



# Fish and Shellfish Program NEWSLETTER

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<https://www.epa.gov/fish-tech>

## Recent Advisory News

### Louisiana Issues Advisory for Bayou D’Inde, Portions of the Calcasieu Ship Channel, and the Upper Calcasieu Estuary

On November 17, 2016, the Louisiana Departments of Health, Environmental Quality, and Wildlife and Fisheries issued a new advisory concerning fish and shellfish for Bayou D’Inde, the Calcasieu Estuary, and the Calcasieu Ship Channel.

For Bayou D’Inde and the Calcasieu Ship Channel between channel markers #31 and #33, state agencies advise the following:

- Do not eat catfish
- Do not eat crab fat
- Limit consumption of other fish and shellfish to two meals per month

For the portion of the Calcasieu Estuary that lies north of channel marker #11 and is not covered by the Bayou D’Inde/Calcasieu Ship Channel Advisory, state agencies advise the following:

- Do not eat crab fat

This advisory is in response to recent sampling and analysis of finfish and shellfish and is based on sampling data from 2011–2015. Shrimp, blue crab, oysters, and finfish were tested for polychlorinated biphenyls (PCBs), dioxins, and furans. Elevated levels of PCBs, dioxins, and furans were found in the tissue (meat/fillet) of some species. Unacceptable levels of PCBs, dioxins, and furans were also found in crab hepatopancreas (fat).

This advisory is issued as a precaution. For more information regarding this advisory, contact the Department of Health at 1-888-293-7020 or visit

[www.ldh.la.gov/EatSafeFish](http://www.ldh.la.gov/EatSafeFish).

[Click here](#) for an informational brochure entitled *Eating Recreationally Caught Seafood in Louisiana: How to Choose, Clean and Cook Your Catch*, or call 1-888-293-7020 to request copies of the brochure.

Source: <http://www.wlf.louisiana.gov/news/40698>.



## Department of Energy and Environment Issues 2016 Fish Consumption Advisory in the District of Columbia

On February 10, 2016, the [Department of Energy and Environment](#) (DOEE) issued its [2016 Fish Consumption Advisory](#) recommending that residents do not eat American eel, carp, and striped bass caught in District waters. The advisory stated that these fish have elevated levels of toxic chemicals such as PCBs.

According to the Advisory, other fish species caught in the District including sunfish, blue catfish, northern snakehead, white perch, largemouth bass, brown bullhead catfish, and channel catfish should be consumed only on a limited basis and in accordance with the District's [preparation guidelines](#). The preparation guidelines outline the importance of trimming away fat from the fish, and broiling or grilling the fish to allow remaining fat to drip away.

“Our goal is to protect the health and wellbeing of our residents,” said DOEE Director Tommy Wells. “This Advisory helps ensure that residents who enjoy fish from District waters are aware of the health risks associated with consuming certain fish species.”

DOEE has been monitoring fish contaminant levels in the District since 1980. During this period, there has been a decrease in contaminant levels associated with some species of fish. As a result, the 2016 Advisory provides for increased consumption of certain species over the earlier advisory. For example, the recommended consumption limit for sunfish and largemouth bass has more than doubled since the first advisory was issued in 1994. Catfish, once classified as “not to consume,” may now be eaten in limited quantities. “The decrease in our resident fish species’ chemical contaminant concentrations is encouraging,” said Director Wells. “But, there is still more work to be done and we must continue our [ongoing efforts to improve the health of our waterways](#).”

The Advisory covers the portions of the Anacostia and Potomac Rivers within District boundaries; it does not apply to fish raised for commercial purposes or those bought in stores, fish markets, or restaurants.

For more information on fishing in the District, visit DOEE’s website at <http://doee.dc.gov/node/9582>.

For more information, contact Julia Robey Christian, PIO, 202-741-0842 (desk), 202-450-7878 (cell), [Julia.Christian@dc.gov](mailto:Julia.Christian@dc.gov).

Source: [http://doee.dc.gov/sites/default/files/dc/sites/ddoe/release\\_content/attachments/2016-02-10-PRESSRELEASE-FISH-CONSUMPTION.pdf](http://doee.dc.gov/sites/default/files/dc/sites/ddoe/release_content/attachments/2016-02-10-PRESSRELEASE-FISH-CONSUMPTION.pdf).



