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Research and Analysis of Fisheries in Illinois

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Annual Report
1 June 2010 – 30 June 2011

INHS Technical Report 2011 (28)
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Prairie Research Institute
Illinois Natural History Survey

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F-69-R (24)

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September 2011

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This technical report is the annual report for Segment 24 of Project F-69-R, Research and Analysis of Fisheries in Illinois, which was conducted under a memorandum of understanding between the Illinois Department of Natural Resources and the Board of Trustees of the University of Illinois. The actual work was performed by the Illinois Natural History Survey, a division of the Prairie Research Institute at the University of Illinois. The project was supported through Federal Aid in Sport Fish Restoration (Dingell-Johnson) by the U.S. Fish and Wildlife Service, the Illinois Department of Natural Resources Division of Fisheries, and the Illinois Natural History Survey. The form, content, and data interpretation are the responsibility of the University of Illinois and the Illinois Natural History Survey, and not that of the Illinois Department of Natural Resources Division of Fisheries.

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EXECUTIVE SUMMARY

Fisheries managers are charged with understanding the interaction between sport fish populations and anglers using a wide array of information to make resource management decisions that support and promote healthy fisheries. Fundamental to this mission is easy access to long-term fisheries data, analytical tools and metrics that offer insight into the quality of a fishery and an understanding of the factors that influence fish population dynamics. Equally important is the need to communicate this scientific knowledge and promote angling opportunities to the public.

Project F-69-R has three overall goals: (1) conduct a wide variety of research studies that elucidate patterns of variation in sport fish populations and the mechanisms that drive those patterns, (2) communicate research findings and basic assessments of sport fish populations to the angling public, and (3) organize, manage, analyze and deliver sport fisheries data to researchers, sport fish managers, and the angling public. Basic and applied research studies, public outreach efforts, and data management activities all work in concert to create a better understanding of the restoration and conservation needs of sport fish populations in Illinois.

Research studies completed in Segment 24 were executed under Job 101.1, Job 101.3, Job 101.4, and Job 101.6. Summarized below, these studies were focused on four areas of sport fish restoration and management. First, development of a Fishing Quality Index (FQI) for sport fish was initiated under Job 101.1 utilizing 20 years of existing creel survey data (collected during previous segments of Project F-69-R) and fisheries independent samples of sport fish populations throughout Illinois. Second, several studies under Job 101.2 explored factors that impact recruitment processes in black bass (*Micropterus* spp.), including the influence of angling-induced selection on aggression levels in nesting male largemouth bass (*M. salmoides salmoides*; see p. 9), physiological mediators of nest abandonment decisions (see p. 13), and more broadly how reproductive success may be a major factor in recruitment dynamics (see p. 16). Third, several studies examined the physiological and stress-related responses by native sport fish (*Lepomis macrochirus* and *M. salmoides salmoides*) to environmental stressors, such as low oxygen and hypercarbia. These studies under Job 101.4 were collaborations with other federally supported projects to develop novel chemical barriers to prevent the spread of Asian Carp to the Great Lakes. Fourth, planning efforts have begun to conduct the 6th iteration of "Fishes of Champaign County" under Job 101.6. The importance and value of these research studies are further discussed below under each section of the Executive Summary, and in greater detail throughout this report.

Outreach activities under Job 101.5 primarily consist of the continued development and maintenance of content for the website www.ifishillinois.org. The website is a heavily visited, popular resource of anglers seeking information about sport fishing opportunities in the state. The site provides basic information about access, as well as science-based assessments about the quality of sport fishing in Illinois waters. Through Job 101.5 we are able to communicate the results of sport fish research and analysis, delivering state-of-the-art information to researchers, managers, and the angling public.

Sport fish data sets are the building blocks that support research studies and outreach activities within Project F-69-R, making the collaborative collection, organization, analysis, and dissemination of sport fish information a critical component of the overall goals of this Project. Through collaborations with the Illinois Department of Natural Resources, Project F-69-R provides additional resources needed to efficiently collect and manage data that reflects that status and trends in sport fish populations in Illinois, and to organize that information in such a way that the needs of all data users can be more efficiently met.

The importance and value of Project F-69-R lies in the ability to be responsive to emerging sport fish management issues through research studies and long-term sport fish data sets, followed by compelling and salient communications of those findings to the angling public. Further below in the Executive Summary is a brief overview of the accomplishments of each job within the project, followed by a more detailed reporting of the specific procedures, findings and recommendations for future activities under this project.

JOB 101.1 SPORT FISH POPULATION AND SPORT FISHING METRIC

Using long-term sport fisheries data, project staff has initiated the development and testing of a Fishing Quality Index (FQI) for individual species of sport fish. Fisheries-dependent data were assembled using creel survey data from 1990 – 2009 and collected in previous segments of Project F-69-R. Creel survey estimates for angler effort, angler catch, and catch biomass of largemouth bass were log-transformed to normalize their distributions, and a 0 to 5 scoring system was developed based on the standard deviation of each distribution. Development of the FQI has required project staff to access a wide variety of currently isolated, individually managed data sets. As such, project personnel have coordinated with DNR Division of Fisheries to discuss integration of these data sets to facilitate their use in FQI development as well as in other aspects of Project F-69-R. Procedures and methods for data assembly, analysis and FQI scoring schemes have been initiated for largemouth bass on Illinois lakes and impoundments and will extend to several other sport fish species and a sport fish community metric for individual lakes, rivers and streams in Illinois.

JOB 101.2 ENHANCED FIELD SAMPLING OF SPORT FISH POPULATIONS

Project F-69-R has awarded several undergraduate students majoring fisheries management (or related fields) the opportunity to participate in enhanced field sampling activities during the summer months. Field assistants worked directly with IDNR Division of Fisheries to conduct sampling of stream fish assemblages in over 30 sampling sites within the Spoon, Mackinaw and Iroquois River basins of Illinois during the summer of 2010, and are currently sampling the Embarrass and Cache River Basins in 2011. This collaboration results in an increased number of sites sampled and promotes the sharing of data in support research studies under this and other Federal Aid projects. Enhanced field sampling also enables fisheries managers to effectively assess sport fish populations and determine the need for future management actions to promote healthy sport fisheries.

JOB 101.3 DETERMINE FACTORS AFFECTING FISHING QUALITY

In the current segment project personnel conducted field studies examining the processes that determine reproductive success and largemouth bass with the goal of gaining a better understanding how angling during the reproductive period may influence recruitment dynamics, and ultimately fishing quality. These experiments showed that more aggressive largemouth bass tend to contribute higher numbers of offspring to the next generation, but that these same highly aggressive males may be more susceptible to angling and removal from their nest (Experiment 3.1). Preliminary results of a second set of experiments indicate that acute predator burden – a measurement of the perceived threat of brood depredation as perceived by the male when released near his nest – is the variable with the greatest explanatory power for describing nest abandonment in largemouth bass (Experiment 3.3). The results of a third experiment (Experiment 3.2) demonstrate the importance of reproductive success in influencing recruitment dynamics. Together these studies show how angling is an important component of recruitment dynamics in largemouth bass, and how life history characteristics are critical factors in understanding variability in sport fish abundance and ultimately fishing quality.

JOB 101.4 COORDINATION WITH ONGOING FISHERIES RESEARCH PROJECTS

Project personnel continue to provide support for a various ongoing fisheries research projects by providing information about sport fish populations from sport fish data sets, demonstrating the importance of collaborative collection, organization, analysis, and dissemination of sport fish information. Additionally, Project F-69-R personnel collaborated directly with personnel from Project CAWFS-74 to determine tolerances of native Illinois sport fish (largemouth bass, bluegill) to low dissolved oxygen and elevated carbon dioxide levels experienced in association with potential chemical barrier technologies designed to prevent intrusion of Asian Carp into the Great Lakes (Experiments 4.1 – 4.3). Water quality represents a primary variable that can impact the health and well being of fishes in the wild. Dissolved oxygen, for example, is crucial for fish, and levels of dissolved oxygen are currently regulated by both state and federal limits. Defining the tolerance limits and suggested levels of water quality parameters is therefore important not only for regulating agencies, but for the health and survival of sport fish populations.

Additionally, in June of 2010, Project personnel began collaborations with the Illinois DNR Division of Fisheries Lake Michigan Program to coordinate field sampling to collect data to assess movement and survival using the presence/absence of oxytetracycline marks in the vertebrae of hatchery-reared Chinook salmon. Sampling also provides data on the presence/absence of coded wire tags in hatchery-reared Chinook salmon and lake trout. F69R project staff will meet with Illinois DNR Fisheries Lake Michigan Program staff and staff from other Federal Aid Projects, such as F-138-R (Lake Michigan near-shore fish communities), F-123-R (Yellow Perch), F-52-R (Lake Michigan Creel Survey), and USFWS Project #301819G032 (Evaluation of lake trout reef spawning areas), to determine knowledge gaps and research needs that can be addressed in the next segment of this Project F-69-R.

