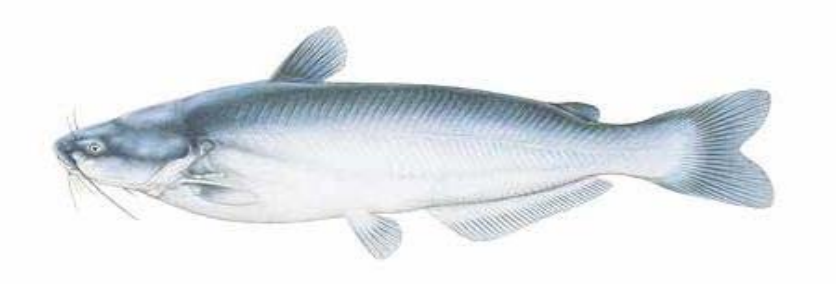
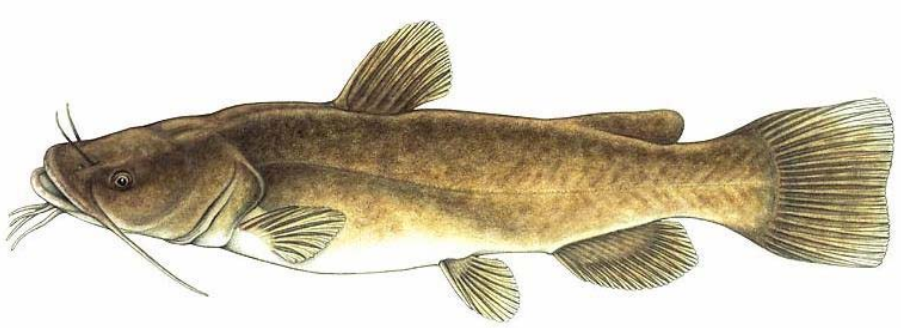
CATFISH IN KANSAS:

A MANAGEMENT PLAN





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CATFISH MANAGEMENT PLAN

Twelve species of catfish have reproducing populations in Kansas (Cross 1967): eleven of these are native to the state; one, brown bullhead *Ameiurus nubulosus*, is an introduced species. The white catfish *A. catus* has been introduced in private ponds, but is not considered to be a self sustaining species in Kansas. Six of these are considered sportfish and may be sought by anglers, black bullhead *A. melas*, brown bullhead, yellow bullhead *A. natalis*, blue catfish *Ictalurus furcatus*, channel catfish *I. punctatus*, and flathead catfish *Pylodictis olivaris*. The remaining six species are madtoms *Noturus spp* and generally not sought by anglers.

Although the current state record catfish is a 123 lb flathead from Elk City Reservoir, blue catfish are the biggest catfish found in Kansas. Cross (1967) cites a report of a blue catfish weighing 250 lbs from the mid 1800's.

Despite the long history of catfish angling, there appears to be a renewed interest in this group of fish, especially trophy-sized individuals. A major symposium on catfish management (Catfish 2000, Irwin et al. 1999) was held in June 1998. Major catfish tournaments are held on Kansas reservoirs, and weekly flathead catfish tournaments are held in the Missouri River through the summer (V. Travnichek, Missouri Dept. of Conservation, personal communication). The Kansas River has become a world-class destination for anglers seeking large flathead catfish (Steve Hoffman, In-Fisherman Inc., personal communication), and articles concerning flathead catfish in Kansas have appeared in *In-Fisherman* magazine.

Approximately 216,000 anglers spend 2.865 millions days and $40.1 million fishing for catfish in Kansas (U. S. Department of the Interior 2001).

The objective of this plan is to review management techniques for channel catfish, blue catfish and flathead catfish as they might apply to Kansas waters. This plan should be reviewed periodically and updated as new information becomes available.

CHANNEL CATFISH

Channel catfish are the most numerous, and widely recognized catfish in Kansas. Being found in all drainages and most lakes, they are one of the foundation blocks of fishing and fisheries management in the state. Kansas anglers regularly recognize channel catfish as the most sought after fish (Central Research Corporation 1975; Hartmann 1984; Schultz 1995). The Kansas Department of Wildlife and Parks fish hatchery at Pratt was established and built a reputation on channel catfish culture in the early 1900's, and this species is still the most widely stocked fish in Kansas. The Kansas strain of channel catfish has been found to be genetically distinct from upper Mississippi and Red River populations (Fields and Philipp 1999).

Although channel catfish are numerous in state streams and large flood control reservoirs, their numbers must be maintained by stocking in small, clear-water lakes and ponds because the 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. Because recruitment is controlled by managed stocking in state fishing lakes (SFLs), this species has the potential of being the most effectively managed fish in these Kansas waters.

Population Evaluation

Standard Sampling Procedures

The standard sampling procedure calls for setting monofilament gill nets during the fall (Mosher and Marteney 2004). Sampling effort is graduated by size of impoundment (Table 1); however, fall netting may not produce adequate results in Kansas SFLs and summer netting may be required to obtain a better sample (Mosher 1997). Because mortality can be high for channel catfish and non target fish during the summer, baited hoop nets should be considered (Sullivan and Gale 1999; Michaletz and Sullivan 2002).

Standard Equipment

See Fish Survey Techniques for Small lakes and Reservoirs, Fourth Edition (Mosher and Marteney 2004). A quick summary of sampling effort is given in Table 1.

Baited Hoop Nets

Traditionally, channel catfish have been sampled in Kansas small impoundments using various types of gill nets. Baited hoop nets rigged in tandem have been shown to be an effective alternative to gill nets (Sullivan and Gale 1999; Michaletz and Sullivan 2002). Advantages of hoop nets include: reduced mortality, fewer individuals of non-target species being collected, and the ability to sample a variety of sizes with a single gear type.

Population Assessment

Age and growth

Typically age and growth analysis is completed by removing a pectoral spine, sectioning a thin piece from the basal process, and reading the section under a dissecting microscope (Sneed 1951;Marzolf 1953; Crumpton et al. 1984). This method works well for young fish, but as fish

Table 1. Number of gill net complements needed to complete standard fall netting sample in Kansas lakes. Expended effort should be at the recommended level for better results.

Impoundment Size (Acres)	Minimal Effort	Recommended Effort
< 300	1	2
300-1999	2	3
2000-5999	4	5
6000-8999	5	8
$\geq$ 9000	6	9

grow, a lumen develops within the basal section and erodes the central portion of the spine. As this happens the first few annuli may be lost. This makes accurate age determination more difficult as channel catfish grow. To eliminate this problem some researchers remove otoliths, or cut a slightly different angle to section spines (Crumpton et al. 1984; Buckmeier et al. 2002). The use of computer enhanced optics and software packages make either method easier. The mean length at annulus and mean length at capture are provided for channel catfish sampled at Kansas SFLs in 1988 and aged by sectioned spines in Appendix B and C. Because age and growth is labor intensive and time consuming, a rapid assessment of individual stock classes can be obtained by giving stocked fish a unique fin clip, and then following changes of mean length during standard netting or creel surveys. When clipping fins it is crucial to clip the fin away from the body line so regeneration marks show in later years. Although clipping close to the body makes the clip readily recognizable for 1-3 years, older fish become more difficult to recognize as the fin grows larger. The mean length and weight of channel catfish at capture in Kansas SFLs during the summer as determined from fin-clipped fish from 1990-1994 are provided in Appendix D and E.

Creel surveys

Periodic creel surveys are warranted to gauge angler catch and harvest of catfish in all lakes. This is especially critical in lakes that are stocked annually with channel catfish, and those where extensive chumming is carried out by anglers .

Management Actions

Regulation guidelines/special regulations

Special regulations may be in order to protect channel catfish in new and renovated lakes, or where a trophy fishery is managed. However, it should be recognized that many Kansas anglers like to eat channel catfish, and efforts should be made to allow prudent harvest. Channel catfish anglers would not support a 16-in length limit at Neosho and Pottawatomie No. 2 SFLs (Mosher 1997a), likely because of inadequate recruitment to this size, and desires to eat smaller fish. Wilde and Ditton (1999), and Schramm et al. (1999) found keeping fish was more important to catfish anglers than other angler groups, and that catfish anglers considered there to be a low need for regulations to prevent over harvest of catfish. The Missouri Department of Conservation (DOC) manages channel catfish for the primary purpose of consumption (Dames et al. 2003). Because channel catfish recruitment is controlled by stocking, over harvest may be a lesser problem for these more intensively managed fisheries.