## 2016 Missouri Fish Advisory: A Guide to Eating Missouri Fish

Annually, the Missouri Department of Health and Senior Services (DHSS) works with the Missouri Department of Conservation and other agencies to evaluate the amount of contaminants in Missouri sport-caught fish. Each year DHSS creates a fish consumption advisory discussing those findings and informing individuals of any potential health risks associated with eating certain Missouri sport-caught fish. The fish advisory provides advice on the amount of fish to safely eat and encourages individuals to eat a healthy diet that includes fish.

The 2016 advisory has three changes:

- 1) Recent testing in Lake Buteo has found that chlordane levels in the fish have dropped below levels of health concern. The Missouri DHSS has removed the advisories associated with chlordane; however, mercury levels in fish in this lake are still high. As a result, DHSS still has a “do not consume” advisory on bass and has added a “no more than 1 meal per month” advisory for all other fish.
- 2) A “no more than 1 meal per month” advisory has been added for catfish and carp of all sizes taken from Lake Springfield due to elevated levels of PCBs being found in catfish. Although Lake Springfield is part of the James River, there is not current data available to be able to determine if fish in the James River also contain elevated levels of PCBs or not.
- 3) A “no more than 1 meal per week” advisory has been added for catfish greater than 24 inches taken from Montrose Lake due to PCBs.

Sources: <http://health.mo.gov/living/environment/fishadvisory/pdf/fishadvisory.pdf>;  
<http://health.mo.gov/living/environment/fishadvisory/>.

## EPA News

### Predicting Effects of Coastal Acidification on Marine Bivalve Populations

The partial pressure of carbon dioxide ( $p\text{CO}_2$ ) is increasing in the oceans and causing changes in seawater pH. This is commonly described as ocean or coastal acidification. When reproduced in laboratory experiments, these increases in  $p\text{CO}_2$  can reduce survival and growth of early life stage bivalves. However, the ways that these impairments translate to effects on whole populations of bivalves are unknown. In this study, laboratory responses were incorporated into field-parameterized population models to assess population-level sensitivities to acidification for two northeast bivalve species with different life histories: *Mercenaria mercenaria* (hard clam) and *Argopecten irradians* (bay scallop). The resulting



Hard clam (*Mercenaria mercenaria*). (Image of USDA via [LeaMaimone, Wikimedia Commons](#))

models permitted translation of laboratory  $p\text{CO}_2$  response functions into population-level responses to examine population sensitivity to future  $p\text{CO}_2$  changes. Preliminary results from our models indicate that if the current *M. mercenaria* negative population growth rate was attributed to the effects of  $p\text{CO}_2$  on early life stages, the population would decline at a rate of 50% per ten years at 420 microatmospheres ( $\mu\text{atm}$ )  $p\text{CO}_2$ . If the current population growth rate was attributed to other additive factors (e.g., harvest, harmful algal blooms), *M. mercenaria* populations were predicted to decline at a rate of 50% per ten years at the preliminary estimate of 1010  $\mu\text{atm}$   $p\text{CO}_2$ . The estimated population growth rate was positive for *A. irradians*, but was predicted to become negative at

$\geq 530 \mu\text{atm } p\text{CO}_2$ , with a 50% decline per ten years at  $\geq 610 \mu\text{atm } p\text{CO}_2$ . Given the continual rise of atmospheric  $p\text{CO}_2$ , mitigation of eutrophication-based  $p\text{CO}_2$  or other stressors is required for sustainable populations. This study demonstrates that elevated rates of early life stage mortality wrought by moderate levels of acidification are enough to produce significant declines in projected abundances and potentially hinder some bivalve restoration efforts. These results are described in a manuscript prepared in collaboration among scientists from EPA's Office of Research and Development, Stony Brook University, and Long Island University, and are currently under review for publication in the peer-reviewed literature.

For more information, contact Jason Grear ([Grear.Jason@epa.gov](mailto:Grear.Jason@epa.gov)) at EPA's National Health and Environmental Effects Research Laboratory, Atlantic Ecology Division, Office of Research and Development.

