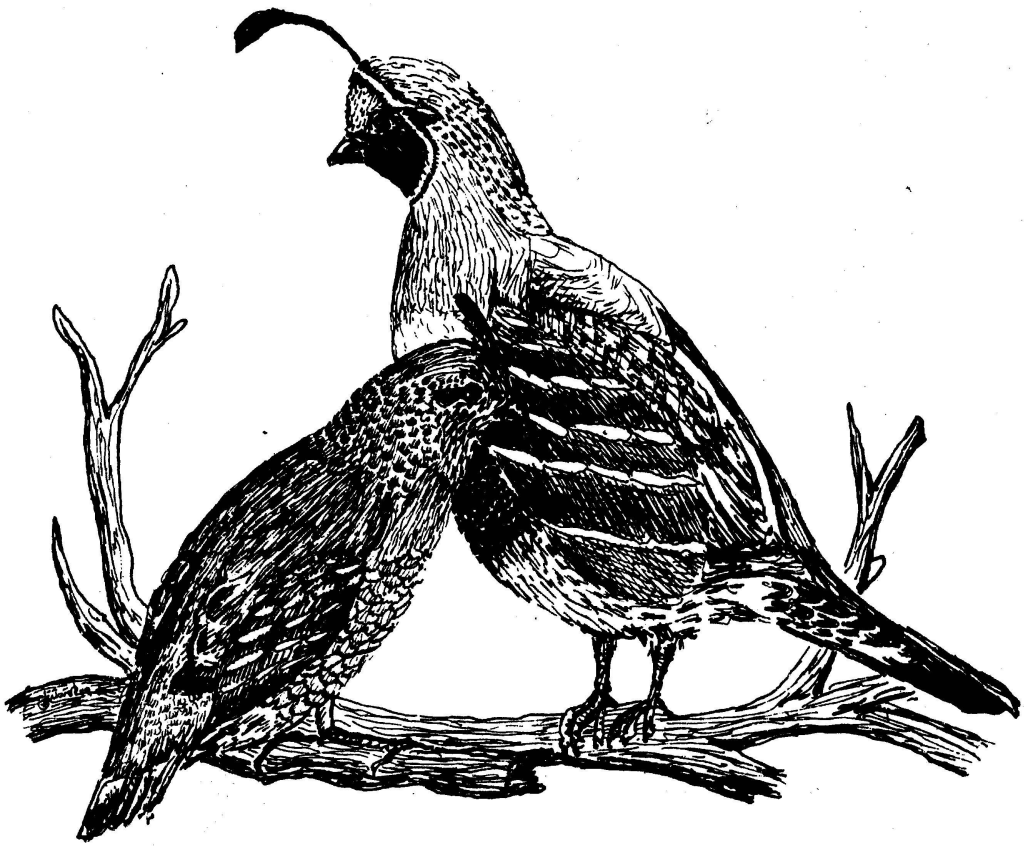
EVALUATION OF WILDLIFE HABITAT DEVELOPED ON GOVERNMENT PROJECT LANDS along Snake River in Washington



Washington Department of Game

Habitat Management Division

31 May 1980

STATE OF
WASHINGTON
Dan W. Ra
Game

DEPARTMENT OF GAME

Walla Walla District Office
1925 E. Isaacs
Walla Walla, Wa 99362

29 October 1980

Ray Oligher
U.S. Army Corps of Engineers, Bldg 603
City-County Airport
Walla Walla, Wa 99362

Ray:

Near the end of the Snake River on-project habitat evaluation contract (No. DACW 68-78-C-0023) the study team was able to conduct some Canada goose nesting studies which were not required by the contract. I coordinated this with Paul Peloquin and agreed to furnish a report as time permitted. Attached is a copy of the report. Where practical, we included comparisons with the first two study years. Canada goose compensation progress for 1980 was determined to be 108 percent.

Sincerely,

DEPARTMENT OF GAME

David Mudd

David Mudd
Snake River Project Manager

DM:ns

cc w/att.:
John McKern, COE
Wendell Oliver, WDG
Ted Cruenwald, WDG

Washington Department of Game
2925 East Isaacs
Walla Walla, Wa 99362

CANADA GOOSE PRODUCTION ALONG THE LOWER SNAKE RIVER IN 1980

By

Lawrence Boe
David Mudd
Robert Bugert

INTRODUCTION

The field work for this report was completed while the authors were working on contract No. DACW 68-78-C-0023 from the U.S. Army Engineer District, Walla Walla. During the report writing and review process, we had time to continue some extra field work to determine Canada goose gosling production for 1980. We stated then that we would complete a report on our findings as time permitted. This is that report.

RESULTS

One hundred and sixty-nine Canada goose nests were found during one boat search (11 to 14 April) and one helicopter search (17 and 18 April) of the 210 km study area. One hundred and six nests were found on islands, 61 in cliffs, and two on artificial nesting structures.

A revisit by boat and on foot was conducted to gather data on clutch size and nesting and hatching success. Clutch size averaged 5.3 $\pm$ 1.3 eggs (N=156 nests), nesting success was 89 percent (N=110 of 124 nests), and hatching success was 93 percent (N=499 of 534 eggs). Many of the cliff nests were inaccessible on foot; however, 30 cliff nests were believed to contain complete clutches when seen from the helicopter, and these data were incorporated into the average clutch sizes.

Data from nests studied were extrapolated to include all nests and to derive an estimated total production of 897 eggs and 760 goslings. Comparisons of three years of observed goose nesting and estimated gosling production are presented in Table 1 and Figure 1.

Table 1. A comparison between years of observed Canada goose nesting and estimated egg and gosling production, lower Snake River, 1978-80.

Year	No. Nests Found	Mean Clutch Size	Percent Nesting Success	Percent Hatching Success	Estimated No. of Eggs	Estimated No. of Goslings
1978	100	5.7 $\pm$ 1.5	89%	98%	565	492
1979	116	5.5 $\pm$ 1.4	96%	98%	632	605
1980	169	5.3 $\pm$ 1.3	89%	93%	897	760

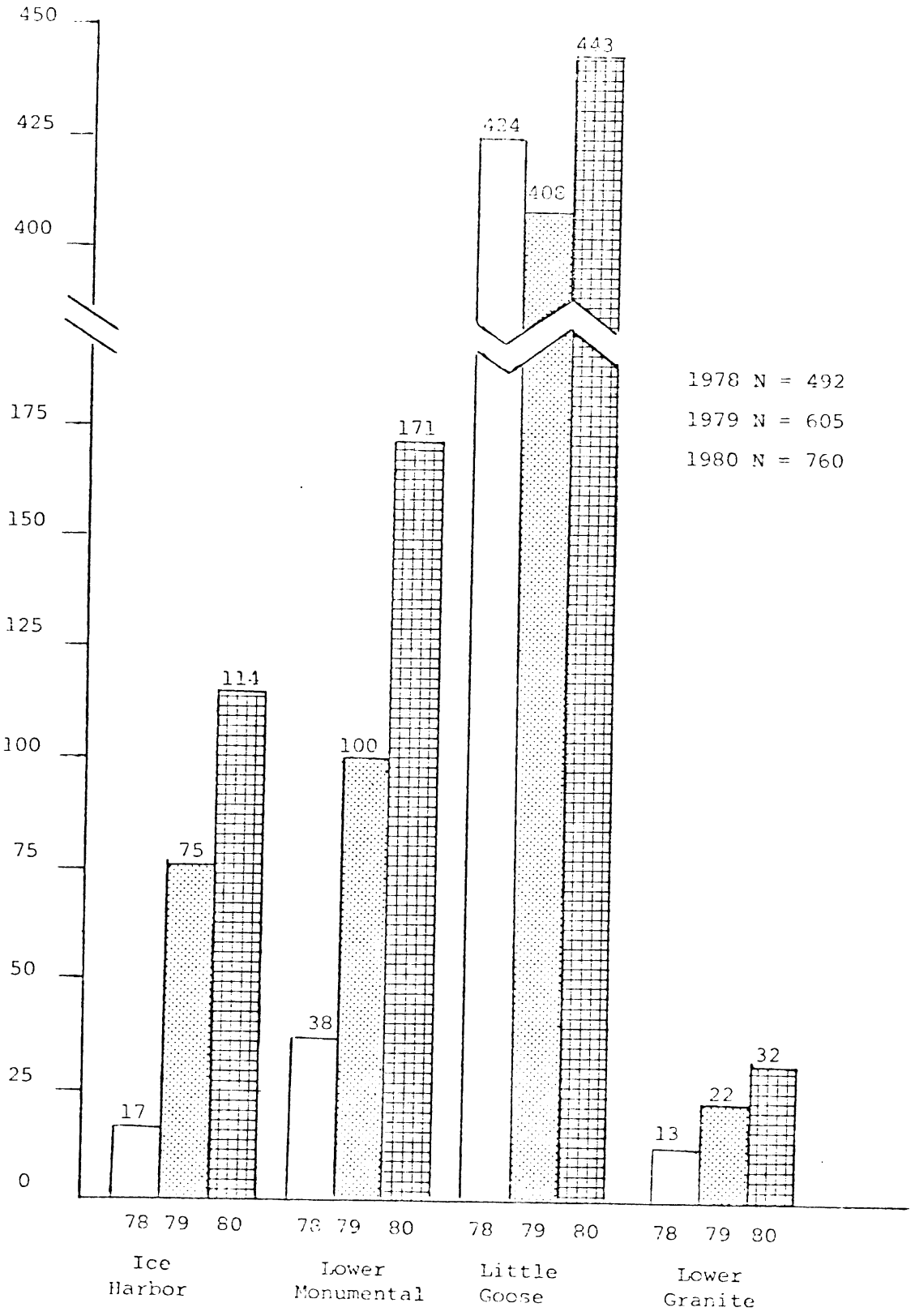


Figure 1. Estimated number of goslings produced during the 1978, 1979, and 1980 breeding seasons, Lower Snake River Study.

The 1980 nesting season represented a 46 percent increase over the number of nests found in 1979. Table 2 breaks down nest site locations from 1978 to 1980 by island, cliff, and artificial structure. We believe the 1980 nesting season represents a general increase in goose nesting throughout the study area, as island nesting and cliff nesting increased 34 and 69 percent respectively over 1979. A further breakdown of cliff nesting by project (Table 3) shows an increase along the entire length of the study area. Reproductive data from cliff nests are presented in Table 4.

Islands continue to account for the majority of nests found along the river (Table 2). New York Island supported 92 nests in 1980 of which 78 hatched. Nesting success and hatching success on New York Island were 86 and 93 percent respectively and resulted in 389 goslings hatched. Reproductive data from all island nests are presented in Table 5.

Table 2. Locations of Canada goose nests found along lower Snake River, 1978-80.

Year	Nests Found		
	Islands	Cliffs	Artificial Structures
1978	93	5[a]	2
1979	79	36[b]	1
1980	106	61[b]	2

[a]Search conducted from boat.

[b]Search conducted from boat and helicopter.

Table 3. A comparison between projects of Canada goose cliff nests per mile of river shoreline, lower Snake River, 1979-80.

Year	Project			
	Ice Harbor	Lower Monumental	Little Goose	Lower Granite
1979	0.21	0.26[a]	0.08	0.02
1980	0.29	0.49[a]	0.13	0.06
Percent Increase (1980 over 1979)	38%	88%	63%	200%

[a]Includes nests found in cliffs adjacent to slack water in Palouse River.

Table 4. Reproductive data from Canada goose cliff nests along the lower Snake River, 1980.

