THE EFFECTS OF CHANNELIZATION ON FURBEARERS AND FURBEARER HABITAT

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Abstract: Biological data were collected over a 3 year period (1974-1977) from an old channelized segment (55 years), an unchannelized segment and a newly channelized segment (4 years) of the Luxapalila River in Mississippi and Alabama. This study revealed that furbearer habitat in the channelized segments has not recovered to the level exhibited in the unchannelized segment. Indices of furbearer abundance were obtained by night lighting and sign counting. Beaver (*Castor canadensis*), mink (*Mustela vison*), muskrat (*Ondatra zibethicus*), and raccoon (*Procyon lotor*) were more numerous in the unchannelized segment than in either the old or newly channelized segments.

Proc. Annual Conf. S.E. Assoc. Fish & Wildlife Agencies 31:259-265

There has been a substantial amount of research information published concerning the effect of river and stream channelization on macroinvertebrates and fish. However, the effect of channelization on mammals associated with the aquatic environment has virtually been ignored. The purpose of this paper is to document and compare the habitat and population indices of furbearers associated with channelized and unchannelized segments of the Luxapalila River in Mississippi and Alabama.

The Luxapalila River provides an unique opportunity to study a segment of one of the oldest channelized rivers in the southeastern United States, a new channelized segment, and an unchannelized segment. This river which originates in Alabama was channelized 55 years ago for a distance of approximately 67.2 km to the Mississippi-Alabama border. The unchannelized segment of the river in Mississippi is in a second growth forest state for a distance of 38.4 km. The newly channelized segment extends from the river's entrance into the Tombigbee River for a distance of 3.3 km. Pole sized hardwood trees cover both sides of the spoil banks on the old channelized segment. On this segment, the channel is still straight with no meandering.

The authors would like to express their appreciation to C. E. Mason and J. C. Huntley for their assistance in the field. This research is a result of a study funded by the Office of Biological Services, Fish and Wildlife Service, U.S. Department of the Interor, Washington, D.C. 20240, Contract No. 14-16-008-739.

METHODS

To determine if similarities or differences existed in furbearer habitat among the channelized and unchannelized segments, soil samples were collected, degree and percentage of slope was calculated, and riparian vegetation was sampled. Beaver and muskrat burrows were searched for and enumerated along each segment of the river. Indices of furbearer abundance were developed by making direct counts of furbearers by floating the river at night using a spotlight and by determining furbearer signs such as tracks and scats at established sign count stations. Soil samples were taken at 3 sites on each of the 3 segments of the river and analyzed for pH, available phosphate, available potash, and percentge of organic matter by the Soil Testing Laboratory of Mississippi State University.

Degree and percentage of slope was determined by triangulation. A pole 1.8 m in length was held vertically at the water's edge; the horizontal distance to the bank was then measured from the top of the pole. These distances were used to determine the slope by trigonometric functions.

Beaver and muskrat burrows were searched for on strips which were approximately 45.7 m long (62 paces). Twenty strips were randomly selected in each of the 3 areas. Numbers were drawn which indicated the floating time in minutes between strips. At the end of each floating period, the boat was beached and 2 strips paced off; one on the opposite side of the bank and one on the bank of the boat landing. The shallow water area adjacent to the banks was probed with sticks to locate underwater muskrat entrances. Logs adjacent to the banks were searched for muskrat feces.

Riparian vegetation was sampled by the systematic establishment of rectangular plots. Plot sites were determined by floating in a flat bottom metal boat for a period of 5 minutes. At the end of a 5 minute time period, the boat was pulled into the bank. Sides of the river bank were alternated to sample herbaceous and shrub vegetation in 7.5 m x 1.2 m plots located at right angles to the stream flow. These plots were further subdivided into 3 subplots measuring 2.5 m x 1.2 m. Seventeen plots with 51 subplots were established in the old channelized segment and 14 plots with 42 subplots were established in the unchannelized segment.

Plants which were tree size (3.6 m or more in height) and possessed a single trunk unbranched at or near the ground level were considered to be woody vegetation. Woody vegetation was sampled by establishing a plot 7.5 m x 7.5 m adjacent to the downstream side of the herbaceous and shrub plot. Seventeen of these plots were established on the old channelized segment and 14 on the unchannelized segment.

Densities of herbaceous, shrub and woody plants were determined by actual count of total stems divided by the total number of plots or subplots. An importance factor was determined by multiplying frequency of occurrence (F) times density (D) and dividing by 100.

