AN EVALUATION OF OKLAHOMA'S CLOSE-TO-HOME-FISHING-PROGRAM

By

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CHAPTER I

DEMOGRAPHICS, BEHAVIORS, AND PREFERENCES OF ANGLERS USING OKLAHOMA'S CLOSE-TO-HOME URBAN FISHING PROGRAM RELATIVE TO LICENSED ANGLERS STATEWIDE AND THOSE LIVING IN METROPOLITAN AREAS

Abstract

Angler demographics, preferences, and behaviors were compared among anglers utilizing the Close-To-Home-Fishing-Program (CTHFP) in Oklahoma City, OK, the general population (using 2000 Census data), and state-wide fishing license holders. A creel survey was conducted over a 2-year period (2006-08) at three CTHFP ponds and was compared to a 2006 statewide questionnaire developed for licensed anglers living in metropolitan and non-metropolitan areas in Oklahoma. Anglers fishing at the CTHFP ponds during the trout and non-trout seasons differed in several ways. Anglers from the non-trout season had more young anglers (≤ 15 years old) than would be expected from the Census data. Over 30% of these anglers reported fishing exclusively at ponds in the CTHFP program. Non-trout anglers had a high proportion of families. During the trout season, anglers were older (> 40 years old), had higher incomes (> $50,000), fewer children in the household (< 12 years old), fished more frequently, and fished other bodies of water more than non-trout anglers. During both seasons, men outnumbered

women nearly 3:1 at the CTHFP ponds and the ethnic composition differed from that expected from the 2000 Census, but the differences were location-specific. Anglers fishing at the CTHFP ponds were more likely to have a high school diploma or GED and a household income of > $20,000 than would be expected from the Census data. They also reported traveling shorter distances to their fishing locations than the statewide anglers living in metropolitan or non-metropolitan areas. Anglers from both the CTHFP and statewide surveys indicated they preferred a compromise between size and quantity of catfish caught. Anglers using the CTHFP differed in several ways from the general public and statewide anglers, suggesting they are a unique user group with different preferences and behavior. Therefore, urban fisheries may benefit from different management, objectives and marketing strategies from those used statewide. Similarly, anglers using the CTHFP ponds during the trout season were dissimilar in many ways from the non-trout season anglers, suggesting this cool-season fishery attracts anglers that may not otherwise use an urban fishery.

Introduction

Over the past decade, fishing license sales have declined internationally (McInnes 2006; Fisheries and Oceans Canada 2007), within the USA (USDI 2007), and at the state level within the USA (including Oklahoma; USDI 2008). With this decrease in angler participation, the number of days anglers fished, and the amount of money spent on fishing-related equipment have also decreased (USDI 2007; USDI 2008). Decreased angler involvement may translate into decreased levels of public, financial, and political

support for fisheries management and a reduced value for aquatic resources (Sutton et al. 2009).

The decline in angler involvement is coincident with an increase in urbanization (U.S. Census Bureau 2000; USDI 2007). Urban residents often choose recreational activities that require small blocks of time due to their busy lifestyle (Fedler 2000; ASA&AFWA 2007). Therefore, to counter the decrease in angler participation, many state agencies have attempted to provide quality fishing opportunities in locations that are close to urban residents to allow convenient recreational opportunities that do not require long time investments. This can lead to increased recruitment and retention of anglers (Fedler 2000; Balsman and Shoup 2008). Understanding the demographics, attitudes, and behaviors of anglers utilizing a fishery is necessary to efficiently manage the resource such that it meets angler needs (Driver and Cooksey 1980; Schramm and Dennis 1993; Balsman and Shoup 2008). This is particularly important in evaluating the success of urban fishing programs as little is known about how these anglers may differ from rural anglers. This information may also provide direction on how best to market fishing to those living in urban areas.

Different angling segments within the general angling population have different expectations and motivations that affect the quality of their recreational experience (Moeller and Engelken 1972; Bryan 1977; Dawson and Wilkins 1981; Spencer 1993; Petering et al. 1995; Fisher 1997). For some angling groups, catching fish is the most important factor (Hicks et al. 1983; Matlock et al. 1988; Spencer 1993). For others, time spent with family or in the outdoors may be the primary source of satisfaction (Moeller and Engelken 1972; Fedler and Ditton 1994; Toth and Brown 1997; Burger 2002).

Different demographic groups also have different constraints and influences that determine whether a person remains an active angler (Fedler and Ditton 2001). Little is known about the differences in demographics and attitudes of urban versus rural anglers, but it is likely that urban anglers constitute a unique angling group with different expectations, motivations, and factors influencing their involvement in fishing (Arlinghaus and Mehner 2004; Arlinghaus et al. 2008).

The theory that urban and rural anglers differ in demographic attributes and attitudes was proposed as early as 1969 (Hendee 1969). However, despite the recent emphasis on urban fishing programs (Eades at al. 2008), few studies have investigated how urban and rural anglers differ. Only two studies have addressed this with U.S. anglers (Manfredo et al. 1984; Schramm and Dennis 1993) and both are over 15 years old. Given the rapid increase in urbanization over the past decade, these studies may no longer reflect the sociology of contemporary urban anglers. More recent studies conducted in Germany have also identified differences between urban and rural anglers (Arlinghaus and Mehner 2004; Arlinghaus et al. 2008), but it is not clear how relevant their results are to U.S. urban fisheries given the cultural differences between countries. Additional and updated research is needed so managers working with urban programs can more effectively market and manage their programs to meet anglers' interests (Fedler 2000; Fedler 2007; Balsman and Shoup 2008).

This study compared the demographics of anglers using an urban fishing program (Close-To-Home-Fishing-Program in Oklahoma City, Oklahoma) with the general public, and with state-wide fishing license holders. We also compare fishing habits and preferences of anglers utilizing the urban fishing program with state-wide anglers living

in metropolitan and non-metropolitan areas. Our goal was to identify how urban fishing participants differ from the general public and other angler types. This information is needed to better understand the clientele using urban fishing programs in order to evaluate the potential role of urban programs in reversing the trend of decreasing fishing license sales (Sutton et al. 2009) and to more effectively manage the programs to meet angler interests (Fedler 2000; Fedler 2007; Balsman and Shoup 2008).

Methods

Urban Fishing Program Creel Survey

In 2002 an urban fishing program was initiated in Oklahoma called the Close-To-Home-Fishing-Program (CTHFP). The program was set up as a cooperative agreement between the Oklahoma Department of Wildlife Conservation and Oklahoma municipalities to manage urban bodies of water for recreational fishing. Angler creel surveys were conducted for two years beginning in September 2006 at three ponds in the CTHFP located in the Oklahoma City metropolitan area (Kid's Lake North, Dolese Youth Pond, and South Lake Park East). A roving creel design was used where creel clerks traveled on foot and interviewed all encountered anglers. All anglers fished from shore (no boats were allowed on the ponds), and creel clerks could access all parts of the pond. Anglers present when creel clerks arrived and newly arriving anglers were given 20-30 min before being interviewed. This allowed anglers to set up and begin fishing before being interviewed, while avoiding the risk of missing anglers that were fishing for a short period of time.

Creel surveys were conducted six times per month at each pond for 2 years (September 2006 - August 2008). Samples were stratified by month, weekday versus weekend, and time of day (Pollock et al. 1994). All strata were sampled evenly. While this can lead to lower precision (Pollock et al. 1994), distributing sampling effort proportionately to fishing effort was not possible as no information was previously known about fishing pressure at these sites. Time of day (morning, mid-day, evening) was defined by dividing the total number of daylight hours for the 15th day of the month by three (all three sites were closed to fishing from sunset to sunrise). Each time-of-day period for weekday and weekend was sampled once during each month. When the time of day interval was longer than 4 h, a 4-h period (with a randomized starting time) was used. A survey pre-test was conducted during August 2006 at all three ponds to test the survey for clarity. Based on the pretest, questions were rephrased for greater clarity prior to the September sample and the August data was not used in the analysis. In total, 985 anglers were interviewed during the creel survey. Data from anglers pursuing rainbow trout *Oncorhynchus mykiss* during the special season (January – March) at Dolese Youth Pond (hereafter referred to as trout anglers) were analyzed separately because they were believed to be a different angling niche with a different demographic, behavior, and preference framework.

Anglers fishing at the ponds were approached by creel clerks and asked if they were willing to participate in a short creel survey. If the angling party contained more than one person, each individual was interviewed unless the group was a family unit, then only one adult in the group was interviewed (but demographic data on all party members were recorded). The creel survey contained three parts: demographic information,

behaviors, and preferences. Gender, race/ethnicity (White/Caucasian, Black/African American, Asian/Pacific Islander, Hispanic, American Indian, or Other; Hispanics included any race of Latino or Hispanic heritage), and age were recorded for all party members by the creel clerk. The zip code of the angler's residence was also recorded. Anglers were handed a separate sheet to fill out potentially sensitive demographic information such as age, income ($10,000 or less, $10,001-19,999, $20,000-29,999, $30,000-49,000, $50,000-99,000, or $100,000 or more), and education (some high school or less, high school diploma or GED, some college, four year degree, or graduate degree) at the end of the survey. The angler's employment status (student, employed, self-employed, unemployed, home-maker, or retired) and the number of children under the age of 12 in their household (none, 1-2, or more than 2) were also recorded.

The behavior questions included where the angler did the majority of his or her fishing (private ponds, CTHFP ponds, small lakes ≤ 100 acres, large reservoirs > 100 acres, or rivers/streams), how many minutes it took them to arrive at the CTHFP pond where they were interviewed, how many miles driven one way to fish at the CTHFP pond, how often they fished at the CTHFP ponds (twice a week, once a week, twice a month, once a month, couple times a year, or first time using a CTHFP pond), how often they fished elsewhere, not including other CTHFP ponds (twice a week, once a week, twice a month, once a month, less than one time a month, or never), and what is the predominant reason they fished (recreation/sport or food).

Two preference questions were asked. First, anglers were asked to rank their first, second, and third choice of species they preferred to fish for in the CTHFP ponds. Second, anglers who ranked channel catfish as one of their top three species were asked

which they would rather catch during a fishing trip: six 12-in catfish that weigh ½-lb, three 18-in catfish that weigh 2-lbs, or one 25-in catfish that weighs 6-lbs.

Oklahoma City Metropolitan Demographic Data

To compare our observed demographic data with that of the general public, we produced a hypothetical population by weighting demographic data from the 2000 Census (U.S. Census Bureau 2000) for each Oklahoma City zip code by the number of anglers we observed fishing at each pond from that zip code. This was done separately for each pond and for the trout season anglers at Dolese Youth Pond. Our creel survey used the same demographic categories as the 2000 Census. The Census Bureau also asked the average travel time to work in minutes; this average time was used as a reference point to compare to the average time it took anglers to travel to the CTHFP pond.

Oklahoma Statewide Licensed Angler Survey

To compare age distribution between the CTHFP and statewide Oklahoma anglers, all anglers in the statewide license database were used. This included anglers who purchased an annual fishing license, annual combination hunting and fishing permit, annual youth fishing permit (for 16-17 years of age), annual youth combination hunting and fishing license (for 16-17 years of age), or 2-d license for residents. Anglers age 15 and under are not required to buy a license. Additionally, seniors age 64 and over can buy a senior license at a reduced rate that is valid for the remainder of their lifetime. Therefore, only age data from anglers between 16–63 years of age from the CTHFP data were used for comparisons to the statewide survey. The angler questionnaire was sent to

a subsample of anglers from the statewide licensed angler database that included resident annual license holders, lifetime license holders, and senior license holders.

To compare behavior and preference data between CTHFP and statewide anglers, responses from a statewide angler questionnaire was used (Summers 2009). Based on the results of previous statewide angler surveys, a 50% response rate was expected. Therefore, in order to achieve 1,200 completed interviews, a sample of 2,500 random respondents were selected from the 2006 licensed angler database to receive the survey. Anglers selected for the survey were mailed a copy of the survey and were later called by phone if they had not responded. Survey participants could complete the survey by mail, phone, or a web-based form. A total of 1,292 surveys were completed. Of these, 721 (55.8%) interviews were completed by phone, 235 (18.1%) were completed online, and 336 (26.1%) were returned by mail (Summers 2009).

While Oklahoma has primarily a rural population base, urban areas of Oklahoma City and Tulsa make up a large proportion of the state's population (U.S. Census Bureau 2000). These two high-density population centers are often assumed to provide lower relative numbers of hunting/fishing license buyers when compared with rural/non-metropolitan areas. In the statewide analysis, the metropolitan areas of Oklahoma City and Tulsa were designated as metropolitan and the remaining areas were designated non-metropolitan. This delineation was based on where the anglers resided and not necessarily where they fished. These metropolitan areas provide 45% of the state's total population over the age of 16 (U.S. Census Bureau 2000).

Anglers from the statewide survey were asked a series of behavior and preference questions that included: where they did the majority of their fishing (reservoirs, small

lakes, private ponds or urban, or rivers/streams), miles driven one way on a typical fishing trip, how many days they spent fishing in the previous year, how important is catching fish for sport (on a 1-5 scale, 5 being a big reason, 1 being not a reason), how important is catching fish to eat (on the same 1-5 scale), and which of the following they would prefer to catch while fishing (fifteen 1 ½-lb catfish, five 3-lb catfish, or one 15-lb catfish; only asked of catfish anglers). Anglers were also asked to rank the first, second, and third species for which they fished most often.

Comparisons and Testing

Demographic data from the CTHFP creel survey were compared with expected values generated from the zip-code-weighted 2000 Census data. The CTHFP survey had two demographic questions for which no direct comparisons could be made to the 2000 Census data; questions regarding the employment status and the number of children > 12 years old in the household. Responses to these questions were pooled for all three CTHFP ponds (for non-trout anglers) and compared to anglers pursuing trout at the Dolese Youth Pond (trout anglers). The age data from the 2006 statewide database was compared with the ages of non-trout and trout anglers. The statewide age data could not be divided into metropolitan and non-metropolitan as this information was not available in the statewide license holder database.

A chi-square test was used to test for significant differences ($P \leq 0.05$) in the frequency of respondents among categories and datasets of planned comparisons. If any expected values were < 5 (which only occurred for the employment status question) we used a G test instead of a chi-square test to avoid bias related to continuity. If results of chi-square or G tests were significant, we used post-hoc tests comparing cell residuals

(standardized residuals for CTHFP versus Census comparisons, adjusted residuals for all other comparisons) with Bonferroni adjustments as appropriate (MacDonald and Gardner 2000) to determine which cells differed from their expected values.

Comparisons also were made between behavior and preference questions from the CTHFP survey and the statewide survey. For behavior data, the CTHFP survey was sub-divided into trout and non-trout anglers and the statewide data was sub-divided into anglers living in metropolitan and non-metropolitan areas. Comparisons between the CTHFP and state data were not originally intended when the surveys were designed and the preference questions varied in wording. Therefore, statistical testing was not conducted for questions that did not have consistent verbiage between surveys, but response rates were presented for comparisons. We did, however, test for differences in behavior and preference responses between CTHFP trout and non-trout season anglers and metropolitan and non-metropolitan statewide anglers using separate chi-square analyses as described above.

Overall species preference for both the CTHFP and statewide surveys was calculated by assigning each first choice species five points, second choice species three points, and third choice species one point for each angler and then summing the points by species across anglers (Summers 2009). The statewide survey originally had more species to choose from, however, species not found in CTHFP ponds were excluded from our analysis. Trout anglers were excluded from the species preference analysis as they were not asked what species they preferred to fish for at the CTHFP ponds.

Results

Demographic data differed between CTHFP anglers and the general population in several ways. Women were underrepresented at the CTHFP ponds compared with the expectation from the Census data (Table 1). Men outnumbered women nearly 3:1 at all ponds in the survey. Racial and ethnic compositions of CTHFP anglers varied by pond, but always differed from the expected Census values (Table 1) Black/African Americans were observed in higher frequency than expected at two ponds (Kid's Lake North and Dolese Youth Pond). Hispanics were observed in lower frequency than expected at two ponds (Kid's Lake North and South Lake Park East). During the trout season at Dolese Youth Pond, we observed a higher frequency of Asian/Pacific Islanders and a lower frequency of Black/African Americans than would be expected.

Age structure varied between CTHFP anglers and the general public, between trout and non-trout CTHFP anglers, and between CTHFP anglers and state-wide anglers (Table 1 and 2). Trout anglers at CTHFP ponds had more older anglers (40-49 and 50-63 years old) and fewer younger anglers ($\leq$ 29 years old) than would be expected based on the Census data (Table 1), the statewide age data, and the CTHFP non-trout anglers (Table 2). Non-trout CTHFP anglers had a greater abundance of children 4-15 years old and lower abundance of seniors over the age of 64 than would be expected from the Census data (Table 1). Compared with the statewide data, middle aged non-trout anglers (30-39 years old) were observed in greater abundance and older non-trout anglers (50-63 years old) in lower abundance at the CTHFP ponds (Table 2).

The education level of CTHFP anglers also differed from the general public for all but South Lake Park East anglers. Anglers at Kid's Lake North, Dolese Youth Pond (non-trout season), and Dolese Youth Pond during trout season reported having a high

school diploma or GED in higher frequency than would be expected, and some high school or less in lower frequency than expected based on the Census data (Table 1).

People with a household income of < $20,000/year were underrepresented at all CTHFP ponds and seasons except at Dolese Youth Pond during the non-trout season. Anglers utilizing the trout season at Dolese Youth Pond also had a greater frequency of individuals with higher incomes (household income > $50,000/year) than would be expected from the general population. Anglers using the CTHFP ponds reported a shorter travel time to arrive at the pond than the work commute time reported by the Census (Table 1).

Both the employment status and the number of children under the age of 12 were significantly different between the CTHFP non-trout and trout anglers (Table 3). A higher frequency of anglers that pursued trout were retired or self employed. Non-trout CTHFP anglers were also more likely to be an employee. More anglers using the CTHFP ponds during the non-trout season had 1-2 children < 12 years old in their household than trout anglers (Table 3).

We found several differences in the frequency of responses to behavior and preference survey questions between CTHFP trout and non-trout anglers (Table 4). While the wording of behavior and preference questions between the CTHFP and statewide surveys differed to some degree (and were therefore not statistically tested), some apparent differences were present between responses (Table 4). Anglers fishing for trout at the CTHFP ponds reported using the CTHFP ponds less, and large reservoirs (> 100 acres) more than anglers fishing there the rest of the year (Table 4). Anglers living in metropolitan areas reported using farm ponds or urban fishing areas less than those living

in non-metropolitan areas (Table 4).

Anglers that fished at the CTHFP ponds did not travel as far to fish as anglers from the statewide survey (Table 4). Less than 10% of anglers in the CTHFP survey reported traveling over 20 miles. Conversely, over 55% of anglers from the statewide survey that lived in metropolitan areas reported traveling 20 miles or more to fish (Table 4). Anglers from the statewide survey living in the metropolitan area traveled significantly longer distances to fish than anglers living in non-metropolitan areas.

In the statewide survey, both anglers living in metropolitan and non-metropolitan areas reported a similar number of days fished in the past year (Table 4). A plurality of statewide anglers only fished 0-4 days. A higher percentage of CTHFP anglers (66–76% of respondents) than statewide anglers (55–56% of respondents) fished at least once per month. Trout anglers from the CTHFP had a higher number of anglers who indicated they fish frequently (once a week or two times a week) than CTHFP anglers fishing the rest of the year (Table 4). Over 30% of CTHFP anglers fishing during the non-trout season reported they never fish elsewhere (Table 4). Trout anglers in the CTHFP were much more likely to fish at least once per week at locations other than the CTHFP ponds.

Anglers in the CTHFP survey reported fishing primarily for recreation or sport rather than for food. However, this was much less pronounced for trout anglers than non-trout anglers. Both metropolitan and non-metropolitan anglers from the statewide survey also indicated fishing for sport was important, but a substantial number of anglers also considered catching fish to eat important (Table 4). Anglers indicated they preferred a balance between catching a larger number of smaller catfish or a smaller number of larger catfish (Table 4). A plurality of anglers from all three data sets chose the middle option,

but this preference was weaker for the CTHFP anglers than for either statewide angler group.

Channel catfish was the top ranked species by anglers using the CTHFP ponds, followed by largemouth bass, crappie, and sunfish (Table 5). In the statewide survey crappie were the top ranked species, followed by largemouth bass, channel catfish, and sunfish (Table 5).

Discussion

We found several key differences in demographics, behaviors, and preferences of anglers using the Oklahoma urban fishing program compared with the general public and state fishing license holders living in metropolitan or non-metropolitan area. This suggests that the urban fishing program provides opportunities for a different segment of anglers and may, therefore, require different management objectives to meet the needs of these urban anglers. It also suggests that marketing campaigns designed to recruit urban residents into fishing should be targeted to this specific audience (Fedler 2007). While even the best planned urban fisheries may never meet the needs of all anglers (Manfredo et al. 1984; Schramm and Dennis 1993), it appears these locations receive high angling pressure (Balsman 2009) and provide angling opportunities that would not otherwise exist in these urban settings.

Previous studies suggest that anglers using urban fisheries are typically younger individuals or individuals with youths living in their household (Schramm and Dennis 1993; Arlinghaus and Mehner 2004) and are predominately males (Schramm and Dennis 1990; Arlinghaus and Mehner 2004; Arlinghaus et al. 2008). Our results are consistent

with this. We found a large percentage of anglers < 15 years old using the CTHFP ponds during the non-trout season. These anglers were also more likely to report having 1-2 children < 12 years old in their household than anglers fishing for trout. We also observed a high proportion of 30-39 year-old adults during the non-trout season. This is consistent with our observations that families were common at CTHFP ponds and constitute a large portion of the user base. Women were outnumbered by men nearly 3:1 at all ponds in our survey. Most studies find that women participate in fishing less than men (Schramm and Dennis 1990; Fedler and Ditton 2001; Hunt and Ditton 2002).

In our study, trout anglers were very different from non-trout anglers. They tended to be older, retired or self employed, included a higher frequency of Asian/Pacific Islanders, fished more often, had higher incomes, and were more consumption-oriented than anglers using the CTHFP ponds the rest of the year. These anglers may have been more consumptive because the trout fishery is a seasonal put-and-take fishery (during cool months only, fish do not survive through summer). These trout anglers primarily fish in large reservoirs or other water bodies and the CTHFP ponds just supplement fishing for a short period of time. By contrast, over 30% of anglers using the CTHFP ponds during the other seasons report fishing exclusively at the urban ponds. Therefore, the trout fishery appears to draw anglers that would not otherwise use this urban fishery, but may be less effective than the warm-season fishery at recruiting anglers who otherwise would not fish at all. This is consistent with previous studies demonstrating that some anglers using urban fisheries seek unique species that could not be found in surrounding rural areas (Arlinghaus et al. 2008).

