Linear Ranges of Large Flathead Catfish in Two Mississippi Streams

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Abstract: Radio telemetry and mark-recapture techniques were used to monitor linear ranges of large (TL > 510 mm) flathead catfish (*Pylodictis olivaris*) in the Big Black River and the Tallahatchie River, Mississippi. Linear ranges of transmitter-tagged fish averaged 0.75 km (SE = 0.09 km, $N = 6$) in the Big Black River and 1.04 km (SE = 0.13 km, $N = 8$) in the Tallahatchie River. In the Big Black River, 116 adult flathead catfish were tagged with Floy T-Bar anchor tags. There were 6 recaptures from the Big Black River with all recaptures occurring <2 km from release sites. In the Tallahatchie River, 103 adult flathead catfish were tagged with Floy T-Bar anchor tags. There were 5 recaptures from the Tallahatchie River with all but 1 recapture occurring <1 km from release sites. A stream reach-specific approach is suggested for management of large flathead catfish. For the Big Black River and Tallahatchie River, a resolution of 2 km is recommended for these purposes.

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Anglers in Mississippi consider catfishes (*Ictaluridae*) to be important components of the state's freshwater fisheries, prefer in general to catch large fish at slow rates rather than small fish at fast rates and, given the choice, prefer to fish in lotic rather than lentic environments (Miranda and Frese 1987). Directed management for large catfishes in Mississippi's streams will likely evolve in response to these orientations.

Among the catfishes, the probable candidate for such directed management programs is the flathead catfish (*Pylodictis olivaris*). This species is a principal component of Mississippi's stream fisheries resources (Jackson and Jackson 1989, Pugibet and Jackson 1989, Jackson and Rhine 1993), and it is especially valuable to many anglers because of its potential for attaining large size and because of the flavor and texture of its flesh (Layher and Boles 1979). Mayhew (1969) noted that

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flathead catfish fisheries are commonly considered as big game fisheries, and that anglers will accept the low productivity often associated with hook and line flathead catfish fishing for the opportunity to catch a few, exceptionally large fish.

Lee and Terrel (1987) outlined in detail habitat/life history considerations for evaluating suitability of environments for flathead catfish. As adults, flathead catfish are generally associated with cover (Pflieger 1975), are almost totally piscivorous (Minckley and Deacon 1959, Swingle 1964, Turner and Summerfelt 1970) and are relatively sedentary (Funk 1955, Robinson 1977, Quinn 1988). They are usually solitary fish (Hackney 1965) and often extremely aggressive to individuals of their own species (Swingle 1964). Consequently, a single unit of cover will usually yield only 1, or at most 2 or 3, adults (Pflieger 1975). When displaced from their cover, flathead catfish seem to exhibit strong homing behavior (Duncan and Meyers 1978, Hart and Summerfelt 1973).

Tendencies regarding locational/habitat affinities, as mentioned above, suggest that discrete management units for large flathead catfish in streams can be established. However, defining the size of such units in streams may be dependent on understanding system-specific movements of these fish. Our objective was to determine linear (upstream-downstream) ranges of large flathead catfish in 2 Mississippi streams.

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Methods

This study focused on flathead catfish in the Big Black and Tallahatchie rivers, Mississippi. Both streams are floodplain river ecosystems with soft substrates, turbid water, and instream structure comprised primarily of woody debris. The Big Black River is located in west central Mississippi and discharges water directly into the Mississippi River; the main channel width in study locations was approximately 20–50 m. The Tallahatchie River is located in northwest Mississippi and is the major tributary of the Yazoo River. It is formed from the junction of the Coldwater and Little Tallahatchie rivers and had a channel 80- to 100-m wide in the study locations.

In each river, flathead catfish were collected using hoopnets 3.66-m long, with 1.07-m hoop diameters and 3.81-cm bar mesh netting. Ten flathead catfish were collected from each river for radio telemetry studies. In each river, 5 of the fish had total lengths between 510 and 710 mm and 5 fish had total lengths ≥710 mm. The minimum total length of 510 mm ensured that only adult flathead catfish would be included in the study (Minckley and Deacon 1959). The ≥710 mm category repre-

sented the "memorable" classification suggested by Anderson and Gutreuter (1983).

Radio transmitters (Custom Telemetry and Consulting, Athens, Ga.) were surgically implanted using techniques similar to those outlined by Hart and Summerfelt (1975). Fish were anesthetized with MS-222 and transmitters were inserted through a 2.54-cm incision located immediately anterior to the pelvic girdle. Internal placement of transmitters was chosen in order to reduce the possibility of entanglement common to externally attached transmitters (Hart and Summerfelt 1973). Transmitters had a 240- to 280-day life expectancy and operated in the 48.05–48.15 Mhz frequency band at 10 Khz intervals. Pulse rates were 55–60 cycles/minute. Transmitter weight was <2% of fish body weight, as recommended by Summerfelt and Hart (1972) and Advanced Telemetry Systems (1982).