Access to fisheries data sets and the efficient and coordinated management of those data sets are critical to the successful completion of all aspects of Project F-69-R. Sport fish data sets utilized by project personnel come from a variety of relatively isolated sources (e.g., creel surveys, lakes surveys, streams surveys), and the many sampling sites within those data sets lack adequate geospatial referencing to support Project F-69-R objectives. Project personnel have begun developing options for modifying how sport fish information is managed to efficiently integrate multiple data sources, include sufficient geospatial data, and broaden the scope of use of the information to support research and management activities. Efficiently integrating sport fish data sets is a difficult endeavor that requires the continued attention of F-69-R project personnel and a strong collaborative partnership with IDNR Division of Fisheries.

JOB 101.5 SUPPORT AND ENHANCE WEB INTERFACE

Project personnel continue to maintain and enhance the website www.ifishillinois.org as the primary method for providing online information about sport fishing opportunities to the public. The website includes information about Illinois sport fish, including weekly fishing reports, findings on long-term analyses of sport fisheries data, trends in fishing quality, and the promotion of Illinois as a fishing destination. This effort makes sport fisheries-related information readily available to the public and continues to provide immeasurable benefit to current and prospective anglers in Illinois.

An average of over 760 people visited www.ifishillinois.org each day to read information about fishing opportunities in Illinois. Significant additions to the website included information about spear and bow fishing in Illinois, an online creel survey for muskie anglers (a partnership with the Illini Muskie Alliance), and the development of information about sport fishing opportunities in the Cache River Basin. Individual fisheries fact sheets for a number of lakes and species were added, as were statewide status reports for several individual sport fish species. Overall, information about visitors to www.ifishillinois.org indicates that the website's popularity continues to grow as coordination between project personnel and IDNR Division of Fisheries provides additional material for the website, promoting sport fishing opportunities in Illinois waters.

JOB 101.6 FISHES OF CHAMPAIGN COUNTY

Building on the efforts of Forbes and Richardson (1908), Thompson and Hunt (1930), Larimore and Smith (1963), and Larimore and Bayley (1996), planning for the next iteration of "The Fishes of Champaign County" was initiated in Segment 24. Field collections will begin in Segment 25 (Spring 2012) and will include sampling of fish populations at pre-determined field sites, assembly and analysis of land use and stream habitat data, collection and analysis of physio-chemical habitat data, and analysis of the effect of fish community and environmental parameter interactions on distribution and assemblage characteristics.

JOB 101.1 SPORT FISH POPULATION AND SPORT FISHING METRIC

OBJECTIVES

The following components constitute the overall objectives for Job 101.1:

- Develop and test a wadeable and non-wadeable Fishing Quality Index (FQI) for common Illinois sport fish species using fisheries data collected through standardized field sampling and creel surveys.

PROCEDURES

Using long-term sport fisheries data, project staff has initiated the development and testing of a Fishing Quality Index (FQI) for individual species of sport fish as well as on sport fish assemblages for individual lakes, rivers and streams across Illinois. Historical creel survey data from 1990 – 2009 will continue to be used to parameterize the fisheries-dependent components of the FQI metric. As development and testing of the FQI continues, standardized sampling data of Illinois lakes, rivers and streams will be used to parameterize the fisheries-independent components of the FQI metric for both wadeable and non-wadeable systems. An annual wadeable and non-wadeable FQI will be calculated for several sport fish species on individual bodies of water (lakes, rivers, and streams) across Illinois, and could be used in concert with traditional sport fisheries management metrics (e.g., proportional stock density, PSD) to more fully describe the interaction between population structure and quality of angling experience.

Development of the FQI has required project staff to access a wide variety of currently isolated, individually managed data sets. As such, project personnel have coordinated with DNR Division of Fisheries to discuss integration of these data sets to facilitate their use in FQI development as well as in other aspects of Project F-69-R. Primary sources of data (e.g., creel survey, lakes sampling, streams sampling, hatchery stocking, regulations) as well as derivative data and information such as FQI will be integrated and into a Sport Fisheries Data Set complete with geo-referencing. Improved data set integration will allow INHS Fisheries Researchers to spatially analyze trends in sport fisheries information and angling quality over time, and will enable fisheries managers to access relevant fisheries information to inform management actions.

FINDINGS

Procedures and methods for data assembly, analysis and FQI scoring schemes have been initiated for largemouth bass on Illinois lakes and impoundments. Fisheries-dependent data were assembled using creel survey data from 1990 – 2009, excluding a small portion of surveys conducted on rivers and streams, large impoundment tail waters, and where surveys were directed exclusively on night fishing and ice fishing. Additionally, creel surveys where catch, effort and biomass estimates had a confidence interval greater that 50% were not included in the analysis, leaving 221 surveys available for developing a scoring system and parameterizing the

fisheries-dependent portion of the largemouth bass FQI model. Creel survey estimates for angler effort, angler catch, and catch biomass of largemouth bass were log-transformed to normalize their distributions, and a 0 to 5 scoring system was developed based on the standard deviation of each distribution.

RECOMMENDATIONS

Evaluation of fisheries-dependent and fisheries-independent metrics and scoring systems will continue to be developed for largemouth bass as well as several other popular sport fish in future project segments. Once a full complement of largemouth bass FQI scoring systems are developed for component metrics, additional sport fish data can be used to parameterize species-specific scoring and determine the appropriate weighting of each component score.

Development of the Fishing Quality Index requires access to the large amount of fisheries data available from decades of creel surveys and standard sampling throughout Illinois. Therefore, project personnel should continue to coordinate efforts with DNR Division of Fisheries to gain access to fisheries data sets necessary for the execution of Job 101.1.

JOB 101.2 ENHANCED FIELD SAMPLING OF SPORT FISH POPULATIONS

OBJECTIVES

The following components constitute the overall objectives for Job 101.2:

- Conduct targeted and supplemental field sampling of sport fish populations to support the data needs of project activities

- Coordinate with other Federal Aid Projects and Division of Fisheries to fill gaps in sampling effort and create efficiencies among federally supported (DJ) projects

PROCEDURES

Project staff will coordinate directly with the Division of Fisheries to determine sport fish population sampling needs in an effort to meet the growing demand for field data collection to support research activities and the analytical needs of fisheries managers. Enhanced field sampling of sport fish populations also provides data needed for FQI development on selected wadeable and non-wadeable waters within the state. Project staff will be used to fill gaps in sampling needs that also support research objectives in this study, and create flexibility in apportioning sport fish population sampling effort to meet the needs of multiple Federal Aid Projects, in addition to the needs of the Division of Fisheries.

FINDINGS

Project personnel worked directly with IDNR Division of Fisheries to conduct sampling of stream fish assemblages in the Mackinaw and Iroquois River basins of Illinois during the summer of 2010. Although data entry and analysis for 2010 collections is currently underway, preliminary analyses provide insights about sport fish populations in these stream basins, described in the following sections:

Mackinaw River Basin

A basin survey was conducted on four main stem river sites and seven tributary sites on the Mackinaw River in 2010. Largemouth bass were most abundant in Six Mile Creek, upstream of Evergreen Lake, and ranged in size up to 10 inches. Smallmouth bass were most abundant at Sweeney Woods Nature Preserve on the Mackinaw River north of Lake Bloomington and ranged in size up to 13 inches. Northern pike, walleye, sauger, and large catfish appear to occur in very low densities in the Mackinaw River Basin.

Iroquois River Basin

A basin survey was conducted on five main stem river sites and 18 tributary sites on the Iroquois River in 2010. The river sites averaged 5.4 largemouth bass and 1.6 smallmouths per hour of sampling, while the tributary sites produced an average of 4.1 largemouth bass and 2.0 smallmouth bass per site. The Iroquois River suffered a significant fish kill in the summer of 2010 due to a diatom algae bloom. Although approximately 80% of the fish killed were catfish species, our main stem river sites averaged 19.8 channel catfish and 1.4 flatheads per hour of sampling. The main stem river catch rates were highly skewed by the record catch rates at Sugar Island, east of Chebanse where catfish appeared to be congregating in the oxygen-rich water of the large riffle while oxygen in other parts of the river dropped nearly to zero. The tributary sites produced an average of 3.2 channel catfish per site. Northern pike and walleye were also collected in low numbers.

RECOMMENDATIONS

Until data entry and analyses are completed, any definitive conclusions about 2010 sport fish assessments in the Mackinaw and Iroquois River Basins would be premature. However, the overall benefit of the collaboration between project personnel and IDNR Division of Fisheries to conduct sport fish assessments is exceptional. Data collected can and will be used to develop and test the FQI metric, provide summary information about sport fish opportunities to the public via www.ifishillinois.org, and to support the research and management needs of multiple collaborators and peers. Coordinated stream surveys should continue in future segments.

JOB 101.3 DETERMINE FACTORS AFFECTING FISHING QUALITY

OBJECTIVES

The following components constitute the overall objectives for Job 101.3:

- Evaluate long-term trends and spatio-temporal variation in the quality of sport fish populations
- Conduct experimental and manipulative experiments to identify the biological mechanisms affecting performance metrics in sport fisheries

Experiment 3.1 – Impacts of angling induced selection on aggression, nest guarding behavior and reproductive success of male largemouth bass (M. salmoides salmoides)

This study examined potential fitness consequences of angling-induced selection by evaluating how recreational fishing may act as an evolutionary force on largemouth bass (*M. salmoides salmoides*) recruitment. The broader goal was to deduce consequences for the management of largemouth bass fisheries by comparing the reproductive success of two lines of largemouth bass selected for high and low vulnerability to angling over three consecutive generations. This selection experiment resulted in a threefold decrease in angling vulnerability for low vulnerability fish (LVF) while the aggression level of high vulnerability fish (HVF) remained unchanged across time (Philipp et al. 2009; see Figure 3.1).