Interestingly, Black/African Americans used the urban fishing program in higher

proportion than would be expected at two of the CTHFP ponds, but were underrepresented during the CTHFP trout season. Hispanics were underrepresented at two of the CTHFP ponds as well. Black/African Americans and Hispanics typically fish fewer days annually, spend less money per trip, and have invested less in equipment than White/Caucasian anglers (Waddington 1995). While urban fishing programs have been suggested as an effective tool to recruit minority groups to angling (Fedler 2000; Fedler 2007; Balsman and Shoup 2008), it appears that for some minority groups, it will take specific marketing that targets these groups (Burger et al. 1999; Balsman and Shoup 2008).

Anglers living in metropolitan areas reported traveling further to fish on average than anglers not living in metropolitan areas in the statewide survey. This suggests many metropolitan anglers do not typically use the CTHFP ponds, possibly because they prefer more remote areas as an escape from the urban environment (Manfredo et al. 1984). Urban anglers often place an emphasis on better fish to catch over a better place to fish, whereas rural anglers preferred a better place to fish (Schramm and Dennis 1993). However, some urban anglers may still prefer a secluded environment; even the best planned urban fisheries may never meet the needs of these anglers (Manfredo et al. 1984; Schramm and Dennis 1993; Arlinghaus and Mehner 2004). Urban anglers often choose urban settings due to their proximity and facilities (Manfredo et al. 1984). The average trip length of anglers fishing at urban ponds is often < 2 h (Lang et al. 2008; Balsman 2009). These urban ponds offer opportunities where anglers can pursue fishing in smaller blocks of time and close to where they live, which may help retain them as active anglers (Fedler 2000; Balsman and Shoup 2008) instead of losing them to other recreational

activities. These short fishing trips may account for the findings that urban anglers were more avid and had more fishing trips (Schramm and Dennis 1993; Arlinghaus and Mehner 2004; and Arlinghaus et al. 2008).

Catching fish is often an important component of the urban fishing experience (Manfredo et al. 1984; Sutton and Ditton 2001; Arlinghaus and Mehner 2004). In our survey, CTHFP non-trout anglers placed a higher importance on fishing for recreation/sport than fishing for food. While this may suggest that CTHFP anglers were not harvest oriented, it should be noted that we observed most anglers responded that both fishing for sport/recreation and food were important to them, but when forced to choose one answer, these anglers often chose the recreation/sport option. This is consistent with the preferences of anglers in the statewide survey, who placed a high importance on both fishing for sport and food, with a slightly higher importance placed on sport. Other studies have also found that urban anglers fish primarily for recreation (Schramm and Dennis 1993). However, harvest is typically more important to catfish anglers (a common group at the CTHFP) than other angling groups (Schramm et al. 1999; Wilde and Ditton 1999). Our results suggest these anglers wanted a balance between many small fish and one trophy fish.

Channel catfish were the most preferred species by anglers fishing at the CTHFP ponds. Channel catfish play an important role in urban fisheries (Brader 2008) and are regularly stocked in the CTHFP ponds. Bass ranked second in preference in both the statewide survey and the CTHFP survey. Bass are highly sought by urban anglers, but large bass are not typically stocked in urban ponds due to the high costs to culture them in a hatchery (Brader 2008). Crappie were the third-ranked species the CTHFP program,

but due to the small size of these ponds, crappie are difficult to manage, so their utility in urban fishing programs is limited (Gabelhouse 1984; Mitzner 1984).

Demographic and social characteristics affect participation rates for recreational activities (Boothby et al. 1981; Godbey 1985; Searle and Jackson 1985; Fedler and Ditton 2001). Understanding the demographics and behaviors of users, or potential users, is essential to marketing urban fisheries programs. Meeting the needs of these anglers in an urban setting is crucial to keeping anglers satisfied and active in angling (Fedler 2000; Fedler 2007; Balsman and Shoup 2008). Additional studies comparing demographics and motives of urban and rural anglers or of urban residents that use and do not use urban fishing programs would further our understanding of how these angling groups differ.

Literature Cited

Arlinghaus, R., and T. Mehner. 2004. A management-oriented comparative analysis of urban and rural anglers living in a metropolis (Berlin, Germany). Environmental Management 33:331-344.

Arlinghaus, R., M. Bork, and E. Fladung. 2008. Understanding the heterogeneity of recreational anglers across an urban-rural gradient in a metropolitan area (Berlin, Germany), with implications for fisheries management. Fisheries Research 92:53-62.

ASA&AFWA (American Sportfishing Association and the Association of Fish and Wildlife Agencies). 2007. Lifestyles and license buying habits of America's anglers: a five-year examination of U.S. license buyers. Southwick Associates, Inc. Available: http://www.rbff.org/uploads/Research_section/Related_Research/ASA-AFWA_License_Analysis_Summary_Report_2006.pdf. (October 2009).

Balsman, D. M. 2009. Catch and harvest rates, angling pressure, preferences and satisfaction at three urban locations in Oklahoma. Chapter 2 *in* Balsman, D. M. An evaluation of Oklahoma's Close-to-Home-Fishing-Program. Master Thesis. Oklahoma State University, Stillwater, OK.

Balsman, D. M., and D. E. Shoup. 2008. Opportunities for urban fishing: developing urban fishing programs to recruit and retain urban anglers. Pages 31-40 *in* R. T. Eades, J. W. Neal, T. J. Lang, K. M. Hunt, and P. Pajak, editors. Urban and community fisheries programs: development, management, and evaluation. American Fisheries Society, Symposium 67, Bethesda, Maryland.

Boothby, J., M. F. Tangutt, and A. R. Townsend. 1981. Ceasing participation in sports

activity: reported reasons and their implications. Journal of Leisure Research 13:1-14.

Brader, J. D. 2008. Aquaculture's role in providing fish for urban fisheries programs. Pages 13-19 *in* R. T. Eades, J. W. Neal, T. J. Lang, K. M. Hunt, and P. Pajak, editors. Urban and community fisheries programs: development, management, and evaluation. American Fisheries Society, Symposium 67, Bethesda, Maryland.

Bryan, H. 1977. Leisure value systems and recreational specialization: The case of trout fishermen. Journal of Leisure Research 9:174-187.

Burger, J. 2002. Consumption patterns and why people fish. Environmental Research Section A 90:125-135.

Burger, J., K. K. Pflugh, L. Lurig, L. A. Von Hagen, and S. Van Hagen. 1999. Fishing in urban New Jersey: ethnicity affects information sources, perception, and compliance. Risk Analysis 19(2):217-229.

Dawson, C. P., and B. T. Wilkins. 1981. Motivations of New York and Virginia marine boat anglers and their preferences for potential fishing constraints. North American Journal of Fisheries Management 1:151-158.

Driver, B. L., and R. W. Cooksey. 1980. Preferred psychological outcomes of recreational fishing. Pages 27-40 *in* R. A. Barnhart and T. D. Roelofs, editors. Catch-and-release fishing as a management tool. California Cooperative Research Unit, Humboldt State University, Arcata.

Eades, R. T., J. W. Neal, T. J. Lang, K. M. Hunt, and P. Pajak, editors. Urban and

community fisheries programs: development, management, and evaluation. American Fisheries Society, Symposium 67, Bethesda, Maryland.

Fedler, A. J. 2000. Participation in boating and fishing: a literature review. Recreational Boating and Fishing Foundation. Alexandria, Virginia.

Fedler, A. J. 2007. Take me fishing: a summary of key learnings from state marketing programs. RBFF. Available: http://www.rbff.org/uploads/Research_section/Program_Evaluation_Files/Key_Learnings_Report_-_FINAL.pdf. (October 2009).

Fedler, A. J., and R. B. Ditton. 1994. Understanding angler motivations in fisheries management. Fisheries 19(4):6–13.

Fedler, A. J., and R. B. Ditton. 2001. Dropping out and dropping in: a study of factors for changing recreational fishing participation. North American Journal of Fisheries Management 21:283-292.

Fisher, M. A. 1997. Segmentation of the angler population by catch preference, participation, and experience: a management-oriented application of recreation specialization. North American Journal of Fisheries Management 17:1-10.

Fisheries and Oceans Canada. 2007. 2005 Survey of recreational fishing in Canada. Fisheries and Oceans Canada, Economic Analysis and Statistics, Ottawa, Ontario.

Gabelhouse, D. W., Jr. 1984. An assessment of crappie stocks in small midwestern private impoundments. North American Journal of Fisheries Management 4:371-384.

Godbey, G. 1985. Nonuse of public leisure services: a model. Journal of Park and Recreation Administration 3:1-12.

Hendee, J. C. 1969. Rural urban differences reflected in outdoor recreation participation. Journal of Leisure Research 1(4):333-341.

Hicks, C. E., L. C. Belusz, D. J. Witter, and P. S. Haverland. 1983. Application of angler attitudes and motives to management strategies at Missouri's trout parks. Fisheries 8(5):2-7.

Hunt, K. M., and R. B. Ditton. 2002. Freshwater fishing participation patterns of racial and ethnic groups in Texas. North American Journal of Fisheries Management 22:52-65.

Lang, T. J., J. W. Neal, and C. P. Hutt. 2008. Stocking frequency and fishing quality in an urban fishing program in Arkansas. Pages 379-389 *in* R. T. Eades, J. W. Neal, T. J. Lang, K. M. Hunt, and P. Pajak, editors. Urban and community fisheries programs: development, management, and evaluation. American Fisheries Society, Symposium 67, Bethesda, Maryland.

MacDonald, P. L., and R. C. Gardner. 2000. Type I error rate comparisons of post hoc procedures for I x J chi-square tables. Educational and Psychological Measurement 60(5):735-754.

Manfredo, M. J., C. C. Harris, and P. J. Brown. 1984. The social values of an urban recreational fishing experience. Pages 156-164 *in* L. A. Allen, editor. Urban fishing symposium proceedings. American Fisheries Society, Fisheries Management Section and Fisheries Administrators Section, Bethesda, Maryland.

Matlock, G. C., G. E. Saul, and C. E. Bryan. 1988. Importance of fish consumption to sport fishermen. Fisheries 13(1):25-26.

McInnes, K. L. 2006. 2004 biennial recreational fishing telephone survey of Queensland

residents. Queensland Department of Primary Industries and Fisheries, Brisbane, Australia.

Mitzner, L. 1984. Crappie management: problems and solutions. North American Journal of Fisheries Management 4:339-340.

Moeller, G. H., and J. H. Engelken. 1972. What fishermen look for in a fishing experience. Journal of Wildlife Management 36:1253-1257.

Petering, R. W., G. L. Isabel, and R. L. Miller. 1995. A survey method for determining angler preference for catches of various fish length and number combinations. North American Journal of Fisheries Management 15:732-735.

Pollock, K. H., C. M. Jones, and T. L. Brown. 1994. Angler survey methods and their applications in fisheries management. American Fisheries Society, Bethesda, Maryland.

Schramm, H. L., Jr., and J. A. Dennis. 1990. Characteristics of urban anglers in Lubbock, Texas. Proceedings of the Annual Conference Southeastern Association of Fish and Wildlife Agencies 42(1988):200-208.

Schramm, H. L., Jr., and J. A. Dennis. 1993. Characteristics and perceptions of users and nonusers of an urban fishery program in Lubbock, Texas. North American Journal of Fisheries Management 13:210-216.

Schramm, H. L., Jr., J. T. Forbes, D. A. Gill, and W. D. Hubbard. 1999. Fishing environment preference and attitudes towards overharvest: are catfish anglers unique? Pages 417-425 *in* E. R. Irwin, W. A. Hubert, C. F. Rabeni, H. L. Schramm, Jr. and T. Coon, editors. Catfish 2000: proceedings of the international

ictalurid symposium. American Fisheries Society, Symposium 24, Bethesda, Maryland.

Searle, M. S., and E. L. Jackson. 1985. Recreation non-participation and barriers to recreation participation among would-be participants. Leisure Sciences 7:227-249.

Spencer, P. D. 1993. Factors influencing satisfaction of anglers of Lake Miltona, Minnesota. North American Journal of Fisheries Management 13:201-209.

Summers, G. L. 2009. Angler opinion survey. Oklahoma Department of Wildlife Conservation Federal Aid Project No. F-50-R, Job 6, Final Report. 29 pp. Oklahoma City, OK.

Sutton, S. G., K. Dew, and J. Higgs. 2009. Why do people drop out of recreational fishing? A study of lapsed fishers from Queensland, Australia. Fisheries 34(9):443-452.

Sutton, S., and R. B. Ditton. 2001. Understanding an urban fishery: Braunig Lake and Calaveras Lake, San Antonio, Texas. Human Dimensions of Recreational Fisheries Report HD-619. 112 pp. Texas A&M University, College Station, Texas.

Toth, J. F., Jr., and R. B. Brown. 1997. Racial and gender meanings of why people participate in recreational fishing. Leisure Sciences 19:129-146.

U.S. Census Bureau. 2000. American factfinder. U.S. Census Bureau. Available: http://factfinder.census.gov. (September 2009).

USDI (U.S. Department of the Interior), U.S. Fish and Wildlife Service, and U.S. Department of Commerce, U.S. Census Bureau. 2007. 2006 National survey of

hunting and fishing, hunting, and wildlife-associated recreation. U.S. Government Printing Office, Washington, D.C.

USDI (U.S. Department of the Interior), U.S. Fish and Wildlife Service, and U.S. Department of Commerce, U.S. Census Bureau. 2008. 2006 National survey of hunting and fishing, hunting, and wildlife-associated recreation-Oklahoma. U.S. Government Printing Office, Washington, D.C.

Waddington, D. G. 1995. Participation and expenditure patterns of Black, Hispanic, and women anglers. Addendum to 1991 national survey of fishing, hunting, and wildlife-associated recreation. U.S. Fish and Wildlife Service, Report 91-3, Washington, D.C.

Wilde, G. R., and R. B. Ditton. 1999. Difference in attitudes and fishing motives among Texas catfish anglers. Pages 395-405 *in* E. R. Irwin, W. A. Hubert, C. F. Rabeni, H. L. Schramm, Jr. and T. Coon, editors. Catfish 2000: proceedings of the international ictalurid symposium. American Fisheries Society, Symposium 24, Bethesda, Maryland.

Table 1. Demographics of anglers using the Close-to-Home-Fishing-Program ponds in Oklahoma City, OK as assessed by a roving creel survey conducted from September 2006 – August 2008. "Dolese Youth Pond Trout" was a separate analysis from "Dolese Youth Pond" and represented only anglers interviewed fishing for trout during trout season (Dolese Youth Pond results do not include these trout anglers). The expected column is derived from the 2000 Census data weighted by sample to the number of anglers observed at each pond from each zip code.

	Kid's Lake North		South Lake Park East		Dolese Youth Pond		Dolese Youth Pond Trout	
	Observed	Expected	Observed	Expected	Observed	Expected	Observed	Expected
Gender								
Males	81.3%	47.9%	73.2%	48.9%	74.8%	48.3%	88.8%	48.5%
Females	18.8%	52.1%	26.8%	51.1%	25.2%	51.7%	11.2%	51.5%
Number of Observations	304		421		655		428	
	$X^2_1 = 135.5$, $P < 0.01$		$X^2_1 = 99.2$, $P < 0.01$		$X^2_1 = 184.5$, P 0.01		$X^2_1 = 278.5$, $P < 0.01$	
Race/Ethnicity								
White/Caucasian	60.2%	67.7%	86.9%	75.9%	64.5%	70.8%	77.0%	73.5%
Black/African American	34.9%	18.0%	6.2%	5.7%	21.8%	11.0%	5.6%	8.6%
Asian/Pacific Islander	2.3%	3.1%	1.7%	3.0%	2.5%	3.3%	7.0%	3.3%
Hispanic	1.6%	5.7%	5.0%	8.0%	9.1%	8.5%	9.4%	8.0%
American Indian	0.0%	2.5%	0.2%	3.8%	0.5%	3.2%	0.9%	3.4%
Other	1.0%	2.9%	0.0%	3.5%	1.7%	3.2%	0.0%	3.3%
Number of Observations	304		421		647		427	
	$X^2_5 = 71.4$, $P < 0.01$		$X^2_5 = 43.2$, $P < 0.01$		$X^2_5 = 94.2$, $P < 0.01$		$X^2_5 = 46.2$, $P < 0.01$	
Age								
4-15	30.8%	16.3%	28.2%	19.1%	32.4%	17.2%	6.9%	17.6%
16-17	2.0%	2.9%	3.4%	3.4%	1.8%	3.0%	0.3%	3.1%
18-29	13.0%	19.7%	16.7%	17.8%	18.7%	19.1%	8.1%	19.1%
30-39	18.2%	15.3%	17.0%	16.3%	17.8%	15.6%	13.5%	15.6%
40-49	13.8%	15.9%	16.4%	16.8%	10.6%	15.9%	29.3%	16.1%
50-63	17.0%	15.1%	10.9%	15.3%	10.6%	14.7%	26.9%	14.9%
64 and Over	5.1%	14.8%	7.5%	11.2%	8.1%	14.4%	15.0%	13.5%
Number of Observations	253		348		556		334	
	$X^2_6 = 57.6$, $P < 0.01$		$X^2_6 = 24.0$, $P < 0.01$		$X^2_6 = 109.7$, $P < 0.01$		$X^2_6 = 122.3$, $P < 0.01$	
Median Age	31	37	31	36	28	36	46	36

Table 1. Continued

	Kid's Lake North		South Lake Park East		Dolese Youth Pond		Dolese Youth Pond Trout	
	Observed	Expected	Observed	Expected	Observed	Expected	Observed	Expected
Education								
Some High School or Less	8.1%	13.4%	11.4%	16.5%	11.5%	16.7%	7.3%	16.0%
High School Diploma or GED	30.2%	23.5%	35.6%	29.9%	34.1%	26.5%	36.5%	26.5%
Some College	22.8%	31.5%	32.2%	33.9%	32.1%	32.4%	30.6%	32.5%
Four Year Degree	25.5%	20.1%	13.9%	13.7%	15.9%	16.1%	20.1%	16.7%
Graduate Degree	13.4%	11.5%	6.9%	6.0%	6.4%	8.2%	5.6%	8.4%
Number of Observations	149		202		296		288	
	$X^2_4 = 12.2$, P 0.02		$X^2_4 = 5.9$, P 0.21		$X^2_4 = 12.6$, $P < 0.01$		$X^2_4 = 29.6$, $P < 0.01$	
Income								
$10,000 or Less	7.6%	10.9%	3.0%	7.9%	6.4%	10.5%	1.3%	9.3%
$10,000 to $19,999	5.9%	13.6%	4.2%	12.0%	12.8%	15.8%	3.9%	14.3%
$20,000 to $29,999	11.8%	14.9%	19.3%	13.7%	18.7%	16.7%	10.4%	15.4%
$30,000 to $49,999	26.1%	23.7%	27.7%	24.6%	27.7%	25.3%	24.7%	25.2%
$50,000 to $99,999	37.8%	26.5%	38.6%	32.9%	28.5%	25.0%	42.9%	27.8%
$100,000 or more	10.9%	10.4%	7.2%	8.8%	6.0%	6.7%	16.9%	8.0%
Number of Observations	119		166		235		154	
	$X^2_5 = 13.3$, P 0.02		$X^2_5 = 19.9$, $P < 0.01$		$X^2_5 = 7.6$, P 0.18		$X^2_5 = 52.1$, $P < 0.01$	
Travel Time								
To Work	20.4		21.9		20.2		21.0	
To Fish at CTHFP Ponds	12.8		11.4		13.1		16.0	

Table 2. Age distribution of anglers fishing the Close-to-Home-Fishing-Program (CTHFP) ponds in Oklahoma City, OK (assessed from a roving creel survey conducted from September 2006 - August 2008) and statewide anglers (assessed from the statewide fishing license database for Oklahoma in 2006).

	CTHFP		
	Non-Trout Anglers	**Trout Anglers**	**Statewide Anglers**
Age			
16-17	3.8%	0.4%	4.3%
18-29	27.2%	10.3%	24.7%
30-39	28.5%	17.2%	21.2%
40-49	21.1%	37.6%	24.1%
50-63	19.5%	34.9%	25.6%
Number of Observations	717	261	223,137
		$X^2_8 = 93.94$, $P < 0.01$	

Table 3. Employment status and number of children in household of anglers fishing at the Close-to-Home-Fishing-Program (CTHFP) ponds in Oklahoma City, OK, as assessed from a roving creel survey conducted from September 2006 - August 2008.

	Non-Trout Anglers	Trout Anglers
Employment Status		
Retired	16.6%	28.1%
Employee	69.7%	57.3%
Self-employed	4.9%	13.5%
Home-maker	1.2%	0.6%
Student	4.7%	0.6%
Unemployed	3.0%	0.0%
Number of Observations	577	178
	$G_5 = 42.87$, $P < 0.01$	
# Children < 12		
None	55.4%	84.8%
1-2	36.1%	12.4%
More than 2	8.4%	2.8%
Number of Observations	570	178
	$X^2_2 = 49.97$, $P < 0.01$	

Table 4. A comparison of preferences and behaviors of anglers living in non-metropolitan and metropolitan areas statewide (assessed from a 2006 survey of statewide fishing license holders in Oklahoma) and anglers fishing at the Close-to-Home-Fishing-Program (CTHFP) ponds in Oklahoma City, OK (assessed from a roving creel survey conducted from September 2006 - August 2008).

