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Effects of gizzard shad introductions on walleye and yellow perch populations in prairie glacial lakes

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ABSTRACT

Fisheries managers often stock prey fish to increase abundance and growth of predatory sport fishes. One species commonly used in the U.S. Midwest is gizzard shad *Dorosoma cepedianum*; gizzard shad have been used to increase growth and condition of walleye *Sander vitreus* in many Midwestern systems. Additionally, with warming climates and stocking, gizzard shad are experiencing a natural range expansion. While this expansion may be beneficial for top predators like walleye, mixed results exist on the effects of gizzard shad on other recreationally important fishes in these systems. Our objectives were to determine if annual growth, relative abundance, and condition of yellow perch, *Perca flavescens* and walleye populations changed following the introduction of gizzard shad. Adult, pre-spawn gizzard shad were introduced in 2008 and 2009 at densities higher than those which resulted in self-sustaining populations in other South Dakota reservoirs. Yellow perch and walleye population dynamics were estimated during 2007 (pre-shad), 2008–2009 (shad present) and 2010 (post-shad) in two glacial lakes stocked with adult gizzard shad and a reference lake (not stocked with shad). Our results suggest that at the densities documented in this study and in the time frame assessed, gizzard shad did not negatively impact yellow perch as total length at age was similar, condition remained high and zooplankton resources were likely not limiting. Walleye did consume gizzard shad when available and shad appeared to have a neutral or positive effect on walleye growth, relative abundance and condition in these systems during this study. The addition of shad may be a viable option to improve walleye populations without negatively impacting sympatric yellow perch populations under the conditions tested in this study. However, the introduction of a non-indigenous species should be done with caution, especially a potential competitor like gizzard shad.

1. Introduction

Stocking of fishes by management agencies to create or enhance recreational fisheries has become a widely accepted and successful practice worldwide (Moffitt et al., 2010). Many of these introductions have occurred to enhance sport fisheries through the direct stocking of desirable sport fishes or through the stocking of prey fishes to enhance the prey base. While these introductions often yield desired outcomes (i.e., species establishment, increased prey abundance) they can also have unforeseen impacts on the fish community as a whole (Vander Zanden et al., 1999; Rahel, 2000, 2002). For example, common carp *Cyprinus carpio* was introduced across North America by the U.S. Fish Commission with the goal of establishing food resources for the growing human population (Nielsen, 1999). However, after stocking common carp, fisheries managers now expend substantial effort and funds in attempt to control the invasive carp, as well as other invasive species (Koehn, 2004; Schrage and Downing, 2004; Weber and Brown, 2009) and reduce its ecological impacts on native fish communities (Lougheed et al., 1998; Parkos et al., 2003; Weber and Brown, 2009).

One species frequently used as an additional prey resource in freshwater lakes and reservoirs is the gizzard shad *Dorosoma cepedianum* (Noble, 1981; Eichner and Ellison, 1983; Porath, 2006). Gizzard shad is a highly fecund, warm water, riverine species prevalent throughout the southern United States (Noble, 1981), although its native range has increased in recent years (White et al., 1987; Fetzer et al., 2011) and now encompasses most of the eastern continental United States and extends from Florida to New Mexico in the south and as far north as North Dakota in the west and New York in the east (Heidinger, 1983; Pflieger, 1997). In fact, it