## **EPA Updates Standards for Toxic Pollutants in Washington Waters**

On November 15, 2016, the EPA announced actions to update the limits for toxic pollutants in Washington's surface waters, which will protect water quality and people who eat fish from those waters. These actions set standards aimed at protecting those who eat salmon and other fish and shellfish from Washington waters.

Specifically, EPA approved 45 of the pollution standards the Washington Department of Ecology (Ecology) adopted earlier this year and finalized updates to 144 additional federal standards. For a complete list of the pollutants addressed in this action go to <https://www.epa.gov/wqs-tech/water-quality-standards-regulations-washington#fed>.

Surveys of local residents in the Pacific Northwest, including tribes with treaty-protected rights, reflect that Washingtonians eat fish and shellfish at levels much higher than the rate that was previously used to set standards for toxics in Washington's waters. EPA and Ecology have been working to establish these new water quality standards based on a far more realistic estimate of the amount of fish Washingtonians eat.

"We applaud the Governor and Ecology's decision to increase the fish consumption rate recognized in the standards and to retain the state's protective one-in-a-million cancer risk level. The fish consumption rate and risk level in the standards match those established in Oregon and clearly recognize that greater protection of people who eat larger amounts of fish is appropriate in the Pacific Northwest where fishing is a part of our heritage," EPA Regional Administrator Dennis McLerran said.

Most of Washington's human health standards for toxics in surface water haven't been updated since 1992. This new set of standards is based on the latest science about health protection and fish consumption rates. These actions ensure that water quality standards are now in place at levels that will adequately protect fish consumers in Washington, including tribes with treaty-protected rights, from exposure to toxic pollutants.

The region's tribes helped both the EPA and the state better understand the particular health risks that tribal members have long faced due to their consumption of large amounts of fish. In establishing a fish consumption rate that better reflects the amount of fish people eat, the Ecology and EPA standards will help to lower health risks from eating fish for all Washingtonians, even those, such as tribal members, who regularly consume large amounts of fish and shellfish. EPA's final rule incorporates Washington's 175 grams per day fish consumption rate and a one-in-one million cancer risk level.

In practice, Ecology and EPA will continue to work together to determine the right level of regulatory flexibility and the feasibility of meeting the new standards when incorporating new pollution limits into state permits and in other Clean Water Act programs. Flexibility in implementing these new standards will be important as pollutant detection and control technologies are developed.

For more information about EPA’s action on Washington’s water quality standards, visit <https://www.epa.gov/wqs-tech/water-quality-standards-regulations-washington#fed>.

For more information, contact Mark MacIntyre ([Macintyre.Mark@epa.gov](mailto:Macintyre.Mark@epa.gov)).

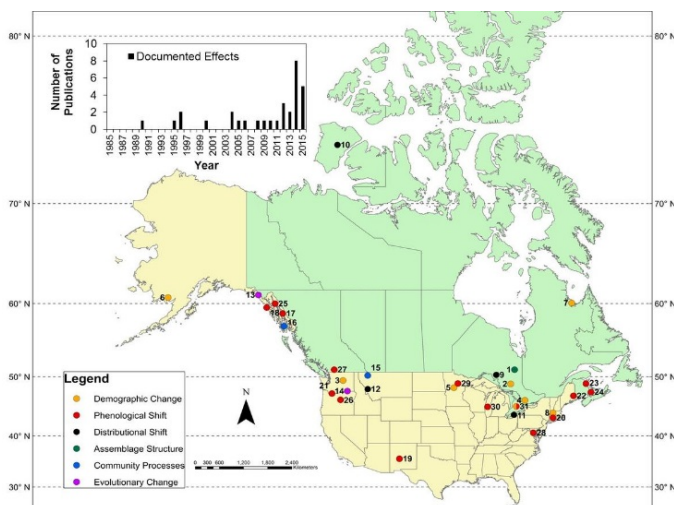
Source: <https://www.epa.gov/newsreleases/epa-updates-standards-toxic-pollutants-washington-waters>.

## Other News

### Climate Change is Affecting North American Fish

Scientists are seeing a variety of changes in how inland fish reproduce, grow and where they can live, according to four new studies published on June 29, 2016, in a special issue of [Fisheries magazine](#).

