By-catch in a recreational fishery: an unmonitored source of mortality.

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Abstract.−The purpose of this study was to infer the possible impact of unmonitored discard of by-catch on a recreational fishery. We recorded by-catch of fishes at a recreational fishery in Northeast Texas, statistically analyzed them, and then projected estimates of mortality if our observations represent a general pattern of behavior. Anglers discarded nine species of fishes during our study. The most frequently discarded fish were Gizzard Shad and Freshwater Drum. Four species of game fish were among the discarded species, but only Channel Catfish and Hybrid Striped Bass composed a large portion of the discarded fishes. Based on our observations, recreational fishing can produce a large amount of by-catch throughout the year and potentially pose an important unmonitored source of fish mortality.

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Introduction

The commercial benefit of recreational fishing is difficult to argue (Kalchreuter 1984, 1987). It is easily one of the most popular outdoor activities in the United States (Cordell 1999; Cooke and Cowx 2006) and as many as 1/3 of people in some other countries participate in the sport (Bauer and Herr 2004). In fact, as many as 57.9 million U.S. residents fish (USDOI and USDOC 1997, Cordell 1999) and spend as much as $38 billion on fishing (Cooke and Cowx 2006). In Texas, residents use ~5,764 (ranked #2 in the U.S.) and nonresidents ~1,209 (ranked #20) fishing days each year (Ditton et al. 2002). Despite the popularity of fishing activities, rather little is known about by-catch from recreational fishing compared to that reported for commercial fisheries. Commercial fisheries are primary causal agents in fish stock declines (Botsford et al. 1997; Smith 2002; Christensen et al. 2003) but the role of recreational fisheries is less understood (Cooke and Cowx 2006). Much of our lacking knowledge about recreational fisheries impacts exists because it is difficult to detect collapses due to recreational fishing pressure, few long-term studies exist, the behavior of anglers is complex, and angler groups are vocal and effective interest groups (Cooke and Cowx 2004). It is important that we improve our understanding of the role that recreational fisheries play as a controller of fish populations if we are to properly manage this resource. In this study, we attempted to characterize the by-catch discarded on the bank by anglers at a popular recreational fishery, the spillway at Wright Patman Lake (Fig. 1), near Texarkana (Bowie Co., Texas).

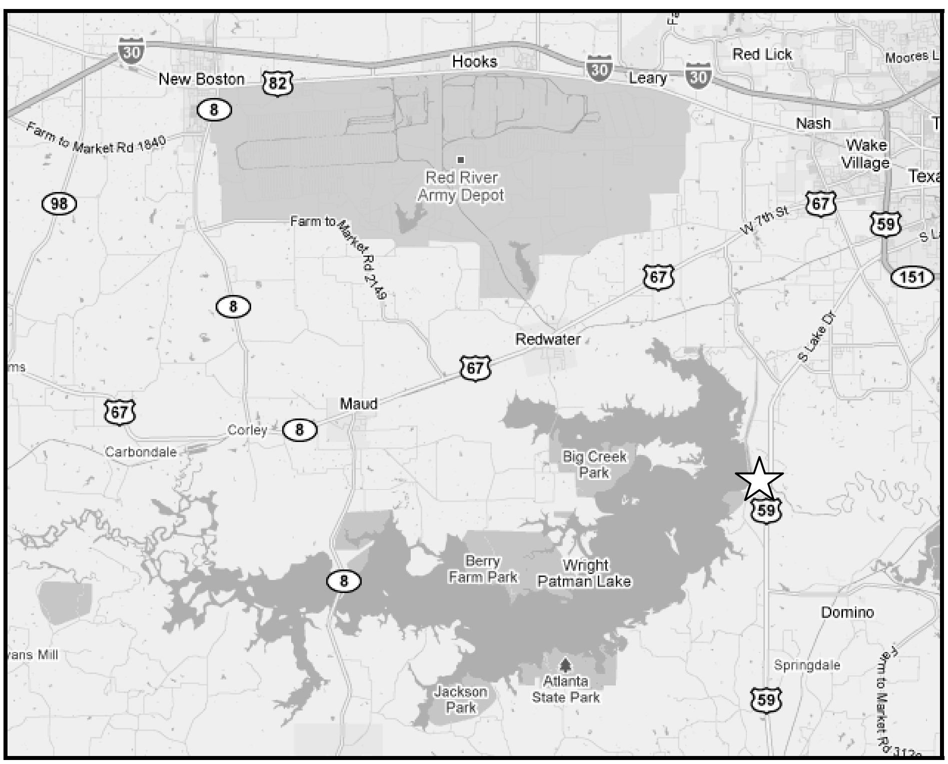

Figure 1. Wright Patman Lake located ~16.1 km south of Texarkana, Texas. The star marks the study site at the spillway. (Image source: Google Maps).

