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Casey W. Schoenebeck
South Dakota State University, casey.schoenebeck@state.mn.us

Michael L. Brown
South Dakota State University

David O. Lucchesi
South Dakota Department of Game, Fish and Parks,

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Seasonal Yellow Perch Harvest in Two Dissimilar South Dakota Fisheries

CASEY W. SCHOENEBECK[1], MICHAEL L. BROWN, AND DAVID O. LUCCHESI

Department of Wildlife and Fisheries Sciences, South Dakota State University, Brookings, SD USA 57007 (CWS, MLB)
South Dakota Department of Game, Fish and Parks, 4500 South Oxbow Avenue, Sioux Falls, SD USA 57106 (DOL)

ABSTRACT Angler effort and fish harvest in South Dakota have historically been quantified through summer and winter creel surveys. However, the late-summer, pulsed recruitment of yellow perch (*Perca flavescens*) into a fishery combined with an increase in fall movement and feeding activity suggested September and October could be significant periods of perch harvest in South Dakota lakes. Seasonal trends in angler effort and yellow perch harvest during 2005–2007 were compared for high- and low-quality yellow perch fishery types commonly found in eastern South Dakota glacial lakes. High-quality yellow perch fisheries are characterized by fast growth (mean total length at age-3 greater than 200 mm), low density and inconsistent recruitment. Low-quality fisheries are characterized by slow growth (mean total length at age-3 less than 200 mm), high density and consistent recruitment. Angler effort directed at yellow perch ($F_{9,20} = 6.59$, $P < 0.001$) and the percentage of anglers targeting perch ($F_{9,20} = 3.82$, $P = 0.006$) were highest during the winter, but perch harvest ($F_{9,47} = 2.75$, $P = 0.012$) was highest during the summer on the low-quality fishery. Angler effort ($F_{9,20} = 6.59$, $P < 0.001$), percentage of anglers targeting yellow perch ($F_{9,20} = 3.82$, $P = 0.006$), and harvest of perch ($F_{9,47} = 2.75$, $P = 0.012$) were highest during the fall in the high-quality yellow perch fishery. High angler effort and yellow perch harvest during the fall in the high-quality fishery suggests that this period should be sampled to avoid underestimation of effort and harvest. Conversely, exclusion of the fall sampling period in low-quality yellow perch fisheries would likely not bias annual perch harvest estimates.

KEYWORDS angler effort, harvest, *Perca flavescens*, pulse recruitment, yellow perch

Yellow perch (*Perca flavescens*) are an important component of recreational fisheries throughout their range (VanDeValk et al. 2002, Su et al. 2007, Brooks and Hiltner 2008) and are the most widespread and sought-after panfish species in South Dakota (Gigliotti 2004). Researchers have documented two distinct but common yellow perch fisheries in South Dakota glacial lakes. Yellow perch fisheries classified as high-quality are typically found in lakes having simple basin morphometry with limited submersed vegetation. High-quality fisheries also are characterized by yellow perch populations with fast growth (mean total length at age-3 greater than 200 mm), large size structure, low abundance and variable recruitment (Lott et al. 1996, Isermann 2003, Schoenebeck and Brown 2010). Conversely, low-quality yellow perch fisheries are generally found in lakes with complex basin morphometry, abundant submersed vegetation, and perch populations characterized by slow growth (mean total length at age-3 less than 200 mm), small size structure, high abundance and relatively consistent recruitment (Lott et al. 1996, Isermann 2003, Schoenebeck and Brown 2010).

Differences in fish growth characteristics may contribute to differences in the timing and duration of recruitment into a fishery (Grant et al. 2004) and therefore, may potentially influence angler effort and harvest. Fast growth of high-quality yellow perch populations may lead to pulsed recruitment into the fishery while slow growth of low-quality populations often results in protracted recruitment into the fishery. Year classes in high-quality perch populations commonly reach an acceptable size to anglers (180–200 mm; Isermann 2003) following the third season of growth (i.e., during late summer as age-2+). Late-summer, pulsed recruitment in fast growing populations could mean that August, and subsequently fall, would present the first opportunity for anglers to potentially harvest recently recruited yellow perch. In this type of fishery, anglers may respond with increased angling effort during late summer and fall.

