Relationship Between Power Plant Recharge Waters and Young-of-year Largemouth Bass Abundance

Veronica M. Pitman, *Texas Parks and Wildlife Department, HCR-7, Box 62, Ingram, TX 78025*

Abstract: This study evaluated the relation between young-of-year (YOY) largemouth bass (*Micropterus salmoides*) density (*N*/ha) and monthly rainfall, make-up water, and discharge of a 547-ha power plant cooling reservoir in Bexar County, Texas, for 1983–1992. Young-of-year largemouth bass density and total dilution (rainfall, make-up water, and discharge combined) during January–February were significantly related ($r^2 = 0.68$, $P < 0.05$). The results of this study suggest that in a eutrophic, closed aquatic system, the total amount and timing of reservoir dilution can be important to the relief of a spawning repressive factor and can help increase YOY largemouth bass abundance.

Proc. Annu. Conf. Southeast. Assoc. Fish and Wild. Agencies 47:605–610

The focus of freshwater sport fishing in Texas is largemouth bass. Although stocking routinely occurs throughout the state to help meet the demand for this resource, self-sustaining largemouth bass populations that provide a predictable annual abundance are still of the utmost importance and highly desirable. Declines in fish abundance have been linked to spawning repression, which can arise from altered water quality conditions (Swingle 1956*a*, Greene 1968), pesticides (Whiteside and Richan 1969, Grant and Mehrle 1970), heavy metals and their salts (McKee and Wolf 1963, Olmsted et al. 1986), and crowded or competitive species (Swingle 1956*b*, Chew 1972, Noble et al. 1976). However, in eutrophic aquatic systems Swingle (1956*b*) and Chew (1972) suggest if flushing occurs prior to spawning, inhibiting or repressive factors might be alleviated.

Repression of largemouth bass spawning was suspected in Victor Braunig Lake, a power plant cooling reservoir in Bexar County, Texas. Young-of-year (YOY) largemouth bass were collected in routine sampling for 3 years after impoundment (1965–1967) indicating at least some fish had spawned (Dean and Bailey 1977). However, for the next 10 years, no YOY were collected (Dean and Bailey 1977). During 1969–1974, Dean and Bailey (1977) conducted a study to determine if reproductive repression in largemouth bass was occurring in the reservoir. They concluded "reproductive failure was not due to poor water quality, overabundance of other fishes, parasite infestations, unusual blood components, pesticide or heavy metal contamination, spawning substrate deficiencies, or egg or fry mortality." The cause of spawning repression was not identified.

To increase largemouth bass production in the reservoir, stocking was routinely implemented. Fish were 19–38 mm total length (TL) when released. A total of 320,830 native largemouth bass were stocked in 1967–1970, 1972, and 1974; a total of 617,248 Florida largemouth bass (*M. s. floridanus*) were stocked in 1976–1978 and 1981–1984, and a total of 483,607 Florida x native hybrid largemouth bass were stocked in 1985–1987. Largemouth bass began to spawn again in Victor Braunig Lake in 1978 and have continued to spawn each year since. However, the success of year classes has been inconsistent (R. W. Luebke, unpubl. data).

This study presumes the presence of a repressive factor is limiting the spawning of largemouth bass in Victor Braunig Lake and tests the hypothesis that diluting the reservoir with recharge waters can alleviate spawning repression. A relation between recharge waters and density of YOY largemouth bass could suggest appropriate management actions and insure a continued productive fishery.

Funding was contributed in part by Federal Aid in Sport Fish Restoration, Project F-31-R of the Texas Parks and Wildlife Department (TPWD). Appreciation is extended to J. A. Prentice for his early involvement in data acquisition and compilation and to personnel of the Texas Water Commission and the City Public Service of San Antonio for providing data. Special thanks to all who reviewed the manuscript for their insight and helpful suggestions.

Methods

Victor Braunig Lake is a 547-ha cooling reservoir for a power plant operated by the City of San Antonio. It has a mean depth of 5.5 m and is highly eutrophic (Dean and Bailey 1977). Because the reservoir is located at a high point in the San Antonio River watershed, it was filled with water pumped up from the river. Water level in the reservoir is maintained year-round between 154.38 and 154.53 m above mean sea level (MSL). When monthly rainfall fails to maintain the desired level, make-up water is pumped up from the San Antonio River. When water levels exceed the desired level, discharge water is either pumped back to the river or flows over the spillway.

I obtained fisheries, rainfall, make-up water, and discharge data for 1983–1992. Densities of 25.4- to 127.0-mm TL largemouth bass were determined from annual June cove rotenone surveys conducted according to procedures described by TPWD (1989). If largemouth bass were stocked in the spring prior to cove rotenone sampling, the number stocked per hectare was subtracted from the number of YOY largemouth bass per hectare in the sample for that year. Monthly rainfall data were provided by the Texas Water Commission. Monthly make-up water and discharge data were provided by the City Public Service of San Antonio. Rainfall, make-up water, and discharge data were combined to serve as an index of dilution.