Stocking Guidelines

Stocking channel catfish is generally not required to maintain populations in large reservoirs and rivers. Because of turbidity, diverse habitat, and relatively low densities of predators, channel catfish populations in these waters are adequately maintained through natural recruitment. Stocking rivers may be considered after a fish kill event for public relations benefits, however channel catfish will repopulate a stream more effectively through colonization than by stocking (Bryson and Lackey 1975).

In small, clear impoundments natural recruitment of channel catfish populations is limited by predation from largemouth bass, bluegill, and crappie (Doze 1925; Marzolf 1957; Davis 1959). Stocking catchable-sized channel catfish has long been a tactic of choice to

provide sport fisheries where predation is a problem (Crance and McBay 1966; Broach 1968; Eder and McDannold 1987). Ideally stocked channel catfish should be large enough to escape predation and provide a suitable fishery in a relatively short time. Krummrich and Heidinger (1973) found channel catfish less than 200 mm long were highly vulnerable to predation by largemouth bass, but Spinelli et al. (1985) found no significant correlation of largemouth size and catfish predation. This suggests that predation by largemouth bass does not increase as the size of largemouth bass increases. Broach (1968) recommended stocking 254-mm channel catfish in Arkansas, but Storck and Newman (1988) showed that stocking 200-mm fish gave the greatest return for investment, and Santucci et al. (1994) found that 250-mm channel catfish did not yield a higher return than 200-mm fish.

Because channel catfish populations in small lakes are controlled by stocking and angler harvest, it is easier to manage populations in these waters than large reservoirs and streams. If populations are heavily harvested, this can be controlled by reducing creel limits or increasing length limits, and populations can be replenished by increasing the number of stocked fish. Alternatively, if populations are overly abundant, stocking can be reduced and harvest encouraged. Numbers of stocked fish need to be reduced if body condition of channel catfish is poor (Wr <80) or growth is slow (Mosher 1997b), or angler exploitation is low (< 30%) (Mitzner 1990). Michaletz (2006a; 2006b) warns that overstocking of channel catfish in small impoundments should be avoided when managing for both channel catfish and bluegill because of potential competition for macroinvertebrates.

A stocking score sheet must be completed before stocking (Appendix A). This score sheet should reflect conditions at the proposed stocking site so the best use of raised fish can be attained. Stocking guidelines are provided by Kansas Fish Stocking Guidelines (KDWP 2006).

Stocking from unknown sources carries the threat of introducing inferior genetic strains, unwanted species and diseases to a fishery. Therefore, outside sources of fish should be certified as Kansas strain, and free of diseases such as viral hemorrhagic septicemia (VHS), catfish virus, bacterial kidney disease, carp viremia, largemouth bass virus and golden shiner virus. Transported water should also be free of all aquatic nuisance species especially zebra mussels, Eurasian water milfoil, and Asian carp. Catchable fish should also be certified free of prophylactics such as malachite green and chloramine-T.

Length Limits

Many channel catfish fisheries are managed to allow maximum harvest by anglers and thus anglers are allowed to choose what size of fish are acceptable for harvest. Without length limits anglers release > 50% of the channel catfish they catch that are less than 11 inches long, but keep > 75% of the fish greater than 11 inches (Appendix F). In these fisheries, the greatest proportion of fish harvested can be expected to be from 12 to 14 inches long (Appendix G).

If the objective of a fishery is to produce larger fish, a length limit may be in order. KDWP now has an option for a 15-inch minimum length limit for channel catfish in small impoundments. In these fisheries the greatest proportion of channel catfish harvested by anglers can be expected to be within the 16-18 inch range (Appendix H).

Creel Limits

Creel limits for channel catfish vary according to the type of water being managed. In rivers and flood control reservoirs where reproduction and recruitment are adequate, anglers are allowed a daily limit of 10 fish. In small lakes where recruitment is limited and populations must be maintained by stocking, the daily limit is 5 fish; however, the daily limit is further reduced to 2 fish where overharvest might be a problem. Careful consideration must be taken when implementing creel limits to ensure that a balance for the fishery and the desires of catfish anglers are met. During the 1995 licensed angler survey, nearly twice as many channel catfish anglers stated they desired more fish than those stating they wanted larger fish (Burlingame 1997). Yet, trophy catfish management should be considered at some lakes, especially if there are nearby fisheries that can supply channel catfish for those wishing to catch higher numbers. A majority of anglers taking an exit poll at Woodson SFL indicated they were willing to accept reduced creel limits to catch larger fish (Leonard Jirak, KDWP personal communication).

MANAGEMENT RECOMMENDATIONS:

1. Stocking channel catfish in reservoirs or rivers is generally not needed and therefore not recommended unless done for public relations motives.
2. Small, clear-water impoundments should be stocked with 200-250 mm channel catfish to escape predation by largemouth bass and other predators. Because many catfish are raised in extensive ponds where grading is difficult, the length of catfish may range above and below the desired size. Ideally, 95% of the stocked channel catfish should exceed 200 mm for optimal survival and return to anglers. If grading can be done efficiently, catfish < 200 mm should be stocked only into turbid impoundments where predation is less likely.

3. Urban waters managed as “put-and-take” fisheries should be stocked with channel catfish greater than 300 mm to accommodate angler demands.
4. Improve facilities at extensive ponds to better allow grading of channel catfish.

CHANNEL CATFISH FEEDING GUIDELINES

Feeding programs should be viewed as a supplemental source of nutrition for catfish and, in most cases, are not intended to be the primary food source.

Channel catfish feeding programs are generally initiated in fishable waters to: concentrate catfish in areas of a lake that are more easily accessible to anglers and thereby increase catch rates, to improve the quality of the catfish population by increasing growth rates and condition factors in lakes with low fertility and/or poor benthic invertebrate communities (Mosher, 1998) or, to increase growth and carrying capacity in more fertile lakes to produce a trophy fishery. The fisheries manager needs to identify the primary management objective and use feeders to best help achieve that objective. To assist the manager in establishing objectives, a recent creel census or some other estimation of catfish catch and harvest, and an evaluation of growth rates are essential. See Kansas Fish Stocking Guidelines (KDWP 2006) for further information.

Improving Channel Catfish Catch Rates

Generally, fisheries managers use fish feeders on larger lakes (> 500 acres) to concentrate channel catfish in areas where they are more likely to be caught by anglers. The channel catfish populations in these lakes can usually be characterized as having good reproduction and recruitment; receiving limited predation and experiencing acceptable growth rates.

Feeder Numbers

The number of feeders placed on a lake to improve channel catfish catch rates is at the discretion of the lake’s manager. However, consideration should be given to the number of

feeders that can realistically be kept filled and maintained. Placing more feeders on a lake than can be filled and maintained on a regular basis should be avoided. Anglers quickly learn when feeders are not functioning properly, and public relations problems can develop if these malfunctions aren't addressed in a timely manner.

Angler demand should also be considered. Placing more feeders on a lake than will be utilized is discouraged to maintain an efficient cost:benefit ratio.

Feeder Placement

The proper placement of feeders is important if improving channel catfish catch rates is one's primary goal. A factor to consider is the depth of the water where the feeder is placed. As a general rule, feeders should be in water that is at least 8 to 10 ft. deep. Water of this depth is adequate to prevent most vandalism while shallow enough to allow minimal loss of feed to deep, poorly oxygenated areas of the lake. If care is taken, locations in the lake could be found that would provide this depth and be within easy casting distance for shoreline anglers.

Consideration should also be given to the maximum depth of water in which the feeder is placed. The manager needs to know whether the candidate lake typically stratifies during the summer months and if dissolved oxygen levels below the thermocline become too low for fish to frequent those depths. Using sinking fish food in feeders that are placed in water that is too deep will greatly reduce their efficiency. If a large proportion of each feeding is lost because it sinks to depths that are unusable to the fish for which it is intended, the optimum benefit of that feeding is not being realized. Furthermore, decaying feed can exasperate anoxic conditions and reduce productivity of the lake.

Often, a problem facing the manager is poor access for shoreline anglers. It is usually financially impractical or logistically infeasible to provide access to all shoreline areas of a large

water body. In those cases, it is much more practical to install fish feeders and concentrate channel catfish in areas more readily accessible to anglers. Often, "fishing complexes" that have been developed with fishing piers or docks and are near a boat ramp make ideal locations for feeder placement.

