# KAW LAKE MANAGEMENT PLAN

**Background**

Kaw Lake impounds the Arkansas River, 8 miles east of Ponca City in Kay County, in northern Oklahoma (Fig. 1). Kaw Lake covers 17,000 surface acres and was constructed in 1976 by the U.S. Army Corps of Engineers. Kaw Lake has a mean depth of 25.9 feet and a maximum depth of 75 feet, a shoreline development ratio (the ratio between length of shoreline and surface area) of 7.4, a water exchange rate (the number of times the volume of a lake is discharged through the dam in one year) of 5.2 and a secchi disc visibility of around 34 inches in the main pool in August; turbidity is both from suspended clay and plankton.

Fish habitat consists primarily of small areas of standing timber in coves along the south shoreline and the upper reaches of Beaver Creek arm, large rock boulders near the old river channel and interspersed sand bars. Heavy siltation has degraded largemouth bass habitat in most of the smaller coves in the upper half of the lake. No aquatic plants occur in Kaw due to high water level fluctuation further limiting bass habitat. Rip-rap habitat is located at three locations for a total length of four miles. Since a large portion of Kaw Lake is east/west oriented and flanked by fairly high topography, there is some protection for boaters from the prevailing north/south winds.

The trophic state index (TSI) using chlorophyll-a was calculated using values collected at 4 sites for four quarters. The average TSI was 56, classifying the lake as eutrophic, indicating high levels of primary productivity and nutrient rich conditions. Eutrophic lake conditions have had negative implications for introduced species, however, most native species tolerate these conditions fairly well. Striped bass fingerling stocking from 1977-2003 produced very few recruited fish although seining results indicated stocking success; age 0 striped bass growth always lagged behind white bass growth. Reservoir strain smallmouth bass fingerling stockings (1992-1995) produced few adult fish and limited natural recruitment. However, White bass X striped bass hybrid introductions started in 2004 and have proven to be fairly successful. Walleye abundance is low due to low reproduction/recruitment and immigration down stream.

Kaw Lake has an 24” water level drawdown starting the last week in July (Appendix A). Mud flats in the upper reaches of the lake are aerial seeded with Japanese Millet. The mature stand of millet is flooded to coincide with the fall migration of waterfowl in October and November. Typically, Kaw will rise 8-12 feet with spring rains but has reached the top of flood control pool, which is a 35 foot rise, three times since impoundment.

Thermal stratification occurs throughout the entire lake during the summer with 14 to 61 percent of the water column experiencing anoxic conditions. Depth of stratification at the dam site ranges from 7 to 11 meters. Water hardness typically is 230ppm and the ph ranges from 6.9 to 8.2. Conductivity can range from 400 to 1100 umho/cm.

**History of Fishery**

Recent fish stockings include striped bass hybrids, striped bass, walleye and paddlefish (Table 1). A 14 inch minimum length limit was placed on all black bass in 1986 in order to prevent overharvest. A 18 inch minimum length limit on walleye was initiated in 1994. A cooperative paddlefish restoration project was begun in 1991 in an attempt to re-establish this species in the Arkansas River and its tributaries above Kaw Lake and was considered successful after recruitment was observed in 1998 however recent December surveys indicate low overall abundance.

A research project contrasting emigration loss downstream of the original white bass X striped bass hybrid with the reciprocal cross hybrid is on going and abundance has increased steadily since the first stocking in 2004 (Table 2, Figure 2).

Largemouth bass have been impacted by poor recruitment due to habitat degradation. Spotted bass abundance is also low but quality sized (>14”) fish are turned in during bass tournaments.

Walleye abundance has remained low due to emigration losses downstream and poor recruitment. Walleye were stocked from 2006-2008 to increase numbers.

Crappie, white bass and all catfish species have generally had a trend of high abundance with some cyclic variations. Blue catfish abundance has increased steadily since 2003 with corresponding angler satisfaction.

Kaw Lake has a very robust forage base consisting primarily of gizzard shad and inland silversides. Gill net catch rates of gizzard shad < 6 inches have ranged from 21.1 – 63.4 per net day

(Table 9, Figure 7). Sunfish species generally have low abundance and are not considered as primary forage.

**Threats to Fishery**

Aquatic nuisance species present include white perch and zebra mussels. White perch were collected for the first time in 2000. The source of the fish was a contaminated striped bass stocking from the state of Virginia that was made into Cheney Reservoir, KS. As of 2007, white perch abundance has been low to moderate with most individuals collected being Age 0. Negative impacts to sport fisheries have not been detected. Zebra mussel veligers were collected in Kaw Lake for the first time in 2004 and numbers increased rapidly in subsequent years. Blue catfish and drum will feed on zebra mussels but will not control them. No negative impact to sport fisheries has been measured. The source of the zebra mussels was from water released from El Dorado Reservoir in Kansas.

The major threat to sport fisheries in Kaw Reservoir is poor water quality and habitat degradation due to large spring inflows resulting in fluctuating water levels, loss of fish downstream, high turbidities and subsequent heavy silt loads that cover spawning substrates, fill in channels and coves and expand mud flats. Fluctuating water levels also prevents establishment of aquatic plants.

## Management Objectives

White bass X striped bass hybrids

The white bass X striped bass hybrid research project has been extended through 2009 but early results look promising for developing a fishery in Kaw Reservoir. Growth rates and recruitment have been good and fall gill netting catch rates in 2007 were above acceptable values for each length group (Table 2, Table 2').

Stocking rate should continue in 2010 with fingerlings at 10/A annually with the hybrid cross (original or reciprocal) that performs the best in this high flow through reservoir. Gill netting should be conducted and otolith samples taken every other year starting in 2011. If acceptable total gill netting catch rates (C/f > 2.4) can be maintained stockings should continue.

A regulation change for a reduced creel limit on hybrids should be considered in Kaw and its tailwaters since it is unregulated at the present time.

Walleye

Walleye were stocked soon after impoundment and ceased in 1986 after natural reproduction was indicated in fall gill netting in 1987. However, recruitment has been limited. Fingerling and/or fry stockings were resumed in 2006 at low stocking rates with some success (Table 3, Figure 3).

