SALTON SEA NATIONAL WILDLIFE REFUGE

CALTPATRIA, CALIFORNIA

ANNUAL NARRATIVE REPORT

CALENDAR YEAR 1988

U.S. Department of the Interior
Fish and Wildlife Service
NATIONAL WILDLIFE REFUGE SYSTEM

REVIEW AND APPROVAL

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Refuge Manager — 7/31/89 Date

Refuge Supervisor Review — 8/8/89 Date

Regional Office Approval — Date

INTRODUCTION

Salton Sea National Wildlife Refuge is located 50 miles north of the Mexican border at the southern end of the Salton Sea in California's Imperial Valley. It is the southern-most refuge in the Pacific Flyway and the only refuge located below sea level. Because of it's southern latitude, -226 elevation and location in the upper Colorado Zone of the Sonoran Desert, the Refuge experiences some of the highest temperatures in the nation. Daily temperatures from May to October generally exceed 100°F with temperatures of 116°-119°F recorded yearly.

The Refuge was established in 1930 for the protection of waterfowl and other migratory birds. Originally, it included approximately 35,000 acres. Nearly 60 percent of the original acreage was open saline lake with the balance comprised of shoreline alkali flats, freshwater wetlands, native desert scrub and upland (farm fields). Due to the inflow of agricultural drain water and a subsequent rise in the level of the Salton Sea, all of the original refuge area has been inundated. In 1947, 24,000 acres were leased from the Imperial Irrigation District and divided between three agencies: California Department of Fish and Game (CDF&G), U.S. Navy and U.S. Fish and Wildlife Service (USFWS). Most of the current Refuge acreage of 47,827 acres has been flooded by a continued rise in the level of the Sea. At present, 2,500 acres of the Refuge is dry ground, with about 2,200 acres suitable for farming and wetland development.

Salton Sea NWR is flat with the exception of Rock Hill located near the Refuge headquarters. It is bordered by the Sea on the north and intensively farmed agricultural lands on the east, south and west. The Refuge is divided into two units, eighteen miles apart. Each unit contains managed wetland habitat, agricultural fields, alkali mudflats and desert brushlands.

Two rivers, the New and Alamo, border the Refuge. Both provide freshwater inflow to the Sea. The New River's source is water outflow and agricultural drainage from Baja California and the Mexican border town of Mexicali. The Alamo River's source is agricultural drainage from the Imperial Valley.

The Salton Sea basin was a prehistoric extension of the Gulf of California and is the largest saline lake in California. It forms a natural sump for the 4,500 square mile Imperial Valley and northern Baja California with its only inflow source being either rainwater or agricultural drainage. The salinity of the Sea has steadily increased. In 1950, it was 35 ppt equaling the Pacific Ocean. In 1988, it was 44 ppt, fully twenty-five percent saltier than the Pacific Ocean.

Habitat management emphasis is placed on the maintenance and improvement of wintering goose and duck habitat, and the reduction of waterfowl depredations to adjacent croplands. Protection and enhancement of nesting habitat for the endangered Yuma clapper rail, maintenance of habitat for nesting and migratory populations of sensitive species and other marsh birds and shorebirds, also are major objectives.

Salton Sea NWR provides habitat for over 373 bird species, 40 mammal species and many reptiles and amphibians, The Refuge winters up to 30,000 snow, Ross' and Canada geese and 60,000 ducks daily from November through February. Marsh

birds and shorebirds account for more than six million use days each year. Endangered species observed on the Refuge include the southern bald eagle, peregrine falcon, California brown pelican and Yuma clapper rail. A significant Yuma clapper rail population nests on the Refuge. Candidate (sensitive) species using the Refuge include the fulvous whistling duck, wood stork, long-billed curlew, mountain plover, and white-faced ibis.

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A. HIGHLIGHTS

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Technical assistance to feeding clubs intensified - Section E.7

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B. CLIMATIC CONDITIONS

The Imperial Valley received 1.32 inches of rainfall during the year which is well below the long term mean average of 2.91 inches. February was the wettest month of the year receiving 0.90 inches of rain. Only 0.5 inches of rain brings farming activities and other habitat management work to a halt because the Valley's non-porous clay soils make dirt roads impassable.

The desert climate of the Imperial Valley generates extremely hot summer temperatures. From May 10 through October 9, 1988 (153 days), 118 days had temperatures of 100°F or higher. The highest temperature for the year was 111°F recorded on July 25 and the lowest was 30°F on three different days in December. Local residents indicated that this year's high temperature period was the longest experienced in recent years.

The level of the Salton Sea has stabilized during the past six years between 226 and 227 feet below sea level. In 1988, the level of the Salton Sea fluctuated from a high of -226.15 msl on May 23 to a low of -227.20 msl on December 10, a variation of 1.05 feet. The evaporation total for the sea in 1988 was 7.02 feet. The evaporation rate and the volume of irrigation runoff determine the level of the Salton Sea.

Month	1914 - 1987 Avg. Temp°F	1914 - 1987 Avg. Rainfall (inches)	1987 Rainfall (inches)	1988 Temperature Min	1988 Temperature Max	1988 Rainfall (inches)	1988 Humidity (%)
Jan	56	0.38	0.05	32	79	0.11	33
Feb	62	0.35	0.22	37	84	0.90	32
Mar	66	0.23	0.00	40	99	0.00	24
Apr	71	0.11	0.00	45	101	0.07	30
May	77	0.01	0.00	50	108	0.00	22
Jun	85	0.00	0.00	54	108	0.01	24
Jul	92	0.09	0.00	69	111	0.04	29
Aug	91	0.37	0.14	67	109	0.12	29
Sep	85	0.39	0.01	58	109	0.00	22
Oct	80	0.26	1.12	59	105	0.07	36
Nov	65	0.20	0.72	40	96	0.00	34
Dec	56	0.52	0.32	30	83	0.00	33
Total		2.91"	2.58"			1.32"	

D. PLANNING

4. Compliance with Environmental and Cultural Resource Mandates

The Sea Levee Rehabilitation Project for Tract 2 was given the "go ahead" by the Corp of Engineers (COE). The project was covered under a national permit because it was repair of an old levee.

5. Research and Investigations
Refuge Personnel

a. Salton Sea Basin Irrigation Drainage Study

In a joint effort the USFWS, Bureau of Reclamation (BR) and U.S. Geological Survey (USGS) began work to determine if irrigation drain waters have caused or have the potential to cause harmful effects on human health, fish and wildlife or other water users. The 1986 reconnaissance study identified problems and determined that more detailed investigations were needed. The following tables provide data collected in 1986 in comparison with other similar studies.

The 1988 data is presently being analyzed and a progress report should be available by October 1989.

Comparison of Selenium Values for Three Sites in California
(Reported in micrograms per gram (dry weight))

	Kesterson 1/		Volta 1/		Salton Sea (1986)	
	min.	max.	min.	max.	min.	max.
Mosquito fish	115	283	1.2	1.4	5.4	16
Sailfin Mollies	--	--	--	--	3.7	11
Coot Liver	21	63	4.4	5.6	14	21
Black-necked Stilt Liver	12	74	--	--	19	20
Duck Liver	19	42	3.9	4.4	8.3	27

1/Ohlendorf, unpublished data (1985). Kesterson evaporation pond receives only drainwater while Volta receives class 1 agricultural water.

Comparison of 1986 Salton Sea trace element data to published values from the National Contaminant Biomonitoring Program (Lowe, et al. 1985) for fish and waterbirds from Kesterson NWR and Westfarmer's evaporation ponds near Kern NWR in the San Joaquin Valley, California.

	FISH		WATERBIRDS		
Element	Salton Sea	NCBP	Salton Sea	Kesterson	Westfarmers
As	ND-2.6	0.88	ND-l.0	--	<0.2
Cd	ND		ND-3.4	0.12-.96	3.7-38
Cr	ND-O.77	--	ND-3.4	--	<0.4
CU	ND-10	3.6	7.5-150	--	18-78
Hg	ND	0.72	0.14-49	0.35-10	1.3-4.6
Ni	ND-3.4	--	ND-2.4	--	0.31-4.3
Se	3.5-17	2.8	7.0-27	25-37	26-120
Zn	8.7-250	160	17-220	55-170	120-180

ND = Not Detected

In 1988, selected biota totalling 263 samples were collected and catalogued from five stations within the vicinity of the Salton Sea. Ninety-two birds, 137 black necked stilt eggs, and 15 fish, crayfish, invertebrates and clam samples were collected on the Salton Sea NWR and vicinity from April 15 through November 10, 1988.

All samples were processed and shipped to the four contract labs; Weyerhaeuser Analytical and Testing Service, Mississippi State Chemical Lab, Texas A&M Research Foundation (organics), and University of Missouri Environmental Trace Substance Research Center (metals) for analysis.

Other Personnel

a, Reproductive Dynamics of Burrowing Owls (Athene Cunicularia) in Southern California

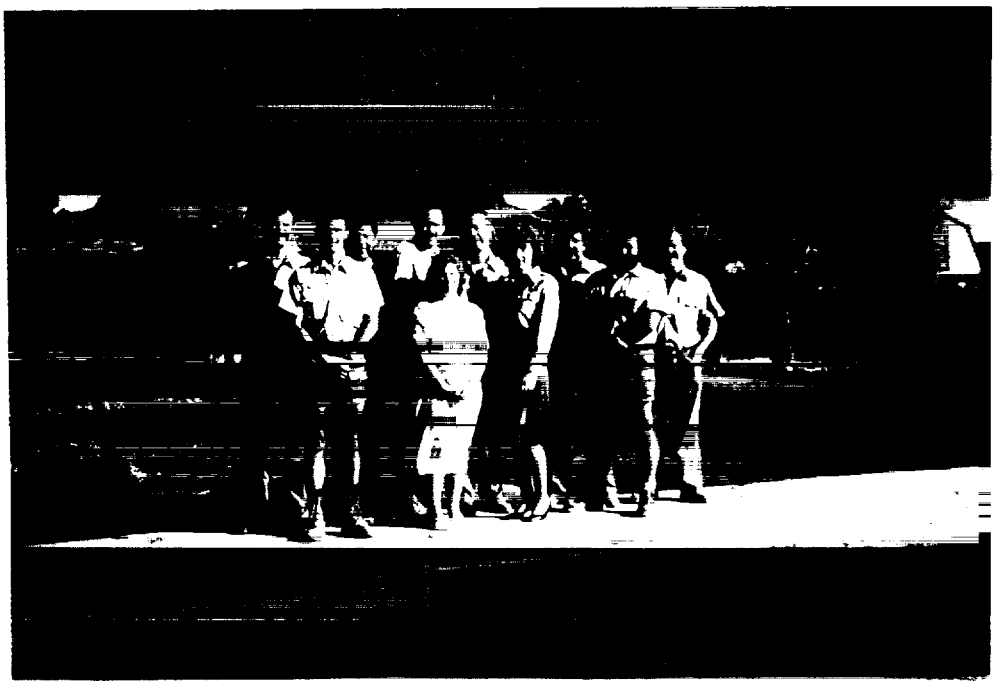
Cameron Barrows

The investigator is attempting to determine: 1) factors for differential reproductive success, 2) degree of site and mate fidelity, 3) degree of juvenile survival and fidelity to natal area, 4) age and sex structure of wintering populations.

Field research plan to begin in the spring of 1990.

E. ADMINISTRATION

1. Personnel



Back Row: 2, 9, 5, 8, 10, 15

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1. Gary Kramer - Refuge Manager, GS-485-13 PFT
2. Thomas Alexander - Assistant Refuge Manager, GS-485-11 PFT
3. Marc M. Weitzel - Asst. Refuge Manager (Tijuana Slough), GS-485-09 PFT
4. Ramon Vega - Asst. Refuge Manager, GS-485-05 PFT
5. William Henry - Wildlife Biologist, GS-486-11 PFT
6. Kathleen Arnett - Program Assistant, GS-303-06 PFT
7. Shelly Hunter - Clerk-Typist, GS-322-04 PFT
8. Lee Laizure - Heavy Equipment Mechanic, WG-5803-10 PFT
9. Richard Marquez - Engineering Equipment Operator, WG-5716-10 PFT
10. Marcos Orozco - Maintenance Worker, WG-4749-08 PFT
11. Steve Clay - Assistant Wildlife Biologist, GS-486-05 TFT,
12. Betty J. Grizzle - Biological Tech. (Tijuana Slough), GS-404-05 TFT
13. Kevin Reyor - Biological Tech., GS-404-05 TFT
14. Patrick Morrow - Wildlife Biologist, GS-486-05 TFT
15. Christian Schoneman - Biological Tech., GS-404-05 TFT
16. Jeff Mackay - Wildlife Biologist, GS-486-07 TFT

Several upgrades occurred in 1988. Assistant refuge manager Alexander was promoted to GS-11 on January 17 for accretion of duties associated with the addition of Coachella Valley NWR to the complex and the staffing of Tijuana Slough NWR.

Ramon Vega began his tour on January 4, as a manager trainee, Ramon had worked at Stillwater WMA under the coop. program.

On June 19, refuge biologist Henry was also promoted to GS-11 to reflect his increased responsibilities on the complex and for the contaminant monitoring program.

Kathy Arnett was promoted from refuge clerk GS-05 to program assistant GS-06 on September 11.

Richard Marquez was converted from crane operator to engineering equipment operator and promoted from WC-09 to WG-10 on June 19.

Shelly Hunter, temporary part time clerk-typist was hired permanent full time as a GS-04 beginning June 19. The position was necessary to handle the increased paper load associated with the contaminant monitoring program and the growing Complex.

Steve Clay, temporary assistant wildlife biologist, transferred to Kern NWR in February to pursue a temporary full time maintenance position. Steve's primary responsibility at Salton Sea NWR was assisting with the irrigation drainwater study and contaminant monitoring project at Tijuana Slough NWR.

Kevin Reyor was hired on March 28 as a temporary biological technician to replace Steve. Kevin resigned on September 9.

On October 31 Chris Schoneman was hired to replace Kevin.

Patrick Morrow was hired as a temporary wildlife biologist to produce a management plan for the Prado Basin for COE. His tour started on April 4 and ended October 3 with COE acceptance of the Plan.

Jeff Mackay was hired on October 23 as a temporary wildlife biologist to provide technical assistance to private duck clubs converting from feeding to non-feeding in order to comply with federal baiting regulations. The feeding duck club issue is discussed in section E-7.

In March Manager Kramer was assigned additional duties to work on the North American Waterfowl Habitat Management Plan. He was rewarded with a temporary GM-13 promotion in May.

2. Youth Programs

The Refuge hosted an eight week, non-resident Youth Conservation Corps (YCC) program which began on June 20 and continued through August 19, 1988. Assistant Refuge Manager, Ramon Vega, was given full responsibility for organization and logistics of the program, Carlos Carlon was hired as the

crew leader of the eight member crew. The work force consisted of three females and five males residing in Brawley or Calipatria. The selection process was by random drawing of the applications submitted in April. Transportation and supplies were provided by the Refuge. Safety was emphasized daily by work and crew leaders. Due to extreme heat (116°F) and high humidity (45+% the crew worked from 7:00 am to 3:30 pm.

Youthful YCC crew at work on favorite project. SAL RV

Salton Sea NWR projects conducted by the YCC crew included: cleaning and removing vegetation from irrigation ditches, pouring concrete anchors for buoys, cleaning and painting signs, eradication of saltcedars from marshes, removal of degraded fences, construction of a resting bench on the hiking trail, construction of tree boxes for refuge residential units and general cleaning and maintenance of refuge equipment. One enrollee assisted office refuge staff with part time clerical work.

Organized environmental education activities were included as part of the YCC program. Salton Sea crew toured: Redlands County Museum, guided tour of Joshua Tree National Monument, Living Desert Museum, Coachella Valley Preserve, self-guided tour of San Diego Natural History Museum, and the Tijuana Slough NWR. Several video tapes were shown of the National Wildlife Refuge system and educational hikes were taken around the Salton Sea NWR.

YCC crew assisting with annual maintenance of boundary signs. SAL RV

Recommendations for 1989 YCC program include: Continue to hire two youth leaders, preferably from past YCC crews and amend the budget to accommodate the increase in the minimum wage scale. Both crew leaders worked extremely well with their crew and accomplished more projects than expected.

3. Other Manpower Programs

In **1988,** two programs were implemented to recruit additional manpower.

Two students sponsored by the Student Conservation Association (SCA) were hired as resource assistants. Jim Barse, from Maryland, worked from November 16, 1987 through May 30, 1988; this time frame encompassed two programs, early and late winter. David Elsey, from England, participated from October 16 through December 20, 1988 on the early winter program. They assisted the biological and maintenance staff ranging from carpentry work to bird surveys. Other duties included planting trees and assisting in guided tours of the Refuge to elementary school classes. Their work was very beneficial to the Refuge therefore the SCA program will continue to be implemented.

"International" help from David Elsey - SCA voluntee
SAL WH

4. Volunteer Program

Volunteers or chain gang? Conservation crew removed undesired saltcedar. SAL WH

5. Funding

A five year funding comparison for Salton Sea NWR and its satellites, Tijuana Slough and Coachella Valley NWR's is listed below.

ACTIVITY	FY 1984	FY 1985	FY 1986	ACTIVITY	FY 1987	ACTIVITY	FY 1988
					385,900		494,200
1260	364,900	317,100	328,000	1261	263,200		342,700
				1262	122,700		151,500
1270	1,500	1,500	1,500		--		--
1520	23,250	19,440	20,700		12,800		--
8610	3,550	900	2,700		2,700		3,953
7201"	--	--	7,000		10,000		7,000
1240	--	--	--		301	1242	700
TOTAL	393,200	338,940	359,900		411,700		505,853
2841[h]	30,000						
1971		139,973'	145,027'		68,600[f]		18,700[h]
1902[d]			15,000		7,000		35,000
1975'					24,500		21,200
RPRP					122,000'		60,000[i]
					222,100	1230'	5,000
					633,800		139,900 / 645,753

"Contributed funds - Coachella Valley NWR.

[b]Construction and Anadramous Fish funding used for dredging and dune reconstruction at Tijuana Slough NWR.

'Mitigation funds received from the Bureau of Reclamation. Funds were used at Salton Sea NWR for habitat improvements.

[d]Habitat Resources Funding for contaminant studies (Salton Sea Irrigation Drainage Study).

'U.S. Navy funds for Sikes Act Management Plan preparation in San Diego area.

[f]U.S. Navy funds for dredging operations at Tijuana Slough NWR.

[g]One time RPRP (1261) funds - $36,000 for Tijuana Slough contaminant studies and ARMM (1262) funds - $86,000 for Tijuana Slough dredging.

[h]Corps of Engineers (Prado Basin Waterfowl Management).

[i]One time (1261) funds - $40,000 for Tijuana Slough NWR Contaminant Study and $20,000 for Rehab, Revegetate Roads.

'North American Waterfowl Management Plan.

6. Safety

The Refuge safety program is directed toward increased safety awareness among all staff members and maintaining a safe environment for the staff and visitors alike.

To involve the whole staff in the safety program, responsibility for monthly safety meetings rotates through the staff. Some topics addressed were heat stress, hearing protection, defensive driving, heavy equipment, shop tools, welding, ATV and aircraft safety.

Because of hazards of working around the polluted New and Alamo Rivers all refuge staff required to work in the field received immunizations for typhoid, tetanus and polio by the County Health Department at refuge expense.

Salton Sea YCC camp was accident free this year for the first time in many years. Tijuana Slough YCC camp had one accident. An enrollee was attempting to set a metal post by standing on the anchor when he slipped and the anchor cut through the boot and into his foot.

