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State of California
THE RESOURCES AGENCY
Department of Fish and Game

YUMA CLAPPER RAIL STUDY
MOHAVE COUNTY, ARIZONA
1973[1/]

by

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ABSTRACT

A Yuma clapper rail study was conducted in Topock Marsh, along the lower Colorado River, from March to October, 1973, with limited study continuing until January, 1974. Clapper rails began to arrive in Topock Marsh in early April and remained until late September. The majority of the summering population had left the area by October 1. Responses to tape recorded calls in November, 1973, and January, 1974, indicate a small population overwinters in Topock Marsh. Clapper rails require cattail or bulrush stands in shallow water near high ground. They establish territories averaging 1.4 hectares (3.55 acres). Light cattail type held the highest densities of rails and dense cattail the lowest. Highest density areas held 7.9 rails per 10 hectares (30 rails per 100 acres).

1/ Supported by Federal Aid in Wildlife Restoration Project W-54-R-6, "Special Wildlife Investigations" Progress Report, Job II-5.9, June 1974.

RECOMMENDATIONS

To preserve and enhance Yuma clapper rail populations on the lower Colorado River, California Department of Fish and Game recommends that:

1. Surveys of marsh areas be conducted to delineate rail habitat in need of protection from dredging, filling and channelization. Those areas not presently controlled by wildlife agencies should be given first consideration.

2. Annual sample censuses of representative areas be conducted to determine population trends.

3. The effect on clapper rail populations of the diking project presently in progress in Topock Marsh be evaluated.

4. Analysis of clapper rail food habits be conducted and availability of food items be determined.

ACKNOWLEDGEMENTS

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INTRODUCTION

Dickey (1923) described a new race of clapper rail (Rallus longirostris yumanensis) from three specimens collected in the Laguna Dam area near Yuma, Arizona. This race is unique in the continental United States in that it inhabits fresh water marshes. Prior to Dickey's findings this race was thought to be restricted in distribution to the Colorado River Delta. Since its appearance in southern Arizona it has extended its range northward (Ohmart and Smith, unpublished) to its present northern limit in Topock Marsh (Tomlinson and Todd, 1973), where the first rail was reported by Welch (1966).

Much concern has been expressed about the survival of this race because dredging, filling and channelization operations along the lower river have destroyed suitable clapper rail habitat. Because habitat requirements were unknown, available habitat could not be wisely managed for the benefit of these rails.

A Yuma clapper rail study was conducted at Topock Marsh, on the lower Colorado River, from March, 1973, through October, 1973. Limited study was also conducted in November, 1973, and January, 1974. The study was designed to:

1. Determine the physical and biological components forming the preferred habitat and assign levels of importance to these factors.

2. Determine rail densities, territory size and gather other general life history data.

3. Develop a method of live trapping clapper rails.

STUDY AREA

Topock Marsh is located in Mohave County, Arizona, near the Arizona-California border. It lies just north of Topock, Arizona, and two miles east of Needles, California. The marsh is a 1,620 hectare (4,000 acre) lake of drowned mesquite (Prosopis pubescens and P. juliflora) with extensive stands of cattail (<u>Typha domingensis</u>) and bulrush (<u>Scirpus californicus</u>) (Figure 1). The marsh is bounded on the north and south by dikes which serve to stabilize the water level. Topock Bay lies south and west of the marsh and is subject to the daily water fluctuations of the Colorado River. Topock Bay includes Lost Lake, Lost Lake Channels, and South Beal Lake and channel.

Areas of high ground are characterized by mesquite, salt cedar (<u>Tamarix pentandra</u>), arrowweed (<u>Pluchea</u> sp.), and seepwillow (<u>Baccharis</u> sp.).

METHODS AND MATERIALS

Censusing

Rails were located by playing tape recorded rail calls and listening for call responses. Calls were broadcasted using a portable reel-to-reel tape recorder (Realistic model 505A) connected to a remote power horn (Realistic model 40-1237). The horn was mounted on the bow of a 17-foot square stern canoe to reduce the deafening effect on the observer. When relatively large areas were censused using the recorded calls, the canoe was propelled by an electric fishing motor.

To determine arrival dates, survey routes (called arrival routes) were worked on a regular basis from March 24 through April 22. Three routes were established along habitat previously determined to contain high rail densities (Cornelius, 1972). The routes were designed so that each could be completed in 2 to 2½ hours using the electric motor at moderate speed. Routes were checked at sunrise and shortly thereafter. In each four day period, a different route was worked each day for three days, and on the fourth day no route was scheduled. The pattern was repeated so that each route was worked at four day intervals, weather permitting. If a given route was not read on the scheduled day (due to high winds, for example) then this route was worked on the off day. In addition to these established transects, vocalizations were broadcasted randomly in the evening in areas that rails are known to have frequented the previous year.

To determine dates of departure, calls were broadcasted in areas occupied by rails during the summer months. Because birds tend to become conditioned to the recordings, calls were broadcasted infrequently. Due to increased local movements by birds in late summer and fall, when they apparently begin to abandon their territories, calls were broadcasted selectively rather than along established census routes. Regular broadcasting of calls was discontinued on October 10, 1973, but numerous departure checks were made in mid-November, 1973, and early January, 1974.

The entire marsh and bay was censused with recorded calls between May 14 and May 28, including areas where rails were not previously reported by Cornelius (1972). Broadcasted calls were followed by approximately 15 seconds of listening by the observer. Alternately broadcasting and listening, the observer conducted the census while moving by canoe at slow speed. Censusing was begun approximately one-half hour before sunrise and terminated about 0900 hours.

In spring and early summer (until mid-June) the breeding status of rails could often be determined by the types of vocalizations given by the rails. Responding rails were classified as definitely paired, probably paired, probably unpaired and definitely unpaired. "Definitely" paired was noted only when both birds responded with a simultaneous clatter call.

Rail locations were plotted on a map. Individuals were assigned a number; when paired birds responded together, they were assigned a hyphenated set of numbers.

Habitat Evaluation

Emergent vegetation in the study area was mapped using these categories: dense cattail, light cattail, dense bulrush and light bulrush. The above categories reflect obvious differences in vegetation density.

In evaluating habitat, belt transects, 0.3 meters (one foot) wide, were run from the intersection of open water areas and emergent vegetation (cattail or bulrush) to high ground or open water. Transects were established at locations where rails were found in the May census (Figure 1). Transect numbers correspond with the number identification assigned the rail or rails found there.

The amount of standing vegetation, fallen vegetation and open potholes was recorded along the entire line. At 4.6 meter (15 foot) intervals water depth and emergent vegetation height above water level were measured. Stem counts were taken at 4.6 meter intervals in quadrats of 0.18 and 0.36 square meters (4.9 and 9.7 square feet). A check after ten transects indicated that the smaller sample areas were sufficient to accurately determine the number of stems per square meter. The distance from the intersection of open water and emergents to high ground was recorded.

Relative abundance of floating stems was categorized as follows:

1. LIGHT: less than 10% of surface covered.
2. MEDIUM: 10-50% of surface covered.
3. HEAVY: 50-95% of surface covered.
4. VERY HEAVY: 95-100% of surface covered.

Several authors, including Oney (1951) and Applegarth (1938), have found crabs to be a major food item of coastal subspecies of clapper rails. In Topock Marsh, crayfish appeared to be fairly abundant; it was speculated that they might constitute a major food item. To determine the relative abundance of crayfish in areas used by clappers, a crayfish trap was set in shallow water areas, 8-20 cm. (3-8 inches) deep, of each transect. Traps were baited with fish heads. Although rails were most active in late afternoon and early morning, crayfish trapping was done at night because crayfish readily escaped the trap during daylight.

