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WILDLIFE INTERACTIONS AT SOLAR ONE FACILITY, DAGGETT, CALIFORNIA: FALL 1982 INTERIM REPORT

BY: WILLIAM D. WAGNER, ROBERT L. MCKERNAN, PATRICIA A. FLANAGAN AND RALPH W. SCHREIBER

SECTION OF ORNITHOLOGY
NATURAL HISTORY MUSEUM FOUNDATION, LOS ANGELES COUNTY
LOS ANGELES, CALIFORNIA 90007

REPORT FOR RESEARCH AND DEVELOPMENT
SOUTHERN CALIFORNIA EDISON COMPANY
ROSEMEAD, CALIFORNIA

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INTRODUCTION

Until recently the use of the sun's energy to produce electricity has never been carried out on a large commercial scale, and the environmental hazards of a fully operational solar generating power plant are virtually unknown. In spring 1982, the Southern California Edison Company (SCE) funded a short term wildlife survey of the Solar Central Receiver pilot plant (Solar One) near Barstow, California (McKernan et al. 1982; a report to Research and Development, SCE). The initial study established a methodology for assessing the potential impact of the facility on the environment and provided a preliminary evaluation of wildlife/solar facility interactions on a seasonal basis. This initial study indicated that avian and insect incinerations combined with avian collisions are the primary biological concern. In September 1982 a second survey was initiated to assess the environmental impact to avian populations during the fall migration period. Similar methodologies employed during the spring study were applied, including a predator/scavenger removal experiment. This present interim report summarizes data collected during the second survey period from mid-September through November 1982.

STUDY AREA AND METHODS

Solar One is located in the Mojave Desert, near Daggett, approximately 24 km east of Barstow, California. The habitat immediately surrounding the Solar One facility consists of abandoned agricultural fields and salt bush scrub (Atriplex polycarpa) (Figures 1 and 2). This dominant native vegetation recolonized the land after it was cleared for agriculture in 1953. Additional fallow agricultural fields exist on the west side of the facility which have laid dormant since 1961. This area is slowly being invaded by weedy plants such as Chenopodium album, Erodium circutarium and Salsola sp.. The east side of the facility consists of irrigated alfalfa fields. The dominant desert plant community surrounding this area is creosote bush scrub.

During fall 1982 the Solar One facility was surveyed on 3 consecutive days during 11 visits, totaling 32 days of observation: 16-18, 21-23, and 28-30 September; 6-8, 12-14, 20-22, and 26-28 October; and 3-4, 9-11, 18-19, and 23-24 November. During this period the solar plant was non-operational on 23, 28 September and 9, 11-26 November because of routine maintenance or inclement weather.

The fallow agricultural fields between Solar One and the evaporation ponds were censused once a day on at least two of the three days of a survey period. No attempt was made to count all birds in the area (Figures 1 and 2) but instead we concentrated on four locations:

1. The weedy agricultural field between the Cool Water ponds and the Solar One facility.

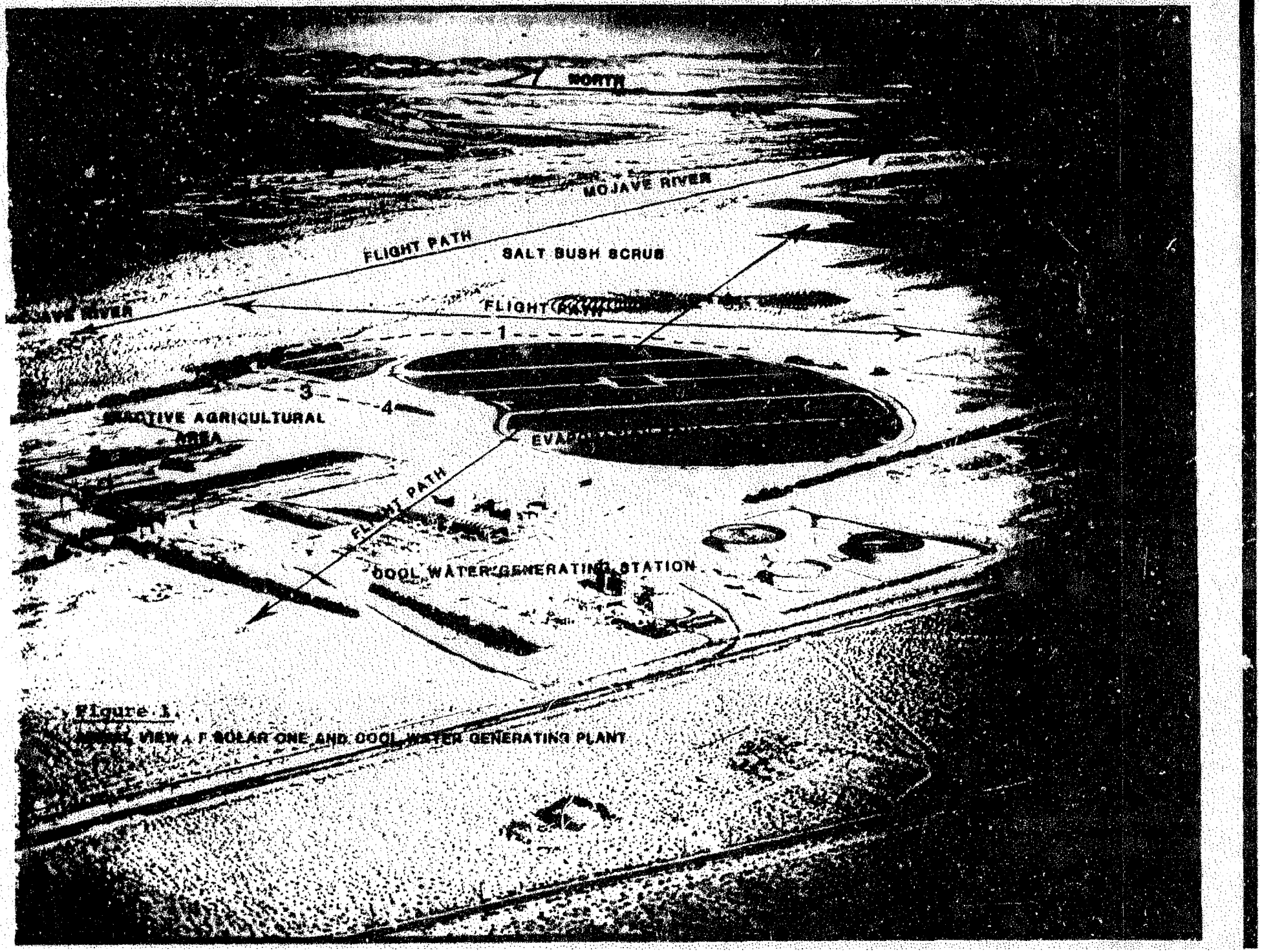
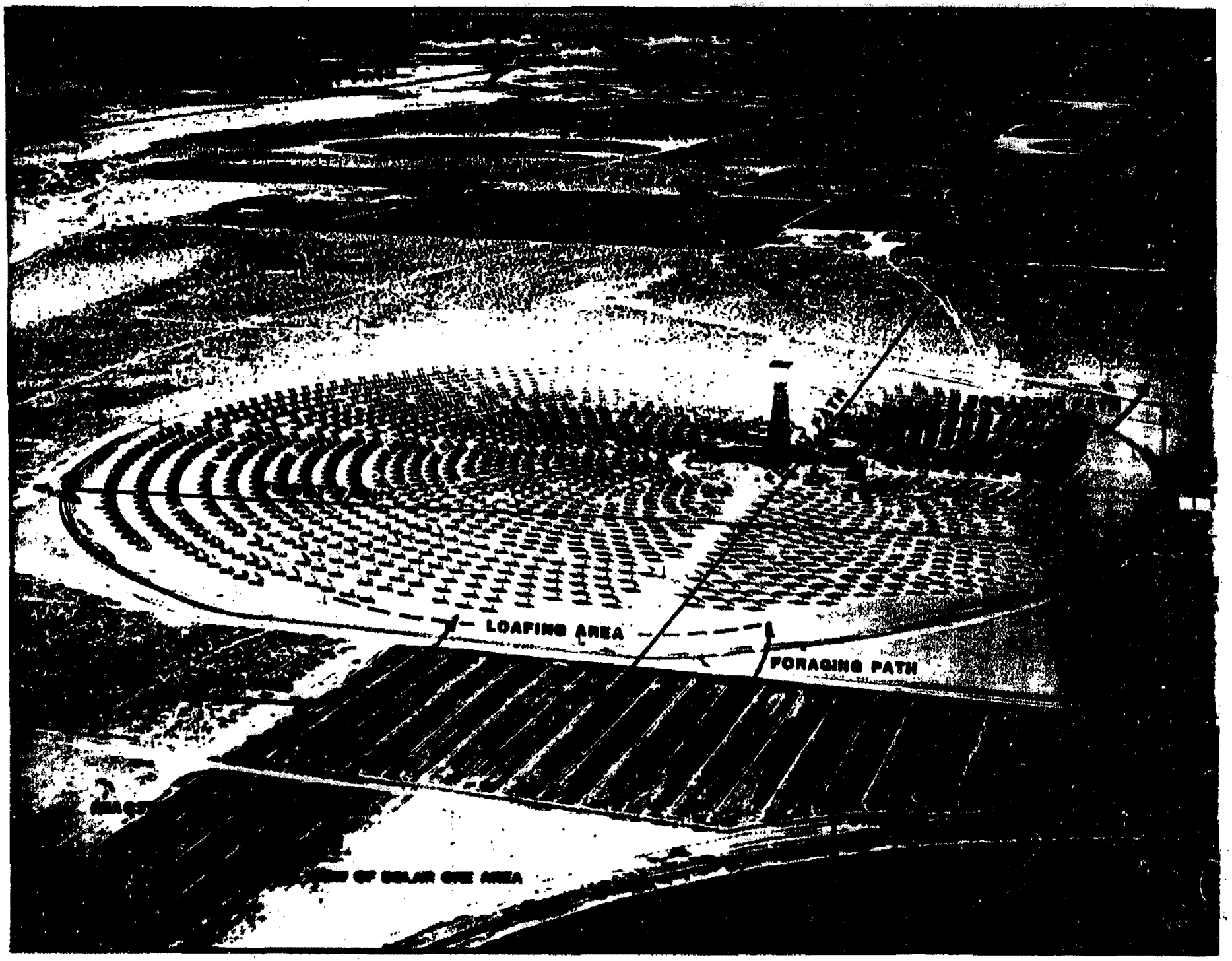