The annual stocking of walleye should continue but at a higher rate of either walleye fry or fingerlings. If acceptable total gill net catch rates (C/f > 2.4) can be maintained after the third year, stocking efforts should be re-evaluated. Fall gill netting will be scheduled every other year starting in 2009.

The forage base in Kaw is strong enough to support this predator in higher numbers. Walleye growth rates and body condition factors have always been acceptable.

Largemouth bass

Largemouth bass catch rates have generally been below acceptable levels since impoundment (Table 4, Figure 4). Habitat degradation and lake physiology have prevented Kaw from being a better bass lake. However, close shoreline brush structure in the less impacted coves in the lower parts of the lake may provide some recruitment benefits in those coves. Also, the water level plan should be modified to prevent the August drawdown when high water level conditions prevent millet seeding. Maximizing flooded terrestrial vegetation through August and September can increase bass recruitment.

Blue catfish

The blue catfish fishery developed slowly but steadily since the initial and only stocking in 1978 (Table 5, Figure 5). Abundance levels are high and growth rates are satisfactory. Otoliths were recovered in a 2004 electrofishing sample indicated blues reached 20 inches at age 7 and 24 inches at age 9 (Table 6). Although Kaw Reservoir produces very few blues over 30 pounds, abundance of fish up to 5 pounds is high and fishermen satisfaction is high. Most of the fishing pressure is on the upper 1/3 of the lake with juglines being very popular.

A two year research project was completed in May of 2008 to determine best habitat and season to collect blue catfish by electrofishing. A creel limit change may be recommended as part of this study.

White Crappie

The abundance of crappie in Kaw is considered satisfactory while growth rates and condition factors are exceptional (Table 7, Figure 6). Age 2 crappie in the fall are > 11 inches while age 3 fish are > 12 inches (Table 8). Angler satisfaction is high except when high water levels in the spring limits angling success.

Additional brush shelters should be built in the lower half of the lake to provide increased angling opportunities. Buoyed brush piles can be helpful in locating crappie especially for novice anglers.

Table 1. Number and size of fish stocked in Kaw Lake from June 1976 to June 2007.

| DATE | SPECIES | NUMBER | SIZE (mm.) |
| --- | --- | --- | --- |
| July, 1976 | Largemouth bass | 416,000 | 38 |
| July, 1976 | Inland silversides | 15,000 | Adults |
| August, 1976 | Channel catfish | 225,000 | 38 |
| | | | |
| April, 1977 | Walleye | 3,000,000 | Fry |
| April, 1977 | Largemouth bass | 300,000 | Advanced Fry |
| June, 1977 | Striped bass | 93,400 | 38 |
| | | | |
| August, 1978 | Largemouth bass | 14,000 | 76 |
| August, 1978 | Blue catfish | 80,730 | 104 |
| | | | |
| April, 1979 | Walleye | 3,500,000 | Fry |
| June, 1979 | Striped bass | 2,000 | Fry Kansas |
| August, 1979 | Striped bass | 1,100 | 104 Kansas |
| | | | |
| June, 1980 | Striped bass | 40,500 | 1900/lb Kansas |
| July, 1980 | Largemouth bass (Native) | 73,162 | 52 |
| July, 1980 | Largemouth bass (Native) | 6,846 | 76-152 |
| July, 1980 | Largemouth bass (Florida) | 31,700 | 52 |
| | | | |
| May, 1981 | Walleye | 64,122 | 38 |
| May, 1981 | Striped bass | 1,500,000 | Fry |
| June, 1981 | Inland silversides | 4,500 | Adults |
| | | | |
| April, 1982 | Walleye | 3,600,000 | Fry |
| June, 1982 | Striped bass | 27,500 | 38 |
| | | | |
| June, 1983 | Walleye | 38,551 | 38 |
| | | | |
| May, 1984 | Walleye | 600,000 | Fry |
| May, 1984 | Walleye | 206,160 | 38 |
| May, 1984 | Largemouth bass (Native) | 167,000 | 25 |
| July, 1984 | Striped bass | 9,090 | 38-178 Texoma |
| | | | |
| May, 1985 | Walleye | 158,085 | 38 |
| June, 1985 | Striped bass | 176,632 | 38-52 |

| | | | |
|---|---|---|---|
| April, 1986 | Walleye | 155,000 | 30 |
| June, 1986 | Striped bass | 177,750 | 35 |
| June, 1987 | Striped bass | 89,000 | 52 |
| July, 1988 | Striped bass | 243,584 | 38 |
| June, 1989 | Striped bass | 93,938 | 26 |
| March, 1990 | Sauger (Tailwater) | 17 | Adults |
| March, 1990 | Sauger (Tailwater) | 34,515 | Fry |
| June, 1990 | Striped bass | 500,000 | Fry |
| July, 1990 | Striped bass | 23,900 | 32 |
| May, 1991 | Striped bass | 117,668 | 32 |
| August, 1991 | Paddlefish | 1,780 | 254 |
| August, 1991 | Paddlefish | 750 | 254 Kansas |
| September, 1991 | Paddlefish | 117 | 305 |
| June, 1992 | Smallmouth bass (Lake Strain) | 40,000 | 38 |
| June, 1992 | Striped bass | 80,000 | 52 |
| June, 1992 | Striped bass | 20,000 | 26 |
| June, 1992 | Paddlefish | 4,200 | 200 |
| July, 1992 | Paddlefish | 3,538 | 5.8lbs. |
| July, 1992 | Paddlefish | 6,612 | 5.8lbs. |
| June, 1993 | Striped bass | 13,440 | 38 |
| June, 1993 | Striped bass | 4,000 | 44 |
| June, 1993 | Smallmouth bass LS | 40,000 | 38 |
| July, 1993 | Paddlefish | 4,800 | 200 |
| August, 1993 | Paddlefish | 1,920 | 203 |
| August, 1993 | Paddlefish | 6,400 | 280 |
| June, 1994 | Striped bass | 192,000 | 32 |
| July, 1994 | Paddlefish | 473 | 274 |
| July, 1994 | Paddlefish | 3,036 | |
| July, 1994 | Paddlefish | 3,475 | 203 |
| August, 1994 | Paddlefish | 2,342 | 203 |
| August, 1994 | Smallmouth bass LS | 3,220 | 70 |
| June, 1995 | Striped bass | 69,600 | 38 |

