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A STUDY OF MUSKRAT PRODUCTIVITY ON A BUTTONBUSH SWAMP

By

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INTRODUCTION

The present study of muskrat productivity was undertaken with the view of adapting knowledge of the life history of this important fur bearer to a particular situation and in so doing learn in what manner the animal reacts to a particular environment.

The field study was conducted on a swamp of 8.7 acres in area. Other types of muskrat habitat were also observed to gain knowledge of muskrat activities in differing situations. The study area, located six miles southwest of Ann Arbor, Michigan, is a buttonbush, sedge kettlehole. The cover types present consist of sedge (Carex sp.) 42%; 15% buttonbush (Cephalanthus occidentalis); 39% buttonbush sedge interspersed with rose (Rosa sp.), dogwood (Cornus sp.), and scattered maples, ash, aspen, willows, and poison sumac; and 4% open water area. Past drainage attempts proved unsuccessful as evidenced by the presence of abandoned drainage ditches.

Normally the swamp is partially filled with water throughout the year; however the summer of 1946 was dry and at times surface water was absent. Late fall rains filled the lower parts of the swamp to a depth of

two feet. Spring runoff from surrounding upland brought the water level to a maximum of three feet at the deepest and an average overall depth of ten inches. The other areas of muskrat habitat referred to are a quarter mile of drainage ditch three miles east of Ypsilanti, Michigan, a two acre mill pond on Fleming creek three miles east of Ann Arbor, and two small upland sedge marshes of one acre size two miles south of the principle study area.

The agricultural land of this region of Michigan is dotted with small buttonbush kettleholes similar to the one studied. Due to their small size these areas usually are not drained. In dry years they afford a small amount of livestock forage but generally are of little agricultural value. Their chief value is as wildlife habitat. They furnish cover for birds and various small mammals. The following animals were seen on the study area and are representative of forms frequenting such habitats: Three pheasants, several cottontail rabbits, one opossum, four lesser scaup ducks, one pair of mallards, three wood ducks, two American bittern, two least bittern, one sora rail, seventeen muskrats, mice, shrews, and numerous songbirds. In addition, tracks of mink, raccoon, fox and weasel were

observed from time to time.

Many of these buttonbush swamps contain small muskrat populations subject to severe fluctuation in numbers due to the uncertainty of water levels. The object of this study is to determine the possibilities of management of these odd areas for muskrat production. In order to develop a management plan it is necessary to ascertain whether or not such a plan may be practically and economically carried out. This entails an accurate knowledge of present population and activities of the muskrats on the area. To accomplish this a system of trapping and tagging was decided upon. It was felt that in this way a conclusion might be reached as to the carrying capacity of the areas together with the limiting factors acting on muskrat productivity.

FALL STUDY, 1946

Trapping was begun September 15, 1946. A preliminary survey showed three concentrations of muskrats along the border of the swamp. These concentration areas were consecutively trapped until it was believed that the entire population had been handled. Ten box traps of ½-inch mesh hardware cloth measuring 10x10x36"

