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HABITAT REQUIREMENTS AND POPULATION CHARACTERISTICS OF THE CLAPPER RAIL (*Rallus longirostris yumanensis*) IN THE IMPERIAL VALLEY OF CALIFORNIA

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Abstract.--Habitat requirements and population characteristics of the Yuma Clapper Rail (Rallus longirostris yumanensis) were examined in the Imperial Valley of California during 1977. Rails used fresh water areas containing mature stands of cattail (Typha domingensis) and bulrush (Scirpus californicus). Water level variation was found to influence the permanence of territories and the breeding effort. Marsh areas with permanent shallow water through the breeding season contained highest rail densities.

Hatching success was high (90 percent), but so was chick mortality, perhaps due to the chicks' inability to swim, the great variability of water levels, and possible predation.

Clapper Rails began arriving in the Imperial Valley in mid-March and remained until the beginning of October. Time of appearance and disappearance of crayfish (Procambarus and Orcopectes, the most common genera) was closely correlated with the arrival and departure dates of Clapper Rails. Ninety percent of the territories of paired birds contained high numbers of crayfish.

A complete census of the valley during the latter half of May, using tape-recorded calls, elicited responses from 160 individuals. A small overwintering population remained as determined by the sampling of high density areas in January and November.

Rail management suggestions based on the results of this paper are also proposed.

HABITAT REQUIREMENTS AND POPULATION CHARACTERISTICS OF THE CLAPPER RAIL (Rallus longirostris yumanensis) IN THE IMPERIAL VALLEY OF CALIFORNIA

Dickey (1923) first described this race of Clapper Rail from specimens collected near Yuma, Arizona. The subspecies, Rallus longirostris yumanensis (A.O.U. 1957, Banks and Tomlinson 1972), is unique in that it is the only Clapper Rail subspecies in the United States that inhabits fresh water marshes. With the increase in marshland habitat following the refilling of the Salton Sea in 1906 (Hosmer 1966) and the continued increase of surface water development, Clapper Rails expanded northwestward into the Imperial Valley. The Whitewater drain at the northern end of the Salton Sea is the rails' farthest advance.

Rallus longirostris yumanensis was classified as an "endangered" species (U.S. Fish and Wildlife Service 1974), and much concern has been shown with regard to critical habitat throughout its range.

This study was designed to examine the habitat requirements and population characteristics of this subspecies in the Imperial Valley. The goals of the study were as follows:

1. Conduct a census of the breeding population in order to determine the location of marsh habitat used by rails in the Imperial Valley.
2. Determine the major biotic and abiotic components comprising the preferred habitat, including

invertebrate availability.

3. Obtain dates when birds arrive and depart the breeding areas.
4. Estimate the size of the wintering population.
5. Obtain information on territory size.
6. Determine densities in the various locations around Imperial Valley.
7. Gather reproductive data and information on the chronology of the reproductive cycle.
8. Make observations on mortality.
9. Prepare management suggestions based on the above results and examine the effects of rising water levels in the Salton Sea.

Study Area

The Imperial Valley is located in southeastern California in Imperial and southern Riverside counties. The Salton Sea forms the drainage sink for the waters of the New River, Alamo River, All American Canal, Coachella Canal, and numerous small drainages originating in the mountains surrounding the basin. Directly adjacent to the Salton Sea, on the southern and eastern shores, are the fresh water ponds of the Salton Sea National Wildlife Refuge and the Imperial Wildlife Area-Wister Unit. The New and Alamo rivers flow through the Valley and terminate in the sea in extensive deltas with adjacent marsh areas. Inland along these rivers and in the creeks and ponds formed by seepage from the Coachella Canal, further habitat can be found.

The emergent vegetation in these shallow-water areas consists of extensive stands of cattail (Typha domingensis) and bulrush (Scirpus californicus). The high ground species are characterized by extensive stands of salt cedar (Tamarix chinensis) and seep willow (Baccharis sp.).

Water level in the managed areas is highly variable depending on scheduling of irrigation water and is often controlled to fill the needs of wildlife. The water level in non-managed areas, in the river deltas, and canal seeps is relatively constant throughout the year.

Materials and Methods

To locate rails a tape recording of Clapper Rail calls, a series of "keks" followed by a "clatter", was employed using either a small hand-held cassette tape recorder or a larger portable eight-track tape player attached to a remote power horn. The calls and responses used in this study have been described by others (Tomlinson and Todd 1973, Smith 1974a). The cassette tape recorder was used when marshes were checked on foot. The eight-track player with the power horn was used from the bow of a twelve-foot flat-bottomed boat powered by an electric motor where water depth allowed use of a boat.

To estimate the wintering population, four areas along the south and eastern shores of the Salton Sea were selected to be monitored using broadcasted tape calls between 25 January and 28 January 1977. Two of these areas were rechecked on 29 and 30 November 1977.

Arrival dates were determined by monitoring four areas which in past years contained high rail densities (Don Tiller, per. comm.). A route was established in each area which could be covered in three to four hours on foot. Areas were checked beginning at sunrise or shortly thereafter. Each area was checked every fourth day between 16 March and 15 April.

Concurrently, the time of emergence of crayfish (Procambarus and Orcopectes, the most common genera) was determined. Two 1 m^2 styrofoam panels were placed in water 10 to 20 cm deep where fresh water entered the marsh ponds in each of the four areas. Crayfish numbers were determined each day a particular study area was monitored for rails. Panels were left in place continually from 16 March to 15 April.

Departure dates were determined by monitoring the sites occupied by rails during the summer. Because of strong local movements of rails in late summer and fall, and poor response to general recorded tapes, specific calls were played through the marshes rather than using established census routes. Regular broadcasting and monitoring of calls was conducted between 15 September and 15 October at four-day intervals. Crayfish disappearance was monitored between 15 September and 15 October using the same technique described for determining the time of appearance.

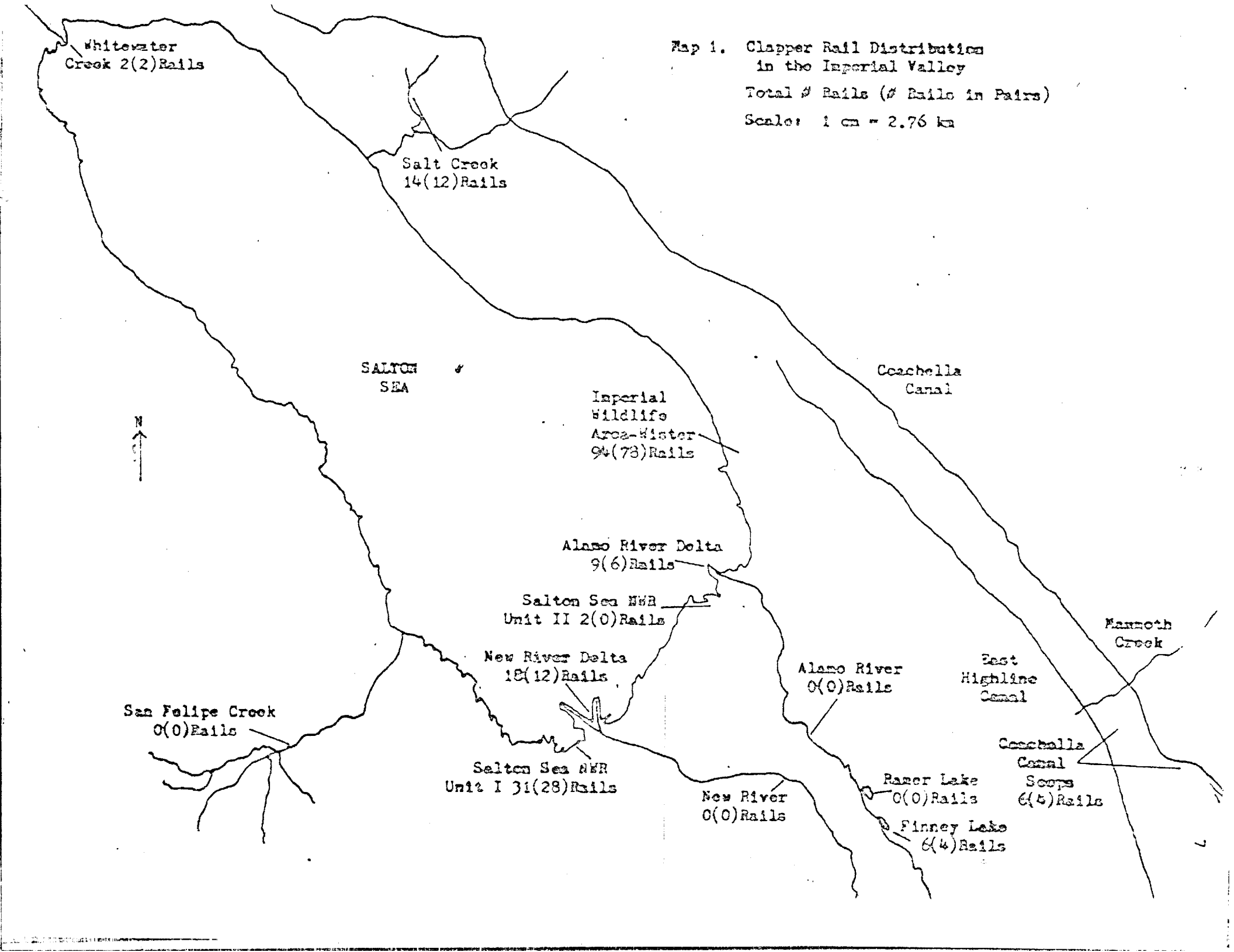
Presence of rails was also determined by noting tracks in the mud along the dikes which form the marsh ponds. By examining selected areas at regular intervals, the departure date was also determined by presence or absence of tracks. Ten sites were selected and checked every third day until

tracks were no longer observed. After each check of a site, the tracks were removed to avoid confusion during the next visit.

To further verify departure dates, two birds were captured in early August and fitted with back-pack radio transmitters. These birds were monitored until they left.

Between 16 May and 4 June a complete census of the rail population in the Imperial Valley was attempted (Map 1). This included checking areas where rails had not been previously located. Using the tape-recorded calls, the census was conducted both on foot and from a boat. The taped calls were played for 15 seconds followed by 15 seconds of listening. Censusing began approximately one-half hour before sunrise and terminated about four hours after sunrise.

