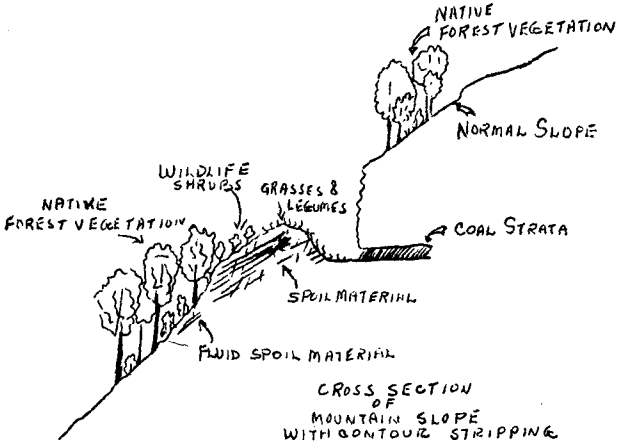

WILDLIFE DEVELOPMENT PLAN V
FOR SPOIL BANK AREAS

CONTROL OF RACCOON PREDATION ON MUSKRATS NEAR CURRITUCK, NORTH CAROLINA

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Raccoon populations have been high for more than a decade in Currituck County in the northeast corner of North Carolina. Small harvests caused by low fur prices have resulted in their steady increase in all parts of the county—from wooded swamp to open marsh. In the marshes, raccoons have been very destructive to nestling muskrat populations. Muskrat yields in the county have dropped about 75 per cent and some marshes are no longer trapped. On the state-owned Northwest River area, muskrats subjected to little or no trapping failed to increase during the six-year period from 1947 to 1952. On the nearby Tice marsh yields dropped 96 per cent from 1947 to 1952.

Experiments in the control of raccoon populations were initiated on the Northwest River area in 1952 and on Tice marsh in 1953. In 1956, control of the raccoon was also attempted on the state-owned marsh near Corolla on the Outer Banks.

DESCRIPTION OF THE STUDY AREAS

The Northwest River area contains 1,263 acres of which about 700 are marsh. The principal marsh cover types are cattails (*Typha latifolia, T. domingensis, T. glauca* and *T. angustifolia*), threesquare (*Scirpus olneyi*), needlerush (*Juncus roemerianus*), cordgrass (*Spartina cynosuroides*), and sawgrass (*Cladium jamaicense*). Cattails and threesquare occupy approximately 60 per cent of the marsh area. About 185 acres of the marsh are diked. The remaining 560 acres of the area contain scattered stands of pine (*Pinus regida* and *P. taeda*) and swampy areas of sour gums (*Nyssa aquatica—biflora—sylvatica*), cypress (*Taxodium distichum*), and red maple (*Acer rubrum*), and swamp rose (*Rosa carolina*). Den trees are numerous. Fish, frogs, crayfish, muskrats, small rodents, cottontail rabbits, gray squirrels, gray foxes, birds, turtles and snakes are common. Deer are present, also otter and a few mink.

The 1,000-acre Tice marsh supports cover types similar to those on the Northwest River area. Six hundred acres are adjacent to swamp; Bray Island, at the mouth of the Northwest River, contains 400 acres of marsh. Marsh on the mainland supports the same species of wildlife found on the Northwest River area. Bray Island, except for a small population of nutria stocked in 1953, contains mostly muskrats.

The Corolla marsh is similar to the Tice and Northwest River areas in vegetative species. The area contains no swamp. The sandy beach or "Outer Banks" are vegetated by dense stands of wax myrtle (*Myrica cerifera*), groundsel tree (*Baccharis halimifolia*), pine (*Pinus taeda*) and dense clumps of greenbrier (*smilax* spp.). Den trees are absent. The village of Corolla borders the area. The principal wildlife species are gray fox, raccoon, cottontail rabbit, muskrat and otter.

RACCOON CONTROL METHODS

The first evidence that the raccoon might be a limiting factor in muskrat production was observed in 1951 during the course of a study of muskrat litter sizes on the Northwest River marsh (1953). In April, 1951, five houses containing recently born young were under observation. Before they could be tagged, however, the houses were dug open by raccoons and the young muskrats taken. Subsequent studies disclosed that raccoons were ravaging hundreds of houses on the study areas.

Prior to 1951, the writer had been working more than three years on the Northwest River area. During this time, however, despite the muskrats' high breeding potential and almost no trapping, muskrat populations showed little or no increase. It appeared especially significant that diked and flooded marsh containing an abundance of food and cover did not produce a larger population of muskrats. Harvests were also dropping in other parts of the county. No evidence of disease had been detected. Some trappers were already placing blame for the small harvests on predation.

Predation a limiting factor in muskrat production? This did not seem likely. Years of experience had convinced the writer that where upland game have plenty of food and cover, the predator is an asset, not a limiting factor. Furthermore, had not Errington (1951) and other investigators found that in good habitat muskrats thrived despite predation? Moreover, did not the State area and most of the remaining tidal marsh in Currituck County support good habitat? The idea that predation might be responsible for the drop in muskrat populations was, therefore, dismissed. Then the facts began to speak. Muskrats on tidal marsh are born and raised in houses. During the first two weeks of life they remain in the nest, blind and practically helpless. During this period they are easy prey to 'coons that dig into the houses.