A typical South Dakota Department of Game, Fish and Parks creel survey, which routinely quantifies the fishery only during summer (May – August) and winter (December – March), may underestimate annual harvest and exploitation for high-quality yellow perch fisheries. Conversely, year classes in low-quality perch populations usually reach an acceptable size to anglers throughout the growing season (protracted recruitment) and at older ages (Grant et al. 2004), thereby reducing the potential for high harvest during the fall and the need for a fall creel survey.

Fall months are rarely sampled during standard creel surveys. Assessment of previous studies failed to reveal any consistent seasonal trend in yellow perch harvest (VanDeValk et al. 2002, Su et al. 2007). A better understanding of the relationship between yellow perch population types and the resulting fishery would enable fisheries managers to schedule creel surveys during periods of high angler effort, resulting in more accurate estimates of angler effort and harvest that could potentially facilitate better management of the perch fishery. Thus, our objective

[1] Present address: Department of Biology, 2401 11th Ave., University of Nebraska at Kearney, Kearney, NE 68849, USA.
Corresponding author email address: schoenebeccw@unk.edu

was to describe differences in seasonal trends in yellow perch angler effort and harvest between a high- and low-quality perch fishery.

STUDY AREA

We selected study populations to represent low-quality and high-quality yellow perch fisheries that are common to natural lakes in eastern South Dakota (Lott et al. 1996, Isermann 2003, Schoenebeck and Brown 2010). We used mean total length at age-3 to classify population types as either high (greater than 200 mm) or low (less than 200 mm) quality yellow perch fisheries. We selected Lake Cochrane (Deuel County) to represent a low-quality fishery due to its relatively slow yellow perch growth (mean length at age 3 was 182–187 mm total length (TL) during 2005–2007) and low population size structure (< 3% of sampled yellow perch larger than 130 mm TL exceeded 250 mm during 2005–2007), moderate submersed vegetation coverage (31.0%) and low productivity (total phosphorus 0.03 ppm; Stukel 2003, Schoenebeck and Brown 2010). We selected Lake Madison (Lake County) to represent a high-quality fishery due to its relatively fast yellow perch growth (mean length at age 3 was 231 to 242 mm TL during 2005–2007) and high population size structure (4 to 39% of the sampled yellow perch larger than 130 mm TL exceeded 250 mm during 2005–2007), low submersed vegetation coverage (<0.1%) and high productivity (total phosphorus 0.27 ppm; Stukel 2003, Schoenebeck and Brown 2010). Lake Cochrane had a maximum depth of 7.3 m, mean depth of 4.0 m, surface area of 144 ha, and Secchi depth (i.e., measure of water transparency) of 2.18 m (Stukel 2003). Lake Madison had a maximum depth of 4.9 m, mean depth of 2.4 m, surface area of 1,069 ha, and Secchi depth of 0.81 m (Stukel 2003). The fish community in Lake Cochrane contained slow growing populations of yellow perch, bluegill (*Lepomis macrochirus*), and hybrid sunfish (bluegill × green sunfish *L. cyanellus*). Black crappie (*Pomoxis nigromaculatus*), largemouth bass (*Micropterus salmoides*), walleye (*Sander vitreus*), northern pike (*Esox lucius*), white sucker (*Catostomus commersonii*), and common carp (*Cyprinus carpio*) also were present. The Lake Madison sport fish community was primarily comprised of walleye and yellow perch, but black crappie, smallmouth bass (*M. dolomieu*), and northern pike also were present. Lake Madison contained a higher abundance of white sucker, common carp and bigmouth buffalo (*Ictiobus cyprinellus*) than Lake Cochrane.

