PUMPKINSEED POPULATION CHARACTERISTICS IN NEBRASKA SANDHILLS LAKES (PISCES, CENTRARCHIDAE: *LEPOMIS GIBBOSUS*)

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2001. *Transactions of the Nebraska Academy of Sciences* 27: 25–30

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ABSTRACT

We investigated pumpkinseed (*Lepomis gibbosus)* population characteristics in Nebraska Sandhills lakes because this region is near the southwestern edge of their native range. Pumpkinseeds were in low abundance (1.3–7.5 stock-length [i.e., ≥ 8 cm] fish per trap net night) and were collected from only seven of 30 lakes sampled. No preferred length (i.e., ≥ 20 cm) pumpkinseeds were collected in any of the seven lakes. Pumpkinseed relative weight (*Wr*) was positively related to bluegill (*Lepomis macrochirus*) and yellow perch (*Perca flavescens) Wr*, suggesting that high condition of pumpkinseed was not detrimental to condition of other panfish species. No relationships were found between largemouth bass (*Micropterus salmoides*), the primary predator in these lakes, and pumpkinseed population characteristics. High pumpkinseed *Wr* was related to high annelid abundance, but not gastropod or chironomid abundance. Pumpkinseed relative abundance increased as lake maximum depth increased, and high relative abundance of 8–15-cm pumpkinseeds was positively associated with high submergent vegetation abundance. Few other relationships were evident between pumpkinseed population characteristics and habitat variables. These results suggest that pumpkinseeds in Nebraska Sandhills lakes are not common and apparently are not detrimental to other panfish in these lakes.

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The pumpkinseed (*Lepomis gibbosus*) is a member of the sunfish family (Centrarchidae). Most native pumpkinseed populations are found in the northeastern United States, although this species has been introduced throughout many of the western states (Lee et al. 1981). The original range for pumpkinseeds extended into north-central Nebraska. Thus, this study provided us with an opportunity to assess pumpkinseed population characteristics near the southwestern edge of their native range.

As part of a larger project designed to assess factors related to quality of panfish (i.e., bluegill, *Lepomis macrochirus*; black crappie, *Pomoxis nigromaculatus*; and yellow perch, *Perca flavescens*) populations, we sampled fish communities, physical characteristics, and invertebrate communities in 30 Nebraska Sandhills lakes (Paukert and Willis 2000). The objectives of this project were to determine the characteristics of pumpkinseed populations sampled in several of those lakes, and to relate population characteristics to physicochemical and biological characteristics found at each lake.

STUDY SITES

Pumpkinseed population samples were obtained from seven Sandhills lakes in north-central Nebraska. These lakes were typically small (15–81 ha surface area), alkaline (85–122 mg/L total alkalinity), shallow (1.9–3.4 m maximum depth), and submergent aquatic macrophytes were present in all seven lakes (Table 1). Largemouth bass (*Micropterus salmoides*) and black bullhead (*Ameiurus melas*) were present in all seven lakes, yellow perch and bluegill were present in six lakes, and northern pike (*Esox lucius*) and black crappie were present in four lakes. A more extensive summary of physicochemical characteristics can be found in Paukert and Willis (2000).

METHODS

Fish communities were sampled with overnight sets of double-throated trap (modified fyke) nets with 16-mm bar measure mesh, 1.1 × 1.5-m frames, and 22-m leads. Total sampling effort was 10 trap net nights in lakes < 50 ha and 20 trap net nights in lakes ≥ 50 ha. Largemouth bass were collected at 12 10-min shoreline electrofishing stations at each lake. Pulsed-DC current with 3–6 A and 200–250 V was used for fish collection. All fish community sampling occurred during May and June, when sampling conditions were optimal for obtaining representative samples (Pope and Willis 1996).

Table 1. Physical and chemical characteristics of seven Nebraska Sandhills lakes sampled during 1998 or 1999.

Lake	County	Surface area (ha)	Mean depth (m)	Maximum depth (m)	Total alkalinity (mg/L)	Submergent vegetation (%)
Cottonwood	Cherry	15	2.3	4.3	128	97.2
Duck	Cherry	27	1.7	3.3	86	28.5
Goose	Holt	81	2.2	2.8	165	43.5
Medicine	Cherry	45	1.2	1.9	85	37.8
Schoolhouse	Cherry	42	2.2	3.3	107	74.4
Shell	Cherry	66	1.6	2.7	122	52.0
Shoup	Cherry	19	1.4	1.9	94	48.7

Some lakes were sampled in 1998, while others were sampled in 1999.

