Kentucky Department of Fish and Wildlife Resources

Annual Research Highlights 2014

Volume VIII, Oct. 2015

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Our Mission:

To conserve and enhance fish and wildlife resources and provide opportunity for hunting, fishing, trapping, boating and other wildlife related activities.

COVER: *Big South Fork mussel release / Lee McClellan*

Foreword

Brook trout fingerlings ready to be placed into Parched Corn Creek / Kevin Kelly

Research and monitoring are key steps towards conserving and enhancing fish, wildlife, and habitat resources throughout the Commonwealth. In order to effectively manage a species it is vital to fully understand its ecology and behavior along with its responses to management activities. As stewards of Kentucky's fish and wildlife, it is our job to ensure seasons and bag limits are sustainable and to determine if management actions are achieving desired goals. The following project summaries serve as a testament to KDFWR's vigilance in the conservation of the fish and wildlife resources that we hold in trust for the public. The 2014 KDFWR Research Highlights document represents targeted efforts by KDFWR and partners to fulfill statewide conservation goals.

Funding Sources and Guide to Federal Programs

KDFWR receives no general fund taxpayer dollars. As a result, the Department relies on hunting and fishing license fees, boat registration fees, and federal programs to fund the seven divisions within KDFWR. Nearly all of the projects included in this document are partially or fully funded by federal programs including the Wildlife Restoration Act (Pittman-Robertson), the Sport Fish Restoration Program (Dingell-Johnson), the State Wildlife Grant Program (SWG), and the Cooperative Endangered Species Conservation Fund (Section 6).

These federal programs serve a variety of purposes; however, each has an underlying goal of fish, wildlife, and/or habitat conservation. Brief descriptions of each of these programs are as follows:

Federal Funding Source	Program Goal
Wildlife Restoration Act (Pittman-Robertson)	To restore, conserve, manage and enhance wild birds and mammals and their habitats
Sport Fish Restoration Program (Dingell-Johnson)	To fund fishery management projects, boating access, and aquatic education
Cooperative Endangered Species Conservation Fund (Section 6)	To fund conservation projects for candidate, proposed, or listed species
State Wildlife Grant Program (SWG)	To develop and implement programs that benefit wildlife and their habitats; specifically, species and habitats of conservation concern

Bear den work / Steven Dobey

These federal programs provided approximately 15.3 million dollars to KDFWR in 2014, while the sale of hunting and fishing licenses provided 27.4 million dollars, over half of KDFWR's budget (see Figure 1). For reference, we have included the state and federal funding sources for each project; however, these projects may be additionally supplemented by outside funding provided by non-profit organizations or universities. For each project summary, we also identify the specific goals addressed by either Kentucky's Strategic Plan or Kentucky's State Wildlife Action Plan, the two guiding documents for our agency.

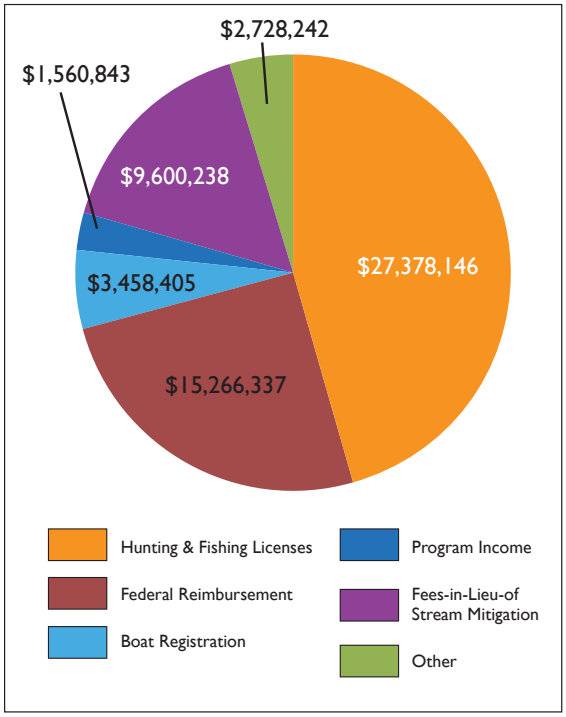

Figure 1. Kentucky Department of Fish and Wildlife Resources Funding Sources 2014. Total revenues for 2014 were $59,992,211.

How to Use This Document

This document is divided into **four main sections**: published research, completed projects, new projects, and project updates. Citations for all **published research** with Kentucky Department of Fish and Wildlife involvement are included in the Table of Contents. For projects that have been completed and not yet published, a detailed summary will be included in the first portion ("**completed projects**") of the document. For projects that began in 2014, a brief 1-page overview of the project is included in the second portion ("**new projects**") of the document. For select ongoing projects, brief status updates are included in the last section ("**project updates**") of this document. In the table of contents, an expected date of completion, where applicable, is listed for each project. This will facilitate looking up detailed summaries of completed projects in later years. A comprehensive **project reference guide** lists all projects included in Research Highlights documents, beginning with publication year 2007.

Please use the following citation when referencing this document:

Kentucky Department of Fish and Wildlife Resources Annual Research Highlights, 2014. Volume VIII. Publication of the Wildlife and Fisheries Divisions. October, 2015, 90 pp.

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Contact Research Coordinator, Danna Baxley (danna.baxley@ky.gov) for reprints of these publications.

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Completed Projects

Daily Energy Needs and Habitat Use of Eastern Population of Greater Sandhill Cranes in Central Kentucky

Erin Harper, Danna Baxley, John Brunjes Kentucky Department of Fish and Wildlife Resources; Rocky Pritchert, U.S. Fish and Wildlife Service

Introduction

As a result of population expansion and milder winters, the Eastern Population (EP) of Greater Sandhill Cranes (*Grus Canadensis tabida*), which breeds around the Great Lakes region and Canada and winters in Florida and Georgia, have begun to winter in Kentucky. After near extirpation in the 18th and 19th centuries, the EP has increased substantially over the last thirty years due to protection, restoration and management of wetlands, a closed hunting season (Walkinshaw 1973), and the crane's ability to include agricultural foods into their diet (McIvor and Conover 1994).

Central Kentucky is predominately rural agricultural and the number of cranes using this habitat during the winter months have continued to increase since 1995. Roughly 22-30% of the EP sandhill cranes winter in Kentucky; and up to 42% of the population is present in the state during peak migration, which can vary due to weather conditions. With such a high proportion of birds utilizing habitat in Kentucky during winter and migration, the central region of the state should be considered an integral part of managing EP sandhill cranes.

Sandhill cranes flying / Erin Harper

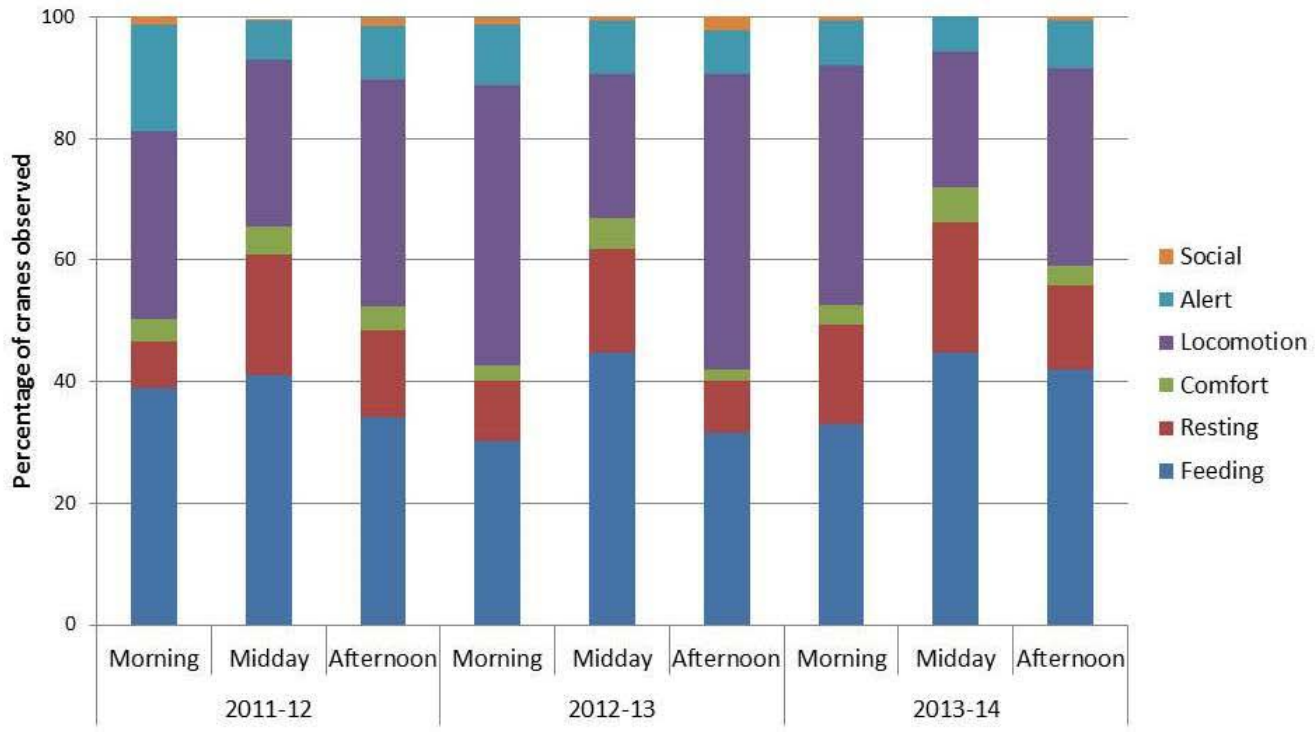


Figure 1: Mean percentage of sandhill cranes observed exhibiting behaviors at various times of day in Cecilia, Kentucky from December to March, 2011-2014.

There is lack of information on habitat use of cranes wintering and staging in central Kentucky. Cecilia is one of the main areas used by EP cranes. It differs from many other staging and wintering areas because all the land is privately owned, with the majority of the area agricultural land. It is important to determine if the habitat available can provide sufficient resources to support the growing number of cranes utilizing the area and what can be done to manage the population during this time. Our objectives were to determine habitat use of EP cranes in central Kentucky and collect activity data to determine how and when the resources are being used, and if there are any other factors affecting the population.

Methods

Study Area

All observations were made within a 140 km² area around Cecilia, located in central Hardin County. The area is privately owned and consists mainly of agricultural land (59% corn, soybean and wheat fields and 39% pasture) interspersed with a large number of ponds and shallow water depressions, some of which are used as roost sites.

Activity Budgets

Time budget data were collected weekly from early December through early March, 2011-2014. Wintering season was divided into two periods based on the population dynamics: (1) wintering period, from December to January, and (2) migration period, from February to early March, when population peaked and later departed for breeding grounds. Observations were made from sunrise to sunset weekly and divided into time blocks: morning (sunrise to 1059), midday (1100-1359), and afternoon (1400 to sunset).

We obtained behavioral observations by instantaneous scan sampling (Altmann 1974) of all flocks encountered along the survey route. We estimated the number of cranes in each flock using 10x50 binoculars and a 15-60x spotting scope. Behavioral categories recorded for each flock were: (1) Feeding, (2) Resting—loafing and sleeping, (3) Comfort—preening, bathing, stretching, and ruffling feathers, (4) Locomotion—flying and walking, (5) Alert, and (6) Social—aggression, jumping, and courtship. Time of day and weather conditions (i.e. temperature, sky, wind speed, and precipitation) were also recorded.

Habitat Use

To determine habitat availability for EP cranes within the study area, we obtained data from USDA National Agricultural Statistics Service Cropscape (http://nassgeodata.gmu.edu/CropScape/) along with ground-truthing and National Land Use Land Cover data using ArcGIS 9. Habitat

types were classified as corn, soybean, alfalfa, pasture (including hay and grass), winter wheat, other crops, and wetlands. Availability of each habitat type was expressed as a percentage of the area mapped. We recorded habitat type and location for each flock encountered.

Statistical Analyses

For activity budget analyses, we calculated percentage of occurrence for each activity for each independent flock. Crane activity budgets and general weather parameters differed among years; consequently, activity budget relationships to weather, period, and time of day were analyzed separately for each of the three years of this study. Non-parametric Wilcoxon signed-rank tests (two-tailed) were employed for activity budget analysis and for post-hoc means comparisons because focal observation data did not meet assumptions of normality or equal variances. To explicitly address habitat use versus habitat availability, we used Chi^2 tests to compare proportion of habitat in the core use area (35,033 acres) to proportion of focal observations in each habitat type. All statistical analyses were conducted with JMP v10.0 (SAS Institute, In., Cary, NC, 2003) and means are presented ± 1 SD.

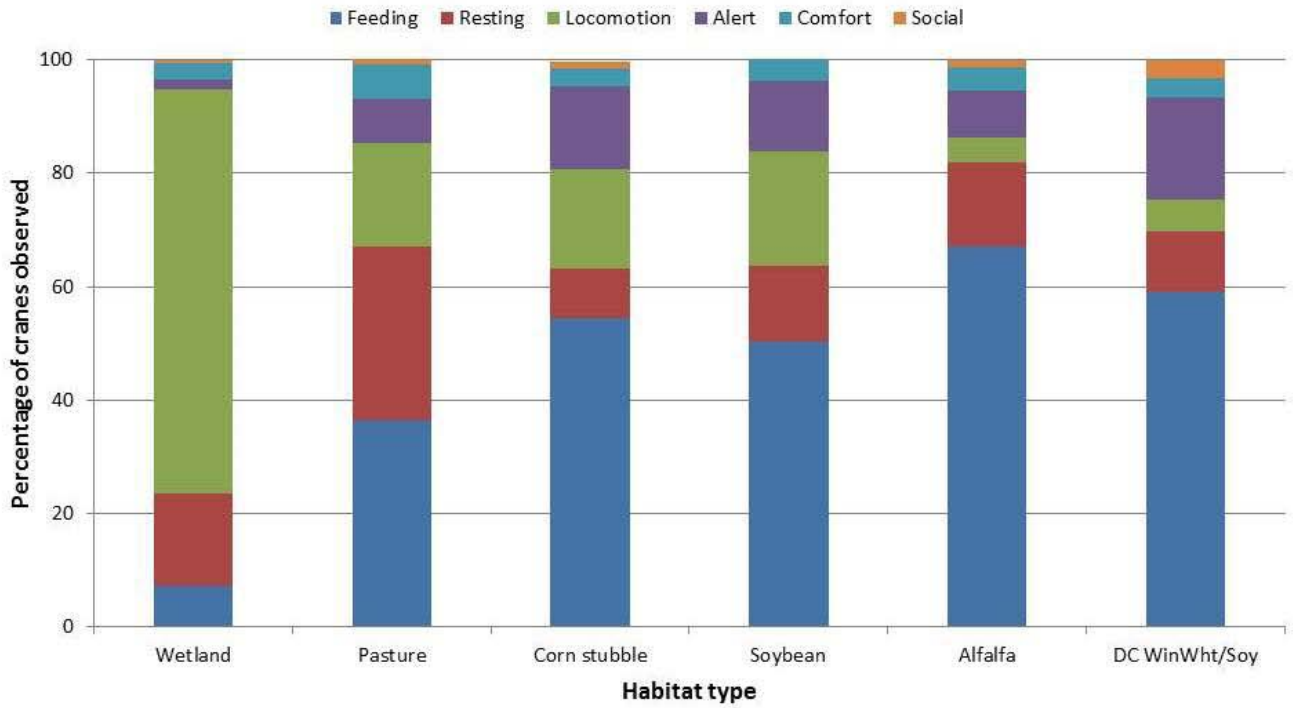
Results

Activity Budgets

We collected activity budgets on 1,790 independent flocks between 01 December and 14 March, 2011-2014. Diurnal activity budgets revealed important variables influencing behavior of sandhill cranes. Behaviors differed significantly ($P < 0.05$) with period, time of day, year, and habitat. Overall, cranes spent more time resting and on comfort activities during midday, and more time on locomotion in the morning and afternoon, walking out of roosts and flying to and from feeding sites and then back again to roost at night (Figure 1). Cranes spent most of their time throughout the day feeding, with a peak occurring midday.

Cranes exhibited different behaviors between wintering and migration periods in each year. In 2011-12, cranes spent significantly more time feeding during wintering period compared to migration ($P < 0.05$). They spent more time alert and twice as much time on comfort activities during migration. Over 35% of the time was spent on feeding in both periods. In 2012-13, cranes spent a similar amount of time on feeding, alert, comfort and social activities in both periods. They spent significantly more time on locomotion in the wintering period. Cranes spent almost twice as much time resting during the migration period compared to the wintering period. In 2013-14, cranes spent significantly more time on all activities during migration compared to wintering period except locomotion ($P < 0.01$).

Figure 2: Mean percentage of sandhill cranes observed in various activities on different habitat types in Cecilia, Kentucky. DC WinWht/Soy = double crop winter wheat and soybeans.



Patterns of behavior among habitats were not significantly different between years, so data were combined. Cranes exhibited habitat-specific behavior across habitat types ($P < 0.05$, Wilcoxon tests). Feeding was the most common activity in all habitat types except wetland (Figure 2). Cranes spent more time resting in pastures than in corn stubble. Cranes spent more time on comfort activities in wheat fields compared to corn stubble and wetland. More time was spent on locomotion activities, mostly flying to and from roosts, and less time alert in wetlands than in any other habitat type.

Habitat Use

There were 7 habitat types available and used on the study site (Table 1). Corn stubble and soybeans made up 31.4% of the landscape. Forest, residential and other land uses made up about 41% of the study area, but were not used by cranes and were excluded from analyses. There was no significant difference between proportions of habitat available between years ($\chi_2^2 = 2.00$, $P = 0.368$), so data were combined. Habitat use differed significantly from availability ($\chi_2^2 = 819869.50$, $P \leq 0.001$). Soybean, double crop winter wheat and soybean, and pasture were used less than expected ($P < 0.05$; Table 2). Pasture made up more than 23% of the landscape, but was underutilized at only 15%. Corn stubble, alfalfa, wetlands, and wheat use exceeded availability. Wetland was the most preferred habitat of cranes with 37% use and representing only 1% of the study area. Corn stubble was the next preferred habitat with 33% use. Many fields were used consistently throughout the study depending on the habitat type and juxtaposition to roosts. Several large corn stubble fields were used frequently in 2011-12 and 2013-14; however, those same fields received little to no use in 2012-13 when habitat type was double crop winter wheat and soybean. Fields adjacent to roosts were used every year without preference for habitat type.

Temporal use of habitat did not differ between years, so data were combined. Cranes used different habitats during various times of day ($P < 0.05$). Corn stubble and soybean use peaked in the afternoon at 44.8% and 42.9%, respectively, as cranes fed heavily before returning to the roosts to rest for the night. Pasture was used more during midday (39.1%) when cranes were usually observed resting or in comfort activities. A few pastures were located next to roosts and were used more often than pastures not adjacent to roosts. Cranes used wetland (36.9%), and the adjacent alfalfa fields (86.1%), more in the morning than any other habitats.

There was a significant difference in observation temperatures between years. It was significantly colder in 2013-14 than previous years with a mean of 31.45 degrees, compared to average of 40 degrees the two previous years ($\chi_2^2 = 196.99$, $P \leq 0.001$). Roosts were often frozen, and the ground was covered in snow for a near record number of days, forcing the cranes to move out of the area.

Crane habitat use varied between winter and migration periods in 2011-12 and 2013-14. Corn was used more during migration in all years, but only significantly more in 2013-14 ($P \leq 0.001$). Pasture was also used more during migration than winter in all three years, but there was no significant difference in 2012-13 ($P = 0.345$). Soybean was used more in winter than migration in 2011-12 and 2012-13; however the difference was not significant ($P = 0.538$ and $P=0.119$, respectively). In 2013-14, soybean was favored during migration period ($P \leq 0.001$).

Discussion

Cranes vary time between fields, activities, seasons, and time of day due to differences in food availability, abundance and nutritional demands (Tacha et al. 1987, Aviles and Bednekoff 2007, England 2009). They must balance time spent feeding with other activities required for survival and maintenance (Aviles and Bednekoff 2007, England 2009). Cranes arrived in Cecilia in early December and departed by early March. Cranes spent most of their time feeding, resting and on locomotion, which was similar to Green et al. (1999). Aborn (2010) found cranes spent most of their time on foraging, alert, and preening.

Seasonal variations were observed influencing behavior, especially in 2013-14 when average temperatures were below freezing and the ground was covered in snow. Cranes spent more time on social activities during migration when more cranes were present and often in larger flocks, which increased aggression encounters (Caraco 1979). More time was spent on feeding during migration than winter, except 2011-12, which was similar to findings by England (2009) in Ontario. By feeding less in the winter period of 2013-14, cranes may have reduced energy expenditures since resources were in low supply (Tacha et al. 1987) due to the frozen, snow-covered ground. Nutritional needs change and cranes store more fat during staging periods (Krapu et al. 1985, Reinecke and Krapu 1986). Cranes were more alert during migration, possibly in search of a mate (de Azevedo et al. 2010) and also more vigilant when other cranes flew overhead.

As in other studies (Lovvorn and Kirkpatrick 1982, Sparling and Krapu 1994, England 2009, Aborn 2010), behavior was influenced by habitat. Changes in activities in different fields may be related to different food available and its nutrient content (Lawson and Clark 1988, Ringelman 1990, England 2009). Similar to cranes in Tennessee (Aborn 2010) and the mid-continental population in Nebraska (Krapu et al. 1984, Sparling and Krapu 1994), cranes in Cecilia foraged primarily in agricultural fields and

Table 1: Habitat use of sandhill cranes observed in Cecilia, Kentucky from December to March, 2011-2014. DC WinWht/Soy = Double crop winter wheat and soybean.

Habitat Type	% Use	% Availability
Alfalfa	0.75	0.34*
DC WinWht/Soy	0.22	2.93*
Corn stubble	32.60	16.54*
Soybean	12.85	14.85*
Pasture	15.31	23.40*
Wetland	36.50	1.33*
Wheat	1.77	0.04*

***P < 0.05**

rested in pastures. Cranes roosted in wetlands and were observed resting or flying from the roosts in morning and returning in late afternoon (Lovvorn and Kirkpatrick 1981). Walking was also observed in many wetlands as cranes waded across the water.

Data on habitat availability and use are important in identifying habitat types used by wintering and migrating sandhill cranes. The study area is similar to other staging and wintering areas (Lovvorn and Kirkpatrick 1982, Aborn 2010) and was dominated by corn stubble and soybean with fields separated by vegetative drainage ditches. Lovvorn and Kirkpatrick (1982) found that habitat type influenced flock size and, similar to cranes in Cecilia, cranes consistently returned to previously used fields and larger flocks used corn more than other habitats. Although there was a similar amount of soybean and corn stubble available each year, cranes preferred corn stubble as their main energy source (Reinecke and Krapu 1979; Iverson et al. 1982, 1987). As in the North Platte River Valley in Nebraska (Iverson et al. 1987), corn stubble was used throughout the day and peaked in afternoon, as cranes fed heavily before returning to roost. Corn has high energy content and is abundant and easily accessible, which likely permits rapid lipid accumulation, as seen in Nebraska (Tacha et al. 1987).

Contrary to what Aborn (2010) observed in Tennessee, cranes did not prefer pasture. However, it was used throughout the day, peaking midday when cranes were observed resting, usually next to roosts or other wetlands. Alfalfa was used mainly in the mornings when cranes fed in fields after leaving the roost. Although cranes fed mainly in corn stubble, they also fed in pasture and alfalfa, likely for the invertebrates available that are rich in protein and calcium, nutrients lacking in corn (Reinecke and Krapu 1986). Krapu et al. (1984) found that cranes spent as much time in grasslands obtaining 3% of their diet from invertebrates as they do in corn obtaining the remaining 97%.

Wetlands were the most preferred habitat and cranes used them throughout the day, with peaks in the morning and afternoon when cranes were leaving or returning to roosts. Sandhill cranes show a strong attachment to roost areas and will return to use them year after year (Lewis 1976, Lovvorn and Kirkpatrick 1981). Lovvorn and Kirkpatrick (1981) also found that roosts were likely used if they were closer to other roosts. There were three roost sites in Cecilia within 200 m of each other that were used during all three years of study, two of which were permanent wetlands. Cranes roosted on nearby temporary wetlands when all available roost habitat was occupied, which occurred during population peaks (Iverson et al. 1987) in February and early March. These wetlands were a result of snow melt, precipitation, and a high water table (Iverson et al. 1987). Iverson et al (1987) found that roosting on these wetlands did not appear to have an adverse effect on crane behavior (Tacha 1981). More temporary wetlands, most close to other preferred wetlands, were available in 2013-14 due to a wet, snow covered winter, which benefited the record number of cranes using the area during migration. Wetlands were also frozen much of 2013-14 and the only fresh water was flowing through the drainage ditches between fields, where the cranes were found feeding and drinking much of the time.

Management Implications

Locations and availability of roost sites and other important resources are essential to high quality winter and spring staging habitats for sandhill cranes (Iverson et al. 1987). Each habitat type provides an important role in behavior patterns, where feeding occurs in alfalfa, grassland and harvested grain crops and resting occurs mainly in pastures and wetlands. Iverson et al. (1987) found current agricultural land use practices are compatible with crane use and discourages changes in practices that reduce availability of grains in important wintering and staging areas, such as early plowing which could alter crane patterns of habitat use (Iverson et al. 1985). Land use by cranes around Cecilia is privately owned, so it cannot be directly managed by the state. However, we could offer incentives to landowners to improve or increase preferred habitats, such as corn and wetlands to support the growing

population of sandhill cranes utilizing the area. For now, as long as corn is grown and harvested and wetlands are not drained, cranes will likely continue to use the area during winter and migration.

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Funding Source: *State Wildlife Grant (SWG)*

KDFWR Strategic Plan. Goal 1. Strategic Objective 5. SWAP: Appendix 3.2, Class Aves, Prioritized Research Project # 4, Prioritized Survey Projects # 1 & 2, Appendix 3.9; Terrestrial Monitoring Projects, Class Aves. SWAP: Appendix 3.2, Class Aves, Prioritized Survey Projects # 1, 2 and 5, Appendix 3.9; Terrestrial Monitoring Projects, Class Aves.

Kentucky bull elk / Dan Crank

2013 Kentucky Elk Hunter Survey

Brian Clark, Gabe Jenkins, Dan Crank, and Will Bowling, Kentucky Department of Fish and Wildlife Resources

Introduction

Kentucky's elk herd is estimated by the Kentucky Department of Fish and Wildlife Resources (KDFWR) at 10,000 animals (Crank et al. 2014), which is larger than all other elk herds east of the Rocky Mountains combined. The Commonwealth's elk hunt attracts substantial interest among resident and nonresident hunters, evidenced by tens of thousands of entries into the hunt drawing each year.

The four Kentucky elk hunt permit types available in 2013 were: bull firearms, bull archery, cow firearm, and cow archery. Applicants could apply for two of the four hunt permit types (two entries into the drawing). A randomized drawing was used to select a total of 1,010 applicants (1,000 regular permits and 10 youth-only permits). Drawn applicants were then allowed to purchase the type of permit they were drawn for and could then legally pursue their quarry in the southeastern 16 counties that comprise the elk zone. A maximum of 10% of nonresident applicants could be selected in the drawing; thus ≥90% of applicants selected in the drawing were residents.

In order to better understand the experiences and opinions of these elk hunters, KDFWR initiated a survey of applicants who were randomly selected in the drawing to hunt elk in Kentucky. We sent invitations to participate in the survey to all 1,010 people drawn for the 2013 elk hunt.

Methods

The sampling frame consisted of the entire population of those selected to hunt. The survey was multi-modal and entailed a pre-survey notification and multiple waves of email and mail invitations to complete the survey questionnaire (Dillman 1978, Dillman 2007). We received 691 questionnaire submissions, yielding a gross response rate of 68.4%.