METHODS

We conducted creel surveys from May 2005 through March 2008 on both lakes to evaluate seasonal trends in yellow perch angler effort and harvest. We conducted a stratified-random, access-point creel survey on both study lakes to estimate month-specific yellow perch angler effort (h ha^{-1}) and harvest (fish ha^{-1}) from 1 May to 31 August (summer), 1 September to 31 October (fall) and 1 December to 31 March (winter; Pollock et al. 1994, Soupir and Brown 2002). We did not conduct creel surveys during November or April of any study year due to the absence of anglers because of unsafe ice conditions. We conducted open-water creel surveys (summer and fall) at 50–60 h $lake^{-1}$ $month^{-1}$ and 40–50 h $lake^{-1}month^{-1}$ during the winter when angler effort was lower. We stratified creel survey sampling effort by day type (60 % weekday, 40% weekend and holiday) and time period (50% morning, 50% afternoon). The lengths of morning and afternoon periods were proportionally adjusted according to hours of available daylight (Isermann et al. 2005). We estimated angler effort using two or three instantaneous angler counts per sample with 12 to 15, 4- to 6-h shifts occurring each month. We classified anglers as either shore or boat anglers during open-water periods and as either open-ice or ice-shack anglers during winter. We calculated angler effort (h ha^{-1}) for fishing by boat or ice shack in the same manner as for shore or open-ice fishing except that boats or occupied ice shacks were counted instead of individual anglers and then expanded to angler hours by multiplying by the mean number of anglers per boat or ice shack (Ryckman 1981). Information gathered from anglers during interviews included the number of anglers in each group (per boat or shack), time of day when the anglers began fishing, if their trip was complete at the time of the interview, which species the anglers were targeting, the number of each species caught, the number of each species harvested, and lengths (TL, mm) of harvested fish.

All angler effort directed at yellow perch and perch harvest estimates (fish ha^{-1}) were calculated using Creel Application Software, Version 2.2 (Soupir and Brown 2002). Differences in angler effort directed at yellow perch, the average percentage of anglers targeting perch, and perch harvest from May 2005 to March 2008 between study lakes (not replicated), years and months were evaluated using a repeated measures ANOVA (Hansen et al. 2007) with statistical significance set at 0.05 (Littell et al. 1996). We used the distribution of lengths at age-3 (TL, mm; Schoenebeck and Brown 2010) between each population to diagnose recruitment as either pulsed (< 50 mm) or protracted (> 50 mm) using a Kolmogorov-Smirnov two sample test.

RESULTS

Interactions between year and month ($F_{18,20} = 3.32$, $P = 0.006$) and lake and month ($F_{9,20} = 6.59$, $P < 0.001$) were significant for yellow perch angler effort. Yellow perch angler effort was highest during September in 2005 and highest during January of 2006 and 2007 on Lake Cochrane (Fig. 1). Yellow perch angler effort was highest from August to October on Lake Madison.

