Seasonal Movement and Distribution of Striped Bass in the Ohio River

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Abstract: Twenty-four adult striped bass (66.8–84.6 cm; 4–7 years) from the McAlpine Pool of the Ohio River were fitted with internal radio transmitters and tracked from May 1989 through May 1990. Study fish were found to be very mobile, although seasonal movement patterns were predictable. Tagged striped bass utilized the tailwater and upper pool sections during the spring, summer, and fall. Little use was made of the lower McAlpine Pool sections by striped bass. Fish in the pool were most often located in water between 0 to 6 m ($\bar{x}$ = 92.1% all seasons). Twenty-four hour surveys determined that striped bass total daily movement ranged from 1.3 to 4.3 km ($\bar{x}$ = 2.1 km/fish), with movement per hour varying from 0 to .3 km/hour. Fifty-eight percent of the daily movement was during the day following by the crepuscular (23.7%) and night (18.3%) periods. Four striped bass (16.7%) were still active at the end of the study. One striped bass died from unknown reasons (4.2%), 4 were creeled (16.7%), 4 emigrated from the McAlpine Pool (16.7%), 4 died from stress-related factors (16.7%), and 7 were not located after release (29.2%).

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The Kentucky Department of Fish and Wildlife Resources began stocking striped bass in the Ohio River because of their ability to utilize the abundant gizzard and threadfin shad forage base and as a means to increase the sport fish diversity. Over 10 million striped bass fingerlings have been released since 1975 in the 8 navigation pools bordering Kentucky, with an annual stocking objective of 4 fingerlings/ha. Creel surveys conducted in Ohio River pools and tailwaters indicated that 16% of all anglers sought striped bass and that 74% of these fish were caught in tailwaters. Harvest of striped bass has not consistently met the harvest objective of 1.1 kg/ha or a 10% increase in the total yield. Movements of striped bass could be contributing to the seasonal and sporadic nature of this fishery.

Telemetry has been used to describe striped bass movement in reservoirs (Combs and Peltz 1982, Farquhar and Gutreuter 1989), reservoir tailwaters (Lamprecht and Shelton 1986), and coastal plain rivers (Wooley and Crateau 1983, Kynard and Warner 1987, Van Den Avyle and Evans 1990). The Ohio River and its navigational locks and dams is unique in that it is a series of rapidly flushing reservoirs where the tailwater area of 1 pool flows directly into the impounded area of the next pool. The present study was initiated in a pool of the Ohio River to determine striped bass movement, distribution, and habitat use patterns, information needed to ultimately increase their harvest and possibly aid in future broodstock collection in the Ohio River.

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Methods

The McAlpine Pool of the Ohio River was chosen as the study site due to its proximity to large metropolitan areas and its central location (Fig. 1). This pool extends from the Markland tailwaters (Ohio River Kilometer (ORK) 855.2) to the Falls of the Ohio in Louisville, Kentucky (ORK 976.3), for 121.2 km (7,608 ha). A minimum 2.7-m navigation channel is maintained by the Louisville District of

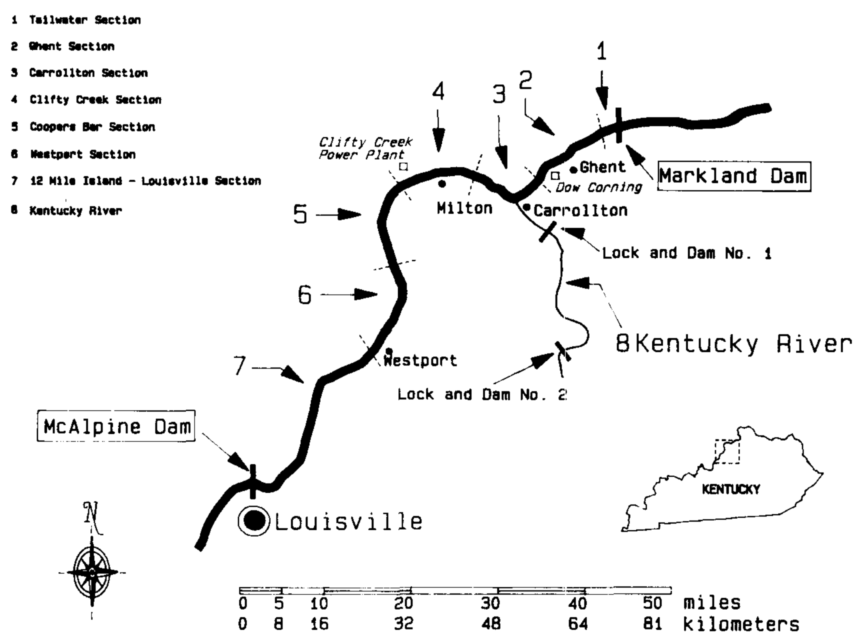

Figure 1. Study sections utilized in the McAlpine Pool of the Ohio River (Ohio River Kilometer 855.4–973.4).

