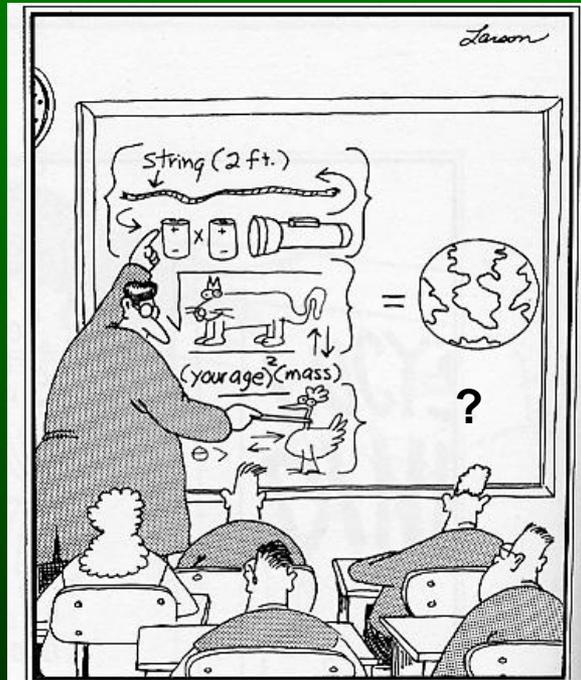


The horns of a warming dilemma: The climate change conundrum for fisheries agencies and managers



Climate Change for Fisheries Agencies

Gary Whelan
MI DNR Fisheries Division
April 2013

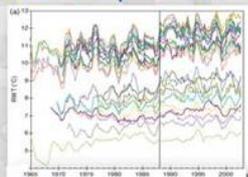


Is it really an issue?

Brown Trout Populations in Switzerland

Trends from 1978-2002

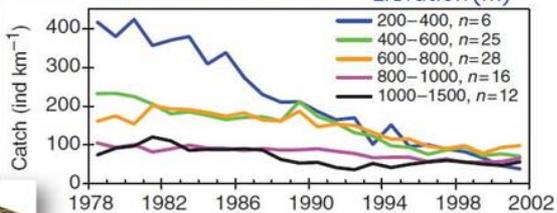
Stream Temp Increases



Disease Outbreaks



Populations declining faster in warm streams



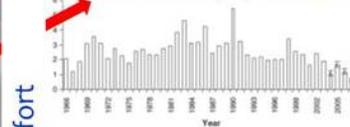
Hari et al. 2006. *Global Change Biology* 12:10-26.

Arctic Char Lake Populations in the U.K.

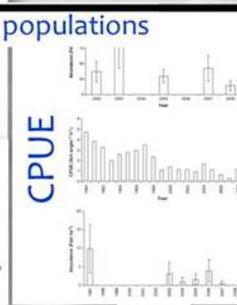
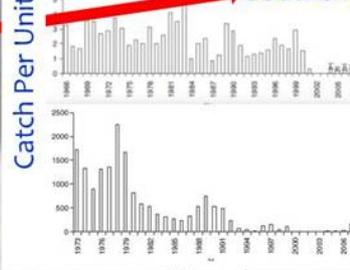
Declining Fastest at Southern Range Extent



Northern population



Southern populations



Year

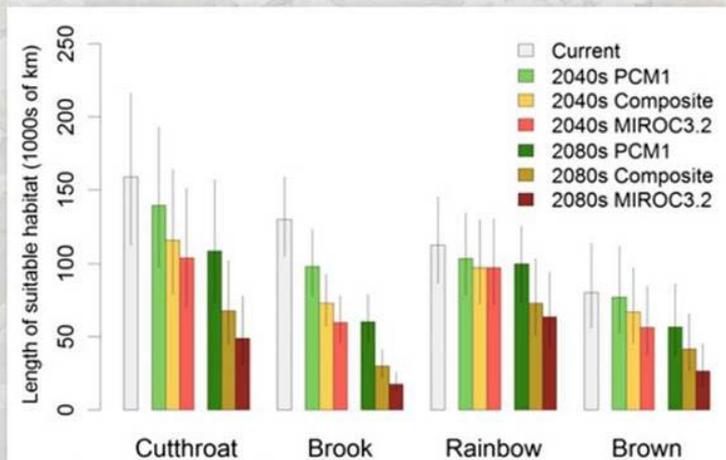
Year

Winfield et al. 2010. *Hydrobiologia* 650:55-65.