In spring and early summer the breeding status of rails could often be determined by the response of the calling bird. Responding rails were classified as definitely paired, probably paired, probably unpaired, definitely unpaired. The definitely paired status was noted only when the paired birds responded with a simultaneous "clatter" call. Birds classified as definitely unpaired used "kek" calls exclusively and for long periods. This response was obtained regardless of the call played from the recorder. Birds classified as probably paired responded to the taped calls with a "clatter", but only one bird of the pair responded. Birds classified as probably unpaired were distinguished only by the lack of a "clatter" and the shortness of time, usually less than five minutes, of the "kek" call.


Map 1. Clapper Rail Distribution in the Imperial Valley
Total # Rails (# Rails in Pairs)
Scale: 1 cm = 2.76 km
Whitewater Creek 2(2)Rails
Salt Creek 14(12)Rails
SALTON SEA
N
Imperial Wildlife Area-Hinter 94(78)Rails
Coachella Canal
Alamo River Delta 9(6)Rails
Salton Sea NWR Unit II 2(0)Rails
New River Delta 18(12)Rails
San Felipe Creek 0(0)Rails
Salton Sea NWR Unit I 31(28)Rails
New River 0(0)Rails
Alamo River 0(0)Rails
East Highline Canal
Mammoth Creek
Coachella Canal Seeps 6(6)Rails
Ramer Lake 0(0)Rails
Finney Lake 6(4)Rails

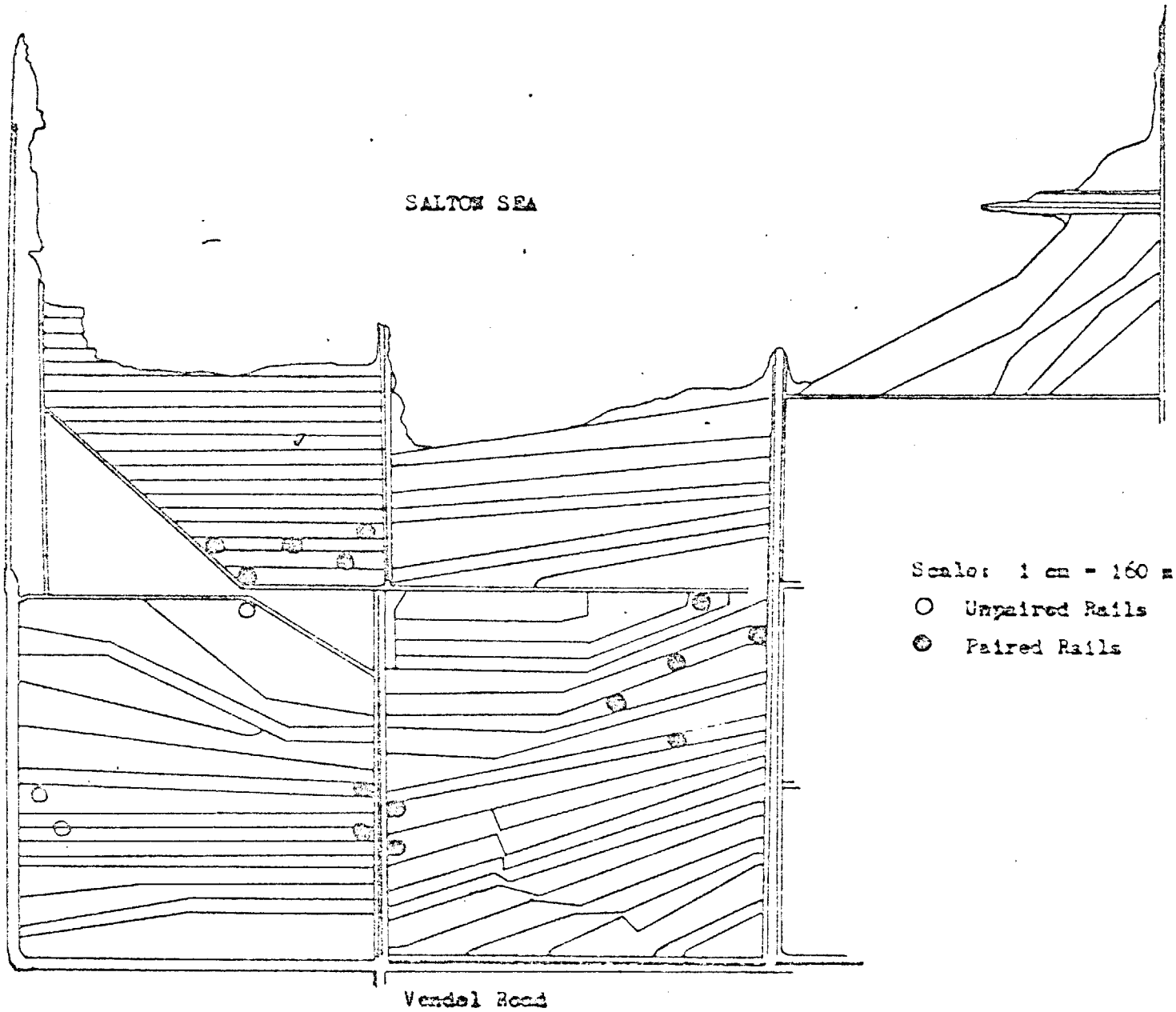
The locations of rail responses were mapped (Maps 2-5) and individuals were assigned numbers. When paired birds responded together, they were assigned a hyphenated set of numbers.

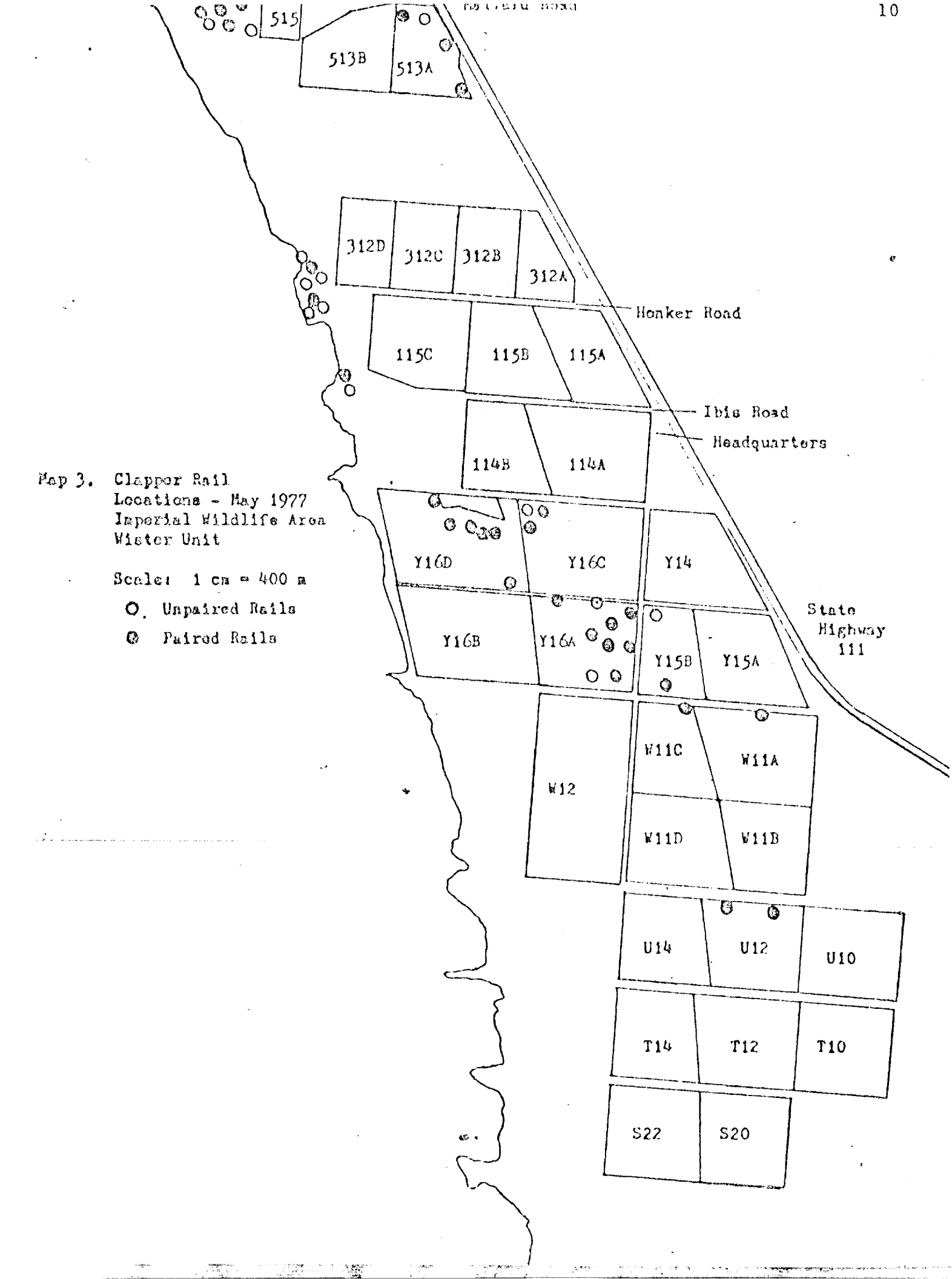
On several occasions it was necessary to determine if a response from two different locations, only a few m apart, came from two birds or one that had moved. A "clatter" call was played roughly halfway between the calls. This was done until the responses were close enough together in time (usually simultaneous) to allow the two birds to be identified as individuals. The longest wait for simultaneous calls to be emitted using this method was 37 minutes. After 90 minutes of attempts, the bird response was deemed to be from a single bird. In many instances birds approached the recorder making interpretation easier.

In areas where rail densities were highest, emergent vegetation types were mapped as dense cattail, sparse cattail, and bulrush. Aerial photographs were used to calculate the amount of suitable habitat provided by each type. Densities of rails in each emergent type, as well as densities of rails within selected high density areas, were determined.

A 20 m line transect was run from the water's edge into the marsh where each rail was located during the spring census. At 5 m intervals along the transect vegetation height and water depth were recorded. Also, at these points emergent stems and recumbent stems were counted in an 0.21 m^2 quadrat. Floating vegetation beneath standing plants was not measured. Exposed mud flat was measured along the entire length of the transect.

