A brief summary of climate change challenges for steelhead

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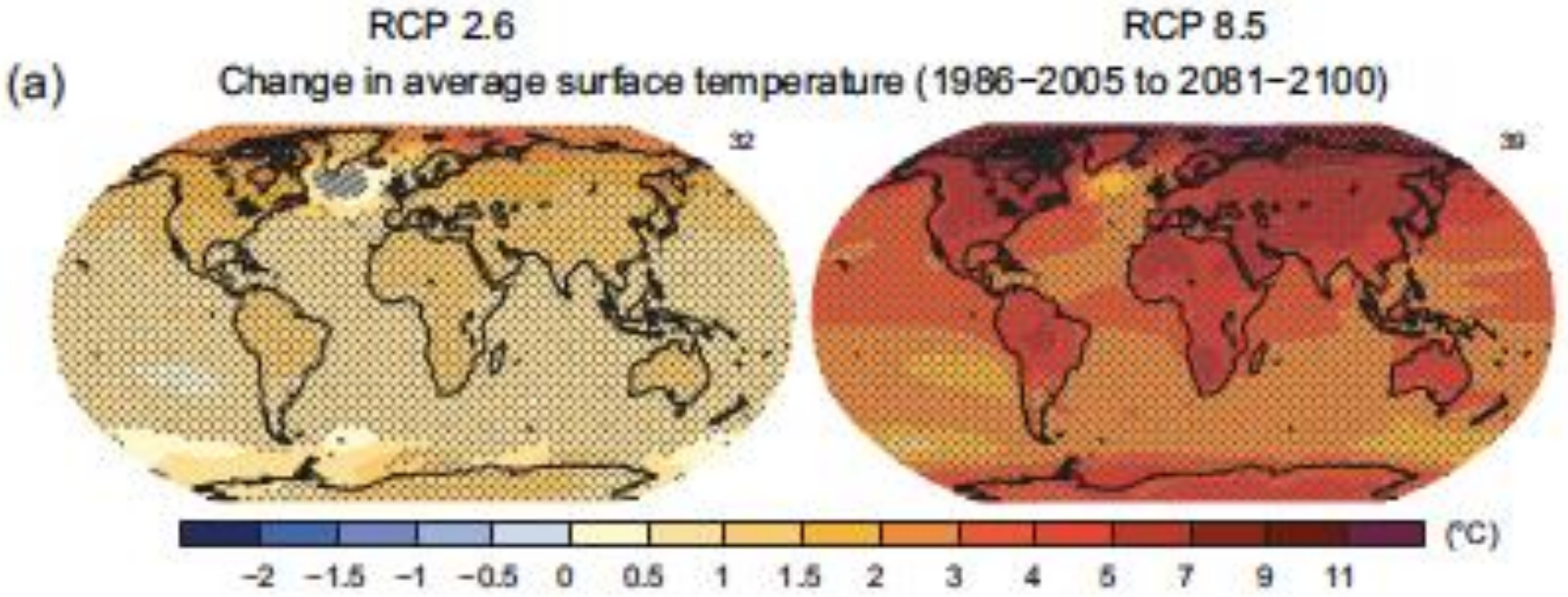
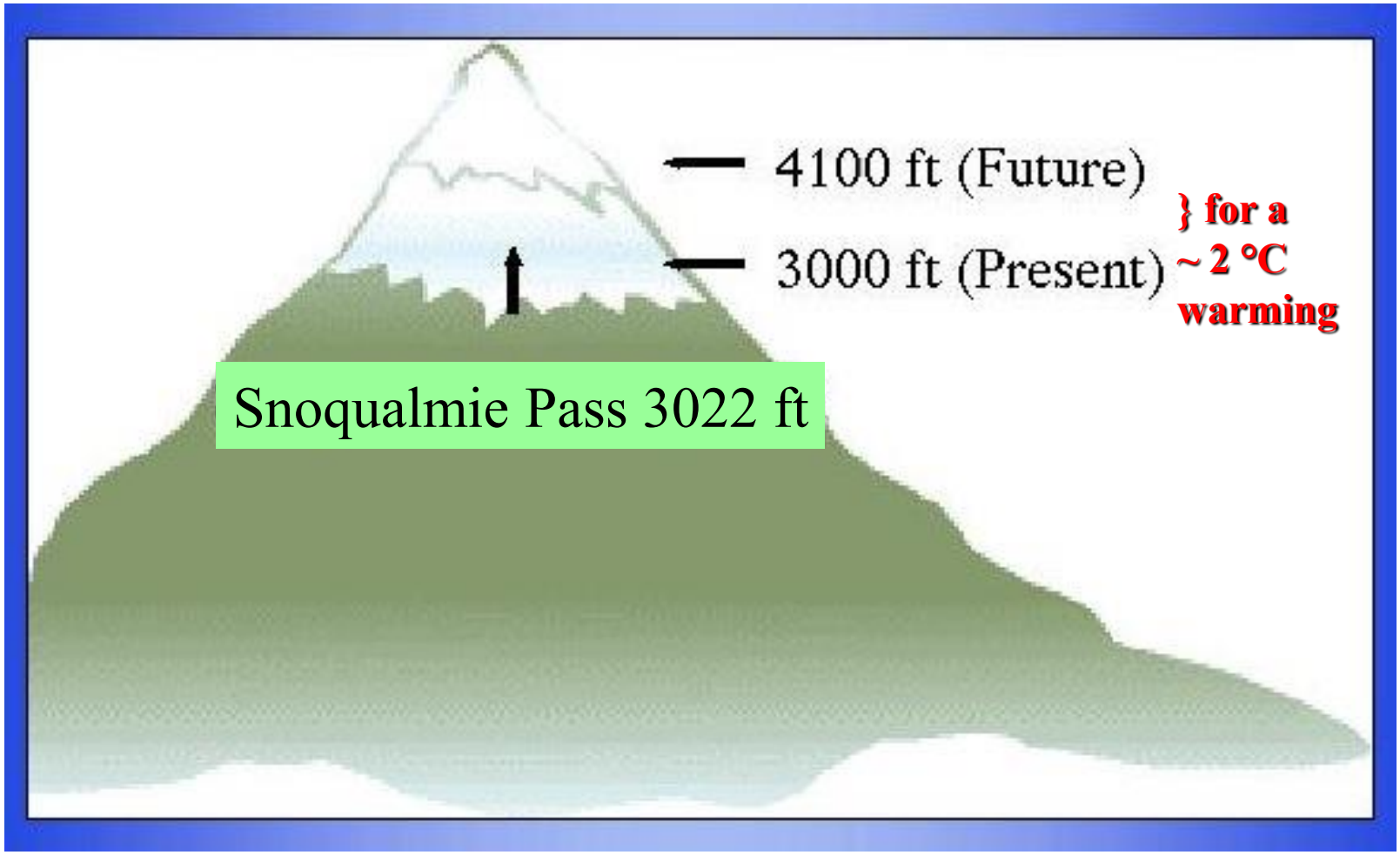
Climate Model Temperature projections
(IPCC AR5 WG1 2013)