Fish that have the most documented risk include those living in arid environments and coldwater species such as sockeye salmon, lake trout, walleye, and prey fish that larger species depend on for food. Climate change can cause suboptimal habitat for some fish; warmer water, for example, can stress coldwater fish. When stressed, fish tend to eat less and grow less. For other fish, climate change is creating more suitable habitat; smallmouth bass populations, for example, are expanding.



Scientific studies between 1985 and 2015 that document climate change on North American inland fish. The color of the dots represents the fish response to climate change in each study. (Image courtesy of USGS)

The authors reviewed 31 studies across North America and Canada (see map) that document fish responses to climate change. The manuscripts describe the impacts of climate change on individual fish, fish populations, recreational fishers, and fisheries managers. One of the takeaway messages is that climate change effects on fish are rarely straightforward, and they affect warmwater and coldwater fish differently.

Smallmouth bass provide one example of how climate change presents fisheries managers with both challenges and opportunities. Smallmouth bass, a popular recreational species, are expanding their range northward with climate change. This expansion can disrupt existing food webs but it also creates new prospects for recreational fishing. Because many recreational fishers want to catch smallmouth bass,

managers may need new management techniques to accommodate the increased fishing demand while still maintaining the native coldwater fish communities. Consequently, the management process may likely be an exercise in managing expectations of the stakeholders for fisheries changing with climate change.

Other major findings:

- Climate change may be altering abundance and growth of some North American inland fishes, particularly coldwater fish such as sockeye salmon, a species experiencing well-documented shifts in range, abundance, migration, growth, and reproduction.
- Climate change may be causing earlier migration timing and allowing species that never occurred together previously to hybridize. For example, native westslope cutthroat trout in the Rocky Mountains are now hybridizing with rainbow trout, a non-native species.
- Shifts in species' ranges are already changing the kinds of fish in a specific waterbody, resulting in new species interactions and altered predator-prey dynamics. For example, in Canada, smallmouth bass have expanded their range, altering existing food chains because the species compete against other top predators for habitat and prey fish.
- Droughts are forecasted to increase in frequency and severity in many parts of North America, especially in arid rivers. Such droughts exacerbate the impacts of water flow regulation in ways that affect people, fish, and aquatic systems.

Source: <https://www.usgs.gov/news/hot-water-climate-change-affecting-north-american-fish-1>.

## Scientists Improve Predictions of How Temperature Affects the Survival of Fish Embryos



Winter-run Chinook salmon embryos in their egg capsules. (Image courtesy of NOAA)

Scientists closely tracking the survival of endangered Sacramento River salmon faced a puzzle: the same high temperatures that salmon eggs survived in the laboratory appeared to kill many of the eggs in the river.

Now scientists have resolved the puzzle, realizing new insights into how egg size and water flow affect the survival of egg-laying fish. The larger the eggs, they found, the greater the water flow they need to supply them with oxygen and carry away waste.

The researcher's model, based on a literature search of laboratory studies, predicted that temperatures in the upper Sacramento River since 1996 almost never got warm enough to cause mortality of salmon embryos. The researchers noted that in the Sacramento River temperature-related mortality could exceed 75 percent.

The results from this study reveal that fish may respond to temperature differently in the field than in the lab. Understanding the causes for this difference may help researchers improve their predictions of how temperature affects fish eggs across different environments.

The goal of the research was to examine why salmon eggs have a much lower thermal tolerance in the field compared to the lab. The researchers developed the hypothesis that salmon eggs die in the river because of insufficient oxygen.

External temperatures govern the biological processes of salmon eggs and the embryos inside. As the water gets warmer their metabolism increases, demanding more and more oxygen. Unlike juvenile and adult fish, eggs cannot move and don't have a developed respiratory or circulatory system. Instead they rely on flowing water to supply oxygen and carry away waste products.



Water flowing over a gravel riffle in the Sacramento River. *(Image courtesy of NOAA)*

Winter-run Chinook salmon are especially challenged when it comes to warmer water temperatures because their eggs are atypically large and require more oxygen exchange. Their egg size evolved to take advantage of cold water above Shasta Dam where they once spawned. However, the salmon now spawn in the warmer Sacramento River below the dam.