| | | | |
|---|---|---|---|
| July, 1995 | Paddlefish | 2,013 | 265 |
| July, 1995 | Smallmouth bass LS | 18,625 | 70 |
| | | | |
| June, 1996 | Striped bass | 94,400 | 25-32 |
| | | | |
| June, 1997 | NLMB | 12,000 | 38 |
| June, 1997 | Striped bass | 210,254 | 32-38 |
| | | | |
| June, 1998 | Striped bass | 19,863 | 59 |
| | | | |
| June, 1999 | Striped bass | 134,900 | 32 |
| | | | |
| July, 2002 | Striped bass | 2,500 | 76 |
| | | | |
| June, 2003 | Striped bass | 29,890 | 38 |
| | | | |
| April, 2004 | Striped bass | 43 | Adults |
| June, 2004 | Hybrid stripers/recip | 34,238 | 52 |
| | | | |
| June, 2005 | Hybrid stripers/recip | 85,000 | 44 |
| June, 2005 | Hybrid stripers/orig | 85,000 | 44 |
| April, 2005 | Striped bass | 15 | Adults |
| | | | |
| April, 2006 | Walleye | 180,000 | Fry |
| May, 2006 | Walleye | 24,000 | 32 |
| June, 2006 | Hybrid stripers/orig | 85,632 | 37 |
| June, 2006 | Hybrid stripers/recip | 83,000 | 32-48 |
| June 2006 | Striped bass | 22 | Adults |
| | | | |
| April, 2007 | Walleye | 170,000 | Fry |
| April, 2007 | Striped bass | 31 | Adults |
| June, 2007 | Hybrid stripers/recip | 80,000 | 38 |
| June, 2007 | Hybrid stripers/orig | 85,350 | 38 |

Table 2. Total number (No.), catch rates (C/f)or(number/day), and relative weights ($W_r$) by size groups of **striped bass x white bass hybrids** collected by gill netting from Kaw Lake. Numbers in parentheses represent acceptable C/f values for a quality fishery. Acceptable $W_r$ values are $\geq$90.

| | Total (>2.4) | | <12 in. ($\geq$.72) | | 12-20 in. (>1.2) | | >20 in. ($\geq$.48) | |
|---|---|---|---|---|---|---|---|---|
| Year | No. | C/f | C/f | $W_r$ | C/f | $W_r$ | C/f | $W_r$ |
| 2004 | 3 | 0.24 | 0.24 | 91 | | | 0.00 | 81 |
| 2005 | 6 | 0.24 | 0.24 | 86 | 0.00 | 78 | | |
| 2006 | 29 | 2.16 | 0.48 | 91 | 1.44 | 97 | 0.24 | 96 |
| 2007 | 44 | 3.84 | 0.72 | 79 | 1.92 | 88 | 0.96 | 89 |

Table 2’. Mean length at age in inches of **common and reciprocal hybrids** collected by fall gill netting from Kaw Lake.

| Year | Age 0 common/recip | Age 1 common/recip | Age 2 common/recip | Age 3 common |
|---|---|---|---|---|
| 2007 | 7.1 / 6.6 | 13.9 / 12.2 | 20.0 / 18.0 | 21.6 |

Table 3. Total number (No.), catch rates (C/f) or number/day, and relative weights ($W_r$) by size groups of **walleye** collected by gill netting from Kaw Lake. Numbers in parentheses represent acceptable C/f values for a quality fishery. Acceptable $W_r$ values are $\geq$90.

| Total | <12 in. | 12-16 in. | >16 in. |
|---|---|---|---|

| Year | No. | C/f (>2.4) | C/f (≥ 1.44) | $W_r$ | C/f (≥ .48) | $W_r$ | C/f (≥ .48) | $W_r$ |
|---|---|---|---|---|---|---|---|---|
| 1978 | 1 | 0.00 | | | 0.00 | | | |
| 1982 | 3 | 0.24 | | | 0.24 | | | |
| 1987 | 19 | 1.44 | 0.96 | 101 | | | 0.24 | 101 |
| 1989 | 2 | 0.24 | | | | | 0.24 | 110 |
| 1992 | 9 | 0.72 | | | | | 0.72 | 97 |
| 1994 | 6 | 0.48 | <0.24 | 92 | | | 0.24 | 100 |
| 1997 | 1 | <0.24 | <0.24 | 98 | | | | |
| 2000 | 15 | 1.2 | 0.24 | 92 | <0.24 | 100 | 0.72 | 100 |
| 2002 | 5 | 0.48 | 0.00 | 81 | | | 0.24 | 98 |
| 2003 | 2 | 0.24 | 0.24 | 86 | | | | |
| 2004 | 15 | 1.20 | 0.48 | 92 | 0.24 | 87 | 0.24 | 92 |
| 2005 | 11 | 0.72 | 0.48 | 91 | 0.00 | 90 | 0.24 | 86 |
| 2006 | 24 | 1.68 | 0.72 | 103 | 0.48 | 109 | 0.72 | 102 |
| 2007 | 2 | 0.24 | | | 0.24 | 100 | 0.24 | 100 |

Table 4. Total number (No.), catch rates (C/f) (number/hour), and relative weights ($W_r$) by size groups of **largemouth bass** collected by spring electrofishing and seining from Kaw Lake. Numbers in parentheses represent acceptable C/f values for a quality fishery. Acceptable $W_r$ values are ≥90.