Three study plots were established to determine clapper rail territory size (Figure 1). These areas of relatively high rail density (Cornelius, 1972) were divided into fifty foot square quadrats so that the rail's position within the emergent vegetation could be accurately determined. Study plots were established prior to the rail's arrival. After the rails had established territories additional study plots were established by marking 15 meter (50 foot) intervals along the edge of open water and emergent vegetation. A bird's location could then be accurately determined whenever a response was elicited. Depth of the responding birds within the emergent stand was estimated. Estimates are reasonably accurate if the observer is within 30-60 meters (100-200 feet) of the calling rail.

Calls were broadcasted randomly throughout the day to locate the birds during their daily cycle. Responses were mapped and then transferred to orthogonal aerial photos. Areas encompassed by these points were used to define a bird's territory. Territory size was determined with a planimeter.

Rails selected for analysis of territory size were in areas where the amount of available habitat would not be a factor influencing territory size or configuration. Birds included those with and without adjacent neighboring territories.

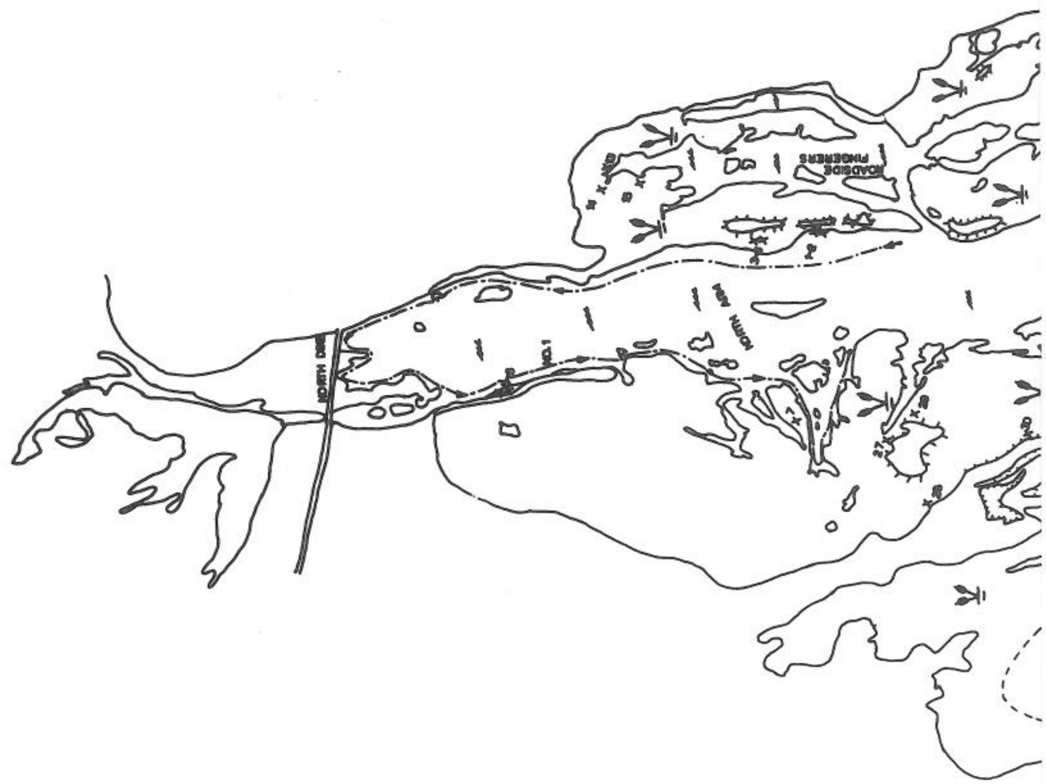
Trapping

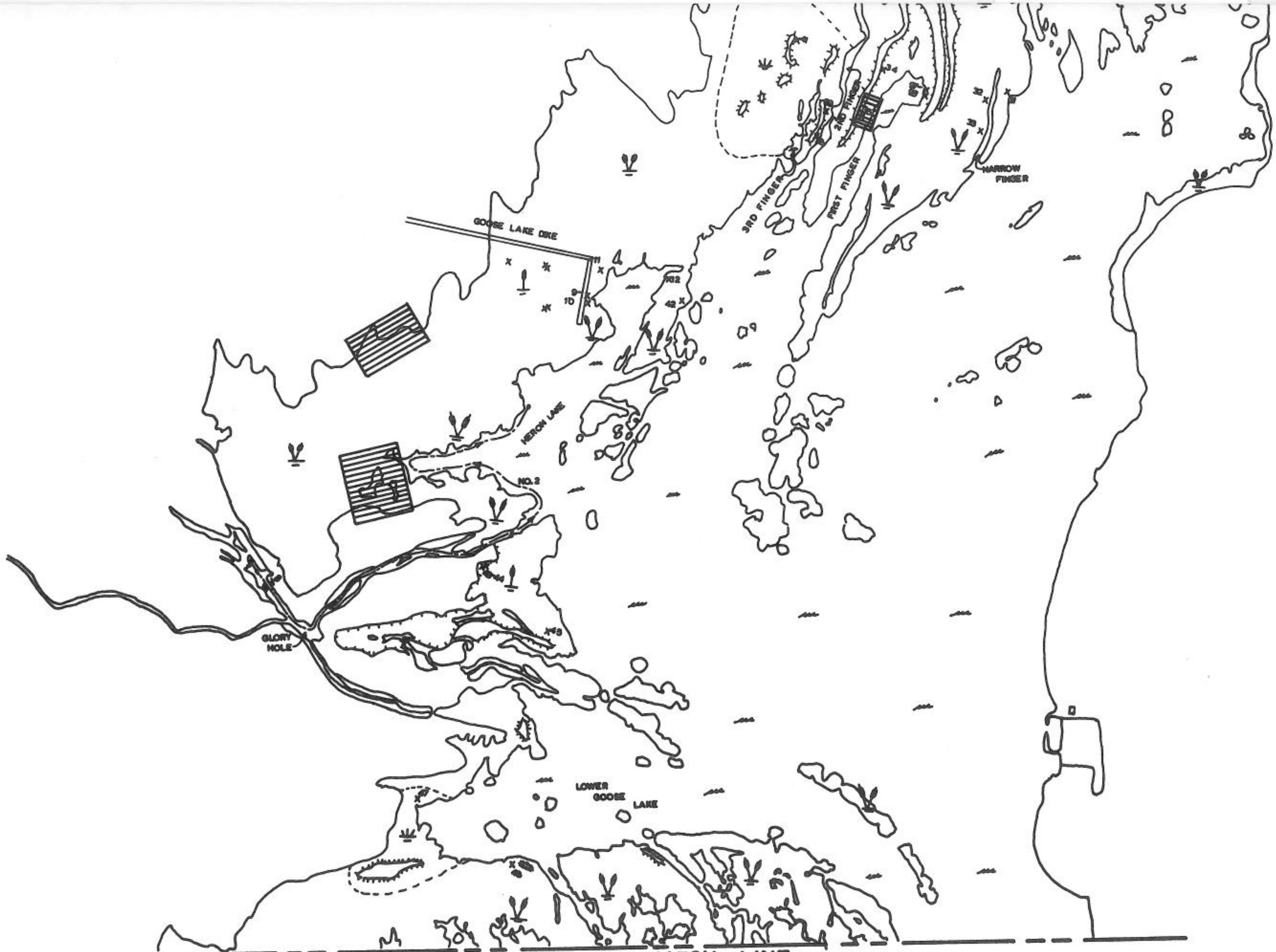
Three methods of live trapping clapper rails were tested using Tomahawk traps (Figure 2). Because the rails inhabit areas of dense foliage it was felt they would have little fear of entering such traps. All sets were established in areas known to be used by clapper rails. Due to the high ambient temperatures (43-48° C maximum) and reduced activity of rails, no trapping was attempted during mid-day.