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Study Site.−Wright Patman Lake (Fig. 1) is a large (7687 ha) reservoir in Northeast Texas that was impounded in 1958 and is managed by the Fort Worth District of the U.S. Army Corps of Engineers. Its main source of water is the Sulfur River and its purpose is to supply drinking water to the residents of Texarkana, provide flood control for the Sulfur and Red Rivers, and to provide recreational opportunities including fishing and boating (US Army Corps of Engineers http://www.swf-wc.usace.army.mil/wrightpatman/ last accessed: 26 January 2011). Its maximum depth is 120 m and vegetation covers < 10% of its surface. The predominant game fish at the lake are Largemouth Bass (*Micropterus salmoides*), Blue Catfish (*Ictalurus furcatus*), Channel Catfish (*Ictalurus punctatus*), Flathead Catfish (*Pylodictis olivaris*), Black Crappie (*Pomoxis nigromaculatus*), White Crappie (*Pomoxis annularis*), Sunfish (*Lepomis* spp.), White Bass (*Morone chrysops*), and Striped Bass (*Morone saxatilis* and *Morone mississippiensis*) (USACE website). The USACE considers populations of Largemouth Bass and Flathead Catfish as good, Sunfish as fair, and Blue Catfish, Crappie and Striped Bass as excellent (USACE website). They do not provide abundance information for Channel Catfish, but our anecdotal experience suggests their numbers are excellent. The lake has been stocked with 503509 fingerling Largemouth Bass (in 2008), 100444 fingerling White and Hybrid Striped Bass (in 2002), and 4976 fingerling Paddlefish (*Polydon spathula*) (in 1994).

Materials and Methods

We visited the lake on four occasions (15 February 2008, 8 June 2008, 15 March 2009, 11 January 2011). The night before each visit, we removed all present discarded fish from the study area (Fig. 2). Then, we returned at 8:00 AM the next morning to tally the individuals of each

Figure 2. The spillway outflow which served as our study site. We collected data within 10 m of the shoreline or spillway wall between the large dotted lines. These are areas where anglers congregate to fish. (Image source: Google Maps).

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species present and measure the standard length of each discarded fish we observed. We searched the area every two hours from 8:00 AM to 4:00 PM. We compiled our data and statistically described them using MiniTab 13.0. We also recorded the number of anglers present on each visit.

We then used RAMAS Risk Calc to estimate potential annual by-catch at this location. Fuzzy numbers for daily by-catch for each species were created by using the lowest, middle, and highest number of fish observed as by-catch as the vertices of the fuzzy number. If any two seasons had the same number, we used a three integer fuzzy number. If all four were different we used a four integer fuzzy number. We did not assess risk for species for which we observed a single specimen throughout the entire study.

Results

Anglers were present at the spillway on every visit, although their numbers varied (15 February 2008 = 48 anglers, 8 June 2008 = 287 anglers, 15 March 2009 = 73 anglers, 11 January 2011 = 27 anglers). We observed nine fishes as by-catch (Table 1), although we observed fisherman catch other fishes that were not present on the banks (Blue Catfish, Flathead Catfish, Crappie, Buffalo [*Ictiobus* sp.] and a Paddlefish). No turtles or other non-fish species were observed as by-catch. Gizzard Shad (*Dorosoma cepedianum*) and Freshwater Drum (*Aplodinotus grunniens*) were the most abundant species observed as discards on the bank. The most common game fish observed were Striped Bass and Channel Cat. Longnose Gar (*Lepisosteus osseus*), Spotted Gar (*Lepisosteus oculatus*), and Bowfin (*Amia calva*) occurred in comparatively small numbers; however, these were all large individuals. Nearly all of the game fish observed as by-catch were below the legal limit (Table 2). Fuzzy projections were possible for all but two species (Table 3).

