SPORT FISH RESEARCH IN ILLINOIS

A look inside Sport Fish Restoration Fund Project F-69-R

SPORT FISH RESTORATION

EXECUTIVE SUMMARY

For over 75 years, the Federal Aid in Sport Fish Restoration Fund has worked with state partners to conserve, protect, and enhance fish and their habitats, along with the sport fishing and recreational boating opportunities they provide. During more than a third of the existence of this important conservation program, Project F-69-R has been the cornerstone for collection and analysis of Illinois fisheries data, with a specific focus through much of its existence on understanding the interface between recreational anglers and the recreational fisheries on which they depend. F-69-R has produced a wide array of groundbreaking research findings, supported modern advancements in fisheries management, and implemented state-of-the-art technologies for fisheries data management. Most recently, this project has opened the door to connect resource users with data-driven information about Illinois fisheries through the use of emergent Internet technologies.

In its first few years, Project F-69-R was tasked with developing an efficient method for conducting regular creel surveys on inland lakes in Illinois. Additionally, several research studies led to improvements in sampling design and a better understanding of how the efficiency of sampling gear used by fisheries managers is affected by environmental conditions. The design and implementation of creel surveys and more effective sampling was supported by what was, at the time, a cutting-edge computerized system for storing and analyzing fisheries data, the Fisheries Analysis System (FAS). This system became the single tool used by fisheries managers and researchers alike to tap into valuable information about sport fish populations across the state. Illinois emerged as a leader in fisheries data management through the development of FAS, serving as a model for other states to develop their own systems.

From 1992 – 2009, Project F-69-R was focused on the execution of inland creel surveys, producing 334 lake and river creel surveys that have played a major role in fisheries management decisions, such as setting size and bag limits, informing supplemental stocking strategies, and identifying needs for habitat improvement. Data from those creel surveys has been utilized by other Federal Aid Projects as well. For example, a project evaluating the effectiveness of stocking largemouth bass at certain sizes and anther project evaluating the regulation and stocking strategies designed to improve stunted bluegill populations were among the many projects that utilized creel survey data on study lakes.

The combination of managing long-term fisheries data and addressing emerging research needs continues to be the cornerstone of Project F-69-R today. In the last three years, the breadth of research topics has expanded to include an evaluation of urban stream restoration on the DuPage River (p. 4–5), an in-depth investigation into largemouth bass recruitment dynamics as affected by spring angling (p. 6–7), an assessment of land-use practices and their impacts through the Fishes of Champaign County study (p. 8), and an investigation into natural reproduction of lake trout in southern Lake Michigan (p. 10). Bringing this information back to the angler has been a key component of Project F-69-R for the last 10 years through the creation of IFishIllinois.org and its social media counterparts (p. 9).

A bright and exciting future is unfolding for the Sport Fish Restoration Program, and F-69-R is a central piece of that future in Illinois. Within these pages is a snapshot of the many contributions this project has made to sustaining sport fish populations in Illinois. As this project evolves to answer more complex, data-driven research questions to inform fisheries management decisions, anglers in Illinois will have access to a wide array of sustainable fisheries for generations to come.

Good Fishing!

Dr. Jeffrey A. Stein, Project Leader
Senior Research Scientist
Illinios Natural History Survey

HISTORY & CREEL SURVEYS

Pre-1987

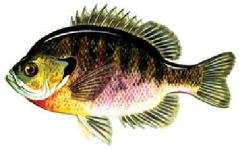
F-46-R: Fisheries Analysis System

A precursor to F-69-R, Project F-46-R was one of the first in the United States to use microcomputers for fisheries data entry and storage to support management activities.

1987–1992

The Fisheries Analysis System (FAS): Creel Survey Methods Development

The first era of studies focused on designing and producing a high quality data entry and analysis system that supported the execution of statewide creel surveys and the storage/analysis of sport fish assessments. Results from these first years enabled refinement of creel methods used in the next 20 years.