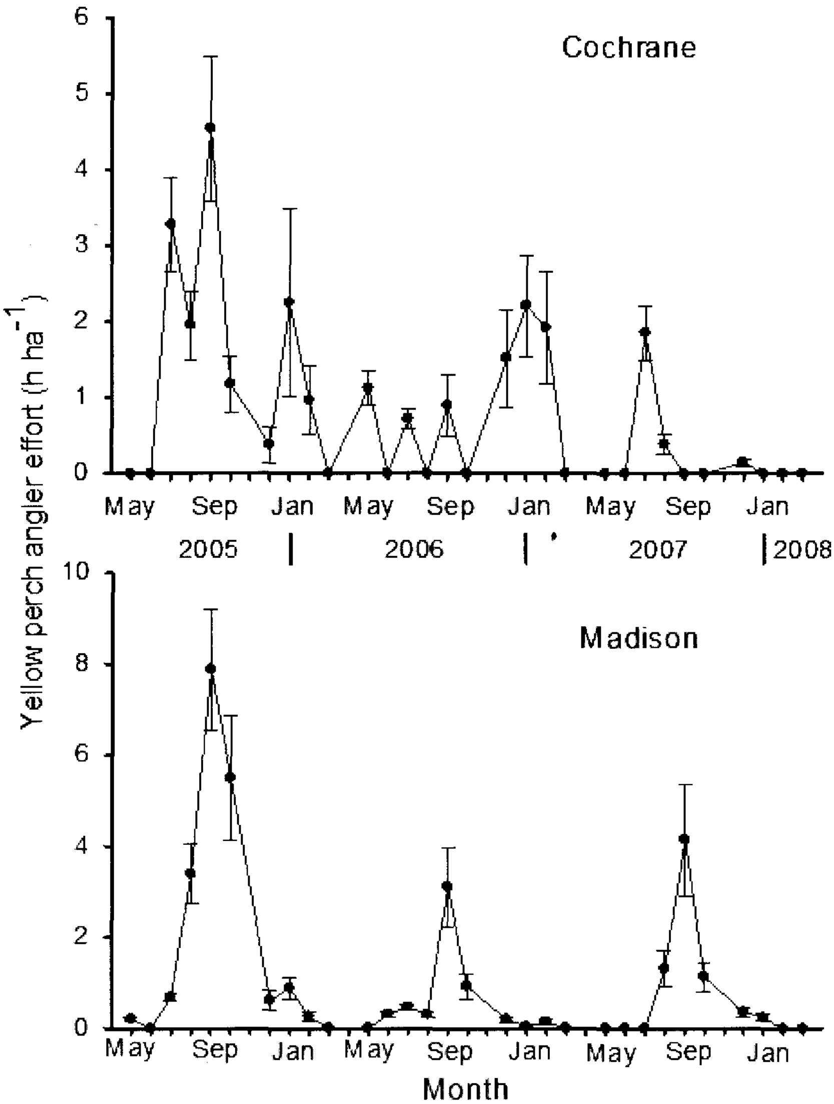

Figure 1. Yellow perch angling effort (h ha^{-1}) on Lake Cochrane and Lake Madison, South Dakota, May 2005–March 2008. Error bars represent standard error.

The interaction between year and month ($F_{18,20}$ = 0.61, P = 0.855) was not significant while the interaction between lake and month ($F_{9,20}$ = 3.82, P = 0.006) was significant for the percentage of anglers targeting yellow perch indicating that more anglers targeted yellow perch on Lake Madison than Lake Cochrane. Further, effort aimed at yellow perch was higher during the fall months on Lake Madison (Fig. 2). The percentage of anglers targeting yellow perch on Lake Madison decreased from the fall throughout the winter. Conversely, the percentage of anglers targeting yellow perch on Lake Cochrane was highest during the winter months.

Interactions between year and month ($F_{18,20}$ = 1.52, P = 0.183) and lake and month ($F_{9,20}$ = 1.90, P = 0.110) were not significant for yellow perch harvest and thus were not included in further analyses. Yellow perch harvested per hectare did not differ between lakes ($F_{1,47}$ = 1.00, P = 0.322) or years ($F_{2,47}$ = 1.60, P = 0.212), but differed among months ($F_{9,47}$ = 2.75, P = 0.012). Yellow perch harvest per hectare was highest from June through August during 2005 and 2006 on Lake Cochrane (Fig. 3). Yellow perch harvest was highest during September in all three years of the study on Lake Madison. During September and October 2005, 2006, and 2007 (e.g., months that are not normally surveyed in South Dakota), 74%, 79%, and 83%, respectively, of the annual yellow perch harvest occurred on Lake Madison.

