Distribution and Habitat Selection of Florida and Northern Largemouth Bass in Lake Tawakoni, Texas

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Abstract: An ultrasonic-telemetry study was conducted to compare spatial and temporal distribution and habitat use of Florida largemouth bass (*Micropterus salmoides floridanus*, FLMB) and northern largemouth bass (*M. s. salmoides*, NLMB). Twenty-four largemouth bass (12 FLMB and 12 NLMB) were implanted with ultrasonic transmitters and released in Waco Bay, a 1,215-ha major arm of Lake Tawakoni, Texas. Eleven FLMB and 10 NLMB were located at least once during the year-long study period (range 1–24). Average 75% and 95% contour level home ranges for FLMB were 19.0 and 44.2 ha, respectively; for NLMB they were 21.5 and 66.1 ha, respectively. Aquatic vegetation, pier/boathouse, brushy shoreline, and clean shoreline were the most important habitat types selected by both subspecies. Habitat overlap was evident between the subspecies. Both inhabited relatively shallow water, most in water ≤2.1 m deep. However, FLMB were located in deeper water further from shore than were NLMB. FLMB demonstrated a distinct movement toward shallower water with increasing water temperature. No similar movement pattern was observed for NLMB. A general movement toward shore was observed for both subspecies as water temperatures increased.

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An important aspect of the study of population dynamics is the manner, or pattern, in which members of a population are distributed within the community (Reid 1961). Florida largemouth bass (*Micropterus salmoides floridanus*, FLMB) have been introduced into existing populations of northern largemouth bass (*M. s. salmoides*, NLMB) partly in the belief they occupy a different niche. Few studies, however, have been conducted to document differences in habitat utilization between the subspecies. Chew (1975) indicated FLMB seemed to prefer shallow vegetated habitat more than NLMB. Nieman and Clady (1980), in a study concerned with winter movement patterns, found no clear indication of different habitat choices between the subspecies in a heated cove of Boomer Lake, Oklahoma. Betsill et al. (1986) reported similar home ranges for FLMB and NLMB in

2 small Texas impoundments; however, FLMB generally made extensive use of small areas within their home ranges while NLMB were more evenly distributed within their home ranges. Apparently there are no published studies comparing distribution and habitat use between the subspecies of largemouth bass in a large reservoir. The objective of this study was to compare, through the use of ultrasonic telemetry, spatial and temporal distribution and habitat use of FLMB and NLMB in Lake Tawakoni, a 14,864-ha Texas reservoir.

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Methods

Lake Tawakoni is located in Hunt, Rains, and Van Zandt counties, Texas. The reservoir was constructed in 1960 by the Sabine River Authority to provide water for municipal and industrial purposes. Waco Bay, a 1,215-ha major arm on the west side of the reservoir, was the study area. Maximum depth in Waco Bay was 12 m. Aquatic vegetation, primarily milfoil (*Myriophyllum* sp.), was sparsely distributed along the shoreline.

Twenty-four largemouth bass (12 FLMB and 12 NLMB) were obtained during October 1988 from the Fish Hatchery Branch of the Texas Parks and Wildlife Department for ultrasonic tagging. Hatchery fish were used because the genetic purity of the stock these fish came from had been certified by electrophoretic analyses of diagnostic proteins. Fish ranged in size from 338 to 384 mm TL for FLMB and 356 to 371 mm TL for NLMB.

An individually coded Type CT-82 ultrasonic transmitter manufactured by Sonotronics, Tucson, Arizona, was implanted into the body cavity of each fish using surgical techniques described by Hart and Summerfelt (1975) except that an antibiotic (10% Povidone-iodine—Betadine) was used prior to and after surgery. After insertion of each transmitter, 2.0 metric black braided silk sutures and an FS-1 cutting needle were used to close the incision. Each transmitter tagged fish was also tagged with a Floy FD-68B T-Bar Anchor Tag to allow identification by anglers. Each Floy tag bore the inscription "TPWD—Radio-Tagged Fish—Please Do Not Remove."