After surgical implants of transmitters, suturing of the incision, and a short recovery period, fish were released back into their respective stream at their capture location. These radio-tagged fish were observed approximately once a week during night and daylight hours from June 1990 through the first week of January 1991. This time frame addressed late spring/early summer and autumn periods, when flathead catfish movements in Mississippi streams, as indexed by hoop net catches (Garavelli 1985, Jackson and Jackson 1989), appear to be greatest.

Fish locations were pinpointed by triangulation from known landmarks and plotted on topographic maps. Distances were measured along the main axis of the respective stream between the 2 most distantly recorded points for each fish. These distances were used as estimates of maximum linear range during the study.

Radio-telemetry data were supplemented by a mark and recapture study in the same study areas. Six 1-km stream reaches were sampled in each river during the spring and fall of 1989 and 1990 using hoopnets (as described earlier). Ten nets were placed in each stream reach for 48-hour periods. All adult flathead catfish (TL ≥ 510 mm) captured were marked with brightly colored, numbered, Floy T-bar anchor tags, implanted through the left operculum. Recaptures from repetitive sampling, as well as through tag returns by anglers and commercial fishermen, were recorded relative to the time and location of each fish captured.

Recapture information collectively assisted in determining movements of a larger number of fish than would have been possible with radio telemetry alone. However, because the exact location of tagging within a reach was not recorded, recapture data only provided a level of resolution of 1.0 km, the length of each designated stream reach.

A randomized complete block analysis of variance (Steel and Torrie 1980) was used to compare flathead catfish home range size for the 2 size classes of fish in the 2 rivers. Means were separated using Fisher's Least Significant Difference Test.

Results

Radio Telemetry

Six of the 20 flathead catfish with implanted radio transmitters were lost soon after tagging. Radio transmitters in 3 of the 6 lost fish (2 fish in the Big Black

Table 1. Radio-telemetry data from flathead catfish monitored in the Big Black and Tallahatchie rivers, Mississippi.

Fish TL (mm)	Tracking period	*N* Observations	Linear range in the river (km)
	Big Black River		
530	17 May 90–3 Jan 91	25	0.48
558	23 May 90–3 Jan 91	23	0.86
616	17 May 90–3 Jan 91	25	0.70
710	23 May 90–3 Jan 91	23	0.67
895	19 May 90–3 Jan 91	25	1.11
1,003	23 May 90–3 Jan 91	22	0.65
	Tallahatchie River		
511	3 Jun 90–2 Jan 91	27	1.01
515	1 Jun 90–2 Jan 91	26	0.82
544	1 Jun 90–2 Jan 91	26	0.83
550	8 Jun 90–2 Jan 91	25	0.87
571	3 Jun 90–2 Jan 91	28	0.89
716	28 Jun 90–2 Jan 91	24	1.03
950	6 Jun 90–2 Jan 91	28	1.85
1,112	3 Jun 90–2 Jan 91	28	1.04

River and 1 fish in the Tallahatchie River) apparently malfunctioned. Erratic signal pulses were detected prior to loss, and there were periods when no signals could be heard. The other 3 fish possibly carried faulty transmitters, suffered post surgical or fishing mortality, or moved out of the study area. These fish could not be located by extensive searches (ca. 30 km) upstream or downstream from the study areas. Subsequently, these 6 fish were dropped from analyses. For the remaining 14 fish, 355 observations were made.

Linear ranges observed for the 6 radio-tagged flathead catfish in the Big Black River ranged from 0.48 to 1.11 km with a mean of 0.75 km (SE = 0.09 km) (Table 1). No significant difference in linear range was found between size groups of fish in the Big Black River ($P > 0.05$). One fish in the Big Black River moved downstream 3.5 km within 1 week after release, then established a range in which it remained for the duration of the study.

The 8 radio-tagged flathead catfish in the Tallahatchie River exhibited linear ranges from 0.82 to 1.85 km with a mean of 1.04 km (SE = 0.13 km). Larger fish had significantly larger ranges (mean = 1.31 km, SE = 0.33 km, $P \leq 0.05$) than did smaller fish (mean = 0.88 km, SE = 0.03). One fish (1,112 mm TL) in the Tallahatchie River exhibited a downstream movement of 2.5 km before establishing a range for the remainder of the study. This downstream movement occurred within 2 days of transmitter implantation.

Mark and Recapture

From June 1989 through August 1990, 6 of the 116 adult flathead catfish tagged and released in the Big Black River and 5 of the 103 adult flathead catfish

Table 2. Time interval and direction of movement for flathead catfish recaptured in hoopnets by the authors or recaptured by anglers in the Big Black and Tallahatchie rivers, Mississippi (May 1989–June 1991).