	CTHFP			Statewide Anglers	
	Non-Trout Anglers	Trout Anglers		Not Living in Metro	Living in Metro
Where do you do the majority of your fishing?			**Where do you do the majority of your fishing?**		
Small lakes < 100 acres	13.1%	9.2%	Small lakes	31.3%	37.2%
Large reservoirs > 100 acres	20.1%	55.6%	Reservoirs	32.0%	39.1%
Rivers and streams	3.7%	6.1%	Rivers, streams or creeks	11.8%	9.8%
Private ponds	14.5%	10.2%	Farm pond/urban fishing areas	24.9%	14.0%
CTHFP ponds	48.7%	19.0%	Number of Observations	591	215
Number of Observations	678	295		$X^2_3 = 13.16$, $P < 0.01$	
	$X^2_4 = 137.98$, $P < 0.01$				
How many miles did you drive to fish today?			**How many miles do you drive one-way to fish?**		
0-9	74.1%	61.2%	0-9	49.6%	33.9%
10-19	20.2%	29.4%	10-19	14.5%	9.5%
20-39	4.2%	7.1%	20-39	10.7%	7.3%
40-59	0.3%	0.7%	40-59	14.4%	17.7%
60+	0.8%	1.7%	60+	10.8%	31.5%
Number of Observations	665	296	Number of Observations	1028	327
	$X^2_{12} = 517.94$, P < 0.01				
	$X^2_4 = 18.19$, $P < 0.01$			$X^2_4 = 89.99$, $P < 0.01$	
How often do you fish at CTHFP ponds?			**How many days did you fish in the past year?**		
This is my first time	17.3%	7.7%	0-4	38.8%	37.3%
Couple times a year	17.0%	16.4%	5-9	6.3%	7.0%
Once a month	23.0%	5.7%	10-19	13.8%	18.7%
Couple times a month	17.6%	12.0%	20-39	19.8%	19.9%
Once a week	8.6%	17.1%	40-99	15.1%	13.8%
Couple times a week	16.5%	41.1%	100+	6.1%	3.4%
Number of Observations	671	299	Number of Observations	1028	327
	$X^2_5 = 117.23$, $P < 0.01$			$X^2_5 = 7.99$, P 0.16	
How often do you fish elsewhere?					
Never	30.4%	6.8%			
Less than one time a month	11.6%	17.0%			
One time a month	15.3%	9.1%			
Two times a month	14.6%	13.6%			
One time a week	15.3%	20.5%			
Two times a week	12.8%	33.0%			
Number of Observations	576	176			
	$X^2_5 = 70.26$, $P < 0.01$				

Table 4. Continued

	CTHFP			Statewide Anglers	
	Non-Trout Anglers	Trout Anglers		Not Living in Metro	Living in Metro
What is the predominant reason you fish?			**How important is catching fish for sport?**		
Recreation or sport	80.9%	50.3%	1 Not a reason	8.9%	7.1%
Food	19.1%	49.7%	2	7.4%	8.8%
Number of Observations	679	298	3	17.0%	21.0%
	X^2_1 = 94.79, P < 0.01		4	21.6%	20.2%
			5 Big reason	45.1%	42.9%
			Number of Observations	676	238
				X^2_4 = 3.02, P 0.55	
			How important is catching fish to eat?		
			1 Not a reason	19.8%	24.5%
			2	11.2%	10.1%
			3	22.2%	24.1%
			4	14.9%	14.3%
			5 Big reason	31.9%	27.0%
			Number of Observations	677	237
				X^2_4 = 3.72, P 0.45	
Which would you rather catch during a fishing trip?			**Which of the following experiences would you prefer to have while fishing for catfish?**		
Six 12" catfish weighing 1/2 lb	26.1%		Fifteen 1 1/2 lb catfish	16.9%	15.2%
Three 18" catfish weighing 2 lb	40.1%		Five 3 lb catfish	60.7%	62.5%
One 25" catfish weighing 6 lb	33.2%		One 15 lb catfish	22.4%	22.3%
Number of Observations	675		Number of Observations	415	112
				X^2_2 = 0.20, P 0.91	

Table 5. Species preference of anglers fishing at the Close-to-Home-Fishing-Program (CTHFP) ponds in Oklahoma City, OK (assessed from a roving creel survey conducted from September 2006 - August 2008) and anglers fishing statewide (assessed from a 2006 Oklahoma statewide angler opinion survey). First choice responses received five points, second choice responses received three points, and third choice responses received one point for species anglers preferred to fish for. The % of total points was the total points for each species divided by the total points of all species.

	CTHFP Anglers		Statewide Anglers	
Species	**Rank**	**% Total Points**	**Rank**	**% Total Points**
Channel Catfish	1	41.9%	3	24.9%
Largemouth Bass	2	30.2%	2	32.4%
Crappie	3	16.7%	1	36.7%
Sunfish	4	11.2%	4	6.0%
Total Points		3077		8233

CHAPTER II

CATCH AND HARVEST RATES, ANGLING PRESSURE, PREFERENCES AND SATISFACTION AT THREE URBAN LOCATIONS IN OKLAHOMA

Abstract

Providing urban fishing opportunities may be an effective strategy to reverse the recent trend of declining angler numbers. However, in order for an urban program to be successful, assessment is necessary to determine if angler interests are being efficiently served by the program. We conducted an angler creel survey at three ponds in the Close-to-Home Fishing Program (CTHFP) in Oklahoma City, OK over a two-year period. Channel catfish are an important aspect of this urban fishery with 66-88% of anglers pursuing this species. Fishing pressure at the sites ranged from 3,969-22,727 angling h/yr or 490-5,235 h/ha. Catch rates of channel catfish ranged from 0.05-0.33 fish/h, but harvest rates never exceeded 0.1 fish/h at any of the ponds. The rainbow trout harvest rate at Dolese Youth Pond (0.28 fish/h) was nearly as high the catch rate (0.33 fish/h); indicating anglers harvested most of the fish they caught. Angler satisfaction could not be directly related to catch rates. Anglers fishing at the CTHFP tended to fish for short periods of time (< 3 hours/trip) and rate their fishing experience as satisfactory or poor. Most anglers said $\geq$ 12 inches was a satisfactory keeper-sized channel catfish, were not supportive of stocking only channel catfish, and were supportive of more restrictive

regulations on channel catfish if they improved fishing. Most anglers thought restrooms followed by fishing docks were the most important amenities to implement/improve at CTHFP sites. Awareness of the CTHFP program varied among ponds (45-75% aware of program), but anglers fishing at Dolese Youth Pond during the trout season were noticeably more aware of the program than anglers fishing during the rest of the year (81% awareness during trout vs. 45% awareness during the rest of the year).

Introduction

Urban fishing opportunities have increased in recent decades (Fedler and Howard 1991; Schramm and Edwards 1994; Hunt et al. 2008) and may hold the key to reversing the recent trend of declining angler numbers (Balsman and Shoup 2008; Hutt and Jackson 2008). Urban fishing programs provide opportunities for anglers to fish close to home (Schramm and Edwards 1994; Hunt and Ditton 1997). However, it is necessary to evaluate these programs after implementation (Ballard 2008). Setting clear objectives for the program and being able to test these objectives is critical. It is essential to gather information about who is using the fishery, their preferences, fishing pressure, catch and harvest rates, and overall satisfaction of anglers to be able to assess the fishery (Yoesting and Burkhead 1973; Driver and Cooksey 1980).

Providing quality fishing opportunities to anglers often requires an understanding of what the anglers' motives are and what they hold as important in a fishing experience (Fedler and Ditton 1994; Finn and Loomis 2001). Some aspects of satisfaction are specific to fishing, while others may be general to outdoor activities (Fisher 1997; Hutt and Jackson 2008). Anglers often seek multiple benefits from fishing, and their motives

can be catch or non-catch related (Hendee 1974; Driver and Knopf 1976; Driver and Cooksey 1980; Fedler and Ditton 1994; Arlinghaus 2006). Understanding motives is important to ensuring anglers are satisfied with the fishery and continue to pursue fishing. Identifying angler demographics and interests can also assist in management and regulation decisions that serve the angling public.

The benefits of creel survey data to determine angler demands and fishing statistics (effort; catch; harvest) has been evident for some time (Clark 1934). Creel surveys are essential to managing fisheries because they directly measure angler interest and the influence anglers have on a fishery (Pollock et al. 1994; Malvestuto 1996).

This study measured catch and harvest rates, fishing pressure, and angler preferences, awareness, and satisfaction at three ponds in Oklahoma City, OK. This study was part of a larger project investigating channel catfish *Ictalurus punctatus* population sizes, size distribution, age, growth, and mortality. Understanding catch and harvest rates, fishing pressure, angler preference, and fish population data should help guide stocking strategies and future management of the Oklahoma urban fishing program.

Methods

Study Area

The Close-to-Home-Fishing-Program (CTHFP) began in 2002. Three ponds with established fisheries were chosen from the program as study sites for this project. All three ponds are located in the Oklahoma City metropolitan area. Kid's Lake North and Dolese Youth Pond are both located in the northern part of Oklahoma City (Oklahoma County). Both ponds are roughly 8.1 ha in size. South Lake Park East is located in

Cleveland County, at the southern edge of the Oklahoma City metropolitan area and is 1.2 ha in size. The ponds were stocked annually in the fall with channel catfish (102-254 mm total length [TL]) as a put-grow-and-take fishery. Additionally, channel catfish of a catchable-size (356-406 mm TL) were stocked during the summer before fishing clinics were held at individual ponds. All three ponds contained channel catfish, sunfish *Lepomis spp.*, crappie *Pomoxis spp.*, and largemouth bass *Micropterus salmoides*. Dolese Youth Pond and South Lake Park East also had introduced populations of black bullhead catfish *Ameiurus melas*. Common carp *Cyprinus carpio* were present in significant numbers in Dolese Youth Pond. Additionally, gizzard shad *Dorsoma cepedianum* occurred in Kid's Lake North and golden shiners *Notemigonus crysoleucas* in South Lake Park East. Rainbow trout *Oncorhynchus mykiss* were stocked annually in Dolese Youth Pond during a special trout season that ran from January 1 through February 28 each year.

Sampling Methods

Angler creel surveys were conducted monthly at Kid's Lake North, Dolese Youth Pond, and South Lake Park East from September 2006 - August 2008. A roving creel design was used where creel clerks traveled on foot and interviewed all encountered anglers. No boats were allowed on the ponds and creel clerks could access all parts of the pond. Anglers present when creel clerks arrived or newly arriving anglers were given 20-30 min before being interviewed. This allowed anglers to set up and begin fishing before being interviewed, while avoiding the risk of missing anglers that were fishing for a short period of time. When possible, anglers were again contacted as they left and the number

and types of fish they had caught, the length of time they fished, and overall satisfaction were updated.

Samples were stratified by month, weekday versus weekend, and time of day (Pollock et al. 1994). All strata were sampled evenly. While this can lead to lower precision (Pollock et al. 1994), distributing sampling effort proportionately to the distribution of fishing effort was not possible as no information was previously known about fishing pressure at these sites. Time of day (morning, mid-day, evening) was defined by dividing the total number of daylight hours for the 15th day of the month by three (no fishing occurred at night as parks closed at dusk). Each time-of-day period was sampled once on a weekday and once on a weekend during each month. When the time of day interval was longer than 4 h a 4-h period was used and the starting times were randomized.

Surveys were designed to collect information about catch and harvest rates for all species, species sought, length of fishing trips, awareness of the urban fishing program, satisfaction and angler preference. When anglers had fish in their possession, creel clerks identified the species and measured the fish (mm TL). Data from anglers pursuing rainbow trout during the special trout season were analyzed separately because they were believed to be a different angling niche with different demographic and preference framework. To test for reliability of answers, a test-retest question was used. "How many channel catfish have you caught today," was added to the end of the survey on 10% of the surveys and re-asked to test for recall bias. The creel clerk acted as though he or she had forgotten to record the answer and simply asked the question again. A survey pre-test was conducted during August 2006 at all three ponds to test if any questions needed to be

reworded. Questions were reworded prior to the September sample and the August data was not used in the analysis.

Catch and Harvest Rates

Catch rates refer to all fish caught whether kept or released, and harvest refers to all fish observed in the angler's possession that they intended to keep. We made an effort to update the catch and harvest rates if the angler was still present an hour or two after the initial survey. We also attempted to update information when anglers were observed leaving. The time of interview and angler satisfaction was updated along with the catch and harvest data. The catch and harvest rate were derived from asking the angler what time they began fishing and how many fish had been caught up to that point. Angling effort was based on pressure counts extrapolated to the number of fishing hours in a day. Pressure was extrapolated according to each stratum within the survey design. Total catch and harvest was not estimated directly, but rather was calculated as the ratio to totals (sum of angler-h x mean fish caught or harvested per h; Pollock et al. 1994). Catch rates for individual species did not take into account what species the angler was targeting or preferred to catch. This undoubtedly led to lower catch rates for some species when anglers fished with gear or baits that were species-specific.

We used linear regression (SAS proc reg; SAS 2004) to test for relationships between angler success (catch rate and size of fish caught) and angler satisfaction. Separate regression models were fit to the data from each pond, and to the data from all ponds combined. Separate models tested for relationships between catch rate and satisfaction for each fish species (using only anglers that ranked the species as one for which they fished at the CTHFP ponds) and all species combined (regardless of the

angler's fish species preference) for each pond. Models were also used to test the relationship between the average and maximum (separate models) size of channel catfish caught and angler satisfaction. This analysis was only performed with data from Dolese Youth Pond and all ponds combined because the observed number of catfish harvested at the other CTHFP ponds was insufficient for separate pond analyses.

Angler Preference

Preference questions were asked in conjunction with satisfaction questions. Anglers were asked what species they preferred to catch at the CTHFP ponds; how long they spent fishing on a typical trip to the CTHFP ponds; what amenities they would like to see improved at the CTHFP pond where they were fishing; if they were aware of the CTHFP program; what size was a satisfactory "keeper" size channel catfish; satisfaction with stocking only channel catfish; if they would be in favor of more restricted bag limits; and satisfaction with today's fishing experience at the CTHFP pond. Questions were read aloud to the angler and the creel clerk recorded the answers. All answers were reported as percent response rate of anglers. For species preference, trout were excluded from analysis for Dolese Youth Pond to make it comparable with other ponds (where trout are not stocked). The percent of anglers that fished for each species was calculated by counting the number of anglers that ranked the species as one they pursued at the CTHFP ponds. Therefore, the percents do not necessarily sum to 100%. The questions that were specific to channel catfish angling were only asked to anglers that ranked channel catfish as a species for which they fished or who stated they had no fish species preference.

Fishing Pressure

Instantaneous angler counts were taken at the beginning of the survey period and at hourly intervals thereafter. The creel clerks spent the time between instantaneous counts interviewing anglers (Malvestuto et al. 1978). The ponds were small enough that all anglers could be observed from a single vantage point. Anglers were defined as anyone who was holding a fishing pole or had been observed holding a pole at some point. Instantaneous counts were averaged within strata and multiplied by the number of hours within the stratum. Weekday and weekend fishing pressure was calculated separately and total fishing pressure for the month was weighted according to day length and the number of weekdays and weekend days within the month (Pollock et al 1994). Fishing pressure for the year was calculated as the sum of the monthly estimates.

Results

Over 1,600 h of creel surveys were conducted on Kid's Lake North, Dolese Youth Pond, and South Lake Park East from September 2006 - August 2008, resulting in 985 angler interviews. Recall bias was measured as 0% during the creel surveys.

Catch and Harvest Rates

Species catch rates varied by pond, possibly due to differing species abundance and the number of anglers pursuing each species among ponds. A large percentage of anglers did not target a specific species (Figure 1). Channel catfish were among the most commonly sought species at all ponds, being specifically sought by 45-50% of anglers (Figure 1). Therefore, 66-88% of anglers may fish for channel catfish (including anglers not targeting a specific species). Angler catch rates for channel catfish varied from 0.05 fish/h at Kid's Lake North to 0.33 fish/h at South Lake Park East (Table 1). Harvest rates

for channel catfish were highest at Dolese Youth Pond but harvest rates did not exceed 0.1 fish/h at any pond. Crappie were highly sought by anglers fishing at Kid's Lake North, as were bluegill *Lepomis macrochirus* at South Lake Park East (Figure 1). Moderate catch rates were observed for anglers specifically targeting those species (Table 1). A large proportion of anglers also fished for largemouth bass in all three ponds (Figure 1). Catch rates for this species were relatively low but those specifically targeting this species had moderate success (Table 1). Rainbow trout had a high harvest rate, nearly matching the catch rate for this species (Table 1).

Angler satisfaction could not be directly related to catch rates. Most models testing this relationship had significant positive slopes, but low R^2 values (all $R^2 \leq 0.12$) suggested the models explained little of the variation in angler satisfaction (Table 2). The mean and maximum size of channel catfish harvested were not significantly related with angler satisfaction (all models $P \geq 0.129$; Table 3). This trend was consistent with creel clerk observations that anglers based their satisfaction rating on a wide range of factors. While catch rates and size of fish caught most likely do play a part in overall angler satisfaction, it cannot solely predict angler satisfaction in the CTHFP.

Angler Preference

When anglers were asked what they thought was a "satisfactory/keeper size catfish" for CTHFP ponds, answers varied widely, but nearly 30% of the respondents reported 12 in (Figure 2), which was larger than the average size of catfish currently being stocked. This question was asked in inches to avoid confusion among anglers.

A plurality of anglers (30-43%) said their average fishing trip length was 2 h (Figure 3). It should be noted that anglers reporting average fishing trips of 3 h or more

rarely stayed that full duration. Anglers fishing during the trout season said they normally spent 2-6 h on a typical trip during trout season, which was longer than the duration reported by anglers fishing for warm-water species the rest of the year at the CTHFP ponds.

When asked what amenities should be implemented or improved, restrooms were the top answer at all three ponds (32-46% of respondents; Figure 4). Fishing docks were not present at any of the ponds surveyed. Between 17-24% of anglers said they were needed. A large percentage (19-30%) of anglers, were happy with current amenities and felt no improvements were needed.

Angler awareness of the CTHFP ranged widely between ponds. Anglers at Dolese Youth Pond during the trout season had an awareness of 81%, much higher than the 45% awareness observed during the remainder of the year. Angler awareness of the CTHFP program exceeded 50% at the other two ponds (Table 4).

Most anglers were opposed to stocking only channel catfish (61-91%). However, these anglers were overwhelmingly in favor of more restrictive bag limits or minimum size limits for channel catfish if it improved the fishing (Table 4).

Over half the anglers at the ponds rated the fishing as satisfactory or poor. There was a large proportion of anglers rating their experience as satisfactory or good, but there were very few anglers ranking their satisfaction level as excellent (Table 4).

Fishing Pressure

January and February were the months with the highest pressure at Dolese Youth Pond due to the trout season. The other two ponds had the highest pressure during the spring and summer months (Figure 5). Pressure was highest during the mid-day time

period in Dolese Youth Pond and during the evening hours at the other two ponds (Figure 6). All three ponds had at least twice as much fishing pressure during weekend days, compared to week days (Figure 7). Kid's Lake North had 3,969 angling h/year (490 h/ha), Dolese Youth Pond had 22,727 angling h/year (2,808 h/ha), and South Lake Park East had 6,355 angling h/year (5,235 h/ha).

Discussion

Catch rates, harvest rates, and stocking strategies

While catch rates were low for most species in the CTHFP, our channel catfish catch rates (0.05-0.33 fish/h) were comparable to those reported by other urban fishing programs (0.1 fish/h, Emme and Buynak 2008; 0.34-0.40 fish/h, Lang et al. 2008). However, harvest rates were considerably lower in our study (0.02-0.07 fish/h) than those reported for Arkansas' urban fishing program (0.30-0.35 fish/h; Lang et. al. 2008). This was presumably due to large catchable-size fish (> 305 mm TL; the size anglers indicate they desire; Figure 2) that are stocked in Arkansas' program on a monthly basis. Response errors can affect catch rate estimates (Pollock et al. 1994). While we found recall bias was 0%, some anglers could not tell the difference between bullheads and channel catfish, and this may have skewed catch rates between the two species. Some anglers released fish at the end of the trip if they did not catch enough to clean. This also could have affected harvest rates as any fish in the angler's possession at the time of the survey was counted as harvested.

Species preference

Channel catfish play an important role in small impoundment fisheries and are a staple for most urban fishing programs (Brader 2008). In our survey, only 21-39% of anglers indicated no species preference. This is slightly lower than the no preference rate published from Kentucky's urban fishing program (52-63%; Emme and Buynak 2008). Nearly half, (45-50%) of anglers targeted channel catfish, which was similar to the percent of channel catfish anglers in Kentucky's urban program (42-49%; Emme and Buynak 2008). However, the actual number was likely higher because many anglers with no preference were fishing in ways that increased their likelihood of catching channel catfish. This supports the stocking efforts of channel catfish within the ponds.

Anglers also showed a strong preference for crappie at Kid's Lake North. While this species can be difficult to manage in small impoundments, a considerable number of anglers came to Kid's Lake North to pursue crappie, an opportunity that does not exist at other CTHFP ponds we surveyed. Largemouth bass were also highly sought at all three ponds. While regulations specify that all bass are to be released, some harvest was observed by creel clerks, especially at Dolese Youth Pond. Largemouth bass are expensive to produce (Brader 2008; Emme and Buynak 2008) and an effort should be made by game wardens to enforce regulations to ensure a sustainable resource without the expenses of stocking (Balsman and Shoup 2008; Eades et al. 2008).

The results of our creel survey suggest that the species available at these ponds typically matches angler interests. However, the species preference was often related to the species composition and abundance within the pond, and it is possible that anglers simply adapt to whatever is present at a given location (or chose to fish elsewhere when

their preferred species was not present and therefore did not influence our creel survey results).

A strong majority of anglers opposed stocking only channel catfish in the CTHFP ponds. However, the survey question related to this topic may have confused some anglers and led to question misinterpretation (Pollock et al. 1994). Many anglers believed that continuous stocking of all species is required to maintain an urban fishery. While channel catfish were the only warm-water species being stocked, anglers were not told this. Anglers also may have thought that new ponds in the program would only be stocked with channel catfish. While these misinterpretations could have inflated the number of people opposed to stocking only channel catfish, the results suggest that anglers are seeking the option to pursue multiple species. Kid's Lake North and South Lake Park East both had healthy sunfish and largemouth bass populations, but additional stocking of hybrid sunfish, hybrid striped bass (Hutt et al. 2008) or largemouth bass could be considered in other CTHFP ponds that do not naturally support stable populations of multiple species. The fishery at Dolese Youth Pond consists primarily of stocked channel catfish and trout. We suggest stocking of additional species, such as hybrid sunfish would improve angler satisfaction. The cost of these additional stockings should be compared with the anglers' willingness to pay to determine if the benefits outweigh the costs.

<u>The importance of pond location and amenities in attracting/retaining anglers</u>

The anglers interviewed in our creel survey had short fishing trips (mode = 2 h). This is similar to Arkansas' urban fishing program, where average trip length was 1.9 h for catfish anglers (Lang et. al 2008). While we did not have enough completed trips to

accurately measure average trip length directly, we observed that many anglers fished for short periods of time, often even shorter than what they indicated in the survey. Urban residents are often time restricted and can be lured to other recreational activities that require smaller blocks of time if fishing opportunities are not provided in close proximity to home or work (Fedler 2000). Therefore, it appears the CTHFP is providing opportunities to urban residents for short-duration trips, and may help to retain them as active anglers (Balsman and Shoup 2008).

Anglers choose to use urban fisheries based on their proximity and available facilities (Manfredo et al. 1984). Having amenities present may also make the angling experience more enjoyable and facilitate recruitment and retention (Balsman and Shoup 2008). Amenities that anglers desired in our survey varied among ponds, supporting the idea that it is important to provide different sets of amenities at different locations in order to accommodate the disparate desires of different urban angling groups (Hunt and Ditton 1997; Toth and Brown 1997).

Anglers interviewed during our survey placed high importance on having restrooms at the CTHFP ponds. This may be due to the large number of family groups with children (Balsman 2009b), the large majority of older anglers (Balsman 2009b), or just the general lack of privacy associated with fishing in these urban environments. Anglers who fish with others, especially other family members, place a high importance on amenities such as picnic tables, restrooms and camping facilities (Hunt and Ditton 1997). Existing parks often already have these types of amenities present and the costs of amenity implementation and upkeep can be shared with other city departments. Keeping anglers satisfied may require enhancing other elements of the experience to keep

anglers from dropping out of recreational fishing (Murdock et al. 1992; Hunt and Ditton 1997), especially if maximum catch and harvest rates can not be maintained via stocking due to budget constraints.