SCA volunteers were involved in three accidents. On March 3, one SCA strained ligaments and tore some tissue in his right knee carrying roofing shingles up a ladder while working on the office carport. On April 18, the same volunteer fell off the back of a stake bed truck he was using as a platform while painting the carport.

The second SCA volunteer was stung or bitten by an insect while irrigating crops, which caused swelling of his forearm and was very painful for a few days,

The accident causing the most lost time happened at law enforcement refresher when Marcos Orozco strained his right shoulder while performing the PBC bench press. After over six months of therapy the shoulder finally underwent an operation to repair torn ligaments. The operation was successful and his shoulder is recovering well.

The most potentially serious accident occurred while Lee Laizure was removing a grease fitting from the tract adjuster on the dragline. When the fitting was loosened it and grease shot out under pressure injuring Lee's hand and covering his arm, chest and face with grease. The fitting was never found, had it hit someone a serious injury could have resulted. Luckily Lee was wearing his safety glasses so his eyes were protected. No grease was injected under his skin but his right hand was battered and bruised from being knocked against the under carriage.

7. Technical Assistance

Through a cooperative agreement with the Los Angeles office of the COE a temporary Wildlife Biologist (GS-05) was hired on April 3, 1988 to provide guidance for the development of a waterfowl habitat management plan for the Prado Flood Control Basin in Riverside and San Bernardino Counties, California. Funding from COE provided salary for the 7 month appointment and

rental of a GSA vehicle. The 65 page report was completed in a timely manner by mid-September and with high regards from all parties involved.

Special thanks goes out to Patrick Morrow for his diligence and dedication.

Following regional direction (December 19871, a technical assistance program aimed at waterfowl feeding clubs in Southern California was initiated. The goal of this action was to further assist duck hunting club owners in their efforts towards producing natural forage (moist soil plants and aquatic invertebrates) prior to enforcement of federal baiting regulations.

Historical Perspective:

Recognizing a need to eliminate crop depredations in the Imperial and Coachella Valleys, waterfowl hunting clubs were licensed by the State of California in 1953 to provide bulk cereal grains for foraging waterfowl. Special regulations for hunting on feed clubs were imposed and included a closed hunting zone around the feeding station, mandatory water impoundment duration on a percentage of the club, a minimum daily amount of high quality feed and a record of waterfowl harvest. Non-compliance with any of these regulations could result in loss of the feeding license and legal proceedings.

In response to a 1975 suit filed against the Federal government by the CDF&G and others to prevent Federal agents from interfering with the state's feeding program, a major study of the issue was ordered by the court. The study was to assess, among other things waterfowl distribution relative to habitat and club type (feeding vs. non-feeding); habitat availability; the occurrence and extent of alleged crop depredation; waterfowl behavior relative to habitat, club and hunting pressure; harvest relative to club type and impact of feeding programs on distribution and numbers of waterfowl, crop depredation and harvest. The University of Missouri, under the direction of Dr. Leigh Fredrickson, was contracted by the Service to conduct the study. Club records analyzed during the study indicated no significant difference in hunting success between feed and non-feed clubs. Dr. Fredrickson also found that even though fed grain was available in quantities that appeared to be more than sufficient to provide existing energy requirements for all wintering pintails feed clubs with vegetated wetlands held more pintails and had a higher hunting success than nonvegetated clubs where only fed grains were available. Vegetated ponds produced more ducks in the bag per hunter day (3.7) than nonvegetated ponds (2.8). Although grains are high in carbohydrates, Dr. Fredrickson felt they may not provide the nutritional base needed for breeding, migration, or other activities. These results stressed the importance of a diverse food base that also promotes the production of important invertebrate populations.

A Service appointed advisory committee made up of 14 waterfowl specialists from throughout the United States made conclusions or recommendations based primarily on Dr. Fredrickson's 1980 report. Among those conclusions were the following: 1) feeding on clubs cannot be justified on the original premise that it would reduce crop depredations; 2) while feeding attracts pintails on clubs, behavior modification prevents a significant increase in the hunter kill; 3) conversion from grain feeding to moist soil management should be

initiated and completed as soon as possible; and 4) a technical assistance program should be conducted to provide waterfowl club owners and operators with information on developing water, food and cover for waterfowl and other wildlife.

During 1980 the Service and CDF&G initiated a program providing assistance to interested private clubs to evaluate their potential to produce natural food and suggest ways by which this could be accomplished. Wendell Miller, a habitat specialist with forty years of experience in California moist soil management was contracted to conduct the program which began in December 1982 and ended in July 1987. Following a report by Mr. Miller on the feasibility of improving waterfowl food production on private duck hunting clubs in southern California and concerns raised by duck club owners relative to their ability to produce natural forage the Service intensified the technical assistance program. Refuge Biologist Henry was assigned duties of conducting the program. In November, Jeff Mackay, a second wildlife biologist (temporary) was hired to assume the technical assistance responsibilities. Feeding clubs were contacted and some inspected. Management efforts by club operators were evaluated and techniques were recommended for each club to improve production of moist soil plants, reduce soil salinity levels, improve water control and management, control undesirable vegetation and enhance aquatic invertebrate production. A few clubs have made excellent progress while others have made no progress towards producing natural forage. All feeding clubs are capable of replacing out of sack grains with natural plant and animal forage. The major limiting factor towards this end is the effort put forth by each club.

F. HABITAT MANAGEMENT

1. General

Salton Sea NWR is geographically located in the upper Colorado Desert Region of the Sonoran Desert where annual rainfall rarely exceeds three inches. Native habitat consists of creosote bush – white bursage and palo verde – mesquite communities with isolated riparian zones dominated by cottonwood and willow. These basic habitat types are considered climax communities and are very stable unless disturbed.

As early as 1850, there were plans to alter the Salton Sink by bringing irrigation water from the Colorado River for irrigation. Since that time, over 475,000 acres have been converted from desert sand and brushlands to agricultural lands.

2. Wet lands

Wetland management is directed toward production of natural foods to provide wintering habitat for waterfowl and nesting habitat for Yuma clapper rails.

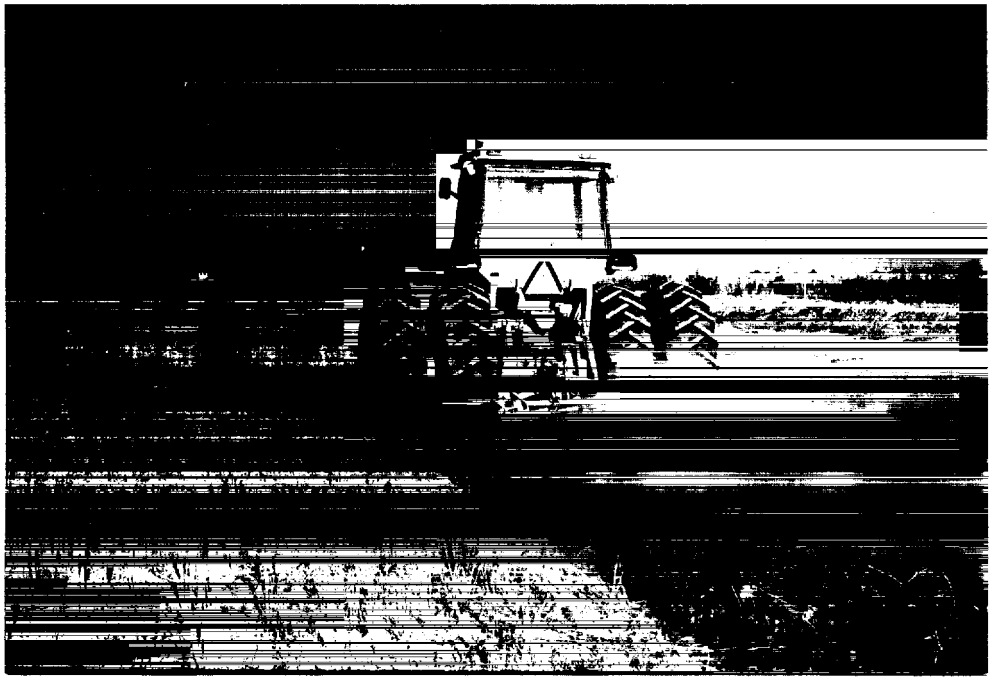
Tract A (160 acres) in Unit I was drawn down to facilitate land-leveling and levee rebuilding that was scheduled for the late summer and fall. Three of the four ponds were completed in December. One pond was seeded with a mixture of alkali bulrush and water-grass. Flood-up began shortly thereafter.

Tract B (160 acres) was also drawn down in late March due to a botulism outbreak and to begin rehabilitation. The work will include levee construction, rough land leveling, improvements in the water delivery and drainage systems and saltcedar control.

All water used to flood Tracts A and B prior to 1985 was agricultural drainage (primarily subsurface – "tile" drain water). Late in 1985, these waters became suspect of carrying toxic trace elements (selenium) and soluble pesticides and their use was discontinued. A new water delivery system is under development and since January 1986, all water used to flood both Tracts was class one agricultural water.

Reidman Ponds 1 and 2 were dewatered on 11 March and Ponds 3 and 4 dewatered in early April. Ponds 1 and 2 produced good and fair stands (respectively) of watergrass and sprangle top with only one additional irrigation in early May. Ponds 3 and 4 were drained to mudflat on 5 April and shallowly flooded intermittently through July, this resulted in additional leaching and an excellent alkali bulrush stand.

In an effort to reduce soil salinity in the Reidman field (adjacent to the Reidman ponds), four 8 acre leach ponds were constructed on the north end of the field during January and February. Drain tile had been installed previous to pond construction to facilitate crop production. Flood-up began after construction was complete in February and ponds remained flooded intermittently until April draw down. Ponds were again flooded during the fall beginning in October with leaching continuing through winter.



Leach ponds provide excellent habitat and will improve farm crop yields. SAL WH

Fall floodup on the Refuge began 19 September and all ponds were at desired depths (4-6 inches) by 23 September. Waterfowl use peaked during the months of December and January with over 2,000 wigeon and 12,000 white geese utilizing the new 80 acre ponds. Shorebird use fluctuated greatly with peaks of over 2000 long-billed dowitchers recorded in March and April.

Newly developed Hazard ponds 1A, 2A and 3A remained barren of any vegetation due to the high water table and hypersaline soils ranging from 8,000 ppm to 19,000 ppm. All ponds were kept flooded to promote wigeon grass (Ruppia) development. Hazard ponds 1 and 2 were kept shallowly flooded and wigeon grass quickly became established. Hazard pond 3 was dewatered in late March but due to hypersalinity failed to produce any plant growth. Hazard ponds 4, 5, 6 and 7 were managed for swamp timothy (Heleochloa) and water grass (Echinochloa) with spring draw downs beginning in early March. One to two irrigations in May produced good to excellent stands. Mowing of scattered clumps of sesbania and saltcedar was completed'in all ponds by late July.

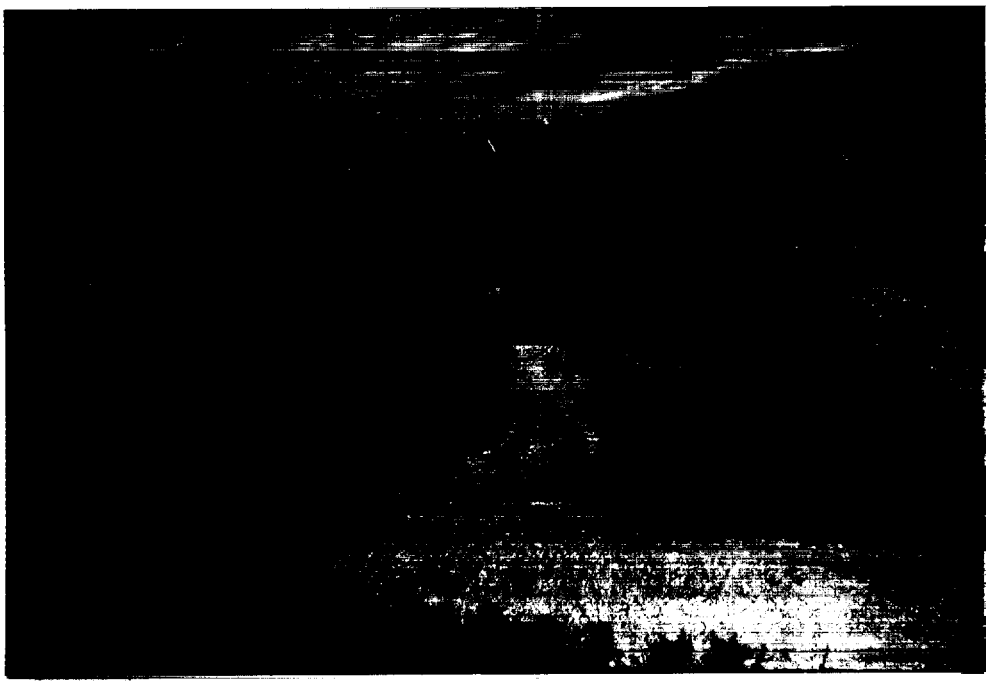
Waterfowl use rose markedly with over 4,000 birds primarily pintails using the Hazard through October and November.

Hazard ponds 8 and 9 were no longer at the mercy of high water flows of the Alamo River and were dewatered via a PTO pump in early May and again on 24 June and left dry until September. This pump was installed by Ducks Unlimited in June 1987.

Hazard pond 10 was dewatered in mid March, and irrigated in May producing a fair stand of watergrass. Mowing in early September was needed to control sesbania and saltcedar.

The headquarters ponds were drained in late March to mudflat and soon after reflooded to stimulate wigeon grass germination. This had a tremendous effect, tripling the area of coverage. The ponds remained flooded with periodic flushing throughout the year.

The recently completed Union Leach ponds (30 acres) were disced, leveled and 20 acres planted to rice at 60 lbs/acre. Results were good to excellent pending individual pond levels. Snow geese (3-4,000) really enjoyed themselves taking only 7 days to wipe out 20 acres. Duck use increased significantly as the stand was opened up.



Union I leach ponds - August rice. SAL WH

Special thanks goes to Pete Knight of Knight Ranch Inc. in Glenn, California for donating 1400 pounds of short grain rice.

Union leach ponds - January, after use by 3000 plus snow geese. SAL WH

4. Croplands

The Refuge had 765 acres of goose pasture with 275 acres in alfalfa and 490 acres in combination of sudan grass (summer) and winter wheat/rye/oats (fall-winter). All farming is under a cooperative agreement that is renewed every four years. The cooperator harvests the alfalfa from April 1 to September 30 leaving the remaining (winter) cuttings for goose browse. The annual summer crop was sudan grass which the cooperator harvested. To provide the governments share, the cooperator planted wheat, barley or rye grass in the fall (after October 1) and the entire crop was grown as green browse for wildlife. No harvesting or cutting of annual crops occurred from October 1 to March 30.

Alfalfa smorgasbord for dining snow geese. SAL GK

The first alfalfa cuttings were made in April with final cuttings in September. Irrigation of field crops was required every ten to twelve days due to the high temperatures and evaporation rates. Alfalfa and sudan fields were hayed every 20-30 days. The total yield was 344 tons of sudan hay and 643 tons of alfalfa hay.

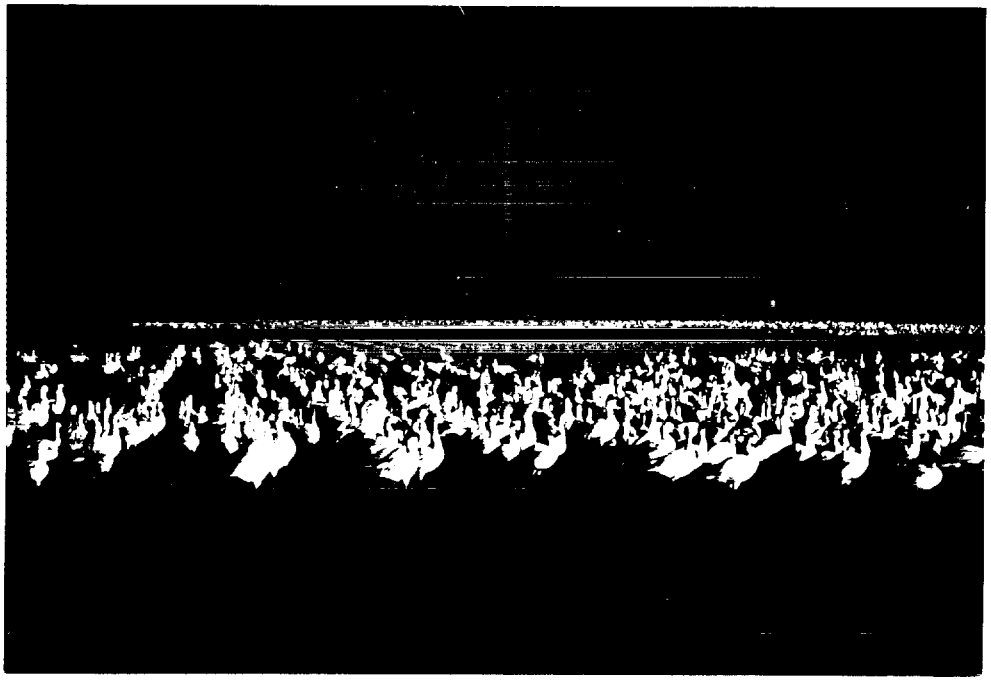
On September 10 the farming agreement with Wallace Swearingen was revoked. Termination was due to failure to meet alfalfa crop standards established by the Refuge at 75 percent. The crop was inspected by SCS and revealed only a 24 percent stand. This left the field in our hands until a new cooperator could be found. The resulting poor stand was burned in late January and resprouted to be quickly consumed by 4,000 snow geese.

The only fields in production at Unit I were S. Johnson, Flammang and Reidman. North Johnson and "C" Tract were left fallow and/or full of weeds. Only 3 fields totalling 280 acres provided browse or grain for wintering geese.

Alfalfa field (Vail 461) before arrival of geese.
SAL GK

The Union Tract (field Vail 419)was disced and seeded to wheat in mid November. The north 30 acres remained in rice-leach ponds. Leaching continued for ten months.

The Refuge fields provided a continuous source of goose browse throughout the winter months. Unit II fields planted to wheat received limited use in 1988 compared to 1987 even though the fields were ready and waiting for the fall migrants. In contrast to the low use of green wheat and oats, heavy use of alfalfa occurred in Unit II with 120 acres 80 percent utilized by mid December. Goose use days for Unit II rose 300% with the corresponding acreage of alfalfa available.



Goose use of alfalfa fields increased 400% compared to green wheat fields. SAL WH

The four acre headquarters field was seeded and irrigated to wheat on 15 March by Refuge staff and left standing for upland birds and wildlife.

6. Other Habitats

During the months of March and April, field borders along the western edge of the Reidman and the eastern edge of the N. Johnson fields were disced, seeded to wheat or milo, corrugated, bordered and planted by Refuge staff with five desert tree species: palo verde (2 types), screwbean and honey mesquite, desert-thorn, and sweet acacia, with excellent results.

9. Fire Management

On May 29, a fire along the Alamo River and Hazard N-37 burned eight acres. Due to inaccessibility the fire was allowed to burn itself out under watch by fire units from Niland and Calipatria.

11. Water Rights

The Refuge currently uses about 2800 acre feet (AF) of water per year for management of wetland units with 30 percent obtained as "free water". The "free water" is a mixture of irrigation water (operational spill) and surface drain waters. Included in the 2800 AF of water is the usage for 4 newly

developed 20 acre impoundments on the Reidman Tract which came on line in the spring of 1986. These areas were previously unflooded farmland.