Results

Applying to Hunt

The most frequently cited important reminders to apply for the Kentucky elk hunt included word of mouth from friends or relatives (43.4% of respondents) and communications from KDFWR (percents varied by platform). The most important reasons for participants entering the drawing were opportunity: to harvest an elk (84.6%), to hunt elk in my home state (77.8%), for special memories with friends or family (69%), and to bring home a substantial amount of meat (60.6%). In terms of selecting

permit types to apply for, respondents indicated that their "likely odds of being drawn for a particular hunt type" (38.8%) and "choice of [hunting] method" (37.8%) were more important than "sex of the animal" (19.7%) or other factors (2.8%).

Hunt Areas

Nearly half of respondents applied for a designated hunt area based on recommendation from a friend or acquaintance (48.5%); other prevalent reasons included prior knowledge of the area (28.7%) and availability of public land (25.0%). Nearly one-third of respondents reported hunting the North At-Large Area (29.3%) and just over one-fourth hunted the Hazard LEA (26.6%), whereas less than a fifth reported hunting the South At-Large Area (19.0), Straight Creek LEA (17.9%), and Caney LEA (4.5%), respectively.

Pre-Hunt Scouting

Most respondents (57%) made trips to the elk zone to scout for their hunts. The mean number of trips taken was 3.0 and mean number of scouting helpers was 2.4. Mean time spent scouting varied among hunt areas, ranging from 1.2 days in the Caney LEA up to 3.5 days in the South At-Large Area. About one-third of respondents used the help of friends or acquaintances to locate hunting properties, while 18% were assisted by someone who had hunted elk in Kentucky before, 16% used the Department website, 12% used an elk guide/outfitter, and 11% used the elk hunt packet sent by KDFWR.

In scouting for their hunts, respondents and their helpers spent considerable amounts of money inside and outside the elk zone. While scouting, hunters and their helpers spent a mean total of $926 inside the elk zone and $545 outside the elk zone.

Hunting for Elk

Nearly 90% of respondents indicated that they went elk hunting in 2013 after being selected in the elk hunt drawing. Hunters took over 3 trips and used the help of ≥ 2 people, on average. Hunters themselves spent nearly 5 days elk hunting, on average.

Just over one-third (35.6%) of hunters reported using a guide or outfitter for elk hunting and spent a mean of $624 for those services. The average total expenditures reported by hunters were $1206 inside the elk zone and $1438 outside the elk zone.

About three-fourths (76.3%) of hunters reported harvesting an elk. Most reported only shooting at and hitting the animal they actually harvested.

Hunting Methods

The most popular hunting technique was "spot and stalk mostly on foot" (58.9%), followed by "spot and stalk mostly with a vehicle" (38.3%). The ratio of firearms hunters to archery hunters in the survey sample was about 2:1, and virtually all firearms hunters (99.2%) used centerfire rifles. The most popular calibers were .30-06, .300, .270 and 7mm, and the mean bullet size was about 171 grains. Very few hunters who purchased firearms permits used bows or crossbows to elk hunt in 2013. Among archery/crossbow hunters, about three-fourths used compound bows and nearly a fourth used crossbows. Compound bow hunters used a mean draw weight of 67.0 pounds and a broadhead weight of 106.6 grains. Among crossbow hunters, mean draw weight was 154.4 pounds and broadhead weight 120.7 grains. About twice as many hunters used fixed broadheads as mechanical. A majority of archery and crossbow hunters applied for archery/crossbow elk permits simply because it was their preferred method of hunting (68.7%) or because of better odds of being drawn for an elk permit (61.7%).

Applying for Future Hunts

The vast majority (90.5%) of 2013 elk hunters indicated that they planned to apply again for the hunt. Most prevalent factors influencing their decisions included total number of permits available (53.3%), number of hunt types/options available for application (46.4%), and number of hunt permits per hunt type (41.2%). As a group, respondents opposed most restrictions on re-application, except for the current 3-year waiting period for bull permits (60.2% support). Respondents were relatively neutral toward a possible 1-year waiting period for cow permits (less than half either supported or opposed).

Interest in Harvesting Bull Elk

Virtually all respondents (96.0%) were interested in taking a Kentucky bull in the future. Mixed responses to a question regarding balancing odds of being drawn for a bull permit against opportunity to harvest large-antlered bulls indicated that there was not strong hunter support for trophy-class bull elk management at the expense of hunter opportunity.

The survey questionnaire included a section with a series of questions pertaining to willingness to harvest different bulls with varying body and antler sizes. For each question, a photograph of a particular bull was referenced, and participants were asked whether they would shoot the bull with one of these responses: yes, no, or depends. In general, a majority of elk hunters expressed willingness to harvest any bull, regardless of size or antlers, though smaller-antlered bulls garnered fewer "Yes" and more "Depends" responses.

Big Game Hunts in Other States

Over two-thirds of respondents (68.1%) had applied for big game hunts in other states. Most popular target species in other states were elk (23.5%), mule deer (14.7%), and white-tailed deer (10.1%). Those who had hunted in other states mostly used centerfire rifles or muzzleloaders

(84.3%). Most attractive features of other states' big game hunts were: amount of public land in hunt area (42.6%), appeal of back-country experience (38.4%), total number of tags/permits available to nonresidents (37.3%), increased odds or rewards for repeat application (33.1%), ease of application (32.6), and types of big game available (32.6%).

Demographics

Six hundred and three (603) respondents were Kentucky residents, representing 109 of the Commonwealth's 120 counties. Twenty-one other states were represented by 83 completed surveys. Most resided in rural areas (61.9%) or in small cities/towns (22.3%). Respondents were predominately male (90.5%) and averaged 45.5 years of age. In terms of household income of respondents, 26% reported earning $49,999 or less, 43.3% garnered $50,000-$99,999, and 26.5% earned $100,000 or more.

Other Feedback

We provided a question at the end of the questionnaire to elicit free responses, which resulted in 318 comments. Responses most frequently fell into one of these categories (number of responses in parentheses): positive experiences and/or compliments on the elk program (120); elk hunt drawing system (38); and public access (35).

Discussion & Management Implications

Communications about Elk Hunting

Findings in this survey highlight the importance of communication with hunters about the Kentucky elk herd. Word of mouth was important for reminding hunters to apply as well as selecting areas to hunt. The variety of communications about elk hunting provided by KDFWR, ranging from application reminder mailings to hunt packets for those drawn to hunt, were also very important to Kentucky elk hunters. KDFWR's and its partners' elk hunt marketing communications should appeal to the variety of hunter motivations identified in this survey, including opportunity to harvest an elk in Kentucky, making special memories with loved ones, elk hunting close to home, opportunity to harvest a quality bull elk, and obtaining a substantial amount of meat.

Expenditures on Elk Hunting

Per capita expenditures by Kentucky elk hunters and their helpers as reported in this survey were substantial. These survey estimates can be used to produce estimates of total expenditures by elk hunters in Kentucky in 2013. Our estimate of total expenditures on hunting and scouting inside the elk zone is $1.91 Million, and total related expenditures outside the elk zone is $1.77 Million, which together total $3.68 Million.

Future Elk Hunt Drawings

Interest in future Kentucky elk hunting opportunities by 2013 elk hunters was extremely high (96%). Participants in this survey indicated that total number of permits, number of permits by hunt type, and availability of public land were all important considerations that would influence their future participation. These are no doubt factors that the Department, its Commission, and other stakeholders in the Kentucky elk program should carefully attend to.

Among 2013 elk hunters, there was stronger support for the current 3-year waiting period for bull hunt applications than a 5-year alternative, which was rated more often with opposition by respondents. Respondents were more ambivalent toward a 1-year waiting period for cow hunt application, whereas the mean rating for 3- and 5-year waiting periods for applying again to cow hunt after being drawn fell between "Somewhat Oppose" and "Strongly Oppose."

Based on responses to questions in this survey, there did not appear to be strong preference among 2013 elk hunters for "trophy" (large-antlered) bulls. These results suggest that providing maximum opportunity and managing for a quality herd overall may be the optimal strategy for satisfying hunter demands.

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KDFWR Strategic Plan. Goal 2, Strategic Objective 2.7.

Habitat Management Influences Northern Bobwhite Survival and Resource Selection on a Reclaimed Surface Mine in Western Kentucky

Jarred Brooke, David Peters, Evan Tanner, Ashley Unger, Craig Harper, and Patrick Keyser, University of Tennessee; John Morgan, Kentucky Department of Fish and Wildlife Resources

Male bobwhite / Jarred Brooke

Introduction

Recent northern bobwhite conservation efforts have focused on managing bobwhite populations on a regional scale by identifying large areas within states to focus management efforts. Surface mine reclamation has created more than 260,000 ha of reclaimed mine land in Kentucky and 600,000 ha in the eastern United States, much of which is dominated by early successional vegetation communities. Reclaimed mine land provides opportunities to conserve bobwhite populations on a large scale because they are large in size and tend to be owned by single entities (mining companies or state wildlife agencies). However, mine reclamation is typically accomplished with non-native invasive species, such as tall fescue and sericea lespedeza, and may represent low-quality habitat for bobwhite (Stauffer 2011).

Extensive cover of non-native invasive species, such as tall fescue and sericea lespedeza, reduce bobwhite habitat quality by outcompeting native vegetation that provide food and cover and by reducing bobwhite mobility. Sericea lespedeza also may reduce the abundance of insects, an important food source for bobwhite during the breeding season. However, managing bobwhite habitat on areas where sericea lespedeza is the dominant plant has not been studied.

The Road to Recovery: The Blueprint for Restoring Northern Bobwhite in Kentucky was published in 2008 and identified reclaimed mine lands as a novel opportunity to manage bobwhite populations. We began an extensive bobwhite demographics study in August 2009 on Peabody Wildlife Management Area in western Kentucky to identify factors that influenced bobwhite survival, productivity, and resource selection on a reclaimed surface mine, and how each of these was influenced by habitat management activities. Data were collected August 2009 – March 2014 and included 4 breeding seasons (1 April – 30 September) and 5 non-breeding seasons (1 October – 31 March).

Study Area and Methods

We conducted our study on the Ken (1,853 ha) and Sinclair (1,471 ha) units of the Peabody Wildlife Management Area, an 18,000-ha property owned and managed by the KDFWR in Ohio and Muhlenberg counties in west-central Kentucky. Peabody consists of reclaimed surface mine land dominated by non-native invasive species established during the reclamation process. We delineated 4 major vegetation types, representing 91% of our study area: open herbaceous (OH), comprised 36% of the study area and was dominated by sericea lespedeza; Shrub cover comprised 25% of the study area and was dominated by trees and shrubs including black locust, sumac, and autumn olive; forest cover comprised 22% of the study area and was characterized by having a semi-open canopy dominated by

eastern cottonwood, green ash, and red maple; planted native warm-season grasses (NWSG) comprised 8% of the study area and were dominated by big bluestem, indiangrass, and switchgrass.

We divided each unit into 2 approximately equal areas (TREATMENT and CONTROL) to assess the influence of habitat manipulations on bobwhite demographics. One half of each unit was randomly assigned as a CONTROL and remained undisturbed and the other half, TREATMENT, was manipulated using a combination of management techniques. Manipulations were applied to TREATMENT areas opportunistically with a goal of altering the composition and structure of the vegetation in open areas. Throughout the study, 50% of open cover on treatment areas (OH and NWSG) were manipulated by prescribed fire, disking (linear firebreaks and blocks), and herbicide application to control sericea lespedeza.

We captured bobwhite from August 2009 to March 2014 using Stoddard (1931) funnel traps. We recorded body mass (g), sex, and age of all captured individuals. Birds weighing >120 g were fitted with a necklace-style VHF radio transmitter (~6g, American Wildlife Enterprises, Monticello, FL, USA). Transmitters were equipped with a 12-hour mortality sensor. Trapping, handling, and banding protocols complied with the University of Tennessee Institutional Animal Care and Use Committee Permit 2042-0911.

We tracked radio-marked bobwhite ≥3 day/week in order to determine survival, resource selection, and to locate nests. We tracked all individuals throughout the year until death or radio failure. Each nest was monitored daily via radio-telemetry until nest completion or failure. If the nest hatched, the brooding individual was tracked daily to characterize brood resource selection. Brooding individuals were flushed weekly starting 2 weeks after nest completion to determine if the brood was still present.

We estimated seasonal survival rates (breeding and non-breeding) for bobwhite on our study sites using a known-fates models in Program MARK. We classified each bird as a TREATMENT or CONTROL bird based on which area contained the majority (>70%) of its locations. We included landscape, home range, and microhabitat metrics in the survival analysis to determine the factors that influence bobwhite survival on a reclaimed surface mine at multiple scales. We identified the model best explaining bobwhite survival using 5 groups of covariates: biological (sex, age, year), experimental (site, year, treatment or control), and habitat (3 scales; landscape, home range, and microhabitat).

We estimated the probability a nesting attempt would survive a 23-day incubation period using the nest survival model with a logit-link function in program MARK. We included landscape composition, configuration, and microhabitat variables in the models to determine factors influencing nest survival. We also identified if the nest was located on a TREATMENT or CONTROL area. For adult seasonal survival and nest survival, we identified the model best based on AIC ranks. We conducted a life stage analysis to determine which parameters (survival, nesting, or fecundity) contributed most to the growth rate of the population.

We used discrete-choice analysis to determine bobwhite resource selection on a reclaimed surface mine. Discrete-choice compares locations used by bobwhite to locations available to the individual at a given time and place. We performed separate analyses for bobwhite breeding season, non-breeding season, nest-site, and brood resource selection. In all three analyses, we included variables related to the composition and configuration of the landscape to determine macrohabitat resource selection. We also included variables related to the composition and structure of vegetation at used vs. random locations to determine microhabitat resource selection. We used locations from individuals on TREATMENT areas to determine how disking, prescribed fire, and herbicide application to control sericea lespedeza influenced resource selection.

Results

We captured 2,015 individual bobwhite from August 2009 to January 2014 including 720 females, 962 males, and 333 for which we could not determine sex. We radio-marked 1,639 individuals and recorded 38,493 radio-telemetry locations. We included 1,131 individuals in our survival analysis and included 283 individuals (breeding season) and 136 coveys (non-breeding season) in our resource selection analysis. We located 129 nests during the 4 breeding seasons and were able to use 124 to determine nest survival rates. All 129 nests were used to determine nest-site selection. We followed 59 brooding adults to characterize brood resource selection.

Our seasonal survival rates for the breeding season and non-breeding season were 0.148±0.015 and 0.282±0.022, respectively. Breeding season survival was greater on TREATMENT than CONTROL (0.179 vs. 0.109), but non-breeding season survival was greater on CONTROL than TREATMENT (0.355 vs. 0.233). The depth of litter (dead plant material) at a bobwhite location negatively influenced survival. The amount of shrub cover within an individual's home range positively influenced survival during the non-breeding season. During the breeding season, vegetation cover from 1.25-1.5 m aboveground negatively influenced survival.

Of the 129 nests located, 59 nests hatched (46%), 44 were destroyed (34%), 20 were abandoned before

completion (15%), and 6 were unsuccessful because of adult mortality (5%). One-hundred and eight nests (85%) were incubated by females and 21 nests (15%) were incubated by males. The male nesting rate on Peabody was 0.228±0.070, the renesting rate was 0.138±0.089, and the double-clutching rate was 0.045±0.038. The average clutch size was 12.5 eggs and an average of 86% of the eggs hatched from each successful nest. The probability a nest would survive the 23-day incubation period was 0.352±0.062. The age of the nest and nest initiation date were the only variables that influenced (positively) nest survival. Parameters associated with nest survival and fecundity (e.g. clutch size and hatching rate) accounted for 94% of the variation in population growth rate compared to 5% for seasonal survival.

Adult bobwhite resource selection during the breeding season was influenced by the distance to shrub cover, the amount of shrub cover to open cover edge, and the interspersion of vegetation types. Individuals were found closer to shrub cover ($\bar{x}$ = 45±1 m), in areas with more shrub-open edge, and in more interspersed areas that would be expected at random. They also selected areas with increased visual obstruction from 1.25-1.5 m aboveground and areas with more stems per hectare than would be expected at random. Bobwhite also were found closer to disked areas and firebreaks than would be expected at random, and they selected areas treated with herbicide to control sericea lespedeza. However, bobwhite avoided areas burned during the previous dormant season.

Adult bobwhite resource selection during the non-breeding season was most influenced by the distance to shrub cover and shrub-open edge density. Bobwhite were found an average of 32±1 m from shrub cover during the non-breeding season. In addition, individuals selected areas with increased visual obstruction >1 m tall. Bobwhite on treatment units were found closer to disked areas than would be expected at random, and they selected areas treated with herbicide and areas burned the previous dormant season.

Quail release / Kyle Servidio

Nest-site selection was not influenced by any landscape variable we measured, but nests on treatment units were more likely to be in areas treated with herbicide compared to untreated areas. Also, nests were located in areas with greater litter depths than would be expected at random. Broods were found closer to disked areas and firebreaks than expected at random. Furthermore, brooding adults were 2.8 times more likely to select a firebreak compared to a disked area. Broods also selected areas treated with herbicide to control sericea lespedeza.

Discussion

Management practices that influenced composition and structure of open areas on Peabody likely were the reason breeding season survival was greater on TREATMENT. Disking and herbicide application reduced sericea cover, increased forbs and seed-bearing annuals, and increased openness at ground level. Sericea limits the establishment of native vegetation, reduces insect abundance, and the seeds provide limited nutritional benefit to bobwhite (Davison 1958, Bugg and Dutcher 1989, Wade 1989). Indeed, our LSA results indicated fecundity was limiting populations of bobwhite on the study area. Therefore, management activities likely increased bobwhite mobility and provided easier access to seeds and insects during the breeding season. Furthermore, our resource selection results suggested these areas were selected more than untreated areas. Conversely, individuals avoided burned areas during the breeding season, likely because burning areas dominated by sericea lespedeza reduced escape cover but did not reduce sericea cover.

Nest survival was lower than what has been reported in other studies (Burger et al 1995*a*, Collins et al. 2009) but was not related to landscape or microhabitat variables; litter depth influenced nest-site selection. Our results indicate the structure of the vegetation is sufficient for nesting in open areas and nesting cover is widely available. However, bobwhite on TREATMENT selected to nest in areas treated with herbicide, suggesting herbicide applications improved nesting conditions. Herbicide applications reduced sericea cover and the overall coverage of herbaceous vegetation. Dense vegetation can limit the mobility of adult bobwhite and broods and limit the availability of food resources adjacent to nest sites. Firebreaks were strongly selected by brooding adults, likely because these areas were open at ground-level, providing easy mobility and access to insects for bobwhite chicks. Firebreaks also were linear features providing broods with

access to shrub cover, which is needed for shade in summer and to escape predators.

Contrary to other bobwhite studies (Burger et al. 1995*b*, Lohr et al. 2011), survival on Peabody was greater in the non-breeding season compared to the breeding season. Increased survival rates during the non-breeding season could be attributed to the amount of shrub cover available on the study area and the contiguous herbaceous cover between shrub cover. The amount of shrub cover available within an individual's home range positively influenced survival, which is consistent with bobwhite literature. Furthermore, bobwhite were in close proximity to shrub cover throughout the winter, which provided escape cover from avian and mammalian predators. Additionally, forested areas where the canopy was open provided sufficient escape cover. However, large open areas far from shrub cover were common on Peabody, and our results suggest as bobwhite move away from shrub cover, their survival decreased and the probability of use decreased. Survival on TREATMENT was less than CONTROL during the non-breeding season, a finding that we attribute to a reduction in isolated patches of shrubs embedded within OH and NWSG having been reduced or eliminated as a result of large-scale burning and/or herbicide treatment. Coveys selected burned areas during the non-breeding season, but a reduction in shrub cover may have exposed them to greater levels of predation.

Management Implications

The extensive coverage of sericea lespedeza and the lack of interspersed shrub cover within open (OH and NWSG) limited habitat quality of reclaimed mine lands for bobwhite, but conditions can be remediated through proper management. Management of reclaimed surface mines where bobwhite are a focal species should concentrate on improving the distribution of shrub cover and reducing dominance of non-native invasive species and dense, planted NWSG. We recommend disking areas dominated by sericea lespedeza and dense NWSG on a ≤3-year return interval. Firebreaks should be disked on a 2-year return interval to maintain these areas for brooding bobwhite and still provide sufficient cover during the non-breeding season. Herbicide applications to control sericea lespedeza should continue on Peabody and can be conducted throughout the growing season. However, regardless of management technique, existing shrub cover in open areas should be protected. Therefore, we do not recommend burning open areas because of its impact on shrub cover and the lack of reduction of sericea lespedeza. Burning should be restricted to forested areas where fire can reduce canopy coverage and increase coverage of herbaceous and shrub plants, increasing the amount of usable space for bobwhite. Future reclamation projects should use native species and focus on creating shrub cover interspersed within herbaceous vegetation. Reclaimed mine land can provide large contiguous tracts of habitat for bobwhite and should be considered when developing strategies to conserve bobwhite populations.

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KDFWR Strategic Plan. Goal 1. Comprehensive Wildlife Conservation Strategy: Appendix 3.2. Class Aves. Priority Research Project #2 and #3.

Flathead catfish sampled from A.J. Jolly Lake / Dane Balsman

Use of Flathead Catfish to Reduce Stunted Fish Populations in a Small Kentucky Impoundment

Dane Balsman and Jason McDowell, Kentucky Department of Fish and Wildlife Resources

Introduction

Flathead catfish (*Pylodictis olivaris*) are a large bodied predacious fish. In Kentucky, flathead catfish are found in several major watersheds including the Cumberland River, Licking, Big Sandy, Kentucky River, Salt River, Green River, Tradewater River, as well as minor Mississippi River tributaries and the mainstem Ohio River (Warren et al. 2000).

Food habits of flathead catfish are well documented. Juveniles feed on invertebrates and switch to an almost exclusive fish diet between 9.0-14.0 in (Brown and Dendy 1961, Holz 1969, Roell and Orth 1993). Introduced populations of 12.0-24.0 in flathead catfish in the Flint River, Georgia consumed other flathead catfish, unidentified fish, and channel catfish (*Ictalurus punctatus*, Quinn 1987). Flathead catfish > 24.0 in fed on gizzard shad (*Dorosoma cepedianum*), sunfish (*Lepomis spp.*), and suckers (Catostomidae). Flathead catfish growth is fast at almost 4.0 in each year of life (Jackson 1999).

Predator-prey dynamics in lentic systems have been studied since the 1950's. When properly stocked with a healthy balance of predators and prey, reservoirs can produce quality-sized fish. If lakes have an initial imbalance in the fish population or are not managed properly, it can result in forage or nuisance fish species overpopulating a reservoir, resulting in undesirable-sized fish. Gizzard shad, which are common in southeastern reservoirs, can quickly overpopulate and affect growth of other fish species higher up the food chain (Noble 1981). Bluegill (*Lepomis macrochirus*) can also become stunted in a system

if largemouth bass (*Micropterus salmoides*) or other top predators have additional forage fish to consume (Noble 1981).

A Virginia study (Odenkirk et al. 1999) stocked 77 flathead catfish in 1990 (average length 10.5 in, average weight 2 lbs) and 34 flathead catfish in 1994 (average length 15.0 in, average weight 3 lbs) into a 79-acre lake in an attempt to reduce a crowded bullhead catfish population. Flathead catfish were stocked in this impoundment at a rate of 1 flathead catfish/acre and 0.03 lbs/acre in 1990. Four years later, another stocking of flathead catfish occurred at a rate of 0.4 fish/acre and 0.04 lbs/acre. In six years, creel surveys showed that angler harvest of brown bullhead (*Ameiurus nebulosus*) fell from 2,285 to 25 fish with a significant increase in the weight of each harvested fish. Gill net results showed similar findings with brown bullhead catch decreasing and average weight increasing. While studies have demonstrated that flathead catfish can reduce stunted fish populations (Swingle 1964, Odenkirk et al. 1999), others have shown the inability of flathead catfish to reduce overcrowded fish populations (Hackney 1966, Bamberg 1975, Crowell 1976). Davis (1985) described successful control of common carp *Cyprinus carpio* and bullheads with flathead catfish, but no control of sunfish.

The objectives of this study were to determine if stocking an additional predator such as flathead catfish can improve sport fish populations at A.J. Jolly Lake. Specifically, 1) improve bluegill growth and size structure, and 2) improve largemouth bass growth, size structure, and year-class production. These two outcomes are co-dependent, in that flathead catfish would reduce sunfish numbers which prey on largemouth bass eggs and fry. With the reduction of sunfish numbers, we would expect to see an increase in largemouth bass recruitment and densities.

Study Site

A.J. Jolly Lake, a 175-acre eutrophic impoundment located in Campbell County just south of the City of Alexandria, has historically contained a sub-par sport fishery for sunfish and largemouth bass. The Kentucky Department of Fish and Wildlife Resources (KDFWR) has tried several alternative management actions in an attempt to improve the size structure and growth of sunfish and largemouth bass. Management actions have included stocking intermediate-sized largemouth bass to improve recruitment of bass and stocking blue catfish *Ictalurus furcatus* and saugeye *Sander vitreus x S. canadensis* to consume small overabundant sunfish (i.e. bluegill, green sunfish *Lepomis cyanellus,* and crappie *Pomoxis*). Unfortunately, these management actions have proven unsuccessful, although the stocking of blue catfish and saugeye has resulted in the development of additional sport fisheries at A.J. Jolly Lake.

Methods

Stocking

In June 2007, the KDFWR stocked 417 flathead catfish that ranged in length from 8.4-36.0 in with weights ranging from 0.5-20.0 lbs. In September 2009, an additional 308 flathead catfish were stocked. Fish ranged in size from 3.0-32.3 in with weights of the stocked fish ranging from 0.1-19.1 lbs. In June 2011, 403 flathead catfish were stocked into A.J. Jolly Lake. The fish ranged in size from 3.8-38.2 in with weights ranging from 0.1-30.8 lbs. The flathead catfish stocked in 2009 and 2011 were smaller on average than the fish stocked in 2007, with 80% and 66% of stocked fish being $\leq$ 12.0 in, respectively. All flatheads were adipose fin clipped prior to stocking. The fish were obtained from the Georgia Department of Natural Resources as part of their non-native flathead catfish eradication program. In addition to the Georgia flathead catfish, Pfeiffer Fish Hatchery raised 2,862 flathead catfish averaging 5.1 in that were stocked in September 2011. A regulation was passed in 2009 that prohibited the harvest of flathead catfish from A.J. Jolly Lake.

Sampling

Largemouth bass (15-min runs) and bluegill (7.5-min runs) were sampled in the spring and fall using daytime 60pps–DC electrofishing from 2008-14. Ten transects were run along the shoreline for each species. Catch-per-unit effort (CPUE), lengths to the nearest 0.1 in, and weights to the nearest 0.01 lb were collected. Otoliths were collected for age and growth analysis. Flathead catfish were collected while electrosampling for largemouth bass and bluegill. Additionally, low pulse 15 pps-DC electrofishing, jug-lines and trotlines were also used to collect flathead catfish at A.J. Jolly Lake. Flathead catfish were identified as native or Georgia stock by presence or absence of an adipose fin.

Results

Bluegill were sampled in the spring to quantify length frequency, CPUE and age frequency. Catch rates for bluegill averaged 417.2 fish/hr from 1995-2007 and 489.2 fish/hr from 2008-14. For bluegill in the 6.0-7.9 in group catch rates averaged 52.7 fish/hr from 1995-2007, and only 8.0 fish/hr from 2008-14. Overall, bluegill catch rates increased during the study, while catch rates of larger bluegill $\geq$ 6.0 in remained well below the pre-study data. Otoliths revealed bluegill reach a maximum age of 6 years. The bluegill in A.J. Jolly Lake exhibit slow growth with fish reaching sexual maturity at a small size. Very few bluegill reach the size desired by anglers. Fall electrosampling was used to determine condition of bluegill. The relative weight of bluegill in the 3.0-5.9 in group ranged from 80-101 during the

study period while bluegill in the 6.0-7.9 in group had relative weights that ranged from 76-85. It is worth noting that a drastic increase was observed in relative weights in 2013 and 2014 for bluegill in the 3.0-5.9 in group. Relative weights increased from the mid/low 80's in 2008-12 to near 100 in 2013-14. This increase in condition of small bluegill is encouraging, however, relative weights of larger bluegill ≥ 6.0 in remains poor (average 81 for 2008-14). Additionally, CPUE of small bluegill still remain high, with no decrease in overall bluegill numbers.

