

A STUDY OF RACCOONS IN PRINCESS ANNE COUNTY, VIRGINIA

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INTRODUCTION

The Virginia Commission of Game and Inland Fisheries has released live-trapped raccoons in various counties of Southwestern Virginia since 1939 in an attempt to restock depleted areas. The results of this raccoon restocking program are shown in Table 1. A constant demand from organizations and individuals for an ever-increasing number of raccoons for restocking purposes has continued from year to year. For example, during 1946 a total of 587 raccoons were requested by the sportsmen in ten counties of Southwestern Virginia, namely: Wise, Buchanan, Scott, Tazewell, Grayson, Smyth, Roanoke, Montgomery, Wythe, and Page.

Prior to 1946, raccoons for restocking were obtained in several ways. Trappers who were granted special permits by the Commission captured raccoons using steel traps, and a few animals were collected alive by enterprising hunters who preferred to capture the creatures rather than shoot them from trees. In addition, live-trapped raccoons were purchased outside the State, principally from Florida. It was felt, however, that to meet the unprecedented demand for raccoons in 1946 a more intensive effort would have to be made. Many persons felt that raccoons live-trapped here in Virginia would be better adapted to conditions in the Commonwealth than would animals captured in swamps of southeastern United States. Therefore, a cooperative raccoon trapping and transplanting project was evolved between the Virginia Commission of Game and Inland Fisheries and the Virginia Cooperative Wildlife Research Unit.

A live-trap was developed at the Research Unit for use in this live-trapping project and 92 traps were constructed during the fall of 1946. All available evidence indicated that Princess Anne County, Virginia harbored as large a raccoon population as any other section of the state. The Game Commission had received numerous complaints from individuals living in this area regarding raccoon destruction, both to agricultural crops and to muskrats in the extensive marshes found in this section. The landowners claimed severe damage to their corn crops, and trappers reported that raccoons consistently destroyed muskrats, especially those rats caught in their traps. Taking these factors into consideration, it was decided that the trapping could best be carried on in selected areas of Princess Anne County. Permission was subsequently obtained from the Fish and Wildlife Service to live-trap raccoons from the islands of the Back Bay National Refuge during the period January 1 to March 15, 1947. At the end of this time the trapping operations were transferred from the islands to the mainland of Princess Anne County and continued until April 26th. After trapping operations were discontinued a study was made of den trees and raccoon breeding habits in Princess Anne County.

Unfortunately, only limited information could be obtained from the trapped raccoons as they were shipped to the southwestern part of the state soon after capture. Of necessity then, this report is concerned principally with the development of a satisfactory live-trap, procedures used in live-trapping, holding, and shipping raccoons, and an appraisal of various other methods employed in obtaining the species for restocking. However, some information was obtained on the life history of raccoons by daily observations and by handling the trapped individuals.

TABLE I

RACCOON RESTOCKING EFFORTS IN THE STATE OF VIRGINIA SINCE 1938

Years	Numbers released
1938-39	6
1939-40	50
1940-41	21
1941-42	137
1942-43	17
1943-44	30
1944-45	53
1945-46	47

REVIEW OF LITERATURE

The raccoon (Procyon lotor) is a native of every state of the union. In Virginia the raccoon is reported from every county, although it is somewhat rarer in the north and southwest than elsewhere in the State (Handley and Patton, 1947). In the early days of the settlement of this country raccoon pelts were used as a medium of exchange (Whitney, 1931). Still very little has been learned about this furbearer. Most of the accounts regarding raccoons are of general popular information which have been handed down for years; for instance, the masked face, the bushy ringed tail, their nocturnal and aboreal habits, and the fantastic tale that 'coons wash all of the food which they consume. Whitney (1931) calls the raccoon "one of the least understood of the mammals".

Some work has been done on the various phases of the life histories of 'coons, but save for two experiments--one in Ohio and the other in Michigan--no accounts in the available literature have been found regarding a complete study of this species. Stuewer (1943) live-trapped and studied the raccoon in the State of Michigan for several years and is perhaps the most complete and valuable reference. Butterfield (1944) carried on similar studies in Ohio.

For the immediate problem of live-trapping raccoon and transporting them for restocking purposes no accounts have been found in the available literature.

DEVELOPMENT OF THE TRAP

The development of an acceptable trap to live-capture raccoons was of primary importance. It was essential to construct a trap that would not only capture raccoons without injury, but one that would hold the captives for an indefinite period. Traps of light construction were necessary for they would have to be transported on a small skiff and then carried throughout the trapping areas. Raccoons have been live-trapped for population studies in other states using an adaptation of the old Biological Survey box trap, and it was decided that further modifications on this type trap would be made for the present project.

During August and September of 1946 20 experimental traps were constructed. They were made entirely of 12½ gauge 1"x2" welded wire, except for the back which was a 12"x1"^{2"}x1" piece of pine. The dimensions on ten of the traps were 12"x12"x36", and the remaining ten were 12"x12"x24". This trap had a 11"x17" wire door which fell inward and closed the entrance when pressure was placed on the treadle.

In late September these traps were transported to the Back Bay area in Princess Anne County where their effectiveness in capturing raccoons was to be tested. The traps were set for five nights (100 trap-nights). The results were largely negative; three traps were sprung and raccoon hair was found on the doors. The traps proved incapable of holding raccoons, mainly due to ineffective door catches. Accordingly, it was decided that the door and trigger mechanism would be scrapped, but the body of the trap would be utilized. A compromise of 30 inches was agreed upon as the most suitable length.

A description of the materials used and procedures followed in constructing the final version of the trap employed in the present study is given in the following pages.

BODY OF TRAP

Materials required--One piece of 1"x2", 12 $\frac{1}{2}$ gauge welded wire 50"x30".

Construction--The welded wire was bent into a rectangular box, thus forming the two sides, the bottom, and the top, all having the dimensions 12"x30". The remaining two inches of wire were utilized in binding the body together at two inch intervals.

BACK OF TRAP

Materials required--One piece of pine board 12"x1"x1", one ten penny nail, twelve small staples, and one strip of $\frac{1}{2}$ " hardware cloth 15"x40".

Construction--The back board was painted a dark green to prevent weathering. A nail which would later accommodate the bait was driven at an angle toward the top of the trap. The back was inserted into the body of the trap, and attached by means of staples. At the same time, hardware cloth was attached at the rear of the trap covering the top and two sides. This features supposedly would prevent any animal from reaching through the wire to obtain the bait, and theoretically would force the raccoons to enter the door to procure the lure or bait.

TREADLE

Materials required--One piece of 1"x2", 12 $\frac{1}{2}$ gauge welded wire 10"x5", one piece of tin 12"x4 $\frac{1}{2}$ ".

Construction--The tin was bent over slightly on the top and two sides and fitted over the welded wire much like an envelope; this also seemed to strengthen the treadle considerably. Four individual strands of wire were used to fasten the treadle to the bottom of the trap. These strands were fashioned into rings, allowing the treadle free-play. The treadle was attached 15" from the rear of the trap.

DOOR

Materials required--A piece of 10 gauge metal 13"x10 3/4".

Construction--The metal doors were cut to size by a local tinner. A finger lift was fashioned by cutting a section $\frac{1}{2}$ "x $\frac{1}{2}$ " at top center, and bending this section out at right angles. It was believed that this would facilitate the manipulation of the slide door.

FRAMEWORK OF THE TRAP

Materials required--Two uprights of white pine 2 $\frac{1}{2}$ "x27"x $\frac{3}{4}$ ", one top piece of white pine 2 $\frac{1}{2}$ "x1"x $\frac{3}{4}$ ", two pieces of white pine 2 $\frac{1}{2}$ "x14 $\frac{1}{4}$ "x $\frac{3}{4}$ ", and twelve ten penny nails.

Construction of framework--Each of the uprights were grooved $\frac{1}{4}$ "x $\frac{1}{4}$ " to accommodate the metal door. These grooves were cut approximately $\frac{1}{2}$ " from the front of the uprights. The top piece of the framework was nailed directly to the uprights. The purpose of this piece was to prevent warping and keep ice, snow, and debris from collecting in the grooves. The bottom piece of the framework fitted between the uprights. It was notched on the front edge, flush with the grooves of the uprights, thus allowing the door to fall into the groove of the bottom piece. This feature was devised to prevent the raccoons

from raising the door, and eliminated the need of any catch or lock. The middle strip also fitted between the uprights. It's purpose was to discourage warping and it also served as an essential part of the trigger mechanism. A $\frac{1}{2}$ " hole was drilled through this piece, parallel to the top and bottom. Before the framework was assembled the door was placed in the grooves, thus making each framework a separate interchangeable unit.

TRIGGER MECHANISM

Materials required--One piece of thin pliable wire approximately 20" long, and an eight penny nail.

Procedure--One end of the wire was connected to the rear of the treadle. The opposite end was free and had a nail attached. The wire led from the treadle to the top of the trap, then to the front where the nail was inserted into the hole in the middle piece of the framework. The purpose of the nail was to hold the door open. Any pressure applied to the treadle would pull the nail from the hole in the framework and the door would fall.

FINAL ASSEMBLY

To facilitate the transportation of the traps from Blacksburg to the trapping area, the final assembly was not completed until arrival at Back Bay. A framework was placed inside each of the traps, thus saving trucking space. (See Fig. 1) The final assembly was accomplished by inserting the framework into the front of the trap and attaching by either wires or staples. Altogether 92 traps were constructed. The fully assembled trap weighed only 11 pounds. (See Fig. 2).



Fig. 1

Group of assembled traps on Ragged Island

The box traps weighed 11 pounds each. Transportation and shifting of 92 traps presented a problem on the islands



Fig. 2

TRAPPING OPERATION--RAGGED ISLAND

Headquarters for the trapping and study of raccoons were established in a small cabin on the southeast section of Ragged Island on January 3, 1947. When the Refuge was established by the Fish and Wildlife Service, this cabin was salvaged from the remains of a once-prosperous duck club. (See Fig. 3).

Ragged Island is the most southerly of the islands comprising the Back Bay National Refuge. (See Map). It is approximately nine hundred acres in area and is composed of a series of smaller islands interspersed with channels, coves, and ponds. The entire area is predominately marshland; the principal vegetation being narrow leaf cattail (Typha angustifolia), cord grass (Spartina cynosuroides), and bulrush (Scirpus sp.). The only trees to be found on Ragged Island grow in the immediate vicinity of the cabin and on Persimmon Point, these two areas being the two highest points on the island. The trees near the cabin consist of a limited number of oaks (Quercus phellos and Quercus nigra), persimmon (Diospyros virginiana), mulberry (Morus rubra), willow (Salix sp.), and myrtle (Myrica cerifera). Japanese honeysuckle (Lonicera japonica) covers most of the understory in this area. Persimmon Point is characterized by a small grove of persimmons and myrtles. Here, too, a luxurious growth of honeysuckle dominates the understory. (See Fig. 4). It is interesting to note that none of the trees on Ragged Island contain cavities which might be used as dens by raccoons.