- Future climate scenarios point to warming most everywhere

A robust impact of climate warming: **higher snowlines**



springtime snowpack will decline in the warmest locations

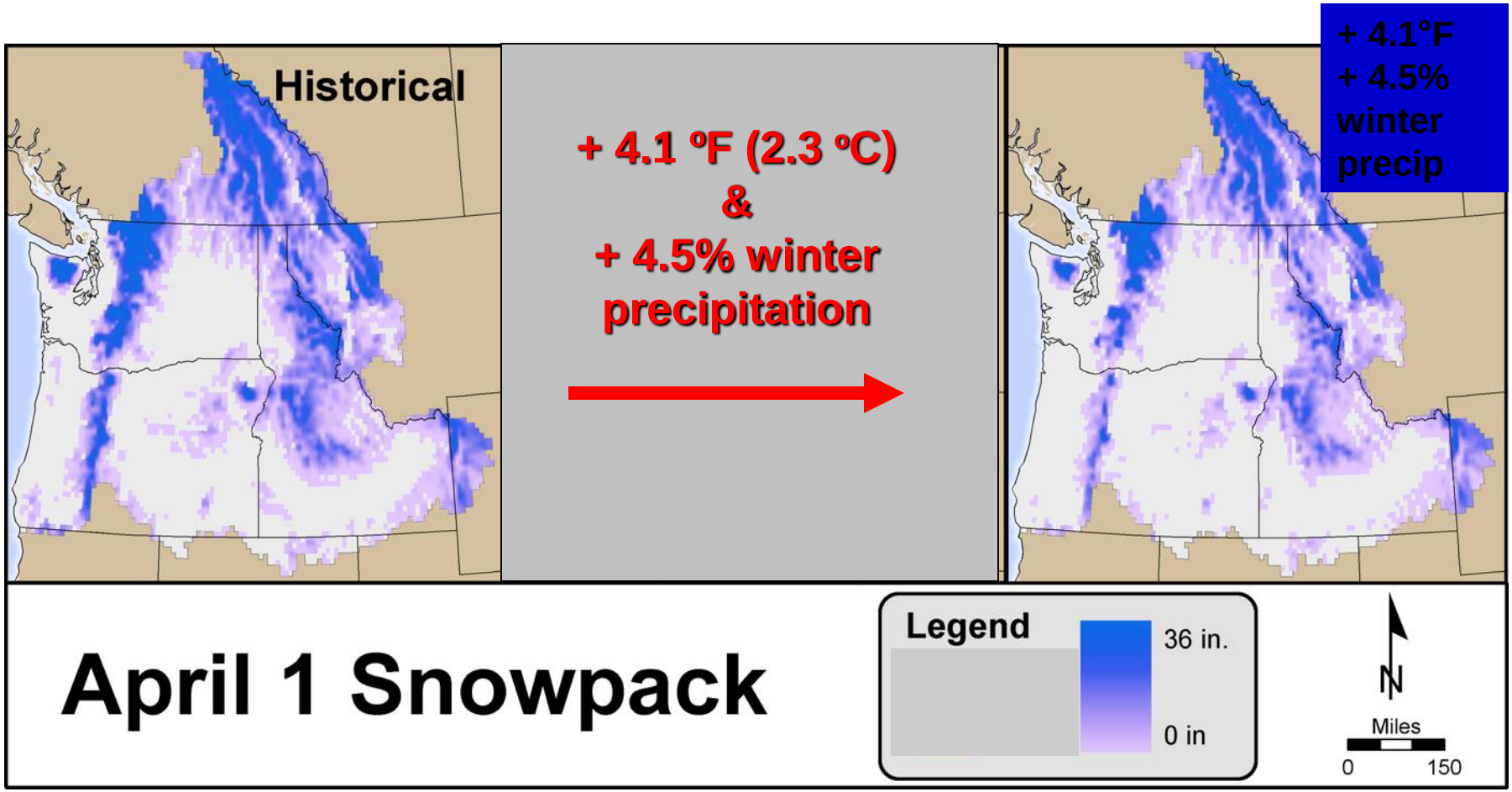