In the furbearer investigations, 3 techniques were tried to develop indices of abundance for beaver, mink, muskrat, otter (*Lutra canadensis*) and raccoon. The first method involved trapping with Tomahawk live traps, leg hold traps, and Conibear traps; however, trapping was found to be ineffective and uneconomical. The second method involved 2 men floating the river in a metal boat, or when the water was low in an inflatable rubber canoe, and using 2 spotlights operated by a 12 volt battery. Floating was planned for twice a month but inclement weather caused some curtailment. A total of 25 float trips were made. Several investigators have reported success in capturing ducks and muskrats with spotlights and nets (Cummings and Hewitt 1964; Bishop and Barratt 1969). The third method used involved sign counting (tracks and feces) in established scent stations and track stations on 0.8 km segments initially selected in the spring of 1974 for trapping. Three segments on both the old channelized portion and the unchannelized portion and 1 segment on the newly channelized portion were selected. Three scent stations were systematically located in each 0.8 km segment for a total of 9 scent stations in the old channelized segment, 9 in the unchannelized segment and 3 in the newly channelized segment. A sardine was placed on top of a large hardwood leaf which had been soaked in the essence of the sardine to attract mink and raccoon. The scent stations (0.9 m dia.) were similar in size to those used by Linhart and Knowlton (1975) in determining coyote abundance and by Lindzey et al. (1977) as an index to black bear abundance.

Track stations were 0.9 m dia. with the same number for each segment. Two of the stations were later deleted from the old channelized data due to possible biases resulting from these 2 track stations being located adjacent to beaver scent mounds and in natural drains. The remaining track stations were located on game trails adjacent to the river on the basis of accessibility by observer and suitability of the area for observing tracks. Both scent and track stations were checked daily during the winter months and approximately twice per week during spring and summer months; sand was sifted over the stations after tracks were counted. An index of relative abundance was calculated as described by Linhart and Knowlton (1975) as follows:

$$\frac{\text{Total animal visits}}{\text{Total operational stations-nights}} \times 1{,}000 = \text{index}$$

RESULTS AND DISCUSSION

Edaphic Aspects and Riparian Slope

Soil test results revealed very acid soil conditions with a pH range from 4.2 to 4.7 in the old channelized segment, 4.3 to 4.6 in the unchannelized segment, and 4.7 to 5.5 in the newly channelized segment. Available potash and phosphate were very low in both the old channelized and unchannelized segments and low to medium in the newly channelized segment. Organic material was very low in both of the channelized segments, with a range from 0 to 0.56 percent, while in the unchannelized segment organic matter ranged from 0.25 to 1.91 percent. These analyses did not indicate differences which could have affected plant succession. A great deal of sand and gravel resulting from excavation and upstream erosion has been deposited on the banks and in the bed of both channelized segments.

Bank slope and soil texture determine whether or not beaver and muskrat are able to construct permanent bank dens and burrows. Research by Earhart (1969) in California revealed that muskrats required a slope of at least 10 degrees to be able to contruct a burrow of any type. The slope of the riparian area of the unchannelized segment ranged from 0° to 72° with a mean of 28.7 while the slope of the banks of the old channelized segment ranged from 22° to 56° with a mean of 38.24°. These ranges would not preclude muskrat and beaver bank burrowing activities in the unchannelized segment or the old channelized segment. Earhart (1969) also reported that the percentage of sand present in the soil was very important in muskrat burrowing; a sand content of 58 to 70 percent resulted in the construction of only temporary burrows. Beshears and Haugen (1953) reported that most functional muskrat burrows were concentrated in soils of loam with clayey texture, while soils of a sandy texture contained mostly old abandoned burrows. Cook (1945) noted that stream muskrats in Mississippi have underwater entrances to dens. Beshears and Haugen (1953) reported typical muskrat burrows began about 15.2 cm beneath the water surface, went in a short distance, and turned upward. The deposition and accumulation of sand and gravel has apparently discouraged burrowing activities of beaver and muskrat in the old and newly channelized segments.

Thirteen beaver dens and 5 muskrat burrows were found on the randomly selected strips in the unchannelized segment. The old channelized and newly channelized segments had only 1 muskrat burrow each. The 1 muskrat burrow found on the newly channelized segment was located approximately 15.2 m from the junction of the Luxapalila River with the Tombigbee River where dredged material has not been deposited. Chi-square analysis indicated a significant difference ($P < 0.05$) between the number of beaver burrows on the unchannelized segment and the channelized segments.