The trapping operations began with four traps being set near the cabin on the night of January 3rd. More traps were set out progressively as they were assembled. The locations of trap sets were governed to a certain extent by accessibility of the skiff to likely-appearing areas, and the trap positions were governed mainly by observations of raccoon activity, such as tracks, runways, and scats. No attempts were made to set the traps in definite grid patterns. The trap sets were changed constantly to correlate with the movements of the raccoons as indicated by their tracks. Their activities appeared to be concentrated along the edges of the marsh and examinations of scats gave evidence that crippled waterfowl was one of the principal sources of food during January. A freshly consumed Canada goose carcass was found on Ragged Island on January 23rd.

Thirteen raccoons were captured on Ragged Island during the period January 3 to the 23, as a result of 731 trap-nights. The first raccoon was trapped in the yard of the cabin approximately seventy five feet from the back door. Four complete nights were lost because of motor trouble and storms on the Bay when the traps could not be tended. January 8 was the most successful night during this period when four raccoons were captured. Three of these animals were trapped at Persimmon Point within a 100 foot radius. Four raccoons were trapped along the edges of Otter Pond, which is located approximately one half mile to the northwest of the cabin. This pond, muddy and shallow, covers a surface area of an acre and has an outlet to the Bay. It appeared to contain a large fish population, and this in turn might well account for the numerous raccoon signs in this

vicinity.

Seven of the raccoons captured on Ragged Island were females. The heaviest 'coon trapped was a male weighing 15 pounds 4 ounces; the smallest, a female which weighed 4 pounds 12 ounces.

A variety of bait was utilized during the trapping on Ragged Island in an attempt to determine the lure most attractive to raccoons in this area. Six raccoons were captured with sardines as bait, three with crippled waterfowl, three with fresh carp, and the last one with smoked herring.

One of the main advantages of carrying on a trapping operation on the islands of the Refuge was that there was relatively no interference with the traps, there being no other inhabitants on the islands. During the trapping on Ragged Island only two mammals besides raccoons were caught in the traps; a large black and white house cat (Felis domestica) was captured the first night the traps were set out and later two rats (Rattus norvegicus) were caught in the traps. The cat, so far as could be determined, had been living on the island for at least eight years and was extremely wild. Tracks of other large mammals found on Ragged Island included muskrat (Ondatra zibethica), otter (Lutra canadensis), and mink (Mustela vison), but none of these animals were captured nor did they disturb the traps. It may be of interest to note that a largeherring gull was caught in a beaver trap at the edge of Otter Pond.

Trapping operations were moved to Long Island on the 24th of January when the raccoon population appeared to have been substantially reduced on Ragged Island.



Headquarters on
Ragged Island

Fig. 3



Southern tip of
Ragged Island
where three raccoons
were captured.

Fig. 4

LONG ISLAND TRAPPING OPERATIONS

Long Island is separated from Ragged Island by the Little Narrows, a channel 150 feet in width. (See Map). The distance from the headquarters on Ragged Island to the southern tip of Long Island is two miles of open water across Sand Bay. Long Island is two and one half miles long running north and south. The total acreage is computed to be about 3,000 acres.

A wooded expanse covering about 25 acres of loblolly pine (Pinus taeda) hackberry (Celtis sp.) and persimmon lies near the southern portion of the island. (See Fig. 5). The understory is dense, consisting of entanglements of Japanese honeysuckle, greenbrier (Smilax sp.), poison ivy (Rhus toxicodendron), and grape (Vitis sp.). An extensive marsh completely surrounds this wooded area with the predominant vegetation of narrow leaf cat-tail, cord grass, bulrush, and spikerush (Eleocharis sp.). (See Fig. 5). During the period when the trapping was in progress most of the marshland was burned to improve the habitat for waterfowl and muskrats.

Two fields comprise 80 acres of the central portion of the island; they are cultivated yearly by the refuge personnel to provide winter feeding grounds for Canada geese. During the winter of 1947 approximately 2,000 geese fed daily on the rye which had been planted for their benefit. Numerous raccoon tracks were observed in and around these fields during high tides; the high water presumably compelled the raccoons to leave the marshlands and they moved to higher ground in search of food. The carcasses of two Canada geese were discovered in the lower

field, but it could not be determined what predator, if any, caused the death of these two geese.

The southern field is bordered on the west by a narrow wooded area composed of loblollies, persimmons, hackberries, and myrtle. An almost impenetrable mass of honeysuckle, grape, and greenbriar constitutes the ground cover. Another small grove of trees, principally persimmon and holly (Ilex opaca) divides the two fields and it is here that the island reaches its narrowest point. At the northern tip of Long Island still another outcropping of persimmons, myrtles, and mulberries can be found, along with the omnipresent greenbriar and honeysuckle.

A superficial survey was made of Long Island before setting out the traps. Innumerable tracks were found on the beaches along the marsh, but it was impossible to cover the extended shoreline with the limited number of traps. It was thought at this time that the majority of the raccoons were denning in the wooded regions and feeding in the surrounding marsh and along the edges of the Bay. In less than an hour's time three raccoons were observed in the wooded area near the southern tip of the island. One 'coon was discovered atop a snag and two others were jumped from their nest beneath a thicket of honeysuckle. It was reasoned that by setting a line of traps around this loblolly woods the raccoons might be lured into the traps en route to their feeding grounds or when they returned to their dens. The first line of traps was established accordingly.

As the operations continued, a thorough search for raccoon signs was made on all sections of the island. As on Ragged Island, the traps

were moved about constantly in an effort to correlate trapping operations with the movements of the raccoons from one area to another. By the time the trapping was discontinued on Long Island all the most likely looking territories had been trapped with varying degrees of success.

The raccoon campaign on Long Island continued from January 24 to March 16th. Due to the very nature of the project many complications arose during this period. Checking the traps daily necessitated a trip across two miles of open Bay in a small skiff equipped with an unpredictable outboard motor (See Fig. 7). According to local inhabitants, the winter of 1947 was the most severe in ten years. The United States Weather Bureau at Cape Henry disclosed a departure from normal temperatures during February of 141° and during March-- 152° . Storms and ice on the Bay, in addition to constant trouble with an outboard motor, resulted in twenty four lost trapping nights. During one period of six days the Bay was completely frozen over and trapping was at a stand-still. During these periods of enforced neglect five raccoons were found dead in the traps. It was not definitely determined whether the creatures perished from exposure, starvation, or some other combination of factors. In addition, three raccoons escaped from the traps during one of these periods; had it been possible to check the traps daily it is improbable that any of these raccoons could have chewed their way to freedom. Storms on the Bay likewise prevented the commercial fishermen from fishing and it was extremely difficult to obtain fresh bait. These unfortunate circumstances doubtless affected the

trapping results.

Thirty one raccoons were trapped on Long Island. Eighteen of these were captured during the first twelve days when the traps were concentrated around the loblolly woods. The most successful night was January 26 when six raccoons were trapped (See Fig. 8). Twenty four of the 'coons trapped on Long Island were males. Whether this was a true picture of the sex ratio was not definitely determined; perhaps this divergence can be explained by female inactivity after the mating season. The heaviest raccoon captured was a male weighing 18 pounds 4 ounces; the lightest, another male weighed only 3 pounds 3 ounces. Twenty five of the raccoons were captured using fresh carp as bait, three with sardines, and one each with smoked herring, salted spots, and bluegill.

Long Island supported at least two mammals not present on Ragged Island; namely, the gray fox (*Urocyon cinereoargenteus*) and the marsh rabbit (*Sylvilagus palustris*). A specimen of the latter was captured in a box trap baited with bluegill sunfish. An otter was captured on the south end of Long Island in a beaver live-trap. (See Fig. 9). Two Virginia rails were caught in box traps.

Trapping operations were discontinued on Long Island when raccoon signs became scarce, and when it no longer appeared practical to continue the operations there.



View of marsh and
loblolly woods on
Long Island

Fig. 5



Back Bay and
wooded area
on Long Island

Fig. 6



Fig. 7

Transportation on Back Bay was provided by skiff and unpredictable outboard motor (note duck blind)



Six raccoons captured on Long Island on January 26th

Fig. 8

TRAPPING ON THE MAINLAND

On March 17 the traps and equipment were moved from Ragged Island and headquarters were established near Back Bay, Virginia. In the hope of interesting local trappers in the live-capture of raccoons for the State's future restocking program, the help of a professional trapper was obtained during the early days of the mainland operation. The trapper was loaned thirty five box traps and two beaver traps. He carried on the work for two weeks (490 trap-nights) and at the end of this time he had captured two raccoons, one in a box trap and one in a beaver trap. By this time the trapper had become disinterested and wished to end the experimental operation; he felt that the financial returns for the great amount of labor required in moving and baiting the traps were too small to warrant his efforts.

In the meantime, lines were set out in other selected areas. Every landowner approached cooperated fully and was happy at the prospects of having the raccoons removed, for they evidently cause considerable damage during corn season and occasionally in chicken pens.

It was difficult to find acceptable areas for trapping. The presence of signs indicating substantial raccoon populations and accessibility to roads were the deciding factors. Between the period March 16 to April 26 eight separate lines were maintained with varying degrees of success. The habitats of the territories trapped differed widely (See Fig. 10). Sets were made in swamps, marshes, and along drainage ditches and rivers. One line encircled a field where

the corn had not been harvested, and to all appearances, the raccoons had been feeding there most of the winter.

The only line which yielded sufficient successes and relevant information to justify a detailed account was the final one established. This line was started on the eastern side of North Landing River near the North Carolina border. A sandy beach merged here with the extensive remains of a cut-over cypress swamp which supported a diversified vegetation. This tract of land had been posted against hunting, thus the factor of protection in combination with an abundance of food and cover, provided an excellent raccoon habitat. It was near this swamp that a farmer reported having trapped 27 raccoons from his cornfield during the late summer of 1946.

In a total of 394 trap-nights (from April 8 to April 26) 16 raccoons were trapped in this region. The trapping success was 4.06%, a much higher percentage than that obtained from any previous line. (See Table 2).

It was decided that trapping would not be advisable after the end of April, mainly for the reason that female raccoons were reaching the end of their gestation periods; capture at this time would have been both impractical and inhumane. Since the raccoons were being used for restocking, it was not desirable to ship males alone and the trapping operation was therefore terminated. The months of May and June were spent in making a study of den trees and the breeding habits of raccoons in this area.

The principal advantage of trapping on the mainland was that the traps could be inspected daily, regardless of the weather conditions.