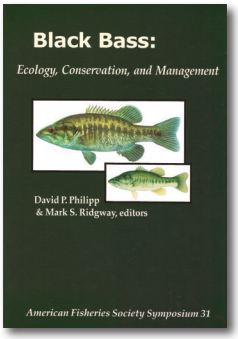


1993–1999

Database Management and Analysis of Fisheries in Illinois Lakes

With the basic Fisheries Analysis System created, work focused on improving the analysis software used by stream and lake fisheries managers. Collaborative research projects using FAS data, including the evaluation of statewide fish stocking programs for bass and bluegill, were established to meet management needs.

2000–2009



Database Management and Analysis of Fisheries in Illinois Lakes: Optimizing Fisheries Management

The continuation of an integrated creel survey program and the use of this data to analyze the status of Illinois sport fish populations began in this era. Long-term trends in angler behavior and research on recruitment dynamics and the effects of recreational angling on fish populations were other components during this phase.

The black bass research conducted in the 1990s was highlighted in 2000 at an AFS Symposium and published in the proceedings book. This book contained seven papers supported by F-69-R.

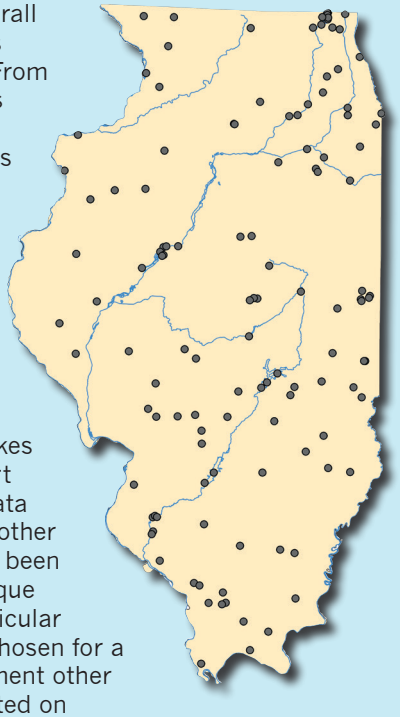
2010–Present

Research and Analysis of Fisheries in Illinois

In recent years, the project's focus has been on studying the interface of sport fish population characteristics and human interaction with the resource. Research projects investigating urban stream restoration, catch-and-release angling, and land-use changes seek to advance sport fish management strategies and are highlighted in the following pages.

OVERVIEW

Creel surveys play a vital role in the successful management of healthy fish populations and the fisheries they support by providing rigorous scientific information about fish populations, angler use, and the overall condition of the state's recreational fisheries. From 1987–2000, the Illinois Natural History Survey conducted creel surveys on a variety of Illinois lakes as a part of the Statewide Creel Survey Program (see map for survey locations). Creel surveys were typically conducted on 8 – 15 lakes each year. In some cases, lakes were chosen in an effort to provide long-term data over multiple years; in other cases, a lake may have been chosen based on a unique data need for that particular year. Lakes also were chosen for a creel survey to supplement other research being conducted on that particular lake.



DATA COLLECTED

A creel survey is a widely accepted scientific method for assessing fish populations and the behavior of anglers. Creel surveys collect data on weather and lake conditions, total number of anglers on a particular lake and the number of hours fished (effort), species of fish sought after by anglers and the number of fish caught, whether those fish were kept or released, and length measurements on fish caught. This data, together with other standardized sampling efforts by fisheries biologists, provides a wide-ranging and informative dataset from which biologists can manage Illinois fisheries.

USING CREEL DATA

The inland creel surveys on Illinois lakes and streams were suspended in 2012; however, the 20+ years of data is providing a wealth of information that is being used to understand the interaction between sport fish angling and fish population changes. For example, this data is being used to evaluate the long-term changes in voluntary release rates of legal-sized fish, indicating a shift from harvest to catch-and-release angling in some species.

Additionally, creel data is used to complement field-based research projects investigating the role of angling on recruitment dynamics in largemouth bass (see pages 6 – 7). Lastly, some creel survey data continues to be collected electronically through the online Muskie Creel Survey form on the website www.ifishillinois.org (see page 9).

