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Department of Fish and Game

SACRAMENTO VALLEY MUSKRAT SURVEY 1978*

by
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ABSTRACT

Sacramento Valley muskrat (Ondatra zibethicus) populations were surveyed in representative habitats during the spring and summer of 1978. Selected valley muskrat populations were studied by mark and recapture techniques throughout the breeding season. A total of 92 individual muskrats were captured during this period. Recaptures of tagged individuals accounted for a total of over 400 captures. The data collected suggested trends in distribution, densities, and reproductive success of California muskrats.

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INTRODUCTION

Since its introduction into the Sacramento Valley in the 1920's the muskrat (Ondatra zibethicus) has become widespread throughout the Sacramento and San Joaquin River drainages. With its expansion in range, it has become so numerous as to be regaurded as the most valuable fur resource in California.

The few studies which have been done on Sacramento Valley muskrats (Storer 1938, Twining and Hensley 1943, Semour 1954) have dealt with distribution and range extensions. The purpose of this study was to investigate the population dynamics of Sacramento Valley muskrats, and supply the necessary base-line data so that this valuable resource can be properly managed.

STUDY AREA

This study was conducted on the Conway Ranch, a large (25,000 acres) farming operation located approximatly six miles east of Woodland in Yolo County. This area produces a variety of food crops including rice, sugarbeets, corn, wheat, etc. The extensive use of man made irrigation canals, supplying water to these crops, has provided the muskrat populations in this area with miles of suitable waterways. It is irrigation canals like these which make up the majority of muskrat habitat within the valley. A natural slough also flowed through this area, and the muskrat populations it contained were also studied.

Only a limited number and length of the available canals were sampled. By concentrating effort, and thoroughly studing limited areas, the best estimates of population dynamics were made. These estimates can then be considered somewhat representative of similar habitats found elsewhere. Unfortunatly, every "type" of canal was not thoroughly sampled due to limitations in time. Effort was concentrated on the most productive habitats in order to gather as much data as possible.

The "natural" vegitation of the area is restricted by agricultural practices to canals, watercourses, and their boundaries. By far the dominant plants associated with these areas are cat-tails (Typha spp.) and bulrushes (Scirpus spp.). A very dense growth of water purslane (Ludwigia sp.) and knotweed (Polygonum sp.) was evident in some areas. The banks and levees adjacent to all canals were covered with a variety of vegitation including mustard (Brassica sp.), fennel (Foeniculum sp.) and a variety of grasses (Phalaris, Avena Bromus, Polypogon, Hordeum, Cynodon).

The agricultural crops associated with each of the study areas was quite variable. The canals sampled were associated with more then one type of agricultural product. Fields bordering a given section canal contain a variety of produce, and were typically replanted with a different crop after being harvested. These differences, and other variables, will be discussed below in considering the specific areas sampled.

Pelican Cut

The "Pelican Cut" is a large drainage canal which contains substantial amounts

of water when irrigation is takeing place, and during times of rainwater runoff. During parts of winter and early spring this canal may be almost dry, with only a narrow channel of water flowing down its course in many areas. When this study started, at the begining of April, the "Pelican Cut" was in this "drought condition". Muskrat "sign" was obvious in the form of runways and channels leading to bank dens exposed by low water conditions. This activity seemed to be concentrated in the lower areas of the ditch where pools of water accumulated and almost covered the width of the thirty to fifty foot wide canal. Sign was absent from areas where only a small stream of water ran through the exposed canal bottom.

By the end of April intensive irrigation started and the water level rose approximately three feet. This made many more areas of this canal suitable for muskrat habitation. The total length sampled was 0.8 miles long, and was seperated from other sections by culverts and road crossings.

A narrow strip of bulrush and cat-tail growth occured along both banks of this canal. The growth of the previously mentioned grass species was extremely dense on both banks. Wheat was present in the field to the north, and sugarbeets to the south. The beet crop was harvested during the first week of June, and corn was immediatly planted.

Drainage Canal

This canal is very similar to the Pelican Cut in that it is a drainage canal, and its banks are lined by essentially the same kind of vegitation. This canal, however, is more typical of the drainage canals in this area in that it is not more than ten feet in width at it widest. It averages closer to three or four feet in width during times of "normal" water flow. Occasionally flows would increase and rapidly rise the level of ths canal several feet for one or two days. During the majority of the time this ditch was only draining the adjacent rice fields which only produced a minimum of flow.