The density of YOY largemouth bass was examined in relation with rainfall, make-up water, discharge, and combinations of these variables. Typically, largemouth bass spawning in Victor Braunig Lake occurs in March. Analyses focused on rainfall, make-up water, and discharge data for each previous February, January, and December. Months were looked at singularly and cumulatively beginning with February and working back. Additional analyses examined the relation between density of YOY largemouth bass and annual dilution, the additive effect of rainfall in the previous summer, and density of tilapia (*Tilapia aurea*). Data were analyzed by log-transformation and analysis of variance (SAS Institute Inc. 1990). Differences were considered significant at $P \leq 0.05$.

Results and Discussion

Density of YOY largemouth bass in Victor Braunig lake fluctuated annually (Fig. 1). Neither rainfall, make-up water, nor discharge for February–December was related with YOY largemouth bass density. Results were non-significant whether data used were for individual months or combinations of months. The strongest relation was between YOY largemouth bass density and dilution for January–February ($r^2 = 0.68$, $P < 0.05$, $N = 10$). When reservoir dilution was reduced during the 2-month period prior to spawning (Fig. 2), YOY largemouth bass density typically decreased. This concurs with Greene's (1968) findings for the Asian cyprinid, *Danio rerio*, in which repressive factors curtailed spawning within

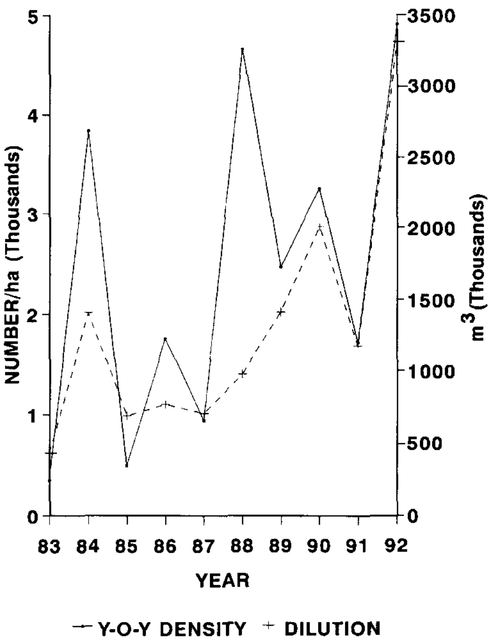

Figure 1. Density of young-of-year largemouth bass (*N*/ha) estimated by June cove rotenone sampling and dilution (m^3) for January and February in Victor Braunig Lake, Texas, 1983–1992.

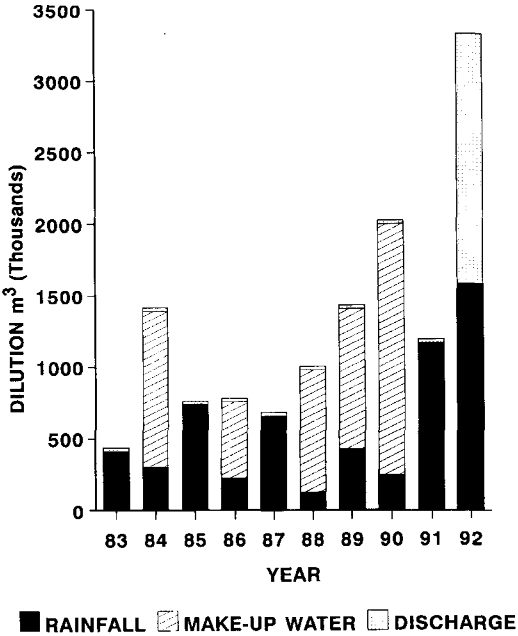

Figure 2. Dilution for Victor Braunig Lake, Texas, 1983–1992, for January and February prior to largemouth bass spawning.

2 months. Results were non-significant when data were examined for a relation between YOY largemouth bass density and annual dilution.

An anomaly occurred in 1988 when the density of YOY largemouth bass reached the second highest peak at a time when January and February reservoir dilution was relatively low (Fig. 1). Searching the data for a possible explanation, I noticed a large discharge occurred during the previous summer. Because of heavy rains in May and June, 9% of reservoir water was returned to the river during June. This was almost twice as much as had ever occurred in any other month during the 10-year period. The addition of annual summer (May–August) dilution data to the January–February model helped to explain the anomaly ($r^2 = 0.87$, $P < 0.05$, $N = 10$) and suggests that a diluting event of sufficient magnitude, even if it occurs earlier in the previous year, can beneficially affect largemouth bass spawning.