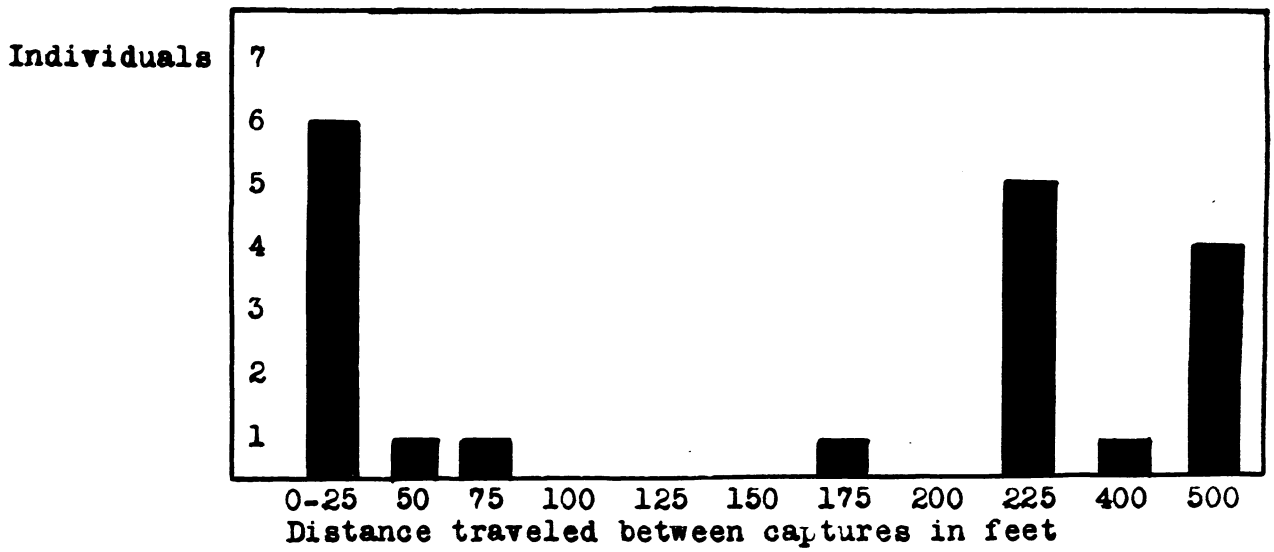

Table #1. Spring muskrat travel between trapping stations

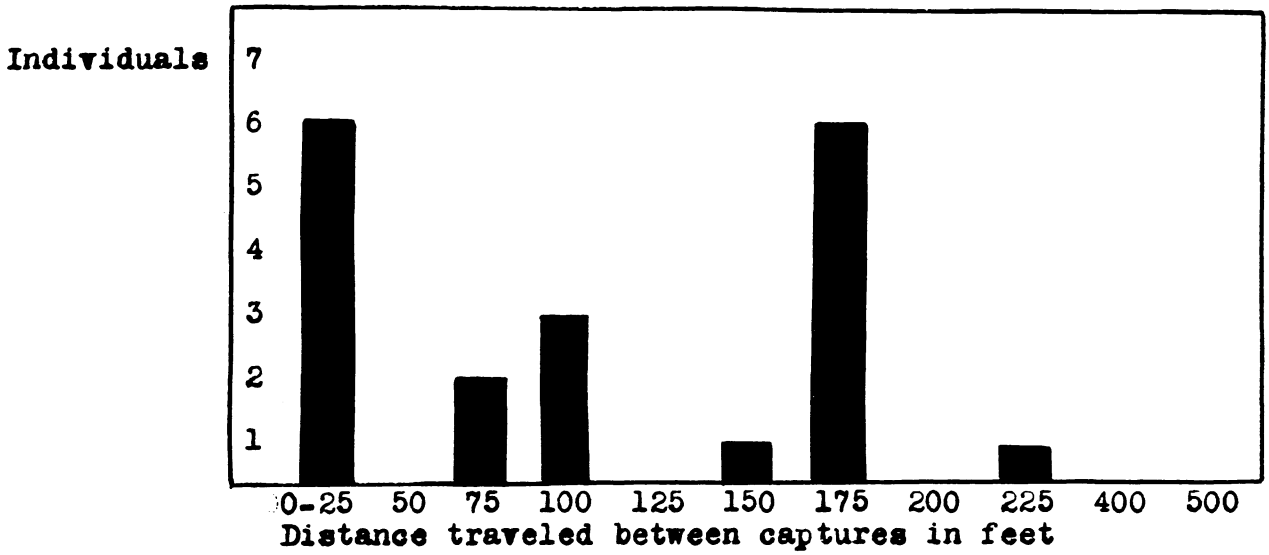

Table #2. Fall muskrat travel between trapping stations

were used. Apples and carrots were used as bait. The muskrats were handled by forcing them into a wire cone where they were tagged in the right ear after the method described by Aldous[1]. The individuals were sexed and aged according to the method described by Dozier[4]. Of fourteen individuals trapped and tagged three were adult males, two were adult females, five were sub-adult males and four were sub-adult females. The fourteen muskrats were handled a total of thirty-eight times. All appeared in good condition as to pellage and weight.