The length of this canal sampled was a one mile stretch running north and south and set off by culverts at each end. Rice fields occupied the land to the south, and the fields to the north being vacant, the wheat being harvested and burnt off during the proceeding summer. This vacant field was planted with sugar beets in late May.

Willow Slough

This waterway is a natural slough which is also used by agriculture for drainage purposes. It, however, differs considerably from the man made drainage canals which are so prevalent in this area. The bulrush and cat-tail growth was extremely dense along this waterway, creating extensive "marshy" areas up to thirty feet wide along its edges. Unlike the agricultural canals, Willow Slough is bordered by areas of riparian vegitation. This dense growth consisted mainly of California blackberry (Rubus ursinus), willows (Salix spp), cottonwoods (Populus fremontii), wild rose (Rosa sp.), valley oak (Quercus lobata), and various grasses and forbs.

The section of slough studied was one half mile in length and varied from thirty to sixty feet in width. At its west end it "blocked off" by a road

and culvert. Its west end was marked by the end of navigable waters where cat-tail and bulrush growth completely choked off the waterway.

Additional Areas

In addition to the areas described above, which were sampled through most of the time this study was in progress, four additional areas were studied for a limited amount of time. Two small drainage canals, very similar to the one extensivily studied, were sampled. A second section of Willow Slough, very different from the first in that bulrush and cat-tail growth was almost non-existant, was also studied.

Very limited sampling was also done in one of the numerous supply canals in the area. Sampling effort was minimal in supply canals because they are completely dry during periods when irrigation is not takeing place, and muskrat densities were suspected to be extremely low. The time available was better spent on more productive habitats.

METHODS

The basic technique used to study muskrat populations during this study was by capturing, tagging, and releasing muskrats. By closely monitoring the populations contained in well defined study areas an indication of the details of muskrat population dynamics would be obtained.

Sixty traps were constructed from one by two inch welded wire fabric, and were patterened after commercially available live traps. Traps were placed on floats constructed of wood and styrofoam, which allowed them to be easily positioned in canals, and remain unaffected by fluctuating water conditions. When the study was first started, twenty traps were set in each of three study areas. During the later part of the study all sixty traps were put in each of the study areas alternatly.

Captured muskrats were transfered into a wire cone where they were weighed and marked. Measurements were taken, sex, age, and capture location was noted. A running summary sheet was used to record the captures of each individual muskrat (appendix I).

Two methods were used during this study to mark captured muskrats, ear tagging and tail banding. Number one ear tags were attached to the right ear of captured muskrats. During the course of this study, no indication of tag "shedding" was noted during the recaptures of numerous individuals. The one difficulty associated with the use of these small tags is the problem of detecting their presence on recaptured muskrats. Tail banding was tried in an attempt to eliminate this problem. Aluminum butt-end leg bands, commonly used for bird banding, were clamped onto the base of adult muskrat tails. On the largest adults there is a noticable restriction at the base of the tail where the size 18 band (inside diameter 0.56 inch), used during this study, fit securely. Success with this kind of marking was very limited. No muskrat retained its tag for more than two weeks. Most appeared to remove their bands within the first twenty-four hours.

By plotting the distribution of captures for each tagged muskrat, home ranges for individuals could be determined. As the breeding season progressed, the

number of kits captured in these canals indicated the reproductive success of the adults established there.

In addition to trapping, field observations of muskrat sign was an important part of this investigation. During part of this study, limited sampling was done in order to investigate muskrat population dynamics in as many areas as possible. Traps were moved out of areas, to be reset eslewhere, when it seemed the populations had been adequately sampled. This was determined by noting the decline in the number of new captures, and by observing the amount of muskrat sign left at trap stations. Often muskrats would climb on the trap float and deposit scats, yet not enter the trap. If scats were not present on unproductive traps, this was considered an indication that few or no uncaptured muskrats inhabitated the area. The size of scats deposited could also be used as an indication of the presence or absence of kits in an area.

RESULTS

A total of 1,960 trap nights during this study produced the capture of 92 individual muskrats. Subsequent recaptures of tagged muskrats made for a total of 415 captures.