Figure courtesy of Alan Hamlet, UW Climate Impacts Group

The coldest locations are less sensitive to warming

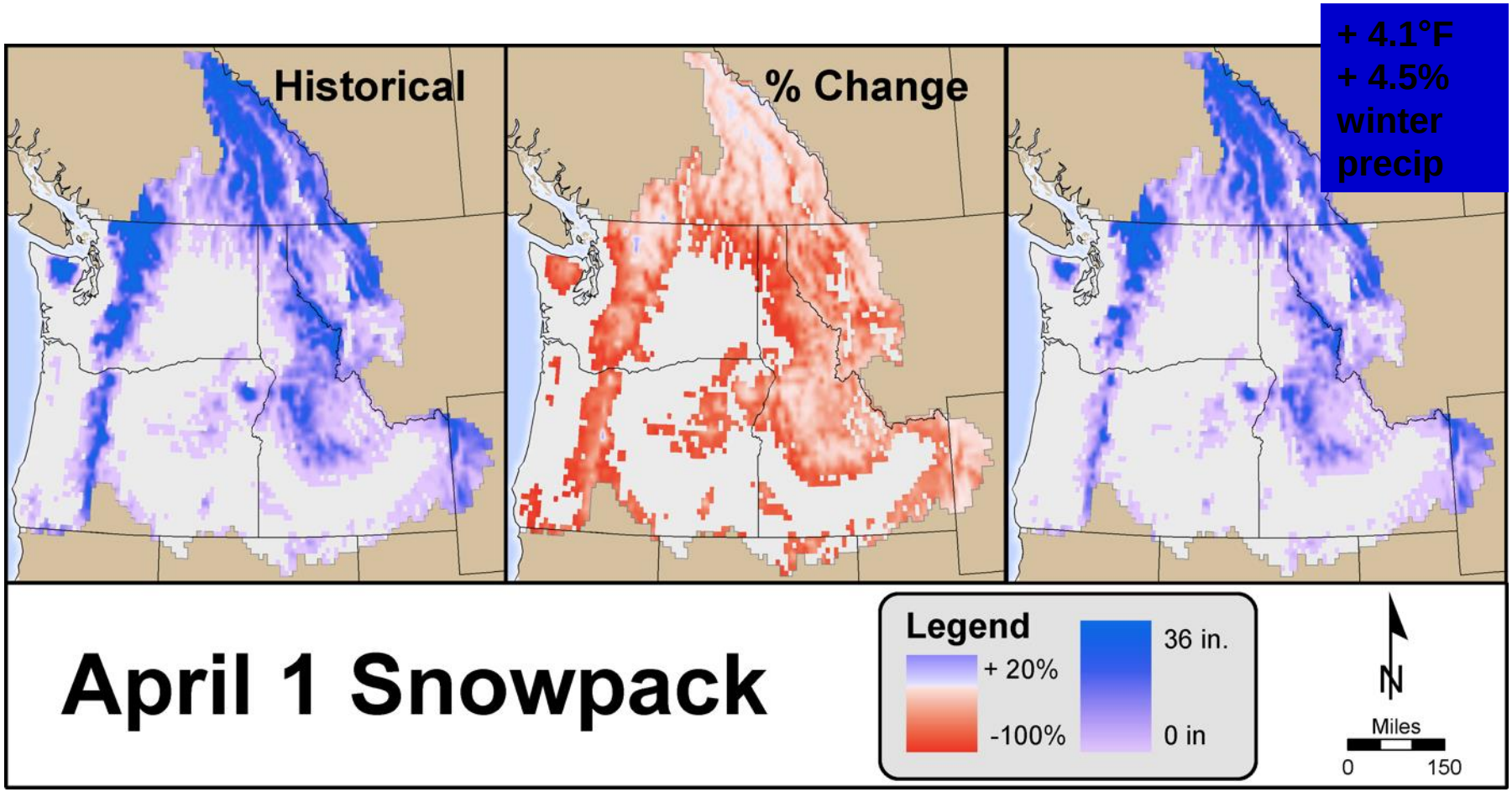
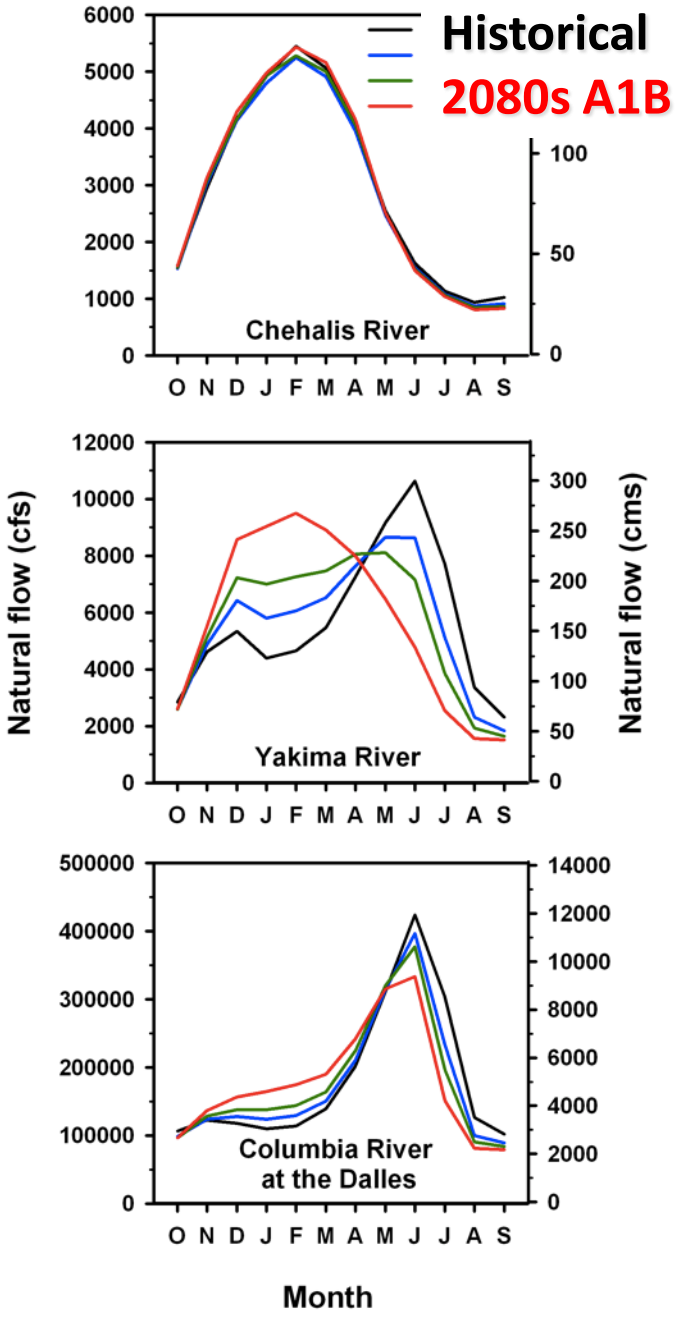