Implanted fish were held in aerated concrete troughs for 2 additional weeks to check for transmitter or tag loss and infection. On 31 October 1988, all fish were transported to Lake Tawakoni and released at approximately the same time and place in Waco Bay. Tagged fish were allowed to acclimate for 3 weeks before any attempt was made to locate them.

An ultrasonic digital receiver (Model USR-5) and a directional hydrophone (DH-2) manufactured by Sonotronics, Tucson, Arizona, were used to locate tagged fish. Sampling was conducted approximately once every 2 weeks for a year. On each sample day, a crew traveled the entire shoreline of Waco Bay by boat between 0800 and 1700 hours. When a tagged fish was located, data on location, distance from shore, water depth, habitat type, and surface temperature were recorded. The entire reservoir was surveyed in June 1989 in an attempt to locate fish that may have emigrated from Waco Bay.

The approximate location of each tagged fish found on a particular survey day was recorded on a detailed topographic map. Distance from shore was measured with either a Ranging Optical Tapemeasure 103X (<30.5 m) or a Rangematic MK5 rangefinder (>30.5 m). Water depth was obtained with either a Humminbird TCR ID-1 electronic depthfinder (>3.7 m) or a calibrated range pole (<3.7 m). Surface temperature was obtained using a YSI 54A oxygen meter. Habitat types were defined as aquatic vegetation, brushy shoreline, clean shoreline, open water, pier/boat house, hump, stickup (solitary tree or bush limb exposed above water surface), drop-off, and rocky riprap.

Distribution was evaluated by comparing home ranges (regions in which individuals normally travel). Home range was calculated for fish with ≥9 location fixes. Each time a tagged fish was located, an X,Y coordinate was assigned to that location for home range determination. These coordinates were analyzed using the harmonic mean transformation option in the microcomputer program McPAAL (Stuwe and Blohowiak 1985). Samuel et al. (1985) state that outliers (extreme points) have a dramatic effect on home range estimates at large contour levels (e.g., 95%), and a far less effect at smaller levels (e.g., 75%), especially when using the harmonic mean technique. A contour level is an area which includes a designated percentage of the location fixes (e.g., 75% or 95%). White and Garrott (1990) point out that the estimate of home range size is highly variable at large percentages, such as 95%, because of the edge effect caused by outliers. They further state "there is no biological justification for the use of 95%; this figure has probably been adopted by biologists because of the use of $\alpha = 0.05$ in statistical tests. Thus, the selection of any percentage can probably be justified if the value fulfills the needs of the experiment being conducted." Therefore, home range was calculated for both the 95% and the 75% contour levels. Home range area (ha) was calculated using Generic CADD Level 3 (1988) computer software.

Habitat use was evaluated by comparing percentage of fixes for a each habitat type. Similarity in seasonal habitat use was evaluated using Schoener's (1970) measure of overlap. Differences in home range size between the subspecies were evaluated using a Mann-Whitney U Test. Differences in water depth utilization and distance from shore were evaluated by comparing the means and variances using the 2 sample analysis (*t*-test) option in Statgraphics (1989). The effects of fish size and number of locations in relation to home range size were evaluated with the regression analysis option in Statgraphics (1989). Home range size was treated as the dependent variable and either fish size or number of locations the independent variable. Probability level for all tests was set at 0.05.

Table 1. Florida (F) and northern (N) largemouth bass tagging and tracking statistics, Waco Bay, Lake Tawakoni, Texas, 1988–1989. Home range was calculated for fish having ≥9 fixes and is reported in hectares.

