University of Nebraska - Lincoln
DigitalCommons@University of Nebraska - Lincoln

Second Eastern Wildlife Damage Control Conference, 1985

Eastern Wildlife Damage Control Conferences

9-22-1985

ECONOMIC AND ENVIRONMENTAL IMPACTS OF BEAVERS IN NORTH CAROLINA

David K. Woodward
North Carolina State University, Raleigh, N.C.

Robert B. Hazel
North Carolina State University, Raleigh, N.C.

Brian P. Gaffney
Advanced Technology Development, R.C.A. Corp., Moorestown, N.J.

Follow this and additional works at: http://digitalcommons.unl.edu/ewdcc2

Part of the Environmental Health and Protection Commons

Woodward, David K.; Hazel, Robert B.; and Gaffney, Brian P., "ECONOMIC AND ENVIRONMENTAL IMPACTS OF BEAVERS IN NORTH CAROLINA" (1985). *Second Eastern Wildlife Damage Control Conference, 1985*. Paper 50.
http://digitalcommons.unl.edu/ewdcc2/50

This Article is brought to you for free and open access by the Eastern Wildlife Damage Control Conferences at DigitalCommons@University of Nebraska - Lincoln. It has been accepted for inclusion in Second Eastern Wildlife Damage Control Conference, 1985 by an authorized administrator of DigitalCommons@University of Nebraska - Lincoln.

ECONOMIC AND ENVIRONMENTAL IMPACTS OF BEAVERS IN NORTH CAROLINA

by David K. Woodward[1], Robert B. Hazel[2], and Brian P. Gaffney[3]

ABSTRACT

In 1984, a postal survey of landowners and managers was conducted in North Carolina concerning the presence of beavers (Castor canadensis) on their property. Major objectives of the survey were to determine: (1) current distribution and relative abundance of beavers in North Carolina, (2) the economic and environmental impacts from an apparently increasing beaver population, and (3) landowner attitudes toward these increasing populations. Of the 1,069 questionnaires returned, data was compiled from 456 landowners (43 percent) who confirmed the presence of beaver activity on their property during 1983. A significant increase in beaver numbers and distribution has occurred throughout much of North Carolina during the past thirty years and currently the species inhabits 80 of 100 counties. Beavers affect a minimum of 35,858 hectares of bottomland in North Carolina. Total estimated damage loss to forestry and agricultural interests in 1983 exceeded benefits by $275,000. Cooperative efforts in administering a beaver management program between the North Carolina Wildlife Resources Commission and other state agencies centers on landowner education and technical assistance in the form of inspection and demonstration, with referral to professional trappers for aid in controlling nuisance animals.

[1]Department of Zoology, North Carolina State University, Raleigh, N.C. 27695-7617

[2]Extension Forest Resources Department, North Carolina State University, Raleigh, N.C. 27695-8003

[3]Advanced Technology Development, R.C.A. Corp., Moorestown, N.J. 08057

INTRODUCTION

With few exceptions, in each Southeastern state where significant beaver populations exist, the status and ecology of this species has been investigated (e.g. Bailey 1954, Engle 1954, Beshears 1967, Larson 1967, Arner et al. 1969, Linscombe 1974, Godbee and Price 1975, Woodward et al. 1976). North Carolina appears to be one of the exceptions. No results of any formal research on beaver populations in North Carolina have been identified in the literature. However, brief accounts have reported the history of beavers in North Carolina including the apparent elimination of the species, C. c. canadensis, from the state by 1897 (Brimley 1944-46). This extirpation is believed to have occurred from intense trapping pressure and the clearing of land for crop production. Subsequent attempts at reintroduction of beavers by various public agencies and private individuals have also been documented (Brimley 1944-46, Taylor 1953, Smith et al. 1960), although a number of transplant efforts were unsuccessful.