Largemouth bass were sampled in the spring to quantify length frequency, CPUE and age frequency. The CPUE for spring bass from 1996-2007 averaged 87.4 fish/hr, whereas the sampling from 2008-14 averaged 73.4 fish/hr. For bass < 8.0 in, 1996-2007 averaged 22.6 fish/hr, compared to 17.5 fish/hr for 2008-14. During the study period, no increases were seen in overall bass densities or the number of small bass indicating an increase in recruitment. Largemouth bass were well distributed through all size classes with good numbers of bass > 15.0 in. Three year old largemouth bass exhibited the highest variation in length with fish ranging from 9.0-14.9 in. Largemouth bass in A.J. Jolly Lake have the potential to reach old ages with several bass aged over 10 years; the maximum age was 13 years.

Relative weight values of fall largemouth bass increase with fish size. This trend was observed during all years of the study period (2008-14). Fish in the ≥ 15.0 in group had the highest relative weights (range 96-102) while bass in the 8.0-11.9 in had the lowest relative weights (range 84-89). Largemouth bass in the 12.0-14.9 in group had relative weights that ranged from 91-99 indicating healthy fish. The mean length of age-0 largemouth bass averaged 4.7 in from 2008-14, compared to 4.1 in from 2004-07. It appears the average size of age-0 bass increased during the study, but this was in part due to sampling a month later during the study period (2008-14).

A total of 331 flathead catfish were sampled from 2008-2014 using electrofishing gear, jug lines, and trotlines. Seventy of the 331 flathead catfish were from the Georgia stockings, two unknowns, while the remaining 259 flathead catfish were native fish or from the Pfeiffer stocking. Of the 331 flatheads catfish sampled, 204 were < 12.0 in (62%). In 2012, a year after the Pfeiffer flathead catfish stocking, 110 of the 123 flathead catfish sampled were ≤ 10 in. Overall, sampling numbers were relatively low for flathead catfish despite effort using various gear types.

Discussion

It is possible anglers could have removed flathead catfish from the 2007 stocking as regulations were not yet in place to prevent harvest. Jug-lines and limb-lines are illegal on A.J. Jolly Lake due to its size, however limb-lines were observed routinely during sampling trips. It is unclear if illegal harvest of flathead catfish had an effect on flathead catfish densities remaining high enough to have a desired effect. Sampling numbers were low for flathead catfish throughout the study, so it was difficult to estimate the population size. Even after stocking, sampling trips revealed very few fish despite thermocline and habitat limiting where flathead catfish would likely be located. Survival of stocked flathead catfish was not studied; however, hauling stress or delayed mortality could have contributed to poor survival. Furthermore, the number of large flatheads present may have been insufficient to have the desired effects. The 2,862 5.0-in flathead catfish stocked in 2011 from Pfeiffer Fish Hatchery, assuming 4.0 in of growth a year (Jackson 1999), would take a couple years to reach a size where they would forage on sunfish. Assuming this growth, we wouldn't expect to see an immediate effect from the Pfeiffer flathead catfish stockings in 2011.

Flathead catfish / Dane Balsman

There was a slight decline in sunfish CPUE in the 2014 sample; however this could be due to annual sampling variation. When we examine the five year average CPUE, the sunfish numbers were still well above the long term average. Since there have been no positive changes with the bluegill population, there is no reason to believe we would see an increase in bass recruitment or densities. The bass recruitment and densities have declined slightly compared to the long term data. If there were an increase in bass reproduction and recruitment, we would expect to see an increase in overall numbers. However, an increase in bass numbers could slow growth further, reduce body condition, and increase numbers of smaller bass which could lead to a crowded bass population. The average relative weight of bass in the 8.0-11.9 in group was 89 for the study period, which was acceptable, but the lowest of any of the bass size groups. There was a slight increase in large bass ≥ 15.0 in observed from 2010-14, but this was likely attributed to strong spawns in 2004-06, and not any effects from the flathead catfish stockings.

Management Implications

The bluegill size structure did not improve with the introduction of flatheads catfish. There are still very few large bluegill present that would

be desirable by anglers. The presence of gizzard shad is likely disrupting the food web, limiting sunfish growth, and leading to a stunted population (Aday et al. 2003). Removal of gizzard shad with a light dose of rotenone would be an option if a sunfish fishery were desired. However, the stockings of blue catfish and saugeye are reliant on the gizzard shad for forage. The blue catfish and saugeye stockings provide additional sport fisheries, which would likely end if gizzard shad were removed. Without a creel survey it is difficult to estimate the utilization and fishing pressure on these species. The sunfish fishery is unlikely to improve with gizzard shad present. Largemouth bass densities for the lake are relatively low compared to other lakes located in the region. However, there are good numbers of large bass present and condition of fish indicate a population that is not crowded with plenty of available forage.

The stocking of flathead catfish at A.J. Jolly Lake was halted in 2011. The catch and release regulation for flathead catfish will be removed now that the study has concluded. A.J. Jolly Lake will continue to be sampled as part of routine monitoring for largemouth bass and bluegill to see if any long term changes occur as a result of the flathead catfish stockings.

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KDFWR Strategic Plan. Goal 1.

Fishes of the Dix River Drainage, with Emphasis on Distribution and Status of the Endemic Sheltowee Darter (*Etheostoma* sp. cf. *spectabile*)

Matthew Thomas and Stephanie Brandt, Kentucky Department of Fish and Wildlife Resources

Introduction

The Sheltowee Darter (*Etheostoma* sp. *cf. spectabile*) is recognized as a valid, but undescribed species in the Orangethroat Darter (*Etheostoma spectabile*) group. It is endemic to the Dix River drainage (Kentucky River basin) in Mercer, Casey, Boyle, Garrard, Lincoln, and Rockcastle counties of the south-central Bluegrass region of Kentucky (Ceas 1997).

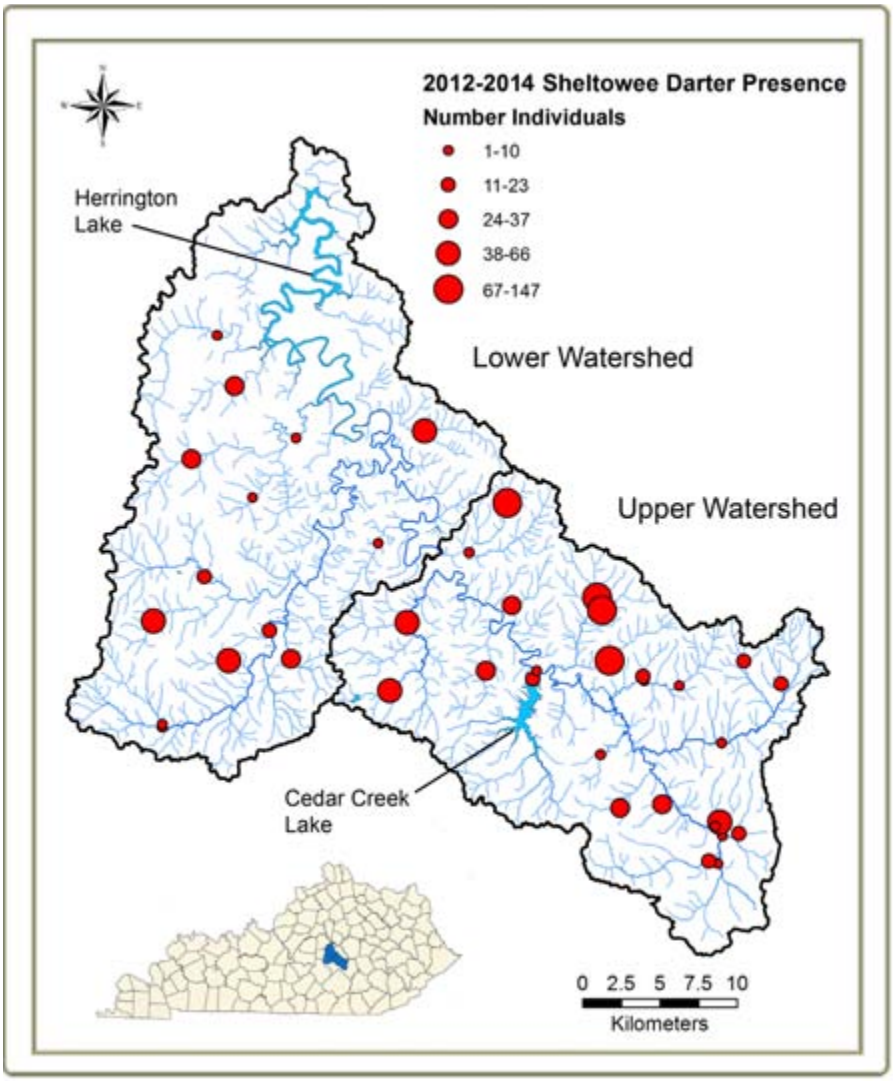

Figure 1: *Current distribution and abundance of the Sheltowee Darter in the Dix River drainage.*

Land use within the Dix River drainage is predominantly agricultural, with high livestock densities and cattle having free access to streams. In addition, failing septic systems and various forms of development and construction activities result in excessive nutrient input and siltation, which have led to habitat and water quality degradation, harmful algal blooms, and subsequent fish kills (Third Rock Consultants, Inc. 2009).

Like other members of the Orangethroat Darter group, Sheltowee Darters concentrate in headwater and small streams over gravel and cobble substrates. Spawning success is dependent upon the presence of clean gravel necessary for females to burrow and lay eggs. Excessive siltation covers the substrate and reduces or eliminates the oxygen supply to the eggs (Etnier and Starnes 1993; Ceas 1997). Although Ceas (1997) reported the Sheltowee Darter to be abundant in suitable habitat, he also suggested that many (perhaps most) populations may be adversely affected by increasing pressure on headwater streams by human activities (P.A. Ceas, pers. comm.).

The objectives of this study are 1): assess the current distribution and status of the Sheltowee Darter to determine whether any level of conservation status designation is warranted; and 2) provide an updated assessment of the fish fauna of the Dix River drainage, with emphasis on Species of Greatest Conservation Need (SGCN). This information is needed to develop effective conservation actions

Figure 2: *Sheltowee Darter breeding male (top) and gravid female (bottom) in Boone Creek, observed April 10, 2013 / Matt Thomas.*

and long-term monitoring strategies aimed at preventing declines in fish SGCN and need for Endangered Species Act protection.

Methods

Study Area

The Dix River is a major tributary of the Kentucky River located in the southern portion of the Bluegrass physiographic region in central Kentucky. The river extends approximately 128 km and drains an area of 725 km^2. Its headwaters originate just south of Broadhead in the northwest part of Rockcastle County flowing northwest through Lincoln, Garrard, Boyle, Casey, and Mercer counties, before emptying into the Kentucky River immediately upstream of High Bridge (Foerste 1912; Greeson 1963; Branson and Batch 1981). Approximately 3.2 km above the mouth, the lower mainstem Dix River was impounded in 1925 by a dam to form Lake Herrington, a narrow and deeply entrenched 650-ha reservoir owned and operated by Kentucky Utilities to generate hydroelectric power. The Dix River drainage above Herrington Lake consists of shallow streams ranging in depth from a few centimeters to 1.5 m (Branson and Batch 1981; pers. obs.).

The Dix River watershed can be divided into upper and lower basin units (USGS HUC10). The upper basin unit includes the headwaters downstream to the mouth of Gilberts Creek at the US-27 crossing between Lancaster and Stanford. Land use in the upper basin is 60% agricultural and 40% rural and wooded (Kentucky Water Research Institute 2000). The headwaters of the system lie within in the Eastern Highland Rim and Knobs-Norman Upland ecoregions, characterized by rounded hills and ridges mostly covered with mixed mesophytic forest and underlain by limestone, chert, shale, siltstone, and sandstone. Streams in these regions have moderate gradients with riffles composed of cobble, gravel, and bedrock. Scattered wide, swampy valley floors are used for livestock and general farming, and rural residential development. The remainder of the upper watershed lies within the Outer Bluegrass ecoregion, characterized by gently rolling agricultural plains underlain by limestone and shale. This portion of the basin is only sparsely forested, with open savanna woodlands that have been converted to pastureland and cropland (Woods et al. 2002).

The lower basin unit includes the mainstem Dix River from Gilberts Creek confluence downstream to the confluence with the Kentucky River. It includes the largest tributary system, Hanging Fork Creek, as well as Herrington Lake. Land use in the lower basin is almost 90% agricultural and almost 5% residential (Kentucky Water Research Institute 2000). Most of the lower basin is situated within the Outer Bluegrass and Inner Bluegrass ecoregions. Between these two ecoregions, the Hills of the Bluegrass forms a thin band crossing east to west immediately above Herrington Lake. The landscape is nearly flat to rolling, with extensive karst, intermittent streams, and expanding urban-suburban areas originally developed near major springs. Open woodlands, savannas, and swamp forests that once existed have been replaced by agriculture (cattle grazing, horse farms, hay, and row crops) and urban-suburban-industrial areas. Traces of deciduous forest mixed with Eastern Redcedar remain in ravines and near streams. Streams are generally exposed with warm temperatures and seasonally variable flows, except those fed by springs, which are colder and have perennial flow. All are low to moderate gradient and have bedrock or cobble

substrates (Woods et al. 2002).

Data Acquisition and Field Methods

We compiled and reviewed previous fish collection records from the Dix River drainage, which included published data from Greeson (1963), Branson and Batch (1981), museum records (Eastern Kentucky University, Illinois Natural History Survey, and Southern Illinois University Carbondale), and unpublished data from Kentucky Department of Fish and Wildlife Resources, Kentucky Division of Water, Kentucky State Nature Preserves Commission, Kentucky Transportation Cabinet, and Third Rock Consultants, LLC. Sample localities were chosen throughout the Dix River drainage based on historic (1953-2008) records of Sheltowee Darter presence, as well as additional sites that could potentially result in new occurrences within the drainage. Fish community sampling was conducted between 30 March 2012 and 1 October 2014, following wadeable stream sampling protocols (Kentucky Division of Water, 2002). Fishes were collected using a backpack electrofisher, dip nets, and 6 X 10' (1/8" mesh) seine. At each site, all habitats within a 100-200m reach were worked thoroughly to ensure a representative sample. Additional emphasis was placed on specific habitats known or considered likely to support Sheltowee Darters and other fish SGCN. Each headwater stream site was electrofished for approximately 500-2000 seconds, depending on the size of the stream and available habitat. In larger wadeable streams, electofishing was followed by 10-20 seine hauls/sets to effectively work the same area and available habitat. In the lower mainstem Dix River below Dix Dam, boat electrofishing was performed to capture larger species occurring in deep pool and channel habitats. Most fish collected were identified on site, enumerated, and released. A limited number of representative specimens

Table 1: *Comprehensive list of fish species reported from the Dix River drainage based on Branson and Batch (1981; and references therein) and the present study (2012-2014). Field collections reported in Branson and Batch (1981) were taken in 1967-1968. Number of localites from which each species was collected is indicated. P = pre-1981 records referenced in Branson and Batch (1981) and J. Crosby (KDFWR, pers. comm. 2015). * = unsubstantiated or considered invalid (Burr and Warren 1986). Species of greatest conservation need are in bold print.*

Scientific Name	Common Name	Pre-1981	2012-2014
Lepisosteus osseus	Longnose Gar	2	2
Dorosoma cepedianum	Gizzard Shad	4	3
Dorosoma petenense	Threadfin Shad	P	1
Campostoma anomalum	Central Stoneroller	37	43
Chrosomus erythrogaster	Southern Redbelly Dace	2	12
Cyprinella spilotera	Spotfin Shiner	6	11
Cyprinella whipplei	Steelcolor Shiner	2	1
Cyprinus carpio	Common Carp	P	1
Hybopsis amblops	Bigeye Chub	10	4
Luxilus chrysocephalus	Striped Shiner	35	38
Lythrurus fasciolaris	Scarlet Shiner	28	12
Notemigonus crysoleucas	Golden Shiner	1	
Notropis atherinoides	Emerald Shiner	4	1
Notropis boops	Bigeye Shiner	19	15
Notropis buccatus	Silverjaw Minnow	21	9
Notropis buchanani	Ghost Shiner	2	
Notropis photogenis	Silver Shiner	11	7
Notropis rubellus	Rosyface Shiner	2	
Notropis volucellus	Mimic Shiner	2	
Pimephales notatus	Bluntnose Minnow	41	47
Pimephales promelas	Fathead Minnow	11	10
Rhinichthys obtusus	Western Blacknose Dace	1	4
Semotilus atromaculatus	Creek Chub	34	39
Carpiodes carpio	River Carpsucker		1
Carpiodes cyprinus	Quillback	1	1
Catostomus commersonii	White Sucker	27	13
Hypentilium nigricans	Northern Hog Sucker	20	16
Ictiobus bubalus	Smallmouth Buffalo	1	1
Ictiobus cyprinellus	Bigmouth Buffalo		1
Ictiobus niger	**Black Buffalo**		**1**
Minytrema melanops	Spotted Sucker	1	1
Moxostoma anisurum	Silver Redhorse	1	
Moxostoma breviceps	Smallmouth Redhorse	7	2
Moxostoma duquesnei	Black Redhorse	4	2
Moxostoma erythrurum	Golden Redhorse	11	7
Ameiurus melas	Black Bullhead	3	
Ameiurus natalis	Yellow Bullhead	4	8
Ictalurus punctatus	Channel Catfish	2	2

Scientific Name	Common Name	Pre-1981	2012-2014
Noturus flavus	Stonecat	3	
Noturus miurus	Brindled Madtom	2	1
**** Noturus stigmosus***	*** Northern Madtom**	**1**	
Pylodictis olivaris	Flathead Catfish		P
Oncorhynchus mykiss	Rainbow Trout	P	1
Salmo trutta	Brown Trout		P
Esox americanus	Grass Pickerel	5	
Labidesthes sicculus	Brook Silverside	10	8
Fundulus catenatus	Northern Studfish	1	20
Fundulus notatus	Blackstripe Topminnow		9
Gambusia affinis	Western Mosquitofish		6
Cottus carolinae	Banded Sculpin	2	4
Morone chrysops	White Bass	1	1
Morone saxatilis	Striped Bass	P	
Ambloplites rupestris	Rock Bass	10	14
Lepomis cyanellus	Green Sunfish	26	43
Lepomis gulosus	Warmouth		2
** Lepomis humilis*	* Orangespotted Sunfish	1	
Lepomis macrochirus	Bluegill	26	21
Lepomis megalotis	Longear Sunfish	27	29
Lepomis microlophus	Redear Sunfish	2	2
Micropterus dolomieu	Smallmouth Bass	9	2
Micropterus punctulatus	Spotted Bass	10	2
Micropterus salmoides	Largemouth Bass	11	4
Pomoxis annularis	White Crappie	1	1
Pomoxis nigromaculatus	Black Crappie	P	1
Etheostoma blenniodes	Greenside Darter	18	16
Etheostoma caeruleum	Rainbow Darter	25	27
Etheostoma flabellare	Fantail Darter	37	49
Etheostoma nigrum	Johnny Darter	26	25
Etheostoma* cf. *spectabile	**Sheltowee Darter**	**29**	**39**
Percina caprodes	Logperch	13	5
Percina maculata	Blackside Darter	9	5
**** Percina macrocephala***	**Longhead Darter**	**P**	
** Percina phoxocephala*	Slenderhead Darter	4	
Sander canadensis	Sauger		1
Sander vitreus	Walleye	P	
Aplodinotus grunniens	Freshwater Drum	1	2

were retained as vouchers that were fixed in 10% formalin, then transferred to 70% ethanol and maintained at KDFWR. For each Sheltowee Darter or other SGCN collected, gender (when possible), total lengths (when >20 individuals), and habitat conditions were recorded. At each site, water chemistry parameters including temperature, conductivity, and pH were recorded. Stream width was measured with a 4X laser rangefinder. Habitat type and condition were assessed qualitatively and documented through field notes and digital photographs.

Results and Discussion

Composition, Abundance, and Distribution of Fishes

Fishes were sampled at 57 sites in 42 streams distributed throughout the Dix River drainage to determine fish community composition, abundance, and species distributions. The only comprehensive survey of the fish fauna of the Dix River drainage prior to this study was by Branson and Batch (1981), who reported a total of 67 species in 14 families. Their records were based on collections taken at 45 sites and other published records available at that time, including Greeson (1963), Blankenship and Crockett (1971), and several unpublished reports of fishery investigations of Lake Herrington. Herrington Lake was the state's first large scale impoundment and over the years has been stocked with several predatory game fish species, including *Sander vitreus* (Walleye), *Esox lucius* (Northern Pike), *Morone saxatilis* (Striped Bass), and *Micropterus dolomieu* (Smallmouth Bass). These introductions failed to meet fishery project objectives and stockings were discontinued. None of these species, except Smallmouth Bass, have persisted in the reservoir or elsewhere in the drainage. Currently, only *Micropterus salmoides* (Largemouth Bass) and hybrid Striped Bass (*Morone saxatilis* X *M. chrysops*) are stocked in the reservoir. *Salmo trutta* (Brown Trout) is stocked in the reservoir tailwaters below Dix Dam and *Oncorhynchus mykiss* (Rainbow Trout) is stocked below Dix Dam and in the tailwaters of Cedar Creek Lake (J. Crosby, KDFWR, pers. comm.).

Our surveys in the mainstem Dix River (above and below Herrington Lake) and 24 tributary watersheds produced a total of 60 species representing 14 families (Table 1). An additional species (Flathead Catfish)

Figure 3: *Smallmouth Buffalo (top) and Black Buffalo (bottom) captured in lower mainstem Dix River on October 1, 2014 / Matt Thomas.*

is known to occur in Herrington Lake but was not present in our river and stream samples. Approximately 77% of the species collected were members of the families Cyprinidae (minnows; 16 species), Catostomidae (suckers; 11 species), Centrarchidae (sunfish and bass; 11 species), Percidae (darters; 8 species). The remaining 14 species represented 10 families. These proportions are consistent with those reported by Branson and Batch (1981). Most of the fish species encountered in our surveys are common and widely distributed in the Kentucky River drainage; the Sheltowee Darter is the only species endemic to the Dix River drainage.

Twelve species reported by Branson and Batch (1981) were not detected during our surveys. These included four minnows (*Notemigonus crysoleucas*, *Notropis buchanani*, *N. rubellus*, and *N. volucellus*), one sucker (*Moxostoma anisurum*), two catfishes (*Ameiurus melas* and *Noturus flavus*), and one pickerel (*Esox americanus*). *Notemigonus crysoleucas* (Golden Shiner) has been widely distributed by bait dealers and likely maintains a localized distribution in the reservoirs and other portions of the drainage. As part of the Sheltowee Darter status assessment, most (65%) of the sites sampled in 2012-2013 were in 1st-2nd order streams with a watershed area of less than 26 km^2 (10 mi^2); therefore, headwater and small stream fish assemblages are more strongly represented in our samples than are larger river and reservoir species. Based on our sampling, it is impossible to determine whether the aforementioned species have become extirpated from the system, are rare, or have such a sporadic distribution that they easily avoid detection through standard sampling methods. Four additional species reported by Branson and Batch (1981) remain unsubstantiated and were considered invalid by Burr and Warren (1986). These include *Noturus stigmosus* (Northern Madtom), Orangespotted Sunfish (*Lepomis humilis*), Longhead Darter (*Percina macrocephala*), and Slenderhead Darter (*Percina phoxocephala*).
Although our present sampling effort did not detect some species previously documented from the Dix River drainage, others including *Ictiobus niger* (Black Buffalo), *Gambusia affinis* (Mosquitofish), *Fundulus notatus* (Blackstripe Topminnow), represent new occurrences for the drainage.

Sheltowee Darter Distribution and Status

Most species in the Orangethroat Darter (*Etheostoma spectabile*) complex, including the Sheltowee Darter, are narrow-range endemics (Ceas and Page 1997). Darters in this group inhabit headwater to small perennial streams in shallow, gravel-bottomed riffles and runs, where they are often very abundant (Kuehne and Barbour 1983; Etnier and Starnes 1993).

Prior to this study, the Sheltowee Darter was known from 49 sites in 35 streams distributed throughout the Dix River drainage. Of all 90 historic sampling events reviewed, the species was present in 73 (81%) of the events and 35 of 39 (90%) of streams sampled. We sampled 24 of the 49 sites with historic records and added 32 sites without prior Sheltowee Darter records. In total, 34 of 35 streams with prior records were sampled. We encountered the species at 23 of 24 (96%) historic sites and 33 of 34 (97%) of historic streams sampled.

Our sampling results indicate that the Sheltowee Darter is widely distributed within the Dix River drainage, but with variable abundances among sites (Figure 1). Most occurrences were in the upper HUC10 basin unit, with presence at 26 of 32 sites (81%) compared with 14 of 25 sites (56%) in the lower basin. In total, the species was present at 40 of 56 sites (71%; Table 3); it was the most abundant darter species at more than half of the occupied sites and composed up to 84% of the total number of fish (all species) observed at a given site. Observed abundances were comparable to those reported for other members of the Orangethroat Darter complex (e.g.,

Ceas and Burr 2002; Cicerello and Butler 2007).

Sheltowee Darters were present in sections of streams that were shallow (depth approximately 30 cm or less) with a rocky substrate (usually bedrock with patches of gravel and cobble) and gentle or no current. Presence and abundance appears to be determined, at least in part, by stream size and permanence of flow. With few exceptions, we did not detect the species in streams that were ephemeral or disconnected from larger streams (e.g., small tributaries feeding into Lake Herrington). Likewise, we failed to detect the species at most large stream sites, including mainstem portions of the Dix River and Hanging Fork Creek with a watershed area exceeding 100 km^2 and channel width greater than 10 m.

We observed brilliantly colored males and females in gravid condition (Figure 2) as early as 14-16 March 2013, when water temperatures were unusually cold (3.1-6.1°C) for that time of year. Most females were spent by the end of April (water temperature 14.5°C). This time period agrees with other accounts of the spawning season for *Etheostoma spectabile* in the Tennessee and Cumberland River drainages (e.g., Etnier and Starnes 1993); however the early spring temperatures in 2013 were colder than normal (e.g., in comparison, 11.2-17.5°C was recorded for 30 March-6 April 2012).

Although the Sheltowee Darter appears to be common at most sites sampled within its range, we also recognize that many aquatic habitats in the Dix River drainage have been significantly altered through various land use practices. Extensive agricultural activity throughout the watershed contributes sediment, nutrients, pesticides, and pathogens into many of its tributary streams. Algal blooms and low dissolved oxygen levels occur especially where the riparian tree canopy has been removed, and livestock density is substantially higher than the Kentucky River basin average (Kentucky Water Research Institute 2002).

Fish Species of Greatest Conservation Need

Ictiobus niger (Rafinesque). Black Buffalo (Figure 3).— In Kentucky, the Black Buffalo is known mostly from scattered records in the main channels of the Ohio and Mississippi rivers. It is considered sporadic and rare in large rivers and reservoirs in the western half of the state (Burr and Warren 1986). Most accounts indicate that the distribution of the Black Buffalo is similar to the Smallmouth Buffalo (*Ictiobus bubalus*), but much less common (e.g., Pearson and Krumholz 1984). The Black Buffalo is listed as a species of Special Concern by the Kentucky State Nature Preserves Commission (2012) and was added as a Species of Greatest Conservation Need by the Kentucky Department of Fish and Wildlife Resources (2013). We collected a single individual (482 mm TL) during boat electrofishing runs on 1 October 2014 in the lower Dix River, 1.1 km upstream of confluence with Kentucky River, Mercer County. No records for this species were reported by Burr and Warren (1986) anywhere in the Kentucky River basin. Although numerous records have been reported since 1986 from various sources, most are from the middle and lower Ohio River and cannot be verified through vouchered specimens or photos. Our collection represents the first vouchered (photo) record for the Dix River drainage.