Initially three traps were set in series in the emergent vegetation a short distance from high ground. An 18-inch drift fence was placed between traps and on each end of the series. A power horn, connected to a hidden recorder, was placed behind the center trap.

The second technique consisted of a single trap with drift fences set perpendicular to the shoreline. This method was intended to capture rails as they moved along the water's edge. Because of the disturbance created while making a set, traps were put out in the afternoon and trapping was attempted the following morning. Bateman (1965) reported success in setting traps in series with drift fences.

A third method consisted of a single trap, with or without drift fences, baited with crayfish. The set was made approximately one hour before sunset and checked just before dark and one hour after sunrise. Use of




GOOSE LAKE DIKE
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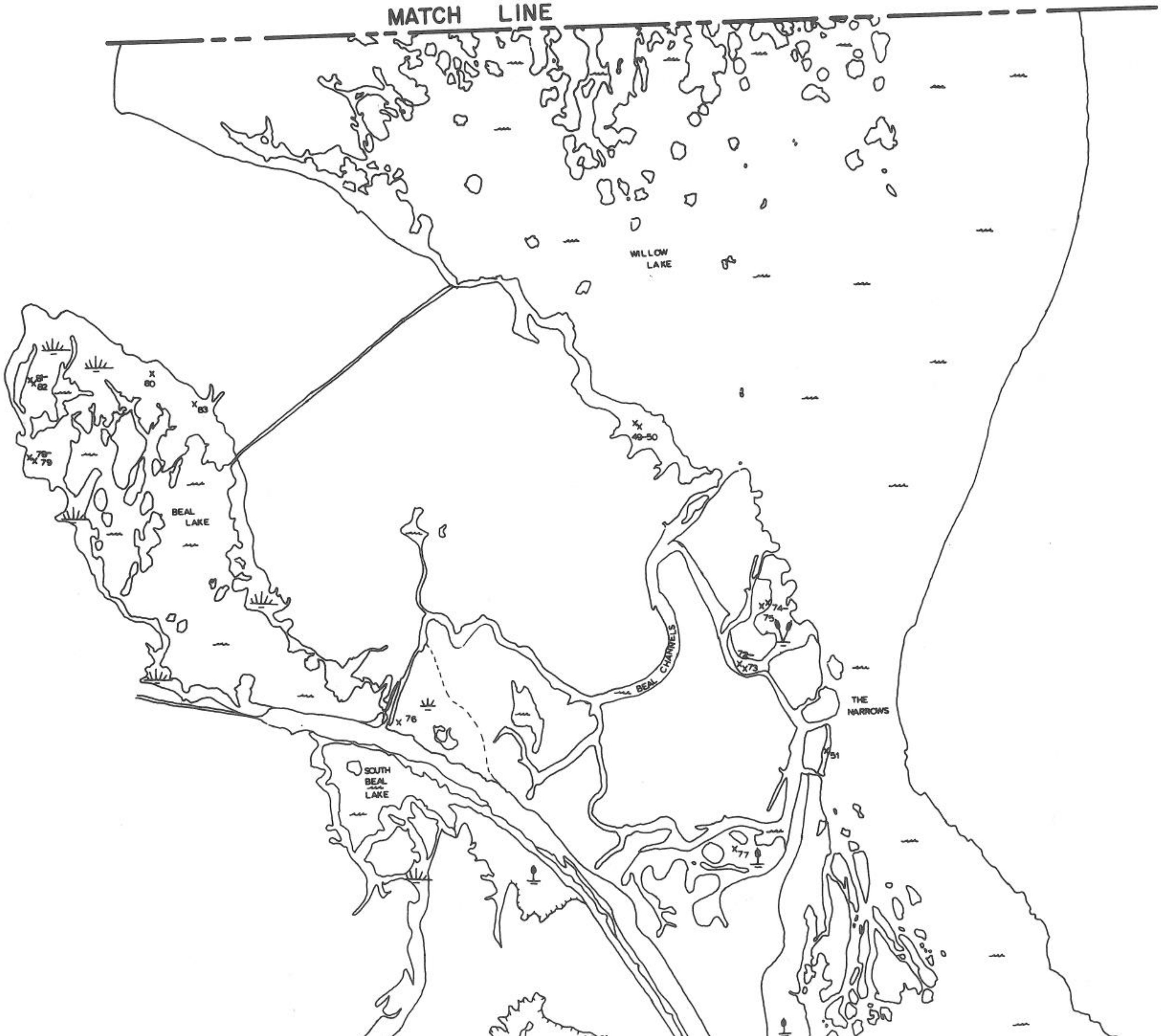
LOWER GOOSE LAKE

MATCH LINE


MATCH LINE
WILLOW LAKE
BEAL LAKE
81-82
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78-79
49-50
BEAL CHANNELS
74-75
72-73
76
THE NARROWS
51
SOUTH BEAL LAKE
77