In 1985 the quality of the "free" subsurface drain water used to flood some ponds was suspect of carrying toxic trace elements and soluble pesticides. As a result of these concerns the use of subsurface drain water was discontinued. Water quality monitoring has been initiated to determine if.these drain waters are of an acceptable quality for irrigation and flooding of our wetlands. Until that data is analyzed, subsurface drain waters will not be used,

With the renovation of 300 acres in Tract A-B and 100 acres in the Hazard the need for delivered water will increase by an additional 2000 AF. This equates to $20,000.00 at the current price of $10.00 acre/foot for class one water purchased from the Imperial Irrigation District (IID).

As the Central Arizona Project and a proposed water transfer from IID to the Southern California Metropolitan Water District comes on line it will cause stricter water conservation measures in the Imperial Valley. This will mean less surface drain water and irrigation spill for use on the Refuge. The time has come to obtain additional funds to purchase water. If funding is not provided to purchase good quality water, some moist soil impoundments heavily used by waterfowl and nesting habitat for the endangered Yuma clapper rail will not be flooded.

G. WILDLIFE

1. Wildlife Diversity

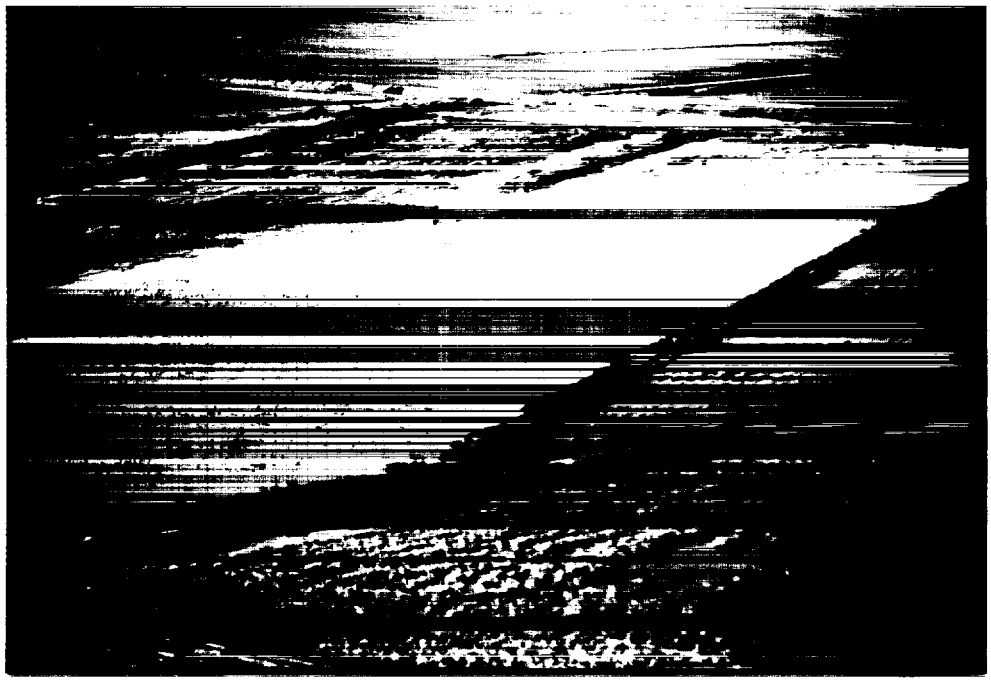
A total of 373 species of birds, the most reported for any refuge in Region 1, have been observed along with 40 species of mammals, 20 species of amphibians and reptiles and 13 species of fish. Bird diversity in the area is largely due to the Refuge's location in the Pacific migration corridor.

2. Endangered and/or Threatened Species

Yuma clapper rail (Rallus longirostris yumanensis) populations remained at levels comparable to 1987 with 11 counted pairs scattered throughout the Refuge with the majority (80%) using Tract 2 and Bruchard area of Unit I. The population appears to remain at levels above the long term average of 8 counted pairs per year for the past nine years such surveys were conducted. Other nesting activity was documented in Hazard pond 10 and along both the Alamo and New Rivers.

Wetland management for the production and maintenance of rail habitat continued with improved water level manipulation. A habitat improvement project was 90% completed on Tract A at Unit I. This involved the completion of construction on three 30 acre ponds, with partial completion of a fourth 50 acre pond. Completion of construction on this larger pond should be accomplished during FY 89. Tract A will follow a seasonal management regime but with emphasis placed on providing adequate forage as well as nesting and brood cover for Yuma clapper rails.

were conducted on non-hunt days. The count area is described as the south end of the Salton Sea and Imperial Valley. Counts were initiated in November, one month later than normal, due to logistical problems relative to availability of aircraft charter services.

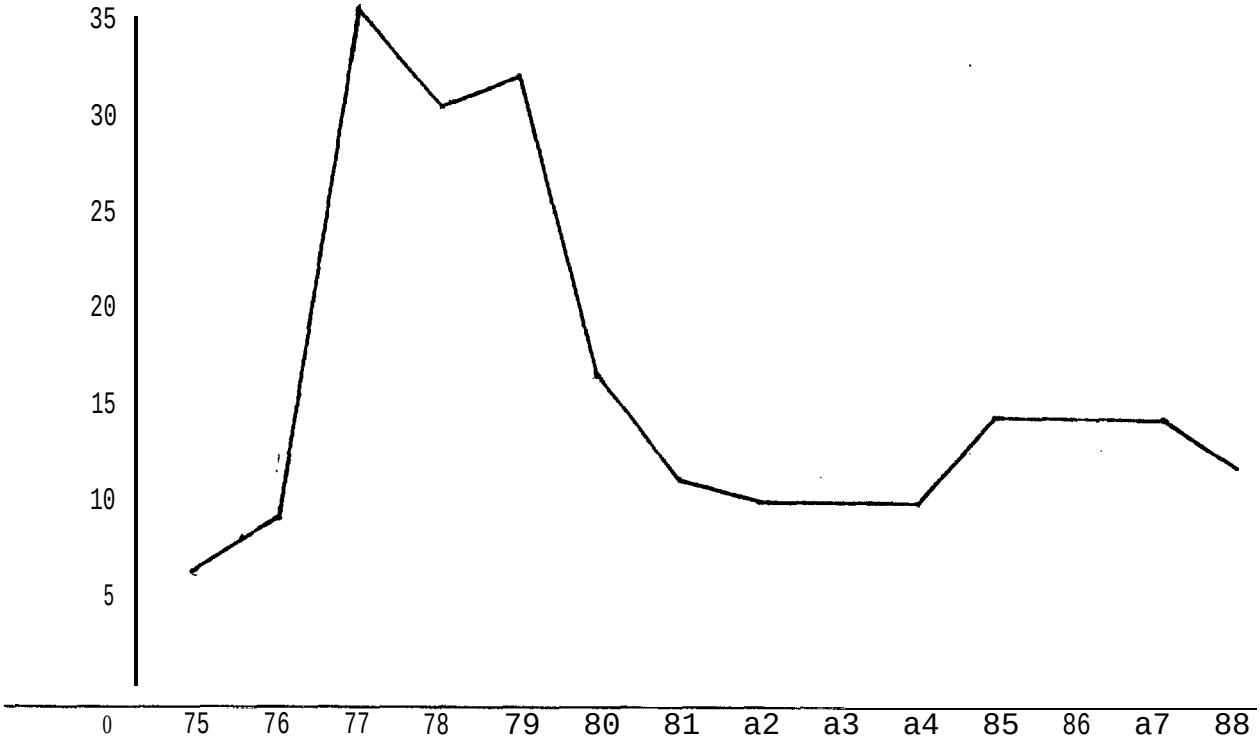


Bird's eye view during aerial survey. SAL WH

Goose populations wintering along the southern edge of the Salton Sea continued the decline observed since 1986. Total goose populations dropped to a high of 20,570 during 1988 from 23,750 observed during 1987. Canada geese continued a downward trend with only 60 percent of 1987 survey totals observed. White goose (snow and Ross') populations dipped from 20,800 in 1987 to a high of 18,700 during 1988. Even with an excellent snow goose hatch, a mild winter held birds to the north and were significant factors in explaining the slight decline.

The Refuge goose population peaked at 9,000 during February. This represents an increase from the peak observed during 1987 but goose use remains slightly below average compared to the past four years. However, the average does not consider the exchange and movements between the Refuge and adjacent areas. The Refuge remains the only significant sanctuary within the Imperial Valley. Nearly every white goose using the Imperial Valley utilized the Refuge ponds and croplands sometime during the winter, spring or fall months.
The first snow geese arrived in the Imperial Valley on 14 October, six days earlier than 1987. The major influx occurred in November with 10,000 birds counted during a three day period beginning on 17 November.

The following graph shows nesting population of Yuma **Clapper rails (Pairs) at** Salton Sea NWR for the last 14 **years.**



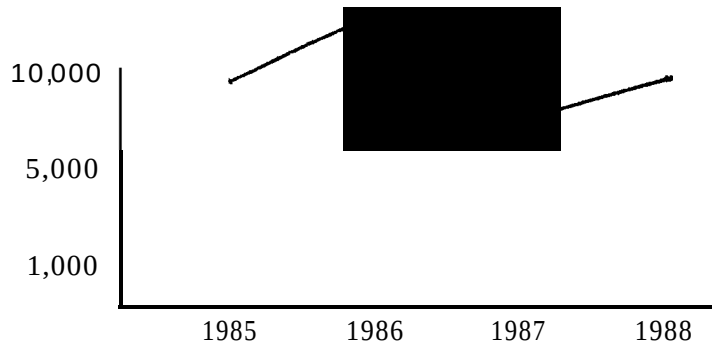
Sightings of other endangered/threatened species included 100 brown pelicans and two individual peregrine falcons. All birds were observed during the fall and winter months.

Historical survey records indicate the desert pupfish (Cyprinoden macularius), an endangered species (federal/state), was found in the Salton Sea and associated rivers and agriculture drain system. Increasing salinity has destroyed nearly all pupfish habitat. The last confirmed sighting was during 1986. Plans are being prepared to improve a two acre pond on the Refuge as pupfish habitat, Stocks of native pupfish are locally available and will be acquired following pond rehabilitation.

3. Waterfowl

Monthly aerial flights were conducted to count waterfowl on Salton Sea NWR, Imperial Wildlife Area (Wister and Finney-Ramer Units), local waterfowl hunting clubs and private farmlands adjacent to the Salton Sea shoreline. In an effort to determine waterfowl use throughout the Imperial Valley surveys

Estimated Goose Population Peaks, Salton Sea NWR



Age ratio counts were conducted from early November through December with 42 percent juveniles in the white goose flock, an increase of 5% from 1987. ROSS' geese comprised 16 percent of the white goose population. No blue phase ROSS' geese were sighted during this year contrary to sightings during the past two years.

Total duck use days decreased to 3,442,500, down from 1987 estimates of 5,123,640 duck use days. This decrease coincides with the continental trend of declining waterfowl populations. Additionally, a portion of the lower day-use estimate may be accountable to duck use patterns in the Imperial Valley versus timing of aerial surveys. Ruddy ducks continue to be the most numerous species observed with estimates as high as 49 percent of the Pacific flyway population wintering on the Salton Sea.

Estimated Waterfowl Peaks, Salton Sea NWR and Vicinity 1988

Species	Salton Sea NWR	Other Areas	Total	Date
Canada Goose	470	2,260	2,730	Feb.
White Goose	8,500	9,000	17,500	Feb.
Pintail	1,160	15,705	16,865	Feb.
Mallard	145	190	355	Nov.
Shoveler	4,655	16,740	21,395	Feb.
Green-winged Teal	1,635	6,935	8,570	Dec.
Cinnamon Teal	255	1,195	1,450	Feb.
Wigeon	845	4,320	5,165	Feb.
Gadwall	105	945	1,050	Feb.
Ruddy Duck	9,390	10,205	19,595	Feb.
Scaup	205	1,125	1,335	Feb.
Canvasback	75	825	900	Feb.
Redhead	510	255	765	Nov.

Recently goose-grazed leach ponds are used by ducks.
SAL WH

4. Marsh and Waterbirds

Colonial nesting declined with only 200 great blue heron, 850 cattle egrets and 11 great and snowy egret nests scattered among the three major colonies along the Sea. Nesting for all colonial species dropped 42 percent from 1987 levels, Apparently loss of food resources in the Salton Sea due to colder

than normal winter temperatures is a major factor. Peak populations were established for white pelicans (33,000) double crested cormorants (2,400) and eared grebes (65,000).

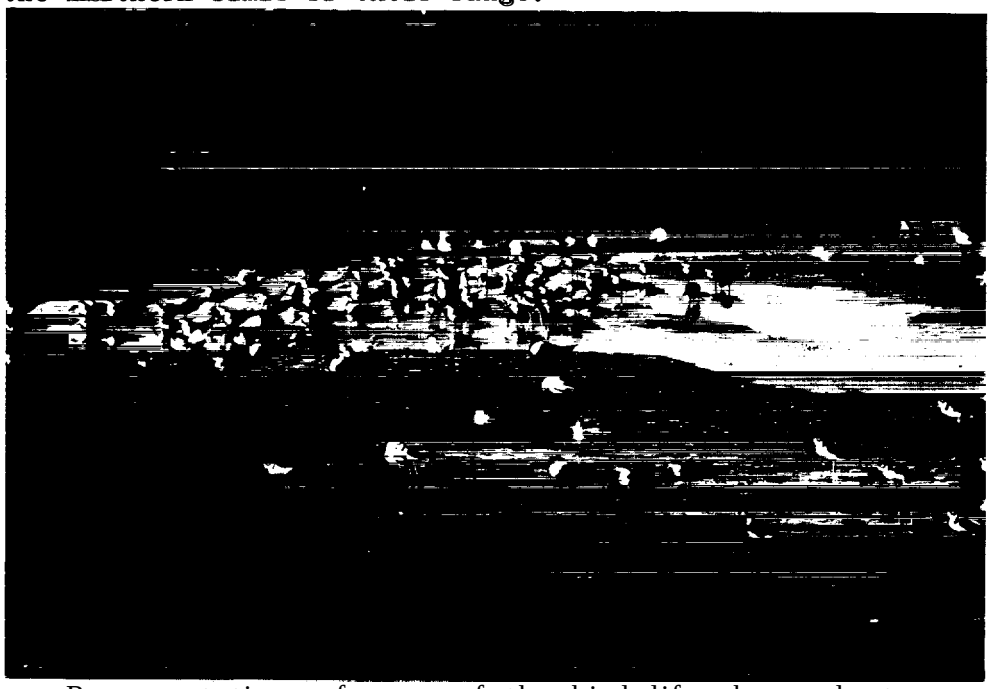
5. Shorebirds, Gulls, Terns and Allied Species

Peak shorebird use continued to occur during the fall and spring months (September - November and February - April). The mud flats and shallow freshwater ponds surrounding the Sea received heavy use by large concentrations of long-billed dowitchers, dunlin, western and least sandpipers and Wilson's and red-necked phalarope,

Long-billed curlews, marbled godwits and whimbrels continue to be abundant during the fall and spring with mountain plovers commonly seen in large wintering flocks in open grass or plowed fields,

Black-necked stilts, avocets and killdeer nested on the Refuge again in large numbers. Snowy plovers continue to breed here with 10 nests located. At least two chicks were observed on Unit I. Gull-billed terns attempted to nest on islands in the Salton Sea north of the Hazard Tract but were subjected to rampant predation apparently by raccoons. Following the loss of these nests 12-15 pair nested on the Hazard Tract.

Approximately 50-60 wood storks and 500 black skimmers were observed throughout the summer months. Stork numbers dropped substantially from 1987 levels of 220 birds and skimmers are down slightly. Skimmers attempted to nest just north of the Alamo River along the Sea. However, most nests were again destroyed by marauding raccoons. This breeding population of skimmers is at the northern limit of their range.



Representatives of some of the bird life observed at the Refuge. SAL WH

The Imperial Valley continued to provide important foraging areas to several thousand wintering white-faced ibis. A survey conducted in late December accounted for 3000 ibis on a single roost site! The Refuge ibis population fluctuated greatly with a peak of 500-600 observed in November.

Large concentrations of ring-billed gulls (30-35,000) continue to gather during the winter months along the Sea edge and in flood-irrigated fields. Mixed in these masses are numerous allies including: yellow-footed, laughing, mew, western and California gulls, Forster's, black and caspian terns.

6. Raptors

American kestrels and barn owls are abundant winter visitors and many remain to nest, primarily in the numerous hay stacks on the Refuge an&in surrounding farm fields. Burrowing owls were a common sight along all major agriculture drainage ditches, primarily in Unit I. Great horned owls are occasionally sighted.

Peregrine and- prairie falcons and merlins were seen occasionally in the fall and winter. Red-tailed and ferruginous hawks and northern harriers were commonly observed throughout the fall and winter. Osprey make occasional appearances during winter and spring.

7. Other Migratory Birds

The Audubon Christmas Bird Count was conducted during late December. Participants observed 140 species for a total of 69,279 individual birds. Total species were well down from 1987 totals but overall about average. Highlights included: a golden-crowned sparrow, dark-eyed juncos, Brewer's sparrows, chipping sparrows, cedar waxwings, chestnut-sided warbler, Eastern phoebe, black-shouldered kites, and a peregrine falcon.

Additional unusual bird observations throughout the year included: Clark's grebe, wood storks, yellow-footed gulls, laughing gulls, black terns, gull-billed terns, black skimmers, red-necked and wilsons phalaropes, mountain plovers, stilt sandpipers, brown pelicans, greater white-fronted geese, Aleutian Canada geese, blue-winged teal, red-breasted merganser, black-shouldered kite, red-shouldered hawk, and mountain bluebirds.

10. Other Resident Wildlife

Desert cottontails, raccoons and striped skunks are very abundant on the Refuge, especially around the headquarters area, Soft-shell turtles, rattlesnakes, desert spiny and whiptail lizards also add variety to the fauna of the Refuge.

11. Fisheries Resources

During the mid-1950's, various species of marine fish from the Gulf of California were transplanted into the Salton Sea by CDF&G. Orangemouth corvina, sargo, gulf croaker, and tilapia have flourished and provide

excellent sport fishing. CDF&G and other researchers consider the Salton Sea to be the most productive fishery in the western United States.

During recent years, the annual inflow of irrigation drainage to the Salton Sea generally has been balanced by natural evaporation. As a result, the five million tons of salt added to the Sea each year have slowly increased salinity to about 40,000 milligrams per liter. If salinity continues to increase, the marine fishery wil1 eventually be destroyed. This will affect the food resources of some endangered species and numerous other fish-eating birds. Various mitigating measures have been proposed and studied, but no project has been funded to solve the salinity problem,

14. Scientific Collections

During 1986 and 1987 reconnaissance level studies identified elevated levels of selenium, arsenic, mercury, boron, DDE and other trace elements and chemicals. The study resulted in the initiation of a multi-year Salton Sea Intensive Study with the emphasis being biological studies, pathway analysis, chemical specification and potential sources of contaminants within the Salton Sea watershed.

During 1988, the first year of the intensive study, biotic samples needed to satisfy the study objectives were collected from the Salton Sea and adjacent agriculture drain system. Refuge personnel were primarily involved with specimen collection, dissection of sample tissue and preparation of samples for shipment. Sample specimens included ruddy ducks, Northern shovelers, crayfish, mudsuckers, mosquito fish, sailfin mollies, black-necked stilts, pileworms, water boatmen and Asiatic clams.

Collecting aquatic invertebrates from the Salton Sea.
SAL WH

Collection Summary 1988 Salton Sea Intensive Study

Specimen	Sample Tissue	Number Collected
Ruddy Duck	liver, breast	74
No. Shoveler	liver, breast	18
Black-necked Stilt	eggs, chicks	157 (137/20)
Fish	entire carcass	5 (164 g.)
Invertebrates	entire carcass	10 (1812 g.)