Likely future issues

Inter-specific Variation in Climate Response



Predicted reduction (2080) =



57%



77%



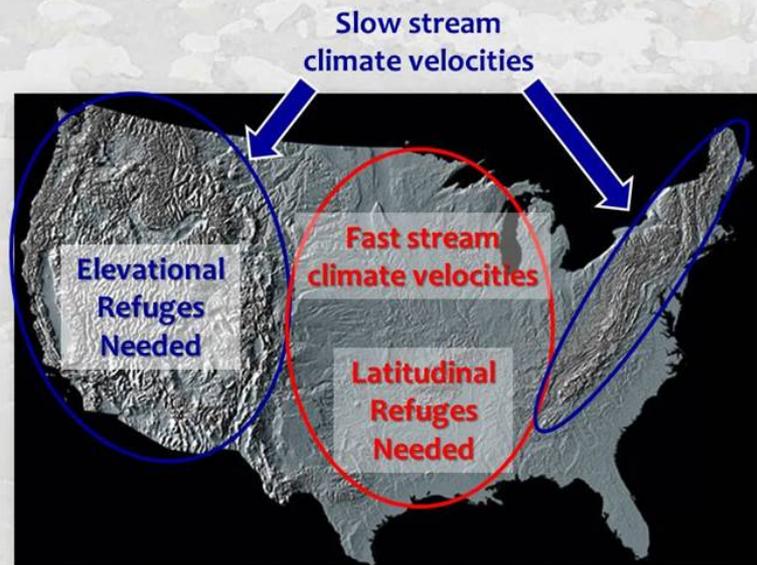
35%



48%

Wenger et al. 2011. PNAS 108:14175-14180

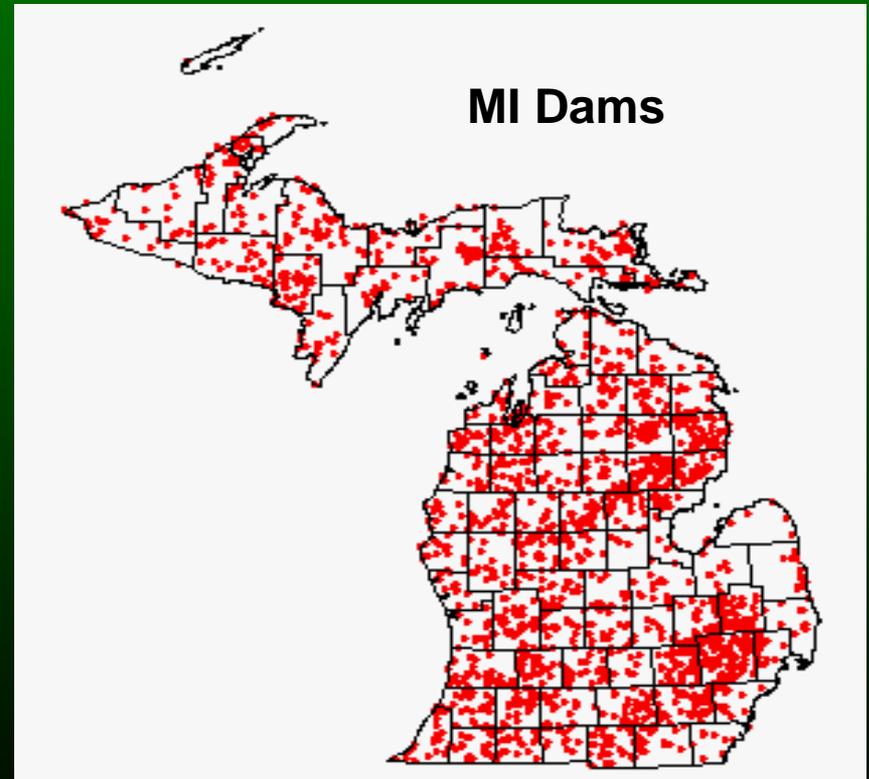
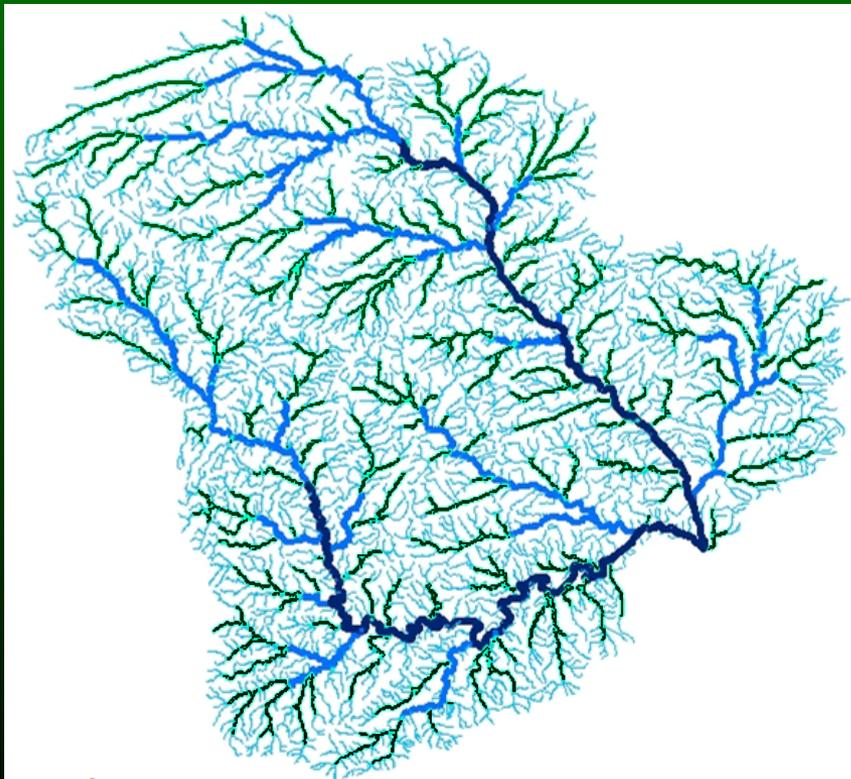
Topography & Climate Vulnerability





Key Aquatic Consideration

- Fish and other aquatic species are limited to watersheds that are already heavily fragmented





What to watch and manage? System Processes

- **Hydrology**
- **Connectivity**
- **Material Recruitment and Transport**
- **Water Quality**
- **Geomorphology (Bottom Form and Living Habitat)**
- **Energy Flow**



Likely Climate Change Effects on System Processes

- Hydrology, Geomorphology and Material Transport
 - Increasing number of intense storm events
 - Increasing amount of “tropical” conditions
 - Increase in desertification – Less water
 - Increasing conversions of land to agriculture and urban areas with reductions in forest and grasslands