Table 1. Fishes that recreational fisherman discarded on the bank at the spillway on Wright Patman Lake, Texarkana, Texas. Data are the combined totals from four visits. (%composition does not equal 100% due to rounding). The mean standard length is provided accompanied by its standard error (SE), minimum (MN), lower quartile (LQ), Median (MD), upper quartile (UQ), and maximum (MX) measurements. N = number.

Species	N	% composition	Mean Standard Length (cm)
Gizzard Shad	625	71.9	17.6 (SE = 0.22, MN = 2.5, LQ = 15, MD = 20, UQ = 20, MX = 40)
Freshwater Drum	99	11.4	18.2 (SE = 0.67, MN = 9, LQ = 12.5, MD = 15, UQ = 25, MX = 35)
Striped Bass	89	10.2	15.9 (SE = 0.42, MN = 10, LQ = 15, MD = 15, UQ = 17.5, MX = 25)
Channel Catfish	24	2.8	12.6 (SE = 1.21, MN = 5, LQ = 9, MD = 11.8, UQ = 15, MX = 35)
Bluegill	16	1.8	8.1 (SE = 0.82, MN = 2, LQ = 5, MD = 10, UQ = 10, MX = 15)
Longnose Gar	7	0.8	65.0 (SE = 12.1, MN = 20, LQ = 30, MD = 60, UQ = 90, MX = 105)
Spotted Gar	7	0.8	52.4 (SE = 13.3, MN = 18, LQ = 24, MD = 30, UQ = 90, MX = 90)
Bowfin	1	0.1	44.0 (--)
Largemouth Bass	1	0.1	30.0 (--)
Total	869	98.1	17.9 (SE = 0.30, MN = 2, LQ = 15, MD = 15, UQ = 20, MX = 105)

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Table 2. Percent of game fishes observed in this study that were below their minimum length limits in Texas.

Species	Minimum Length (cm)	% Smaller than Minimum Legal Length
Striped Bass	45	100 (89/89)
Channel Catfish	30	95.8 (23/24)
Largemouth Bass	35	100 (1/1)

Discussion

The number of anglers present was provided as a frame of reference, but was not tracked sufficiently to ensure it is representative of how many anglers were present throughout the day. The number of anglers present was consistent with our anecdotal observations from our own fishing trips to this location. The large numbers of small shad on the banks probably arose from fishermen collecting them on site for bait and then not cleaning up what they did not use. We have observed this behavior many times. Fishermen at this location frequently toss Freshwater Drum and Striped Bass on the bank. Many use the Freshwater Drum as bait possibly explaining the smaller individuals. However, many of the anglers at this location consider the various kinds of Striped Bass as trash fish (MLM, pers. obs.). This is unfortunate, especially considering that some stocking of these fish has occurred. These observed behaviors are in line with the general perception that people simply care less about the environment today than they once did (see McCallum and Bury 2013).

By extrapolating the discarded by-catch over the year, we see that the numbers of discarded fish at this single site is substantial. In just three years the anglers would discard more fish than were stocked in 2008 (USACE website). Further, the number of gar thrown aside is certainly large enough to impact a small population. Perhaps the most telling story about this by-catch is not large numbers of fish are likely discarded throughout the year. Consider if this behavior was prevalent in habitats harboring endangered or at-risk species, especially one which casual anglers might consider a trash fish. The impact of recreational fishing on such a species could be catastrophic. More studies of this kind should be done at a much larger regional or national scale

Table 3. Fuzzy projection of annual (T = 365 days) discarded by-catch for each species at the Wright Patman Lake spillway. All values are numbers of fish. (--) = insufficient data to calculate.

Species	Minimum	Best Estimate	Maximum
Gizzard Shad	9125	10,965	186,405
Freshwater Drum	0	7655-7676	28,509
Striped Bass	--	32,530	--
Channel Catfish	0	4010-4021	4386
Sunfish	0	1458-1462	4021
Longnose Gar	0	729-731	1878
Spotted Gar	0	1094-1097	1462
All Fishes	9113	13851-36550	259140

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to determine how much risk by-catch discarding behavior by anglers could impact on fishes of conservation concern.

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