the Corps of Engineers. The pool was divided into 8 sections which included Markland tailwater (ORK 855.2–856.0), Ghent (ORK 856.1–872.1), Carrollton (ORK 872.2–888.2), Clifty Creek (ORK 888.3–904.3), Coopers Bar (ORK 904.4–920.4), Westport (ORK 920.5–936.5), Louisville (ORK 936.6–973.4), and the Kentucky River (ORK 878.2), the largest of several tributaries.

Telemetry equipment was manufactured by Advanced Telemetry Systems, Inc., of Isanti, Minnesota. A programmable, scanning receiver (Challenger Model 2000) operating on 48.020–48.620 MHz was used to locate positions of striped bass. A 4-element (low frequency), 48 to 50 MHz, Yagi antenna was used to track striped bass from boat, while 2 loop antennas (30 MHz–55 MHz) were used during aircraft searches. Temperature sensing Model 5A transmitters (48 MHz; 45 g weight in air) were selected for their 420- to 520-day duration.

Striped bass were captured by electrofishing in the area immediately below the Markland tailwater, tailwater of Kentucky River Lock and Dam No. 1, and the heated discharge of the Clifty Creek and Ghent power plants. Captured striped bass were sedated for approximately 15 minutes in a 100 mg/l solution of tricaine methanesulfonate (MS-222), measured (to the nearest 0.2 cm), weighed (to the nearest 0.04 kg), and scales removed for age and growth determination. Transmitters were inserted into the abdominal cavity along a 3.8-cm line adjacent to the midline and halfway to the lateral line following procedures similar to Hart and Summerfelt (1975) and Moss (1985). A Floy tag was placed just behind the dorsal fin as an external marker to indicate a $20 reward for the return of the transmitters.

Striped bass locations were determined from combined aerial and boat surveys. Aerial surveys were conducted a minimum of once per month to locate striped bass within the study pool and those egressing the primary survey area. Boat surveys were made 3–4 days per week during summer (June–Aug 1989) and 1–2 days per week during the spring (May 1989; Mar–May 1990), fall (Sep–Nov 1989) and winter (Dec 1989–Feb 1990). The entire study pool was searched at least once by boat each week and fish not located were given priority status on the next search to determine the cause of absence. Fish were located as comprehensively as possible; however, movement estimates of total, daily, and net (overall direction of movement between the start and end of a season) striped bass movement were not always made on a continuous basis (day to day) and can only be considered as minimum estimates of movement and are used for determining trends. A total of 4 striped bass were located once an hour during 2 24-hour periods in the Markland Tailwater area to determine daily movement patterns in August. The following information was recorded at each position: fish number, date, depth, distance from shore (using a Rangematic 1200 Rangefinder), river kilometer, transmitter pulses, river level, secchi disk disappearance depth, surface/bottom dissolved oxygen and temperature.

Limnological data were collected every 2 weeks from 4 Ohio River locations (ORK 855.3 Markland TW, ORK 877.9 Carrollton, ORK 930.2 Westport, and ORK 969.9 Louisville) and 1 Kentucky River location (KRK 1.0 Carrollton). Water quality parameters included river level, secchi disk disappearance depth, and surface/bottom dissolved oxygen and temperature. Flow data for the Ohio River at Maryland

Locks and Dam were obtained from the Engineering Division of the Louisville District, Army Corps of Engineers.

SAS-PC (SAS Inst., Inc. 1988) was used to process data. A Wilcoxon Sign-rank test was used to determine if late summer water temperatures may have affected the survivability of tagged striped bass due to their size (weight at capture). A formula developed by Neu et al. (1974) was used with chi square to analyze preference or avoidance of tagged striped bass to depth contours and different sections of the pool in proportion to their areas of occurrence in the McAlpine Pool. Contour areas were determined with a digital planimeter from a 1:600 scale U.S. Corps of Engineers map of the McAlpine Pool.