Map 2. Clapper Rail Locations - May 1977
Salton Sea National Wildlife Refuge - Unit I





Map 3. Clapper Rail Locations - May 1977 Imperial Wildlife Area Wister Unit

Scale: 1 cm = 400 m

○ Unpaired Rails

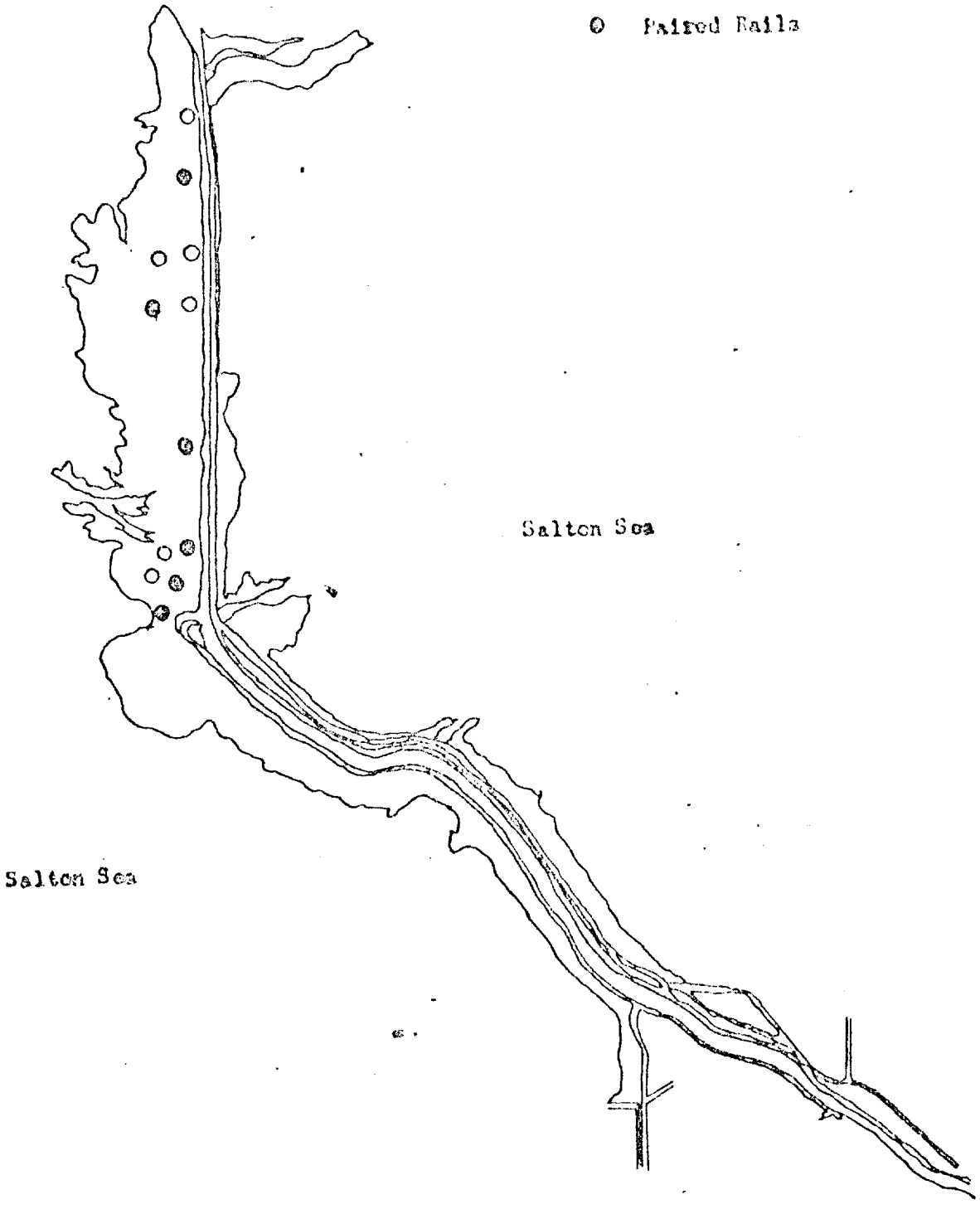
◎ Paired Rails

Map 4. Clapper Rail Locations - May 1977
New River Delta

Scale: 1 cm = 80 m

O Unpaired Rails

O Paired Rails

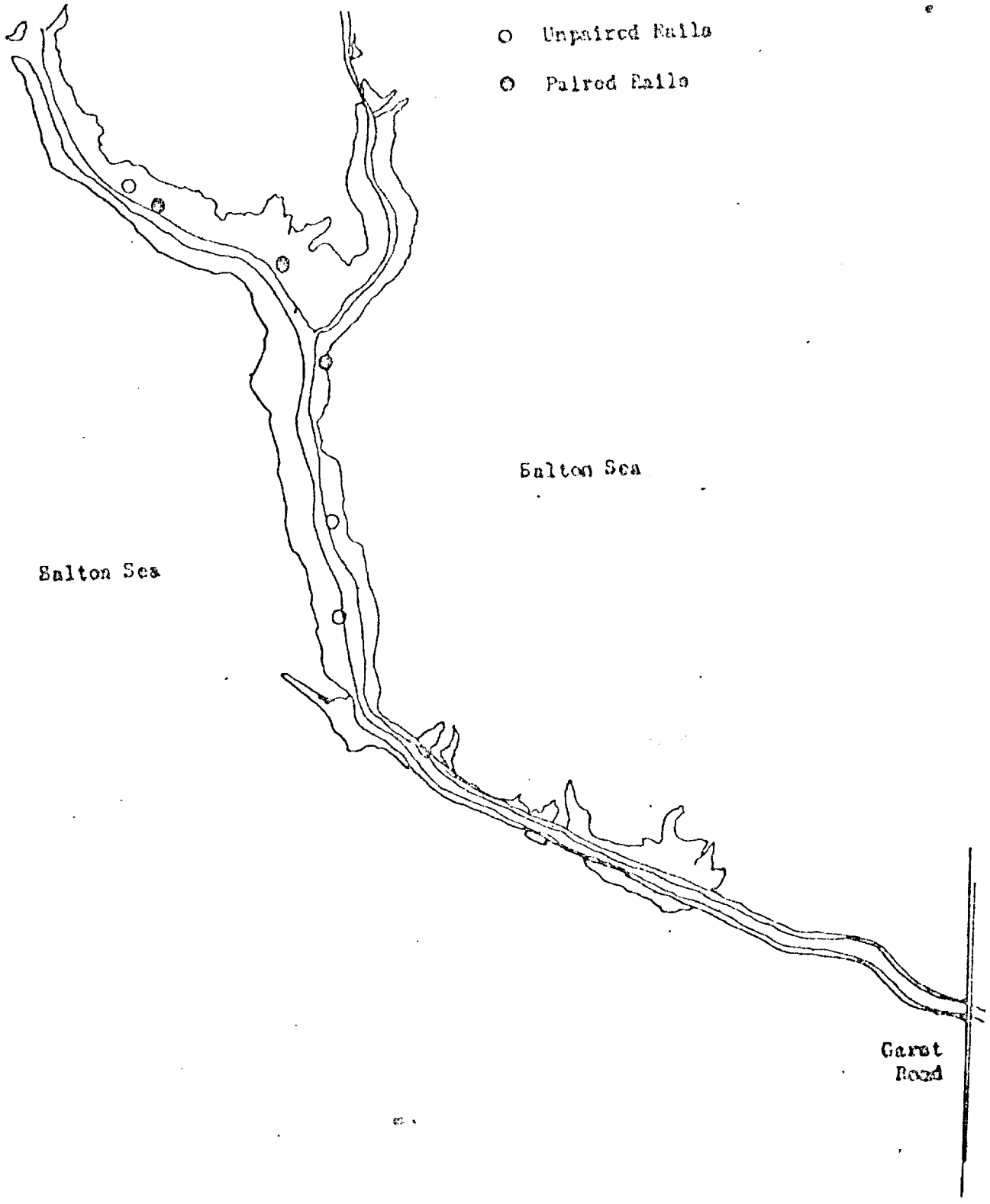


Map 5. Clapper Rail Locations - May 1977
Alamo River Delta

Scale: 1 cm = 80 m

O Unpaired Rails

O Paired Rails



Because crayfish form a major portion of the Clapper Rails' diet (Ohmart and Tomlinson 1977) and are abundant in the area, crayfish counts were made at each site. An m^2 styrofoam sheet was placed in water 10 to 20 cm deep along the transect and left for a period of 24 hours. Shortly after sunrise the sheets were lifted and the number of crayfish counted.

In certain areas fresh-water clams (Corbicula sp.) were present in large numbers. These areas were sampled for density estimates by raking a 2 m by 0.5 m area along the transect 1 m from the edge of the water.

The number of rails in each type of emergent vegetation was compared to the relative amount of suitable habitat which that type provided. Variability of water level due to management planning was also noted at each site.

After arrival the position of 16 rails within the marsh was monitored using the taped call. It was possible to locate birds within 5 m in the marsh when the observer was less than 30 m from the calling bird. This technique was used at random times (n = 28/territory) over a two-week period and locations were plotted on aerial photographs. Approximations of territory size were determined by planimetry.

Both paired and unpaired birds and birds with and without adjacent neighbors were selected. In all cases there was marsh adjacent to the rail(s) which was not used, thereby eliminating the amount of habitat available to the rail(s) as an influencing factor.

Capture techniques using live-traps were highly varied. When fencing was used, the technique was similar to that used

by Smith (1974a). The first technique involved setting from one to three traps in series a short distance inside the emergent vegetation with 61 cm high drift fence placed parallel to the shore between the traps. The second technique involved setting from one to three traps inside the marsh with the drift fence forming wings extending into the marsh. The third method consisted of a single trap placed in the marsh with no fencing. All methods were tried using combinations of crayfish bait, mirrors, or tape-recorded calls from speakers placed inside the traps. Birds were sometimes found to approach mirrors and calls readily.

Birds captured were weighed, banded with colored plastic leg bands on the right leg, a U. S. Fish and Wildlife Service band on the left leg, and a colored humeral band was placed on the right wing. Two birds were fitted with transmitters in lieu of colored leg and wing bands. Small radio transmitters (29 g complete with harness) were mounted on the backs of the two birds. In each case the completed back pack was approximately 12 percent of the bird's body weight. They were banded with U. S. Fish and Wildlife Service leg bands.

Results

Calls and Responses.--From early March until late June the "kek" call was continuously used by unpaired males in the marsh. Continuous calling seldom lasted for periods longer than 30 minutes without a break. Under quiet conditions this call was clearly heard to a distance of from 100 to 200 m. When a tape of this call was played within this distance, the bird would

immediately respond and continue emitting calls for periods up to 30 minutes in length even though the taped call was stopped at the time the bird began its response. If the taped call was played continually or in response to a bird, the length of the bird's call would increase up to an hour. After the bird ceased calling, there was usually a period of rest in which no calls would be elicited. This period lasted anywhere from 10 minutes up to 2 hours; longer periods of rest occurred in late May and June.