These captures produced data which is indicative of muskrat populations within each area studied. Data was collected which suggested trends in densities, age and sex structure, home range, and reproductive rates.(table 1). The three areas studied throughout this investigation produced data which shows the increase in the muskrat populations of these areas as the breeding season progressed (figure 1, 2, and 3).

DISCUSSION

The degree to which this study accomplished its goals varies with the aspects of muskrat population dynamics in question. The study methods used produced results which gave indication of densities and home ranges. Other aspects of muskrat population dynamics were investigated, but problems existing with sampling techniques produced a degree of error in the results obtained.

Each of the aspects of California muskrat population dynamics will be considered in this discussion. The limitations imposed by the sampling techniques, and its affect on the results, will also be discussed.

Reproductive Rates

This study attempted to estimate the reproductive rates of muskrats, under actual field conditions, by noting the number of kits captured during the breeding season. Unfortunately the methods used during this study had a very undesirable affect in that the constant sampling of muskrat populations in a given area created stresses on those animals which would not normally exist. Muskrats were so susceptible to "trap addiction" that one adult female, for example, was captured a total of 29 times. Under such stress it appeared this female did not produce a single litter, as no kits were captured in her territory. The extent to which stress limits the female muskrats ability to reproduce has been suggested by Dozier (1947) who, in reference to the raising muskrats in captivity, stated "handling and disturbing female muskrats during the breeding period and after copulation was found to be detrimental to conception and reproduction".

	Pelican Cut	Willow Slough(1)	Drainage Canal(1)	Willow Slough(2)	Drainage Canal(2)	Drainage Canal(3)	Supply Canal	Total
linear miles of canal	0.80	0.50	1.0	0.65	1.0	1.0	1.0	5.95
total captures	149	148	68	19	10	18	3	415
number of individuals	24	32	15	6	4	9	2	92
adults	11	11	9	2	3	1	0	37
male	6	6	5	1	1	0	0	19
female	5	5	4	1	2	1	0	18
juveniles	13	21	6	4	1	8	2	55
male	3	9 1?	3	2	1	4	2	24 1?
female	10	11	3	2	0	4	0	30
mortalities	8	12	3	0	0	2	1	26
captures per trap night	.26	.32	.12	.08	.09	.10	.05	.21
individuals/mile	30	64	15	9.2	4	9	2	15.4
trap nights	575	467	344	233	105	178	58	1,960

TABLE 1. Capture Data,
Sacramento Valley Muskrat Survey, 1978.