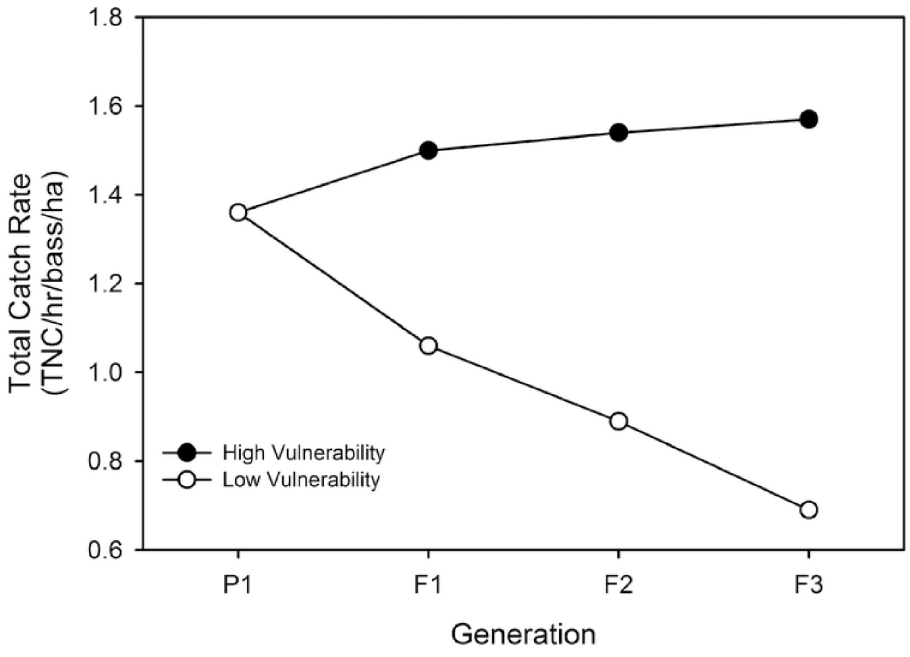


Figure 3.1. Total catch rates of high-vulnerability and low-vulnerability largemouth bass, showing the divergence across three generations of selection from the parental (P_1) generation (Philipp et al. 2009).

Nest-guarding males in the HVF line spend more time in their nests and have higher fanning and turning rates than their LVF counterparts (Cooke et al. 2007). Furthermore HVF have higher metabolic rates, reflected by higher oxygen consumption and lower growth rates due to high energetic expenditures (Redpath et al. 2010). The goal of the present study was to test the hypothesis that reproductive success of individual fish may be dependent on these behavioral and physiological characteristics as they have been altered by angling-induced selection.

PROCEDURES

To compare the reproductive success of the two lines, a common garden study was conducted in INHS research ponds from April to September 2009. The experiment consisted of six replicate ponds, each containing four HVF males and four LVF males, as well as seven wild-type female fish obtained from Lake Mingo. Swimmers regularly snorkeled the six ponds throughout the spawning season and recorded the amount of time a male spent on his nest and the duration of parental care through the season. Males were also presented with three different artificial hookless fishing lures for which strike rates and nest defense behaviors were recorded. In mid-September, each pond was drained and all juvenile largemouth bass were collected. A subsample of young-of-the-year (YOY) from each pond were assigned to individual males using nine distinct microsatellite markers obtained from tissue samples collected from both the adult males and the YOY, and the reproductive success (number of offspring contributed) of each male was determined.

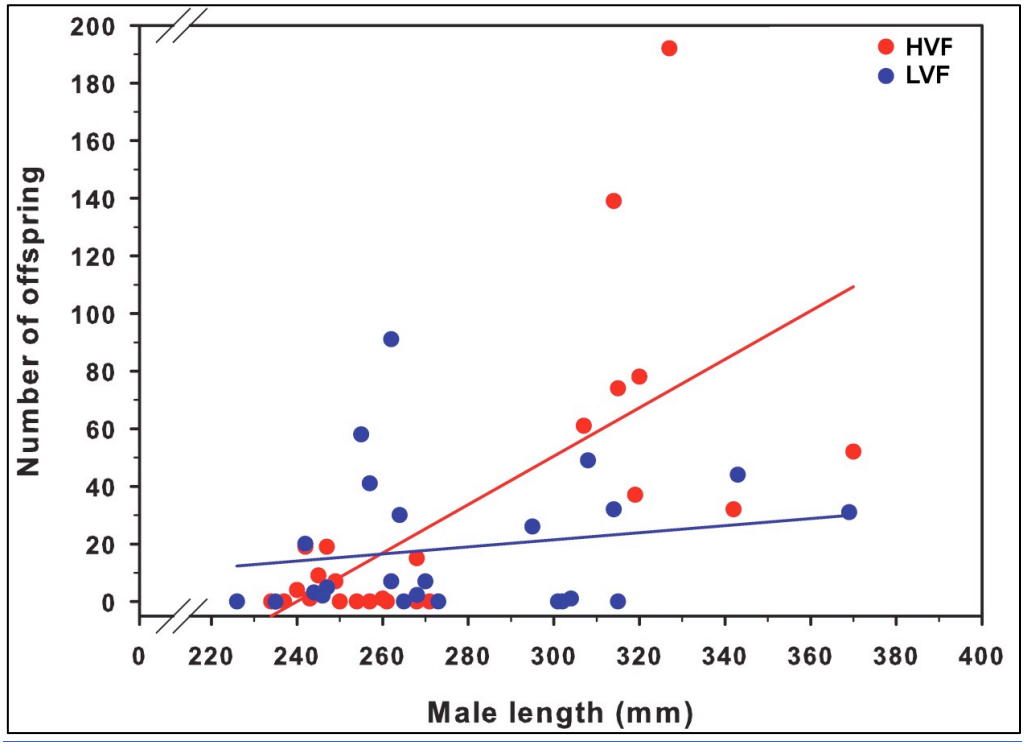


Figure 3.2. Number of genotyped offspring for males with high vulnerability to angling (red circles, red regression line) and low vulnerability to angling (blue circles, blue regression line) and given total length (Generalized Linear Mixed Model, $P < 0.05$)

FINDINGS

Reproductive success differed between lines and was influenced by male size, with the highest number of offspring contributed by large HVF males and the fewest offspring produced by small HVF (Figure 3.2). Comparisons of behavioral assessments showed that HVF spend more time on nest and were two times more likely to hit a lure than LVF independent of male size (Figure 3.3). The duration a male parental care to his offspring was influenced by male size, with large HVF providing the longest parental care (Figure 3.4). These findings suggest a higher investment in parental care activities by HVF.

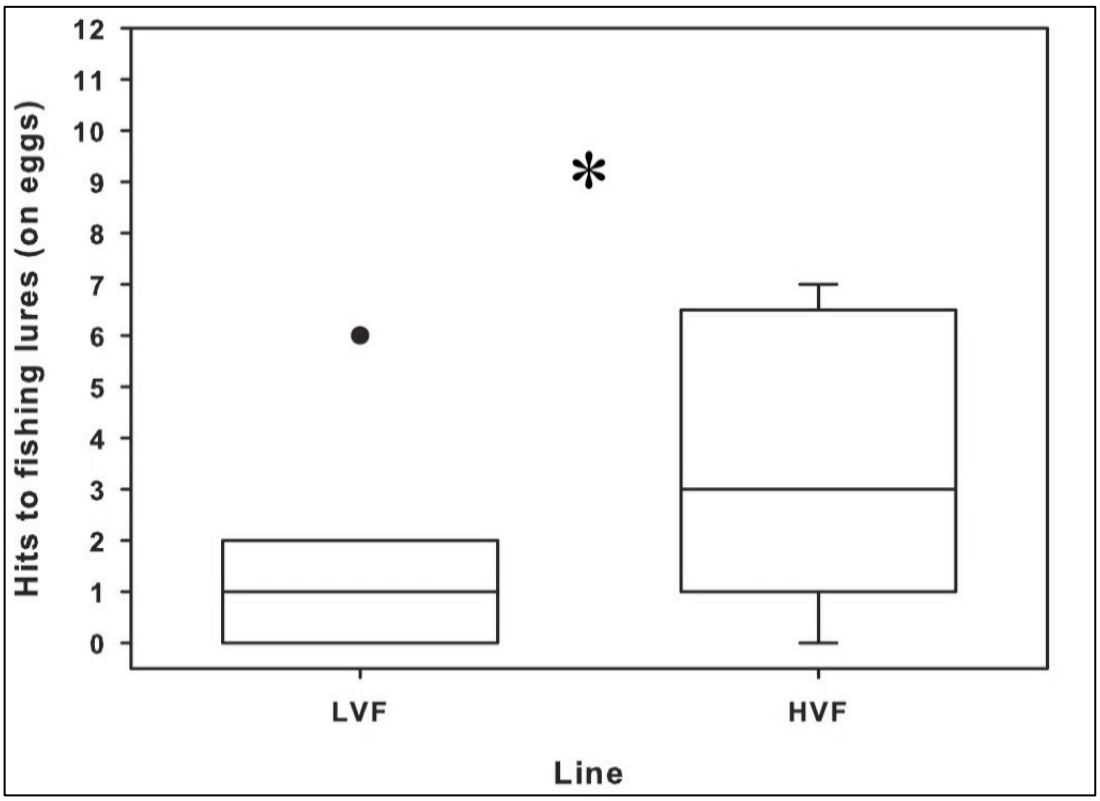


Figure 3.3. Comparison of vulnerability to angling between bass selected for low vulnerability to angling (LVF) and bass selected for high vulnerability to angling (HVF) (Generalized linear mixed model $P < 0.05$)

