Activity and Habitat Utilization of Beaver Colonies in South Carolina

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Abstract: Movements, primary use areas, activity periods, and habitat use were evaluated for beaver (*Castor canadensis*) from 2 adjacent colonies, a stream colony, and a lake colony in the Piedmont of South Carolina. Beaver were monitored from February 1983 through March 1984. Minimum total distance moved by individual beaver ranged from 0.26 to 6.83 km. Distance between extreme locations ranged from 0.08 to 1.86 km. Lake colony beaver movements exceeded those of stream colony beaver. Beaver were more active during fall and winter months. Areas frequented by beaver ranged from 10.95 ha to 14.67 ha. For each colony habitat, types were not used in proportion to availability and habitat use varied between colonies.

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Most descriptions of beaver movements are based on capture/recapture studies (Townsend 1953, Beer 1955, Libby 1957, Leege 1968,) or direct observation during daylight hours (Tevis 1950, Hodgdon and Larson 1973). Studies using telemetric monitoring of beaver are limited. Lancia (1979) used radio collars to monitor seasonal activity patterns of beaver in Massachusetts. Busher (1975) monitored beaver movements in California for 4 months using tail-mounted radio transmitters. In the Southeast, transmitters were implanted intraperitoneally to monitor beaver activity, dispersal, home ranges, and habitat utilization in South Carolina (Davis 1984, Boller 1991) and Mississippi (Reinke 1986, Weaver 1986). There is a general lack of data regarding movements of beaver on a monthly or seasonal basis. The objectives of our study were to describe monthly, seasonal, and yearly activities of beaver in the Piedmont of South Carolina, determine sizes of areas impacted by beaver, compare lake colony beaver activity to an adjacent stream colony, and describe habitat utilization by beaver in the Piedmont of South Carolina.

Methods

The study was conducted on the Lake Issaqueena watershed located within the Clemson Experimental Forest in the western Piedmont of South Carolina. The area is characterized by slightly to moderately rolling hills with elevations to 305-m above sea level (Natl. Oceanic Atmos. Admin. 1974). Annual precipitation averages 131 cm (Natl. Oceanic Atmos. Admin. 1974) and temperatures range from a mean high of 25° C in July to a mean low of 6.7° C in January (Landers 1968).

Beaver colonies existed within the 40.5-ha reservoir and on streams feeding into this reservoir, thus allowing for a comparison of lake and stream populations. Access to the area by the general public was limited to recreational activities during spring and summer months. During these months, public use was considered high and primary activities included fishing, boating, swimming, and hiking. The area was closed to the public during the fall and winter months, and hunting and trapping were not allowed. Beaver impoundments along the feeder streams were estimated to be >10 years of age (Edwards 1983). Eight distinct habitat types occurred on the study area. A general description of each type follows:

(1) Pine. Loblolly (*Pinus taeda*) and shortleaf pine (*P. echinata*) dominated the overstory. Red oaks (*Quercus* spp.) and water oak (*Q. nigra*) made up the majority of the midstory species.

(2) Upland hardwoods. White oak (*Q. alba*), yellow poplar (*Liriodendron tulipifera*), southern red oak (*Q. falcata*), and hickory (*Carya* spp.) were the primary overstory species. The midstory was dominated by dogwood (*Cornus florida*), sourwood (*Oxydendrum arboreum*), tag alder (*Alnus serrulata*), hickory, and white ash (*Fraxinus americana*).

(3) Tag alder. Only 2 overstory species occurred in this type, yellow poplar, which dominated, and black willow (*Salix nigra*). The midstory was dominated by tag alder.

(4) Bottomland hardwoods. The overstory was very diverse (16 species) dominated by sycamore (*Platanus occidentalis*), yellow poplar, and white ash. The midstory was primarily privet (*Liqustrum sinense*), dogwood, and black walnut (*Juglans nigra*).

(5) Privet. The overstory was primarily sycamore, black willow, river birch (*Betula nigra*), and yellow poplar. The midstory was dominated by privet.

(6) Pond lily. This shallow water type was dominated by pond lily (*Nuphar luteum*) which covered 75% to 100% of the water surface from mid-spring through early winter.

(7) Marsh. This type was characterized by an abundance of aquatic marsh grasses, shrubs including button bush (*Cephalanthus occidentalis*), and small sparsely scattered trees consisting primarily of tag alder and black willow. Waterways in the form of creek channels and beaver canals dissected these areas. All marshes were a consequence of past beaver activity.