However, several disadvantages were encountered which did not exist on the islands of the Refuge. The raccoons could range over unlimited areas while the traps were necessarily concentrated in small areas. More interference with the traps was experienced on the mainland than on the islands, resulting in losses of bait and a reduction in the potential trapping successes. The chief offenders were opossums and house cats. Both of these proved difficult to keep out of the traps. Other offenders were crows and dogs. A turkey vulture and a snapping turtle were also captured during this period. On at least two occasions traps were tampered with by humans. All the traps on one line were systematically sprung and upset, and a week later there was a repetition of the same interference. In the latter instances, characteristic damage to two of the traps revealed that two raccoons had been released from the traps.



Live otter captured
off Long Island

Fig. 9

Typical swamp habitat
on mainland



Fig. 10

Attention Patron:

Page 24 omitted from
numbering

REMOVAL OF RACCOONS FROM AREAS

Handling

During the initial stage of the project a funnel was devised to facilitate the handling of raccoons. It was constructed of 1"x2" welded wire fashioned into a cone 36" long and a 10" diameter at the maximum, tapering down to 3 inches. A square of masonite was attached to the end which then fitted snugly into the doorway of the traps. The small end was enclosed with welded wire after a small raccoon had succeeded in crawling through it. Fortunately, this raccoon was being tagged and weighed in the cabin and it was recaptured. When the door of the trap was raised, the raccoon would usually slink cautiously into the funnel and become imprisoned in the smaller end. A series of sticks inserted behind the 'coons would prevent any further movement and while thus imprisoned the creatures could be handled without danger. The total weight of the funnel was one pound. (See Fig. 11).

After capture the raccoons were conveyed to headquarters in several different ways. If the trap had been damaged and consequently in need of repair, the 'coon was usually retained in the trap and carried back. At other times the funnel was utilized and the raccoons were transferred from the trap to a carrying cage or a burlap bag. Transporting the captured animals in the traps proved more satisfactory, for the construction of the carrying cage was such that it was difficult to remove the raccoons, and when using a bag there was always a chance that the raccoons would chew their way to freedom.

At the island headquarters an elevated platform was constructed

to accommodate six traps and by setting it against the western side of the cabin some protection from the elements was afforded the captives. A strip of tin covered the tops of the holding pens and during severe weather 12" boards were placed on either side to provide added shelter. The use of an elevated platform allowed the scats to fall to the ground and prevented contamination of the pens. (See Fig. 13).

The traps proved to be excellent holding cages. It was relatively easy to insert food and water for the captive raccoons merely by raising the door slightly. Several experiences with larger holding pens belonging to local hunters and trappers proved most unsatisfactory. During the course of the study no raccoons escaped from the trap-holding pens once they were provided food and shelter. However, on one occasion, a male raccoon which had been chased for several hours by a pack of dogs was placed in one of the traps prior to the return to headquarters; this raccoon knawed away the bottom piece of the framework and made his escape.

It was found that once the raccoons were imprisoned in the funnel they were reluctant to enter it again, and to eliminate unnecessary handling the tagging, weighing, and shipping were usually performed the same day in one operation. There was difficulty at times in coaxing raccoons into the funnel, but it was found that this reluctance was usually created by excessive tension in the raccoons. It seemed that any distracting noises, presence of a dog, or more than two attending people would arouse the raccoons to the point of fury and they would prove correspondingly uncooperative.

A large sized fish-tag (No. 3 Monel) numbered and bearing pertinent information was clipped to the ear of each raccoon in order that the survival rate in their new habitat might later be ascertained. (See Fig. 12). According to Stuewer (1943) it was found that only six tags were known to have been lost out of 256 individuals tagged in this manner. While still in the funnel, the raccoon was weighed, sexed, measurements taken, and any abnormalities noted. Inspection was also made for the presence of ectoparasites.

Shipping

There were nine shipping crates utilized during the trapping period, all of them varying in size. (See Fig. 14). Their sides were covered with welded wire to allow ventilation, and the top, bottom, and ends were made of wood. The top was later made to serve as a door by attaching hinges and hasps. When the first shipments were made, only one or two raccoons were placed in a crate, but later it was found that larger numbers could be put in one crate without harm. On one occasion, seven male raccoons were shipped together, all of which arrived at their destination in good condition.

In preparing for the first shipment, the raccoons were turned from the funnel into bags and then the bags containing the 'coons were placed in the shipping crate. The crate top was then closed and by holding onto the bottom of the bags and gradually pulling them out, the raccoons were deposited in the crate. This procedure became difficult and impractical when more than two raccoons were being shipped in the same crate and alterations were therefore made

on each of the crates. An 8"x8" square was cut in the side of each crate and a door was constructed to fit this opening. The raccoons could then be transferred directly into the crates from the funnel. (See Fig. 15). This innovation speeded up the shipping procedure and was generally more satisfactory than the former method. Without exception, once the raccoons were in the crate they would huddle beneath the door and much care had to be exercised to prevent all of them from escaping when additional raccoons were introduced into the opening.

A can for water was fastened in each crate, but neither food nor bedding were provided. All the raccoons shipped in this manner withstood their journeys satisfactorily. In contrast, seven raccoons had been shipped from the area by local hunters, prior to the operations beginning January 1, 1947, and it was reported that two of them had died during shipment, presumably from suffocation.

When the trapping was being carried out on the islands shipments of raccoons necessitated periodic trips to the mainland on the game warden's launch, and from there the raccoons were transported to the express office in Norfolk. A card was invariably sent to the game warden who was to receive the shipment of raccoons with instructions to notify the writer regarding the physical condition of the raccoons upon arrival.

During the present study 75 raccoons were shipped to 6 of the counties in Southwestern Virginia:

Scott County -----	4
Wise -----	20
Tazewell -----	20
Buchanan -----	17
Smyth -----	10
Montgomery -----	4
	<hr/>
	75



Fig. 11
Funnel used in tagging and examining raccoons
(Photos by G. O. Handley)



Fig. 12
Each raccoon was tagged with a No. 3 Monel tag
in order that the survival rate might later be
ascertained.



Fig. 13

Box traps were utilized
as holding pens.



Fig. 14

Two 'coons ready for
shipment to South-
western, Virginia.



Fig. 15

Raccoon being
transferred from
funnel to shipping
crate.

OBSERVATIONS ON THE RACCOON BOX TRAPS

It seems appropriate at this time to present an appraisal of the raccoon box traps which were developed for the trapping and study of raccoons by this investigation. The traps were generally good; their best features are listed below:

1. It was proven that they will capture and hold raccoons if the traps can be checked on a daily basis.

2. The groove in the bottom piece of the framework has demonstrated its worth. The door falls into this groove and below the wood surface and the raccoons attempting to lift the doors are thwarted. Raccoons are very adept with their front paws and constantly probed and searched for a possible opening when first captured. If the door fell on a flat surface many would have undoubtedly escaped. This groove made a catch or lock device on the traps unnecessary.

3. The box trap operates on a simple principal and inflicts no injury on the animal.

4. The versatility of the traps was ascertained by its usefulness as a fish live-box, a holding pen, and a carrying cage.

5. Even though the traps were subject to all types of weather conditions, none of them warped and few were ever sprung.

6. The trigger mechanism was simple and effective. It was found that by rubbing vaseline on the nail and wire the mechanism worked more smoothly and efficiently.

7. The traps, though necessarily large, were relatively light (11 pounds). This feature was important in that they had to be con-

stantly moved and carried about the islands.

Disadvantages of this trap are as follows:

1. In that the framework fitted inside the trap, the raccoons were provided with an available surface for chewing. Though only one raccoon was able to escape by chewing the framework, much damage was done to the traps by the captured raccoons. Constant repair on the framework was therefore necessitated. By placing the framework on the outside of the wire all damage to the woodwork would have been eliminated. This could be accomplished by lengthening the three interior pieces of the framework and increasing the width of the metal door. The damage could be prevented also by covering the exposed portions of the framework with tin.

2. The hardware cloth which covered the backs on the top and two sides of the traps would have proven advantageous: had it been continuous and extended across and included the bottom. When bait (such as sardines) was used which could not be hung on the nail and had to be placed on the bottom of the trap back of the treadle, much of the bait was lost by small rodents digging underneath and thence into the back of the trap.

3. The doors should be of heavy metal. At least five raccoons escaped from the traps by forcing the thin metal doors (12 gauge) out of the grooves and then crawling out between the door and the framework. This condition was corrected when a strip of wood was nailed to the top and bottom of the thin metal doors, thus making them rigid.

5. Undoubtedly the traps should have been enclosed during the

winter trapping to afford some protection to the captive animals. Mortality would possibly have been reduced.

6. Almost without exception a captured raccoon ripped the treadle loose from it's attachment, and often bent the treadle in half. Constant repair of the treadles was therefore made necessary. The only solution here would be to construct treadles of heavier gauge metal and secure them with heavier wire rings. It seemed that the raccoons would first expend their wrath on the treadles, then after disconnecting them they would invariably reach out through the wire on either side of the trap and pull in fragments of surrounding vegetation and debris.

BAILEY BEAVER TRAP

As a test experiment in determining the best type trap for live-capturing raccoons, twelve Bailey beaver traps of the Virginia Wildlife Unit were utilized at intervals during the period of study. (See Figs. 9 and 16).

Only three raccoons were captured in these traps—one on Ragged Island, one near Pungo, and one at Pulintary Marsh. Actually, these traps are well adapted to the capture of raccoons; they can be set directly in a runway, while the box trap presents an obvious blocking at an established runway and raccoons tend to detour. For this reason, the box traps were placed at right angles to the runway but the beaver trap is in the open and appears to be easily obtained. Another good feature is that the trigger mechanism is well adapted to the feeding habits of the raccoons. They utilize their front paws for digging and obtaining food, and in grasping the bait wired to the trigger, the trap is easily thrown without causing injury to the captive.

The beaver traps were utilized infrequently, however, for their weight and bulkiness made them impractical for island trapping. They weigh approximately 37 pounds, and naturally only one or two of the traps could be carried in the small skiff. Too, only one trap could be carried into the marsh at one time and this was slow and burdensome work. In contrast, four of the box traps could be carried and set with greater ease.

A lack of the proper type bait also limited the use of these traps. During several periods in February and March only sardines were available

and these could not be used to bait beaver traps. Of the three 'coons captured in the beaver traps, one was caught with the leg of a crippled snow goose, one with the tail of a bowfin, and the third with catfish heads. Incidentally, the raccoon captured in a beaver type live-trap near Pungo, Virginia was destroyed. Judging by track evidences a dog had dragged the trap a considerable distance, and had somehow managed to squeeze through the trap mesh to chew off three legs of the captured raccoon and rip the fur from its back.