16, Marking and Banding

Following the close of waterfowl (duck) season on January 19, duck trapping began at two locations on the Hazard tract. A total of 291 ducks of 5 species were banded with metal USFWS bands. The Refuge banding program, besides yielding important scientific information, provides hands-on experience and is used in conjunction with the environmental eduction program for elementary school groups and the SCA volunteer.

Nine returns from previous banding efforts were received. These bands were collected from 3 Pacific Flyway states. Marking and banding efforts are summarized below. The table also includes information on band returns.

Waterfowl Banding Summary at Salton Sea NWR, 1988

Species	# Banded	Returns'
Northern Pintail	225	6
Green-winged Teal	50	2
Mallard	2	0
Cinnamon Teal	9	0
Fulvous Whistling Duck	5	0
Subtotal	291	8
Lesser Scaup	---	1 (banded 2/87)
Lesser Snow Goose	---	1 (banded 2/67)
Total	291	10

'Return location listed below in order of species presented above.

i	McGrath, AK	07/08/88
1	Cathedral City, CA	12/20/88
1	Richmond, CA	12/20/88
1	Bend, OR	11/22/88
1	Long Beach, CA	12/17/88
1	Delano, CA	12/15/88
1	Bellflower, CA	12/17/88
1	Ontario, CA	10/15/88
1	Calipatria, CA	12/15/88
1	Norwalk, CA	01/03/88

17. Disease Prevention and Control

During late March and into May a moderate epidemic of avian botulism on the Refuge was discovered. Crews collected 324 carcasses and 44 sick birds from Tract B of Unit 1. The unit was in the process of draw-down in anticipation of major rehabilitation work. Fast response by USFWS crews on carcass removal prevented a potential major epidemic from occurring.

A second moderate epidemic of avian botulism occurred between mid-April through early May. Carcasses were collected from the Shady Acres duck club, adjacent to a portion of Unit I by USFWS crews. The size of the epidemic may have been reduced if earlier notification had been received. The area affected is not regularly patrolled by Refuge personnel and the duck club owners reside out of county. An inability to adequately drain the duck club due to high water level of the Sea created ideal conditions for the production of botulism toxin. A total of 595 carcasses were collected along with 65 sick birds. The birds were rehabilitated using standard treatment methods and released at Refuge Headquarters. It is unknown how many of the treated birds survived because the Refuge does not have a hospital recovery facility.

Bio. Tech Reyor and SCA Volunteer Barse treating botulism sick birds. SAL WH

In light of monitoring problems with treated and released sick birds, plans are on the drawing table for construction of a hospital recovery facility. Construction should begin during FY 90. The facility will be fenced and include a shaded area with fresh water available at all times. Fully recovered birds will be allowed to escape by flight. As a side benefit all birds will be banded before release.

Summary of Waterfowl and Other Waterbird Mortality Due to Avian Botulism, 1988

Species	# Carcasses	# Treated/Released
Gadwall	6	**0**
Wigeon	38	1
Green-winged Teal	206	32
Blue-winged/Cinn. Teal	(2)/42	2
Shoveler	258	51
Pintail	13	4
TOTAL DABBLERS	71	11
Redhead	2	0
Ruddy Duck	68	10
Bufflehead	1	1
TOTAL DIVERS	71	11
coot	12	
Black-necked Stilt	24	
Avocet	76	5
Snowy Egret	4	
Long-billed Dowitcher	39	3
Western Sandpiper	115	
Black-crowned Night Heron	1	
Great Blue Heron	3	
Ring-billed Gull	2	
Willet	1	
Black-bellied Plover	1	
Semipalmated Plover	2	
Killdeer	3	
TOTAL OTHERS	283	8
TOTAL BIRDS	919	109

H. PUBLIC USE

1. General

This year public use was estimated between 25,000 and 30,000 with the bulk of the visitation occurring November through March. The Salton Sea area remains a popular area for bird watching and as the facilities continue to improve public use increases.

The headquarters visiting area provides an observation tower, interpretive panels and trail, restroom, shaded picnic area and interior exhibit for refuge visitors.

4. Interpretive Foot Trails

The Rock Hill hiking trail provides visitors an excellent opportunity to observe wildlife and wildlife habitat. The trail begins at the headquarters and heads west one half mile along a mesquite tree row on the edge of a wheat field utilized by wintering geese then turns north on the main levee along the Salton Sea. Visitors overlook a barnacle bar heavily used by a wide variety of birds year round. The trail ends on the top of Rock Hill where visitors can overlook the Refuge and surrounding area. Interpretive signs along the trail and on top of Rock Hill help visitors appreciate their surroundings. The trail is a mile long and return is by the same route.

6. Interpretive Exhibits/Demonstrations

The interior exhibit completed in 1987 continues to draw favorable comments from the public. The exhibit included 35 birds, mounted and displayed in a floor to ceiling case depicting three habitat types found on the Refuge - seasonally flooded freshwater wetlands, cropland and coverstrips.

8. Hunting

Hunting on the Refuge is limited to waterfowl hunting and by permit only. Permits are issued by CDF&G as part of the Imperial Wildlife Area hunt unit.

The Refuge has ten waterfowl blinds located in moist soil units on the Hazard tract and four goose pits in green browse fields on the Union tract,

Installation of much needed new hunting blinds. SAL WH

The Imperial County Fish and Game Commission purchased eight fiberglass blinds for the Refuge to replace deteriorated hunting blinds. The Refuge purchased an additional eight and installed fourteen for fall hunting season.

A 25 shell limit was initiated in 1986 on the Refuge and the nearby state operated Imperial Wildlife Area. The regulation limits a hunter (in the field) to 25 shells in possession; there is no limit on the.number of times a hunter may return to his vehicle to replenish his shell supply. The regulation is welcomed by most hunters as a method of improving hunting quality by reducing sky scraping and crippling. Steel shot was required for Imperial County starting in 1987.

The duck hunting season was split again with seasons running October 15 through November 9 and December 7 through January 8. The daily bag limit was reduced to four with not more than one hen mallard and one pintail or either sex in the bag and a possession limit of eight with not more than two mallard hens and two pintails. The goose season opened October 15 and ran through January 15, with a one week delay for Canada geese, October 22 through January 15. Limits were six birds per day/six birds in possession with no more than three white geese and three dark geese of which only one may be a Canada goose.

Hunting was best on the Hazard tract with 441 hunters taking 772 ducks and 15 geese for an average of 1.78 birds per hunter.

Waterfowl Harvest

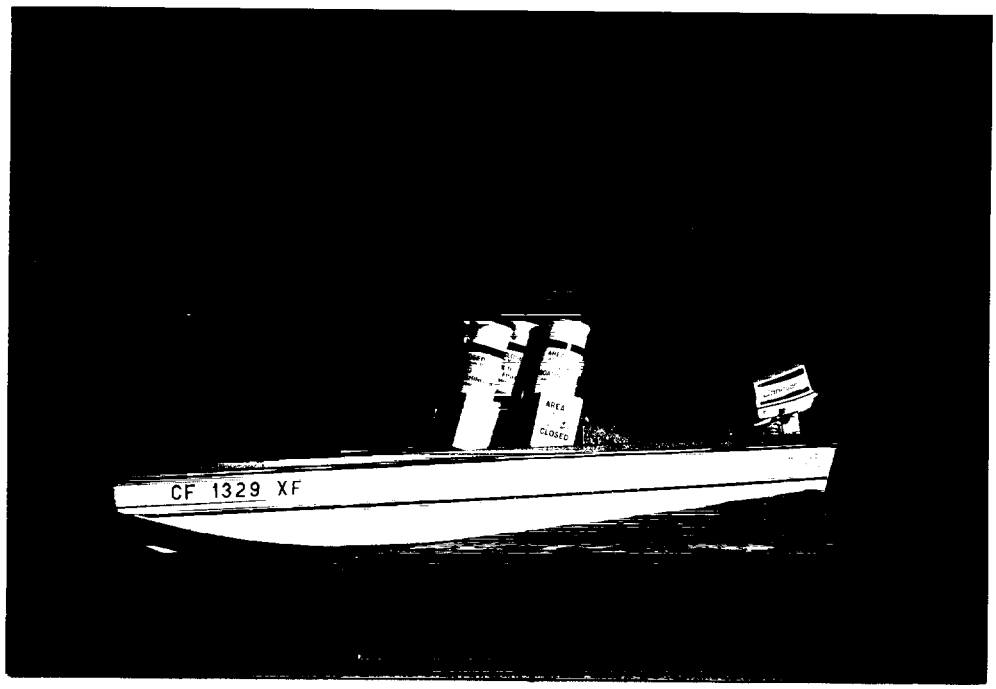
	Ducks	Geese	Hunt Average	Hunters
1988-89	787	254	1.45	717
1987-88	684	236	1.81	508
1986-87	694	133	1.17	706
1985-86	270	237	1.10	460
1984-85	187	364	0.83	664
1983-84	152	193	1.07	305
1982-83	488	184	1.05	639
1981-82	82	245	0.73	444
1980-81	1084	203	1.45	886

9. Fishing

Much of the Refuge is inundated by the Salton Sea. The majority of this area is open to public fishing. With an estimated 26,000 angler use days/year, these areas contribute significantly to the overall use of the Refuge. In a survey conducted by CDF&G, the Salton Sea had one of the highest catch-per-angler hour values of any inland fisheries within the State and possibly the nation. Fishermen caught an average of 1.46 fish per hour for over 76,000 pounds of fish taken legally each year. Tilapia made up 41 percent of this catch followed by bairdiella (gulf croaker) - 28 percent, sargo - 28 percent and corvina - 3 percent.

In April 1986, the closed area of the Sea adjacent to Rock Hill was opened to fishing for the first time. This area (approximately 1000 acres) had been closed since it was inundated in the early 1970's and acts as the only sanctuary for migratory birds on the Sea. The area was opened to summer fishing, April 1 to September 30, on a trial basis after the refuge biologist determined that fishing activity would not have a significant impact on colonial nesting birds. Over the last three summers no adverse effects have been observed and compliance with the winter closure is much better.

Twenty-one new marker buoys were purchased and placed on the Refuge boundary to better mark the closed area. A sign explaining purpose of the closed area was also installed at the Red Hill boat launch.



Heading out with another load of buoys to mark closed area of Unit II on the Salton Sea. SAL RV

On April 26, 1986, California Department of Health Services recommended adults limit their consumption of Salton Sea fish to no more than eightounces per month because of the elevated levels of selenium found in fish samples taken by the State. Since the warning was issued fishing activity on the Sea has been cut in half.

The "60 Minutes" story on the New River which aired on December 28, 1986 may have further reduced angler interest in the Salton Sea. The New River, which "60 Minutes" called the most polluted river in the world, begins in Mexico and empties into the Sea near Unit I of the Refuge.

11. Wildlife Observation

Wildlife observation at Salton Sea NWR translates into bird watching. The Refuge supports 373 species of birds. This year serious birders from Canada, England, Switzerland, Belgium, Norway, Australia and throughout the U.S. visited the Refuge to see a variety of birds found only in extreme southeastern California, Some of the rare or unusual birds.that attracts these people include: Abert's towhee, brown and blue-footed booby, crissal thrasher, gull-billed tern, yellow footed gull, mountain plover, fulvous whistling duck, black-bellied whistling duck and wood stork.

Audubon and Natural History Museum groups and University classes from all over the southwest annually visit the Refuge during January and February.

17. Law Enforcement

The number of violation notices issued dropped substantially this year mainly because no tickets were issued for boat trespass in the closed area of the Sea adjacent to Rock Hill. Since the areas was opened to summer fishing (April 1 - September 30) in 1986 compliance with the winter closure has been good overall.

This year five violation notices were issued for boat trespass. Previously, as many as 30 violation notices were issued annually to anglers thinking the best fishing had to be in the closed area.

	Number
Trespass (boat)	5
Trespass (vehicle)	2
Custody of birds of another	1
Take/unplugged shotgun	1

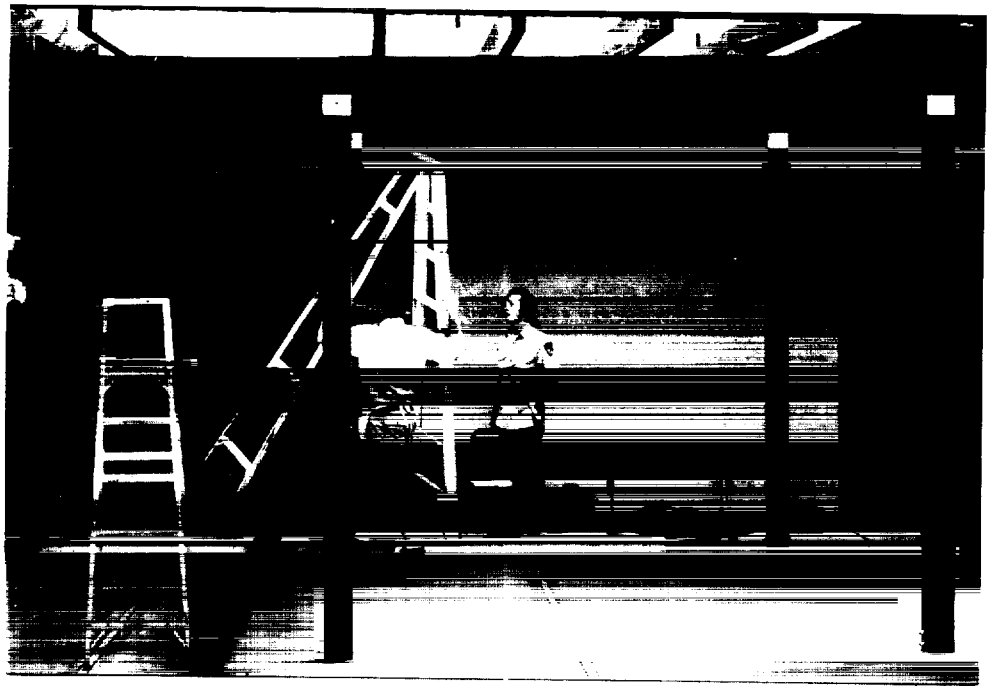
I. EQUIPMENT AND FACILITIES

1. New Construction

Again this year Ducks Unlimited (DU) sponsored a project on the Refuge. The Hazard Lift Pump #2 project , #CA-922-01-002, was completed for $28,000: $20,000 from DU and $8,000 Challenge Grant matching funds.

Nearly completed twin pump project on the Hazard. SAL WH

A four car shade was built on the back of the office. The carport was needed to protect the vehicles from the sun and the 100°F plus temperatures.



SCA volunteer and assistant biologist join forces to construct carport. SAL TA

2. Rehabilitation

In July Anderson-Merrill Contractors started work on the Unit I Tract A pond rehabilitation project. The Refuge field crew had cleared the vegetation, ripped the old dikes and disked most of the 160 acres to ensure maximum dirt would be moved under the equipment rental contract. But despite the crews continuing efforts, working with the contractor ripping hard ground and using the dozer to assist in dike construction the project was only about 60% completed when the money ran out. Under contract number 14-16-0001-88080 (LFG) $41,872.50 was obligated and two add-ons brought a total of $62,619.50 spent on the project, Luckily the owner of Eagle A Construction, the sub-contractor, was an avid waterfowler and donated $4,471.75 worth of equipment hours to complete pond 3 so the Refuge would have three completed ponds. The refuge staff installed water control structures, seeded the ponds with watergrass and flooded in mid-December. The remaining work includes leveling pond 4 and construction of four ponds on Tract B, building dikes and leveling pond bottoms.

Installing cross-over on water delivery ditch for newly rehabed wetland at Unit I. SAL RV

After a few problems the riprapping of the new Unit I dike was finally completed under contract number 14-16-000l-88023(LFG) for $55,000. First, all bids were above the $55,000 allotted for the contract so the rock tonnage was reduced through negotiations with the lowest bidder. By the time negotiations were completed and the contract awarded, the source from which he planned to obtain the rock had shut down, leaving him with a much longer distance to haul rock and a money losing contract. Since the bid was awarded three days after

the bid acceptance period the contract was declared null and void and the next lowest bidder was notified. After negotiations the contract was awarded to Fish Construction Inc. of Mancor, Colorado and although the rock tonnage was cut nearly in half by this time, it was sufficient to cover 95% of the dike. The 5% left exposed is not subject to erosion at the present level of the Salton Sea.

The Rock Hill pond land leveling project was awarded to Master Construction under contract number 14-16-0001-89010(TS) for $13,200 in late November. Work was started immediately so the project could be completed before any winter precipitation, However, with only about 20 hours of work to go a January rain of only 0.84 inches shut the project down. The area is heavy clay with a high water table. Work was delayed for three months.

After 2 years of draw down rehab work finally under way. SAL RV

The remaining 430 feet of the headquarters water delivery ditch was concrete lined for $6,379.55 under contract number 14-16-0001-88085(SLS).

Leach ponds were developed on the north third of the Reidman field to remove excess salts. The area will be leached for several years by holding water on the ponds which leaches through the ground to the drain tile removing salts with it. The area will only be leached in the winter months due to high evaporation rates in the summer. The pond also provides additional wetlands for waterfowl.

4. Equipment Utilization and Replacement

In April the 1974, 4400 Ford backhoe/loader finally reached the point where it was not feasible to repair anymore. The engine and hydraulic system were both worn out.

Ruby Lake NWR loaned their new John Deere 210 backhoe/loader to the Refuge for the last half of the summer to install water control structures on Unit I. Since then the Refuge has been dependent on CDF&G, Imperial Wildlife Management Area for a backhoe. The Refuge and Management Area are less than ten miles apart and have helped each other out in a pinch before but this is the first time sharing of equipment has been an such a regular basis.

The Refuge was scheduled to receive a new backhoe with ARMMs funds for FY 89 but project priorities changed and the backhoe was dropped.

J. OTHER ITEMS

4. Credits

Sections A, H, and I were written by Tom Alexander; section F by Bill Henry; section E.7 and G by Jeff Mackay; section B by Ramon Vega; section E.5 by Kathy Arnett; and all other sections were written by their combined efforts. Editing was done by Ken Voget and Jeff Mackay. Credits, typing, and assembly of report was done by Shelly Hunter.

COACHELLA VALLEY NATIONAL WILDLIFE REFUGE

THOUSAND PALMS, CALIFORNIA

ANNUAL NARRATIVE REPORT

CALENDAR YEAR 1988

U.S. Department of the Interior
Fish and Wildlife Service
NATIONAL WILDLIFE REFUGE SYSTEM

REVIEW AND APPROVAL

COACHELLA VALLEY NATIONAL WILDLIFE REFUGE

THOUSAND PALMS, CALIFORNIA

ANNUAL NARRATIVE REPORT

CALENDAR YEAR 1988

Refuge Manager — Date 7/31/89

Refuge Supervisor Review — Date 8/8/89

Regional Office Approval — Date

INTRODUCTION

Coachella Valley NWR is presently a 2,589 acre refuge in Southern California located about 10 miles east of Palm Springs in the heart of the rapidly developing Coachella Valley. The Refuge was established in 1985 as part of the Coachella Valley Preserve with the primary purpose of protecting the threatened Coachella Valley fringe-toed lizard (Uma inornata) (CVFTL) and the desert ecosystem that supports this species. The Preserve is a 13,000 acre area jointly managed by the Bureau of Land Management (BLM), The Nature Conservancy (TNC), California Department of Fish and Game (CDF&G) and the U.S. Fish and Wildlife Service (USFWS). Because of the expanding human population in the area, which has doubled to over 180,000 people during the last ten years, the Preserve is essential to protect an array of desert ecosystems threatened by the development associated with this population growth. The three most dynamic ecosystems are the palm oasis woodlands sustained by water available through fractures in the bedrock along the San Andreas Fault, perennial desert pools which are a result of subterranean pressures that force ground water to the surface through fractures along the San Andreas Fault, and the blow-sand habitat necessary for the survival of the CVFTL. In addition to the CVFTL, the Preserve supports three amphibians, 23 reptiles (including the flat-tailed horned lizard, a candidate species for federal listing), 180 birds and 25 mammals. Two plant species found on the Refuge are listed as endangered by the State of California and are being considered for federal listing.