Results

Twenty-four striped bass were fitted with transmitters in the spring 1989 (Table 1). Striped bass ages ranged from 4 to 7 years ($\bar{x}$ = 5 years). Lengths varied from 66.8 cm to 84.6 cm and weights ranged from 4.2–9.1 kg (avg. = 5.9 kg). Females

Table 1. Implantation and physical data for striped bass monitored in the McAlpine Pool of the Ohio River from 01 March 1989–24 May 1990.

Fish No.	Length (cm)	Weight (kg)	Age (years)	Sex	Date implanted	Date last located	Duration (days)	*N* sightings	Estimated total distance moved (km)	Cause of termination
20	67.3	4.2	4	F	24 May 89	24 Jan 90	264	34	323.8	Emigration
42	72.6	5.3	5	N	24 May 89	14 Jun 89	21	2	15.6	Undetermined
60	77.2	6.7	6	ND	27 Mar 89	24 May 90	423	90	310.3	Active
82	73.7	5.8	6	M	01 Mar 89	25 Aug 89	177	53	35.7	Creeled
100	70.1	4.8	5	M	21 Apr 89	04 Apr 90	348	73	212.0	Active
180	75.4	5.8	4	F	03 May 89	02 Jun 89	30	2	30.1	Undetermined
200	70.6	5.4	4	F	01 May 89	15 May 89	14	2	37.8	Undetermined
220	76.4	6.0	6	ND	28 Mar 89	11 May 90	409	54	308.3	Active
240	71.1	5.0	4	F	25 May 89	25 May 89	0	0	0	Undetermined
260	77.7	8.4	6	M	03 May 89	10 Oct 89	160	21	62.3	Stress mortality
280	76.7	6.1	6	F	21 Apr 89	19 Jun 89	59	2	76.1	Undetermined
300	77.5	8.6	6	F	01 May 89	15 Aug 89	106	27	106.7	Creeled
320	76.7	6.9	6	F	02 May 89	05 Sep 89	126	26	64.9	Stress mortality
340	66.8	4.0	4	M	01 May 89	06 Sep 89	128	31	128.7	Creeled
360	74.9	5.9	5	F	01 May 89	07 Jun 89	37	4	129.7	Undetermined
400	73.2	5.8	5	F	01 May 89	21 Sep 89	143	29	96.6	Stress mortality
430	69.8	5.2	ND	M	01 May 89	15 Aug 89	106	25	14.5	Creeled
478	71.4	5.9	4	F	05 May 89	16 Jun 89	42	3	62.4	Emigration
500	69.8	5.0	4	F	01 May 89	24 May 90	388	47	168.3	Active
520	69.1	5.3	ND	M	01 May 89	26 Jul 89	86	2	189.7	Emigration
550	74.9	5.9	ND	F	03 May 89	03 May 89	0	0	0	Undetermined
570	84.6	9.1	7	F	24 May 89	31 Sep 89	120	17	35.2	Stress mortality
590	69.6	4.8	5	M	24 Apr 89	24 Apr 89	0	0	0	Undetermined
620	69.6	5.1	4	M	01 May 89	01 Nov 89	184	58	68.7	Emigration
Mean	73.2	5.9	5.0				140	23	103.2	
Total								603	2,477.4	

(N = 13) comprised 59% of the study cohort. Four striped bass (16.7%) were still active at the end of the study. One striped bass died from unknown reasons (4.2%), 4 were creeled (16.7%), 4 emigrated from the McAlpine Pool (16.7%), 4 died from stress-related factors (16.7%), and 7 (29.2%) were not located after release.

Water quality measurements could not be statistically related to any seasonal or daily movement trends. There was no indication of any thermal stratification and dissolved oxygen levels were >6.5 ppm in the water column in both the Ohio and Kentucky rivers. Surface temperatures in the Ohio River ranged from 1.1 C in December to 28.8 C in August, with the Kentucky River not varying more than 3.0 C in difference during the study. The average monthly flow rate for the Ohio River varied from 1,511 cubic meters per second (cms) in December to 8,242 cms in February ($\bar{x}$ = 4,149 cms).