	No. Nests Found	Mean Clutch Size	Nest Success	Hatching Success	Estimated Eggs Produced	Estimated Goslings Hatched
Ice Harbor	18	5.8 ± 0.9	100.0%	100.0%	104	104
Lower Monumental	30	4.8 ± 1.3	100.0%	97.4%	144	140
Little Goose	10	5.1 ± 0.7	80.0%	100.0%	51	41
Lower Granite	3	5.3 ± 0.6	100.0%	100.0%	16	16
Total	61	5.2 ± 1.1	95.5%	98.9%	315	301

Table 5. Reproductive data from Canada goose island nests on lower Snake River, 1980.

	No. Nests Found	Mean Clutch Size	Nest Success	Hatching Success	Estimated Eggs Produced	Estimated Goslings Hatched
Ice Harbor	5	5.3 ± 1.5	66.7%	55.8%	26	10
Lower Monumental	5	6.2 ± 0.8	100.0%	100.0%	31	31
Little Goose	94	5.3 ± 1.3	84.0%	92.9%	501	396
Lower Granite	2	8.0 ± 1.4	100.0%	100.0%	16	16
Total	106	5.4 ± 1.3	84.0%	92.5%	574	453

A total of 21 artificial nesting structures (16 tripods, two rafts, and three rock structures) were serviced for potential goose nesting in 1980. A tripod on New York Island and a rock structure in Little Goose reservoir contained successful nests. The same tripod contained a successful nest in 1979. The three rock structures, which are rock-filled circles of hog wire about one meter in diameter and 1.3 meters in height, were set in place on an intermittently submerged island (Prop Island) downstream from Boyer Park, and an intermittently submerged concrete tower base downstream from Walker. The upstream rock structure on Prop Island contained the nest. Reproductive data from artificial nest structures are presented in Table 6. Driftwood and nesting material were placed on dredged islands off Swift Bar and Matthews as another goose management measure. Two nests (one hatched, one deserted) were found on the island off Swift Bar.

Compensation progress for 1980 was determined using the same formula as for 1979. Thus, of the estimated 760 goslings hatched, 646 were expected to survive to flight stage. Since the pre-project estimate was 600 goslings raised to flight stage, compensation progress for Canada geese has now reached 108 percent.

Table 6. Reproductive data from Canada goose nests found on artificial nest structures along the lower Snake River, 1980.

	No. Nesting Structures	No. Nests Found	Mean Clutch Size	Nest Success	Hatching Success	Estimated Eggs Produced	Estimated Goslings Hatched
Ice Harbor	2	0	-	-	-	0	0
Lower Monumental	10	0	-	-	-	0	0
Little Goose	9	2	4.0	100%	75%	8	6
Lower Granite	0	0	-	-	-	0	0
Total	21	2	4.0	100%	75%	8	6

Observations of goose broods were recorded between 15 April and 28 May 1980 and are presented in Table 7. Observations were recorded during searches for goose nests and other work conducted on the river.

Table 7. Observations of Canada goose broods on lower Snake River, 1980.

Project	River Mile	Location	No. Goslings	No. Adults
Ice Harbor	18S	Fishhook Park	4	2
	18S	Fishhook Park	3	2
	18S	Fishhook Park	6	4
	24S	Hollebeke	5	2
Lower Monumental	45N	Tranquility	5	2
	48N	Skookum	6	4
	48N	Skookum	4	2
	49N	Skookum	5	2
	55S	Ayer	3	2
	59N	Palouse River	18	8
	60N	Two Islands	5	2
	62N	Sargent	5	2
Little Goose	78	New York Gulch	48	25
	94	Swift Bar	4	2
Lower Granite	None Observed			

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By
David Mudd
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Applied Research Biologists
Washington Department of Game

Final Report
31 May 1980

Prepared for
U.S. Army Engineer District, Walla Walla
Contract DACW 68-78-C-0023

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ABSTRACT

The Washington Department of Game was contracted by the Army Corps of Engineers to determine base line wildlife populations on the lower Snake River to be used to measure the success of wildlife habitat development. A second major objective was a current measurement of wildlife compensation progress. Ice Harbor, Lower Monumental, Little Goose, and Lower Granite projects were studied.

Two hundred seventy-eight pheasants were flushed in spring 1979 and a cock/hen ratio of 1:5.4 determined. In 1980, 506 pheasants were flushed resulting in a 1:4.9 cock/hen ratio.

Winter flushing counts were made with the aid of dogs on 10 irrigated and 10 dryland management units. A total of 418 ring-necked pheasants, 84 California quail, 13 chukar, 25 gray partridge, 16 mourning doves, and 50 cottontails were flushed.

Pheasant, dove, quail and chukar calls were counted at 60 listening stations along the river. Pheasant call counts ranged from 0 to 12 per two-minute period with a mean of 1.9 ± 2.2. Dove call counts ranged from 0 to 20 per three-minute period, with a mean of 1.2 ± 3.3. California quail calls were counted during the pheasant and dove call counts. A mean of 0.1 ± 0.8 was calculated for both counts. Chukar call responses to a taped rally call were counted. The range was 0 to 19 calls per ten-minute period with a mean of 1.0 ± 3.4. We recommend omitting all of the call counts in future years since they provide only population trends and not actual wildlife numbers. Winter flushing counts on each management unit are more accurate for determining actual wildlife numbers.

Counts of chukar from helicopter during December 1979 found high chukar populations in Lower Granite (8440), moderate populations in Little Goose (1987) and Lower Monumental (538), and low populations in Ice Harbor (162). Deer counts from helicopter totalled 1938, 1591 mule deer and 347 white-tailed deer. Buck ratios were similar to last year with 4.5 mule deer bucks/100 does and 6.8 white-tailed bucks/100 does. Fawn ratios were down because of poor forage conditions caused by drought. Fawn ratios were 50.0 mule deer fawns/100 does and 60.9 white-tailed fawns/100 does.

During summer brood counts the mean brood sizes were: ring-necked pheasants 6.3, gray partridge 10.3, chukar 11.3, and California quail 10.0. The peak of pheasant hatching was about 25 May, approximately 10 days later than 1978.

One hundred and sixteen western Canada goose nests were found in the study area. Seventy-eight of the nests were on islands, 36 on cliffs, one on an isthmus, and one on an artificial nesting structure. An estimated 514 goslings were produced to flight stage. Seventy-three broods were recorded to locate brooding areas. Twenty-one upland nests were found during two searches of 68 0.25 ha search plots. Nests of seven bird species were found: ring-necked pheasant, mallard, northern oriole, Brewer's blackbird, spotted sandpiper, western meadowlark, and house sparrow. Nest densities were low.

Goose use of the future irrigated pastures was determined from dropping counts. Goose use was greater during autumn-winter than during spring-summer. Ridpath and Skookum had the most goose use.

Bird densities were determined for breeding and winter periods. Chief Timothy supported the highest breeding bird density (1088 birds/km^2) followed in order by Hollebeke, New York Bar, 55-Mile, Swift Bar, Big Flat, Wilma, and Skookum. Wilma supported the highest winter bird density (555 birds/km^2) followed in order by Swift Bar, Hollebeke, Chief Timothy, Big Flat, New York Bar, Skookum, and 55-Mile. Bird densities were high in trees and shrubs, and tall forb cover, and low in other cover types. Bird diversity and richness were high in trees and shrubs and generally low in other cover types. Base line density, diversity, evenness, and richness were calculated at the eight study sites.

Observations of future guzzler sites were made to determine base line use of the sites. Use of the sites was low and consisted primarily of non-game birds.

Linear correlations were calculated between habitat diversity and bird density, bird diversity, bird evenness, and bird richness. Both bird density and bird richness were found to be dependent on habitat diversity.

The current level of compensation progress was determined. For Canada geese it was 86 percent, breeding non-game birds 17 percent, wintering non-game birds 3 percent, upland game 2 percent, chukars 0 percent, and deer 0 percent. Total wildlife compensation was estimated to be 4 percent.

Base line measurements were calculated for each segment of our study. These data will be used to measure future wildlife population estimates against to determine the success of habitat development.

INTRODUCTION

The Army Corps of Engineers is developing wildlife habitat on Corps-owned lands to replace wildlife losses caused by construction of Ice Harbor, Lower Monumental, Little Goose, and Lower Granite dams on the lower Snake River. The Corps contracted the Washington Department of Game (WDG) on 1 March 1978 to determine wildlife population changes attributable to this habitat development. The original contract period was 15 months and a final report was submitted 31 May 1979. The contract was extended for 12 months and this is the final report for this contract.

Replacement of wildlife losses caused by the Snake River dams has been a slow process, and habitat development plans have undergone many changes. Impacts on wildlife populations began in the early 1960's with construction of Ice Harbor Lock and Dam and continue to today. It was not until 1975 that a comprehensive report of the wildlife losses caused by the dams was completed (U.S. Army Engineer District, Walla Walla 1975a). That same year a design memorandum describing wildlife habitat development on project lands was completed and approved (U.S. Army Engineer District, Walla Walla 1975b). It contained plans for 20 irrigated management units (917 acres) and four dryland units (189 acres) totalling 1,106 acres. In 1978, a supplemental design memorandum was drafted by the Corps modifying the approved 1975 plan and proposing irrigated habitat development on 11 units (1,141 acres) and dryland habitat development on nine units (313 acres) totalling 1,454 acres (U.S. Army Engineer District, Walla Walla 1979). Detailed analysis has revealed, however, that only 750 acres (726 by solid-set big gun sprinklers, 10 by windmill, and 14 by flood) will actually be irrigated because water from the sprinklers will cover only about 65 percent of the acreage listed as irrigated.

Between these two habitat development design memoranda published in 1975 and 1979, another Corps' plan proposed 12 irrigated units and 12 dryland units. Our 1978-79 study team scope-of-work was designed around this plan. When the 1979 habitat development design memorandum was implemented, our 1979-80 scope-of-work was modified accordingly.

During this first two years of study, we have determined the existing wildlife population levels along the Snake River prior to habitat development. This information will be used as a base line to measure future changes against. In this manner the wildlife population changes attributable to habitat development will be determined. During 1979-80 we have also measured wildlife compensation progress to date.

Most of the irrigation systems are installed and some habitat development will begin in 1980. The Corps is contracting WDG to develop, operate, and maintain the compensation lands, also. That contract was signed in March 1980.

OBJECTIVES

1. Measure progress of wildlife compensation toward the numerical goals established for principal game species listed in Table 11 of the Lower Snake River Fish and Wildlife Compensation Plan.
2. Determine the amount of change occurring as a result of habitat development within selected animal populations such as deer (mule and white-tailed), ring-necked pheasants, gray partridges, chukar, California quail, mourning doves, and waterfowl (ducks and geese) by means of routine counts conducted on project lands along the lower Snake River between Ice Harbor Lock and Dam and the city limits of Lewiston, Idaho.
3. Determine and associate the response of selected animal groups and avian community characteristics (composition, density, and diversity) to specific developments being implemented to accomplish wildlife compensation on selected units managed by the U.S. Army Engineer District, Walla Walla.
4. Provide recommendations on the management of wildlife habitat being developed on Government lands for use by the U.S. Army Engineer District, Walla Walla, in its operations and maintenance of compensation lands.

DESCRIPTION OF STUDY AREA

The study area extends 210 kilometers (130 miles) along the lower Snake River between Ice Harbor Lock and Dam and the city limits of Lewiston, Idaho. It includes four hydroelectric projects: Ice Harbor, Lower Monumental, Little Goose, and Lower Granite.