RECOMMENDATIONS

In this experiment, HVF males appear to be higher quality parents that provide a more intense parental care (longer time on nest, higher strike rates towards fishing lures). However, small HVF contributed fewer offspring than small LVF, reflecting an interaction between breeding line and male size. Large HVF males provided the longest parental care and made the largest contributions to recruitment. Limited energy reserves of small adult males combined with a higher activity in HVF during parental care are likely the main drivers for the observed differences in contribution to the recruitment class across lines.

The harvest of aggressive males from a population may cause angling-induced evolution that favors survival of fish expressing lower levels of aggression. This, however, could be detrimental in environments with high levels of nest predation as lower aggression levels could decrease overall fitness of the species. This could reduce not only recruitment of largemouth bass and potentially decrease population fitness, but also decrease overall angling vulnerability and thus fishing quality of aquatic habitats where angling induced selection occurs. Additional studies that examine potential compensatory mechanisms in largemouth bass recruitment are necessary to appreciate the full impact of angling-induced evolution of male aggression on population dynamics. Regulations intended to protect spawning stocks, such as catch and release restrictions, may not prevent the occurrence of angling-induced selection in systems with high densities of brood predators. Therefore, angling pressure, brood predator density, duration of spawning season, and other factors that influence survival should be considered when developing management actions that impact nesting largemouth bass.

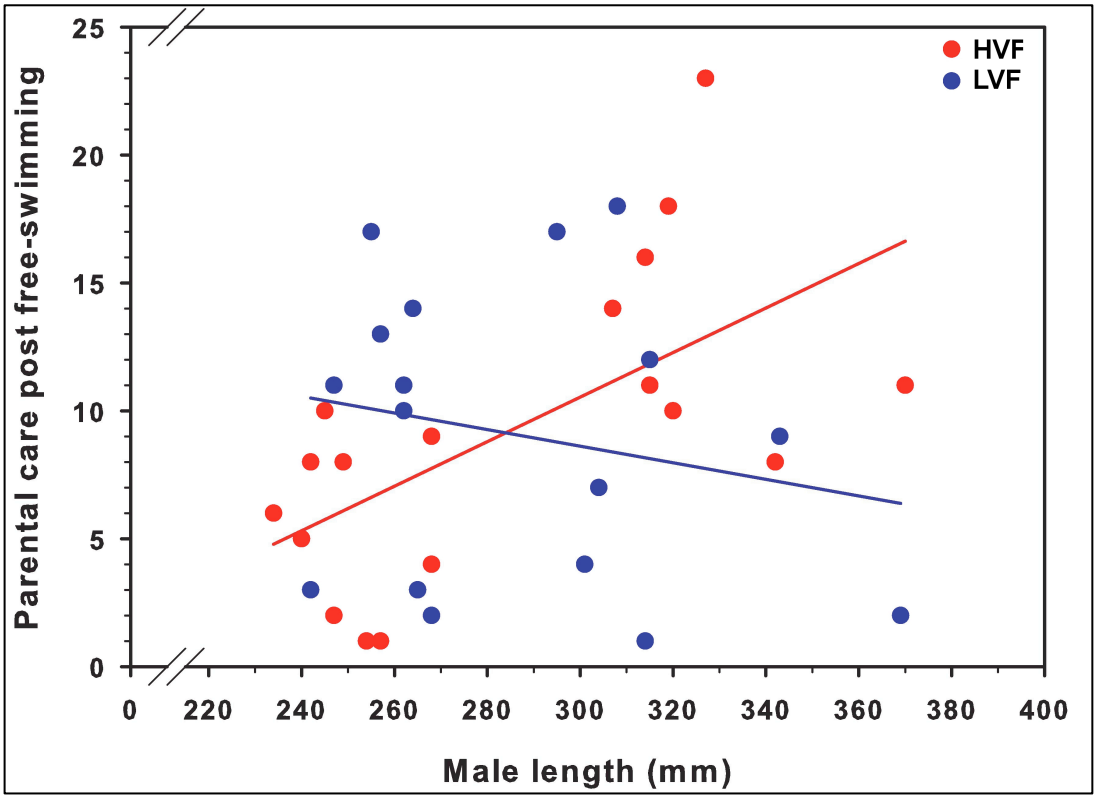


Figure 3.4. Duration of parental care provided for swim-up fry by males with high vulnerability to angling (red circles, red regression line) and low vulnerability to angling (blue circles, blue regression line) and given total length (Generalized Linear Mixed Model, $P < 0.05$)

Experiment 3.2 – Physiological mediators of nest abandonment decisions in largemouth bass during the spawning season

Investment into parental care behaviors (e.g., fanning eggs, guarding nest from potential brood predators) is energetically and physiologically costly; parental males exhibit a decrease in nutritional condition and an increase in physiological stress as the reproductive period progresses. Parental male bass, when challenged by an acute or chronic stressor, may prematurely abandon a nest before their offspring have reached independence, forfeiting any reproductive potential for that spawn year. While recruitment of largemouth bass is, in part, dependent upon reproductive success, it is unknown how the physiological condition of the parental male and varying levels of brood predator densities influences premature nest abandonment. Understanding how these factors affect nesting success can provide insight into temporal variation in recruitment numbers of largemouth bass, and subsequently provide insight toward making informed management decisions.

The objectives of this experiment are to determine whether abandonment decisions are mediated by a) *nutritional condition* of the male, and the energetic reserves available during the parental care period; b) *hormonal stress* of the male, and the biological responses of an individual to the hormone response; c) *circulating androgen (hormone) levels* of the parental male, particularly 11-keto testosterone, the assumed primary androgen in mediating parental decisions in fish; d) *oxidative damage* and an individual's capacity to prevent oxidation, as a measurement of overall health of that individual; e) *chronic predator burden*, the quantification of which is analogous to the consistent threat of predation upon a brood; and f) *acute predator burden*, the quantification of which is analogous to potential predation at the time of a stressor (e.g., angling) as perceived by the parental male.

PROCEDURES

To locate nesting largemouth bass, weekly snorkel surveys were conducted at the onset of largemouth bass spawn activity through the end of the spawning season. Nests were located and uniquely marked, and the number of brood predators within a 2 m radius of the nest was recorded as a measure of chronic predator burden. Each male was captured via conventional hook-and-line angling and blood was non-lethally collected via the caudal vessel and prepared and frozen for subsequent laboratory analyses using standard techniques. During blood sampling and immediately after the male was released, an observer located at the bow of the boat recorded the maximum number of potential brood predators within a 2 m radius of the nest as a measure of acute predator burden. Follow-up snorkel surveys were conducted within 48 hours of blood sampling to determine whether the male had abandoned his brood or continued providing parental care. Sampled nests with no male present were considered abandoned, whereas males present with a lower caudal fin clip were considered to have continued parental care.

Several suites of plasma physiological parameters were analyzed to determine stress, nutritional condition, androgen levels, and oxidative stress condition of each male sampled. Stress levels were evaluated based on concentrations of the plasma ions potassium (K^+), sodium (Na^+), and chloride (Cl^-), as well as plasma glucose and cortisol concentrations. Nutritional condition was

evaluated as a measure of plasma total protein, triglyceride concentrations and cholesterol concentrations. Plasma concentrations of the androgen 11-keto Testosterone (11-KT) were used to measure androgen levels. Oxidative damage was determined by measuring concentrations of plasma protein carbonyls, a by-product of protein oxidation, and correlates of lipid peroxidation via colorimetric assay. Total antioxidant capacity, a measurement of an individual's resistance to oxidative damage, was analyzed via colorimetric assay.

FINDINGS

Sixty-three (63) males were sampled in the spring and summer of 2010, of which 18 males abandoned their nests after the angling event and 45 successfully raised a brood to independence. Laboratory analyses have been concluded for stress correlates (cortisol, glucose, chloride, potassium, and sodium), nutritional condition (protein and cholesterol), and androgen condition (11-KT). Analyses of triglycerides and oxidative stress correlates (TAC, protein carbonyl, lipid peroxidation) are slated to be completed by September 2011. Preliminary analyses indicate that acute predator burden – a measurement of the perceived threat of brood depredation as perceived by the male when released near his nest – is the variable with the greatest explanatory power for describing nest abandonment in largemouth bass ($p < .0211$; AICc=0); this finding could change, however, following the completion of all parameters to be measured. Model selection was determined by the difference in AICc scores (ΔAICc), with interactions between acute predator burden, chronic predator burden, male size, and physiological stress to be plausible influences on abandonment (Table 3.1). These results, indicate that higher predator burdens are likely to influence abandonment decisions after an angling event, and that larger (i.e., older) males are less likely to abandon a brood given any stressor.