Figure courtesy of Alan Hamlet, UW Climate Impacts Group



3 basic streamflow patterns

1. ***rain-dominated***

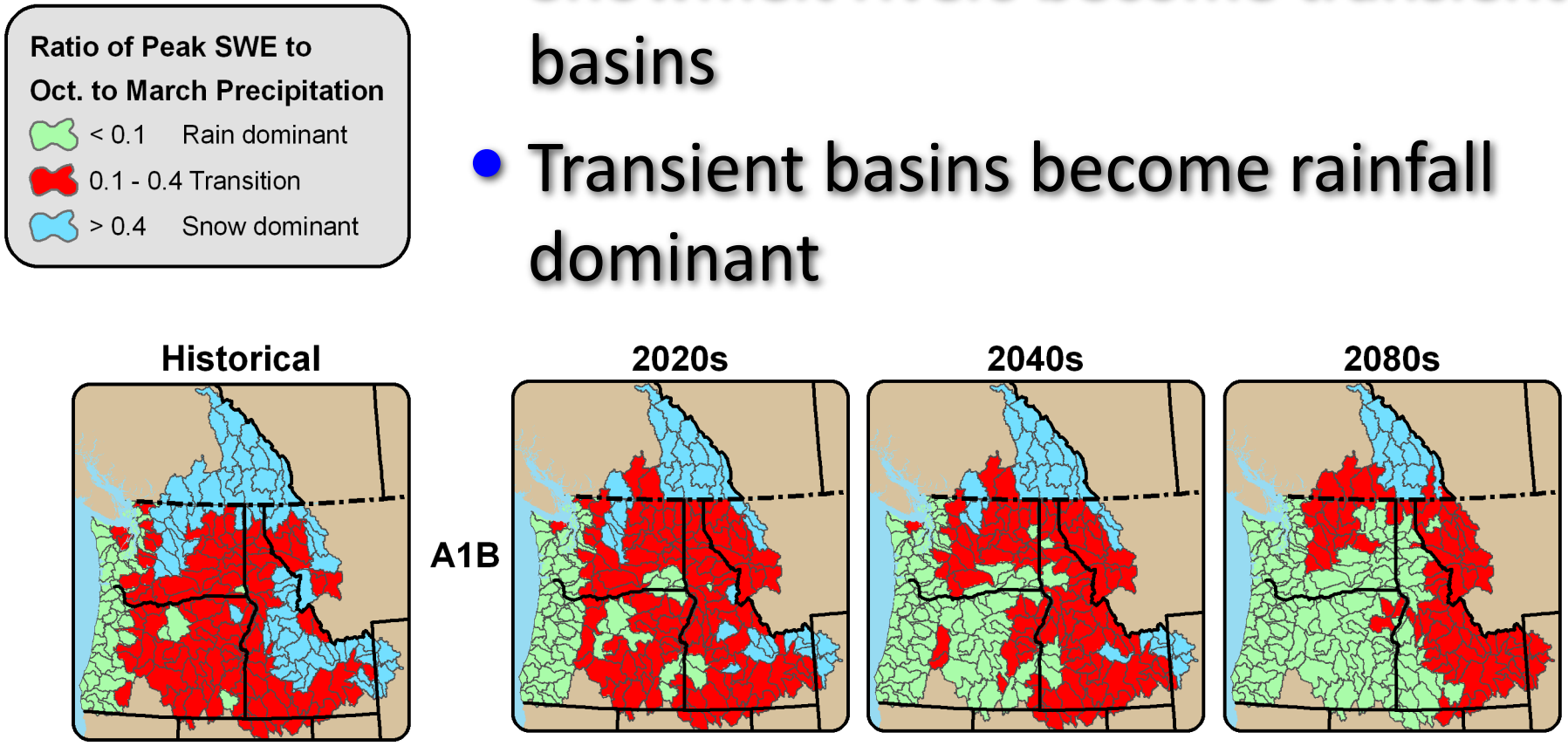
2. "***transient***" runoff basins with an early winter peak from rainfall, and a spring peak from snowmelt

3. ***snowmelt-runoff*** basins, where streamflow peaks in late spring and early summer

Elsner et al (2010)