Eight irrigated development units (two per project) received intensive study of bird populations, upland nest densities, goose use, guzzler use, cover mapping, and habitat diversity indices and were named "study sites." The study sites were Big Flat, Hollebeke, Skookum, 55-Mile, New York Bar, Swift Bar, Chief Timothy, and Wilma. Trend counts of pheasant, dove, and chukar populations, upland game bird brood counts, pheasant sex composition, and wintering game bird population levels were determined at 20 "management units," 10 irrigated and 10 dryland (Table 1). The wildlife impacts of the Corps'

fencing program were studied at the units listed in Table 2. Aerial surveys of deer, coyotes, and chukar, searches for goose nests, and the measurement of compensation progress covered the entire 420 km (260 miles) of study area shoreline.

Table 1. Locations of listening stations for pheasant, dove, quail, and chukar call counts, Lower Snake River Study, 1979.

PROJECT Development Type Management Unit	Side of River	River Mile Downstream Station	 Central Station	 Upstream Station
ICE HARBOR				
Irrigated				
Big Flat	North	14.7	15.6	16.7
Lost Island	North	22.1	23.0	24.2
Hollebeke	South	24.3	25.3	26.3
Dryland				
Charbonneau	South	11.0	12.0	13.1
Walker	South	29.7	30.6	31.7
Couch Landing	North	31.0	32.0	33.1
LOWER MONUMENTAL				
Irrigated				
Skookum	North	47.9	48.9	49.9
55-Mile	North	54.0	55.0	56.2
Dryland				
Ayer	South	52.7	53.7	54.7
Joso	South	56.3	57.4	58.5
LITTLE GOOSE				
Irrigated				
Ridpath	North	75.1	76.2	77.4
New York Bar	South	78.5	79.7	81.0
Swift Bar	North	94.4	95.4	96.6
Dryland				
L. Goose Rec. Area	South	71.1	72.2	73.2
Purrington	North	84.2	85.2	86.3
Schultz Bar	North	99.3	100.3	101.3

Table 1. (Cont.)

PROJECT Development Type Management Unit	Side of River	River Mile Downstream Station	 Central Station	 Upstream Station
LOWER GRANITE				
Irrigated				
Chief Timothy	South	131.3	132.2	133.2
Wilma	North	133.8	134.8	135.8
Dryland				
G. Goose Pasture	South	118.5	119.5	120.4
Moses	North	128.5	129.6	130.8

Table 2. Locations of study sites to determine impact of habitat improvement fencing on bird populations and upland nesting densities, Lower Snake River Study, 1979.

POOLED PROJECT Study Site	River Mile[a]
ICE HARBOR - LOWER MONUMENTAL	
Levey Landing	12N[b]
Lost Island	23N
Ayer	53S[b]
LITTLE GOOSE - LOWER GRANITE	
Beckwith Bar	98S
G. Goose Pasture	120S

[a]"N" denotes north side of river; "S" denotes south.

[b]Levey Landing was originally chosen as a fencing study site; the breeding bird surveys and upland nest searches were completed there. However, the vegetation there was not representative of typical fenced areas and a large colony of bank swallows biased the bird density data so the study was moved to Ayer, where winter bird surveys were conducted.

METHODS

Methods were outlined originally by Corps of Engineers' biologists during December 1977. Some modifications were requested by the Department of Game and implemented by the Corps prior to initiation of the study. Further modifications were made in 1979 to account for the changes in habitat development proposed in the 1979 habitat development design memorandum.

Sex Composition of Pheasants

Between 5 February and 4 April 1979, and 2 February and 20 March 1980, 20 management units (see Table 1) and other selected pheasant wintering areas were searched. Pheasants were flushed, visually sexed, and counted.

In 1979, searches were conducted on foot by four biologists (86.7 man-hours), five student volunteers from Washington State University (42.1 man-hours), and four dogs (48.3 dog-hours). Number of searchers at any area varied from two to five individuals and one to three dogs. We attempted to search all cover on the units where upland game birds were likely to be. Maximum distance searched from a project boundary was 1.2 km at Almota Creek, Little Goose Project. In 1980, searches were conducted by three biologists (86.2 man-hours), six student volunteers from WSU (38.5 man-hours), and four dogs (74.1 dog-hours). Number of searchers at any area varied from two to eight individuals and one to three dogs. Maximum distance searched from a project boundary was 0.3 km at Votaw, Ice Harbor Project.

On the narrow management units (i.e. Ayer, Schultz Bar, Wilma) we searched the entire unit. On the larger units we searched all of the areas of winter cover but only searched part of the entire unit. We covered 15 percent of Big Flat, 35 percent of Hollebeke, 50 to 75 percent of Lost Island, Charbonneau, 55- Mile, Joso, and New York Bar, and 100 percent of all other units.

Composition counts were subjected to Chi-square analysis to determine if there was any difference between units.

Counts of Wintering Upland Game

Methods were identical to the methods used for sex composition of pheasants. Both studies were conducted simultaneously. Since we conducted the counts in February and March when the upland game should have been concentrated in or near the winter cover, and we searched all of the winter cover, we believe our counts represent a reliable estimate of the total winter population on each unit.

Counts of Pheasant, Dove, and Quail Calls

Calling counts were recorded for ring-necked pheasants between 25 April and 10 May 1979 and for mourning doves between 6 June and 15 June 1979. Management units where counts were conducted are listed in Table 1. Three permanent listening stations were established at each unit: a station near the center, a station downstream from the center approximately 1.0 mile by boat, and a station upstream from the center approximately 1.0 mile by boat. Where canyon walls rose steeply from the river, stations were established at bases of draws.

Guidelines of Kimball (1949) were followed for pheasant call counts, those of U.S. Fish and Wildlife Service (1973) for dove call counts. During dove call counts we conducted counts during winds exceeding the allowable 19 kph at three stations because of time limitations.

Calls of pheasants were counted during two-minute periods and calls of doves during three-minute periods; a second count began 15 to 30 seconds after the first count ended. Calls from the opposite side of the Snake River were not counted. Listening stations for all units were located so that a semi-circle was censused; call count figures were doubled to make them comparable with values in the literature.

Calls of California quail and chukars were recorded during calling counts of both pheasants and doves. For quail only the complete call of the cock was recorded as a call. For chukar only the rally call was recorded as a call. These chukar call counts were compared with the taped rally call chukar call counts conducted in late summer.

Data were subjected to analyses of variance with nested classification to determine if any difference existed between years, pooled projects, and types of development.

Pheasant breeding population densities were calculated for each management unit based on call counts and sex ratios using formulae from Kimball et al. (1956:240). Formulae and sample calculations are presented in Appendix A. Figures were converted to birds per 100 acres and birds per square km.

Counts of Chukar Calls

Chukar call counts were conducted between 6 and 13 September 1979 under modifications of guidelines presented by Oelklaus (1976). Call counts were taken at the same 60 listening posts used for pheasant and dove call counts (see Table 1). Counts were taken between 1000 and 1500 hours when winds averaged less than 8 kph and no precipitation was occurring.

A two-man team, one listener and one tape player operator, traveled between listening posts by boat. We went ashore if we could remain hidden from the chukars but stayed in the boat if we could not. After arriving at the listening post, we waited five minutes and then broadcast three rally calls with an interval of 25 seconds between successive calls. The first call was broadcast perpendicular to the river, the second call 45° to one side of the first call, and third call 45° to the other side of the first call. The calls were audible to the human ear at 400 to 500 meters, the approximate range of an actual chukar call (Williams 1961:117). Chukar responses (number of calls and number of coveys) were recorded by one-minute intervals for five minutes following the first call. Immediately following the end of the first five-minute listening period the series of calls and five-minute listening periods were repeated.

Counts were halted for five minutes following disturbance of the count area by avian predator, car, or boat; 30 minutes following disturbance by coyote.

A Panasonic RQ-323S portable cassette recorder and Fanon MV-16SC 16-watt megaphone were used to broadcast recorded chukar calls. The recording of chukar rally calls was obtained from Florida State Museum, Gainesville, Florida.

Aerial Surveys of Chukar

Chukars were counted during the winter deer and coyote helicopter survey conducted between 5 and 18 December 1979 from a Hiller 12E helicopter. The survey extended away from the Snake River 2.5 km and included the entire canyon from Ice Harbor Lock and Dam to Lewiston, Idaho, except the upper portions of large side canyons such as Alpowa, Steptoe, Wawawai, Almota, Tucannon, etc. Counts were recorded by project and side of river. Densities were calculated by dividing the number of birds seen by the number of square miles searched. The following figures were used: Ice Harbor-93 square miles, Lower Monumental-87 square miles, Little Goose-111 square miles, and Lower Granite-96 square miles.

Counts of Upland Game Bird Production

Brood counts of upland game birds were made on a sight-frequency basis between 7 June and 30 August 1979. Areas searched for broods included locations where upland game birds had been sighted previously, or where cover appeared likely to contain birds. Some sightings were made when a team member was conducting other field work and flushed a bird. When birds were flushed the surrounding area was searched to locate any remaining birds.

Data gathered included number of hens (pheasants) or adults (partridges,quail), number of juveniles, and age of juveniles (pheasants). A guide obtained from Wendell Oliver of the Washington Department of Game was used to determine the age of juvenile pheasants (see Appendix B). Lack of sexual dimorphism in plumage of gray partridge and chukar, and brood-rearing by cock California quail (Anthony 1970:285) were the reasons we did not attempt to visually sex adults of these species.

Searches for Goose Nests

Islands, artificial nesting structures, and shorelines were searched for goose nests twice during 1979. The initial search was conducted between 10 and 18 April. Revisits, and the second search, were conducted between 25 April and 10 May. An associated helicopter search was made on 18 to 20 April.

Shorelines and cliffs adjacent to the water were searched for geese by scanning with binoculars from boats. Immediately following this search from boats, a helicopter was employed to search the cliffs in the study area. Colored markers were dropped in the vicinity of discovered nests to allow relocation of the nests from the ground. Nest locations were recorded by triangulation (bearings to landmarks were measured with a Brunton pocket transit) and accessible nests were examined to collect nesting data.

Active nests were revisited and islands and artifical nesting structures were searched again, during the second search period. Cliff searches were less intense during the second period because island searches indicated that the nesting season was virtually over. Active nests found during the second search were revisited several weeks later.

Clutch size, presence of down, and vertical and horizontal distance to the high water mark were recorded during the first visit. Nest success and fate of eggs were recorded during the revisit. Decisions about the condition and fate of nests and eggs were based on descriptions given by Hanson and Eberhardt (1971:13). Nest success, hatching success, mean clutch size, and estimated number of goslings produced were calculated.

Index of Goose Use

Goose dropping surveys were conducted to determine relative amounts of goose use on the study sites. Six transects were established in the future pasture cover type at each site. The six transects formed two equilateral triangles, 50 m on each side. Each transect had five sample plots, one sample

plot located randomly along each 10 m segment, for a total of 30 plots per study site. Individual sample plots along each goose dropping transect were chosen with a random numbers table. Each plot was circular and measured one square meter. All droppings found were recorded and removed from the plot.

Data were subjected to analysis of variance to determine whether significant differences existed between years or pooled projects. An estimate of the number of goose-use days per hectare on each study site was determined with the formula:

$$\text{Goose-use days/hectare} = \frac{\text{Droppings/hectare}}{92 \text{ Droppings/day}}$$

The defecation rate for Canada geese is reported to be 92 droppings/day (Taylor 1957, cited by Owen 1971).

Aerial Surveys of Deer and Coyotes

Deer and coyotes were counted from a helicopter (Hiller 12E) from 5 to 18 December 1979. This count determined post-hunting season populations wintering within the Snake River canyon. Mule and white-tailed deer were identified and placed into sex and age groups as follows: adult buck (branched antlers), yearling buck (spiked antlers), doe, and fawn.

