Habitat Hotline Atlantic

Issues of Concern for Atlantic Marine Fish Habitat August 2002, Volume IX, Number 2

How is the Drought Impacting Fish Habitat?

No matter where you live in the United States, you are probably familiar with drought. According to the National Climatic Data Center, 36% of the contiguous United States was in severe to extreme drought by the end of June.[1] Drought conditions are impacting the East and West coasts, as well as the South and interior portions of our country (see Figure 1). In cases of severe drought, emergency water use restrictions can be imposed to conserve water such as prohibitions on car washing and watering plants. Drought can result in lower water levels (lakes and rivers) and increased water salinity (bays and estuaries).

During a drought, fresh water flow is reduced to bays and estuaries. This is happening particularly in the mid-Atlantic region (see Figure 2). For example in the Chesapeake Bay, while there appears to be a natural cycle of high and low water flows, the current severe drought conditions have resulted in the lowest fresh water input since 1941.

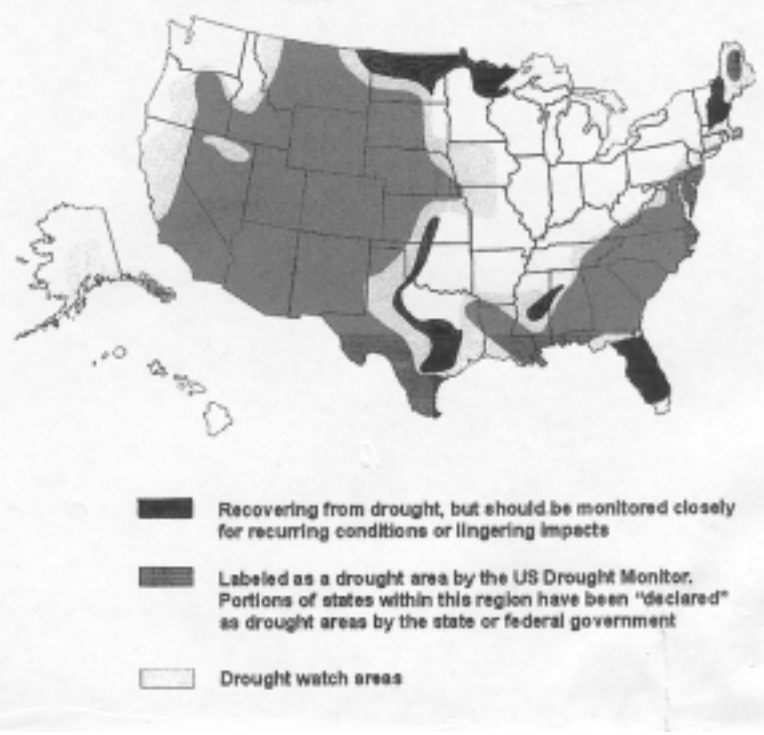

Figure 1. Map showing drought impacts in the United States, June 11-July 5, 2002. Source: National Drought Mitigation Center (http://drought.unl.edu/impacts/us/usimpact.htm).

A drought can affect a whole ecosystem including the physical, chemical and biological components. In aquatic systems, seagrasses, plankton, invertebrates, fish, and marine mammals are impacted in some way. This article focuses on possible drought impacts to fish and fish habitat in lakes, rivers, estuaries and bays.

Drought impacts on water levels, temperature, salinity and dissolved oxygen

Temperature, salinity and dissolved oxygen are important related factors that determine aquatic

(continued on page 2)

ASMFC, 1444 Eye Street, NW, Sixth Floor, Washington, DC 20005 (202) 289-6400 phone (202) 289-6051 fax

(continued from page 1)

species abundance and distribution. Aquatic animals and plants have specific ranges or tolerances of these variables and changes can alter abundance and distribution as well as impact reproduction and survival. For example, marine worms need as little as 1 milligram of dissolved oxygen in a liter of water. Blue crabs and Bay anchovies require 3 and American shad and striped bass require the most—about 5 milligrams. In addition, young fish are more likely to be sensitive to low-oxygen conditions than adults.[2]

Usually, drought is associated with warm weather conditions. Below average rainfall results in low water levels in lakes, streams, and rivers as well as reduced freshwater flow to bays and estuaries. As a result of lower water levels temperatures in many water bodies can rise. Reduced freshwater flow can result in higher salinity in bays and estuaries and also in adjacent portions of rivers and streams. Temperature and salinity directly affect the amount of dissolved oxygen in water. As water temperature increases, the amount of dissolved oxygen that water can hold decreases. Similarly, the more saline the water, the less oxygen the water can hold.[3]