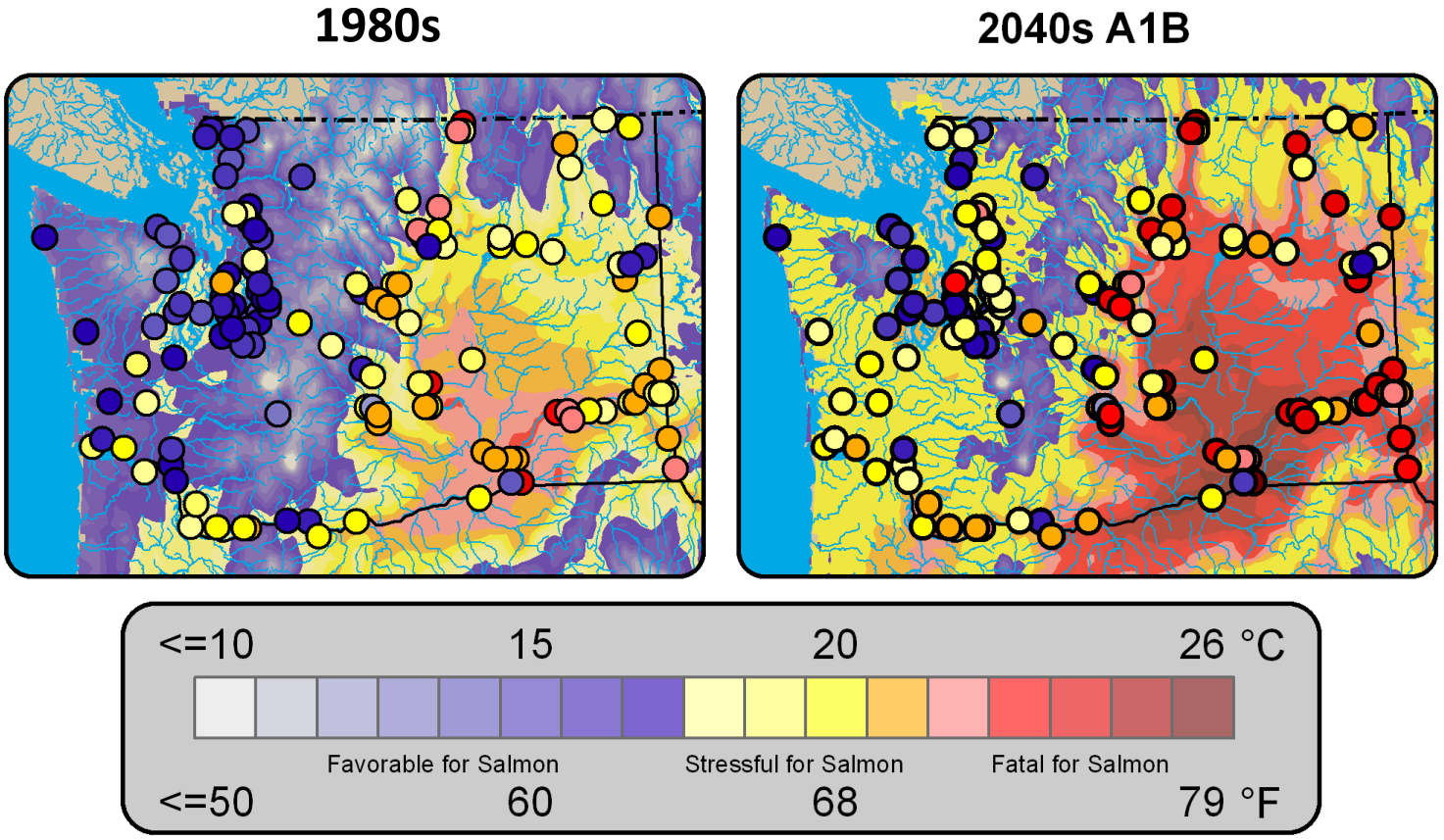
Changing Watershed Types:

- Snowmelt rivers become transient basins
- Transient basins become rainfall dominant



Source: Alan Hamlet, Columbia Basin Climate Change Scenarios Project Map: Rob Norheim

Western Washington's "maritime" summer climate becomes as warm as today's interior Columbia Basin, temperatures in the interior Columbia Basin become as warm as today's Central Valley in California