In 1939, a successful introduction of 29 beavers of Wisconsin stock C. c. canadensis Kuhl) via Pennsylvania was made by N. C. Department of Conservation and Development biologists to the Hoffman State Park (Sandhills Wildlife Management Area) in Richmond county (T. Critcher, pers. comm.). By 1959, the population in that and neighboring counties was estimated at 1,000 animals. Small numbers of beavers from the Sandhills population were subsequently relocated throughout North Carolina by Wildlife Commission personnel upon requests from landowners during the period 1951-1956. In 1957, fifteen 'Carolina' beavers (C. c. carolinensis) were obtained from Alabama and successfully introduced into Umstead State Park, near Raleigh (F. S. Barkalow, pers. comm.). In addition, other agencies, such as

the U. S. Forest Service and various branches of the military establishment, have engaged in both the intra- and interstate movement of beavers. Beavers from the adjacent states of South Carolina, Georgia, Tennessee and Virginia have also dispersed into North Carolina via several of the major river systems. A recent compilation of mammal distribution records at the Museum of Natural History in Raleigh listed 31 counties from which specimens had been obtained. The report further stated that beavers are distributed "apparently statewide but uncommon and scattered on (the) outer coastal plain..." (Lee et al. 1982).

As beaver populations increased across North Carolina during the 1960's, state game laws, passed in 1929 prohibiting the taking of beaver by any method, were amended to allow the regulated trapping of beavers in counties where landowners complained of damage. A statewide trapping season on beavers was established in 1963. Harvest levels in North Carolina have averaged only several hundred animals per year for the past decade. Such low harvests, not only in North Carolina but throughout the southeastern United States, undoubtedly reflect the reduced demand for shorthaired furs, and beavers in particular, in international markets (Hill and Novakowski 1984).

Several of the natural resource agencies in North Carolina have received an increased number of inquiries relating to beaver damage problems in recent years. Apparently, population levels in North Carolina have increased to the point where in many areas the beaver is considered a pest animal. Although it has been shown in the Southeast that beaver pond habitats may produce beneficial results, excessively high numbers of beavers can cause significant losses to forestry and agribusines production (Hill 1982, Arner and Dubose 1982, Woodward 1983, Hill and Novakowski 1984, Spencer 1985). Because there was no information regarding the current status of beavers in North Carolina, a project was initiated at North Carolina State University to determine the distribution, economic and environmental impacts, and landowner attitudes toward resident beaver populations. This paper summarizes the results of an extensive questionnaire survey of North Carolina landowners and managers conducted in 1984.

We would like to thank the following North Carolina organizations for help in distributing beaver questionnaires: Agricultural Extension Service (Chairmen), Forestry Association, Society of Consulting Foresters, Farm Bureau Federation, Wildlife Federation, Wildlife Resources Commission (Enforcement), County Forestry Associations and the U. S. Soil Conservation Service. We also appreciate the technical assistance of R. Raudebaugh, M. McKellar, E. Vaca, G. San Julian, and the North Carolina Wildlife Resources Commission District Biologists. Financial support was provided by a grant from the Renewable Resources Extension Act through the N. C. Agricultural Extension Service. We extend special thanks to the hundreds of landowners who completed the beaver questionnaires that provided the information on which this paper is based.

METHODS

A questionnaire was prepared by the modification of a survey form written by the senior author for a similar study conducted in South Carolina (Woodward 1977). Special efforts were made to design the questions so that responses could be indicated by a check mark or by providing a numerical value. Questions covered a variety of potential interactions between the landowner, his property, and the resident beaver population. We were primarily interested in obtaining information on the statewide distribution of beavers, benefits and/or damages received, types of habitats and number of hectares of land affected, economic impacts, control efforts attempted and success rates, and the overall attitudes of landowners toward beavers. Addi-

tional information requested included: years beavers had been present on the property, length and name of stream(s) inhabited, types and amounts of construction activities, number of colonies estimated to be present and the major land-use practices on the property of each respondent reporting beaver activity. A copy of the questionnaire is available upon request from the senior author.