(8) Kudzu. This type lacked an overstory and midstory but the groundcover was completely covered by kudzu (*Pueraria lobata*).

Beavers were live-captured in Bailey traps or snares and surgically implanted with radio-transmitters (Davis et al. 1984). Sex was determined by external palpation for an os penis or testes (Osborn 1955). Mass and body measurements were used to age animals as adults, subadults, yearlings, or kits (Patric and Webb 1960, Shipes 1979). All beavers were ear-tagged but only adults and sub-adults were sur-

gically implanted with radio-transmitters (Davis et al. 1984). All beaver were released at their capture site.

Dams, impoundments, and lodges were located and mapped using aerial photographs and ground reconnaissance. Telemetry reading stations were established at 100-m intervals on a road surrounding the study area. Monitoring of each animal began no sooner than 8 days after surgery to allow recovery from the surgery (A. F. Von Recum, Interdisciplinary Studies, Clemson Univ., pers. commun.). Subsequent examination of re-trapped beaver revealed little or no effect on the health of beaver (Guynn et al. 1987), therefore effects of the surgery and implanted transmitter on beaver behavior and movements were considered minimal.

Accuracy of telemetry locations was tested by placing a transmitter within a beaver carcass and placing the beaver in areas within the study area. A series of readings were taken and locations plotted. In each of 10 tests, locations were within 20 m. Difficulties arose whenever transmitters were placed in burrows, as range and signal strength decreased appreciably. However, we were able to detect signals of all beaver even when they were in lodges. Because of dramatic differences in signal strength between in-lodge and out-of-lodge locations, we were able to determine when beaver exited or entered lodges. Lodges were located by homing on signals during daylight hours. Location errors were minimized by keeping distances from receiver to transmittered beaver to a minimum. Most readings were taken <100 m of the monitored beaver and often observers could see or hear the beaver being monitored. We assumed that the relatively high levels of human activity on this area and the prohibition of hunting or trapping had acclimated beaver to the presence of humans and that the beavers did not alter their behavior even when researchers were close by.

Beaver were monitored 3–4 times per month from 3 February 1983 until 26 March 1984. A monitoring period consisted of locating each beaver once per hour from the time they left the lodge in the evening until movements ceased generally soon after sunrise the next day. Locations were mapped by plotting the center of the smallest area polygon formed by the intersection of ≥2 compass bearings of the strongest signals received at various reading stations around the study area. Beaver occupying the same lodges were assumed to belong to the same colony.

Movement patterns were described using total distance moved (TDM) and distance between extreme locations (DBE). TDM was calculated by summing the distances from consecutive points beginning and ending at the lodge, and DBE was the distance between the 2 most extreme points. When possible, straight line distances were used to connect points. Beaver traveling from their lodges located on the lower portion of Lake Issaqueena to high activity areas located in the upper portions of the lake did not traverse peninsulas but instead followed water courses around peninsulas. This was observed on several occasions at dusk and dawn, and the speed at which beaver went from lodge to activity areas precluded the time needed to travel across land; therefore, movement estimates were modified to reflect use of water courses for lake colony beaver traveling to and from activity areas located in the upper reaches of Lake Issaqueena. Movement data were com-

bined to determine mean monthly and seasonal TDM and DBE for each individual and for the colony. Activity periods were determined by summing the time beaver spent outside their lodge. Only complete monitoring periods were used to calculate TDM's, DBE's, and activity periods.

Primary use areas (PUA) were defined as the area in which beaver were most active outside their lodges. PUA's were identified by a concentration of active beaver locations (>90%) clumped within a specific area forming a distinct area of high visitation. PUA's were described so that the sizes of areas actually impacted by beaver could be determined and compared. PUA's did not necessarily contain the lodge if activity adjacent to the lodge was low. PUA's were calculated as follows: a zone was drawn around the entire study area extending 35-m perpendicular to the water's edge (the maximum zone of beaver influence at Lake Issaqueena, Edwards 1983); lines were then drawn connecting all perimeter locations, except those within lodges, within the 35-m zone. PUA's were made as convex as possible given this restriction and were calculated for month and season for each colony.