Movements of a bird in response to the taped call depended on the pair status and the amount of cover present. In all cases the unpaired males approached to within 5 m of the call and often exposed themselves on dry ground next to the emergent vegetation. If the "kek" call was played while the bird was in the open, the Clapper Rail would occasionally approach the recorder to within 1 to 2 m. The unpaired males showed no reluctance to approach the tape even in the presence of the investigator (Map 2). Unpaired males responded to the taped call from much greater distances than paired males. The longer the pair bond was established, the closer the tape had to be to the rails before they would respond. Early in pair bond formation males responded to the call as did unpaired males; however, after four to six weeks with the female, the response to the call became shorter and the approach to the taped call became less open. Often the bird would not approach the call and merely respond for a short period of time. Females, whether paired or not, would seldom call in response to the "kek" but would readily approach the call if cover was present. Females seldom

exposed themselves in the open at any time.

From July to late February rails rarely responded to the taped call; when they did, they were within 25 m of the recorder. The usual reaction at this time of year in both adults and immatures was to approach the call quietly and circle it at a distance of 5 to 10 m while remaining in cover.

The "agitated kek" was emitted by birds under conditions of surprise or harassment. This call usually was elicited when the taped call was started within 5 m of a bird. The response ceased shortly, often becoming a "kek" call if the bird was an unpaired male. The "agitated kek" was also emitted by males when they rapidly approached the taped call. The charging bird would often cover 50 m and approach within 10 m of the tape recorder.

The only continual use (longer than 1 minute) of this call was made by nesting females. Females frightened from the nest emitted an "agitated kek" when approximately 2 m from the nest and continued calling while circling the intruder. This only occurred when the intruder approached a nest within 2 to 5 m. After circling the intruder, the bird would silently return to the nest only to reinitiate this calling response if the intruder remained. No calls were heard from a bird while it was on the nest. Immature birds, if they emitted calls, would generally use this call to the exclusion of all others.

The most conclusive evidence of pairing, other than actually seeing two birds together, was the use of the "clatter" call by a mated pair. The call was seldom given more than three

times within an hour, even when the taped call was played continuously. The number of times the call was given decreased during the mating season from March through June. By late June, if the birds responded at all, it was with a single "clatter" call. Quite often the paired birds, when separated in the marsh, would be heard moving quietly toward each other after the taped calls were played. When reunited, the pair would emit a "clatter" call.

The "hoo" call was heard under only two related circumstances. When the observer moved through the emergent vegetation, the birds would emit a "hoo" call when within about 10 m of the observer. The only other time this call was heard was from a female when she was located between the taped call and a male giving a "kek" call from within the marsh. The female gave a series of "hoo" calls and went to the male. The pair then gave a "clatter" call. Only females and immatures were actually seen giving the "hoo" call. The call was heard throughout the year.

The "burp" call was used by mature males under very similar circumstances to the females' use of the "hoo" call. When the observer was in the marsh or adjacent to the marsh, males would often "burp" when cautiously approaching the tape recorder or observer, and they often gave this call after a "charge". The "burp" call was the only sound emitted by males, females, or immatures when they were in the traps. This call was heard throughout the year.

If members of a pair were separated when the taped calls were broadcast, they would sometimes emit "kek-hurrah" calls individually. Shortly thereafter the birds would often move

toward one another and emit a "clatter" if the taped calls were played for a period of more than 5 to 10 minutes. Near the end of June this call ceased to be given.

The "kek-burr" was infrequently heard in the Imperial Valley. The few birds that did emit it did so continuously and possibly in place of the "kek" call. The birds which used this call invariably finished a series of "keks" with a trilled finishing note. The only bird seen making this call was a large unmated male. It was last heard in early July.

On rare occasions when a bird was flushed, the rail would emit a "kak" call. This call was quite similar in volume to the "kek" and "clatter" calls. It was almost always followed by an "agitated kek" once the bird returned to cover.

When attempting to attract the rails for observation or trapping, the most effective combination of broadcasted calls was a mixture of "kek" calls to bring birds into the general area (within 5 m), and "hoo" and "burp" calls to entice the birds into a trap or open area. The "hoo" and "burp" broadcasted calls seem to induce investigative behavior, causing the birds to approach foreign objects (traps, cameras, blinds and even observers) much more closely than normal. By using this technique, it was sometimes possible to get paired birds to reveal themselves. This only occurred if the male and female were separated. When the male spotted the female in the open, he would charge the female and both birds would return to cover immediately. Pair exposure was rare even with the aid of the "hoo" and "burp" taped calls.

To increase the response effectiveness of the broadcasted

calls during the censusing portion of the study, "kek" calls and "clatter" calls were broadcast in series. Using this technique, it was possible to hear calls from several birds at the same time, thus eliminating the problem of over or under counting.

Birds responded most readily during the early morning hours after temperatures exceeded 18°C, which was reached approximately two hours after sunrise in early spring. As early morning temperatures rose during late spring and summer, the birds responded earlier but seldom before one-half hour after sunrise. Responses to tape-recorded calls would continue from four to five hours after sunrise. The time interval shortened as morning temperatures increased much beyond 32°C. The exception to this was the unpaired male who would respond at any time of day through mid-June.

During summer and early fall the best time to elicit responses was from one hour before sunset to one-half hour past sunset. This took advantage of the birds' habit, whether paired or unpaired, of calling once or twice before dark.

Windy conditions below 20 k.p.h. did not seem to diminish bird responsiveness downwind to the tape recorder, but any wind above 10 k.p.h. made precise location of the rails difficult.

At any time throughout the year rails would sometimes respond to the starting or stopping of a motor. Several birds were located in this manner during the winter and late fall.

Wintering Population.--A small wintering population of rails was represented by nine birds located in January (Table 1).

TABLE 1. Wintering population of the Clapper Rail, January 1977

Location	Number of Rails	
Salton Sea National Wildlife Refuge Unit I	6*	(3)
New River Delta	1	(1)
Imperial Wildlife Area, Wister Unit, Y-16A	2**	(0)
Imperial Wildlife Area, Wister Unit, Mallard Road Drain	0	(0)
TOTAL	9	(4)

Parentheses represent birds responding to tape.

*Three birds responded to a vehicle stopping.

**Two birds sighted.

Four responded to taped calls, two were seen, and three responded to the stopping of a vehicle's engine. Responses such as this have been reported by Smith (1974a) in R. l. yumanensis and Oney (1954) for R. l. waynei. A mid-November check located five rails. All birds which responded did so with the "kek" call and were unpaired males.

Arrival and Population Buildup.--The first spring response to a broadcasted call was heard on 24 March in the Salton Sea National Wildlife Refuge - Unit I. This area had been monitored the previous week. During the following week, rail responses to taped calls began to increase in the National Wildlife Refuge. First appearances were made on 29 March in the New River Delta and the Imperial Wildlife Area-Wister Unit-Y16A, and on 30 March in the Imperial Wildlife Area-Wister Unit-Mallard Road drain. Early responses indicated that most rails arrived at the nesting area unpaired (Table 2). The rail population along the southern and eastern shores of the Salton Sea gradually increased during April and peaked in mid-May (Fig. 1).

Once a rail was located, it could generally be relocated in the same area on subsequent days. Unpaired rails sometimes moved from one area to another if a mate was not obtained at the original site. This movement usually occurred in areas where the marsh dried after the rail arrived. Territories of paired birds were seldom moved, and in only two observed instances was a pair forced to move by the drying of the marsh surrounding the nesting site. In one case the birds reestablished a territory about 500 m away along an irrigation ditch.

Because crayfish have been reported to be a primary food

TABLE 2. New arrival dates and breeding status of Clapper Rails in Salton Sea, 1977.

Date	Location	No. of Rails	No. of New Rails	Breeding Status of New Rails
16 March	Salton Sea N.W.R. Unit I	6*	0	
16 March	New River Delta	1*	0	
16 March	Imperial Wildlife Area, Wister Unit, Y-16A	2*	0	
24 March	Salton Sea N.W.R. Unit I	8	2	2 unpaired
28 March	" " " " "	13	5	5 unpaired
29 March	New River Delta	2	1	1 unpaired
29 March	Imperial Wildlife Area, Wister Unit, Y-16A	6	4	1 pair 2 unpaired
30 March	Imperial Wildlife Area, Wister Unit, Mallard Rd. Drain	2	2	2 unpaired

*Unpaired birds located in January.

FIGURE 1.