NORTH
MOJAVE RIVER
FLIGHT PATH
SALT BUSH SCRUB
FLIGHT PATH
1
3
4
EVAPORATION
FLIGHT PATH
COOL WATER GENERATING STATION

Figure 1.


LOAFING AREA
FORAGING PATH

2. A tamarisk row (Tamarix ramosissima), approximately 1 km long, just adjacent to the ephemeral Mojave River.
3. A small area along an access road with standing water and introduced weedy plants, including Ditch Beardgrass (Polypogon interruptus), London Rocket (Sisymbrium irio), Russian Thistle (Salsola sp.), Lamb's Quarters (Chenopodium album), Curly Dock (Rumex crispus), and Bermuda Grass (Cynodon dactylon).
4. A row of tamarisk trees, approximately 1 km long, adjacent to the Cool Water evaporation ponds.

The central receiving tower and standby region (Figure 3) were observed for avian and insect incinerations from several different vantage points depending on the time of day. This sampling was conducted for a period of 60 minutes once or twice a day. These observations included time of day, bird species and abundance, flight direction, location in relation to the tower (whether the birds flew over the heliostats, the cleared field, or outside the heliostat field), and other related behavioral activities or responses. A systematic search for dead or injured birds was conducted once a week through the heliostat field and along the peripheral fence. Inclement weather or plant facility activities prevented the survey on 20-22 and 26-28 October. Experiments were also conducted to determine the rate of scavenger removal from the heliostat field. Plant personel aided in collecting and recording additional wildlife/plant interactions during non-censusing periods and volunteered many informative discussions.