Three 0.1-ha sample plots (10 x 40 m) were randomly placed within each forested type to ascertain woody species composition, basal area, stem densities and average dbh for trees (≥11.4-cm dbh), saplings (<11.4-cm dbh and ≥1.4-m tall) and seedlings (<1.4-m tall). Herbaceous stems were tallied within 4 1-m^2 plots placed within each 0.1-ha plot. Beaver locations in open water were considered transient locations to and from lodges and between habitat types and were omitted from analysis of habitat type utilization. Procedures for determining habitat preference or avoidance were presented by Neu et al. (1974) and Byers and Steinhorst (1984).

Results and Discussion

The complete sex and age compositions for colonies on the study area were not determined. Five radio-marked beavers (2 adult females, 1 adult male, 1 female sub-adult, and 1 male sub-adult) shared lodges that occurred on Lake Issaqueena and were designated as the lake colony. Four radio-marked beavers (1 adult female, 2 female sub-adults, and 1 male sub-adult) shared lodges located on the banks of Six Mile Creek and were identified as the stream colony. Two to 4 beavers were monitored each month from the lake colony, and 1 to 4 beavers were monitored each month from the stream colony. Total locations for the entire 14-month period were 1,659 and 1,245 for the lake and stream colonies, respectively. Monitoring periods averaged 199.9 days per beaver. Differences in activities between sex and adult and sub-adult age classes were not compared due to the small sample sizes.

Movements

For the 9 beavers monitored, TDM ranged from 258 m to 6,834 m and DBE ranged from 84 m to 1,863 m. TDM and DBE were consistently larger for the lake

Table 1. Mean monthly and seasonal values of total distance moved (TDM) and distance between extreme locations (DBE) for 2 beaver colonies monitored in the Piedmont of South Carolina (Feb 1983–Mar 1984).

	Lake colony				Stream colony			
Period/ Year	*N* Beavers	*N* MP's[a]	TDM (m)	DBE (m)	*N* Beavers	*N* MP's	TDM (m)	DBE (m)
Feb/83	3	12	3,084	804	0	0	–	–
Mar/83	3	10	3,105A[b]	901A[b]	1	1	2,124A	564A
Apr/83	2	6	3,574	949	2	5	1,521	458
May/83	2	8	2,858	970	2	8	1,386	497
Jun/83	3	12	2,590	947	2	8	1,370	508
Jul/83	3	12	3,200	990	2	8	1,035	392
Aug/83	4	15	2,917	1,018	2	8	1,450	530
Sep/83	3	9	4,025	1,293	3	8	1,593	479
Oct/83	3	10	4,451	1,258	3	12	1,969	665
Nov/83	2	8	3,472	1,179	3	12	2,056	472
Dec/83	2	6	2,940A	868A	4	7	2,099A	576A
Jan/84	2	6	3,544	1,250	2	6	1,621	414
Feb/84	2	8	3,007A	861A	2	8	1,846A	571A
Mar/84	2	6	2,936A	894A	2	6	2,834A	803A
Spring/83	3	26	2,899	955	2	21	1,412	492
Summer/83	4	36	3,288	1,078	3	24	1,359	467
Fall/83	3	24	3,747	1,134	4	31	2,032	570
Winter/84	2	20	3,147	988	2	20	2,075	594

[a] Total monitoring periods where 1 MP = 1 beaver for each nightly activity period monitored.
[b] Similar means within rows followed by the same letter are not sigificantly different ($P > 0.05$) as determined by Student's t-test.

colony than the stream colony (Table 1). There were significant differences ($P \leq 0.05$) between colonies in mean values of TDM and DBE for each month except March and December 1983 and February and March 1984. TDM values for the lake colony were lowest in June 1983 and highest in October 1983, whereas DBE values were lowest in February 1983 and highest in September 1983. TDM and DBE values for the stream colony were lowest during July 1983 and highest in March 1984.

Mean seasonal values of TDM and DBE for the lake colony were significantly ($P < 0.05$) larger than for the stream colony (Table 1). Maximum movements of lake beaver occurred in fall 1983, whereas maximum movements of stream beaver occurred in winter 1984. Minimum movements for the lake beaver occurred during spring 1983, whereas minimum movements for the stream beaver occurred in summer 1983.