RECOMMENDATIONS

The current findings indicate nest abandonment after an angling event is influenced by brood predator burden, with male size and physiological stress as minor interaction effects. Understanding the relationship between brood predator densities, post-angling nest abandonment, and reproductive success in largemouth bass may provide insights into determining factors that limit bass recruitment. Managers seeking ways to explain poor recruitment in Illinois lakes should consider high brood predator densities and high angler catch rates as one possible explanation for poor recruitment, and investigate management actions designed to target these specific recruitment mechanisms.

Table 3.1. Model Selection Results. Akaike's Information Criterion results for factors influencing nest abandonment in largemouth bass. Models are ranked in descending order from most-likely to explain premature abandonment, with the lowest difference in AICc (ΔAICc) representing the best-fit model. Several models with likelihoods equal to 0.00 were not included in this table. *Denotes significance as determined by Wald-type likelihood test, α=.05.

Model	AIC_C	Δ AIC_C	AIC_C Weight	Model Likelihood	Pr > F
AcutePred	70.5	0	0.25	1.00	**.0211***
ChronPred*AcutePred	71.49	0.99	0.15	0.61	0.2868
PredAcute*Cort	71.74	1.24	0.13	0.54	0.2414
PredAcute*TL	72.11	1.61	0.11	0.45	0.5936
TL*PredAcute*Cort	72.15	1.65	0.11	0.44	0.1001
Prot*Stage	72.97	2.47	0.07	0.29	0.5927
Gluc	73.18	2.68	0.07	0.26	0.1005
Protein	75.33	4.83	0.02	0.09	0.6716
ChronPred	75.41	4.91	0.02	0.09	0.3916
Cl	75.8	5.3	0.02	0.07	0.5442
Cort	76.19	5.69	0.01	0.06	0.9973
Na	76.19	5.69	0.01	0.06	0.998
Gluc*Cort	77.03	6.53	0.01	0.04	0.8135

Experiment 3.3 – Impacts of reproductive success on smallmouth bass recruitment

A wide number of environmental factors are attributed to larval growth and survival and it has been a long-held assumption in the fisheries management community that recruitment is independent of individual reproductive success. However, in sport fish species that have high fishing pressure and that exhibit parental care, such as the black basses, the connection between the number of successful nests in a year and recruitment may be a strong one. In this experiment, we tested the hypothesis that reproductive success in a given season is correlated with abundance of age 1+ recruits the following year.

PROCEDURES

We conducted a field experiment to test whether nesting success, mating success and/or reproductive success impacts recruitment of age 1+ individuals. In this study, we quantified nesting success as the number of smallmouth bass who spawned within a defined study area. We estimated mating success using an egg and fry scoring system for each male, and we quantified reproductive success as the number of males that defended their brood to the swim up fry stage. Finally, we conducted visual assessments of the abundance of age 1+ juveniles the following season. Total number of nests, number of reproductively successful nests, and an estimate of total fry production were compared to measures of corresponding age 1+ juveniles.

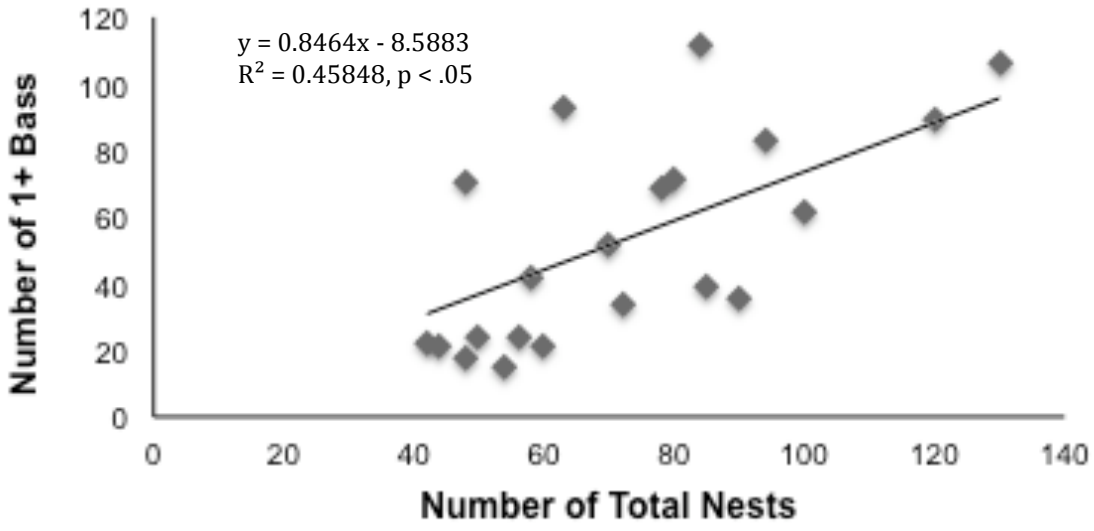


Figure 3.5. Relationship between those nests that successfully raised a brood to the total number of age 1+ bass observed in the following year.

FINDINGS

The long-term study is the first to document a correlation between the number of reproductively successful nests within a population of smallmouth bass and recruitment to age 1+ the following season (Figure 3.5). There was also a correlation between total number of nests and recruitment

(Figure 3.6) as well as the between the estimated number of fry produced and recruitment (Figure 3.7). These findings indicate that recruit abundance is directly related to reproductive success, demonstrating an important link to parental care and black bass recruitment dynamics.

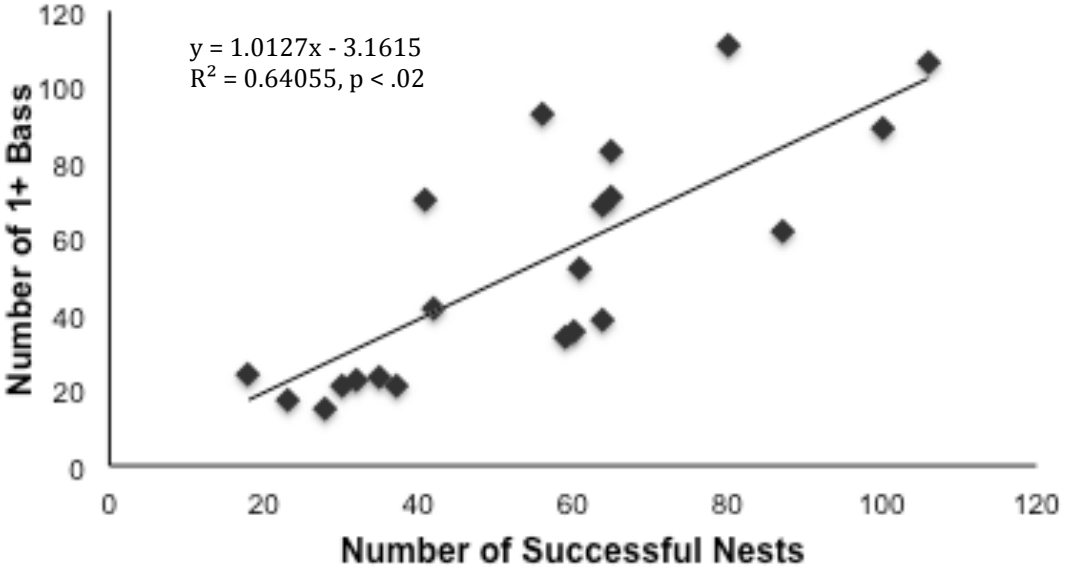


Figure 3.6. Relationship between the total number of nests where spawning occurred And the total number of age 1+ bass observed in the following year.

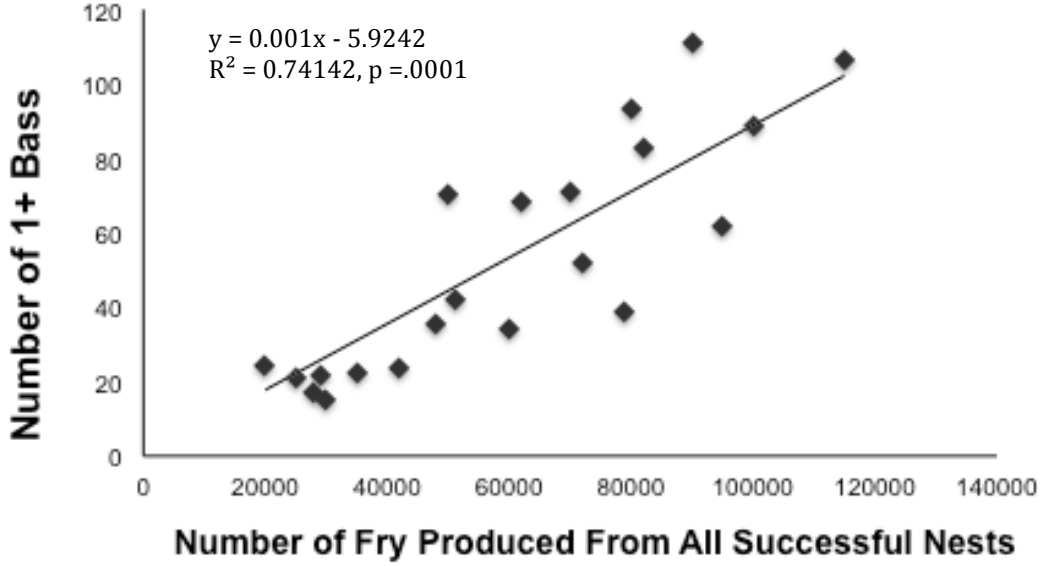


Figure 3.7. Relationship between the estimated number of fry produced and the total number of age 1+ bass observed in the following year.

