# Survival, Growth, and Food Habits of Striped Bass in Small Impoundments

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*Abstract:* Striped bass (*Morone saxatilis*) were introduced into 2 East Tennessee lakes to evaluate their survival, growth, and food habits in small impoundments of $<5$ ha. Small fingerling striped bass (33–96 mm) introduced late in the growing season exhibited poor survival. Good survival was depedent upon early introduction and larger size at stocking. The preferred habitat of striped bass in small impoundments does not support a sufficient forage base to sustain good growth. Food habit analyses revealed that approximately 85% of all food items consumed by yearling striped bass were fish. Sunfish (*Lepomis* sp.) comprised 62% of the total fish consumed while 29% were largemouth bass (*Micropterus salmoides*) and 9% were unidentified fish remains. Striped bass began utilizing fish as a primary food source at approximately 170 mm total length.

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The striped bass has been successfully introduced into large reservoirs across the United States in recent years. They were introduced to utilize the overabundance of clupeids (*Dorosoma cepedianum* and/or *D. petenense*) commonly available as forage in most reservoirs and simultaneously provide an attractive sport fishery. Overabundance of prey is also common in small impoundments but usually as sunfish, primarily bluegill (*L. macrochirus*). Preference of striped bass for clupeids may be a function of availability based on shared habitat.

Striped bass can be successfully caught by angling using sunfish as bait, indicating that they will utilize sunfish when present. Thomas (1967), Gomez (1970), and Ware (1970) reported the occasional occurrence of sunfish (*Lepomis* sp.) and largemouth bass in the diet of adult striped bass. Consequently, striped bass may have potential as a management tool to alleviate overpopulation of sunfish in small

impoundments. The purpose of this study was to examine survival, growth, and food habits of striped bass introduced into small impoundments not populated with clupeids.

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## Methods

Striped bass young-of-the-year (Y-O-Y) and yearlings were introduced into 2 small impoundments. Clyde York Lake is approximately 2.5 ha, with an established bass-bluegill population. Maximum depth was 5.0 m and the summer maximum surface water temperature reached 33° C. Surface area of Rucker Lake is approximately 4.2 ha with an established bass-bluegill population and a few muskellunge (*Esox masquinongy*). The maximum depth was 4.5 m and the summer maximum surface water temperature reached 30° C.

A summary of striped bass introductions into these impoundments is presented in Table 1. A total of 1,465 striped bass were introduced into Clyde York Lake in 1978, 1979, and 1980. In addition to the 1979 scheduled introduction, 900 additional fish were accidentally released into the lake. One hundred striped bass were introduced into Rucker Lake in 1980.

Collection gear utilized for sampling striped bass in both Clyde York Lake and Rucker Lake included minnow and bag seines, gill nets, and electrofishing equipment. Night electrofishing proved to be the most successful collecting technique from September 1979 throughout the 1980 collecting period. Fish collections along with temperature and dissolved oxygen profiles were taken at monthly intervals.

Total length (mm) and weight (g) of each captured striped bass were recorded. Scales were removed for age analyses from the left side, between the spiny dorsal fin and the lateral line. Each recaptured fish was injected abdominally with 1.0 to 5.0 cc of 10% formalin to halt digestion.

In October 1980 Clyde York Lake was drawn down to approximately 1.25 ha

**Table 1.** Striped bass introductions and survival percentages in small impoundments.

| Lake | Date | Number stocked | Mean length (mm) | Recaptures | Survival (%) |
|---|---|---|---|---|---|
| Clyde York | Aug 1978 | 105 | 87 | 2 | 2 |
| Clyde York | Aug 1979 | 1,300[a] | 44 | 0 | 0.0 |
| Clyde York | Apr 1980 | 60[b] | 130 | 38 | 23 |
| Rucker | Apr 1980 | 100[b] | 130 | 5[c] | — |

[a]Includes 900 young-of-the-year accidentally released from holding cage
[b]Stocked as yearling fish
[c]Total recaptures, no drawdown, therefore survival not calculated

with a depth of approximately 2.5 m. Seining and electrofishing removed most of the striped bass present. Length, weight, and scales were taken as described above. These fish were subsequently tagged and released.