After further analysis of field data, scientists found a fundamental difference between conditions in the laboratory and conditions that effect eggs in the wild.

Laboratory studies estimating the temperature tolerance of the Chinook eggs included water flowing over the eggs at about two to three times faster than salmon eggs typically experience in the wild. The faster-moving water provided more oxygen to the eggs in the laboratory, allowing them to survive higher temperatures.

The researchers borrowed concepts from physics to develop a model to determine how much oxygen flowing water can supply to fish eggs, depending on its velocity. The model predicted that the slower flowing water in the river would not supply the oxygen needed for egg viability in elevated temperature conditions. Field studies found that the slower flow in the river equated to about a 3 °C difference in the temperature tolerance of eggs, exactly what the model predicted.

This new model also provides an explanation for why fish species produce larger eggs in colder water. In general, the oxygen demand of eggs is proportional to their volume, while oxygen supply is proportional to the surface area of the egg, where the oxygen diffuses into the egg from the surrounding water. The surface area to volume ratio of an egg decreases with increasing egg size, which sets a limit on how large eggs can be and still get enough oxygen to survive. Since oxygen demand increases with temperature, fish species in warm water must make smaller eggs to match oxygen demand with supply. However, this model also predicts that fish can produce larger eggs in warm waters when they are in high flow environments.

The researchers compiled data on 180 fish species and found that eggs in high flow environments, such as rivers, consistently produce larger eggs than expected for a given temperature. Some fish have even adapted to produce larger eggs in warm waters by using their tail to fan water over their eggs, which comes with a significant cost in terms of energy, time, and risk of predation.

One important implication of this model is that warming conditions and declines in oxygen levels in aquatic systems may create evolutionary pressure for fish to produce smaller eggs in the future.

For more information, contact Southwest Fisheries Science Center Fisheries Ecology Division, [Landscape Ecology Team](#).

Source: <https://swfsc.noaa.gov/news.aspx?ParentMenuId=54&id=22302>.

## Robot Shellfish May Tell Us About Climate Change's Impact on Marine Species

Out in a bed of mussels, off the Monterey coast in California in a space exposed at low tide, a handful of green light-emitting diodes blink, indicating the location of a cohort of robomussels.

The little black data loggers, formed from polyester resin, have been precisely engineered to mimic the mussels already living there, a few of which researchers plucked out to make space for the fake ones. They are here for a study of climate change, and, more precisely, its effect on one of the most important species found in the ocean.

There have been more than 70 of these plots, scattered across the globe, over the last 18 years. They have been logging information, in 10-minute intervals, on the temperature of the actual bodies of the *Mytilus californianus* mussels.

The mussels, which biologists call an “engineering species,” drive biodiversity and create habitat for other animals and so the scope of this research extends beyond the state of the intertidal ecosystems where the mussels live and to the way we understand the impacts of climate change on species, and how, and where, mussel farmers put their farms.

There are a couple of ways temperature can kill a mussel. Heat stress, in general, makes one less fit to continue its other normal functions. It’s costly, from an energy perspective, to live in a warm environment, and that’s less energy the mussels have to eat or reproduce. In more extreme circumstances, too much heat can destroy the proteins in the mussel’s body, similar to what happens when you cook one.

Small loggers, called Tidbits, are used to record the temperatures over six to eight months, after which they must be replaced and their data uploaded.

Temperature is only one part of the equation. A mussel’s health depends on food availability, pH, and more, all in combination. The latest research has begun to identify hyperlocal niches of mussel resilience and vulnerability, and the bulk of it has shown a surprising trend: latitude often has little to do with the temperature of individual mussel



beds, let alone their overall health. All the factors combined lead to a patchwork of sites that are at varying degrees of risk for collapse.

Source: [http://www.smithsonianmag.com/innovation/robot-shellfish-may-tell-us-about-climate-changes-impact-on-marine-species-180960977/?utm\\_source=smithsoniandaily&no-ist](http://www.smithsonianmag.com/innovation/robot-shellfish-may-tell-us-about-climate-changes-impact-on-marine-species-180960977/?utm_source=smithsoniandaily&no-ist).