RECOMMENDATIONS

The findings of this study have important implications for understanding recruitment dynamics and managing black bass populations in Illinois. The link between reproductive success and recruitment should be considered when exploring management actions that may impact parental care, especially in systems where the management goal is improved black bass recruitment. Although the results presented for this study are for smallmouth bass, similar data have been gathered on largemouth bass populations and currently being analyzed. Further work should continue on other Centrarchid species of management concern to determine how the removal of nest guarding males effects recruitment.

JOB 101.4 – COORDINATION WITH FISHERIES RESEARCH PROJECTS

OBJECTIVES

The following components constitute the overall objectives for Job 101.4:

- Provide supportive information on sport fish population dynamics/structure in study lakes, streams, and rivers associated with ongoing Federal Aid projects (e.g., F-101-R, F-135-R, F-138-R, F-123-R, F-52-R) and other federal- and state-supported activities (e.g., CAWFS-74, USFWS #301819G032)

- Maintain and enhance systems for managing and delivering fisheries data and analyses to data users

- Coordinate with related Federal Aid Projects and support the objectives of those projects where practicable

Several research experiments, ecological field studies, and collaborative activities were conducted in support of the objectives of Job 101.4. The procedures, findings, and recommendations for each of these activities are presented below.

Experiment 4.1 – Improved understanding of environmental tolerances of bass and bluegill

Water quality represents a primary variable that can impact the health and well-being of fishes in the wild. Dissolved oxygen, for example, is crucial for fish, and levels of dissolved oxygen are currently regulated by both state and federal limits. Defining the tolerance limits and suggested levels of water quality parameters is therefore important not only for regulating agencies, but for the health and survival of sport fish populations.

PROCEDURES

In FY2010, CAWFS-74, along with support from F-69-R personnel, began experiments whereby largemouth bass and bluegill were subjected to conditions of low dissolved oxygen and elevated carbon dioxide in the laboratory. The primary goal of these experiments was to develop a chemical barrier to deter the movements of Asian carp into the Great Lakes Basin. Results, however, will not only improve our understanding of the physiological tolerance limits of sport fishes, but also can potentially be used to adjust regulatory guidelines of environmental parameters that will benefit sport fish populations.

Using a closed system of circulating water, largemouth bass, bluegill, and two species of Asian Carp were subjected to both hypercarbia (high carbon dioxide) and low dissolved oxygen challenges. During this exposure, behaviors were recorded, including fish ventilation rates as

well as behaviors indicative of agitation (coughing, twitching, loss of equilibrium). Blood- and tissue-based physiological assessments were also conducted after 1 or 2 hour exposures. Analyses included changes in: plasma cortisol, plasma glucose, plasma lactate, and ion balance as compared to control subjects.

FINDINGS

Analyses have quantified the limits at which largemouth bass and bluegill can or will tolerate exposures to hypercarbia and low dissolved oxygen. Behavioral observations were used to define concentrations of these gasses at which fish expressed discomfort or loss of equilibrium. Dissolved oxygen concentrations of 2.0 mg/L O_2, and dissolved CO_2 at 35mg/L (correlating to a drop of pH from 8 to roughly 7) was sufficient to cause both behavioral and physiological disturbance in the species of fish studied (increased stress hormones, ion imbalance).

RECOMMENDATIONS

Results from this study will be valuable in improving regulations for dissolved oxygen levels intended to protect sport fish populations. Recent studies have also suggested that levels of carbon dioxide in the water can have negative impacts for fishes in rearing systems and hatcheries, providing important information for hatchery managers rearing largemouth bass and bluegill.

Experiment 4.2 – Development of molecular tools to quantify stress and disturbance in bass and bluegill

The stress response is common to all fishes and occurs following the perception of potentially harmful conditions. While the purpose of the stress response in fish is to maintain homeostasis and ensure survival, there can be negative consequences associated with prolonged upregulation of the stress response, including disease susceptibility, loss of performance and reduced fitness. Typically, the stress response in fishes is quantified through the production of hormones, such as cortisol, sampled in blood. However, cortisol is expressed following a broad range of stressors and can be expressed following handling and/or sampling. Therefore, it would be advantageous to develop novel indicators of stress for fishes, particularly those that are robust against handling stressors or those that are expressed following specific stressors. Molecular markers, such as the expression of stress genes, represent sensitive stress indices that can be upregulated after specific environmental challenges, and are quick to respond to challenges.

PROCEDURES

In FY2010, CAWFS-74, along with support from F-69-R personnel, began projects to develop novel molecular stress indices (i.e., development of stress genes) using largemouth bass and bluegill. In particular, the project sought to define stress markers that could be quantified in red blood cells, allowing the non-lethal determination of stress for these sport fishes.

Using a closed system of circulating water, largemouth bass and bluegill were subjected to both hypercarbia (high carbon dioxide) and low dissolved oxygen challenges. Red blood cells and heart, muscle and gill tissue were all collected after 1 and 2 hour exposures.

FINDINGS

Currently, primers have been developed for these species for one gene expressed following hypoxia exposure (HIF-1α), four general stress genes (GR-1, GR-2, HSP70-1, HSP70-2) and two "housekeeping genes" that can be used as reference points (EF-1, β-actin). Work is currently underway to quantify the expression of these genes in the collected tissues.

RECOMMENDATIONS

Results from this study will represent a significant improvement in our ability to quantify stress and disturbance in sport fishes. The ability to non-lethally quantify molecular markers of stress in wild fishes will improve our ability to identify healthy vs. "stressed" populations of largemouth bass and bluegill, and this technology can then be applied elsewhere to other fish species. In addition, following publication in peer-reviewed journals, the primer sequences for the stress genes in largemouth bass and bluegill will be available for use by other researchers, allowing the expansion of these techniques elsewhere.

Experiment 4.3 – Development of novel chemical barriers to prevent the spread of Asian carp and to protect existing sport fish populations in the Great Lakes

Asian carp represent a significant threat to the Great Lakes ecosystems. Currently, there is a single electric barrier preventing the movement of Asian carp from the Mississippi River drainage to the Great Lakes basin. Electric barriers are size-selective, however, preferentially targeting large fish, leaving smaller fishes free to escape the electric current. It would therefore be valuable to develop additional, redundant barriers that are not size-selective that would provide additional safety and security to the Great Lakes basin by deterring the movement of Asian carp.

PROCEDURES

In FY2010, CAWFS-74, along with support from F69R personnel, began projects to develop novel chemical barriers to deter the movement of Asian carp. In particular, the study sought to quantify the effectiveness of carbon dioxide and low oxygen as barriers. Due to the collaborative nature of Job 101.4 and the supportive role of Project F-69-R in the execution of Project CAWFS-74, brief highlights of this experiment are included here.

Using a closed system of circulating water, largemouth bass, bluegill, and two species of Asian Carp were subjected to both hypercarbia (high carbon dioxide) and low dissolved oxygen challenges. During this exposure, behaviors were recorded, including fish ventilation rates as well as behaviors indicative of agitation (coughing, twitching, loss of equilibrium). Blood- and tissue-based physiological assessments also conducted by after 1 or 2 hour exposures. Analyses included changes in: plasma cortisol, plasma glucose, plasma lactate, and ion balance as compared to control subjects.

Furthermore, hypercarbia avoidance behavior was observed in a shuttle box system. For this, fish were free to choose between two connected tanks of which one side was subjected to hypercarbia while the other side received only compressed air. This experiment essentially 'chased' fish within the two tanks, and allowed researchers to quantify avoidance behaviors when Asian carp 'chose' to leave a tank due to elevated carbon dioxide. Additional swimming performance trials were performed to quantify the ability of fishes to perform burst swimming upon entering a region of elevated carbon dioxide.

In addition, experiments were performed to test the feasibility of applying carbon dioxide to a small-scale pond (0.1 and 0.25 ha) and whether large-scale field applications are practical (both from a cost and feasibility perspective).

FINDINGS

Analyses have quantified the limits at which largemouth bass and bluegill can or will tolerate exposures to hypercarbia and low dissolved oxygen. Behavioral analyses revealed that bluegill, largemouth bass and Asian carp all exhibit signs of discomfort (coughing, twitching, loss of equilibrium) at 2.0 mg/L dissolved oxygen, or 30 mg/L carbon dioxide. Analyses of blood

variables corroborated this finding, and exposure of fish to these concentrations resulted in significant physiological disturbances (increased ion levels, increased stress response, etc.).