Adult Coachella Fringe-toed lizard. CV UNK

INTRODUCTION

G. WILDLIFE

H. PUBLIC USE

I. EQUIPMENT AND FACILITIES

J. OTHER ITEMS

A. HIGHLIGHTS

CVFTL juvenile population was down 100 percent, (Section G.2).

ORV traffic finally under control. (Section H.17).

Equestrian group pushes for more trails on the Preserve. (Section H.16).

B. CLIMATIC CONDITIONS

Weather conditions in the Coachella Valley are typical of the southern interior desert with hot summers and mild winters. The area averages less than five inches of annual precipitation with January through March usually being the wettest months. The area experiences extremely hot summer temperatures usually exceeding 110°F.

1988

Month	Precipitation (inches)	Temperature (°F) Max	Min
January	1.15	74	37
February	0.75	86	37
March	0.00	100	36
April	0.75	103	49
May	0.04	111	53
June	0.00	110	59
July	0.00	114	76
August	1.07	112	75
September	0.00	112	63
October	0.00	101	58
November	0.00	88	38
December	0.20	80	30

C. LAND ACQUISITION

1. Fee Title

The fee title lands remained at 2588.73 acres through 1988. The last parcel to be purchased by USFWS, a 10 acre tract, has been tied up for over a year. Any further acquisitions will be made by TNC with mitigation funds.

Two land trades are pending; a forty acre even land swap with CDF&G to consolidate boundaries and a much more complicated trade with a developer on the west side. This involves trading two parcels of USFWS land, 2.7 acres and 24.2 acres for two parcels of the developers property, 7.7 acres and 10.5 acres. The trading of 26.9 acres for 18.2 acres will eliminate a stair step effect on the southwestern boundary and align the boundary with prevailing winds and sand transport. This will permit the removal of two tamarisk wind

rows and restore sand delivery to approximately 160 acres of Refuge land enhancing habitat quality.

D. PLANNING

2. Management Plan

All management activities on the Refuge are guided by the Coachella Valley Preserve System Management Plan which was signed in October 1986 by the four land owning agencies - USFWS, BLM, CDF&G, and TNC. The Plan list ten goals and then details the actions required to meet them. The goals are as follows:

1) Maintain and enhance the natural condition of all lands within the Coachella Valley Preserve System.

2) Restrict vehicle access within the Coachella Preserve System to the minimum number of routes needed to service authorized rights-of-ways and private land.

3) Remove all exotic plant and animal species where and when feasible to the benefit of native species.

4) Restrict the use of firearms on all lands within Coachella Preserve System.

5) Remove abandoned buildings, cars, and debris.

6) Establish hiking and equestrian trail systems through the major habitats of the Coachella Preserve System. Locate equestrian trails outside sensitive habitats such as palm oases and sand dunes.

7) Provide the public with information on the resources, origin and cooperative nature of the Coachella Valley Preserve System.

8) Monitor the sensitive biological components contained within the Coachella Valley Preserve System.

9) Make the Coachella Valley Preserve System available for use by researchers.

10) Provide refugia for endangered species of native plants and animals which occur in similar habitats (e.g. desert pupfish).

Management meetings with a representative from each agency are held monthly to coordinate activities on the Preserve. The chairmanship of the Management Committee rotates among all four agencies. In 1988, the USFWS representative acted as chairman.

4. Compliance with Environmental and Cultural Resource Mandates

In 1986 the Habitat Conservation Plan (HCP) was signed by the USFWS, BLM, CDF&G, TNC, the County of Riverside and the cities of Desert Hot Springs, Palm Springs, Cathedral City, Rancho Mirage, Palm Desert, Indian Wells, La Quinta, Indio and Coachella, The signing of the HCP cleared the way for issuing an Endangered Species Act Section 10(a) permit. This allowed the incidental taking of CVFTL and the development of CVFTL habitat outside the Preserve boundaries. As a stipulation of the 10(a) permit developers are required to pay a $600 per acre fee which goes into an endowment fund for the Preserve.

An Endangered Species Act Section 7 Internal Consultation was submitted for the land trade on the southwestern boundary discussed in section D.l.

Work was started on a Section 7 Consultation for an equestrian access through the southern part of the Preserve to the trails in the northern half of the Preserve; discussed in section H.16.

5. Research and Investigations

Other Personnel

a. Fraction of net primary production attributable to mycorrhizal fungi in a warm desert ecosystem.

Dr. T.V. St. John, National Science Foundation grant BSR 86-96089.

The study will attempt to estimate: the fraction of net primary production attributable to vesicular-arbuscular mycorrhizal symbionts in a warm desert ecosystem and the production of carbon allocation to the symbionts, based on NPP and fungal respiration.

Field research is completed and final results are being prepared.

b. Seed selection in wintering desert sparrows and finches

Dick Repasky, M.S. candidate, University of British Columbia, Vancouver, B.C. Canada.

The project will attempt to determine: the efficiency with which the different species use different food types and the competition between wintering desert sparrows and finches.

Field research began in November 1986 and will continue through spring 1989.

E. ADMINISTRATION

1. Personnel

The Refuge is an unstaffed satellite, with all administrative and maintenance functions handled by personnel from Salton Sea NWR.

2. Youth Program

Again this year the Salton Sea NWR YCC crew spent a week working on the Preserve. The crew cleaned up an old building and replaced the roof so it could be used for storage. They also conducted the normal litter pick up.

4. Volunteer Program

A group of four volunteers have participated in the tour and guide program at the Nature Conservancy's Palm Canyon Visitors Center throughout the year. They introduce the visiting public to the Preserve and provide guided tours. Other volunteers assisted Cameron Barrows, manager of the Preserve, in eradication of saltcedars on the Preserve. Marina High School volunteers provided fence work on the area. All volunteer activities occur throughout the Preserve including refuge lands.

5. Funding

Salton Sea NWR receives funds for management of the Coachella Valley NWR from a management endowment fund managed by TNC for the Preserve. The account is set up to handle money generated from developer's mitigation fees ($600 per acre) collected for development activities on fringe-toed lizard habitat outside the Preserve in accordance with section 10(a) of the Endangered Species Act.

Once the full endowment fund is established at approximately 2.5 million, the annual budget of the Preserve will be limited to interest yields from the endowment. By the end of 1988 the mitigation fees remained below a million dollars with most of the collected fees going for acquisition.

The Refuge received $7,000 in FY 88 for law enforcement activities, biological monitoring of the lizard, removal of saltcedar and buildings on newly acquired lands and to off-set administrative costs.

F. HABITAT MANAGEMENT

1. General

The Refuge contains large areas of blow-sand fields which are created by a combination of surface water and wind transport processes. The sand fields are dependent upon periodic flooding in the nearby mountains which funnels sand down the watershed to create sand fields and dunes. This action coupled with strong winds create and maintain the blow sand habitat critical to the CVFTL.

The Refuge presently administers 13 percent of the proposed 13,030 acres of designated critical habitat for the federally threatened CVFTL and is responsible for the protection of some 81 annual herbs, eight perennial herbs, 29 shrubs and vines, 23 rushes and sedges, three trees and two succulent plants. Species of special concern which may occur include Wiggin's croton (Croton wigginsii), flat-seeded spurge (Euphorbia platysperma), and Coachella milk-vetch (Astragalus lentinginosus var. coachellae).

G. WILDLIFE

1. Wildlife Diversity

Vertebrate species observed in the general vicinity of the Refuge include: three amphibians, 23 reptiles, and 25 mammals, many of which occur as permanent residents; and 180 birds which are primarily migrants and utilize valley floor habitats on a seasonal basis.

Two species of special management concern include the Elat-tailed horned lizard (Phrynosoma mcallii) (FTHL) and the CVFTL.

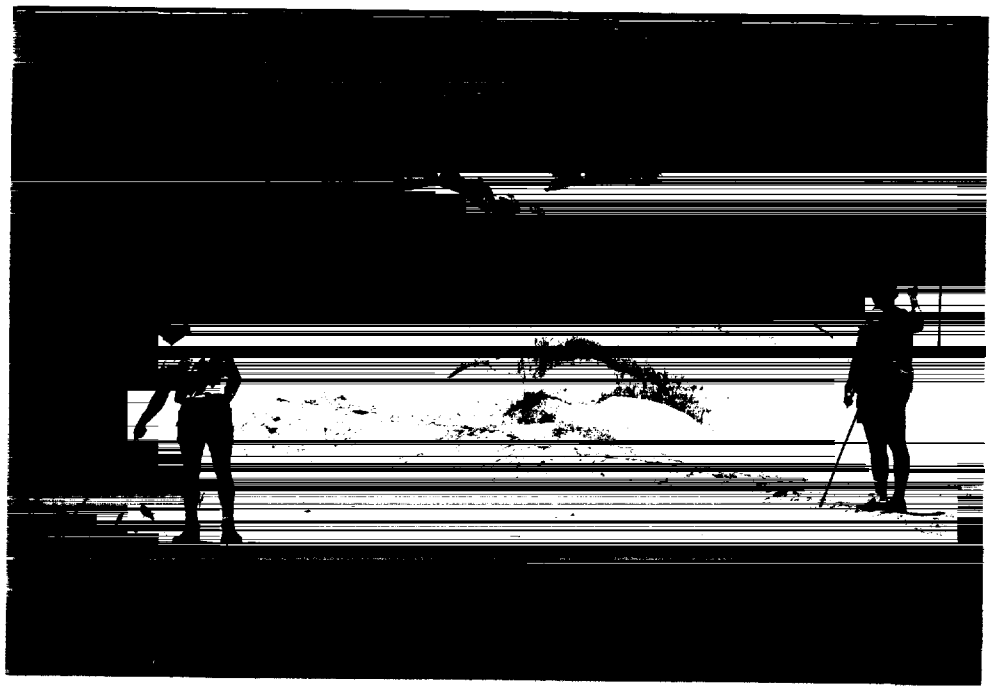
The FTHL, a candidate species for federal listing, is also present in sandy habitats where soils are sufficiently hard to support colonies of harvester ants, their principal prey. The species is generally considered difficult to find and, although the geographic range is relatively extensive, FTHL's are comparatively rare throughout.

Federal list candidate flat-tailed horned lizard. CV UNK

2. Endangered and/or Threatened Species

The CVFTL is a highly specialized species endemic to blow-sand areas of Coachella Valley and was federally listed as threatened on September 25, 1980 (Federal Register 45:188). In a parallel action, the State of California Fish and Game Commission designated the CVFTL as "endangered".

In order to determine existing populations of CVFTL on the Refuge, a monitoring program was initiated in May 1986. Three permanent 1000 meter transects, covering the full diversity of CVFTL habitat, were established and censused during the period of May 14 to July 8. Each of the three transects is surveyed once daily, for six consecutive days. Running a transect consists of two people walking abreast and agitating any vegetation occurring within five meters of the transect midline. All sightings of CVFTL are recorded, along with any other sightings of reptiles or mammals.



The quest for CVFTL, biologist and Preserve manager conduct lizard surveys. CV WGH

In 1988, overall numbers of CVFTL on all transects were down considerably from last year, Examining the age class distribution of lizards seen this year versus last year reveals that the decline can be explained by a nearly complete lack of recruitment from the breeding effort in 1987, Numbers of adults on all transects either increased slightly or did not change from last year's findings; no changes were significant. However, the number of juveniles on all transects did drop significantly. In 1987 the cumulative total juveniles on each transect averaged 9.5. In 1988 the cumulative total juveniles per transect averaged 0.4; only two juveniles were observed. These results could be predicted based on last year's drought, and the resultant low reproductive activity of adults; few hatchlings were produced and those few had a low survivorship. Conditions for breeding in 1989 appear much better. Those adults who were observed at close range were "fat" and showed lots of breeding colors.

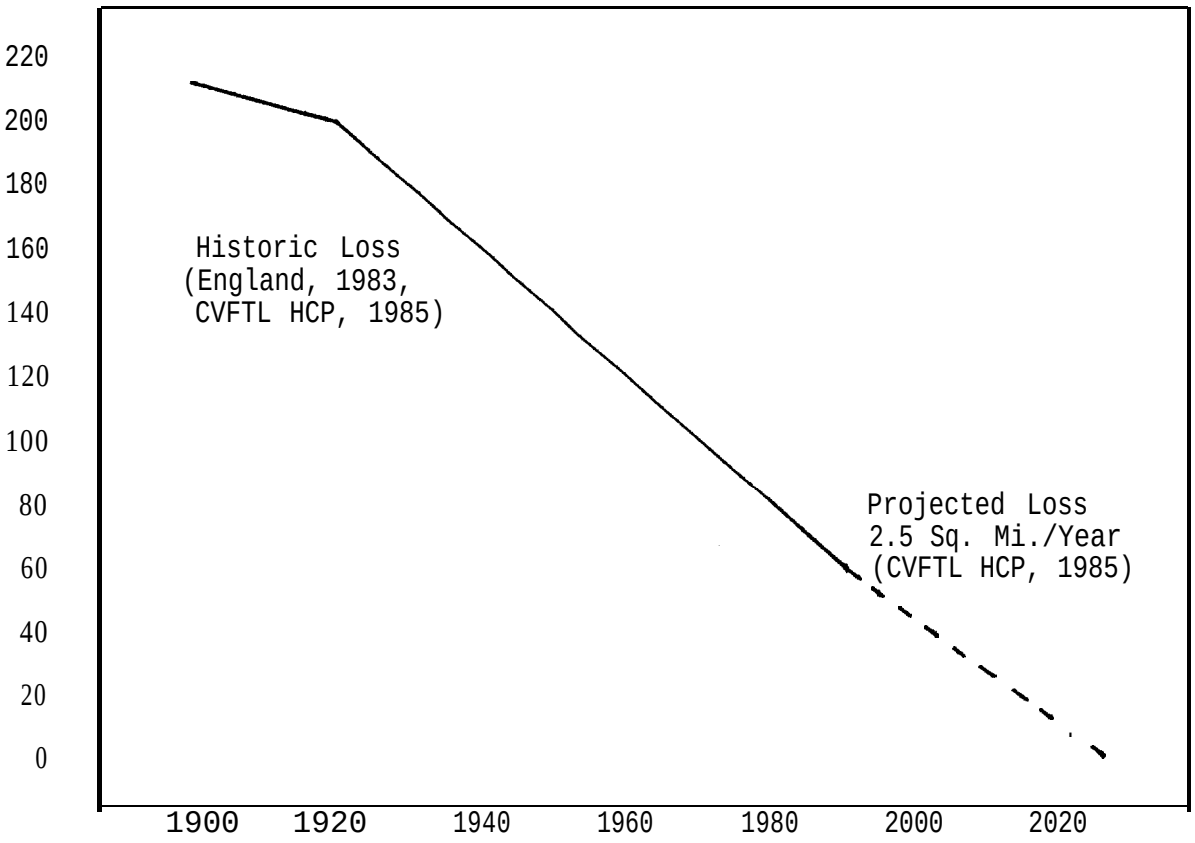
Based on these conditions, 1989 monitoring should reveal a considerable increase in the juvenile composition of the CVFTL population. Adult numbers

should either remain stable or decline slightly due to normal attrition and the near absence of the 1987 cohort for replacement.

Recent research has derived an adjustment factor to be used when determining populations based upon transect data. This factor was used in deriving population estimates for CVFTL on the Refuge. For 1988, the peak population estimate of CVFTL on the Refuge was 826 individuals. Adults remained stable with juveniles down 100 percent from 1987. This suggests that no production occurred. As for the adults, either mortality was high, or this years' harsher conditions have kept the otherwise reproductively active adults much less active.

Historically, some 200 square miles of the Valley and an additional 70 square miles in peripheral areas were covered with loose, windblown sand and served as CVFTL habitat. The range of this species has been reduced by 50 percent, principally due to the loss of habitat associated with agricultural development and urbanization. It is projected that, without some type of restrictions to protect habitat, all the remaining CVFTL range could be lost within 50 years (Figure 1).

FIGURE 1: RATE OF CVFTL HABITAT LOSS



The continued perpetuation of this highly specialized species is dependent upon the continuing renewal of windblown (aeolian) sand. Wind shielding by development stabilizes and eventually prevents renewal of its habitat and results in elimination of the lizard population. Other threats to habitat include off-road vehicles, flood control projects, and invasive exotic plants.

The CVFTL is a medium-sized lizard that displays several striking adaptions for living in the severe environment of blowsand ecosystems. These include the species' ability to "swim" through sand, run across the surface at high speed, and dive into the sand to escape predators and heat. Physical characteristics that make this possible are the small, rounded scales on the lizard's skin, the enlarged scales or "fringes" on the toes for which the lizard is named, a wedge-shaped nose, double eye membranes, and a skin flap over the ear to keep sand out.

Taxonomically, the species is related to two other species of Uma, the Colorado fringe toed lizard (U. notata) and the Mojave fringe toed lizard (U. scoparia). Because of their geographic isolation from each other, the three species are functionally separate, even if they occasionally interbreed in captivity. By virtue of its isolation in the Coachella Valley, U. inornata has evolved morphological and behavioral differences from the other two species.

Fringe toed lizards use burrows of other animals and can construct burrows in loose sand, with only minimal adhesive structure, which they apparently use for thermoregulation and for incubating their eggs. The lizard is active when its body temperature is between 26° and 45°C, with a mean of 38°C (100°F). It attains these temperatures by basking on the sand. When the external temperatures are too hot, the lizards spend most of the day below the surface and are active only in the early morning and late afternoon. The species hibernates from November through February or March when external temperatures are often below its activity range.

Individual fringe-toed lizards live for about five years. They attain sexual maturity at two years and are capable of breeding each year thereafter. Multiple clutches of eggs may be laid in one season. Hatchlings appear from late June to early September. It is reported that the amount of winter rainfall can influence reproduction in Uma. In years of low rainfall winter annual plants may fail to germinate and thus do not support the normal insect population on which the CVFTL feeds, In response to a food supply shortage, the reproductive system of the lizards is depressed and fewer young are produced.

Similar to several other lizards, CVFTL are omnivorous, but they seem to have a preference for insects over other food items. Predators on CVFTL include snakes, birds, and other lizards (e.g. leopard lizards).