Noturus stigmosus Taylor. Northern Madtom.— This species is sporadically distributed in Kentucky. It is uncommon in the upper Big Sandy River, and occasional and locally common in the Salt and Licking river drainages (Burr and Warren 1986). The Northern Madtom is listed as a species of Special Concern by the Kentucky State Nature Preserves Commission (2012) and a Species of Greatest Conservation Need by the Kentucky Department of Fish and Wildlife Resources (2013). According to Branson and Batch (1981), a 70.5 mm SL specimen was collected on 15 June 1968 from the Dix River, 2.8 km northeast of Stanford, Lincoln County. The habitat was described as 7.6-15 m stream width with riffles 25-46 cm deep; pools 1.1 m deep; bottom of limestone rocks, mud, sand, and bedrock; aquatic vegetation (*Justicia americana*). This location is just downstream of the US-27 crossing, along Rankin Rd. The habitat description given by Branson and Batch (1981) was consistent with our observations; however our 2012-2014 sampling effort failed to detect the Northern Madtom.

Percina macrocephala (Cope). Longhead Darter.— In Kentucky, this species was reported by Burr and Warren (1986) to be sporadic and rare in the upper Barren and upper Green River basins, but in a more recent status assessment of these populations, Cicerello (2003) indicated that it may be more abundant and widespread than data indicate due to difficulties in capturing specimens using standard sampling gear. It appears to be most common in the upper Barren River and Kinniconick Creek (Burr and Warren 1986; Eisenhour et al. 2011). Greeson (1963) reported a single specimen from the Dix River just above its junction with Lake Herrington. Branson and Batch (1981) did not encounter the Longhead Darter and noted that the habitat was not typical for the species, suggesting that the earlier record could have been a mis-identified *Percina phoxocephala* (Slenderhead Darter). Both the Longhead Darter and Slenderhead Darter records are unsubstantiated and neither species was detected in our 2012-2014 surveys.

Conclusions and Management Recommendations

Fish community sampling in the Dix River drainage during 2012-2014 detected a total of 60 species. Overall faunal composition has changed slightly during the past 40 years. Twelve species reported previously in Buck Creek were not detected in our study; however, four of these species were determined to be invalid or based on unsubstantiated records. We documented new drainage records for three species, including one SGCN (Black Buffalo). Slight discrepancies between our results and previous survey data (i.e., Branson and Batch 1980) likely resulted in large part from differences in sampling gear and methods used between the present and past surveys, but may also reflect changes in habitat and environmental fluctuations.

The Dix River drainage supports two fish SGCN. The presence of the Black Buffalo in the lower Dix River below Dix Dam is likely part of a larger Kentucky River population. Buffalofishes have also been observed in Herrington Lake during sportfish sampling (J. Crosby, KDFWR, pers. comm.). It is possible that Black Buffalo is present in the reservoir. More sampling effort is needed in larger river and reservoir habitats before the status of this species can be reasonably assessed. The Sheltowee Darter was widely distributed in the Dix River drainage, occuring at 40 of 57 sites sampled and in 34 of 35 streams with historic records. Streams supporting Sheltowee Darters were generally small (1st and 2nd order with average watershed area of 28 km^2) with perennial flow and shallow riffles and runs over bedrock with patches of gravel. Because the species occupies a large number of historical and present-day sites, occurs at high densities, and appears to be tolerant of habitat disturbance, it is considered to be stable and does not need immediate conservation or recovery action.

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Funding Sources: *State Wildlife Grant Program (SWG)*

KDFWR Strategic Plan. Goal 1. Strategic Objective 5. Comprehensive Wildlife Conservation Strategy: Appendix 3.9; Class Actinopterygii and Cephalaspidomorphi.

Evaluation of White Bass Stocking to Enhance Existing Reservoir Populations

Dave Dreves, Jason Russell, and David Baker, Kentucky Department of Fish and Wildlife Resources

Introduction

The white bass (*Morone chrysops*) is native to the southern Great Lakes, Mississippi River basin and Gulf Coastal drainages and has been widely introduced elsewhere (Etnier and Starnes 1993). Populations thrive in both lentic and lotic systems and can become very abundant in reservoirs. Consequently, in many areas the species has become an important predator and sport fish (Guy et al. 2002). White bass in lentic systems exhibit spring spawning runs from the main lake to headwater areas where they become very susceptible to angling. In addition, anglers also frequently fish for the species in the summer when white bass and other piscivorous fishes are in the "jumps"… or schooled up and chasing shad on the water's surface.

White bass populations are notorious for having highly variable recruitment (Bauer 2002, Colvin 2002a, 2002b, DiCenzo and Duval 2002, Sammons and Bettoli 2000, Schultz 2002, Willis 2002). However, the factors affecting recruitment in reservoirs are not yet completely understood (Guy et al. 2002). Some of these factors include: spring inflow (DiCenzo and Duval 2002), gizzard shad density (Schultz et al. 2002), prey type (Bauer 2002), and large scale climatic patterns (Sammons and Bettoli 2000, Willis et al. 2002).

In recent years, many Kentucky reservoirs have experienced severe declines in white bass populations, including Barren River Lake (BRL) and Dewey Lake (DWL). The cause of declines in white bass fisheries at these lakes is also unknown. BRL receives annual stockings of hybrid striped bass which may create a competitive bottleneck at some stage in their life histories. Because of the mass migrations of white bass to the headwaters of reservoirs in the spring it has also been speculated that deficiencies in physical parameters such as rainfall and/or reservoir inflow in consecutive dry years are factors that have contributed to poor year classes and the eventual decline of the white bass fishery at BRL. Even during wet years, white bass recruitment could be low at reservoirs exhibiting extreme siltation problems, such as at DWL, because the increased flow carries in more sediment, smothering eggs and impeding foraging success.

Catch rates of white bass in fall gill netting at BRL averaged 24.5 fish/net-night in the 1980's. In a 1981 creel survey at BRL, white bass harvest accounted for 0.73 fish/acre and 0.64 lb/acre. From 1991 through 2000, fall gill netting catch rates averaged just 2.4 fish/net-night and there hadn't been a single year averaging even 7.0 fish/net-night since 1990. More recent creel surveys were conducted at BRL in 1996 and 1999. In 1996, white bass catch was 0.17 fish/acre and harvest was 0.07 fish/acre and 0.05 lb/acre. By 1999, the catch was 0.07 fish/acre and harvest was both 0.02 fish/acre and lb/acre. Historically, there is only evidence of a low level white bass population at DWL although Johns Creek further upstream in Pike County had been noted as having good spring white bass runs. The white bass harvest in a 1975 creel survey was 0.08 fish/acre and 0.04 lb/acre and harvest was 0.13 fish/acre and 0.14 lb/acre in a 1980 creel survey. There was no mention of white bass harvest in creel surveys from 1976, 1979, 1982, 1987, and 1988. In the more recent creel surveys prior to initiating white bass stocking, white bass catch and harvest were 0.01 fish/acre and 0.01 lbs/acre in 1990 and 0.04 fish/acre were caught with a harvest of both 0.01 fish/acre and lb/acre in 1997.

Typically, resource agencies have not expended a lot of effort managing white bass populations. Realizing that white bass populations were going to undergo variable recruitment and the popularity of the fishery was often seasonal, fisheries managers often overlooked the cyclic nature of the fishery and focused management efforts on other species. Angler dissatisfaction over poor white bass populations in Kentucky reservoirs that historically had very popular fisheries has resulted in the need to try new management strategies. Although white bass have been widely introduced, there is no evidence in the literature of supplemental stocking of white bass to enhance an existing population. Through supplemental stocking of white bass, it was hypothesized that the number of fish surviving to reproductive age could be boosted to the point where the population is not only self-sustaining but provides a high-quality fishery.

Study Sites

BRL and DWL are US Army Corps of Engineers flood control reservoirs. BRL, completed in 1964, is a 10,000 acre impoundment of the Barren River in Allen and Barren Counties located in southwestern Kentucky. BRL has a drainage area of 940 square miles. The surrounding land-use is primarily livestock grazing. DWL, completed in 1949, is a 1,100 acre impoundment of Johns Creek in Floyd County located in eastern Kentucky. DWL has a drainage area of 207 square miles. The sur-

White bass sampling / Dave Dreves

rounding land is primarily forested but there is also substantial mountain-top removal coal mining activity present in the watershed. Both study lakes contain the same traditional warmwater fish species found in Kentucky, with the exception that BRL also contains two other *Morone* species. The lake is stocked annually with hybrid striped bass (*M.* chrysops x *M. saxatilis*) fingerlings (20 fish/acre) and was colonized by another Morone spp., yellow bass (*M. mississippiensis*), about the same time as this study began.

Methods

White bass fingerlings (1.5 in) were produced at Pfeiffer and Minor Clark Fish Hatcheries and stocked for five consecutive years beginning in the spring of 2003 at BRL and DWL (Table 1). Each lake was stocked at approximately 30 fish/acre in all five years. Stocked white bass were marked as fingerlings with oxytetracycline (OTC) following methods in Brooks et al. (1994). Since BRL is also stocked with hybrid striped bass, these fish were OTC marked at the fry stage in order to help differentiate them from white bass at ages 0 and 1. OTC marking was either done in hatchery raceways prior to being loaded for stocking or on the stocking truck as it was on the way to the receiving body of water. Efficacy of the OTC marks on white bass and hybrid striped bass was checked by holding a subsample of fry or fingerlings in 0.1 acre hatchery ponds for an additional one to two months. The ponds were harvested and five to ten fish from each respective stocking cohort were sacrificed and the otoliths removed for later examination with fluorescence microscopy.

At each lake, 24 hr mortality assessments were conducted to document possible mortality of stocked fingerlings due to hauling stress. The assessments consisted of floating three 33-gallon trash barrels at a marina on each lake. The barrels had a portion of the sides removed and the area replaced with fine mesh, allowing lake water to circulate with no escapement of the walleye fingerlings. Each barrel had an opaque lid and signage stating that they were part of a KY Fish and Wildlife research study and should not be disturbed. At the time of stocking, approximately 100 fingerlings were removed from the stocking truck and placed in each of the barrels. The temperature and dissolved oxygen of water in the hauling truck and the receiving water was recorded. KDFWR personnel returned 24 hrs later and counted the number of living and dead fingerlings in each barrel. The percent mortality from each of three replicates was averaged to come up with an overall 24-hr percent mortality. Measurements of total length were taken from 100 fish to determine mean size of the stocked fish.

White bass sampling was conducted with direct current electrofishing in the headwaters of each reservoir beginning in spring 2003 at both lakes and continued through 2010. Sampling

was conducted in late March or early April depending on water temperature, lake level and stream inflow. All white bass collected were measured for total length and the sex of mature white bass was documented. Otoliths were removed for age determination and later examination for OTC marks that would indicate if the fish were naturally produced or stocked fish.

Fall gill netting was also conducted at each lake in late October after thermal destratification from 2003 through 2010. Gill netting was conducted over at least two consecutive nights with a preferred minimum catch of 100 white bass. A total of eight net-nights of gill netting over two nights were conducted on BRL in 2003. Effort was increased in subsequent years; going to 18 net-nights of sampling over three nights in 2005-2006 and then 36 net-nights over three nights from 2007-2010. Effort at DWL began as 16 net-nights over two nights in 2003. DWL gill netting effort increased to 20 net-nights over two nights in 2004-2005, and then to 30 net-nights over three nights in 2006-2010. Gill nets used were 8 ft. tall experimental nets consisting of 4 – 50 ft. sections of 0.75", 1.0", 1.5" and 2.0" monofilament mesh. White bass are not fully recruited to the fall gill nets until age-1, so recruitment of stocked fish to the population was based on the catch rates of age-1 OTC marked white bass in fall gill net samples. Otoliths were removed from all suspected age-1 Morone sp. (BRL: 9-12 in classes; DWL: 7-12 in classes) and at least 10 fish per inch class of other sizes to get a general age sample. The presence of a fry mark, fingerling mark, or the absence of a mark allowed for the differentiation of stocked white bass, stocked hybrid striped bass and naturally spawned white bass. The recruitment of stocked fish to the reproducing stock was also analyzed by examining the proportion of mature OTC marked fish in spring electrofishing and fall gill net samples.

Creel surveys were conducted on both BRL and DWL at three year intervals during the course of the study (2004, 2007 and 2010). Creel surveys generally began in late March or early April and ran through the end of October. A roving creel survey design was used with all areas have equal probabilities. The creel clerk surveyed 10 weekdays and 6 weekend days during all months. Creel survey periods were half days in all months and also had equal probabilities. In conjunction with the creel survey, the creel clerk also administered a survey to query anglers as to their satisfaction with the fishery and their experience.

Results and Discussion

Green River Lake (8,210 acres) and Taylorsville Lake (3,050 acres) were used as control lakes for the study and so were not stocked with white bass. However, it was decided that data from these lakes would not add to the limited analysis of the treatment lakes data and so control lakes data will not be discussed.

Stocking Mortality

The 24-hr mortality assessments that were conducted at each white bass stocking showed that there was excellent short-term survival. Survival of stocked white bass in these experiments averaged 91% at BRL with a range of 76 to 97% and averaged 98% at DWL with a range of 96 to 100% (Table 1). The fact that these fish had already undergone OTC marking, which in itself is a stressful event, may mean that the weakest fish may have already been culled (Ron Brooks, personal communication). Based on the high short-term survival rates, the assumption was made that stocked white bass could have equivalent survival to naturally produced fish of the same size. However, the average size of white bass fingerlings was less than the 1.5-in goal in four out of five years for BRL and two out of five years at DWL and it is unknown what role this may have had in the survival of the stocked fish.

Barren River Lake

Spring spawning migrations of white bass out of reservoirs and into headwaters concentrates the fish near riffles making them susceptible to electrofishing. Because of the nature of this sampling (during a spawning migration), spring electrofishing catch rates should not be expected to be well correlated with fall gill net catch rates. Spring catch rates of white bass in the Barren River above BRL generally were higher in the first four years of the project (2003-2006) than in the last three years (2008-2010) (Figure 1). The relatively higher number observed were not related to the supplemental stocking of white bass as the relative lack of OTC-marked fish indicated the vast majority of these fish were natural. The stocked fish from the 2003 cohort first began showing up in the spring sample in 2005 as represented by a few age-2 fish in the 10-12 in classes (Figure 1). This was apparently on top of a strong natural year class, as all fish collected and aged that were between 10.0 and 13.3 in were age-2. White bass at BRL average 7.6 in, 12.0 in, and 14.0 in at ages 1-3 (Tables 2 and 3). This same stocked year class was represented by just two age-3 fish in the spring 2006 sample. The only other stocked fish seen in spring samples were age-1 and 2 stocked fish present in the spring 2008 sample, though again in low numbers. The hatchery efficacy tests of OTC marking of white bass showed that all marked fish had readily discernible marks. OTC marks were also easily distinguishable on transverse-sectioned white bass otoliths from up to age-6 wild fish and there is no reason to believe they could not be seen on otoliths from white bass of any age.

Fall gill net catch rates at BRL were highly variable over the eight years of the project and there was no discernible increasing trend that would correlate with stocking. Catch rates ranged from 0.6 fish/nn to 10.6 fish/

nn with the highest catch rates in the first two years and the last year of the project (Table 4). Average catch rate over the eight years of the study was 3.3 fish/nn, which is slightly higher than the 2.4 fish/nn observed in the previous ten years at the lake. Gill net catches also showed low contribution of stocked fish from the five years of stocking, as the percent contribution of age-1 stocked fish ranged from 0.0 to 35.3% and averaged 15.7% (Table 5). In 2006 and 2008, no age-1 white bass were collected, natural or stocked, suggesting either complete failure of the 2005 and 2007 year classes or the lack of a representative gill net sample. The mean length of stocked fish and natural fish at BRL was similar except in 2004 when stocked age-1 fish were longer than natural fish ($p=0.03$).

In a general sense, a low relative contribution of stocked fish to a year class could happen with good survival of stocked fish when there is a strong natural year class. This was not the case at BRL, as there was low contribution to relatively low year classes.

The condition of white bass in fall gill nets at BRL from 2003-2010 was variable, with overall condition ranging from 85-99 (Table 6). The only noticeable pattern was that relative weight was generally lowest during 2003-2005. White bass of all size classes had lower condition in these three years than in other years. This disparity was not likely due to white bass supplemental stocking because, as has been noted, few stocked white bass were present in the population during these years. The hybrid striped bass population was probably not a factor either, as densities fluctuated up and down during these years. Though there is no direct evidence of competitive interactions, yellow bass were first found to have colonized the lake in 2003 when they were present in good numbers alongside white bass during spring electrofishing of BRL headwaters.

During the course of the BRL study, there was some concern that gill nets did not routinely catch a representative sample of the white bass population. With the exception of 2004 and 2005, the gill net catch was dominated by fish less than 9 inches. This fact contrasts with very high catch rates of greater than 9 in white bass during spring 2005 and 2006 electrofishing. The increased gill netting effort instituted from 2005-2010 did not seem to provide a better representative sample of white bass.

Creel survey results from BRL in 2004, 2007 and 2010 indicate a declining white bass population (Table 7). The number of white bass caught/acre went from 1.75 fish/acre in 2004 to 0.05 in 2007 and 0.01 in 2010. There were zero white bass harvested in the 2007 and 2010 creel surveys. There was an even greater decline in the number of hybrid striped bass caught and harvested over the same time period. In contrast, yellow bass numbers caught and harvested increased over the same time period. Not surprisingly, there was a decrease in fishing effort targeting *Morone* spp. and decrease in percent fishing success (Table 7).

Dewey Lake

The headwaters of DWL (Johns Creek) were first sampled for this project in spring 2003. No white bass were collected (Figure 2). The spawning run could have been missed but sampling was conducted on 26 March 2003 when water temperatures were 59-60 °F and within the prescribed sampling window. Adequate samples of white bass were collected with spring electrofishing in all other years with the exception of 2007, when sampling was delayed due to high, turbid water conditions and only five fish were collected. Electrofishing catch rates of white bass were highest from 2008-2010. As at BRL, stocked white bass first appeared in 2005 spring sampling at DWL with both the 2003 and 2004 stocked white bass present. White bass growth rates are slower at DWL than those at BRL (Tables 8 and 9) as they average 6.5 in, 11.2 in, and 13.0 in at ages 1-3. Because of the slower growth rates, stocked white bass were a major component of the reproductive stock through completion of the project in 2010, even though stocking concluded in 2007. Stocked fish were the majority of the spring 2010 sample, even though the last of the stocked fish were cycling through the population.

Fall gill net catch rates of white bass at DWL ranged from 1.9 fish/nn to 5.4 fish/nn with the highest catch rates in 2003, 2004, 2008, and 2010 (Table 10). Like BRL, and in contrast to spring electrofishing catch rates, there was no discernible trend of an increasing white bass population with supplemental stocking based on gill net catches. As noted above and also in contrast to BRL, stocked fish were relatively heavy contributors to the DWL white bass population. The percent contribution of age-1 stocked fish ranged from 50 to 100% and averaged 78.3% (Table 5). In 2005 and 2007, few age-1 white bass were collected suggesting relatively poor 2004 and 2006 year classes. The mean length of stocked fish and natural fish at DWL was similar except in 2006 when stocked age-1 fish were longer than natural fish ($p=0.02$). It is noteworthy that the highest gill net catch of age-0 white bass (5.5 -8.6 in) was in 2010 (Table 10), meaning there was good survival of a natural year class in the last year of the study.

The overall condition of white bass in fall gill netting at DWL from 2003-2010 ranged from 89-99 (Table 11). White bass condition at DWL tended to be higher during the first four years of the project than the last four years.

In contrast to BRL, creel surveys at DWL showed an increasing white bass population. Anglers caught few white bass during 2004 and 2007 and did not harvest any those two years. No anglers were specifically targeting white bass in either year (Table 12). However, 1.28 fish/acre were caught in 2010 and 0.63 fish/acre were harvested. There were 45 trips targeting

white bass in the 2010 creel survey, but this was 1.2% of all trips. White bass anglers had very good success in 2010 (56.3%).

Management Implications

White bass supplemental stocking does not appear to be effective in every situation because of the many different dynamics that can be at work in determining year class survival, as evidenced at BRL. There does not appear to be a shortage of spawning habitat in the headwaters of BRL, but the white bass population, as sampled by gill nets, remained low during the course of this research despite the supplemental stocking. Over the five years of white bass stocking, there was a low contribution of stocked fish at BRL. This could be due to competition with other *Morone* spp. present at BRL, but determining interspecific competition was beyond the scope of this study.

White bass supplemental stocking can be used to provide put and take fisheries in reservoirs with a lack of spawning habitat in headwater streams as at DWL. White bass populations are usually dominated by two and three old fish so a good year class is needed every third year to maintain a fishable population. Contribution of stocked fish was generally high at DWL, although year class strength was variable. The supplemental stocking did lead to a white bass population of reproductive size at DWL after 2005. The excellent natural spawning that produced the 2010 year class is evidence that a reproducing white bass population had been re-established.

If it is desired to maintain a white bass population at DWL, it should be monitored and supplemental stocking should occur as needed. This procedure could also be used at other reservoirs with compromised headwater streams.

Like most research, the results of the current study lead to more questions that could be the basis for future research:

1. Design a study to compare gill netting with other sampling methods to determine white bass sampling effectiveness.
2. It would also be helpful to know, after white bass are hatched, how quickly and at what size white bass fry/fingerlings migrate back to the lake? The answer to these questions may help to better tailor our stockings.
3. Design a bioenergetics study to determine if there is competition among *Morone* spp. at BRL and at what size there may be a bottleneck. These results may answer the question if white bass and hybrid striped bass populations could both flourish with alternate year stocking.

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KDFWR Strategic Plan. Goal 1, Strategic Objective 5.

Propagation and Culture of the Endangered Purple Catspaw Mussel, *Epioblasma obliquata obliquata* (Raf., 1820)

Monte A. McGregor, Kentucky Department of Fish and Wildlife Resources, Center for Mollusk Conservation; Leroy Koch, US Fish and Wildlife Service, Kentucky Field Office; Angela Boyer, US Fish and Wildlife Service, Ohio Ecological Services Field Office; Steve Ahlstedt, Retired, USGS, Knoxville, TN

Figure 1: *Adult catspaw showing teeth and brood chambers / Monte McGregor*

Introduction

The Center for Mollusk Conservation in Kentucky has been actively working since December 2013 on methods to culture and rear the purple catspaw, *Epioblasma obliquata,* from Killbuck Creek, OH. The catspaw historically was found in the Ohio and Cumberland River systems, but has since been extirpated from all of its range except for one known population discovered in the mid 1990's in Killbuck Creek, OH. Known host fish for the catspaw include the rock bass, mottled sculpin, greenside darter, stonecat, blackside darter, and logperch. The catspaw infects its host by luring it with a fleshly lure, catching and holding it with serrated teeth located on the edge of the shell (Figure 1). The catspaw is currently limited to a few individuals in the wild and/or captivity, making it one of the rarest mussels in North America. Efforts to locate females have proven difficult and have taken years of survey effort. In 2012, biologist located a few females from Killbuck Creek and attempts were taken to propagate juveniles. This work was a joint effort from both federal and state wildlife agencies.

Figure 2: *Juvenile catspaw reared at the CMC / Monte McGregor*

Methods

In spring 2013, under the direction of the catspaw recovery team, a few individuals of the catspaw were taken from Killbuck Creek to three mussel propagation facilities, including the Columbus Zoo/Ohio State University Facility, White Sulphur Springs National Fish Hatchery, and the Center for Mollusk Conservation (KY Dept of Fish and Wildlife). Larvae (glochidia) were extracted from the adult and inoculated onto known host fishes at all three facilities. The adults were returned to the Creek and attempts were made to repeat the trials in 2014 using mottled sculpin and advanced *invitro* (culture media solution used in an incubator to bypass the host) culture methods. In 2014, we were able to try a second and third attempt to culture the catspaw.

Figure 3: *Culture trays rearing juvenile mussels / Monte McGregor*

Juveniles (Figure 2) were recovered and reared at the Center for Mollusk Conservation's greenhouse using cultured and commercially available algae in closed aerated tray systems with automated feeders and water exchanges (Figure 3).

Results

Thirteen juvenile catspaw individuals from White Sulphur Springs (WSS) were obtained in Dec 2013 (1-3mm in size) and reared in CMC trays. The juveniles had an average weight of .051 grams (.012 to .088 g) and average size of 6.0 mm (range 3.9 mm to 7.5 mm). We held juveniles in a variety of systems (bowls, trays, upwelling screens) and tested a variety of food items. As of Dec 2014, 12 juveniles (92% survival) were alive and averaged about 10.5 mm, with an increase in total weight from 0.7 to 3.25 grams. Individuals had increased about 4.5 mm in length and .22 grams (4.5 times increase in weight and a 56% increase in length). In April, 2014, efforts at the CMC produced juveniles from May 9 to May 18 (1000 juveniles from *invitro* culture and 100 juveniles from West Virginia mottled sculpin). In July 2014, only 20 juveniles survived, but were able to get 18 to survive through December 2014. In December 2014, they had an average weight of 0.203 grams (.075 to .35 g) and average size of 10.03 mm (range 7.6 mm to 12.38 mm). In November 2014, CMC staff got 100 larvae from 1 female catspaw (larvae placed in *invitro* culture media on site). Of the original 100 larvae, we had ~72 transform to the juvenile stage. These 72 were placed in a tray and in December, we had 22 juveniles. We currently have 47 juveniles in captivity from at least 3 - 4 females representing 3 year classes (2012-2013, 2013-2014, and 2014-2015). All individuals are 8-13mm (Figure 4).

Figure 4: *Juvenile catspaw with siphons / Monte McGregor*

Funding Sources: *State Wildlife Grant Program (SWG), Kentucky Aquatic Resources Fund (KARF)*

KDFWR Strategic Plan. Goal 1. Strategic Objective 5. Comprehensive Wildlife Conservation Strategy: Appendix 3.2, Class Bivalvia. Priority Survey Project #1

Qualitative and Quantitative Assessment of the Freshwater Mussel Population in Sinking Creek (Rockcastle River system), Kentucky

Monte A. McGregor, Andy McDonald, David Cravens, and C. Owen, Kentucky Department of Fish and Wildlife Resources, Center for Mollusk Conservation; L. Koch, and J. Garland, US Fish and Wildlife Service, Kentucky Field Office

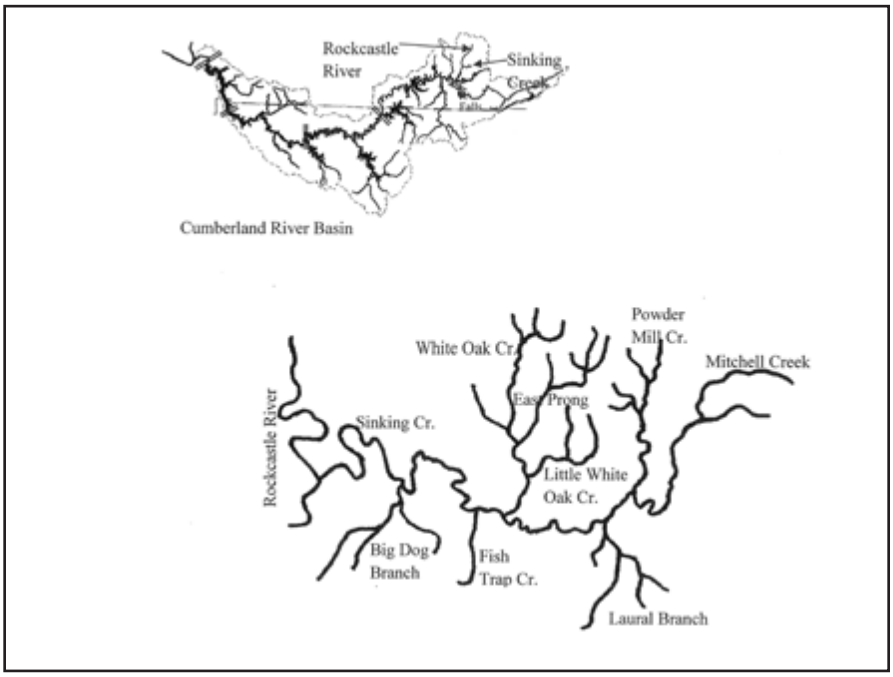

Figure 1: *Map of Cumberland River Basin (upper left) and Sinking Creek and its major tributaries. The falls are indicated by the double lines (||).*

Introduction

Freshwater mussels represent a relatively small group of species on the planet, with approximately 840 species worldwide (Graf and Cummings 2007), and almost 300 species in North America (Williams et. al 1993). Much of the freshwater mussel diversity in North America occurs east of the Rocky Mountains (90% of the fauna), with a significant number of species in the Southeastern states of Alabama (178), Tennessee (129), Georgia (123), and Kentucky (104). Currently, about 25 percent of the Southeast's mussel fauna are federally listed (88 US listed species) and about 12 percent are extinct. No other native faunal group approaches this level of imperilment. Much of the declines are due to human alteration of rivers and streams, habitat destruction, pollutant sources, and subsequent poor water quality.