Surveys were made by a three-man team (one helicopter pilot and two observers). The survey required 54 hours of flight time. The entire 420 km (260 miles) of study area shoreline were surveyed. The census area extended up the canyon walls approximately 2.5 km from the river. All deer and coyotes sighted during the surveys were recorded by river mile, side of river, and elevation contour. Population densities of both deer and coyotes were computed.

Surveys of Bird Density

Bird survey transects and sample plots were established on each of our eight study sites to determine bird density, diversity, evenness, and richness by future cover type, existing cover type, and study site. A breeding season survey was made during May and June, and a wintering season survey was made during December, January, and February.

To determine bird data for future cover types, one transect was placed within each of the following future cover types at each study site: pasture, legume, meadow, shrub, and save. An additional future cover type, food plots, was surveyed by sample plots since the food plots generally were not large enough to allow placement of a transect. Plot

densities were converted to transect densities through the use of regression equations developed in 1978-79. Locations of transects and plots are shown on the cover maps of each study site.

To determine bird data for existing cover types, we used the information from many of the same transects and plots that were established for future cover type analysis. We also added one transect at Hollebeke and two plots at Chief Timothy in riparian trees because riparian areas were not adequately sampled by the other transects and plots. Data for existing cover types were used to calculate bird density, diversity, evenness, and richness for each study site.

An additional set of transects was established on the habitat improvement fencing study sites listed in Table 2. These transects were used to evaluate the changes in bird populations due to habitat improvement caused by restricting livestock from Corps-owned lands. Twenty transects were established, 10 on ungrazed Corps' land and 10 on grazed private land directly adjacent. Transect locations were chosen to best represent typical grazed and ungrazed vegetation within the study area.

Line transects generally followed guidelines outlined by Emlen (1971), and were surveyed three times during each sampling period. Transect boundaries were 300 m in length and 100 m in total width unless a natural boundary restricted the dimensions. The perpendicular distance from the transect to the first detection of a sitting bird was recorded. Birds were not counted if first seen outside transect boundaries. Birds first detected flying within transect boundaries were counted upon landing, provided they landed within the transect boundaries.

Emlen (1971, 1977) omitted species of birds which rarely land, but field experience with his method for four years showed the senior author that some flying birds (i.e. feeding swallows, soaring hawks) used the cover type over which they were flying. Consequently, a method to determine flying bird densities was modified from a method designed and successfully used during the Bonneville Second Powerhouse Study (Mudd and Merker, 1977:4). Instantaneous counts of flying birds were taken twice along the transect. During instantaneous counts, flying birds detected within the boundaries of the transect were recorded.

The count period at each sample plot was 10 minutes. Distance from bird to observer was recorded for both sight and sound detections. Two instantaneous counts of flying birds were taken at each plot, one preceding and one following the 10-minute count period. Like the transects, plots were restricted to a 50 m or less radius due to restricted cover type size.

All bird surveys were conducted during the first three hours of

daylight and cancelled during precipitation or when winds averaged more than 19 kph. The three transect-plot replications were spread over the sampling period and completed by a minimum of two, and usually three different observers. Time-of-day bias was reduced by conducting transects in a different order when logistically feasible so that individual surveys were conducted at different times within the three hour sampling period (Shields, 1977:382).

Data computation for transects and plots was similar. Histograms were made using detection distances of each species in each existing cover type during each sampling period. We used 5 m bands on the histograms since that was a close approximation of the 10 foot bands which Emlen (1971:328) used. Coefficients of detectability were determined from the histograms and used along with the known sample area of each transect and plot to calculate bird densities. One hundred percent detection was assumed in the future cover types which were narrow strips (example: save transect at Chief Timothy). Species diversity, evenness, and richness were computed. Formulae and sample calculations are reported in Appendix C. Density, diversity, evenness, and richness values were tested by analysis of variance to determine if significant differences existed between years, pooled projects, study sites, future cover types, existing cover types, and survey periods.

Searches for Upland Nests

Upland nest searches were conducted on the eight study sites and on four areas selected to determine the results of habitat improvement fencing. Forty-eight plots were searched on the study sites (one plot per future cover type per study site) and 20 plots were searched on the fencing study sites (ten on the grazed section, ten on the ungrazed.) The 150 m sample plot stakes from bird survey transects were used as reference points for nest search plots. Whenever possible, each nest search plot was 50 m square (0.25 ha) and randomly located about the 150 m sample plot stake. Present or planned habitat boundaries sometimes restricted the shape or location of nest search plots.

Two or three biologists delimited (with the aid of a Brunton pocket transit and 50 m rope) and systematically searched each plot twice during the nesting season. Searches were accomplished by repeatedly traversing the plot and probing the vegetation with stakes.

Initial searches were conducted from mid-April to mid-May to coincide with nesting of upland game birds, ducks, and some passerines. Second searches were conducted from mid-May to 3 July. Logistics problems made it impossible to maintain a constant interval between first and second searches. Plots were searched twice in a 13 to 57 day interval.

Nests were identified to species by flushing the adults or by keying the nest and eggs (Harrison 1978). A stake was placed 5 m from each nest and locations were recorded by triangulation to nearby landmarks with a pocket transit. Descriptions and reproductive data were obtained from nests in all stages of completion. Nests that were found before or during incubation were revisited to obtain data on nest and hatching success. Nest densities, nest success, clutch size, hatching success, and estimated young produced were determined. Data were subjected to analyses of variance to determine any significant differences between years, pooled projects, study sites, or cover types.

Observations of Guzzler Use

Installation of one or more guzzler complexes is planned for each of our eight study sites. Each complex will consist of a gallinaceous guzzler, quail roost, food plot, several shrub plantings, and a small grassland. Total area for each complex will be approximately 0.1 ha.

One proposed site of a guzzler complex was located and marked on each of the study sites. A control area, with vegetation and topography similar to the guzzler complex, was also marked on each site. Control areas were placed 60 to 100 m from guzzler complexes to allow simultaneous observation of the two areas by a single observer. Locations of guzzler complexes and control areas studied are shown on cover maps of each irrigated study site.

Observations were made from portable blinds or vehicles placed at least 45 m downwind from each observation area. Blinds were used on all units except Charbonneau and Walker where proximity of a road made use of a vehicle more practical. Blinds were erected 15 to 30 minutes before sunrise and the observer remained concealed for at least 15 minutes preceding sunrise.

A total of six observation periods (two per morning on three different mornings) were completed at each of the irrigated and dryland study sites between 21 July and 4 October. Observation periods were 30 minutes in duration. For logistical efficiency, two observation periods were completed sequentially in the first hour following sunrise. Observers alternated sites so that successive paired observations were not made by the same individual. Observations were not made within 24 hours following substantial precipitation.

All wildlife activity within 20 m of the center of the observation area was recorded. Species, number of individuals, time of arrival, duration of visit, and general activities were recorded for each animal visit. Animals that were seen only once during

the period were assumed to have been present for one-half the remainder of the period.

Wildlife use was summarized by minutes of individual animal-use per observation area. Analysis of variance with nested classification was used to test for differences between guzzler and control areas, years, irrigated and dryland developments, and pooled projects.

Cover Mapping

Cover maps of the original twelve study sites were completed during September, October and November 1978. All cover types, vegetative ecotones, and physical developments were located and drawn on 27x51 cm maps. The scale of these maps and aerial photographs supplied by the Corps of Engineers was 1:6000. Three of the twelve sites have been deleted from our study; only the maps of those areas which we studied in 1979 are included in this report.

Classification of cover types was similar to previous work done on the Snake River by Asherin and Claar (1976) and is based upon that system. Our cover maps are more detailed, however, since we were able to concentrate on smaller study areas. Moreover, a greater emphasis was placed on wildlife's relative needs within a particular cover type. Classification of vegetation based solely upon taxonomy was felt to be inadequate when comparing habitat diversity to bird density, diversity, evenness, and richness. The present cover mapping system is an effort to correlate vegetation with wildlife use.

Cover maps were determined in the following manner. One to three biologists traversed each unit and visually estimated cover types and boundaries with the aid of aerial photographs. Cover type classes had been determined during preliminary field visits. Hitchcock and Cronquist (1973) was the authority used for plant identification.

The surface area of each cover type was measured with a compensating polar planimeter and measurements were summarized by existing cover type, study site, and project.

Habitat Diversity Index

Ecotones (the edge separating two different cover types) were measured on aerial photographs of each study site using two methods: actual measurement by bow compass (measured edge) and estimation by radial grid (estimated edge). The amount of edge per unit area is a measure of the habitat diversity.

Actual measurements were made of the amount of edge on each study site using a bow compass. Site boundaries were not included on edge measurements, unless there was an obvious vegetation change due to grazing. The amount of edge between each pair of cover types was determined and totalled by site and project.

Radial grid sampling was adapted from the method developed by Schuerholz (1974). A mylar overlay containing a radial grid (lines two cm in length) was superimposed on the aerial photograph of each study site, and each time a grid line touched an ecotone it was counted as one "hit." The number of radial grid "hits" for each site was compared to total edge measured for that site by means of linear regression analysis. The regression equation derived was used to determine the estimated edge. Comparisons between estimated edge and measured edge were made.

The number of man-hours spent on actual measurements and radial grid sampling was recorded to compare the relative efficiency of each method. Analysis of variance was used to determine whether significant differences in amount of edge per unit area existed between projects.

Simple linear regression was used to determine whether a linear relationship existed between habitat diversity indices and bird density, diversity, evenness, and richness for both breeding and winter bird surveys.

Photographs

Color slides were taken from permanent camera stations to record the existing cover types prior to habitat development. The 50 m stake along the bird transects and the food plot #1 stake were used as the camera stations. These same stations will be used in future years. Two slides were taken from each station during early summer: one showing near (3-10 m) and one showing far (10-300 m) conditions. Slides were also taken of study methods, changes attributable to fencing, habitat plantings, and wildlife.

Compensation Progress

For the first time since the early 1960's when wildlife populations began to decrease on the Snake River because of dam construction, an estimate of the amount of wildlife compensation has been made. Our intent was to determine the percentage of wildlife losses replaced.

Losses were determined from two sources. Upland game (ring-necked pheasant, California quail, gray partridge, and cottontail rabbit), chukar, mourning dove, Canada goose, furbearing mammal, and deer (mule and white-tailed) losses were taken from the Lower Snake River Fish and Wildlife Compensation Plan (U.S. Army Engineer District 1975:69,71). Non-game bird losses were derived from data reported by Lewke (1975:107-113). Lewke studied riparian and weedy-floodplain habitats in Lower Granite Project prior to inundation. His non-game bird density estimates in these cover types, together with the calculated acreage of each cover type (U.S. Army Engineer District 1975:56), were used to compute non-game bird losses at all four projects.

Wildlife restoration was judged to have occurred through the following: natural revegetation of riparian vegetation, park trees, habitat improvement fencing, bunchgrass plantings, dredged material islands, and artificial nesting structures. For natural revegetation and park trees, the amount of wildlife inhabiting the area prior to revegetation was subtracted from the amount of wildlife present following revegetation. In this manner the amount of wildlife superimposed on existing populations by habitat development was determined. For habitat improvement fencing, the percentage increase in wildlife of fenced versus unfenced areas was applied to all fenced lands. Bunchgrass plantings, dredged material islands, and artificial nesting structures were designed to improve Canada goose production. Current goose production was compared with estimated production before the dams were constructed.