Attempts to capture raccoons in box traps proved too slow. Steel traps were also too slow because many individuals escaped. Shifting populations caused by trapping, and flood water that often allowed the raccoon to swim over the trap were other handicaps. Attempts to kill 'coons by hunting with dogs was dismissed as impractical because of miles of adjacent dense swamp and open water.

Following a conference in March, 1952, with Larry C. Whitehead, District Agent, Predator and Rodent Control, Fish and Wildlife Service, North Carolina State College, Raleigh, North Carolina, it was decided to attempt to control the raccoon with strychnine. This was to be used with sardines, prunes, or corn. Later, eggs and persimmons (when in season) were employed. Control measures were started during 1952 and are still in progress. This report covers the methods used to control the raccoon and the results obtained.

SARDINES

Techniques: Experiments with sardines were conducted from March to May, 1952. As in all methods of raccoon control, the alkaloid form of powdered strychnine was used. The formula used: (1) Mix one ounce of strychnine thoroughly with one ounce of baking soda and ⅛th ounce of powdered saccharine, baking powder and saccharine to counteract the bitter taste of the strychnine. (2) Open can of sardines, drain off oil, split fish down middle and put in mixture, enough to cover head of dime. (3) Put sardine in small paper cup and place where available to raccoon. Special care taken to place

baits away from trails and water courses used by otter and mink. Domestic dogs and cats too scarce to be a problem. Lines run about twice a week and results recorded.

Findings: Uncertain. Of 160 baits used, 29 or 18 per cent apparently eaten by raccoons but no bodies found. Because of possible mortality to otter and mink and difficulty of interpreting results, this technique concluded after seven weeks.

Recommendations: Before using this method of control, try corn or eggs. If used, increase dose over that used in this study.

PRUNES

Techniques: Work with prunes was done from March to May, 1952, and the same formula used with sardines was employed. Procedure was as follows: Prunes soaked overnight in water, seeds removed and each prune filled with enough of the formula to cover the head of a dime. Some baits dipped in honey in March before ants active. One prune per paper cup tacked to top of dike at about 200-yard intervals. When used in other places, care taken to select sites where wind could not blow cup and bait into water. Control lines run once a week and new baits put out every ten days to two weeks.

Findings: Of 272 prunes used, 55 or 20 per cent disappeared. Only three dead raccoons located and one of these about a half-mile from bait. Raccoons frequently pushed baits from cups into water and some such may have been considered consumed. During seven weeks of project, sign of the raccoon dropped noticeably. Sardines used during same period also probably contributed to drop. However, the damage to muskrat houses continued and in May, 1952, when it became apparent that some raccoons did not recognize the prune as food, this project was concluded.

Recommendations: Impractical to use when the bait is not generally recognized as food. If accepted as food, present the prunes in wax paper bags in the same manner as persimmons.

PERSIMMONS

By 1954, it was obvious that some raccoons would not eat corn treated with strychnine. To control this small but potentially destructive remnant, experiments were conducted with persimmons.

Techniques: The following steps were employed in preparing and placing the baits: (1) First ripe persimmons gathered late in September and stored in refrigeration at about 40° F. (2) Slit one end of persimmon and treat with pure strychnine (no baking soda-saccharine used as in other formulas) at about twice dosage used in prunes. (3) Use two persimmons in each bait and place in wax paper fashioned into a bag, to minimize chance of consumption by other wildlife. (4) Tie bag and attach to pole or branch about 15 inches from ground in raccoon's trail. (5) Replace old baits with fresh ones about once a week. This method was used only during the fall (October—November) of 1954 and 1955.

Findings: Very successful. Of 43 baits put out in October and November, 1954, 11 eaten and remains of four raccoons found. Since all sign of raccoons disappeared at site of other baits, all animals presumed killed. During October and November, 1955, only two of 24 baits taken and no bodies found. House digging, however, stopped. Raccoons that ignored corn baits, readily opened wax paper bags and ate persimmons. Deer, fox and opossum, all of which eat persimmons, not attracted by bait. Paucity of baits eaten interpreted to indicate small raccoon populations, rather than dislike of persimmons. Fruits in bags remained palatable about ten days, then soured and dried. Absence of baking soda-saccharine ingredients in formula did not stop 'coons from eating baits.

Recommendations: Best to use in fall when persimmons are in season. To minimize taking by other wildlife, always present baits in wax paper bag or similar container. To use at other seasons of year, freeze ripe persimmons (unripe fruits tasted bitter after thawing) and use as needed.

EGGS

During April and May, 1955, a small outbreak of raccoon predation on nestling muskrat populations got out of control. Attempts to kill the 'coons with corn failed, so eggs were tried. In 1956, this method of control was again used on a small scale.