What to feed

As stated earlier, the ultimate goal of fish feeders in this situation is to increase the channel catfish catch rate. Because this management technique assumes that the channel catfish population experiences adequate growth and is in good condition, feed with high protein and other nutritional additives is not needed.

Some managers use whatever type of feed is inexpensive and readily available. If grain prices are low, thought might be given to using milo, wheat or corn exclusively or in combination with other types of feed. Another option would be using un-medicated 12% protein cattle feed. It is in small pellet form and should readily pass through most commercially available fish feeders. Currently, its cost is about 1/3 that of sinking catfish feed.

When to feed

To accomplish the goal of increasing channel catfish catch rates it is necessary to attract them into the vicinity of the feeder and entice them to remain in the area. Fish feeders that are equipped with programmable timers that allow multiple feedings per day make this task easier to accomplish.

It is recommended that feeders be programmed for frequent (minimum of 8/day), short duration drops. The actual duration of the drops will depend upon the amount of feed (lbs/acre/day) that the manager finds necessary to reach the management objective of the lake. The general guideline, however, should be to use the minimum amount of feed to get fish into

the area and to persuade them to stay.

Additional Management Considerations

An additional benefit of fish feeders can be to encourage anglers to utilize areas of a lake that often receive lower fishing pressure. In this way, the manager may be able to spread out fishing pressure and/or reduce conflicts between anglers and other recreational users of the lake.

Attaining Management Objectives for Channel Catfish Catch and Growth Rates

If the density, growth rate, and condition (*Wr*) of channel catfish in a body of water are less than desirable, feeding may be one alternative available to improve the situation. In-lake feeding is more desirable than fertilization because the added nutrients will more directly benefit the fish and less likely enhance eutrophication (Carney 1993). While feeding could, theoretically, be used to provide the bulk of the nutritional needs for the channel catfish in a body of water, in most cases it would be impractical to attempt such an undertaking. At best, feeding should be considered as a supplement to the lake's natural food supply. For this reason, feeding channel catfish is most effective in smaller bodies of water (<500 acres) where the number of feeders and the amount of feed needed to achieve the desired results is economically feasible. Alternatively, it may be necessary to provide the primary feed in small ponds (< 5 acres) with little or no natural productivity to sustain a fishery.

Lakes that would be candidates for this type of feeding program could be characterized as being relatively small with good angler access; with a channel catfish population that has poor reproduction and recruitment, slow growth, and heavy fishing pressure.

Feeder Numbers

In theory, the number of feeders needed in a given body of water should be dictated by the goals established by the lake's fisheries manager. The number of feeders placed on any body

of water will be dictated by real-world considerations. Some managers suggest that one feeder for each 10 to 20 surface acres is a reasonable goal. The major consideration will generally be how many feeders can, realistically, be kept filled and maintained. The logistics of weekly transporting large quantities of feed to remote lakes may make it impractical to install as many feeders as theoretically possible and may prohibit some waters from being candidates.

Feeder Placement

Again, the depth of the water where feeders are placed is important. As a general rule, 8-10 feet should be the minimum depth for placement. Maximum depth should be dictated by oxygen availability during stratified conditions. If care is taken, locations in the lake could be found that would provide this depth and, yet, **not** be within easy casting distance for shoreline anglers.

Some managers feel that placing feeders above or near brush piles and other types of escape cover is desirable. Their rationale is that cover keeps fish in the immediate vicinity of the feeder where they are more likely to benefit from the feeding program. In addition, anglers will be less likely to harvest fish that are protected by heavy cover. In fact, many anglers may avoid the area entirely. There is some risk that such a strategy will cause poor public relations between the manager and the catfish anglers utilizing the lake. This problem may be somewhat avoided by placing feeders in more remote or less easily accessible areas of the lake. Obviously, the longer the fish are in the lake and have food available to them, the larger they will grow.

What to feed

Because this management technique assumes that the channel catfish population is at low density or is experiencing inadequate growth and is in less than desirable condition, it behooves the fisheries manager to use a feed that is high in protein and other nutritional additives. Protein

content of commercially available catfish feed generally range from 25% to 32%. The higher the protein content the more expensive the feed. Managers should use feed with the highest protein level that is economically feasible and readily available.

Some managers prefer to use a combination of floating and sinking catfish feed in their feeders. This gives them an opportunity to observe the fish feeding and to determine whether a large number of undesirable species such as carp are taking advantage of the feeding operation. It also allows anglers to see that fish are, in fact, utilizing the feed. If floating fish feed is utilized, consideration should be given to placing a floating ring around the feeder. This device keeps feed from drifting to areas where it will be less beneficial to the catfish population.

When to feed

Bailey and Harrison (1945) noted channel catfish fed most actively when water temperature was 50-94^{o} F. Randolph and Clemens (1976) found channel catfish began eating artificial feed when water temperature reached 12^{o} C (53.6^{0} F). Therefore, feeding should be done when water temperatures are above 55° F (April-October). At this temperature, fish should begin actively feeding and the amount of feed left uneaten should be minimal.

To avoid concentrating anglers at feeders, many managers set the timers on their feeders so that ½ of the feedings occur at night. Channel catfish have been found to feed most actively from sundown to midnight (Bailey and Harrison 1945).

Feeding time can affect growth and fat content of channel catfish. Feeding a full ration early in the day is more conducive to growth, whereas feeding a full ration late in the day increases fat content; feeding a half ration early and a half ration late increases both growth and fat content (Noeske-Hallin et al. 1985).

How much to feed

By monitoring the growth rate and condition factor of the lake's channel catfish population, the manager can "fine tune" his feeding program to achieve those goals. Lake fertility indexes (Mosher 1998) should be a base to start from. Lakes with low fertility might warrant higher feeding rates. A growth rate of ½ lb per year and a fall mean *Wr* value of 95 has been suggested by some managers as a reasonable goal. Managers undertaking feeding programs should use the natural fertility in combination with supplemental feeding to achieve the growth objective.

As a starting point, a feeding rate of 50 lbs/surface acre/year appears reasonable (Carney 1993). The amount of feed can then be adjusted until the most efficient rate is found to maximize growth with the amount fed. Feeding may then be increased to produce desired results. However, over-feeding is wasteful if large portions of feed are not utilized or growth of fish does not increase proportionately with the increase of feed. If large numbers of "non-target" species are present and competing with catfish for the available feed, the feeding rate may need to be increased, or if carp are the only fish using the feeder, suspended. However, it may be wise to attempt to remove "rough" fish.

Additional Management Considerations

Environmental conditions have been shown to affect growth and feeding by channel catfish. Andrews et al. (1973) found catfish growth to be less in waters where dissolved oxygen (DO) was less than 100% saturation. Randolph and Clemens (1976) noted that although channel catfish fed when DO was as low as 3 mg/l, feeding actively declined when DO fell below 5 mg/l. Simco and Cross (1966) noted growth of channel catfish declined when DO fell below 3 mg/l,

but that catfish showed no distress until DO was less than 1 mg/l. Fishing success for channel catfish has been shown to improve when DO increased (Mosher 1983).

Feeding may negatively affect DO. Tucker et al. (1979) found DO frequently declined below 2.0 mg/l when feed was applied at 56 kg/hectare (50 lb/acre) and was usually below 2.0 mg/l when the feeding rate was 78 kg/hectare (70 lb/acre) in culture ponds during August and September. Although larger lakes may be more insulated from depletion of DO, it is still of concern when adding any nutrient to a system. Therefore, DO in lakes with feeders should be monitored to prevent negative effects from oxygen depletion. DO testing should be done in the early morning after respiration peaks and before photosynthesis resupplies the lake with DO.

Cost benefit ratios should be a consideration. Biologists should use feeders to attain a mean harvest rate of 0.5 channel catfish per hour for fish fifteen inches and longer. Average seasonal harvest rates in excess of 2.0 fish per hour may be cost prohibitive. Benefits may also be taken from increased catch and release fishing and total anglers fishing the lake. At urban lakes that are stocked frequently, feeding programs that cost more than the commercial delivered price per pound are not cost effective and should not be undertaken (Table 2).

In lakes that are supplementally stocked, it might be advisable to reduce the stocking density and/or frequency to allow the fish to better utilize whatever natural food resources are available in the lake.