A total of 10,929 questionnaires were forwarded to the various organizations listed in the acknowledgement section above. Each organization, in turn, distributed the survey forms to their membership or to landowners and managers believed to have beavers on their property. Duplication of effort was often minimized by the close working relationships under which many of these groups routinely function. A postage-free, self-addressed envelope was enclosed for return of the form. Individuals who returned incomplete questionnaires were recontacted by mail or telephone. The data from each survey form was entered onto disk with a microcomputer. Compilation of data was accomplished by uploading to a mainframe system utilizing programs prepared by B. P. Gaffney. Although the information was tabulated by county, the following results are presented on a statewide basis.

With the exception of including the "miscellaneous" group (e.g. electric power companies, state parks, national forests, wildlife refuges, branches of the military, etc.) and timber company returns in the discussion of total hectares (ha) affected by beavers in North Carolina, the results reported in this paper are limited to data compiled from 430 private landowners who returned the questionnaire. The primary reason for not including the two former groups in most of the data analyses was because few of these large landowner/managers could provide specific information concerning their resident beaver populations.

It is important to emphasize that not all landowners in North Carolina with beavers on their property were contacted. The following results, therefore, reflect variable efforts in attempting to contact as many landowners as possible with resident beaver populations and should be interpreted as representing minimum rather than total state values. We also recognize the biases associated with damage/benefit estimates as many of the forms were given to property owners with known beaver problems. To determine the magnitude of such biases, a companion study, called the "Intensive Stream Survey", is presently in progress at North Carolina State University. The primary objective is to develop an index of the difference between actual (on-the-ground) versus landowner estimated economic and environmental effects from beaver activity. Impacts from beaver activity are being measured utilizing aerial photography over a two county area with comparisons to estimated impact data compiled from completed questionnaires describing the same tracts of land.

RESULTS

Allocation and Return of Questionnaires

Of the total 10,929 questionnaires forwarded to public and private organizations for distribution to landowners, 1,069 (10 percent) were returned to North Carolina State University for analysis. Of this number, 456 landowners (43 percent) reported beaver activity on their property. A total of 430 forms were from private landowners. The remaining 26 returns were comprised of 11 questionnaires from the "miscellaneous" group and 15 returns from the major timber companies in North Carolina.

The most effective organizations in locating property owners with resident beavers were: (1) County Extension Chairmen, 123 returns (27 percent), (2) Soil Conservation Service, 82 returns (18 percent), (3) Intensive Stream Survey (see Methods section), 77 returns (17 percent), and (4) N. C. Forestry Association, 50 returns (11 percent). The return rate from the "Intensive Stream Survey" was considered good with 157 out of 272

(58 percent) total questionnaires returned with 77 (49 percent) of the returns positive for beaver activity. This result was expected due to the high probability of contacting landowners with beavers on their property along streams known to have high densities of beavers.

Current Range in North Carolina

The beaver's range in North Carolina has increased markedly since the dozen or so counties were re-populated with "out-of-state" animals during the period 1940-1960. We have documented that beavers are currently present in a minimum of 80 counties in the state. There may be additional counties which have beaver colonies, but if so, we believe their population levels are low and their effects minimal. The major river basins with beaver populations are the Chowan, Roanoke, Tar, Neuse, Cape Fear, Lumber, Yadkin-Pee Dee, Hiwassee, Little Tennessee, and New-Watauga (Fig. 1). With the exception of one historic site in Buncombe County, few if any beavers were reported from the Pasquotank, Catawba, Broad, and French Broad River basins.

Land Resources Survey and Categories Affected

The total number of hectares owned or managed by the 456 questionnaire respondents was 1,579,323 ha and ranged from 0.01 ha to 242,820 ha per return. To facilitate comparisons, the land areas were placed into one of eight size classes (Table 1).