The Rockcastle River is a tributary to the Cumberland River (94 mussel species) and is located in Pulaski, Laural, and Rockcastle Counties in southeastern Kentucky. Historically, the Rockcastle River supported 39 species of mussels and currently supports several rare species. Sinking Creek is a fourth order tributary to the Rockcastle River and drains approximately 100 km^2 of mostly the Daniel Boone National Forest and areas in and around the city of London, Ky. The stream is a boulder, gravel, and sandy stream with shallow riffles, long shallow runs and pools. The gradient is variable but generally low in most of the lower section. It has six major tributaries with White Oak Creek and Laurel Branch being the largest.

A few studies have documented several mussel species in Sinking Creek. Groves and Schuester (2000) reported 8 species, Cicerello (2003) reported 11 species, Ahlstedt (2014) reported only 3 species (study limited to the upper part of the watershed), and KDFWR have documented similar numbers as well (Table 1). Groves and Schuester (2000) reported two endangered species- the Cumberland bean (*Villosa trabalis*), and the Cumberland elktoe (*Alasmidonta atropurpurea*), and 6 other common species: the plain pocket book, (*Lampsilis cardium*), wavyrayed lampmussel, (*L. fasciola*), painted creekshell, (*V. taeniata*), rainbow mussel, *V. iris*, spike, (*Elliptio dilatata*), and the fluted shell, (*Lasmigona costata*). Cicerello (2003) added to the list three additional species, including the pheasant shell (*Actinonaias pectorosa*), pink heelsplitter (*Potamilus alatus*), and the Cumberland papershell, (*Anodontoides denigrates*) (all limited to only 1 specimen each). The Center for Mollusk Conservation initiated a study in 2012 and 2013 to document the current status of the mussel fauna in Sinking Creek and to qualitatively examine the lower 9 miles of the stream and quantitatively examine the three

best areas for mussel populations.

Methods

A survey of the freshwater mussels in Sinking Creek (Figures 1 and 2) was completed in August 2012 to October 2013. A total of 19 sites were qualitatively surveyed for presence/absence and three sites for quantitative analyses. The quantitative mussel sampling was completed at three sites in Sinking Creek in August and October 2013. One hundred eighty four (184) 1.0 meter squared samples were examined at three sites: Lower Sinking Creek at Sinking Creek Mile 3.2, Middle Sinking Creek at Sinking Creek Mile 4.6, and Upper Sinking Creek at Sinking Creek Mile 8.2.

Results (qualitative surveys)

Eight species were detected in all qualitative surveys (Table 1). Nine of the qualitative sites had 5 to 7 species, while the remaining sites has less than 5 species, with only 1 site having only 1 species. Only one federally endangered species was encountered in the surveys: the Cumberland bean (*Villosa trabalis* (Figure 3). The Cumberland bean was detected live at 8 sites, with relicts found at 6 additional sites. No sites had more than 5 individuals of the Cumberland bean, giving all sites a VR (very rare-1 specimen), R (rare-2 specimens), or UC (Uncommon-3-5 specimens) categorical grouping. The painted creekshell (*Villosa taeniata*), was the most commonly encountered species, present at 95% of the sites, followed by the spike, (*Elliptio dilatata*), and wavyrayed lampmussel, (*Lampsilis fasciola*), and the plain pocketbook, (*Lampsilis cardium*). The pheasant shell, (*Actinonaias pectorosa*), was only found at two sites. We did not detect the endangered Cumberland elktoe, (*Alasmidonta atropurpurea*), the Cumberland papershell, (*Anodontoides denigrates*), or the pink heelsplitter, (*Potamilus alatus*). Results were similar to that of Groves (2000) and Cicerello (2003). The best sites are sites in miles 4 to 8. River Miles 1 to 3 had very few mussels, mostly due to the differences in habitat. Several log jams and high velocity areas were observed in the 0-3 mile section, potentially creating unstable habitat for mussels during high water. Miles 4 to 9 had several long (few hundred meters) runs with areas of stable sand mixed

Scientific Name	Common Name	Source			
Actinonaias pectorosa	pheasantshell		C		M
Alasmidonta atropurpurea E	Cumberland elktoe	G	C		M*
Anodontoides denigratus	Cumberland papershell		C		
Elliptio dilatata	spike	G	C		M
Lampsilis cardium	plain pocketbook	G	C		M
Lampsilis fasciola	wavyrayed lampmussel	G	C	A	M
Lasmigona costata	fluted-shell	G	C		M
Potamilus alatus	pink heelsplitter		C		
Villosa iris	rainbow	G	C	A	M
Villosa taeniata	painted creekshell	G	C	A	M
Villosa trabalis E	Cumberland bean	G	C		M

Table 1: *Mussel species that are documented from Sinking Creek from current and previous surveys (G=Groves and Schuester 2000, C=Cicerello 2003, A=Ahlstedt 2014, M= KDFWR Sinking Creek Records,M*=KDFWR most recent record, 2010).*

	Upper Sinking Creek Site	Middle Sinking Creek Site	Lower Sinking Creek Site
Elliptio dilatata	1	6	1
Lampsilis fasciola	2	0	1
Villosa iris	19	2	1
Villosa taeniata	21	12	2
Villosa trabalis	3	2	0
Total # Mussels	46	22	5
Total # Species	5	4	4
Density (per sq m)	0.767	0.367	0.083
# Grids with Mussels	25	20	4
% Grids with Mussels	41.7%	33.3%	6.3%

Table 2 : *Comparison of Summary Statistics between Sites in Sinking Creek 2013*

with a diverse gravel, pebble, and boulder substrata.

Results (quantitative surveys)

The quantitative mussel sampling was completed at three sites in Sinking Creek in August and October 2013 (Table 2). One hundred eighty four (184) 1.0 meter squared samples were examined at three sites: Lower Sinking Creek at Sinking Creek Mile 3.2, Middle Sinking Creek at Sinking Creek Mile 4.6, and Upper Sinking Creek at Sinking Creek Mile 8.2. The grid sampling required 15.93 hours of actual survey time with a 2-4 team approach. Survey time for all sites per grid ranged from 1 to 23 minutes (average of 2 to 8 minutes depending on the site and number of individuals found). Low densities of the endangered Cumberland bean was detected at two of the three sites: densities were 0.067 to 0.033/m^2, which is lower than densities where recruitment usually can occur. It is suspected that pockets of 2-3 mussels are able to connect with the fish host and somehow survive at these low densities. Species diversity was similar (4-5 species-spike, Cumberland bean, wavyrayed lampmussel, painted creekshell, and rainbow) at all quantitative sites, but densities were higher at the Upper Site (0.767/m^2) followed by the Middle (0.367/m^2) and Lower (0.078/m^2) Sites. In general, all sites had low densities, which is common in small streams in the Cumberland basin. The Cumberland bean ranged in size from 25 to 50 mm, and 7 to 16 years in age. In general, all mussels found ranged in size from 25 to 79 mm and 6 to 19 years in age, indicating limited recruitment for most species.

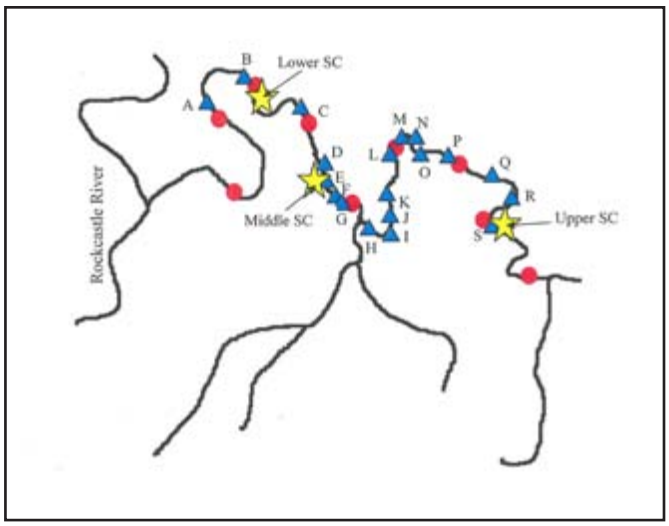

Figure 2: *Map of Sinking Creek showing river mile locations (red dots) for miles 1 to 9, qualitative sampling sites (blue triangles), and quantitative monitoring sites (yellow stars).*

Figure 3: *Photo taken of mussels in Sinking Creek Quantitative sampling (10-2-2013) : painted creekshell (a), Cumberland bean (b), spike (d), wavyrayed lampmussel (e), and rainbow (c).*

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Funding Sources: *State Wildlife Grant Program (SWG), Kentucky Aquatic Resources Fund (KARF), U.S. Fish and Wildlife Service (USFWS)*

KDFWR Strategic Plan. Goal 1. Strategic Objective 5. Comprehensive Wildlife Conservation Strategy: Appendix 3.2, Class Bivalvia. Priority Survey Project #1

Community Changes in a Freshwater Mussel Bed from 2004 to 2014 in the Green River, Kentucky

Monte A. McGregor, Adam C. Shepard, Christopher Owen, Travis Bailey, Andy McDonald, Fritz Vorisek, and David Cravens, Kentucky Department of Fish and Wildlife Resources, Center for Mollusk Conservation

Introduction

North America hosts the most diverse freshwater mussel fauna on Earth (Haag 2010), with approximately 300 species representing 36% of the total global mussel diversity (Graf and Cummings 2009). Kentucky has one of the most diverse mussel populations in North America, with 41 genera and 105 recognized species, representing 35% of the fauna. In Kentucky, 12 mussels are presumed extinct, and another 28 are listed by the U.S. Fish and Wildlife Service as Threatened or Endangered. Nine of the 28 are considered extirpated from the state. Kentucky also has 46 species on the list of Species of Greatest Conservation Need.

The Green River is the largest river system in the state extending from the Highland Rim and Hills of central Kentucky flowing west and north into the Ohio River near Henderson. The mainstem Green has several dams, with Green River, Rough River, Barren, and Nolin being the only ones in operation. The section through Mammoth Cave National Park has been designated a Kentucky Wild River.

The Green River historically supported a few hundred (maybe a few thousand) species (mussels, snails, fishes, crayfishes, aquatic insects, reptiles, amphibians, birds, mammals, plants, etc.). Add in the significance of the world's largest cave system (Mammoth Cave) and its surrounding freshwater and terrestrial ecosystems, and the Green River ecosystem emerges as a hotspot for biological diversity. The River, especially the upper Green River, is rated fourth in the US by the Nature Conservancy for the highest aquatic biodiversity in the United States. The most significant stretch is the 114 un-impounded river miles between Lock and Dam 6 in Mammoth Cave National Park and Green River Lake Dam on the upper end. It is especially rich in fishes and freshwater mussels.

Figure 1: *Diverse mussel assemblage in the Green River, KY. / Monte McGregor*

The Green River has 74 species of freshwater mussels (or 71% of all KY species) (Figure 1). Twenty five percent (25%) of all North American mussels are found in the Green River. Six of the 74 are considered extirpated from the Green. There are 17 Threatened and Endangered mussels in the Green, representing 16% of the T&E species in the state and 32% of all US listed mussels (88 species listed by the USFWS in 2014). Of the 74 species, KDFWR has identified 28 (or 38%) as species of greatest conservation need. Nine of the 17 Threatened and Endangered species can still be found in the Green River. The Green River is currently home to several endangered mussels, including the ring pink, *Obovaria retusa*; fanshell, *Cyprogenia stegaria*; rough pigtoe, *Pleurobema plenum;* clubshell, *Pleurobema clava*; pink mucket, *Lampsilis abrupta;* the scaleshell, *Leptodea leptodon*; catspaw, *Epioblasma obliquata obliqua*ta; tubercled blossom, *Epioblasma t. torulosa*, northern riffleshell, *Epioblasma torulosa rangiana*, rayed bean, *Villosa fabalis*, sheepnose, *Plethobasus cyphyus*, snuffbox, *Epioblasma triquetra*, rabbitsfoot, *Quadrula c. cylindrica*,

Figure 2: *Quantitative grid sampling for mussels. / Lee McClellan*

Figure 3: *Map of Kentucky showing the Green River in Kentucky and the mussel monitoring station surveyed in 2004, 2009, and 2014.*

orangefoot pimpleback, *Plethobasus cooperianus*, cracking pearlymussel, *Hemistena lata*, fat pocketbook, *Potamilus capax*, spectaclecase, *Cumberlandia monodonta*. It also supports one endemic mussel, the Kentucky creekshell, *Villosa ortmanni*. Of all the threatened and endangered species found in the Green, the rabbitsfoot, rough pigtoe, clubshell, fanshell, and spectaclecase seem to be doing the best. The fanshell has the best populations of all threatened and endangered species, with multiple sites showing recruitment.

In 2005, the Center for Mollusk Conservation (CMC) initiated efforts to monitor the freshwater mussel populations in the Green by establishing several long-term monitoring stations. The first site was examined in the section just upstream of Mammoth Cave National Park and is the subject of this report.

Materials and Methods

We assessed the mussel population at one mussel bed in the Green River near Mundfordville, KY, in a 1,000 m^2 area with the use of 1m^2 quadrats in the summers of 2004, 2009, and 2014 (Figure 2). We determined species presence, abundance, and distribution patterns for all species. We considered mussels rare (0.1 mussels/m^2) or very rare (0.001 to 0.01 mussels/m^2) and/or if a species was present at < 0.5% of the assemblage. We estimated population density, estimated size structure to indicate recent recruitment (individuals < 30mm in length), and established guidelines for monitoring the site and others over time (i.e., establish long-term trends). First, we defined the grid area (i.e., the specific area where the quantitative sampling would be conducted) as the upstream and downstream boundaries of the mussel bed in question by using previous survey information and by surveying the area using snorkeling techniques under low water conditions. The ~ 1,000m^2 grid area was selected in 2004 and resurveyed in 2009 and 2014. We randomly sampled 180 samples (18% of the grid) based on sampling fraction estimates needed (10 percent for areas ≥ 500m^2 and < 5,000m^2). We used 1m^2 quadrats, and surveyed each grid using a two person team approach (a collector and data recorder) (Figure 2). The data recorder was given a record sheet, a list of random sites (organized from downstream to upstream), a clipboard (with ruler), sample collection basket (for speed of processing multiple mussels), and assigned a starting point. Each square meter sampling unit is sampled by scanning the entire area from downstream to upstream and right to left to check for surface exposed mussels. Individuals are hand picked and given to the data recorder, identified, measured (total length in mm), aged (subsample only), sexed (if possible), and then returned to the water next to the grid for later placement back in the original quad. The collector samples while all the data is being recorded and removes additional specimens by excavating with the hands to a depth of at least 10

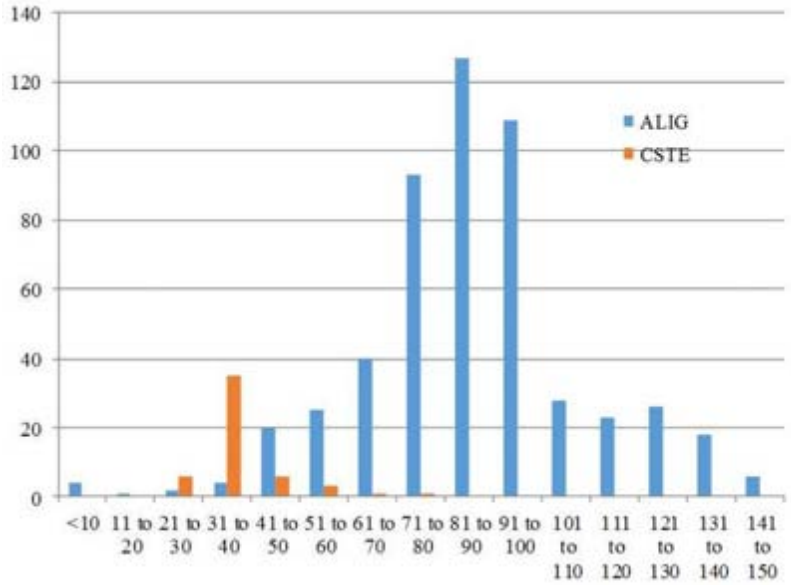

Figure 4: *Frequency distribution of muckets (ALIG, **Actinonaias ligamentina**) and fanshells (CSTE, **Cyprogenia stegaria**) collected in 2014 at monitoring site in the Green River.*

Table 1: *Mussels species collected in quantitative sampling in the Green River at monitoring location in 2004, 2009 and 2014.*

	#/m² by Species by Year					
	2004		2009		2014	
Species	#/m²	%	#/m²	%	#/m²	%
Actinonaias ligamentina	5.483	70.6	2.124	32.0	2.923	36.1
Alasmidonta marginata			0.017	0.3		
Amblema plicata	0.378	4.9	0.382	5.8	0.538	6.7
Cyclonaias tuberculata	0.356	4.6	0.904	13.6	0.533	6.6
Cyprogenia stegaria	0.072	0.9	0.303	4.6	0.286	3.5
Ellipsaria lineolata	0.006	0.1	0.006	0.1		
Elliptio crassidens	0.017	0.2	0.017	0.3	0.011	0.1
Elliptio dilatata	0.100	1.3	0.511	7.7	1.038	12.8
Fusconaia flava			0.006	0.1		
Fusconaia subrotunda	0.189	2.4	0.185	2.8	0.242	3.0
Lampsilis abrupta					0.033	0.4
Lampsilis cardium			0.011	0.2	0.077	1.0
Lampsilis fasciola	0.006	0.1	0.056	0.8	0.154	1.9
Lampsilis ovata	0.106	1.4	0.163	2.5	0.247	3.1
Lasmigona costata	0.044	0.6	0.028	0.4	0.060	0.7
Leptodea fragilis	0.006	0.1	0.028	0.4	0.016	0.2
Ligumia recta	0.006	0.1	0.017	0.3	0.049	0.6
Megalonaias nervosa	0.233	3.0	0.303	4.6	0.198	2.4
Obliquaria reflexa	0.039	0.5	0.051	0.8		
Plethobasus cyphyus	0.039	0.5	0.006	0.1	0.022	0.3
Pleurobema cordatum	0.033	0.4	0.073	1.1	0.011	0.1
Pleurobema plenum	0.006	0.1	0.017	0.3		
Pleurobema rubrum	0.000	0.0			0.005	0.1
Pleurobema sintoxia	0.111	1.4	0.337	5.1	0.401	5.0
Potamilus alatus			0.017	0.3	0.027	0.3
Ptychobranchus fasciolaris	0.100	1.3	0.073	1.1	0.192	2.4
Quadrula cylindrica	0.028	0.4	0.017	0.3	0.005	0.1
Quadrula metanevra	0.183	2.4	0.489	7.4	0.324	4.0
Quadrula pustulosa	0.100	1.3	0.298	4.5	0.538	6.7
Quadrula quadrula			0.006	0.1		
Strophitus undulatus	0.006	0.1	0.017	0.3	0.044	0.5
Tritigonia verrucosa	0.072	0.9	0.129	1.9	0.110	1.4
Truncilla truncata	0.056	0.7	0.045	0.7	0.005	0.1
# per sq m	7.77		6.63		8.09	
# species	27		31		27	
overlapping species	23		23		23	
# species <1%	15		17		13	
# species <0.1%	6		4		3	
# unique species	0		3		2	

cm if necessary to remove any subsurface mussels. Upon completion of all sampling within the quad, all excavated material and mussels are returned.

Results

We collected 33 species (4,053 individuals) for all three events (Table 1, Figure 3). The most dominant species found in all three events was the mucket, *Actinonaias ligamentina* (71%, 32%, and 36% of the total abundance). Mucket densities ranged from 5.483/m² in 2004 to 2.124/m² in 2009, and 2.923/m² in 2014. Muckets ranged in size from 5 mm to 150 mm, with large numbers in the 70 to 100mm range (Figure 4). Other abundant species were the purple wartyback, *Cyclonaias tuberculata* (5-14%), threeridge, *Amblema plicata* (5-7%), washboard, *Megalonaias nervosa* (2-5%), pimpleback, *Quadrula pustulosa* (1-7%), round pigtoe, *Pleurobema sintoxia* (1-5%), spike, *Elliptio dilatata* (1-13%), and the monkeyface, *Quadrula metanevra* (2-7%), which collectively accounted for 76-86% of the individuals. Mussels were considered rare if densities were less than 0.1/m². Mean densities by species ranged from 0.005 to 5.48/m². Thirteen species were rare in 2014 (2 T&E), 19 rare in 2009 (3 T&E), and 18 rare in 2004 (4 T&E). Average mussel density for all years ranged from 6.63 to 8.09/m² with maximum densities ranging from 30 to 40/m². The endangered fanshell, *Cyprogenia stegaria* varied in density from 0.072/m² in 2004 to 0.393/m² in 2009, and 0.286/m² in 2014 (Figure 4). In 2005 only 1 species was present at densities > 0.5/m², compared to 3 species in 2009, and 5 species in 2014.

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Funding Sources: *State Wildlife Grant Program (SWG), Kentucky Aquatic Resources Fund (KARF)*

KDFWR Strategic Plan. Goal 1. Strategic Objective 5. Comprehensive Wildlife Conservation Strategy: Appendix 3.2, Class Bivalvia. Priority Survey Project #1

Big South Fork mussel release / LeeMcClellan

New Projects

Least tern on nest / John Brunjes

Capture and Marking of Adult Interior Least Terns

John Brunjes, Erin Harper, and Constance Powell, Kentucky Department of Fish and Wildlife Resources

Interior least terns are listed as an endangered subspecies under the Endangered Species Act and are currently the only Endangered bird species to nest in Kentucky. Populations nest along many interior rivers of the United States, but the core of the population occurs along the Mississippi River from Kentucky and Missouri southward to the Gulf Coast. Interior least terns nest on sandbars separated from the mainland which are largely vegetation free. In Kentucky, on a good year, as many as 17 nesting islands may be exposed on the Mississippi and Ohio rivers. The Kentucky Department of Fish and Wildlife Resources has recorded more than 1,000 pairs nesting in KY. This represents 10% to 15% of the entire population of interior least terns.

While much is known about factors influencing nesting success, little is known about interior least terns away from the breeding site. In 2014, we began a long term project to identify movements away from the nest site. We began banding nesting adults with USGS hard metal bands in 2014. Birds were trapped on the nest using box type traps made of wire. Traps were placed over the nest and, once the adult returned, a string was used to release the trap. We captured/banded a small sample of 21 adults to monitor nest fate post-capture. Of the 21 nests where an adult was captured, 20 produced at least 1 chick (95%). The one nest that failed continued to nest for 11 days post-capture. Nest success of non-trapped nests on the island was 68%. Banding did not reduce the survival of nests in 2014.

For future seasons, least terns will be outfitted with USGS hard metal bands on the left leg, and plastic color bands and flags (a plastic color band with "flag" extending behind band) on the right leg. Each flag will have a 2 digit code (0-9 and A-Z) and be red with white letters or green with white letters. We will use flags because we hope to use these flags as an attachment point for future tracking devices (Micro GPS or Geo-Tag). These devices will allow birds to be tracked to their wintering grounds in Central or South America.

Funding Sources: *State Wildlife Grant Program(SWG)*

KDFWR Strategic Plan. Kentucky Comprehensive Wildlife Conservation Strategy: Appendix 3.2, Class Aves. Priority Survey Project #2.

Breeding Season Thermal Environment Assessment for Northern Bobwhite on Peabody WMA

John Morgan, Danna Baxley, Gary Sprandel, Eric Williams, Ben Robinson, and Jeremy Orange, Kentucky Department of Fish and Wildlife Resources; Don Yow, Eastern Kentucky University

Over the last five years, KDFWR conducted intensive management and research for northern bobwhite on Peabody Wildlife Management Area (WMA). The work has generated a wealth of new information to guide management actions in the future. However, some results generated a need for further investigation. Three of those results were centered on bobwhite population dynamics in the summer (breeding season). Bobwhite exhibited low production of young and lower than normal hatchability of eggs. Adult bobwhite also exhibited extremely low summer (breeding season) survival compared to other studies.

Northern bobwhites are naturally characterized as having high annual mortality that is offset by a high reproductive rate. On Peabody, bobwhite reproductive capacity appears to be lower than other environments. Low reproductive potential could slow population growth and limit the carrying capacity of the area. High adult summer mortality also limits the population's reproductive potential, and it contradicts the majority of published research that report the late winter period as the leading instance of mortality.

We have two primary hypotheses that may be driving these phenomenons. Each hypothesis is associated with the extensive infestation of sericea lespedeza. First, Peabody WMA is a food limited system, because a low diversity of plant species minimizes insect populations and seed production. This can have negative ramifications for summer survival and reproductive potential, because hens in poor physical condition lay lower quality eggs and have limited renesting capacity. The second hypothesis involves the temperature of the environment. Sericea transpires moisture at high rates which gives it a competitive advantage over many other plants. Therefore, it dries out the area elevating the temperature of the site. High ambient temperatures can cause reproductive complications.

Northern Bobwhite Nest / Jarred Brooke

Reyna and Burggren (2012) investigated upper lethal temperatures of bobwhite eggs in an incubator. They found that ambient temperatures of 46, 44, and 40ºC resulted in >50% death of bobwhite eggs for 1, 3, and 6 hours respectively. Therefore, hot environments can affect the hatchability of eggs. Extreme heat also can limit bobwhite chick foraging efficiency which may have negative effects on their survival, particularly when coupled with an insect limited system.

We will assess the summer (June – August) thermal environment on the Sinclair Tract of Peabody WMA. Our first priority is to document if ambient temperatures on the area exceed those outlined by Reyna and Burggren (2012). This may help explain lower egg hatchability. The study will focus on native grass and sericea cover as the primary nesting options. A third cover type will also be measured. Block disking of rank native grasses and sericea has been the most effective management technique on Peabody. Therefore, we will investigate if that practice also enhances the thermal nesting environment further demonstrating the importance of the management practice.

Temperatures will be collected using a HOBO pendant temperature logger. The loggers will be placed under a solar shield to eliminate direct radiant energy from the sun. This will allow us to measure the ambient temperature that is more representative of the Reyna and Burggren study. The loggers will record 6 temperatures per hour throughout the study period.

Funding Sources: *Wildlife Restoration Program (Pittman-Robertson)*

KDFWR Strategic Plan. Goal 1. Strategic Objective 1.1.

