River Herring Technical Expert Working Group (TEWG)

Climate Change Subgroup Webinar/Conference Call
December 15, 2014
1:00-3:00 pm (EST)

Summary

I. Overview

The Climate Change Subgroup of the River Herring Technical Expert Working Group was established to "consider the impacts of climate change and climate variability on river herring rangewide (including freshwater)" in order to help contribute to the expected products of the TEWG. Janet Nye and Michael Alexander, co-chairs of the Climate Change Subgroup, convened a call on December 15, 2014, to continue to hear and discuss the latest research on climate change science. This included a continuation of the previous Climate Change Subgroup call which was focused on the impact of physical factors based on river herring and other anadromous species derived from observations, and an examination of future changes from model projections. The call also focused on how climate and thus, river herring habitat are expected to change in the future and how lessons/modelling from Pacific salmon climate projections may be applied to river herring. The draft agenda for the meeting included topics such as: 1) speaker presentations; 2) discussion of presentations, and 3) review paper outline to report on the subgroup's findings. This meeting summary includes the primary discussion topics and outcomes to contribute to future TEWG discussions. The information provided below reflects individual expert opinion and not consensus.

II. Key Topics

The following is a list of individual expert opinions provided by Climate Change Subgroup members or the public on various overarching topics. Some ideas have been combined where appropriate.

- Speaker's conclusions (full presentations available at the website below) and individual comments include:
    - *Review and progress of climate change downscaling since workshop* presented by Michael Alexander (NOAA/ESRL/PSD). A few years ago, Michael Alexander did a study using regional models to downscale climate change over eastern United States. He compared the difference between two time periods: the 20th (1968-1999) and the 21st century (2038-2069) from the the North American Regional Climate Change Assessment Program's (NARCCAP) maps, which uses combinations of Global Climate Models (GCMs) and Regional Models (RCMs). Output from the RCMs, which have a horizontal resolution of ~50 km, exhibited changes in temperature and precipitation due to an increase in greenhouse gasses in the latter period. There is robust warming throughout the eastern United States. The temperature will be approximately 2°-3°C warmer on land in the mid-21st

century to late 20th century. There is also greater warming in the ocean at the surface than at depth that leads to enhanced stratification. There is enhanced precipitation in the fall and winter, but there is more uncertainty in this than in temperature. While the model simulations show that there will be reduced snow depth and earlier snow melt in the northeast, there is a large spread in the model simulations of when this occurs.

Alexander then looked at the three hydrological units (HUCs, essential large watersheds) along the Atlantic coast at 50km resolution. When looking at precipitation as a function of the seasonal cycle, it is enhanced in the wintertime in the future. The models also suggest that the summer can be drier in the southeast. In HUC 1 (the area furthest north), there is more snow in the 20th century that in the 21st century. There tends to be more runoff earlier in the year, and it increases up to April.

Alexander noted a web portal is available (http://www.esrl.noaa.gov/psd/ipcc/) which includes information on lands and rivers, as well as oceans and marine ecosystems. Feedback is welcome on how to improve it.

- Comments: Most of the spatial resolution in the GCMS is on the order of 100 km. Michael Alexander is looking at plotting bottom temperature to see what it looks like at this resolution. These models don't have complex topography and bathymetry. USGS in Maine have documented historic snow fall which might be useful to look at with past river herring data.

- *Northeast US flood trends and relevance to river herring passage and habitat,* presented by Mathias Collins (NOAA/NMFS/OHC/HRD). Flood magnitude and frequency can directly and indirectly affect river herring passage and habitat. For example, floods directly affect stream habitat via influence on sediment transport and alluvial channel size. Very little is known about how other factors such as migration timing, juvenile survival and growth are affected by flood magnitude and/or frequency.