Techniques: Two methods of treating eggs were employed. Method #1 was obtained from the Robbins Brothers, owners of 17,000 acres of tidal marsh in Dorchester County, Maryland, and Method #2 from the U. S. Fish and Wildlife Service. The formula of each method follows:

Method #1. (1) Place one-eighth ounce of strychnine into quart of warm water. Allow to stand for about 30 minutes, shaking jar every five minutes. (2) Stir ingredients and pour through fine mesh strainer to remove undissolved strychnine that might clog hypodermic needle. (3) Use awl to break tiny hole into air pocket end of egg. Eggs one week to ten days old preferred to fresh eggs because of larger air pocket. (4) Fill hypodermic needle with liquid and inject 5 cc (or an amount just short of filling air space) into egg. Quart of liquid from this formula will treat about one gross of eggs.

Method #2. (1) Mix equal parts of strychnine alkaloid and baking soda (Arms and Hammer). (2) Chip one end of egg, lay back membrane and insert into egg an amount of strychnine and soda mixture equal to the size of a buck shot on the point of pocket knife. (3) Close membrance and shell. To keep ants from getting into egg, seal chipped end of egg with masking tape.

Place one or two eggs in a depression on top of muskrat house and cover with two to three inches of material. During cool (30° to 60° F.) weather, replace uneaten eggs every 10 to 14 days; in warm (70° to 100° F.) weather, every four to seven days. Eggs placed on land buried one to two inches in ground in area of raccoon activity. Of 87 eggs used in experiments, 70 treated by Method #1 and 17 by Method #2.

Findings: Raccoons readily ate eggs but no bodies found. Despite this, eggs appeared to be effective because in most instances following their disappearance, damage to muskrat houses stopped. When buried in houses they were easily found by raccoons but apparently never eaten by other wildlife. Notwithstanding their possibilities, only a small amount of work was done with eggs. But this was because corn, in most instances, controlled raccoon adequately, and corn baits remained edible longer. Baiting with eggs also took more time.

Eggs treated by Method #1 gave best results when two were placed at each site. Method #2 was tried too little to determine its effectiveness.

Recommendations: Use this method of control before others. Remember that raccoons have a knack for finding eggs, so always bury them.

CORN

The appeal of corn as a food to many forms of wildlife is well known. It was very important, therefore, to present the corn in a manner easily recognized by raccoons but not likely to be taken by muskrats, waterfowl, deer, gray squirrels, mourning doves and other wildlife in the study areas. As a safety precaution, initial experiments with corn were first applied only on State marsh. This work was started in 1952. During 1953, control measures were extended to Tice marsh, and in 1956 to Corolla marsh. Records of the number of raccoons killed (includes only those found) are listed for only State marsh.

Techniques: The formula used to control the raccoon was prepared in the following manner: (1) Using scales graduated to grams, weigh out one ounce of powdered strychnine, one ounce of baking soda, one-eighth ounce of saccharine and mix all ingredients together. (2) Dissolve one ounce of Argo starch in ½ cup of cold water; then pour in 2½ cups of hot water and stir. (3) Add ½ cup of brown karo syrup to 2⅛ ounces of dry mixture and stir. (4) Boil starch and stir into karo syrup-strychnine ingredients. Pour into quart jar, seal and label POISON. To prevent spoilage (fermentation and loss of viscidity) of unused ingredients, bury about 20 inches in ground. When used with dry corn on cob, this recipe will treat about 75 baits.

Preparation of baits for use in the field involved the following procedure: (1) Cut desired number of small stakes (about ¼ inch diameter and 15 to 20 inches long) and sharpen both ends. (2) Using hatchet, chop ear of corn into baits one to two inches long. (3) Impale corn on stake and dip in strychnine formulation. (4) Cover dipped bait with double or triple layer of wax paper, twist loose ends of paper around stick and seal with tape. Wax paper protects baits from washing rains and usually attracts only raccoon. This is important.

Baits were placed along 'coon trails, on top of muskrat houses and at den trees. Except in 1955, lines were run about once a week in spring, at two to

four week intervals in summer and early fall and when possible after every heavy rain. Uneaten baits were usually replaced with fresh corn once a month.

Findings: On May 13, 1952, 24 baits placed in raccoon trails at scattered points along two-mile perimeter encompassing 100-acre main dike on State marsh. Experiment conducted after two months' work with sardines and prunes killed an unknown number of raccoons but failed to noticeably reduce muskrat house digging. Two days later, inspection of baits disclosed six dead 'coons and a probable seventh. Two animals found dead at one bait. By end of May, 21 raccoons taken and 45 during year (prunes and traps accounted for another 3 and 8). An unknown number died that were never found. Though the bulk of the 1952 crop of nestling muskrats had been devoured, house digging dropped off abruptly. An inspection of 48 houses late in April, before corn was used, showed that 19 had been recently dug into. In June, about a month after the first corn was put out, only one of 21 houses was found ravaged. Despite the reduced number of raccoons, overflow populations from a vast expanse of adjacent swamp filled the vacuum by spring each year. Control was continued and corn put out in 1953 accounted for 19 raccoons. Twenty carcasses were found in 1954, 7 in 1955, and 16 in 1956. These and the 45 in 1952 brought the five-year total to 107 raccoons taken on corn. See Table I.