Retention Times of Hard Metal Bands Compared to Aluminum Bands in Wood Ducks

Female wood duck gets banded / John Brunjes

John Brunjes, Erin Harper, Robert Colvis, and Charlie Plush, Kentucky Department of Fish and Wildlife Resources

Each year, the Kentucky Department of Fish and Wildlife Resources (KDFWR) bands more than 2,000 wood ducks (*Aix sponsa*). Banding serves a critical role in the management of waterfowl populations. Population models are utilized by waterfowl biologists in Adaptive Harvest Management for setting annual regulations. These models depend on population estimates from spring surveys and accurate harvest/survival rates obtained from banding data. Because no spring survey is available for wood ducks, banding data is utilized to estimate population sizes.

Biologists traditionally band ducks with a single, uniquely numbered band made from aluminum. Statistical estimates used in models depend upon the assumption that bands are retained for the life of the bird. In recent years, waterfowl biologists have become concerned with the durability of some aluminum bands. In Kentucky, KDFWR recaptured bands that were only a few years old and yet were unreadable. Acidic waters in the wetland habitats of wood ducks on both the breeding grounds and wintering areas could be responsible for this wear. Currently, no estimate exists for band loss/wear for aluminum bands in wood ducks. Hard metal (stainless steel or an alloy known as Incoloy) bands provide an alternative to aluminum bands. Hard metal bands have been used on shorebirds and sea birds for years to combat the corrosive conditions bands on these birds face. They have not been widely adapted in ducks due to increased cost and difficulty for banders to apply.

In the summer of 2014, KDFWR banded 400 hatch year wood ducks (200 male and 200 female) with both aluminum and stainless steel bands. At the completion of annual hunting seasons, a sample of the hunters which report harvesting these bands will be contacted. Bands will be "borrowed" from hunters and comparisons of wear between aluminum and stainless bands will be compared. We will also compare retention of each band type as well. Information gained in this study will help determine if a conversion to hard metal bands might be necessary for wood ducks.

Funding Sources: *Wildlife Restoration Program (Pittman-Robertson)*

KDFWR Strategic Plan: Goal 1.

Evaluation of Muskellunge Stockings in the Kentucky River

Jason Herrala, David Baker, Nick Keeton, and Ryan Kausing, Kentucky Department of Fish and Wildlife Resources

The Kentucky River has been stocked for many years with multiple species including largemouth bass, blue and channel catfish, walleye, sauger, white and hybrid striped bass, and muskellunge. Electrofishing studies along various pools of the river have shown that the return on stocked fish is low and some species can only be maintained through stocking. Of particular interest is the muskellunge. While stockings of this species do occur, they are in low numbers (up to 50 fish/per pool for pools 4-9) and infrequent—only occurring when hatcheries have excess production. Routine electrofishing surveys conducted by the Kentucky Department of Fish and Wildlife (KDFWR) on the Kentucky River during late winter and fall yielded low but consistent numbers and sightings of muskellunge despite low-density and infrequent stockings. Low stockings with noticeable returns are indicative that stockings of muskellunge are likely effective in bolstering population numbers in the Kentucky River. Habitat and prey base could be affecting the survival of other sport fish that have not seen elevated success in the Kentucky River. Studies have shown that the preferred habitat of stocked musky is submerged woody debris. The Kentucky River is lined with downed and submerged trees that provide cover.

Kentucky River musky / Jay Herrala

The Kentucky River is also home to a large population of rough fish such as common carp, drum, and redhorse, all of which are common food items of muskellunge.

In 2014, stocking rates were augmented in pools 2 and 3, and initial sampling began to monitor the impacts of these stockings and document any natural reproduction. Before being stocked, all fish were fin clipped to distinguish between stocked year classes. Additionally, all 13.0" musky received a microwire tag to identify stocking size. Pools 2 and 3 received a total of 298 fingerlings (50% 9.0 in fingerlings and 50% 13.0 in fingerlings) at a rate of 9.0 fish/mi. Pool 4 was a control site and did not receive any stockings.

Spring electrofishing sampling was conducted in March 2014. Eight 15 min. transects were completed in each pool. Only 2 musky were collected in the spring sample. Catch rates of musky ranged from 0.0 fish/hr in pools 2 and 4 to 1.0 fish/hr in Pool 3, with a total catch per unit effort (CPUE) of 0.3 fish/hr. Musky ranged from 42.4 – 44.5 in with a mean length of 43.5 in.

A second sample was conducted this fall in October following the same protocol as spring sampling. In addition, all musky were checked for fin clips/wire tags. A total of 6 musky were collected with catch rates ranging from 0.5 fish/hr in Pool 2 to 1.5 fish/hr in Pool 3 with a total CPUE of 1.0 fish/hr. Fish ranged in length from 37.5 – 44.8 in with a mean length of 40.4 in. No age-0 fish from this year's stockings were observed.

Funding Sources: *Sport Fish Restoration Program (Dingell-Johnson)*

KDFWR Strategic Plan. Goal 1.

Green River trophy smallmouth / Ryan Kausing

Assessment of Statewide Size and Creel Limits on Smallmouth Bass in Pool 6 of Green River

David Baker, Jason Herrala, Nick Keeton, and Ryan Kausing, Kentucky Department of Fish and Wildlife Resources

Warm water stream fisheries are a valued resource in the southeastern United States. These streams provide excellent sport fishing opportunities for many species including smallmouth bass. In Kentucky, smallmouth bass are generally distributed in upland streams throughout the eastern two-thirds of the state. Smallmouth bass are a popular sport fish among both Kentucky anglers and anglers across the country. As a result of high angler interest, management agencies are beginning to implement stream specific strategies to improve and enhance stream smallmouth bass fisheries.

Pool 6 of the Green River (125 miles in length) is part of the Blue Water Trails Adventure Tourism Initiative and is located from immediately below Green River Lake downstream to lock and dam 6 near Mammoth Cave National Park. The majority of this pool is unimpounded and provides free flowing habitat to support a quality smallmouth bass fishery. Public boat ramps and canoe carry-down sites are located throughout this pool, Mammoth Cave National Park reports that recreational canoeing, kayaking and boating has increased 18.8% from 2003-2012 in Pool 6, boaters have averaged 12,448 trips/year for the past five years.

During late April 2014, black bass sampling was completed at four sites in Pool 6. Smallmouth bass were collected at 25.0 fish/hr and ranged from the 2.0-22.0 in size class. Thirty-three percent of the sample was above quality size (≥12.0 in) with trophy size (≥20.0 in) smallmouth bass collected at 0.6 fish/hr. The smallmouth bass fishery received an assessment score of 16, representing a "good" rating.

Fall electrofishing was conducted during late September 2014 at three sites in Pool 6 of the Green River for black bass. Smallmouth bass were collected at 22.3 fish/hr with fish ranging from the 1.0-20.0 in size class. Twenty-five percent of the sample consisted of quality size fish (≥12.0 in) with trophy size (≥20.0 in) smallmouth bass collected at 0.3 fish/hr. Relative weight values were fair across all size groups with this fishery receiving an overall Wr value of 84.

During the spring sample, otoliths were collected representing fish from age-1 through age-8. Smallmouth bass on average reached the 12.0 in minimum statewide size limit at age-4, 14.8 in at age-5 and 15.8 in at age-7. The primary goal of this study is to collect detailed baseline data on the smallmouth bass population in Pool 6 of the Green River to determine if the use of statewide size and creel limits are the best management option for this species.

Funding Sources: *Sport Fish Restoration Program (Dingell-Johnson)*

KDFWR Strategic Plan. Goal 1, Strategic Objective 4.

Golden eagle release at Bernheim Forest

Project Updates

Effects of Conservation Reserve Enhancement Program on Bird Populations at Local and Landscape Scales in Kentucky

John Yeiser and James Martin, University of Georgia; John Morgan, Danna Baxley, Gary Sprandel, and Keith Wethington, Kentucky Department of Fish and Wildlife Resources

Native grasslands are one of the rarest habitats in the eastern United States, and northern bobwhite (*Colinus virginianus*; hereafter bobwhite) have been declining for several decades. Habitat loss has been a major factor behind bobwhite declines and converting agricultural lands to native grasslands has been a central tool of bobwhite management. These grasslands benefit other species of concern as well including grassland birds.

The Conservation Reserve Enhancement Program (CREP) is a federally funded private-land conservation initiative, and its practices have created a lot of native grasslands in Kentucky. CREP practices have been shown to benefit grassland bird populations at the field scale; however, less is known about the benefits of the CREP at the landscape scale. Therefore, we have designed at study to understand how much habitat is needed across agricultural landscapes to positively influence bird populations at locations with low amounts of habitat and determine how the spatial patterning of habitat, crops, and other land features influence bird populations in agricultural landscapes.

This study focuses on agricultural areas within the Green River basin. Points across the study area were chosen based on different combinations of CREP densities at both landscape (3000 m radius) and local (510 m radius) scales. The amount of CREP habitat was allowed to vary at the landscape scale but was kept relatively low and constant at local scales. Kentucky Department of Fish and Wildlife Resources (KDFWR) biologists have been collecting data on grassland birds at these sites since 2010, and data collection will continue into June 2015. Further data collection will focus on quantifying habitat other than CREP across the study area.

Preliminary analysis indicates that increasing the amount of CREP at landscape scales increases the number of some species (e.g., bobwhite), but not others (e.g., eastern meadowlark, *Sturnella magna*). Further analysis will uncover the relative importance of both the amount of habitat on the landscape and the pattern of land features to bird populations. Understanding how landscape-scale habitat influences grassland birds will not only improve grassland management in Kentucky, it will inform future conservation in the Southeastern US.

Funding Sources: *Wildlife Restoration Program (Pittman-Robertson)*

KDFWR Strategic Plan. Goal 1. Strategic Objective 1.1. Comprehensive Wildlife Conservation Strategy: Appendix 3.2, Class Aves. Priority Research Project #8.

CREP field full of wildflowers / Zak Danks

Cerulean Warbler and Associated Species Response to Silvicultural Prescriptions in the Central Appalachian Region

Gretchen E. Nareff, West Virginia University; Petra B. Wood, USGS, WV Cooperative Fish and Wildlife Research Unit, West Virginia University; Todd Fearer, Appalachian Mountains Joint Venture; Mark Ford, USGS, VA Cooperative Fish and Wildlife Research Unit, Virginia Tech University; Jeff Larkin, Indiana University of Pennsylvania; Scott Stoleson, Northern Research Station, USFS; Scott Freidhof, Kentucky Department of Fish and Wildlife Resources

The cerulean warbler is a steeply declining, late-successional songbird species whose core breeding range is in the hardwood forests of the Appalachian Mountains. The cerulean uses heavily forested landscapes with heterogeneous vegetation structure. The U.S. Fish and Wildlife Service considers it a species of management concern, based on a range-wide population decline of 3.2% per year between 1966 and 2011. We are evaluating the songbird community response, using the cerulean as our primary focal species, to a range of forest management treatments recommended by the "Cerulean Warbler Management Guidelines for Enhancing Breeding Habitat in Appalachian Hardwoods." One goal of our study is to recommend ways to improve or broaden the habitat guidelines for the cerulean and associated bird species in Kentucky, Pennsylvania, Virginia, and West Virginia.

Cerulean warbler / Bill Hubick

Two of four field seasons of this study have been completed. Three sites in Pennsylvania and West Virginia were harvested prior to the study. The Kentucky site was harvested between the 2013 and 2014 breeding seasons, and two sites in West Virginia were harvested between the 2014 and 2015 breeding seasons. The remaining sites will be harvested prior to the 2016 breeding season. Different silvicultural treatments (e.g., shelterwoods, clearcuts, variable retention harvests) are integrated into a mosaic of harvests at the West Virginia sites, while shelterwood harvests are implemented in the remaining states. We are using point counts in the four states to evaluate changes in songbird abundance pre-harvest and post-harvest; and spot mapping techniques in West Virginia to evaluate changes in territory density, pre- and post-harvest, of six focal species (eastern towhee, indigo bunting, hooded warbler, cerulean warbler, wood thrush, and worm-eating warbler) representing a range of preferred basal areas.

In 2013 and 2014, average annual territory density was 0.38/ha at harvested sites and 0.26/ha at unharvested sites. At harvested sites in 2013 and 2014, ceruleans were detected at 50.0% of point count stations at harvest interior points, 40.0% of point count stations at harvest edge points, and 63.4% of point count stations in reference stands. Ultimately we will quantify cerulean warbler selection for various vegetative characteristics (e.g. residual basal area, canopy structure, tree species composition) and for landscape characteristics (e.g. slope position, aspect, landform) at the point count and territory levels. We hope to explain how ceruleans select territories on a landscape-scale within an implemented harvest matrix that offers structural diversity to the birds and how other songbird species may be managed under the umbrella of cerulean warbler breeding habitat management.

Funding Sources: *USGS, WV DNR, Pennsylvania Game Commission*

KDFWR Strategic Plan. Goal 1. Comprehensive Wildlife Conservation Strategy: Appendix 3.2, Class Aves. Priority Research Project #2.

Golden eagle caught on camera at Bernhiem Forest in 2014 / Andrew Berry

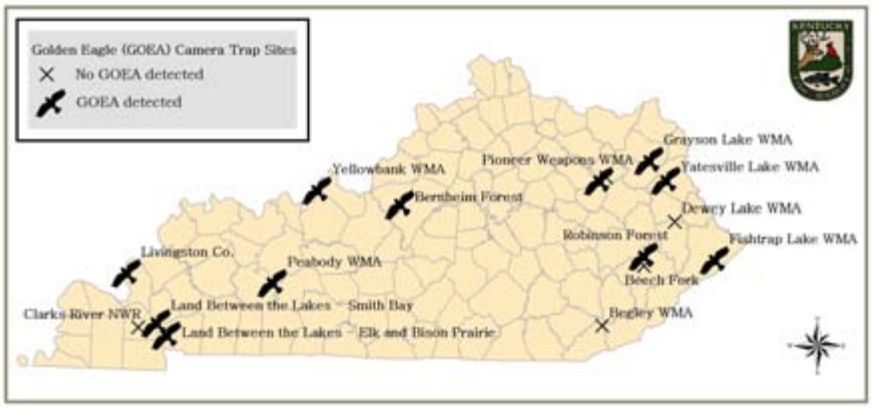
Golden Eagle Camera Trapping Survey - 2014 Update

Kate Heyden, Kentucky Department of Fish and Wildlife Resources

Although the golden eagle is one of the most widely distributed birds of prey in the world, they are rare to Kentucky and the eastern United States. Golden eagles do not nest in Kentucky, but they arrive in the winter, when the nesting population in Canada migrates south.

KDFWR and partners are now using camera trapping techniques to better understand the abundance and distribution of golden eagles in Kentucky. Camera trapping involves setting up motion-activated cameras in areas that may appeal to golden eagles and then using road-killed deer to bait the birds into view. This project is a coordinated effort with the Eastern Golden Eagle Working Group.

Since 2011, 16 sites have been surveyed for golden eagles statewide. Sites were run by KDFWR, Bernhiem Forest, US Forest Service, and the US Fish and Wildlife Service. Surveys revealed golden eagle visitation at several sites (see map at bottom right).



Golden eagle camera trap sites during 2011-2014. Not all sites were run every season.

This effort was carefully planned to avoid detrimental effects and hobbyists should not try to duplicate this research by feeding eagles. Feeding eagles can disrupt their natural behavior and put them at risk of poisoning, vehicle collisions and other harm.

Funding Sources: *State Wildlife Grant Program (SWG)*

KDFWR Strategic Plan. Goal 1.

Statewide Osprey Nesting Survey - 2014 Update

Kate Heyden, Kentucky Department of Fish and Wildlife Resources

Nestling Ospreys at Land Between the Lakes in June 2014 / Kate Heyden

In Kentucky, Osprey historically nested along the floodplains of the lower Ohio and Mississippi Rivers. However, Ospreys, like many other fish-eating birds and raptors, declined significantly in numbers during the 1960s and early 1970s, due to their productivity being hindered by the pesticide DDT. As a result of the ban on DDT in 1972 and the release of young birds in the 1980's and 1990's, Kentucky's nesting Osprey population started to reestablish in the mid-1980's. Since the 1990's, regular nesting surveys have been conducted.

A statewide survey was conducted in 2014 to approximate the current size of Kentucky's nesting Osprey population. Known nesting locations statewide were checked, where possible, by ground and boat, during the nesting season (late March-July).

The Land Between the Lakes (LBL) area and the Tennessee River between KY Dam and the Ohio River were surveyed by boat and ground by KDFWR personnel on June 3-5, 2014. The Cumberland River, north of Barkley Dam, was surveyed on June 24. Nests east of LBL were monitored from the ground by KDFWR personnel, volunteers and USFS personnel. Nests were considered occupied if one or more Osprey were observed at the nest during the nesting season. At least 164 locations were checked for nesting activity statewide.

During 2014, 128 occupied Osprey nests were documented in Kentucky. The majority of nests were on manmade structures (76%) such as navigation lights and transmission towers. Western KY supports the bulk of the nesting population, but there are several nests in central and eastern KY near major rivers and larger reservoirs (Figure 1).

The statewide Osprey survey will be conducted at three-year intervals with the next survey in 2017.

Figure 1. *Distribution of occupied Osprey nests for 2014.*

Funding Sources: *State Wildlife Grant Program (SWG)*

KDFWR Strategic Plan. Goal 1.

Population Dynamics of Adult Female White-tailed Deer in Southeast Kentucky

Caleb Haymes and John Cox Ph.D., University of Kentucky; Gabriel Jenkins, Will Bowling, and Kyle Sams, Kentucky Department of Fish and Wildlife Resources

Rearchers work-up of captured deer / Caleb Haymes

Captured deer / Caleb Haymes

The white-tailed deer (*Odocoileus virginianus*) is a highly regarded game species throughout North America. Early in the 20th century, the deer population in the state of Kentucky was believed to number at 2,600 individuals. After almost 90 years, 50 of which contained active restoration efforts, the deer herd now exceeds 750,000 individuals statewide. Although most of the state contains healthy numbers of deer, many counties in southeastern Kentucky are thought to have stable, low density populations.

Our research focuses on adult does in Clay County, KY, in an effort to identify survival, cause-specific mortality, fecundity, and natality of this important reproductive demographic group in an area of relatively low deer density. Does were captured and immobilized using clover traps, drop-nets, and free-range darting, then fitted with a very high frequency (VHF) radio-transmitter collar. Pregnancy and number of fetuses were determined using an ultrasound, and vaginal implant transmitters (VIT) were inserted in pregnant does to facilitate location of birth-sites and fawns for a companion research project. Adult does were monitored twice weekly to estimate mortality for 18-24 months. We have thus far captured 52 adult female deer. These data should inform state wildlife managers about regional deer population dynamics that can be helpful for refinement of population models and overall management of this important game species.

Funding Source: *Wildlife Restoration Program (Pittman Robertson) and University of Kentucky*

KDFWR Strategic Plan. Goal 1.

Two male fawns captured during the 2014 fawning season in Clay county. / Will Bowling

Cause-Specific Mortality and Survival of White-tailed Deer (*Odocoileus virginianus*) Neonates in a Southeastern Kentucky Population

Joe McDermott, Caleb Haymes, Dr. John Cox, University of Kentucky; Gabriel Jenkins, Will Bowling, John Hast, Kentucky Department of Fish and Wildlife Resources; Tina Brunjes, Georgia Department of Natural Resources

Following an extensive trapping and relocation project that ended in 1999, it was observed that the white-tailed deer (*Odocoileus virginianus*) population in southeastern Kentucky was in decline, while populations in the rest of the state were stable or increasing. Because the factors influencing population declines in southeastern Kentucky are scientifically unknown, the goal of this research project is to estimate fall recruitment rates of white-tailed deer through a survival and cause-specific mortality study of neonates. Understanding summer mortality and survival rates of fawns is critical when preparing population models; when combined, the two rates will allow researchers to estimate the number of individuals added to the huntable population each year.

For this study, fawns were located and subsequently captured using vaginal implant transmitters (VITs) inserted into females that were captured during a complimentary adult mortality survey. Fawns were also located at night with the use of thermal imaging cameras. Once captured, fawns were fitted with an expandable neonate collar that allowed us to monitor the animals for a period of approximately 9 months. During the 2014 season, 35 fawn collars were deployed: 20 from VITs and 15 from a combination of ground and thermal searches. Data collection will continue into the 2015 fawning season. Data generated from this study will allow us to better understand the factors that are influencing fawn survival throughout southeastern Kentucky. Upon completion, the results of this project will guide future management decisions made by biologists regarding deer management in southeastern Kentucky populations.

Funding Source: *Wildlife Restoration Program (Pittman Robertson) and University of Kentucky*

KDFWR Strategic Plan. Goal 1.

Cause-Specific Mortality, Behavior, and Group Dynamics of Cow Elk in Kentucky

Brittany L. Slabach, John T. Hast, P.H. Crowley, John J. Cox. University of Kentucky Depts. of Forestry and Biology; Dr. Tina Brunjes, R. Daniel Crank, Will Bowling, and Gabriel Jenkins, Kentucky Department of Fish and Wildlife Resources

Group dynamics - associations and relationships between individuals – are a key, yet often uninvestigated, parameter important to understanding population structure and persistence. Dynamics are influenced by individual behaviors, genetic, and socio-ecological factors such as conspecific presence and human disturbance. Factors, such as selective take, have been shown to have differential effects on recruitment and fecundity, as well as group cohesion (connectedness) and membership. Yet short and long-term effects of these factors on group dynamics are not understood. Using standard very high frequency (VHF) mortality collars and behavioral observations we have been exploring the relationship between group dynamics and human disturbance in cow elk herds.

A total of 94 cow elk have been outfitted with VHF collars and ear tags for individual identification (2013, N = 40; 2014, N = 54) since 2013. No additional animals were captured during the 2015 field season. Physiological parameters such as age, body condition, and morphological measurements have been taken upon capture. Mortality is monitored weekly and behavioral observations occur during three biological time periods (winter herd, nursery herds, and rut harems). A total of 69 marked individuals were on the landscape at the start of the 2014 hunting season. A mortality rate of 32% was observed (N= 20; 7 archery; 13 modern gun; 2 wounding loss).

Minimal mixing between herds occupying adjacent habitats and a linear dominance hierarchy persists over seasons (Fig.1). The density (connectedness) of groups differs between sites, presumably due to the difference in human activity (site 1 = 0.97; site 2 = 0.19). The herd at site 1 experiences the highest frequency of human activity in the form of recreational vehicles and foot traffic. Preliminary analyses suggest a relationship between association patterns and probability of mortality; dominance status is negatively correlated with age ($\beta = -0.29$, $p < 0.04$) and probability of mortality ($\beta = -0.28$, $p < 0.03$). This suggests that age effects position in the dominance hierarchy and dominance status effects probability of mortality due to human harvest. The effect of selective take of key individuals (Fig. 1 – blue circles) on herd association patterns and persistence over time is currently being analyzed. Field data collection will be completed in January of 2016 after the conclusion of the 2015-2016 hunting season. Continued investigation into how these populations are structured and influenced by human factors will help in understanding gene flow, demographic factors, and transmission routes of pathogens, further aiding management decisions.

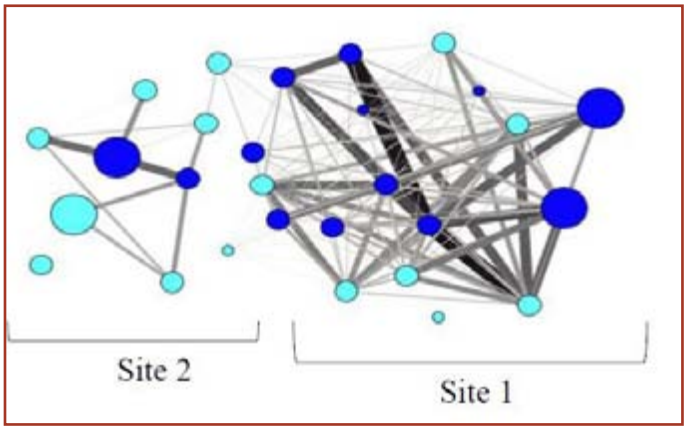


Fig. 1: Whole network associations for two sites during 2013. Each circle represents one individual; size represents age class, older individuals (10+) being the largest, calves the smallest. Lines depict an association between individuals; line thickness represents a stronger association. Dark blue denotes individuals that were harvested during the 2013 hunting season.

Elk calf sniffs for mom at Paul van Booven WMA / B. Slabach

Funding Source: *Rocky Mountain Elk Foundation*

KDFWR Strategic Plan. Goal 1.

Preliminary Assessment of a Newly Established Blue Catfish Population in Taylorsville Lake

David Baker, Jason Herrala, Ryan Kausing, and Nick Keeton, Kentucky Department of Fish and Wildlife Resources

In 2002, a blue catfish stocking program began in Taylorsville Lake to identify the potential of developing a quality fishery that could produce trophy size (≥35.0 inches) fish. The initial stockings were very successful and the blue catfish fishery flourished. This fishery quickly became popular amongst anglers, and the pressure on this fishery has increased exponentially over the past 13 years. An exploitation study conducted in 2008 revealed that 81.0% of blue catfish caught were harvested from Taylorsville Lake. In March 2011, a new regulation was implemented allowing anglers to only harvest 15 catfish (blue and channel catfish combined) a day and only one of those could be ≥25.0 inches.

During August 2014, Taylorsville Lake received its annual stocking of 23,500 blue catfish that averaged 7.0-14.0 inches. These late summer stockings were designed to not only allow for larger fish to be stocked based on increase survivability but allow for naturally spawned age-1 fish to be detected during the July sample. Unfortunately, natural reproduction has not been detected to date.

Low-pulse electrofishing was completed on both the upper and lower sections of the lake during July. Three hundred seventy-eight fish were collected in the lower section compared to 165 fish collected in the upper section of the lake resulting in a catch rate of 216.0 fish/hr and 110.0 fish/hr, respectively. Overall, fish were collected at 167.1 fish/hr which is the highest catch rate recorded since 2007. Fish were distributed from the 9.0-36.0 inch size class; catch rates of the 12.0-19.9 inch size group (119.4 fish/hr) were higher than the historical average (84.1 fish/hr) while the 20.0-24 inch size group (7.1 fish/hr) remained lower than the historical average (11.2 fish/hr) for the fourth consecutive year. Fish in the 25.0-29.9 inch size group have remained stable since 2012 while fish ≥30.0 have been on a steady increase since 2010, with 2014 recording the highest catch rate (5.2 fish/hr) of fish in the ≥30.0 inch size class.

Gill netting, using 5 inch bar mesh was conducted in January and February 2015, with a total of 175 fish collected in 16 net-nights. Catch rates were the highest in the upper lake with fish collected at 22.2 fish/nn and 4.2 fish/nn in the lower lake. Blue catfish were collected from the 16.0-46.0 inch size class with 76.0% of the sample comprised of fish in the ≥30.0 inch size class. Twenty-three percent of the blue catfish sampled were trophy size (≥35.0 inches). Relative weight (Wr) values indicated that blue catfish during the winter months are in excellent condition as the overall Wr was 121.

Funding Source: *Sport Fish Restoration Program (Dingell-Johnson)*

KDFWR Strategic Plan. Goal 1.

Taylorsville Lake Catfish Stocking / Nick Keeton

Evaluation of a 36-inch Minimum Length Limit on Muskellunge at Three Kentucky Reservoirs

Dave Dreves and Bobby Widener, Kentucky Department of Fish and Wildlife Resources

Biologist holding shocked muskellunge / Paul Wilkes

The muskellunge (*Esox masquinongy*) is an ecologically and economically important sport fish in many temperate fresh water ecosystems of North America. The species is native to many of the river drainages of Kentucky, including the Green, Kentucky and Licking River drainages and historically provided very popular fisheries. During the 1960's and 1970's, the U. S. Army Corps of Engineers constructed dams impounding these rivers, creating Buckhorn Lake (1,230 acres) on the Middle Fork of the Kentucky River, Green River Lake (8,210) and Cave Run Lake (8,270) on the Licking River. The KDFWR maintains a muskellunge fishery in these reservoirs through annual stockings of 0.33 fish/acre. Each of these reservoirs now supports excellent sport fisheries for muskellunge with exceptional growth potential. A demand for increased quality of muskellunge fisheries by anglers precipitated recent fisheries management strategies directed towards establishing trophy fisheries through the use of regulations such as minimum size and bag limits. These regulations are designed to equitably distribute the catch and protect certain size classes of fish in order to develop the trophy fishery.