Channel catfish regulations in the CTHFP

The majority of anglers in our survey were in favor of more restrictive size or bag regulations for channel catfish. Anglers typically support both size limits (Dawson and Wilkins 1981; Quinn 1992; Petering et al. 1995) and bag limits (Hardin et al. 1988; Quinn 1992; Reed and Parsons 1999) as management tools. Given the slow channel catfish growth rates in the CTHFP ponds (Balsman 2009a), minimum length limits probably would not be appropriate in these fisheries. However, a more restrictive bag limit on large fish could be implemented if larger fish were to be stocked. While logical for the current situation (abundant slow-growing fish), the current bag limit of six channel catfish may be too liberal if larger fish are stocked. Exploitation of channel catfish in small lakes can be high (Eder and McDannold 1987; Santucci et al. 1994; Parrett et al. 1999), especially in urban ponds where fishing pressure exceeds that of rural lakes. Low harvest rates at heavily fished urban ponds often indicate depletion of harvestable-size fish (Michaletz and Stanovick 2005). This is particularly likely for the channel catfish populations because catfish anglers are typically more harvest-oriented than other angling groups (Schramm et al. 1999; Wilde and Ditton 1999). Only one angler was observed harvesting a bag limit of channel catfish and only two other parties had a bag limit in aggregate of all anglers in the fishing party during our 2-year study. This was not caused by anglers releasing large channel catfish, but rather reflected the low catch rates of large fish.

Angler satisfaction

Angler satisfaction is typically based on relaxation, enjoyment of the outdoors, companionship, and a number of other benefits from the fishing experience (Pollock et al. 1994). However, even for anglers that place little importance on catch motives, satisfaction rates often correlate strongly with catch rate (Matlock et al. 1988; Arlinghaus 2006). Catching fish or at least having a good opportunity to catch fish, after all, is why the anglers participate in fishing. Fish densities are one of the components of satisfaction that fisheries managers do have some control over in the urban fishing experience. However, we found no meaningful relationship between catch rate or size of fish caught and satisfaction. It is possible that the range of catch rates and sizes of fish caught was insufficient to lead to differences in satisfaction even for anglers whose satisfaction is tied to catch. Alternatively, the anglers using the CTHFP may be different than those in previous studies where catch was found to correlate with satisfaction (Matlock et al. 1988; Spencer 1993; Arlinghaus 2006). To address how angler satisfaction relates to catch rates, it would have been useful to specifically ask anglers to rate their satisfaction for the number and quality of fish caught today. This would have provided more specific information to help guide adjustments to stocking strategies.

Potential survey shortcomings

The creel survey was designed to interview all anglers that agreed to complete the survey. However, a few non-English speaking anglers could not be interviewed due to the language barrier. While this did not happen frequently, there were several Hispanic and Asian Americans who could not complete the survey.

Some anglers who fished a given pond frequently were interviewed multiple times, giving their opinions more weight. The percent of anglers who were aware of the CTHFP program increased throughout the survey, potentially as a result of prior contacts with creel clerks and the survey. New signage about the program was also erected at two of the ponds during the survey that could also have increased awareness. Existing signs with regulations and the CTHFP logo were already posted near parking lots and around the ponds prior to the survey period.

Conclusions

Angler satisfaction is an important factor in keeping anglers active and buying licenses. If they are not satisfied with their fishing experience they may be lost to other recreational activities (Fedler 2000). Channel catfish are an important aspect of the CTHFP program and one facet of the fishing experience that fisheries managers are able to adjust. Catch rates were low (0.05-0.33), and harvest rates even lower (< 0.1 fish/h) for channel catfish in the CTHFP ponds. Additional stocking of large catchable-sized catfish may be needed to improve angler satisfaction and meet the needs of anglers. Anglers were in favor of more restrictive bag limits which, in conjunction with an increase in the size of fish stocked, may improve the fishing. Additional studies on anglers' willingness to pay for stockings may be warranted. Trout are also a popular species in the CTHFP ponds and anglers that may not otherwise use the resource utilize these ponds during the trout season. Trout stockings at other ponds in the CTHFP may be popular and bring in additional funds through trout stamps and license sales that could be reinvested in the program.

Literature Cited

Arlinghaus, R. 2006. On the apparently striking disconnect between motivation and satisfaction in recreational fishing: the case of catch orientation of German anglers. North American Journal of Fisheries Management 26:592-605.

Ballard, K. K. 2008. Conducting an evaluation of your urban fishing program. Pages 323-332 *in* R. T. Eades, J. W. Neal, T. J. Lang, K. M. Hunt, and P. Pajak, editors. Urban and community fisheries programs: development, management, and evaluation. American Fisheries Society, Symposium 67, Bethesda, Maryland.

Balsman, D. M. 2009a. Assessing channel catfish population sizes, growth rates, harvest rates, and stocking strategies in Oklahoma's urban fishing program. Chapter 3 *in* Balsman, D. M. An evaluation of Oklahoma's Close-to-Home-Fishing-Program. Master Thesis. Oklahoma State University, Stillwater, OK.

Balsman, D. M. 2009b. Demographics, behaviors, and preferences of anglers using Oklahoma's Close-to-Home urban fishing program relative to licensed anglers statewide and those living in metropolitan areas. Chapter 1 *in* Balsman, D. M. An evaluation of Oklahoma's Close-to-Home-Fishing-Program. Master Thesis. Oklahoma State University, Stillwater, OK.

Balsman, D. M., and D. E. Shoup. 2008. Opportunities for urban fishing: developing urban fishing programs to recruit and retain urban anglers. Pages 31-40 *in* R. T. Eades, J. W. Neal, T. J. Lang, K. M. Hunt, and P. Pajak, editors. Urban and community fisheries programs: development, management, and evaluation. American Fisheries Society, Symposium 67, Bethesda, Maryland.

Brader, J. D. 2008. Aquaculture's role in providing fish for urban fisheries programs. Pages 13-19 *in* R. T. Eades, J. W. Neal, T. J. Lang, K. M. Hunt, and P. Pajak, editors. Urban and community fisheries programs: development, management, and evaluation. American Fisheries Society, Symposium 67, Bethesda, Maryland.

Clark, G. H. 1934. The need for a measure of the angler's catch. Transactions of the American Fisheries Society 64:49-53.

Dawson, C. P., and B. T. Wilkins. 1981. Motivations of New York and Virginia marine boat anglers and their preferences for potential fishing constraints. North American Journal of Fisheries Management 1:151-158.

Driver, B. L., and R. C. Knopf. 1976. Temporary escape: one product of sport fisheries management. Fisheries 1(2):21–29.

Driver, B. L., and R. W. Cooksey. 1980. Preferred psychological outcomes of recreational fishing. Pages 27–40 *in* R. A. Barnhart and T. D. Roelofs, editors. Catch-and-release fishing as a management tool California Cooperative Fishery Research Unit, Humboldt State University, Arcata.

Eades, R. T., L. D. Pape, and K. M. Hunt. 2008. The role of law enforcement in urban fisheries. Pages 41-51 *in* R. T. Eades, J. W. Neal, T. J. Lang, K. M. Hunt, and P. Pajak, editors. Urban and community fisheries programs: development, management, and evaluation. American Fisheries Society, Symposium 67, Bethesda, Maryland.

Eder, S., and W. E. McDannold Sr. 1987. The channel catfish fishery at Pony Express Lake, Missouri, 1963-1984. North American journal of Fisheries Management 7:502-512.

Emme, K. A., and G. L. Buynak. 2008. Year-one evaluation of Kentucky's urban fishing program. Pages 333-346 *in* R. T. Eades, J. W. Neal, T. J. Lang, K. M. Hunt, and P. Pajak, editors. Urban and community fisheries programs: development, management, and evaluation. American Fisheries Society, Symposium 67, Bethesda, Maryland.

Fedler, A. J. 2000. Participation in boating and fishing: a literature review. Recreational Boating and Fishing Foundation, Alexandria, Virginia.

Fedler, A. J., and L. E. Howard. 1991. The status of urban fishing programs nationwide. Sport Fish Institute, Washington, D.C.

Fedler, A. J., and R. B. Ditton. 1994. Understanding angler motivations in fisheries management. Fisheries 19(4):6–13.

Finn, K. L., and D. K. Loomis. 2001. The importance of catch motives to recreational anglers: the effects of catch satiation and deprivation. Human Dimensions of Wildlife 6:173–187.

Fisher, M. R. 1997. Segmentation of the angler population by catch preference, participation, and experience: a management-oriented application of recreational specialization. North American Journal of Fisheries Management 17:1–10.

Hardin, S., J. D. Rayburn, and G. Posnansky. 1988. Attitudes, practices and preferences of licensed freshwater anglers in Florida. Proceedings of the Annual Conference Southeastern Association Fish and Wildlife Agencies 41:168–177.

Hendee, J. C. 1974. A multiple-satisfaction approach to game management. Wildlife Society Bulletin 2:104–113.

Hunt, K. M., H. L. Schramm Jr., T. J. Lang, J. W. Neal, and C. P. Hutt. 2008. Status of

urban and community fishing programs nationwide. Pages 177-202 *in* R. T. Eades, J. W. Neal, T.J. Lang, K. M. Hunt, and P. Pajak, editors. Urban and community fisheries programs: development, management, and evaluation. American Fisheries Society, Symposium 67, Bethesda, Maryland.

Hunt, K. M., and R. B. Ditton. 1997. The social context of site selection for freshwater fishing. North American Journal of Fisheries Management 17(2):331-338.

Hutt, C. P., and J. R. Jackson. 2008. Implications of angler motivations and preferences for urban fisheries management. Pages 63-76 *in* R. T. Eades, J. W. Neal, T. J. Lang, K. M. Hunt, and P. Pajak, editors. Urban and community fisheries programs: development, management, and evaluation. American Fisheries Society, Symposium 67, Bethesda, Maryland.

Hutt, C. P., J. W. Neal, and T. J. Lang. 2008. Stocking harvestable hybrid striped bass in an urban fishing program: angling success, angler satisfaction, and influence on bluegill size structure. Pages 403-411 *in* R. T. Eades, J. W. Neal, T. J. Lang, K. M. Hunt, and P. Pajak, editors. Urban and community fisheries programs: development, management, and evaluation. American Fisheries Society, Symposium 67, Bethesda, Maryland.

Lang, T. J., J. W. Neal, and C. P. Hutt. 2008. Stocking frequency and fishing quality in an urban fishing program in Arkansas. Pages 379-389 *in* R. T. Eades, J. W. Neal, T. J. Lang, K. M. Hunt, and P. Pajak, editors. Urban and community fisheries programs: development, management, and evaluation. American Fisheries Society, Symposium 67, Bethesda, Maryland.

Malvestuto, S. P. 1996. Sampling the recreational creel. Pages 591-623 *in* B. R. Murphy

and D. W. Willis, editors. Fisheries techniques, 2nd edition. American Fisheries Society, Bethesda, Maryland.

Malvestuto, S. P., W. D. Davies, and W. L. Shelton. 1978. An evaluation of the roving creel survey with nonuniform probability sampling. Transactions of the American Fisheries Society 107:255–262.

Manfredo, M. J., C. C. Harris, and P. J. Brown. 1984. The social values of an urban recreational fishing experience. Pages 156-164 *in* L. A. Allen, editor. Urban fishing symposium proceedings. American Fisheries Society, Fisheries Management Section and Fisheries Administrators Section, Bethesda, Maryland.

Matlock, G. C., G. E. Saul, and C. E. Bryan. 1988. Importance of fish consumption to sport fishermen. Fisheries 13(1):25-26.

Michaletz, P. H., and J. S. Stanovick. 2005. Relations among angler use, harvest, and stocking rates of channel catfish in Missouri impoundments. Proceedings of the Annual Conference Southeastern Association of Fish and Wildlife Agencies 59:263-272.

Murdock, S. H., K. Backman, R. B. Ditton, Md. N. Hoque, and D. Ellis. 1992. Demographic change in the United States in the 1990's and the twenty-first century: implications for fisheries management. Fisheries 17(2):6-13.

Parrett, T. P., J. A. Marshall, and D. J. Bright. 1999. A comparison of daytime and nighttime channel catfish fisheries at two Ohio impoundments Pages 391-394 *in* E. R. Irwin, W. A. Hubert, C. F. Rabeni, H. L. Schramm, Jr. and T. Coon, editors. Catfish 2000: proceedings of the international ictalurid symposium. American Fisheries Society, Symposium 24, Bethesda, Maryland.

Petering, R. W., G. L. Isabel, and R. L. Miller. 1995. A survey method for determining angler preference for catches of various fish length and number combinations. North American Journal of Fisheries Management 15:732–735.

Pollock, K. H., C. M. Jones, and T. L. Brown. 1994. Angler survey methods and their applications in fisheries management. American Fisheries Society, Bethesda, Maryland.

Reed, J. R., and B. G. Parsons. 1999. Angler opinions of bluegill management and related hypothetical effects on bluegill fisheries in four Minnesota lakes. North American Journal of Fisheries Management 19:515–519.

Quinn, S. P. 1992. Angler perspectives on walleye management. North American Journal of Fisheries Management 12:367–378.

Santucci, V. J., Jr., D. H. Wahl, and T. J. Storck. 1994. Growth, mortality, harvest, and cost-effectiveness of stocked channel catfish in a small impoundment. North American Journal of Fisheries Management 14:781-789.

SAS Institute. 2004. SAS/STAT user's guide, version 9.1.3. SAS Institute, Cary, North Carolina.

Schramm, H. L., Jr., and G. B. Edwards. 1994. The perspectives on urban fisheries management: results of a workshop. Fisheries 19(10):9-15.

Schramm, H. L., Jr., J. T. Forbes, D. A. Gill, and W. D. Hubbard. 1999. Fishing environment preference and attitudes towards overharvest: are catfish anglers unique? Pages 417-425 *in* E. R. Irwin, W. A. Hubert, C. F. Rabeni, H. L. Schramm, Jr. and T. Coon, editors. Catfish 2000: proceedings of the international

ictalurid symposium. American Fisheries Society, Symposium 24, Bethesda, Maryland.

Spencer, P. D. 1993. Factors influencing satisfaction of anglers on Lake Miltona, Minnesota. North American Journal of Fisheries Management 13:201-209.

Toth, J. F., Jr., and R. B. Brown. 1997. Racial and gender meanings of why people participate in recreational fishing. Leisure Sciences 19:129-146.

Wilde, G. R., and R. B. Ditton. 1999. Difference in attitudes and fishing motives among Texas catfish anglers. Pages 395-405 *in* E. R. Irwin, W. A. Hubert, C. F. Rabeni, H. L. Schramm, Jr. and T. Coon, editors. Catfish 2000: proceedings of the international ictalurid symposium. American Fisheries Society, Symposium 24, Bethesda, Maryland.

Yoesting, D. R., and D. L. Burkhead. 1973. Significance of childhood recreation experience on adult leisure behavior: an exploratory analysis. Journal of Leisure Research 5(4)25-36.

Table 1. Angler catch and harvest rates of fish in three Close-to-Home-Fishing-Program ponds in Oklahoma City, OK. Rates are calculated from a year-round roving creel survey conducted from September 2006 – August 2009. Rainbow trout catch and harvest rates are from January – April 2007 and 2008. Dolese Youth Pond was the only pond stocked with rainbow trout.

	Kid's Lake North		**Dolese Youth Pond**		**South Lake Park East**	
	Catch	Harvest	Catch	Harvest	Catch	Harvest
Channel Catfish	0.05	0.02	0.26	0.07	0.33	0.03
Crappie	0.80	0.24	0.05	0.00	0.02	0.00
Sunfish	0.53	0.20	0.06	0.00	0.72	0.17
Largemouth Bass	0.15	0.01	0.14	0.11	0.12	0.00
Rainbow Trout	-	-	0.33	0.28	-	-
Bullhead Catfish	-	-	0.15	0.01	0.28	0.01
Common Carp	-	-	0.05	0.01	-	-

Table 2. Linear regression statistics relating angler satisfaction with catch rates at three Close-to-Home-Fishing-Program ponds in Oklahoma City, OK. Species-specific analyses were conducted using records where anglers ranked the species as one they preferred to catch. Anglers who had caught no fish but still ranked the species were included. "All species" models included the total catch of all fish species regardless of the angler's species preference ranking.

Species	Slope	Intercept	P	R^2	Number of Observations
Kid's Lake North					
Channel Catfish	0.107	1.980	0.838	0.001	68
Sunfish	0.562	1.855	0.021	0.115	46
Crappie	0.499	1.741	0.002	0.108	89
Largemouth Bass	0.529	1.961	0.065	0.043	80
All Species	0.597	1.377	0.000	0.117	154
Dolese Youth Pond					
Channel Catfish	0.001	2.143	0.995	0.000	209
Sunfish	-0.990	2.186	0.329	0.016	61
Largemouth Bass	0.955	2.014	0.018	0.046	120
Rainbow Trout	0.292	2.354	0.250	0.004	304
All Species	0.357	2.000	0.000	0.020	597
South Lake Park East					
Channel Catfish	-0.065	2.313	0.640	0.002	101
Sunfish	0.126	2.226	0.279	0.020	60
Largemouth Bass	0.084	2.297	0.691	0.002	90
All Species	0.182	2.126	0.054	0.018	213
All Lakes Combined					
Channel Catfish	0.022	2.148	0.817	0.000	378
Sunfish	0.215	2.108	0.026	0.030	167
Crappie	0.362	2.005	0.005	0.033	236
Largemouth Bass	0.388	2.091	0.014	0.021	290
All Species	0.287	1.993	0.000	0.023	964

Table 3. Linear regression statistics relating angler satisfaction to mean and maximum size of channel catfish caught by anglers at three Close-to-Home-Fishing-Program ponds in Oklahoma City, OK (Dolese youth Pond, Kid's Lake North, and South Lake Park). Separate analysis was only performed with data from Dolese Youth Pond because the observed number of catfish harvested at the other CTHFP ponds was insufficient for separate pond analyses.

Species	Slope	Intercept	P	R^2	Number of Observations
Dolese Youth Pond					
Mean Size of Channel Catfish	0.553	-0.307	0.290	0.034	35
Maximum Size of Channel Catfish	0.506	-0.079	0.327	0.029	35
All Lakes Combined					
Mean Size of Channel Catfish	0.651	-0.961	0.161	0.041	49
Maximum Size of Channel Catfish	0.695	-0.256	0.129	0.048	49

Table 4. Harvest preference, awareness of the urban fishing program, and satisfaction of anglers using the Close-to-Home-Fishing-Program ponds in Oklahoma City, OK as assessed by a roving creel survey conducted from September 2006 – August 2008. "Dolese Youth Pond Trout" was a separate analysis from "Dolese Youth Pond" and represented only anglers interviewed fishing for trout during trout season ("Dolese Youth Pond" results do not include these trout anglers).

	Pond			
	Kid's Lake North	**Dolese Youth Pond**	**South Lake Park East**	**Dolese Youth Pond Trout**
Awareness of CTHFP				
Yes	75.2%	44.7%	59.0%	80.9%
No	24.8%	55.3%	41.0%	19.1%
Would you be happy if only channel catfish were stocked?				
Yes	26.1%	24.9%	39.4%	8.7%
No	73.9%	75.1%	60.6%	91.3%
Would you be happy with length restrictions or reduced bag limits for channel catfish if it improved fishing?				
Yes	68.9%	73.8%	76.7%	
No	12.6%	9.6%	10.6%	
No opinion	18.5%	16.7%	12.8%	
Rate today's fishing experience on this pond				
Excellent	6.8%	11.0%	9.7%	13.9%
Good	23.6%	30.1%	35.2%	34.7%
Satisfactory	32.9%	30.1%	34.3%	25.5%
Poor	32.3%	26.9%	19.4%	25.9%

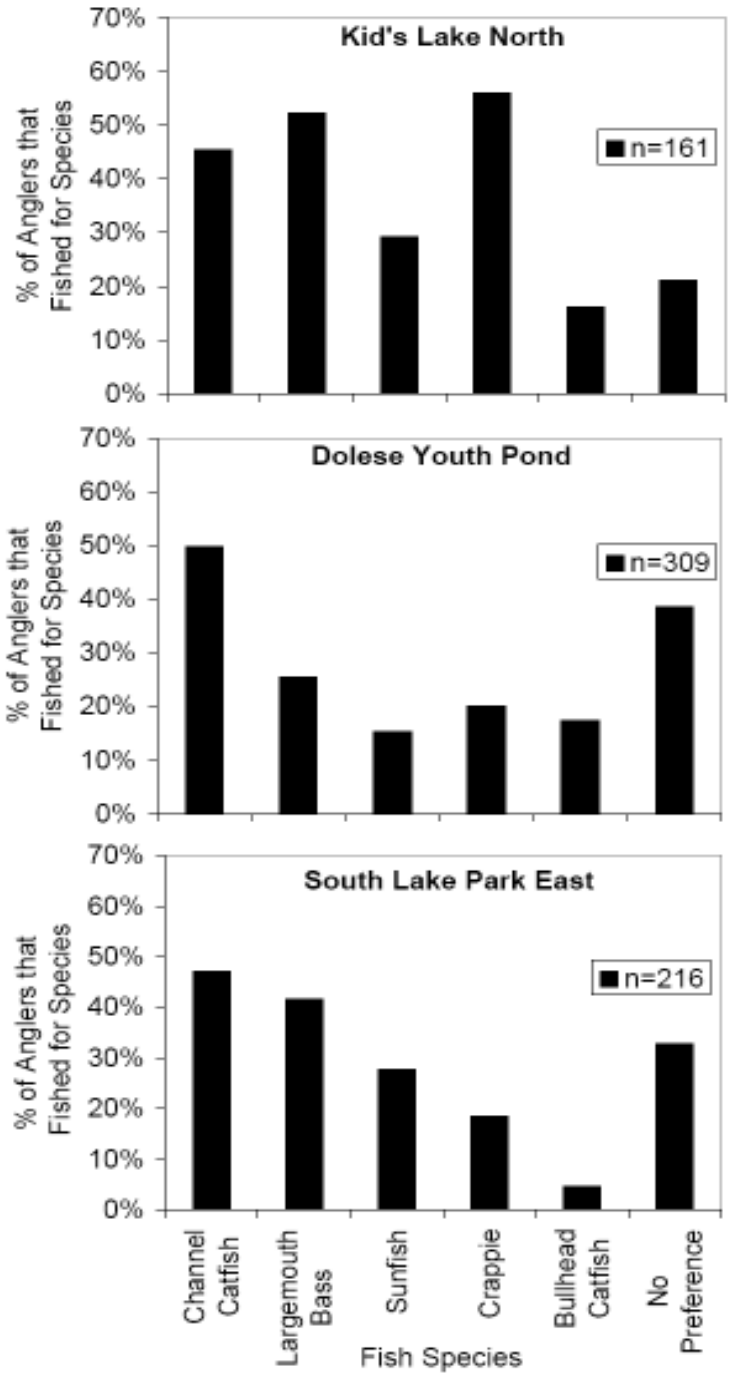

Figure 1. Species preference of anglers at three Close-to-Home-Fishing-Program ponds in Oklahoma City, OK, as assessed from a roving creel survey conducted from September 2006 - August 2008. Trout anglers were excluded from analysis because the majority of these anglers fished exclusively for trout during the special trout season.