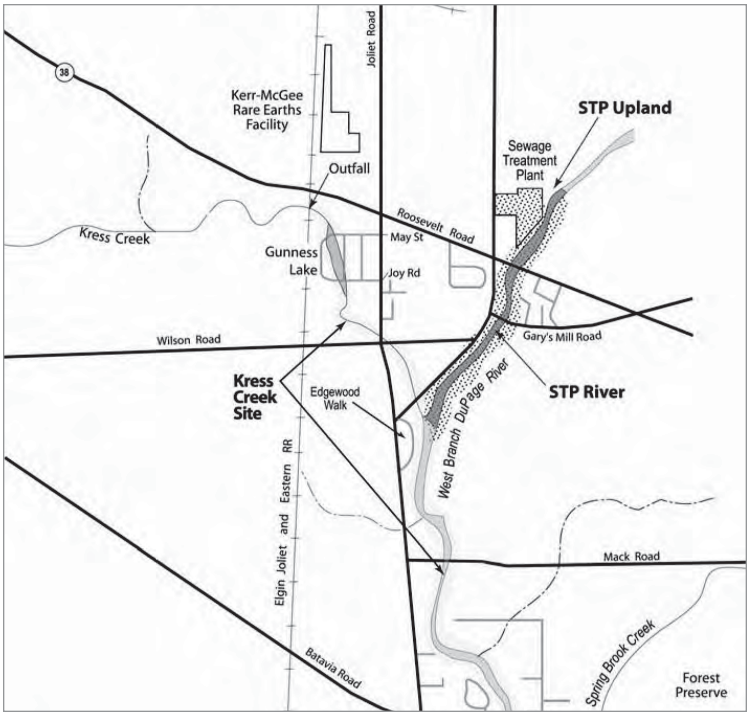
DUPAGE RIVER RESTORATION

OVERVIEW

Urban areas have experienced dramatic growth in recent decades, resulting in major impacts on aquatic ecosystems. These impacts often include industrial pollution, stream modifications, habitat degradation, and eutrophication. In some instances, improper hazardous waste disposal has made it necessary for large-scale restoration efforts to restore the health of both human and wildlife populations. These restoration efforts have wide-ranging benefits that can increase wildlife conservation, play a role in flood prevention, and improve recreational opportunities, including sport fishing.

IMPORTANCE

Identifying and providing angling opportunities in densely populated urban areas has become an important component of fisheries management. The recent completion of a large-scale Superfund clean-up and stream bed reconstruction on the West Branch of the DuPage River provides an excellent opportunity to monitor, investigate and assess the natural recovery of sport fish populations in a restored urban stream and highlights the potential for a quality urban stream fishery. By conducting extensive sampling of a wide array of ecological factors that influence sport fish abundance, researchers and managers will gain important insights into the need for specific management action to enhance natural recovery while providing angling opportunities to the public in a densely populated suburban setting.



The Kress Creek/West Branch DuPage River site is located in DuPage County, IL. The sewage treatment plant became contaminated when radioactive thorium residuals from the Kerr-McGee facility were hauled to the treatment facility and used as fill material. Some of the contamination entered the West Branch DuPage River adjacent to the sewage treatment plant property. As part of a comprehensive Superfund settlement, sites along Kress Creek and the West Branch of the DuPage River were remediated between 2005 and 2012. This clean-up effort was part of a large-scale remediation project designed to restore a historic river corridor and replenish the health of its ecosystem. Approximately 8 miles have been cleaned up and the stream restored.

RIVER RESTORATION

- The restoration of the West Branch of the DuPage River in DuPage County took place from 2005 to 2012 and cost over $70 million. This effort involved removing radioactive substrate, clearing non-native plants, planting native plant species, removing dams, enhancing river habitats, floodplain restoration, and fish and mussel stocking.
- Following the Superfund clean up and restoration, this project is examining the fish communities within both the restored West Branch section and the neighboring unrestored East Branch.
- Seasonal sampling on the two tributaries will determine the differences in the abundance, population structure, feeding ecology, and spatio-temporal distribution of a top predator smallmouth bass.
- Comparing the restored and unrestored branches will allow an assessment of the differences in fish and macroinvertebrate community abundance and diversity attributable to the restoration.
- Quantifying differences in land use, in-stream habitat, flow regime and water quality in restored and unrestored tributaries of urban streams will help determine the ecological effectiveness of restoration action in the West Branch.