Aquatic and Riparian Vegetation

No rooted aquatic vegetation was found along the entire length of the old or newly channelized segments. In the unchannelized segment Justicia (*Justicia americana*) was the only plant found growing in shallow water and on sand bars. This plant was fairly common with 52 beds of Justicia located on a 9.6 km unchannelized segment. There was evidence of Justicia being used as food by both beaver and muskrat during the spring and summer months.

On the newly channelized segment, weeping love grass (*Eragrostis curvula*) established on the newly constructed levees was the most dominant vegetation. Erosion is common and replanting frequent.

Analysis of data for the riparian herbaceous and shrub strata of the old channelized and unchannelized segments indicated the following: (1) Species composition of the herbaceous strata was similar in both segments with panic grass (*Panicum* spp.), poison ivy (*Rhus radicans*), Japanese honeysuckle (*Lonicera japonica*), and violets (*Viola* spp.) being the most commonly encountered species (Table 1). (2) Shrub species composition

Table 1. A comparison of frequency, density, and importance of common riparian herbaceous plants found along 2 segments of the Luxapalila River. Each plot was 1.2 x 7.5 m.

	Unchannelized				*Old Channelized*		
	Frequency[a]	*Density*[b]	*Importance*[c]		*Frequency*[a]	*Density*[b]	*Importance*[c]
Total Plot				Total Plot			
Panicum spp	100	58.4	58.4	*Panicum* spp.	100	60.8	60.8
Rhus radicans	93	56.1	52.2	*Lonicera japonica*	88	57.6	50.7
Poa autumnalis	79	50.4	39.8	*Viola* spp.	88	41.3	36.3
Mitchella repens	50	57.1	28.6	*Rhus radicans*	76	21.3	16.2
Viola spp.	93	28.7	26.7	Unknown herbs	82	14.1	11.6
Lonicera japonica	71	33.4	23.7	*Hedyotis purpurea*	82	12.8	10.5
Smilax spp	100	19.6	19.6	*Poa autumnalis*	41	20.9	8.6
Cyperaceae	71	24.0	17.0	Cyperaceae	76	11.1	8.4
Aster discoidea	71	12.9	9.2	*Aster discoidea*	65	7.6	4.9

[a] $\text{Frequency} = \frac{\text{Occupied Plots}}{\text{Total Plots}} \times 100$

[b] $\text{Density} = \frac{\text{Total Stems}}{\text{Total Plots}}$

[c] $\text{Importance} = \frac{\text{Frequency x Density}}{100}$

differed in that the species encountered most frequently in the old channelized segment were privet (*Ligustrum sinense*), Virginia willow (*Itea virginica*) and elderberry (*Sambucus canadensis*), while in the unchannelized segment switch cane (*Arundinaria gigantea*), blueberry (*Vaccinium* spp.), and sebastian bush (*Sebastiania fruticosa*) were the most commonly encountered species (Table 2). (3) The major riparian tree species in the

Table 2. A comparison of the abundance of shrubs common to the riparian vegetation found along 2 segments of the Luxapalila River. Each plot was 1.2 m x 7.5 m.

	No. Stems	
	Unchannelized	*Old Channelized*
Total Plot		
Arundinaria gigantea	148	0
Euonymus americanus	3	0
Forestiera acuminata	6	0
Ilex decidua	13	0
Illecium floridanum	0	2
Itea virginica	0	10
Ligustrum sinense	2	81
Sambucus canadensis	0	8
Sebastiania fruticosa	99	0
Vaccinium spp.	112	7

old channelized segment were sweet gum (*Liquidambar styraciflua*), river birch (*Betula nigra*), and red maple (*Acer rubrum*) (Table 3), while in the unchannelized segment water oak (*Quercus nigra*), American hornbeam (*Carpinus caroliniana*), and deciduous holly

Table 3. Average dbh, stem count, frequency, density, and importance of a most important riparian woody species found in 17 plots located along the old channelized segment of the Luxapalila River. Each plot was 7.5 m x 7.5 m.