In an effort to enhance the quality of the muskellunge fishery, the KDFWR increased the minimum length limit for muskellunge in Cave Run and Green River lakes from 30 to 36 inches in spring 2010. The minimum size limit was also set at 36 inches at Buckhorn Lake, which had been changed to a 40-inch size limit in 2003. The daily bag limit at all lakes was maintained at one fish per day. The expected result of this regulation change is to increase the abundance of muskellunge below 36 inches and to increase the average length of all muskellunge in the populations at Cave Run and Green River lakes. However, due to the paucity of information pertaining to stocking efforts and the aforementioned regulation changes, it is unknown whether these effects will be realized with this management strategy, as well as how these population changes may affect the entire fish community. A thorough evaluation of this management strategy will add to the existing knowledge base in the field and allow the KDFWR to most effectively manage the muskellunge fishery and fish community in these reservoirs.

Each year, stocked muskellunge receive a batch mark (fin clip or wire tag) prior to stocking in the fall. Population sampling is being conducted with boat-mounted pulsed DC electrofishing gear from mid-February through the end of March at all three reservoirs. Electrofishing catch per unit effort data (CPUE) is being used to index age-1 year-class strength, the relative frequency of various length groups of interest and mortality calculations. The muskie populations are being monitored for changes in growth and condition. In the future, muskellunge will also be tagged to estimate angler exploitation. Statistical comparisons of CPUE of size groups for pre-regulation and post-regulation change will be made.

Creel surveys and angler attitude surveys were conducted at each study lake in 2014. There was a desire to have additional ways to uniquely mark muskie after exhausting the clipping of the paired fins. So a pilot study was conducted in 2014 to evaluate tag retention and survival of muskie using different wire tagging locations for the batch mark. It was determined that the cheek, dorsal, and caudal areas were the body locations with the best combination of retention (≥92%) and survival (≥89%).

Funding Source: *Sport Fish Restoration Program (Dingell-Johnson)*

KDFWR Strategic Plan. Goal 1.

Evaluation of a Seasonal Rainbow Trout Fishery in Cedar Creek Lake

Dave Dreves and Bobby Widener, Kentucky Department of Fish and Wildlife Resources

Rainbow trout (*Oncorhyncus mykiss*) are stocked in many small impoundments throughout Kentucky by KDFWR. This is in an effort to create an alternative fishery to traditional warmwater species and to provide a fishing opportunity during the cooler months of the year when other species do not bite as well. In a 2002 trout angler survey of various waters stocked with trout, the category "lakes and reservoirs" was second in terms of the amount of effort expended fishing for trout. Most of these impoundments are small urban lakes that are part of KDFWR's Fishing in Neighborhoods (FINS) program. However the KDFWR does stock rainbow trout in a few larger reservoirs that are believed to have sufficient water quality to support trout year round. Cedar Creek Lake will be the largest reservoir (784 acres) that KDFWR has stocked with rainbow trout exclusively for a seasonal fishery. Cedar Creek Lake, impounded in 2002, is a KDFWR-owned lake in Lincoln County. From conception, the lake was designed and intended to be primarily a sport fishing lake. There is no swimming, no water skiing or jet skis allowed. The lake has a 300 ft buffer zone around the shoreline which is also owned and managed by KDFWR. Since Cedar Creek Lake is promoted and managed by KDFWR as a "fishing lake" then it is reasonable to desire year round fishing opportunities for anglers. The lake already has tremendous fishing pressure during warmer months of the year. In a 2009 creel survey conducted at the lake, there were an estimated 49.2 trips per acre and about 245.8 man/hours per acre of fishing pressure. This represents more pressure than at any other lake of a similar size or larger. So, it is expected that the stocking of rainbow trout will provide another fishing opportunity that will extend the quality fishing at the lake throughout the winter months. It is hoped that this new fishing opportunity will spur increased fishing license and trout permit sales.

The primary objective of this study is to evaluate the angler utilization of rainbow trout and angler satisfaction with this new seasonal fishery in Cedar Creek Lake. Previous temperature and dissolved oxygen profiles at Cedar Creek Lake have shown that suitable water quality conditions exist to support trout from about the beginning of October to about early May. A total of 21,000 harvestable-size (9 in) rainbow trout have been stocked during the cooler seasons at Cedar Creek Lake, with 12,000 fish being stocked in October and 9,000 fish in February. Each stocking was allocated evenly among three stocking sites: 1) the lower ramp, 2) the middle ramp and 3) the bank fishing area near the Hwy 1770 bridge. An exploitation study and a creel survey were conducted in the first year of the project (2012-13) to evaluate rainbow trout angling pressure and harvest. The exploitation study involved tagging 600 fish in each of the two stockings and then tracking angler return of tags. Anglers targeting rainbow trout was low and exploitation study showed only about 13.5% of the 21,000 stocked rainbow trout were caught and about 9% were harvested.

Tagging study signage / Adrienne Yancy

The exploitation study and creel surveys are currently being repeated again in 2014-15 season to determine if angler use of rainbow trout has increased. Preliminary results are showing increased trout fishing pressure and increased trout harvest. The results of this study will be used to make the determination of a continuation of the rainbow trout stocking program or to cease stockings and whether this type of fishery could be successful in other warmwater reservoirs in the state.

Funding Source: *Sport Fish Restoration Program (Dingell-Johnson)*

KDFWR Strategic Plan. Goal 1, Strategic Objective 5.

Investigation of the Restoration of Native Walleye in the Upper Barren River

Native Walleye in the Upper Barren / Dave Dreves

Dave Dreves and Bobby Widener, Kentucky Department of Fish and Wildlife Resources

Walleye is a freshwater fish native to most of the major watersheds in Kentucky, including the Barren River watershed located in southwestern Kentucky. By the late-1800's, growing concern for declining fisheries prompted the stocking of Kentucky rivers and lakes by the U.S. Fish Commission and the Kentucky Game and Fish Commission. In 1912, and from 1914-1917, these two agencies stocked walleye fry in various rivers and streams throughout Kentucky, including the Barren River. Unfortunately, it was not yet known that the Lake Erie strain walleye used in the stocking efforts are adapted to lentic (lake) environments, unlike the native Kentucky walleye which are adapted to lotic (river) environments. As a result, it is believed that the majority of these stocked northern walleye could not survive in the river environment or were ultimately confined to lake systems (e.g. Lake Cumberland). Another walleye stocking attempt (4.15 million walleye fry) in the Barren River occurred in 1966, in response to low population numbers, shortly after the river was impounded in 1964. Since there are no known recent reports of walleye from the Barren River or Barren River Lake, it is suspected that the "northern" strain fry stockings in 1917 and 1966 were not successful and the native population in the river has been lost.

Although portions of the Barren River are impounded, there is approximately 31 miles of unimpounded mainstem of the Barren River above Barren River Lake. The broad goal of this project is to re-establish a reproducing native "southern" strain walleye population to this section of the Barren River. An established population of native walleye in the Barren River will serve as a source of broodstock for potential native walleye restorations in other Kentucky river systems and will create a walleye sport fishery in the upper Barren River. In order to accomplish these restoration goals, beginning in 2007, native strain walleye were collected from Wood Creek Lake and the Rockcastle River in the spring and transported to Minor Clark Hatchery to be used as broodfish. Walleye were spawned and the resulting fry were reared to fingerling size (1.5 in.) in ponds, and then stocked in the Barren River in late May or early June. The stocking rate was a minimum of 50 fingerlings/acre or about 600 fingerlings/mile. In conjunction with stocking, we assessed 24-hour stocking mortality using mesh-lined barrels secured in the river. To monitor and assess stocking success, we used boat-mounted pulsed DC electrofishing gear to sample walleye in the spring at multiple sites, recording weight and length measurements and sex of the fish. We have been successfully sampling walleye in the Barren River for several years now and fish have been observed in excess of eight pounds. In 2008, we began marking stocked fingerlings with oxytetracycline (OTC) to determine recruitment of stocked fish. Beginning in 2013, small walleye were sacrificed and otoliths removed for examination for OTC marks. So far, all sacrificed fish were marked indicating they were stocked fish. We also have implanted PIT tags in captured walleye to determine movement and growth rates. Good electrofishing catch rates of adult walleye in 2014 led to the recommendation to cease stocking and begin the natural recruitment monitoring phase. Walleye sampling for the natural recruitment monitoring is slated to continue through 2019.

Funding Source: *Sport Fish Restoration Program (Dingell-Johnson)*

KDFWR Strategic Plan. Goal 1, Strategic Objective 5.

River Sport Fishery Survey – Ohio River Catfish

Jason Herrala, David Baker, Nick Keeton, and Ryan Kausing, Kentucky Department of Fish and Wildlife Resources

Commercial fishing for catfish in the Ohio River has recently switched from harvest for flesh to harvesting trophy-sized fish for pay lakes. A high quality, recreational catch-and-release trophy catfish fishery also exists in the Ohio River. This has led to conflict between the two user groups. In response to these issues, the Kentucky Department of Fish and Wildlife began investigating basic catfish population parameters to address these issues, and enacted new regulations to protect the trophy fishery from overharvest. In June 2014, the new regulations were made law; however, an injunction on the regulation was filed by commercial fishermen shortly after its enactment and regulations on commercial fishermen were not enforceable until December 1, 2014. The regulation is as follows:

Recreational fishermen on the main-stem Ohio River will be allowed 1 blue catfish ≥35.0 in, 1flathead catfish ≥35.0 in, and one channel catfish ≥28.0 in. The majority of commercial fishermen fishing in the Ohio River and its tributaries where commercial fishing is allowed will be allowed 1 blue catfish ≥35.0 in, 1 flathead catfish ≥35.0 in, and one channel catfish ≥28.0 in per day. However, 50 commercial fishermen will be allowed to harvest 4 (in aggregate) blue and flathead catfish ≥40.0 in and channel catfish ≥30.0 inches in Kentucky's portion of the Ohio River and its tributaries open to commercial fishing below Cannelton Lock and Dam. Harvest of fish below their respective length limits will not be regulated for recreational or commercial anglers.

In order to continue to monitor catfish populations in the Ohio River population data will be gained through trotline and electrofishing samples, ride-alongs with commercial fishermen, and monitoring of recreational catfish tournaments. In 2014, trotlines were used to sample catfish in Meldahl, Cannelton, JT Meyers, Smithland, and lower river pools. CPUE of blue catfish (1.3 fish/line) and channel catfish (1.0 fish/line) were below historical average (3.2 and 1.4 fish/line, respectively), while CPUE of flathead catfish (0.2 fish/line) was above historical average (0.1 fish/line). Trophy catfish (blue and flathead catfish ≥35.0 in and channel catfish ≥28.0 in) accounted for 4.5% of the total catfish catch (up from 1.2% in 2013), and no trophy channel catfish were collected.

Ride-alongs with commercial fishermen were conducted in the Markland and JT Meyers pools to gather data from hoop net catch. Blue catfish mean CPUE was 0.8 fish/net-night and was at or above historical average hoop net catch (0.4 fish/net-night) in all pools. No trophy blue catfish were observed in the Markland Pool and 6.4% of blue catfish in the JT Meyers Pool were trophy-sized. Flathead catfish CPUE decreased from 2.6 fish/net-night to 0.8 fish/net-night and was below the historical average (1.5 fish/net-night). Trophy flathead catfish accounted for 4.2% of flathead catfish in the Markland Pool and 3.1% of flathead catfish in the JT Meyers Pool. Overall trophy catfish accounted for 4.3% of the total catch.

Electrofishing was conducted in June 2014 in all pools of the Ohio River bordering Kentucky. A total of 463 blue catfish, 210 channel catfish, and 788 flathead catfish were collected throughout the Ohio River. CPUE of

Ohio River Catfish Surveys / Derek Roger

blue catfish was 19.3 fish/hr (up from 11.4 fish/hr in 2013. CPUE of channel catfish was 8.8 fish/hr (down from 27.2 fish/hr in 2013) and was below historical average catch rates (9.7 fish/hr). Flathead catfish CPUE was 32.8 fish/hr (down slightly from 34.9 fish/hr in 2013) and was above historical average (23.0 fish/hr). Less than 1.0% of all catfish sampled were trophy size.

A total of 14 recreational catfish tournaments were attended with more than 700 boats weighing in catfish. In all 1,007 blue catfish, 518 channel catfish, and 241 flathead catfish were weighed in with a 3-species total CPUE of 2.5 fish/boat. Blue had a mean CPUE of 1.4 fish/boat, and channel catfish lengths had a mean CPUE of 0.7 fish/boat. Flathead catfish were not as commonly caught (CPUE=0.3 fish/boat). Roughly 10% of all catfish weighed in were considered trophy catfish in Kentucky.

Funding Source: *Sport Fish Restoration Program (Dingell-Johnson)*

KDFWR Strategic Plan. Goal 1.

Lake Sturgeon Restoration in the Upper Cumberland River Drainage in Kentucky

Matthew Thomas, Steven Marple, and Stephanie Brandt, Kentucky Department of Fish and Wildlife Resources

The Lake Sturgeon (*Acipenser fulvescens*) is considered critically imperiled in Kentucky, where it is currently limited to the Ohio and Mississippi rivers. In 2007, the Kentucky Dept. of Fish and Wildlife Resources (KDFWR) initiated a long-term (20+ years) project to restore a self-sustaining population of Lake Sturgeon to the upper Cumberland River drainage, where the species occurred historically. The project area extends from Wolf Creek Dam, upstream to Cumberland Falls, including major tributaries such as Rockcastle River and Big South Fork Cumberland River.

Since 2007, fertilized eggs have been obtained annually from the Wisconsin Dept. of Natural Resources taken from upper Mississippi basin stock (Wisconsin River and Yellow River). These eggs are hatched at the KDFWR Pfeiffer Fish Hatchery in Frankfort and the young are reared to an approximate average of 7.5-10.2 inches total length. Since spring 2008, young Lake Sturgeon have been released annually at two locations in the upper Cumberland River drainage. The Cumberland River at the mouth of Laurel River received 959 fish (average 7.4-8.5 inches) in 2008, 2,004 fish (average 7.5 inches) in 2009, 4,539 fish (average 5.5-7.8 inches) in 2010, and 2,150 fish (average 8.2-8.9 inches) in 2011, and 2,964 fish (average5.7-10.1 inches) in 2014. The

Clockwise Right to left: Lake Sturgeon; Stephanie Brandt and Jason McDowell working up fish; Laurel River; Matt Thomas taking fin clips

Big South Fork Cumberland River at the Alum Creek access area received 716 fish (average 7.4 inches) in 2008, 1,973 fish (average 7.5 inches) in 2009, 4,063 fish (average 5.5-7.8 inches) in 2010, and 2,766 fish (averaging 4.9– 8.7 inches) in 2014. To date, a total of 22,134 fish have been stocked into the Cumberland River above Lake Cumberland. Prior to release, young Lake Sturgeon are differentially marked by sequentially removing two adjacent scutes in the lateral series to distinguish year classes: right anterior scutes 2-3 for 2007, left anterior scutes 2-3 for 2008, right anterior scutes 3-4 for 2009, left anterior scutes 3-4 for 2010, right anterior scutes 5-6 for 2011, left anterior scutes 7–8 for 2014. Stocking did not occur in 2012 or 2013. Local print media (Times Tribune, Corbin, KY) and Corbin High School students have been present at the Lake Sturgeon release events each year. Kentucky Afield television, magazine, and radio have also featured the reintroduction effort for this rare species in the Cumberland River.

Thirty reports of Lake Sturgeon captured by anglers were received in 2009-2014. Most fish were captured from various locations in the impounded portion of the river (Lake Cumberland) and below Wolfe Creek Dam. The individuals below the dam either passed through the dam from the reservoir or migrated upstream from Tennessee. The size range of fish captured was 13-15 inches weighing 1 lb or less (10 reports) and 20-30 inches weighing 2-5 lbs (12 reports). A variety of sampling techniques are being evaluated to determine survival, habitat use, and movement patterns of stocked fish.

Funding Source: *State Wildlife Grant Program (SWG)*

KDFWR Strategic Plan.
Goal 1. Strategic Objective 5. Comprehensive Wildlife Conservation Strategy: Appendix 3.9; Class Actinopterygii and Cephalaspidomorphi: Taxa specific project.

Ohio River Supplemental Stocking Survey - Markland Pool

Jason Herrala, David Baker, Nick Keeton, and Ryan Kausing, Kentucky Department of Fish and Wildlife Resources

Largemouth bass year-class production in the Ohio River is believed to be negatively impacted by the lack of high quality spawning habitat. In turn, poor year-class production results in a less than optimal largemouth bass fishery in the river. Supplemental stocking has been shown to benefit largemouth bass population levels in some large riverine systems. The Kentucky Department of Fish and Wildlife Resources began stocking largemouth bass fingerlings into embayments of the Markland Pool on both sides of the river (Kentucky and Indiana) in June of 2007 and continued stocking through June of 2014.

For the duration of the initial stocking project the goal stocking rate was 100 fish/acre in each of the selected embayments. Fingerlings were marked with oxytetracycline (OTC) in order to estimate the contribution of stocked fish from age-0 to adulthood, compare growth between stocked and wild fish, and determine the contribution of stocked fish to year-class strength. Preliminary results have shown that stocked fish compose 37% to 79% of the age-0 fish and that this contribution to year-class strength appears to be adding to the fishery. A total of 143,885 fingerlings (mean length=2.1 in) were stocked into 13 embayments in 2014.

Spring nocturnal electrofishing was used to sample black bass in six embayments. A total of 125 largemouth bass were collected during 5.8 hrs of nocturnal electrofishing of the Markland Pool in spring 2014. Catch-per-unit-effort (CPUE, fish/hr) of largemouth bass ranged from 8.0 fish/hr in Woolper Creek to 31.0 fish/hr in Paint Lick Creek (mean CPUE=21.6 fish/hr). Mean largemouth bass CPUE was much lower than in 2012 (CPUE=88.2 fish/hr) and 2013 (CPUE=59.5 fish/hr).

A total of 431 largemouth bass were collected during 5.8 hrs of nocturnal electrofishing in 6 embayments of the Markland Pool in October 2014. CPUE of largemouth bass ranged from 46.0 fish/hr in Woolper Creek to 127.0 fish/hr in Big Bone Creek (mean CPUE=74.3 fish/hr). Mean CPUE of largemouth bass was 74.3 fish/hr and was the second highest historical fall catch rate of the study.

Otoliths were removed from a subsample of young-of-the-year largemouth bass this fall. Age-0 largemouth bass lengths ranged from 4.2 – 10.3 in in the six study embayments this fall. Catch rates for stocked largemouth bass fingerlings in fall 2014 ranged between 1.1 fish/hr in Paint Lick Creek to 34.2 fish/hr in Craigs Creek. Mean CPUE of stocked age-0 largemouth bass increased dramatically from 2013 (CPUE=0.9 fish/hr) to 2014 (CPUE=18.2 fish/hr). Forty-six percent of all age-0 fish examined were stocked fish, and all stocked embayments had more stocked age-0 fish than natural age-0 fish, while all control embayments had more natural age-0 fish than stocked age-0 fish.

Ohio River Bass Stocking – Markland Pool / Doug Henley

Funding Source: *Sport Fish Restoration Program (Dingell-Johnson)*

KDFWR Strategic Plan. Goal 1.

Ohio River Bass Stocking – Meldahl Pool / Doug Henley

Ohio River Supplemental Stocking Survey - Meldahl Pool

Jason Herrala, David Baker, Nick Keeton and Ryan Kausing, Kentucky Department of Fish and Wildlife Resources

Meetings with Ohio River black bass fishermen in 1997 informed the Department that problems existed with black bass population structure in the Meldahl Pool. Efforts were initiated to sample various embayments and main river sites in this pool and determine the factors influencing these populations. The department has sampled Meldahl Pool since 1997; however, it began sampling using Ohio River Fish Management Team sampling protocol during the fall of 2001. This preliminary sampling confirmed anglers concerns and indicated that a relatively poor largemouth bass population existed in Meldahl Pool compared to other Ohio River pools. Electrofishing surveys indicated that young-of-the-year production was low, potentially due to limited spawning habitat.

The Department conducted a spawning habitat manipulation study from 2003 through 2010 to determine if largemouth bass spawning could be enhanced through the introduction of supplemental spawning structures and cover. While black bass were observed utilizing both structures, the effort needed to significantly influence black bass reproduction on a pool wide basis through these means appeared immense. Based on the bass stocking study conducted in Markland Pool, stocking may be a more viable option to increase year-class strength and enhance the largemouth bass fishery. A total of 33,485 largemouth fingerlings were stocked in June 2014. Five embayments (Big Snag, Big Locust, Bracken, Lawrence, and Lee's Creek) were stocked at a rate of 100 fish/acre and Big Turtle Creek was stocked at a rate of 200 fish/acre.

Six transects were nocturnally electrofished in each embayment in spring 2014 for a total of 36 transects (6.0 hr total sample time). A total of 48 largemouth bass were collected in the sample. CPUE of largemouth bass (CPUE=8.0 fish/hr) was down drastically from 2013 (CPUE=31.9 fish/hr), and ranged from 4.0 fish/hr in Lawrence Creek to 16.0 fish/hr in Big Snag Creek.

Six transects were nocturnally electrofished in each embayment in fall 2014, except for Lee's Creek (only 3 transects could be completed) for a total of 33 transects (5.5 hr sample time). A total of 334 largemouth bass were collected. CPUE ranged from 32.0 fish/hr in Big Snag Creek to 97.0 fish/hr in Lawrence Creek, while the overall mean CPUE was 60.7 fish/hr.

Otoliths were taken from a subsample of young-of-the-year largemouth bass. Catch rates for stocked largemouth bass fingerlings in fall 2014 ranged between 1.0 fish/hr in Big Locust Creek to 32.3 fish/hr in Lawrence Creek. Mean CPUE of stocked age-0 largemouth bass increased from 2013 (CPUE=4.5 fish/hr) to 2014 (CPUE=15.5 fish/hr). Forty-five percent of all age-0 fish examined were stocked fish.

Funding Source: *Sport Fish Restoration Program (Dingell-Johnson)*

KDFWR Strategic Plan. Goal 1.

Evaluation of Sauger Stockings in the Kentucky, Green, Barren, and Salt Rivers

David Baker, Jason Herrala, Ryan Kausing, and Nick Keeton, Kentucky Department of Fish and Wildlife Resources

In Kentucky, sauger (*Sander canadensis*), are found in the Ohio and Mississippi Rivers and their major tributaries. Sauger are a native top-level predator that inhabit main channel areas of large turbid rivers. During the spring, sauger tend to congregate below dams and near the mouth of creeks to spawn, creating an important seasonal fishery in many of Kentucky's rivers.

Sauger populations fluctuate naturally due to biotic and abiotic factors that affect spawning success and recruitment, causing year-class strength to be highly variable. Long-term declines in sauger populations are largely associated with the loss of suitable spawning habitat due to channel alterations and barriers that impact seasonal migrations. Research shows that supplemental stocking can enhance these populations.

In an effort to enhance the sauger fishery in the Kentucky River, the Kentucky Department of Fish and Wildlife Resources implemented a sauger stocking program from 2006-2010 in the Kentucky River. Sauger stocking in the Kentucky River have been successful in establishing a put-grow-take type fishery; however, very little natural reproduction has been detected.

Sauger Stocking / David Baker

Similar stocking are being evaluated in the Green, Barren and Salt rivers. Fingerling sauger averaging 1.7 inches in length, have been stocked in each river system from 2010-2014 at an annual rate of 10 fish/a. Sauger populations in these three river systems have been monitored through fall 2014 to determine if a self-sustaining fishery will develop.

During 2014, spring sauger catch rates were the lowest observed in the Green, Barren and Salt rivers. Green River catch rates decreased from 12.0 fish/hr in 2013 to 3.0 fish/hr during 2014, with sauger ranging from 9-17 in size classes. Meanwhile, 2014 spring catch rates on Barren River was 0.3 fish/hr, down from 5.5 fish/hr collected in 2013. Catch rates on the Salt River continue to decline: 2012 (29.0 fish/hr), 2013 (11.0 fish/hr) and 2014 (1.0 fish/hr). Thus far, little to no natural reproduction has been detected in any of the study areas.

Fall electro-fishing surveys from 2012-2014 indicate the overall condition of sauger in the Green, Barren and Salt Rivers remain poor across all size classes. Fall catch rates in all study areas remain relatively low. Stockings have not had the desirable effect of producing a self-sustaining sauger fishery or providing a quality recreational fishing opportunity.

Funding Source: *Sport Fish Restoration Program (Dingell-Johnson)*

KDFWR Strategic Plan. Goal 1.

Warm Water Stream Sport Fish Surveys

Warmwater Stream Surveys / David Baker

David Baker, Jason Herrala, Nick Keeton, Ryan Kausing, Kentucky Department of Fish and Wildlife Resources

There are countless miles of rivers and streams that flow throughout Kentucky making stream fishing accessible to all of Kentucky's anglers. Anglers have taken notice to the resource and realize how valuable and productive stream fishing can be throughout the state. With all this attention the Kentucky Department of Fish and Wildlife Resources (KDFWR) has taken note that more information is needed to better inform the public of these opportunities while making sure that these resources are being managed in a way that not only protects these fisheries but maximizes the fisheries potential.

During 2014, general sport fish surveys were completed in the Green, Barren, and Kentucky rivers, Floyds Fork, Rolling Fork and North Fork Elkhorn Creek. Information was collected from these systems in effort to gain a better understanding of sport fish composition, size structure, relative abundance and condition. These sites were selected based on public input received primarily from Fisheries District Offices. New sites are continually being added with streams scheduled to be sampling on a 3-5 year rotation in effort to develop trend data. The purpose of collecting this data is to help KDFWR make informed management decisions in effort to further promote stream fishing in Kentucky, inventory current access sites and identify new areas that could benefit from future management.

Data collected in 2014, showed trophy size smallmouth bass (≥20.0 in) are present in the Green and Barren rivers. Smallmouth bass populations in the Green River, Barren River, Floyds Fork, and Rolling Fork all received "good" to "excellent" assessment rating in 2014. North Fork Elkhorn Creek recorded the best smallmouth bass catch rates at 38.8 f/h with fish sampled up to 15 inches. The walleye fishery in Green River (62.0 f/h) remains impressive not only for quantity but quality with trophy fish (≥25.0 in) present since 2012. Quality channel catfish populations were present in the Kentucky River, Rolling Fork and upper Green River with fish collected up to 26 inches. Quality size (≥8.0 inches) rock bass were collected in Green and Barren rivers, North Fork Elkhorn Creek, Elkhorn Creek, Floyds Fork and Rolling Fork.

Funding Source: *Sport Fish Restoration Program (Dingell-Johnson)*

KDFWR Strategic Plan. Goal 1. Strategic Objective 4.

Alligator Gar Propagation and Restoration in Western Kentucky

Steve Marple, Matthew Thomas, and Stephanie Brandt, Kentucky Department of Fish and Wildlife Resources

The Alligator Gar (*Atractosteus spatula*) is the largest of the living gars and one of the largest freshwater fishes in North America. These fish are capable of reaching lengths of over 9 feet and weights of over 300 lbs. The largest reported size of an alligator gar is 9 feet, 8 inches. This specimen weighed approximately 302 lbs. Its native range once occurred from the Florida panhandle west into the Gulf Coastal Plain to Veracruz, Mexico and throughout the Mississippi River Basin, including the lowermost Cumberland and Tennessee Rivers. In Kentucky, the Alligator Gar is native to the Ohio, Mississippi, and lower Cumberland and Tennessee River systems.