Higher salinities can impact aquatic ecosystems in other ways as well. Higher salinity can increase oysters' susceptibility to two diseases, Dermo and MSX, that have been devastating oyster populations. However, these higher salinity can also provide more favorable spawning conditions for oysters. Submerged aquatic vegetation, including seagrasses, can die off because many have adapted to specific salinity levels and they can't tolerate the higher levels found during a drought.[4]

Figure 2. Map of below normal 7-day average streamflow compared to historical streamflow for all weeks of the year, July 24, 2002. (Source: U.S. Geological Service, http://water.usgs.gov/waterwatch/W_drya_map.html).

Considerations for Diadromous[5] Fish: Migration, Fish Passage, Habitat Availability and Susceptibility to Disease

Lower water levels in streams can increase susceptibility to disease in fish. Due to the low water levels, fish are stressed from crowding conditions, increased competition for food, and increased predation from birds, making them more susceptible to disease.[6]

During periods of drought, migratory fish can get trapped by low water levels. Such was the case in May 2002 when thousands of spawning fish died along the Apalachicola River in Florida. Many were concerned about the possible harm to the threatened Gulf sturgeon, whose eggs may have dried up before they could hatch.[7]

During periods of drought, low water flow can reduce available fish habitat in streams. For example, spawning areas can dry out and important cover (vegetation and woody debris) may be inaccessible to juvenile fish increasing their susceptibility to predation. Drought can also affect migratory fish by causing low water flow over or through fish passages making it difficult or impossible for fish to use, especially smaller passages.

In the Pacific Northwest, drought conditions created a fight over water for energy production and migrating salmon, some of which are endangered. With very low water levels in spring 2001, biologists undertook efforts to record salmon strandings and rescue fish. In one count, over 700,000 migrating juvenile fall Chinook were stranded on a beach.[8] Studies have been conducted to try to determine the response of juvenile Atlantic salmon to falling stream water levels. However, the results are contradictory with regard to whether the fish move to deeper pools or remain in shallow water and more research is needed.[9]

Periods of prolonged drought with reduced water flow can affect channel maintenance and fish reproduction in streams. Channel maintenance can become an issue because high water flows are important for scouring and sediment transportation.[10] Overwintering fish eggs that are laid on stream bottoms and covered with gravel can be harmed by

(continued on page 3)

(continued from page 2)

'anchor ice' produced because of the low water flow conditions. The anchor ice obstructs normal stream water from flowing through the gravel to bring oxygen to and remove wastes from eggs and embryos.[11] In addition, study results show a correlation between water flow and striped bass recruitment where higher survival related to adequate fresh water flow during the Spring spawning period.[12]

Drought impacts on Nutrient Levels

Reduced fresh water flow also means reduced nutrients and sediments coming into a bay through runoff. Reduced nutrients could result in fewer harmful algal blooms in the bay. This reduction can help maintain adequate dissolved oxygen levels, especially when the water temperature and salinity are higher. However while nutrients are reduced into a bay during a drought, this means that nutrients are now trapped in tributaries stimulating algal blooms and affecting dissolved oxygen levels in those areas.

A reduction in nutrients and sediments can also improve water clarity. Increased water clarity allows more light to reach submerged aquatic vegetation (SAV), thus, improving conditions for SAV growth and photosynthesis. SAV provide important habitat for many species, including fish and crabs.[13]

Opportunities for Habitat Restoration

Drought conditions and low water levels can provide opportunities for improving fish habitat. A fish and wildlife habitat restoration project was undertaken in Lake Walk-In-Water (Weohyakapka) a 7,500-acre freshwater lake in Florida renowned as a top bass fishing lake. The project involved removing unwanted decaying plant material around the shoreline that was increasing nutrients to the lake, impeding water flow and choking sportfish spawning areas and waterfowl habitat. In addition, the project sought to check the uncontrolled growth of cattails through use of herbicides and replanting the shoreline areas with beneficial aquatic plants e.g., native grasses and bulrush.[14] Another project underway is Florida's Harris Chain of Lakes that seeks to reestablish beneficial native plants in an effort to improve fish and wildlife habitat in these lakes.[15] In addition, low water and warm weather provide conditions that are conducive for dam removal. Dam removal improves fish habitat by opening passage to migrating fish and improving water flow and water quality.[16]

Recovery

How do fish and fish habitat recover from drought impacts? In one study, Paller (1997)[17] examined the recovery of a fresh water reservoir fish community from drawdown impacts. The water level was lowered for 3.5 years. The study results showed that within 9 months of refill, the fish community recovered in terms of number of species and overall fish abundance. However, size structures were different after drawdown—there were fewer large individuals and more smaller individuals.