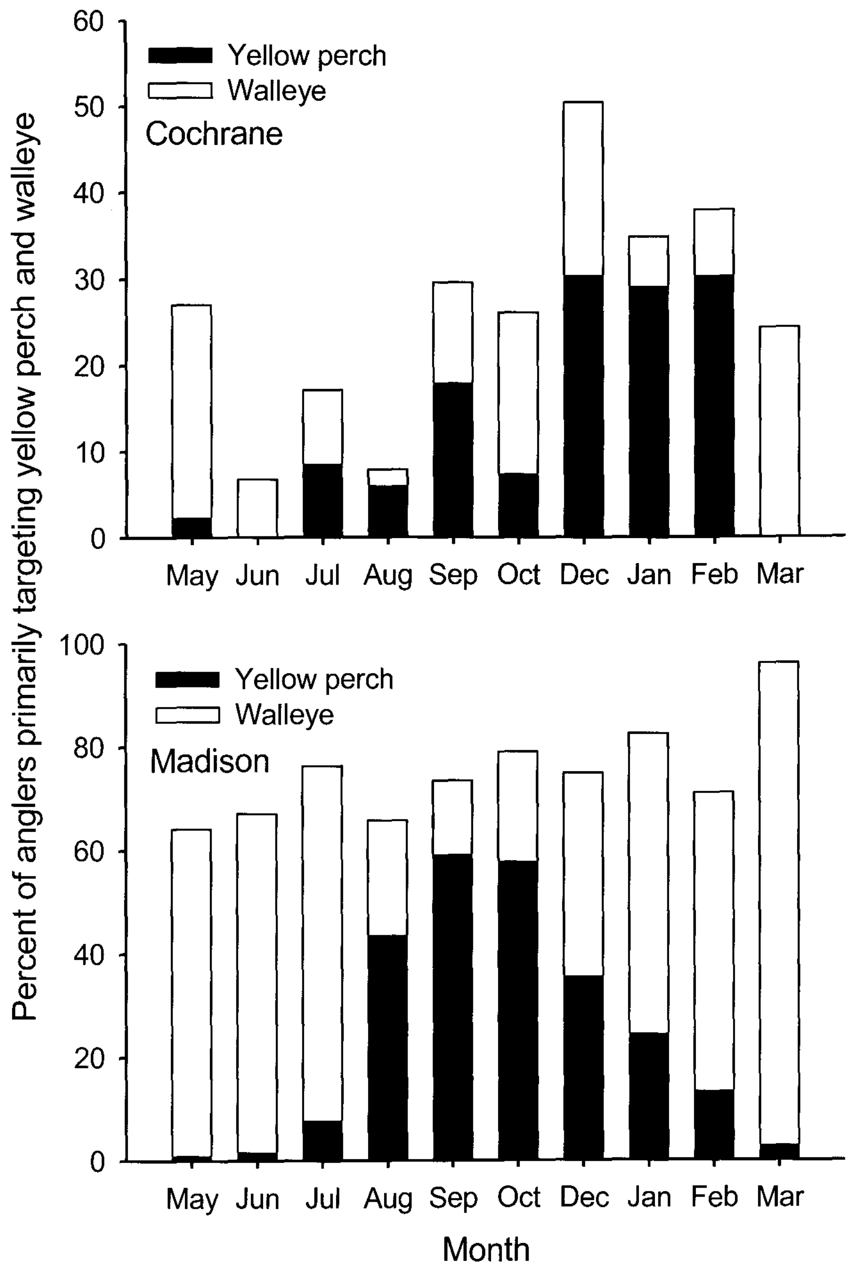

Figure 2. The average percentage of anglers targeting yellow perch (solid bars) and walleye (open bars) for Lake Cochrane and Lake Madison, South Dakota, May 2005–March 2008.

Yellow perch recruitment to the fishery differed (D = 1.00, $P < 0.001$) between the two lakes. Recruitment was pulsed at Lake Madison as the mean length of harvested yellow perch decreased from June through September and the range of lengths within an age group was narrow (age-3 total lengths ranged from 231 to 261 mm) during 2007 (Fig. 4). Recruitment of the 2005 yellow perch year class into the Lake Madison fishery during the late summer and fall of 2007 coincided with a decrease of 81 mm in mean total length of harvested yellow perch from 299 mm in June to 218 mm in October (Schoenebeck and Brown 2010). Conversely, recruitment was protracted at Lake Cochrane as the mean total length of harvested yellow perch remained relatively unchanged with only an 8 mm difference from May to October 2007. Total lengths within the age-3 cohort ranged from 121 to 204 mm during 2007 (Fig. 4).