Lake beaver moved significantly longer distances than stream beaver (Table 1). Stream beaver seldom moved >800 m from their lodge, but lake beaver often moved as much as 1,400 m. The reasons for the difference may be that the area where the stream colony was located had a higher amount of stream edge and thus greater access to forage than the lake colony, therefore stream beaver did not have to travel as far to find sufficient food.

Table 2. Mean monthly activity period lenth (hours) for 2 beaver colonies monitored in the Piedmont of South Carolina (Feb 1983–Mar 1984).

	Lake colony			Stream colony		
Month/ Year	*N* Beavers/ MP's[a]	$\bar{x}$	S.E.	*N* Beavers/ Location	$\bar{x}$	S.E.
Feb/83	3/12	12.5	0.39			
Mar/83	3/10	11.0	0.62	1/1	9.8	
Apr/83	2/6	11.7	0.49	2/5	9.1	0.51
May/83	2/8	10.6	0.25	2/8	9.1	0.50
Jun/83	3/12	9.4	0.36	2/8	9.7	0.37
Jul/83	3/12	9.6	0.33	2/8	8.6	0.46
Aug/83	4/15	9.7	0.30	2/8	9.5	0.33
Sep/83	3/9	10.8	0.19	3/8	10.8	0.22
Oct/83	3/10	12.1	0.16	3/12	10.8	0.19
Nov/83	2/8	12.1	0.26	3/12	11.8	0.15
Dec/83	2/6	12.5	0.31	4/7	12.0	0.28
Jan/84	2/6	11.8	0.28	2/6	11.9	0.34
Feb/84	2/8	11.5	0.27	2/8	11.1	0.24
Mar/84	2/6	11.0	0.38	2/6	11.1	0.47

[a] Total monitoring periods (MP) where 1 monitoring period = 1 beaver for each nightly activity period monitored.

Activity Periods

Peak activity periods of lake and stream colony beaver occurred in December with values of 12.5 hours and 12.0 hours, respectively (Table 2). Minimum activity periods for lake and stream colonies occurred during the months of June and July and were 9.4 and 8.6 hours, respectively. Beaver were more active during the fall and winter and less active during spring and summer.

Beaver activity periods were highly correlated with average monthly air temperature (Table 3). The longest activity period for both colonies occurred during December when the average monthly temperature was among the lowest at 4.1° C. The shortest activity period for the stream colony and next to lowest activity period for the lake colony occurred during July when the average temperature was highest (27.3° C). High summer temperatures may have had the same limiting effect on beaver activity as did the cold winter temperatures on beavers studied by Lancia (1979). He reported longest activity periods in the mid to late summer, whereas our study showed beaver activity periods to be shortest during the summer months. This suggests that extreme temperatures may limit beaver activity.

Average monthly precipitation was highly correlated with beaver activity periods although less so than temperature (Table 3). Precipitation was lowest in the spring and summer (9.4 and 5.5 cm, respectively) when activity periods were shortest and precipitation was highest in the fall and winter (17.4 and 14.2 cm, respectively) when activity periods were longest. Increased stream flow in fall and winter may have resulted in beaver spending more time exploring, feeding, and dam building in areas that were inaccessible during the drier spring and summer.

Table 3. Correlation coefficents and proability levels for mean monthly temperature and precipitation when correlated with mean monthly activity period length for 2 beaver colonies in the Piedmont of South Carolina (Feb 1983–Mar 1984).

Beaver colony	Mean mean temp		Mean monthly high temp		Mean monthly low temp		Mean monthly precip.	
	r	*P*	r	*P*	r	*P*	r	*P*
Lake	-0.859	0.0001	-0.856	0.0001	-0.859	0.0001	0.757	0.0017
Stream	-0.748	0.0001	-0.752	0.0030	-0.742	0.0037	0.603	0.0291

Also beaver may have had to expend more time repairing dams damaged by higher stream flow resulting in longer activity periods during the fall and winter.

Other factors may have contributed to longer activity periods in the fall and winter months. Peak breeding in South Carolina occurs in late December and early January (Woodward 1977, Shipes 1979). In our study, the active period length for both colonies was greatest during December (Table 2). Also higher precipitation during these months may have triggered an increase in dam construction. Jenkins and Busher (1979) suggested that dam construction may be an innate behavior released by the sound of running water.