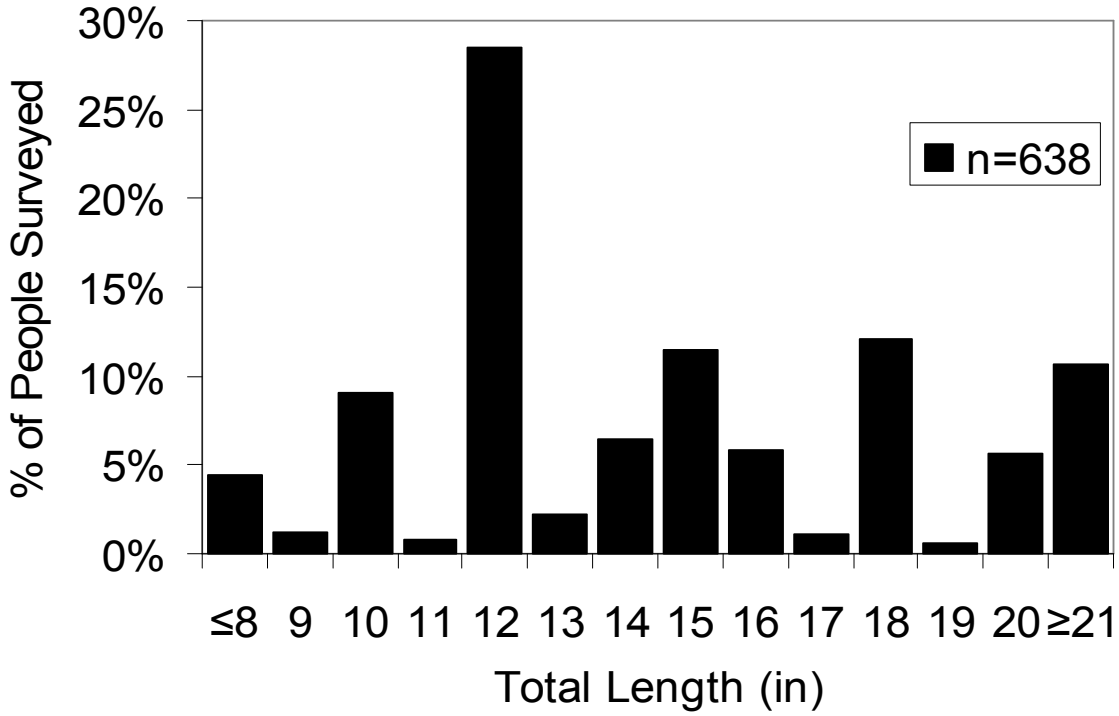

Figure 2. Angler opinion of the size of a "satisfactory/keeper-size channel catfish in inches" at the Close-to-Home-Fishing-Program ponds in Oklahoma City, OK, as assessed from a roving creel survey conducted from September 2006 - August 2008.

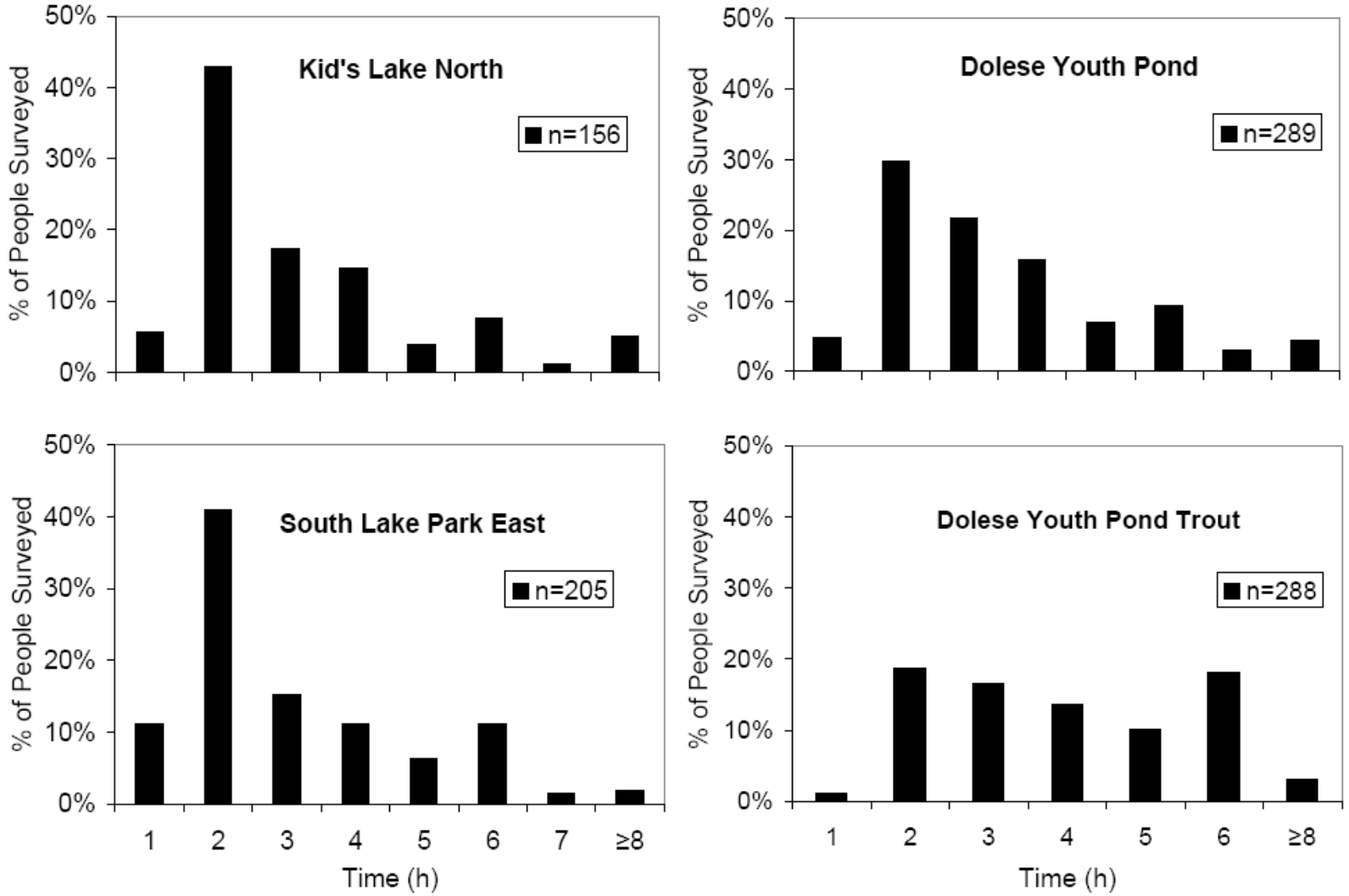

Figure 3. Length of a typical fishing trip at the Close-to-Home-Fishing-Program ponds in Oklahoma City, OK as recalled by anglers during a roving creel survey conducted from September 2006 - August 2008.

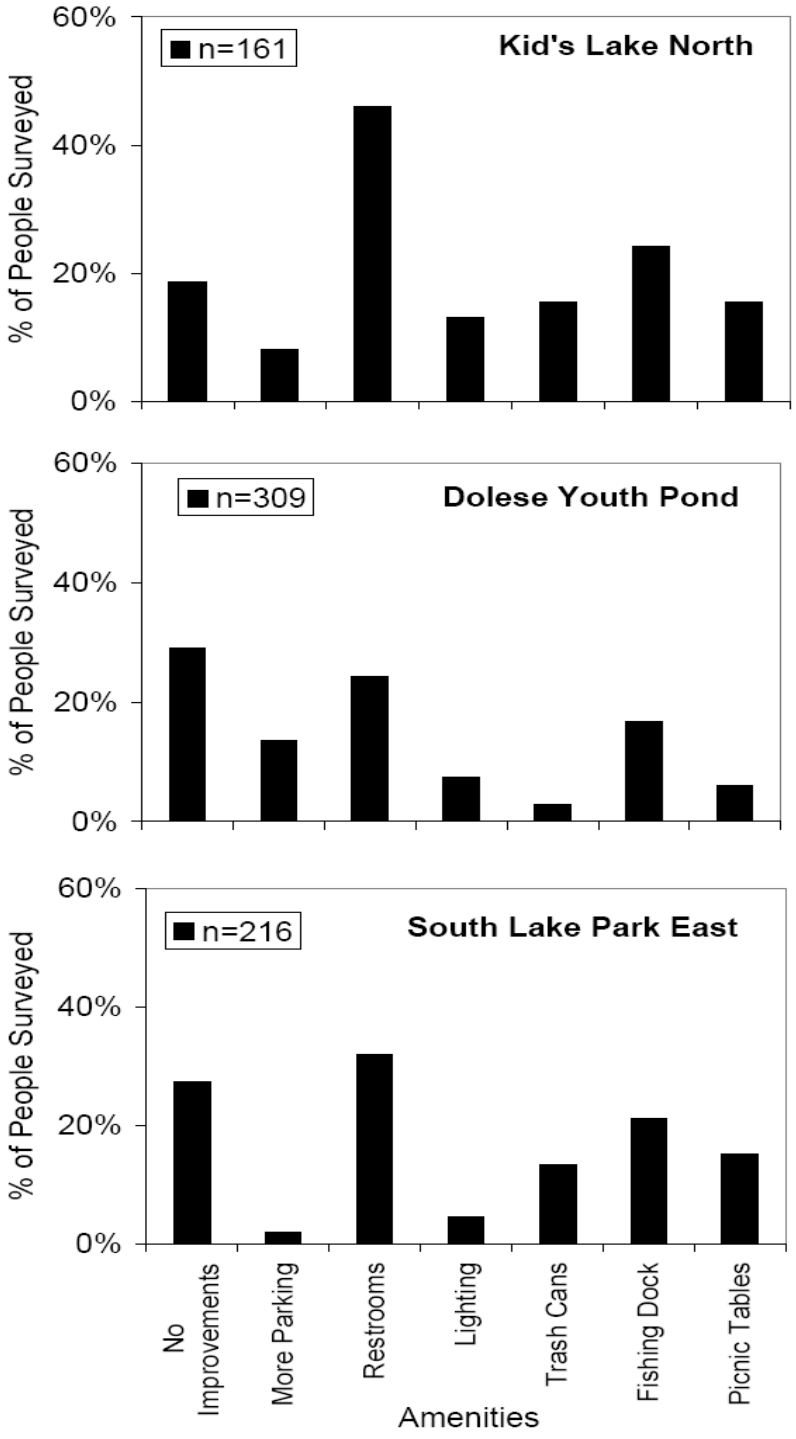

Figure 4. Amenities anglers would like to see implemented or improved at the Close-to-Home-Fishing-Program ponds in Oklahoma City, OK, as assessed from a roving creel survey conducted from September 2006 - August 2008.

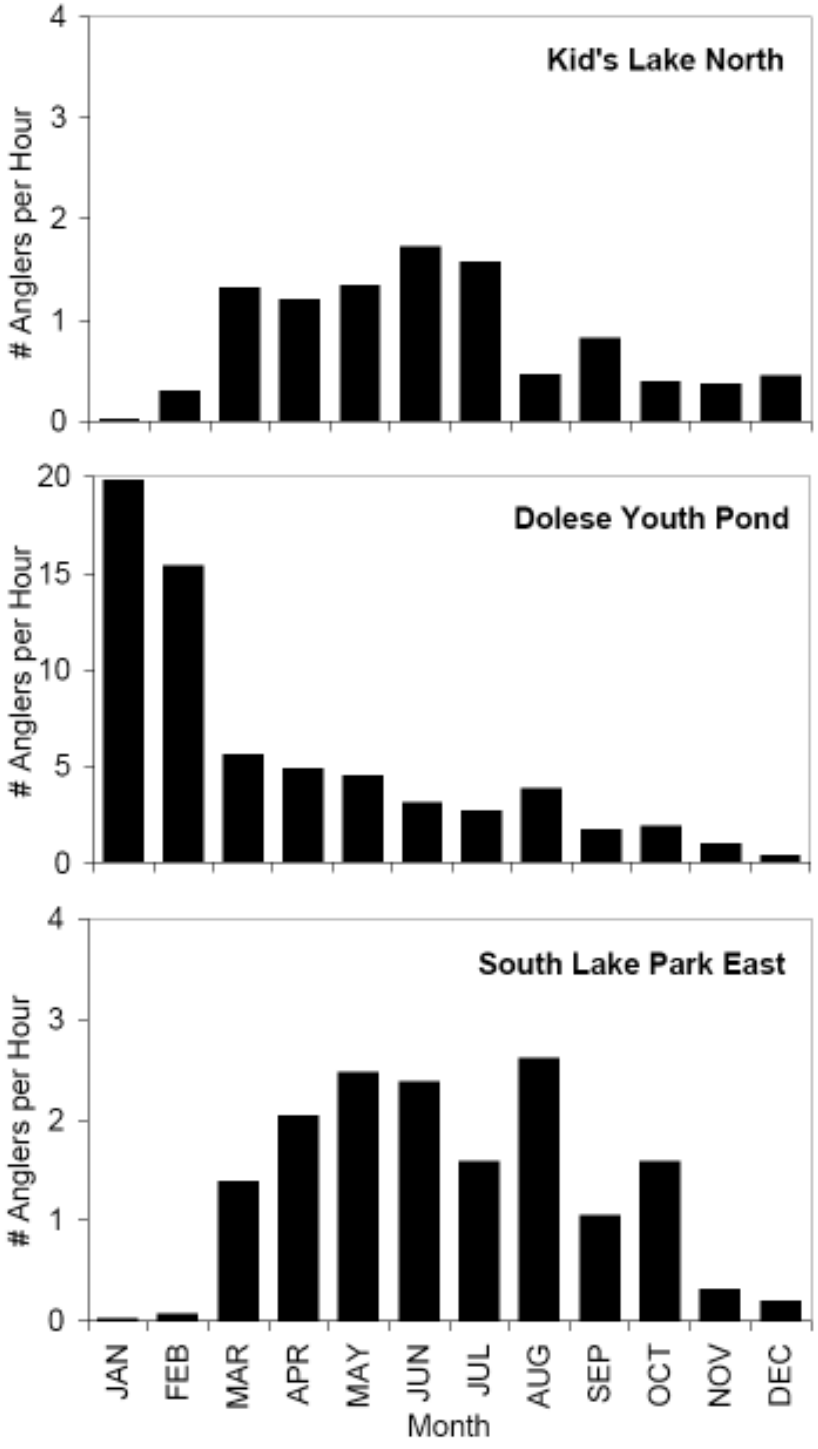

Figure 5. Mean number of anglers fishing at three Close-to-Home-Fishing-Program ponds in Oklahoma City, OK by month from September 2006 – August 2008. Note different Y axis scaling for Dolese Youth Pond.

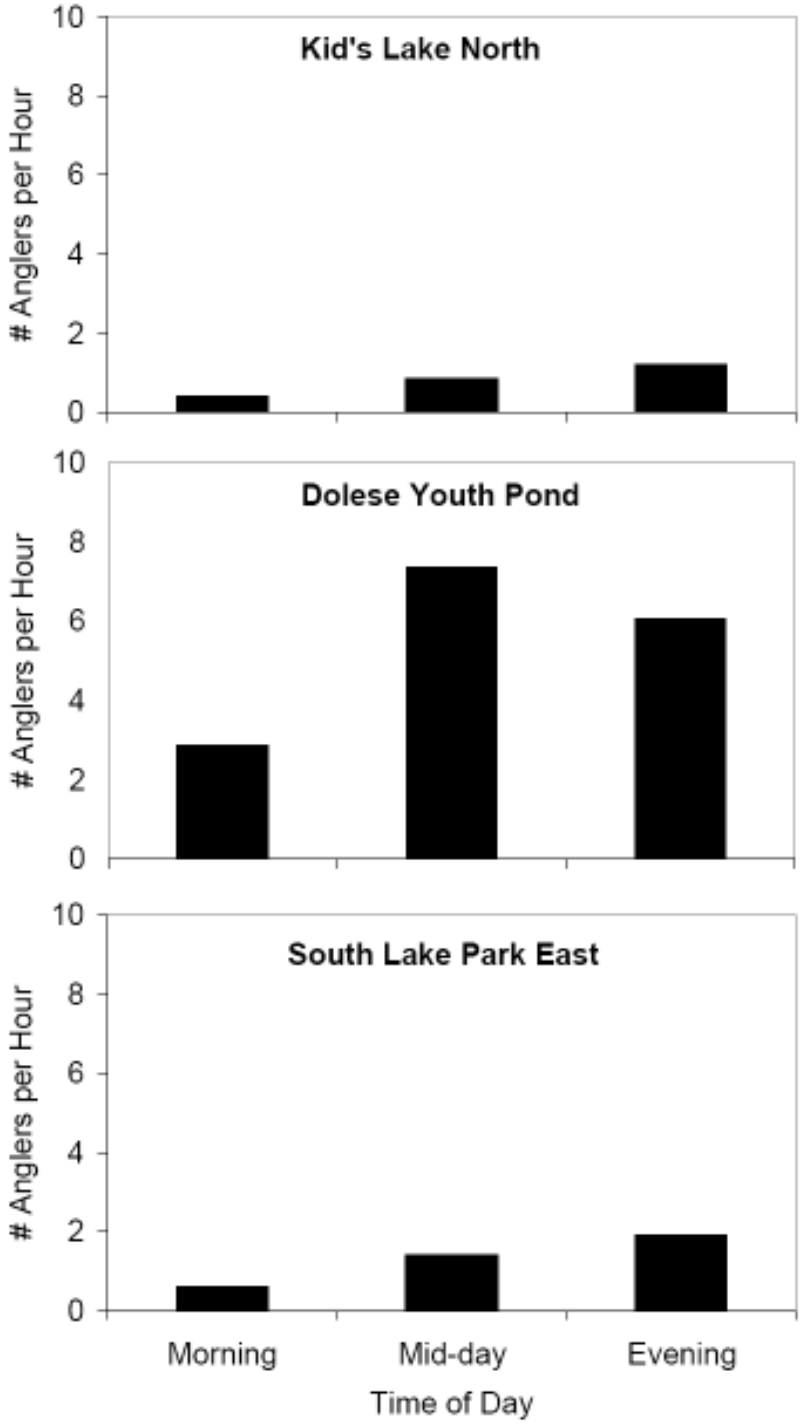

Figure 6. Mean number of anglers at three Close-to-Home-Fishing-Program ponds in Oklahoma City, OK by time of day from September 2006 – August 2008.

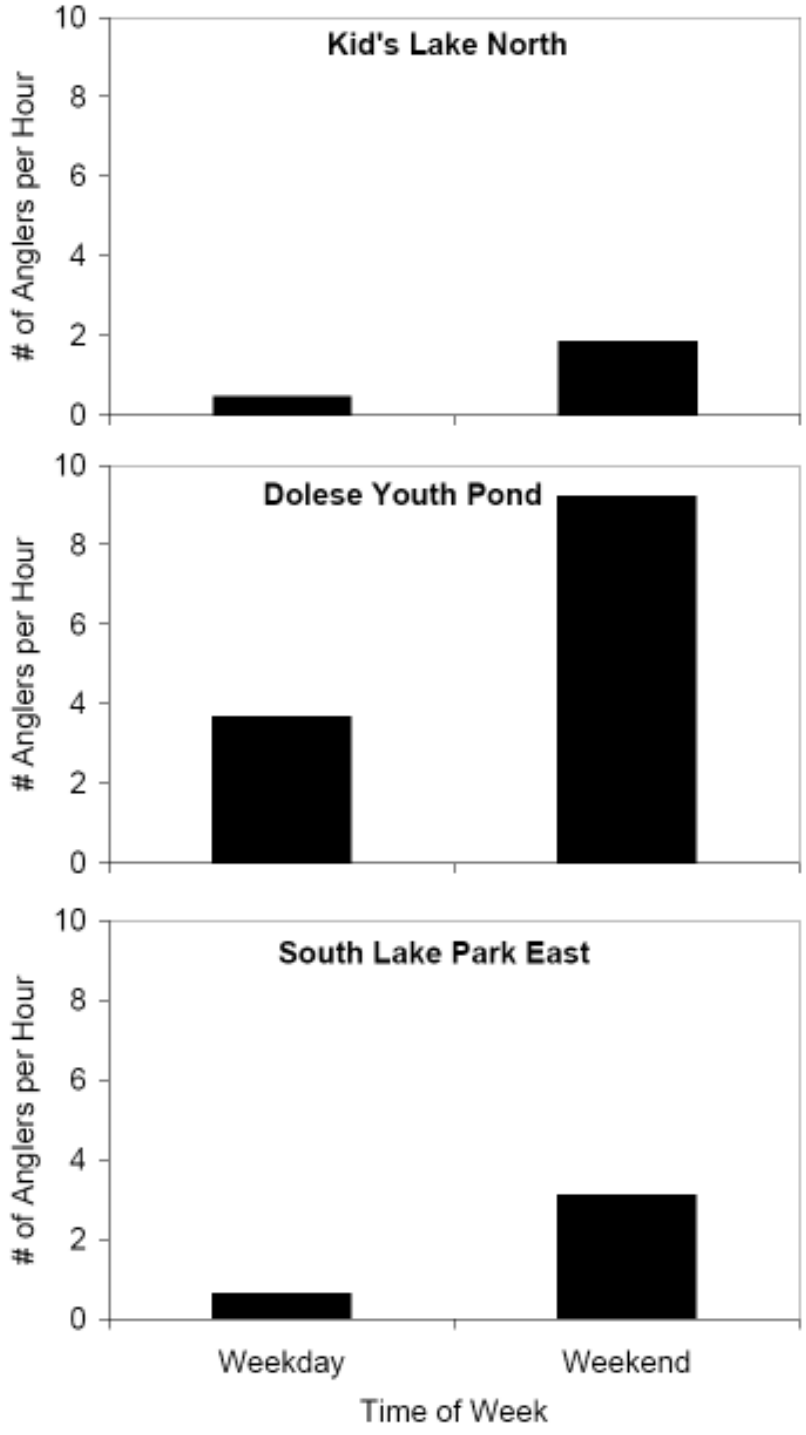

Figure 7. Mean number of anglers at three Close-to-Home-Fishing-Program ponds in Oklahoma City, OK on weekday vs. weekend from September 2006 – August 2008.