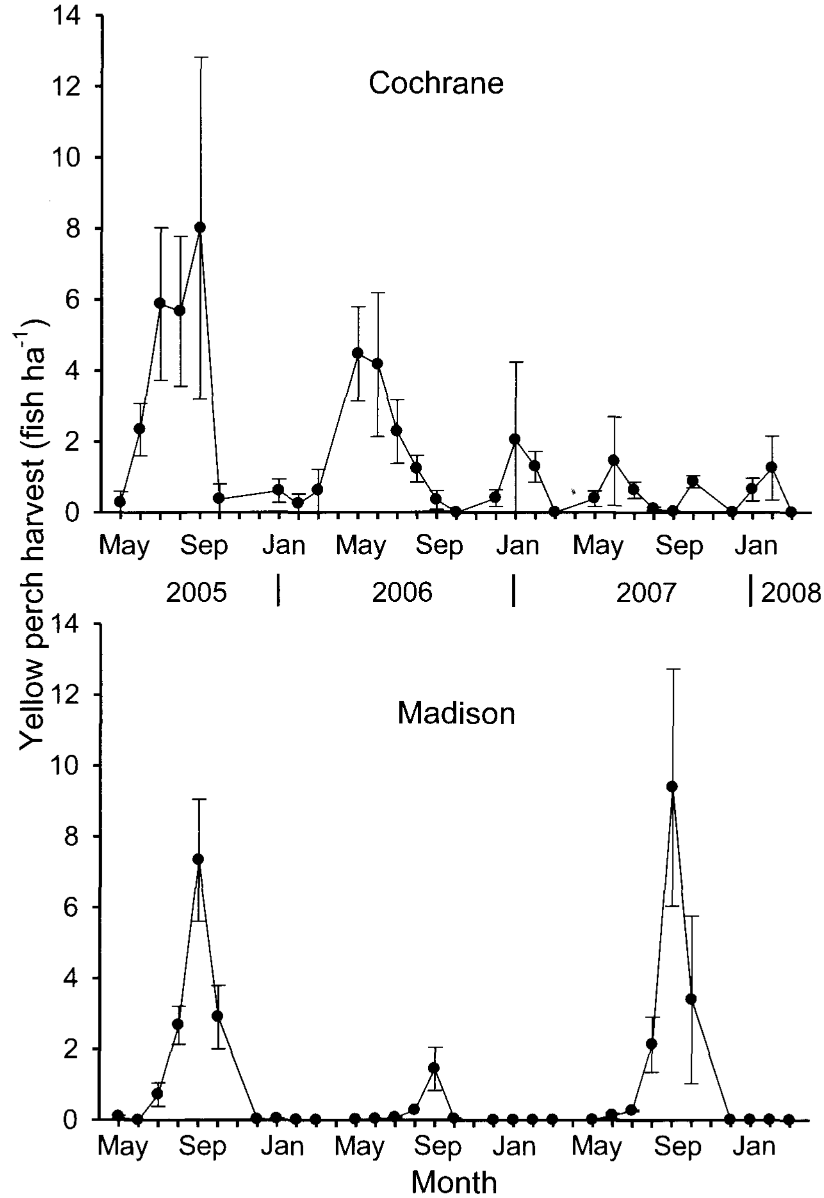

Figure 3. Yellow perch harvest (fish ha^{-1}) from Lake Cochrane and Lake Madison, South Dakota, May 2005–March 2008. Error bars represent standard error.

DISCUSSION

Seasonal trends in yellow perch angler effort and harvest varied between the two fisheries. Angler effort directed at yellow perch and perch harvest were variable for the low-quality yellow perch fishery, whereas yellow perch angler effort and harvest were highest during the fall for the high-quality fishery. Differences in the time of recruitment may account for some of the temporal differences in yellow perch angler effort and harvest. Fast growth and a narrow range of lengths within an age group exhibited by high-quality yellow perch fisheries can result in fish of a particular age group reaching an acceptable size to anglers (180–200 mm; Isermann 2003) in a short time period (e.g., during the fall), thereby concentrating angler effort directed at yellow perch harvest during this time period. Conversely, slow growth and a wider range of lengths within an age group of yellow perch in the low-quality population suggest protracted recruitment and subsequently, a more uniform distribution in monthly angling effort and harvest would be anticipated as fish would reach an acceptable size to anglers throughout the growing season.