There appeared only one instance of unthrift. The animal was in a weakened condition so as to lead to the conclusion that it might not survive. One adult male showed an open wound on the flank about an inch in diameter. Subsequent recapture showed complete healing in eleven days and the hair completely grown out over the scar in nineteen days.

Sub-adult muskrats were little disposed to attack while being handled; however adults were very belligerent and on several occasions, when released, attempted to attack the trapper.

Prior to the fall trapping a muskrat house count was made but failed to give a true indication of the

population. This was due to the presence of houses from past seasons. It was impossible to determine with any certainty which of the houses were being occupied, as all the houses were kept in repair by the muskrats and trapping observations indicated that an individual might be using more than one house. Possibly the surplus houses served as shelters or feeding stations along the travel routes between food and cover.

During the three months of fall trapping the water level was at its lowest for the year. Surface water was present only in the network of runways which the muskrats had dug between houses and feeding areas. These runways were six to eight inches wide and varied from well defined paths to ditches eight inches deep. The water level during this period varied from a few inches of surface water in the lowest parts of the swamp to six inches below the surface of the muck bottom. The runways were dug deep enough to maintain several inches of water throughout their length. The muskrat had access to its house by means of burrows below the underground water level. These burrows were from one to twenty feet in length. The traps were set at the entrance to the burrows.

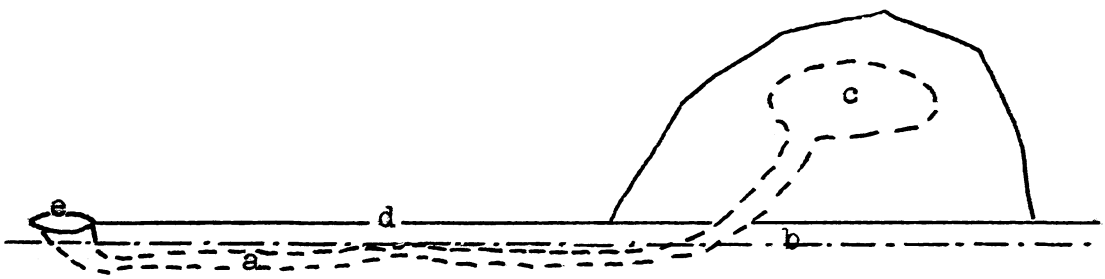

Fig. 2. Muskrat house showing entrance burrow.
a) Burrow
b) Water level
c) Room
d) Swamp bottom
e) Entrance

The houses were constructed of sedge, muck and a small amount of twigs of buttonbush. They averaged about three feet in height and six feet basal diameter.

No muskrats were killed for stomach analysis to determine feeding habits. However feeding evidences and appearance of droppings indicated that the staple food during this time was the underground parts of Carex together with leafy shoots of this plant. Numerous small excavations were left in the feeding areas by muskrats in their digging for roots of the sedge. There appeared to be no shortage of food available to the population in the fall.