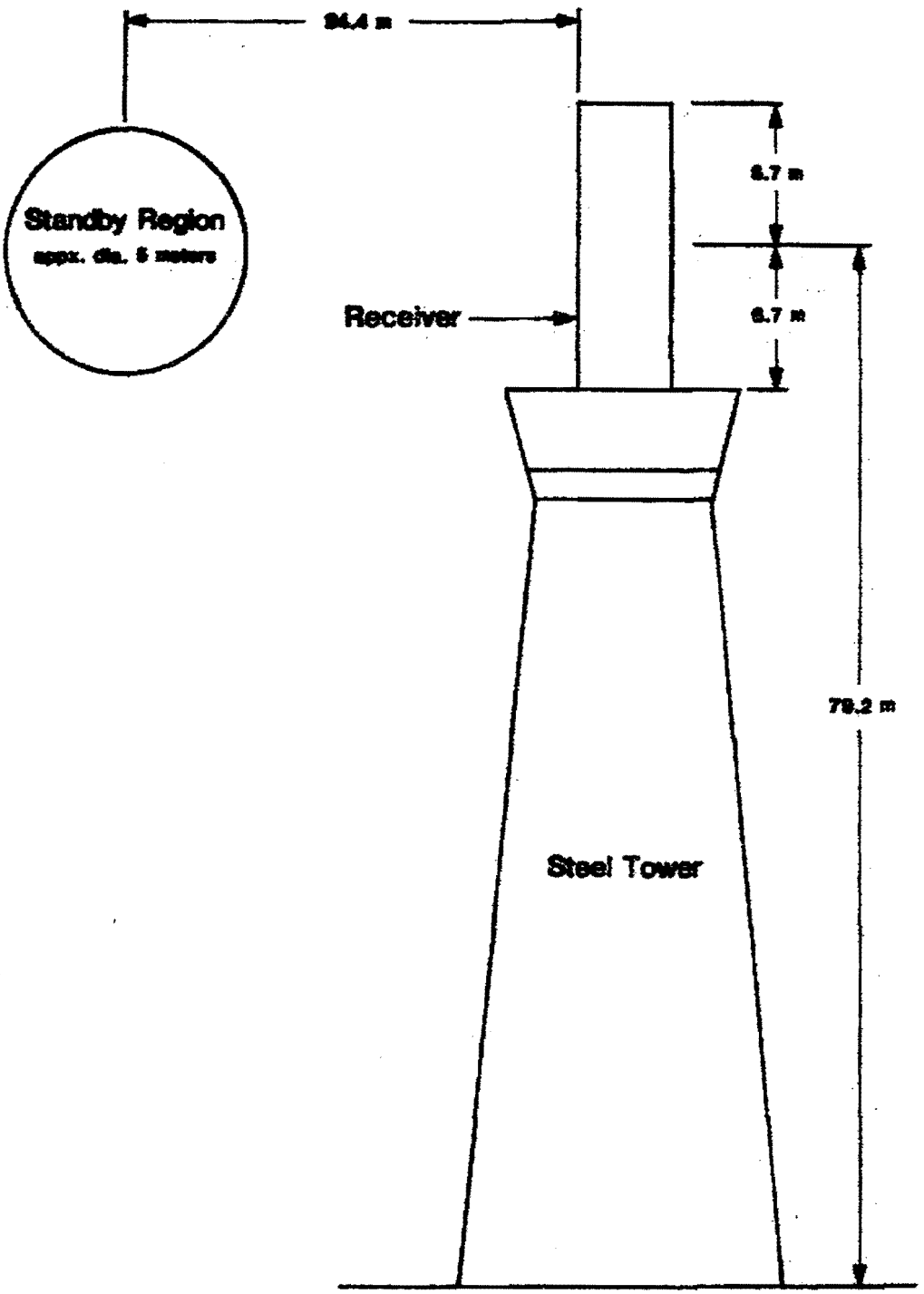


Figure 3. Diagram of the receiving tower with standby region. There are four standby regions, located to the NW, SW, S and SE. They are focal points for the mirrors when the mirrors are not focused on the receiver.

RESULTS AND DISCUSSION

Bird Populations

During 26 days of censusing, 82 species of birds were observed, an increase of 22 species over spring 1982. Although the number of species was greater in fall, individual abundance was markedly lower than in the previous spring (Figure 4, Table 1). Data from this study indicates that September through mid-October is the peak period for fall migration of shorebirds and waterfowl at this locality, while passerine abundance peaked during mid-October (Table 2). Species composition in fall was primarily made up of migrant birds (84%), with most occurring in low numbers. An increase in foraging flocks was noted during late fall in the agricultural fields as certain passerine species tend to become gregarious during non-breeding periods (fall and winter) and exploit the rich food resource of this vegetation. These species include Horned Lark (Eremophila alpestris), Water Pipit (Anthus spinoletta), White-crowned Sparrow (Zonotrichia leucophrys), Savannah Sparrow (Passerculus sandwichensis), Red-winged Blackbird (Agelaius phoeniceus), Brewer's Blackbird (Euphagus cyanocephalus), and House Finch (Carpodacus mexicanus). These species also frequented the Solar One heliostat field periodically during foraging and loafing (Figure 2).

A marked increase in raptor populations was evident in October, as these birds began to migrate through the area. Raptor species

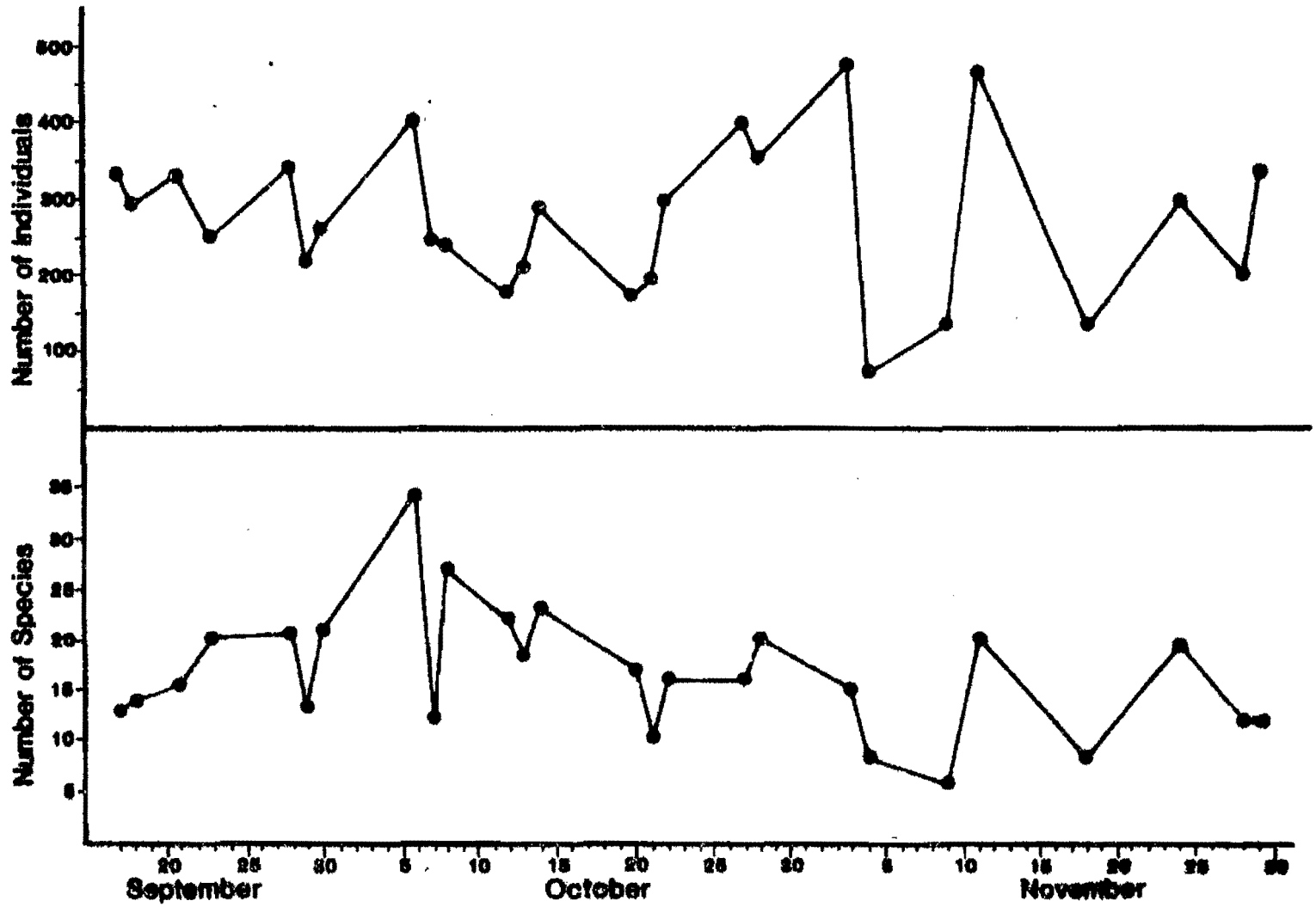


Figure 4. Species and bird abundance observed during the Solar One study, fall 1982.

recorded in this study include Northern Harrier (Circus cyaneus), Red-tailed Hawk (Buteo jamaicensis), Ferruginous Hawk (Buteo regalis), Golden Eagle (Aquila chrysaetos), American Kestrel (Falco sparverius), and Prairie Falcon (Falco mexicanus). These birds were periodically observed soaring over the heliostat field, although usually well above the receiving tower and standby regions. Occasionally a Prairie Falcon, Golden Eagle or Red-tailed Hawk flew very close to the hazardous standby regions, with no obvious evasive maneuvres or change of flight direction.

Table 1. Bird species and numbers at Solar One, Spring and Fall 1982

	Spring	Fall
Total species/census	60	82
Mean species/census	22.3	16.6
Mean individuals/census	366 (8-1040)*	274 (66-474)*
Peak abundance	1,040 (12 May)	474 (4 Nov.)
Resident species	12 (20%)	13 (16%)
Migrant species	48 (80%)	69 (84%)

* Frequency range.