## Warming Ocean May Bring Major Changes for U.S. Northeast Fishery Species

National Oceanic and Atmospheric Administration (NOAA) scientists have released the first multispecies assessment of just how vulnerable U.S. marine fish and invertebrate species are to the effects of climate change. The study examined 82 species that occur off the Northeastern United States, where ocean warming is occurring rapidly. Researchers found that most species evaluated will be affected, and that some are likely to be more resilient to changing ocean conditions than others.

To characterize potential risks that ocean warming may pose to marine fish and invertebrates, the researchers identified factors influencing species resilience. This research could help fisheries scientists' better plan for the effects of ocean warming when developing management measures.



Young-of-the-year haddock (*Image courtesy of NOAA*)

The study is formally known as the Northeast Climate Vulnerability Assessment and is the first in a series of similar evaluations planned for fishery species in other U.S. regions. Conducting climate change vulnerability assessments of U.S. fisheries is a priority action in the NOAA Fisheries Climate Science Strategy. Similar assessments are now underway for the Bering Sea and California Current Ecosystems.

The 82 species evaluated include all commercially managed marine fish and invertebrate species in the Northeast, a large number of recreational marine fish species, all marine fish species listed or under consideration for listing on the federal Endangered Species Act, and a range of ecologically important marine species.

The method tends to categorize species that are “generalists” as less vulnerable to climate change than are those that are “specialists.” For example, Atlantic cod and yellowtail flounder are more generalists, since they can use a variety of prey and habitat, and are ranked as only moderately vulnerable to climate change. The Atlantic sea scallop is more of a specialist, with limited mobility and high sensitivity to the ocean acidification that will be more pronounced as water temperatures warm. Sea scallops have a high vulnerability ranking.

The method also evaluates the potential for shifts in distribution and stock productivity, and estimates whether climate change effects will be more negative or more positive for a particular species.

Researchers used existing information on climate and ocean conditions, species distributions, and life history characteristics to estimate each species' overall vulnerability to climate-related changes in the region. Vulnerability is defined as the risk of change in abundance or productivity resulting from climate change and variability, with relative rankings based on a combination of a species exposure to climate change and a species' sensitivity to climate change.

Each species was evaluated and ranked in one of four vulnerability categories: low, moderate, high, and very high. Animals that migrate between fresh and salt water (such as sturgeon and salmon), and those that live on the ocean bottom (such as scallops, lobsters and clams) are the most vulnerable to climate effects in the region. Species that live nearer to the water's surface (such as herring and mackerel) are the least vulnerable. A majority of species also are likely to change their distribution in response to climate change. Numerous distribution shifts have already been documented, and this study demonstrates that widespread distribution shifts are likely to continue for the foreseeable future.

A specific summary of results has been prepared for each species to help put the rankings into context. These narratives discuss what is known about the effects of climate change on the species and provide the foundation for future research.

Source: [http://www.nefsc.noaa.gov/press\\_release/pr2016/scispot/ss1603/](http://www.nefsc.noaa.gov/press_release/pr2016/scispot/ss1603/).

## **Recently Awarded Research**

### **Ocean Acidification: Oxygen-limited CO<sub>2</sub> Tolerance in Squids (Ommastrephidae and Loliginidae)**

The National Science Foundation awarded \$15,422 to Irwin Forseth (EF and Emerging Frontiers) and Brad Seibel (University of South Florida) in May of 2016.

This award funds research aimed at predicting the consequences of ocean acidification on ecosystem health and function. Specifically, it addresses the extent to which the combined effects of ocean acidification, global warming, and expanding hypoxia may affect the energetics of squids. Squids provide a critical link in oceanic food chains, feeding on the massive zooplankton populations, and serving as prey to fish and mammalian predators. Their growth rates and maximum sizes respond quickly to environmental conditions and serve as real time indicators of ecosystem health. Oceanic squids are the only non-calcifying organisms whose sensitivity to ocean acidification was specifically predicted based on highly pH-sensitive oxygen binding by hemocyanin, the blood pigment of squids. Only a single study has tested this prediction, finding that elevated CO<sub>2</sub> constrains metabolism and activity levels in the jumbo squid, *Dosidicus gigas*. The analysis will integrate across levels of performance, from cell, to systemic, to whole-animal function, comparing squid species with variable blood-oxygen binding properties and CO<sub>2</sub> exposure histories. It addresses the combined effects of declining environmental oxygen, increasing oxygen demand due to warming, and reduced oxygen transport due to high CO<sub>2</sub> on the function of these "high-performance" invertebrates. These squids are believed to be the most CO<sub>2</sub>-sensitive non-calcifying taxa. The research effort will be complemented by an extensive education and outreach effort in collaboration with the Ocean Exploration Trust.