Ten fish per cm length group for each species were measured for total length (mm) and weighed (g). All additional fish were tallied by centimeter length group by species. Catch per unit effort (CPUE), an index to population abundance (Hubert 1996), was defined as the number of fish ≥ stock length caught per net night or per hour of electrofishing. Size structure was indexed using proportional stock density (PSD; percentage of stock-length fish that also exceed quality length)(Anderson and Neumann 1996). Fish condition was quantified using relative weight (*Wr*; weight of the fish/standard weight for a fish that length × 100) for stock to quality length fish (Anderson and Neumann 1996). Minimum stock and quality lengths are 8 and 15 cm for bluegill and pumpkinseed, 13 and 20 cm for yellow perch, and 20 and 30 cm for largemouth bass.

Zooplankton samples were collected at four offshore sites during July using a 2-m integrated tube sampler and then filtered through a 65-μm mesh net. In the laboratory, zooplankton were identified to genus, measured for total length under a dissecting microscope, and enumerated. Benthic macroinvertebrates also were collected in July using an Ekman grab; three benthic grabs were collected at four offshore sites. Samples were sieved in the field, and identified to family and enumerated in the laboratory using a dissecting microscope.

Total alkalinity, total phosphorus, total dissolved solids, conductivity, Secchi depth, turbidity, and chlorophyll *a* were sampled at four offshore locations in each lake during July. Vegetation was quantified at all seven lakes during July of 1999 at 50- to 200-m intervals along five to seven evenly spaced transects across each lake. Vegetation was classified as emergent, submergent, or floating within a 1-m^2 grid placed along the boat. Depth was measured to the nearest 0.1 m at each of the vegetation sites. Mean depth was calculated by dividing the sum of all the depth measurements for each lake by the number of sites on that specific lake.

Pearson correlations were used to explore relationships between variables. A *t*-test was used to compare means. Because we sampled only seven pumpkinseed populations and because these analyses were exploratory, we used an alpha level of 0.10.

RESULTS AND DISCUSSION

Pumpkinseed population characteristics

Pumpkinseeds were not abundant in any of the lakes that we sampled (Table 2). Mean CPUE for stock-length pumpkinseeds ranged only between 0.6 and 7.5 per net night. In contrast, the maximum mean CPUE documented for the closely related bluegill in our 30-lake sample was 233 stock-length fish per net night (Paukert and Willis 2000).

The PSD for pumpkinseed population samples varied widely among lakes (Table 2), ranging from 0 to 71. The longest pumpkinseed that we collected was 19 cm at Cottonwood Lake. In contrast, we collected bluegills longer than 20 cm in 18 of 21 populations that we sampled as part of the 30-lake study (Paukert and Willis 2000).

Mean *Wr* values for 80–149-mm pumpkinseeds ranged from 82 to 122, with only one mean being below 100. A *Wr* value of 100 represents the 75th percentile of weights at a given length for a fish species across its entire range (Anderson and Neumann 1996). Thus, six of the seven Sandhills populations exhibited above optimal condition.

Neither pumpkinseed PSD ($r = 0.64$, $P = 0.17$) nor mean *Wr* ($r = 0.32$, $P = 0.48$) was significantly related to mean CPUE. Thus, we could find no evidence of den-

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Neither pumpkinseed PSD ($r = 0.64$, $P = 0.17$) nor mean *Wr* ($r = 0.32$, $P = 0.48$) was significantly related to mean CPUE. Thus, we could find no evidence of denspecifically to habitat relationships for pumpkinseed. However, high submergent macrophytes typically are associated with high bluegill abundance (Olson et al. 1998).

Invertebrate relations

Pumpkinseed condition was related to annelid abundance (Fig. 3). Mean *Wr* for 80–149-mm pumpkinseeds was near 100 when annelid abundance was $\leq 50/m^2$ but near 120 when annelid abundance was $> 50/m^2$ (t = 3.98, P = 0.03). Surprisingly, we did not find any relationships between pumpkinseed *Wr* and chironomid (r = 0.20, P = 0.66) or gastropod (r = 0.31, P = 0.55) abundance, as suggested by others. For example, Liao et al. (1995) found that mean *Wr* of 80–149-mm pumpkinseeds was positively related to chironomid biomass, while mean *Wr* of 150-mm and longer fish was positively related to gastropod biomass. Sadzikowski and Wallace (1976) reported that pumpkinseeds in First and Second Sister lakes in Michigan shifted from feeding on littoral invertebrates to gastropods at a length of approximately 70 mm.

