Channel Catfish Movements in Relation to River Channel-Floodplain Connections

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Abstract: We conducted a study of channel catfish *(Ictalurus punctatus)* movements in the Yockanookany River, Mississippi, a river subjected to a long-reach decoupling of the river channel from its respective floodplain. We collected 40 channel catfish and surgically implanted radio-transmitters. Fish were tracked during 2 periods—March–June 1994 and November 1994–June 1995. Most fish moved ≤5 km. During elevated flows, radio-tagged fish in the river moved to or remained in the river section coupled with the floodplain. Four fish moved from the river channel into an oxbow lake when it was coupled with the river by high water. While we recognize the importance of addressing floodplain river ecosystems at a landscape and system level of resolution, and absolutely support management at this scale, our study indicates that 5-km channel sections should be considered the minimum management unit for channel catfish in small Mississippi rivers.

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Channel catfish are principal fishery resources for anglers exploiting river ecosystems in Mississippi (Miranda and Frese 1989, Jackson and Dillard 1991, Brown et al. 1996, Cloutman 1997). It is a species considered an opportunistic fluvial generalist (Cloutman 1997), and one capable of successfully utilizing highly modified riverine habitats to establish and maintain exploitable stocks (Jackson 1995, Ye 1996).

Under elevated flow regimes resulting in overbank flooding, channel catfish are known to forage on a wide variety of items, including those of terrestrial origin (Robinette and Knight 1981, Flotemersch 1996). Because of the close association

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between terrestrial and aquatic components of floodplain river ecosystems (Junk et al. 1989) and their associated fisheries (Welcomme 1985, Ye 1996, Cloutman 1997), the extent of connectedness between river channels and their associated floodplains is a matter of concern (Bayley 1995). This is especially so in light of anthropogenic modifications to these systems that decouple river channels from their floodplains (Jackson and Jackson 1989, Bayley 1991, Jackson et al. 1993).

Several studies have addressed movements of channel catfish in riverine ecosystems (Funk 1955, McCammon 1956, Muncy 1957, Lambou 1959, McCammon and LaFaunce 1961, Hubley 1963, Humphries 1965, Coon and Dames 1989, Dames et al. 1989). To date, however, channel catfish movements along stream reaches to gain access to floodplains have not been specifically addressed.

We therefore conducted a study of channel catfish movements in a river subjected to long-reach decoupling of the river channel from its respective floodplain. Our null hypothesis was that sections of the river coupled with the floodplain and sections of the river decoupled from the floodplain provide similar resources to channel catfish, and subsequently that channel catfish movement along the continuum of the river channel is random. Our alternative hypothesis was that river sections coupled with the floodplain differ from those decoupled from the floodplain with respect to their attractiveness to channel catfish, and subsequently that channel catfish move to sections of the river channel that retain connections with their respective floodplains, conceivably to access floodplain resources. Acceptance of the alternative hypothesis would underscore the value of floodplain river connections, even for an opportunistic, fluvial generalist species such as channel catfish.

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Methods

We conducted our study during a 3-year period (1993–1995) on the Yockanookany River, a small floodplain river ecosystem in central Mississippi. The Yockanookany River is approximately 100 km long with a 124,010-ha watershed and a 34,705-ha floodplain (Soil Conserv. Serv. 1983). It Is a major tributary of the Pearl River which flows southwesterly and discharges directly into the Gulf of Mexico.

Our study focused on a 35-km segment of the Yockanookany River. We divided the river into 2 primary sections—a lower section that is coupled with the floodplain during elevated flow regimes, and an upper section that is decoupled from the floodplain by levees constructed for flood control. Although elevated flows can occur throughout the year, most occur during winter.

We collected 40 channel catfish with hoopnets and surgically implanted radio transmitters using procedures modified from Hart and Summerfelt (1974). Twelve of

the channel catfish receiving radio transmitters were from the decoupled section of the river, 20 were from the coupled section of the river, and 8 were from an oxbow lake that couples with the river during elevated flow regimes. All fish were released back into their respective capture locations.

Transmitters had 200- to 240-day life expectancies and operated in the 31- to 32-MHz frequency with 40 beats/minute. They had a dry weight of 14 g and a wet weight of 8 g. Reduced wet weight was as a result of the partial buoyancy of the transmitter encasement. Fish receiving radio transmitters had total lengths ≥ 400 mm. This corresponded to the recommended minimum size for these transmitters (Custom Telemetry, Watkinsville, Ga.).

We used boat-mounted whip antennas first to determine the general location of fish and then a hand-held loop antenna to triangulate more precise locations. We categorized fish activities as 1) local movements <1 km, 2) movements 1–5 km, 3), movements 6–10 km, 4) movements >10 m, 5) location on the floodplain, or 6) movement among habitat types (e.g., coupled river channel, decoupled river channel, floodplain, oxbow lake).

Radio tracking was conducted during 2 periods—March–June 1994 and November 1994–June 1995. Radio tracking was conducted weekly and also opportunistically when elevated streamflow events occurred.