In lakes that receive high fishing pressure and where feeding programs are being considered, the use of reduced creel limits and minimum length limits might also be advisable.

Table 2. Cost Analysis Table (Costs paid by KDWP)

Mileage Costs	Miles driven per season X (current cost/mile)	
Wages	Hours per season X hourly rate	
Feed	Price per lb. X Lb fed during season	
Fish Production Cost	Number of fish stocked X $0.82[1]	
Total Cost		
Cost Per Fish	Number of fish stocked ÷ Total Cost	
	Your cost per : Commercial cost per fish delivered	
Bottom Line	Are your fish more expensive than the commercial fish?	

1. This cost reflects the highest cost/channel catfish reared at Milford Hatchery and Woodson Rearing Pond provided by Harold Jagerson and Randy Nelson, KDWP. During 1998-2005 the average cost/fish at WORP was $0.52/fish and $1.32/pound.

Blue Catfish

Blue catfish are a big river fish (Pflieger 1997), and the biggest catfish in the United States (Graham 1999). Graham (1999) lists alligator gar *Lepisosteus spatula,* lake sturgeon *Acipenser fulvescens*, and white sturgeon *A. transmontanus* as the only freshwater fish that attain larger sizes in the United States. In Kansas, the native range includes the Missouri, lower Kansas, and lower Marais des Cygnes rivers (Cross 1967). Lee et al. (1980) show the native range to include the Arkansas River near the Kansas border in Oklahoma, so historically, they may have inhabited the lower Arkansas in Kansas. Blue catfish prefer deep, swift channels and flowing pools (Jenkins and Burkhead 1994; Pflieger 1997), and open waters of large reservoirs (Graham and DeiSanti 1999). Poor results were obtained from attempts to establish populations in Kansas state fishing lakes and small, shallow reservoirs with low retention during the 1970's. Growth at Lyon SFL was slow and fish averaged only 14 inches after four years. Blue catfish are highly migratory and frequently emigrate downstream from reservoirs (Graham 1999). Tagged fish stocked at Marion Reservoir in the 1970's were recovered primarily in Grand Lake, OK. Marion is a shallow reservoir that has little suitable habitat for blue catfish. Although tagged blue catfish stocked at El Dorado Reservoir in 2005 have been caught in the spillway and Walnut River downstream from the dam, others have been recovered in the lake (Craig Johnson, KDWP personal communication). However, blue catfish stocked in a large reservoir (>16,000 acres) with little flow through the dam has created a good fishery with natural reproduction at Milford Reservoir (Goeckler et al. 2003). Blue catfish have displaced white catfish in the Cape Fear River drainage in North Carolina (Moser and Roberts 1999) and channel catfish as the dominant catfish in Kaw Reservoir, OK (Bill Wentroth, OK Dept. of Conservation,

personal communication). Blue catfish populations in the Kansas and Missouri rivers have gained renewed interest from anglers. The current state rod and reel record blue catfish (94 lb) was caught in the Kansas River in 2000. The lake record for Milford Reservoir is currently 54 lb and increases almost every year (John Reinke, KDWP personal communication).

Young blue catfish feed on invertebrates including mussels (Brown and Dendy 1961; Minckley 1962; Perry 1969). Richardson et al. (1970) stocked blue catfish in California to help control Asiatic clams, and Moser and Roberts (1999) found Asiatic clams to be a staple item for blue catfish in North Carolina. Therefore, reservoirs with Asiatic clam and/or zebra mussels may benefit from stocking blue catfish. Although blue catfish are unlikely to control these mussel populations, they will utilize the mussels. Blue catfish stocked in El Dorado Reservoir have been caught with zebra mussels in their stomach (Craig Johnson, KDWP personal communication).

Population Evaluation

Standard sampling procedures

The current standard method for collecting blue catfish is with gill nets during the fall sample period (Mosher and Marteney 2004). However, Oklahoma samples blue catfish with low pulse DC electrofishing during the summer (120-170 V, 2-4 Amps, 15 cycles/second) (Gilliland 1988). This method is being utilized at Milford Reservoir (J. Reinke KDWP, personal communication) and should be given more consideration in Kansas. The method employs a single electrofishing boat with two chase boats, one on each side, to collect fish. The electrofishing boat travels a standard transect or remains stationary for a set time and the chase boats collect stunned fish as they surface. This allows a station to be sampled for a set

distance and time that can be compared across years. Chasing stunned catfish with the electrofishing boat is inefficient and distracts from the ability to sample a standard distance and time due to the frequent course changes while capturing fish. Bodine and Shoup (2007) reported blue catfish were most effectively sampled with electrofishing when water temperature exceeded 18^0 C in Oklahoma.

Population Assessment

See channel catfish section. Similar methods used for channel catfish age and growth, and angler exploitation should be utilized for blue catfish.

Management Actions

Regulations

Because blue catfish are a trophy fish, consideration should be given to setting length limits and lower daily creel limits at lakes where this species is managed. A statewide five fish daily creel limit seems appropriate, and would coincide with Missouri's limit and thus help with regulations on the jointly managed waters of the Missouri River.

Stocking Guidelines

The blue catfish population in Milford Reservoir was established by stocking 1 fish/acre/year for five years. Stocking size ranged from 39/lb to 4.7/lb. In reservoirs, fish larger than 200 mm are not needed as with channel catfish in small lakes because of the larger, more turbid waters, more diverse habitat, and the relatively low abundance of predators. Because blue catfish are highly migratory, it is important to consult neighboring states before stocking. The Missouri Department of Conservation has no problems with the strains we stock; however, the Oklahoma Department of Conservation prefers we stock Arkansas River fish into impoundments that drain into their state. Except at Milford

Reservoir, blue catfish stocking should be considered experimental and any lake receiving them needs to be sampled to verify success of the stocking program. If blue catfish are not present after three years, stocking should cease.

Stocking from unknown sources carries the threat of introducing unwanted species and diseases to a fishery. Therefore, outside sources of fish should be certified free of diseases such as catfish virus, bacterial kidney disease, spring viremia of carp, largemouth bass virus and golden shiner virus. Transported water should also be free of all aquatic nuisance, species especially Eurasian water milfoil, zebra mussels and Asian carp. Catchable fish should also be certified free of prophylactics such as malachite green and chloramine-T.

Recommendations

1. Establish a separate 5 fish per day creel limit for blue catfish in waters with sustainable fisheries rather than a combined limit with channel catfish.
2. Stock blue catfish into lakes with zebra mussels. Although they will not control the mussels, blue catfish will utilize the mussels.
3. Establish new populations in larger reservoirs by stocking 1-2 fingerlings per acre for 3-5 years. Yearly samples will be taken to gauge progress, and stocking will cease if populations are not established after three years.
4. Stocking into high flow through lakes should be avoided because of the migratory nature of blue catfish.

Flathead Catfish

Flathead catfish are common to large eastern Kansas streams (Cross 1967) and consequently developed populations within reservoirs after dams were closed; however,

they avoid streams with high gradients and intermittent flow (Pflieger 1997). This species is a highly predatory fish that, unlike channel catfish and blue catfish, usually eats only live prey (Pflieger 1997), and is a trophy species within Kansas waters.. The current world record pole-and-line flathead catfish was taken at Elk City Reservoir in 1998. Because of the secretive nature of these fish and the anglers who harvest them, little is known about their populations in most streams and reservoirs in Kansas. Intensive fisheries often develop for flathead catfish below low-head dams in late spring and early summer following high water events. Although angler exploitation is relatively unknown, it may be possible to effectively manage discreet sections of rivers because of the small home ranges of adult flathead catfish (Skains and Jackson 1995; Dobbins et al. 1999). Flathead catfish have been stocked in small impoundments to control overabundant panfishes (Michaletz and Dillard 1999), although Hackney (1966) found that stocking 50 flathead catfish/acre in a pond did not correct a stunted bluegill population after 320 days. However, flathead catfish have caused problems when introduced outside their native range (Li and Moyle 1993; Moser and Roberts 1999), and caution should be taken when stocking small impoundments if the fisheries populations could be overly sensitive to predation. Because of their secretive nature, young flathead catfish often survive predation in small, clear water lakes, and once established are difficult to remove. Flathead switch from an invertebrate diet to piscivory after reaching 25-36 cm (Brown and Dendy 1961; Roell and Orth 1993), and adults are primarily piscivorous (Minckley and Deacon; Turner and Summerfelt 1971).