Table 1. Number and size of tracts with beaver activity reported by 456 landowners in North Carolina.

Size Class (hectares)	(acres)	Number of Landowners	(%)
<20	(<50)	55	12
21-40	(51-100)	67	14
41-101	(101-250)	104	23
102-202	(251-500)	86	19
203-404	(501-1000)	55	12
405-1214	(1001-3000)	44	10
1215-4047	(3001-10000)	19	4
>4047	(>10000)	26	6

A relatively even distribution of tract sizes was noted with 80 percent of the total number of properties smaller than 404 ha each.

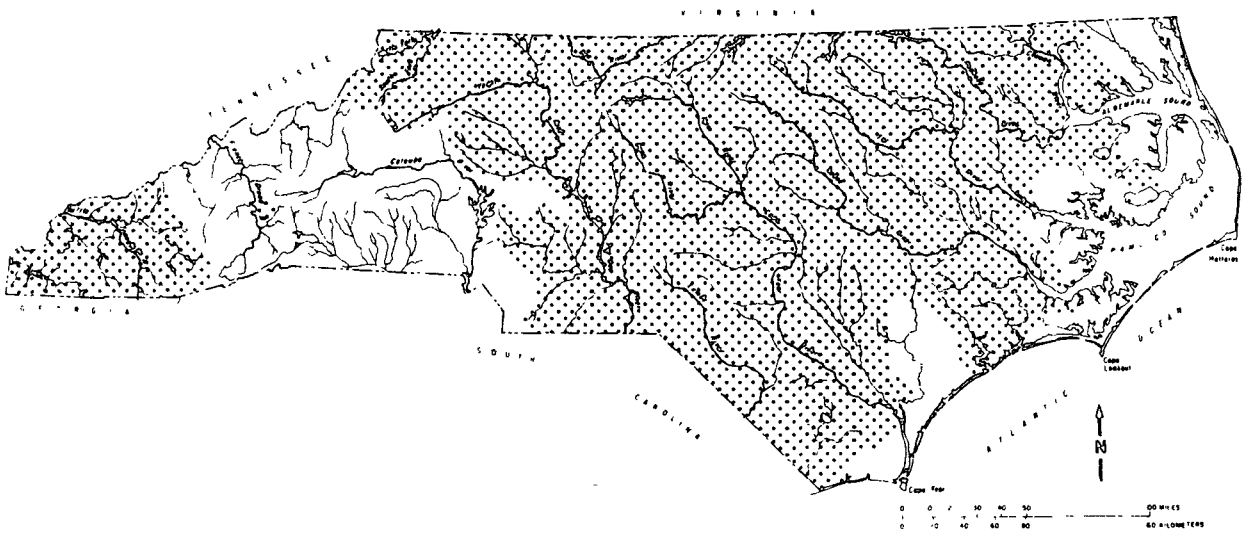

Figure 1. The distribution of beaver (shaded area) in North Carolina as determined by a 1984 questionnaire survey of landowners. (Base map prepared by John Teel, U.S.G.S, Raleigh)

Respondents were asked to indicate land-use practices on their property. Of the 430 private landowner returns, crop production was checked by 285 people (66 percent); followed by timber production, 205 (48 percent); livestock, 113 (26 percent); and other 60 (14 percent). A majority of the property owners indicated their land was used for multiple commodity production.

Because beavers often forage over land to locate food and construction material, landowners were asked to estimate both the amount of area flooded (Table 2) and the total area affected by beaver activity. Timberlands comprised 2,718 ha (66 percent) of the 4,112 ha flooded by beavers on 238 tracts of land. Estimates from 89 respondents indicated a minimum of 1,045 ha of cropland flooded (25 percent of total).

Table 2. Number of private landowners indicating land-use types and area flooded by beaver in N. C.