Fish community relations

Pumpkinseed PSD was not significantly correlated with largemouth bass mean CPUE (r = 0.32, P = 0.54). We had expected that largemouth bass density might be related to pumpkinseed size structure because largemouth bass mean CPUE was positively correlated with PSD of both bluegills (r = 0.52, P = 0.02) and yellow perch (r = 0.82, P = 0.001) in our 30-lake study (Paukert and Willis 2000).

Pumpkinseed PSD was positively correlated with bluegill PSD in seven study lakes (r = 0.75, P = 0.09; Fig. 4). However, pumpkinseed mean CPUE declined as bluegill PSD increased (r = 0.66, P = 0.08). Perhaps larger bluegills are more effective in competition with pumpkinseeds. Mittelbach (1988) found that bluegill and pumpkinseed competed for food resources when confined by predators to littoral zone vegetation.

Pumpkinseed condition values followed similar trends as condition of both bluegills and yellow perch (Fig. 5). Mean *Wr* of the stock- to quality-length groups were significantly correlated for both pumpkinseed and bluegill (r = 0.83, P = 0.01) and yellow perch (r=0.77, P = 0.04). Relative weight may best serve as an indicator of prey availability (Blackwell et al. 2000). Thus, these positive correlations for condition indices between species may simply reflect prey availability in these productive Sandhills lakes.

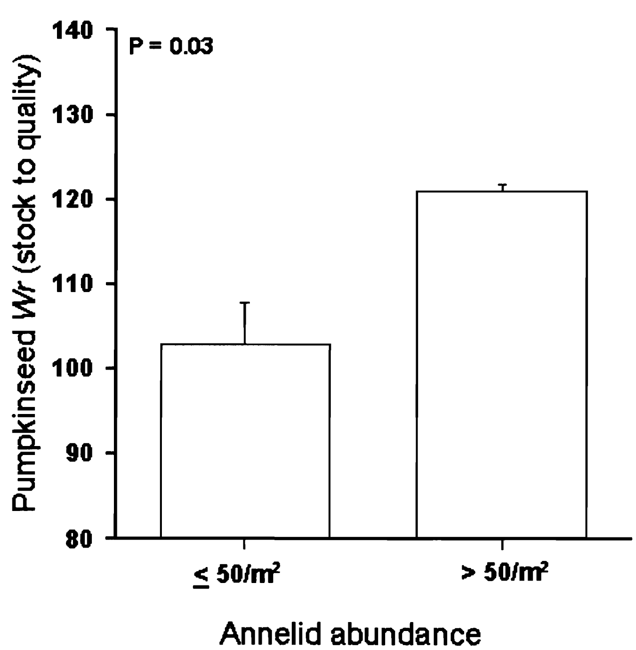

Figure 3. Mean pumpkinseed relative weight (*Wr*) in Nebraska Sandhills lakes with low or high annelid abundance. Vertical bars represent one standard error of the mean.