The reclaimed West Branch of the Dupage River provides excellent habitat for smallmouth bass.

IMPACT OF STREAM RESTORATION ON MOVEMENT OF SMALLMOUTH BASS

- This project examines the habitat use by smallmouth bass in a restored urban stream to assess the effectiveness of restoration efforts.
- To track movements, acoustic coded transmitters are implanted into adult fish to track their movement within the watershed. If fish come into range of any of the 10 receivers that have been secured within the river, their presence is recorded.
- The movement of adult smallmouth bass within the restored reach is tracked throughout the year to determine seasonal movements, including during reproduction and flood events, to discern habitat usage and how regularly they rely on the restored habitat.

Surgically implanting acoustic tags allows scientists to track the movements of smallmouth bass within the watershed to determine habitat usage throughout the seasons.

This map shows where acoustic receivers have been placed along the river to track movements of adult smallmouth bass. If a fish that has been implanted with an acoustic tag swims by a receiver, the time and date of the signal is recorded by the receiver.

BASS ECOLOGY & MANAGEMENT

OVERVIEW

Black bass are the most sought-after sport fish in North America, making up 38% of all freshwater angling in the U.S. They also exhibit remarkable reproductive behaviors, including extended male parental care while on the nest. Aggressive nest defense behaviors make both largemouth and smallmouth bass especially vulnerable to angling during the reproductive period. Angling during the spawning season is regulated differently among the various state agencies. Some jurisdictions prohibit capturing nesting bass entirely during the spawning period; others limit angling for nesting bass to catch-and-release only; while most have no protective measures in place. In Illinois, smallmouth bass are protected in most streams and rivers by a catch-and-release only regulation from April 1 – June 15. Determining the relationship between reproductive success and recruitment for black bass is a critical first step in developing an effective management strategy for these important fisheries.

RESEARCH FOCUS

The long-term consequences of these various management practices are the main focus of our bass research program, which addresses the following questions:

1. What is the relationship between individual reproductive success and annual recruitment?
2. What are the factors that determine if a nesting bass successfully raises a brood or not?
3. How does angling during the reproductive season affect nesting success and recruitment?
4. Under what conditions do nesting bass need to be protected?

Answering these questions is especially important for developing long-term management strategies in Illinois lakes and streams where there is high angling pressure on bass during the spring reproductive season. In addition, new stressors, such as climate change and invasive species introductions, also could impact black bass nesting activity and, as a result, play a role in year-class production and the overall health of the black bass fishery.

The research pond facility at the University of Illinois Natural History Survey allows for designing experiments for reproduction, growth and survival. At any point, a pond can be drained, fish recovered for quantity and/or quality evaluation, and then refilled and restocked.

FACTORS AFFECTING RECRUITMENT IN SMALLMOUTH AND LARGEMOUTH BASS

Understanding how life history, reproduction and recruitment intersect to determine population dynamics is fundamental to effective management of black bass fisheries. This study examined factors that affect survival of offspring.

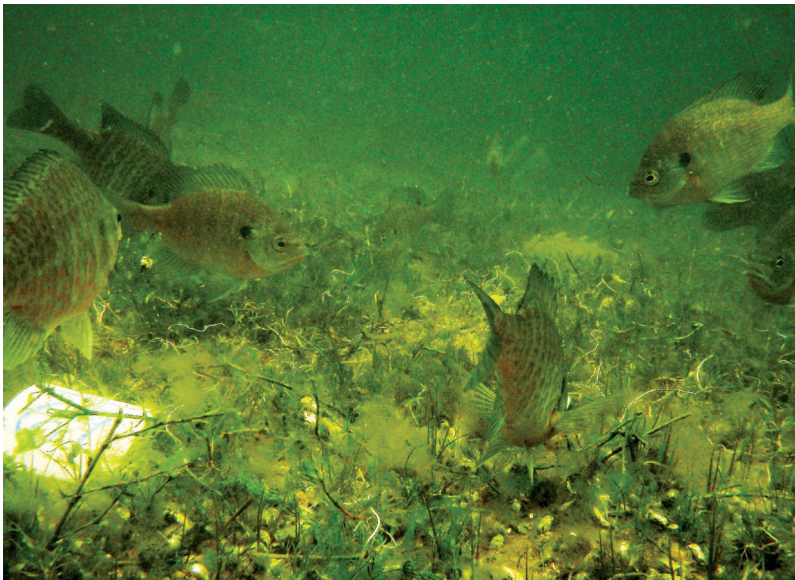
- For each year of this study, we quantified the lake-wide nesting success, mating success, and the final reproductive success for each individual male in three populations.
- This research has demonstrated that lake-wide recruitment (i.e., annual year-class strength) is directly related to the reproductive success of the population. In those years when a large number of male bass on nests produced abundant independent fry, the result was a larger year class the following year. In those years in which reproductive success was low, the year class was smaller.
- The long-term nature of this study has allowed us to demonstrate the strong relationship between reproductive success across a population and recruitment. This data is now being explored to assess how possible climatic changes, as well as the introduction of non-native species, could be affecting reproductive activities in bass, thus improving our ability to manage and conserve bass populations.