Land-Use Type	Number of Respondents	Total Hectares Flooded	Percent of Total
Timber	238	2,718	66
Crops	89	1,045	25
Pasture	62	231	6
Other[1]	31	118	3
Total	430	4,112	100

[1]Includes power line right-of-way, roads,etc.

Table 3. Summary of total hectares affected by beavers in North Carolina in 1983 by type of respondent group.

Source (N)	Hectares Owned/ Controlled	Hectares Affected	(%)
Private Landowners (430)	117,792	9,196	7.8
Timber Companies (26)	948,414	18,857	2.0
"Misc." Groups (11)	513,117	7,804	1.5
Total	1,579,323	35,858	2.2

The total area affected by beavers, reported by 456 respondents, was 35,858 ha and represents about 2.2 percent of the total area owned and/or managed by the three groups surveyed (Table 3). A total of 9,196 ha was affected by beavers on the 430 private landowner tracts which was 7.8 percent of the land area owned by this group. Further analysis of area data from this group revealed individual tracts owned ranged from 0.4 ha to 6,070 ha and affected areas ranged from 0.004 ha to 607 ha ($\bar{x}$ = 21 ha, ± 2.9). A total of 464 kilometers (km) of stream and/or lake shoreline (range 0.01 km to 35.0 km) were estimated to be inhabited by beavers on 412 tracts.

Damage/Benefit Interactions Reported

Landowners were questioned about 17 potential interactions relating to benefits and/or damages received from the activity of beavers (Table 4).

Table 4. Responses of 430 landowners reporting damages and/or benefits received from beavers on their property.

Potential Interaction	Number of Landowners Affected	Percent of Landowners Affected
Damage Type:		
Girdled Timber	314	73
Flooded Timber	226	53
Blocked Culverts	148	34
Flooded Crops	105	24
Fed on Crops	93	22
Flooded Roads	85	20
Damaged Fish Ponds	77	18
Flooded Pasture	59	14
Decreased Livestock Water	4	1
Benefit Type:		
Provided Waterfowl Hunting	126	29
Provided Aesthetic Enjoyment	116	27
Provided Fishing	57	13
Provided Recreational Trapping	34	8
Provided Irrigation Water	25	6
Increased Livestock Water	21	5
Monetary Return from Fur Sale	8	2
Used Meat for Food	6	1

To encourage careful reading of each possible interaction, the types were inter-mixed on the survey form. Each possible interaction was checked by at least one respondent. Overall, more damage interactions were checked by a greater percentage of respondents than were benefit types. In particular, girdling and flooding of timber, two of the most readily observed activities of beavers, were reported by 73 and 53 percent of the landowners, respectively. Other significant damages reported included: (1) blocking of culverts (34 percent), (2) flooding of crops (24 percent), (3) feeding on crops (22 percent), (4) flooding of roads (20 percent), and (5) damage to fish ponds, usually by blocking the overflow pipe (18 percent).

Although most returns had one or more damage interactions checked, 126 landowners (29 percent) indicated they had utilized beaver ponds on their property for waterfowl hunting. Also, 116 respondents (27 percent) believed their resident beavers provided them with 'aesthetic enjoyment'. Fifty-seven landowners used their beaver ponds for fishing. Thirty-four returns had recreational trapping marked as a benefit; however, only eight respondents indicated receiving money from the sale of beaver pelts and even fewer (six returns) had utilized beaver as food.

Economic Impacts of Beavers

For an evaluation of the monetary impacts beavers were having in North Carolina, respondents were asked two questions: (1) "What was the estimated dollar damage caused by beavers on your property during the previous year (1983)?" and (2) "What was the estimated dollar damage for the total number of years beavers have been present on your property?". Of the 430 private landowner returns, 232 respondents (54 percent) gave usable answers (a numerical figure of $0. or greater) indicating damage in 1983 ranged from none to $40,000 per return and a total damage value of $303,230. For the total number of years beavers had been present on their property, 293 (68 percent) respondents estimated a total damage figure of $2.35 million with individual losses ranging from none to $400,000.