Another disadvantage of the beaver trap was the difficulty occasioned in removing captured raccoons from the traps. This maneuver was accomplished by using a dip-net which had been fashioned by bending heavy gauge wire into a hoop and a short handle; the hoop was then sewed into the open end of a burlap bag. The trap was opened slightly and the net inserted into the trap. By holding onto the handle and by careful manipulations, the raccoon could be desposited in the bag and then lifted from the trap.



Salley beaver trap
set on Sagged Island

Fig. 16

One of three raccoons
captured in Salley
beaver trap



Fig. 17

STEEL TRAPS AS A METHOD OF LIVE-CAPTURING RACCOONS

An existing law prohibits the trapping of raccoons in Virginia, and raccoon hides being literally worthless, illegal trapping is probably negligible. However, a number of enterprising trappers have been granted special permits issued by the Commission and have been live-trapping raccoons for the restocking program using steel traps.

There are several advantages of the steel trap over the box trap. A trapper can easily carry 50 steel traps into habitat where the box traps and beaver traps could not be employed, and by concealing the steel traps in runways, bait is not always necessary.

The greatest disadvantage in using steel traps to capture raccoons for restocking is the injury imposed on the creatures themselves. It appears to the writer that for restocking any species only the healthiest specimens should be released. Regardless of the size used, the steel trap almost invariably inflicts some damage to the feet or toes of the imprisoned raccoons; usually the bones are broken and the creature eventually loses feet or toes. Much of the damage is self-inflicted for raccoons tend to "ring" or chew off the captured members in attempts to escape. In most instances, the larger the individual the more damage is suffered. It can hardly be argued that a raccoon with only three legs or feet will make the best risk in a restocking effort. An animal undoubtedly has adversities enough in adjusting itself to a new environment without physically handicapping it in such vital activities as food-getting, climbing, and locomotion. However, the raccoons seem able to adapt themselves to varied circum-

cumstances. Two of the raccoons captured on Ragged Island lacked front legs, but appeared well able to take care of themselves; they were, in fact, unusually obstinate and difficult to handle.

As an experiment, 12 steel traps were set for a week near Pungo and four raccoons were captured. Two small raccoons were caught across the toes with the skin barely broken, but a large male had mangled his leg severely. The carpal bones were protruding through the skin and it appeared likely that he would lose his foot. The fourth raccoon was found dead in the trap; he had accidentally drowned but it was clearly evident that he had chewed his leg extensively prior to drowning.

There have been some reports of live-trapping raccoons with steel traps without injury to the creatures. This is accomplished by wrapping the jaws of the trap with tape or by altering the spring mechanism. The traps must be tended early and the raccoons taken from the traps in order that self-inflicted damage be minimized.

There is still another disadvantage concerned with steel trapping. Raccoons are at times savage and belligerent, and it is difficult to release them from steel traps. The best method found was to throw a dip net over the captured raccoons before attempting the release, but this was infinitely less satisfactory than the box-trap funnel arrangement.

VERBAIL TRAPS

During the latter part of April, six Verball traps were obtained to test their effectiveness in capturing and holding raccoons. They were set out for 66 trap-nights, but no raccoons were captured in them. A variety of sets were attempted. The traps were placed in runways without bait, the bait was placed at various heights above the traps, and some sets were tried with the bait buried beneath the traps. On several occasions the bait was stolen and five different times the traps were thrown. During the time when the Verbails were being tested 12 raccoons were captured in the box traps in the same general area. As a further test for the traps, two of them were set for five nights in a 3'x3'x5' holding pen containing a raccoon; they were set in such a manner that the raccoon would be forced to step on the traps. For five straight nights both of the traps were sprung, but on all occasions they failed to hold the raccoon. The feet of a raccoon are slender and tapered and they appear able to escape easily from Verball traps.

HUNTING WITH DOGS AND LIVE-CAPTURING RACCOONS

Another method utilized in acquiring live raccoons was that of using dogs to tree the raccoons, and then by various means taking the 'coons from the trees. This procedure has excellent possibilities as a source of supply if enough 'coon hunters can be induced to live-capture their prey rather than shoot them from trees. The fact that raccoon hides have recently been bringing less than a dollar each has convinced many hunters that it is preferable to obtain live raccoons for the State. For example, the Game Commission collected over 200 raccoons from hunters and trappers during the winter of 1947 by paying a premium price for live-trapped 'coons.

Live-capturing 'coons with the aid of dogs is not easy. It is important that a man who is able to climb and handle himself well above ground be included in the hunting party. Once the raccoon is "treed" it is necessary that one of the members of the party scale the tree and shake it out. Those below snare the fallen animal with a dip net. If the raccoon has taken refuge in a hollow it is drawn out with a noose, tongs, fire, or explosives.

In Princess Anne County much of the 'coon hunting is done in the daytime. The writer spent several days in the field with a group of hunters, but the hunts were unrewarding. On one occasion, the 'coons refused to "tree" and three raccoons were killed by dogs in the marsh. Two of the three were pregnant females. Sixteen raccoons were turned over to the State by a hunter who had been granted a special permit, but he would not disclose the total number of 'coons his dogs had

killed in the process of capturing the sixteen. (See Fig. 17).

At the present time the 'coon hunters in Princess Anne and adjoining counties are organizing an association. Two of the aims of this organization are to prohibit shooting raccoons from trees and to discourage the practice of destroying trees. If these conservationists take their self-imposed rulings seriously, the State may find that hunters will furnish them a yearly quota of live raccoons. Thirty five hunters and several hundred dogs should be able to capture alive a substantial number of raccoons during a season. Such 'coons would be very valuable for use in any raccoon restocking project which might be undertaken here in Virginia.



Fig. 17

A raccoon caught in the marsh by
hounds. This 'coon refused to "tree".

BAIT

It was important from the beginning to determine the bait or lure most readily acceptable to raccoons in this region, and one which could be both easily obtained and economical. In the Michigan trapping, Stuewer (1943) found that a combination of smoked herring and corn was the most tempting bait. The herring was used to serve as the lure and the corn was eaten once the raccoon was in the trap.

The raccoon, like all other species, will eat what is available in season, and as this particular trapping project was being carried on in the winter, natural food was at a minimum. This fact probably accounts for the success which was obtained with a wide variety of bait. The most effective bait tried on the islands was fresh carp, but on the mainland raccoons were captured in greater numbers with a combination of carp and corn. Sardines, both the California variety packed in tomato sauce and those packed in soy bean oil, were equally successful. However, sardines had several disadvantages which rendered them impractical. In the first place, they are rather expensive; to adequately bait a trap a full can should be utilized. At the cost of twenty two cents a can and with a total of 92 traps to be baited, the cost of baiting one night with sardines would have been twenty dollars. Sardines were employed sparingly when other baits were unavailable by having one can usually serve to bait at least five traps. Another disadvantage was that rodents appeared to relish sardines and were responsible for daily losses. Too, when the traps were set along the edges of the marsh, sardines were consistently washed away by the tide

when it rose or fell according to the changes in wind direction.

Ordinarily, carp could be bought from commercial fishermen on the bay for six cents a pound, but during the winter trapping adverse weather conditions suspended most fishing activities and baiting of the traps suffered accordingly. Carp could usually be obtained on the mainland, but with the advent of spring, the carp in the traps became putrid in a few days and the baiting became progressively expensive. 'Coons would not enter a trap unless the fish was relatively fresh. The carp was cut into sections of about one half pound each.

In summary, the following baits were used to trap raccoons: carp, catfish, bowfin, fried catfish, corn, mackeral and corn, carp and corn, perch, sardines, leg of snow goose, crippled canvas back, smoked herring, salted spots, and bluefin sunfish. Other baits used without success were: muskrat carcasses, honey, after-dinner mints, apples, cracklings, bread with jelly, and blue crabs.

NUMBERS HANDLED

During the trapping period January 3 to April 26 seventy raccoons were captured. Forty four of these were trapped on the islands of the Back Bay National Refuge and 26 in the variagated habitats of Princess Anne County. Eleven raccoons were collected from a local hunter who possessed a special permit to obtain live raccoons for the State, and three live 'coons were obtained from a local trapper. The total number of raccoons handled during the study was eighty four. This figure does not include the immature raccoons attended during the breeding habits study. The trapping success by month is given in Table 2.

The data in this Table would seem to indicate that January was the best trapping month of the four, and that any future live-trapping of raccoons might be most successfully carried on during that month. However, there are certain factors which should be considered before any such conclusions can be reached.

January, 1947 was unusually warm. The United States Weather Bureau at Cape Henry reported an accumulated departure from normal temperatures of plus 251° F during January. The higher temperatures probably accounted for the general increased activity of the raccoon populations during the entire month.

The law of diminishing returns is well exemplified in the trapping of raccoons. Only a definite number inhabit a region and the greatest success was usually obtained during the first week of trapping in a given area. As the raccoons were removed, the population naturally

decreased and the chances of trapping the animals correspondingly diminished.

Bait was an important factor. When the traps were baited daily the chances of capturing the raccoons undoubtedly increased. The mild January weather permitted more regular checking of sets than was possible during the months of February and March when the Bay was un navigatable a good deal of the time, thereby making it impossible to tend the traps regularly.

The month of April shows a percentage success ratio of 1.87% but during the latter part of this month one separate line yielded a 4.06% ratio.

The best time for trapping raccoons in Southeastern Virginia could not definitely be determined, in that trapping was attempted only during a four-month period. Raccoons are probably less active in the winter but their natural food supply is limited. During the summer and fall the raccoons are more active, but natural food is available. In the latter seasons, the presence of juvenile raccoons should substantially increase trapping results. Stuewer (1943) found that the months of May, July, and August were the most profitable trapping periods in Michigan.

TABLE II

TRAPPING SUCCESS BY MONTH AND BY AREA

<u>Month</u>	<u>No. of 'Coons</u>	<u>Trap-nights</u>	<u>Trapping Success Percentage</u>
January	26	1190	2.18
February	14	712	1.9
March	12	1314	0.91
April	18	958	1.87
	<hr/>	<hr/>	<hr/>
Totals	70	4174	1.67
	<hr/>	<hr/>	<hr/>
Ragged Island	13	731	1.77
Long Island	31	1731	1.77
Mainland	26	1712	1.5
	<hr/>	<hr/>	<hr/>
Totals	70	4174	1.67

DESCRIPTION OF THE RACCOON

Hamilton (1943) describes only one subspecies of the eastern raccoon (Procyon lotor lotor) as appearing in Tidewater Virginia. Hunters and trappers in this area declare that there are at least four varieties of raccoons. They tell of swamp 'coons, marsh 'coons, woods 'coons, and a long-legged variety known as the "old coaster". Any raccoon seen by these men can be quickly classified into one of these groups. There is no doubt about there being color variations among individual raccoons, and it has been observed during the trapping operations that raccoons live in any of the habitats available--swamps, marsh, and woods. Whether or not there are more than one sub-species in this area of Virginia has not been definitely established.