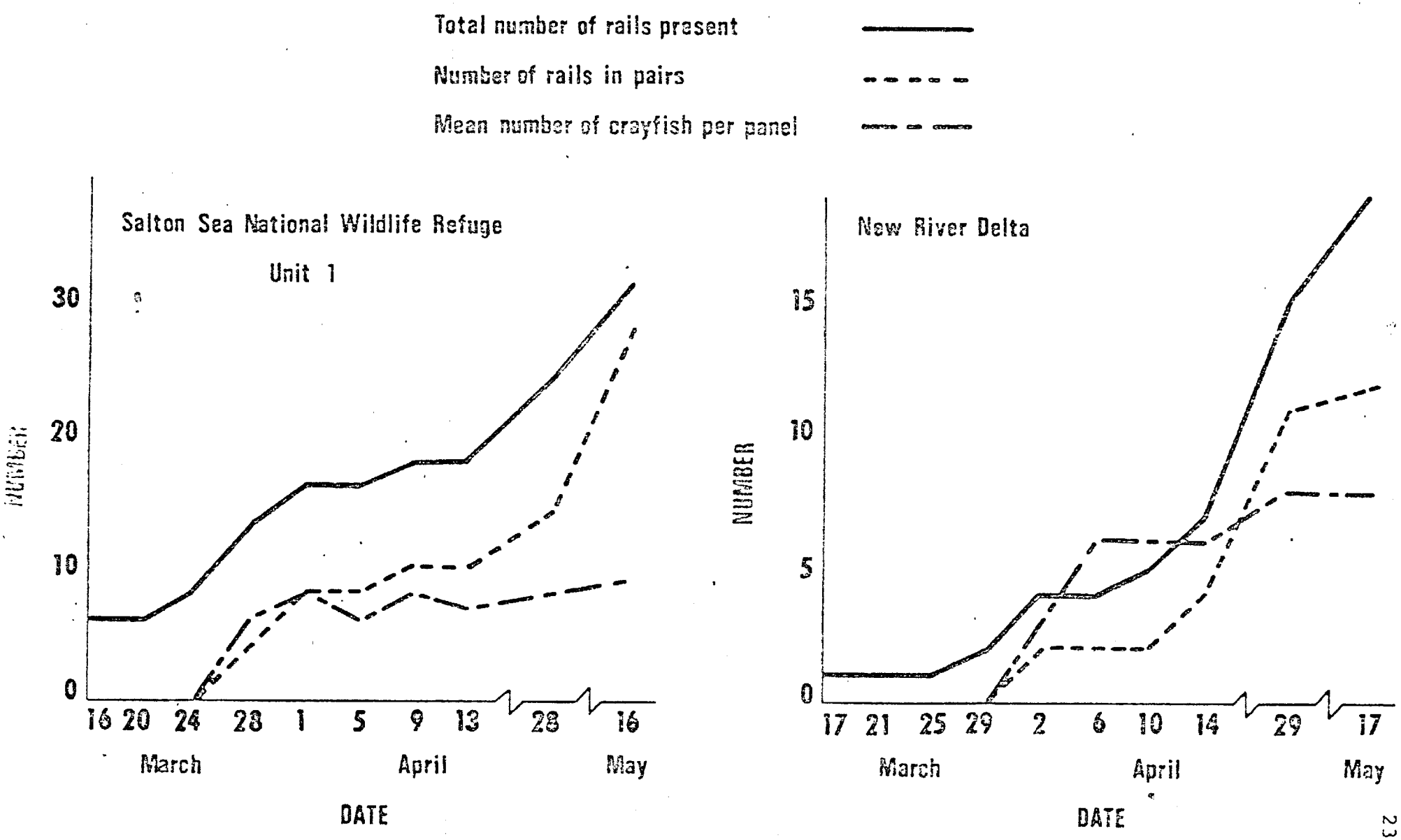
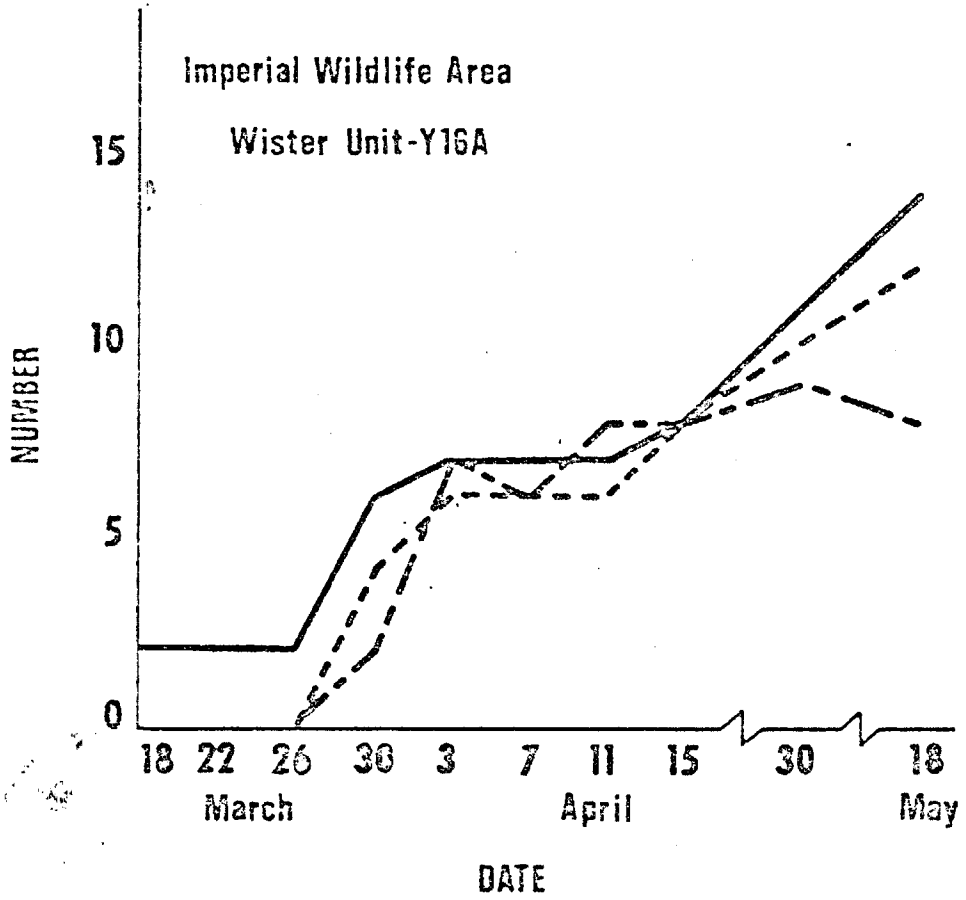
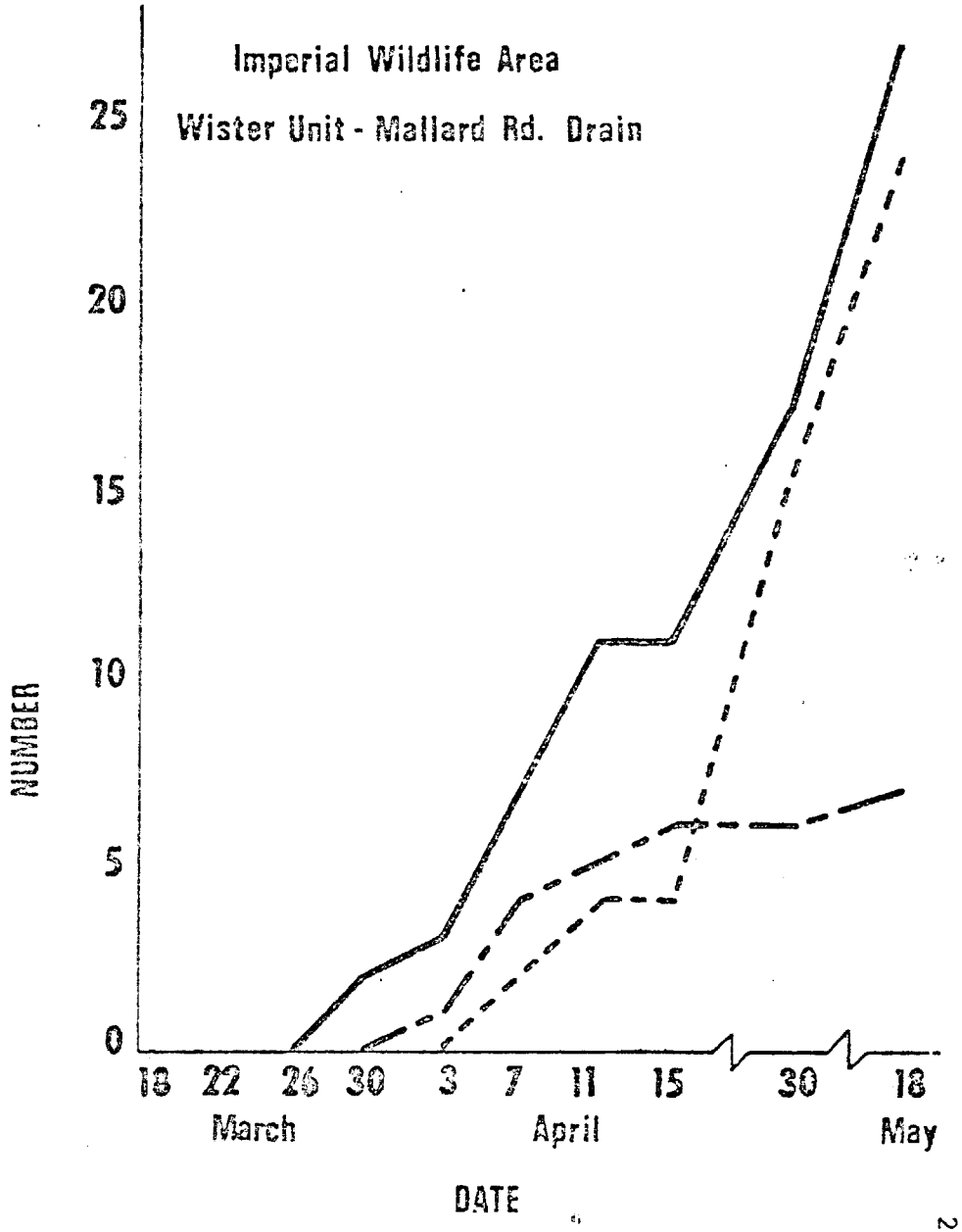

Total number of rails present
Number of rails in pairs
Mean number of crayfish per panel
Salton Sea National Wildlife Refuge
Unit 1
NUMBER
30
20
10
0
16 20 24 28 1 5 9 13 28 16
March
April
May
DATE
New River Delta
NUMBER
15
10
5
0
17 21 25 29 2 6 10 14 29 17
March
April
May
DATE

FIGURE 1. Continued.





source for the Clapper Rail (Ohmart and Tomlinson 1977), we looked for a possible relationship between the appearance of crayfish and the arrival and/or initiation of breeding in Clapper Rails. Crayfish were first noted between 26 March and 29 March in all areas except New River where they did not appear until 1 April. These times of appearance corresponded to the arrival dates of the Clapper Rails. Crayfish population buildup paralleled the increase in rail population in April (Fig. 1).

Departure Dates.--The responsiveness of the Clapper Rails to recorded calls decreased throughout the summer. Two factors may have been responsible: 1) birds ignoring calls after repeated playing; and 2) reduced calling as the breeding season waned. Even young birds and older birds not exposed to the call would only respond once, if at all, to the taped recording. A census of the Y16A field of the Wister Unit in the Imperial Wildlife Area and Unit I on the Salton Sea National Wildlife Refuge, where a total of 26 responses were heard in the May census, revealed only 10 responses on 6 September, 8 responses on 24 September, 6 on 1 October, and 2 responses on 7 October and 8 October.

The ten sites monitored periodically from mid-September on also indicated that most of the rails had left the Salton Sea area by early October. Departure dates based on these data are shown in Table 3.

The two birds fitted with radio transmitters departed the area on 19 September. No signal was received from either bird after this date.

TABLE 3. Departure dates of Clapper Rails, Salton Sea, California, 1977.