  Historically, there has been as much as a 20% increase in annual precipitation in the northeast (Peterson et al. 2013). There has also been a pronounced increase in the frequency and intensity of very heavy precipitation (Karl et al 2009; Spierre and Wake 2010, Douglas and Fairbank 2011, and Kunkel et al. 2013). Mathias Collins has been looking at flood magnitude in HUCs 1 and 2 in the northeast. The climate sensitive gauges that have been used have on average 75 year records. The majority of the gauges show upward trends in flood magnitude and frequency and the results are field significant. The data suggest step increases in flood magnitude and frequency around 1970.

Projected increases in heavy precipitation suggest further increases in floods and associated impacts. We still know very little about historical changes or future projections in flood timing for the northeast.

- Comments: These data were not season specific, but were annual series. A separate study was done to look at the flood regimes in the region, and there were no trends in the mechanisms themselves (e.g., rain, rain-on-snow, snowmelt). It appears that the spring and fall are important times for river herring. According to the subgroup, there is no known study on the effects of flooding on river herring.

- *West coast salmon and climate change research*, presented by Nate Mantua (NOAA/NMFS/SWFSC). The Pacific salmon life cycle provides a framework for evaluating climate impacts at various life history stages. It includes freshwater spawning and rearing, sometimes estuary rearing, and an extended period in the ocean for growth and maturation. In their freshwater habitats, flow and temperature are critical climate pressure points. Pacific salmon use marine habitat in the north Pacific that are enriched in nutrients and high in food-web productivity. In their marine habitat, productive food webs are critical for ocean growth and survival. They spend most of their life and 99% of their growth in marine habitat.

  For many west coast salmon populations, adult spawning migrations are sensitive to water temperatures greater than 21°C. When it gets this warm, they are likely to either halt their migrations or seek out cooler temperatures until the temperature drops. These high temperatures can create great duress and promote pathogens that massively kill adult salmon. This has led to the closing of ocean fisheries in the past. Water temperature is also an important part of marine habitat for salmon. By the 2080s, it is predicted that sockeye salmon thermal habitat in the Gulf of Alaska will be decreased due in part to a relatively low upper thermal limit.

  There are several models that have been used to look at the affects of climate change on Pacific salmon. Simple regression models have been used to translate future air temperature scenarios into stream temperature scenarios (Mantua et al. 2010). The model that was done for the Columbia River predicts that the number of weeks that the river will reach 21°C or above will increase, start earlier, and last later in the year. Habitat temperature needs for a particular species can be overlayed onto a map to show the historical and future salmon habitat.

  Battin et al. 2007 evaluated the benefits of alternative habitat restoration plans under different future climate scenarios by using linked hydrologic and

salmon lifecycle models. The results showed that climate change will make salmon restoration more difficult due to increased flows in the winter that will crush or bury the eggs. By 2050, climate change effects are likely to increase the proportion of Snohomish Basin Chinook spawning at lower elevations.

Wade et al. 2013 looked at the vulnerability of steelhead to climate change. They defined vulnerability as sensitivity x exposure to climate change. Another study that is closely related to the vulnerability assessment is Beechie et al. 2012 where they looked at habitat restoration alternatives with respect to particular climate change threats to salmon with a focus on flow and temperature. This helps to show the most effective actions for different problems. This can also be done by creating a flow chart that shows various outcomes.

- Comments: Temperature is correlated with other factors. There are efforts to study other factors such as photo period and flow.

- The subgroup talked about next steps related to reporting out on their progress to date. Comments included the following:
  - Research needs will be an important component to include in the report.
  - The river herring life cycle could be a good way to structure a report or publication, because temperature and flow have been identified as the main stressors of climate change. Each section could be broken up by life stage with climate change projections. The case studies from other species could be projected forward on river herring.
  - During the 2012 Climate Change Workshop, a table was presented with different life stages river herring that included different water bodies and regions. There was not a lot of information so this table was not completed at the workshop.
  - There might be different effects that impact different life stages in different areas. Another component might be useful in the report.
  - The report might need a section on predator/prey distribution and interaction.
  - There might not be enough information for a regional section. Should there be another category at the end of the regional component? Would it be broken up by the stock structure groups that were proposed or by HUC units?
  - Juvenile rearing and migration should be separated in the report, because rearing is specifically in freshwater, and migration is in estuarine and marine environments.
  - It would be beneficial to look at climate in relation to restoration in order to see where our efforts are best applied and where they are most likely to succeed.
  - The report might need a section on predator/prey distribution and interaction.