Results

Most channel catfish tracked during our study had movements ≤ 5 km (Table 1). During low flow periods, radio-tagged channel catfish were confined to the channel of the Yockanookany River and tended to move <1 km. During elevated flows, radio-tagged channel catfish in the river moved to or remained in the river section coupled with the floodplain. Seven radio-tagged channel catfish were observed on the floodplain at least once. Five fish radio-tagged in the section the river decoupled from the floodplain moved into the section coupled with the floodplain. No fish were observed moving from the coupled section to the decoupled section. Four fish moved from the river channel into the oxbow lake when it was coupled with the river by high water. One radio-tagged fish moved approximately 40 km downstream and out of the study area.

Table 1. Movements of channel catfish implanted with radio-tags in sections of the Yockanookany River, Mississippi, coupled with and decoupled from their respective floodplains, 1994–1995.

	N fish									
	Maximum range of movement					Movement pattern				
Section and *N* fish tagged	Lost	<1 km	1–5 km	6–10 km	>10 km	On floodplain	To coupled	To decoupled	River to oxbow	Oxbow to river
Coupled section 20	7	6	4	2	1	5		0	4	0
Decoupled section 12	2	6	4	0	0	1	5		0	0
Oxbow lake 8	2	2	2	0	2	1	5	0	0	5

Discussion

Hydrologic fluctuations occurring in floodplain river ecosystems generate intermediate disturbance of habitats, serve as environmental reset mechanisms, and preclude equilibrium. Through these dynamics, floodplain river ecosystems are maintained at a less mature (non-equilibrium) state (Connell 1978) that increases energy flow per unit biomass (Margalef 1963). Euryceous, fluvial-generalist species like channel catfish tend to do well under such conditions (Ye 1996, Cloutman 1997). Activities or structures that limit or preclude inundation of floodplains, such as construction of flood control levees along river channels, can disrupt the disturbance regimes, thereby rendering the ecosystem more complex and subsequently less capable of supporting the less specialized species.

Due to the popularity of channel catfish as sport fishes in Mississippi, we were particularly interested in discerning the extent to which this species could overcome the challenges of disconnected floodplains in a small floodplain river ecosystem. Such a study is particularly relevant to proactive management of floodplain river fisheries in Mississippi because the biopolitical climate of this state continues to advance flood control programs incorporating dissociation of river channels from their floodplains, and avoiding non-structural alternatives.

We found that channel catfish will move along the continuum of a river channel to gain access to inundated floodplain habitats, including backwater oxbow lakes. When considering that channel catfish primarily utilize olfaction to orient themselves toward and interact with forage material, it was surprising to find that, under elevated flow regimes, channel catfish actually swam downstream from channels disconnected from floodplains in order to gain this access. Contrastingly, we were unable to document channel catfish swimming upstream from the floodplain-connected river section to the river section decoupled from its floodplain by levees. This suggests that on a relative scale, a given lowland river section's lateral connection with its respective floodplain (sensu Junk et al. 1989) is more influential regarding channel catfish stock dynamics than are upstream energetic contributions to the section via allochthonous material imports (sensu Vannote et al. 1980). Our study indicates that river sections along the continuum of the Yockanookany River vary with respect to their attractiveness to channel catfish and that channel catfish will move along the continuum to locate foraging opportunities on or emanating from the floodplain and associated backwaters.

Most channel catfish movements we documented were ≤5 km. We believe that this was not because the fish could move no further. In fact, some fish we tracked moved considerable distances (10–50 km). Rather, we contend that movements we documented reflect channel catfish locating the object(s) of their searches (e.g., foraging opportunities) within this 5-km distance.

The Yockanookany River floodplain alongside the downstream, floodplain-coupled section of the system is expansive and predominantly comprised of bottomland hardwood forest, sloughs, oxbows, and swamps. It affords floodplain-oriented fishes

with good foraging opportunities, directly or indirectly, and particularly so with respect to crayfish, the principal forage item for channel catfish in this system (Flotemersch 1996). Similar forage resource-rich floodplains exist in the decoupled section of the river but fishes cannot gain access to them due to the levees alongside the river channel (Flotemersch 1996).

Biopolitical realities in the southeastern United States, coupled by concepts of property rights, render it apparent to us that fisheries management programs for lowland rivers need to be section- or reach-specific if possible. Skains and Jackson (1993) recognized this situation and, following radio-telemetry studies for flathead catfish *(Pylodictis olivaris)*, proposed a level of resolution for managing riverine flathead catfish stocks of 2 km. In these rivers, flathead catfish abundance and stock structure was, respectively, directly related to the proportion of riparian vegetation comprised of mature forest and the number of snags (large woody debris) in the channel that could be spotted via low-altitude aerial photography (Insaurralde 1992). Management to protect streamside zones was proposed. Similar management orientations may be appropriate for channel catfish. However, channel catfish tend to be more far ranging than are flathead catfish, thereby necessitating a larger scale of resolution. In that regard, our study indicates that 5-km channel sections should be considered the minimum management unit for channel catfish in small Mississippi rivers such as the Yockanookany River.

We recognize the importance of addressing floodplain river ecosystems at a landscape and system level of resolution (Jackson et al. 1993, Ye 1996), and absolutely support management at this scale if at all possible. However, smaller units as proposed above can provide river fisheries managers with opportunities tailored to address more localized channel catfish resource issues. If incorporated as a management strategy, as the number of units increases, synergy among units can assist in restoring the floodplain river ecosystem.

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