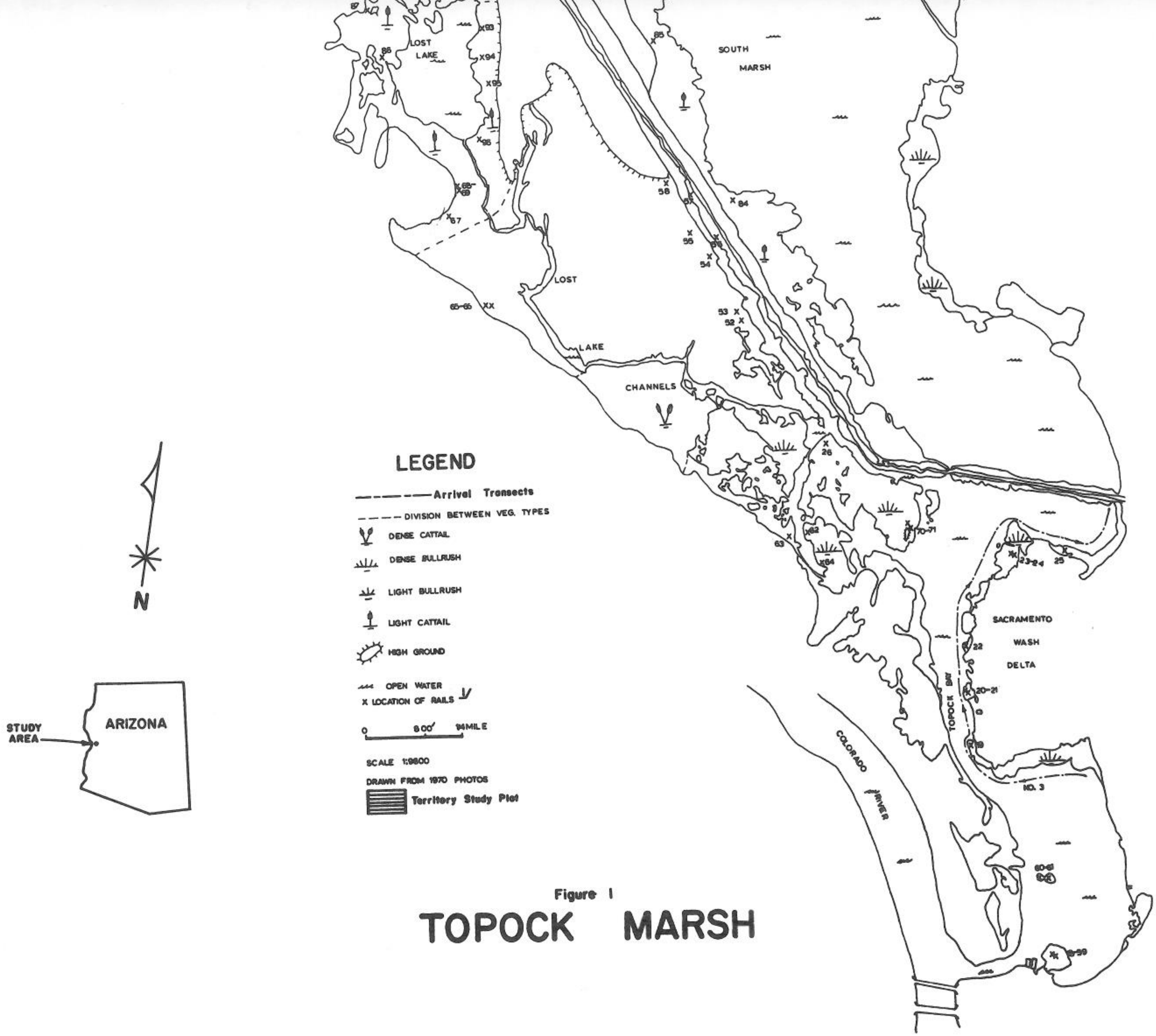
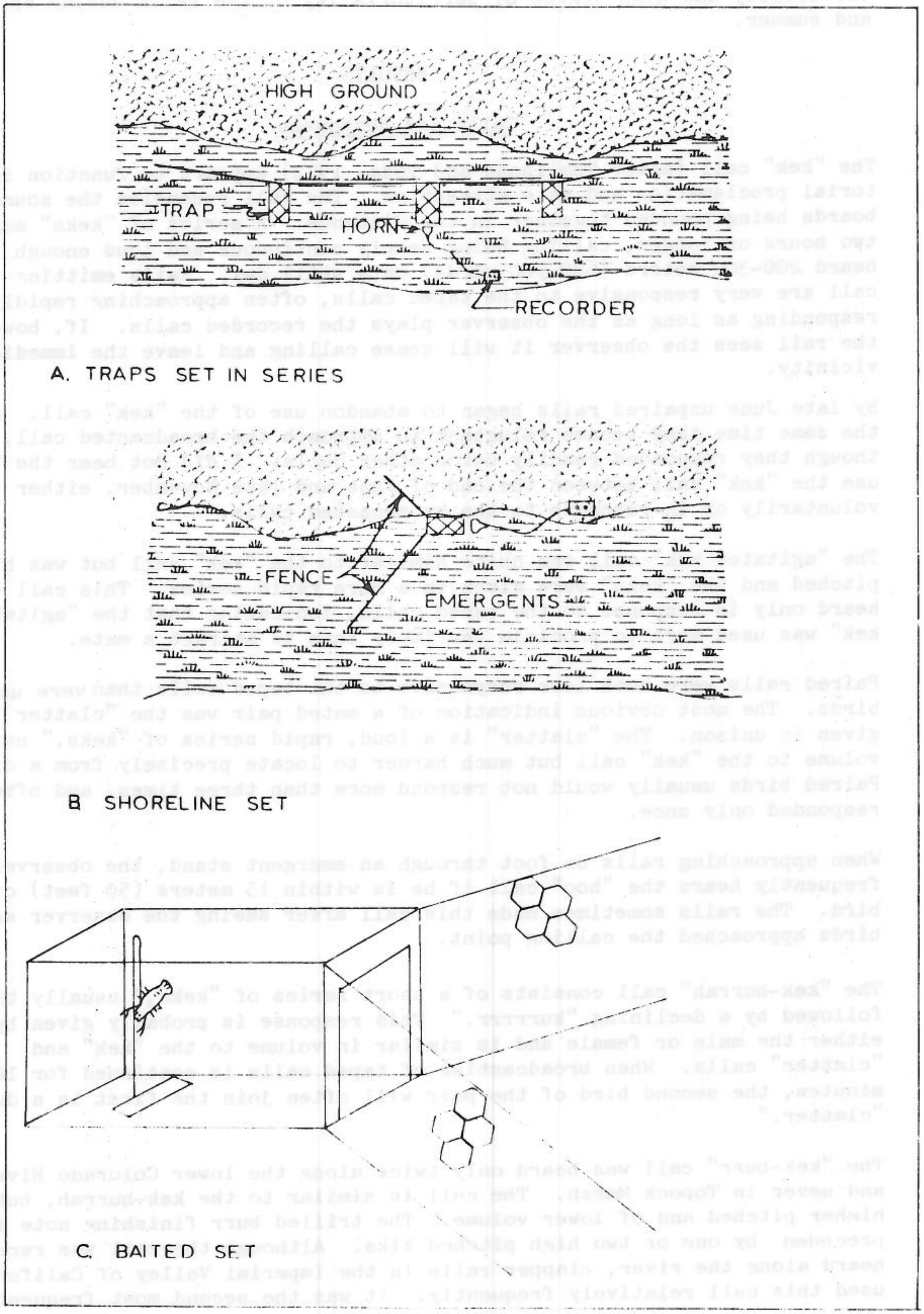


Figure 1

TOPOCK MARSH

1/ Numbers refer to individual rails as well as locations of habitat evaluation transects.

Figure 2. Yuma Clapper Rail Trap Sets.



elaborate cloverleaf type traps (Low, 1935) was impractical because of the low density and high degree of territoriality of the rails during spring and summer.

RESULTS

Calls and Responses

The "kek" call (after Tomlinson and Todd, 1973) appears to function in territorial proclamation and mate attraction. The call resembles the sound of two boards being pounded together in the distance. A series of "keks" may last two hours or longer, calling being nearly continuous and loud enough to be heard 200-300 meters (600-900 yards) on a still day. Rails emitting this call are very responsive to the taped calls, often approaching rapidly and responding as long as the observer plays the recorded calls. If, however, the rail sees the observer it will cease calling and leave the immediate vicinity.

By late June unpaired rails began to abandon use of the "kek" call. At the same time they became reluctant to approach the broadcasted call, even though they responded readily using other calls. I did not hear the birds use the "kek" call between the end of June and late November, either voluntarily or in response to the broadcasted calls.

The "agitated kek" call was quite similar to the "kek" call but was higher pitched and the "keks" were given in a more rapid series. This call was heard only in response to the taped calls, indicating that the "agitated kek" was used more to proclaim territory than to attract a mate.

Paired rails were much less responsive to the taped calls than were unpaired birds. The most obvious indication of a mated pair was the "clatter' call given in unison. The "clatter" is a loud, rapid series of "keks," equal in volume to the "kek" call but much harder to locate precisely from a distance. Paired birds usually would not respond more than three times, and often they responded only once.

When approaching rails on foot through an emergent stand, the observer most frequently hears the "hoo" call if he is within 15 meters (50 feet) of the bird. The rails sometimes made this call after seeing the observer as the birds approached the calling point.