Primary Use Areas

Lake colony beaver were most often located in 2 areas. The smaller area contained a large amount of kudzu that beaver fed upon heavily during the summer. During late fall and winter, beaver from the lake colony fed almost exclusively in the larger primary use area (PUA) located in the upper reaches of Lake Issaqueena including the mouths of Six Mile and Wildcat Creeks. Only 1 of the 2 primary lodges of the lake colony was included in either area.

The PUA of stream colony beaver included their entire home range area. Unlike the lake colony, stream colony beaver locations exhibited no clumped activity areas away from lodges. Both lodges of the stream colony were included within its PUA's.

Monthly PUA's ranged from 6–13 ha ($\bar{x}$ = 10 ha) for the lake colony and from 5–11 ha ($\bar{x}$ = 8.5 ha) for the stream colony (Table 4). Seasonal PUA's remained relatively constant throughout the year with a maximum difference of 2.03 ha for the lake colony and 3.27 ha for the stream colony. The annual PUA's for lake and stream colonies were 17.4 ha and 15.3 ha, respectively.

Habitat Type Utilization

All 8 habitat types occurred within the annual lake colony PUA and all except kudzu appeared within the stream colony PUA. Lake beaver use of habitat types was equal to or greater than expected for all seasons with the exception of the upland hardwood type. The upland hardwood type was utilized less than expected for all seasons even though it comprised 56% of their annual PUA. Stream beaver use of the upland hardwood type was less than expected for winter and spring. Of the 12

Table 4. Monthly and seasonal primary use area (PUA) sizes utilized by 2 beaver colonies monitored in the Piedmont of South Carolina (Feb 1983–Mar 1984).

Period/ Year	Lake colony		Stream colony	
	N Beavers/ MP[a]	PUA (ha)	*N* Beavers/ MP	PUA (ha)
Feb/83	3/12	12.76		
Mar/83	3/10	12.53	1/1	4.74
Apr/83	2/6	12.21	2/5	9.14
May/83	2/8	7.72	2/8	9.45
Jun/83	3/12	8.25	2/8	8.81
Jul/83	3/12	9.02	2/8	6.65
Aug/83	4/15	10.82	2/8	10.32
Sep/83	3/9	9.44	3/8	8.55
Oct/83	3/10	10.46	3/12	11.07
Nov/83	2/8	11.23	3/12	8.47
Dec/83	2/6	6.02	4/7	7.82
Jan/84	2/6	9.17	2/6	7.44
Feb/84	2/8	12.32	2/8	9.22
Mar/84	2/6	8.02	2/6	9.14
Spring/83	3/26	13.38	2/21	11.13
Summer/83	4/36	14.67	3/24	10.95
Fall/83	3/24	12.64	4/31	13.90
Winter/84	2/20	14.08	2/20	14.22

[a] Total monitoring periods (MP) where 1 monitoring period = 1 beaver for each nightly activity period monitored.

species that occurred in the midstory of this type, only flowering dogwood and eastern redbud (*Cercis canadensis*) ranked in the 5 most preferred species reported on this same area by Edwards (1983). Together they comprised only 22.7% of the stems/ha in this type. Also, Edwards reported that beavers preferred stems ≤2.5-cm dsh (diameter stump high); however, stems in the upland hardwood type averaged ≥3.9 cm. Lastly, the number of herbaceous ground cover stems/ha (81,436 stems/ha) was the lowest of all types. Many authors have reported the heavy use of herbaceous species especially during the warmer months (Swank 1949, Woodward 1977, Shipes 1979, Hill 1982). Low quality and lack of available forage within this type, which included over half of the lake colony's annual PUA, may have contributed to the less than expected use of other habitat types within lake colony's PUA's.

For all seasons, the tag alder habitat type was used at levels greater than expected by lake beaver and at expected levels by stream beaver. Even though tag alder ranked sixth in species preference, the average dsh of 1.9 cm fit within the preferred size class range (Edwards 1983). The abundance of stems within this size class most likely made tag alder 1 of the most utilized for lodge and dam material, and fresh cuttings were observed at both types of structures. This type also had the most lush herbaceous groundcover of all types with approximately 2.4 million stems/ha. The tag alder type was prevalent in the boundary or overlap area between the lake and stream colony, and territoriality was exhibited by both colonies

within this interface (Davis 1984) and no doubt had an effect on habitat usage. Scent mound and dam construction occurred within this type. Therefore, utilization of this habitat type was probably influenced by activities associated with intra-colony social interaction (territoriality), dam construction, and foraging.