Bird No.	Location	Date of Disappearance
028-029	Salton Sea N.W.R. Unit I	16 September
048-049	Imperial Wildlife Area, Wister Unit, Y-16A	16 September
089-090	Imperial Wildlife Area, Wister Unit, Mallard Road Drain	16 September
024-025	Salton Sea N.W.R. Unit I	19 September
036-037	Imperial Wildlife Area, Wister Unit, Y-16A	19 September
087-088	Imperial Wildlife Area, Wister Unit, Mallard Road Drain	19 September
018-019	Salton Sea N.W.R. Unit I	24 September
016-017	" " " " "	27 September
003-004	" " " " "	27 September
038-039	Imperial Wildlife Area, Wister Unit, Y-16A	1 October

By 10 October crayfish were no longer found under any of the eight panels used to monitor crayfish populations.

A mid-November check for tracks revealed a population of four rails in Unit I on the Salton Sea National Wildlife Refuge, and two rails in field Y16A on the Wister Unit of the Imperial Wildlife Area.

Population Census.--A complete census of the area was undertaken between 16 May and 4 June and produced responses from 160 individual Clapper Rails. There were 51 definite pairs, 22 probable pairs, 19 probably unpaired, and 17 birds that were definitely unpaired (Table 4). Thus, 67 percent of the males were paired in the latter half of May; this figure increased somewhat by mid-June.

Rail Density.--Highest rail densities occurred throughout the Imperial Valley in the following areas:

New River Delta	17 individuals	6.3 rails/10 ha
Salton Sea N.W.R.-Unit I	27 "	4.0 "
Alamo River Delta	7 "	3.8 "
Salt Creek area	12 "	2.9 "
Imperial Wildlife Area-Wister Unit wash drains	34 "	1.2 "
Imperial Wildlife Area-Wister Unit	47 "	1.1 "
Imperial Wildlife Area-Finney Lake Area	5 "	0.9 "

All areas were characterized by stands of dense cattail in shallow water surrounded in small areas by sparse cattail or bulrush. Both the Alamo and the New River deltas contained extensive

TABLE 4. Breeding status of Clapper Rails responding during May census of Imperial Valley, California, May 1977.

Bird No.	Birds Actually Responding	Location*	Definite Pair	Prob. Pair	Definite Single	Prob. Single	Prob. No. of Rails
001--002	2	1	X				2
003-004	2	1	X				2
005-006	2	1	X				2
007	1	1				X	1
008-009	1	1		X			2
010-011	1	1		X			2
012-013	2	1	X				2
014	1	1				X	1
015	1	1			X		1
016-017	1	1		X			2
018-019	1	1		X			2
020-021	2	1	X				2
022-023	2	1	X				2
024-025	2	1	X				2
026-027	2	1	X				2
028-029	2	1	X				2
030-031	2	1	X				2
032	1	2 (F7)				X	1
033	1	2 (F7)			X		1
034-035	1	3 (Y16A)		X			2
036-037	2	3 (Y16A)	X				2
038-039	2	3 (Y16A)	X				2
040	1	3 (Y16A)				X	1

TABLE 4. Continued

Bird No.	Birds Actually Responding	Location*	Definite Pair	Prob. Pair	Definite Single	Prob. Single	Prob. No. of Rails
041	1	3 (Y16A)			X		1
042-043	2	3 (Y16A)	X				2
044-045	1	3 (Y16A)		X			2
046-047	2	3 (Y16A)	X				2
048-049	1	3 (Y16A)		X			2
050-051	1	3 (Y16D)		X			2
052-053	2	3 (Y16C)	X				2
054	1	3 (Y16C)				X	1
055-056	2	3 (Y16C)	X				2
057-058	2	3 (Y16D)	X				2
059-060	2	3 (Y16D)	X				2
061-062	2	3 (Y16D)	X				2
063-064	2	3 (Y16D)	X				2
065-066	1	3 (Y16D)		X			2
067-068	1	3 (W11A)		X			2
069-070	2	3 (W11C)	X				2
071-072	2	3 (Y15B)	X				2
073-074	2	3 (U12)	X				2
075-076	2	3 (U12)	X				2
077	1	3 (Y15B)				X	1
078-079	2	3 (513A)	X				2
080	1	3 (513A)			X		1
081-082	2	3 (513A)	X				2
083-084	2	3 (513A)	X				2

TABLE 4. Continued

Bird No.	Birds Actually Responding	Location*	Definite Pair	Prob. Pair	Definite Single	Prob. Single	Prob. No. of Rails
085-086	2	3 (514)	X				2
087-088	2	4 (Mallard Rd.)	X				2
089-090	2	4 (Mallard Rd.)	X				2
091-092	2	4 (Mallard Rd.)	X				2
093-094	2	4 (Mallard Rd.)	X				2
095-096	1	4 (Mallard Rd.)		X			2
097-098	2	4 (Mallard Rd.)	X				2
099	1	4 (Mallard Rd.)				X	1
100-101	2	4 (Mallard Rd.)	X				2
102-103	2	4 (Mallard Rd.)	X				2
104-105	2	4 (Mallard Rd.)	X				2
106-107	2	4 (Mallard Rd.)	X				2
108	1	4 (Mallard Rd.)			X		1
109-110	1	4 (Mallard Rd.)		X			2
111-112	1	4 (Mallard Rd.)		X			2
113	1	4 (Mallard Rd.)			X		1
114-115	2	4 (Honker Rd.)	X				2
116	1	4 (Honker Rd.)				X	1
117	1	4 (Honker Rd.)			X		1
118-119	1	4 (Honker Rd.)		X			2
120	1	4 (Honker Rd.)				X	1
121	1	4 (Honker Rd.)				X	1
122	1	4 (Honker Rd.)			X		1
123-124	1	4 (Ibis Rd.)		X			2

TABLE 4. Continued

Bird No.	Birds Actually Responding	Location*	Definite Pair	Prob. Pair	Definite Single	Prob. Single	Prob. No. of Rails
125	1	4 (Ibis Rd.)			X		1
126	1	5			X		1
127	1	5				X	1
128-129	1	5		X			2
130-131	2	5	X				2
132-133	2	6	X				2
134-135	2	6	X				2
136	1	6				X	1
137-138	1	6		X			2
139-140	2	6	X				2
141	1	6			X		1
142	1	6				X	1
143-144	2	6	X				2
145	1	6			X		1
146	1	6			X		1
147-148	2	6	X				2
149	1	6			X		1
150-151	1	7		X			2
152	1	7				X	1
153	1	7			X		1
154-155	1	7		X			2
156-157	2	7	X				2
158	1	7				X	1
159-160	1	8		X			2

TABLE 4. Continued

Bird No.	Birds Actually Responding	Location*	Definite Pair	Prob. Pair	Definite Single	Prob. Single	Prob. No. of Rails
161-162	2	8	X				2
163-164	2	8	X				2
165-166	2	8	X				2
167-168	2	8	X				2
169	1	8				X	1
170-171	2	8	X				2
172	1	8			X		1
173-174	1	9		X			2
175-176	1	10		X			2
177	1	10				X	1
178	1	10			X		1
179-180	2	10	X				2
181	1	10				X	1
182	1	10				X	1
TOTAL	160		51	22	17	19	182

* 1 - Salton Sea National Wildlife Refuge-Unit I
2 - Salton Sea National Wildlife Refuge-Unit II
3 - Imperial Wildlife Area-Wister Unit (field no. given)
4 - Imperial Wildlife Area-Wister Unit-Shoreline Wash Drains (road given)
5 - Imperial Wildlife Area-Finney Lake
6 - New River Delta
7 - Alamo River Delta
8 - Salt Creek
9 - Whitewater Creek Drain
10 - Coachella Canal Seeps

portions of Phragmites sp. with isolated stands of dense cattail intermixed. Paired rails found on these deltas were always associated with cattail. The ponds located on the Wister Unit received little rail use due to fluctuating water levels during spring and summer. The exceptions to this were the canals furnishing water to these ponds and the central ponds, Y16A and Y16D. These ponds contained a rail density (26 individuals) of 2.8 rails per 10 ha, but there was a relatively constant water level throughout spring and summer. Washes in the Wister Unit supported narrow bands of marsh adjacent to the Salton Sea and contained low densities of rails. The northernmost drain was quite wide extending inland up to 0.6 km. This marsh supported a density of 3.8 rails per 10 ha (23 individuals). The low density of rails in the Finney Lake area was the result of high water levels and steep banks along the lake proper with only the marsh area at the input drain and the marsh along the Alamo River adjacent to Finney Lake providing suitable rail habitat.

Habitat Requirements.--All rails were located in those habitat types mentioned in Table 5. All paired rails were located in cattail, or bulrush associated with cattail. The available habitat was determined for each area in which rails were found and was recorded only when the plants were emergent or were immediately adjacent to the water, i.e. dry ponds of any vegetation type were not included.

A chi-square analysis of the distributional data (Table 5) was highly significant ($p<0.01$) indicating that the rails do

TABLE 5. Distribution of Yuma Clapper Rails and available emergent vegetation types.

Emergent Type	Probable Number of Rails	Percent of Population	Percent of Available Habitat	Mean Number of Rails per 10 Hectares
Dense Cattail	110 (96)*	60.4 (65.8)	47	2.2 (1.9)
Sparse Cattail	47 (38)	25.8 (26.0)	25	1.7 (1.4)
Bulrush	3 (0)	1.7 (0.0)	5	0.6 (0.0)
Bulrush and sparse Cattail	18 (12)	9.9 (8.2)	8	2.1 (1.4)
Salt Cedar	2 (0)	1.1 (0.0)	4	0.5 (0.0)
Carrizo Cane	2 (0)	1.1 (0.0)	11	0.2 (0.0)
TOTAL	182 (146)	100.0 (100.0)	100	Mean 2.0 (1.7)

*Parenthetical values for paired birds.

not select territories randomly with respect to the vegetational types in which they were found. A chi-square analysis of the distribution in those habitats where paired birds were found was significant ($p<0.05$), indicating that paired birds do not select nesting territories randomly with respect to the vegetational types in which they were found. Dense cattail was used more heavily than expected based on the proportion of suitable habitat available to both paired and unpaired birds. Sparse cattail and bulrush with sparse cattail were used in approximately their expected proportions; whereas bulrush, salt cedar, and Phragmites sp. were used far below their expected values by unpaired birds in this vegetational type. No paired rails were found where there was an absence of cattail. All nests found were located in cattail stands. Birds responding from areas containing no cattail eventually moved to different localities by June or were thought to be transients. Clapper Rails were observed to forage in many types of vegetation during the summer months but always returned to sparse or dense cattail during the night.