Early morning and evening flights of blackbirds and other passerines were observed daily over Solar One, with all flights occurring well above the heliostat field and standby regions (Table 3). These groups of birds utilized the irrigated agricultural fields primarily and were observed only infrequently at the Cool Water ponds and the Solar One facility grounds during the day (Figures 1 and 2).

Table 2. Numbers of birds censused by habitat near Solar One, September-November 1982.

Habitat*			Species	9-17	9-18	9-21	9-23	9-28	9-29	9-30	10-6	10-7	10-8	10-12	10-13	10-14
AG	CP	S1														
	X		Eared Grebe	0	8	8	2	2	3	3	0	7	2	0	0	0
	X		Western Grebe	0	0	0	0	0	0	0	0	0	0	0	0	0
	X		Am. White Pelican	0	0	0	0	0	0	0	0	0	0	0	0	0
	X		Great Blue Heron	0	1	0	2	1	0	1	0	0	0	1	0	0
	X		Great Egret	0	0	0	0	0	0	0	0	0	0	1	0	0
	X		Snow Goose	0	0	0	0	0	0	0	0	0	0	0	0	0
	X		Canada Goose	0	0	0	0	0	0	0	0	0	0	0	0	0
	X		Mallard	17	33	1	0	3	3	0	3	0	0	0	0	0
	X		Northern Pintail	2	1	0	5	30	18	11	0	35	12	0	17	78
	X		Cinnamon Teal	31	23	40	47	24	35	28	27	10	9	25	19	25
	X		Northern Shoveler	0	0	0	0	2	0	0	0	0	0	0	0	0
	X		Gadwall	0	0	0	1	1	0	1	0	0	0	0	0	0
	X		American Wigeon	0	0	6	0	0	0	0	0	0	5	0	0	0
	X		Bufflehead	0	0	0	0	0	0	0	0	0	0	0	0	0
	X		Ruddy Duck	0	0	0	0	1	0	0	0	0	0	0	0	0
X			Turkey Vulture	0	0	70	24	0	0	0	0	0	0	0	0	0
X	X	X	Northern Harrier	0	0	1	0	0	0	0	0	0	0	0	0	0
X	X		Sharp-shinned Hawk	0	0	0	0	0	0	0	0	0	0	0	0	0
X		X	Red-tailed Hawk	0	0	0	0	0	0	0	2	0	0	0	0	0
X		X	Ferruginous Hawk	0	0	0	0	0	0	0	1	0	0	0	0	0
X		X	Golden Eagle	0	0	0	0	0	0	0	0	0	0	0	0	0
X	X	X	American Kestrel	0	0	0	0	0	0	1	0	0	0	0	0	0
X	X	X	Prairie Falcon	0	0	0	0	0	0	0	2	0	1	0	0	1
X			Gambel's Quail	0	0	0	0	0	0	0	2	0	0	0	0	0
	X		Snowy Plover	0	0	0	1	0	0	0	0	0	0	0	0	0
	X		Semipalmated Plover	2	0	0	0	0	0	0	0	0	0	0	0	0
X	X		Killdeer	23	21	34	16	24	2	24	68	72	27	5	3	12

Table 2 Continued

Habitat*			Species	10-20	10-21	10-22	10-27	10-28	11-3	11-4	11-9	11-11	11-18	11-24	11-28	11-29
AG	CP	S1														
	X		Eared Grebe	0	0	0	0	0	0	0	0	0	0	0	0	0
	X		Western Grebe	0	0	0	0	0	0	0	0	1	0	0	0	0
	X		Am. White Pelican	0	0	0	0	0	0	0	0	0	0	0	1	0
	X		Great Blue Heron	0	0	0	0	0	0	0	0	0	0	0	0	0
	X		Great Egret	0	0	0	0	0	0	0	0	0	0	0	0	0
	X		Snow Goose	0	0	0	0	0	0	0	0	2	0	0	0	0
X	X		Canada Goose	0	0	0	0	0	0	0	0	0	0	2	28	0
	X		Mallard	0	0	0	0	5	0	0	0	0	0	10	0	7
	X		Northern Pintail	25	0	50	76	60	113	2	4	150	3	4	14	150
	X		Cinnamon Teal	0	0	0	0	7	0	0	0	0	0	0	0	0
	X		Northern Shoveler	0	0	0	0	0	0	0	0	0	0	0	0	0
	X		Gadwall	0	0	0	0	0	0	0	0	0	0	0	0	0
	X		American Wigeon	0	0	0	0	23	4	0	0	1	0	30	78	10
	X		Bufflehead	0	0	0	3	0	0	0	0	2	0	1	0	0
	X		Ruddy Duck	0	0	0	0	0	0	0	0	0	0	0	0	0
X			Turkey Vulture	0	0	0	0	0	0	0	0	0	0	0	0	0
X	X	X	Northern Harrier	0	0	0	0	1	0	0	0	0	0	0	1	0
X	X		Sharp-shinned Hawk	0	0	0	0	0	0	0	0	0	0	0	0	1
X		X	Red-tailed Hawk	0	1	1	0	0	0	0	0	0	0	0	0	0
X		X	Ferruginous Hawk	1	0	0	1	1	0	0	0	1	0	0	0	0
X		X	Golden Eagle	0	1	0	0	0	0	0	0	0	0	0	0	0
X	X	X	American Kestrel	0	0	1	2	0	0	0	0	0	0	1	0	0
X	X	X	Prairie Falcon	1	0	1	0	0	0	0	0	1	0	0	0	1
X			Gambel's Quail	0	0	0	0	0	0	0	0	0	0	0	0	0
	X		Snowy Plover	0	0	0	0	0	0	0	0	0	0	0	0	0
	X		Semipalmated Plover	0	0	0	0	0	0	0	0	0	0	0	0	0
X	X		Killdeer	6	50	10	3	29	45	13	2	1	0	2	0	0

Table 2 Continued

Habitat* AG	CP	SI	Species	9-17	9-18	9-21	9-23	9-28	9-29	9-30	10-6	10-7	10-8	10-12	10-13	10-14
	X		Black-necked Stilt	0	0	7	0	0	0	0	0	0	0	0	0	0
	X		American Avocet	0	2	0	2	3	0	0	0	1	0	0	0	0
	X		Greater Yellowlegs	0	5	1	2	0	0	0	0	4	0	0	0	0
	X		Spotted Sandpiper	0	2	1	1	0	0	0	0	0	0	0	0	0
	X		Marbled Godwit	0	0	0	0	0	1	0	0	0	0	0	0	0
	X		Sanderling	0	0	6	4	5	2	2	0	0	0	0	0	0
	X		Western Sandpiper	11	0	5	2	34	16	14	23	6	2	3	0	1
	X		Least Sandpiper	91	86	109	64	148	128	89	145	91	104	23	98	47
	X		Baird's Sandpiper	3	4	0	0	0	3	0	0	0	1	0	0	0
	X		Pectoral Sandpiper	0	0	0	0	1	1	1	0	0	0	0	0	0
	X		Dunlin	0	0	0	0	0	0	0	0	0	0	0	0	0
	X		Long-billed Dowitcher	0	0	0	0	0	0	0	3	6	3	9	2	3
	X		Red-necked Phalarope	81	97	48	38	28	3	6	1	0	0	0	0	0
	X		Bonaparte's Gull	0	0	0	0	0	0	0	0	0	0	0	0	0
	X		Ring-billed Gull	0	0	0	5	0	0	17	3	2	0	40	16	16
	X		California Gull	0	0	0	0	0	0	0	0	0	0	0	1	1
	X		Herring Gull	0	0	0	0	0	0	0	0	0	0	0	1	3
	X		Mourning Dove	0	0	0	0	0	0	0	0	0	0	0	0	0
X			Greater Roadrunner	0	0	1	0	0	0	0	2	0	0	0	0	0
X			Great Horned Owl	0	0	0	0	0	0	0	1	0	0	1	0	0
X	X		Northern Flicker	0	0	0	0	1	0	0	0	0	0	0	1	2
X	X	X	Say's Phoebe	1	1	1	2	3	0	0	3	0	0	1	0	0
X	X	X	Horned Lark	66	12	2	32	23	0	34	1	4	6	1	1	11
	X		Tree Swallow	1	0	0	1	1	0	1	0	0	0	0	0	0
	X		Cliff Swallow	0	0	0	0	0	1	5	5	0	3	0	0	0
	X		Barn Swallow	0	0	0	0	0	0	16	0	0	0	0	0	0