In attempting to describe a raccoon representative of the area, the following observations are given:

Dentition--I:3/3 C: 1/1 PM: 4/4 M: 2/2 equals 40; canines from 10-15 mm. long, distance between canines from 18-31 mm; canines are often worn or broken in individuals handled; at times canines worn to level of incisors; mollars broad.

Ears, Head, and Face--Ears 25-43 mm. long, prominent, usually erect except when angry, then ears flattened against neck; ears usually light gray in color; top of head dark gray and black with black stripe running between eyes almost to snout; intense black marking or mask surrounding eyes and narrowing at back of cheek; whitish gray usually above and be-

low mask; muzzle rather long and sharp, snout black and flexible; whiskers light ray; eyes prominent, black.

Neck and Back—Neck short; usually a reddish-gold "sunspot" on neck region; yellow-tan on middle of back growing progressively darker toward rump; pelage thick and long.

Underparts—Silver gray or yellow-tan, always lighter than the back region.

Tail—Striped with alternate dark brown and yellow-tan, bushy, average length 150-210 mm.

Legs and Feet—Light, bleached-out gray with mixture of dark brown; hind feet resemble those of human infant; naked, thin, long, 5 toes with claws; average from 91-100 mm.

Local hunters claim that the sex of raccoons can be determined by examining the mask; if the black is continuous across the face, the 'coon is a male; if the mask is broken by a lighter coloration on either side of the eyes, the 'coon is a female. This method of distinguishing the sexes has been tested. In some cases the hunters were right, but the writer has found this feature too unreliable to be used as a criteria. Another supposed method of distinguishing between the sexes is to observe the "sun spot" immediately back of the neck. The male usually has an intense marking, whereas that of the female blends into the coloration of the back region.

Among the individuals handled during this study, there was a surprising variation in coloration. A raccoon captured with dogs near Munden, Virginia was almost entirely black. It is interesting

to note that this raccoon "treed" in a snag not over six feet tall, and that an extremely light, cream-colored female was found in the same den.

There have been several reports of albinism in the raccoon population in Princess Anne County. One particular Norfolk hunter has a mounted specimen of a pure albino captured in the county.

SEX RATIOS

Stuewer (1943) found a male:female ratio of 1.08:100 (133 males to 123 females) among 256 raccoons trapped in Michigan. Butterfield (1944) reports a sex ratio of 46% male:54% female among juvenile raccoons trapped during 1942 and 1943 in Ohio.

It is believed that sex ratios of raccoons in most areas are about equally divided. However, of the 84 raccoons handled in the present study, 58 were males and 26 were female; a male to female ratio of 2.23:1. Of the raccoons live-trapped, there was a ratio of 2.04 males to 1 female (47 males to 23 females). The raccoon population appeared to be more nearly equal on Ragged Island than in any other region. Since the raccoon is polygamous and the trapped creatures were being used to restock depleted areas, a predominance of females would have been preferable. The ratio obtained was undesirable, but unavoidable. It may well be that the ratio found is not a true picture of the raccoon population in Princess Anne County. A total of 84 raccoons may not be considered an adequate sampling of the population. Considerable work would have to be done over a period of years to determine whether this trend is definitely significant.

It may be that the disproportionate sex ratio shown on Table 3 may be explained by the fact that the trapping was done during the breeding season and that the females were consequently less active during this period. The 'coon hunters in Princess Anne County claim that for many years they have been catching an even higher percentage of males than the present ratio indicates. They believe that female

raccoons are either more difficult to capture, or that for some unknown reason the female population in this county has been reduced. Of the 11 raccoons collected from local hunters, 8 were males. The three raccoons captured with steel traps were males. Perhaps the present ratio is an indication of a condition of over-population or of a limited food supply.

TABLE III

SEX RATIO BY AREAS AND BY MONTH

	<u>Total</u>	<u>Male</u>	<u>Female</u>	<u>Ratio</u>
Ragged Island	13	6	7	1:1.2
Long Island	31	24	7	3.4:1
Mainland	26	17	9	1.9:1
	-----	-----	-----	-----
	70	47	23	2:1
	<u>Total</u>	<u>Male</u>	<u>Female</u>	
January	26	17	9	1.9:1
February	14	10	4	2.5:1
March	12	8	4	2:1
April	18	12	6	2:1
	-----	-----	-----	-----
	70	47	23	2:1

WEIGHTS OF RACCOONS

Seton (1929) gives an account of a 'coon weighing 49 pounds. Dave Robertson, Game Warden of Norfolk, reported a raccoon in the Norfolk Zoo weighing over 30 pounds, but this individual had been castrated. In regard to weights of raccoons, Whitney (1931) states: "The author has read accounts of raccoons which weighed as much as 55 pounds. Such raccoons are weighed with the imagination and muscles of men rather than by mechanical scales". The largest 'coon of over 300 captured in Massachusetts and Connecticut weighed 22 pounds 10 ounces. (Whitney--1931).

Raccoons handled during the present study were weighed while in the funnel. The nature of the present project warranted only one weight record on any one individual, but there is undoubtedly a variation of weights from season to season, as well as in age groups. If the raccoons had been trapped, weighed, and released, then retrapped throughout the year, more definite information could have been obtained on the weights of raccoons in Princess Anne County.

It seems reasonable to assume that since the trapping was being done at a season when the natural food supply was at its lowest, the weights of the raccoons captured would be less than at any other period of the year. Raccoons supposedly eat large quantities of persimmons, corn, acorns, crayfish, and other natural food abundant during the fall season. Theoretically, they are attempting to accumulate enough fat to tide them through the winter when there are numerous days of inactivity and food is limited. Stuewer (1943) found that the majority of Michigan raccoons were at a minimum weight during March.

During the periods in February when ice and storms on the Bay prevented the checking of traps regularly, four raccoons died in the traps on Long Island. Three of the raccoons were obviously yearlings-- a female and two males weighing only 3 pounds 8 ounces, 3 pounds, 4 ounces, and 4 pounds 2 ounces respectively. Autopsies revealed that none of these raccoons possessed any body fat, a factor probably contributing to their deaths (See Fig. 18).

A female weighing 9 pounds 4 ounces was captured during a six day period when the Bay was completely frozen over; she was found in a weakened condition and died within 24 hours. This raccoon had a thick layer of fat on her body.

During the trapping period, the heaviest raccoon handled was a male weighing 19 pounds 8 ounces. This individual was captured in January with the aid of dogs in Princess Anne County. The heaviest male live-trapped was caught on Long Island on January 26, weighing 18 pounds 5 ounces. The heaviest female trapped weighed 11 pounds 4 ounces; she was captured on Long Island on January 28th.

The average weights of the individuals trapped by locality are given in Table 4.



Fig. 10

This raccoon died in a trap and
weighed 3½ pounds.
Note complete absence of body fat.

TABLE IV

AVERAGE WEIGHTS OF LIVE-TRAPPED RACCOONS BY AREA AND BY MONTH

	<u>No.</u>	<u>Male</u>	<u>No.</u>	<u>Female</u>
Ragged Island	6	9# 11 oz.	7	7# 6 oz.
Long Island	24	10# 11 oz.	7	8# 10 oz.
Mainland	17	10# 12 oz.	9	7# 9 oz.
	<u>No.</u>	<u>Ind. Weight Males</u>	<u>No.</u>	<u>Ind. Weight Females</u>
January	17	11# 4 oz.	9	8#
February	10	9# 8 oz.	4	7# 8 oz.
March	8	9# 14 oz.	4	7# 13 oz.
April	12	10# 14 oz.	6	7# 14 oz.
<p>The average weights of 47 male raccoons trapped was 10 pounds 8 ounces. The 23 females captured averaged 7 pounds 14 ounces.</p>				

LONGEVITY

It is important from a management standpoint to know the maximum age a species attains in the wild. It is also important to know the maximum age at which both sexes breed. A review of literature revealed that there is little available information on the longevity of raccoons. Linduska (1946) in a personal communication with Stuewer mentions a tagged raccoon recaptured after 7 years. The president of the Tidewater 'Coon Hunters' Association claims to have kept a female in captivity for fourteen years after capturing her as a juvenile.

Several raccoons captured during the present study had the appearance of being extremely old. One male raccoon captured on January 26 possessed a course, dry pelt, his canines were worn down to the level of the incisors, and he lacked external ears. However the studies in Michigan indicated that even though there are indices for distinguishing between juveniles and yearlings, there is as yet no reliable standard for judging the exact age of any individual raccoon captured. Dentition studies might be an indicator, but the exact or even approximate age is impossible to determine.

The only method of determining actual age is to tag the individuals when they are young, then by keeping in close contact, perhaps by successive trapping yearly, something definite could be learned. "A 'coons age" has been a favorite phrase in this country for years, but what a "'coon's age" is remains a mystery. Nonetheless, it seems reasonable that with no outstanding predators except man and dog, this species has a chance of attaining an age at least comparable to that of a dog.

ACTIVITY

Most mammalogists will agree that raccoons are essentially nocturnal in their activities. Anthony states definitely that "raccoons are strictly nocturnal in habit and unless disturbed do not come out in the daytime". However, there has been some evidence during the trapping in Princess Anne County that the raccoons often feed and move about freely during a twenty four hour period. This tendency may or may not be peculiar to this particular region.

The writer was surprised to learn that some of the most successful hunting in Princess Anne County is day-time hunting, and this fact alone would indicate that raccoons are active then.

At least one raccoon was captured while feeding diurnally and it is probable that many others entered the traps before night. The sets were usually checked in early morning and were not visited again until the following day. On January 7 the traps had been tended at 7:00 in the morning, and during the afternoon the writer chanced to be in that same locality and discovered a raccoon in one of the traps. On March 2 a raccoon was surprised in a thicket of greenbriar on which it was evidently feeding at the time it was observed. In a period of less than an hour, three raccoons were seen on Long Island; one was sunning itself atop a loblolly snag, while the other two scampered from a honeysuckle bed. On May 17 fishermen observed three raccoons feeding at mid-day on a Ragged Island marsh. During June an adult and three kits were observed by the writer crossing a highway near Pungo, Virginia.

Trapping records and field notes bear testimony that raccoons in this county are comparatively inactive during periods of moonlight. This characteristic was originally pointed out by hunters who claim that their dogs rarely strike a trail on moonlight nights, and as a parallel, it is interesting to note that of the raccoons captured, few were trapped on or during the period leading to full moon.

Tracks, as well as trapping successes, were greatly reduced during cold, windy weather. The highest degree of trapping success was experienced during, warm, wet weather, indicating that raccoons are more active during rainy periods.