FACTORS INFLUENCING PREDATION RATES DURING CATCH-AND-RELEASE ANGLING

A major component of parental care in nesting male bass includes guarding his brood from predators. When a male bass is removed from the nest, brood predators, such as catfish and sunfish, will quickly move in to consume the eggs or fry of an unprotected nest.

- **Our experiment:** Field observations across multiple lakes were used to assess brood predation occurring upon removal of a nest-guarding male bass during a catch-and-release angling event. Project scientists measured:
  - The length of time that elapsed between removal of the parental male and first intrusion of a brood predator
  - The density of brood predators near the nest
  - How quickly brood predators consume eggs
  - How quickly the male returns to guard his nest once released
- **What the data show:** In some cases, brood predators enter an unguarded nest to consume eggs in as little as 3 minutes, and depending on the density of brood predators nearby, can wipe out an entire nest in as little as 20 minutes.
- **What this means:** Significant brood predation can occur even during catch-and-release angling. In lakes where the densities of brood predators are high, there may be negative impacts on reproductive success within a population, which may require regulations that protect spawning bass.

Black bass are fierce defenders of their nest sites for good reason. If they leave their nest or are removed by angling, brood predators, such as the bluegill shown below, will quickly move in to devour the eggs or fry in the nest.



FISHES OF CHAMPAIGN COUNTY

OVERVIEW

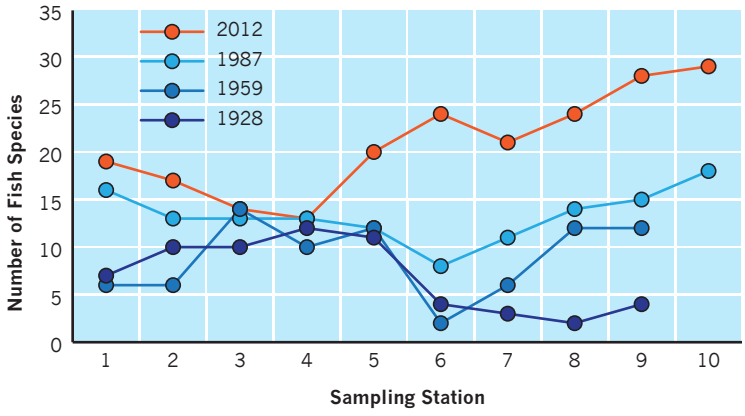
The past 115 years have brought about many changes to the Midwestern landscape, including the expansion of both agricultural and urban areas. These changes have, in one way or another, affected the distribution of stream fishes. Some species have seen drastic declines in their distributions and populations, while others seem to have thrived in these human-altered environments.

IMPORTANCE

Understanding the long-term implications of changing land-use practices and, more recently, climatic conditions on stream fish assemblages is critical to sound environmental management and planning. The historic Fishes of Champaign County long-term data sets provide a unique opportunity to scientifically assess changes in biodiversity and stream fish population health over more than a century of human development.