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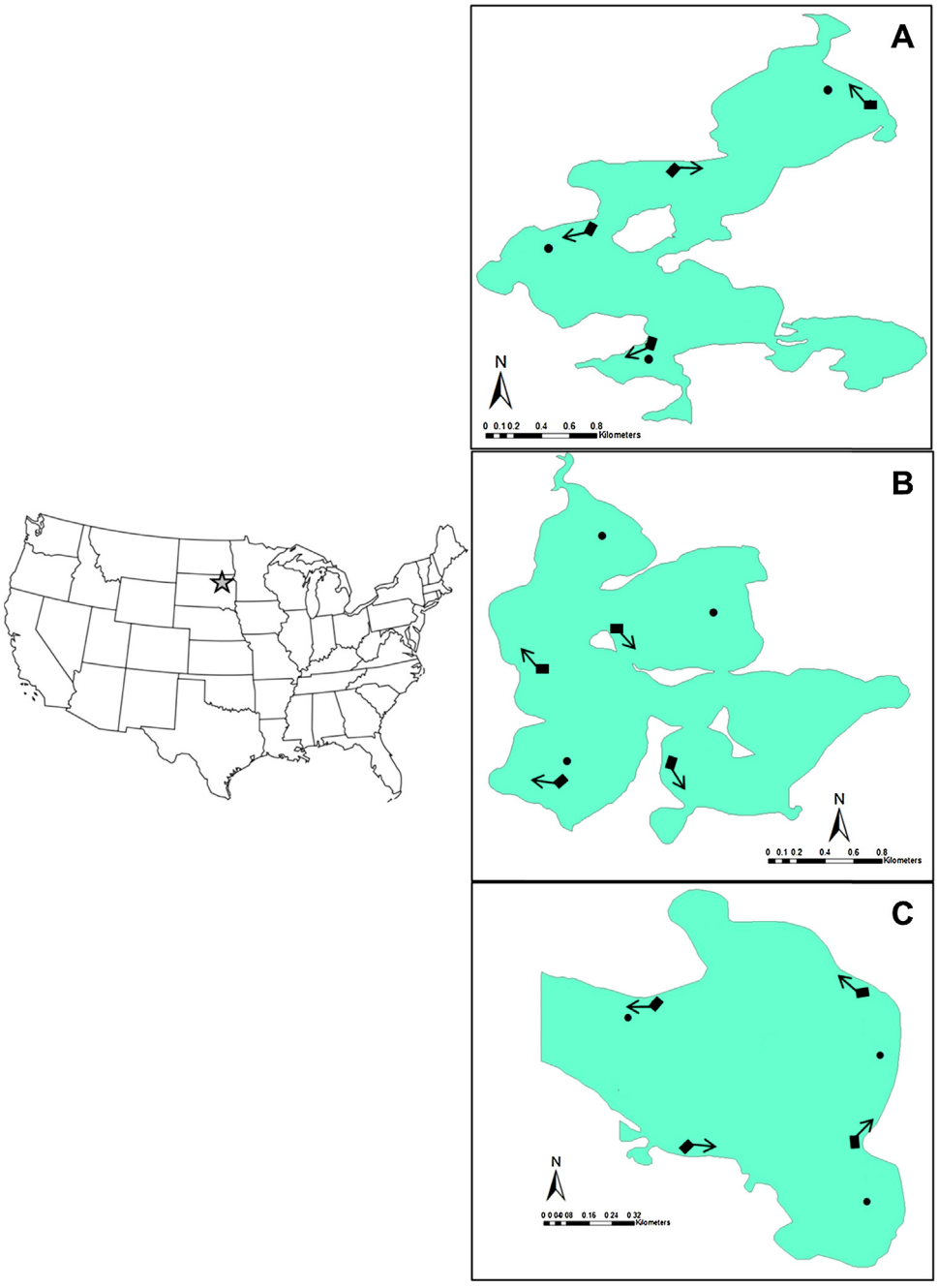

Fig. 1. Left panel: Map of the United States with gray star denoting Day County, South Dakota (study area). Right panel: (A) Lardy (reference), (B) Middle Lynn and (C) East Krause Lakes, Day County, South Dakota. Black circles symbolize locations of standardized gill net sets. Black rectangles indicate starting location for standardized autumn age-0 walleye electrofishing transects; arrows indicate boat direction from starting location.

has become a common practice for fisheries managers of Great Plains states to collect adult gizzard shad brood stock and transfer them to receiving waters in the spring prior to spawning (Eichner and Ellison, 1983; Porath, 2006). For example, gizzard shad introductions in western South Dakota irrigation reservoirs provided additional prey that led to increased growth and size structure for walleye *Sander vitreus* populations (Miller et al., 2007; Ward et al., 2007). Similarly, when young gizzard shad were available in two South Dakota reservoirs, Angostura Reservoir (Ward, 2005) and Lake Sharpe (Elrod et al., 1987; Wuellner et al., 2010), walleye preyed almost exclusively on them.

While gizzard shad is an important prey fish (Michaletz, 1998; Porath, 2006; Wuellner et al., 2010) and an important component in nutrient cycling (Schaus and Vanni, 2000), its impacts on recreational fishes varies greatly depending on the system and the fish community. DeVries and Stein (1992) suggested that recruitment of other fishes was reduced by gizzard shad. The authors indicated that the emergence of larval gizzard shad caused massive declines in zooplankton, forcing other fishes into suboptimal habitats and in turn reducing their growth and survival. Aday et al. (2003) confirmed that bluegill *Lepomis macrochirus* growth rates and adult size structure were reduced in systems containing gizzard shad, although direct competition for food resources may not have been the mechanism. Alternatively, the presence of gizzard shad did not have negative impacts on white crappie *Pomoxis annularis* (Pope and DeVries, 1994) or juvenile yellow perch *Perca flavescens*