In discussing dormancy of raccoons during severe winter weather, Hamilton (1943) states that "such dormancy is not akin to hibernation, for the metabolism is not lowered as with the woodchuck and other true hibernators". The winter of 1947 was exceptionally severe in Princess Anne County and there were periods of a week or more when raccoons appeared to have "holed up" temporarily; no raccoons were captured, tracks and other evidences of movement were non-existent. At the advent of milder weather, the raccoons resumed their usual habits. On March 9 there was a three-inch tracking snow on the islands. A systematic survey of the area failed to reveal any raccoon tracks. Whether the 'coons do not move during snowfall could not be determined from this one opportunity offered by a tracking snow.

RACCOON-MUSKRAT RELATIONSHIPS

One of the main objections to raccoons in Eastern Virginia is that they reputedly destroy young muskrats and rob traps of captured 'rats. Trappers naturally object to this interference with their profits from the muskrat trap lines. There were numerous muskrat homes under observation on the islands and they were checked periodically for signs of raccoon disturbance. (See Fig. 19). Unfortunately, operations were transferred to the mainland before the young muskrats were born, and thus nothing was established on the extent of raccoon predation. A reconnaissance was made on Long Island on June 5 and a number of muskrat homes were noted; none appeared to have been disturbed during the spring months.

Normally, muskrat trapping is permitted on the Refuge, but due to the absence of the refuge manager during the winter of 1947, all commercial trapping was prohibited. For this reason, no conclusive evidence could be obtained regarding raccoon thefts from muskrat traps.

On one occasion 14 fresh muskrat carcasses were used as bait during 84 trap nights. No raccoons were captured, but this does not prove that they are not acceptable food to raccoons. Portions of muskrat carcasses were placed in the holding pens of four captive raccoons, and the meat was consumed in all cases. This, however, cannot be presented as proof of a predilection for muskrat on the part of raccoons.

Numerous observations were made on the islands where raccoons and muskrats had fed in the same habitat; their tracks could be found closely intermingled along the beaches. Even though no absolute plund-

ering was discovered, it is possible that raccoons may occasionally destroy houses and even consume the young 'rats. Circumstantial evidence is offered by the trappers, but the writer did not obtain evidence that would convict the raccoon of muskrat predation.

Literature presents some facts regarding raccoon-muskrat relationships. Smith (1938) found that "individual raccoons sometimes form the habit of breaking into muskrat houses, probably in search of young, and will break open all the houses in a large area in a surprisingly short time. Whether they kill adults has not been established. A mass of raccoon fecal waste found on the marsh on August 10, 1932, was composed largely of muskrat fur. When a raccoon forms the house-breaking habit it does great damage, but the species cannot be considered a serious pest".

Giles (1939) found one 'coon scat containing fur and bone fragments of a muskrat.

Lay (1945) presents some facts which might well account for some damage blamed on the raccoon. He states that "intraspecific strife (muskrats fighting among themselves) causes more than one third of the pelt damage on well-stocked marshes and is more important than any other among damage causes. Any muskrat caught, but not killed by the trap, apparently is attacked by the first muskrat that passes".



Fig. 19

Maskret den on Long Island

SURVIVAL

Each raccoon shipped from Princess Anne County was marked for future identification by a metal tag placed in it's ear. Little information has been accumulated on the survival of the raccoons shipped, and it is too early to ascertain the results. A follow-up and careful check on the release areas in Southwestern Virginia is strongly recommended. If the State is to continue having raccoons live-trapped from this and other areas, it is important to have knowledge of the survival rate of the individuals already shipped.

Information has been given by Mr. Handley on the fate of two out of five raccoons liberated in Montgomery County during the winter of 1947. These five raccoons had been caught with steel traps in Eastern Virginia, and, according to the report, two of the five were in such weakened conditions that they could barely drag themselves off from the point of release. One of these 'coons was captured alive by a violator several weeks later and was in turn sold to another individual. One of the five raccoons who appeared to be in good condition when marked and released, was found dead along a stream several weeks later, some three miles from the point of release. The raccoon was in a state of decomposition and the cause of death could not be determined.

Even though the raccoon is an intelligent and rugged animal capable of adjusting to difficult circumstances, there is some question of the ability of the raccoon to adjust itself to a habitat too

drastically varied from his original environment. There is a tremendous ecological variance between the marsh-swamp territories where the animals were trapped this past winter and the areas where they are being released in the mountain regions of Southwestern Virginia. Perhaps raccoons displaced from their native marshes will not remain in their new habitats, but will move in search of more familiar environment. In Arkansas a tagged raccoon was recovered 150 miles from the point of release, according to Butterfield (1944).

FEEDING HABITS

The raccoon is an omnivorous feeder and generally will eat whatever is available in season. During the present study no concentrated attempts were made to carry on a qualitative or quantitative food habits study, but some superficial information was obtained. Numerous scats were examined from time to time, and foods available at the various periods of examination were carefully noted.

During September when the first twenty traps were transported to Back Bay for trial, many scats were found throughout Long Island. They appeared to contain persimmon seeds for the most part. There are a good number of persimmon trees on Long Island and it was concluded that raccoons eat abundantly of this fruit in the autumn. There was no cultivated corn on the island and the most producing trees were negligible. Hackberry trees doubtless supplied a source of food during the fall season.

Back Bay has long been famous for its duck shooting, and even though the waterfowl population has diminished considerably, it is still a favorite sport in this locality. It naturally follows that crippled ducks are available to the mammals. During January most of the raccoon scats examined contained quantities of waterfowl feathers, and waterfowl carcasses were found along the edges of the marsh both on Ragged and Long Islands. Three raccoons were captured by using crippled waterfowl as bait. The majority of the scats examined during February and March contained large quantities of Smilax berries. Holly berries were also available but for the most part, the raccoons

on the islands appeared to be beachcombers, following the shores in search of fish, crabs, and other aquatic organisms.

Warmer weather in March and April brought forth earthworms, frogs, and crayfish for the raccoon's consumption on the mainland. Tracks were abundant in fields and drainage ditches where these organisms could be found.

Corn and mast which were still available were being utilized during the springtime. Four 'coons were captured in and around a cornfield where the crop had not been harvested.

Opportunity to observe captive raccoon feeding was offered over a period of months. Even though these observations were made under unnatural conditions, they might be worthy of record.

Each evening the raccoons were given a substantial quantity of commercial dog food and a can of water. They were supplied with fresh fish, sardines, apples, and table scraps when such items were available. During the breeding habits study the females were fed a wide variety of foods. One female 'coon refused to eat any food except chicken eggs and survived on this diet for several weeks. (See Fig. 20). On several occasions live crabs were given to the captive raccoons. The 'coons had doubtless had experiences with crabs before; they invariably consumed both claws before attacking the remainder of the organism.

The individuals differed in their acceptances of food. Some would eat readily the first night after capture, while others would refuse to eat for several days. There was also an individual variation in the time of eating. Some raccoons would eat almost immediately after the

food was placed in the pen, while others would wait until later at night and were never observed feeding. While eating the raccoon will sit on his haunches much like a squirrel, using his front paws to place the food in his mouth.

One of the most controversial subjects regarding the feeding habits of raccoons is whether or not they wash their food before consuming it. Anthony (1928) and Seton (1929) both expressed the belief that raccoons will, whenever possible, wash their food. Hamilton (1939) states that "The raccoon by no means invariably washes its food before consumption, as has often been erroneously stated". Whitney (1931) likewise objects: "Unquestionably the most common error into which writers have fallen in regard to the habits of raccoons is that the raccoon washes most of the food that he eats. Lotor means "the washer", but in the wild state the raccoon washes almost nothing that he eats".

During the present study the writer had an opportunity to daily observe different 'coons feeding in the holding pens for a period of approximately six months. Even though water was always present in the pens, no observations were made of raccoons washing their food, regardless of the type of food offered them. It seems logical that if washing food was a habit of the species, some of the individuals would have displayed the tendency. It does not seem reasonable that a 'coon will gather an armful of persimmons or corn and then run down to a stream to wash it before eating.

DENNING HABITS

Constant efforts were made to locate den trees during the six months period of study. The trees in the vicinity of each area trapped were systematically checked. If trees contained cavities or potential dens they were climbed when physically possible.

On the islands of the Refuge every tree was examined critically and only two den trees were discovered, both being on Long Island. One was a loblolly pine snag approximately twenty feet high. This snag was open at the top and would provide no shelter whatsoever from the elements, yet it was found occupied. The other den was located in a large mulberry tree on the northern end of Long Island. The trunk of this tree had been broken six feet from the ground; the remainder of the tree was at right angles to the trunk in an elevated position. At the point of the break there was a well-concealed entrance to the den. Raccoon hairs were found around the entrance and well-worn runways led to this particular tree.

Loblolly pine, hackberry, and persimmons are the principal trees on the islands, but these species appear to be largely free of cavities of sufficient size to accommodate raccoons.

When it is considered that 44 raccoons were removed from the islands and that a substantial number undoubtedly remain, the question of where the 'coons denned becomes a problem. The greatest trapping success on Long Island was achieved with a line encircling the wooded area on the south. Twenty four raccoons were captured around the edges of this woodlot, but a survey of each tree failed to

reveal any den trees. Honeysuckle was extremely thick in the woods and it is believed that a large percentage of the raccoons on the islands denned on the ground beneath the honeysuckle. One such bed was found occupied by two raccoons, and numerous runways traversed the honeysuckle. A similar condition of no den trees but dense honeysuckle was found on Ragged Island at Persimmon Point; here three raccoons were captured in one night.

Raccoons also inhabit the marsh of this region, probably in muskrat houses or in excavations dug by the rats. Raccoon tracks were found leading to underground dens. Many of the trapped individuals were extremely muddy when caught, indicating that they might be denning in the burrows.

Butterfield (1944) found that in Ohio "Many raccoons seem to be utilizing ground dens of one type or another, and the groundhog is playing an important part in the management of raccoons". Davis (1939) states that "Due to the scarcity of large deciduous trees in Southern Idaho, raccoons often are found occupying dens in basaltic cliffs and outcroppings!"

Though basically arboreal, raccoons sometimes establish unusual homes. When the cabin was first occupied on Ragged Island, the presence of scats and raccoon hair indicated that raccoons had been utilizing the chimney and the foundation of the cabin. Raccoons were found to occupy the nests of larger birds, but these may have been only temporary refuges rather than permanent homes. Berrytold (1925) observed a female with young in a magpie nest.

When the raccoon study was moved to the mainland, trees and marshland also were critically examined in all areas trapped. A pair of "climbers" were obtained and likely-looking trees were examined. Although numerous cavities were inspected, no occupied dens were discovered. The results would doubtless have been more revealing if dogs had been used in the search for den trees, but with the advent of spring dog owners were reluctant to allow their hounds to run in the marsh because of the prevalence of snakes.