Table 2 Continued

Habitat* AG	CP	S1	Species	10-20	10-21	10-22	10-27	10-28	11-3	11-4	11-9	11-11	11-18	11-24	11-28	11-29
	X		Black-necked Stilt	0	0	0	0	0	0	0	0	0	0	0	0	0
	X		American Avocet	0	0	0	0	0	0	0	0	0	0	0	0	0
	X		Greater Yellowlegs	0	0	0	0	0	0	0	0	0	0	0	0	0
	X		Spotted Sandpiper	0	0	0	0	0	0	1	0	0	0	0	0	0
	X		Marbled Godwit	0	0	0	0	0	0	0	0	0	0	0	0	0
	X		Sanderling	0	0	0	0	0	0	0	0	0	0	0	0	0
	X		Western Sandpiper	0	0	4	0	0	0	0	2	0	0	0	0	0
	X		Least Sandpiper	66	0	80	85	121	68	42	72	39	34	36	12	15
	X		Baird's Sandpiper	0	0	0	0	2	0	0	0	0	0	0	0	0
	X		Pectoral Sandpiper	0	0	0	0	0	0	0	0	0	0	0	0	0
	X		Dunlin	0	0	0	0	1	0	0	0	0	0	0	0	0
	X		Long-billed Dowitcher	2	0	0	0	0	0	0	0	0	0	3	0	0
	X		Red-necked Phalarope	0	0	0	2	0	0	0	0	0	0	0	0	0
	X		Bonaparte's Gull	0	0	0	0	0	0	1	0	0	0	0	0	0
	X		Ring-billed Gull	3	0	0	47	12	35	2	12	16	0	113	0	0
	X		California Gull	0	0	0	0	0	0	0	0	0	0	0	0	0
	X		Herring Gull	0	0	0	0	0	0	0	0	0	0	0	0	0
	X		Mourning Dove	0	0	0	0	0	5	0	0	0	0	0	0	0
X			Greater Roadrunner	1	0	0	0	0	0	0	0	0	0	1	0	0
X			Great Horned Owl	0	0	0	0	0	0	0	0	0	0	0	0	0
X	X		Northern Flicker	1	0	0	0	1	0	0	0	0	0	0	0	0
X	X	X	Say's Phoebe	1	0	4	2	0	0	0	0	0	0	0	2	2
X	X	X	Horned Lark	2	15	36	56	11	5	0	0	108	43	0	15	100
	X		Tree Swallow	0	0	0	0	0	0	0	0	0	0	0	0	0
	X		Cliff Swallow	0	0	0	0	0	0	0	0	0	0	0	0	0
	X		Barn Swallow	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 2 Continued

Habitat*			Species	9-17	9-18	9-21	9-23	9-28	9-29	9-30	10-6	10-7	10-8	10-12	10-13	10-14
AG	CP	S1														
	X		Common Raven	0	0	0	0	0	0	0	0	0	0	0	0	0
X			Verdin	0	0	0	0	0	0	0	1	0	0	0	0	0
X			Bewick's Wren	0	0	0	0	0	0	0	2	0	0	0	0	0
X			House Wren	0	0	0	0	0	0	0	0	0	0	1	0	0
X			Ruby-crowned Kinglet	0	0	0	0	0	0	0	1	0	1	4	0	2
X			Bl.-tailed Gnatcatcher	0	0	0	0	0	0	0	0	0	0	0	0	1
X			Hermit Thrush	0	0	0	0	0	0	0	0	0	1	0	0	0
X	X	X	Water Pipit	0	0	0	0	0	0	0	1	0	0	0	0	0
X		X	Loggerhead Shrike	0	0	0	0	0	0	0	5	0	2	0	1	1
X			European Starling	0	0	0	0	0	0	0	0	0	16	1	0	0
X			Warbling Vireo	0	0	0	0	0	0	0	1	0	1	0	0	0
X			Orange-crowned Warbler	0	0	0	0	0	0	0	2	0	0	0	0	0
X			Nashville Warbler	0	0	0	0	0	0	1	0	0	0	0	0	0
X			Yellow-rumped Warbler	0	0	0	0	0	0	0	2	0	14	43	50	29
X			B-t Gray Warbler	0	0	0	0	0	0	1	0	0	0	0	0	0
X			Common Yellowthroat	0	0	0	0	0	0	0	0	0	0	1	1	0
X			Chipping Sparrow	0	0	0	0	0	0	0	1	0	0	0	0	0
X			Brewer's Sparrow	0	0	0	0	0	0	0	1	0	1	1	0	0
X		X	Lark Sparrow	0	0	0	0	0	0	0	1	0	2	4	6	4
X	X	X	Savannah Sparrow	0	0	0	0	0	0	1	19	0	3	3	4	6
X			Lincoln's Sparrow	0	0	0	0	0	0	0	1	0	1	0	0	0
X	X	X	White-crowned Sparrow	0	0	0	0	0	0	0	55	7	10	0	12	12
X			Red-Winged Blackbird	0	0	0	0	0	0	0	0	0	0	0	7	3
X	X	X	Western Meadowlark	1	0	0	0	1	0	2	0	0	0	1	1	5
X	X	X	Y-headed Blackbird	0	0	0	1	0	0	0	0	0	0	0	0	0