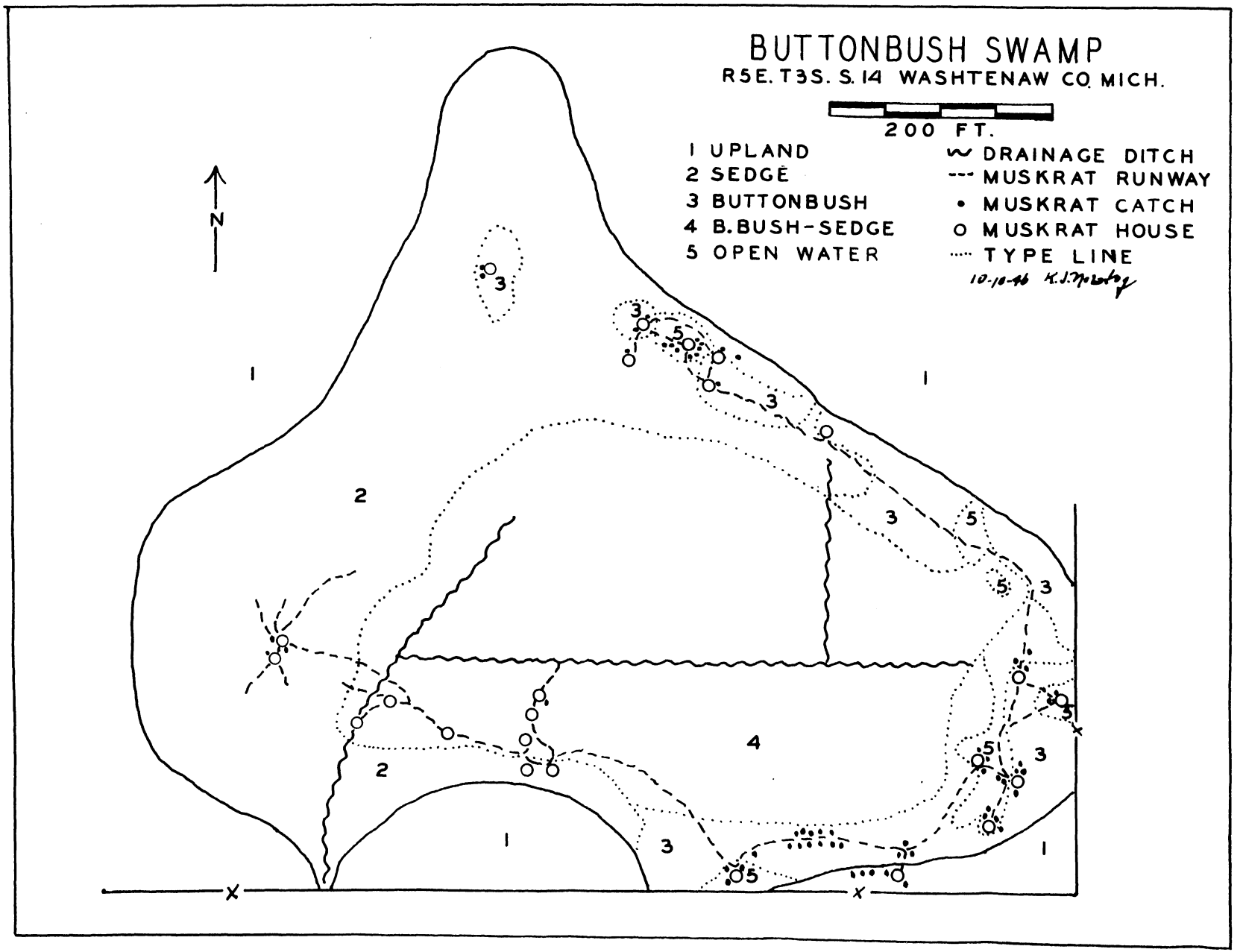

Fig. 1. Cover map of study area.

WINTER STUDY, 1946-47

Winter observations indicated little surface muskrat activity and showed that mink were preying on the muskrat population. The mink gained access to the interior of the houses by digging through the side of the house above the surface of the ice. Nearly all the twenty-five houses were broken into in this fashion. Three muskrat kills could definitely be laid to mink. It is possible that other kills might have occurred and escaped observation. Remains of three muskrats were found but the cause of death could not be determined. One muskrat wandered off the area the tenth of January, traveling a quarter of a mile to a small stream. Two muskrats were killed by automobiles while crossing a road bordering the swamp and adjacent to a cornfield. Water in the swamp had frozen to the bottom. After the spring thaw the bottom of the swamp around occupied houses showed numerous runways in the muck which indicated winter use of tunnels underlying the ice. Scatterings of shredded vegetation on the bottom seemed to indicate that the animals had access to food.

SPRING STUDY, 1947

In the spring of 1947 the same general plan of

trapping and tagging was used as had been practiced the preceding fall, with the exception that trap sites were changed from runways to the tops of houses and along the shore, due to the high water which would have covered the traps had they been placed on the bottom. Only three muskrats were taken from April seventh to May ninth. None of these had been taken the preceding fall. No evidence of their having been tagged the preceding fall was found. It is assumed that the three individuals were winter or early spring migrants to the area. The three individuals were handled a total of twenty-two times and again it was felt that the entire population had been taken. Two of the muskrats were males, the other a female.