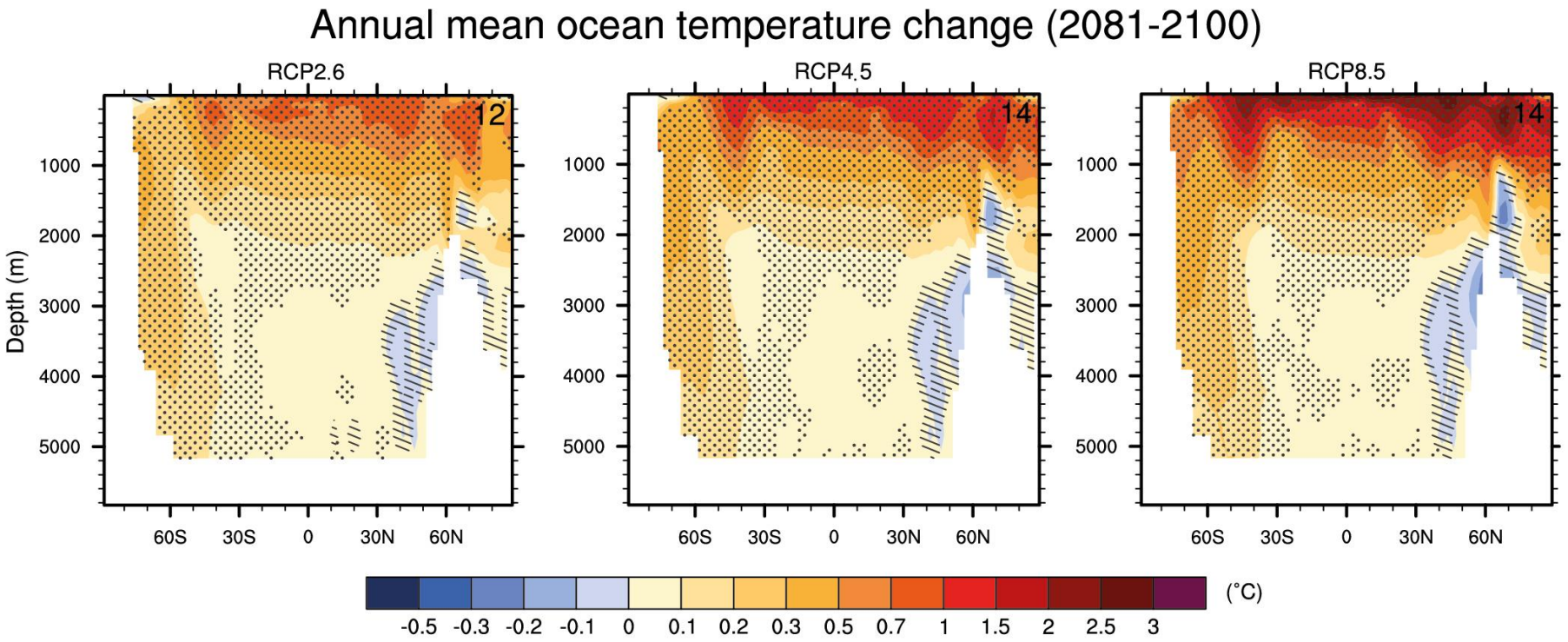
Mantua et al (2010): Climatic Change

Increased conflict over use of surface water in summer

- Human demands on surface water are projected to increase during times of high salmon vulnerability

Most warming is projected for the upper ocean

Warming surface waters will increase stratification, which in turn will impact the upwelling and retention of nutrients in the sun-lit upper ocean.

