EFFECTS OF STRIPED BASS PREDATION UPON SHAD IN LAKE E. V. SPENCE, TEXAS

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Abstract: Striped bass (*Morone saxatilis*) introduced into Lake E. V. Spence, a west Texas reservoir, showed reduced growth rates as shad (*Dorosoma* sp.) declined. To study the relationship between these pehenomena, scales and stomach samples were collected from striped bass caught in gill nets, and the standing crop of shad was estimated from rotenone samples in August, 1972-1978. Declines in both striped bass growth and occurrence of food items in their stomachs coincided with the depletion of 76 and 178 mm shad after 1972. Surviving gizzard shad (*D. cepedianum*) grew rapidly, but threadfin shad (*D. petenense*) virtually disappeared as brood fish were decimated. Reducing the annual stocking rate from 24.7 to 12.4 striped bass fingerlings/ha in 1976 may have allowed gizzard shad to establish sufficient reproductive capacity to provide adequate forage.

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A fishery for striped bass, was established in Lake E. V. spence by annual stocking of 50 mm fingerlings beginning in 1969, the first year of its impoundment. Fishing reports and routine biological surveys indicated that striped bass growth and condition deteriorated after 1973, and that standing crops of gizzard shad and threadfin shad also declined.

The principal forage of striped bass is clupeid fishes such as shad (Stevens 1958, Goodson 1964, Mensinger 1971, and Ware 1971). A landlocked reproducing population in Santee-Cooper Reservoir, South Carolina, "crashed" after depleting the shad population (Stevens 1969), but there has been little or no measured effect on shad populations in most other striped bass reservoirs (Bailey 1975). This paper is presented to correlate striped bass growth in Lake E. V. Spence with shad standing crop trends.

MATERIALS AND METHODS

Lake E. V. Spence is a 6,000 ha municipal water supply reservoir on the Colorado River in Coke County, Texas. It has remained between 2,000 and 3,000 ha since 1972, with a mean depth of 7.3 m and maximum depth of 20-22 m (Morris 1975). Striped bass fingerlings (TL approximately 50 mm) were stocked at an annual rate of 24.7 per current surface hectare from 1969 through 1975. The stocking rate was changed to 12.4 ha in 1976 and 1977. Striped bass were not stocked in 1978.

To determine feeding habits and growth, striped bass were collected in 2.4 m x 45.7 m monofilament gill nets with 19, 32, and 51 mm bar mesh set 2 t 3 nights each month from October through December, 1972-1976, and in November, 1977. Stomach contents of 644 fish (0.06-8.2 kg) were examined. Lengths at various ages were back-calculted from annuli on scales collected from 193 fish, 1975-1977.

Standing crops of shad were estimated from rotenone samples in August, 1972-1974 and 1976-1978. Scales from 26 gizzard shad collected in the 1977 sample were examined to determine which year classes were present.

RESULTS AND DISCUSSION

Approximately 74% of all food occurrences were wholly or partly shad. Striped bass stomachs containing food declined from 79% in 1972 to 25% in 1977 (Fig. 1).

Back-calculated lengths indicated striped bss growth rates declined each year after 1972. Fig. 2 shows percentage deviation from overall average growth each year, 1972-1976, and percentage deviations from average growth for each age group of fish. First-year growth remained fairly constant but growth in the second and subsequent years of life declined.

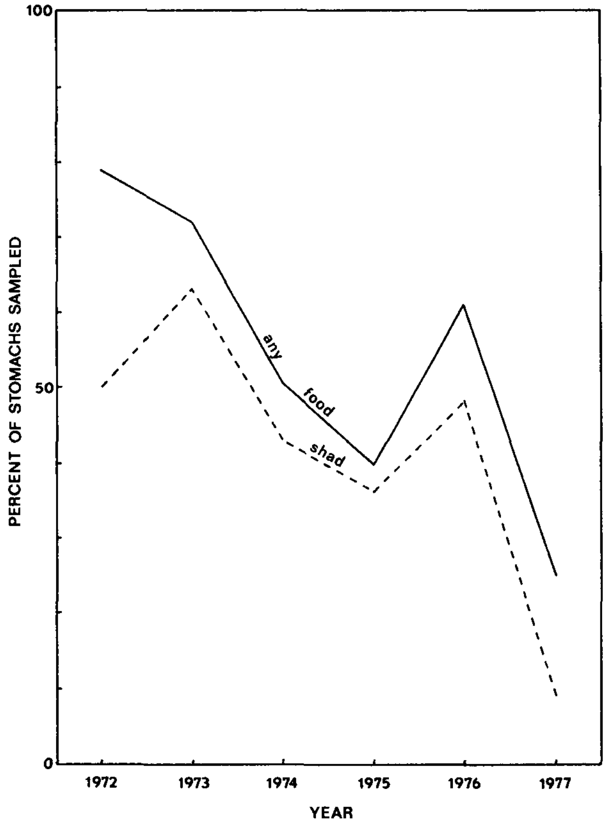

Fig. 1. Percentages of striped bass collected from Lake E. V. Spence, October-December, 1972-1977, containing food and containin shad.