| | Total[1] (≥40) | | <8 in.[1] (15-45) | | 8-12 in.[1] (15-30) | | >12 in.[1] (≥15) | | >14 in. (≥10) | | Age 0[2] (≥1.0) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Year | No. | C/f | C/f | $W_r$ | C/f | $W_r$ | C/f | $W_r$ | C/f | $W_r$ | C/f |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1977 | | | | | | | | | | | 1.9 |
| 1978 | | | | | | | | | | | 0.1 |
| 1980 | 138 | 12.0 | 4.4 | 101 | 2.1 | 93 | 5.5 | 99 | 3.8 | 100 | 0.1 |
| 1981 | 240 | 25.3 | 11.3 | 88 | 4.3 | 95 | 9.7 | 108 | 5.8 | 110 | |
| 1982 | 120 | 20.0 | 6.8 | 89 | 4.0 | 93 | 9.2 | 107 | 7.3 | 111 | 0.1 |
| 1983 | 202 | 12.5 | 3.0 | 86 | 4.9 | 88 | 3.1 | 105 | 2.6 | 108 | |
| 1988 | 249 | 23.9 | 3.0 | 85 | 7.2 | 102 | 13.7 | 107 | 8.1 | 106 | |
| 1992 | 253 | 35.0 | 4.0 | 89 | 7.2 | 98 | 23.8 | 108 | 15.0 | 108 | |
| 1997 | 143 | 19.2 | 5.5 | 98 | 4.7 | 94 | 9.0 | 95 | 6.4 | 94 | |
| 2000 | 137 | 27.4 | 9.6 | 100 | 5.8 | 102 | 12.0 | 105 | 8.8 | 104 | |

[1] Spring electrofishing
[2] Seining

Table 5. Total number (No.), catch rates (number/day)(C/f), and relative weights ($W_r$) by size groups of **blue catfish** collected by gill netting from Kaw Lake. Numbers in parentheses represent acceptable C/f values for a quality fishery. Acceptable $W_r$ values are $\geq$90.

| | Total ($\geq$.10) | | <12 in. ($\geq$.05) | | >12 in. ($\geq$.05) | | >16 in. ($\geq$.03) | |
|---|---|---|---|---|---|---|---|---|
| Year | No. | C/f | C/f | $W_r$ | C/f | $W_r$ | C/f | $W_r$ |
| 1980 | 5 | 0.48 | | | 0.48 | | 0.24 | |
| 1982 | 12 | 0.72 | | | 0.72 | | 0.72 | |
| 1987 | 14 | 0.96 | 0.72 | 120 | 0.24 | 144 | 0.24 | 144 |
| 1989 | 4 | 0.24 | 0.24 | 106 | 0.24 | 103 | | |
| 1992 | 34 | 2.40 | 0.96 | 101 | 1.44 | 107 | 1.20 | 109 |
| 1994 | 78 | 5.30 | 0.48 | 104 | 4.80 | 116 | 3.80 | 118 |
| 1997 | 37 | 3.40 | 1.68 | 104 | 1.68 | 107 | 1.44 | 110 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 2000 | 51 | 3.80 | 0.72 | 95 | 3.12 | 98 | 2.16 | 101 |
| 2002 | 70 | 5.30 | 0.96 | 105 | 4.56 | 100 | 3.60 | 102 |
| 2003 | 63 | 5.00 | 2.88 | 87 | 1.68 | 98 | 0.72 | 105 |
| 2004 | 73 | 6.00 | 1.92 | 98 | 4.08 | 93 | 2.16 | 96 |
| 2005 | 161 | 10.6 | 5.04 | 99 | 5.52 | 91 | 3.60 | 91 |
| 2006 | 180 | 17.3 | 1.20 | 106 | 14.4 | 102 | 12.7 | 102 |
| 2007 | 77 | 8.16 | 0.48 | 98 | 6.24 | 89 | 5.52 | 89 |

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Table 6

**KAW BLUE CATFISH ELECTRO 2004 AND EXPO 2007 COMBINED (MEAN LENGTH AT AGE)**

| AGE | N | MEAN LENGTH (mm) | MEAN LENGTH (IN) |
|---|---|---|---|
| 1 | 21 | 174 | 6.9 |
| 2 | 75 | 232 | 9.1 |
| 3 | 259 | 272 | 10.7 |
| 4 | 129 | 325 | 12.8 |
| 5 | 39 | 401 | 15.8 |
| 6 | 22 | 481 | 18.9 |
| 7 | 12 | 511 | 20.1 |
| 8 | 6 | 544 | 21.4 |
| 9 | 14 | 665 | 26.2 |
| 10 | 15 | 663 | 26.1 |
| 11 | 11 | 697 | 27.4 |
| 12 | 37 | 718 | 28.3 |
| 13 | 18 | 707 | 27.8 |
| 14 | 49 | 741 | 29.2 |
| 15 | 3 | 805 | 31.7 |
| 16 | 8 | 764 | 30.1 |
| 17 | 40 | 774 | 30.5 |
| 18 | 6 | 783 | 30.8 |
| 19 | 1 | 787 | 31.0 |
| 20 | 10 | 749 | 29.5 |
| 21 | 1 | 914 | 36.0 |

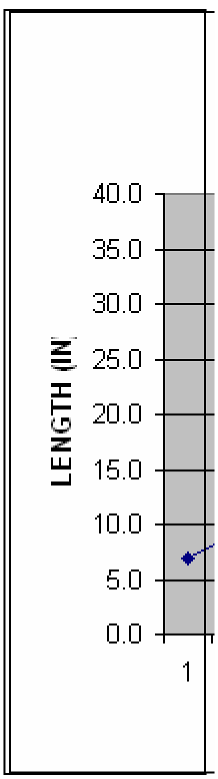

Table 7. Total number (No.), catch rates (number/day)(C/f), and relative weights ($W_r$) by size groups of **crappie** collected by gill netting from Kaw Lake. Numbers in parentheses represent acceptable C/f values for a quality fishery. Acceptable $W_r$ values are ≥90.