Fish tag no.	Fish type	Start date	End date	*N* Fixes	75% Home range	95% Home range
T2273	N	21 Nov 88	31 Jan 89	6	N/A	N/A
T2246	N	21 Nov 88	04 Apr 89	10	0.8	2.0
T2255	N	21 Nov 88	09 Oct 89	15	7.0	43.8
T2228	N	21 Nov 88	18 Jan 89	3	N/A	N/A
T2327	N	21 Nov 88	18 Jan 89	3	N/A	N/A
366	N	20 Dec 88	28 Feb 89	6	N/A	N/A
384	N	05 Dec 88	25 Sep 89	15	N/A	N/A[a]
456	N	05 Dec 88	05 Dec 88	1	N/A	N/A
339	N	05 Dec 88	25 Sep 89	17	56.6	152.6
267	N	21 Nov 88	21 Nov 88	1	N/A	N/A
T2336	F	21 Nov 88	25 Apr 89	12	29.8	53.7
T555	F	21 Nov 88	04 Jun 89	12	14.7	25.5
T465	F	21 Nov 88	21 Nov 88	1	N/A	N/A
T2354	F	05 Dec 88	09 Oct 89	23	33.7	51.8
T2237	F	21 Nov 88	14 Mar 89	9	0.9	2.5
T2345	F	21 Nov 88	09 Oct 89	24	N/A	N/A[a]
276	F	05 Dec 88	25 Apr 89	9	4.7	14.9
249	F	21 Nov 88	14 Mar 89	9	N/A	N/A[b]
447	F	21 Nov 88	11 Apr 89	9	7.8	42.6
258	F	21 Nov 88	28 Aug 89	19	19.8	58.9
285	F	21 Nov 88	09 Oct 89	22	40.6	103.5

[a] Fish presumed dead or tag shed because their exact location never changed.
[b] Area occupied was so small, it could not be drawn with computer software used.

Results and Discussion

Eleven FLMB and 10 NLMB were located at least once (Table 1). Number of location fixes for individual fish ranged from 1 to 24 (total *N* fixes = 226). Three fish (1 FLMB and 2 NLMB) were never located after being released. Signals from 12 fish ceased for unknown reasons at various times throughout the study period. Six fish were harvested by anglers and tags returned. Two tagged fish ceased movement after being initially located and were considered to have died or shed their transmitters. Only 1 tagged fish could be located outside of Waco Bay. By the end of the sampling schedule, only 2 FLMB and 1 NLMB bass could be located. Therefore, all statistical comparisons, except those for home range, are made on data collected during the winter and spring quarters when ample numbers of tagged-fish were available for sampling.

Home range was calculated for 8 FLMB and 3 NLMB (Table 1). The average 75% contour level home range for FLMB was 19.0 ha (range = 0.9 to 40.6), while the 95% contour level average home range was 44.2 ha (range = 2.5 to 103.5). Northern largemouth bass 75% contour level average home range was 21.5 ha (range = 0.8 to 56.6) while the 95% contour level home range averaged 66.1 ha (range = 2.0 to 152.6). No significant difference was detected for home range size at either contour level between the subspecies. Furthermore, home range size was not affected by the number of fixes at either the 75% or 95% contour level (r^2 = 0.43 and 0.22, respectively). Likewise, size of test fish also had no affect on home range size (75% $r^2 = 0.17$ and 95% $r^2 = 0.01$).

Home range sizes obtained in this study were generally larger than previously reported for either subspecies. However, most home range studies have been conducted on smaller impoundments and Nieman and Clady (1980) state that home range size estimates for largemouth bass vary greatly. Therefore, home range, as used in this study, was likely more important for describing distribution patterns than size of area occupied.

Two FLMB established multiple home ranges (separate and distinct home areas) at the 75% contour level. At the 95% contour level, there were no multiple home ranges for FLMB. All 3 NLMB established multiple home ranges at both contour levels. One NLMB established separate home ranges on opposite sides of Waco Bay. Warden and Lorio (1975), Winter (1977), and Fish and Savitz (1983) also reported multiple home range areas for NLMB. Betsill et al. (1986) reported multiple activity centers for both subspecies.

As stated earlier, there is an unfounded belief that the use of high contour levels (e.g., 95%) must be used in home range estimates. Apparently, this does not seem to present a problem when animal movements are on land. However, when used for fish, the mechanics of including the required percentage of fixes in the higher contour level can result in an overestimation of home range size because of outliers and possibly the inclusion of land in the overall estimate. In this study, the 75% contour level seemed to more accurately describe distribution patterns and therefore home range, as observed through sampling, than did the 95% contour level.