CHAPTER III

ASSESSING CHANNEL CATFISH POPULATION SIZES, GROWTH RATES, HARVEST RATES, AND STOCKING STRATEGIES IN OKLAHOMA'S URBAN FISHING PROGRAM

Abstract

Channel catfish are a popular sportfish commonly stocked in urban fisheries. Despite the large investment of money and effort in stocking, little effort is directed at evaluating and adaptively managing these fisheries. We investigated channel catfish population sizes, size distribution, age, growth, and mortality in three ponds in the Close-to-Home-Fishing-Program (CTHFP) in the Oklahoma City, OK metropolitan area over three sampling years. Fyke nets and modified fyke nets baited with waste cheese were used in sampling (24-h sets in July and August) the first year with some success. Tandem hoop net sets baited with cheese logs (72-h sets in May – August) were used in years two and three of the study with higher catch rates, less effort, and wider fish size distribution. Population sizes of channel catfish differed between lakes and years, (ranged from 224-1686 fish). Most catfish at Dolese Youth Pond and South Lake Park were < 305 mm total length (TL). Kid's Lake North had a moderately large population of catfish > 305 mm TL. Catch per unit effort was highest in the tandem hoop nets sets

the first set period and declined in subsequent samples. Pectoral spines and otoliths were collected for age and growth analysis. Growth rates were highly variable both among lakes and fish. Total annual mortality ranged from 0.3–0.61. We recommend stocking larger fish in Dolese Youth Pond and South Lake Park with a put-and-take strategy due to the slow growth in these ponds. Growth rates of fish in Kid's Lake North were high enough that this strategy may be unnecessary.

Introduction

Utility of Channel Catfish in Small Impoundments

Channel catfish *Ictalurus punctatus* are found in most small impoundments and drainages across the USA, especially in the midwest and south (Pflieger 1997). They are one of the most popular sportfish in Oklahoma (Summers 2009) and are widely sought by anglers across the USA (Vanderford 1984; USDI and USDC 2002). Channel catfish are the most heavily stocked warmwater fish by weight in every region of the USA (Halverson 2008). They are also commonly stocked in urban fishing programs (Brader 2008). In small clear impoundments continual stocking is often needed to maintain populations because the eggs and/or young are preyed upon by bluegill *Lepomis macrochirus*, largemouth bass *Micropterus salmoides*, and crappie *Pomoxis spp.* (Marzolf 1957; Davis 1959), and fail to recruit in sufficient numbers to provide an adequate fishery. Stocking of catchable-sized channel catfish is effective in small impoundments where natural reproduction is limited and predation is an issue (Crance and McBay 1966; Broach 1968; Eder and McDannold 1987; Michaletz and Dillard 1999). In other cases, smaller fish can be stocked to produce a put-grow-and-take

fishery. Despite the large investment of money and effort in stocking channel catfish in small impoundments, little effort is directed to evaluating and managing these fisheries (Michaletz and Dillard 1999). To ensure funds are spent efficiently, sampling of channel catfish populations is necessary to assess the fishery.

Urban anglers are particularly harvest-oriented (Alcorn 1981; Murdock et al. 1992; Arlinghaus and Mehner 2004), which increases the costs of maintaining urban fisheries. Larger stocked channel catfish are more vulnerable than small fish to catch and harvest (Michaletz et al. 2008). Because harvest is usually the desired effect in a put-and-take fishery, stocking larger fish may be advisable. However, if fishing pressure is low and growth rates are high, stocking smaller-sized catfish and allowing them to grow to harvestable size may be more practical. Channel catfish within small urban impoundments should be relatively easy to manage as populations can be controlled both by manipulating stocking and angler harvest. If populations are heavily harvested then reduced bag limits and/or implementing length limits may be effective if increasing the number of stocked fish is not practical. Alternatively, if catfish numbers are too high stocking should be reduced and harvest encouraged. Overstocking of channel catfish can be detrimental and should be avoided because it can lead to competition between channel catfish and bluegill for macroinvertebrates (Michaletz 2006a; 2006b). Stocking harvestable fish is typically the greatest cost associated with an urban fishing program (Long 2003). Therefore, periodic assessment to ensure the proper stocking rates is essential.

Review of Channel Catfish Sampling Methods

Until recently, effective channel catfish sampling methods had not been established. In small impoundments gill nets, trap nets, or electrofishing were the

methods most commonly used in the past (Michaletz and Dillard 1999). Of the three sampling gears, gill nets may be the most effective (Robinson 1999; Santucci et al. 1999), but they cause high mortality (Hubert 1996), are highly size selective (Hubert 1996), and may not provide high catch rates (Mitzner 1999; Robinson 1999; Santucci et al. 1999; Michaletz 2001). More recently, tandem hoop nets have proven an effective means of sampling channel catfish within small impoundments (Sullivan and Gale 1999; Michaletz and Sullivan 2002). Tandem hoop nets sample a variety of size classes, have low mortality on catfish and non-target fish, and collect fewer non-target species. However, nets should be set at depths above the thermocline, and should not be used in impoundments with high turtle densities to reduce mortalities (Michaletz and Sullivan 2002).

Age and Growth

Pectoral spines can be removed from channel catfish as a non-lethal means of ageing (Michaletz 2005). Spine-derived ages are accurate for young fish, but as fish grow, a lumen appears in the basal section of the spine that can erode the central portion of the spine. As this happens, the first few annuli can be lost (Muncy 1959; Mayhew 1969). To eliminate this problem some managers prefer using otoliths (Crumpton et al. 1984). Age and growth data can be used to assess if growth rates are sufficient to provide anglers with keeper-size fish or if larger fish need to be stocked in an urban program. Urban anglers often prefer better fish to catch over a better place to fish (Schramm and Dennis 1993). Without sampling catfish populations and assessing angler interests, there is no way to evaluate if these needs are being met.

This study measured channel catfish population sizes, size distribution, age, growth, and mortality in three ponds in the Oklahoma City, OK metropolitan area. This research was conducted to assess the urban fishing program that was newly established and to see if current stocking strategies were meeting the needs of anglers.

Methods

Study Area

The Close-to-Home-Fishing-Program (CTHFP), Oklahoma's urban fishing program, began in 2002. Three ponds, located in the Oklahoma City metropolitan area, with established fisheries were chosen from the program as study sites for this project. Kid's Lake North and Dolese Youth Pond are located in the northern part of Oklahoma City (Oklahoma County). Both ponds are roughly 8.1 ha in size. South Lake Park East is located in Cleveland County at the southern edge of the Oklahoma City metropolitan area and is 1.2 ha in size. The ponds were stocked annually in the fall with channel catfish (102-254 mm total length [TL]) as a put-grow-and-take fishery. Additionally, catchable-size channel catfish (356-406 mm TL) were stocked before summer fishing clinics were held at the ponds. All three ponds contained channel catfish, sunfish *Lepomis spp.,* crappie, and largemouth bass. Dolese Youth Pond and South Lake Park East also had introduced populations of black bullhead catfish *Ameiurus melas*. Common carp *Cyrpinus carpio* were present in significant numbers in Dolese Youth Pond. Additionally, gizzard shad *Dorsoma cepedianum* occurred in Kid's Lake North and golden shiners *Notemigonus crysoleucas* in South Lake Park East.

Sampling Methods

In 2006 channel catfish were sampled in July and August with fyke and modified-fyke nets baited with waste cheese in mesh bags in the cod end of the nets (Marshall 1991; Michaletz, and Dillard 1999). Four modified-fyke nets with 1.27-cm bar mesh and two fyke nets with 2.54-cm bar mesh were set in each pond and sampled daily for 16 d (nets were removed from the lake over weekends). The fyke nets were attached to a 10-m lead net such that the nets were facing each other. The modified-fyke nets were set independently with a 10-m lead net and cod end attached to weights.

In June and July 2007 and June 2008, we sampled channel catfish using tandem hoop net sets (Sullivan and Gale 1999; Michaletz and Sullivan 2002) baited with cheese-logs in mesh bags placed at the cod end of the nets. The cheese logs were a mix of soybeans, cheese, and molasses. The use of soybean cake during summer is more effective than waste cheese (Flammang and Schultz 2007). Three hoop nets with 1.27-cm bar mesh and six hoop nets with 2.54-cm bar mesh were set at fixed sampling sites in each pond and sampled every 72 h until eight samples had been collected (nets were not removed these years on weekends; South Lake 2008 was only sampled six times). Nets were set in a three-net tandem with 1-m bridles between nets; the first net always being 2.54-cm bar mesh and the second and third nets either being 1.27-cm or 2.54-cm bar mesh (half the nets had 1.27-cm as the second net in the set and the other half had 2.54-cm bar mesh). The smaller nets were incorporated to detect smaller size classes of channel catfish that the larger nets would not have captured. Weights were attached to the front and back of the nets. The rear throat of all hoop nets was further constricted with cable ties to reduce fish escaping the net (Sullivan and Gale 1999).

Population Estimates

To estimate population sizes for fish ≥ 100 mm TL, we marked all captured fish ≥ 100 mm TL with an upper caudal fin clip and analyzed recapture data with the Schnabel mark-recapture method (Van Den Avyle 1993; Krebs 1998). Sampling subjectively ended when the estimated population size and the 95% confidence interval stabilized (typically when changes in mean values on subsequent samples were < 2%). A population estimate for fish ≥ 305 mm TL (the size most anglers considered harvestable-size) was also calculated by analyzing data with only fish over that size. If the number of recaptures was ≤ 50 fish, confidence limits for the Schnabel population estimates were obtained from the Poisson distribution (Krebs 1998); otherwise, the normal approximation method (Seber 1982) was used. A PSD value for channel catfish was also calculated (Gabelhouse 1984). Catch per unit effort was calculated as the mean number of channel catfish caught over the 72-h sampling period from all three nets in a tandem sampling set.

Age and Growth

Pectoral spines and otoliths were pulled from fish after the population size estimates were completed. Spines were pulled from five fish in each 10-mm length class by laying the spine flat against the fish and twisting in a counterclockwise direction (Sneed 1951; Marzolf 1957; Ashley and Garling 1980). Spines were allowed to dry for at least three weeks. Excess flesh was then removed and each spine was placed in a vial with a mixture of 1,893 ml of warm water and 150 ml of Biz powder detergent that covered the entire spine. The vials were then placed in a drying oven for 11-15 h at 37 ^{o} C. The spines were then rinsed with cold tap water and submerged in a mixture of 50/50 cold tap water and yellow ammonia for ≥ 5 h (typically 24 h). Finally, the spines were

rinsed and placed in a 50/50 mixture of cold tap water and 200-proof ethyl alcohol until they were sectioned and prepared for reading (Earl Buckner, Missouri Department of Conservation, personal communication). Pectoral spines were sectioned near the distal end of the basal groove with an Isomet® low-speed saw (Sneed 1951).

Up to five fish from each 100-mm length class were sacrificed and their otoliths removed and aged to validate spine ages. Otoliths were heated on a hotplate until they turned a yellowish brown. They were then mounted on a glass microscope slide, posterior end against the slide, with Crystalbond® thermoplastic cement. Otoliths were sanded to remove 1/3 to 1/2 of its thickness with 400 grit wet/dry sandpaper, revealing the nucleus. Otoliths were then polished using 600 grit wet/dry sandpaper, coated with glycerin to reduce glare, and aged under a dissecting microscope with illumination from the side using a fiber optic light cable (CMTCSDAFS 2005).

A blind concert read of two individuals was used and disagreements were resolved by mutual examination until a consensus could be reached. Prior to age determination, readers were trained with an instructional dvd from the American Fisheries Society (Estimating Fish Age From Otoliths - Techniques For Largemouth Bass and Channel Catfish and Known Age Otolith Database - Largemouth Bass and Catfish).

Growth rates for each year from each pond were calculated as growth increments from a mean length at age calculated using a length-age key (DeVries and Frie 1996). A length age-key could not be constructed for Kid's Lake North 2006 due to poor catch rates.

Length at age was also modeled using the von Bertalanffy growth equation:

$$l_t = L_\infty \left[1 - e^{(-k*(t-t_0))}\right]$$

Where l_t = fish size at time "t"; L_∞ = average maximum fish size; e = base of natural log; k = constant describing growth rate; and t_0 = length at time 0 (Gullard 1969 and Gallucci and Quinn 1979).

Mortality

Channel catfish angling mortality was calculated from daily harvest rates, calculated as the ratio of the means (Pollock et al. 1994). Mean daily harvest estimates (stratified by month, time of day, and weekend vs. weekday) were then expanded to monthly estimates by multiplying by the number of angling hours in each stratum for the month. Monthly harvest estimates were then summed to calculate total harvest for each year.

Total annual mortality was estimated using the Robson and Chapman method (1961) to account for variable recruitment/stocking. The mean size of channel catfish harvested was calculated from all catfish the creel clerks observed in anglers' possession while conducting the creel survey.

Results

Population Estimates

Natural reproduction was observed in Dolese Youth Pond and when the sampling was conducted in July and August, significant numbers of fish < 100 mm TL were observed. For population estimates and length frequency histograms, these fish were excluded. But, it should be noted that due to spawning structures placed in the pond, high turbidity, and the low abundance of centrarchid predators, reproduction of channel catfish occurred in this pond.

Channel catfish population size in Kid's Lake North ranged from 376-727 (Table 1) and from 88-550 for fish > 305 mm TL (Table 2). In Dolese Youth Pond, the population size ranged from 586-1686 (Table 1) and 85-216 for fish > 305 mm TL (Table 2). In South Lake Park East, the population size for all channel catfish > 100 mm TL ranged from 224-1243 (Table 1) and 46-127 (Table 2) for catfish > 305 mm TL. The length frequency of channel catfish in Kid's Lake North was variable, but always contained a substantial portion of the population > 305 mm TL (Figure 1). In 2006 we caught few large channel catfish in fyke and modified-fyke nets at Kid's Lake North. Results from 2007 and 2008 suggest the catfish population had a large proportion of fish > 305 mm TL, indicating a lot of harvestable-size channel catfish and a healthy population, suggesting the 2006 data may not have adequately represented the abundance of large fish. The majority of fish were < 305 mm TL in Dolese Youth Pond (Figure 2) and there was a very small proportion of the channel catfish at a harvestable size (> 305 mm TL). The mean length of fish from South Lake Park East increased each year (Figure 3). South Lake Park East had a relatively low proportion of fish > 305 mm TL in 2006 and 2007. After a fish kill reduced population size in 2007 catfish growth increased and a larger proportion of fish were > 305 mm TL in 2008 (Table 2; Figure 3).

PSD values varied among ponds and years. Kid's Lake North had PSD values of 47 and 31 in 2007 and 2008 respectively, indicating a relatively healthy population of large catfish. Dolese Youth Pond had PSD values of 13, 16, and 26 from 2006-08, respectively. Dolese Youth Pond had a large proportion of fish under the stock size of 280 mm TL and only a small proportion of quality-size fish. South Lake Park East had PSD values of 2 and 3 in 2006-07 but increased to 16 in 2008 (after the population size

decreased and growth increased). Therefore, while the PSD value increased, there were still a relatively low number of quality-size fish.

Catch rates varied from 24 to 112 fish per tandem net set on the first sampling period for the tandem hoop net sets. Catch rates were always highest in the first sampling period and typically declined after each subsequent sampling period (Table 3). In 2007, South Lake Park East had a low CPUE, likely due to a fish kill that occurred several weeks earlier (caused by low dissolved oxygen levels). Samples taken prior to the fish kill averaged > 100 fish per set, but insufficient data were collected prior to the fish kill to estimate population size. Once oxygen levels increased again, the population estimate study was restarted without using the original data. Catch rate data from 2006 were not considered because it was collected with a different net design.

Age and Growth

We found growth was highly variable both among and within ponds. This variability caused issues when building a length age key. We omitted any fish that appeared to be large catchable-size catfish from the hatchery (identifiable by fast age-0 growth) stocked for fishing clinics, so that the calculated growth rates would better reflect growth in the pond environment. Kid's Lake North had the fastest growth rates and fish reached harvestable-size at earlier ages than the other two bodies of water (Table 4). South Lake Park East had slow growth rates in 2006 and 2007 but growth rates improved in 2008 after catfish densities decreased (Table 4).

We attempted to fit von Bertalanffy growth curves to each year's data in all three ponds, but results were highly variable. The growth curve did not work well because

faster growth was observed at older ages. The growth curve parameters were highly variable, and are therefore suspect (Table 5).

Mortality

Annualized mortality of channel catfish ranged from 0.30-0.61 (Table 7). No pond consistently had higher or lower mortality rates than the others. From September 2006 – August 2007 the estimated number of channel catfish harvested was 251 in Kid's Lake North, 1106 in Dolese Youth Pond, and 147 in South Lake Park East. From September 2007 – August 2008 the estimated number of fish harvested was 49 in Kid's Lake North, 998 in Dolese Youth Pond, and 92 in South Lake Park East (Figure 4). The mean size of channel catfish harvested ranged from 308 mm TL at South Lake Park East to 371 mm TL at Kid's Lake North (Figure 5).

Discussion

The tandem hoop net sets (Sullivan and Gale 1999; Michaletz and Sullivan 2002) captured more fish with less effort than the fyke and modified fyke nets used the first year. Using the two different mesh sizes also allowed us to capture a wider range or fish sizes. We used large sample sizes to get narrow confidence intervals on our population estimates, but reasonably precise population estimates were available with only three samples. While length frequency and CPUE can be determined from replicate nets set for a single unit of effort, with a little extra effort, a true population estimate can be established for the body of water. From what we observed between the two sampling gears and what anglers caught, we believe the tandem hoop sets produced a more representative sample of the channel catfish population in each pond. We also switched

bait types from waste cheese the first year to cheese logs made of cheese, soy, and molasses the second year of the study. The cheese logs were less messy and proved to be as or more effective than the waste cheese.

Otoliths are preferred over pectoral spines as an ageing structure because pectoral spines can lead to underestimation of age (Muncy 1959; Mayhew 1969). The subsample of fish from which we aged both spines and otoliths did not indicate any age bias from spines. We chose to use spines for most of our ageing as we did not expect old fish to be abundant in these systems because high fishing pressure is typical of urban fisheries (Emme and Buynak 2008; Lang et al. 2008; Balsman 2009). Furthermore, we did not want to sacrifice many large fish as this could damage the fishery. If any pectoral spine age bias existed, it would be conservative with respect to our conclusion of slow channel catfish growth.

The channel catfish population size at Kid's Lake North was moderately low all three years (Table 1) despite high stocking rates (Table 6) and minimal observed harvest (Figure 4). This suggests there is high natural mortality (Table 7). There appeared to be an abundance of prey available consisting of gizzard shad and sunfish, suggesting little competition existed among catfish, leading to fast growth rates (Table 4). Overall, the catfish population appeared to be quite healthy (numerous harvestable-size catfish and good growth rates). Because of the low fishing mortality, we recommend reducing the number of fish stocked at this location. However, if the high natural mortality rate does not compensate, this could lead to a reduction in population size. Therefore an adaptive approach is recommended. Alternatively, fewer but larger fish could be stocked to avoid the high natural mortality that occurs in the first several years of the fish's life.

The catfish population was stable at Dolese Youth Pond in 2006 and 2007 but decreased dramatically in 2008. This pattern was also observed in the number of fish > 305 mm TL. Harvest rate estimates were relatively high (harvest was similar to the estimated population size), so overharvest could have occurred. Harvest rates increased dramatically in the weeks following the stocking of harvestable-size fish stocked for summer fishing clinics. This flux in harvest may have inflated our estimate of the number and mean size of channel catfish harvested for that month. However, even for our lowest harvest estimates, the number harvested exceeded the population estimate for fish over 305 mm TL and the number of catchable-size fish stocked before fishing clinics. Nearly 40% of the fish harvested were < 305 mm TL. While this was shorter than the length that anglers considered a satisfactory "keeper size" catfish (Balsman 2009), they were still harvested. Mean harvest size was 332 mm TL, but this was strongly influenced by the large size (356-406 mm TL) of the few catchable-size fish we observed being harvested following fishing clinics. The increased harvest rate after stocking of catchable-size fish also suggests most of these fish are being harvested and are not being lost to natural mortality. Growth rates were low, presumably due to food limitation. Therefore, the current stocking strategy appears detrimental to growth and may not be cost effective. Periodic stockings of catchable-size fish throughout the summer may increase harvest rates while keeping costs comparable to stocking large quantities of small fish. Fishing pressure is extremely high at Dolese Youth Pond and the current stocking strategy may need to be revised to meet the needs of anglers looking to catch and harvest catfish at this location.

The channel catfish population was extremely large at South Lake Park East in 2006. The pond had only been established for a few years and stocking rates were high (200-750 catfish/ha; Table 5). Of the estimated 1200 catfish in the pond (Table 1), less than 100 were > 305 mm TL (Table 2), and growth was slow (Table 4). The decrease in the channel catfish population size between 2006 and 2007 can be explained partly by 332 channel catfish that died within hoop nets in 2007 when low oxygen levels (< 1 mg/L) occurred after the nets were set. While this does not account for the total decrease in population size, it is likely that other fish outside of the nets died as well. While the nets were set in 1-2 m of water, nearly 100% mortality of all species in the nets was observed. The cause of the low dissolved oxygen event was not determined, but a major storm occurred after the nets were set and an influx of cold water may have caused a turnover event, leading to hypoxic conditions. The dissolved oxygen remained low for several weeks and the nets could not be reset until oxygen levels improved. The 2007 fish kill in South Lake Park East was followed by increased growth rates the next year (Table 4) and an increase in the number of fish over 305 mm TL (Table 2). Proportional stock density also increased from 2-3 in 2006-07 to 16 in 2008. Larger fish became more abundant in the length frequency distribution (Figure 3). While observing growth rings on otoliths and pectoral spines the next year, annuli were closely spaced prior to the population decrease and were spaced further apart for the last and second to last annulus. There was also a substantial black bullhead catfish population present in this pond, which further increased competition and may be hindering growth. These fish were not originally stocked, but had washed in from the overflow of another pond. Fishing pressure was high in this pond, but most anglers were fishing for sunfish. The creel

clerks recorded few catfish being caught or harvested. Because of its small size and high fishing pressure, stocking catchable-size catfish may be advisable at South Lake Park East.

The stocking of larger channel catfish comes at increased cost, but stocking smaller fish may be futile (with high mortality of small stocked fish before they reach a harvestable size) or worst yet counterproductive (if it causes slow growth). While angler satisfaction is not strictly catch-oriented (Hutt and Jackson 2008), even for anglers that place little importance on catch motives, satisfaction rates are primarily catch dependent (Matlock et al. 1988; Arlinghaus 2006). Catch is also one factor that can be fairly easily manipulated to meet the anglers' needs through stocking. However, other factors, such as amenities, contribute to overall angler satisfaction and also need to be considered. The management of the fish within the system is only a partial step into recruiting and retaining anglers through urban fishing programs.

Literature Cited

Alcorn, S. R. 1981. Fishing quality in two urban fishing lakes, St. Louis, Missouri. North American Journal of Fisheries Management 1:80-84.

Arlinghaus, R. 2006. On the apparently striking disconnect between motivation and satisfaction in recreational fishing: the case of catch orientation of German anglers. North American Journal of Fisheries Management 26:592-605.

Arlinghaus, R., and T. Mehner. 2004. A management-oriented comparative analysis of urban and rural anglers living in a metropolis (Berlin, Germany). Environmental Management 33:331-344.

Ashley, K. W., and D. L. Garling, Jr. 1980. Improved methods for preparing pectoral spine sections of channel catfish for age determination. Progressive Fish-Culturist 42:80-81.