Muskrat activity was considerably greater during this season due to the considerable increase in water area and depth. Food was abundant and consisted of the leafy shoots of Carex. Evidences of muskrat feeding were numerous. Muskrats ranged throughout the entire area of the swamp and trapping was very successful considering the small population.

STUDY OF OTHER MUSKRAT HABITAT

By way of contrast, an area of high muskrat pro-

ductivity was studied through the fall and winter of 1946-47. This area consists of approximately two acres of water backed up by a small mill dam on Fleming creek east of Ann Arbor. The pond has been trapped by the owner for the past thirty years. The catch during this period has averaged thirty muskrats per season and the past winter thirty-five were taken from this small area. Silting behind the dam has resulted in a flat expanse of pond two to three feet deep, with the exception of a deep channel leading to the millrace. Twenty-five houses were counted last fall. All were built during 1946, since spring floods annually remove the past season's accumulation of houses. The owner estimated the total population at forty-five, which seems a reasonable figure in view of the fact that the yield remained high until the end of the trapping season. Vegetation consists of bulrush (Scirpus sp.), sedge (Carex sp.), a small amount of cattail (Typha sp.), and bur reed (Sparganium sp.). The submerged vegetation consists mainly of coontail (Ceratophylum demersum). It was concluded that the high level of productivity here is due to a stable and optimum water level for muskrats.

Two dry sedge marshes previously mentioned sup-

ported one muskrat each through the fall of 1946. The animals fed in bordering cornfields during the fall and early winter. One muskrat was taken by a trapper; the other left the area in midwinter and may be the same animal which took refuge under a corncrib on a nearby farm.

A quarter mile of drainage ditch north of Willow Run, Michigan carried one muskrat until January of 1947 when cold weather froze the stream to the bottom, forcing the animal upland where it fed on the fruits of hawthorne (Crataegus sp.) and several days later wandered off, presumably in search of a more attractive habitat. Observation of drainage ditches in the vicinity of Ann Arbor indicates that they are poor muskrat habitat due to the sparseness of vegetation which might be utilized as food. Cornfields bordering ditches furnish adequate summer and fall food but little late fall and winter food is left by clean harvest methods.

MUSKRAT BREEDING

Males and females are sexually mature the year following birth. It is not definitely known whether a female born during the latter part of March or early April might not give birth to a litter late in August.

Examination of muskrats handled in the course of the present study indicated that young of the year had not bred.[17] The males during the rutt are very active. Of the three individuals taken a total of twenty-two times two males were taken twenty times and one female on just two occasions. The increased spring activity of the males allows a degree of selective trapping. There is considerable strife between muskrats during the breeding season. Aldous found 40% of pelts taken in the spring were scarred as a result of this interspecific strife[2].

Two litters a year seems common among muskrats, with indication that a number of females may give birth to three litters a year.[14,17] The period of gestation is twenty-nine or thirty days and breeding may immediately follow birth of the young.[14] At the end of thirty days young muskrats are able to leave the nest and shift for themselves.[9]

Adults	Breeding age	Young per litter	Litters per year	Total
2	1 yr.	6	2	14

Table #3. Muskrat breeding potential, per year.

The muskrat is considered to be loosely monoga-

mous in its breeding habits. The sex ratio for 24,981 muskrats taken in Minnesota, Maryland, Ontario, South Dakota, Iowa and Michigan averaged 56.03% males and 43.97% females. The sex ratio of the seventeen muskrats taken in the present study was 58.7% males and 41.3% females.

Locality	Number sexed	% male	% female
Minnesota [17]	1,094	55	45
Ontario [16]	14,166	52.7	47.3
South Dakota [2]	237	64.2	35.8
Maryland [5]	5,415	56	44
Iowa [9]	876 (Young under 2 weeks old)	54.4	45.6
Iowa [9]	86 (Newborn)	58.1	41.9
Michigan [3]	8,107	51.8	48.2
	24,981	56.03	43.97

Table #4. Sex ratios in muskrat populations.