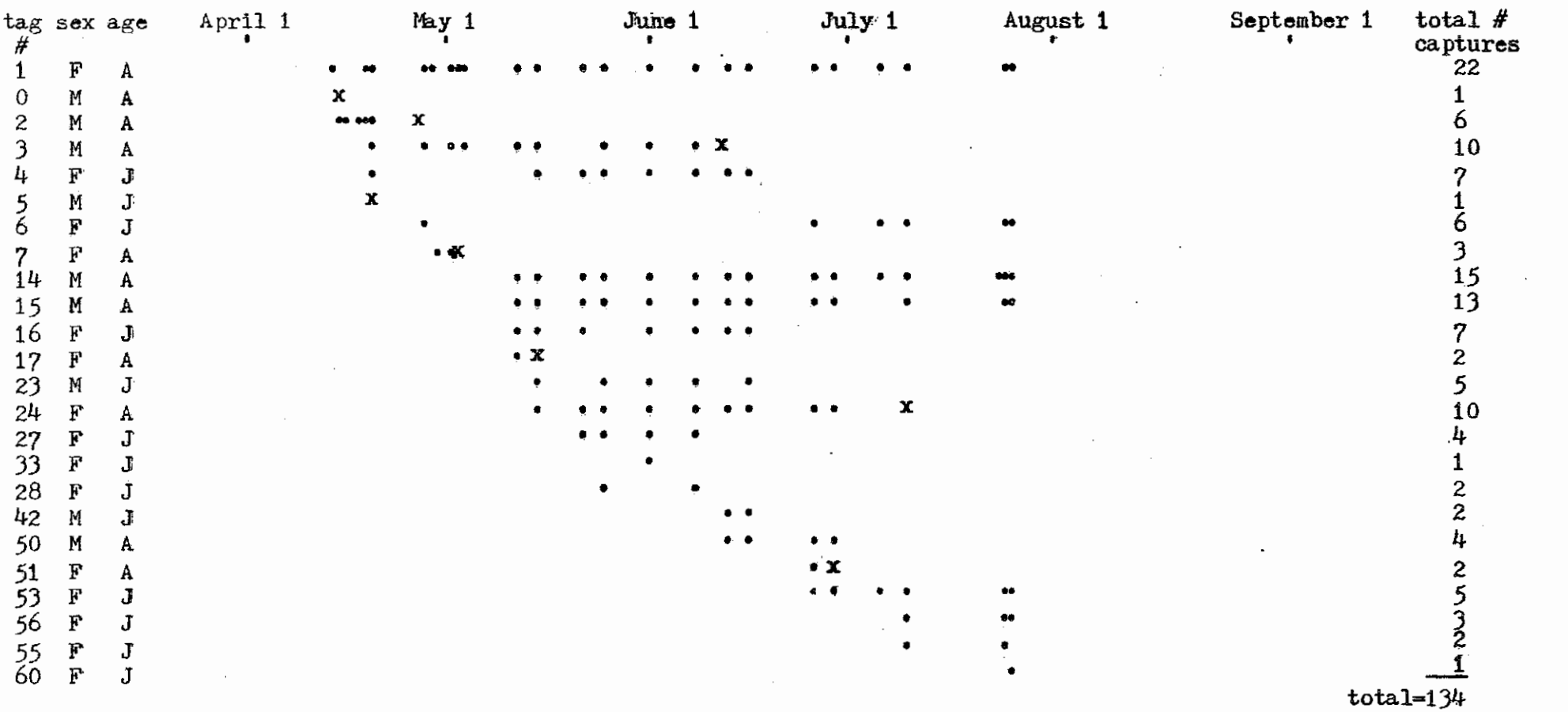

FIGURE 1. Distribution and Frequency of Captures Recorded in the Pelican Cut. (• = capture, x = trap mortality).

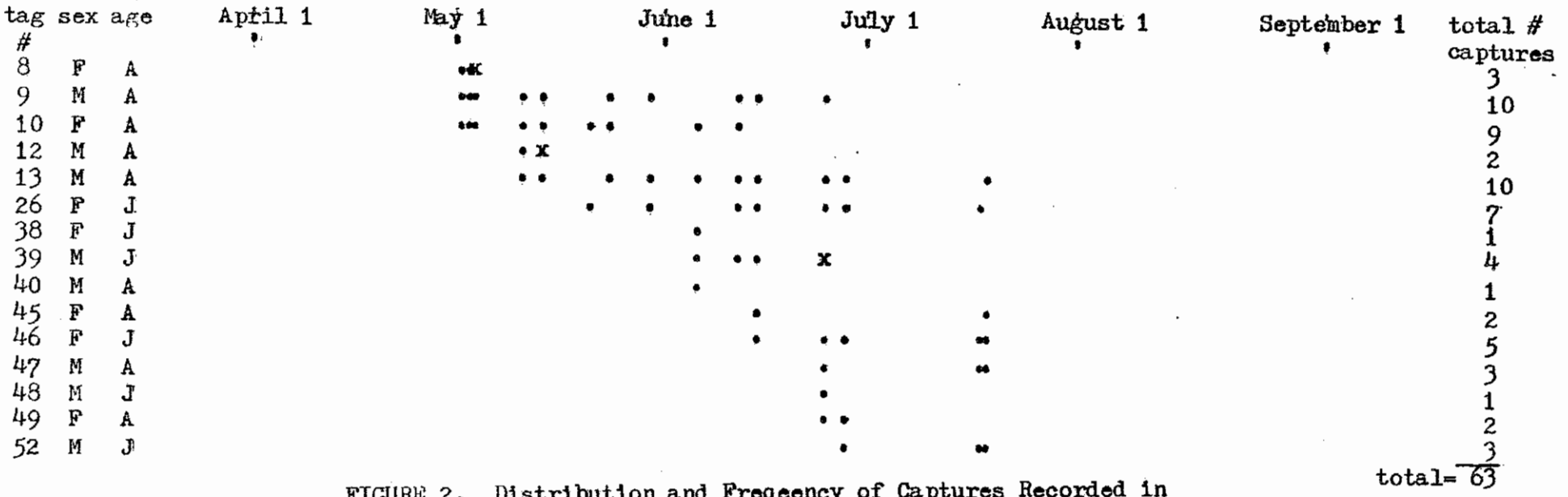

FIGURE 2. Distribution and Freqeency of Captures Recorded in the Drainage Canal (• = capture, x = trap mortality).