Balsman, D. M. 2009. Catch and harvest rates, angling pressure, preferences and satisfaction at three urban lakes in Oklahoma. Chapter 2 *in* Balsman, D. M. An evaluation of Oklahoma's Close-to-Home-Fishing-Program. Master Thesis. Oklahoma State University, Stillwater, OK.

Brader, J. D. 2008. Aquaculture's role in providing fish for urban fisheries programs. Pages 13-19 *in* R. T. Eades, J. W. Neal, T. J. Lang, K. M. Hunt, and P. Pajak, editors. Urban and community fisheries programs: development, management, and evaluation. American Fisheries Society, Symposium 67, Bethesda, Maryland.

Broach, R. W. 1968. Arkansas' catchable channel catfish program. Proceedings of the Annual Conference Southeastern Association of Game and Fish Commissioners 21:445-452.

CMTCSDAFS (Catfish Management Technical Committee Southern Division American Fisheries Society). 2005. Catfish otolith aging workshop: catfish otolith processing. American Fisheries Society. Available: http://www.sdafs.org/catfish/Other%20Information /Otolith%20Workshop/ otolith%20processing%20handout.pdf. (May 2009).

Crance, J. H., and L. G. McBay. 1966. Results of tests with channel catfish in Alabama ponds. Progressive Fish-Culturist 28:193-200.

Crumpton, J. E., M. M. Hale, and D. J. Renfro. 1984. Aging of three species of Florida catfish utilizing three pectoral spine sites and otoliths. Proceedings of the Annual Conference Southeastern Association of Fish and Wildlife Agencies 38:335-341.

Davis, J. 1959. Management of channel catfish in Kansas. State Biological Survey, and Forestry, Fish, and Game Commission of Kansas. University of Kansas Museum of Natural History Publication No. 21, Lawrence, Kansas.

DeVries, D. R., and R. V. Frie. 1996. Determination of age and growth. Pages 483-512 *in* B.R. Murphy and D.W. Willis, editors. Fisheries techniques, 2nd edition. American Fisheries Society, Bethesda, Maryland.

Eder, S., and W. E. McDannold, Sr. 1987. The channel catfish fishery at Pony Express Lake, Missouri, 1963-1984. North American Journal of Fisheries Management 7:502-512.

Emme, K. A., and G. L. Buynak. 2008. Year-one evaluation of Kentucky's urban fishing program. Pages 333-346 *in* R. T. Eades, J. W. Neal, T. J. Lang, K. M. Hunt, and P. Pajak, editors. Urban and community fisheries programs: development,

management, and evaluation. American Fisheries Society, Symposium 67, Bethesda, Maryland.

Gabelhouse, D. W., Jr. 1984. A length-categorization system to assess fish stocks. North American Journal of Fisheries Management 4:273-285.

Gallucci, V. F., and T. J. Quinn. 1979. Reparameterizing, fitting, and testing a simple growth model. Transactions of the American Fisheries Society 110:594-603.

Gulland, J. A. 1969. Manual of methods for fish stock assessment, part 1. Fish population analysis. FAO (Food and Agriculture Organization of the United Nations) Manuals in Fisheries Science 4:1-154. Rome.

Halverson, M. A. 2008. Stocking trends: a quantitative review of governmental fish stocking in the United States, 1931 to 2004. Fisheries 33(2):69-75.

Hubert, W. A. 1996. Passive capture techniques. Pages 157-192 *in* B.R. Murphy and D.W. Willis, editors. Fisheries techniques, 2nd edition. American Fisheries Society, Bethesda, Maryland.

Hutt, C. P., and J. R. Jackson. 2008. Implications of angler motivations and preferences for urban fisheries management. Pages 63-76 *in* R. T. Eades, J. W. Neal, T. J. Lang, K. M. Hunt, and P. Pajak, editors. Urban and community fisheries programs: development, management, and evaluation. American Fisheries Society, Symposium 67, Bethesda, Maryland.

Flammang, M. K., and R. D. Shultz. 2007. Evaluation of hoop-net size and bait selection for sampling channel catfish in Iowa impoundments. North American Journal of Fisheries Management 27:512-518.

Krebs, C. J. 1998. Ecological Methodology, 2nd edition. Benjamin Cummings, New

York.

Lang, T. J., J. W. Neal, and C. P. Hutt. 2008. Stocking frequency and fishing quality in an urban fishing program in Arkansas. Pages 379-389 *in* R. T. Eades, J. W. Neal, T. J. Lang, K. M. Hunt, and P. Pajak, editors. Urban and community fisheries programs: development, management, and evaluation. American Fisheries Society, Symposium 67, Bethesda, Maryland.

Long, C. C. 2003. Angler characterization and youth recruitment in a pilot community-fishing program for central and southeast Arkansas. Master Thesis. University of Arkansas at Pine Bluff.

Marshall, J. A. 1991. Evaluation of stocking yearling channel catfish (*Ictalurus punctatus*) in small southeastern Ohio impoundments. Ohio Department of Natural Resources, Federal Aid in Sport Fish Restoration, Project F-29-R-27 to R-30, Study 104, Final Report, Columbus, OH.

Marzolf, R. C. 1957. The reproduction of channel catfish in Missouri ponds. Journal of Wildlife Management 21:22-28.

Matlock, G. C., G. E. Saul, and C. E. Bryan. 1988. Importance of fish consumption to sport fishermen. Fisheries 13(1):25-26.

Mayhew, J. K. 1969. Age and growth of flathead catfish in the Des Moines River, Iowa. Transactions of the American Fisheries Society 98:118-120.

Michaletz, P. H. 2001. Evaluation of channel catfish sampling methods in small impoundments. Missouri Department of Conservation, Federal Aid in Sport Fish Restoration, Project F-1-R-50, Study I-36, Job 1, Final Report, Jefferson City, MO.

Michaletz, P. H. 2005. Does pectoral spine extraction cause mortality to channel catfish? North American Journal of Fisheries Management 25(2):533-535.

Michaletz, P. H. 2006a. Do channel catfish stockings affect growth and size structure of bluegills in small impoundments? Transactions of the American Fisheries Society 135:1254-1264.

Michaletz, P. H. 2006b. Prey resource use by bluegill and channel catfish in small impoundments. Fisheries Management and Ecology 13:347-354.

Michaletz, P. H., and J. G. Dillard 1999. A survey of catfish management in the United States and Canada. Fisheries 24(8):6-11.

Michaletz, P. H., and K. P. Sullivan. 2002. Sampling channel catfish with tandem hoop nets in small impoundments. North American Journal of Fisheries Management 22:870-878.

Michaletz, P. H., M. J. Wallendorf, and D. M. Nicks. 2008. Effects of stocking rate, stocking size, and angler catch inequality on exploitation of stocked channel catfish in small Missouri impoundments. North American Journal of Fisheries Management 28:1486-1497.

Mitzner, L. 1999. Assessment of maintenance-stocked channel catfish populations in Iowa lakes. Pages 467–474 *in* E. R. Irwin, W. A. Hubert, C. F. Rabeni, H. L. Schramm, Jr. and T. Coon, editors. Catfish 2000: proceedings of the international ictalurid symposium. American Fisheries Society, Symposium 24, Bethesda, Maryland.

Muncy, R. J. 1959. Age and growth of channel catfish from the Des Moines River, Boone County, Iowa, 1955 and 1956. Iowa State Journal of Science 34:127-137.

Murdock, S.H., K. Backman, R. B. Ditton, Md. N. Hoque, and D. Ellis. 1992. Implications of future demographic change for participation in fishing in Texas. North American Journal of Fisheries Management 12:548-558.

Pflieger, W. L. 1997. The fishes of Missouri. Revised ed. Missouri Department of Conservation, Jefferson City, MO.

Pollock, K. H., C. M. Jones, and T .L. Brown. 1994. Angler survey methods and their applications in fisheries management. American Fisheries Society, Bethesda, Maryland.

Robinson, M. S. 1999. Evaluation of three gear types for sampling channel catfish in small impoundments. Pages 265–269 *in* E. R. Irwin, W. A. Hubert, C. F. Rabeni, H. L. Schramm, Jr. and T. Coon, editors. Catfish 2000: proceedings of the international ictalurid symposium. American Fisheries Society, Symposium 24, Bethesda, Maryland.

Robson, D. S., and D. G. Chapman. 1961. Catch curves and mortality rates. Transactions of the American Fisheries Society 90:181-189.

Santucci, V. J., Jr., D. H. Wahl, and D. F. Clapp. 1999. Efficiency and selectivity of sampling methods used to collect channel catfish in impoundments. Pages 317–328 *in* E. R. Irwin, W. A. Hubert, C. F. Rabeni, H. L. Schramm, Jr. and T. Coon, editors. Catfish 2000: proceedings of the international ictalurid symposium. American Fisheries Society, Symposium 24, Bethesda, Maryland.

Schramm, H. L., Jr., and J. A. Dennis. 1993. Characteristics and perceptions of users and nonusers of an urban fishery program in Lubbock, Texas. North American Journal of Fisheries Management 13:210-216.

Seber, G. A. F. 1982. The estimation of animal abundance and related parameters. 2nd edition. Griffin, London.

Sneed, K. E. 1951. A method for calculating the growth of channel catfish, *Ictalurus lacustris punctatus.* Transactions of the American Fisheries Society 80:174-183.

Sullivan, K. P., and C. M. Gale. 1999. A comparison of channel catfish catch rates, size distributions, and mortalities using three different gears in a Missouri impoundment. Pages 293-300 *in* E. R. Irwin, W. A. Hubert, C. F. Rabeni, H. L. Schramm, Jr. and T. Coon, editors. Catfish 2000: proceedings of the international ictalurid symposium. American Fisheries Society, Symposium 24, Bethesda, Maryland.

Summers, G. L. 2009. Angler opinion survey. Oklahoma Department of Wildlife Conservation Federal Aid Project No. F-50-R, Job 6, Final Report. 29 pp. Oklahoma City, OK.

USDI (U.S. Department of Interior), Fish and Wildlife Service, and USDC (U.S. Department of Commerce), Bureau of the Census. 2002. 2001 National survey of fishing, hunting, and wildlife-associated recreation. Washington, D. C.

Van Den Avyle, M. J. 1993. Dynamics of exploited fish populations. Pages 105-135 *in* C.C. Kohler and W.A. Hubert, editors. Inland fisheries management in North America. American Fisheries Society, Bethesda, Maryland.

Vanderford, M. J. 1984. Channel catfish management in the 50 states. U.S. Fish and Wildlife Service, St. Paul, Minnesota.

Table 1. Channel catfish population size estimates and 95% confidence intervals (CI) for Close-to-Home-Fishing-Program ponds in Oklahoma City, Oklahoma (based on Schnabel mark-recapture surveys). Sampling during 2006 was done with fyke and modified-fyke nets with sixteen 24-h sets per pond. Sampling during 2007-08 was done with tandem hoop nets with eight 72-h net sets per pond (except South Lake Park East in 2008 where six net sets were used).

Pond/Year	Population Estimate	Lower 95% CI	Upper 95% CI
Kid's Lake North 2006	376	168	955
Kid's Lake North 2007	557	467	692
Kid's Lake North 2008	727	627	866
Dolese Youth Pond 2006	1226	1009	1562
Dolese Youth Pond 2007	1686	1524	1887
Dolese Youth Pond 2008	586	513	682
South Lake Park East 2006	1243	898	1862
South Lake Park East 2007	257	192	390
South Lake Park East 2008	224	185	284

Table 2. Channel catfish population size estimates and 95% confidence intervals (CI) for fish > 305 mm total length in Close-to-Home-Fishing-Program ponds in Oklahoma City, Oklahoma from Schnabel mark-recapture surveys. Sampling during 2006 was done with fyke and modified-fyke nets with sixteen 24-h sets per pond. Sampling during 2007-08 was done with tandem hoop nets with eight 72-h net sets per pond (except South Lake Park East in 2008 where six net sets were used).

Pond/Year	Population Estimate	Lower 95% CI	Upper 95% CI
Kid's Lake North 2006	88	26	493
Kid's Lake North 2007	346	282	447
Kid's Lake North 2008	550	466	671
Dolese Youth Pond 2006	149	96	264
Dolese Youth Pond 2007	216	183	264
Dolese Youth Pond 2008	85	65	123
South Lake Park East 2006	91	17	1784
South Lake Park East 2007	46	30	74
South Lake Park East 2008	127	99	180

Table 3. Mean CPUE for tandem hoop net sets during summer 2007-08 in Close-to-Home-Fishing-Program ponds in Oklahoma City, Oklahoma. Catch per unit effort was calculated as the number of channel catfish caught over a 3-d sampling set in all three nets set in a tandem design. Means and standard errors are from three tandem sets used on each date.

Pond	Date	Mean CPUE	Standard Error
Kid's Lake North	6/22/2007	42.7	24.4
Kid's Lake North	6/25/2007	30.0	9.1
Kid's Lake North	6/29/2007	21.0	6.6
Kid's Lake North	7/2/2007	5.3	2.6
Kid's Lake North	7/5/2007	13.0	5.6
Kid's Lake North	7/8/2007	22.0	8.5
Kid's Lake North	7/11/2007	17.3	5.5
Kid's Lake North	7/14/2007	6.3	3.5
Kid's Lake North	7/17/2007	10.3	4.7
Kid's Lake North	6/6/2008	60.7	14.9
Kid's Lake North	6/9/2008	38.3	16.0
Kid's Lake North	6/12/2008	35.3	17.4
Kid's Lake North	6/15/2008	41.0	12.4
Kid's Lake North	6/18/2008	18.3	6.4
Kid's Lake North	6/21/2008	13.3	0.9
Kid's Lake North	6/24/2008	3.7	0.9
Kid's Lake North	6/27/2008	12.0	1.7
Dolese Youth Pond	6/22/2007	94.7	24.5
Dolese Youth Pond	6/25/2007	94.7	51.5
Dolese Youth Pond	6/29/2007	36.7	5.2
Dolese Youth Pond	7/2/2007	38.3	10.5
Dolese Youth Pond	7/5/2007	55.0	5.2
Dolese Youth Pond	7/8/2007	65.3	9.2
Dolese Youth Pond	7/11/2007	50.0	14.2
Dolese Youth Pond	7/14/2007	49.3	15.9
Dolese Youth Pond	7/17/2007	63.7	24.2

Table 3. Continued

Pond	Date	Mean CPUE	Standard Error
Dolese Youth Pond	6/6/2008	112.3	31.8
Dolese Youth Pond	6/9/2008	53.7	12.3
Dolese Youth Pond	6/12/2008	25.0	11.2
Dolese Youth Pond	6/15/2008	15.7	5.2
Dolese Youth Pond	6/18/2008	9.7	2.6
Dolese Youth Pond	6/21/2008	12.3	2.3
Dolese Youth Pond	6/24/2008	6.0	2.0
Dolese Youth Pond	6/27/2008	12.0	6.5
South Lake Park East	7/20/2007	24.3	4.9
South Lake Park East	7/23/2007	17.7	4.7
South Lake Park East	7/26/2007	5.3	1.2
South Lake Park East	7/29/2007	6.5	2.9
South Lake Park East	8/1/2007	1.5	0.4
South Lake Park East	8/4/2007	2.0	0.8
South Lake Park East	8/7/2007	2.0	0.6
South Lake Park East	8/20/2007	7.3	3.8
South Lake Park East	8/23/2007	5.7	2.4
South Lake Park East	6/6/2008	58.3	41.5
South Lake Park East	6/9/2008	17.3	5.5
South Lake Park East	6/12/2008	9.0	4.2
South Lake Park East	6/15/2008	11.0	0.6
South Lake Park East	6/18/2008	6.0	3.6
South Lake Park East	6/21/2008	7.3	2.6

Table 4. Mean length at age (total length in mm) and standard errors (SE) for channel catfish in Close-to-Home-Fishing-Program ponds in Oklahoma City, Oklahoma. Kid's Lake North 2006 is absent due to the low number of ageing structures available.

	Age						
	1	**2**	**3**	**4**	**5**	**6**	**7**
Kid's Lake North 2007							
Mean length at age	355.6	396.7	410.0	642.0			
SE	6.2	2.7	0.0	28.0			
Kid's Lake North 2008							
Mean length at age	284.3	448.9	383.4	395.4			
SE	5.5	6.9	3.1	10.9			
Dolese Youth Pond 2006							
Mean length at age	200.1	225.1	299.0	306.4	362.7	356.7	360.0
SE	1.8	4.6	5.0	19.9	4.7	17.2	0.0
Dolese Youth Pond 2007							
Mean length at age	230.2	243.0	282.5	350.5	391.3	376.4	382.0
SE	1.9	1.7	5.6	3.2	3.6	3.5	5.2
Dolese Youth Pond 2008							
Mean length at age	220.2	258.2	300.6		407.1		
SE	0.7	3.2	6.1		1.3		
South Lake Park East 2006							
Mean length at age	192.2	247.3	249.2	230.3			
SE	2.4	4.0	3.4	9.1			
South Lake Park East 2007							
Mean length at age	222.7	240.9	276.4	291.8	330.0		
SE	3.0	3.2	4.4	3.3	9.9		
South Lake Park East 2008							
Mean length at age		282.6	343.6	461.7	383.4		
SE		1.2	2.8	9.7	2.2		

Table 5. Von Bertalanffy growth parameters for channel catfish at Close-to-Home-Fishing-Program ponds in Oklahoma City, Oklahoma. There were insufficient ageing structures to estimate a growth curve for Kid's Lake North 2006. Kid's Lake North 2007 and Dolese Youth Pond 2008 had growth rates that were too variable to effectively estimate growth curves.

Pond	Year	K	$L\infty$	t_o	Max. Age
Kid's Lake North	2008	1.41	398.49	-0.17	4
Dolese Youth Pond	2006	0.28	394.93	-0.94	7
Dolese Youth Pond	2007	0.21	433.09	-2.02	7
South Lake Park East	2006	1.01	248.46	-2.15	4
South Lake Park East	2007	0.12	432.82	-4.60	5
South Lake Park East	2008	0.90	400.07	0.11	5

Table 6. Stocking records for channel catfish in Close-to-Home-Fishing-Program ponds in Oklahoma City, Oklahoma. Size stocked represents the mean total length of fish at stocking in inches. Where a range of sizes is present, it represents the range of mean sizes stocked at multiple stocking events.

Dolese Youth Pond			Kid's Lake North			South Lake Park East		
Date	# Stocked	Size Stocked (inches)	Date	# Stocked	Size Stocked (inches)	Date	# Stocked	Size Stocked (inches)
Fall 08	760	9	Fall 08	800	9	Fall 08	600	4.25
Summer 08	150	16	Summer 08	100	16	Fall 08	300	9
Summer 08	150	6	Fall 07	1080	9	Summer 08	178	16
Fall 07	780	9	Fall 06	780	8.75	Fall 07	940	5-6
Summer 07	600	14	Fall 06	1128	4.75	Fall 06	900	4.75-5.5
Fall 06	1140	4	Fall 05	988	7	Fall 05	450	4.5
Fall 06	780	8.75	Fall 05	1425	4.5	Fall 04	300	7
Summer 06	440	14-16	Fall 04	760	7	Spring 04	200	14
Spring 06	155	10	Fall 03	1830	7-8	Spring 04	414	8
Fall 05	988	7	Summer 03	200	15	Summer 03	30	14
Fall 05	1425	4.5				Spring 03	2400	3-5
Summer 05	310	14						
Fall 04	760	7						
Summer 04	450	14						
Spring 04	304	8						

Table 7. Annualized mortality rates for channel catfish using the Robson and Chapman method in Close-to-Home-Fishing-Program ponds in Oklahoma City, Oklahoma.

Pond	Year	Annualized Mortality
Kid's Lake North	2007	0.61
Kid's Lake North	2008	0.43
Dolese Youth Pond	2006	0.55
Dolese Youth Pond	2007	0.31
Dolese Youth Pond	2008	0.53
South Lake Park East	2006	0.46
South Lake Park East	2007	0.33
South Lake Park East	2008	0.30

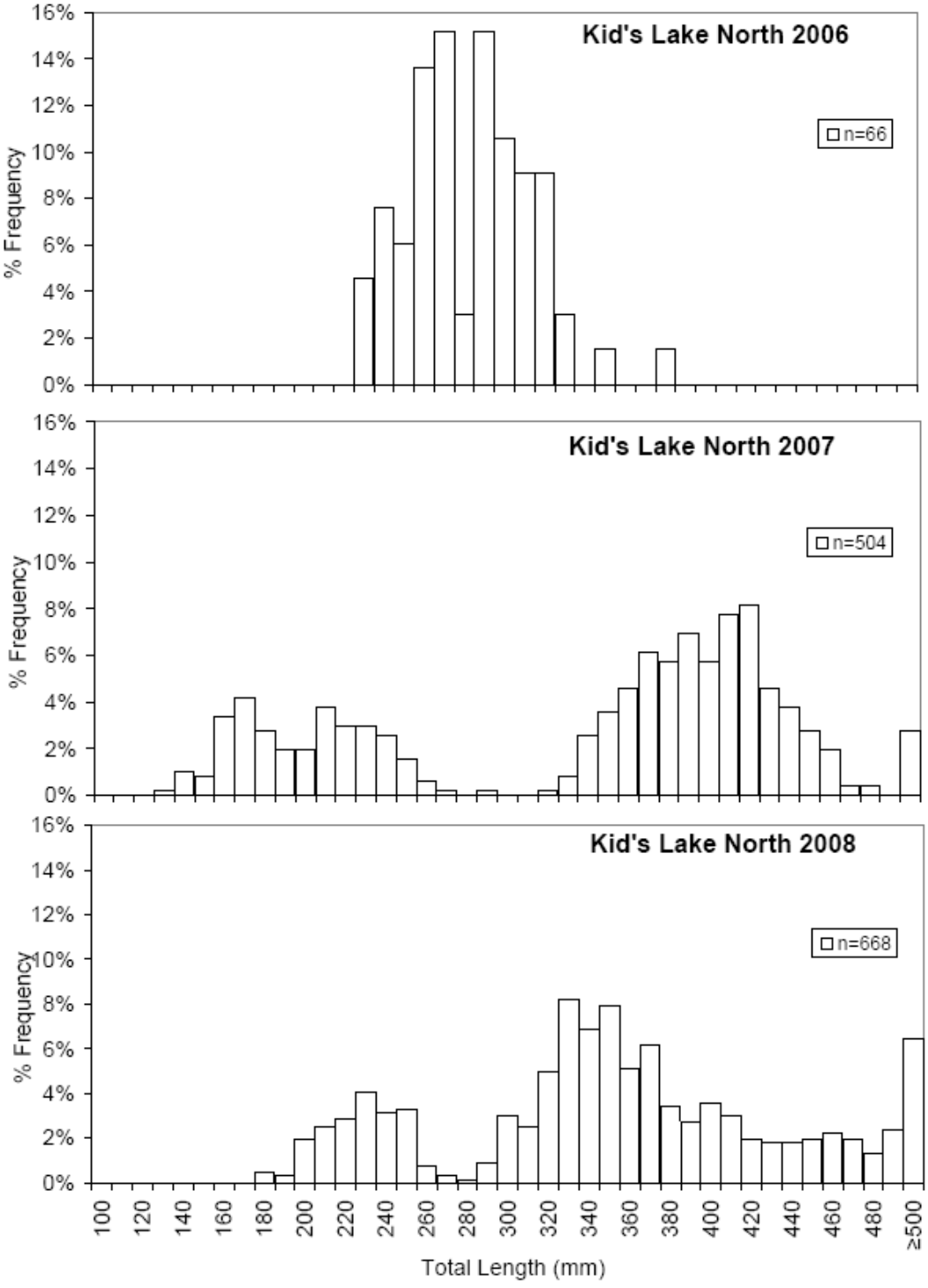

Figure 1. Length-frequency distribution of channel catfish in Kid's Lake North in Oklahoma City, OK from fyke and modified-fyke net samples in 2006 and tandem hoop net samples during summers 2007-08.