(continued on page 4)

Climate and Drought

With a network of data collecting buoys, scientists can now link ocean conditions (sea surface temperature) in the equatorial Pacific to changes in rainfall and temperature in the U.S. El Niño refers to the condition when sea surface temperatures in the tropical Pacific are warmer than normal. El Niño events happen every 3 to 5 years on average. During El Niño events, the southeast U.S. can receive a lot of rain causing severe flooding and the northeast can experience major storms. La Niña refers to the condition when sea surface temperatures in the tropical Pacific are colder than normal. During La Niña events, rainfall is below normal in the southeastern United States causing drought conditions. La Niña tends to occur after El Niño, but not always. The intensity of these events varies, some are mild and some are strong.

Is there a relationship between global warming and severe drought conditions? Some scientists say that global warming may accentuate El Niño impacts since El Niño events have increased in frequency and have had greater climate impacts over the past century. This change corresponds to a rise in global temperatures. (www.cpc.ncep.noaa.gov/products/outreach/advance.html under "El Niño and Global Warming: Any Connection?" by NOAA's Climate Prediction Center web team.

Along the East coast of the United States, El Niño and La Niña impacts are beginning to be better understood (e.g., drought in the southeast associated with La Niña). Further research will hopefully reveal more links between these events and our coastal ecosystems, especially with regard to changes in fish habitat, populations, distribution, abundance, predation, and mortality. The difficult part will be trying to tease out climate impacts to fish and fish habitat from other impacts e.g., human related impacts.

NOAA has just declared (July 11, 2002) that we are officially entering an El Niño phase once again. Hence scientists have another opportunity for research. This hopefully will signal the end of the severe drought in the U.S.

Sources: NOAA's El Niño web site at www.elnino.noaa.gov; NOAA's Climate Prediction Center's fact sheets at http://www.cpc.ncep.noaa.gov/products/outreach/facts.html; and NOAA Press Release, July 11, 2002, at http://www.publicaffairs.noaa.gov/releases2002/july02/noaa02089.html

(continued from page 3)

Considerations for Management

Drought conditions impact fish and their habitat and drought severity can vary greatly. Planning for low water flow conditions should be undertaken particularly considering diadromous species spawning and migration. Plans could be developed to respond to severe drought conditions including water release/spillover schedules, monitoring and collection of stranded fish, and alternative fish passage options. In addition, habitat restoration projects could be designed for implementation during drought conditions, especially efforts to restore native vegetation and to improve water quality.

---

[1] "Drought parches One Third of the Nation," ENS, July 19, 2002, http://ens-news.com/ens/jul2002/2002-07-19-09.asp.

[2] "Drought and Dissolved Oxygen in the Chesapeake Bay watershed," Watershed Radio on Tuesday, April 23, 2002, www.watershedradio.org/april2002/042302droug.htm.

[3] Ibid.

[4] "Drought and the Chesapeake Bay", Chesapeake Bay Program, www.chesapeakebay.net/info/drought.cfm.

[5] Diadromous refers to fish that migrate between freshwater and saltwater.

[6] "Drought may dry up fish population as well as fishing holes", Penn State News, http://aginfo.psu.edu/News/january99/fish.html).

[7] "Spawning fish die along Apalachicola" by Bruce Ritchie, Tallahassee.com, May 7, 2002.

[8] "Low flows, held water threaten salmon" by Lynda V. Mapes, Seattletimes.com, Friday, June 8, 2001.

[9] Huntingford, F.A., D. Aird, P. Joiner, K.E. Thorpe, V.A. Braithwaite and J.D. Armstrong, 1999. How juvenile Atlantic salmon, Salmo salar L., respond to falling water levels: experiments in an artificial stream. Fisheries Management and Ecology, 6: 357-364.

[10] "How does drought affect fish?" by Rob Neumann, University of Connecticut, www.ctiwr.uconn.edu/Publications/Drought/Fish.htm.

[11] "Drought May Dry up Fish Population as Well as Fishing Holes," Penn State News, January 28, 1999, http://aginfo.psu.edu/News/january99/fish.html.