Tagged striped bass used the tailwater and Ghent sections (14.5% of the study area) greater than expected, during the spring, summer, and fall when compared to the total area of the remaining McAlpine Pool sections (6,965 ha) (Fig. 2; X^2 = 5,912.3, P = 0.01, df = 8). No fish were found in the tailwater area during the winter. Study fish made use of the remaining river sections dependent upon season, with greater than expected observations of striped bass being found in the Carrollton (winter and fall) and Clifty Creek (spring, fall, and winter) sections. Less than expected use was made of the remaining lower pool sections by tagged striped bass during all seasons. Depth at location values for tagged striped bass were seasonally disproportionate to the total area of depth contours available in the study pool (Fig. 3; X^2 = 825.1, P = 0.01, df = 7). Utilization of the 0 − 3 m contour was greater than expected during all seasons, with 87.5% of winter locations occurring in this

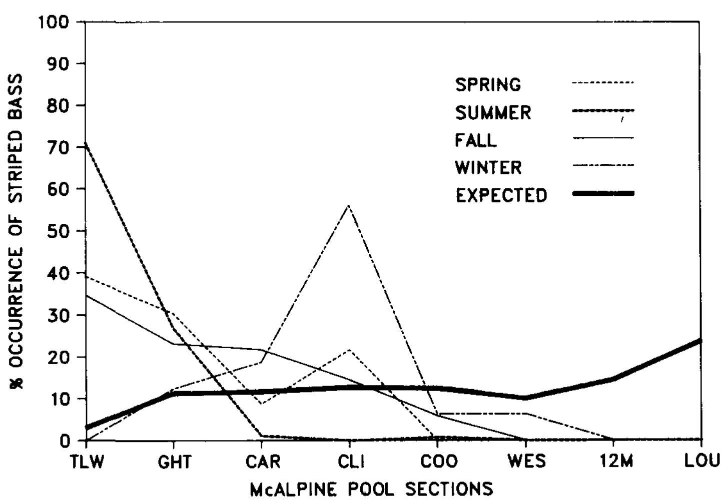

Figure 2. Proportion of observed and expected observations of striped bass across seasons among eight McAlpine Pool sections in the Ohio River from May 1989 to May 1990.

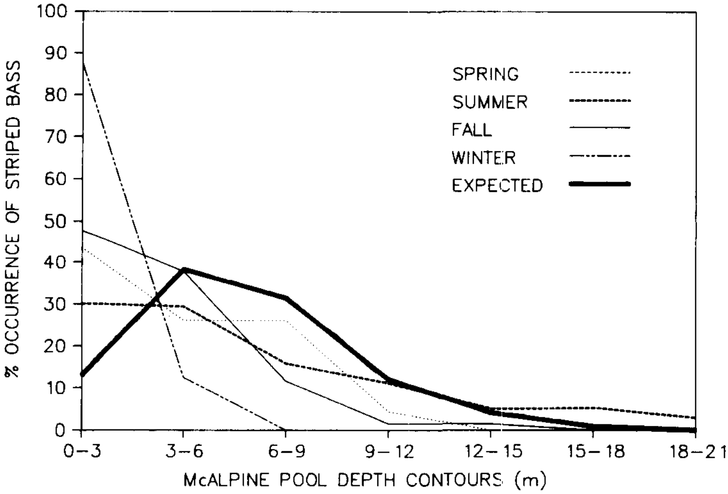

Figure 3. Proportion of observed and expected observations of striped bass across depth contours and seasons in the McAlpine Pool (excludes the tailwater area) of the Ohio River from May 1989 to May 1990.

contour. Striped bass continued to utilize shallower contours during each season as most were located between shore and the 6 m contour (avg = 92.1% across all seasons) and none were observed in the deeper river channel of the pool. Striped bass were present in the tailwater section during spring, summer, and fall (Fig. 4; $X^2 = 65.5$, $P = 0.01$, df = 7). Chi square values for spring depth at location (N = 10) were not significant and striped bass were found between the 3 and 9 m contour during this season. Striped bass utilized the 0 − 6 m contours greater than expected during the summer and fall, with deeper contours being used less frequently.

Five striped bass emigrated from the McAlpine Pool during the study period. Fish 520 was located during an air survey of the Cannelton Pool approximately 189.9 km downstream from its original implanting site on 26 July (86 days after implantation). Striped bass 260 was located in the Markland Pool approximately 36.4 km above the McAlpine Pool during an air survey on 23 August following several sitings in the Markland tailwater in July. A month after sighting this fish (260) in the Markland Pool, it re-entered the McAlpine Pool (20 September) and was located 65.6 km downstream from the Markland Pool site. Striped bass 20, 478, and 620 exhibited out-of-pool movement through the McAlpine Dam during high flow events in June, November, and January.

Spring Movement Patterns

Habitats utilized during the spring consisted of the tailwater (10.2%), pool (34.7%), and Kentucky River (55.1%) (Table 2). Minimum estimates of daily movement averaged 6.4 km/fish (mean total movement = 17.2 km per fish) (Fig. 5), with 63.1% of the total movement during this period within the Kentucky River.