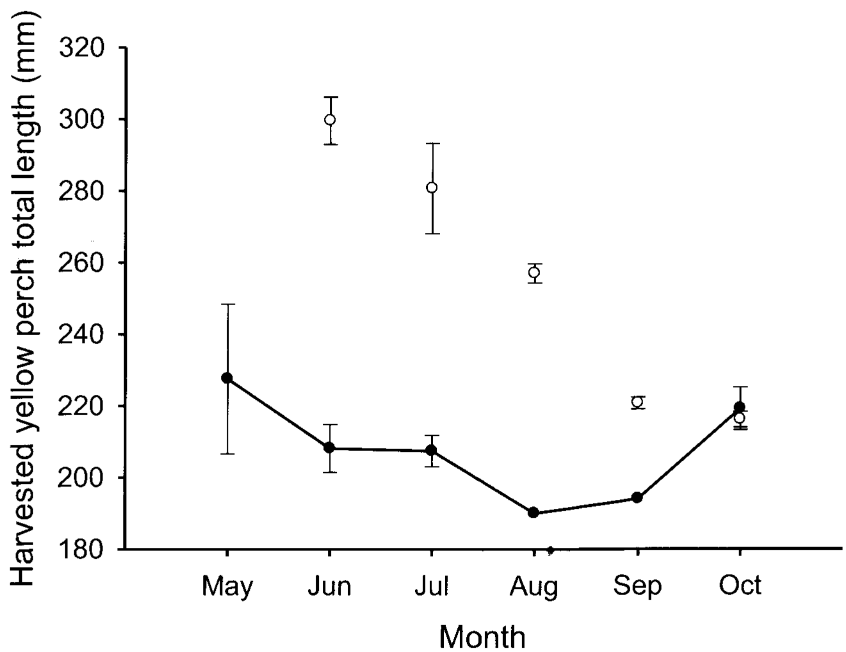

Figure 4. Mean total length (mm) of yellow perch harvested from Lake Cochrane (solid line) and Lake Madison (dotted line), South Dakota, May 2007–October 2007. Error bars represent standard error.

Differences in fish communities between fishery types may explain differences in the percentage and timing of anglers targeting yellow perch. Anglers on Lake Madison primarily target yellow perch and walleye throughout the year in this relatively simple fish community. During this study, a higher percentage of anglers targeted yellow perch than any other species during the months of August, September, and October on Lake Madison. In comparison, anglers on Lake Cochrane tend to be generalists targeting a variety of species available in that complex fish community. Anglers did not target yellow perch on Lake Cochrane even when yellow perch harvest was at its highest during the summer and fall of 2005.

Seasonal changes in yellow perch behavior may have influenced seasonal trends in harvest between fishery types. Increases in fall movement have been documented for adult yellow perch in Lake Madison and Lake Sinai, another high-quality South Dakota yellow perch population (Radabaugh et al. 2010). Increases in fall movement are likely associated with increased feeding activity and could have translated into higher susceptibility and increased angler catch rates during this time period (Costa 1973, Radabaugh et al. 2010).

Peak angling effort and harvest of yellow perch during fall has been documented for Lake Madison and has previously been observed for other high-quality perch fisheries. For instance, yellow perch harvest from private (60%) and charter (83%) boat anglers in the Ohio waters of Lake Erie occurred during September and October 2007 (Ohio Division of Wildlife 2008). Despite small sample sizes, Radabaugh (2006) also reported high (37%) fall harvest of yellow perch in Lake Madison in eastern South Dakota. Although not documented, substantial harvest of yellow perch has occurred during September and October on Waubay Lake and Big Stone Lake, other high-quality yellow perch fisheries in South Dakota (B. Blackwell, South Dakota Department of Game, Fish and Parks, personal communication).

MANAGEMENT IMPLICATIONS

Not sampling angler use and harvest of a yellow perch fishery during the fall months could potentially underestimate harvest estimates, consequently rendering creel survey estimates biased and unreliable for directing management decisions. Conversely, exclusion of the fall yellow perch harvest for low-quality fisheries may not bias annual harvest estimates allowing personnel to be redirected to high-quality fisheries during the fall. Pulsed recruitment of a yellow perch year class into the fishery should result in a decreased mean length of harvested fish. Given this information, a fisheries managers who typically samples the recreational creel only during the summer months could schedule a fall creel survey for a high-quality population if a decrease in mean total length of yellow perch harvested is observed or if summer netting data indicate that fall recruitment of a year class is likely. Scheduling a fall creel survey under these circumstances would help ensure the most accurate information on angler effort and yellow perch harvest was collected and used to manage the fishery.

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