Species or Genera	*Ave. Dbh of Stems Over 2"*	*Stems <2"*	*Stems >2"*	*Total Stems*	*Frequency*[a]	*Density*[b]	*Importance*[c]
Liquidambar styraciflua	7.2	24	44	68	76	4.00	3.000
Betula nigra	7.2	13	35	48	76	2.80	2.100
Acer rubrum	5.7	10	22	32	82	1.90	1.600
Quercus nigra	10.0	23	11	34	65	2.00	1.300
Carpinus caroliniana	4.8	30	4	34	47	2.00	0.900
Nyssa sylvatica	4.8	12	4	16	47	0.90	0.400
Alnus serrulata	3.5	36	2	38	29	2.20	0.600
Carya spp.	—	20	—	20	41	1.20	0.500
Ilex opaca	—	14	—	14	24	0.80	0.200

[a]Frequency $= \frac{\text{Occupied Plots}}{\text{Total Plots}}$

[b]Density $= \frac{\text{Total Stems}}{\text{Total Plots}}$

[c]Importance $= \frac{\text{Frequency x Density}}{100}$

(*Ilex decidua*) were the major riparian tree species (Table 4). (4) The abundance and density of riparian herbaceous plant species were significantly greater on the unchannelized segment as compared to the old channelized segment. Analysis of variance indicated a very highly significant difference in the number of herbaceous stems ($P < 0.005$). Analysis of variance showed that herbaceous plant species diversity was significantly different ($P < 0.01$), with a mean of 10.59 species per plot found in the old unchannelized segment as compared to a mean of 13.0 species found in the unchannelized segment. (5) Ocular estimates of crown closure revealed little difference between the unchannlized and old chanelized segments with means of 48 and 57 percent, respectively.

Table 4. Average dbh, stem count, frequency, density, and importance of 14 most important woody species found in 14 plots located along the unchannelized segment of the Luxapalila River. Each plot was 7.5 m x 7.5 m.

Species or Genera	Ave. Dbh of Stems Over 2"	Stems <2"	Stems >2"	Total Stems	Frequency[a]	Density[b]	Importance[c]
Quercus nigra	8.1	18	16	34	59	2.40	1.400
Carpinus caroliniana	5.4	15	20	35	41	2.50	1.000
Ilex decidua	5.0	34	1	35	35	2.50	0.800
Ulmus spp.	8.7	20	6	26	35	1.80	0.600
Carya spp.	3.5	21	2	23	29	1.60	0.500
Taxodium distichum	12.1	2	8	10	53	0.70	0.400
Forestiera acuminata	2.5	17	2	19	24	1.40	0.300
Vaccinium spp.	4.0	20	2	22	18	1.60	0.300
Betula nigra	6.9	—	11	11	24	0.80	0.200
Acer rubrum	5.9	2	8	10	24	0.70	0.200
Planera aquatica	4.9	6	7	13	18	0.90	0.200
Juniperus virginiana	11.2	2	4	6	29	0.40	1.100
Liquidambar styraciflua	8.0	2	5	7	29	0.40	0.100
Nyssa sylvatica	5.9	—	8	8	24	0.60	0.100

Items commonly utilized by beaver for food were found in both the old channelized segment and the unchannelized segment. Herbaecous food items commonly used by muskrat such as panic grass (Cook 1945) and cyperus were common in the riparian areas of both the old channelized and unchannelized segments (Table 1). Muskrat droppings were observed in 15 different sites in the unchannelized area and none in the channelized areas. It appears that while beaver move considerable distances away from their dens to feed in the riparian areas and the old channelized segment, muskrat activity is relegated to areas closely associated with their burrows.

Furbearer Indices

Trapping with both live and Conibear traps proved to be time consuming and expensive and relatively inefficient in taking muskrat, beaver and raccoon. Night floating with a spotlight proved to be the most effective and economical method for locating beaver and muskrat. In 25 nights of floating, 113 animals were sighted while 194 nights of trapping (live traps, Conibear traps and leg hold traps) resulted in only 22 captures. The determination of animal signs such as tracks and scats by establishing scent stations and selected stations for sign count was effective in providing additional information on mink and otter.

The results of night floating and sign counts are given in Tables 5, 6, and 7. Mink

Table 5. Summary of furbearer counts during 25 night float trips from February 1975 to April 1976 on the Luxapalila River.