[12] Stevens, D.E. 1977. Striped bass (Morone saxatilis) year class strength in relation to river flow in the Sacramento-San Joaquin Estuary, California. Transactions of the American Fisheries Society 106(1): 34-42.

Uphoff, J.H. 1989. Environmental effects on survival of eggs, larvae, and juveniles of striped bass in the Choptank River, Maryland. Transactions of the American Fisheries Society 118(3):251-263.

[13] "Drought and the Chesapeake Bay", Chesapeake Bay Program, www.chesapeakebay.net/info/drought.cfm.

[14] Florida Fish and Wildlife Conservation and Commission web site, www.floridaconservation.org/whatsnew/region01/wiwrestore-sw.html.

[15] Florida Fish and Wildlife Conservation and Commission web site, www.floridaconservation.org/whatsnew/region02/harrischain-neast.html.

[16] American Rivers Press Release, July 18, 2002, http://www.amrivers.org/pressrelease/damremoval071802.htm.

[17] Paller, Michael H., 1997. Recovery of a Resevoir Fish Community from Drawdown Related Impacts. North American Journal of Fisheries Management 17: 726-733.

New Online Atlas of the Oceans

On June 5 the United Nations and leading international scientific agencies launched an Internet-based atlas providing users with continuously updated data on the state of the world's oceans, maps, development trends and threats to human health from the deteriorating marine environment. The Atlas will spotlight important issues, e.g., over-fishing and coastal habitat destruction, and provide links to real-time maps and tracking data. The Atlas is intended for a wide range of users from schoolchildren, educators and the general public to policy makers, scientists, the media, NGOs, and resource managers needing access to comprehensive databases.

The Atlas contains an initial 14 global maps and links to hundreds of others, including 264 maps showing the distribution of fishery resources and another 100 maps showing global ice cover, temperature gradients, bottom contours, salinity and other ocean characteristics. The Atlas organizes information into four general subject areas, including uses (e.g., fisheries), issues (e.g., climate variability and climate change), background (information about the oceans such as biology and ecology), and geographical (categorizes information according to geographic region). Fishing, algal blooms and invasive species are among the issues addressed.

Partners include the U.S. National Oceanic and Atmospheric Administration, the Russian Head Department of Navigation and Oceanography, the National Geographic Society, the UN Division for Ocean Affairs, the Law of the Sea and others. The need for the Atlas was identified during the 1992 Rio Earth Summit in response to a call to identify and address the greatest environmental challenges facing the planet.

The UN Oceans Atlas is funded by the United Nations Foundation and is online at www.oceansatlas.org.

Source: Press release, UN Atlas of the Oceans: http://www.oceansatlas.org/html/docs/pr_e.html.

63 Dams to be removed in 2002

Sixty-three dams in 15 states and the District of Columbia are scheduled for removal in the 2002 calendar year— the most since American Rivers began conducting its annual survey in 1999. Warm weather and low water are conducive to these projects and many removal efforts will be getting underway in coming weeks.

The nation's aging dam infrastructure, combined with a growing appreciation of the ecological impacts of dams is the impetus behind this burgeoning dam removal movement. About 40 dams have been removed since 1999 when the breaching of Edwards Dam on Maine's Kennebec River captured national attention.

The dams slated for removal this year represent just a tiny fraction of the dams in place across the country. There are approximately 75,000 dams greater than 6 feet high and countless smaller obstructions. The majority of these were built for purposes such as running mills, controlling floods, and to create municipal and agricultural water supplies. Less than 3% generate hydroelectricity.

While dams can provide valuable services, they have impacts—dams drown valuable habitat under reservoirs, block the annual migrations of fish, and can create downstream conditions inhospitable for fish and wildlife. Furthermore, as dams age, their benefits often diminish while maintenance costs and safety hazards increase. For example, it would have cost $400,000 to repair Deerskin Dam on the Deerskin River in Wisconsin. Instead, the community chose to remove it in 2000 at a cost of just $15,000. The Association of State Dam Safety Officials estimates that approximately 30% of America's dams have reached the end of their useful lives.

American Rivers, Trout Unlimited, and River Alliance of Wisconsin all provide educational, technical, and financial assistance to communities that are considering or have committed to removing a dam it no longer needs.