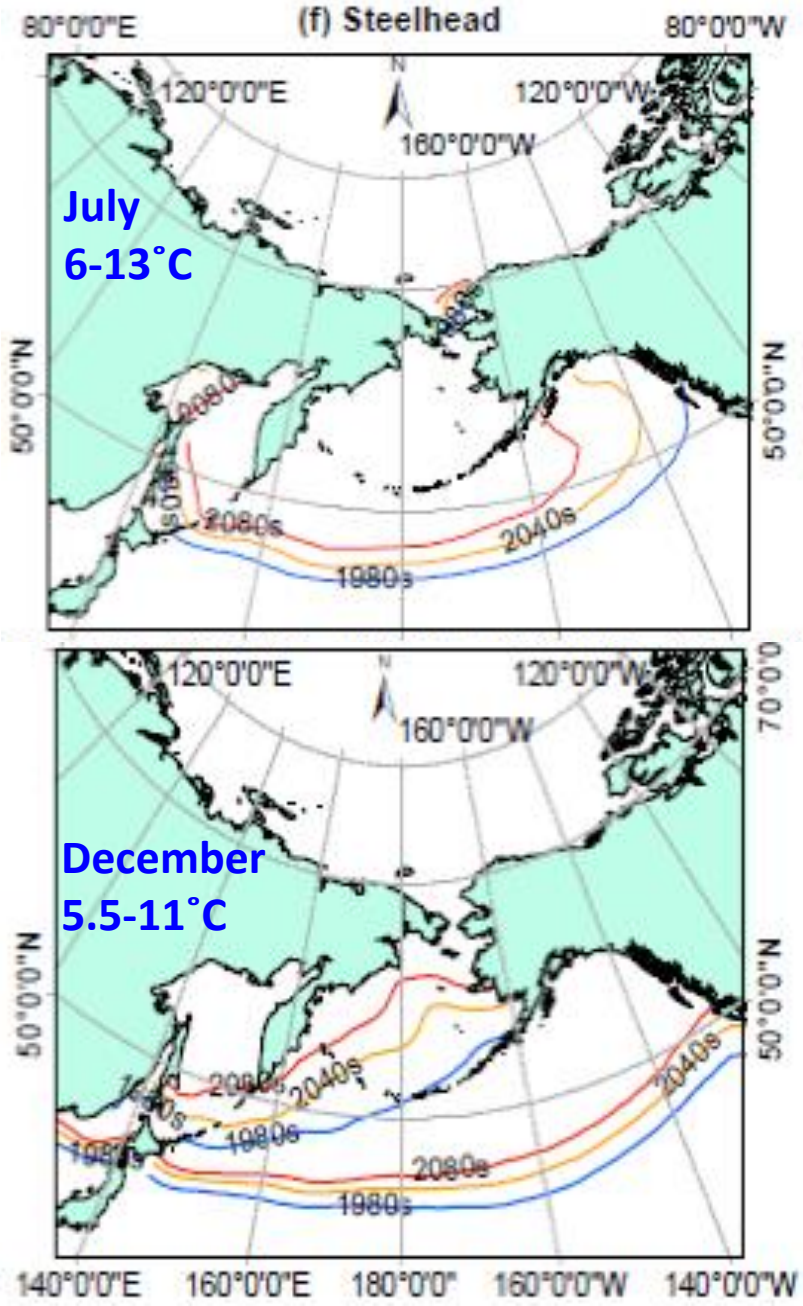


IPCC AR5 WG1 report, 2013

Thermal habitat for steelhead shifted to the north?

These scenarios assume that observed thermal habitat use in high-seas recoveries applies in the future

Aziz et al. 2011, CJFAS

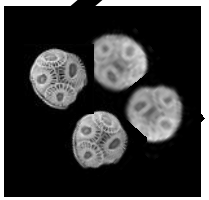


What are the biological implications of ocean acidification?