BREEDING HABITS STUDY

In an attempt to obtain information on the breeding habits of raccoons in Princess Anne County, an experiment was initiated during the month of April, 1947. Plans were made to live-trap and hold pregnant female raccoons in captivity. When the young were born, they would be weighed and measured weekly, and thus a growth curve would be developed which might be used as a criteria for other litters found in the wild. It was believed that other pertinent data could be collected, such as: average size of litters, age at which the young first open their eyes, care of the young by the females, and the approximate conception dates. It was realized that the experiment would, of necessity, be carried out under unnatural conditions and that the results obtained would not necessarily be typical of raccoons in the wild.

A holding pen 10'x6'x3' was constructed of 1"x2" 12 $\frac{1}{2}$ gauge welded wire and pine two-by-fours and divided into four individual compartments each 3'x3'x5'. Each section had a hinged door 15"x30" through which food and water could be given the captive females. The top of the holding pen was covered with tar paper and the northeastern side was enclosed with tin as a precaution against storm waves from the Bay. A nail keg filled with nesting materials was placed in each compartment to serve as a den for the female raccoons. (See Fig. 21).

During the experiment five females were live-trapped from varied habitats and placed in the holding pen. All of the raccoons appeared to be pregnant, as evidenced by swollen abdomens and enlarged mammaries. An attempt was made to keep disturbing influences away from the holding

pen, and care was exercised in selecting proper food for the animals. Observations were made at intervals during the day and night. The females were numbered one through five for purposes of identification and a history based on observations was kept on each.

Female #1, weighing 8 pounds 12 ounces, was captured on March 30; she was retained in a trap until April 10 when she was placed in the larger holding pen. While in captivity this female ate very little, only occasionally consuming fresh carp or corn. She evidently chewed at her tail for it soon appeared almost devoid of hair. Two young were born on May 3 at approximately 5:00 A.M. (at 6:00 A.M. the young were being washed thoroughly by the female). The pair of young were observed during the following day, but the female managed to hide them rather completely. On May 4 the peculiar cry of young 'coons could not be heard from the pen, and upon closer investigation, one immature raccoon was found dead in the rear of the holding pen, its head and neck badly mangled. Since it was impossible for predators to enter the enclosure, it was concluded that the female had killed it. She was taken from the pen and a search was made for the other offspring; as it was not discovered it was assumed that the mother had devoured it. The male juvenile weighing 84.5 grams was preserved in alcohol. Judging from the date of the birth, it can safely be estimated that this female conceived around March 1, assuming the gestation period to be 63 days. This female was later shipped to Grundy, Virginia and released.

Female #2 was captured on April 7; she weighed 10 pounds 2 ounces, more than any of the other captive females. She readily consumed all

all food placed in her pen and on May 2 she gave birth to three young. Her conception date was thus around March 1. The nest and the young were left undisturbed for two weeks, but were observed daily. During this time, the female appeared to be feeding and caring for her offsprings faithfully. On several occasions she was observed cleaning up their excrement.

The three kits were removed from the nest on May 16 when they were two weeks old. The female was first persuaded to enter a box trap, then the young were carried to the cabin to be weighed and measured. Rubber gloves were worn while the immature &coons were being handled to eliminate the human odor as much as possible. The writer had been warned by individuals who had attempted to raise young 'coons that the female would dispose of her young once they were disturbed by humans.

The three juveniles were males. They were designated #10, #20, and #30 at random. It was not necessary to mark them in any way since they were sufficiently dissimilar in physical characteristics for identification. Number 10 appeared dwarfed and weighed only half as much as his brothers, and had suffered a lip injury. Number 20 had a dark tan pelt, while #30 was light tan. The three weights in grams were as follows:

#10	-	101
#20	-	208
#30	-	249

The following measurements and observations were made on #30:
Hind foot 35 mm, ear 14 mm., tail 60 mm., with a total length of 175 mm. The eyes were closed; ears lay close to head, mask beginning

to form on face; tail rings indistinct; hair fine, body clean; legs weak, not able to support weight of body; claws present.

The immature raccoons were replaced in the den box and fresh nesting material was provided. The female was then turned into the holding pen. She seemed perturbed and immediately fled into the den, only to return with one of the young in her mouth. She was evidently searching for a new nest location. She calmed down in about fifteen minutes, at which time each member of her family was thoroughly washed.

On May 19 immature raccoon #10 was found outside the nest in a mangled condition. It's pelt had been ripped off and there were teeth marks around the neck and head. This had been a weakling when handled on the 16th and it was deduced that for some reason the mother was neglecting it while concentrating great care on his brothers.

The two remaining young were again taken from the female on May 23 when they were three weeks old, with the following measurements and observations:

Male #20	hind foot--40mm.	tail	72 mm.	ear	17 mm
	total length	225 mm.	weight	378	grams

Male #30	hind foot--40 mm.	tail	72 mm	ear	17 mm
	total length	220 mm.	weight	387	grams

Eyes not open, no evidence of teeth, ears more erect, mask formed, tail rings still indistinct; abdomen large; legs still too weak for support, navigate by crawling with bodies; voice much stronger. Female did not appear excited during the separation process.

On May 29 it was observed that #20 had opened his eyes, but #30's were still closed.

Observations May 30 when juveniles were one month old:

Male #20 hind foot 50 mm. tail 90 mm ear 20 mm.
total length 275 mm. total weight 502 grams

Male #30 hind foot 50 mm. tail 90 mm ear 20 mm.
total length 260 mm. total weight 514 grams

Eyes of #20 open but appeared milky, eyes of #30 mucused, just beginning to open, rings on tail now distinct; ears erect; hind feet oily, claws prominent; both fat, awkward, not able to navigate well, but strong, did not cry as lustily as last week, no evidence of teeth. The female did not appear to object to the separation and readily resumed her maternal duties, continued to eat regularly. All excrement of young was disposed of immediately by female; she kept the den clean and had a "latrine" in the corner of the holding pen.

On June 6 the immature raccoons were taken from female; they were 35 days old. The following observations were made:

Male #20 hind foot 60 mm. tail 90 mm. ear 25 mm.
total length 322 mm total weight 651 grams

Male #30 hind foot 60 mm. tail 87 mm. ear 23 mm.
total length 300 mm. total weight 623 grams

Incisors and canines beginning to form; bands on tail and facial mask distinct; claws more pronounced; legs still weak, but able to hold onto erect objects; did not cry during weighing and measurements. (See figs. 22 and 23).

The two immature 'coons were later taken to Blacksburg where they gradually became stronger and more difficult to handle. They were finally released with their mother in Montgomery County.

Female #3 was captured April 8; she weighed 7 pounds 8 ounces, appeared tame, but ate very little. A large variety of food was placed in her pen, but to no avail. She died on April 21, probably from starvation. When autopsied she was found to contain three embryos, two males and 1 female, well advanced.

Female #4 was captured April 15; she weighed 7 pounds 12 ounces and appeared exceptionally heavy with young when captured. Considerable hair was missing from her back. Four days from the time of capture she gave birth to two male kits. She evidently cared for her litter for a period of two weeks, then lost interest in them. The kits were ejected from the nest on four occasions by the female and returned to her side by the writer. The young kits died 17 days after their birth, probably from starvation.

Female #5 was captured April 17; she weighed eight pounds and appeared heavy. She readily ate all food provided until May 3 when she went on a hunger strike. She became progressively weaker and it was thought that she would not survive. After a week's privation she began eating an egg each night but would touch nothing else. Although left in captivity until late in June this female did not produce any young. She was eventually released in Montgomery County.

In summary, it may be said that the results of this particular experiment were for the most part negative. Three of the females gave birth to litters, one female died in captivity when she refused to eat, and the fifth female was unproductive. Two of the productive females displayed a cannibalistic instinct by disposing of their litters; one

killed her offspring two days after their birth and the other appeared to lose her maternal instincts after two weeks and refused to care for them. Nevertheless, some information was obtained which may or may not be significant. The exact dates of birth of three litters were observed on April 19, May 2, and May 3, respectively. It is generally agreed that the gestation period of raccoons is 63 days (Ashbrook, 1929); therefore, the three raccoons conceived around February 15, March 1, and March 2nd. It is realized that three records do not afford an adequate sample, but they indicate that the breeding season in Princess Anne County falls in February and the early part of March.

Most mammalogists agree that raccoons bear from three to seven young. Stuewer found an average of four offspring per litter in Michigan. Anthony (1928) also states that four is the average litter size. During the present study four pregnant females were autopsied and three births were observed. The births included litters of 3, 2, and 2 and the autopsies revealed embryos numbering 3, 3, 2, and 1. The seven females would have produced a total of 16 young raccoons, assuming that all survived, making the average slightly over two per female. Of course, seven records is hardly a fair sample but it may indicate a trend. Another interesting situation was presented when the embryos and immature raccoons were sexed, for a definite predominance of male raccoons in this small sample was evident. This information directly correlates with results obtained in trapping mature raccoons.



Holding pen for
female raccoons
used in breeding
habits study

Fig. 20



Captive female racoon
eating perch

Fig. 21



Figs. 22 and 23

These two "kits" were the sole survivors from 3 female raccoons. They were eventually released in Montgomery County.

RECOMMENDATIONS FOR THE MANAGEMENT OF RACCOONS

During the period of the study there were no opportunities to observe the areas where the trapped raccoons were being released, but from observations made in Princess Anne County and from literature studied on the species, some recommendations might be made regarding the management of the raccoon in the State of Virginia.

The most obvious need from a management standpoint is an extensive study of raccoons in areas where they are supposedly scarce. This study should attempt to determine numbers as well as physical conditions of raccoons in depleted areas, and an attempt should be made to determine the limiting factor of the species. There seems to be a variety of reasons for the decline of raccoon populations. In Nevada, raccoon populations are small due to the absence of water in their habitat (Hall, 1946). In Idaho, Davis (1939) reports a shortage of large deciduous trees suitable for dens. Mills (1928) reported that "the raccoon is certainly diminishing in numbers alarmingly, due largely to over-trapping and to hunting for sport. Deforestation is also playing a part in the troubles of the raccoon".

Thus, in Southwestern Virginia an attempt should be made to ascertain the available food supply for a 12 month period, the availability of den trees, the hunting pressure, and the amount of illegal hunting and trapping. If the habitat is found to be suitable to support larger raccoon populations, then only should restocking be attempted. On the other hand, if the environment is lacking in some habitat requirement of raccoons, management steps should be taken.

For instance, if den trees are lacking denning boxes could be provided. If winter food is the limiting factor, corn could be planted in certain localities and allowed to stand during the winter. "The most obvious need in restoring raccoon populations is an improved habitat" according to Brown and Yeager (1943). An educational program among 'coon hunters might help the situation. The hunters should be instructed that cutting of den trees, use of fire and explosives, excess bags and illegal trapping are all detrimental to raccoon populations.