The "kek-hurrah" call consists of a short series of "keks," usually three, followed by a declining "kurrrrr." This response is probably given by either the male or female and is similar in volume to the "kek" and "clatter" calls. When broadcasting of taped calls is continued for 10-15 minutes, the second bird of the pair will often join the first in a dual "clatter."

The "kek-burr" call was heard only twice along the lower Colorado River and never in Topock Marsh. The call is similar to the kek-hurrah, but is higher pitched and of lower volume. The trilled burr finishing note is preceded by one or two high pitched kiks. Although the call was rarely heard along the river, clapper rails in the Imperial Valley of California used this call relatively frequently. It was the second most frequently heard call during late May and early June 1974, the clatter being heard more frequently. The function of the kek-burr call is unknown.

In spring (April and early May) the female gives the "purr" call. This call was most frequently heard when there were several birds in the area or when a pair of rails was separated. This subdued call, approximately at the level of a normal speaking voice, resembles the purr of a cat. This call was heard only once after mid-June.

Somewhat louder than the "purr" call, the "agitated-purr" sounds more like a low growl than a purr. Although the call is of sufficient volume to be heard at least 15 meters (50 feet), it was heard only when the taped calls were broadcast within 3-5 meters (9-15 feet) of the responding rail.

Infrequently heard, the "burp" call is apparently a variation of the "kek" call and is used as a location call when two birds of a pair are separated. The other member of the pair will usually approach the calling rail.

Occasionally when rails are surprised in relatively open areas, they will flush and give a loud "kak-kak-kak" call. The call is quite loud, being similar in volume to the "kek" and "clatter" calls. It is very much like the flushing call of the least bittern, except that is lower pitched. A "kak" call appears to be an expression of surprise and/or danger.

When attempting to attract clapper rails for trapping or observation, broadcasting a combination of "kek" and "purr" calls was most effective. When cover was available unpaired clappers often approached the calling point quite readily, although they were reluctant to advance into open areas. Overcast conditions seemed to reduce this hesitancy. If the calling point was strategically located, several unpaired birds could be called into an area from surrounding territories. Paired rails rarely approached the call.

In the spring when morning temperatures were less than 21° C, rails did not respond readily to broadcasted calls until the sun rose and the ambient temperatures began to rise, about ½ to 1 hour after sunrise. Later in the summer, early morning temperatures were higher and clapper rails responded well to broadcasted calls from dawn to 3 or 3½ hours later (0800-0830 hours). Broadcasting after 0830 in mid-summer is of limited effectiveness, although some birds, especially unpaired males, will respond any time of day.

When wind velocity exceeded approximately 16 k.p.h. (10 m.p.h.) responsiveness of rails decreased markedly. Call responses were also more difficult to hear under windy conditions. Thus, censusing during windy periods was impractical.

When approaching an area to broadcast calls, the sound of a conventional outboard motor had little effect on the responsiveness of the rails. Occasionally, rails that had not responded to the broadcasted calls would respond when the outboard was started. Such calling in response to loud noises by R. l. waynei was reported by Oney (1954).

The technique of pausing for a few minutes while wading through cattail or bulrush was an effective method of eliciting responses without use of broadcasting calls. This was useful especially later in the summer when the rails were less responsive to the broadcasted calls.

Dates of Arrival

Determining arrival dates of migrant rails was complicated by the possible presence of wintering birds. Until April 6, no rails responded to broadcasted calls along arrival routes. In the author's opinion, had there been resident rails along these routes between March 24 and April 6, they would have been detected with recordings. In fact, early calling by a clapper rail was heard in late March near Imperial Dam (Charles Repking, personal communication), an area with climatic conditions similar to Topock Marsh. The rapid increase in number of responses in all areas of the marsh after April 6 demonstrated that the rails began arriving in early April.

The first response to broadcasted calls was encountered on April 6 just south of the north dike (Table 1). This route had been read the previous day with no results. Early responses indicated that most clapper rails arrive in the area unpaired. During April the population of rails in the study area gradually increased until early May when it appeared that the total compliment of rails was present.

Table 1. Early Arrival Dates and Breeding Status of Yuma Clapper Rails at Topock Marsh, 1973.

Date	Location	No. of Birds	Breeding Status
April 6	North Dike	1	unpaired
April 10	Sacramento Delta	3	1 pair, 1 unpaired
April 11	Beal Channels	2	unpaired
April 12	Glory Hole Channel	1	unpaired
April 13	Sacramento Delta	3*	1 pair, 1 unpaired
April 14	North Arm	1	unpaired
April 16	Second Finger	3	unpaired
April 18	North Arm	1	unpaired

*Birds located on April 10 were also relocated.

Once a rail was located it could generally be relocated in the same area on subsequent days. Eventually, however, unpaired rails will abandon an established territory and relocate if pairing does not occur. After paired rails established a territory, they normally remained in it. I encountered only one case in which a pair moved their territory. The distance of this move was only 200 meters (600 feet).

Dates of Departure

In late summer, responsiveness of rails to broadcasted calls decreased markedly. This tendency was most noticeable in birds that had heard the tape frequently. Other clapper rails generally responded immediately but would respond only once.

By early October, 1973, nearly all rails had left the area. Although three rails had been heard in the Sacramento Delta of Topock Bay on September 19, no responses were recorded on a census of Topock Bay and Lost Lake on September 26. The census of this area was repeated on September 27, again no responses were elicited. Also, where 34 responses were heard on the

May census in the north half of the marsh, only seven responses were recorded on the September 24 census, four on October 4, none on October 8, one on October 9 and one on October 10.

Departure checks in November, 1973, and January, 1974, indicate that at least a small resident winter population occurred in the marsh. During the period of November 22-26, four individual rails were heard; three calls in response to broadcasted calls and one gave a spontaneous call. From January 9-12, five rails were heard in the same general area. Three of these were in the same locations as the November responses. At 30 locations checked in November, 1973, 37 rails had been recorded in the May census. At 33 locations checked in January, 1974, 41 rails had been recorded in May.

Census

The overall census conducted May 14-28 produced responses from 98 individual clapper rails (Figure 1). The total consisted of 21 definite pairs, 20 probable pairs, 6 probably unpaired rails and 27 rails that were definitely unpaired (Table 2). All unpaired rails are assumed to be males.

Assuming all "probable" classifications are correct; 55 percent of the males were paired in late May. This figure increased to an estimated 75 percent by mid-June. In three instances where two birds were classified as probable pairs in the May census, it was uncertain whether the rails were actually paired since they did not respond in the manner typical of mated birds. In 17 other cases, rails responded in a manner indicative of mated birds; however, only one member of the pair responded to the calls.

Rail Density

Trapping attempts were conducted from June 21 to October 1, 1973. Two clapper rails were captured. Both were caught in traps baited overnight with crayfish. An immature male was captured near where rail number 47 was found during the May census. This captured bird was nearly adult size and weighed 216.4 grams. The second bird was an adult male which weighed 252.9 grams. Both birds were captured in areas where bulrush stands were down, where high ground was nearby and where the water was less than 15 centimeters (6 inches) deep.

No birds were captured in 75 trap nights using unbaited traps in series.

Also unsuccessful were three attempts to attract rails to traps using tape recorded calls. On three occasions rails were attracted to the immediate vicinity of the traps but did not enter.

Trapping

Highest densities of rails were in light cattail stands, and the lowest densities were in the heavy cattail stands (Table 3). Highest rail densities in limited areas occurred in the Sacramento Delta area (7 individuals), 7.9 rails per 10 hectares; the Goose Lake Dike area (7 individuals), 6.9 rails per 10 hectares; and the Lost Lake region (14 individuals), 3.5 rails per 10 hectares. The Delta and Lost Lake regions

Table 2. Breeding Status of Clapper Rails Located During the May Census of Topock Marsh and Bay.