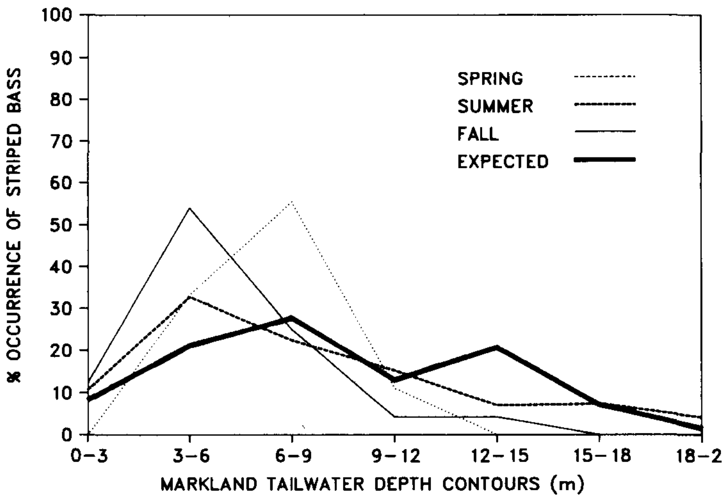

Figure 4. Proportion of observed and expected observations of striped bass across depth contours and seasons in the Markland Tailwater (McAlpine Pool) of the Ohio River from May 1989 to May 1990.

Table 2. Seasonal location and habitat use data for striped bass in the McAlpine Pool of the Ohio River from 01 March 1989 to 24 May 1990.

	Markland Tailwater *N* (Movement, km)	McAlpine Pool *N* (Movement, km)	Kentucky River *N* (Movement, km)	Other Tributaries *N* (Movement, km)
Spring	5(51.5)	17(111.0)	27(277.3)	
% of *N*	10.2	34.7	55.1	
% of movement	11.7	25.2	63.1	
Summer	270(520.4)	122(721.9)	21(29 .4)	10(11.1)
% of *N*	63.8	28.8	5.0	2.4
% of movement	40.6	56.3	2.3	1.0
Fall	34(90.4)	46(446.3)	2(0)	1(0)
% of *N*	41.9	55.4	2.4	1.2
% of movement	16.8	83.2	0.0	0.0
Winter	17(151.6)	8(145.5)	2(0)	
% of *N*	51.9	29.6	7.4	
% of movement	51.0	49.0	0.0	
Total	309(662.3)	202(1,430.8)	58(45 2.2)	13(11.1)

Net movement of striped bass from their initial starting point during this season was directed upstream (net movement 11.1 km upstream per fish) as fish began moving into pre-spawn staging areas in the upper sections of the McAlpine Pool by early April. Several fish utilized the tailwater of Kentucky River Lock and Dam No. 1 as a pre-spawn staging site until high water levels inundated the dam and allowed these fish to enter the next pool and swim to the tailwater of Lock and Dam No. 2 (45.1

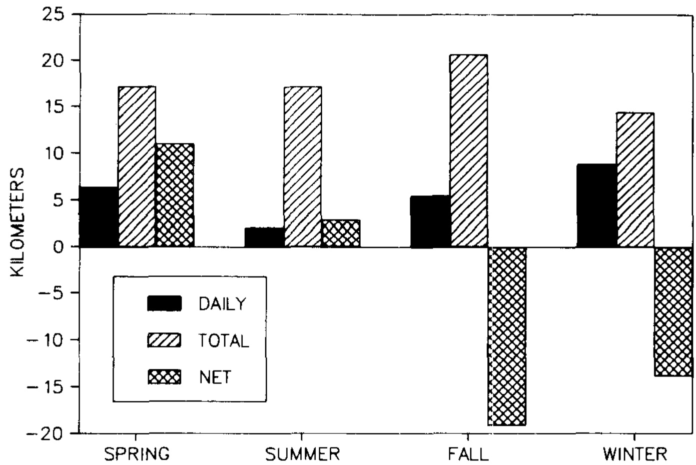

Figure 5. Minimum seasonal estimates of mean daily, net, and total movement rates of striped bass in the McAlpine Pool of the Ohio River from May 1989 to May 1990.

km upstream), a suspected striped bass "spawning" area. A second staging and suspected "spawning" site was situated approximately 2.4 km below Markland Dam at the upper end of McAlpine Pool.