If restocking is found to be essential, certain steps could be taken to assure better results from the effort. Only raccoons in the best physical condition should be accepted for restocking; those 'coons captured with steel traps and injured should not be used. Since the object is to increase 'coon populations, and in that the raccoon is polygamous, a premium price should be paid for female raccoons. If possible, raccoons for restocking should be collected in localities where the environmental conditions do not vary too widely from the habitat where they are to be released. All stocked 'coons should be tagged and a survival study should be made at chosen release points in order to ascertain the survival rate of displaced raccoons. If the raccoons are not surviving, there appears to be no logical reason for continuing to restock areas on a yearly basis. Such stocking will perhaps provide a temporary increase in hunting, but if the environmental conditions are undesirable for reproduction, there seems little practical value in continuing the program until habitat improvements could be made.

SUMMARY AND CONCLUSIONS

1. Seventy raccoons were live-trapped in 4174 trap nights. An additional 14 'coons were collected in Princess Anne County during the period of the study.

2. A modification of the old Biological Survey box trap was utilized, principally in live-trapping raccoons. This trap proved capable of capturing and holding 'coons, but it's bulkiness plus the cost of operating limits it's practicability. If raccoon restocking is to continue in the State, perhaps the most efficient method of obtaining live raccoons is to collect them from hunters and trappers in areas where there is a large raccoon population.

3. The most readily accepted bait for raccoons proved to be fresh carp on the islands of Back Bay and a combination of corn and carp on the mainland.

4. A male-female ratio of 2.04:1 was found among the 84 raccoons handled.

5. The average weights of 47 male raccoons trapped was 10 pounds 8 ounces. The 23 females captured averaged 7 pounds 14 ounces.

6. Raccoons in Princess Anne are not strictly nocturnal. Numerous observations were made which indicate that 'coons move about diurnally.

7. Trapping results indicated that raccoons were more active during periods when the temperatures were relatively high and when there was precipitation.

8. With regard to the controversial issue as to whether or not raccoons wash their food, the writer had opportunity during the present study to make daily observations on raccoon feeding habits for a period

of six months. Even though water was always available in the holding pens, none of the raccoons displayed the tendency to wash their food, regardless of the type food given them.

9. Den trees were scarce in most sections of Princess Anne County. On the islands where 44 raccoons were removed, only two tree dens were discovered. Raccoons are probably using ground dens constructed by the muskrat and dens underneath honeysuckle.

10. The five female raccoons were retained in captivity in order that information might be obtained on the breeding habits of raccoons. Three of the females gave birth to litters, one female died in captivity, and the fifth 'coon was unproductive. Two of the productive females displayed the cannibalistic instinct in disposing of their litters. The exact dates of birth of the three litters were: April 19, May 2, and May 3, respectively. These dates would seem to indicate that the breeding season in Princess Anne County reaches its peak in February and early March. An average litter of 2.3 "kits" per female was found among seven female raccoons; this average was reached by including three birth records and four autopsies on pregnant female raccoons.

BIBLIOGRAPHY OF TITLES ON
STUDY OF RACCOONS

1. Aldous, S.E. - "Live Trapping and Tagging Muskrats," Journal of Wildlife Management, 1946, Vol. 10, pp. 42-44.
2. Allen, D. L.- "Michigan Fox Squirrel Management," Department of Conservation, 1943.
3. Anthony, H. E. - "Field Book of North American Mammals," Putnam, New York.
4. Ashbrook, Frank G. - "Fur-Farming for Profit," The Macmillan Company, New York.
5. Bailey, John W. - "The Mammals of Virginia," Williams Printing Company, Richmond, Virginia.
6. Baker, R. H. - C. C. Newman and Ford Wilke, "Food Habits of the Raccoon in Eastern Texas," Vol. 9, pp. 45-48.
7. Baumgartner, L. L. - "Fox Squirrel Dens," Journal of Mammalogy, Vol. 20, pp. 456-465, 1939.
8. Bergtold, W. H. - "Unusual Nesting of a Raccoon," Journal of Mammalogy, 1925, Vol. 6, pp. 280-1.
9. Bissonette, T. H. - "Experimental Control of Sexual Periodicity in Animals and Possible Applications to Wildlife Management," Journal of Wildlife Management, Vol. 2, pp. 104-118.
10. Bissonette, T. H. and A. G. Csech - "Sexual Photoperiodicity of Raccoons on Low Protein Diet and Second Litters in the Same Breeding Season," 1939, Journal of Mammalogy, Vol. 19, pp. 342-8.

11. Brown, Louis G. and Lee C. Yeager - "Survey of the Illinois Fur Resource," Bulletin of the Illinois Natural History Survey, Vol. 22, Article 6, 1943.
12. Burt, William H. - "The Mammals of Michigan," The University of Michigan Press, Ann Arbor, Michigan, 1946.
13. Butterfield, R. T. - "Populations, Hunting Pressure, and Movement of Ohio Raccoons," Transactions of the Ninth N.A. Wildlife Conference, pp. 337-344, 1944.
14. Casto, W. and Clifford C. Presnall - "Comparison of Coyote Trapping Methods," Journal of Wildlife Management, Vol. 8, pp. 65-70, 1944.
15. Chapman, Royal N. - "Animal Ecology," McGraw-Hill Book Company, New York, 1931.
16. Crabb, Wilfred D. - "Growth, Development and Seasonal Weights of Spotted Skunks," Journal of Mammalogy, Vol. 25, pp. 213-221,
17. Dice, L. R. - "Methods of Indicating the Abundance of Mammals," Journal of Mammalogy, Vol. 12, pp. 376-381.
18. Davis, William B. - "The Recent Mammals of Idaho," Caxton Printers, Caldwell Idaho, 1939.
19. Errington, P. L. and Thomas G. Scott - "Reduction in Productivity of Muskrat Pelts on an Iowa Marsh Through Depredations of Red Foxes," Journal of Agricultural Research, Washington, D.C., Vol. 71, No. 4, pp. 137-148.
20. Gabrielson, Ira A. - "Wildlife Refuges," McMillan, New York, pp. 165-166, 1943.
21. Giles, L. W. - "Fall Food Habits of the Raccoon in Central Iowa," Journal of Mammalogy, Vol 20, pp. 68-70, 1939.

22. Giles, L. W. - "Food Habits of the Raccoon in Eastern Iowa,"
Journal of Wildlife Management, Vol. 4, pp. 375-82, 1940.
23. Hall, E. Raymond - "Mammals of Nevada," University of California Press, Berkeley, California, 1946.
24. Hamilton, W. J., Jr. - "American Mammals," McGraw-Hill, New York, 1939.
25. Hamilton, W. J., Jr. - "The mammals of Eastern United States,"
Comstock, New York, 1943.
26. Handley, C. O., Jr. and Clyde P. Patton - "Wild Mammals of Virginia," Virginia Commission of Game and Inland Fisheries, Richmond, Virginia, 1947.
27. Harding, A. R. - "Fur Farming," A.R. Harding, St. Louis Mo., 1909.
28. Jones, J. Walter - "Fur-Farming in Canada," Commission of Conservation, Montreal, 1913.
29. Lay, Daniel W. - "The Problem of Undertrapping in Muskrat Management," Transactions of Tenth North American Wildlife Conference, pp. 75-78, 1945.
30. Leopold, Aldo - "Game Management," Scribner, New York, 1946.
31. Linduska, J. P. - "Longevity of Some Michigan Farm Game Mammals,"
Journal of Mammalogy, Vol. 28, pp. 126-129, 1946.
32. Martin, E. D. - "Propagation of Ohio Raccoons in Pens," Ohio Conservation Bulletin #194, 1940.
33. Miller, J. P. and Burwell B. Powell - "Game and Wild-Fur Production and Utilization on Agricultural Land," U.S.D.A. Circular #636, 1942.

34. Mills, David C. - "Conservation of Fur bearers," Transactions of the Fifteenth National Game Conference, 1928.
35. Mohr, Carl o. - "Illinois Furbearer Distribution and Income" Bulletin of the Illinois Natural History Survey, Volume 22, Article 7, 1943.
36. Mosby, Henry S. - "The Raccoon" Virginia Wildlife, Vol. VIII, No. 2, pp. 8-9, 1947.
37. Pearse, A. S. - "Animal Ecology," McGraw Hill, New York., 1939.
38. Phelps, Chester F. - "The Big Five Upland Game Animals in Virginia," Vol VIII, No. 2, Virginia Wildlife, pp. 12-14, 1947.
39. Rausch, Robert - "Suggestions for the Handling of Certain Mammals;" Journal Wildlife Management, Vol. 11, p. 189.
40. Seton, Ernest Thompson - "Lives of Game Animals," Doubleday, Doran and Company, New York, 1929.
41. Shillinger, J. E. - "Diseases of The Fur Animals," U.S.D.A. Bulletin, No. 1777, 1937.
42. Smith, Frank R. - "Muskrat Investigations in Dorchester County," U.S.D.A. Circular, No. 474, 1938.
43. Stuber, J. W. - "'Coon Propagation in Ohio," Nineteenth American Game Conference Transactions, pp. 328-33, 1932.
44. Stuewer, F. W. - "Studies of molting and Priming of Fur of the Eastern Raccoon," Journal of Mammalogy, Vol. 23, pp. 399-404.
45. Stuewer, F. W. - "Raccoons: Their Habits and Management in Michigan," Ecological Monographs, Vol. 13, pp. 203-258, 1943.
46. Stuewer, F. W. - "Reproduction of Raccoons in Michigan," Journal of Wildlife Management, Vol. 7, pp. 60-73., 1943.

47. Whitney, L. F. - "The Raccoon and It's Hunting," Journal of Mammalogy, Vol. 12, pp. 29-38, 1931.
48. Whitney, L. F. - "The Raccoon--Some Mental Attributes," Journal of Mammalogy, Vol. 14, pp. 108-114, 1933.
49. Van Dersal, W. R. - "Utilization of Oaks by Birds and Mammals," Journal of Wildlife Management, Vol 4, pp. 404-428, 1940.
50. Yeager, Lee E. - "Storing of Muskrats and Other Food by Minks," Journal of Mammalogy, Vol. 24, pp. 100-101, 1943.
51. Yeager, Lee E. and William H. Elder - "Pre- and Post-Hunting Season Foods of Raccoons on an Illinois Goose Refuge," Journal of Wildlife Management, Vol. 9, pp. 48-56, 1945.
52. Yeager, Lee E. - "Capacity of Illinois Land Types to Produce Furs," Transactions of the Tenth North American Wildlife Conference, pp. 79-86, 1945.