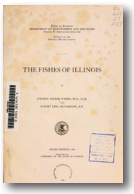
NEXT STEPS

- Building on the efforts that have spanned over a 100 years, this project is resurveying sampling sites from four previous studies.
- This study compares the land-use changes of the past, and how fish communities have responded to various environmental pressures.



The Fishes of Champaign County Survey includes ten sampling stations along the Saline Branch of the Salt Fork of the Vermilion River. Note the increased number of fish species found at each location over the past two surveys. This is likely due to the implementation of the Clean Water Act in 1972 as, prior to this Act, this stream was among the most polluted streams in the county due to industrial dumping in downtown Urbana and raw sewage from both Champaign and Urbana.

1885–1901



The original Fishes of Champaign County survey, conducted between 1885 and 1901, described 65 fish species at 48 stream sites, providing a good representation of fish communities at the beginning of the 20th century. These samples were used for the first *Fishes of Illinois* by Stephen S. Forbes, published in 1901.

1928

The second survey was expanded to include 132 sampling sites where 73 species of fish were recorded, including 14 species not previously caught.

1959

Modern electrofishing technology was deployed for the third survey, which included 151 sites and resulted in 9 species that were new to the county.

1987

This survey repeated the methods and sites of the previous survey with the same number of sites sampled. 74 species were recorded.

Present

Twenty-five years later, the current survey is sampling 172 sites using the same methods and techniques that were used in the previous surveys. The return of three Illinois Endangered Species—the bigeye chub (not seen since 1928), the bluebreast darter (not seen since 1950), and the eastern sand darter (not seen in this area previously)—is a promising result that these populations may be recovering.

Bluebreast darter

Illustration by Danielle M. Ruffatto, INHS.

I FISH ILLINOIS

OVERVIEW

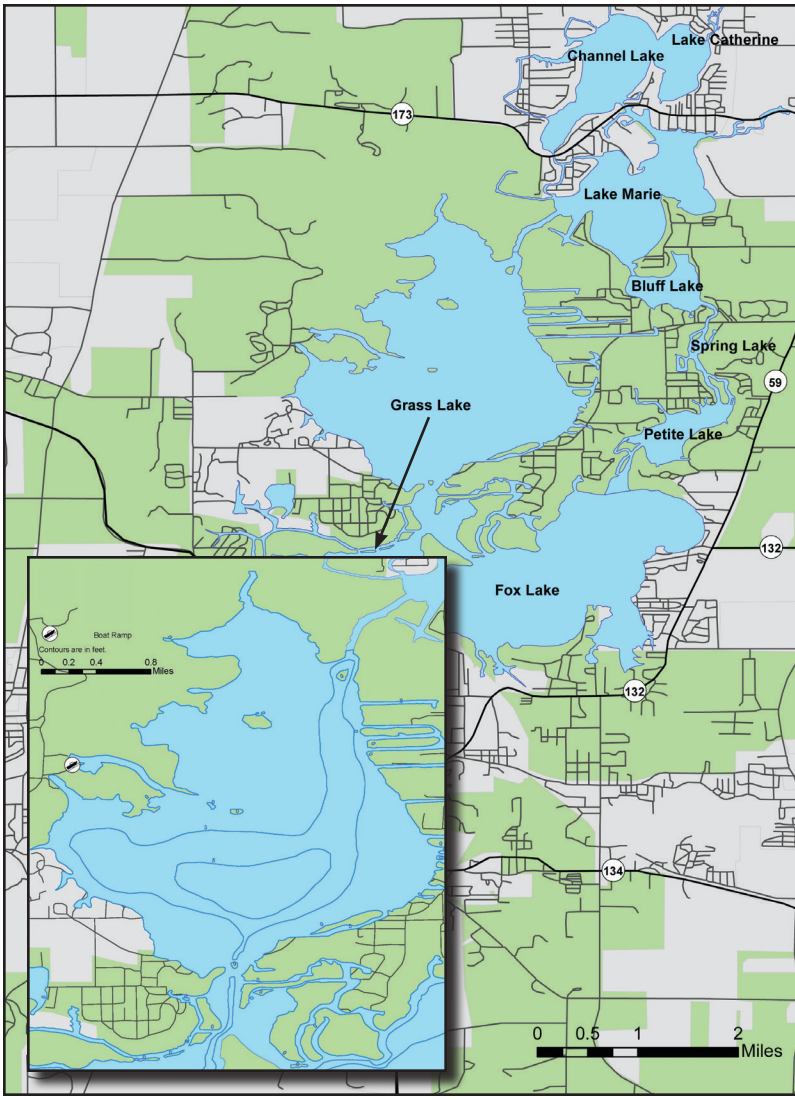
A current survey conducted by the US Fish and Wildlife Service revealed that one million anglers fished in Illinois waters during 2011. Our state fishery agency needs an effective way to inform these anglers where to fish, when to fish, what sport fish are in our state, and what regulations to follow. However, while nationwide angling numbers have risen, Illinois has experienced a decrease in the number of fishing license sales, as well as angling participants. This is not surprising given that kids are spending less time outdoors, but it does highlight why it is critical to find ways to engage with children about the value of outdoor activities. Education will continue to be a key component in fostering the next generation of Illinois anglers and conservation enthusiasts. The IFishIllinois.org website has been designed to serve as the information outlet for all state fisheries activities and to be the one-stop, go-to place for all anglers fishing in Illinois waters. This website strives to make sport fisheries-related information readily available to the public in a timely manner.