Sample Size

Future sample size requirements were calculated from data gathered during both years of study. A formula reported by Eberhardt (1978:224, 230) was used:

$$n = \frac{4}{p^2} c^2$$

n = sample size

p = probability

c = coefficient of variation (standard deviation divided by mean)

We calculated the sample sizes necessary to satisfy confidence limits 0.10, 0.15, 0.20, 0.25, and 0.30 (Table 3). The level of precision used was 0.95. Robson and Regier (1964:225) recommended a 0.25 confidence limit with 0.95 precision for accurate management studies. These figures mean that there is a 95 percent chance that the sample sizes will yield results which are $\pm$ 25 percent. In Table 4 we have combined the sample size results of 1978-79 and 1979-80. Coefficients of variation are presented in Table 5 and compared with average

expected values reported by Eberhardt (1978:227). Our values are similar to the expected values, indicating that our calculations and methods are valid (Snedecor and Cochran 1967:63).

Table 3. Number of samples needed to satisfy confidence limits ranging from 0.10 to 0.30 at 0.95 precision, Lower Snake River Study, 1979-80 data.

Field Method	Confidence Limits				
	0.10	0.15	0.20	0.25	0.30
Counts of Pheasant Calls	296	131	74	47	33
Counts of Dove Calls	190	85	48	30	21
Counts of Chukar Calls	108	48	27	17	12
Index of Goose Use	795	353	199	127	88
Surveys of Bird Density	225	100	56	36	25
Searches for Upland Nests	190	85	48	30	21
Observations of Guzzler Use	686	305	172	110	76

Table 4. Recommended number of samples needed to satisfy 0.25 confidence limits at 0.95 precision, 1978-79 and 1979-80 data combined, Lower Snake River Study.

Field Method	Number of Samples		
	1978-79	1979-80	1978-79 & 1979-80 Combined
Counts of Pheasant Calls	40	47	43
Counts of Dove Calls	36	30	34
Counts of Chukar Calls	-	17	17
Index of Goose Use	68	127	89
Surveys of Bird Density	55	36	45
Searches for Upland Nests	6	30	9
Observations of Guzzler Use	55	110	83

Table 5. Coefficients of variation from 1978-79 and 1979-80 data combined compared with average coefficients of variation reported by Eberhardt (1978:227).

Field Method	Coefficient of Variation	
	This Study	From Eberhardt
Counts of Pheasant Calls	0.82	0.60-0.70
Counts of Dove Calls	0.73	0.60-0.70
Counts of Chukar Calls	0.52	0.60-0.70
Index of Goose Use	1.18	1.00-1.40
Surveys of Bird Density	0.84	0.30-2.00
Searches for Upland Nests	0.37	-
Observations of Guzzler Use	1.14	-

RESULTS

Sex Composition of Pheasants

In 1979, 278 ring-necked pheasants (42♂, 228♀, 8 unclassified) were flushed resulting in a 5.4:1 hen to cock ratio. In 1980, 506 pheasants (78♂, 384♀, 44 unclassified) were flushed resulting in a 4.9:1 hen to cock ratio. Both counts showed an increase in hens per cock over our 1978 ratio of 4.1:1. We feel the 1978 ratio is a low estimate since we were only able to flush 97 pheasants that year because the timing of our contract did not allow field work to begin until 15 March. Pheasants are concentrated and better counts can be obtained during February and March. We feel our 1979 and 1980 counts made with the use of dogs accurately reflect the population and that 4.9 to 5.4 hens per cock is a reliable estimate.

1979 and 1980 pheasant sex composition counts for each management unit are presented in Appendix D. For both years we found a statistical difference between management units (1979 chi-square = 35.10, df=19, $P < 0.025$; 1980 chi-square = 34.51, df=19, $P < 0.025$). Composition counts by project are presented for 1979 and 1980 in Table 6.

Table 6. Sex composition counts of ring-necked pheasants along the lower Snake River, late winter 1979 and 1980.

Project	1979 ♂	1979 ♀	1979 ♀/♂	1980 ♂	1980 ♀	1980 ♀/♂
Ice Harbor	7	25	3.6	18	67	3.7
Lower Monumental	1	11	11.0	12	61	5.1
Little Goose	18	122	6.8	38	158	4.2
Lower Granite	16	70	4.4	10	98	9.8
Total	42	228	5.4	78	384	4.9

A comparison of our composition counts with other counts from Washington, Idaho, and Oregon is presented in Table 7. Our counts consistently show more hens per cock along the lower Snake River than adjacent areas in Washington, Idaho, and Oregon. There are two reasons for this difference. Our counts are field drives involving numerous people resulting in the flushing of most pheasants present. The counts our data are compared with were conducted primarily from

vehicles and these data were probably biased toward the more visible cocks. Also, all of our study areas are public land and probably receive more hunting pressure than the mixture of public and private lands from which the other counts are derived. Since hunters can harvest only cocks legally, the areas with more hunting pressure tend to have a higher hen to cock ratio.

Table 7. Sex composition counts of ring-necked pheasants in selected areas of Idaho, Oregon, and Washington, 1979 and 1980.

Area	1979 ♀/♂	1979 Birds Counted	1980 ♀/♂	1980 Birds Counted	Source
Idaho (Clearwater, Latah, Nez Perce counties)	1.5	821	1.5	521	Sam McNiel, Idaho Department of Fish and Game
Oregon (Umatilla County)	2.7	514	3.2	776	Don Wilt, Oregon Department of Fish and Wildlife
Washington (Columbia, Garfield, Walla Walla, Whitman counties)	4.2	540	3.4	1765	Pat Fowler, Washington Department of Game
Washington (Lower Snake River)	5.4	270	4.9	462	This study

Counts of Wintering Upland Game

Winter flushing counts of upland game were conducted in 1980 in conjunction with pheasant composition counts. We believe these counts provide our most reliable estimates of upland game populations on the management units. Counts are reported in Table 8. Several counts stand out: 52 quail at Granite Goose Pasture (two coveys in dense forbs and wild rose), 141 pheasants at Swift Bar (more than 100 of them flew across the river), 14 mourning doves at Moses (flushed from trees), and 19 cottontails at Wilma.

Table 8. Winter flushing counts of upland game along the lower Snake River, 8 February to 20 March 1980.

Type of Development Management Units	California quail	Ring-necked pheasant	Chukar	Gray partridge	Mourning dove	Cottontail
Irrigated						
Big Flat	0	20	0	0	0	4
Lost Island	0	13	0	8	1	4
Hollebeke	13	43	0	0	0	5
Skookum	0	0	0	0	0	0
55-Mile	0	4	2	5	0	2
Ridpath	0	15	1	0	0	1
New York Bar	0	1	3	0	0	0
Swift Bar	0	141	0	0	1	0
Chief Timothy	0	0	0	0	0	0
Wilma	0	51	0	0	0	19
Dryland						
Charbonneau	0	9	1	6	0	1
Walker	1	2	0	0	0	4
Couch Landing	17	2	2	2	0	1
Ayer	0	20	0	0	0	4
Joso	0	0	0	2	0	0
Little Goose Rec. Area	0	4	4	2	0	0
Purrington	1	9	0	0	0	0
Schultz Bar	0	42	0	0	0	0
Granite Goose Pasture	52	13	0	0	0	0
Moses	0	29	0	0	14	5
Total	84	418	13	25	16	50

The figures reported for cottontails are low because cottontails are very difficult to flush. Few were seen at a distance of more than 20 meters. They were most abundant where tall forbs and shrubbery were dense. Cottontail populations are much higher than indicated at Hollebeke, Moses, and Wilma.

Counts of Pheasant, Dove, and Quail Calls

The mean number of pheasant calls heard during 1979 was 1.9 per station. Counts for each listening station are presented in Appendix E. A compilation of pheasant calls by pooled projects and type of development is presented in Table 9.

Table 9. Number of ring-necked pheasant calls heard per two-minute period by pooled projects and type of development along lower Snake River, 25 April to 10 May 1979.[a]

Pooled Projects	Type of Habitat Development		
	Irrigated	Dryland	Mean
Ice Harbor/ Lower Monumental	1.4 ± 1.9	2.3 ± 2.7	1.9 ± 2.4
Little Goose/ Lower Granite	2.6 ± 2.2	1.3 ± 1.8	2.0 ± 2.1
Mean	2.0 ± 2.1	1.8 ± 2.3	1.9 ± 2.2[b]

[a]Counts at listening stations (Appendix E) were multiplied by two since only a semi-circle was surveyed.

[b]Mean and standard deviation were computed from the mean call count of each listening station (N=60).

The mean number of pheasant calls heard along the lower Snake River during 1978 and 1979 (1.2 and 1.9) is low. For both years the average number of calls heard along the river is only 34 percent of the average number heard in adjacent Latah County, Idaho, and only 23 percent of the average heard in adjacent counties in Washington. A comparison of the mean number of pheasant calls heard per station in 1978 and 1979 between the lower Snake River and adjacent areas of Idaho and Washington (Oregon does not conduct these counts) is presented in Table 10.

Table 10. Comparison of the number of pheasant calls heard per two-minute period in 1978 and 1979 in the Lower Snake River Study with adjacent areas of Idaho and Washington.

Area	Year	Number of Calls	Number of Stations	Source
Idaho (Latah County)	1978	3.5	20	Sam McNiel, Idaho Department of Fish and Game
	1979	5.7	20	
Washington (Columbia, Walla Walla, Whitman counties)	1978	5.8	77	Pat Fowler, Washington Department of Game
	1979	6.5	116	
Washington (Lower Snake River)	1978	1.2	60	This study
	1979	1.9	60	

Analysis of variance with nested classification showed a difference between years (1978-1979, $P < 0.025$) for pheasants (Appendix F). No difference was found between pooled projects or type of development.

Pheasant breeding population densities were calculated for each management unit using the sex ratio of 5.4:1 (Table 6), and pheasant call count data (Appendix E), and are presented in Appendix G. Mean pheasant breeding densities went from 0.75 ± 0.76 in 1978 to 1.47 ± 1.27 in 1979. An increase in cock call counts and an increase in the hen to cock ratio accounted for the increase in breeding densities. The results still indicated extremely low pheasant populations for both years. The low population estimates are a result of the low number of calls heard during call counts. While our call counts are useful for comparison with adjacent areas they do not provide a reliable population estimate. Our winter flushing counts and spring and winter transects provide a more reliable estimate of pheasant populations.

The mean number of mourning dove calls heard during 1979 was 1.2 per station. Mourning dove call counts for each listening station are presented in Appendix H. A compilation of dove calls by pooled project and type of development is listed in Table 11.

Table 11. Number of mourning dove calls heard per three-minute period by pooled projects and type of development along lower Snake River, 6 June to 15 June 1979.[a]

Pooled Projects	Type of Habitat Development		
	Irrigated	Dryland	Mean
Ice Harbor/ Lower Monumental	1.4 ± 4.9	0.9 ± 3.4	1.1 ± 4.1
Little Goose/ Lower Granite	0.8 ± 2.1	1.7 ± 2.6	1.2 ± 2.4
Mean	1.1 ± 3.7	1.3 ± 3.0	1.2 ± 3.3[b]

[a]Counts at listening stations (Appendix G) are multiplied by two since only a semi-circle was surveyed.

[b]Mean and standard deviation were computed from the mean call counts of each listening station (N=60).

The mean number of dove calls heard declined from 3.3 in 1978 to 1.2 in 1979. By comparison, in 1979 calls at 20 stations in Benton County, Washington, averaged 2.7 (Lee Stream, personal communication). In Lewis County, Idaho, counts at 20 stations produced no calls (Sam McNiel, personal communication). These low counts in Idaho and Washington are well below the eastern Washington five-year mean (1970-74) of 13.6 (Ziegler 1977:16) and may reflect the severe winter of 1978-79.