Table 2 Continued

Habitat*			Species	10-20	10-21	10-22	10-27	10-28	11-3	11-4	11-9	11-11	11-18	11-24	11-28	11-29
AG	CP	S1														
	X		Common Raven	0	3	0	0	0	0	0	0	2	0	1	0	0
X			Verdin	0	0	0	0	0	0	0	0	0	0	0	0	0
X			Bewick's Wren	0	0	0	0	0	0	0	0	0	0	0	0	0
X			House Wren	0	0	0	0	0	0	0	0	0	0	0	0	0
X			Ruby-crowned Kinglet	0	0	0	0	0	1	0	0	0	0	0	0	0
X			Bl.-tailed Gnatcatcher	0	0	0	0	0	0	0	0	0	0	0	0	0
X			Hermit Thrush	0	0	0	0	0	0	0	0	0	0	0	0	0
X	X	X	Water Pipit	0	0	0	37	21	65	5	43	11	0	5	15	12
X		X	Loggerhead Shrike	0	0	1	0	0	0	0	0	0	0	0	0	0
X			European Starling	0	0	0	0	0	0	0	0	0	0	0	0	0
X			Warbling Vireo	0	0	0	0	0	0	0	0	0	0	0	0	0
X			Orange-crowned Warbler	0	0	0	0	0	0	0	0	0	0	0	0	0
X			Nashville Warbler	0	0	0	0	0	0	0	0	2	0	0	0	0
X			Yellow-rumped Warbler	34	16	1	15	0	2	0	0	0	4	2	5	0
X			B-t Gray Warbler	0	0	0	0	0	0	0	0	0	0	0	0	0
X			Common Yellowthroat	0	0	0	0	0	0	0	0	0	0	0	0	0
X			Chipping Sparrow	0	0	0	0	0	0	0	0	1	0	0	0	0
X			Brewer's Sparrow	0	0	0	0	0	0	0	0	0	0	0	0	0
X		X	Lark Sparrow	0	0	0	0	1	0	0	0	1	0	0	0	0
X	X	X	Savannah Sparrow	6	6	3	6	4	4	0	0	11	0	3	0	0
X			Lincoln's Sparrow	0	0	0	0	0	0	0	0	0	0	0	0	0
X	X	X	W-c Sparrow	15	10	20	36	10	12	0	0	10	30	30	10	13
X			Red-winged Blackbird	0	0	0	0	0	0	0	0	0	0	0	0	0
X	X	X	Western Meadowlark	2	0	1	0	2	7	0	0	5	5	5	0	5
X	X	X	Y-headed Blackbird	1	6	1	1	1	2	0	0	1	0	1	0	0

Table 2 Continued

Habitat*			Species	9-17	9-18	9-21	9-23	9-28	9-29	9-30	10-6	10-7	10-8	10-12	10-13	10-14
AG	CP	S1														
X	X	X	Brewer's Blackbird	0	0	4	0	5	0	0	10	0	1	2	0	0
X		X	Blackbird species	0	0	0	0	0	0	0	0	0	0	0	0	1
X	X	X	House Finch	0	0	0	0	0	0	0	2	0	8	0	8	18
X			Lesser Goldfinch	0	0	0	0	0	0	0	6	0	3	1	0	3

				10-20	10-21	10-22	10-27	10-28	11-3	11-4	11-9	11-11	11-18	11-24	11-28	11-29
X	X	X	Brewer's Blackbird	0	0	0	0	0	0	0	0	0	0	0	0	0
X		X	Blackbird species	0	0	0	0	0	0	0	0	0	0	0	0	0
X	X	X	House Finch	9	79	83	21	43	106	0	0	103	22	45	20	26
X			Lesser Goldfinch	0	0	0	0	0	0	0	0	0	0	0	0	0

*AG Agricultural fields located between Coolwater Evaporation Ponds and Solar One.
CP Cool Water Evaporation Ponds
S1 Solar One

From mid-morning on, these birds forage within the agricultural areas performing limited short distance flights while remaining close to the ground. Based on our observations during the fall study period, the Solar One facility will have no detrimental impact on these species.

Incinerations

Arthropods: In this fall study we continued to observe arthropod incinerations in the standby region (Table 3). Although large numbers of insects were frequently killed during a short period of time, incineration episodes occurred only sporadically. Incinerations occurred on an average of 10.5 per minute. On two days of observations, 18 September and 8 October, we recorded extremely heavy periods of arthropod incinerations. On 8 October, an estimated 800 insects were incinerated during three separate closely spaced 15-second intervals. This is probably a minimum incineration rate for this period, as only a portion of the standby region can be observed at any one time. The relative brightness of most observed incinerations was probably indicative of medium to large insects.

There appeared to be far fewer insect species and lower numbers of individuals during this study than during the previous spring. The lower number of insects in the area during fall was probably a result of lower food availability during this period (See Nagano memo: Appendix II). The most abundant insects during fall were several species of moths which occurred in large concentrations in the alfalfa fields, on

Table 3. Observations of bird flight at the Solar One Facility, Fall 1982.

Observation Period	Total Hours of Observation	Events*/hr.	Species/hr.	Birds/hr.	Flight Direction			H	C	O
					East	West	Other			
AM	22	7	3.4	91	24	54	2	33	16	11
PM	15	6.4	1.2	74	17	8	20	8	31	23

* An event is a discreet action by one or more birds

H- Birds flew over heliostats

C- Birds flew over cleared field inside power plant

O- Birds flew outside the power plant

blooming tamarisk shrubs (Tamarix ramosissima), and on rabbitbrush (Chrysothamnus nauseosus). The latter two plants are of low density but attract many pollinating insects (moths, bees, wasps, flies, etc.).

Birds: In spring 1982, three birds were incinerated during the five week survey period. During this 12 week fall survey, only one confirmed incineration occurred; a Yellow-rumped Warbler (Dendroica coronata) which was found near the control tower on 29 October with its back, stomach, and tail feathers burned, although the bird was still alive. Another unconfirmed sparrow incineration may have occurred on 20 October. This bird appeared burned and was flying poorly but escaped the pursuer (a plant employee). Avian mortality caused by incineration in the standby regions or the receiver during fall averaged 0.72 birds/month. Twelve additional birds were found on the facility grounds which had apparently died from collisions with facility structures, primarily the heliostat mirrors (4.3 birds/month). Total avian mortality which can be attributed to the Solar One facility averaged 5.1 birds/month.

We located bird parts (wings, heads, or headless bodies) from an additional 38 individuals within the heliostat field, the majority of which were concentrated on the west side (Figure 5). We were unable to determine whether these birds were killed by predators outside the Solar One facility and carried into the heliostat field for consumption or whether the fatalities were attributed to collisions or incinerations within the plant facility and then consumed.