Exploration Vessel Nautilus operates under a new paradigm of “telepresence-enabled” expeditions. Satellite and high-bandwidth Internet2 technology transmits data, including remotely operated vehicle video feeds, to shore in real time, supporting the participation of science teams around the world and reaching a growing public and student population. Moreover, the Nautilus program is teamed up with the JASON Project that brings marine science to K-12 classrooms via curriculum development. The investigators on this project will contribute time and expertise in ocean acidification to the development of a new curriculum on Climate and Oceanography and develop a webcast for the JASON Live interactive series that will be broadcast from sea with Nautilus.

Please report errors in award information by writing to [awardsearch@nsf.gov](mailto:awardsearch@nsf.gov).

Source: [https://www.nsf.gov/awardsearch/showAward?AWD\\_ID=1641200](https://www.nsf.gov/awardsearch/showAward?AWD_ID=1641200).

## **Effects of Climate Change on Estuarine Fish Nurseries: Analysis and Implications from Decades-long Time-series**

The effects of climate change will be especially relevant to estuaries, which are important nurseries for juvenile fish including species of recreational and commercial importance. Estuaries may be especially susceptible to climate change because they are relatively shallow and this effect may be compounded by greater anthropogenic influences such as development, pollution, and habitat degradation as a result of human pressures. Further, the complicated relationships between climate and fish recruitment are not always intuitive. Our understanding of these interrelationships can benefit from long-term monitoring.

This study will determine the impact of changing temperature and other environmental variables due to climate change on estuarine fish recruitment by analyzing time-series data, over seasonal and annual periods, from a representative New Jersey estuary. More specifically, to test the response of larval and juvenile fishes to climate change, this study will examine species composition, abundance, size, and phenology relative to environmental variables from 25 years of data collected at weekly to seasonal frequencies.

This project has several benefits. First, it is consistent with the need to determine the effects of climate change on estuarine fish nurseries. Second, this analysis will help plan for management and related estuarine impacts on important commercial and recreational fisheries. Third, the project should help us to understand estuarine impacts of climate change on our fisheries and thus help to evaluate their resiliency.

For more information, contact Dr. Kenneth W. Able ([Able@marine.rutgers.edu](mailto:Able@marine.rutgers.edu)), Dr. Thomas M. Grothues ([Grothues@marine.rutgers.edu](mailto:Grothues@marine.rutgers.edu)), or Katherine Nickerson ([KNickerson@marine.rutgers.edu](mailto:KNickerson@marine.rutgers.edu)).

Source: <http://njseagrant.org/wp-content/uploads/2016/04/Able-Page.pdf>.