| | Total (≥.20) | | <8 in. (.05-.30) | | ≥8 in. (≥.08) | | ≥10 in. (≥.04) | |
|---|---|---|---|---|---|---|---|---|
| Year | No. | C/f | C/f | $W_r$ | C/f | $W_r$ | C/f | $W_r$ |
| 1977 | 133 | 8.16 | 8.16 | | 0.00 | | | |
| 1978 | 128 | 9.36 | 2.40 | | 6.48 | | 2.64 | |
| 1980 | 36 | 2.64 | 0.72 | | 1.92 | | 1.68 | |
| 1982 | 25 | 1.68 | 0.48 | | 1.20 | | 0.72 | |
| 1987 | 44 | 3.12 | 0.00 | 87 | 2.88 | 125 | 1.68 | 129 |
| 1989 | 6 | 0.48 | | | 0.48 | 107 | 0.24 | 110 |
| 1992 | 11 | 0.72 | 0.48 | 91 | 0.48 | 86 | 0.24 | 83 |
| 1994 | 78 | 5.28 | 3.36 | 96 | 2.16 | 108 | 1.44 | 109 |
| 1997 | 35 | 3.12 | 0.96 | 89 | 2.16 | 100 | 1.20 | 103 |
| 2000 | 62 | 4.56 | 2.64 | 85 | 2.16 | 95 | 1.20 | 98 |
| 2002 | 14 | 1.20 | 0.24 | 87 | 0.96 | 100 | 0.96 | 00 |
| 2003 | 20 | 1.44 | 0.96 | 87 | 0.48 | 107 | 0.48 | 108 |
| 2004 | 19 | 1.68 | 0.48 | 92 | 1.20 | 94 | 0.72 | 96 |
| 2005 | 35 | 2.16 | | | 1.68 | 98 | 1.20 | 100 |
| 2006 | 43 | 3.36 | | | 3.36 | 106 | 1.68 | 108 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 2007 | 58 | 5.28 | 2.88 | 90 | 2.40 | 95 | 1.68 | 98 |

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Table 8. Mean length at age in inches of **crappie** collected by gill netting from Kaw Lake. Numbers in parentheses represent values for acceptable growth rates.

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| Year | Age 1 (≥6.3 in.) | Age 2 (≥7.9 in.) | Age 3 (≥8.9 in.) | Age 4 (≥9.8 in.) |
|---|---|---|---|---|
| 1990 | | 11.2 | | |
| 1991 | 7.8 | | | |
| 1994 | 9.9 | 12.4 | 14.6 | |
| 1997 | 8.2 | 11.4 | 12.8 | |
| 2000 | 8.2 | 11.0 | | 13.5 |
| 2002 | 7.3 | 11.2 | 12.1 | |
| 2003 | 7.4 | 11.6 | 12.8 | 13.3 |
| 2004* | 8.2 | 10.2 | 12.0 | 11.4 |
| 2005 | 8.6 | 11.4 | 12.4 | |
| 2006 | 10.0 | 12.7 | | |
| 2007 | 7.7 | 11.5 | 12.9 | 13.1 |

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*Collected by trap netting from Kaw Lake.

Table 9. Total number (No.), catch rates (number/day) (C/f), and relative weights ($W_r$) by size groups of **gizzard shad** collected by spring electrofishing and gill netting from Kaw Lake. Numbers in parentheses represent acceptable C/f values for a quality fishery. Acceptable $W_r$ values are $\geq$90.

| | Total[1] (≥40) | | <8 in.[1] (≥20) | | Total[2] (≥.20) | | <8 in.[2] (≥.10) | | Age 0[3] - | |
|---|---|---|---|---|---|---|---|---|---|---|
| Year | No. | C/f | C/f | $W_r$ | C/f | $W_r$ | C/f | $W_r$ | No. | C/f |
| 1977 | | | | | 9.84 | | | | | |
| 1978 | | | | | 12.5 | | 2.16 | | | |
| 1980 | 250 | 27.8 | 20.9 | 114 | 11.5 | | 5.04 | | | |
| 1981 | 304 | 32.0 | 17.2 | 103 | | | | | | |
| 1982 | 353 | 58.8 | 39.8 | 109 | 17.8 | | 12.0 | | | |
| 1987 | | | | | 15.8 | 96 | 5.30 | 111 | | |
| 1988 | 583 | 91.5 | 58.4 | 94 | | | | | | |
| 1989 | | | | | 14.6 | 82 | 7.90 | 84 | | |
| 1992 | 299 | 80.4 | 55.4 | 93 | 30.2 | 77 | 22.1 | 78 | | |
| 1994 | | | | | 16.1 | 86 | 10.8 | 87 | | |
| 1997 | 258 | 40.4 | 2.5 | 96 | 8.40 | 81 | 3.10 | 77 | | |
| 2000 | 263 | 75.1 | 73.1 | 93 | 27.4 | 83 | 19.4 | 83 | 420 | 31.2 |
| 2002 | | | | | 15.1 | | 9.80 | | 299 | 23.0 |
| 2003 | | | | | 20.4 | | 6.70 | | 300 | 21.1 |
| 2004 | | | | | 50.6 | | 38.6 | | 731 | 63.4 |
| 2005 | | | | | 30.2 | | 19.6 | | 509 | 32.2 |
| 2006 | | | | | 44.4 | | 22.1 | | 513 | 62.4 |
| 2007 | | | | | 80.6 | | 78.2 | | 599 | 55.7 |

[1] Spring electrofishing
[2] Gill netting, no small meshes (½ and 5/8)
[3] Gill netting, ½ and 5/8 inch meshes (<150mm)

Appendix A.

## KAW LAKE WATER LEVEL MANIPULATION PLAN

**1.** **June 1 - July 1** - Allow lake level to rise as quickly as possible to a **1013** msl level and hold until **July 15**. Purpose: Prepares shoreline soil from elevation **1010** (conservation pool) **to 1013** for millet seeding (two stages) and irrigates desirable emergent vegetation that has volunteered. Raising lake level to **1013** also stores sufficient water to provide for adequate downstream releases to ensure sufficient flows to maintain interior least tern nesting islands and minimize nesting losses from predation and disturbance.