Aquatic vegetation was the most frequent habitat type utilized by FLMB and

Table 2. Habitat use by Florida largemouth bass (FLMB) and northern largemouth bass (NLMB) in Waco Bay, Lake Tawakoni, Texas, November 1988 through April 1989.

	% Use	
Habitat type	FLMB	NLMB
Aquatic vegetaion	28.2	33.9
Brushy shoreline	14.9	26.2
Clean shoreline	14.9	9.2
Open-water	7.0	0.0
Pier/boathouse	18.4	16.9
Hump	3.5	0.0
Stickups[a]	0.0	10.8
Dropoff	9.6	1.5
Rocky riprap	3.5	1.5

[a] A solitary bush or tree limb exposed above the water surface.

NLMB. Pier/boathouse, brushy shoreline, and clean shoreline were also important habitat types utilized by both subspecies during the winter/spring periods (Table 2). These were also the most important habitat types utilized by tagged fish remaining throughout the study period. These findings are similar to those of Fish and Savitz (1983), Mesing and Wicker (1986), and Smith and Orth (1990) for aquatic vegetation; to Colle et al. (1989) for the importance of piers; and Scott and Crossman (1973), Vogele and Rainwater (1975), and Schlagenhaft and Murphy (1985) for brushy habitat.

Habitat overlap was evident between the 2 subspecies for the winter/spring period (Schoener's overlap index = 0.75). Habitat use overlap indexes for the winter period were 0.67 and 0.49 for spring. Overlap values ≥0.60 are considered

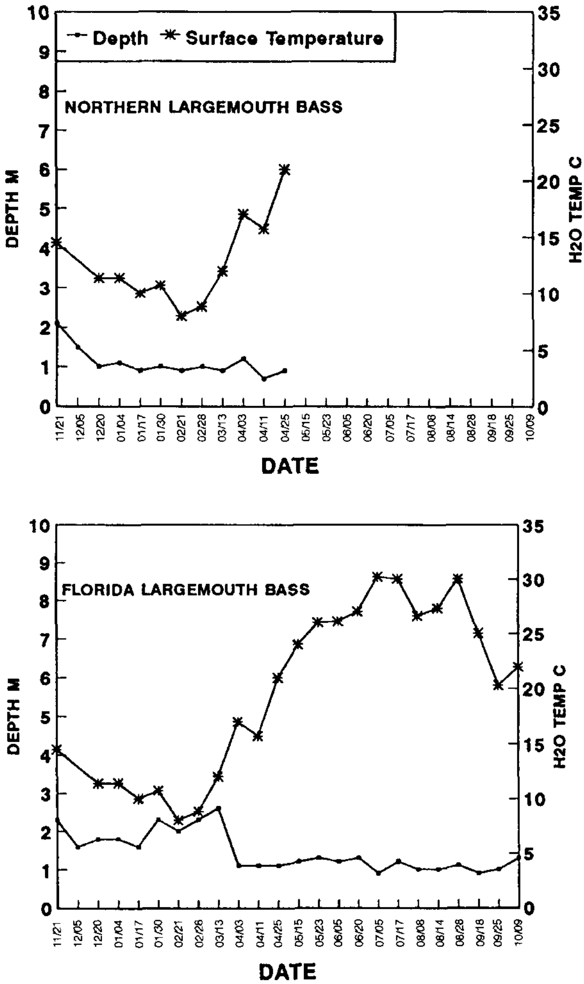

Figure 1. Average surface water temperatures and depths at locations of ultrasonic-tagged Florida and northern largemouth bass in Waco Bay, Lake Tawakoni, Texas, 1988–89.

biologically significant in food habit studies (Galat and Vucinich 1983); however, Schlagenhaft and Murphy (1985) felt values as low as 0.51 to be significant in habitat studies. The declining number of tagged NLMB remaining in the study area after the winter and early spring probably had a negative impact on the overlap index for spring and precluded comparisons for summer and fall.