Summer Movement Patterns

Striped bass in the summer were located in the Markland tailwater (63.8%), upper pool area (28.8%), and lower portions of the Kentucky River (5%) (Table 2). Striped bass formerly found in the Kentucky River during the spring migrated downstream and moved upstream in the Ohio River by early summer. Overall movement by striped bass was upstream (Fig. 5). Total movement estimates were the same as during the spring, although the minimum daily movement was lowest of all seasons (2.1 km/fish). Seven striped bass occupied the Dow Corning discharge (ORK 870.7; Fig. 1) until early July. By mid-July most striped bass were concentrated in the Markland tailwaters near the hydroelectric discharge, dam tainter (control) gates, or among the inundated ruins of Dam 39. Exceptions were striped bass 20, 400, 478, and 570 which did not use the Markland tailwater during the summer. Fish 20 moved continuously throughout the upper 50% of the pool, striped bass 570 (the largest fish of the study) utilized the tailwater of Kentucky River Lock and Dam No. 1, and fish 478 emigrated through the McAlpine Dam in late June. Striped bass 400 remained at or near the Dow Corning discharge (discharge temperature 24 C) during the entire summer period. Striped bass located in the pool during the summer exhibited greater total movement (721.9 km; 56.3%) than those remaining in the tailwater (520.4 km; 40.6%) (Table 2). Water temperatures reportedly critical to adult striped bass survival (Coutant 1985) were measured on 11 July and remained

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through 15 August (≥27 C; 36 days) in the Ohio River. The warmest surface temperature recorded in the Ohio River was 28.8 C. Four fish ($\bar{x}$ = 78.0 cm, 7.5 kg) died following this 36-day period of critical temperatures. A Wilcoxon Sign-rank test revealed no significant differences ($P = 0.24$) between the lengths of dead and the remaining live striped bass ($N = 6$); however, there was a significant difference ($P < 0.05$) between their weights at capture and their ability to survive the period of critical temperatures. This indicates that larger (heavier) striped bass were not able to tolerate extended periods of critically high temperatures in the Ohio River.

A total of 4 striped bass were located once an hour during 2 24-hour periods in the Markland tailwater during August. Total movement ranged from 1.3 to 4.3 km ($\bar{x}$ = 2.1 km/fish) and movement per hour varied from 0 to 0.3 km/hour. Striped bass 60, 100, and 620 were associated with the inundated ruins of Dam 39 or Markland Dam discharge during the daytime period (Fig. 6). Depths at location ranged between 1.2 and 7.3 m (Fig. 7). Striped bass utilized the deeper waters near the Markland Dam during the afternoon, with shallow areas being approached at dusk. Fish moved back into the ruins of Dam 39 at night (between 4.0 and 5.0 m deep). Just prior to dawn the striped bass moved back to shallow nearshore areas

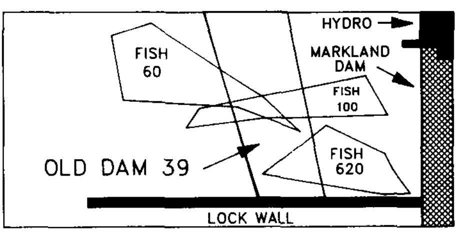

Figure 6. Twenty-four hour activity centers of striped bass 60, 100, and 620 in the Markland Tailwater (McAlpine Pool) of the Ohio River during August 01 and 24, 1989.

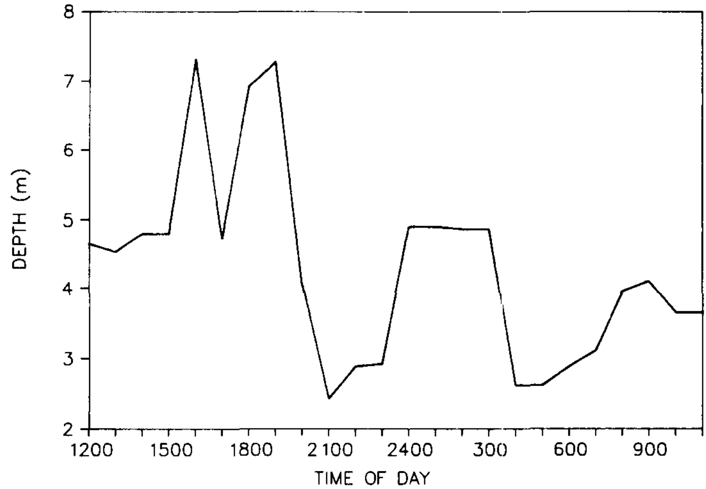

Figure 7. Depth distribution of striped bass 60, 100, and 620 monitored during a 24-hour period in the Markland Tailwater (McAlpine Pool) of the Ohio River on 1 and 24 August 1989.