Tag	Marked	Recaptured	Movement form release site (km)		
			Upstream	Downstream	Same reach
		Big Black River			
221[a]	12 Jul 89	11 Aug 89			<1
096[a]	26 Jul 89	18 Aug 89	<2		
170[a]	28 Jul 89	16 Aug 89			<1
386[a]	11 Aug 89	25 Oct 89		<2	
688[a]	18 May 90	15 May 91	<2		
678[b]	18 May 90	25 May 91		<2	
		Tallahatchie River			
266[a]	2 Aug 89	8 Sep 89			<1
196[a]	4 Aug 89	3 Jun 90			<1
351[b]	4 Aug 89	12 Sep 89			<1
497[a]	10 Sep 89	6 Jun 90			<1
821[a]	30 Aug 90	6 Jun 91	<3		

[a] Recaptured in hoopnets.
[b] Tag returned by angler.

tagged and released in the Tallahatchie River were recaptured. In the Big Black River, all 6 of the fish were recaptured <2.0 km from their respective release site and 2 of these were recaptured <1.0 km from their respective release site (Table 2). The mean length of time fish recaptured were at large in the Big Black River was 184 days (range 19–368 days). In the Tallahatchie River, 4 of the 5 recaptured flathead catfish were captured <1.0 km from their respective release site. The other fish was recaptured <3.0 km downstream from its release site. The mean length of time at large for recaptured fish in the Tallahatchie River was 186 days (range 36–307 days). There was no noticeable trend regarding upstream or downstream movement of recaptured flathead catfish in either river.

Discussion

Coon and Dames (1989) recommended that management for flathead catfish in streams be on a more localized level of resolution than would be appropriate for channel catfish (*Ictalurus punctatus*), which is apparently a more widely ranging species. The relatively small linear range of large adult flathead catfish in the Big Black and Tallahatchie rivers suggests the potential for a stream reach-specific approach to management for these fish. In these 2 rivers, we believe that 2-km increments can be utilized for addressing fisheries for large flathead catfish. Of the 25 large flathead catfish for which movement data were collected during our study, only 1 fish had a range which may have been >2 km. Multiples of the 2-km increment would be dependent upon desired stock size and structure for the management program (influenced by stream reach-specific features).

To address reach-specific features influencing flathead catfish stocks, Insaurralde (1992) developed models describing flathead catfish relative abundance and population structure in Mississippi streams. Hoopnet catch per unit of effort (kg/net-night) was positively related ($r^2 = 0.77$) to the proportion of riparian vegetation classified as "old growth successional stage". Proportional stock density (PSD, Gablelhouse 1984) was positively related ($r^2 = 0.61$) to the number of snags (large woody debris) in the streams. Insaurralde (1992) found that these single variable models could not be improved by adding data addressing abundance and composition of associated fish assemblages in the streams, macroinvertebrate drift (as proxy for secondary production), human demographic characteristics/fish stock exploitation potentials, or watershed features (from Landsat multispectral scanner and National Aircraft Program color infrared images).

A stream reach-specific management orientation for flathead catfish does not preclude consideration of rivers as integrated, dynamic ecosystems, whose biological production potentialities are influenced by energetic transfers among lateral, upstream, and downstream components (cf., Welcomme 1979, Vannote et al. 1980, Junk et al. 1989). What it does suggest, however, is that within such integrated systems, managers addressing fisheries for flathead catfish can designate different management objectives to different locations along the stream continuum.

River size and instream habitat features may influence system-specific levels of resolution in this regard. For example, mean linear ranges of 0.8 and 1.0 km for large adult flathead catfish in the Big Black and Tallahatchie rivers, respectively, were smaller than ranges reported for flathead catfish by Grace (1985) for the Missouri River (mean = 10.5 km; $N = 14$ fish). However, Robinson (1977) reported that all but 1 flathead catfish in his Missouri River study ($N = 24$ fish) ranged from 0.3 to 4.0 km. In a comparison between channelized and unchannelized sections of the Missouri River, Morris et al. (1971) reported that in unchannelized sections, 92% of their radio-tagged flathead catfish ($N = 40$ fish) moved <1.6 km from their release sites while in the larger, channelized section, only 51% exhibited movements <1.6 km.

We noticed similar trends in our study. Flathead catfish in the Tallahatchie River tended to have larger ranges than did fish in the Big Black River. The Tallahatchie River is the largest of the 2 systems and has been impacted by channelization. The larger ranges of flathead catfish in the Tallahatchie River may be related to the need to travel greater distances for foraging activities in channelization-impacted streams (Skains 1992).

Regardless of the system-specific level of resolution determined appropriate for a river, the strategy of designating stream reaches to different fisheries management objectives has appeal in public resources arenas where multiple use orientations are appropriate. We can envision management programs wherein streams are partitioned spatially, with sections exclusively designated for general angling, trophy angling, and commercial fisheries for flathead catfish. Allocation of such management orientations for flathead catfish along the stream continuum can evolve in concert with changes in stream characteristics, fish stock dynamics, and social expectations.

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