In addition, results from the shuttle box experiment showed that it is possible to 'chase' fish with carbon dioxide; following an elevation of CO2 concentration in the water to approximately 30 mg/L, fish will show signs of discomfort (twitching, elevated activity, surface respiration), followed by them vacating the area of elevated CO2.

Field studies showed that the application of CO2 into small ponds (0.1 and 0.25 ha) is easy, straightforward and effective. Additions of small quantities of carbon dioxide into the water will result in achieving target values of 30 mg/L, and carbon dioxide levels remain stable at this level for several days.

RECOMMENDATIONS

Results from this series of experiments identify carbon dioxide as a chemical that can be used as a potential barrier to impede the movement of Asian carp, but would also prevent movements of largemouth bass and bluegill. Carbon dioxide is preferred over low dissolved oxygen because dissolved oxygen concentrations need to be dropped below 2.0 mg/L to ensure effectiveness, and this is logistically challenging. While future efforts are required to verify the use of carbon dioxide as a chemical barrier, this result can have important conservation implications for sport fishes throughout the Great Lakes drainage.

IDNR Division of Fisheries Collaboration

Additionally, in June of 2010, Project personnel began collaborations with the Illinois DNR Division of Fisheries to conduct research studies and management activities on Lake Michigan. Project personnel and DNR staff have begun identifying current and future research needs relative to Great Lakes sport fish restoration for consideration as specific activities in future segments.

PROCEDURES

Project personnel, working with the IDNR Division of Fisheries Lake Michigan Program, conducted coordinated field sampling to collect data to assess movement and survival using the presence/absence of oxytetracycline marks in the vertebrae of hatchery-reared Chinook salmon. Sampling also provides data on the presence/absence of coded wire tags in hatchery-reared Chinook salmon and lake trout.

FINDINGS

In March of 2011, an estimated 300,000 Chinook salmon were marked at Jake Wolf Fish Hatchery as part of a lake-wide, inter-agency collaboration spearheaded by the U.S. Fish and Wildlife Service, and also involving Michigan DNR, Indiana DNR, and Wisconsin DNR. In June of 2011, a new full-time position was added to Project F-69-R to collaborate with Division of Fisheries and other agency partners on the mass-marking project in addition to other fisheries management research studies on Lake Michigan. This collaboration has begun and data collection is currently underway.

RECOMMENDATIONS

F69R Project personnel should continue coordinated data collection and analyses to support management activities and research studies. F69R project staff will meet with Illinois DNR Fisheries Lake Michigan Program staff and staff from other Federal Aid Projects, such as F-138-R (Lake Michigan near-shore fish communities), F-123-R (Yellow Perch), F-52-R (Lake Michigan Creel Survey), and USFWS Project #301819G032 (Evaluation of lake trout reef spawning areas), to determine knowledge gaps and research needs that can be addressed in the next segment of this Project F-69-R.

Sport Fish Data Set Organization and Access

Access to fisheries data sets and the efficient and coordinated management of those data sets are critical to the successful completion of all aspects of Project F-69-R. As project staff seek to utilize existing fisheries information and ensure that future data collection meets the needs of this and other federal and state supported fisheries research, continued access to sport fish data sets are required.

PROCEDURES

Project personnel collaborated with IDNR Division of Fisheries to identify necessary modifications and improvements to the collection, storage and retrieval of fisheries information by researchers, managers, and the public. Project personnel began developing online data browsing tools for use by project personnel to support activities in Job 101.1, Job 101.3 and Job 101.5.

FINDINGS

Sport fish data sets utilized by project personnel come from a variety of relatively isolated sources (e.g., creel surveys, lakes surveys, streams surveys), and the many sampling sites within those data sets lack adequate geospatial referencing to support Project F-69-R objectives. Project personnel have begun developing options for modifying how sport fish information is managed to efficiently integrate multiple data sources, include sufficient geospatial data, and broaden the scope of use of the information to support research and management activities.

RECOMMENDATIONS

Efficiently integrating sport fish data sets is a difficult endeavor that requires the continued attention of F-69-R project personnel and a strong collaborative partnership with IDNR Division of Fisheries. Further efficiencies and modifications to fisheries information systems should be explored and implemented in future project segments, thus making information about sport fish populations in Illinois more readily accessible to researchers, managers, and the public.

JOB 101.5 – SUPPORT AND ENHANCE WEB INTERFACE

OBJECTIVE

The following components constitute the overall objectives for Job 101.5:

- Enhance and maintain a web interface for the dissemination of sport fisheries data and analyses to the public, and develop additional site enhancements upon request of DNR Fisheries.

PROCEDURES

Project personnel continue to maintain and enhance the website www.ifishillinois.org as the primary method for providing online information about sport fishing opportunities to the public. The website includes information about Illinois sport fish, including weekly fishing reports, findings on long-term analyses of sport fisheries data, trends in fishing quality, and the promotion of Illinois as a fishing destination. This effort makes sport fisheries-related information readily available to the public and continues to provide immeasurable benefit to current and prospective anglers in Illinois.

FINDINGS

Improvements and additions to ifishillinois.org

Spear and Bowfishing: In response to requests from statewide bowfishing associations, this past year spear and bowfishing information was added to the website. IDNR provided project personnel a list of state records to include along with downloadable certificates. The tournament dates and results for the 2nd annual Bowfishing Association of Illinois Directors' Shoot were added to the website along with tournament photos.

Muskie Creel Survey: Project personnel, in coordination with the IDNR Division of Fisheries and the Illini Muskies Alliance, created an online system for muskie anglers to voluntarily report their muskie catch. Using a web-based form, anglers can provide creel information about their muskie catch, and that information is then automatically stored in a muskie creel data set that can be linked to other fisheries data and information utilized under Job 101.4.

Cache River: Responding to public concern over improving the access to quality sport fishing in the Cache River and its tributaries, the Project personnel and IDNR Division of Fisheries collaborated to assess the sport fishing quality in the Cache River basin. Project staff developed and launched information about angling opportunities on the Cache River as a way to both promote fishing in the basin and to publicize efforts to assess fishing quality on the Cache. Fishing reports and canoeing information for the Cache River were included also, thus improving accessibility to this location for anglers targeting sport fish.

General Website Improvements: IDNR biologists provided individual fisheries fact sheets for a number of lakes, which were then added to the website. Additionally, statewide status reports for several individual sport fish species were updated during Segment 24, and individual species factsheets were created (Table 5.1). This information provides anglers basic information about the status of Illinois sport fish, and includes physical descriptions, photos, illustrations, distribution maps, and information about the basic biology of the species (Figure 5.1).

Table 5.1. Sport fish species fact sheets and status reports available on www.ifishillinois.org.

Sport Fish Species	Scientific Name	Species Factsheet	Statewide Status Reports
Largemouth bass **Smallmouth bass**	*Micropterus salmoides* *Micropterus dolomieu*	Yes Yes	1999, 2008-2011
Bluegill	*Lepomis macrochirus*	Yes	None
Redear sunfish	*Lepomis microlophus*	Yes	None
Green sunfish	*Lepomis cyanellus*	Yes	None
White crappie **Black crappie**	*Pomoxis annularis* *Pomoxis nigromaculatus*	Yes	None
Channel catfish	*Ictaluris punctatus*	Yes	1999, 2007-2009, 2011
Walleye **Sauger**	*Sander vitreum* *Sander canadense*	Yes	1999, 2008-2011
White bass **Yellow bass**	*Morone chrysops* *Morone mississippiensis*	Yes	None
Striped bass (including hybrids)	*Morone saxatilis*	Yes	1999, 2006-2009, 2011
Northern pike	*Esox lucius*	Yes	2007-2011
Muskellunge	*Esox masquinongy*	No	1999, 2006-2011
Yellow perch	*Perca flavescens*	Yes	None
Coho salmon	*Oncorhynchus kisutch*	Yes	None
Bigmouth buffalo **Smallmouth buffalo** **Black buffalo**	*Ictiobus cyprinellus* *Ictiobus bubalus* *Ictiobus niger*	Yes	None
Black bullhead **Brown bullhead** **Yellow bullhead**	*Ameiurus melas* *Ameiurus nebulosus* *Ameiurus natalis*	Yes	None

Website Statistics Analysis

As of March 15, 2011, www.ifishillinois.org began using Google Analytics to collect information regarding visitors to the site. Google Analytics provides reports on how often each page is visited, which pages have the highest numbers of visitors, the trends in the website visitors (higher on weekends, holidays, etc.), what pages have the highest exit rates, etc. This

information allows us to assess where we need to focus our time and efforts to improve the site and to ensure that we are providing the public information in which they are interested.

Visitor Information

- We receive an average of 762 visits/day to www.ifishillinois.org.
- From March 15, 2011 – July 30, 2011, we had 76,052 people visit our site 105,215 times (some visited more than once).
- Each visitor views an average of 8 pages per visit.
- The average amount of time spent on the site per visitor is 4 minutes
- Our bounce rate[1] is a low 29%.
- Of all visitors, 81% in Illinois; 3.5% from Missouri; 1.9% from New York, 1.5% from Indiana. We've even had 8 visitors from Alaska.
- Of all visitors, 59% find us using a search engine, while 23% find us through the DNR website and 12% come directly to our site by typing in the web address.