BENEFITS

Today's anglers are asking more questions than ever about techniques, equipment, and where to go fishing. Additionally, with the popularity of mobile devices, anglers are accessing information while they are out enjoying the sport, making up-to-date information imperative. Providing anglers with easy access to all types of information and data not only improves their success, but provides an opportunity for them to learn about the management, research, and conservation efforts of the Illinois Department of Natural Resources.

WHAT'S INCLUDED

- Newly designed in 2013, the IFishIllinois website provides both broad overviews and detailed information about Illinois sport fish, including:
  - fishing reports
  - angling tips and areas for greatest success
  - lake profile pages with both an expandable map and a fishing forecast as provided by IDNR biologists
  - informational pages on fishing equipment, fishing tips and tips for taking kids fishing
  - IDNR fishing programs
  - catch-and-release fishing
  - trends in fishing quality
- Angling-related news, such as IDNR press releases, awareness of invasive species, park closures, and useful information regarding angling in Illinois, is regularly distributed to the public via IFishIllinois.org and social media.



LAKE MICHIGAN RESEARCH

SPORT FISH POPULATION ASSESSMENTS IN LAKE MICHIGAN

OVERVIEW

Chinook and coho salmon, lake trout, and yellow perch are major components of the Lake Michigan sport fishery. Annual population assessments allow researchers and managers to track changes in these populations over time. Researchers and managers on Lake Michigan work together to sample sport fish populations using electrofishing boats and commercial gill nets and by collecting implanted tags from fish caught by anglers. Data collected during these assessments inform management decisions and support research through data sharing and the development of new research questions.

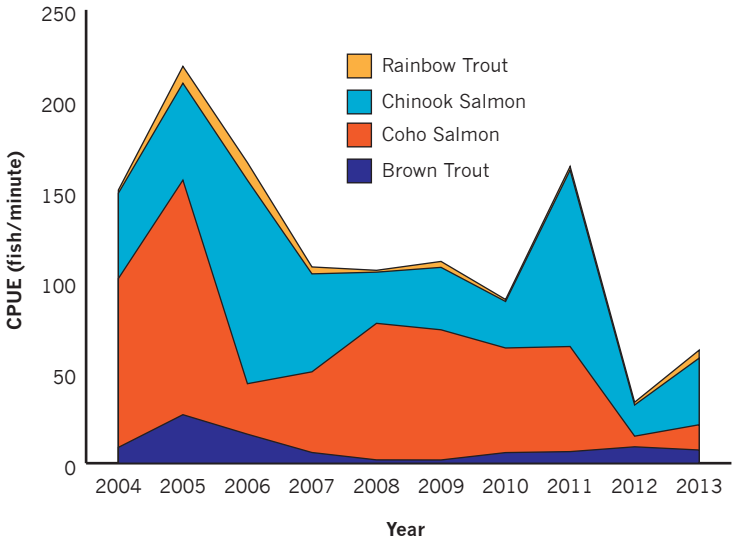
IMPORTANCE

Sudden changes in sport fish populations can affect the quality of fishing in Lake Michigan. By directly partnering with IDNR managers on assessments, project scientists can investigate these changes by developing research projects that explore how and why fishing is affected by these population changes. At the same time, fishery managers can address these changes with such management actions as the establishment of new regulations.