Although annual fluctuations in YOY largemouth bass density in Victor Braunig Lake were related to pre-spawn dilution, the overall trend of increased annual abundance (Fig. 1) may have been partially influenced by a combination of stocking efforts and changes in harvest regulations. Approximately 1.5 million fingerling largemouth bass (19–38-mm TL) were released in the reservoir in 1967–1987; and in 1985, 533-mm minimum TL and 2 fish/day harvest limits were enacted. Prior to 1985, there were 254-mm minimum TL and 10 fish/day harvest limits and a large number of largemouth bass were harvested before they were sexually mature. The new restrictive limits helped to protect brood stock. Accordingly, as the adult population increased, more fish were available for spawning each year.

Chew (1972) noted that a successful year class might occur in an inhibiting environment even if only few fish were able to spawn. This was evident in Victor Braunig Lake during the study when, in years of reduced dilution prior to spawning, YOY largemouth bass typically decreased in numbers but were never totally absent from the sampling effort (Fig. 1).

I also examined the relation between tilapia and YOY largemouth bass. Tilapia are abundant in Victor Braunig Lake and studies have indicated they interact with largemouth bass in small impoundments (Noble et al. 1976; Shafland and Pestrak 1981, 1983). However, I found no significant statistical relationship ($P > 0.10$) between annual densities of tilapia and YOY largemouth bass.

The relationships identified in this study are consistent with the idea that a spawning repressive factor inhibiting largemouth bass spawning exists in Victor Braunig Lake. Further studies are needed to help identify this factor. Most importantly, my results suggest that the total amount and timing of reservoir dilution events can be important to the relief of a spawning repressive factor. In addition to stocking regimes and appropriate harvest regulations, regulating make-up water and discharge at similar impoundments can contribute to a successful fishery.

Literature Cited

Chew, R. L. 1972. The failure of largemouth bass, *Micropterus salmoides floridanus* (Lesueur), to spawn in eutrophic, over-crowded environments. Proc. Annu. Conf. Southeast. Assoc. Game and Fish Comm. 26:306–319.

Dean, W. J. and W. H. Bailey. 1977. Reproductive repression of largemouth bass in a heated reservoir. Proc. Annu. Conf. Southeast. Assoc. Game and Fish Comm. 31:463-470.

Grant, G. F. and P. M. Mehrle. 1970. Chronic endrin poisoning in goldfish, *Carassius auratus*. J. Fish. Res. Board Can. 27:2, 225–2, 232.

Greene, G. W. 1968. A reproduction control factor in the cyprinid fish, *Brachydanio rerio*. FAO Fish. Rep. 4(44), IV/E-1:86–92.

McKee, J. E. and H. W. Wolf. 1963. Water quality criteria. The Water Resour. Agency Calif. State Water Qual. Board. Pub. No. 3. 549pp.

Noble, R. L., R. D. Germany, and C. R. Hall. 1976. Interactions of blue tilapia and largemouth bass in a power-cooling reservoir. Proc. Annu. Conf. Southeast. Assoc. Game and Fish Comm. 29:247–251.

Olmsted, L. L., D. J. Degan, J. S. Carter, and P. M. Cumbie. 1986. Ash basin effluent as a concern of fisheries managers: a case history and perspective. Pages 261–269 *in* G. E. Hall and M. J. Van Den Avyle, eds. Reservoir fisheries management: strategies for the 80's. South. Div. Am. Fish. Soc., Bethesda, Md.

SAS Institute Inc. 1990. SAS procedures guide, release 6.03 edition. SAS Inst. Inc., Cary, N.C. 441pp.

Shafland, P. L. and J. M. Pestrak. 1981. Predation on blue tilapia by largemouth bass, in experimental ponds. Proc. Annu. Conf. Southeast. Assoc. Fish and Wildl. Agencies. 35:443–448.

——— and ———. 1983. Suppression of largemouth bass production by blue tilapia in ponds. Proc. Annu. Conf. Southeast. Assoc. Fish and Wildl. Agencies. 35:441–446.

Swingle, H. S. 1956*a*. Appraisal of methods of fish population study, Part IV. Determination of balance in farm fish ponds. Trans. N. Am. Wildl. Conf. 21:298–322.

———. 1956*b*. A repressive factor controlling reproduction in fishes. Proc. 8th Pac. Sci. Congr. 3A:865–871.

Texas Parks and Wildlife Department (TPWD). 1989. Texas inland fishery assessment procedures. TPWD loose leaf mimeo. 3-171-06/16/89, Austin. 58pp.

Whiteside, B. G. and F. J. Richan. 1969. Repressive factors controlling reproduction in goldfish. Prog. Fish-Cult. 31:165.