Population Evaluation

Standard sampling procedures

Standard gill netting samples very few flathead catfish. Options should include using low-frequency electrofishing (< 20 Hz) (Gilliland 1988; Quinn 1988; Pugibet and Jackson 1991; Cunningham 1995; Stauffer and Koenen 1999) as described for blue catfish, hoop nets, or set lines.

Population Assessment

Age and growth

Age and growth for flathead catfish have been determined using spines, vertebrae and otoliths (Jackson 1999). Spines display similar problems for flathead catfish as they do for channel catfish and otoliths give a more reliable estimate of age, especially for older fish (Nash and Irwin 1999). Because using ototliths requires killing the fish pectoral spines may give adequate results (Jenkins 1952; Mayhew 1969).

Creel surveys

Because of their fishing techniques (trot lines and limb lines), flathead anglers are often missed during standard creel surveys. Standard creel surveys may interview a few rod and reel anglers, but their activities may also take place outside the realm of standard schedules.

Management Actions

Regulation guidelines/Special regulations

Daily creel limits are currently 5 fish and there are no standard length limits. It is recommended that the 5/day creel limit be maintained.

The Department has been approached to allow hand fishing for flathead catfish. The practice is allowed in several southern states. Oklahoma has allowed this method for years. Missouri evaluated hand fishing, but rescinded the regulation in 2007. Jackson et al. (1997)

report hand fishing to be less effective for flathead catfish than for blue catfish, and that flathead catfish were more readily caught by hoopnets. Hand fishing may allow harvest of flathead catfish that may not be vulnerable to other fishing methods (Jackson 1999). However, because flathead catfish spawn in cavities (Cross 1967; Pflieger 1997) during the summer after streams reach stable flows (Pflieger 1997), large adult males may be more vulnerable to exploitation and nesting success may be negatively affected by removal of the guarding males. If hand fishing is allowed it should be permitted only in waters open to the public after July 15. No equipment other than hands may be used (no hooks, gaffs, ropes, chains, etc.). Fish may be harvested from natural cavities only, or adjacent to bridges, dykes, rip rap, piers, docks. No artificial habitat may be added to attract fish. An evaluation period of five years should be established during which time all harvest must be reported to the Department, and anglers will be required to provide number, length and sex of fish caught and harvested, and a spine of all fish harvested. A decision needs to be made whether to keep a daily limit of 5 fish, or establish a seasonal limit for hand fishing activities. Regardless of the decision, a 5-fish daily limit should be enforced if anglers participate in traditional methods and hand fishing. A special hand-fishing permit should be required.

Stocking guidelines

There is little information available concerning stocking of flathead catfish. It is possible populations can be established with stocking densities similar to those discussed for blue catfish.

Stocking from unknown sources carries the threat of introducing unwanted species and diseases to a fishery. Therefore, outside sources of fish should be certified free of diseases such as catfish virus, bacterial kidney disease, carp viremia, largemouth bass virus

and golden shiner virus. Transported water should also be free of all aquatic nuisance, species especially Eurasian water milfoil, zebra mussels and Asian carp. Catchable fish should also be certified free of prophylactics such as malachite green and chloramine-T.

Recommendations

1. Maintain 5 fish per day creel limit.
2. If hand fishing is pursued, limit this activity to Kansas River and Arkansas River after the spawning period with a 5 fish per day limit. Require reporting of all fish caught, and evaluate for three years before expanding the program.

Kansas Water Types

State Fishing Lakes/Small Lakes

Channel catfish are the most popular fish at our state fishing lakes and are present in each lake. In state fishing lakes, channel catfish populations are managed mostly as a put-grow-take fishery and must be maintained by stocking, usually once a year during the Fall. At many SFLs growth is slow and feeders have been installed to supply supplemental feed to enhance growth. Because channel catfish must be maintained by stocking, creel limits should be 5 daily. Where harvest and demand are especially high, daily creel limits may be reduced to 2 fish. However, it should be demonstrated that harvest remains about 30% or stocking should be reduced.

Some SFLs may be managed as trophy fisheries for channel catfish, however these should be in areas where anglers have ample opportunity to harvest channel catfish in other locations. At these lakes, feeding may exceed the ration used for supplemental nutrition, and creel limits and length limits may be more stringent than at most put-grow-and-take fisheries.

In small urban lakes channel catfish are often maintained as a put-and-take fishery. These lakes receive high pressure and channel catfish must be stocked several times during the year to ensure anglers have an opportunity to harvest fish close to home.

Flathead catfish are present in some SFLs, but blue catfish generally do not do well in these small lakes. It is recommended that blue catfish not be stocked in SFLs. Creel limits for flatheads if present should be 5 daily.

Urban Waters

Urban fishing waters are those designated waters located in a Kansas metro area with a human population exceeding 40,000 people within a 25 mile radius. The size of these waters varies greatly and may range from 0.1 to 240 acres. Angler demand in urban areas greatly exceeds the natural productivity of those urban waters, and the capacity of state hatcheries to provide a consistent fishery. Therefore, harvestable-sized channel catfish are commercially purchased and generally stocked semi-monthly to monthly at a rate designed to maintain an average density greater than 15 fish/acre from April through September. Bid specifications for these fish require that they be ≥ 12 inches or 0.5 pound and ≤ 18 inches or 1.5 pounds, with an overall average weight of 0.75 pound/fish. These waters are generally managed as a put-and-take fishery. However, fishing pressure may be so great that a reduced creel limit is needed to maintain a fishery between stocking dates.

Reservoirs

Channel catfish and flathead catfish are present in all Kansas reservoirs; blue catfish are presently stocked in four reservoirs. Intensive chumming operations have enhanced channel catfish harvest in some reservoirs, but KDWP does not know the full affect of this practice. Blue catfish and flathead catfish have the potential to grow to large size in Kansas

reservoirs. Blue catfish do well in large reservoirs and rivers, but are drawn to flowing water. As a result, they emigrate from small to mid-sized reservoirs with high flow before they contribute to the fishery, and therefore should not be stocked in these. More information is needed about mortality and angler exploitation for blue catfish in reservoirs. Because of the higher growth potential and status as a trophy fish, lower daily creel limits of 5 per day should be considered for blue catfish as with flathead catfish in reservoirs.

Chumming with soybeans and other products has concentrated channel catfish in some reservoirs and contributed to an increase in angler harvest. On these impoundments, fisheries biologists need to monitor the channel catfish population to ensure adequate recruitment is maintained. Where chumming is excessive and angler exploitation is especially high, a reduced creel limit on channel catfish may be considered if netting data indicates a decline in population size, otherwise maintain the 10 per day limit.

Rivers

Channel catfish are present in all Kansas rivers, and flathead catfish are present in most large rivers. Blue catfish populations have been increasing in the Kansas and Missouri rivers due to stocking impoundments within these drainages in Kansas. Little is known about catfish populations within Kansas rivers. It appears that channel catfish are doing well, but mortality and angler exploitation are unknown. There is a growing fishery for trophy-sized flathead and blue catfish, especially in the Kansas and Missouri rivers. Consideration should be given to regulations to enhance trophy populations of these fish. Daily creel limit of blue catfish should be reduced to 5 per day in the Kansas and Missouri rivers.

Research/Resource Needs

Population dynamics and exploitation studies of flathead catfish are limited. Studies should be conducted to provide better information so this species can be more appropriately managed in Kansas.

Relationships between feeding rates, growth, and harvest of channel catfish in SFLs are poorly understood. Feeding programs should be evaluated to ensure that the most efficient approach is incorporated, providing the best possible growth and harvest opportunities to satisfy Kansas anglers. Of special concerns are water quality changes and pellet size of feed.

Evaluate the effects of reservoir hydrodynamics on retention of blue catfish in Kansas, and determine the effects of lake size on blue catfish population parameters to more effectively manage these fish.

Evaluate the effects of chumming in reservoirs on harvest and population structure of channel catfish.

Evaluate stocking densities for channel catfish, especially in urban lakes, to more efficiently supply angler needs.

Evaluate compensatory growth of channel catfish in extensive ponds to determine if retaining smaller than desired fish is economically feasible.

Evaluate desire of anglers to create a trophy fishery for channel catfish in selected small lakes.

Evaluate the possibility of creating trophy channel catfish populations with more restrictive creel and length regulations.