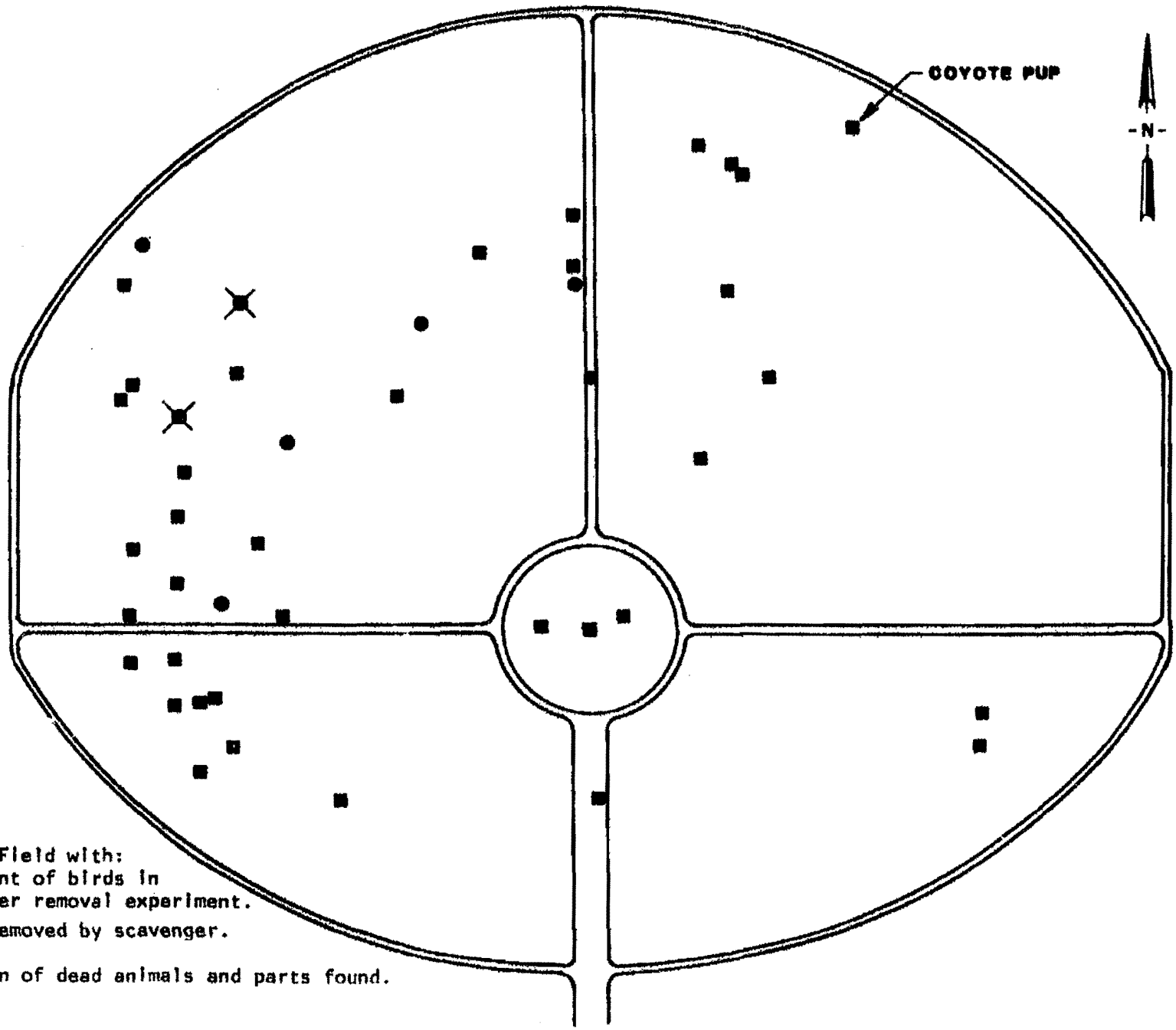


Figure 5.
Heliostat Field with:
● Placement of birds in scavenger removal experiment.
✱ Birds removed by scavenger.
■ Location of dead animals and parts found.

Scavenger Removal Experiment

An experiment was performed to determine possible predator/scavenger removal of dead birds from the heliostat field. A total of 13 birds ranging in size from Western Gull (Larus occidentalis) to House Finch were used in the experiment. On 17 September, between 1045 and 1145 hours, we placed 7 birds 120 m apart in the northwest quadrant of the facility (Figure 5). An additional 6 birds were placed outside the facility confines to the northwest. These birds were placed in salt bush scrub habitat and spaced 120 m apart. By 1500 hrs on that same day, a small bird within the heliostat field had been removed. This was the only bird removed from the facility grounds during the experiment. Outside the fence no birds were missing until the week of 6 October, when 2 birds had disappeared and another had been torn apart and partially consumed. From this experiment it appears that scavenger removal of bird fatalities within the Solar One grounds is minimal and would not effect the overall detection of bird mortality during the fall survey.

CONCLUSIONS

During the fall study period (17 Sept - 29 Nov) avian mortality from incinerations and collisions with plant structures averaged 5.1 birds/month. This is slightly lower than the mortality rate (5.6 birds/month) recorded during the spring 1982 study period. This decrease may be attributed to the lower abundance of birds observed during fall (274/census vs. 366/census). Peak abundance for a single day was also significantly lower during fall (474 on 4 Nov. vs. 1,040 on 12 May).

The greatest concentration of birds (primarily waterfowl and shorebirds) occurred at the evaporation ponds. The greatest abundance for a single species, the Least Sandpiper (Calidris minutilla) (73/census) also was recorded at these ponds, with Northern Pintail (Anus acuta) (33/census) the second most numerous. The fallow agricultural fields were heavily utilized by birds, primarily large finch flocks, for foraging. Although not included in our censuses, the adjacent irrigated alfalfa fields to the east of Solar One provided foraging habitat for several hundred blackbirds, finches, and sparrows throughout the fall season. The agricultural fields adjacent to the Cool Water ponds had far less concentrations of these species. Although foraging occurred predominately outside the Solar plant, there was periodic use of cleared areas within the facility.

Observations of insect incinerations at the standby points during five days in September and October revealed that an average of 632 insects were killed per hour. The rate of insect incinerations varied greatly from day-to-day and ranged from only one incineration per hour on 21 September to over 5,000 per hour on 8 October. Insect incinerations during fall involved very few species and significant incinerations occurred on only a few days.

Only one bird incineration was documented during the twelve week fall study, in contrast to 3 birds killed during five weeks of censusing during the previous spring. This reduction in bird incinerations may be attributed to the lack of aerial insectivores at this site during fall migration as compared to spring. An additional 12 birds died from collisions with facility structures, mainly heliostat mirrors. These results are comparative to the spring study when 8 birds died from collisions with facility structures. This indicates that collisions with heliostats is the primary cause of avian mortality at a solar generating plant rather than incinerations.

Although the Solar One facility may periodically kill large numbers of insects, the overall impact to wildlife appears to be minimal. Avian mortality in particular is very low and does not warrant major concern to birds at this locality during fall migration. With the lack of suitable habitat for birds characteristic of the Mojave Desert, the man-made habitat (i.e. agricultural fields and Cool

Water ponds) of this site acts as an important attractant to overwintering bird populations and warrants further study during the winter months to assess avian/Solar One interactions.

Appendix I. Comprenensive Species List for Solar One, Fall 1982

Eared Grebe	Podiceps nigricollis
Western Grebe	Aechmophorus occidentalis
American White Pelican	Pelecanus erythrorhynchos
Great Blue Heron	Ardea herodias
Great Egret	Casmerodius albus
Snow Goose	Chen caerulescens
Canada Goose	Branta canadensis
Mallard	Anas platyrhynchos
Northern Pintail	Anas acuta
Cinnamon Teal	Anas cyanoptera
Northern Shoveler	Anas clypeata
Gadwall	Anas strepera
American Wigeon	Anas americana
Bufflehead	Bucephala albeola
Ruddy Duck	Oxyura jamaicensis
Turkey Vulture	Cathartes aura
Northern Harrier	Circus cyaneus
Sharp-shinned Hawk	Accipiter striatus
Red-tailed Hawk	Buteo jamaicensis
Ferruginous Hawk	Buteo ragalis
Golden Eagle	Aquila chrysaetos
American Kestrel	Falco sparverius
Prairie Falcon	Falco mexicanus
Gambel's Quail	Callipepla gambelli
Snowy Plover	Charadrius alexandrinus
Semipalmated Plover	Charadrius semipalmatus
Killdeer	Charadrius vociferus
Black-necked Stilt	Himantopus mexicanus
American Avocet	Recurvirostra americana
Greater Yellowlegs	Tringa melanoleuca
Spotted Sandpiper	Actitis macularia
Marbled Godwit	Limosa fedoa
Sanderling	Calidris alba
Western Sandpiper	Calidris mauri
Least Sandpiper	Calidris minutilla