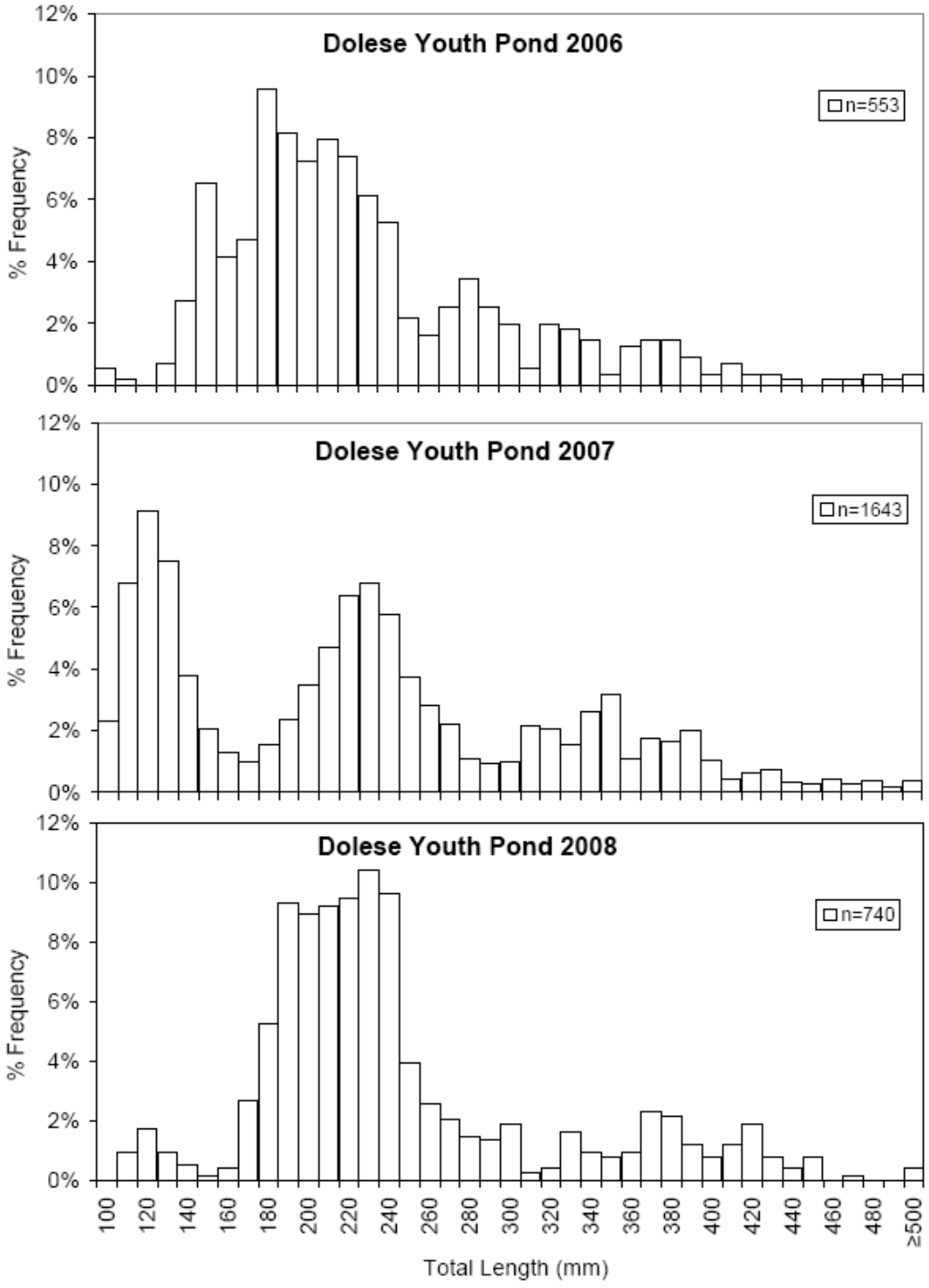

Figure 2. Length-frequency distribution of channel catfish in Dolese Youth Pond in Oklahoma City, OK from fyke and modified-fyke net samples in 2006 and tandem hoop net samples during summers 2007-08.

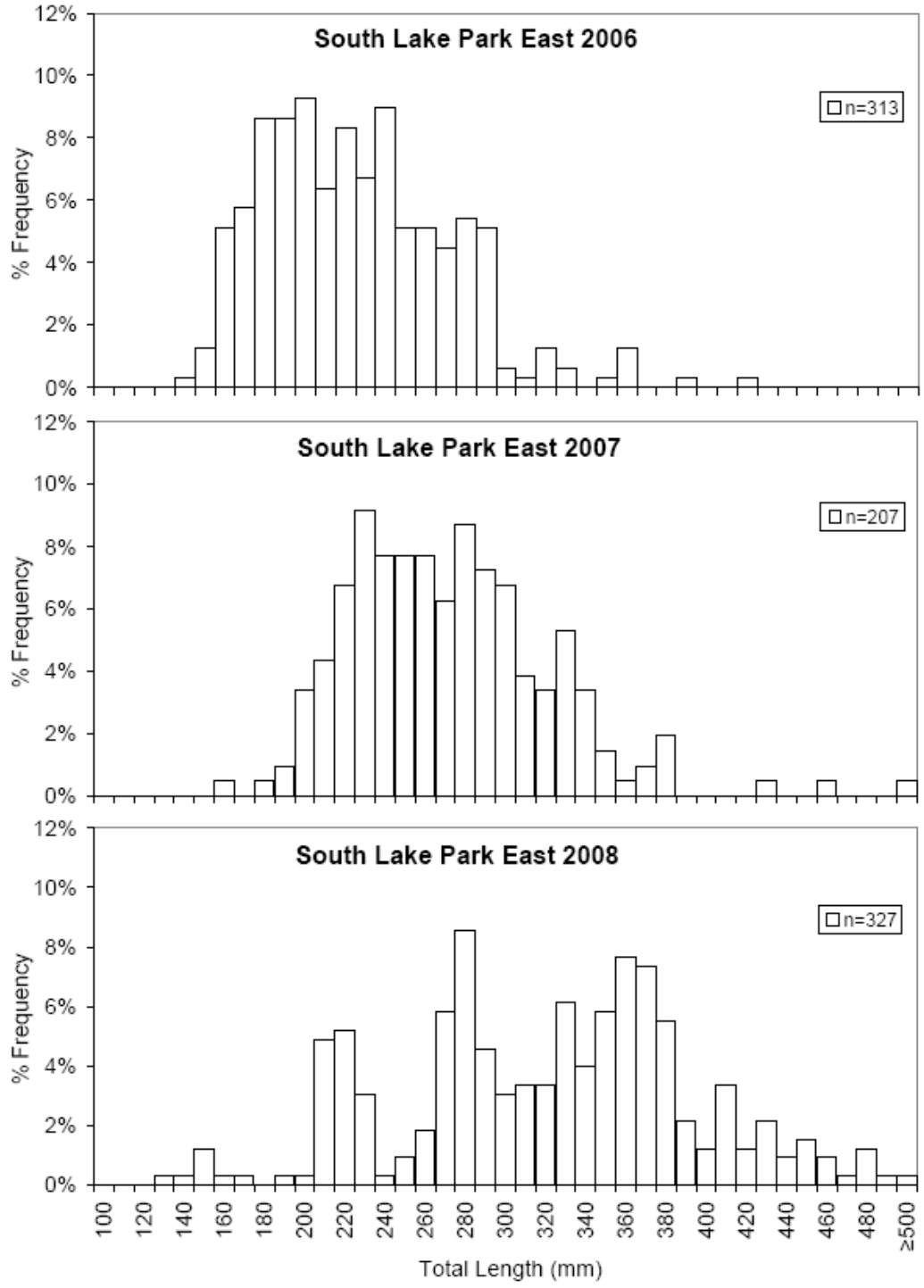

Figure 3. Length-frequency distribution of channel catfish in South Lake Park East in Oklahoma City, OK from fyke and modified-fyke net samples in 2006 and tandem hoop net samples during summers 2007-08.

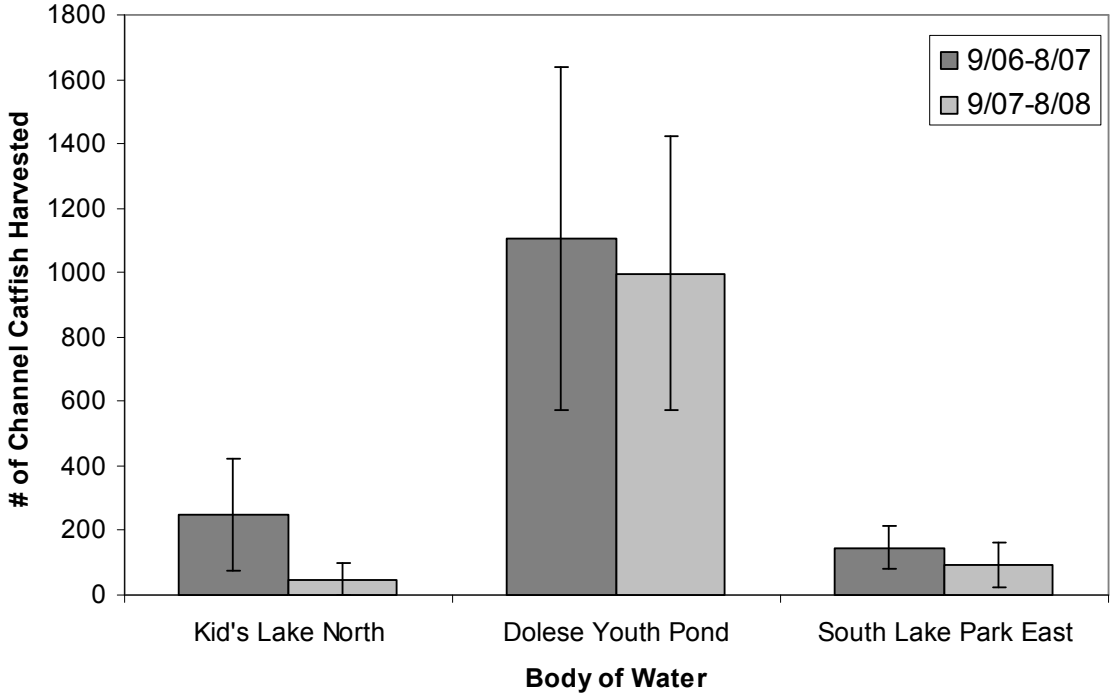

Figure 4. The number (± SE) of channel catfish harvested by anglers, estimated from a creel survey conducted from September 2006 - August 2008 at Kid's Lake North, Dolese Youth Pond, and South Lake Park East in Oklahoma City, OK.

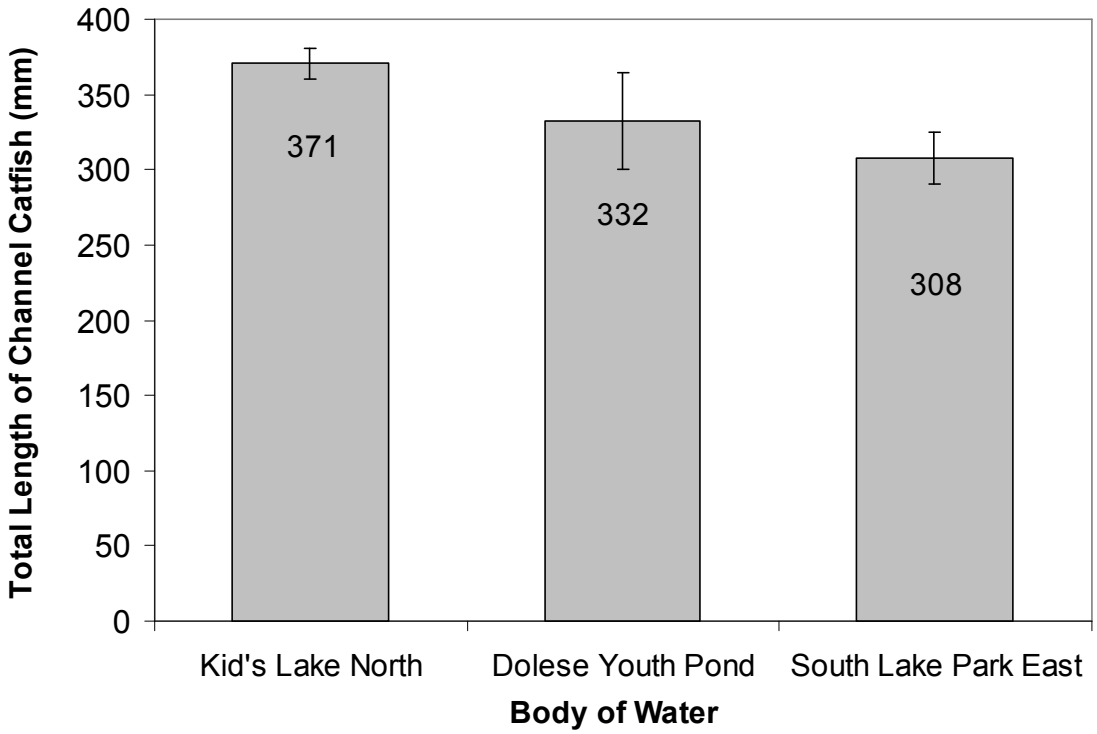

Figure 5. Mean length of channel catfish harvested by anglers (+ SE), estimated from a creel survey conducted from September 2006 - August 2008 at Kid's Lake North, Dolese Youth Pond, and South Lake Park East in Oklahoma City, OK.

Appendix A. Close-To-Home-Fishing-Program creel survey conducted from September 2006 – August 2008 at Kid's Lake North, Dolese Youth Pond, and South Lake Park East in Oklahoma City, OK.

Fishing Pressure from pressure counts done every hour during the creel period:

- Lake
- Date
- Time of count
- # of anglers

Catch statistics from interviews done between pressure counts:

- Lake
- Date
- Time of interview
- Gender of Persons in Party
  #Male ___ #Female ___
- Race/Ethnicity
  Asian or Pacific Islander___ Black/African American ___ Hispanic ___
  American Indian___ White/Caucasian ___ Other ___
- Time party started fishing _____
- Finished fishing for the day? (Y or N)
- How many people does this party include for the catch data (1 person being interviewed or group of ___)
- # rainbow trout caught and released, _____ # in possession ____
- # black bass caught and released, ____ # in possession ____
- # channel catfish caught and released, ____ # in possession, ____ lengths of fish in possession _____
- # sunfish caught and released, _____ # in possession, _____
- # crappie caught and released,___ # in possession ____
- # bullheads caught and released, ____ # in possession _____
- # other species caught and released, _____ # in possession _____

Catch Data before fisherman leaves (later on after initial survey)
Time of Measurement ____

- *# rainbow trout caught and released, ___ # in possession ____*
- *# black bass caught and released, ____ # in possession ____*
- *# channel catfish caught and released, ____ # in possession, ____ lengths of fish in possession _____*
- *# sunfish caught and released, _____ # in possession, # crappie caught and released,___ # in possession ____*
- *# bullheads caught and released, ____ # in possession _____*
- *# other species caught and released, _____ # in possession _____*

Ask Again if they want to change how they would rate the day's fishing experience.
How would you rate today's fishing experience on this pond? Poor ___ Satisfactory___ Good ___ Excellent ___

Age of each member of the party *not being interviewed.* AGE(S) _____

Residency Zip Code _____

What is your occupation? Student ____ Employee _____ Self-employed ____ Unemployed _____ Home-maker _____ Retired _____

How many children under the age of 12 are in your household? None _____ 1-2 _____ More than 2 _____

How many years have you been fishing? ACTUAL # YEARS _____

Were you aware this pond is in the Close-to-Home Fishing Program? Yes __ No ___

How much time do you normally spend traveling to this pond? Minutes _____

Ask following 2 questions without reading possible answers then check appropriate box. If unclear as to answer ask interviewee to clarify.

How often do you use Close-to-Home Fishing Program ponds? A couple times a week ___ Once a week ___ A couple times a month ___ Once a month ___ Couple times a year ___ First time fishing in a CTHFP pond ___

How often do you fish elsewhere, not the CTHFP ponds? Never_____ Two times a week_____ One time a week_____ Two times a month_____ One time a month_____ Less than one time a month____

How much time do you normally spend on a fishing trip to the CTHFP ponds not counting travel? ACTUAL # _____

Rank in order the fish you fish for most often in the CTHFP ponds? (Please Number 1, 2,etc…) Channel Catfish ___ Bass ___ Bluegill/sunfish ___ Crappie ____ Bullhead Catfish ___ Other (specify) _____ No preference ___

If person doesn't rank a species ask if they ever fish for that species.

Where would you say you do the majority of your fishing? Private ponds _____ CTHFP ponds ___ Small lakes ≤100 acres ___ Large Reservoirs > 100 acres ___ Rivers and Streams ___

What is the predominant reason you fish? Recreation or sport ___ Food ___

Which would you rather catch during a fishing trip? Six 12" catfish that weigh a ½ pound ___ Three 18" catfish that weigh 2 lbs. ___ One 25" catfish that weighs 6 lb. ___

What size do you think is a satisfactory/keeper catfish to catch in inches? _____

How would you rate today's fishing experience on this pond? Poor ___ Satisfactory___ Good ___ Excellent ___

Would you be happy with a restrictive length limit on channel catfish or a reduced bag limit if it improved the quality (size or number) of fishing? Yes___ No_____ No Opinion_____

It is difficult to manage urban ponds like this one for a good combination of bass, bluegill, and catfish fishing. Would you be happy if only channel catfish were stocked? Yes ___ No ___

What would you recommend ODWC and the Oklahoma City Parks and Recreation Department do to improve the facilities at this CTHFP pond? Rank responses with the most important being 1. Nothing___ More parking ____ Restrooms ____ Lighting____ Trash Cans ____ Fishing Docks or Piers ____ Picnic Tables_____ Other _____

The following page was handed to angler for them to read and fill out.

We want to assure you that participation is voluntary and your answers will remain **confidential**. If answered completely, the following questions will help us better serve the close to home fishing program.

1. **How old are you (years)?_____**
2. **What is the highest level of education you have attained?**

   ☐ Some High School or Less ☐ High School Diploma or GED

   ☐ Some College ☐ Four Year Degree

   ☐ Graduate Degree

3. **Which of the following broad categories best describes your household's total income from all sources in one year?**

   ☐ $10,000 or less ☐ $10,001 to $20,000

   ☐ $20,001 to $30,000 ☐ $30,001-50,000

   ☐ $50,001 to $100,000 ☐ $100,001 or more

VITA

Dane Michael Balsman

Candidate for the Degree of

Master of Science

Thesis: AN EVALUATION OF OKLAHOMA'S CLOSE-TO-HOME-FISHING-PROGRAM

Major Field: Natural Resource Ecology and Management

Biographical:

Personal Data: Born in Cape Girardeau, Missouri on November 22, 1983, the son of Terry R. and Barbara. A. Balsman.

Education: Graduated from St. Vincent High School, Perryville, Missouri, in May 2002; received a Bachelor of Science in Wildlife Conservation Management from Missouri State University, in Springfield, Missouri, in May 2006; completed the requirements for the Master of Science in Natural Resource Ecology and Management at Oklahoma State University, Stillwater, Oklahoma in December, 2009.

Experience: Urban Fisheries Biologist for Kentucky Department of Fish and Wildlife Resources 2009; Graduate Research Assistant for Oklahoma Cooperative Fish and Wildlife Research Unit, 2006-2009; Biology Lab Technician for Missouri State University, 2006; Fisheries Assistant for Missouri Department of Conservation, 2004 and 2005; Gypsy Moth Trapper, Missouri Department of Conservation, 2004; Volunteer Animal Care Assistant for Wonders of Wildlife Museum, 2004.

Professional Memberships: American Fisheries Society, Oklahoma Chapter of the American Fisheries Society.

Name: Dane Michael Balsman Date of Degree: December, 2009

Institution: Oklahoma State University Location: Stillwater, Oklahoma

Title of Study: AN EVALUATION OF OKLAHOMA'S CLOSE-TO-HOME-FISHING-PROGRAM

Pages in Study: 108 Candidate for the Degree of Master of Science

Major Field: Natural Resource Ecology and Management

The Close-to-Home-Fishing-Program (CTHFP) began in 2002 to provide anglers with fishing opportunities close to where they live. This study evaluated the program using a 2-year creel survey and channel catfish population sampling. Angler demographics, preferences, and behaviors were compared among anglers utilizing the CTHFP (trout and non-trout anglers), the general population (using 2000 Census data), and state-wide fishing license holders. Users of the CTHFP during the non-trout season tended to be young anglers or families, who travel short distances, fish primarily for recreation/sport, and typically fished exclusively at urban ponds. Anglers fishing at CTHFP ponds during the trout season were older, had higher incomes, fished more frequently, harvested more of their catch, fished other bodies of water more frequently, and were more aware of the CTHFP program. The trout fishery appeared to attract anglers that may not otherwise use an urban fishery. Men outnumbered women nearly 3:1 at all CTHFP ponds. Anglers fishing at the CTHFP ponds also reported traveling shorter distances to their fishing locations than the statewide anglers. Anglers fishing at the CTHFP fished for short periods of time (< 3 hours/trip) and rated their fishing experience as satisfactory or poor. Angler satisfaction was not directly correlated with catch rates. Fishing pressure was high at all sites ranging from 3,969-22,727 angling h/yr (490-5,235 h/ha). Channel catfish were an important aspect of the program with 66-88% of anglers pursuing them. Catch rates of channel catfish were low (< 0.33 fish/h), and harvest rates never exceeded 0.1 fish/h at any of the ponds. Most anglers said $\geq$ 12 inches was a satisfactory harvestable-sized channel catfish, were not supportive of stocking only channel catfish, and were supportive of more restrictive regulations on channel catfish if it improved fishing. Most anglers thought restrooms followed by fishing docks were the most important amenities to implement/improve at CTHFP sites. Population sizes of channel catfish were variable among ponds and years. Most catfish were < 305 mm total length. Stocking of larger channel catfish may be need to meet anglers' needs at CTHFP ponds as fishing pressure was high and growth rates of channel catfish were slow.

ADVISER'S APPROVAL: Daniel E. Shoup