 - Changes in water elevations
 - Direct competition for increasingly scarce water resources



Likely Climate Change Effects on System Processes

- Water Quality
 - Contraction of coldwater habitat northward and higher in elevation
 - Agriculture and urban conversation will bring declining water quality



Likely Climate Change Effects on System Processes

- Energy Flow
 - Coldwater fish distribution will likely contract
 - Increasing issues with recruitment
 - Marginal habitat will become unsuitable
 - Warm and coolwater fish distributions will expand
 - Invasions of non-native species will likely increase
 - Increasing homogenization of the worlds fauna and flora
 - System energy flow will likely become more unstable and unpredictable

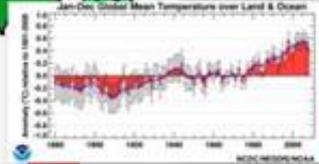
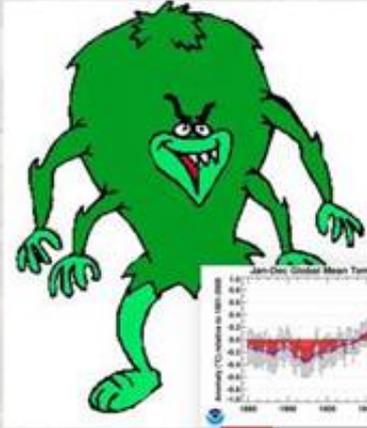


So What is Issue for Fisheries Managers - \$100 billion



There's A Lot on the Line...