Of the total 109 rail locations, all were proximal to high ground, i.e. dikes, shore lines, or mud hummocks within the immediate vicinity. High ground did not seem to be as limiting to the birds as was found in tidal marshes described by Bateman (1965) and Kozicky and Schmidt (1949). On the Wister Unit several rails attempted to establish territories in areas which contained water in early May but became dry during late May and early June. In all cases but one the birds moved to canal ditches close to the original pond site. The exceptional pair

returned to the area which was reflooded and established a nest only to abandon the nest in late June when the pond dried. This pair did not return again to this site.

In early May unpaired males established territories in marginal habitat but deserted them within a few days if they were unsuccessful in obtaining a mate. Three of these birds established territories in brackish water at the edge of the Salton Sea but abandoned the area after a few days.

Rails were associated with three levels of management effort:

1. Areas in which no management of vegetation was ever attempted and no water flow control existed.
2. Areas where vegetation management had not occurred for at least two years but some water flow control existed.
3. Areas in which active vegetation management, including planting of marsh vegetation and tilling of the substrate along with extensive water control, occurred.

Type one areas contained 52.7 percent of the rail population, type two areas contained 36.3 percent, and type three areas contained 11.0 percent.

In those areas of no management (Type 1) the habitat situation encountered by the rails was much as Smith (1974a) reported in Topock Marsh. However, in the managed and partly managed areas, rails encountered a slightly different set of habitat parameters. The managed areas were cut into dry-bed ponds with a somewhat uniform water depth. Water

depth in some areas varied from completely dry to 20 cm in depth over a period of one month. The areas were originally seeded with bulrush, but in all cases where paired rails were found were invaded by cattail. The dikes often provided the only high ground available, forcing the birds to nest over the water inside the cattail stands which provided nesting cover or along an exposed dike where little cover existed.

Compared with the sparse cattail type (Table 6), dense cattail was characterized by: 1) more stems per m^2, $p<0.001$; 2) greater height of plants above water level, $p<0.001$; and 3) a higher percentage of fallen vegetation, $p<0.001$. Mean water depth and percent of mud flat displayed considerable overlap between these vegetational types. Shallow water areas also included extensive stands of salt cedar and Phragmites sp. adjacent to cattail stands.

In the Imperial Valley stem density of cattails, vegetation height, amount of fallen vegetation, and plant vigor appeared to be a function of stand age, since sparse stands were found in areas of new growth at the edge of a dense stand of cattail or in areas which had received water only in the past one or two years.

The mean number of crayfish found under the panels in each vegetation type was 6.86 crayfish per panel in dense cattail, 4.33 crayfish per panel in sparse cattail, and 4.67 crayfish per panel in bulrush with sparse cattail. The only significant difference in vegetation types was between dense and sparse cattail ($p<0.05$). The highest numbers of crayfish were found in water partly covered with floating vegetation, 6 to 10 cm deep,

TABLE 6. Comparison of emergent types of vegetation used by paired Clapper Rails.

	Dense Cattail (n=49)	Sparse Cattail (n=18)	Bulrush with sparse Cattail (n=6)	
Stems/m^2				
Mean	79.60	61.98	201.96	62.46
L*	72.66-86.54	53.65-70.31	121.38-282.54	56.54-68.28
Mean Water Depth (cm)				
Mean	9.60	6.45	4.51	
Vegetation Height (m)				
Mean	3.17	2.07	0.82	2.06
L*	2.50- 3.84	1.62- 2.52	0.68- 0.96	1.59- 2.53
% Fallen Vegetation				
Mean	46.80	21.90	20.60	15.30
L*	34.26-59.34	-8.25-32.08	10.90- 30.30	5.30-25.30
% Mud Flat				
Mean	26.60	32.60	44.60	

* 95 percent confidence limits.

and near flowing fresh water, either a pond inlet or along a stream bank. The number of crayfish per panel varied from zero to 18. Ten percent of the sites associated with paired birds had no crayfish under the panels. With respect to availability of clams, 38 of 73 (52.1 percent) sites contained no clams. Of those sites where no crayfish were found 50 percent had clams present in numbers ranging from 4 to 12 clams per m^2. No significant difference in number of clams was noted in the various vegetational types.

Nesting and Reproduction.--Nine active nests were found in May and June (Table 7). All nests were located in stands of cattail with one exception. The nest of pair 069-070 was constructed of dry cattail and was located at the base of a salt cedar adjacent to a flooded cattail stand. This nest was eventually abandoned due to the drying of the pond. The other nests consisted of dry interwoven cattail with some grass or twigs included in at least two nests. When the ground underneath the nest was covered by water, the nests were tied into the cattail stems and were located between 35 and 54 cm above the water surface. These nests all had a "ramp" of fallen cattail leading up from the water surface. The female would consistently use this ramp to enter or exit the nest. When the ground under the nests was reasonably dry, the nests were located on fallen cattail between 5 and 16 cm above the wet ground surface. There was no ramp associated with these nests.

In several of the nesting territories other nests were located within 20 m of the nest containing eggs. They were

TABLE 7. Clapper Rail nests, Imperial Valley, California 1977

Rail No.	Location	Date of Discovery	Date of Hatching	No. of Eggs	No. Hatched	No. Infertile
003-004	Salton Sea N.W.R.-Unit I	7 May	19 May	9	8	1
001-002	Salton Sea N.W.R.-Unit I	16 May	31 May	8	8	0
075-076	Imperial Wildlife Area-Wister	27 May	5 June	5	5	0
078-079	Imperial Wildlife Area-Wister	29 May	6 June	10	8	2
059-060	Imperial Wildlife Area-Wister	29 May	5 June	7	7	0
069-070	Imperial Wildlife Area-Wister	29 May	*	8	0*	*
050-051	Imperial Wildlife Area-Wister	29 May	3 June	7	6	1
055-056	Imperial Wildlife Area-Wister	1 June	13 June	8	6	2
018-019	Salton Sea N.W.R.-Unit I	3 June	14 June	8	8	0
Mean ± Standard Deviation				7.8±1.4 (n=9)	7.0±1.2 (n=8)	0.8±0.9 (n=8)

*Nest abandoned due to drying of pond in early June.

identical to the nest in use, but their function could not be determined. In many areas inside the marsh, loafing nests, consisting of 6 to 20 stems lying parallel to one another, were found at the base of cattails on the mud flat. Tracks leading to and from these nests indicated continual use.

Prior to the hatching date, the female spent most of the heat of the day shading the eggs with her body and wings. During periods of cooler temperatures, in the evening and early morning, she brooded the eggs. The female left the nest for short periods of time when disturbed. The usual response to an intruder involved leaving the nest and giving "agitated keks" while circling the area. After several minutes of this behavior, the bird would return to the nest. This behavior pattern often alerted the observer to the presence of a nest and accounted for the location of 56 percent of the nests. All other nests were located by following Clapper Rail tracks in the mud.

The average egg count prior to hatching was 7.8 eggs per nest as compared to a mean of 6.5 eggs from four nests reported by Abbott (1940). The hatching dates ranged from 19 May to 14 June with most eggs hatching during the first week in June. Hatching success was ninety percent.

The young were precocial and followed the adult into the marsh within 48 hours after hatching. Approximately a month after hatching three different family groups were observed. In all cases the adult was accompanied by only one or two immature birds indicating a mortality rate of about 80 percent. The areas were observed continuously for several days, but no additional immature birds were seen with the adult.

Territory Size.--Size of territories ranged from 0.32 to 0.70 ha in unpaired birds, and 0.27 to 0.71 ha in paired birds, with a mean size of 0.48 and 0.47 ha, respectively (Table 8). In several instances adjacent pairs shared the dike between their territories, but we never observed a bird to enter another bird's territory once it was established.

Territories in which the occupant(s) had an adjacent neighbor were smaller ($p<0.001$) than territories in which the occupant(s) had no rails adjacent. In all cases where birds were adjacent, there was no "no man's land" between the birds as described by Smith (1974a). Rails in dense cattail also had significantly smaller territories ($p<0.001$) than rails found in sparse cattail.

Rail Capture Success.--Trapping attempts were conducted from 21 March to 17 August (450 trap nights). Nine birds were captured during this period, giving an overall trap success of 50 trap nights/capture (Table 9). All birds were captured in areas containing dense cattail which allowed trap concealment. Sex of the captured birds was determined by body weight and by calls given on release in the case of adults, and by calls alone given on release in the case of immatures. Females seldom gave any call during capture or after release; males invariably gave a "kek" call on release regardless of the month of capture. Adult males were also heavier than adult females. Adult males averaged 253 g, whereas females averaged 230 g.

Several trapping techniques were used with varying degrees of success. 1) Traps were baited with crayfish and set in the

TABLE 8. Clapper Rail territories, Imperial Valley, 1977.

Rail No.	Location	Vegetation Type	Adjacent Neighbor	Territory Size (Hectares) Unpaired	Paired
005-006	Salton Sea N.W.R. Unit I	Dense Cattail	Yes	0.32	(0.33)
008-009		Dense Cattail	Yes	0.36	(0.36)
016-017		Dense Cattail	No	0.44	(0.41)
020-021		Dense Cattail	No	0.57	(0.51)
028-029		Dense Cattail	Yes	0.47	(0.41)
030-031		Dense Cattail	No	0.61	(0.58)
137-138	New River Delta	Dense Cattail	Yes	0.44	(0.46)
143-144		Sparse Cattail	No	0.64	(0.67)
147-148		Sparse Cattail	Yes	0.45	(0.44)
034-035	Imperial Wildlife Area Wister Unit	Dense Cattail	No	0.45	(0.50)
036-037		Sparse Cattail	No	0.49	(0.57)
038-039		Sparse Cattail	No	0.70	(0.71)
046-047		Dense Cattail	No	0.52	(0.55)
055-056		Sparse Cattail	Yes	0.41	(0.43)
087-088	Imperial Wildlife Area Wister Unit Wash Drains	Dense Cattail	Yes	0.34	(0.38)
089-090		Dense Cattail	Yes	0.40	(0.27)
	Mean ± S. D.			0.48±0.11(n=16)	0.47±0.12(n=16)

TABLE 9. Capture and identification of Clapper Rails.