Examination of fall trapped muskrats will give the ratio between sub-adults and adults in the fall population. Applying this ratio to the breeding potential will give an indication of the survival of the young produced. These figures will not be completely accurate since there is undoubtedly a loss in adult indivi-

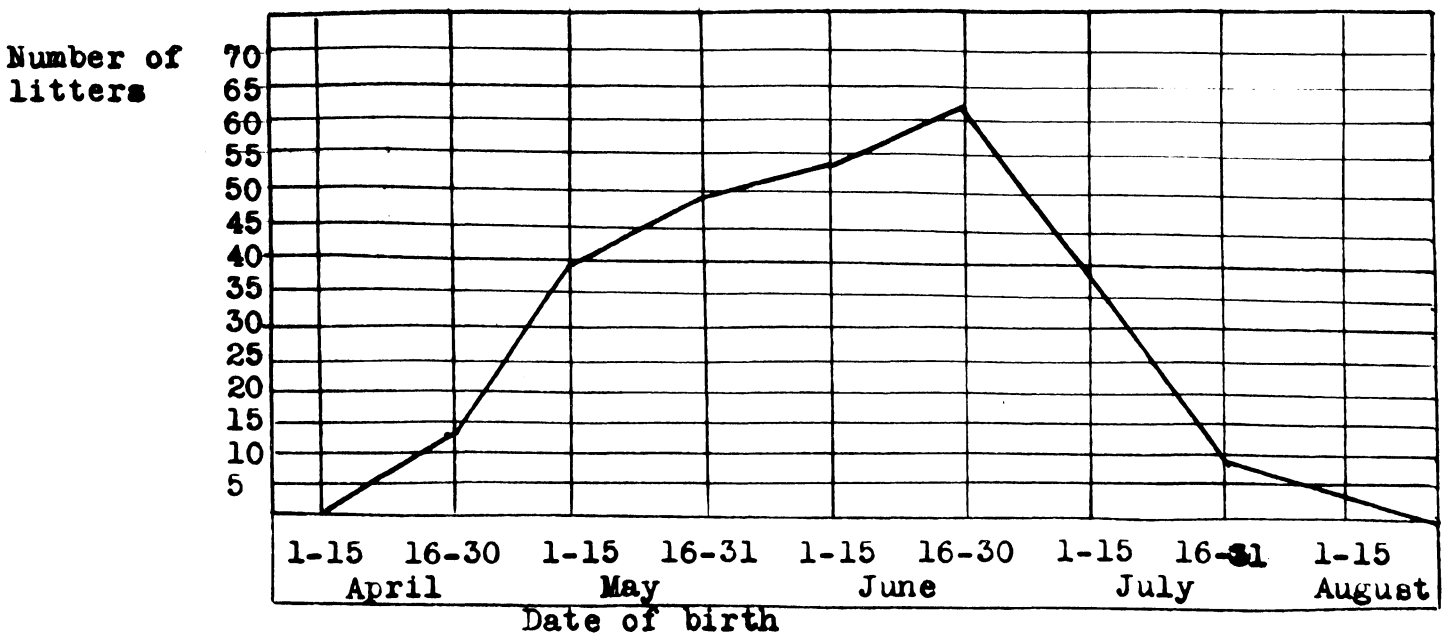

Table #6 Breeding activity, Iowa muskrats, 1935-36. 282 litters.

duals through the summer. However juvenile muskrats appear more susceptible to mortality than the adults, particularly during the first few weeks following birth. Abandonment, drowning,[13] drouth,[8] predation,[11] disease and interspecific strife[9] take a disproportionate number of young muskrats.[8] This is born out in the fall age ratios.

Locality	Number of muskrats	Adults	Subadults
Minnesota[16]	567	27.4	72.6
Illinois[3]	981	28.8	71.2
"	176	29.0	71.0
Michigan[3]	7,511	35.3	64.7
	9,735	30.1	69.9

Table #5. Age classes in fall muskrats.

In the Northern United States breeding activity begins the second week in March and continues into the first half of August. Of 207 muskrats taken from March 20 to 24, Hatfield found only two females containing embryos.[15]

FACTORS LIMITING PRODUCTIVITY

The chief limiting factor observed on the study

area was drouth. Drouth exposed the population to predation and brought about winter freezeout due to insufficient water depth.