The estimated standing crop of gizzard shad declined from approximately 150 kg/ha in 1972 to 80 in 1976, then increased to 280 in 1978 (Table 1). Threadfin shad declined from 8 kg/ha in 1973 to none in 1977. The dominant size class of gizzard shad in 1972 was 102 mm; in 1976, 229 mm; in 1977 and 1978, 102 mm with a secondary mode at 254 mm (Fig. 2). As gizzard shad size modes shifted upward, those of threadfin shad shifted downward (Fig. 4).

Examination of gizzard shad scales showed individuals of age classes 0, I, and II present in 1977. There were no missing year classes, and no gizzard shad die-offs were observed or reported during the study.

First-year striped bass, less dependent upon forage fishes than older fish (Gomez 1970), grew well throughout the study. Reduced growth rates of striped bass more than 1 year old were correlated with reduced abundance of 76 to 178 mm gizzard shad and 76 to 102 mm threadfin shad. This decline in forage abundance was reflected in stomach samples.

Progressive depletion of shad in the 76 to 178 mm size classes was strong evidence of selective predatory pressure. Gizzard shad escaping predation grew rapidly, became too large to be readily eaten by striped bass, and spawned. Gizzard shad reproduce in late

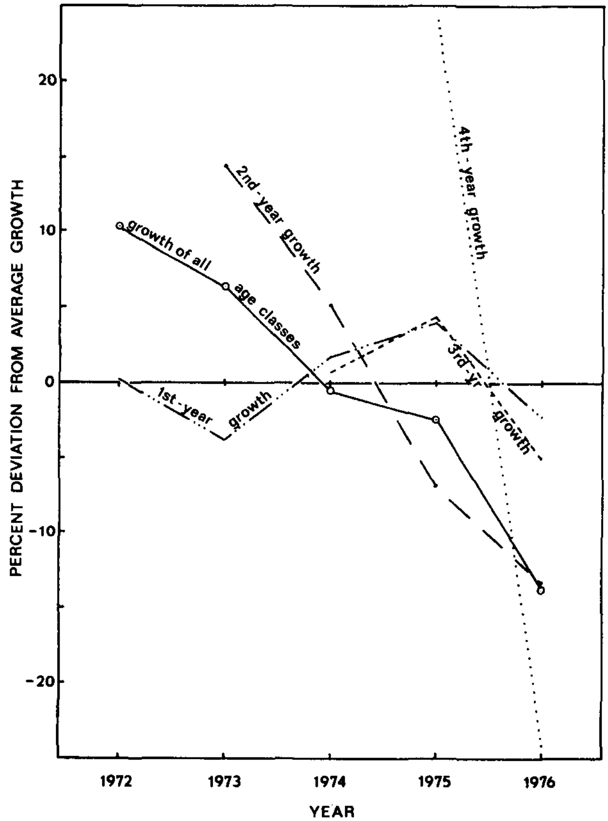

Fig. 2. Growth of striped bass collected October-December, 1975-1977 in Lake E. V. Spence.

April or May (Baglin and Kilambi 1968). Environmental conditions in Lake E. V. Spence from May to August each year were excellent for gizzard shad survival (Morris 1975). The presence of successive year classes indicated gizzard shad reproduction was not inhibited.

Conversely, predatory pressure on threadfin shad was strongest on the larger, sexually mature 76- to 102-mm fish. Selective removal of brood fish inhibited recruitment, and threatfin shad were severely depleted. Under other conditions, threadfin shad have been shown to suppress gizzard shad survival and production (Bryant and Houser 1969, Jenkins 1969). In Lake E. V. Spence, however, predation apparently favored gizzard shad reproduction and hindered that of threadfin shad.

In 11 southeastern U.S. lakes stocked with 11.6 fingerlings/ha annual, striped bass had no measurable effect upon shad populations, but 3 lakes stocked annually with 29.4 fingerlings/ha showed "significant" or "drastic" reductions (Bailey 1975). Lake E. V. Spence was stocked annually with 24.7 fingerlings/ha through 1975 and 12.4/ha thereafter. The presence of 102 mm gizzard shad in 1977 and 1978 seems to indicate this species has established sufficient reproductive capacity to provide adequate striped bass forage at the lower stocking rate.