Little is known about the biology and habitat of this species in Kentucky and throughout the majority of its native range. In its southern range, the Alligator Gar typically inhibits big rivers, swamps, bayous, and brackish waters. The Alligator Gar is the most salt tolerant of all the gar species. In Kentucky, the Alligator Gar occupied sluggish pools, backwaters, and embayments of big rivers and larger reservoirs in western Kentucky. Females tend to grow larger than males and reach sexual maturity at 11 years and live in excess of 50 years. Males reach sexual maturity at 6 years and live up to 26 years.

Alligator Gar records have been confirmed from five locations in Kentucky: 1) Cumberland River, 3 miles below Dycusburg, Crittenden County (1925); 2) Ohio River at Shawnee Steam Plant, McCracken County (1975); 3) mouth of the Ohio River, Ballard/Carlisle County (1966); 4) mouth of Bayou du Chein, Fulton County (1974); and 5) Kentucky Lake at Cypress Creek embayment, Henry County, TN (1976). Alligator Gar have not been reported in Kentucky since 1977, despite numerous surveys. Currently, the Alligator Gar is listed as endangered by the Kentucky State Nature Preserves Commission and is listed as a Species of Greatest Conservation Need by the Kentucky Department of Fish and Wildlife Resources Wildlife Action Plan.

In an effort to restore this species back to the waters of the Commonwealth, the Kentucky Department of Fish and Wildlife Resources (KDFWR) implemented a captive propagation and stocking program in 2009. In partnership with the United States Fish and Wildlife Service (USFWS), the KDFWR has committed to a long-term restoration effort of this species. Annually, the KDFWR will receive Alligator Gar fry from the Wisconsin Department of Natural Resources. These fry will be reared at both the Pfeiffer Fish Hatchery and Minor Clark Fish Hatchery prior to being released into the wild. Stocking sites are areas that have historically contained Alligator Gar and which still provide suitable habitat for optimal survival.

From 2009-2014, a total of 33,462 Alligator Gar were stocked by the KDFWR. Size at stocking ranged from 7.3 to 14.5 inches. Alligator Gar were stocked in the following areas: (1) Clarks River; (2) Phelps Creek; (3) Bayou Creek; (4) Tradewater River; (5) Deer Creek; (6) Obion Creek; (7) Massac Creek; (8) Bayou de Chein; (9) Mayfield Creek; (10)Ballard WMA; (11) Barlow Bottoms WMA; and (12) Doug Travis WMA.

Funding Source: *State Wildlife Grant Program (SWG)*

KDFWR Strategic Plan. Goal 1. Strategic Objective 5. Comprehensive Wildlife Conservation Strategy: Appendix 3.9; Class Actinopterygii and Cephalaspidomorphi: Taxa specific project.

Alligator gar illustration / Rick Hill

Propagation and Reintroduction of the Kentucky Arrow Darter *(Etheostoma sagitta spilotum)* in the Upper Kentucky River Drainage

Matthew Thomas and Stephanie Brandt, Kentucky Department of Fish and Wildlife Resources; Crystal Ruble, Patrick Rakes, Melissa Petty, and J. R. Shute, Conservation Fisheries, Inc.

The Kentucky Arrow Darter, *Etheostoma spilotum*, has a limited distribution in the upper Kentucky River drainage, where it inhabits headwater (mostly 1st and 2nd order) streams. The Kentucky Department of Fish and Wildlife Resources (KDFWR) indentified the Kentucky Arrow Darter as a Species of Greatest Conservation Need in its State Wildlife Action Plan to address research and survey needs for the species. A variety of human activities, including coal mining, logging, agriculture, gas/oil exploration, and land development have contributed to the species' decline. Based on its decline and the magnitude and imminence of its threats, the U.S. Fish and Wildlife Service determined that the Kentucky Arrow Darter warrants listing under the Endangered Species Act. It is currently a Candidate for Federal Listing based on its inclusion in the USFWS Candidate Notice of Review published in the Federal Register (Nov. 10, 2010; Federal Register / Vol. 75, No. 217). In 2008, the KDFWR partnered with Conservation Fisheries, Inc. (CFI) to develop successful spawning protocols and produce the offspring needed to re-establish extirpated populations within the species' historic range.

Left to right, clockwise: CFI and KDFWR staff conducting follow up monitoring surveys in Long Fork, Clay Co., KY. Kentucky Arrow Darters marked with a Visible Implant Elastomer (VIE) tag (red, left dorso-lateral side) / CFI

Long Fork (Red Bird River drainage) in Clay County was chosen as the reintroduction stream because: 1) it is within the historic range of the species; 2) habitat conditions are suitable; and 3) there is some level of protection (i.e., within the Daniel Boone National Forest).

Brood stock including one male and seven females were collected in February 2014 from Big Double Creek, a tributary of the Red Bird River in the Daniel Boone National Forest, Clay County. The new wild-caught females and male were used in this year's effort in addition to three captively conditioned (2012) wild males and six captively conditioned (2012) wild females. March spawning was observed in aquaria at CFI's hatchery facility when temperatures briefly exceeded 13°C. Spawning activity quickly declined in late April and on 5 May the chiller was removed and water temperatures allowed to rise above 19°C.

On 30 July 2014, the young (n=400) were tagged with visible implant elastomer (VIE) tags and released into Long Fork at multiple sites spanning the reach from the mouth to ~1.5 km upstream to the Long Fork Road crossing. A total of 1,447 Kentucky Arrow Darters have been stocked in Long Fork since 2012. Periodic surveys were conducted in 2012-2014 in Long Fork by CFI biologists and KDFWR by performing a combination of visual surveys and seine hauls. A total of 400 Kentucky Arrow Darters were observed in 2012-2014. While these results are encouraging, other non-game fish restoration attempts have shown it takes several years to document success when stocking relatively limited numbers of individuals, particularly small species that are short-lived and cryptic. Captive propagation, reintroduction, and field monitoring will continue in 2015.

Funding Source: *State Wildlife Grant Program (SWG)*

KDFWR Strategic Plan. Goal 1, Strategic Objective 5. Comprehensive Wildlife Conservation Strategy: Appendix 3.9; Class Actinopterygii and Cephalaspidomorphi: Taxa specific project.

Propagation and Reintroduction of the Cumberland Darter *(Etheostoma susanae)* in the Upper Cumberland River Drainage

Matthew Thomas and Stephanie Brandt, Kentucky Department of Fish and Wildlife Resources; Crystal Ruble, Patrick Rakes, Melissa Petty, and J. R. Shute, Conservation Fisheries, Inc.

Left to right, clockwise: Cogur Fork, McCreary Co., KY.; CFI and KDFWR and staff hiking in brood stock; CFI and KDFWR staff conducting follow up monitoring surveys; CFI staff conducting visual surveys.

The Cumberland Darter (*Etheostoma susanae*) has a limited range in the upper Cumberland River drainage, most of which is in Kentucky. The U.S. Fish and Wildlife Service published a final rule (Sept. 8, 2011; Federal Register / Vol. 76, No. 153) listing the species as endangered throughout its range because of recent range curtailment and fragmentation resulting from habitat degradation. In 2008, KDFWR partnered with Conservation Fisheries, Inc. (CFI) to develop successful spawning protocols for the Cumberland Darter and produce the offspring needed to re-establish extirpated populations within its historic range. Because of the apparent rarity of this species, captive propagation and reintroduction is considered an appropriate tool for its recovery and eventual delisting. Artificially propagated individuals are being released within the watershed from which brood stock are taken, to avoid mixing potentially unique evolutionary lineages. Cogur Fork (Indian Creek-upper Cumberland River drainage) in McCreary County was chosen as the reintroduction stream because: 1) it is within the historic range of the species; 2) habitat conditions are suitable; and 3) there is some level of protection (i.e., within the Daniel Boone National Forest).

Twenty nine individuals were collected for brood stock in December 2013 from Barren Fork, McCreary County Following observations of darkly pigmented males (heads and fins) defending cavities under slabs, weekly checks for eggs were initiated on 26 March 2014, at which time the first nest was collected. By 14 April, all eggs from the first clutch had hatched and the water temperature was ~17°C. Approximately 671 larvae were reared successfully to juveniles yielding ~80% overall survivorship. In July and August, a total of 668 propagated juveniles were tagged with visible implant elastomer (VIE) tags and released into three nearly adjacent reaches in lower Cogur Fork.

A total of 4,095 Cumberland Darters have been stocked in Cogur Fork since 2009. Periodic surveys were conducted in 2010-2014 in Cogur Fork by CFI biologists and KDFWR by performing a combination of visual surveys and seine hauls. Monitoring efforts so far have confirmed the survival of tagged fish released into Cogur Fork for periods exceeding one year and limited evidence of natural reproduction. However, it would be premature at this point to suggest that the project has been successful in restoring a wild population. The small number of untagged individuals could indicate the early establishment of a wild population in Cogur Fork, but collection of much larger numbers over several years, or untagged fish collected after stocking ceases are benchmarks needed to support any strong argument for successful establishment of a reproducing population. Captive propagation, reintroduction, and field monitoring will continue in 2015.

Funding Source: *State Wildlife Grant Program (SWG)*

KDFWR Strategic Plan. Goal 1. Strategic Objective 5. Comprehensive Wildlife Conservation Strategy: Appendix 3.9; Class Actinopterygii and Cephalaspidomorphi: Taxa specific project.

Surveys for the Diamond Darter, an Endangered Species Known Historically from the Green River, Kentucky

Matthew Thomas and Stephanie Brandt, Kentucky Department of Fish and Wildlife Resources

The Diamond Darter (*Crystallaria cincotta*) is a small, slender perch (maximum size 3") that formerly occurred throughout much of the Ohio River basin, including the Green River in Kentucky. Currently, it exists only within the lower 36 km (22 mi) of the Elk River in West Virginia. Because of its rarity, information on its population status, life history, and ecology is lacking. The Diamond Darter was federally listed as an endangered species in July 2013.

In Kentucky, the Diamond Darter was last collected in the Green River near Cave Island (now within Mammoth Cave National Park), Edmonson County, in 1929. Despite extensive sampling for fishes in the middle and upper Green River during the past 25 years, no records of Diamond Darter occurrence have been reported. However, it is possible that the species could still exist and has been overlooked because of inadequate methodologies available to capture small-bodied benthic fishes in areas inaccessible to seining. Furthermore, because it is a nocturnally active species, standard daytime sampling methods have proven far less effective than nighttime searches in the Elk River.

The upper Green River contains habitat similar to that occupied by the Diamond Darter in the Elk River; these include shallow (<1 m deep) transition areas immediately upstream and downstream of riffles (glides and runs, respectively) with moderate to slow current, smooth water surface, and bottom of mostly sand mixed with gravel and cobble. A 94.5 mi section of the Green River from the downstream end of Cave Island (River Mile 200.3) to Roachville Ford (River Mile 294.8) has been designated as a critical habitat unit (CHU) for the Diamond Darter in accordance with section 4(b)(2)(A) of the Endangered Species Act. This unit is tentatively being treated as unoccupied, pending a survey using gear appropriate for capturing the species.

Diamond Darter from Elk River, WV/ U.S. Geological Survey / Stuart Welsh

As of September 2014, we completed daytime sampling using an 8' benthic trawl at 31 sites distributed within the 138.5 mile CHU. This approach more effectively targets habitats too deep to sample via standard collecting gear (e.g., backpack electrofisher and seine). Our sampling sites were chosen in reaches known or suspected to support Western Sand Darter (*Ammocrytpa clara*), Streamline Chub (*Erimystax dissimilis*), Shoal Chub (*Macrhybopsis hyostoma*), and/ or Stargazing Minnow (*Phenacobius uranops*), all of which have habitat requirements similar to those of the Diamond Darter. At each site, one to five hauls averaging 2.5 min were performed; the number of hauls and haul duration varied depending on water depth and presence of snags. Physical habitat, flow, and water quality data were recorded at each site, as well as fish community data (composition and abundance).

Benthic trawl sampling yielded 46 species of fish and, although no Diamond Darters were encountered, we detected presence of the following six at-risk species (number of sites where captured/total sites sampled): Spotted Darter, *Etheostoma maculatum* (20/31); Tippecanoe Darter, *Etheostoma tippecanoe* (18/31); Western Sand Darter, *Ammocrypta clara* (7/31); Stargazing Minnow, *Phenacobius uranops* (4/31); Longhead Darter, *Percina macrocephala* (2/31); and Popeye Shiner, *Notropis ariommus* (1/31).

In addition to trawling, we began nocturnal searches in glide habitats using seines and visual inspection using spotlights; however, frequent rain events and elevated water conditions during late summer and fall of 2014 prevented us from completing this work. During 2015, nocturnal surveys will be performed at seven selected sites within the CHU and one additional reach between Munfordville and Mammoth Cave National Park will be sampled by benthic trawling. This effort will complete our study.

Funding Source: *Kentucky Aquatic Resources Fund (KARF)*

KDFWR Strategic Plan. Goal 1. Strategic Objective 5. Comprehensive Wildlife Conservation Strategy: Appendix 3.9; Class Actinopterygii and Cephalaspidomorphi: Taxa specific project.

Lake Sturgeon Restoration in the Cumberland River

Cumberland River Lake Sturgeon Restoration / Matt Thomas

Jason Herrala, David Baker, Matt Thomas, and Stephanie Brandt, Kentucky Department of Fish and Wildlife Resources

In Kentucky, lake sturgeon were once native to the Mississippi, Ohio, and the Cumberland River drainage, but since the 1950's lake sturgeon have been extirpated from the Cumberland River. In 2008, KDFWR began reintroducing lake sturgeon back into the Cumberland River and committed to a 20 year restoration effort. Since 2007, a total of 21,435 lake sturgeon fingerlings have been stocked; 12,601 in the Cumberland River and 8,834 in the Big South Fork. One major component of this reintroduction program is to assess the survival, movements, and habitat use of stocked sturgeon and document their transition into the natural environment. In order to determine movement patterns, lake sturgeon were monitored using a stationary receiver array from 2012 - 2014. The array monitored movement outside the stocking areas into local tributaries and Lake Cumberland.

Thirty lake sturgeon were surgically implanted with ultrasonic transmitters at the Pfeiffer Fish Hatchery in Frankfort, KY. Twelve stationary receivers were deployed at sites upstream and downstream of the two stocking sites in the Big South Fork and Cumberland River to determine movement out of the stocking areas. All fish have been accounted for throughout the study and all stationary receivers have detected fish. Some of the lake sturgeon have been detected moving over 35.0 miles, while others appear to be staying in the areas where they were stocked. Fish that displayed movement, moved downstream into Lake Cumberland during the summer and early fall, and current tracking data and stationary receiver logs indicate that the majority of fish are still in Lake Cumberland below the KY Route 90 Bridge. It is also apparent that some tagged fish have remained upriver of stocking sites (specifically in the Big South Fork). Half of the ultrasonic transmitters had short battery lives and have now expired; no additional data will be available from those fish. All receivers were pulled in March 2014.

Trotline sampling was used in the Cumberland River in December 2014 and January 2015 to assess the stocking success of lake sturgeon. A total of 21 trotlines were set in the upper end of the study site (near the mouth of Laurel River). All fish collected were measured (nearest 0.1 in fork-length), weighed (nearest 0.1 lb), checked for scute removal/age, and released. A total of 54 lake sturgeon were collected (CPUE = 2.6 fish/line), and ranged from 18.6 to 34.9 in fork-length with a mean fork-length of 21.9 in. CPUE by age was also determined. Age-3 fish dominated the catch accounting for 92.5% of the total catch with a CPUE of 2.4 fish/ling. Growth and condition of stocked lake sturgeon both appear to be exceptional. On average fish were reaching 21.3 in by age 3, and relative weight of for all ages captured was over 100.

Funding Source: *Sport Fish Restoration Program (Dingell-Johnson); State Wildlife Grant Program (SWG)*

KDFWR Strategic Plan. Goal 1. Comprehensive Wildlife Conservation Strategy; Appendix 3.9; Class Actinopterygii and Cephalaspidomorphi: Taxa Specific Project.

The Fishing in Neighborhoods (FINs) Program: Providing Fishing Opportunities to Residents in Cities across the Commonwealth

Dane Balsman and Jason McDowell, Kentucky Department of Fish and Wildlife Resources

In an effort to boost license sales and increase fishing opportunities, the Kentucky Department of Fish and Wildlife Resources (KDFWR) initiated the Fishing in Neighborhoods (FINs) program in 2006. The FINs program currently includes 40 lakes in 25 counties. Quality fishing opportunities now exist in cities of all sizes across the Commonwealth thanks to partnerships between KDFWR and local municipalities. As part of a cooperative agreement between KDFWR and local governments, the lake owners provide a 25% in-kind match for services at the lake to cover the cost of fish stockings. With the cooperative agreement KDFWR works with the local parks to arrange fish stockings, provide technical guidance and promote fishing in the lakes.

These lakes are conveniently located near large populations of people. Anglers do not have to travel far from home to find good fishing. In 2014, 143,750 rainbow trout and 100,392 channel/blue catfish were stocked in the FINs lakes. The fish stockings provide fishing opportunities in lakes that in the past were overfished due to their size and fishing pressure exceeding the resources' capabilities. These lakes require routine stockings of catchable-size fish to sustain quality fishing opportunities to a diverse group of anglers. Lakes are stocked up to four times annually with catchable-size catfish (12 – 18 inch) and three times annually in the cool months (October – March) with rainbow trout (8 – 12 inch). Bass and sunfish populations are routinely sampled to ensure natural reproduction is meeting the needs of the anglers. In 2014, hybrid sunfish were produced at Pfeiffer Fish Hatchery and 64,210 (3 – 8 inch) fish were stocked in May, June and September at lakes that had poor sunfish numbers or heavy fishing pressure. A standard set of creel limits is in place at all FINs lakes to help spread out fish harvest and ensure fishing opportunities can be enjoyed by as many people as possible. Daily limits for each angler fishing a FINs lake includes five rainbow trout, four channel/blue catfish, one largemouth bass over 15 inches, and 15 bluegill or other sunfish.

Information kiosks have been erected at nearly all of the lakes to disperse information to the public about fish stockings, license requirements, fish identification, poacher hotline, basic knot typing instructions, rod loaner equipment and the mission statement of the FINs program. Additionally, the FINs program has been intensively marketed through press releases, social media, radio, television, license vendors, boat shows and the KDFWR website.

A 2012 angler attitude survey at 27 FINs lakes indicated that the FINs program is attracting families with 29% of anglers fishing at FINs lakes ≤ 15 years old. The program is also recruiting and retaining license buyers with 12% of anglers reporting they had never bought a license and 28% reporting they had not bought a license the previous year. Minorities were also well represented at FINs lakes with a higher proportion observed fishing at the lakes than expected from the Kentucky general population according to the 2010 U.S. Census. The overwhelming majority (94%) of anglers traveled ≤ 30 minutes to get to the lake. Angler satisfaction was extremely high at the FINs lakes with 85% of anglers reporting their overall trip as "good" or "excellent". Fishing pressure continues to increase at these lakes and the feedback from local parks and anglers has been very positive.

Funding Source: *Sport Fish Restoration Program (Dingell-Johnson)*

KDFWR Strategic Plan. Goal 2, Strategic Objective 2, Goal 4. Strategic Objective 1.

Young anglers fishing at a FINs lake / John Williams

Kentucky Fishing, Attitudes and Opinions: 2015 Angler Survey

Dave Dreves and Bobby Widener, Kentucky Department of Fish and Wildlife Resources

Fishermen in boat / Rick Hill

Fishing is an important recreational activity enjoyed by over one million men, women and children each year in the state of Kentucky. There were 721,000 licensed anglers over age 16 who fished an estimated 9.2 million days in 2006 resulting in fishing expenditures of $855 million. The Fisheries Division of the KDFWR is responsible for the management of fisheries resources in the state. With such a diversity of aquatic resources as found in Kentucky, and the diversity of the anglers that utilize them, it is critical that we attempt to understand the attitudes and opinions of our constituents. The Fisheries Division has periodically surveyed constituents in the past (1982, 1991, and 2003) to gain insight into angler attitudes regarding fisheries resources, regulations, programs and needs. This information is used to assist in making decisions on where to focus management efforts and where resources can best be utilized to meet the needs and interests of Kentucky anglers. However, developing an understanding of fisheries users is not only important for making management decisions but also for marketing purposes.

Now, over a decade since the last survey, the KDFWR is again conducting a mail survey of anglers to get an up-to-date snapshot of fishing activities, attitudes, and opinions. Brainstorming sessions with the Fisheries Division staff began in late summer 2013 in order to determine what questions would be asked of anglers. This process continued over the next year entailing multiple meetings and reviews of potential questions via email by all Fisheries Division staff. Revisions of the survey questions continued into early fall 2014. A questionnaire booklet was constructed with the final survey questions giving careful consideration to the layout of the survey. Copies of the survey booklet were then distributed to a small number of people having a wide spectrum of angling experience for pre-testing. Any problems respondents had in filling out the survey were addressed before the full mail out began.

The survey sample was randomly selected from the total population of all anglers who purchased a 2014 annual resident fishing license (which includes annual fishing, 3-year fishing, combination fishing and hunting, joint fishing, sportsman's, and senior/disabled licenses). It should be noted that the survey did not include children under age 16 because they are license exempt. With a population of this size (> 20,000), a minimum of 400 responses were needed for 95% confidence level. Based on observations from our previous mail surveys, very conservative estimates on the number of bad addresses and return rates were used to ensure an adequate beginning sample size. It was estimated that a sample size of 1,800 potential respondents was needed.

The 2015 angler survey followed the multiple contact model advocated by Dillman and the accepted standard in survey work. This methodology prescribes multiple contacts with each potential respondent to maximize response rate. Each person on the mailing list was contacted a minimum of three times and a subset who didn't return the survey initially was contacted a fourth time. Preliminary results already show a corrected response rate of over 52%. In-house keypunching of the data is currently taking place. Data analysis will be completed later in 2015 and a final report produced in 2016.

Funding Source: *Sport Fish Restoration Program (Dingell-Johnson)*

KDFWR Strategic Plan. Goal 1.

Kentucky Trout Fishing, Attitudes and Opinions: 2013 Trout Angler Survey

Trout fishing the Cumberland Tailwater / Gerard Buynak

Dave Dreves and Bobby Widener, Kentucky Department of Fish and Wildlife Resources

There were an estimated 38,000 trout anglers in Kentucky who fished an estimated 336,000 days for trout in a 2006 U.S. Fish and Wildlife Service survey. The KDFWR manages roughly 300 miles (97 miles in tailwaters) of trout fisheries in 66 streams (include 15 tailwaters). The KDFWR has periodically surveyed constituents to gain insight into angler attitudes regarding fisheries resources, regulations, programs and needs. This information is used to assist in making decisions on where to focus management efforts and where resources can best be utilized. The KDFWR surveyed Kentucky anglers with a mail survey in 1982, a telephone survey in 1991, and another mail survey in 2003. Each of these surveys focused on general statewide attitudes and opinions. In 2003, a survey was conducted for the first time specifically targeting Kentucky trout anglers. The trout angler attitude mail survey was designed to gather information from the broad spectrum of trout anglers on their fishing habits and opinions.

Now, a decade later, the KDFWR again conducted a mail survey of trout anglers to get an up-to-date snapshot of trout water use, attitudes and opinions. Brainstorming sessions with the Fisheries Division staff began in late summer 2012 in order to determine what questions would be asked of trout anglers. This process continued through the end of the year entailing multiple meetings and reviews of potential questions via email by all Fisheries Division staff. Revisions of the survey questions continue into early 2013. A questionnaire booklet was constructed with the final survey questions giving careful consideration to the layout of the survey. Copies of the survey booklet were then distributed to a small number of people having a wide spectrum of trout angling experience for pre-testing. Any problems respondents had in filling out the survey were addressed before the full mail out began.

The survey sample was randomly selected from the total population of all anglers who purchased a trout permit in 2012 and who can be matched with an address. The sample did not include children under age 16 and persons who purchased either Sportsman's or Senior/Disabled licenses, though these populations can legally harvest trout. With a population of greater than 17,000 trout permit purchasers, a minimum of 400 responses was needed for statistical significance at the 95% confidence level. Based on observations from our previous mail surveys, very conservative estimates on the number of bad addresses and return rates were used to ensure an adequate beginning sample size. It was estimated that a sample size of 1,800 potential respondents was needed.

The 2013 trout angler survey again followed the multiple contact model advocated by Dillman and the accepted standard in survey work. This methodology prescribes multiple contacts with each potential respondent to maximize response rate. Each person on the mailing list was contacted a minimum of three times and a subset who didn't return the survey initially was contacted a fourth time. The implementation of the survey was delayed until early July 2013 due to difficulties with printing and supplies delivery and the fourth quarter agency spending freeze. A total of 781 completed surveys were returned for a corrected response rate of just under 50%. In-house keypunching of the data took place in late 2013 and error resolution in early 2014. Data analysis is continuing and a report will be completed in early 2015.

Funding Source: *Sport Fish Restoration Program (Dingell-Johnson)*

KDFWR Strategic Plan. Goal 1.

2015 mast survey / Kevin Kelly

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Big Game
(Elk and Deer)

Small Game
(Quail, Squirrels, Rabbits)

Turkey

Furbearers

Bear

Birds
Songbirds and Raptors

Migratory Shorebirds and Colonial Nesting Waterbirds

Bats

Reptiles and Amphibians

Mollusks

Crayfish

Fishes

Habitat Restoration / Management

KDFWR Contacts

More information regarding the project summaries within this publication can be obtained by contacting the KDFWR authors or contacts listed here.

General questions can be directed to:
The Kentucky Department of Fish and Wildlife Resources
1 Sportsman's Lane
Frankfort, KY 40601
1-800-858-1549
info.center@ky.gov

Skunk / Adrienne Yancy

David Baker	**David.Baker@ky.gov**
Travis Bailey	**Travis.Bailey@ky.gov**
Dane Balsman	**Dane.Balsman@ky.gov**
Danna Baxley	**Danna.Baxley@ky.gov**
Will Bowling	**Wille.Bowling@ky.gov**
Stephanie Brandt	**Stephanie.Brandt@ky.gov**
John Brunjes	**John.Brunjes@ky.gov**
Brian Clark	**Brian.Clark@ky.gov**
Robert Colvis	**Robert.Colvis@ky.gov**
Dan Crank	**Dan.Crank@ky.gov**
David Cravens	**David.Cravens@ky.gov**
Dave Dreves	**Dave.Dreves@ky.gov**
Scott Freidhof	**Scott.Freidhof@ky.gov**
Erin Harper	**Erin.Harper@ky.gov**
John Hast	**John.Hast@ky.gov**
Jason Herrala	**Jason.Herrala@ky.gov**
Kate Heyden	**Kathryn.Heyden@ky.gov**
Gabriel Jenkins	**Gabriel.Jenkins@ky.gov**
Ryan Kausing	**Ryan.Kausing@ky.gov**
Nick Keeton	**Nick.Keeton@ky.gov**
Steve Marple	**Steve.Marple@ky.gov**
Andy McDonald	**Andy.McDonald@ky.gov**
Jason McDowell	**Jason.McDowell@ky.gov**
Monte McGregor	**Monte.McGregor@ky.gov**
John Morgan	**John.Morgan@ky.gov**
Christopher Owen	**Christopher.Owen@ky.gov**
Charlie Plush	**Charlie.Plush@ky.gov**
Constance Powell	**Constance.Powell@ky.gov**
Ben Robinson	**Ben.Robinson@ky.gov**
Jason Russell	**Jason.Russell@ky.gov**
Kyle Sams	**Kyle.Sams@ky.gov**
Adam Shepard	**Adam.Shepard@ky.gov**
Gary Sprandel	**Gary.Sprandel@ky.gov**
Matthew Thomas	**Matt.Thomas@ky.gov**
Fritz Vorisek	**Fritz.Vorisek@ky.gov**
Bobby Widener	**Bobby.Widener@ky.gov**