before returning to Dam 39 just after dawn. Fifty-eight percent of the total daily movement was during the day followed by the crepuscular (23.7%) and night (18.3%) periods. Movement was probably associated with feeding patterns because forage fish were continually observed in these areas. Fish 82, however, was an anomaly to this pattern as it was initially located in the Ohio River 2.9 km downstream of the Markland Dam. In the afternoon it progressively moved along the shoreline upstream into a small tributary adjacent to the entrance of the navigation locks. It remained in the tributary (surface temperature = 24.2 C) all night and left it the following morning to return downstream near the initial departure point. Although the deepest water occupied by this fish was 6.7 m, striped bass 82 typically remained in very shallow water during the survey ($\bar{x}$ = 2.6 m).

Fall Movement Patterns

Striped bass were located in the pool (55.4%), tailwater (41.9%), Kentucky River (2.4%), and other tributaries (1.2%) during the fall period (Table 2). Striped bass gradually moved downstream from the Markland tailwater and became distributed throughout the upper half of the study pool. Average daily movement was estimated to be 5.5 km per fish (Fig. 5). Total movement was greatest during this season and was oriented downstream ($\bar{x}$ = 20.7 km/fish). Fish were commonly associated with nearshore sites (bars and tributary months).

Winter Movement Patterns

Winter observations were limited due to adverse climatological conditions. Striped bass were all located downstream of the tailwater but remained in the upper half of the McAlpine Pool (51.9% Pool, 29.6% Kentucky River, 7.4% other tributaries) (Table 2). Estimates of mean daily movement (8.8 km/fish) were highest of all seasons, although the average total distance traveled by each fish was lowest (14.5 km/fish) (Fig. 5). As in the fall, striped bass continued to exhibit overall downstream movement. While all other fish continued to move during the winter, Fish 60 was the only striped bass to establish a "winter holding area," which was immediately downstream of the Clifty Creek Power Plant discharge in the heated plume and associated tributary (Clifty Creek (Fig. 1). Striped bass were associated with the near shore areas during the winter (average distance to shore = 25.0 m).

Discussion

Tagged striped bass in the Ohio River displayed movement and seasonal patterns similar to both reservoir and river populations, with highest mean daily movement in the winter, followed by spring, fall, and summer, respectively. Reduced summer movement has been observed by Farguhar and Gutreuter (1989), Cheek et al. (1985), and Hampton et al. (1988). Low movement rates of striped bass in the Ohio River during the summer were associated with the concentration of striped bass in the Markland tailwaters. The use of this area was probably related to the presence of old Dam 39 and the abundance of prey associated with this structure, rather than water temperatures which were isothermal throughout the pool. Similar concentrations of striped bass in tailwaters have been observed by Lamprecht and Shelton (1986) and Kynard and Warner (1987). Cooler water temperatures in the fall triggered increased movement in the upper 50% of the study area, which is also characteristic of striped bass (Cheek et al. 1985, Lamprecht and Shelton 1986, Van Den Avyle and Evans 1990). Winter movements were high probably due to a lack of permanent winter sites such as spring-fed areas (Van Den Avyle and Evans 1990), with the exception of the one warm-water discharge site. The second highest rates of movement occurred in the spring as water temperatures approached 14.4 C in response to pre-spawning and spawning movement patterns. Upstream migration occurred in both the Ohio River and the Kentucky River. Pre-spawning striped bass staged in the Ohio River between 13 and 22 km downstream of the Markland Dam and below Lock and Dam 1 on the Kentucky River. As temperatures reached 15.6 C and flows increased, striped bass moved into suspected spawning sites that were located approximately 2.4 km below Markland Dam and 49.9 km upstream in the Kentucky River below Lock and Dam No. 2.

Daily movement of striped bass was only examined during the summer period. Daily movement patterns described by Hampton et al. (1988) in a Kansas reservoir closely paralleled those of striped bass in the McAlpine Pool. They observed most activity in the early morning until mid-day and again in the late afternoon period; the crepuscular and night time periods were the least active. However, Stooksbury (1977) observed most striped bass activity during the 2 crepuscular periods in the summer. Dudley et al. (1977) reported that striped bass were most active at night after spawning.