Climate Boogeyman



Recreational Fisheries

Low Flows Prompt Fishing Closure On Upper Beaverhead River And Reduced Limits On Clark Canyon Reservoir

Wednesday, September 29, 2004
Fishing



High Water Temperature In Grande Ronde Kills 239 Adult Spring Chinook
Columbia Basin Bulletin, August 14, 2009 (PST)

Land Use & Water Development



ESA Listed Species





Key Questions for Resource Managers

- Should we play God or let species or groups of species go extinct?
 - What species do we manage for and for how long?
- How do we keep fish and other aquatic life in the water in the face of increasing engineering solutions to water scarcity and level changes?
- How to keep increasing fragmented systems functioning?

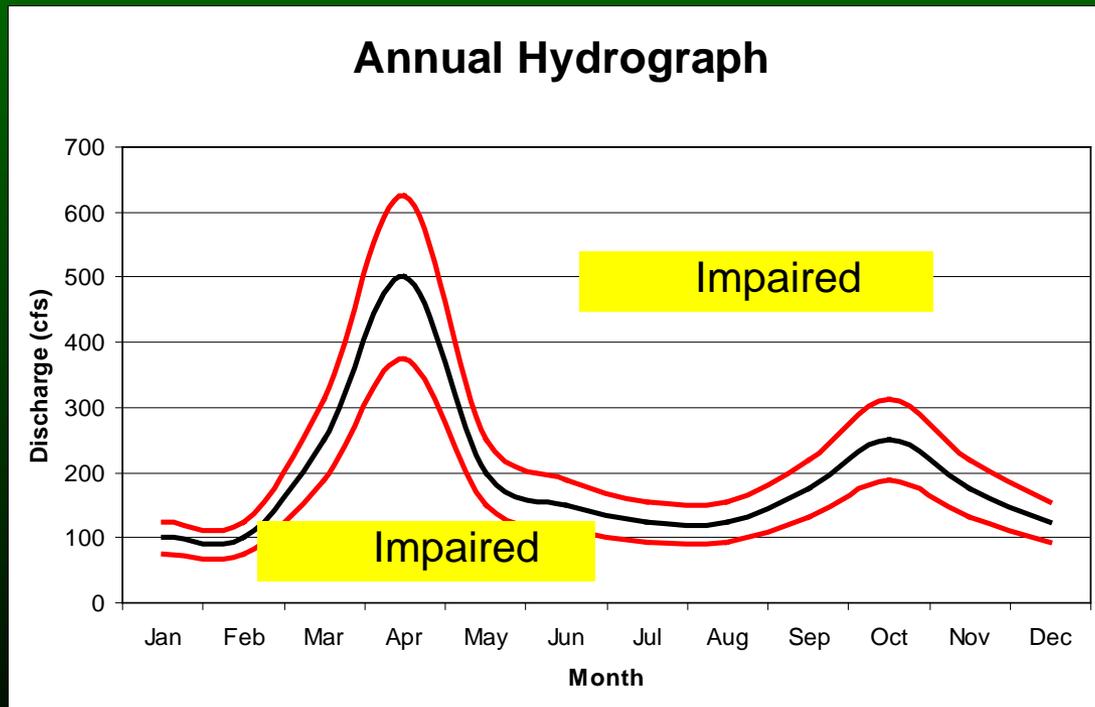


What are the best management options?