Table 1. Estimated standing crops of shad and other fishes in Lake E. V. Spence, based on August rotenone sampling, 1972-1974 and 1976-1978.

	Kg/ha					
Species[a]	*1972*	*1973*	*1974*	*1976*	*1977*	*1978*
Gizzard shad	149.12	120.36	97.05	78.86	84.28	278.83
Threadfin shad	2.31	8.46	1.18	0.56	0.00	trace
Carp	199.76	24.09	15.40	12.36	179.29	187.67
River carpsucker	14.73	15.31	37.04	9.10	27.09	75.65
Channel catfish	21.81	23.35	7.07	7.62	25.49	43.24
Bluegill	51.03	37.14	20.50	27.55	22.63	40.38
Largemouth bass	21.15	13.13	23.89	11.23	10.78	18.10
White crappie	6.51	0.27	1.42	13.87	5.36	17.30
Freshwater drum	0.91	1.03	2.38	17.45	65.50	147.58
Others	12.93	6.91	10.58	12.06	14.21	41.02
Total	480.26	250.05	216.51	190.66	434.63	849.77

[a]Common names from Bailey (1970).

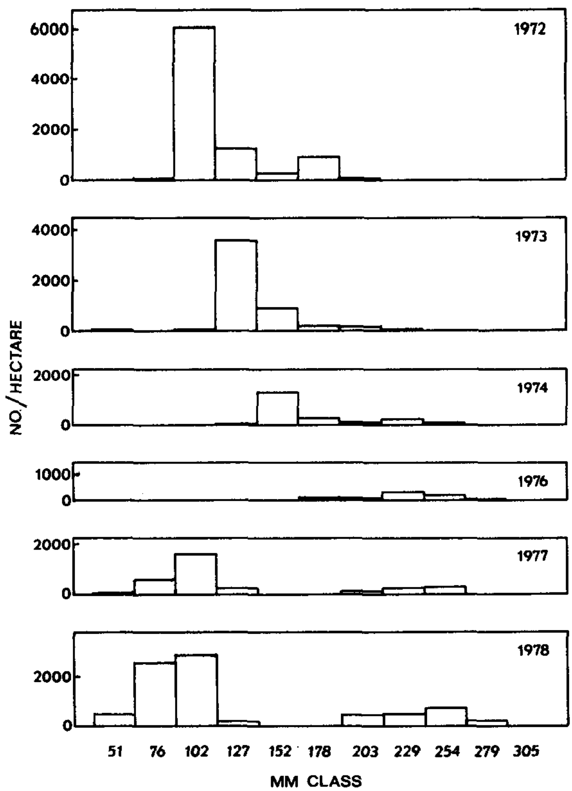

Fig. 3. Estimated standing crops and size distributions of gizzard shad in Lake E. V. Spence, based upon August rotenone samples, 1972-1974 and 1976-1978.

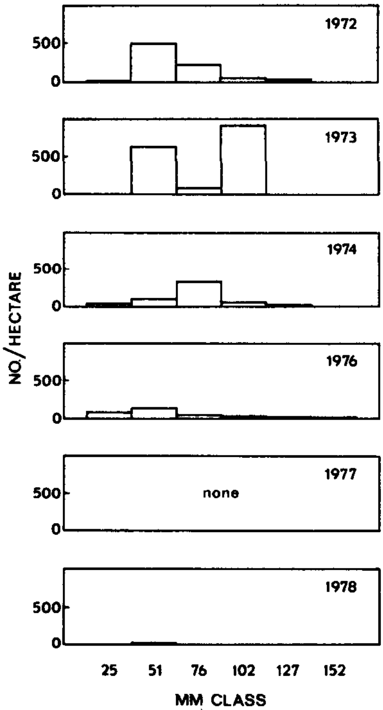

Fig. 4. Estimated standing crops and size distributions of threadfin shad in Lake E. V. Spence, based upon August rotenone samples, 1972-1974 and 1976-1978.

In food chains in which a predator is heavily dependent on a single prey species, oscillations in the predator population tend to lag a year or more behind those in the prey population (Odum 1959). Since striped bass do not reproduce in Lake E. V. Spence, oscillations in shad populations probably have more effect on striped bass growth rates than on striped bass population size. Data will be gathered in late 1978 to determine whether striped bass growth rates improve as a result of gizzard shad population recovery.

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