Striped bass in the tailwater during the summer moved in a "rest and go" pattern as first described by Koo and Wilson (1972) and later observed by Stooksbury (1977), Schaich and Coutant (1980), and Hampton et al. (1988). This pattern of intermittent movement was most prevalent during the summer. Hampton et al. (1988) observed striped bass making overnight forays and returning to the same activity center by morning.

Striped bass have not been observed to exceed 8 years of age in the Ohio River (Henley 1987, 1988), but their longevity in other freshwater systems ranges from 8–12 years (Wooley and Crateau 1983, Ball and Brown 1987, Kinman 1988). The age structure of the striped bass population in the Ohio River could be impacted by high natural mortality, angler mortality, emigration, entanglement in commercial fishing gear, or a combination of any of these factors. Angler exploitation information for the Ohio River is limited, but it is thought to be low (4 tags were returned in this study). The size of fish harvested has been observed to be between 38.1 cm to 96.5 cm (38.1 minimum length limit).

This study provides circumstantial evidence that natural mortality may be a factor in limiting numbers of older striped bass. Four striped bass in this study (16.7%) probably died after being exposed to temperatures ≥27 C for 36 days in July and August. Although Coutant (1985) reported 25 C to be the upper limit of the striped bass's preferred temperature range, Zale et al. (1990) reported that striped bass were able to recover from a 1-month exposure of temperatures ≥27 C if water quality improved; however, fish exposed to these temperatures for 49 days were unable to survive. Those fish succumbing to thermal mortality in the Ohio River were significantly heavier in weight (at capture) ($P < 0.05$) when compared to fish that survived the elevated summer temperatures. Use of the Dow Corning Plant discharge by fish 400 and the small tributary near the navigation locks by fish 82 during the summer was indicative of a stressful environment. Four striped bass from this study emigrated from the McAlpine Pool, although there was no information to indicate they departed the Ohio River. Movement of three fish through McAlpine Locks and Dam was associated with high water periods in early summer, late fall, and winter. Koo and Wilson (1972) documented that striped bass generally moved in the same direction as the flow by either swimming or drifting with the current. Zale and Jacks (1987) documented several striped bass migrating downstream from a tailwater area during high flow periods. Van Den Avyle and Evans (1990) observed striped bass moving through and downstream of a dam and determined that the highest chance of downstream passage of fish was in fall or winter when they were concentrated in the main pool of a reservoir. Wooley and Crateau (1983) reported striped bass moving upstream through a lock and several moving downstream more than 99.8 km into the lower Apalachicola River.

Seven striped bass were not located following release and transmitter failure was considered unlikely. Corresponding to the release, there was entanglement gear being used by commercial fishermen in the vicinity. Ohio River commercial fishermen are restricted to 10.2 cm bar mesh, which could theoretically entangle striped bass 81.3 cm in mean length (Dew 1988). The susceptibility of striped bass to gill netting has been documented (Heitman and Van den Avyle 1978, Matthews et al. 1989, Zale et al. 1990). Although Ohio River commercial fishermen are required to release all sport fish incidentally caught in their gear, delayed mortality of striped bass is probably high. Since striped bass released from gill nets would have been monitored regardless of their fate, the capture of these fish by commercial gear and subsequent removal of transmitters from the study area may explain the fate of these missing fish.

Conclusions

Seasonal distribution, movement, and habitat utilization were determined for striped bass in the McAlpine Pool of the Ohio River. This information was site specific, so different conditions, i.e., tailwater habitat or major tributaries in other pools, may prevent extrapolation of these results to other areas in the Ohio River. This study determined that striped bass in the McAlpine Pool are extremely mobile, although seasonal movement patterns are fairly predictable. Therefore, striped bass anglers could utilize this information to improve their fishing success and the total harvest. However, assuming the tagged fish in this study are representative of the total striped bass population in the McAlpine Pool, there are several negative factors impacting the population density including emigration from the pool, summer thermal stress, and possible susceptibility to commercial entanglement gear.

Recommendations

The striped bass sport fishery program in the Ohio River should be evaluated by describing optimum stocking rates, growth, sport fishery statistics, and forage fish populations in order to determine the cost-effectiveness of this stocking program.

The impacts of commercial gear on striped bass populations should be determined in the Ohio River either through department emulation or by contracting a commercial fisherman.

Available information from the literature and neighboring states should be used to determine if stocking hybrid striped bass is a viable alternative to stocking striped bass in lieu of inherent thermal problems observed in Ohio River striped bass.

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