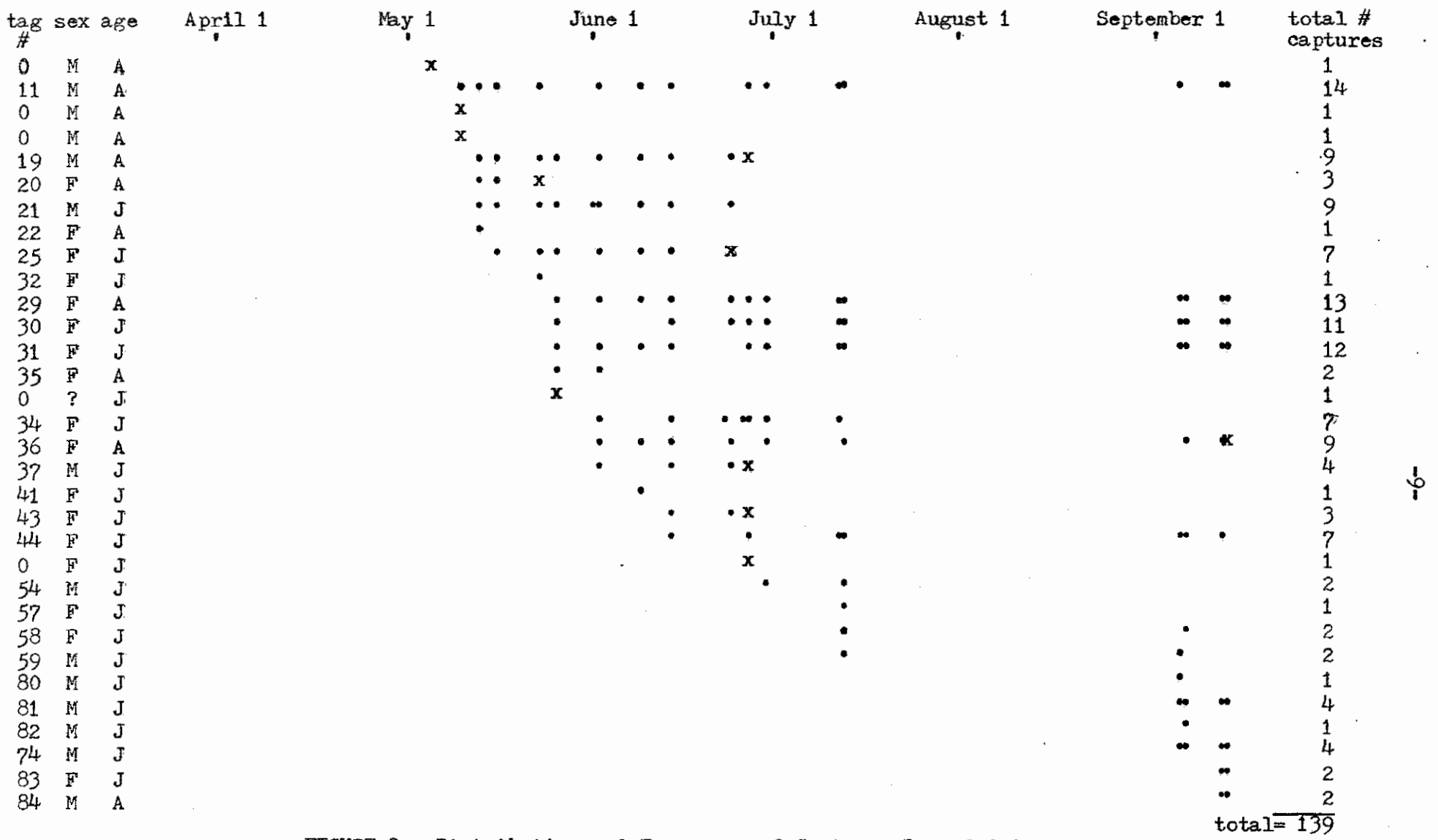

FIGURE 3. Distribution and Frequency of Captures Recorded in Willow Slough (• = capture, x = trap mortality).