Rail No.	Birds Actually Responding	Location	Definite Pair	Probable Pair	Definite Single	Probable Single	Probable No. of Rails
1-2	2	North Arm	X				2
3-4	2	North Arm	X				2
5-6	2	North Arm	X				2
7	1	North Arm			X		1
8	1	Glory Hole Channel				X	1
9-10	2	Heron Lake	X				2
11	1	Heron Lake			X		1
12	1	Heron Lake			X		1
13-14	2	Roadside Fingers		X			2
15	1	Roadside Fingers			X		1
16	1	Roadside Fingers			X		1
17	1	North Arm			X		1
18-59	2	Topock Bay	X				2
19	1	Topock Bay			X		1
20-21	2	Topock Bay	X				2
22	1	Topock Bay		X			2
23-24	2	Topock Bay	X				2
25	1	Topock Bay				X	1
26	1	Topock Bay			X		1
27	1	North Arm			X		1
28	1	North Arm			X		1
29	1	North Arm			X		1
30	1	North Arm			X		1
31	1	North Arm			X		1
32	1	Narrow Finger		X			2
33	1	Narrow Finger			X		1
34	1	First Finger			X		1
35	1	First Finger			X		1
36	1	Second Finger			X		1
37	1	Second Finger		X			2
38	1	Second Finger			X		1
39	1	Second Finger			X		1
40	1	Second Finger			X		1
41	1	Third Finger		X			2
42	1	Heron Lake			X		1
43-44	2	Lower Goose Lake	X				2
45	1	Lower Goose Lake		X			2
46	1	Lower Goose Lake		X			2
47	1	Lower Goose Lake		X			2
48	1	Lower Goose Lake		X			2
49-50	2	Willow Lake	X				2
51	1	The Narrows			X		1
52-53	2	South Beal Channel	X				2
54-55	2	South Beal Channel		X			2
56	1	South Beal Channel			X		1
57	1	South Beal Channel				X	1
58	1	South Beal Channel			X		2
60-61	2	Topock Bay	X				2
62-63	2	Topock Bay		X			2
64	1	Topock Bay			X		1
65-66	2	Lost Lake Channel	X				2
67	1	Lost Lake Channel		X			2
68-69	2	Lost Lake Channel	X				2
70-71	2	Topock Bay	X				2
72-73	2	Beal Channels	X				2
74-75	2	Beal Channels	X				2
76	1	Beal Channels		X			2
77	1	Beal Channels				X	1
78-79	2	Beal Lake	X				2
80	1	Beal Lake			X		1
81-82	2	Beal Lake	X				2
83	1	Beal Lake		X			2
84	1	South Marsh			X		1
85	1	South Marsh		X			2
86	1	Lost Lake			X		1
87	1	Lost Lake				X	1
88-89	2	Lost Lake	X				2
90-91	2	Lost Lake	X				2
92	1	Lost Lake		X			2
93	1	Lost Lake		X			2
94	1	Lost Lake		X			2
95	1	Lost Lake		X			2
96	1	Lost Lake		X			2
97-98	2	Lost Lake	X				2
Total	98		21	20	27	6	115

both had fluctuating water levels, while the water level in the Goose Lake Dike region was stable. Lost Lake and the Goose Lake Dike regions were both characterized by light cattail type with scattered hummocks of high ground, and the Delta region by extremely heavy bulrush.

Table 3. Distribution of Yuma Clapper Rails Among Emergent Vegetation Types.

Emergent Type	No. of Rails	Percent of Population	Percent of Available Habitat	Rails/10 Hectares	Rails/100 Acres
Dense Cattail	31	30.1	48	0.9	3.6
Light Cattail	41	39.8	29	1.9	7.8
Dense Bulrush	23	22.3	17	1.7	6.8
Light Bulrush	8	7.8	6	1.8	7.1
Total	103	100.0	100	Mean 1.6	6.0

Habitat Requirements

All rails located were in stands of cattail or bulrush. A chi square analysis of the distribution data (Table 3) yielded a highly significant P value (0.01) indicating that rails do not select territories randomly with respect to emergent vegetation. Dense cattail type comprised 48 percent of the available habitat yet contained only 30 percent of the rail population. All three remaining types were used more heavily than expected based on the proportion of available habitat.

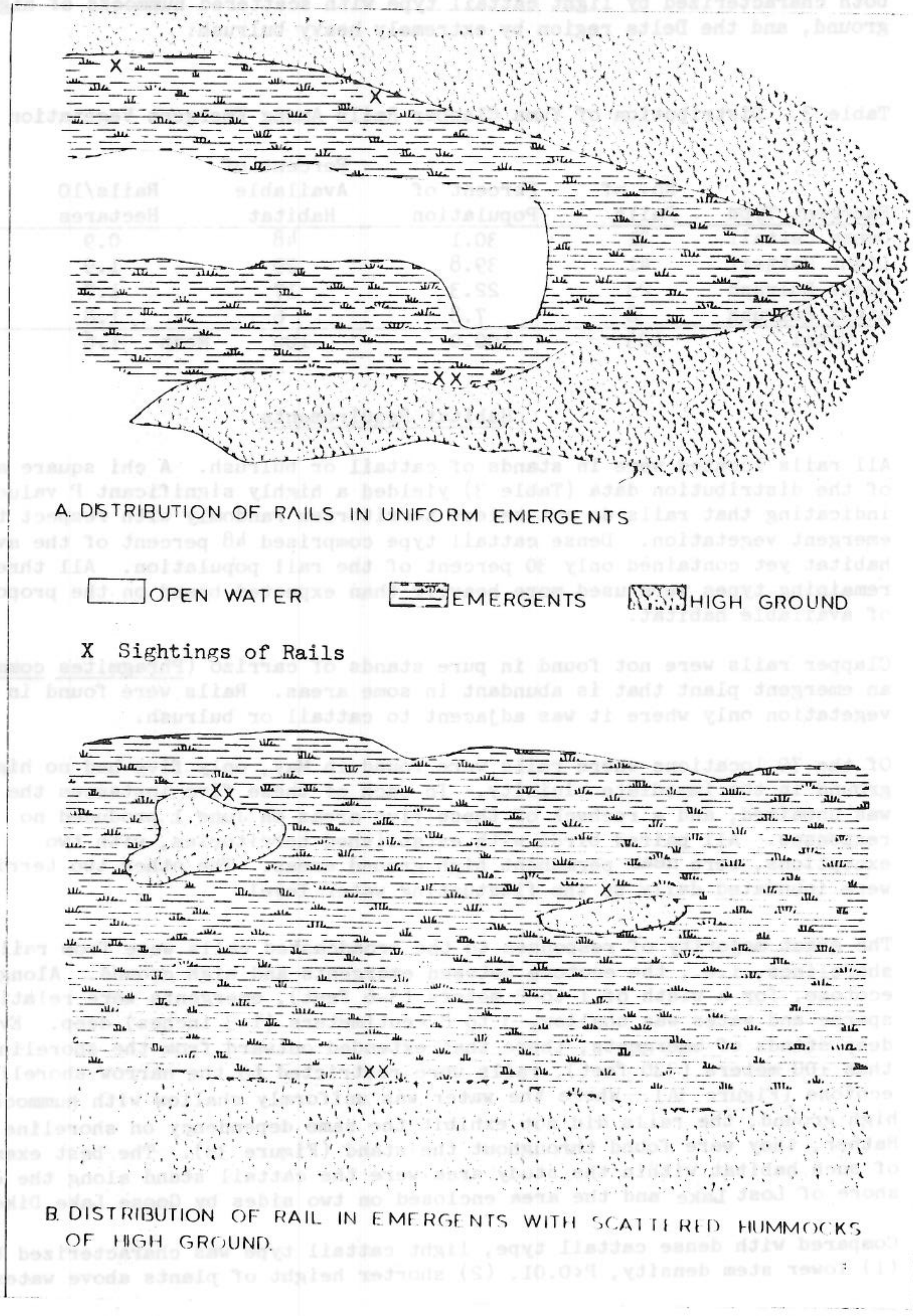
Clapper rails were not found in pure stands of carrizo (Phragmites communis), an emergent plant that is abundant in some areas. Rails were found in this vegetation only where it was adjacent to cattail or bulrush.