Scales were examined using a microfiche projector with a 15 mm lens (48X magnification). Annuli and margin lengths were determined for 3 typical scales from each fish. Stomachs were excised and examined for food habits. Food items in the stomach were identified to the lowest practical taxon using a Bausch and Lomb dissecting microscope.

Back-calculation of body lengths was made using the formula proposed by Everhart et al. (1976) and the coefficient of condition (K) was calculated using Fulton's condition factor (Ricker 1975). Frequency of occurrence of all foods ingested was recorded and categorized by month for each food item class.

Survival percentages from Clyde York Lake were calculated from the number of fish captured during the 1980 drawdown. Twenty-five of the original 60 striped bass stocked in 1980 were removed for stomach analyses. Consequently, 1980 survival values were calculated based on 35 fish.

## Results and Discussion

Survival for striped bass introduced into the 2 small impoundments is summarized in Table 1. Poor survival in 1978 and 1979 was attributed to small fish size and late introduction. Temperature and dissolved oxygen at this time were not considered to be limiting for striped bass survival. Competition for food with the overabundant small bluegills may have reduced survival of the small striped bass. In addition, striped bass were stocked much later than the onset of bass and bluegill spawning; fry produced at this time would have grown too large for the striped bass to eat. Eight of the remaining 35 fish (60 original—stocked in April 1980), were recovered from Clyde York Lake resulting in 23% survival. Survival in 1980 was much better when compared to the 1978 and 1979 introductions and was attributed to stocking larger fish earlier in the growing season. Sampling difficulties prevented an accurate estimate of survival at Rucker Lake; there were only 5 fish recovered during 1980.

The results clearly show that small fingerlings introduced late in the growing season exhibited very poor survival. In a similar study, the U.S. Department of the Interior, Fish and Wildlife Service (unpubl. data) introduced a total of 1,400 striped bass into 2 established bass-bluegill lakes (3.6 ha and 4.8 ha) containing shad. Stocking rates were 111 fish/ha and and 125 fish/ha, respectively, with a mean total length of 75 mm. Only 4 fish were recovered. Poor survival was attributed to small fish size and high introduction densities. Van Den Avyle and Higginbotham (1979) reported that survival and average sizes at age I and II of striped bass in Watts Bar Reservoir, Tennessee, were directly related to introduction size and inversely related to introduction density.

A total of 41 fish from Clyde York Lake were captured in 1980; 38 were fish from the 1980 introductions and 3 were from the 1978 stocking. The mean back-calculated

length for 1980 introductions at age I was 116 mm. Mean back-calculated lengths for 1978 introductions were: age I = 109 mm, and age II = 247 mm.

Mean lengths and weights per month of Clyde York Lake striped bass recovered from 1980 introductions are summarized in Table 2. Mean stocking length was 130 mm with a mean weight of 16 g. Fish averaged 250 mm in length and 161 g after 6 months growth. Fish total length increased at an average rate of 20mm/month and weight increased at an average rate of approximately 24 g/month. Maximum monthly growth occurred from May to June (35 mm). The high growth rate may be a data artifact due to the small sample size in May (3 fish); however, it was believed that the increased availability of forage fish due to natural reproduction produced the good growth. Previous striped bass studies have shown that these fish were large enough at introduction to utilize small forage fish (Gomez 1970, Ware 1970, Harper and Jarman 1971). However, it was speculated that the striped bass in Clyde York Lake fed primarily on zooplankton and insect larvae until forage densities increased in May.

Minimum monthly average growth (2 mm) occurred from June to July. Again, a small sample size may be a factor. However, poor oxygen levels in preferred thermal areas in July may have suppressed growth (Table 3). Magnuson et al. (1979) reported that striped bass restricted to temperatures above their fundamental thermal niche by low dissolved oxygen concentrations may experience reduced growth rates.

Growth for 1980 striped bass varied as much as 102 mm total length in September. Ware (1970) reported that Y-O-Y striped bass in Florida reservoirs exhibited accelerated growth after reaching sufficient size (150 mm total length) to take fish in the diet. When the larger fish from 1980 introductions were utilizing forage fish, the smaller fish were utilizing insect larvae; thus, growth was enhanced in the larger fish.

The mean condition factors ($K_{TL}$) for yearling striped bass in Clyde York Lake and Y-O-Y striped bass in Cherokee Reservoir, Tennessee (Saul 1981), in 25-mm length classes are compared in Table 4. Condition of yearling Clyde York Lake fish was consistently lower than reservoir fish indicating a forage deficiency for striped bass in Clyde York Lake.