**2.** **July 16 - July 25*** - Draw down lake level from **1013 to 1010** as quickly as possible. Aerially seed exposed mud flats occurring within the **1013 to 1011.5** elevations with Japanese millet at a rate of 15 lbs./acre as soon after the target elevation of **1011.5** is reached (Stage 1). Continue rapid draw down of lake level from **1011.5 to 1010** and aerially seed additional exposed mud flats at same seeding rate (Stage 2). Purpose: Expose mud flats within the **1013 to 1010** elevations for the first two stages of millet seeding. Drawing the lake down as quickly as possible and seeding millet in two stages helps insure optimal mud flat conditions for successful seeding and millet germination and survival. Lake draw down releases will also provide for sufficient downstream flows to maintain least tern nesting areas and minimize nest losses due to predation and disturbance.

**3.** **July 26 - August 5*** - Continue draw down of lake from **1010 to 1008** as quickly as possible and aerially seed exposed mud flats occurring within the **1010 to 1008** elevations with Japanese millet at a rate of 15 lbs./acre as soon after the target elevation of **1008** is reached (Stage 3). Purpose: Expose mud flats within the **1010 to 1008** elevations for the third stage of millet seeding. Continued lake draw down releases provide for sufficient downstream flows to maintain least tern nesting islands and protect late nesting least terns.

**4.** **August 6 - October 15** - Minimize any lake level increase above **1008.** Any lake level increase above the target elevation, especially any increase in the lake elevation early in the millet germination and growth period (August 6-September 20) or relatively large lake level increases (> 1 ft.) should be avoided or reduced as quickly as possible. Purpose: Maximize millet germination and survival and protect growing millet from detrimental flooding during the primary millet growing period.

**5.** **Oct 16 - Nov 30** - Allow lake level to gradually rise from **1008 to 1010.5** (approx. 4.5 inches/week) and minimize any large lake level increases above **1010.5** Purpose: Flood portion of planted millet for utilization by early season migratory birds. Prevent excessive flooding of millet above the target lake level elevation that would reduce benefits to foraging waterfowl and other migratory birds.

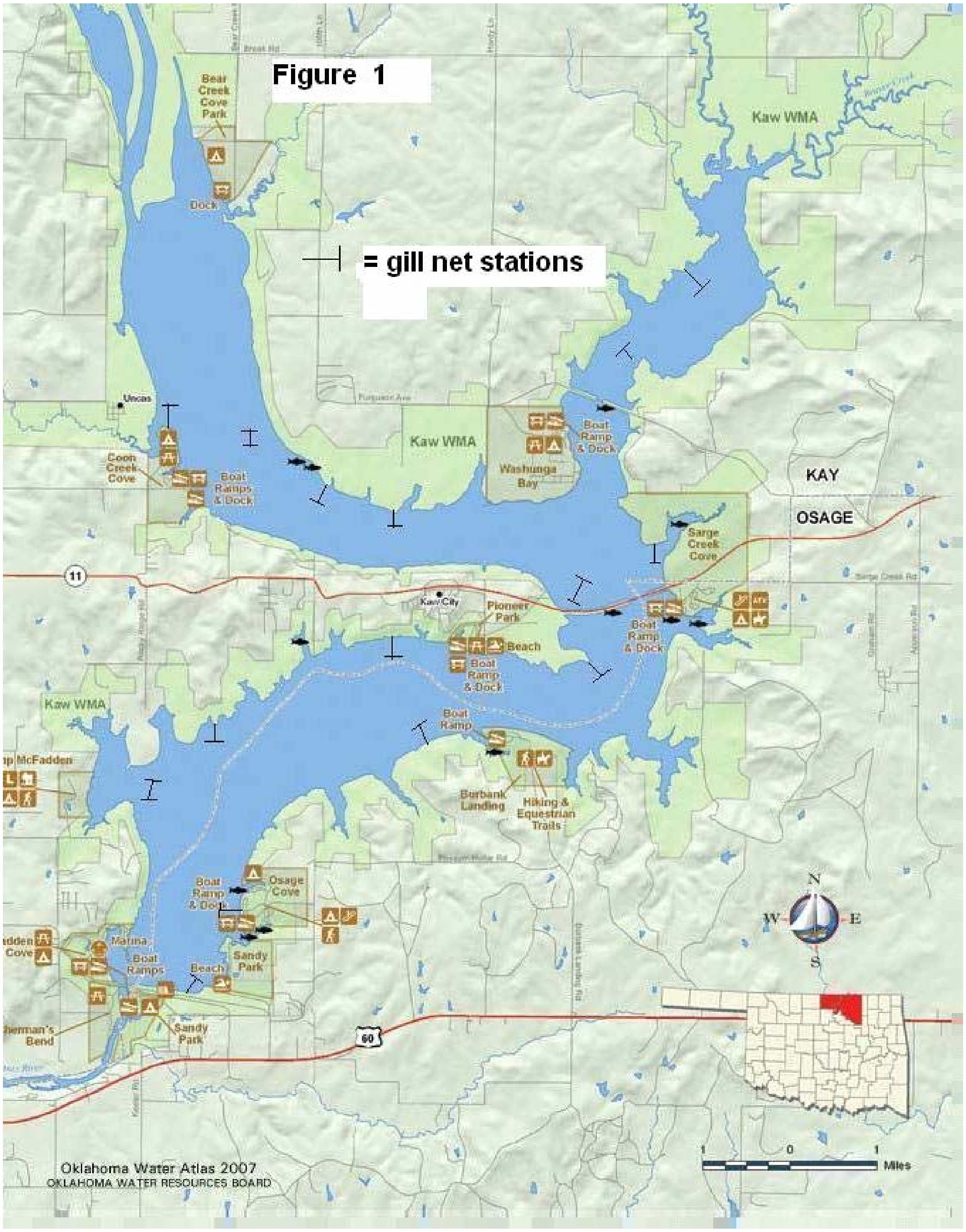
6. **Dec 1 - Jan 15** - Allow lake level to gradually rise from **1010.5 to 1013** (approx. 4.5 inches/week) and minimize any large lake level increases above **1013**. Purpose: Flood remainder of millet and native emergent vegetation for use by late season waterfowl and other migratory bird migrants. Prevent excessive flooding of millet above the target lake level elevation that would reduce benefits to foraging waterfowl and other migratory birds.