Of the 70 locations where rails were found in May, only five had no high ground in the immediate vicinity. In each of these five instances the rail was unpaired, and a recheck of these five areas on June 1 produced no responses. All paired birds with established territories, with two exceptions, were near permanent high ground areas. The other two territories were inundated daily by the fluctuating water level.

The great majority of responses to the broadcasted calls were from rails along shorelines, i.e., the ecotone between emergents and high ground. Along this ecotone, for a width of 1 to 2 meters (3-6 feet), emergents were relatively sparse and water was shallow, 3 to 8 centimeters (1-3 inches) deep. Even in deep stands of emergents, those that extended outward from the shoreline more than 100 meters (330 feet), rails were restricted to the narrow shoreline ecotone (Figure 3A). Where the water was uniformly shallow with hummocks of high ground, the rails did not exhibit the same dependency on shoreline areas. Rather, they were found throughout the stand (Figure 3B). The best examples of such habitat within the study area were the cattail stand along the eastern shore of Lost Lake and the area enclosed on two sides by Goose Lake Dike.

Compared with dense cattail type, light cattail type was characterized by (1) lower stem density, $P<0.01$, (2) shorter height of plants above water

Figure 3. Examples of Distribution of Yuma Clapper Rails in Relation to High Ground.



level, P<0.01, and (3) shallower mean depth of water, P<0.02 (Table 4). Shallower water is also indicated by the greater overlap of salt cedar and emergents in the light cattail type (Appendix A). Stem density, plant vigor and vegetation height are apparently a function of water depth since light stands were found in areas of shallow water, or where the base of the plants was only periodically inundated by fluctuating water levels.

Dense and light bulrush types showed similar differences, however, due to greater variability within each type and smaller sample sizes, the differences were not statically significant.

All areas where rails were located had more than five percent surface coverage by downed vegetation, and only one transect had less than 10 percent surface coverage.

I searched for rails in two cattail stands that had burned in early April. In the first burn area, just north of North Dike, a rail remained for a period of 19 days in April. After this time no rails were heard in the area until early October. Cornelius (1972) reported five rails in the same area the previous year. No responses were recorded in the second burn area, in the Lost Lake Channels of Topock Bay, although it was checked periodically throughout the summer.

Table 4. Comparison of Emergent Types.

Emergent Type	No. of Transects	Stem Density ($Stems/m^2$) Mean	L_1*	L_2	Mean Water Depth(cm) Entire Stand	4.6 Meters from High Ground	Veg. Height(m) Mean	L_1	L_2
Dense cattail	20	78.69	75.88	81.50	34.50	8.89	3.05	2.92	3.17
Light cattail	20	72.47	69.73	75.71	27.31	8.89	2.18	2.05	2.31
Dense bulrush	14	242.00	---	---	41.88	7.62	---	---	---
Light bulrush	5	180.00	---	---	33.30	12.70	---	---	---

*L = 95% confidence limits.

Territory Size

Sizes of ten territories are listed in Table 5. The small size of the territory of pair #20-21 may have been due to restricted amount of contiguous emergent vegetation.

Table 5. Yuma Clapper Rail Territories, Topock Marsh.

Rail No.	Location	Mating Status	No of Location Points	Territory Size (Hectares)	(Acres)
1-2	North Arm	Pair	10	1.25	3.08
3-4	North Arm	Pair	6	0.35	0.87
17	North Arm	Unpaired*	9	3.59	8.86
19	Topock Bay	Unpaired*	11	1.10	2.71
20-21	Topock Bay	Pair	8	0.13	0.32
23-24	Topock Bay	Pair	11	0.82	2.02
25	Topock Bay	Unpaired*	6	0.73	1.79
34	First Finger	Unpaired	8	1.70	4.18
35	First Finger	Unpaired	8	3.12	7.71
97-98	First Finger	Pair	11	1.62	3.99
Mean				1.44	3.55

*became paired during June

Paired rails appeared to restrict themselves to smaller territories than did unpaired birds. However, comparison of territory sizes of paired versus unpaired birds did not reveal any significant statistical differences.

Food Availability

Crayfish were captured in all areas where clapper rails were located. Trap success was highest in water 8 to 15 centimeters (3-6 inches) deep with abundant stems and leaves lying in the water. Crayfish were never caught in traps placed in open water or in water more than 0.7 meters (2 feet) deep.

In August, 1973, sixteen Yuma clapper rail stomachs were examined. Preliminary food habit studies indicate that crayfish form an important part of the diet (Ohmart and Tomlinson, unpublished).

DISCUSSION AND CONCLUSIONS

Along the lower Colorado River, Yuma clapper rails require mature stands of cattail or bulrush in shallow water near high ground. However, in the Colorado River Delta in Mexico, Tomlinson and Todd (1973) reported that Yuma clapper rail habitat differs substantially from that along the Colorado River. Cattails and bulrush are sparse in the Delta.

Yuma clapper rails did not prefer areas of highest vegetation density in Topock Marsh. This was also true for clapper rails in Georgia, where Oney (1954) found that R. l waynei preferred salt marsh cordgrass (Spartina alterniflora) of medium height and density. Oney did not mention the abundance of recumbent vegetation.

In the study area, floating and recumbent stems are important as foraging areas. These provide habitat for crayfish and serve as platforms for rails to walk on while foraging.

High ground is an important component of clapper rail habitat along the lower Colorado River. High ground appears to provide loafing areas for adult rails and rearing areas for the young. Swimming apparently presents no problems to adult birds, but the down of young becomes soaked and matted rather rapidly (Pettinghill, 1938).

High ground areas have been shown to be important to king rails and other clapper rail races. Meanley (1969) found that king rails, generally considered the fresh water ecological equivalent of clapper rails (Lowery 1955, Meanley and Wetherbee, 1961), nested near edges of marshes despite the presence of large areas of uniform vegetation. Clapper rails in coastal areas prefer to nest on areas of high ground not generally inundated by tides (Kozicki and Schmidt, 1949; Zucca, 1954; Adams and Quay, 1958; Bateman, 1965). These areas are near creek banks, tidal guts or mosquito ditches. During extreme high tides in coastal areas, clapper rails retreat to the high ground areas (Zucca, 1954). During July, 1973, a period of unusually high water in Topock Marsh, some rails were forced to retreat from established territories to high ground. When the water levels receded after two weeks, some rails returned to previously held territories.