NEXT STEPS

In 2012, sport fish population assessments revealed that nearly 50% of lake trout captured in fall spawning surveys were unmarked (not stocked from the hatchery), indicating that they may be the result of natural reproduction. As a result,

- Additional funding was secured to use otolith microchemistry to determine the natal origin of these fish.
- New studies (see *Natural Reproduction of Lake Trout*) have been proposed to determine if lake trout are using reef complexes in the southern basin of Lake Michigan for spawning, and whether that spawning is successfully producing surviving adults.



Annual fall sampling of harbors in the Illinois waters of Lake Michigan are one perspective on the status of the salmonid fishery. This 10-year trend shows annual variability, but a general decline in salmonid abundance, demonstrating the need for continued management of these important sport fish in pursuit of the goal of establishing self-sustaining populations.

DETECTION OF NATURAL REPRODUCTION OF LAKE TROUT IN LAKE MICHIGAN

OVERVIEW

Lake trout supported an important commercial and sport fishery in the Great Lakes until sea lamprey, overfishing and pollution decimated naturally-reproducing populations. For several decades, management agencies have been working to re-establish self-sustaining, naturally-reproducing lake trout populations in Lake Michigan through sea lamprey control programs and hatchery stocking. Recent increases in the proportion of unmarked lake trout adults in fall spawning surveys has revealed the possibility that adults are successfully spawning on deep-water reefs in southern Lake Michigan.

IMPORTANCE

Determining whether lake trout are naturally reproducing in southern Lake Michigan is critical to understanding the effectiveness of restoration efforts and adaptive management actions designed to achieve strategic fisheries management goals. On a more basic level, understanding whether lake trout are using historically important spawning reefs will provide insights into the reproductive ecology of the species, which will ultimately lead to specific management recommendations.

NEXT STEPS

Over the next three years, project personnel will work in collaboration with the INHS Lake Michigan Biological Station, the IDNR, and the University of Wisconsin–Milwaukee to develop multiple lines of evidence demonstrating natural reproductions of lake trout. Specifically, this project will focus on Julian's Reef and Waukegan Reef complexes to:

- Use acoustic telemetry to determine whether lake trout (both hatchery and unmarked adults) are congregating during the fall in spawning aggregations
- Quantify density of fall egg and spring sac fry to determine the extent of successful reproduction using a remotely operated vehicle suction sampler (see photo at right).
- Determine natal origin of unmarked adult lake trout using otolith microchemistry.

During scientific studies, adult lake trout are collected using commercial gill nets. Using gill nets provides the best method for collecting adequate numbers of lake trout from the vast waters of Lake Michigan. © SEAN LANDSF

Using a remotely operated vehicle sampler, scientists are able to quantify the density of fall and spring sac fry to determine success of natural reproduction. Photo courtesy of J. Janssen.

EFFECTS OF ASIAN CARP BARRIER TECHNOLOGIES ON NATIVE SPORT FISH

Perhaps the greatest ecological threat to the Great Lakes is the potential invasion of Asian carp. An electric field barrier is already in place to prevent fish movements through the Chicago Sanitary and Ship Canal, which connects the Illinois River Basin with Lake Michigan. To enhance the electric barrier and create redundancy in barrier systems, University of Illinois researchers are working with state and federal agencies to develop and evaluate a multitude of technologies designed to prevent Asian carp from entering Lake Michigan. One approach has been to utilize high levels of carbon dioxide in the water to deter Asian carp from moving toward Lake Michigan. To better understand the effect of this technique on sport fish, project scientists have conducted experiments on bluegill and largemouth bass, as well as silver carp and bighead carp, and have found that carbon dioxide is an effective barrier to all these species and works on all sizes of fish. Future studies will scale up the experiments to larger volumes of water.

www.IFishIllinois.org

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