	Beaver		Mink		Muskrat		Raccoon		Total Distance Traveled	
River Segment	Total Observed	No./1.6 km (Mile)	Total Observed	No./1.6 km (Mile)	Total Observed	No./1.6 km (Mile)	Total Observed	No./1.6 km (Mile)	km	(Mile)
Old Channelized	21	0.347	2	0.033	1	0.017	9	0.149	96.8	(60.5)
Unchannelized	40	1.111	0	—	17	0.472	9	0.250	57.6	(36.0)
Newly Channelized	8	0.635	0	—	5	0.397	1	0.079	20.2	(12.6)

Table 6. Sign count of furbearers made at scent stations from December 1975 through March 1976 on the Luxapalila River.

	Relative index[a]	
River Segment	Mink	Raccoon
Old Channelized	85.71	57.14
Unchannelized	88.23	117.65
Newly Channelized	[b]	[b]

$$^{a}\frac{\text{Total animal visits}}{\text{Total operational station-nights}} \times 1{,}000 = \text{relative index}$$

Table 7. Track counts of furbearers made at track stations from October 1974 through August 1975 on the Luxapalila River.

	Relative Index[a]				
River Segment	*Beaver*	*Mink*	*Muskrat*	*Raccoon*	*Otter*
Old Channelized	132.35	73.53	[b]	411.76	[b]
Unchannelized	147.06	205.88	14.70	455.88	14.70
Newly Channelized	[b]	[b]	[b]	[b]	[b]

[a] $\frac{\text{Total animal visits}}{\text{Total operational station-nights}} \times 1{,}000 = \text{relative index}$

apparently used the old channelized segment while beaver and muskrat were much more frequently inventoried by night floating in the unchannelized segment than in the old or newly channelized segment. The only otter sign recorded was in the unchannelized segment.

Beaver were observed nearly 4 times as frequently in the unchannelized segment as in the old channelized segment and nearly twice as frequently as in the newly channelized segment. Beaver observations on the newly channelized segment were associated with small streams entering the new channel. Beaver were using this segment to feed on such preferred food as sweet gum. Only 1 night observation of muskrat was made in the old channelized area and 5 in the newly channelized segment. The observations in the channelized segments were always in close proximity to the mouth of feeder streams. Seventeen observations of muskrat were made in the unchannelized segment. Track counts indicated beaver activity in the old channelized segment. No muskrat tracks or feces were located in the old or newly channelized areas. Muskrat tracks and feces were found in the unchannelized segment (Table 7). Sign counts (Tables 6 and 7) indicated mink and raccoon utilized both old channelized and unchannelized segments but not the newly channelized segment.

Raccoon observations and sign counts (Tables 5, 6 and 7) were more common on the unchannelized than the old or newly channelized segments.

CONCLUSIONS

The data indicated that habitat for beaver, muskrat and raccoon has been damaged by channelization and has not fully recovered even after a period of 55 years and complete reversion to polewood size hardwoods with abundant herbaceous vegetation in the riparian areas.

It appears that the greatest damage has been done in the reduction of suitable denning areas for muskrat and beaver. The deposition of sand and gravel from dredging and upstream erosion has, for all practical purposes, destroyed den sites in both the channelized segments. In addition, water depth in the channelized segments of this river becomes extremely low at different periods of the year. Very often water depth was below 15.2 cm for as long as 4 or more weeks at a time. Such water depths would preclude construction of underwater entrances for beaver and muskrat. The deposition of sand and gravel undoubtedly adversely affects riverine food sources for raccoon and mink.

LITERATURE CITED

Beshears, W. W., Jr., and A. O. Haugen. 1953. Muskrats in relation to farm ponds. J. Wildl. Manage. 17(4):450-456.

Bishop, R. A., and R. Barratt. 1969. Capturing waterfowl in Iowa by night-lighting. J. Wildl. Manage. 33(4):956-960.

Cook, F. A. 1945. Fur resources of Mississippi. Survey Bull., Miss. Game and Fish Comm. Jackson, MS. 100 pp.

Cummings, G. E., and O. H. Hewitt. 1964. Capturing waterfowl and marsh birds at night with light and sound. J. Wildl. Manage. 28(1):120-126.

Earhart, C. M. 1969. The influence of soil texture on the structure, durability and occupancy of muskrat burrows in farm ponds. Calif. Fish and Game Comm. 55(3): 179-196.

Lindzey, F. G., S. K. Thompson, and J. I. Hodges. 1977. Scent station index of black bear abundance. J. Wildl. Manage. 41(1):151-153.

Linhart, S. B., and F. F. Knowlton. 1975. Determining the relative abundance of coyotes by scent station lines. Wildl. Soc. Bull. 3(3):119-124.