Barrie Kovish

Vicki Fabry

Pteropods



Coccolithophores

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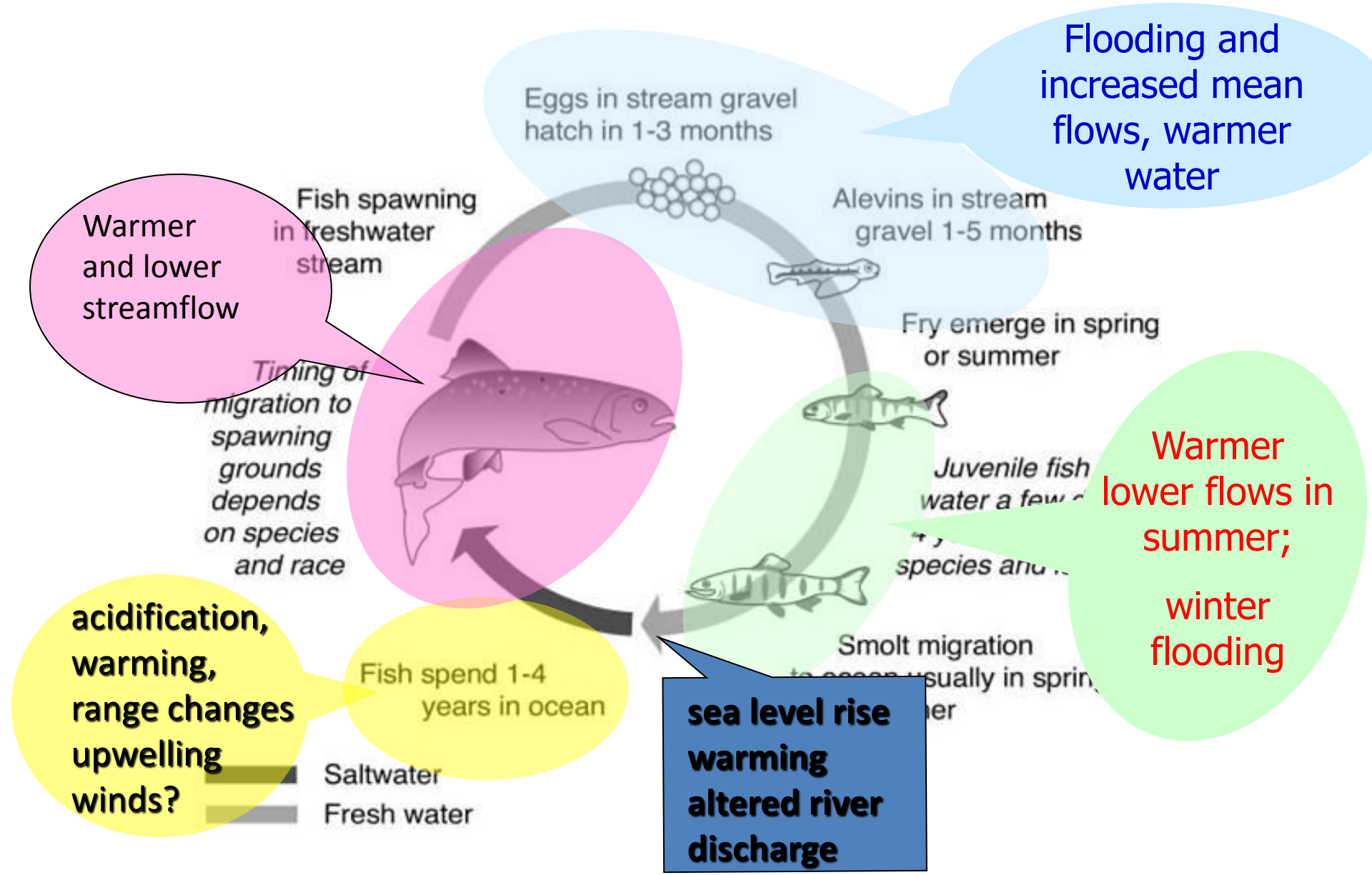
Copepods

- Reduced calcification rates for calcifying (hard-shelled) organisms
- physiological stress
- Shifts in phytoplankton diversity and changes in food webs
- Reduced tolerance to other environmental fluctuations
- ***Potential for changes to fitness and survival, but this is poorly understood***

(Slide provided by Dick Feely, NOAA)

Impacts summary for PNW steelhead



Questions for our panel

1. *what can be done to improve the prospects for steelhead to respond to changing ocean conditions now and into the next century?*
   - *Research, Monitoring, and/or Management actions?*
   - *Where would you expect to find the most promising management actions/interventions, in freshwater, estuaries, or marine habitats?*

2. *At what point do we 'write-off' a population because the climate-related challenges are deemed insurmountable and instead shift limited resources to preserve/restore populations with higher likelihood of success? Are there criteria we should consider in making these difficult decisions?*