Content Information

- The Weekly Fishing Report page is the #1 most-visited page and landing page.
- Our regional lake selection page is the second most-visited page.
- Region 2 is the most visited, followed by Region 1, then Kids Hotspot, then Region 3, followed by Region 4, Rivers Select and Region 5.
- Region 2 had twice as many visitors as Region 5.
- The most popular lake profile is Lake Michigan, followed in order by the Fox Chain O' Lakes, Heidecke, Tampier, Busse, Shabbona, Diamond and Shelbyville Lakes.
- If there is a link that directs a visitor away from our site (e.g., DNR link) or directs you to a download (e.g., Cache River Calendar of Events), we cannot track those as they are not included in analytics.

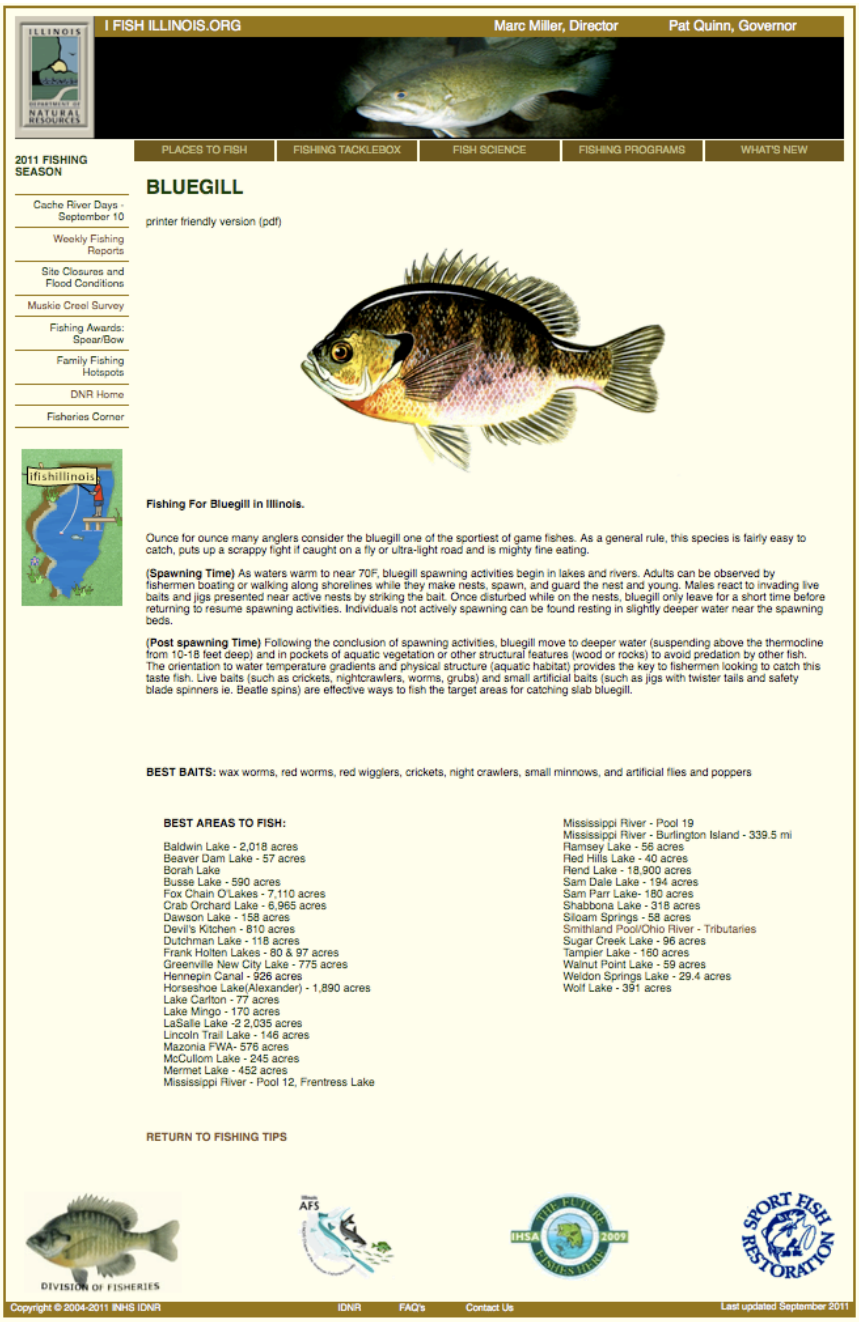
A Case Example for Google Analytics

A brief analysis of Google Analytics data for www.ifishillinois.org during August 2011 revealed that on Sunday, August 7 we had twice the number of visitors as we had on average each day for the month prior (1299 visitor on August 7, 2011 -- a 112% increase over the average). Of those 1299 visitors, 91% were from within the state of Illinois, and 81% of those visitors used a search engine to find us, using such words as "fishing reports," and "Illinois fishing reports." Of those visitors not using a search engine to find www.ifishillinois.org (11% of visitors), an overwhelming proportion (90%) were referred through the Illinois DNR website. Google

[1] Bounce rate is the percentage of single-page visits or visits in which the person left your site from the entrance (landing) page. A high bounce rate generally indicates that site entrance pages aren't relevant to your visitors. The more compelling your landing pages, the more visitors will stay on your site and convert.

Analytics data provides additional insights as to why web traffic was so high on this particular day. Pages with the highest number of visitors were pages with fishing reports, and no particular region of the state had more visits than any other, leading to the conclusion that visitor traffic to www.ifishillinois.org was widespread, higher than normal, and may simply be a reflection of large numbers of anglers choosing that day to "Fish Illinois."

Figure 5.1. Bluegill species fact sheet available on www.ifishillinois.org.



RECOMMENDATIONS

Information about visitors to www.ifishillinois.org indicates that the website's popularity continues to grow as coordination between project personnel and IDNR Division of Fisheries continues to provide additional information about sport fishing in Illinois waters. Further integration of fisheries information from data sources including coordination conducted under Job 101.4 of Project F-69-R will provide science-based information set for anglers and managers alike. As the development of the Fishing Quality Index proceeds in the next segment under Job 101.1, its inclusion in web pages profiling individual lakes as well as statewide status reports will further enhance the quality and quantity of information provided to the angling public.

JOB 101.6 – FISHES OF CHAMPAIGN COUNTY

OBJECTIVE

The following components constitute the overall objectives for Job 101.6:

- Analyze the changes in fish species in Champaign County during the last 100 years and identify components of stream fish assemblages that have significantly changed over time, as well as the key factors contributing to those changes over the last century

PROCEDURES

Building on the efforts of Forbes and Richardson (1908), Thompson and Hunt (1930), Larimore and Smith (1963), and Larimore and Bayley (1996), the next iteration of "The Fishes of Champaign County" will be conducted. The study will include sampling of fish populations at pre-determined field sites, assembly and analysis of land use and stream habitat data, collection and analysis of physio-chemical habitat data, and analysis of the effect of fish community and environmental parameter interactions on distribution and assemblage characteristics. To the maximum extent practicable, field crews will replicate sampling methods (e.g., electric seine and block nets) and locations (140+ sample sites) used in previous iterations of this long-term study (previously funded under Federal Research Project F-76-R).

FINDINGS

In Segment 24, preliminary activities for conducting the Fishes of Champaign County study included organization and planning by project leaders and reviewing and assembling data from previous iterations of the study. Approximately 140 sampling sites have been identified, and the need for converting generalized site location information (township, range, section as well as paper maps) to geo-referenced site data (latitude and longitude) has emerged as a key priority prior to field sampling activities. Staffing needs have been determined, some sampling gear has been acquired, and a project schedule has been developed.

RECOMMENDATIONS

During the fall and winter of 2011-2012 (Segment 25), a Fishes of Champaign County project manager should be identified and tasked to prepare for field sampling in the spring and summer of 2012. Permission from private landowners for access to sampling sites should be requested and secured prior to spring 2012, remaining sampling equipment and procedures developed, and field crews hired. Sampling of sites is scheduled to take place during the spring, summer and fall of 2012 (Segment 25) and 2013 (Segment 26).

Segment 24 Job Costs - Budget v. Actual

	Budget	Actual	Over/(Under)
Job 101.1 – Sport Fish Population and Sport Fishing Metric	$75,166	$75,634	$468
Job 101.2 – Enhanced Field Sampling of Sport Fish Populations	$163,771	$159,243	($4,028)
Job 101.3 – Determine Factors Affecting Fishing Quality	$396,396	$391,453	($4,343)
Job 101.4 – Coordination with Ongoing Fisheries Research Projects	$73,355	$75,376	$2,521
Job 101.5 – Support and Enhance Web Interface	$84,092	$84,881	$962
Job 101.6 – Fishes of Champaign County	$7,220	$5,879	($1,341)
Total Costs	**$800,000**	**$792,466**	**($7,534)**
Federal Share	**$600,000**	**$594,349**	**($5,651)**
State Share	**$200,000**	**$198,117**	**($1,883)**

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