TABLE I

WILDLIFE KILLED* ON NORTHWEST RIVER AREA DURING RACCOON CONTROL EXPERIMENTS (1952-1956)

	Bait					*Wildlife Killed***						
Year	*Corn*	*Sardine*	*Prune*	*Persimmon*	*Egg*	*Raccoon*	*Opossum*	*Gray Fox*	*Woodduck*	*Crow*	*Cottonmouth Moccasin*	*Additional Baits Missing—No Carcasses Found*
1952	X	—	—	—	—	45	2	1	1	..	..	15
1952	—	X	—	—	—	..	..	..	..	..	3	29
1952	—	—	X	—	—	3	..	..	..	..	..	55
1953	X	—	—	—	—	19	1	..	..	1	..	18
1954	X	—	—	—	—	20	2	..	..	..	..	10
1954	—	—	—	X	—	4	1	..	..	..	..	11
1955	X	—	—	—	—	7	..	..	..	..	..	12
1955	—	—	—	—	X	..	..	..	..	..	..	11
1955	—	—	—	X	—	..	..	..	..	..	..	2
1956	X	—	—	—	—	16	..	1	..	..	..	17
1956	—	—	—	—	X	..	..	..	..	..	..	4
						114	6	2	1	1	3	184

* Data include only carcasses of wildlife that were found.
** Small rodents not included.

The amount of food in the raccoon's stomach at the time of bait consumption appeared to be related to the speed of kill. Specimens with no food in their stomachs usually dropped dead within one to 60 feet from the bait, while those

with food normally traveled greater distances before dying. 'Coons in this category, it is believed, were the ones that wandered into dense vegetation where their remains could not be found. On one occasion, a carcass was located about a half-mile from the nearest bait.

After ripping the wax paper, most 'coons ate the corn off the cob on the stake but a few (about 5 per cent) of them carried it away. Though their bodies were seldom found, it is believer that all of these raccoons (there was no evidence that other wildlife carried off the baits) ate the baits. About one-fourth of the victims consumed all the corn on the baits (cobs 1½ inches long with about 100 kernels were average size) but most victims ate only about half the baits. The smallest dosage known to kill a raccoon was 13 kernels. This animal was a small, six-pound specimen, found about 300 feet from the bait.

Party eaten baits void of wax paper lost their toxicity. Rain washed off the poison and the raccoons that ate them did not always die. On occasions, some raccoons ripped the wax paper off baits and ignored them completely. Most of this occurred on the Outer Banks, where corn is not grown and presumably is not recognized as food. These nuisance 'coons and others that ignored baits were usually controlled with eggs and persimmons.

Corn kept dry had excellent lasting qualities. Baits placed in February and March remained in good condition for more than four months, those put out in the spring, two to three months, summer baits one month and in dry weather, two months.

Corn accounted for 94 per cent of all the raccoons killed on State marsh by poisoning and its use on Tice marsh was equally effective. Had eggs and persimmons been used more, they might have been equally effective. But the perishable quality of these baits required more than twice the time to maintain an effective line. Eggs in particular would have been used more had the corn lines killed much beneficial wildlife. But this did not happen. Therefore, corn proved to be the best bait.

Recommendations: Use corn to control raccoons after test baits indicate other wildlife will not suffer. Cover all baits with wax paper and place along well-used trails. For precautionary purposes, run first lines every two or three days. Cover exposed baits immediately. In early stages of 'coon control, put out one bait for every five or ten acres. As populations subside, use fewer baits, possibly one for every 20 to 30 acres. If muskrats are known to eat corn, do not place baits on houses. During the spring period of heavy muskrat production, run control lines at least once a week. Put out first baits in late February or as soon as raccoons begin to move. In summer where 'coons leave marsh for cornfields, no control is necessary but place fresh baits in September. Should these baits be ignored, use persimmons and tend lines until November. Post a chart to record complete data for every bait.

MORTALITY TO OTHER WILDLIFE

Every method of control employed was capable of destroying some form of wildlife—not just the raccoon. Despite this, however, apparently little damage resulted to wildlife on the Northwest River area (data are not available for the other study areas but Tices reported finding dead opossums and a fox). Sardines killed three cottonmouth moccasins, each of which was found less than a yard from the bait. During five years of work with corn, five opossums, two gray foxes, one crow, one female woodduck and an unknown number of rice rats and mice were killed—but not one muskrat. In localities where muskrats eat corn, baits (even when covered by wax paper) would probably result in some mortality. Woods in which gray squirrels were common contained between four and six corn baits for five years. During this time, however, not one dead squirrel was found nor was there any evidence of their tampering with baits. The nearest farm being more than a mile away, it is possible that the corn was not recognized as food. Deer (an estimated one to 60 acres) occupy the area and some corn baits were put in their trails but none was ever eaten. Persimmon was the only other bait known to kill beneficial wildlife. This occurred in 1955 when a dead opossum was found at a bait. This low rate of mortality to wildlife (other than raccoons) is believed closely associated with the isolated location of the study area, the curious nature of the raccoon and the methods of presenting baits.