Analysis of variance with nested classification showed a difference between years (1978-79, $P < 0.025$) but no difference between pooled projects, or types of development (Appendix F).

California quail call counts were conducted during both pheasant and dove call counts. Few calls were heard: eight during pheasant call counts and six during dove call counts (Appendices I and J). Mean quail calls heard at each listening station during pheasant call counts (two-minute period) were 0.1 ± 0.8 (N=60). Mean quail calls heard at each listening station during dove call counts (three-minute period) were 0.1 ± 0.8 (N=60). Analysis of variance with nested classification indicated no significant difference between pooled projects, or types of development (Appendix F). We recommend quail call counts be continued in conjunction with both pheasant and dove call counts if pheasant and dove call counts are continued. However, winter flushing

counts and spring and winter bird surveys provide a more reliable estimate of quail populations and should continue to be used to measure compensation progress and success of habitat development.

Counts of Chukar Calls

Limited chukar call response was obtained to the taped rally calls. The mean number of calls per listening station was 1.0 ± 3.4 (N=60) (Table 12). Analysis of variance showed no difference ($P > 0.05$) in number of calls heard between the types of development or between pooled projects. Comparisons between years were not made because excessive precipitation during the 1978 chukar census period disrupted the counts. Data obtained in the 1979 census will be compared to data collected in future years.

Table 12. Number of chukar calls heard per ten-minute period by pooled projects and type of development along the lower Snake River, 25 April to 10 May 1979.

Pooled Projects	Type of Habitat Development		
	Irrigated	Dryland	Mean
Ice Harbor/ Lower Monumental	1.0 ± 3.6	0.1 ± 0.3	0.5 ± 2.6
Little Goose/ Lower Granite	0.1 ± 0.5	2.8 ± 5.6	1.6 ± 4.1
Mean	0.6 ± 2.6	1.5 ± 4.1	1.0 ± 3.4

To determine the number of chukar at each management unit, we used Oelklaus' (1976) regression equation of $Y = -1.857 + 2.529X$, where Y is the number of birds in the sample area, and X is the cumulative number of responses heard in the 10-minute sampling period. Density values were determined from the estimated number of chukar in each sample area. Williams (1961) found that the chukar call is audible for 500 yards under ideal conditions. We used this figure to determine the area surveyed at each listening station. The number of chukar responses and coveys heard along with the estimated population and density values for each listening station are provided in Appendix K. These call counts indicated that Granite Goose Pasture and Skookum have the largest chukar populations, followed by Little Goose Recreation Area, Moses, and Chief Timothy.

Our field experience with the taped rally call technique causes us to question the validity of the technique in its current application. Broadcast of the taped calls did not seem to stimulate chukar responses, in fact it seemed to repress chukar calling at some units. At the units where responses were obtained the chukar were calling prior to our broadcast of the call and continued to call during our count period. Wilma and Schultz Bar are known to have large chukar populations nearby but only one call was heard on the two units.

Since the chukar were usually close to the river during the heat of the day in late summer when the counts were conducted, our arrival at the unit in a powerboat tended to repress calling also. For example, at Ridpath we counted no chukar calls during the 10-minute count period, but as we prepared to leave two coveys of chukar totalling 70 birds flushed from within 75 m of us. The chukar then proceeded to call approximately 150 times during the next 10 minutes. We have no suggestions to offer for improving the technique and recommend it be eliminated in future study years. A late summer flushing count may provide a better estimate of chukar congregating on the management units seeking shade and cooler temperatures near the river.

Counts of chukar calls were also made during April-May pheasant call counts and June dove call counts (Appendix L). The greatest number of calls were heard at Schultz Bar, Granite Goose Pasture, Moses, and Wilma. These are the units with the largest populations of chukars nearby. Analysis of variance indicated no difference ($P > 0.05$) in number of chukar calls heard during the April-May, June, and September call count periods.

Aerial Surveys of Chukar

Counts of chukars were made from a helicopter during December 1979. A total of 11,127 chukars were counted in the study area (Table 13). One thousand one hundred and forty-four coveys were counted yielding an average covey size of 9.7. Seventy-six percent of the chukar were counted in Lower Granite, 18 percent in Little Goose, 5 percent in Lower Monumental, and 1 percent in Ice Harbor. Densities ranged from 87.9 chukar per square mile in Lower Granite to 1.7 chukar per square mile in Ice Harbor.

At least 150 gray partridge were included in these counts. We did not attempt to count gray partridge separately from chukar because of the difficulty in separating the two species from the air at up to 200 m away.

Table 13. Number of chukars, number of coveys, and densities (birds/square mile) determined from helicopter along lower Snake River, December 1979.

Project	Number of Chukars	Number of Coveys	Density
Ice Harbor			
North	152	10	3.3
South	10	1	0.2
Total	162	11	1.7
Lower Monumental			
North	457	40	10.5
South	81	7	1.9
Total	538	47	6.2
Little Goose			
North	1301	135	23.4
South	686	76	12.4
Total	1987	211	17.9
Lower Granite			
North	4110	463	85.6
South	4330	412	90.2
Total	8440	875	87.9
Total	11,127	1144	28.2[a]

[a]Mean weighted by square miles of each project.

The number of chukars dependent upon each management unit was determined by totalling the counts from the three river miles closest to each unit on the same side of the river (Appendix M). Counts ranged from zero chukar at five sites in Ice Harbor/Lower Monumental projects, to 730 chukars at Granite Goose Pasture.

Correlation coefficients were calculated to compare December counts from helicopter, March counts from helicopter (reported in 31 May 1979 report), September taped call counts, June call counts, and May call counts (Table 15). We believe the December counts from helicopter to be the most reliable and accurate. Chukars were in large coveys during December and much easier to flush and count than during the March counts from helicopter when the chukars were in mated pairs. The March counts from helicopter were much lower than the December counts but were closely correlated (r=0.96). June call counts were also closely correlated with December helicopter counts (r=0.94), and March helicopter counts (r=0.95).

Table 15. Correlation coefficients and levels of significance of March 1979 and December 1979 helicopter surveys of chukar to chukar population indices obtained from taped rally calls and two spring call counts, Lower Snake River Study, 1979.

Type of Counts	Correlation Coefficient(r)	Level of Significance(P)	Regression Equation
December helicopter vs. March helicopter	0.96	0.001	y=6.9x + 14.1
December helicopter vs. September taped call	0.85	0.001	y=263.9x + 51.3
March helicopter vs. September taped call	0.78	0.001	y=34.3x + 6.2
December helicopter vs. May call	0.59	0.01	y=13.2x + 48.6
March helicopter vs. May call	0.63	0.01	y=2.0x + 4.8
December helicopter vs. June call	0.94	0.001	y=15.3x + 35.8
March helicopter vs. June call	0.95	0.001	y=2.2x + 3.4

We recommend using the December chukar counts from helicopter as base line data in the on-project and off-project (Element Y) evaluations. Since this count has been made only once, and that was during a peak chukar population year, we recommend another chukar count from helicopter in December 1980. The average of the two years should provide a more realistic base line figure.

Counts of Upland Game Bird Production

Twenty-eight ring-necked pheasant hens and 124 pheasant chicks (27 broods, four single chicks) were flushed and counted between 7 June and 29 August. Three broods counted in late August were over 12 weeks of age, too old to visually age using our guide. The estimated hatching dates of the remaining 24 broods, four single chicks, and one recently hatched nest (found 19 May) were used to determine peak of hatching. Figure 1 presents a comparison of estimated hatching dates between 1978 and 1979. The estimated peak of hatching along the lower Snake River occurred about 10 days later in 1979 (25 May vs. 15 May), perhaps a result of the severe winter of 1978-79 and cool spring weather.

A comparison of peak hatching dates in Oregon and Washington (Table 16) suggest the Snake River canyon is later phenologically than Umatilla County, Oregon, to the south, and earlier phenologically than adjacent Washington counties which are primarily at higher elevations.

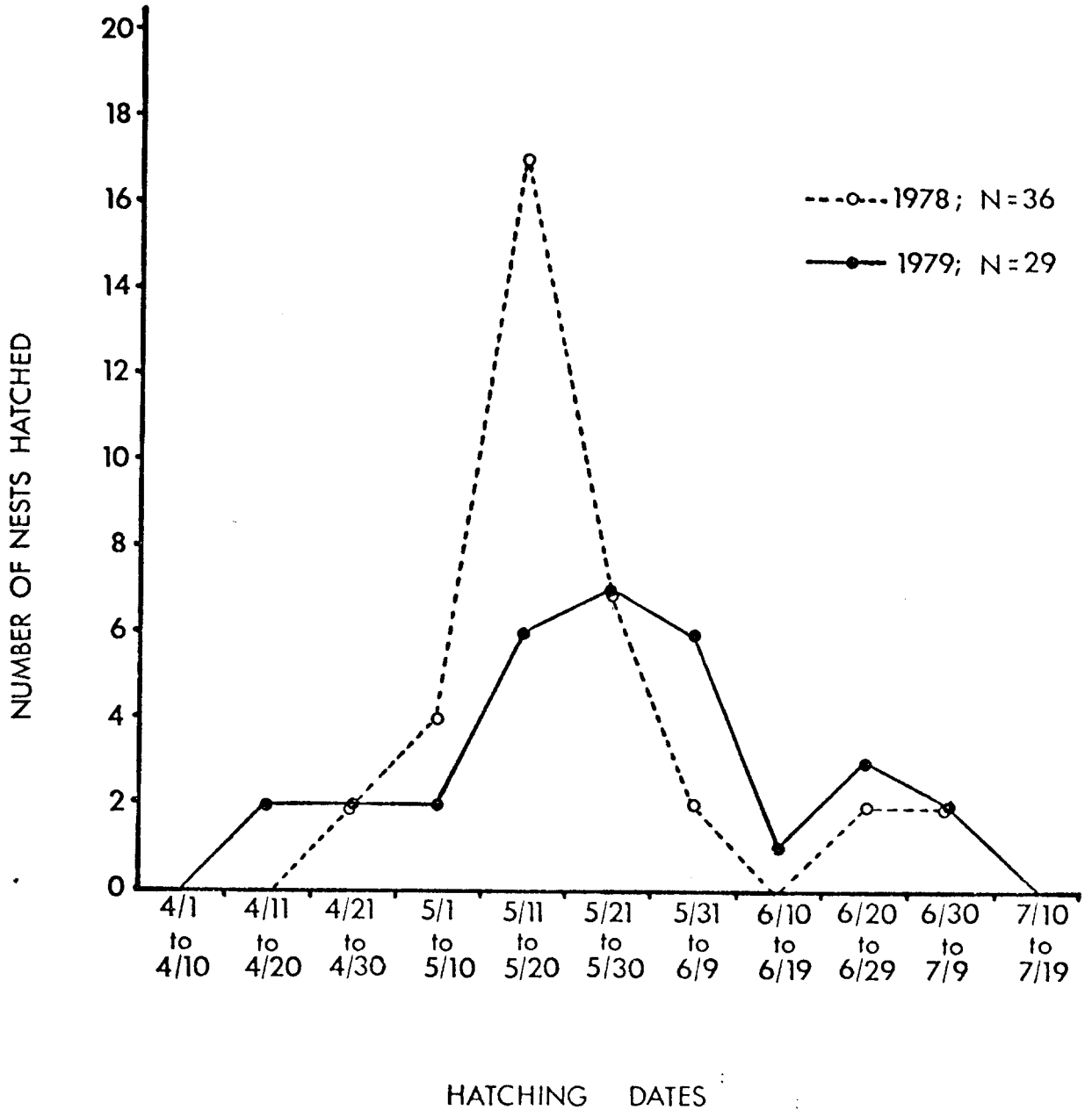


Figure 1. Comparison of approximate hatching dates of ring-necked pheasants along lower Snake River, 1978-79.