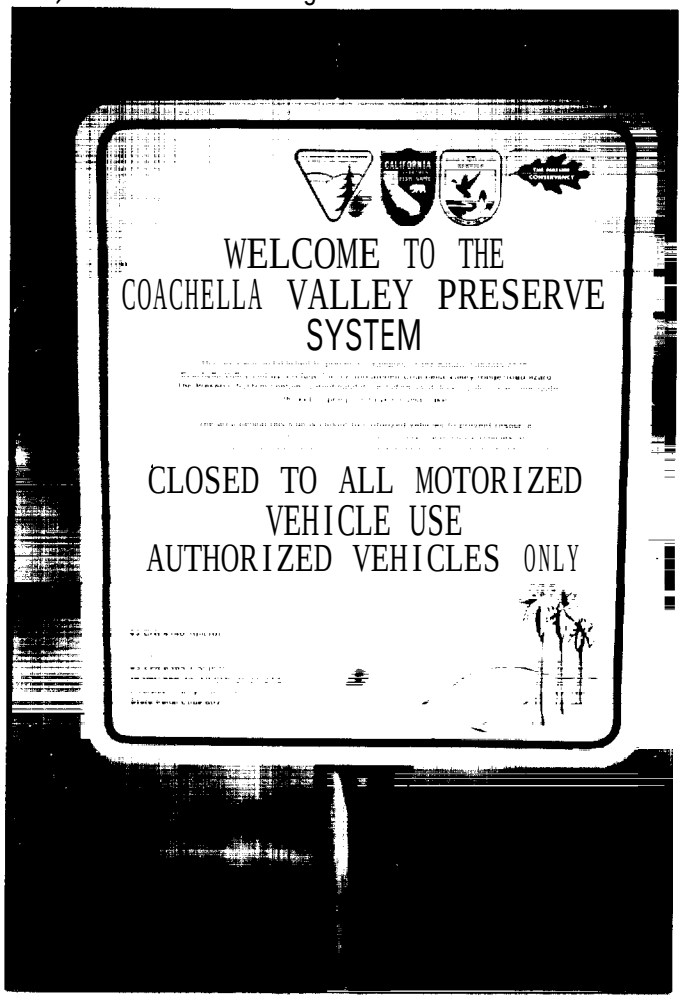
While the taxonomy, sand adaptations, behavior and reproductive physiology are relatively well known, the population biology and ecology of the species has been little studied. Information such as the population density throughout the Valley, population size and reproduction from year to year, movement of individuals, barriers to movement, and contiguity of subpopulations throughout

the Valley are conjectured, but not documented. CVFTL may be more abundant on natural blowsand sites where plant density and diversity are greater.

H. PUBLIC USE

1. General

The Preserve receives approximately 10,000 visitors annually. Most of the visitation occurs from November through April with the majority of the people visiting the Palm House, which is owned by TNC and acts as the Preserve visitor center/headquarters. Popular activities on the Preserve are hiking, birding, and photography particularly along the trails located on the north end of the Preserve. However, because the Preserve encompasses lands under the jurisdiction of CDF&G, TNC, BLM and USFWS, rules and regulations vary from one area to the next. Horseback riding, a traditional activity in the area, is growing in popularity and will have to be restricted to trails in non-critical habitat. An equestrian trail system is still in the planning stages. The Refuge, located on the south half of the Preserve, has no hiking trails and relatively low public use, Most of the prime lizard habitat within the 13,000 acre Preserve., is on the Refuge.



Dual purpose public entry/boundary sign. CV TA

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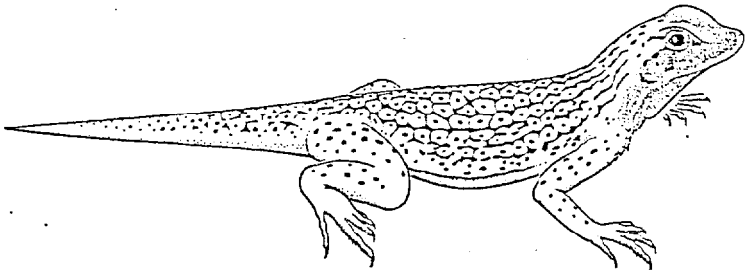
COACHELLA VALLEY PRESERVE BOUNDARY



Jointly Managed by: Bureau of Land Management, Caiifornia **Department of Fish** & Game, Fish & Wildlife **Service, and The Nature Conservancy..**

UNAUTHORIZED ENTRY PROHIBITED

Ccnsult Reserve Manager for Current Regulations Phone: **(619)-343-1234**

ECOLOGiCAL RESERVE BOUNDARY

Section 630 (b), (40 Title 14 CAC

0

Preserve boundary designed by USFWS Regional Office.

All four agencies finally agreed on boundary signs to be used throughout the Preserve. The old sign was a cross between an entry sign and a boundary sign. The new sign was designed by Melvie Wong, a visual information specialist at the Regional Office. After only a few modifications the sign was accepted. TNC will have the sign printed in 1989 and the entire Preserve will be marked.

16. Other Non-Wildlife Oriented Recreation

The Preserve area has historic equestrian use with several horse boarding ranches on the Preserve boundaries. This combined with a very active equestrian organization, the Desert Riders, which have close ties to the Coachella Valley Association of Governments complicates any efforts to limit equestrian use,

The trail system in the northern part of the Preserve was accepted as necessary to control public activity. But the closing of southern portion, owned by the USFWS, to protect critical habitat used by the lizard, was met with immediate opposition. The first meeting in April with the Desert Riders to discuss an application for riding trail in this area was very hostile. After several more meetings and much one on one discussions the riders seemed to be ready to accept an access route along the western edge of the preserve to the trails in the north.

A Section 7 Consultation was submitted in early 1989 and the issue should be resolved by the end of the year.

17. Law Enforcement

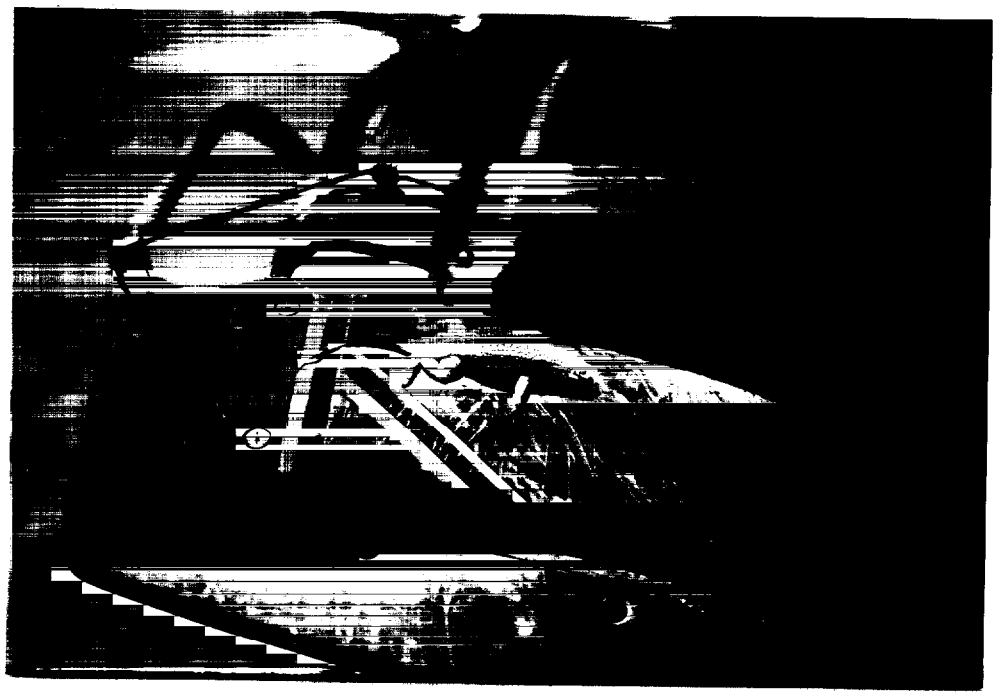
Trespass by off-road vehicles (ORV) had been the problem of greatest concern on the Preserve, but through a continuous law enforcement effort by both BLM and USFWS, ORV use has been greatly reduced. ORV's directly impact the fringe toes lizard by destroying habitat and inadvertently harassing the lizards. A few cases of actual mortality caused by ORV's running over lizards, eggs and burrows have been documented. Continued patrol is required to prevent ORV use from increasing in the future.

The first major law enforcement effort to control ORV use took place in 1986 on Easter weekend when two Refuge Officers from Salton Sea NWR worked with two BLM Rangers. Prior to that effort, TNC with help from BLM and volunteers had installed a three strand barbed wire fence along 38th Avenue and Washington Street. The fence was cut and repaired several times over the weekend and a few ORV's made it on and off the Preserve without being apprehended. However, for the first time the public was aware the area was closed to ORV use.

Since then a BLM Ranger has been assigned half-time to the Preserve and at least one Ranger and one Refuge Officer has worked most holiday weekends. In addition fence building continued until most access points were closed. At first fence repair was a constant job for the part-time TNC maintenance worker but persistence paid off and vandals finally stopped cutting the fence.

In 1988 BLM issued over 40 federal and state tickets, down about 25% from 1987. Most of the tickets were issued by BLM Rangers because of their broader

authority under CFR **43 to enforce laws on all public lands and the Rangers** state authority granted by CDF&G. BLM has the lead responsibility for law enforcement on **the** Preserve and Rangers patrol the area regularly.



Mortality from ORV trespass. CV TA

J. OTHER ITEMS

1. Cooperative Programs

The Refuge is managed cooperatively with BLM, TNC and CDF&G as part of the Preserve within the guidelines of the Management Plan but it still remains part of the National Wildlife Refuge System and must be managed independently to meet its own objectives. Few problems arise from this because the other agencies are in the same situation.

4. Credits

Section B was written by Ramon Vega; sections F, G, and part of D by Bill Henry. The remainder of the narrative was written by Tom Alexander. Editing was done by Ken Voget and Jeff Mackay. Credits, typing, and assembly of report was done by Shelly Hunter.

Wildlife

of Salton Sea
National Wildlife Refuge

California

Enjoying the Refuge's Wildlife

The study of wild animals in their natural habitat has **become increasingly popular.** Viewing of wildlife can be greatly enhanced by a pair of **binoculars or spotting scope and a good** wildlife/birding guide.

Wildlife species in this brochure have been grouped into four categories: Birds, Mammals, Reptiles and Amphibians, and Fish.

Birds

Bird populations vary greatly in numbers and species according to seasons. Heavy migrations of waterfowl, marsh and shorebirds occur during spring and fall. Throughout the mild winter and spring a wide variety of smaller birds and birds of prey are present. They are attracted to the freshwater marshes and riparian habitat along the New and Alamo Rivers. The best opportunity to observe the greatest diversity of bird life is from November to May.

The following list of birds contains 371 species that have been recorded on Salton Sea NWR and the adjacent Imperial Valley. The nominclature and taxonomic order used in this list follows that appearing in the **6th** edition of the American Ornithologists' Union Check-List of North *American Birds* published in 1983. Salton Sea NWR holds the distinction of having the most diverse array of bird species found on any of the over 400 National Wildlife Refuges.

When looking at a bird, pay close attention to characteristics such as color, size, shape, and wing and head markings. Always observe first and then refer to your identification **book because the** bird may not remain where it can be readily observed for a long period of time. This is especially true of perching birds.

Legend

SP — Spring, April through May
s — Summer, June through August
F — Fall, September through October
w — Winter, November through March

Spring — Some species migrate much earlier than **others, appearing** in the area of Salton Sea during March, but are none-the-less spring migrants **rather than winter visitors. Their status at this** time of the year is indicated under Spring rather than Winter.

Summer — Status indicated under this heading indicates the relative abundance of summering birds. Observers must remember late spring migrants can be found into early June, and that early fall migrants can occur as early as late June, but these are not summering birds. Their status as migrants is indicated under Spring and Fall rather than Summer.

Fall — Since some species, particularly shorebirds, migrate quite early in the fall, appearing in the area of the Salton Sea in July or earlier. Their status as fall migrants in July and August is indicated under Fall rather than Summer.

Winter — As indicated above, some early spring migrants may be present during March or earlier, as with the swallows. Likewise, some late fall migrants linger in November. However, these occurrences are omitted from the winter column so as to clearly indicate the status of each species as a winter visitor.

Notes — Information over and above the relative abundance shown for each season to clarify the status of some species in the area.

Abundance Codes

C — Common to Abundant, easily found in suitable habitat.
u — Uncommon to Fairly Common, found where looked for in suitable habitat, but can be missed.
r — Rare to Very Uncommon, more often missed than seen, even when looked for in suitable habitat.
o — Occasional, normally less than five individuals per season during any given year, but to be looked for.
a — Accidental, less than ten records for the entire area, and not to be expected.

Threatened/Endangered Species

Habitat Codes

o - **Open** Water - Restricted to the open water of the Salton Sea and larger lakes in the Imperial Valley.

b - Beach and Mudflat - Basically the shore line of the Salton Sea, but expanded to include flooded fields and other such areas of shallow water and mud.

m - Marshes - Cattail marshes and other such areas found at various locations around the Salton Sea, along the rivers and canals, and at shallow lakes.

f - Farmland Agricultural land found extensively throughout the Imperial Valley south of the Salton Sea, including planted and unplanted fields alike.

s - Shrubland Mesquite thickets and other brushy areas Some shrubland contains scattered trees.

r - Riparian Vegetation - Limited to areas of salt cedar and willows along waterways, and at some points along the shore of the Salton Sea.

a - Aerial Use limited to those strong flying species most often seen in the air.

h - **Houses** and **Towns** - Immediate area of ranch houses and the residential areas of such towns as Niland and Calipatria. It is in these areas that most of the larger trees can be found and where ornamental planting supports a variety of landbirds.

Abbreviation Listed Under Notes

b - Species regularly breeds in the area

b+ - Species has bred in the area, and may continue to breed sporadically in the area, but is not expected to become a regular nesting species.

I - Species occurs only locally within the area

e - An erratic species, occurring in numbers some years, and being very scarce or even absent in others.

x - Species formerly occurred in the area, but is now extripated, occurring only as an accidental straggler if at all.

xb - An extripated breeder formerly nesting in the area, but with no recent breeding records.

p - A post-breeding visitor to the area from the south, being most numerous in the area between July and September.

1 - 9 Actual number of recorded occurrences for those species listed as accidentals in the area.

Common Name	Habitat	S	W	Notes
LOONS				
Red-throated Loon			a	
Pacific Loon	o	a	a	
Common Loon	o	a	a	
GREBES				
Pied-billed Grebe	m	u	u	p
Horned Grebe	o	a	o	
Eared Grebe	o	u	c	p
Western Grebe	o	u	u	p
Clark's Grebe	o	u	u	p
ALBATROSS				
Laysan Albatross		a		1
FULMARS, PETRELS AND SHEARWATERS				
Cook's Petrel		a		1
Buller's Shearwater		a		1
Sooty Shearwater		a		2
STORM-PETRELS				
Leach's Storm-Petrel		a		2
Black Storm-Petrel				
Least Storm-Petrel				
BOOBIES AND GANNETS				
Blue-footed Booby	o			p
Brown Booby				
PELICANS AND CORMORANTS				
American White Pelican		u	u	xb
Brown Pelican	o	r	o	p
Double-crested Cormorant		o	c	p
Olivaceous Cormorant		a	a	6
FRIGATEBIRDS				
Magnificent Frigatebird		o	a	p
BITTERNS, HERONS AND EGRETS				
American Bittern	m	o	u	
Least Bittern	m	u	o	b
Great Blue Heron	bm	c	c	p
Great Egret	bm	c	c	p
Snowy Egret	bm	c	c	p
Little Blue Heron	m	o	a	b+
Tricolored Heron	bm	o	a	
Reddish Egret		a		5
Cattle Egret	fm	c	c	p
Green-backed Heron	m	u	u	p
Black-crowned Night-Heron		c	c	p
IBIS AND SPOONBILLS				
White Ibis		a		2
White-faced Ibis	mf	u	c	b+
Roseate Spoonbill	bm	o	a	xb
STORK				
Wood Stork	bm	c	a	1
WATERFOWL				
Fulvous Whistling-Duck	r	o	a	b+
Black-bellied Whistling-Duck		a		3
Tundra Swan	om		o	
Greater White-fronted Goose	fm		r	

Common Name	Habitat	S	W	Notes
Snow Goose	fm	o	c	
Ross' Goose	fm		c	
Brant	om	o	a	
Canada Goose	fm	o	c	
Wood Duck	om	a	o	
Green-winged Teal	om	r	c	
Baikal Teal			a	
American Black Duck			a	
Mallard	om	o	u	
Northern Pintail	om	r	c	
Blue-winged Teal	om	o	o	
Cinnamon Teal	om	u	r	
Northern Shoveler	om	r	c	
Gadwall	om	r	u	
Eurasian Wigeon	om		o	
American Wigeon	om	o	c	
Canvasback	o	o	c	
Redhead	o	u	u	
Ring-necked Duck	o	a	r	
Tufted Duck			a	
Greater Scaup	o	a	r	
Lesser Scaup	o	o	c	
Oldsquaw	o	a	o	
Black Scoter		a	a	
Surf Scoter	o	o	o	
White-winged Scoter	o	o	o	
Common Goldeneye	o	o	u	
Barrow's Goldeneye			a	
Bufflehead	o	o	u	
Hooded Merganser	o		o	
Common Merganser	o	a	r	
Red-breasted Merganser	o	r	r	
Ruddy Duck	om	c	c	
VULTURES				
Turkey Vulture	af	r	r	
OSPREY, KITES, EAGLES AND HAWKS				
Osprey	ao	r	r	
Black-shouldered Kite		o	o	
Bald Eagle	ao		o	
Northern Harrier	afm	o	c	
Sharp-shinned Hawk	ars		u	
Cooper's Hawk	ars		u	
Harris' Hawk				
Red-shouldered Hawk			o	
Broad-winged Hawk			a	
Swainson's Hawk	af			
Zone-tailed Hawk				
Red-tailed Hawk	af	r	u	
Ferruginous Hawk	af		r	
Rough-legged Hawk	af		o	
Golden Eagle			a	
FALCONS				
American Kestrel	afh	u	c	
Merlin	af		r	
Peregrine Falcon	am	o	o	
Prairie Falcon	af	o	r	
GALLINACEOUS BIRDS				
Ring-necked Pheasant	f	r	r	
Gambel's Quail	s	u	u	

Common Name	Habitat	S	W	Notes
RAILS				
Black Rail	m	o	o	b
Clapper Rail	m	r	r	b
Virginia Rail	m	r	u	b
Sora	m		c	
Common Moorhen	m	u	u	b
American Coot	om	c	c	b
CRANES				
Sandhill Crane	f		u	
PLOVERS				
Black-bellied Plover	bf	u	c	
Lesser Golden-Plover	bf		a	
Snowy Plover	b	u	r	b
Wilson's Plover		a		1x b
Semipalmated Plover	b	o	r	
Killdeer	fb	c	c	b
Mountain Plover	f		u	
OYSTERCATCHERS				
American Oystercatcher				1
STILTS AND AVOCETS				
Black-necked Stilt	mf	c	c	b
American Avocet	m	c	c	b+
SHOREBIRDS				
Greater Yellowlegs	mf	o	c	
Lesser Yellowlegs	mf		r	
Spotted Redshank				1
Solitary Sandpiper	mf		a	
Willet	mf	u	c	
Wandering Tattler	m			
Spotted Sandpiper	m		u	
Whimbrel	mf	o		
Long-billed Curlew	mf	u	c	
Hudsonian Godwit				1
Marbled Godwit	b	u	u	
Ruddy Turnstone	b		a	
Black Turnstone	b			
Surfbird	b	a		
Red Knot	b	a	o	
Sanderling	b		o	
Semipalmated Sandpiper	b			
Western Sandpiper	b	o	c	
Little Stint				1
Least Sandpiper	b	o	c	
White-rumped Sandpiper				3
Baird's Sandpiper	b			
Pectoral Sandpiper	b		a	
Dunlin	b	o	u	
Curlew Sandpiper				2
Stilt Sandpiper	b		r	
Ruff			a	3
Short-billed Dowitcher	b	o		
Long-billed Dowitcher	b	o	c	
SNIPE				
Common Snipe	m		r	
PHALAROPES				
Wilson's Phalarope	bo	o	a	
Red-necked Phalarope	bo	o	a	
Red Phalarope	o	a		