Landowners were also asked to estimate the monetary benefits believed to have been gained from beaver activity on their property. Only 15 responses (3 percent) indicated a dollar figure greater than $0. for benefits gained in 1983; the total figure was $21,920 with the range of estimates from $10 to $10,000. Similarly, just 27 landowners (6 percent) gave benefit estimates for total years on property of $170,800 (range $25 to $100,000). It was apparent during the compilation of both damage and benefit figures that a significant proportion of the respondents were either unable or unwilling to provide monetary estimates based on additional comments written on the forms.

Methods of Control

A total of 233 landowners attempted to reduce or eliminate their beaver population using one or more methods of control. The most common method utilized was trapping, with 145 attempts (62 percent) and 27 successes (19 percent) (Table 5). Shooting was the second most attempted (and successful) method of control indicated by 116 respondents. Although dynamite was utilized by one-third of those landowners trying at least one method, few had any success. Nine returns had "poison" marked as an attempted con-

Table 5. Methods of beaver control and success reported by 233 landowners in North Carolina who tried one or more methods.

Control Methods	Attempts (%)	Successes (%)
Trap	145 (62)	27 (19)
Shoot	116 (50)	16 (14)
Poison	9 (4)	0
Dynamite	77 (33)	8 (10)
Other[1]	35 (15)	14 (40)

[1]See text for examples.

trol but the exact substances used were not identified; apparently these landowners were unaware there are no poisons legally available at the present time for controlling beavers. Methods listed under "Other-successes" (Table 5) included the following: (1) live traps (including box traps), (2) persistent breaking of dams, (3) use of dogs to discourage the presence of beavers, (4) installation of electric fences, and (5) mechanical elimination of food and/or building materials. Of those landowners who attempted to control beavers by trapping, 52 percent used foothold traps and 48 percent used the #330 Conibear.

In response to the question "Do you wish to have beaver removed from your property?", 53 percent of the respondents stated they would prefer to have 'all' beavers removed but 24 percent indicated they wanted no removal. Sixty landowners (14 percent) were undecided. An additional seven percent of the total 428 who expressed their opinion on this question wanted some degree of population control. Of those desiring removal, 56 respondents stated they would be willing to pay an average of $13.84 per beaver (range $1 to $50) and $113.00 per affected hectare (range $24.71 to $370.65) for effective control. Fifty-one landowners indicated they would pay for removal of beavers from their property but did not state an amount.

When asked the question, "Would you be willing to devote some of your land to beaver and associated benefits such as waterfowl hunting, fishing and increased wildlife diversity?", 74 individuals (17 percent) responded positively and of these 54 (73 percent) indicated they would be interested in technical assistance in developing such an area.

DISCUSSION - MANAGEMENT IMPLICATIONS

Our survey has established that beavers have significantly extended their range and increased their populations in North Carolina during the past thirty years. Such a phenomenon has been recorded in many other Southeastern states but appears to have lagged in North Carolina until recently. We believe the environmental and economic impact of this expansion in North Carolina has not been fully realized. Although most river basins with suitable habitat now contain beavers, many of the animals have arrived during the past decade (primarily through natural dispersal) and saturation of available habitats has yet to occur.

Potential and realized losses of bottomland hardwood species may be extensive within the floodplains of the large river systems draining the Piedmont and Coastal Plain regions of North Carolina. Hundreds of hectares of seasonally-flooded lands are presently kept inundated throughout the growing season by beaver dams which are often less than 0.5 meters high. Effective beaver control in these areas is made more difficult by the extended foraging range of the animal. Where forestry and agribusiness production is intensively managed or human safety is involved, beaver numbers will have to be controlled. However, in areas where multi-use educational, environmental, and recreational benefits can be realized, beavers and their activities should be promoted as part of an overall management program.