Table 16. Comparison of peak hatching dates of ring-necked pheasant nests in selected areas of Oregon and Washington, 1979.

Area	Date	No. Broods	Source
Oregon (Umatilla County)	16 May	48	Don Wilt, Oregon Department of Fish and Wildlife
Washington (Benton, Yakima counties)	20 June	62	Lee Stream, Washington Department of Game
Washington (Asotin, Columbia, Garfield, Walla Walla, Whitman counties)	28 May	162	Pat Fowler, Washington Department of Game
Washington (Lower Snake River)	25 May	29	This study

In 1979, 16 percent of the successful pheasant nests along the lower Snake River were from apparent renesting, compared to 10 percent in 1978 (Table 17). These percentages include broods over 12 weeks old when counted. Both percentage of hens with broods and brood size were higher in 1979, an indication of excellent nesting conditions.

Table 17. Comparison of observed ring-necked pheasant production between years (1978-1979) along the lower Snake River.

Year	No. Hens	Hens with Broods %	First Nest No.	First Nest Brood Size	Renesting No.	Renesting Brood Size
1978	21	86	31	5.3 ± 5.3	4	3.3 ± 2.9
1979	28	89	22	6.4 ± 3.7	5	6.0 ± 3.5

A comparison between pheasant production along the lower Snake River and adjacent areas of Idaho and Washington (Table 18) indicates a wide variation. This may be a result of a real difference or different sampling techniques. Information on locations and sightings is presented in Appendix N.

Table 18. Comparison of ring-necked pheasant production in selected areas of Idaho and Washington, 1979.

Area	Hens No.	Hens % with Broods	Broods No.	Broods Average Size	Source
Idaho (Latah, Lewis Nez Perce counties)	10	100	19	8.7	Sam McNiel, Idaho Department of Fish and Game
Washington (Benton, Yakima counties)	69	71	62	4.5	Lee Stream, Washington Department of Game
Washington (Asotin, Columbia, Garfield, Walla Walla, Whitman counties)	127	76	150	5.5	Pat Fowler, Washington Department of Game
Washington (Lower Snake River)	28	89	27	6.3	This study

Twenty-six California quail (6 adults, 20 juveniles), 230 chukars (59 adults, 171 juveniles), and 43 gray partridges (12 adults, 31 juveniles) were counted between 18 June and 18 August 1979. Comparisons of observed production between years (1978 vs. 1979) and between other areas in Idaho, Oregon, and Washington are reported in Table 19 and 20, respectively. Juveniles per adult for California quail increased in 1979 but the sample size was small. Chukar juveniles per adult decreased in 1979 which is surprising since chukar populations following the 1979 breeding season were high indicating an excellent breeding season. Gray partridge juveniles per adult decreased also, but the sample size was small. Information on locations of observations and brood size is presented in Appendix N.

Table 19. Comparison between years of observed California quail, chukar, and gray partridge production along lower Snake River, 1978-79.

	California quail		Chukar		Gray partridge	
	No.	Juv/Ad	No.	Juv/Ad	No.	Juv/Ad
1978	89	2.3	303	3.6	37	6.4
1979	26	3.3	230	2.9	31	2.6

Table 20. Comparison between selected areas in Idaho, Oregon, and Washington of observed California quail, chukar, and gray partridge production, 1979.

Area	California quail		Chukar		Gray partridge		Source
	No.	Juv/Ad	No.	Juv/Ad	No.	Juv/Ad	
Idaho (Latah, Lewis, Nez Perce counties)	29	3.8	81	4.8	135	5.8	Sam McNiel, Idaho Department of Fish and Game
Oregon (Umatilla County)	148	1.7	200	2.9	-	-	Don Wilt, Oregon Department of Fish and Wildlife
Washington (Benton, Yakima counties)	203	6.0	64	5.4	16	4.3	Lee Stream, Washington Department of Game
Washington (Asotin, Columbia, Garfield, Walla Walla, Whitman counties)	596	2.7	964	5.1	142	4.1	Pat Fowler, Washington Department of Game
Washington (Lower Snake River)	26	3.3	230	2.9	31	2.6	This study

Searches for Goose Nests

One hundred and sixteen western Canada goose nests were found during two boat searches (10 to 18 April 1979, and 25 April to 10 May 1979) and one helicopter search (18 to 20 April 1979) of the 210 km study area. Seventy-eight of the nests were located on islands, 36 on cliffs, one on an isthmus, and one on an artificial nesting structure (tripod).

Of the 116 nests found within the study area, 112 could be reached and provided data on clutch size and nesting and hatching success. Mean clutch size was 5.5 ± 1.4 (N=112) eggs. Clutch size calculated from last year's search (N=72) was 5.7. Culbertson et al. (1971) reported a clutch size of 5.8 for the same population. Hanson and Eberhardt (1971:19) and Bellrose (1976:160) reported clutches of 5.5 and 5.3, respectively.

Twelve of the 619 eggs in successful nests were left unhatched. Two nests of five eggs were abandoned. Other eggs were assumed to have hatched unless there was evidence of destruction. The hatching success rate was 98 percent. Most of the data were collected on New York Island where 98 percent of 377 eggs hatched. Eggs from other parts of the study area also had a hatching rate of 98 percent (237 of 244). Hatching successes of 89 percent have been reported by Hanson and Eberhardt (1971:29) and Bellrose (1976:161).

Chi-square analysis showed no difference ($P > 0.05$) in nesting success or hatching success between years or projects (Appendix F).

The estimated number of goslings produced in the study area in 1978 and 1979 was 492 and 605, respectively. The estimate for 1978 is conservative because only 28 goslings were known to be produced on cliffs. Our helicopter cliff nest search in 1979 revealed that cliff nest production was 177 goslings indicating that many cliff nests were not located in 1978 when searches were only from boats. Estimated production by project is shown in Figure 2.

To determine compensation progress it was necessary to determine the percentage of goslings lost between hatching and flight stage. Bellrose (1978:162, 163) cited seven studies of Canada goose gosling survival between hatching and flight stage. Results ranged from 7 percent to 28 percent mortality with an average of 15 percent (N=5959 nests). Hanson and Eberhardt (1971:30) found 14 percent mortality during the first three weeks following hatching on the Hanford Reservation, so the 15 percent average reported by Bellrose appears to be accurate for our application, Thus, of the 605 goslings hatched, 514 were estimated to have survived to flight stage.

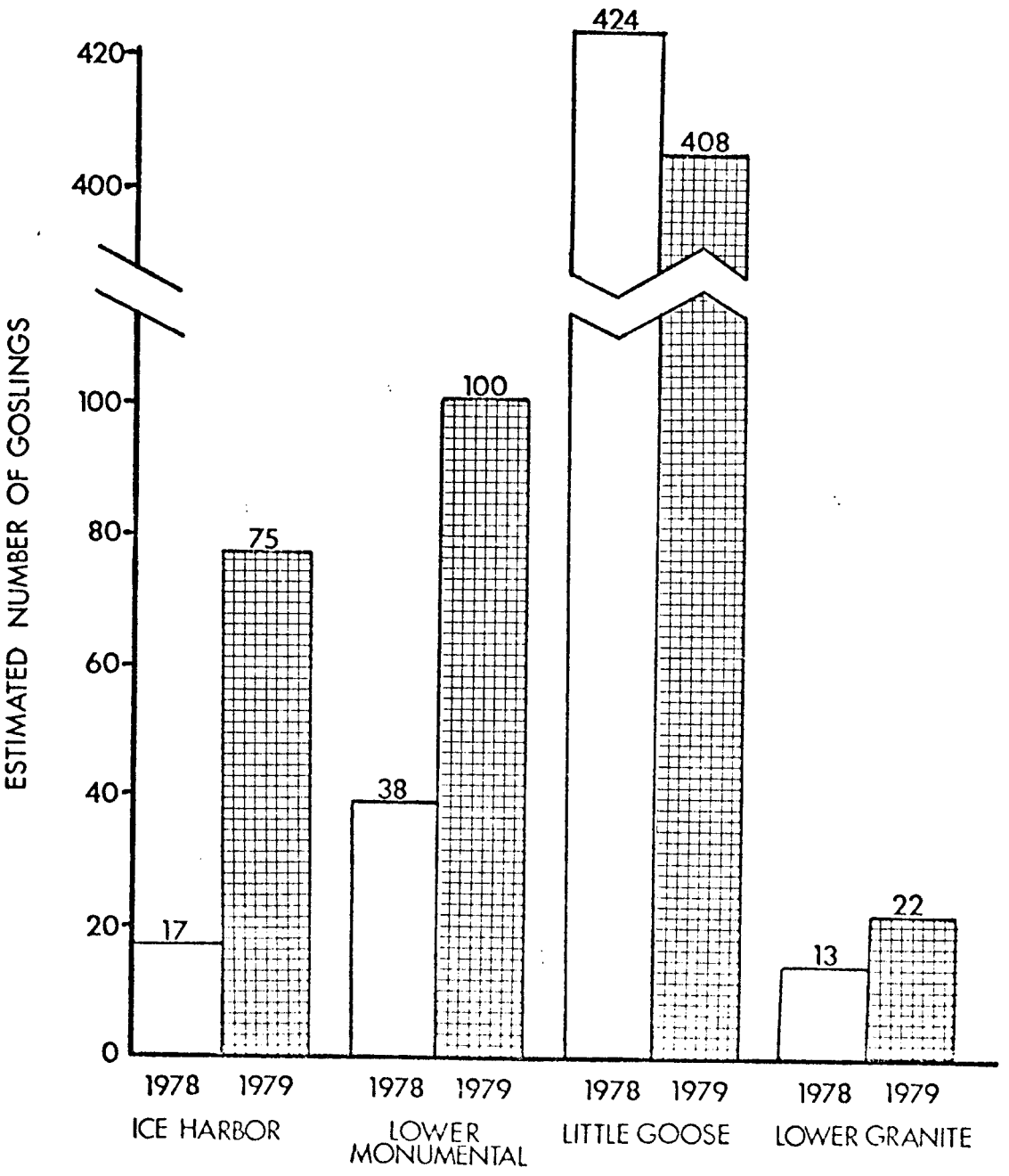


Figure 2. Estimated number of goslings produced during the 1978 and 1979 breeding seasons, Lower Snake River Study.

Reproductive data from artificial nest structures are presented in Table 21. We found 18 intact structures, two floating and 16 tripod. Five floating structures and five tripods were destroyed last winter. Tripod structures placed in the river had been tipped over by ice floes. Where possible, structures were erected and made suitable for goose nesting by placing driftwood and nesting material in them. Twelve tripods (seven in Lower Monumental reservoir and five on New York Island) and two floating structures were prepared for the breeding season. Driftwood and nesting material were also placed on the dredged material islands near Matthews and Swift Bar. Geese successfully nested on a serviced tripod structure on New York Island and on the dredged material island near Swift Bar. No other artificial structures were used.

Reproductive data from cliff nests are presented in Table 22, and data from island nests are presented in Table 23. The number of cliff nests found per mile of shoreline (both sides of river included) were: Ice Harbor 0.21, Lower Monumental (including the slack water Palouse River) 0.26, Little Goose 0.08, and Lower Granite 0.02.