Habitat and Process Management

- **Process Management**

- Maintain processes as long as possible within the natural expected variation – No more than 25% beyond

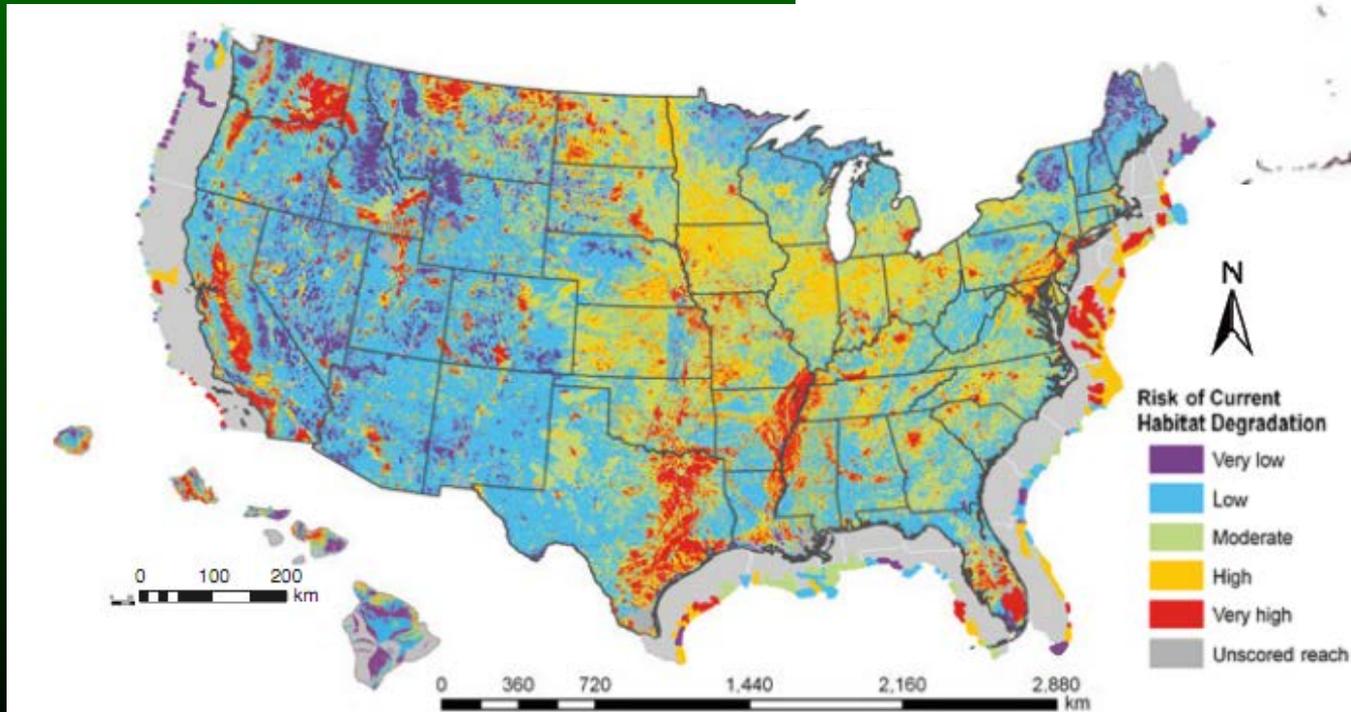
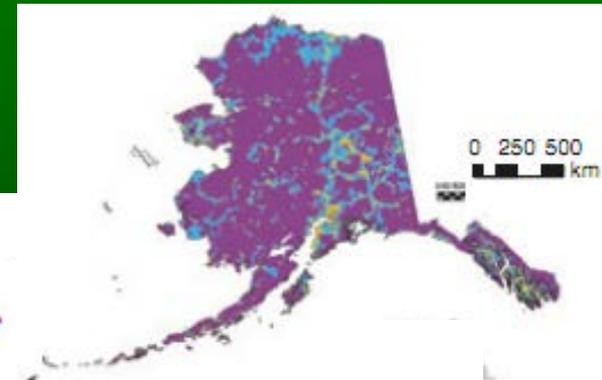




What are the best management options?

Protect the best of what is left

- Protect the best of what we have today
- Create and establish refugia
- Build and maintain healthy systems





What are the best management options?