Currently, the management of beavers in North Carolina is a multi-agency, cooperative effort between the N. C. Wildlife Resources Commission, the N. C. Agricultural Extension Service, the N. C. Trappers Association, and North Carolina State University. A variety of management options are made available to landowners emphasizing: (1) education and information exchange relating to ecology, benefits/damages, effective control methods for, and utilization of both the animal and its activities to ensure that economically and environmentally responsible decisions can be reached, and (2) technical assistance in the form of on-site inspection of impacted areas and demonstration of optional management strategies including the forwarding of names of profes-

sional, licensed trappers when reduction or control of beaver numbers is desired.

LITERATURE CITED

ARNER, D. H., J. BAKER, D. WESLEY, AND B. HERRING. 1969. An inventory and study of beaver impounded water in Mississippi. Proc. Annu. Conf. Southeast. Assoc. Fish Wildl. Agencies 23:110-128.

ARNER, D. H. AND J. S. DUBOSE. 1982. The impact of the beaver on the environment and economics in the southeastern United States. Trans. Int. Congr. Game Biol. 14:241-247.

BAILEY, R. W. 1954. Status of beaver in West Virginia. J. Wildl. Manage. 18(2):184-190.

BESHEARS, W. W. 1967. Status of the beaver in Alabama. Proc. First Alabama Beaver Symp. Game and Fish Div., Alabama Dept. of Conserv. and Alabama For. Product Assoc. Montgomery, Alabama. pp. 2-6.

BRIMLEY, C. S. 1944-1946. The mammals of North Carolina. Carolina Tips - Installment 9. Carolina Biological Supply Co., Elon College, N.C.

ENGLE, J. W., Jr. 1954. Present status of the beaver in Virginia. Va. Wildl. 15(4):16-17.

GODBEE, J. AND T. PRICE. 1975. Beaver damage survey. Georgia For. Comm., Macon. 24pp.

HILL, E. P. 1982. Beaver. Pages 256-281 in J.A. Chapman and G. A. Feldhamer, eds. Wild Mammals of North America: biology, management and economics. Johns Hopkins Univ. Press, Baltimore.

LARSON, J. S. 1967. Beaver research in Appalachian Maryland. Atlantic Nat. 22(1):5-12.

HILL, E. P. AND N. S. NOVAKOWSKI. 1984. Beaver management and economics in North America. Acta Zool. Fennica 172:259-262.

LEE, D. S., J. B. FUNDERBURG, Jr., AND M. K. CLARK. 1982. A distributional survey of North Carolina mammals. Occas. Papers of the N. C. Biol. Survey. N. C. Mus. Nat. History, Raleigh, 10:1-70.

LINSCOMBE, G. 1974. The beaver is back. Louisiana Conservationist. 26(11-12):18-21.

SMITH, E. R., J. B. FUNDERBURG, AND T. L. QUAY. 1960. A checklist of North Carolina mammals. N. C. Wildl. Res. Comm. Raleigh. 19pp.

SPENCER, J. 1985. A plague of beavers. American Forests. 91(5):22-27,62-63.

TAYLOR, D. L. 1953. Life history and management of the beaver in North Carolina. Game Div., N. C. Wildl. Res. Comm., Raleigh, 14pp.

WOODWARD, D. K. 1977. The status and ecology of the beaver (Castor canadensis carolinensis) in South Carolina with emphasis on the Piedmont region. M.S. Thesis. Clemson Univ., Clemson. 208pp.

_____. 1983. Beaver management in the southeastern United States: a review and update. Pages 163-165 in D. A. Decker, ed. Proc. First Eastern Wildl. Damage Control Conf. Ithaca, N. Y.

WOODWARD, D.K., J. D. HAIR, AND B. P. GAFFNEY. 1976. Status of beaver in South Carolina as determined by a postal survey of landowners. Proc. Annu. Conf. Southeast. Fish Wildl. Agencies. 30:448-454.