## Recent Publications

### Journal Articles

#### Climate Change and Possible Impacts on Fish and Shellfish

- ▶ [Environmental boundaries of marine cladoceran distributions in the NW Mediterranean: Implications for their expansion under global warming](#)  
Atienza, D., A. Sabatés, S. Isari, E. Saiz, and A. Calbet. 2016. Environmental boundaries of marine cladoceran distributions in the NW Mediterranean: Implications for their expansion under global warming. *Journal of Marine Systems* 164:30–41.
- ▶ [Quantification of climate change implications for water-based management: A case study of oyster suitability sites occurrence model along the Kenya coast](#)  
Aura, C.M., S. Musa, M.K. Osore, E. Kimani, V.M. Alati, N. Wambiji, G.W. Maina, and H. Charo-Karisa. 2017. Quantification of climate change implications for water-based management: A case study of oyster suitability sites occurrence model along the Kenya coast. *Journal of Marine Systems* 165:27–35.
- ▶ [Climate change tightens a metabolic constraint on marine habitats](#)  
Deutsch, C., A. Ferrel, B. Seibel, H.O. Pörtney, and R.B. Huey. 2015. Climate change tightens a metabolic constraint on marine habitats. *Science* 348(6239):1132–1135.
- ▶ [Cardiorespiratory responses in an Antarctic fish suggest limited capacity for thermal acclimation](#)  
Eggington, S., and H.A. Campbell. 2016. Cardiorespiratory responses in an Antarctic fish suggest limited capacity for thermal acclimation. *Journal of Experimental Biology* 219:1283–1286.
- ▶ [Identifying alternate pathways for climate change to impact inland recreational fishers](#)  
Hunt, L.M., E.P. Fenichel, D.C. Fulton, R. Mendelsohn, J.W. Smith, T.D. Tunney, A.J. Lynch, C.P. Paukert, and J.E. Whitney. 2016. Identifying alternate pathways for climate change to impact inland recreational fishers. *Fisheries* 41(7):362–372.
- ▶ [Grey mullet \(Mugilidae\) as possible indicators of global warming in South African estuaries and coastal waters](#)  
James, N.C., A.K. Whitfield, and T.D. Harrison. 2016. Grey mullet (Mugilidae) as possible indicators of global warming in South African estuaries and coastal waters. *Marine Environmental Research* 122:188–195.
- ▶ [Challenging the links between seafood and human health in the context of global change](#)  
Lloret, J., H.J. Rätz, J. Leonart, and M. Demestre. 2016. Challenging the links between seafood and human health in the context of global change. *Oceans and Human Health* 96(1):29–42.
- ▶ [Climate change effects on North American inland fish populations and assemblages](#)  
Lynch, A.J., B.J.E. Myers, C. Chu, L.A. Eby, J.A. Falke, R.P. Kovach, T.J. Krabbenhoft, T.J. Kwak, J. Lyons, C.P. Paukert, and J.E. Whitney. 2016. Climate change effects on North American inland fish populations and assemblages. *Fisheries* 41(7):346–361.
- ▶ [Phenomenological vs. biophysical models of thermal stress in aquatic eggs](#)  
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## **Ocean Acidification and Possible Impacts on Fish and Shellfish**

- ▶ [Oxidative responsiveness to multiple stressors in the key Antarctic species, \*Adamussium colbecki\*: Interactions between temperature, acidification and cadmium exposure](#)  
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- ▶ [And on top of all that... Coping with ocean acidification in the midst of many stressors](#)  
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- ▶ [Differential protein expression using proteomics from a crustacean brine shrimp \(\*Artemia sinica\*\) under CO<sub>2</sub>-driven seawater acidification](#)  
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- ▶ [Slow shell building, a possible trait for resistance to the effects of acute ocean acidification](#)  
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### Other

- ▶ [The genomic landscape of rapid repeated evolutionary adaptation to toxic pollution in wild fish](#)  
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## Upcoming Meetings and Conferences

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### [Seafood Safety: New Findings & Innovation Challenges Conference](#)

January 25-26, 2017  
Brussels, Belgium

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### [109<sup>th</sup> Annual Meeting of the National Shellfisheries Association](#)

March 26-30, 2017  
Knoxville, Tennessee

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### [11<sup>th</sup> International Conference on Molluscan Shellfish Safety](#)

May 14-18, 2017  
Galway, Ireland

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### [The 77<sup>th</sup> Midwest Fish & Wildlife Conference](#)

February 5-8, 2017  
Lincoln, Nebraska

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### [10<sup>th</sup> Biennial Symposium of the Freshwater Mollusk Conservation Society](#)

March 26-30, 2017  
Cleveland, Ohio

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### [13<sup>th</sup> International Conference on Mercury as a Global Pollutant](#)

July 16-21, 2017  
Providence, Rhode Island

### Additional Information

This monthly newsletter highlights current information about fish and shellfish.

For more information about specific advisories within the state, territory, or tribe, contact the appropriate state agency listed on EPA's National Listing of Fish Advisories website at <https://fishadvisoryonline.epa.gov/Contacts.aspx>.

For more information about this newsletter, contact Sharon Frey ([Frey.Sharon@epa.gov](mailto:Frey.Sharon@epa.gov), 202-566-1480).

Additional information about advisories and fish and shellfish consumption can be found at <https://www.epa.gov/fish-tech>.