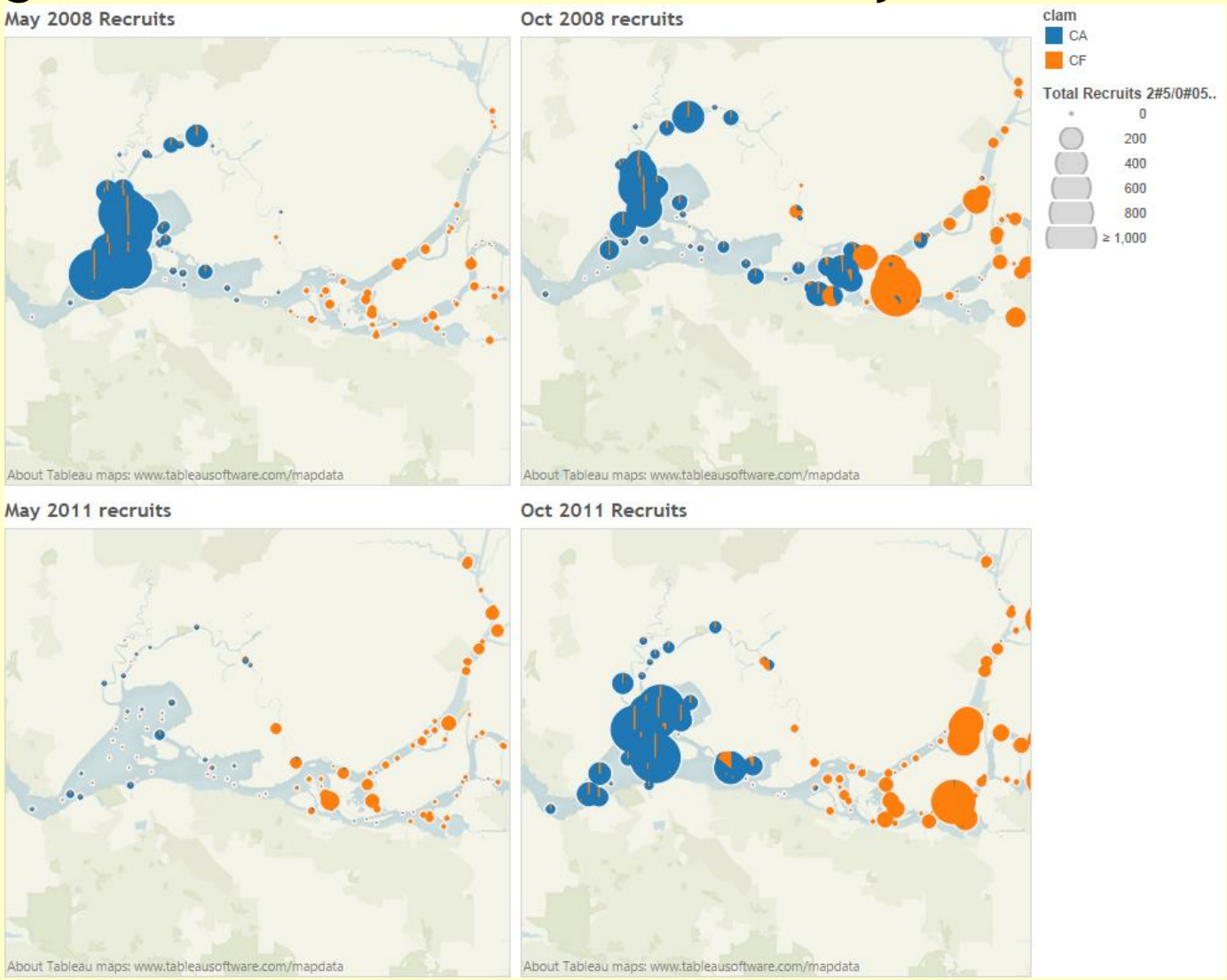


DWR IEP/EMP Samples; USGS processed

Most of these distribution patterns are driven by recruit distribution which overlaps at X2, an important ecological zone in the northern estuary.

Dry after Dry year

Wet after Normal year



Other changes that could be important

- ✓ Change in bathymetry – increase in shallow water area could increase importance of bivalve grazing
- ✓ Change in bathymetry – increase in deep water area could decrease importance of bivalve grazing and increase the possibility of water column stratification and oxygen limits
- ✓ Increased blue-green micro-algal growth could decrease dissolved oxygen, particularly if coincident with water column stratification – neither bivalve does well with low oxygen
- ✓ Any increase in food availability could increase the bivalve biomass as both species appear to be food limited