The bottomland hardwood type comprised only 4.3% of the lake colony's annual PUA compared to 29.8% for the stream colony. Sweetgum and privet comprised 77% of the total saplings and were the 2 woody species most preferred by beaver on this area (Edwards 1983). Mean dsh of saplings was 2.4 cm which was in the preferred sapling size category. Stream beaver locations within this type increased from expected levels during spring and summer to higher than expected levels during fall and winter. Lake colony beaver were found within this type at more than expected levels in summer and fall, but usage dropped dramatically during the winter.

Privet type utilization by both colonies was equal to or more than expected for all seasons. Lake beaver locations within the privet type declined from fall (14.92%) to winter (4.44%), whereas stream beaver usage increased (from 9.3% to 12.3%) during this same period. Bottomland hardwoods and privet made up only 2.14 ha (8%) of the lake colony PUA. A drop in usage by the lake colony within the privet and bottomland hardwood types during winter may be because beaver had depleted the available woody forage within these areas during the summer and fall and forage levels were not sufficient to attract them during winter. In contrast, these 2 types comprised 5.33 ha (38%) of the stream colony PUA.

Lake colony use of the pine type increased dramatically from 9.94% in fall to a use greater than expected of 31.87% during winter. Many large diameter pines (dbh ≥25 cm) were partially or fully girdled on this area during the winter. Several studies have documented pines as preferred forage especially during colder months (Chabreck 1958, Woodward 1977, Roberts 1981, Edwards 1983). The lake colony may have shifted into this area due to depletion of forage in other areas. Similar shifts in feeding areas due to forage depletion have been reported in Mississippi (Reinke 1986). The stream colony used the pine type more than expected for all seasons except spring when it was used at the expected level. There was only a slight (2.8%) increase in fall to winter use of the pine type by the stream colony.

Pond lily was heavily utilized in all seasons by both colonies. During spring and summer, beaver fed on pond lily stems and leaves. During fall and winter, beaver fed on the roots as evidenced by the gnawed remnants scattered along shorelines. Lake colony and stream colony utilization of pond lily was approximately the same for summer, fall, and winter with differences in use between the lake and stream colonies being most apparent during the spring at 32.4% and 13.4%, respectively.

Use of marshes varied considerably between the 2 colonies. Lake colony beaver used marshes at levels equal to or more than expected for all seasons with highest use in the fall and winter. In contrast, stream beaver were found within this type at the expected level during winter and were found at less than expected levels

for spring, summer, and fall. Marsh usage was highest for both colonies in the winter which may have been due to activities associated with building of dams and impoundment use to gain access to woody species located on the edges. Beaver also fed on black willow, button bush, and tag alder which occurred within this type. Roberts (1981) reported black willow as 1 of the most important woody species utilized by beaver in Mississippi. Beaver were observed felling woody stems in forested types and carrying them back to water evidently seeking refuge in the water. Piles of debarked stems located in shallow water suggested beaver may have preferred to feed in the relative safety of water. This behavior may have contributed to the above normal use of aquatic habitat types.

Lake beaver fed heavily on kudzu during the summer as was apparent by an increase in locations from 4.1% in the spring to 26.7% in the summer. Several beaver were observed feeding on kudzu vines and roots. This type did not occur within the PUA of the stream colony.

Because of the quality and distribution of forage, it appeared that the stream colony possessed the superior PUA and the lake colony had a lesser quality PUA especially for fall and winter months. This was less evident for the summer when kudzu provided an abundant food source for lake colony beaver.

Management Implications

Damage to crops, timber, and streams by beaver in the Southeast continues to be a serious problem for resource managers (Hill 1982). Distances traveled by a resident beaver in a single night can be extensive. As populations increase and food supplies diminish, the sizes and types of impacted areas can be expected to expand. Preventing beaver from exceeding carrying capacity and expanding impact areas dictates a continuous monitoring and trapping program to reduce beaver numbers and impacts. Beaver were most active in fall and winter months; therefore, trapping and/or census efforts may be most effective during that time. Using boats at night with a spotlight proved to be the most economical and effective method of counting beaver in Mississippi (Gray 1977) and using the method at night during colder months when beaver are more active and when herbaceous cover is minimal may be the most effective means for census or control of beaver in reservoirs and navigable streams.

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