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Appendix A

INTERMEDIATE CHANNEL CATFISH RANKING CRITERIA

REGION_____LAKE_____DATE_____

1. **DOES THIS LAKE CHARGE A FEE TO FISH OTHER THAN THE STATE FISHING LICENSE? Yes_____ Go to TOTAL SCORE and enter 0**
   No_____ Continue to number 2.

2. **Is this lake enrolled in the urban fisheries stocking program?**
   Yes_____ Go to G before continuing to 3.
   No_____ Continue to number 3.

3. **New or Renovated Lakes**
   Lakes may be considered New or Renovated for **2** years after filling or renovation, however year 2 receives this status only if the fall sampling in year one yields less than 5 channel catfish per net complement night.

   Lake Size (maximum of 100 pts.)

   1. < 300 acres (100 pts)
      a. Requesting ≤ 40/acre (100 pts)
      b. Requesting > 40/acre (10 pts)* _____

   2. 301-499 acres
      a. Requesting ≤ 25/acre (100 pts)
      b. Requesting > 25/acre (10 pts)* _____

   3. ≥ 500 acres
      a. Requesting ≤15/acre (100 pts.)
      b. Requesting >15/acre(10 pts.) _____

   - If more channel catfish are desired, manager may request fingerlings

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4. **Lake Has Existing Channel Catfish Population**

   A. Lake Size (maximum 20 pts.) _____
      1. < 300 acres
         a. Requesting ≤ 40/acre (20 pts)
         b. Requesting > 40/acre (5 pts)
      2. 301-499 acres
         a. Requesting ≤ 25/acre (10 pts)
         b. Requesting > 25/acre (5 pts)

3. ≥ 500 acres (0 pts)

B. Fishing Pressure (maximum 25 pts) _____
1. > 200 trips/acre (25 pts)
2.100-200 trips/acre (15 pts)
3. <100 trips/acre (5 pts)

C. Ownership (maximum 20 pts) _____
1. KDWP (20 pts)
2. CFAP (15 pts)
3. F.I.S.H.
a. Impounded (5 pts)
b. stream (0 pts)
4. Non-CFAP (5 pts)

D. Fish Condition (mean Wr*)(maximum 20 pts) _____
Fall sampled channel catfish ≥ 280 mm
1. > 95 (20 pts)
2. 85-95 (15 pts)
3.75-84 (5 pts)
4. < 75 (0 pts)

E. Distance to Nearest Public Waters (maximum 5 pts) _____
1. ≥ 30 miles (5 pts)
2. < 30 miles (0 pts)

F. Fish Requested Previous Year but Not Received _____
Add 10 pts for each year not filled
Subtract 5 pts if surplus fish received prior year and not already subtracted from this request

G. Enrolled in Urban Stocking Program (-50 pts) _____

INTERMEDIATE CHANNEL CATFISH **FINAL SCORE** _____

Regional F&W Supervisor Approval_____

Fisheries Management Coordinator Approval_____

Appendix B

Mean length (mm) at annulus of channel catfish caught at selected Kansas SFLs in fall 1988. Age was determined by spine sections. The number in brackets is the number sampled.

	Annulus												
Lake	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XV
Atchison		218	342	400	503								
		[32]	[2]	[1]	[1]								
Barber-lower		245	282	327			548	446					
		[6]	[2]	[3]			[3]	[1]					
Barber-upper		268	309	324	346	456							
		[3]	[1]	[1]	[2]	[1]							
Bourbon			301	481	526	596							
			[5]	[12]	[6]	[4]							
Brown	87	203	277	373	322	460		434		511			
	[1]	[8]	[3]	[1]	[2]	[2]		[2]		[2]			
Clark		228	235	265	327	346	472	514		485		732	
		[6]	[6]	[5]	[14]	[10]	[6]	[1]		[1]		[1]	
Crawford		213		472	492	534							
		[4]		[2]	[3]	[1]							
Douglas	92	263	300		453	522				765			
	[4]	[12]	[16]		[8]	[1]				[1]			
Goodman		293											
		[19]											
Leavenworth		247	276	367	430	523	524						
		[4]	[21]	[3]	[6]	[1]	[2]						
Miami			370	519	533		675						
			[11]	[12]	[1]		[1]						
MiddleCreek		231	358	454	490								
		[27]	[8]	[3]	[12]								
Montgomery		273	298		521								
		[9]	[3]		[11]								
Neosho		189	483										
		[17]	[8]										
Osage		205	252	278	336		463	378	558				
		[1]	[3]	[2]	[31]		[3]	[1]	[1]				
Sheridan			267	293	347	391	393						564
			[8]	[16]	[8]	[5]	[1]						[1]
Wilson			383		503	537							
			[7]		[3]	[2]							
Woodson		186	307		446								
		[1]	[5]		[3]								
Mean	90	233	315	379	438	485	512	443	558	587			
Low	87	186	235	265	322	346	393	378		485			
High	92	293	483	519	533	596	675	514		765			

Appendix C

Mean length (mm) at capture of channel catfish caught at selected Kansas SFLs in fall 1988. Age was determined by spine sections. The number in brackets is the number sampled.

	Age												
Lake	1	2	3	4	5	6	7	8	9	10	11	12	15
Atchison		301 [32]	444 [2]	520 [1]	575 [1]								
Barber-lower		299 [6]	336 [2]	367 [3]			621 [3]	497 [1]					
Barber-upper		306 [3]	332 [1]	364 [1]	373 [2]	495 [1]							
Bourbon			398 [5]	535 [12]	565 [6]	652 [4]							
Brown	211 [1]	264 [8]	331 [3]	430 [1]	368 [2]	509 [2]		416 [2]		564 [2]			
Clark		266 [6]	274 [6]	297 [5]	384 [14]	393 [10]	517 [6]	568 [1]		556 [1]		754 [1]	
Crawford		341 [4]		535 [2]	564 [3]	592 [1]							
Douglas	249 [4]	343 [12]	388 [16]		508 [8]	547 [1]				778 [1]			
Goodman		370 [19]											
Leavenworth		310 [4]	331 [21]	436 [3]	470 [6]	622 [1]	584 [2]						
Miami			502 [11]	553 [12]	606 [1]		718 [1]						
Middle Creek		342 [27]	416 [8]	502 [3]	532 [12]								
Montgomery		373 [9]	424 [3]		571 [11]								
Neosho		394 [17]	580 [8]										
Osage		268 [1]	311 [3]	309 [2]	366 [31]		489 [3]	428 [1]	612 [1]				
Sheridan			289 [8]	317 [16]	367 [8]	413 [5]	415 [1]						583 [1]
Wilson			488 [7]		553 [3]	575 [2]							
Woodson		297 [1]	348 [5]		487 [3]								
Mean	230	320	387	430	486	533	557	477	612	560			583
Low	211	264	274	297	366	393	415	416		556			
High	249	394	580	553	606	652	718	568		778			

Appendix D

Mean length(mm) of channel catfish during first July after stocking in Kansas SFLs 1990-1994. The age was determined by fin clips. The number in parentheses is the sample size.

Lake	1990	1991	1992	1993	1994	Yearly Mean
Barber-lower	260(58)	265(29)			256(29)	260
Clark	265(55)	283(8)		272(21)	254(55)	269
Cowley	330(57)	287(30)	262(10)	262(15)	283(9)	285
Douglas	294(37)	271(24)	268(14)	281(15)	283(12)	279
Lyon	273(77)	268(14)		279(75)		273
McPherson	275(82)	285(17)	245(52)	263(9)	254(45)	264
Montgomery	328(27)	289(45)	302(101)	321(108)	321(45)	312
Neosho	332(43)	300(43)	294(80)	292(43)	313(26)	306
Ottawa	274(12)	252(34)	294(74)	264(17)	264(36)	270
Pottawatomie 2	260(85)	250(6)	268(14)		269(64)	262
Sheridan	290(53)	292(6)		268(16)	276(18)	282
Average	289	277	276	278	277	278

Mean length(mm) of channel catfish during second July after stocking in Kansas SFLs 1991-1994. The age was determined by fin clips. The number in parentheses is the sample size.