Common Name	Habitat	S	W	Notes
JAEGERS				
Pomarine Jaeger		a		
Parasitic Jaeger	o	a		
Long-tailed Jaeger				
GULLS AND TERNS				
Laughing Gull	ob	c	o	
Franklin's Gull	ob	o		
Little Gull			a	
Bonaparte's Gull	ob	r	o	
Heermann's Gull	ob	o	a	
Mew Gull	ob	a	o	
Ring-billed Gull	obf	u	c	
California Gull	obf	c	u	
Herring Gull	obf	o	c	
Thayer's Gull	ob	a	r	
Lesser Black-backed Gull			a	
Yellow-footed Gull	ob	c	r	
Western Gull	ob		o	
Glaucous-winged Gull	ob	o	r	
Glaucous Gull	ob	a	o	
Black-legged Kittiwake		a		
Sabine's Gull	o			
Gull-billed Tern	bf	u	a	
Caspian Tern	ob	c	u	
Elegant Tern		a		
Common Tern	ob	r		
Arctic Tern				
Forster's Tern	ob	c	u	
Least Tern	ob	o		
Black Tern	bf	c	a	
SKIMMERS				
Black Skimmer	b	u	a	
SEABIRDS				
Ancient Murrelet		a		
DOVES				
Rock Dove	h	c	c	
Band-tailed Pigeon				
Spotted Dove				
White-winged Dove	sh	u	a	
Mourning Dove	fsh	c	c	
Inca Dove	h	r	r	
Common Ground-Dove	sh	u	u	
CUCKOOS				
Yellow-billed Cuckoo		a		
Greater Roadrunner	sf	c	c	
Groove-billed Ani				
OWLS				
Common Barn-Owl	sh	r	r	
Flammulated Owl				
Western Screech-Owl	sh	r	r	
Great Horned Owl	sh		o	
Burrowing Owl	f	c	c	
Long-eared Owl	r		o	
Short-eared Owl	f		r	
Northern Saw-whet Owl			a	

Common Name	Habitat	S	W	Notes
GOATSUCKERS				
Lesser Nighthawk	fs	u	a	
Common Poorwill	s			
Whip-poor-will				
SWIFTS				
Black Swift				
Vaux's Swift	a			
White-throated Swift	a		r	
HUMMINGBIRDS				
Black-chinned Hummingbird	h	r		
Anna's Hummingbird	h	r	u	
Costa's Hummingbird	hs	r	u	
Calliope Hummingbird	hs			
Rufous Hummingbird	hs			
Allen's Hummingbird	h			
KINGFISHERS				
Belted Kingfisher	rm		u	
WOODPECKERS				
Lewis' Woodpecker	h		o	
Red-headed Woodpecker		a		
Acorn Woodpecker				
Gila Woodpecker	h	r	r	
Yellow-bellied Sapsucker			a	
Red-naped Sapsucker	h		r	
Red-breasted Sapsucker	h		o	
Ladder-backed Woodpecker	sh	u	u	
Nuttall's Woodpecker				
Northern Flicker	hs		c	
FLYCATCHERS				
Olive-sided Flycatcher	hs			
Greater Pewee				
Western Wood-Pewee	hs			
Willow Flycatcher	hs			
Least Flycatcher	hs		a	
Hammond's Flycatcher	hs			
Dusky Flycatcher	hs			
Gray Flycatcher	hs		a	
Western Flycatcher	hs			
Black Phoebe	hm	u	c	
Eastern Phoebe			a	
Say's Phoebe	f	r	c	
Vermilion Flycatcher	h	o	r	
Ash-throated Flycatcher	sh	r		
Tropical Kingbird				
Cassin's Kingbird	h		a	
Western Kingbird	fh	c	a	
Eastern Kingbird				
Scissor-tailed Flycatcher				
LARKS				
Horned Lark	f	u	c	
SWALLOWS				
Purple Martin	a			
Tree Swallow	a	o	c	
Violet-green Swallow	a		a	
Northern Rough-winged Swallow	a	c	u	
Bank Swallow	a	o	a	
Cliff Swallow	a	c		
Barn Swallow	a	c	r	c o b

Common Name	Habitat	Sp	S	F	W	Notes
JAYS, MAGPIES AND CROWS						
Scrub Jay	hs				o	
American Crow	f				r	
Common Raven	af		r		r	
CHICKADEES AND TITMICE						
Mountain Chickadee						
VERDIN						
Verdin	s	c	c		c	
NUTHATCHES						
Red-breasted Nuthatch	h	o			o	
White-breasted Nuthatch						
CREEPERS						
Brown Creeper	h				o	
WRENS						
Cactus Wren	s	c	c		c	
Rock Wren	s				r	
Bewick's Wren	s				r	
House Wren	sr		r		u	
Winter Wren					a	
Marsh Wren	m	c	c		c	
KINGLETS, BLUEBIRDS AND THRUSHES						
Golden-crowned Kinglet	rh				o	
Ruby-crowned Kinglet	rsh	u			c	
Blue-gray Gnatcatcher	rs	o			u	
Black-tailed Gnatcatcher	s	u	u		u	
Western Bluebird	sh				o	
Mountain Bluebird	f				u	
Townsend's Solitaire	s				o	
Swainson's Thrush	rsh					
Hermit Thrush	rsh				u	
American Robin	h				u	
Varied Thrush					a	
MOCKINGBIRDS AND THRASHERS						
Northern Mockingbird	sh	c	c		c	
Sage Thrasher	s				o	
Brown Thrasher					a	
Bendire's Thrasher					a	
Curve-billed Thrasher					a	
Crissal Thrasher	s		r		r	
Le Conte's Thrasher						
WAGTAILS AND PIPITS						
Water Pipit	f			c		
Sprague's Pipit						
WAXWINGS						
Cedar Waxwing	h				u	
PHAINOPEPLA						
Phainopepla	s				u	
SHRIKES						
Northern Shrike					a	
Loggerhead Shrike	sf	u	u		u	
STARLINGS AND MYNAS						
European Starling	hf	c	c		c	

Common Name	Habitat	Sp	S	F	W	Notes
VIREOS						
Bell's Vireo					a	
Solitary Vireo	sh				o	
Warbling Vireo	sh				a	
Red-eyed Vireo						
WARBLERS						
Tennessee Warbler						
Orange-crowned Warbler	r				c	
Nashville Warbler	rs				a	
Virginia's Warbler	s					
Lucy's Warbler						
Northern Parula					a	
Yellow Warbler	rh				r	
Chestnut-sided Warbler					a	
Magnolia Warbler						
Cape May Warbler					a	
Black-throated Blue Warbler						
Yellow-rumped Warbler	rsh				c	
Black-throated Gray Warbler	sh				o	
Townsend's Warbler	sh				o	
Hermit Warbler	sh					
Prairie Warbler						
Palm Warbler					a	
Bay-breasted Warbler						
Cerulean Warbler						
Black-and-white Warbler	hr				o	
American Redstart	rh				r	
Ovenbird						
Northern Waterthrush	r		o			
MacGillivray's Warbler	rs					
Common Yellowthroat	mr		u		u	
Wilson's Warbler	rs				o	
Yellow-breasted Chat	r		o			
TANAGERS						
Summer Tanager	h				a	
Western Tanager	hs				o	
GROSBEAKS AND BUNTINGS						
Pyrrhuloxia			a		a	
Rose-breasted Grosbeak						
Black-headed Grosbeak	hs					
Blue Grosbeak	rs		u		a	
Lazuli Bunting	rs					
Indigo Bunting						
Dickcissel						
TOWHEES AND SPARROWS						
Green-tailed Towhee	s				r	
Rufous-sided Towhee	s				r	
Abert's Towhee	s		c		c	
American Tree Sparrow					a	
Chipping Sparrow	h				r	
Brewer's Sparrow	fs				u	
Black-chinned Sparrow						
Vesper Sparrow	f				u	
Lark Sparrow	fs				r	
Black-throated Sparrow	s					
Sage Sparrow	fs				u	
Lark Bunting	fs				o	
Savannah Sparrow	f		o		c	
Grasshopper Sparrow			a		a	
Fox Sparrow	rs				o	

Common Name	Habitat	S	W	Notes
Song Sparrow	rm	r	u	
Lincoln's Sparrow	rf		c	
Swamp Sparrow	m		o	
White-throated Sparrow	rsf		o	
Golden-crowned Sparrow	rsf		o	
White-crowned Sparrow	rsf		c	
Harris' Sparrow	sf		o	
Dark-eyed Junco	sf		u	
McCown's Longspur	f		o	
Lapland Longspur	f		o	
Chestnut-collared Longspur	f		o	
Bobolink		a		
BLACKBIRDS, MEADOWLARKS AND ORIOLES				
Red-winged Blackbird	fm	c	c	
Tricolored Blackbird			a	
Western Meadowlark	f	u	c	
Yellow-headed Blackbird	mf	c	u	
Brewer's Blackbird	fh	o	c	
Great-tailed Grackle	mf	u	u	
Bronzed Cowbird	h	r		
Brown-headed Cowbird	fhs	u	c	
Orchard Oriole			a	
Hooded Oriole	h	u	o	
Northern Oriole	hrs	r	a	
Scott's Oriole			a	
FINCHES				
Purple Finch	rh		o	
Cassin's Finch	rh		o	
House Finch	hs	c	c	
Red Crossbill	hs		o	
Pine Siskin	rsh		r	
Lesser Goldfinch	s	r	u	
Lawrence's Goldfinch	s		r	
American Goldfinch	s		r	
WEAVER FINCHES				
House Sparrow	h	c	c	

Mammals

All mammals listed are considered resident species with the exception of the bats which migrate on a seasonal basis like many of the birds. Families follow that of *A Field Guide to the Mammals* by Burt and Grossenheider.

Shrews
Desert Shrew

Cats
Bobcat

Dogs
Coyote
Desert Kit Fox
Gray Fox

Leafnose Bats
California Leafnose Bat

Plainnose Bats
California Myotis
Western Pipistrel
Big Brown Bat
Spotted Bat
Hoary Bat
Western Yellow Bat
Pallid Bat
Long-tongued Bat

Freetail Bats
Mexican Freetail Bat
Pocketed Freetail Bat
Big Freetail Bat

Rabbits/Hares
Desert Cottontail
Blacktail Jackrabbit

Raccoons
Raccoon

Squirrels/Chipmunks
Roundtail Ground Squirrel
Antelope Ground Squirrel

Weasels, Skunks, Badgers
Striped Skunk
Spotted Skunk
Badger

Pocket Gophers
Valley Pocket Gopher

White Footed Mice
Cactus Mouse
Deer Mouse

Pocket/Kangaroo Mice and Kangaroo Rats
Desert Pocket Mouse
Little Pocket Mouse
Desert Kangaroo Rat
Spiny Pocket Mouse
Merriam Kangaroo Rat
Longtail Pocket Mouse

Woodrats
Desert Woodrat
Whitethroated Woodrat

Voles and Muskrats
Muskrat

Old World Rats and Mice
House Mouse
Black Rat
Norway Rat

Amphibians and Reptiles

Reptiles are found in brushy areas on the refuge and surrounding desert habitats while amphibians are found in or near freshwater. Names used follow that found in *A Field Guide to Western Reptiles and Amphibians* by Stebbins.

Amphibians
Bullfrog
Leopard Frog
Red-spotted Toad
Spiny Softshell Turtle

Lizards
Side-blotched Lizard
Leopard Lizard
Long-tailed Brush Lizard
Desert Horned Lizard
Flat-tailed Horned Lizard
Desert Spiny Lizard
Western Whiptail Lizard

Snakes
Gopher Snake
Common Kingsnake
Checkered Garter Snake
Western Rattlesnake
Western Blind Snake
Red Racer
Western Patch-nosed Snake
Desert Glossy Snake
Western Ground Snake

Fish

Very few fish can tolerate the high salinity of the Salton Sea. In 1950 attempts were made to introduce several marine fish. These attempts resulted in the largest inland fishery in California. The introduced saltwater species are underlined. Freshwater species are found in rivers, canals and some marsh areas.

Orangemouth Corvina
Sargo
Gulf Croaker
Threadfin Shad
Sailfin Molly
Desert Pupfish
Longjaw Mudsucker
Mosquitofish
Red Shiner
California Killifish
• Tilapia
Largemouth Bass
White Catfish
Channel Catfish

• *found in both fresh and saltwater*

For additional information contact:

Refuge Manager
Salton Sea NWR
PO Box 120
Calipatria, CA 92233
Telephone (619) 348-5278

Notes

Date _____ No. Species _____
Time Afield _____
Observers _____
Weather _____
Remarks _____

Salton Sea

National Wildlife Refuge

CALIFORNIA

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DEPARTMENT OF THE INTERIOR
Fish and Wildlife Service
Salton Sea National Wildlife Refuge
P.O. Box 120
Calipatria, CA 92233

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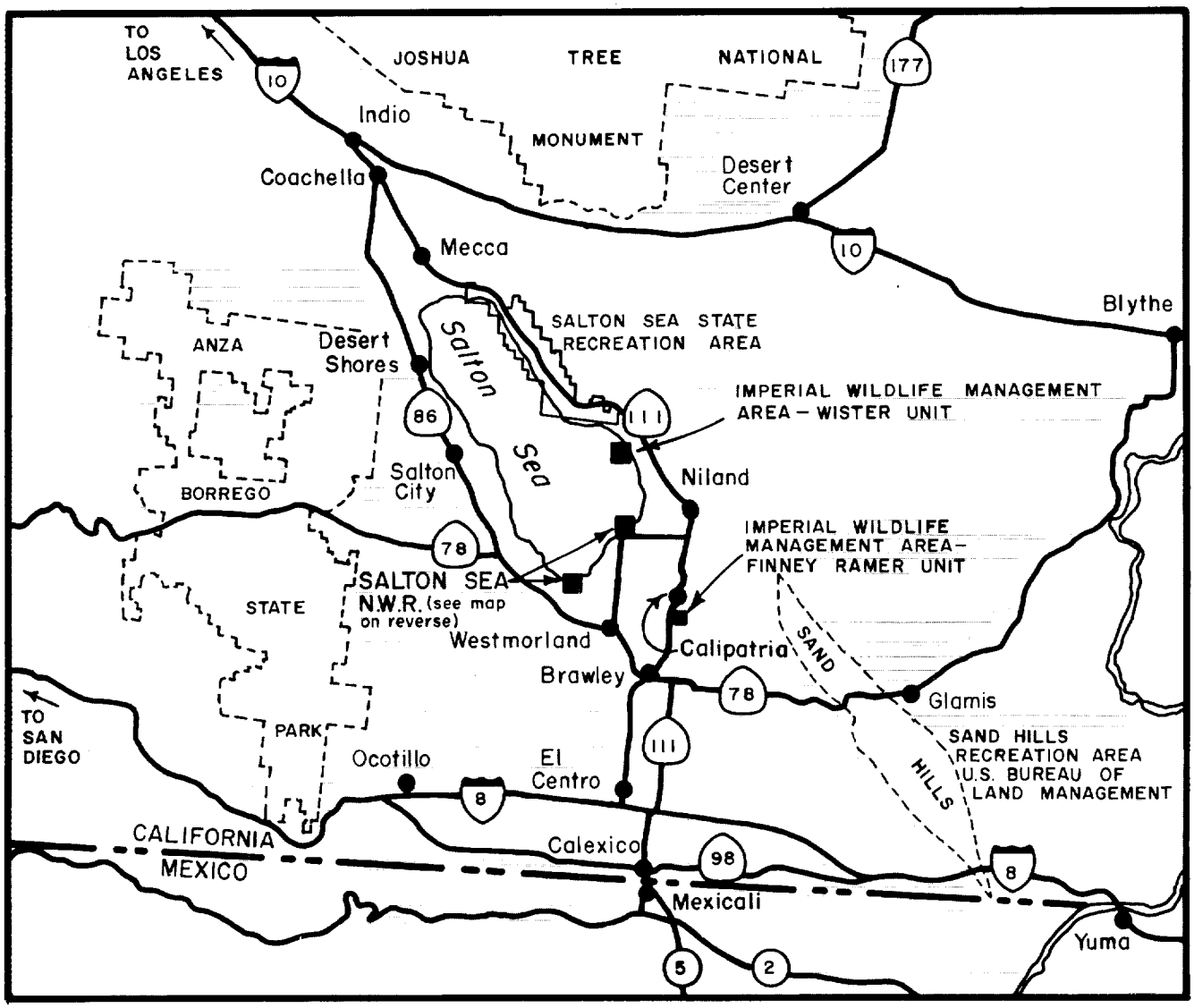
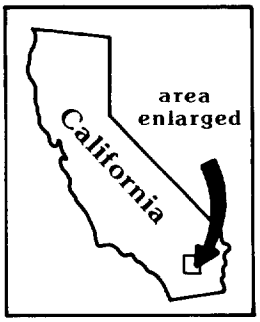


SERVICES AVAILABLE NEARBY

Motels are available in Brawley (20 miles), Niland (10 miles), Imperial (28 miles) and El Centro (33 miles). **Restaurants, gasoline and other supplies** are available in Brawley, Calipatria, El Centro, Imperial, Niland and Westmorland.

Camping is permitted at the Wister and Finney Ramer units of the Imperial Wildlife Area and Salton Sea State Recreation Area.



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WILDLIFE AND A CHANGING SEA

Snow Geese

The Salton Sea National Wildlife Refuge has shrunk—The Salton Sea National Wildlife Refuge was established in 1930 by a Presidential Proclamation. It is the southernmost refuge of the Pacific Flyway and is located in the Imperial Valley of California. Originally the refuge consisted of approximately 35,000 acres. Now, because of flooding by the Salton Sea, only about 2,200 manageable acres remain. Dikes are expected to keep the sea from further expansion on the refuge.

From Gulf to ancient sea to desert—At one time the Gulf of California extended into what is now known as the Imperial and Coachella Valleys. A natural dam was then formed through silt deposits from the Colorado River. This deposit blocked off the Gulf and resulted in the formation of an ancient sea. Through time, the sea evaporated and formed a dry alkaline basin. In the early 1900s only dry desert shrubs were present where the refuge and lake shore is today.

Sea re-created in 1905 from break in irrigation canal—In 1901, Colorado River waters were diverted from Yuma, Arizona into Mexico and back into the Salton Sea basin for agricultural development. In 1905, failure of a diversion structure caused the Colorado to flow unchecked into the Imperial Valley between 1905-1907, thus creating the present Salton Sea. Agricultural drainage and run-off from the surrounding mountains now supply the Salton Sea. There is no outlet from the Sea and water is removed only by evaporation.

Over 200 feet below sea level—The Salton Sea presently covers over 380 square miles. Its width varies from 9-15 miles and it is 35 miles long with about 115 miles of shoreline. Salton Sea is 40 feet deep and the current level is 227 feet below sea level.

Canada Goose

Waterfowl have adapted to changing habits and foods in Imperial and Mexicali Valleys—Before Salton Sea was formed waterfowl were only found along the marshes and delta of the Colorado River (primarily in Mexico). During the 1920's, as more water was diverted from the Colorado River for agriculture, marshes were inadvertently created. These marshes, at the edges of the then smaller Salton Sea, resulted from agricultural water runoff. Waterfowl were attracted to the marshes from their former winter home in the drying Colorado River Delta. As farming intensified in the 1940's and the Salton Sea expanded, marshland once again shrunk and waterfowl turned to farmers' crops for food. Today, crops are grown on the refuge to feed wintering waterfowl and to keep the birds from eating farmers' crops.