**Table 2.** Mean monthly lengths, weights, and condition factors $K_{(TL)}$ of yearling striped bass recovered from Clyde York Lake in 1980.

| Month | *N* | Mean length (mm) | Range | Mean weight (g) | Range | Mean $K_{(TL)}$ |
|---|---|---|---|---|---|---|
| Apr | 60[a] | 130 | 113–148 | 16 | | 0.71 |
| May | 3 | 135 | 134–135 | 20 | 19.5– 21.8 | 0.84 |
| Jun | 8 | 170 | 158–180 | 50 | 40.7– 60.6 | 1.00 |
| Jul | 4 | 172 | 157–190 | 51 | 35.5– 73.2 | 0.96 |
| Aug | 10 | 205 | 164–241 | 90 | 42.4–141.2 | 1.00 |
| Sep | 5 | 228 | 193–295 | 129 | 63.3–281.5 | 0.94 |
| Oct | 8 | 250 | 214–286 | 161 | 88.1–236.7 | 0.99 |

[a]Initial stock

**Table 3.** Temperature and dissolved oxygen levels in Clyde York Lake, July, 1980

| Depth in mm | Temperature (C) | Dissolved Oxygen |
|---|---|---|
| 0.0 | 33 | 6.8 |
| 0.5 | 32 | 6.8 |
| 1.0 | 31 | 6.6 |
| 1.5 | 30 | 6.7 |
| 2.0 | 30 | 6.1 |
| 2.5 | 27 | 3.6 |
| 3.0 | 25 | 1.7 |
| 3.5 | 16 | 0.4 |
| 4.0 | 14 | 0.2 |

**Table 4.** Mean condition factors $K_{(TL)}$ for yearling striped bass in Clyde York Lake and young-of-the-year striped bass in Cherokee Reservoir, Tennessee, in 25-mm length classes.

| Length class (mm) | Clyde York Lake yearling | Cherokee Reservoir young-of-the-year |
|---|---|---|
| 126–150 | 0.84 | 1.08 |
| 151–175 | 0.97 | 1.15 |
| 176–200 | 0.96 | |
| 201–225 | 0.98 | 1.07 |
| 226–250 | 1.02 | |
| 251–275 | 1.00 | 1.05 |
| above 275 | 1.04 | 1.28 |

The frequency of occurrence by month of food organisms taken by striped bass from Clyde York Lake is summarized in Table 5. Fish were the principal food item when striped bass reached approximately 170 mm total length; approximately 85% of all food items consumed were fish. Sunfish (*Lepomis* sp.) comprised 62% of the total fish consumed while 29% were largemouth bass and 9% were unidentified fish remains. Insects (Diptera and Odonata) supplemented the piscivorous diet.

Although sunfish were the principal food item taken by striped bass in Clyde York Lake, almost one-third of the fish consumed were largemouth bass, possibly indicating selection of largemouth bass over other prey species. Harper et al. (1968) reported that soft-rayed fishes of fusiform body shape were desirable to introduce as forage fish in striped bass culture ponds while laterally compressed or spiny-rayed fishes were not suitable. Striped bass were apparently selectively feeding on young largemouth bass in Clyde York Lake.

In summary, good survival is dependent upon early introduction and larger size at stocking. The preferred habitat of striped bass in small impoundments does not support a sufficient forage base to sustain good growth. Sunfish comprised 62% of the total fish consumed while 29% were largemouth bass and 9% were unidentified fish remains.

**Table 5.** Frequency of occurrence (%) by month of food organisms taken by striped bass in Clyde York Lake in 1980.

| | | | | Food Organisms (%) | | | | |
|---|---|---|---|---|---|---|---|---|
| Month | Length (mm) | Examined | Empty Stomachs | Odonata | Diptera | Sunfish | Largemouth Bass | Unidentified Fish |
| May | 135 | 3 | 2 | | 100 | | | 100 |
| Jun | 170 | 8 | 3 | 20 | 40 | | 40 | 20 |
| Jul | 172 | 4 | 1 | | | 67 | 67 | 33 |
| Aug | 206 | 5 | 1 | | 25 | 50 | 75 | |
| Sep | 228 | 5 | 1 | | | 100 | 50 | |

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