Lake	1991	1992	1993	1994	Yearly Mean
Barber-lower	268(50)	276(15)			272
Clark	270(13)	346(8)		315(34)	310
Cowley	360(35)	270(4)	300(2)	324(6)	314
Douglas	355(16)	335(9)	342(5)	352(14)	346
Lyon	306(20)	303(55)		342(28)	317
McPherson	346(23)	310(9)	311(11)	294(14)	315
Montgomery	423(12)	427(3)	401(15)	419(30)	418
Neosho	421(9)	401(6)	373(18)	389(9)	396
Ottawa	339(2)	315(10)	330(20)	309(12)	323
Pottawatomie 2	290(5)	303(2)	334(35)		309
Sheridan	286(27)			339(16)	313
Average	333	329	342	343	330

Mean length(mm) of channel catfish during third July after stocking in Kansas SFLs 1992-1994. The age was determined by fin clips. The number in parentheses is the sample size.

Lake	1992	1993	1994	Yearly Mean
Barber-lower	303(26)	318(4)		311
Clark	339(14)			339
Cowley	365(34)	332(18)	376(9)	358
Douglas	370(4)	379(4)	380	376
Lyon	343(54)	357(14)		350
McPherson	379(4)	367(3)		373
Montgomery	525(5)	514(1)	468(3)	502
Neosho	570(6)	421(3)	487(6)	493
Ottawa	366(8)	350(23)	384(23)	367
Pottawatomie 2	346(5)		408(2)	377
Sheridan	296(18)	322(12)		309
Average	382	373	417	378

Mean length(mm) of channel catfish during fourth July after stocking in Kansas SFLs 1993-1994. The age was determined by fin clips. The number in parentheses is the sample size.

Lake	1993	1994	Yearly Mean
Barber-lower	326(2)		326
Clark	349(3)		349
Cowley	398(24)	358(3)	378
Douglas	432(4)	405(3)	418
Lyon	401(5)	420(5)	410
McPherson	none sampled		
Montgomery	552(1)	571(1)	562
Neosho	none sampled		
Ottawa	431(5)	414(13)	422
Pottawatomie 2	380(4)		380
Sheridan	333(28)	385(6)	359
Average	400	426	413

Mean length(mm) of channel catfish during fifth July after stocking in Kansas SFLs 1994. The age was determined by fin clips. The number in parentheses is the sample size.

Lake	1994
Barber-lower	344(1)
Clark	434(4)
Cowley	424(11)
Douglas	470(1)
Lyon	none sampled
McPherson	none sampled
Montgomery	none sampled
Neosho	none sampled
Ottawa	481(10)
Pottawatomie 2	457(3)
Sheridan	398(12)
Average	416

Appendix E

Mean weight (g) of channel catfish during first July after stocking in Kansas SFLs 1990-1994.
The age was determined by fin clips. The number in parentheses is the sample size.

Lake	1990	1991	1992	1993	1994	Yearly Mean
Barber-lower	122(58)	126(29)			118(29)	122
Clark	134(55)	160(8)		156(21)	121(55)	143
Cowley	285(57)	174(30)	134(10)	129(15)	169(9)	178
Douglas	207(37)	148(24)	148(14)	158(15)	161(12)	164
Lyon	161(77)	142(14)		166(75)		156
McPherson	201(82)	195(17)	123(52)	153(9)	132(45)	161
Montgomery	302(27)	207(45)	247(101)	269(108)	266(45)	258
Neosho	301(43)	230(43)	205(80)	210(43)	248(26)	239
Ottawa	170(12)	132(34)	232(74)	150(17)	136(36)	164
Pottawatomie 2	143(85)	140(6)	145(14)		146(64)	144
Sheridan	197(53)	186(6)		168(16)	179(18)	183
Average	202	167	176	173	168	174

Mean weight (g) of channel catfish during second July after stocking in Kansas SFLs 1991-1994.
The age was determined by fin clips. The number in parentheses is the sample size.

Lake	1991	1992	1993	1994	Yearly Mean
Barber-lower	131(50)	161(15)			146
Clark	153(13)	418(8)		264(34)	278
Cowley	353(35)	153(4)	208(2)	243(6)	239
Douglas	346(16)	322(9)	311(5)	329(14)	327
Lyon	219(20)	216(25)		316(28)	250
McPherson	359(23)	281(9)	242(11)	212(14)	274
Montgomery	645(12)	678(3)	536(15)	606(30)	616
Neosho	683(9)	578(6)	435(18)	495(9)	548
Ottawa	312(2)	263(10)	342(20)	234(12)	288
Pottawatomie 2	202(5)	241(2)	333(35)		259
Sheridan	169(27)			334(16)	252
Average	325	331	344	337	316

Mean weight (g) of channel catfish during third July after stocking in Kansas SFLs 1992-1994.
The age was determined by fin clips. The number in parentheses is the sample size.

Lake	1992	1993	1994	Yearly Mean
Barber-lower	207(26)	258(4)		233
Clark	410(14)			410
Cowley	385(34)	290(18)	448(9)	374
Douglas	416(4)	424(4)	418(11)	419
Lyon	307(54)	382(14)		345
McPherson	465(4)	437(3)		451
Montgomery	1225(5)	1200(1)	975(3)	1133
Neosho	1838(6)	755(3)	1192(6)	1262
Ottawa	452(8)	404(23)	537(23)	464
Pottawatomie 2	319(5)		536(2)	428
Sheridan	209(18)	312(12)		261
Average	567	496	684	525

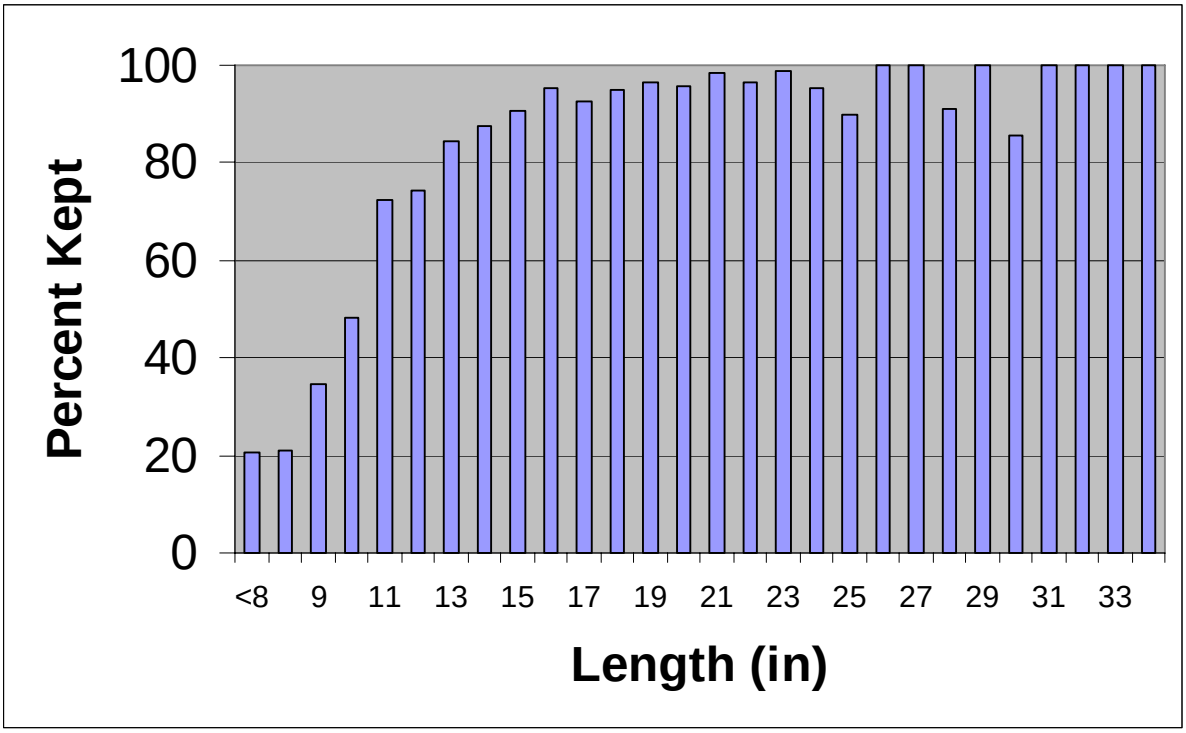
Mean weight (g) of channel catfish during fourth July after stocking in Kansas SFLs 1993-1994. The age was determined by fin clips. The number in parentheses is the sample size.