EFFECTS OF RACCOON CONTROL ON MUSKRAT POPULATIONS

On marsh where control of the raccoon was conducted consistently from March into November, increases in muskrat populations were relatively large, Conversely, however, spasmodic control resulted in only small population increases. This occurred on marsh where lines were run at month intervals during March and April. On Corolla marsh where insufficient time was spent on control of the raccoon, the muskrat management situation worsens. To clarify the picture, the total effect of raccoon control on muskrat populations is covered for each study area.

Northwest River Area: During the five years (1947-1951) prior to the first experiments in raccoon control muskrat house counts on the 400-acre study area ranged from 105 to 158. See Figure 1. In 1952 an effective method of 'coon control was discovered too late to save many young. That year, the marsh supported only 132 houses. Work in 1953 resulted in almost complete control and a total of 229 houses—97 more than 1952. Continued control of the raccoon in 1954 resulted in 227 houses, and in 1955, despite a small but damaging outbreak of raccoon predation on nestling populations, the study area supported 240 houses. During 1956, control lines were run four to six times a month instead of allowing a lapse of two to four weeks between inspections which occurred in 1954 and 1955 during peak of muskrat production. No new outbreaks have occurred, and it now appears that the 1956 house counts—and muskrat populations—will be the greatest in the history of the project.

In 1953, following the first season of raccoon control, muskrat increases were sufficient to allow some trapping on the 400-acre marsh and other State-owned marsh adjacent to the study area. That year, 273 muskrats were trapped. Despite this small harvest, it represented 55 more muskrats than the 218 trapped during the six years (1947-52) prior to raccoon control. See Figure 2. The 1954-55 trapping season yielded 425 rats and in 1955-56 a record harvest of 583 was taken. This yield came from about 550 acres of marsh. Of this acreage, 172 acres of diked marsh produced 291 (50%) and 378 acres of undiked marsh yielded 292 (50%) muskrats. Better control of the raccoon in 1956 should result in a harvest of at least 700 muskrats.

Tice Marsh: House count records were kept for 181 acres of this 1,000-acre marsh nine years (1947-1955). During the six years from 1947 to 1952, they dropped from 325 houses in 1947 to 25 in 1952—a 92 per cent shrinkage. See Figure 3. During 1953, numerous houses were found ravaged by raccoons and control measures were immediately started. Failure to run lines consistently, however, resulted in only partial control. Small muskrat population increases resulted and in 1955, the 181 acres supported only 108 houses. Yields from this marsh indicated that where raccoons habitually devour nestling muskrats, partial control is not enough.

The nine-year (1947-1955) trapping record for the 1,000-acre Tice marsh reflects the raccoon's role as a predator of muskrats. During the 1947-48 trapping season when raccoon populations were still relatively small, the harvest totaled 958 muskrats. The next winter's harvest dropped to 617, and four years later, during the winter of 1952-53, to 35 muskrats—a 96 per cent drop in six years. See Figure 4. By 1953, the 'coons were doing such a thorough job of locating nestling muskrats that litters more than one week old were rarely found. Then control of the raccoon was started. Partial control was effected on 600 acres of mainland marsh and complete control on Bray Island, but no trapping was done in the winter of 1953-54. This control brought an immediate increase in muskrat populations, especially on Bray Island. The next winter, the entire 1,000-acre marsh was trapped and the harvest totaled 705 muskrats. Of these, 173, or 25 per cent, came from 600 acres of mainland marsh and 532—1.3 muskrats per acre—from Bray Island. During the six years before raccoon control, the largest catch from the 400-acre island totaled .68 muskrats per acre. Because of this, it was thought that the island had been overtrapped. The next winter (1955-56), however, the yield totaled 762 or 1.9 muskrats per acre, while the 600 acres of mainland marsh produced only 392 or .65 muskrat per acre. Since both island and mainland marsh support similar habitat, the much heavier yields from Bray Island were attributed to complete control of the raccoon.