Both subspecies inhabited relatively shallow water. During the entire study, 83% of the FLMB location fixes and 95% of the fixes for NLMB came from water <2.1 m (classified as inshore by Colle et al. 1989). However, FLMB were found in deeper water ($P < 0.05$) than were NLMB (1.8 m ± 0.2 SE and 1.1 m ± 0.1 SE, respectively). Individuals of both subspecies were found in water as shallow as 0.3 m. The maximum depth of water in which tagged fish were located was 6.7 m

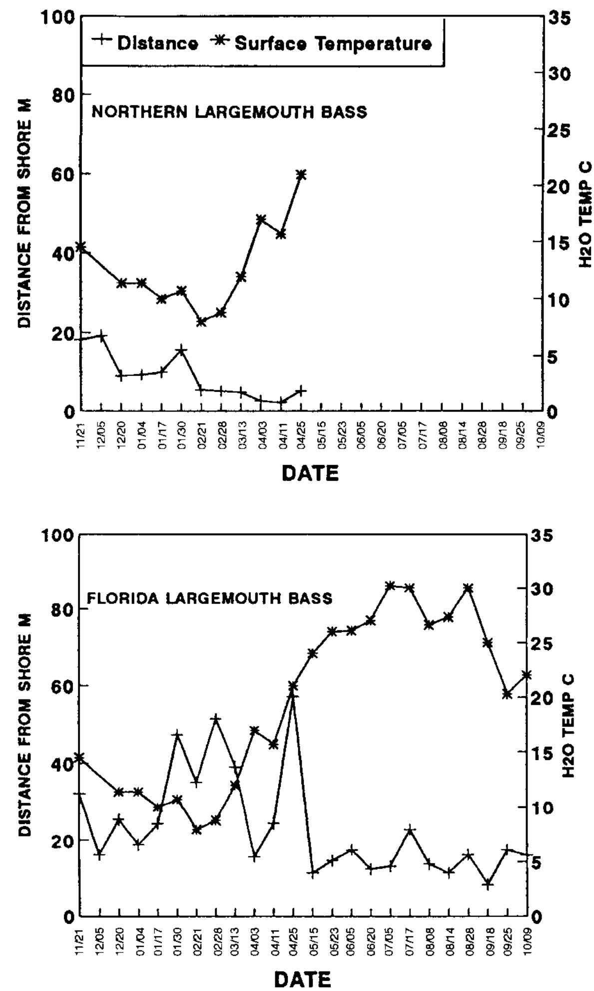

Figure 2. Average surface water temperatures and distances from shore at locations of ultrasonic-tagged Florida and northern largemouth bass in Waco Bay, Lake Tawakoni, Texas, 1988–89.

for FLMB and 5.6 m for NLMB. FLMB bass demonstrated a distinct movement toward shallow water as surface water temperatures increased. No similar pattern was observed for NLMB (Fig. 1).

Both subspecies remained relatively close to shore during the study period. However, FLMB were located significantly farther ($P < 0.05$) from shore (39.7 m ± 9.0 SE) than did NLMB (9.0 m ± 1.7 SE). Fish were located as close to shore as 0.6 m for FLMB and 0.9 m for NLMB and as far from shore as 205.7 m for FLMB and 91.4 < for NLMB. A general movement toward the shore by FLMB and NLMB occurred as water temperatures increased (Fig. 2).

This study demonstrated that shallow water close to shore with adequate cover was important for both subspecies. Habitat overlap indices suggest that the subspecies, at least in Lake Tawakoni, do not occupy a different niche as first thought by fisheries managers. This fact should be considered when stocking one subspecies into an existing population of the other if maintaining integrity of the gene pool, as Philipp (1992) argues, or intraspecific competition is a concern to the fishery manager. However, habitat overlap is probably responsible for the success various agencies have had in introducing the Florida gene into NLMB populations.

The use of hatchery fish may be questioned by some despite the rationale given for their use. Some may feel that "hatchery" fish behave differently than "wild" fish. However, comparison of results obtained in this study and those from literature show that "hatchery" fish used in Lake Tawakoni behaved similar to their "wild" counterparts. This is important since many largemouth bass populations, especially in the southern part of the United States, are started and/or maintained by stocking hatchery fish. In fact, populations of FLMB located outside their native range are derived from "hatchery" fish and their offspring. Therefore, the use of hatchery fish is not thought to have affected results obtained in this study.

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