Appendix I Continued

Baird's Sandpiper	Calidris bairdii
Pectoral Sandpiper	Calidris melanotos
Dunlin	Calidris alpina
Long-billed Dowitcher	Limnodromus scolopaceus
Red-necked Phalarope	Phalaropus lobatus
Bonaparte's Gull	Larus philadelphia
Ring-billed Gull	Larus delawarensis
California Gull	Larus californicus
Herring Gull	Larus argentatus
Mourning Dove	Zenaida macroura
Greater Roadrunner	Geococcyx californianus
Great Horned Owl	Bubo virginianus
Northern Flicker	Colaptes auratus
Say's Phoebe	Sayornis saya
Horned Lark	Eremophila alpestris
Tree Swallow	Tachycineta bicolor
Cliff Swallow	Hirundo pyrrhonota
Barn Swallow	Hirundo rustica
Common Raven	Corvus corax
Verdin	Auriparus flaviceps
Bewick's Wren	Thryomanes bewickii
House Wren	Troglodytes aedon
Ruby-crowned Kinglet	Regulus calendula
Black-tailed Gnatcatcher	Polioptila melanura
Hermit Thrush	Catharus guttatus
Water Pipit	Anthus spinoletta
Loggerhead Shrike	Lanius ludovicianus
European Starling	Sturnus vulgaris
Warbling Vireo	Vireo gilvus
Orange-crowned Warbler	Vermivora celata
Nashville Warbler	Vermivora ruficapilla
Yellow-rumped Warbler	Dendroica coronata
Black-throated Gray Warbler	Dendroica nigrescens
Common Yellowthroat	Geothlypis trichas

Appendix I Continued

Chipping Sparrow	*Spizella passerina*
Brewer's Sparrow	*Spizella breweri*
Lark Sparrow	*Chondestes grammacus*
Savannah Sparrow	*Passerculus sandwichensis*
Lincoln's Sparrow	*Melospiza lincolnii*
White-crowned Sparrow	*Zonotrichia leucophrys*
Red-winged Blackbird	*Agelaius phoeniceus*
Western Meadowlark	*Sturnella neglecta*
Yellow-headed Blackbird	*Xanthocephalus xanthocephalus*
Brewer's Blackbird	*Euphagus cyanocephalus*
Brown-headed Cowbird	*Molothrus ater*
House Finch	*Carpodacus mexicanus*
Lesser Goldfinch	*Carduelis psaltria*

Appendix II

TO: Ralph Schreiber

FROM: Chris Nagano

SUBJECT: The effect of the operation of Solar One on insect populations

DATE: 30 December 1982

GENERAL: Due to the unique nature of Solar One, no data base exists with which to compare this investigation. Additionally, the reaction of diurnal flying insects to a large bright hot object in their immediate surroundings remains unstudied.

OBSERVATIONS: Field work began at 0900 hrs. and ended at 1300 hrs. on 3 November 1982. Observations were made within and around the outside of the perimeter fence of Solar One, at the alfalfa fields located to the southeast of the site and the evaporation ponds to the southwest.

The few flying insects observed inside the Solar One plant were temporary transients, as there is no source of food on site in October, 1981 (Schreiber, pers. comm.). They are the dragonfly Tarnetrum corruptum (based on the identification of dead specimens), a species widespread in southern California that has previously been observed in migrating swarms (Nagano, pers. obs.). This species probably breeds in ponds located in the immediate area used for swimming and for raising catfish (Pat Flanagan, pers. comm.). No ground inhabiting insects were seen, and it is unlikely that any significant native insects inhabit the site.

The only insects observed breeding in the evaporation ponds southwest of Solar One were brine flies (Ephydridae). A number of species in this family inhabit bodies of extremely saline and hot water. Ephydrids rarely stray from their breeding site, and I do not expect significant numbers will be found at Solar One.

"Pest" butterflies (Colias philodice, Colias eurytheme, and Pieris rapae) breed at the alfalfa fields to the southeast of Solar One. These insects, as well as other insects including Honey Bees (Apis mellifera), native bees, wasps, and flies and an undetermined noctuid moth were observed feeding in large numbers on the flowering bushes next to the southwest side of the power plant.

RESULTS: The primary effect of Solar One appears to be a relatively small reduction in the numbers of diurnal aerial insects resulting from their flying into the top of the tower and being incinerated. This is probably not a serious environmental problem because most insect populations, like many other invertebrates, are composed of extremely large numbers of individuals and thus small reductions are not deleterious.

Based on my observations of the insect fauna surrounding Solar One and on the descriptions of the incinerations, I suspect that in the fall season dragonflies (Tarnetrum corruptum) comprise the bulk of insects destroyed with lesser numbers of diurnal moths, bees, and wasps also being killed.

Another short-term problem involves the attraction of flying aquatic insects who may mistake the shiny mirrors for bodies of water. This would not reduce the numbers of these insects and should be only a temporary inconvenience.

The only long-term effect is a reduction in the diversity and abundance of species as a result of the initial construction of Solar One. The removal of vegetation, erection of structures and associated earth moving no doubt eliminates many populations and numbers of individuals. Habitat destruction has been documented as the primary cause of extinction in insects.

No species of insects known to be under state or federal protection were observed or anticipated at Solar One.

RECOMMENDATIONS: I recommend that, although no short-term problems were observed, field work be done during the peak insect flight periods in the spring (April-May) and fall (September-October). The long-term problem of habitat destruction has already occurred and no mitigation measures can be taken.

Appendix III

Data on animals found dead at Solar One, Fall 1982

9/17/82 Coyote pup in advanced state of decay.

9/17/82 Yellow-headed Blackbird (Xanthocephalus xanthocephalus), a complete but very old and dessicated specimen.

9/17/82 Blackbird sp., a complete but old and dessicated specimen.

10/07/82 Blue-winged Teal (Anas discors) found dead on the 2nd level of the Central Receiver Tower. Apparently collided with tower.

10/12/82 Red-necked Phalarope (Phalaropus lobatus). Probable heliostat fatality.

10/20/82 Savannah Sparrow (Passerculus sandwichensis). A fresh specimen found dead beneath heliostat with the tip of the lower mandible broken.

10/20/82 A sparrow-sized bird with singed wing and tail feathers was observed in the SE quadrant. The bird was flying poorly but escaped the observer and was not seen subsequently.

10/22/82 A hummingbird sp. (carcus very old) was found under the west standby point. It was not possible to tell cause of death.

10/27/82 White-crowned Sparrow (Zonotrichia leucophrys) found near the Condensate Tank with fresh blood on side of the bill.

10/27/82 Savannah Sparrow (Passerculus sandwichensis). Probable heliostat fatality.

10/29/82 Yellow-rumped Warbler (Dendroica coronata) found adjacent to the Control Tower. The back, breast, and tail feathers were singed, however the bird was still alive.

11/02/82 Savannah Sparrow (Passerculus sandwichensis) found under the south standby point. Specimen was very old and no singed feathers were evident.

11/04/82 Dark-eyed Junco (Junco hyemalis) found with no obvious injury. Probable heliostat fatality.

Identifiable bird parts attributed to unknown predators

Eared Grebe	Podiceps nigricallis	3 parts
Black-necked Stilt	Himantopus mexicanus	2 parts
American Avocet	Recurvirostra americana	1 part
Bonaparte's Gull	Larus philadelphia	1 part
Mourning Dove	Zenaida macroura	1 part
Horned Lark	Eremophila alpestris	2 parts
European Starling	Sturnus vulgaris	1 part
Brewer's Blackbird	Euphagas cyanocephalus	4 parts
House Finch	Carpodacus mexicanus	4 parts