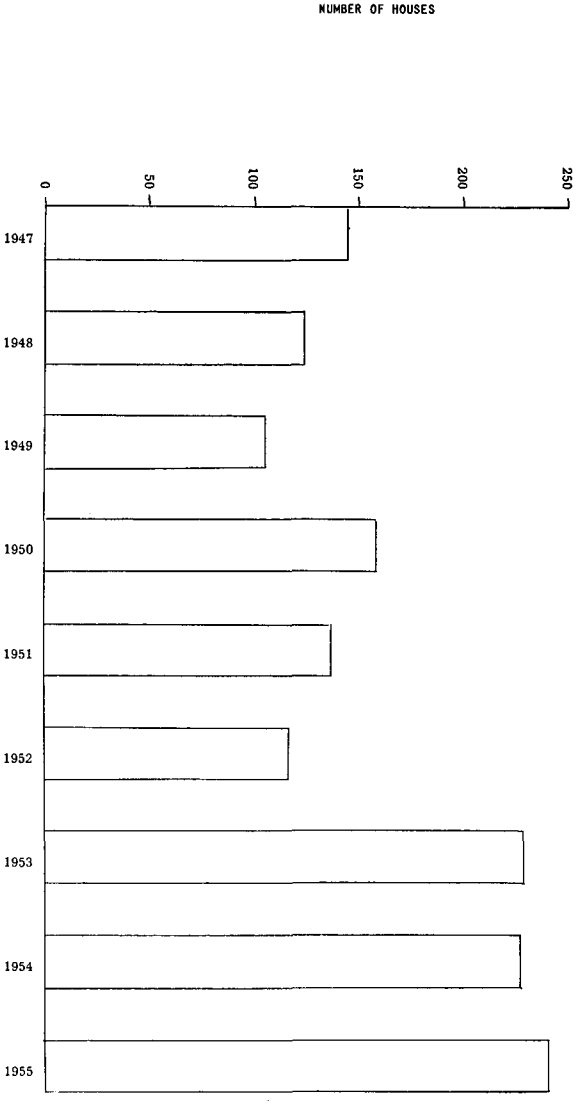


FIGURE 1.

MUSKRAT HOUSES ON 400-ACRE MARSH, NORTHWEST RIVER AREA, 1947-55

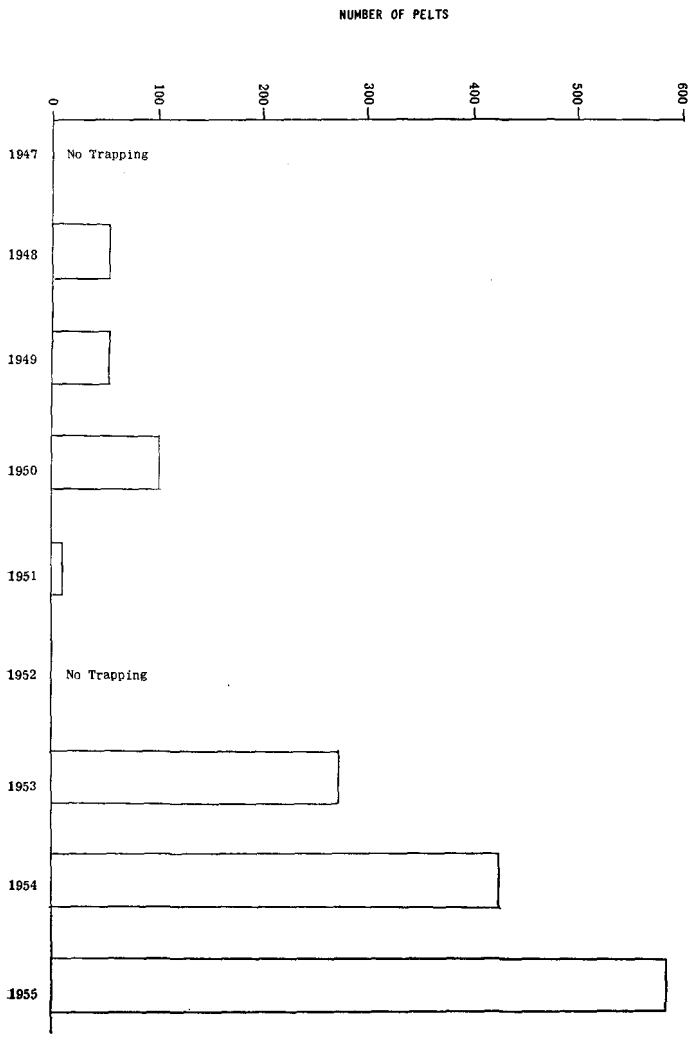
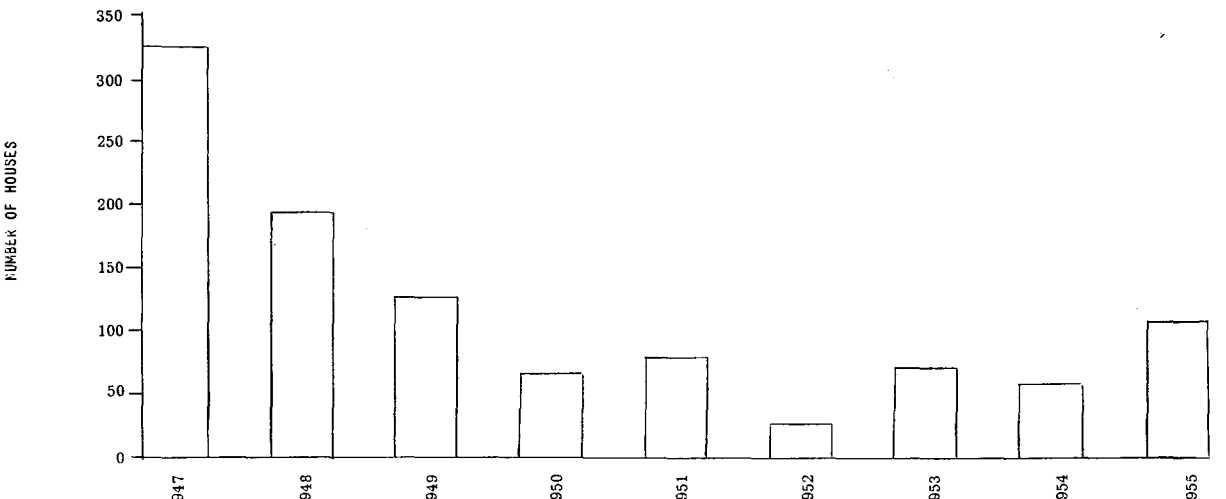


FIGURE 2.
MUSKRAT YIELDS FROM STATE MARSH
(about 550 acres)
1947-1955

FIGURE 3.