Increasing sea salt stresses fish transplants - As the salinity of the Salton Sea began to rise as the result of evaporation, many of the native freshwater fish species began to die out. In the 1950s the salinity of the Salton Sea was nearly that of the Pacific Ocean (35,000 parts per million). Attempts were made to introduce several marine fish. These attempts resulted in the establishment of the Orange-mouth Corvina, Sargo and Gulf Croaker (Bairdiella), all transplanted from the Gulf of California. Later tilapia, an African species, were introduced into canals surrounding the Salton Sea. They are now well established in the Sea. Unfortunately the fishery is threatened by increasing salinity. In 1988 the salinity of the Salton Sea was about 40,000 parts per million or roughly ten percent more salty than the Pacific Ocean.

Long-billed Dowitchers

Other animals introduced into the Salton Sea, accidently or intentionally, include barnacles, pile worms and copepods. These animals play a very important part in providing food for the fishery. The relationship between the fish and their food is so close that if one were to disappear the entire system would be significantly affected.

Numerous wildlife now conserved on the refuge - Thousands of waterfowl and other birds spend the winter at the refuge. Canada geese, snow geese, American avocets, black-necked stilts, pintails, green-winged teal, eared grebes and a wide variety of other species are commonly seen during the winter.

The primary purpose of the refuge is to provide winter habitat for migrating waterfowl. The refuge is also important in providing a home and resting area for a large number of shorebirds and in supporting a diversity of wildlife species throughout the year.

White Pelicans

Endangered species at the refuge—The Yuma clapper rail breeds in marshes along the Colorado River from the Nevada/California border south to the Colorado Delta region of Mexico. It is also found in marsh habitat around the southeastern portion of the Salton Sea. The preferred habitat is mature cattail-bulrush stands in shallow water disected by narrow channels of flowing water. A small breeding population can be found in refuge marshes from April to July.

Other endangered/threatened species occasionally observed on the refuge include the bald eagle, California brown pelican and peregrine falcon.

Yuma Clapper Rail

ENJOYING THE SALTON SEA NATIONAL WILDLIFE REFUGE

REFUGE HOURS—Refuge open sunrise to sunset. Office hours 7:00 am to 4:30 pm Monday-Friday.

WILDLIFE OBSERVATION AND PHOTOGRAPHY—These activities are encourged from designated trails. Self-guided interpretive exhibits are available near the office. A wildlife list is available.

DESIGNATED TRAILS—Walking and hiking are enjoyed on designated trails. Most refuge roads and trails are closed to vehicles.

WATERFOWL HUNTING—Waterfowl hunting is permitted on areas shown on map under State and Federal Regulations. Write the Refuge Manager for hunting regulations leaflet.

FISHING—Boat fishing only is permitted, except where posted as closed. From April 1 to September 30, areas on the Sea between the buoys and shoreline are open to boat fishing. These areas are closed to all entry at other times of the year. No bank fishing.

PETS—Pets must be on a leash at all times. Hunting dogs on the public hunting areas must be under effective control.

LITTERING—Please help us save your tax money for clean-up. Don't litter.

CAMPING—No camping is allowed on the Refuge.

FOR MORE INFORMATION CONTACT:

Refuge Manager
Salton Sea National Wildlife Refuge
P.O. Box 120
Calipatria, CA 92233
Phone (619) 348-5278

Information on other nearby recreation land can be obtained from:

Salton Sea State Recreation Area
P.O. Box 3166
North Shore, CA 92254
Phone (619) 393-3052

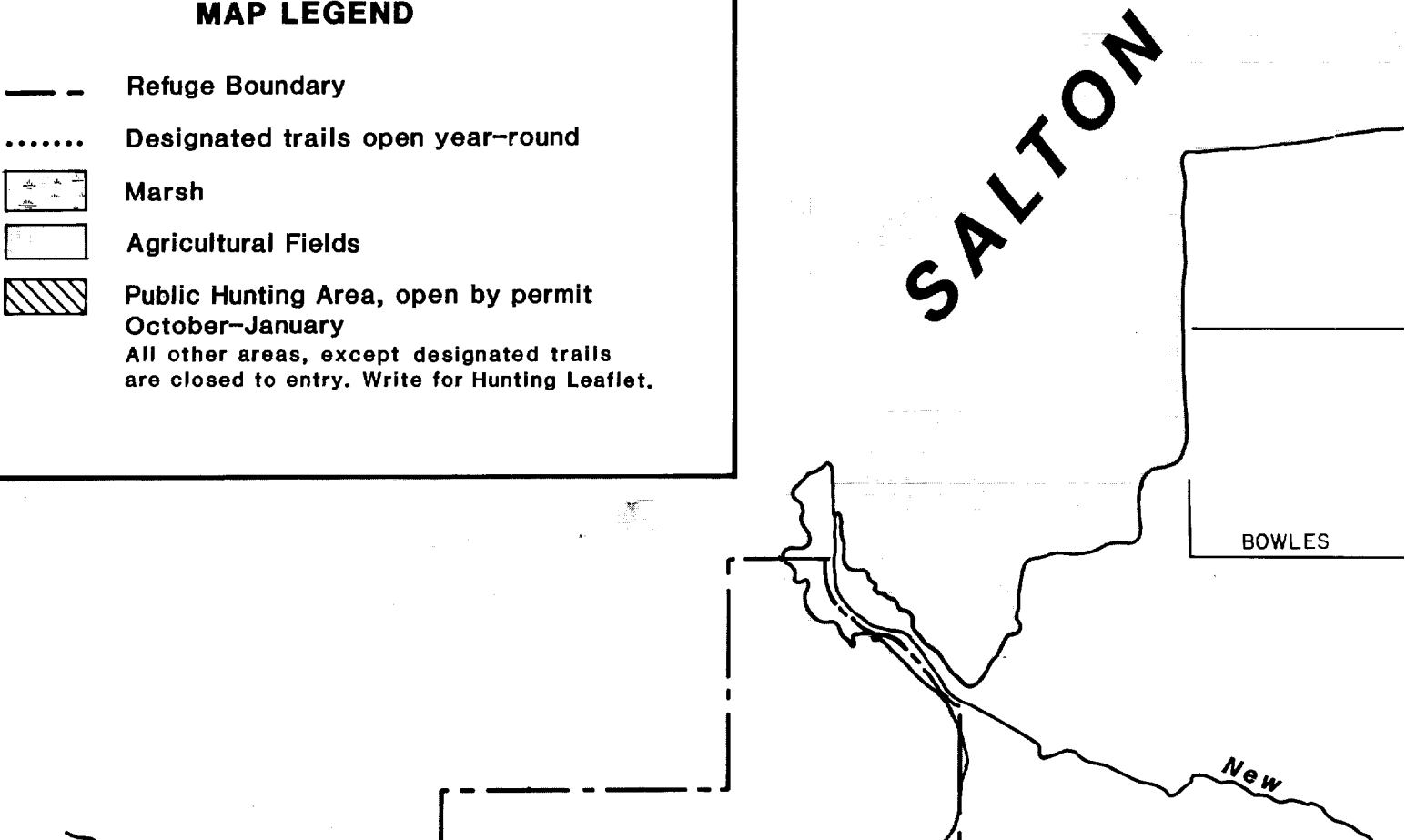
Bureau of Land Management
U.S. Department of the Interior
333 South Waterman Avenue
El Centro, CA 92243
Phone (619) 352-5842

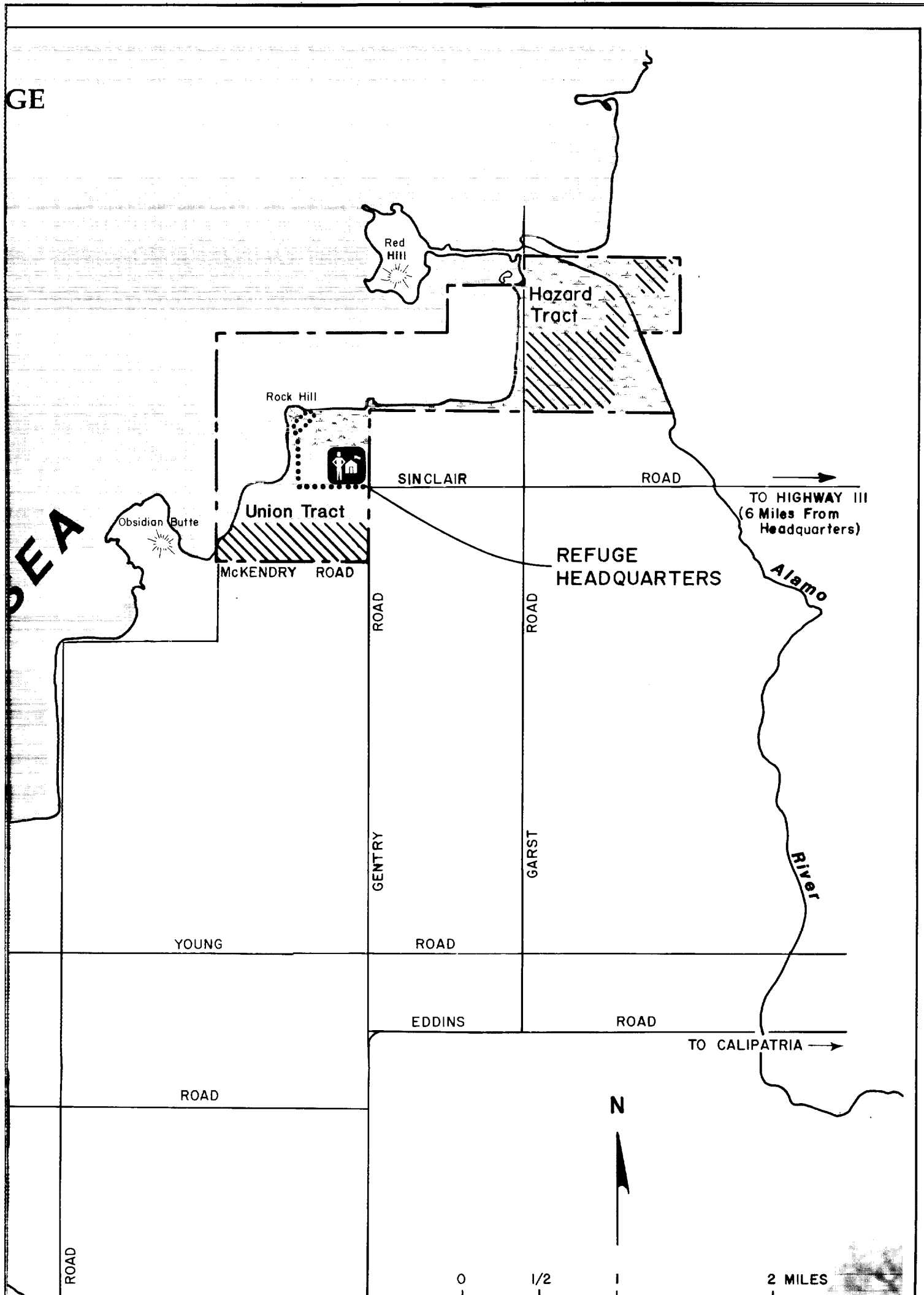
California Department of Fish and Game
8700 Davis Rd.
Niland, CA 92257
Phone (619) 348-0577

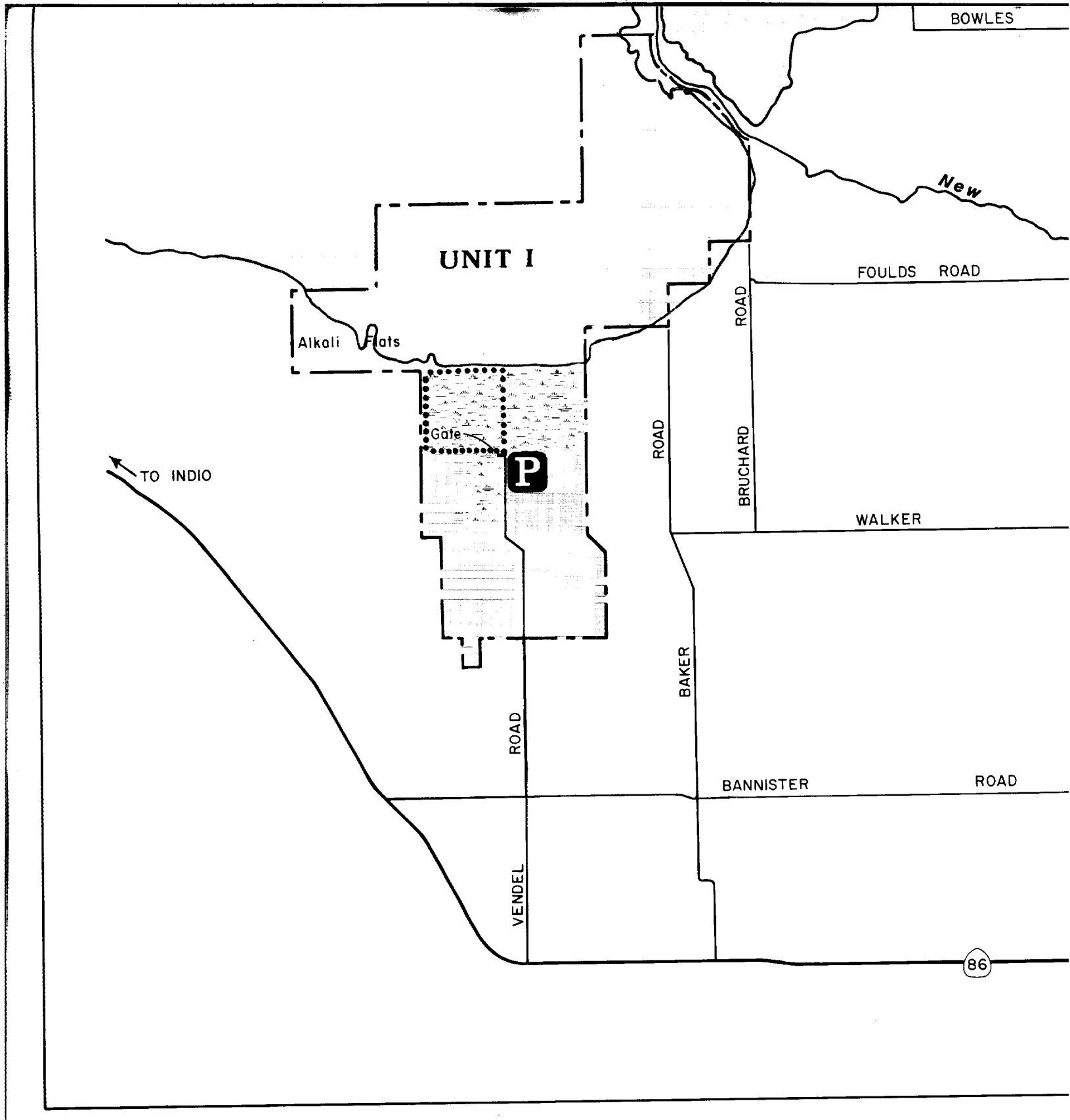
MAP LEGEND

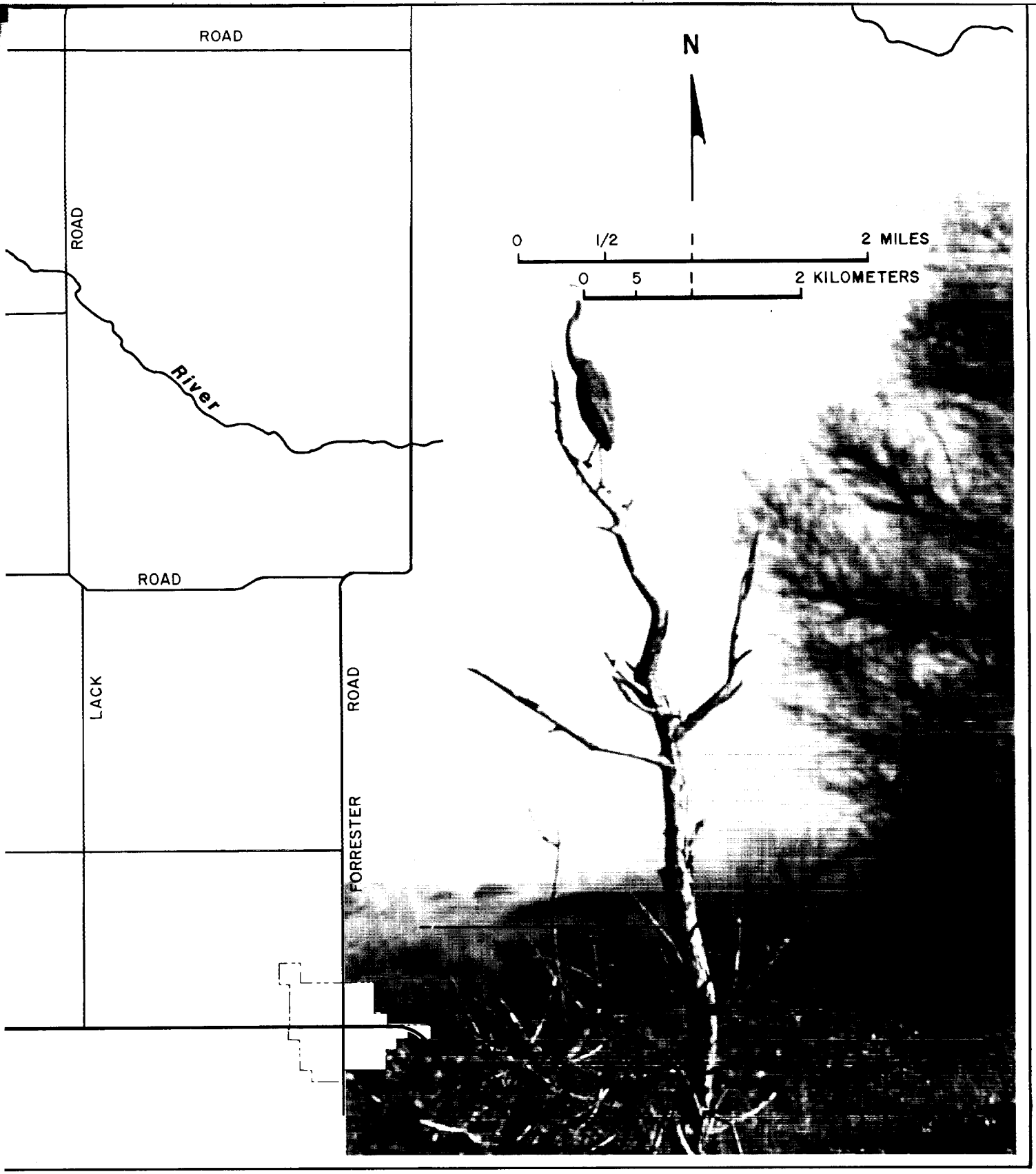
- Refuge Boundary
- Designated trails open year-round
- Marsh
- Agricultural Fields
- Public Hunting Area, open by permit October–January

All other areas, except designated trails are closed to entry. Write for Hunting Leaflet.




GE
Red Hill
Hazard Tract
Rock Hill
SINCLAIR ROAD
TO HIGHWAY 111
(6 Miles From Headquarters)
Obsidian Butte
Union Tract
McKENDRY ROAD
REFUGE HEADQUARTERS
Alamo
ROAD
ROAD
GENTRY
GARST
River
YOUNG ROAD
EDDINS ROAD
TO CALIPATRIA
ROAD
ROAD
N
0
1/2
2 MILES


BOWLES
New
UNIT I
FOULDS ROAD
ROAD
Alkali Flats
Gate
P
TO INDIO
ROAD
BRUCHARD
WALKER
ROAD
BAKER
BANNISTER
ROAD
VENDEL
86


ROAD
ROAD
River
ROAD
LACK
ROAD
FORRESTER
N
0 1/2 1 2 MILES
0 5 1 2 KILOMETERS