Other evidence that stress was a factor during this study was shown by the autopsy of an adult female which was a victim of trap mortality on July tenth. Prior to this date this muskrat had been captured nine times (figure 7., #24). Inspection of its uterus revealed five embryos, three of which were undergoing normal development, and two appeared to be resorbing. If this was typical of the many females which were being repeatedly recaptured, then a substantial effect was being produced by the sampling techniques. For this reason, traps were moved out of the areas being sampled and other canals, where normal reproduction should have already occured, were studied.

Trap mortality problems also undoubtedly had some affect on reproduction in the three intensively studied areas. The removal of adult females, especially early in the breeding season, greatly reduced the potential fall population. Removal of adult males could have produced a similar affect due to the monogamous habit of muskrats. Matters were further complicated in that after adults were removed, new adults appeared to move in from outside the study area. It was then difficult to determine if the "kits" being captured in that area were offspring from the original residents, or if they were brought in by newly established individuals.

Simply by considering the capture data (figure 1) one can make estimates as to the reproductive rates of the muskrat populations studied. The data collected in the sampling of Willow Slough (table 1., and figure 4.) shows a population of five adult females producing a total of 21 juveniles. Consideration should be given to the fact that one of these females was a victim of trap mortality early in the study, and the others were subjected to the stresses of multiple recaptures (figure 3.). This sort of problem is apparent to a greater extent in the other two intensively studied areas.

The four areas subjected to limited sampling give some indication of reproductive rates which were quite variable (table 1.). In drainage canal #2 there were three adult muskrats (one male, two females) and one juvenile captured. In drainage canal #3 one adult (a female) and eight young were captured. This would indicate a much more productive area.

The data collected in all these areas falls short, in terms of reproductive rates, in comparison to studies done in other areas. Numerous studies have been done on muskrat reproductive rates by considering placental scar count data collected from fall trapped muskrats. Although this method of investigation differs considerably from this study, comparisons are valid. Errington (1963), in twelve years of field studies in Iowa, found litter size averaging 7.5 young. A sixteen year record of breeding activity revealed an average of 2.54 litters per year. These averages are considerably higher than what the data collected during this study (table 1) would seem to indicate. The apparent low fecundity of the muskrats studied during this investigation is probably a factor of the difficulties associated with sampling methods.

DURATION OF BREEDING SEASON

The very first capture of a juvenile muskrat during this study occured on April twentieth in the Pelican Cut (figure 1.). Two juveniles were captured on this date, one weighing 200 grams, and the other weighing 140 grams. From the capture locations, it is believed these were the young of different females. Data on the growth of young muskrats collected by Errington (1963) shows these muskrats to be approximately 30 and 24 days old. This would place their birth during the last week in March.

An indication of the termination of the breeding season was complicated by the fact that the sampling techniques used may have artificially shortened the breeding season. On September fourth a very young muskrat, less than 300 grams estimated weight, was observed crossing a road adjacent to recently drained rice fields. This muskrat was probably born in late July or early August. Admittedly, one observation does not make for a valid determination of significant breeding activity, but it does provide evidence of breeding.

The duration of the breeding season, as found by other investigators, seems to be quite variable. Dixon (1922) found breeding to occur during every month of the year in studying muskrat populations in the Imperial Valley of Southern California. Errington extensive field work (1963) found signs of breeding in the months of March through September, with the bulk of activity occuring in May and June.

SEX RATIOS

As expected for monogamous populations, adult muskrats captured during this study showed close to a fifty-fifty sex ratio (table 1). In the three areas thoroughly sampled there appeared to be slightly more males than females present. This discrepancy was probably a result of the elimination of individual males, due to trap mortality, and their replacement by males from outside the study area.

The sex ratios, in most cases, for juveniles appeared to be close to fifty-fifty, although the sample size is admittedly small. The kits caught in the Pelican Cut show a sex ratio weighted in favor of females (10:3). This is probably a factor of the difficulties associated with sexing very young kits. Later work revealed that young males were easily mistaken for females.

DENSITIES, HOME RANGE, AND MOVEMENTS

The ease with which muskrats can be recaptured has produced data on the home range and movements of some individuals. The first muskrat tagged was recaptured on 21 of the 24 additional days sampled in that area. With the addition of being recaptured more than once on a single day, that muskrat was captured a total of 29 times.