7. **Jan 16 - Jan 31 -** Maintain lake level at **1013.**

8. **Feb 1 - March 1** - Draw down lake level from **1013 to 1008** and hold stable. Purpose: Aerate exposed mud flats between **1013 and 1008** and provide for increased flood water storage capability and minimize large lake level fluctuations above the conservation pool elevation that could be detrimental to early spawning fish species.

9. **March 1 - April 20** - Gradual rise in lake level from **1008 to 1010.** Purpose: Provide for stable fish spawning habitat.

10. **April 20 - June 1** - Stable lake level at **1010** Purpose: Maintain stable fish spawning habitat.




**11.** **June 1 - July 25** - Repeat procedures described in step #1.

* **<u>Note:</u>** Listed dates are target time periods and actual millet seeding dates could vary within this time period depending upon actual lake draw down rates, schedule of water releases to protect nesting interior least terns and stream inflows to the lake.

Figure 2

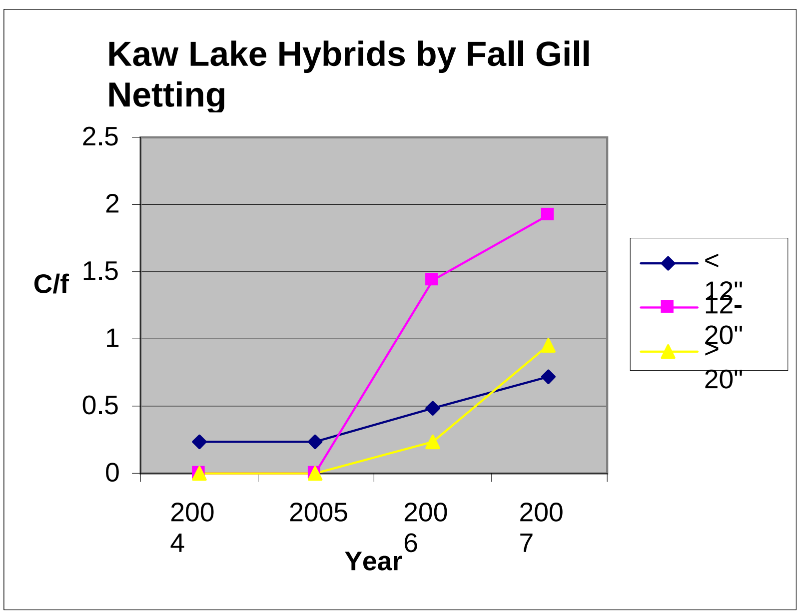



Figure 3

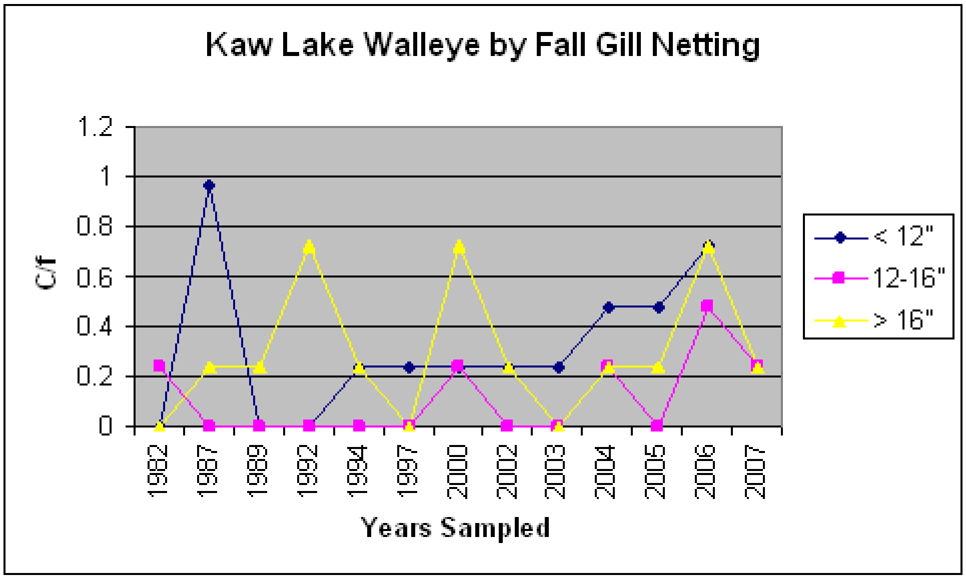



Figure 4

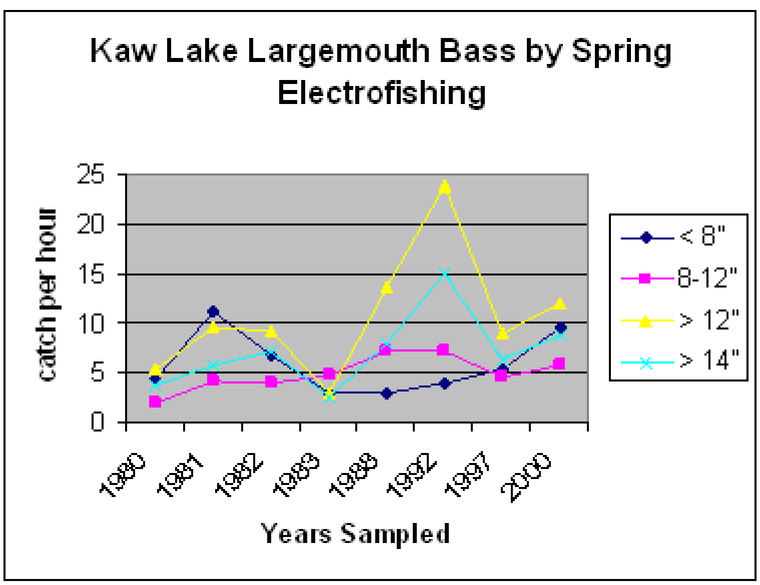



Figure 5

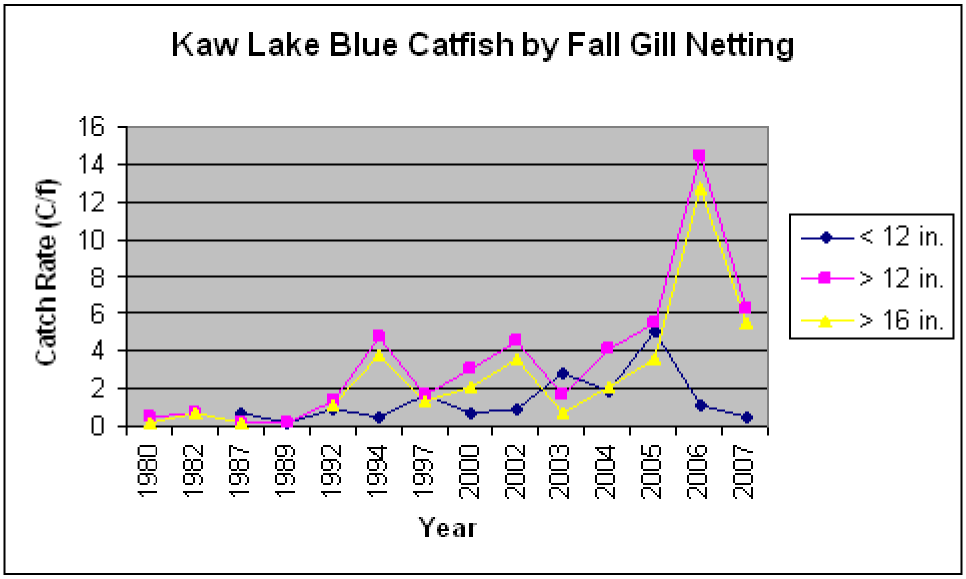



Figure 6

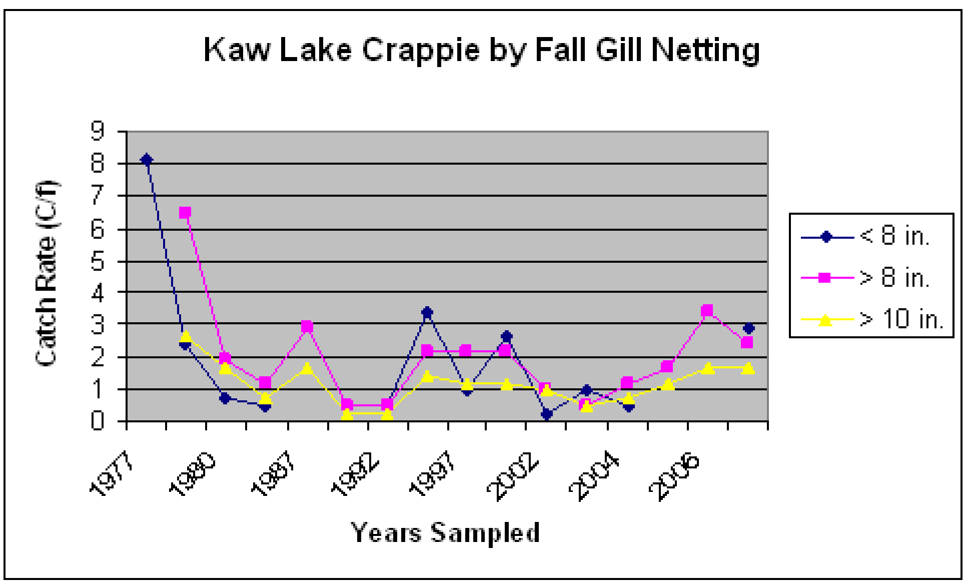
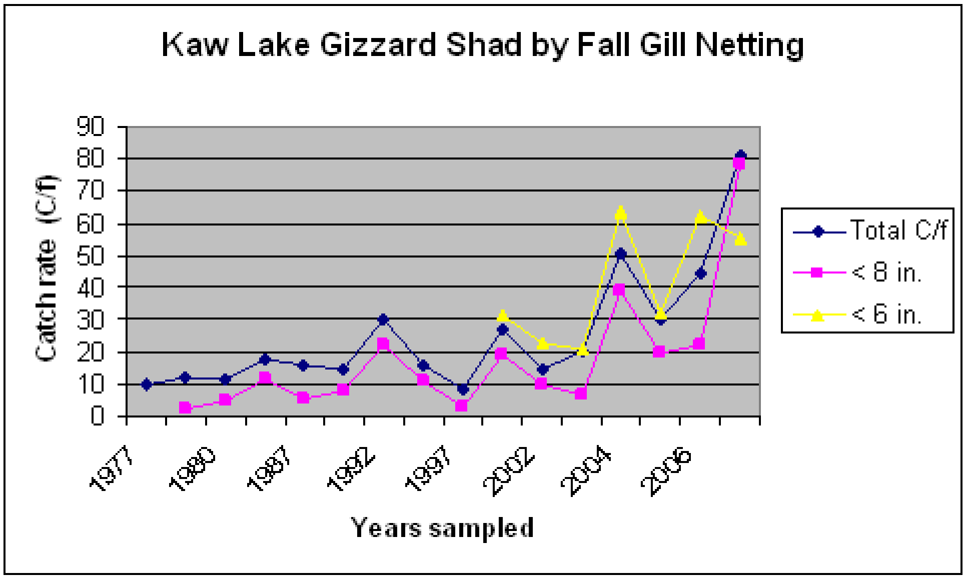



Figure 7


Kaw Lake Gizzard Shad by Fall Gill Netting
Catch rate (C/f)
90
80
70
60
50
40
30
20
10
0
1977
1980
1987
1992
1997
2002
2004
2006
Years sampled
Total C/f
< 8 in.
< 6 in.