Dams in Atlantic coast states scheduled for removal in 2002 include:

Connecticut: *Eight Mile River*
District of Colombia: *Rock Creek (2x)*
Massachusetts: *Town Brook and Third Herring Brook*
Maine: *St. George River and Presumpscot River*
New York: *Back Creek*
North Carolina: *Hitchcock Creek, Little Sugar Creek and Marks Creek Tributary*
Pennsylvania: *Conodoguinet Creek, Perkiomen Creek, Chickes Creek, Conewago Creek, Ridley Creek, Delaware River Tributary, Delaware Water Gap National Recreation Area, Trindle Spring Run and Wyomissing Creek (3x)*

For more information contact Elizabeth Maclin or Eric Eckl at American Rivers (202) 347-7550.

Source: American Rivers Press Release, July 18, 2002, http://www.amrivers.org/pressrelease/damremoval071802.htm.

Beach Water Quality Information Available Online

Beach goers can now find out easily whether their favorite ocean beach is clean enough for swimming or closed because of water pollution. By logging on to www.oceana.org or www.earth911.org, health advisory, beach closure and ocean pollution information will be easy to access in one location. Information is also provided on community-specific actions that can be taken to help keep local beaches, coastal waters, and lakes, streams, and rivers clean and safe. The application is currently being expanded in several communities and will soon be available nationwide.

Environmental organizations Oceana and Earth 911 have joined with state and local health and other environmental agencies to establish the national Beach Reporting System (BRS), which compiles the most recent data on beach water quality across the country. The results of official government water tests are reported to the system and the new web service presents the information in colorful, easy to read maps that link to descriptions of beach water quality on both organizations web sites.

The BRS was created in response to the Beaches Environmental Assessment and Coastal Health (B.E.A.C.H.) Act of 2000 that created a consistent approach to public notification of water quality monitoring results. The BRS allows local health and environmental officials to notify the public of water quality sampling results and health determinations immediately as they are detected using both the Internet and a toll-free hotline.

Oceana is a new international environmental organization created to protect the world's oceans. In May, Oceana merged with the American Oceans Campaign. Oceana's Beach Water Quality Site, Media Center and other information resources are available at www.Oceana.org or by calling toll-free 1-877-7-OCEANA.

Earth 911 is a nationwide network of community-specific environmental resources and information available online (Earth911.org) or toll-free (1-800-CLEANUP), delivering yearlong local resources on recycling, household hazardous waste disposal, beach water quality and other environmental issues.

Source: Oceana Press Release, July 2, 2002, http://www.oceana.org/index.cfm?sectionID=10&fuseaction=35.detail&pressreleaseID=52.

Low-Polluting Engine Initiative Expands in New England

The U.S. Environmental Protection Agency (EPA) has joined with New England state environmental agencies and marine industry and trade associations to expand a voluntary initiative to encourage the sale of low-polluting outboard motors and personal watercraft engines. Modeled after a successful program by the state of New Hampshire, the "Get On Board" initiative is being expanded this year by EPA to the rest of New England and New York's Lake Champlain region. The program is designed to accelerate the sale of low-pollution two-and four-stroke marine engines which emit substantially less pollution than conventional marine engines. The conventional engines discharge up to 30 percent of their fuel directly into the water and air as pollution. This produces airborne hydrocarbon emissions which contribute to the formation of ground-level ozone or smog. Gasoline discharged to the water elevates concentrations of benzene, MTBE (methyl tertiary-butyl ether, a gasoline additive) and other toxics in lakes, ponds, and coastal waters.

Current low-pollution marine gasoline engines are either four-stroke or improved, fuel-injected two-stroke engines. Engines meeting EPA low-pollution requirements reduce air pollution by 75 percent or more, lower gasoline discharges to the water, improve fuel efficiency by 35-50 percent, and use up to 50 percent less oil. Other benefits include easier starting, better response, and less smoke and noise. While low-pollution engines cost more initially (15 percent more, typically), EPA estimates that the savings from lower fuel use will more than repay the difference over the life of the engine.

All parties have signed Memorandums of Understanding. Under the agreements, participating retailers will encourage customers to buy low-polluting engines. EPA regulations require that by 2006, all manufacturers' average emissions for new outboard and personal watercraft engines meet low-pollution standards.

Source: EPA New England Press Release, July 11, 2002; Release # 02-07-16, http://www.epa.gov/region1/pr/2002/jul/020716.html

Atlantic States Marine Fisheries Commission
1444 Eye Street, N.W., 6th Floor
Washington D.C. 20005

Return Service Requested

Habitat Hotline
Atlantic

Robin L. Peuser
Carrie D. Selberg
Editors

Funded by