MUSKRAT HOUSE COUNTS ON 181
ACRES OF TICE MARSH
1947-1955



Corolla Marsh: Before raccoons invaded the Outer Banks in the early 1950s, the 300-acre marsh at Corolla was one of the heaviest producing muskrat areas in the state. Aerial photographs made in 1948 show a two-acre segment of marsh with more than 40 houses. Trappers who trapped the marsh made lots of money but unfortunately did not keep records of what they caught. According to Dexter Snow, Superintendent of the Whalehead Gun Club, every trapper paid him one-third of what he earned. But Mr. Snow did not keep records either. He remembered the 1950-51 trapping season, however, because it was the last good year for muskrats and his one-third share amounted to about $750.00. Since the total value of the fur was approximately $2,250.00 and the estimated value of the average pelt was $1.80, the harvest that year probably totaled about 1,250 muskrats. The next year an unknown but much smaller catch was harvested and, according to Mr. Snow, no trapping has been done since. A survey of the marsh in March, 1956 revealed why. In the locality of the two-acre segment of marsh that contained more than 40 houses in 1948, only two houses were found and of 21 houses in the vicinity every one had been ravaged by raccoons.

During March, 1956, 10 corn baits were placed on muskrat houses on the state-owned marsh. But they were never eaten. Additional baits put out later failed to kill any 'coons. During July, ten eggs placed in the top of five muskrat houses took an unknown number of raccoons. Too few, however, to help much and next winter as in the past five winters, there will be no muskrat trapping at Corolla.

DISCUSSION

Effectiveness of raccoon control was largely influenced by the following factors: (1) Attractiveness and lethal effect of bait. (2) Population densities on study areas and surrounding terrain, and (3) Seasonal activity of the raccoons.

Corn was the most effective bait and sardines were the least effective. Persimmons and eggs were intermediate. Ninety per cent of the raccoon control effort was with corn.

Baits put out in February and March disappeared faster than at other seasons when food was more plentiful on the marsh. During these months, more bodies were found and this made results easier to measure. The vacuum was usually filled with raccoon from surrounding habitat in May and June until most raccoons left for cornfields. By late summer and early fall, populations in marsh started building up again. From December through February, however, no ingress or egress of animals was noted. To obtain maximum production of muskrats in this type of area, control of the raccoon was necessary from March to November. On sparely populated Bray Island where the influx of raccoons was practically nil, lines were run only in March and April.

By 1954, it was apparent that it did not take many raccoons to destroy the population of nestling muskrats. Evidence of the approximate number was not obtained, however, until May of 1955. A line of eight corn baits had been placed around the perimeter of the 100-acre diked State marsh. Not one had been eaten in five weeks and it appeared that no 'coons were in the vicinity. On May 9, however, an inspection of the marsh disclosed heavy damage to 32 of 35 nesting houses on about 40 acres. Damage stopped after killing two raccoons.

Raccoons dug into houses for other food (nestling rice rats and mice, insect larvae, snake and turtle eggs), not just nestling muskrats. Most of these diggings, however, were on the exterior of the house. Some houses were disturbed and/or opened two and three times a week. On such marsh most litters were apparently devoured before they were one week old. It was not until 1953, following control of the raccoon on State marsh that young nearly two weeks old were found in nests. Some 'coons apparently did not dig into muskrat houses.

Trapping records (see Figures 2 and 4) and statements by trappers indicate that marsh in the vicinity of the study area seldom equaled and rarely exceeded one muskrat per acre. This has always seemed strange to the writer because the habitat in general appears to be equal or superior to marsh elsewhere in the county that produces much heavier yields. Some marsh bordered by wooded swamp has probably always supported some raccoons, it is believed that this animal has been devouring nestling muskrat populations annually, not just in

recent years but for many generations. Furthermore, it appears that marsh not near wooded swamp normally produces a much larger crop of muskrats. While there are no data from other sources, the recent relatively large yields from Bray Island support this theory.