Date	Location	Age	Probable Sex	Weight	F&WS Leg Band No.	Colored Wing Band	Colored Leg Band
29 Mar	Salton Sea N.W.R.Unit I	Adult	Male	254g	505-39609	Blue/yel	White/red/white
14 Apr	" " " " "	Adult	Male	250g	505-39610	Red/red	Red/red/red
9 May	Wister Unit, Y-16A	Adult	Female	228g	505-39611	Blue/red	Red/blue/red
7 Jun	Wister Unit, Mallard Road Wash	Immature	Male	187g	505-39612	Green/blue	White/blue/white
27 Jun	Wister Unit, Beach Road Wash	Immature	Male	210g	505-39613	Red/yellow	Red/white/red
27 Jun	" " " "	Adult	Female	232g	505-39614	Yel/yellow	White/white/white
3 Aug	Salton Sea N.W.R.Unit I	Adult	Male	255g	505-39615	*	*
11 Aug	" " " " "	Immature	Female	236g	505-39616	*	*
13 Aug	" " " " "	Immature	Female	217g	505-39617	Yel/green	Red/blue/red

*No wing or leg bands were attached. Birds were mounted with transmitters.

cattail stand. Four birds were caught in 79 trap nights (19.75 trap nights/capture). 2) Fencing used with trap sets as described by Smith (1974a) yielded four birds in 110 trap nights (27.50 trap nights/capture). 3) A mirror was placed inside the trap, since birds were strongly attracted to their own image when mirrors were placed in the open. This technique yielded three birds in 300 trap nights (100 trap nights/capture). 4) The most successful technique was to first determine common dike-crossing areas for an individual rail, and to place the trap at that point. Five birds were captured in 79 trap nights using this method (15.80 trap nights/capture). The latter technique, while most effective, was very time-consuming, since the traps had to be constantly moved to match the movements of the birds. Combinations of the above techniques were used with no apparent increase in effectiveness.

Using tape-recorded calls to entice the bird into the trap was attempted on 25 separate occasions. No captures were made using this technique. Short periods of calling would, however, draw the bird into the open allowing photography or technique No.4 to be used more efficiently during the spring.

In the five captures which were witnessed, the rails did not appear to be concerned with what was in the trap. The birds were moving through what appeared to be a gap in the marsh and were caught. Therefore, good trap camouflage was essential.

Discussion

In the Imperial Valley, Yuma Clapper Rails used fresh water ponds and creek beds containing mature stands of cattail in shallow water near high ground. This differs slightly from the rail habitat use data along the lower Colorado River (Smith 1974b). In the Imperial Valley rails did not use the pure bulrush stands which are prevalent in the ponds on the Wister Unit. The lack of rail use of this habitat appears to be because of low crayfish densities, and the ponds are flooded only periodically with dry periods lasting up to a month. Rails were observed foraging in bulrush after the nesting season when the dried ponds were reflooded.

The most common factor for paired birds between sites was the presence of cattail. Birds were continually observed to retreat to cattail when disturbed, even in the presence of large expanses of bulrush. All nests were found in or directly adjacent to cattail, and in all cases were primarily constructed of cattail stems.

The variables which appeared to be most important in territory selection were higher stem densities combined with greater stem height, water depth, larger amounts of fallen vegetation, and crayfish abundance; whereas Oney (1954) and Smith (1974a) reported that areas of higher vegetational density were generally selected fewer times than areas of lower vegetational density. In the Imperial Valley low density cattail is adjacent to high density stands, and rails usually incorporated some of each vegetational type into their territories. Water depth and the amount of mud flat showed considerable overlap between vegetational

types and is probably the most significant criteria rails used in habitat selection.

Water level consistency throughout the nesting period was important as 1) birds abandoned areas, and sometimes nests when water level varied greatly, and 2) most birds were found in areas where water flow was not regulated. Nonregulated areas did not show great variance in water depth throughout the summer. The presence or absence of surface water dictated the abundance and availability of the primary food base--crayfish (Ohmart and Tomlinson 1977). Although these experiments were fortuitous, they indicate the importance and necessity of water level maintenance during the reproductive period of rails.

High ground was always present in the form of dikes or shoreline and was used extensively by adults for loafing and the rearing of young. While adults can swim, in deep water the downy chicks mat readily (Pettingill 1938), and in one case during this study a chick was observed to drown while attempting to cross deep water. Most nests were located over water from 1 to 15 cm in depth. In all the nests which were over water greater than 7 cm in depth, there was a "ramp" of fallen cattail tied into the nest and leading to a mud flat or high ground. A sudden increase in water depth after egg laying and before hatching may have resulted later in the drowning of the precocial chicks when the adult led them from the nest.

Hatching success was high, 90 percent in those nests not abandoned. This compared favorably for other subspecies of Clapper Rails (Adams and Quay 1958, Ferrigno 1966). However, the few times that chicks were seen with their parents after

density increases the probability of adjacent neighbors should increase resulting in smaller territory size. This is supported by evidence reported by Meanley (1969) that as more King Rails (R. elegans) moved into an area where another rail was established, the size of the original territory was reduced considerably. In the Imperial Valley where rails were found in low densities and the birds had no adjacent neighbors, territory sizes were found to be smaller than along the Colorado River.

The 160 individual rails located during the spring census probably do not represent the entire population of Clapper Rails in the Imperial Valley. A few assumptions may produce a more realistic population estimate: (1) The broadcasted calls produced a 72 percent response rate (the frequency known pairs responded during prime calling periods) in paired rails, and a 92 percent response rate in unpaired rails; (2) that all rails classified as probably paired and probably unpaired were classified correctly; (3) that there is a 50:50 sex ratio; and (4) that there were no duplicate counts. Using these assumptions, the population in the Imperial Valley was estimated at 242 birds. The weakest of these assumptions is the even sex ratio.

Conversely, if only assumption 4 is used, and that only birds responding to the taped call were present, the estimated rail population would be 160. This high number of rails when compared to the census of Smith (1974b) does not indicate a rise in the population in the intervening years. The current census was more than thorough in that it covered a larger number of marsh areas.

Broadcasting of tape-recorded Clapper Rail calls was useful

hatching, they were always in very reduced numbers compared to the initial number hatched. Never were more than three chicks seen with an adult even when observed only a few days after hatching. Family breakup occurs between the eighth and tenth week in other subspecies of Clapper Rail (MacNamara and Udell 1970) and was, therefore, ruled out as a cause of the low chick numbers found one month after hatching. None of the nests under observation was disturbed by raccoons or other possible predators, which were quite common in the marshes. Drowning due to water variance may be the primary cause of chick mortality, but this needs investigation.

Clapper Rail densities in the Imperial Valley were lower than that reported in other coastal marshes. Oney (1954) found 4.7 rails per ha in the highest density areas in Georgia, and Zucca (1954) found 2.5 rails per ha in marshes near San Francisco Bay. The densities of rails in Topock Marsh, as reported by Smith (1974a), were comparable to those found in the Imperial Valley; 1.6 birds per 10 ha in Topock Marsh and 2.0 birds per 10 ha in the Imperial Valley.

Comparable overall densities of rails, but smaller territory size in the Imperial Valley than was found in Topock Marsh, may be explained by the higher use of the dense cattail vegetational types. In dense cattail paired rail densities were higher, 1.9 rails per 10 ha, and territory size smaller; while paired birds in sparse cattail occupied larger territories with a resultant lower density, 1.4 rails per 10 ha. This follows from the significant difference between rail territory size with adjacent neighbors and nonadjacent neighbors. As rail

in determining arrival dates, breeding population size, and territory size of Clapper Rails in the Imperial Valley during the spring months, March through June. Rails became less responsive to tape-recorded calls and displayed unpredictable patterns of response from late June through late February. For these reasons the use of the tape-recorded call in monitoring departure dates and size of the wintering population was marginal.

The overwintering population represented approximately ten percent of the nesting season rail population. This was based on the number of overwintering birds compared with the nesting season population of birds found in the same areas. A mid-November check indicated that 13 percent of the rail population was still present.

The majority of rails arrived from mid-March through April and departed from mid-September through the beginning of October which coincided with the appearance and disappearance of crayfish. Crayfish were also found in 90 percent of the sites of territorial establishment. The importance of crayfish in the diet of this subspecies was reported by Ohmart and Tomlinson (1977), and the relative abundance of crayfish as rails arrive and depart indicates the importance of this food resource to rails. Future management goals should be predicated toward the habitat requirements of crayfish as well as the biological needs of Clapper Rails.

All techniques used in trapping were found to be extremely time-consuming and had low capture rates. It was possible to capture enough birds for radio-telemetry studies, but in order to capture large samples, other techniques must be developed.

The principal problems involved low densities of rails, combined with their high mobility in dense marsh vegetation.

The rising water level of the Salton Sea is slowly eradicating the rail habitat located on the New River Delta and the Alamo River Delta. In addition those areas of rail habitat along the edge of the Salton Sea are slowly being lost. These areas include the Salton Sea National Wildlife Refuge, the wash drains along the Imperial Wildlife Area-Wister Unit, and the Whitewater Creek drain. Both the National Wildlife Refuge and the Wister Unit have land available in dry ponds where marsh areas could be developed. Any long range plans must be concerned with this marsh loss, if a viable rail population is to be maintained.

One further point concerning water available for marsh habitat needs mentioning. The marshes along the Coachella canal are solely dependent on continuous water leakage from the canal. Any lining of the canal or other effort to reduce this leakage will result in the partial or total loss of these marsh areas.

Rail Management Suggestions

As a result of this study several points should be considered in improving or maintaining the Yuma Clapper Rail population in the Imperial Valley through altered management practices. Three major areas of potential improvement have been noted in this paper:

1. Ponds consisting of mature cattail standing in less than 10 cm of water would coincide with the current

habitat use by rails. Between mid-March and the beginning of October water levels in these ponds must be kept relatively constant in order to reduce the abandonment of nesting territories and possibly reduce chick mortality. Ponds should be given priority in flooding so as to allow population expansion from current high density areas.

2. Maintenance and enhancement of local crayfish populations should have a positive effect on rail populations. This can be accomplished by maintaining water levels in ponds from mid-March through early October, and establishing areas of water flow between ponds. During this study, areas where water flowed through the dikes consistently had large crayfish populations. In several cases outside the refuges the presence of ammonia fertilizer in canal water appeared to result in a significant reduction in crayfish numbers. Such occurrences should obviously be avoided. Disturbance of the substrate in tilling, etc., also reduced the crayfish population in the area, and this disturbance should be kept to a minimum.

3. The presence of dikes and other high ground is essential to Clapper Rails for loafing, rearing of the young, and drying activities. The rails, however, avoid high ground with very steep banks, higher than 40 cm. Therefore, dikes should be as low as possible within

the limits of effective water containment.

Highest rail densities occurred in areas of minimal variability in water depth and highest crayfish populations. These areas provide a good example by which to model managed habitat.

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