- The charge is to review what we know and outline what we do not know that would be useful to assess impacts of climate change on river herring. Knowledge gaps should be included in the report.

III. Key Outcomes

Below is a list of individual expert opinions provided by participants related to specific threats, data gaps, research projects, information to be considered and/or monitoring (i.e., the identified research projects and/or conservation actions). Some ideas have been combined where appropriate. These outcomes are listed in no particular order, and those related to other subgroups are also included in the "Cross-Cutting Issues" section below.

a. Data Gaps
   - Effects of flooding on river herring populations.
     - Effects of flood's magnitude and/or frequency on river herring migration timing, survival, and growth.
   - Historical changes or future projections in flood timing for the northeast.

b. Research Projects
   - Climate change in relation to habitat restoration (e.g., where are efforts best applied or where are they most likely to be successful).

c. Information To Be Considered (e.g., published papers)
   - A climate change web portal is currently being developed to help show the change in ocean conditions (http://www.esrl.noaa.gov/psd/ipcc). There are a lot of fields to look at including chlorophyll, and more fields will be added shortly.
   - The USGS Maine office has historical data documenting less snow pack as time progresses. That might be useful to compare with past river herring data.
   - A post doc from Stony Brook University found that the Monument River has not been impacted by snow pack. It could be related to the strengths of the river runs and recruitment.

IV. Next Steps

The Climate Change Subgroup discussed the following next steps:

- Janet Nye will take lead in organizing all the sections for the report.
- The following people have been assigned or will be asked to work on section of the report. Subgroup members will be asked for additional input on the report and sections they might want to contribute to:
  - Michael Alexander – Climate, changes in the physical environment
  - Stephen McCormick – Juvenile migration
  - Karen Wilson – Estuary
  - Karin Limburg – Estuary and freshwater (to be asked)
  - Andrew Jones & Joel Llopiz – Eggs and larvae

    - Janet Nye – Marine
    - Charles Stock – Climate
    - Desiree Tommasi – Phenology (to be asked)
- Janet Nye will narrow down the list of research needs to about 15 total and will share with the rest of the subgroup for review and prioritization. All rankings will be kept confidential. Janet and Mike Alexander will be seeking additional research needs from the subgroup.
- A draft meeting summary will be distributed to the subgroup.

V. Cross-Cutting Subgroup Issues

The following cross-cutting subgroups issues were discussed and will be further considered by the TEWG and its Ecosystem Integration Committee.

- None

VI. Participants

a. Subgroup Members

The affiliation of each member can be found on the subgroup roster available at the TEWG Climate Change Subgroup website:
http://www.greateratlantic.fisheries.noaa.gov/protected/riverherring/tewg/climate/index.html

Michael Alexander
Diane Borggaard
Frank Borsuk
Jon Hare
Stephen McCormick
Peter Moore
Eric Nelson
Janet Nye
Charles Stock
Karen Wilson

b. Other Participants

Edith Carson
Matt Collins
Andrew Jones
Joel Llopiz
Nate Mantua

VII. Meeting Materials

The following materials were provided to support the meeting. Additional information can be found at the TEWG Climate Change Subgroup website:
http://www.greateratlantic.fisheries.noaa.gov/protected/riverherring/tewg/climate/index.html

a. Draft Agenda
b. PowerPoint presentation showing the outline for the report of the subgroup's findings
c. PowerPoint presentation showing list of research needs