Studies made by Harris (1952) on the Blackwater National Wildlife Refuge in Maryland disclosed that raccoons often tear into muskrat houses. As spring approaches, the number of damaged houses increases steadily and he states, "This increase parallels the expected increase in the birth of young as the main breeding season is approached . . . During April, 1951, an area of about 140 acres was surveyed . . . On the area, 75% of the 55 estimated fall houses had been disturbed, and an estimated 60% of the disturbed houses were severely damaged. Raccoon tracks indicated that the disturbance must have occurred within a period of several nights previous to the survey. The tracks led from one house to the next and did not suggest the presence of more than one raccoon. On one house was found evidence of recent muskrat predation . . . During early May, 1951, a search was made for litters on another refuge area. Most of the few small freshly built houses, in which young muskrats are often found, had been broken into by raccoons." Additional data obtained by Harris in 1949 and 1950 disclosed house damage per cents ranging from 56 to 76 per cent—rates that closely parallel those found on Currituck County marsh. Harris acknowledged this during April, 1954, following an examination of muskrat houses ravaged by raccoons near Currituck. Contrary to our conclusions, however, Harris states: "Raccoons are probably not responsible for the drop in the muskrat population. Raccoon predation alone is probably not severe enough to hold the populations at a low level. However, predation on young muskrats during low population, together with unfavorable habitat conditions, might prevent a rapid increase in the muskrat population."

Control of the raccoon has raised muskrat yields on the Tice marsh from 35 in 1952 to 1,153 in 1955. (See Figure 4.) Currently, raccoon populations remain high in many parts of the county and muskrat populations continue low. Trappers blame otters, raccoons, hawks, and the flood water from hurricanes. J. J. Flora, a fur dealer at Moyock, North Carolina, has this to say, "I have been buying muskrats at Poplar Branch for more than 30 years and on the average about 1,000 a week. In recent years, however, the trappers have not been bringing them in and last winter my purchases averaged about 200 a week." Mr. Flora and three other buyers bought an estimated total of 4,500 muskrats at Poplar Branch during the 1955-56 trapping season. Since Poplar Branch buyers normally handle about 20,000 muskrats, this represents a crop shrinkage of about 75 per cent. The evidence observed indicates this drop to be caused by raccoon depredation on nestling muskrats.

SUMMARY

Experiments to control excessive raccoon populations were conducted for five years (1952-56) on three study areas near Currituck, North Carolina.

Techniques of control involved the use of strychnine with corn, eggs, persimmons, prunes and sardines. Of these, corn was the most attractive to the raccoons and was the most durable.

Full to partial control of the raccoon was achieved on two of the three study areas. The third area was remote from farmland and contained 'coons that apparently did not recognize corn as food.

Control of the raccoon resulted in immediate muskrat population increases. The harvest on the Tice marsh increased from 35 pelts in the 1952-53 trapping season to 1,154 in 1955-56.

Currently raccoon populations are high on most tidal marsh in the county and muskrat populations remain low. According to fur dealers' reports, the number of muskrat pelts purchased are about 75 per cent below normal.

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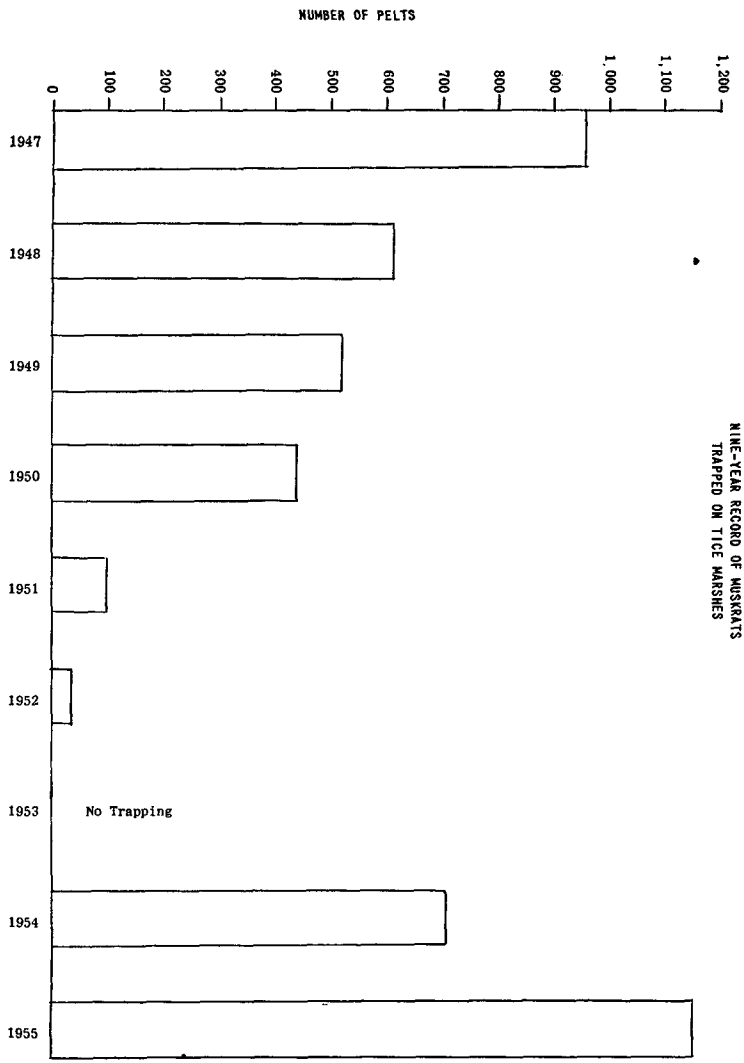

FIGURE 4.
NINE-YEAR RECORD OF MUSKRATS TRAPPED ON TICE MARSHES