Suitable muskrat habitat consists of a year round presence of water of a sufficient depth to maintain free water at entrances to burrows and in runways leading to an adequate food supply. More than three feet of water prevents the growth of emergent vegetation nor as a rule will muskrats construct houses in water much deeper than three feet. Shallow water in this region freezes up and forces muskrats to move to deeper water. Insufficient water manifests itself in decreased productivity. Drouth exposes muskrats to starvation and predation[8] and winter freezeout. During the fall trapping it was observed that trapping success varied with the rainfall and presence of surface water. When the swamp bottom was dry activity was at its lowest but the presence of several inches of water in runways resulted in a resumption of activity. It is possible that prolonged inactivity due to drouth may result in a condition of unthrift in the muskrat population due to curtailed feeding. Errington found muskrat populations depleted where muskrats were exposed to mink and

fox predation through drouth.[11] Aldous,[2] in a winter study of South Dakota muskrats found that "Large houses comprised 21.8%, medium 34.5%, and small, 43.7% of the total. 20.7% of the houses were in water 25 inches or deeper, 39.9% in water 16-24 inches, and 39.1% in water 16 inches and less. Of 183 untrapped houses opened in January, 1944, 67.7% were in water up to 15 inches deep and were already frozen up inside. Those in water 16 to 25 inches deep had 40.3% frozen and those in water deeper than 25 inches had only 12.9% frozen. Another group of houses left untouched until early in March showed that those in water 15 inches or less were all frozen. Those in water 16-24 inches were 86% frozen. Those deeper than 25 inches were 22% frozen."

Freezeout on the study area was undoubtedly a contributing factor to the severe winter decline in the population, restricting underwater mobility and forcing animals to abandon houses.

MANAGEMENT RECOMMENDATIONS

The present study indicates that drouth is perhaps the chief factor limiting muskrat productivity in the

area.

If no attempt is to be made at improving the habitat, management should consist of full utilization of the annual muskrat yield. In this case an attempt should be made to trap out the entire population each season since it appears that the population does not survive winter mortality. Migration of muskrats into the area should provide adequate restocking for the following season. In wet years the yield would undoubtedly be greater than the fourteen muskrats taken in 1946.

Two methods of stabilizing the water level might be employed on the area: Damming to hold water in the swamp, and level ditching to lower the swamp bottom. The first would not be feasible due to the prohibitive cost of constructing and maintaining dykes to prevent flooding of nearby agricultural land. Level ditching seems the more suitable method.

Propagation charges of dynamite may be used to blast ditches where the hardpan is less than ten feet below the surface of the muck bottom. A fall survey indicated this method to be practicable on the area since in the parts of the area where blasting might be done, the hardpan underlies eight feet or less of muck.

Blasting by the propagation method in muck excavates a ditch eight to ten feet in width and three to four feet in depth, with the length dependent on the number of charges used. The total cost of blasting is estimated at fourteen cents a cubic yard.[18]

One thousand feet of ditch would provide adequate wintering habitat for the breeding stock left after fall trapping. It would also provide a suitable medium of travel between food and cover. Plantings of cattail and duck potato (Sagittaria sp.) in the ditches would increase the food available to the higher population. It is proposed that the ditches be put in close to the margin of the swamp where the hardpan is near the surface and such placement would also provide muskrats with the opportunity of burrowing into the high ground bordering the swamp. Undoubtedly there would be an overflow of muskrats from the ditches to less suitable parts of the swamp following a productive breeding season. These individuals should be taken first during trapping as they would be less likely to survive the winter. Trapping should be conducted in such a manner that 20% of the fall population is left as breeding stock.

SUMMARY

1. The study area, a typical buttonbush, sedge kettle-hole, subject to severe fluctuations in water level, carried fourteen muskrats into the late fall of 1946. None survived the winter of 1946-47. Three muskrats apparently migrated into the area the spring of 1947.

2. The combination of mink predation and freezing out of the population contributed to the total decimation of muskrats in the winter of 1946-47.

3. A breeding pair of muskrats produce an average of twelve young per year, of which 50% survive to attain fall trappable age. A 20% breeding stock is sufficient to insure sustained yield.

4. Management under present conditions should consist of complete utilization of the fall population. Habitat improvement should consist of stabilizing the water level by level ditching.

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