Home ranges of paired adults very seldom overlap significantly with that of adjacent adults. After elimination of adult muskrats, due to trap mortality, the muskrats of adjacent territories appeared to expand their range into the removed muskrat's territory. This caused discrepancies in determining "natural" territories that existed at the start of this study. In spite of the problems associated with trap mortality, the muskrats caught along the three canals studied intensively showed territorial behavior as evidenced by recapture records. In the 0.8 miles of canal studied along Pelican Cut there were four pairs of adult muskrats. Two pairs had distinct 0.2 mile territories. The two other pair would have probably shown approximately 0.2 mile territories if it wasn't for trap mortality problems.

The densities of the muskrats found along Willow Slough was approximately 10 pairs to the linear mile of canal. In the one half mile studied there appeared to be five pairs of adult muskrats present. Here, also, trap mortality problems created difficulties in determining "natural" territory sizes, but the number of muskrats per mile estimate is valid. The drainage canal sampled intensively had a density of five pairs per linear mile of canal (table 1). Well defined territories were also present here, although some overlapping did occur. Again, trapping mortality did create problems in determining territory sizes.

CENSUSING TECHNIQUES

Additional work was done at the conclusion of this study to try and determine a valid technique for censusing muskrat populations. As population sizes had been determined for several areas, an attempt was made to locate some indicator of that size, such that densities could be easily estimated. The most valid indicator of muskrat numbers is undoubtably reflected in the presence of muskrat "sign" within the area being considered. Assigning some useable value to to this indicator is where the difficulty lies in describing a census technique.

The presence of muskrat sign in the form of feedbeds , accumulations of vegitation remaining at muskrat feeding stations, is often a good indicator of muskrat activity. By noting the number of feedbeds along a given section of canal, it may be possible to estimate population densities.

Attempts to correlate feedbed abundance to population densities was not successful in that feed bed abundance seemed to be related to the type of area, not necessarily the abundance of muskrats. The marshy areas along Willow Slough contained numerous feedbeds, whereas the areas censused in the Pelican Cut, where muskrats were abundant, contained few feedbeds, although "cuttings" were loosely distributd along the canal.

Possibly the best means by which muskrat populations could be censused, as noted by Errington (1963), would be by plotting foci of muskrat activity at the start of the breeding season when territories are established. This would be at the time of lowest population numbers, and it may be possible to accuratly estimate the number of "breeding pairs" in a given section of canal.

ACKNOWLEDGMENTS

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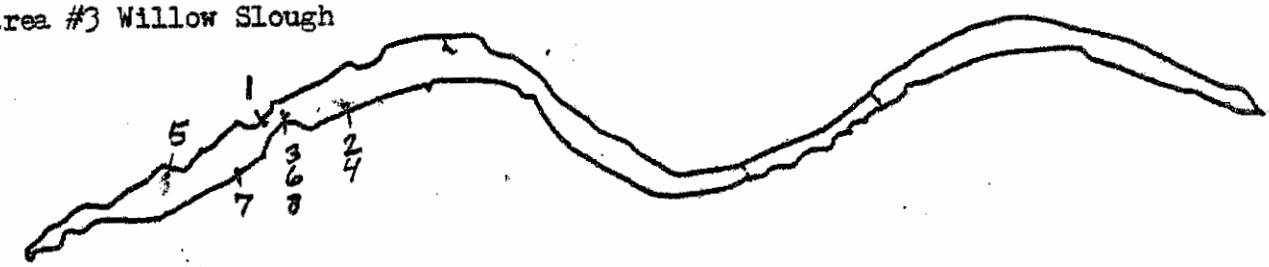
APPENDIX 1. Individual Muskrat Capture Summary Sheet

SACRAMENTO VALLEY MUSKRAT SURVEY 1978
Study Area #3 Willow Slough



Ear Tag # 21

Capture #	Date	Sex	Age	Weight	Tail Length	Tail Height	Comments
1	13 May	♂	J	220	125		Hind foot ~65 mm, Body ~150 mm, Dark fur
2	16 May	♂	J				
3	23 May	♂		260	140	11	tail cut.
4	26 May			260			
5	2 June	♂	J	320	?	?	Escaped out of canoe
6	9 June	♂		330	150	12	
7	14 June	♂	J	330	154	12	
8	24 June	♂		320	157	12	
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