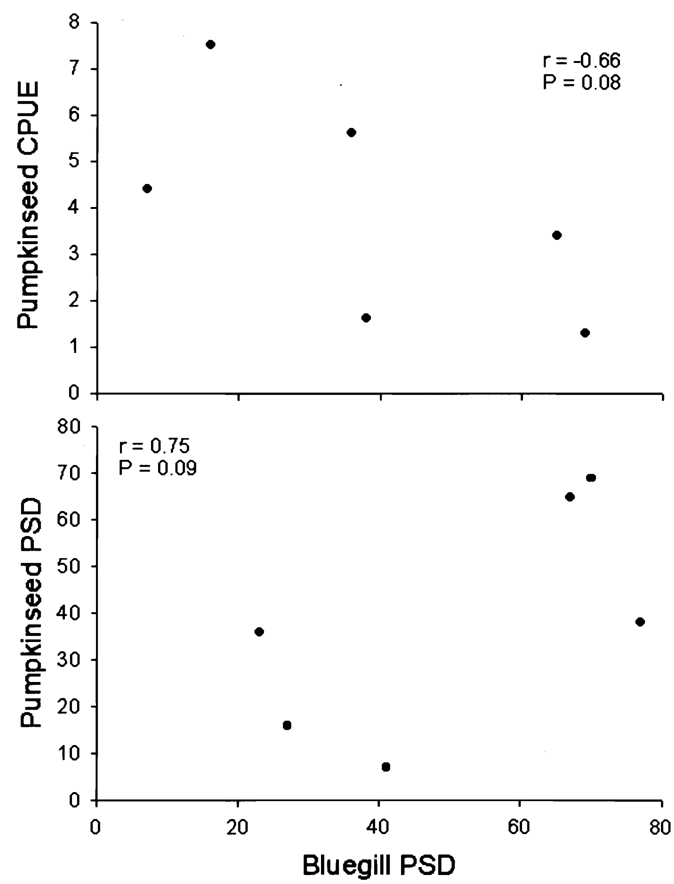

Figure 4. Relationships between bluegill proportional stock density (PSD) and both pumpkinseed mean catch per unit effort (CPUE) and PSD in seven Nebraska Sandhills lakes sampled in spring of 1998 and 1999.

MANAGEMENT IMPLICATIONS

Relatively few Nebraska Sandhills lakes contained pumpkinseed populations. When pumpkinseeds were present, they tended to occur in deeper lakes and those with increased abundance of submergent vegetation. Pumpkinseed populations tended to have relatively low size structure (i.e., no individuals exceeded 19 cm), but had high condition values. We found no relationships between pumpkinseed and largemouth bass, the primary predator in these lakes. However, high pumpkinseed condition was positively associated with high bluegill and yellow perch condition. Based on our results, pumpkinseeds in the Nebraska Sandhills most likely occur in too low abundance to have detrimental effects on other panfish in these productive lakes.

ACKNOWLEDGMENTS

We would like to acknowledge the assistance provided by Joel Klammer, Andrew Glidden, and Mathew Wilson (Nebraska Game and Parks Commission), Royce Huber and Wayne Stancill (U.S. Fish and Wildlife Service), and Phil Chvala, Howard Fullhart, and Brian Heikes (South Dakota State University). Partial funding for this research was provided by the Nebraska Game and Parks Commission through Federal Aid in Sport Restoration Project F-118-R. This manuscript was approved for publication by the South Dakota Agricultural Experiment Station as Journal Series Number 3246.

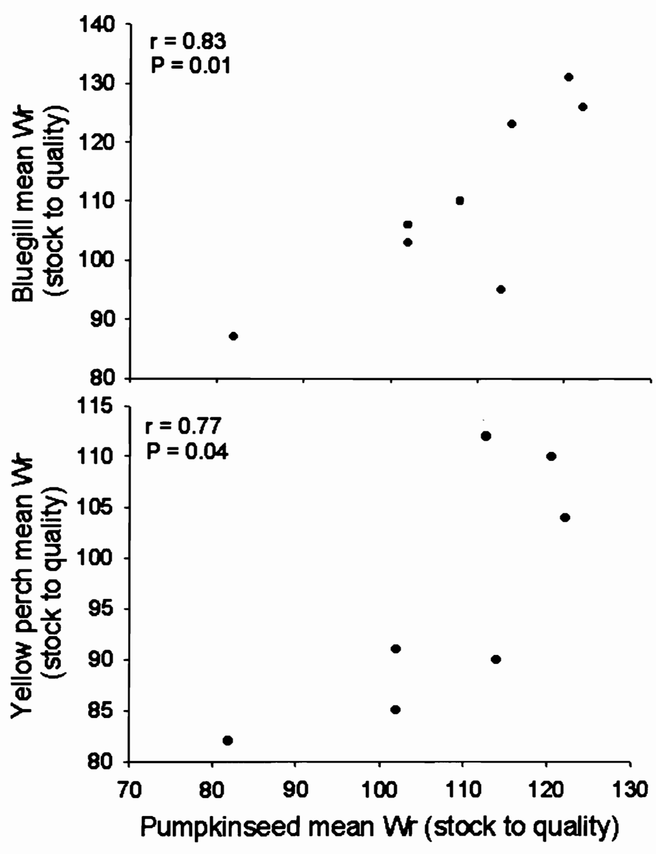

Figure 5. Relationships between mean pumpkinseed relative weight (*Wr*) and both mean *Wr* of both bluegill and yellow perch during May or June in Nebraska Sandhills lakes. Stock length is 80 mm for bluegill and pumpkinseed and 130 mm for yellow perch; quality length is 150 mm for bluegill and pumpkinseed and 200 mm for yellow perch.

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