Hydrology Management

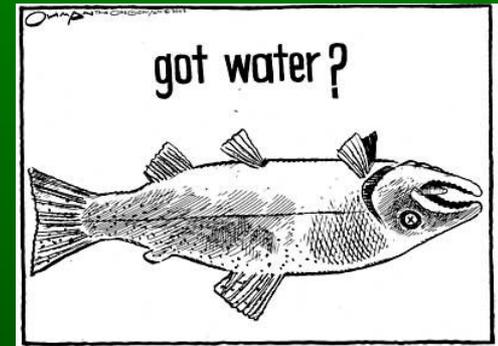
- **Key focus areas**

- Annual hydrograph shape and mean annual Q to include both surface and groundwater
- Maximum and minimum Q
- Event timing changes – Date, Duration, Number, and Flow reversals

- **Ensure freshwater input into estuaries**

- **Maintain channel flow velocity diversity**

- **Be a part of infrastructure discussions**





What are the best management options? Hydrology Management

- Critical to maintain or move to natural fragmentation baseline
 - Best passage is no barrier
- Key factors to obtain removal or passage
 - Dams
 - Tidal gates
 - Culverts
 - Channelized areas
 - Water quality issues
 - Levees
- Need to be part of infrastructure discussion





What are the best management options? Water Quality Management

- **Key factors**
 - **Temperature**
 - Maintain riparian corridors
 - **DO saturation**
 - **Salinity**
 - Maintain hydrograph
 - **Nutrient input rates and storage**
 - Phosphorus
 - Nitrogen
 - **Contaminants**
 - Contain and remove





What are the best management options?

Material Recruitment Management

- Maintain riparian zone connectivity
- Sediment and woody debris input and transport within expected rates
 - Recruitment rates
 - Transport rates
 - Storage





What are the best management options? Geomorphology Management

- **Maintain expected bottom configurations**
 - Hydrology and material recruitment effects
 - Reduce and minimize channelized rivers, lakes and coastal areas
 - Reduce and minimize jetty and hardened shoreline installation
 - Reduce footprint of harbors
- **Maintain living habitat**
 - Shellfish beds
 - Submerged aquatic vegetation
 - Wetlands

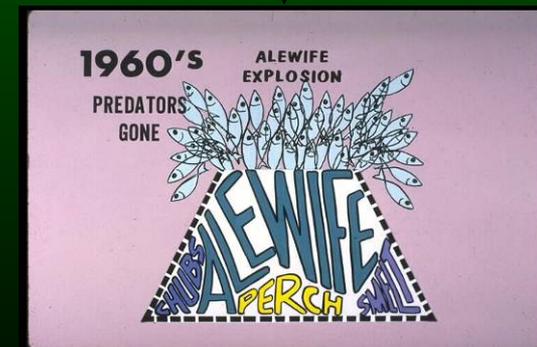
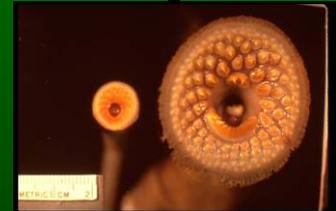
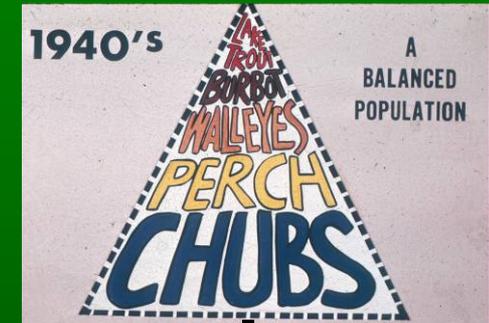




What are the best management options?

Energy Flow Management

- Make sure everyone is and has a home – Niche space occupancy
 - Native species
 - Naturalized surrogate species
- Nuisance and Invasive Species – Reduce vectors and contain
 - Impair energy flow
 - Distribution
 - Control effects
- Stabilize particle size (length or volume) frequency
 - Directs effects water quality and sediment





What are the best management options?

Energy Flow Management

- **Regulations**

- Protect sensitive species in refugia
- Shift fisheries to faster generational and “new” species
 - Reduce harvest of long-lived species
- Reduce vectors and contain invasive species

- **Fish Production**

- Likely will increase in short term to maintain some fisheries
 - Coldwater fish in marginal habitats – Ag and Urbanization pressure
- Much broader range of species

Questions? Comments?



Great Lakes, Great Times, Great Outdoors

www.michigan.gov/dnrfishing

whelang@michigan.gov