Lake	1993	1994	Yearly Mean
Barber-lower	268(2)		268
Clark	440(3)		440
Cowley	515(24)	341(3)	428
Douglas	734(4)	577(3)	644
Lyon	526(5)	578(5)	552
McPherson	none sampled		
Montgomery	1625(1)	2900(1)	2262
Neosho	none sampled		
Ottawa	820(5)	660(13)	740
Pottawatomie 2	482(4)		482
Sheridan	356(28)	504(6)	430
Average	640	926	694

Mean weight (g) of channel catfish during fifth July after stocking in Kansas SFLs 1994. The age was determined by fin clips. The number in parentheses is the sample size.

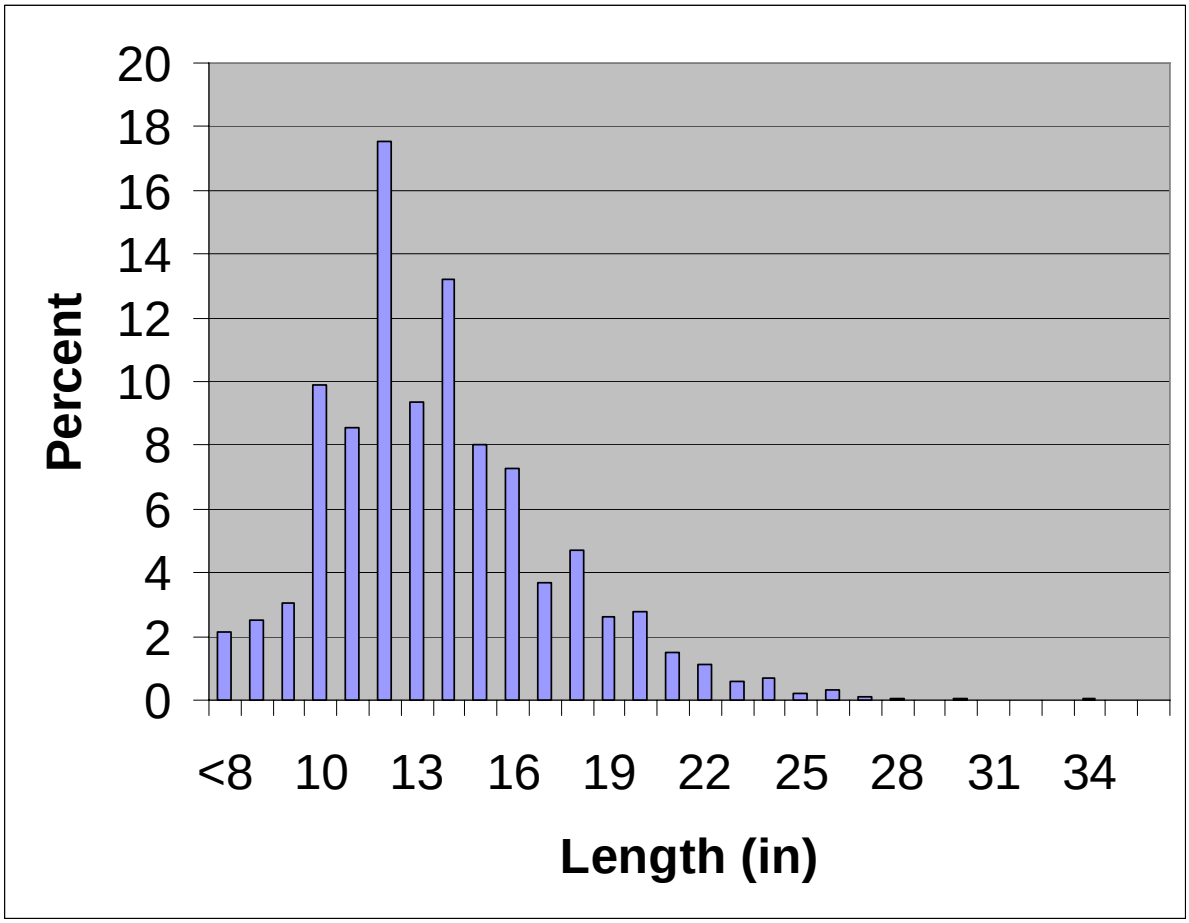
Lake	1994
Barber-lower	340(1)
Clark	852(4)
Cowley	613(11)
Douglas	810(1)
Lyon	none sampled
McPherson	none sampled
Montgomery	none sampled
Neosho	none sampled
Ottawa	1178(10)
Pottawatomie 2	944(3)
Sheridan	582(12)
Average	695

Appendix F



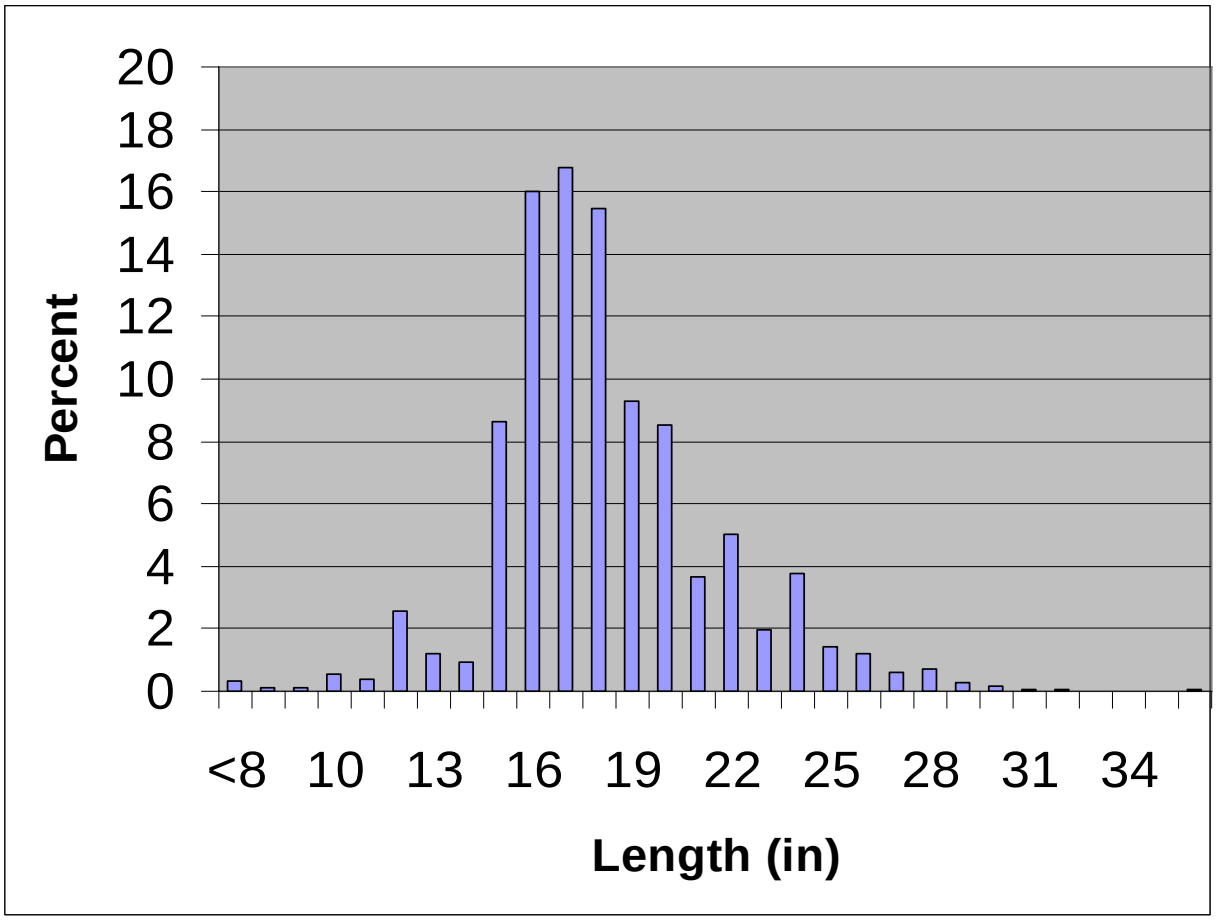
The percent of channel catfish harvested per inch group at Kansas state fishing lakes without length limits 1985-2005, N=88 lakes.

Appendix G



The percent of total harvest of channel catfish kept by anglers at Kansas state fishing lakes without length limits 1985-2005, N = 88 lakes and 14,158 fish.

Appendix H



The percent of total harvest of channel catfish kept by anglers at Kansas state fishing lakes with 15-inch length limits 1985-2005, N = 34 lakes and 4,028 fish.