Yuma clapper rails apparently do not require these high ground areas for nest sites. Abbott (1940) reported that clapper rails at Salton Sea, California, nested on "small mud hummocks or in the crotches of small shrubs" where the water was "a few inches to knee deep." In April, 1973, California Department of Fish and Game personnel located a Yuma clapper rail nest in emergent cattail vegetation at Wister Wildlife Management Area, Imperial County, California, (Gary Stacey, personal communication). Three inactive nests located in Topock Marsh were in similar situations.

In Topock Marsh, clapper rail density is lower, and territory size larger, than in two other study areas in coastal marshes. Oney (1954) found 4.7 rails per hectare (1.9 rails per acre) in highest density areas of the Georgia coastal marshes, and Zucca (1954) found approximately 2.5 rails per hectare (1 rail per acre) in the Dumbarton Bridge marsh in San

Francisco Bay. The high densities of clapper rails in coastal marshes would necessitate territories of 0.4 to 0.8 hectares (1 to 2 acres) per pair. This compares to a mean territory size of 1.44 hectares in Topock Marsh, where territory sizes may be larger than necessary due to the low overall density of rails. Meanley (1969) states that as more king rails move into an area where a rail has established a territory, the size of the original territory is reduced considerably.

Broadcasting of tape recorded clapper rail calls was useful in determining arrival and departure dates, breeding population size and territory size of Yuma clapper rails in Topock Marsh. Because the rails became less responsive to tape recorded calls as summer approached, broadcasting was of little use in determining breeding status after mid-June. In November and January, rail responses were elicited only after broadcasting calls for long periods of time, up to 20 minutes. In the author's opinion it would be impractical to attempt a census of clapper rails during the winter months in the study area. However, wintering Yuma clapper rails in the Colorado River Delta of Mexico are quite responsive to tape recorded calls (Roy Tomlinson, personal communication).

Although the technique of attracting rails into traps by use of recordings was unsuccessful, I believe this method could be used effectively in the spring, when the birds often approach the broadcasted calls eagerly. Because receipt of traps was delayed, trapping was not begun until late June, about the time rails became reluctant to approach taped calls.

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APPENDIX A

Vegetative Composition of Cattail and Bulrush Habitats in Topock Marsh

Table A-1. Vegetative Composition of Dense Cattail Habitat.

Transect Number	Transect Length (Meters)	Vegetative Composition (Percent of Transect Length) — Cattail: Fallen	Cattail: Standing	Cattail: Open Water	Bulrush: Fallen	Bulrush: Standing	Salt Cedar Overstory: Cattail	Salt Cedar Overstory: Bulrush
1-2	17.33	22.8	77.2	---	---	---	---	---
3-4	50.77	5.4	90.0	4.7	---	---	---	---
7	79.04	28.4	71.6	---	---	---	---	---
9-10	20.06	---	54.4	45.5	---	---	---	---
11	13.38	4.5	92.0	3.4	---	---	---	---
12	65.66	---	100	---	---	---	---	---
13-14	101.23	9.01	90.09	---	---	---	---	---
15	48.64	---	100.0	---	---	---	---	---
16	24.01	---	67.0	10.1	---	---	22.8	---
17	18.24	---	76.6	8.3	---	---	15.1	---
27	45.60	---	84.0	8.0	---	---	8.0	---
29	92.72	---	57.1	4.6	---	---	38.3	---
31	57.15	---	97.3	2.7	---	---	---	---
34	89.98	---	92.9	7.1	---	---	---	---
35	73.87	2.8	93.8	3.3	---	---	---	---
36	23.71	---	83.3	6.4	---	---	8.9	---
37	38.87	---	83.3	---	---	---	3.4	---
40	29.79	---	78.6	21.4	---	---	---	---
42	68.40	---	100	---	---	---	---	---
97-98	60.19	2.5	63.1	5.1	---	---	29.3	
Subtotal	1015.66	4.28	84.5	4.44	---	---	6.73	---

Table B-1. Vegetative Composition of Light Cattail Habitat.

Transect Number	Transect Length (Meters)	Vegetative Composition (Percent of Transect Length) — Cattail: Fallen	Cattail: Standing	Cattail: Open Water	Bulrush: Fallen	Bulrush: Standing	Salt Cedar Overstory: Cattail	Salt Cedar Overstory: Bulrush
5-6	60.50	54.0	---	---	---	46.0	---	---
26	91.20	9.3	18.3	---	58.3	14.1	---	---
45	41.65	---	91.2	6.6	---	---	2.2	---
46	31.01	---	57.8	13.7	---	---	21.2	---
47	39.52	---	21.5	18.5	22.3	38.5	---	---
52-53	91.20	---	65.7	1.0	26.3	7.0	---	---
54-55	91.20	---	70.7	7.3	---	---	22.0	---
56	41.34	13.2	65.4	8.1	---	---	5.9	---
57	29.79	11.2	66.3	---	---	22.5	---	---
58	30.40	---	14.0	---	---	---	86.0	---
59-18	13.68	---	100	---	---	---	---	---
65-66	62.02	---	94.6	3.4	---	---	2.0	---
67	89.68	---	91.5	5.8	---	---	2.7	---
68-69	76.00	---	84.0	1.6	---	---	10.4	---
72-73	15.81	---	100	---	---	---	---	---
86	46.21	13.8	58.6	---	---	---	27.6	---
90-91	88.16	9.0	81.0	10.0	---	---	---	---
94	29.18	---	74.0	---	---	---	26.0	---
L_1	79.04	---	94.2	---	---	---	5.8	---
L_2	60.80	3.0	25.5	---	---	---	71.5	---
Subtotal	1108.38	3.02	66.17	3.84	7.76	6.21	12.48	---

Table C-1. Vegetative Composition of Heavy Bulrush Habitat.

Transect Number	Transect Length (Meters)	Vegetative Composition (Percent of Transect Length): Cattail			Bulrush		Salt Cedar Overstory	
		Fallen	Standing	Open Water	Fallen	Standing	Cattail	Bulrush
8	19.46	---	---	18.8	29.9	47.7	---	4.7
19	20.37	---	---	---	89.5	10.5	---	---
20-21	33.44	---	---	---	---	45.5	---	54.5
22	21.28	---	---	---	57.2	42.8	---	---
23-24	58.37	---	---	---	38.0	62.0	---	---
25	57.15	---	---	44.1	---	55.9	---	---
60-61	41.04	---	---	---	2.2	81.5	---	16.3
62-63	45.60	---	---	4.0	13.3	82.7	---	---
64	76.61	---	---	17.1	16.7	63.9	---	18.3
70-71	34.66	---	---	---	19.3	58.8	---	21.9
78-79	22.80	---	---	---	12.0	88.0	---	---
81-82	22.80	---	---	---	16.0	73.3	---	10.7
84	69.92	---	---	25.2	16.5	53.9	---	4.4
85	86.64	4.6	28.4	2.5	16.1	43.5	---	4.9
Subtotal	610.13	0.65	4.04	10.41	19.11	58.42	---	9.37

Table D-1. Vegetative Composition of Light Bulrush Habitat.

Transect Number	Transect Length (Meters)	Vegetative Composition (Percent of Transect Length): Cattail			Bulrush		Salt Cedar Overstory	
		Fallen	Standing	Open Water	Fallen	Standing	Cattail	Bulrush
38	21.89	---	16.7	---	9.7	73.6	---	---
39	26.14	---	---	---	---	94.2	---	5.8
48	18.85	---	22.6	17.7	---	59.7	---	---
49-50	70.83	---	58.7	---	---	33.1	---	7.3
51	39.52	---	17.7	8.5	---	73.9	---	---
Subtotal	177.23	---	31.25	3.77	1.2	59.01	---	3.77