Observations of western Canada goose broods were recorded between 25 April and 2 July 1979. Locations of brooding areas and relative use are reported in Table 24. Almost all of the management units had some goose brooding. The major brooding area was New York Gulch which is adjacent to New York Island. New York Bar, Dry Gulch, and Phalen Gulch also provide brooding areas for the young produced on New York Island. Asherin and Claar (1976:166) reported that in 1974 and 1975 many of the goslings produced on New York Island appeared to travel upstream 8 to 12 miles to brood at WSU Farm and Rice Bar. We did not observe any movement of this kind in 1978 or 1979. We found only one brood in those areas each year.

Table 21. Reproductive data from Canada goose nests found on artificial nesting structures on lower Snake River, 1979.

Project	No. of Nesting Structures	No. of Nests Found	No. of Active Nests Studied	Nest Success (%)	No. of Eggs	Mean Clutch Size (± SD)	Estimated No. of Eggs Produced	Hatching Success (%)	Estimated No. of Goslings Produced
Ice Harbor	1	-	0	-	-	-	-	-	-
Lower Monumental	10	-	0	-	-	-	-	-	-
Little Goose	7	1	1	100	7	7	7	100	7
Lower Granite	0	-	-	-	-	-	-	-	-
Total	18	1	1	100	7	7	7	100	7

Table 22. Reproductive data from Canada goose nests found among cliffs on lower Snake River, 1979.

Project	No. of Nests Found	No. of Active Nests Studied	Nest Success (%)	No. of Eggs	Mean Clutch Size (± SD)	Estimated No. of Eggs Produced	Hatching Success (%)	Estimated No. of Goslings Produced
Ice Harbor	13	13	92	70	5.4(±1.0)	70	84[a]	59
Lower Monumental	16	14	100	73	5.2(±1.4)	83	100[b]	83
Little Goose	6	6	100	35	5.8(±1.3)	35	95[c]	33
Lower Granite	1	1	100	-[d]	-	5	100	5
Total	36	34	97	178	5.4(±1.2)	193	98	180

[a]Does not include four nests which had clutch sizes determined from helicopter, but were inaccessible for hatching success determination.

[b]Does not include three nests which had clutch sizes determined from helicopter, but were inaccessible for hatching success determination.

[c]Does not include two nests which had clutch sizes determined from helicopter, but were inaccessible for hatching success determination.

[d]Could not determine clutch size.

Table 23. Reproductive data from Canada goose nests found on islands on lower Snake River, 1979.

Project	No. of Islands	No. of Nests Found	No. of Active Nests Studied	Nest Success (%)	No. of Eggs	Mean Clutch Size (± SD)	Estimated No. of Eggs Produced	Hatching Success (%)	Estimated No. of Goslings Produced
Ice Harbor	3	4	4[a]	75	23	5.8(±0.5)	23	70	16
Lower Monumental	12	4	4	100	17	5.0(±1.0)	17	100	17
Little Goose	2	68	66[b]	97	375	5.6(±1.5)	375	98	368
Lower Granite	6	3	3	100	17	5.7(±2.5)	17	100	17
Total	33	79	77	96	432	5.6(±1.4)	432	97	418

[a]Includes one nest located on an isthmus.

[b]Does not include occupied artificial nesting structure on New York Island that is reported in Table 21.

Table 24. Observation of Canada goose broods on lower Snake River, 1979.

Project	River Mile	Location	No. Broods	No. Goslings	No. Adults	Date
Ice Harbor	13N	No Name	1	6	2	25 April
	13S	Charbonneau	3	13	6	7 June
	16N	Big Flat	2	12	4	26 April
	16N	Big Flat	5	23	10	7 June
	17S	Fishhook	2	12	5	25 April
	23N	Lost Island	4	22	8	6 June
	30S	Walker	1	2	2	18 April
	32N	Couch Landing	4	13	8	20 May
Lower Monumental	50N	Skookum	1	5	5	2 July
	51S	Ayer	1	2	2	25 April
	51S	Ayer	1	4	2	25 April
	54S	Ayer	1	2	4	15 June
	55N	55-Mile	1	4	2	19 May
	57S	Joso	2	10	4	19 May
	63N	Sargent	1	3	2	19 May
	66S	Texas Rapids	1	3	4	19 May
	67N	Riparia	1	4	2	19 May
Little Goose	74S	No Name	1	11	3	26 April
	76S	Dry Gulch	1	4	2	26 April
	76S	Dry Gulch	1	5	2	26 April
	77S	Phalen Gulch	6	35	12	12 May
	78S	New York Gulch	1	9	2	26 April
	78S	New York Gulch	1	2	2	26 April
	78S	New York Gulch	1	2	2	26 April
	78S	New York Gulch	4	17	8	26 April
	78S	New York Gulch	4	20	8	12 May
	80S	New York Bar	8	45	7	29 June
	84N	Purrington	7	40	14	3 May
	93S	Rice Bar	1	2	2	3 May
Lower Granite	128S	No Name	1	2	2	5 May
	128S	No Name	1	3	2	5 May
	128S	No Name	1	5	2	5 May
	134N	Wilma	1	6	2	5 May
	134N	Wilma	1	3	2	5 May

The location, size, number of goose nests found, and nesting density for each of the 23 islands in the study area is presented in Appendix O. The location of all artificial nesting structures for geese is also presented in Appendix O.

Index of Goose Use

The index of goose use was completed twice during this study year. The spring-summer goose brooding index was taken between 24 September and 4 October 1979. The winter index, taken between 28 February and 7 March 1980, indicated the amount of goose use in autumn and winter.

The calculated number of goose droppings per day per hectare and estimated goose-use days per hectare are presented in Table 25. Most sites showed greater autumn-winter goose use than spring-summer goose use. Ridpath and Skookum had the greatest goose use; Swift Bar and Wilma had no goose use because of tall forb cover, and Chief Timothy had no use because of habitat development activities. Autumn-winter goose use was greater in 1979 than 1978. Spring-summer goose use was not determined for 1978 and could not be compared.

Data were subjected to analysis of variance. There was no difference ($P > 0.05$) between years or pooled projects (see Appendix F).

Table 25. Number of goose droppings per day per hectare and estimated goose-use days per hectare, Lower Snake River Study, spring-summer 1979 and autumn-winter 1979-80.

Project	Study Site	Goose Droppings/ Day/Hectare		Goose-Use Days/ Hectare	
		Spring	Winter	Spring	Winter
Ice Harbor	Big Flat	19	61	43	112
	Hollebeke	19	20	43	36
Lower Monumental	Skookum	19	142	43	243
	55-Mile	6	66	11	112
Little Goose	Ridpath	102	213	250	341
	Swift Bar	0	0	0	0
Lower Granite	Chief Timothy	0	-[a]	0	-[a]
	Wilma	0	0	0	0

[a]Counts were not conducted at Chief Timothy in winter 1979-80 because the vegetation, study plots, and markers were removed during habitat development.

Concern about the large amount of goose pastures planned for the irrigated management units has increased within the Game Department. As we reported in our 31 May 1979 report, approximately 110,000 geese could be supported indefinitely on the 328 acres of pasture planned. We are recommending that the majority of these lands be managed as upland bird cover and nesting areas rather than goose pastures. We also recommend that the Game Department consider removing the waterfowl hunting closures on Lower Monumental, Little Goose, and Lower Granite projects. We recommend retaining the hunting closure on Ice Harbor project.

Aerial Surveys of Deer and Coyote

Helicopter counts of mule deer (Odocoileus hemionus), white-tailed deer (Odocoileus virginianus), and coyote (Canis latrans) were made within the entire study area. We counted 1938 deer (1591 mule, 347 white-tailed) and 136 coyote between 5 and 19 December 1979. The area covered in the survey was 387 square

miles, giving an average density of 5.0 deer per square mile. Mule deer, white-tailed deer, and coyote densities by project are presented in Table 26. Densities of pooled sex and age classes of deer are reported in Appendix P. Sex and age ratios for mule and white-tailed deer are presented in Table 27. No winterkilled deer or fence mortalities were seen this year.

The 1979 count of 1938 deer was down considerably from the 1978 count of 2458 deer. This decrease is attributed to the poor fawn production in 1979 which was caused by drought conditions. The number of adult deer remained relatively constant: 1297 in 1979, and 1320 in 1978. Fawn production was 661 in 1979, down from 1138 in 1978. The limiting factor on the deer population appears to be drought which reduces the quantity and quality of forage available. This weakens the does during the period that they are carrying fetuses and causes the fetuses to abort or to be born in a weakened condition and not survive.

Table 26. Numbers and density (animals per square mile) of mule and white-tailed deer and coyote along lower Snake River, December 1979.

Project	Total Deer		Mule Deer		White-tailed Deer		Coyote	
	No.	Density	No.	Density	No.	Density	No.	Density
Ice Harbor								
North	41	0.9	40	0.9	1	0.0	6	0.1
South	21	0.4	21	0.4	0	0.0	4	0.1
Total	62	0.7	61	0.7	1	0.0	10	0.1
Lower Monumental								
North	165	3.8	161	3.7	4	0.1	7	0.2
South	21	0.5	20	0.5	1	0.1	15	0.3
Total	186	2.1	181	2.1	5	0.1	22	0.3
Little Goose								
North	550	9.9	307	5.5	243	4.4	45	0.8
South	514	9.3	439	7.9	75	1.4	25	0.4
Total	1064	9.6	745	6.7	318	2.9	70	0.6
Lower Granite								
North	239	5.0	228	4.8	11	0.2	19	0.4
South	387	8.1	375	7.8	12	0.2	15	0.3
Total	626	6.5	603	6.3	23	0.2	34	0.4
Total Study Area	1938	5.0	1591	4.1	347	0.9	136	0.4

Table 27. Sex and age ratios of mule and white-tailed deer along lower Snake River, December 1979.

Project	Bucks/100 Does	Fawns/100 Does
Ice Harbor		
Mule deer	5.0	47.5
White-tailed deer	-[a]	-[a]
Lower Monumental		
Mule deer	8.0	73.0
White-tailed deer	-[a]	-[a]
Little Goose		
Mule deer	2.5	50.7
White-tailed deer	5.8	60.7
Lower Granite		
Mule deer	6.0	43.7
White-tailed deer	-[a]	-[a]
Total		
Mule deer	4.5	50.0
White-tailed deer	6.8	60.9

[a]Insufficient numbers of white-tailed deer seen to calculate meaningful ratios.

Bucks were classed as adults (branched antlers) or yearlings (spiked antlers). Total number of bucks in each class by respective project were: Ice Harbor 2 adult, 0 yearling (mule), 0 adult, 0 yearling (white-tailed): Lower Monumental 6 adult, 2 yearling (mule), 0 adult, 0 yearling (white-tailed); Little Goose 11 adult, 1 yearling (mule), 9 adult, 2 yearling (white-tailed): Lower Granite 21 adult, 3 yearling (mule), 3 adult, 0 yearling (white-tailed).

Sex and age ratios determined in this study were compared to other Pacific Northwest ratios derived from similar surveys (Table 28). In general, buck ratios were similar to Washington Blue Mountain ratios but less than ratios from Oregon and Idaho. Fawn production decreases were consistent with decreases found in adjacent survey areas.

The location of deer and coyote was recorded by elevational contour and presented in Figures 3 and 4. Most deer were recorded between 400 and 1200 feet above pool elevation. Most coyotes were observed between 400 and 800 feet above pool elevation. Deer and coyotes probably avoid the lower elevations because they are primarily cliffs, or because of the proximity of roads in some areas. Few deer and coyotes were recorded at elevations greater than 1500 feet above pool level because there are few areas in the canyon that are above that elevation.

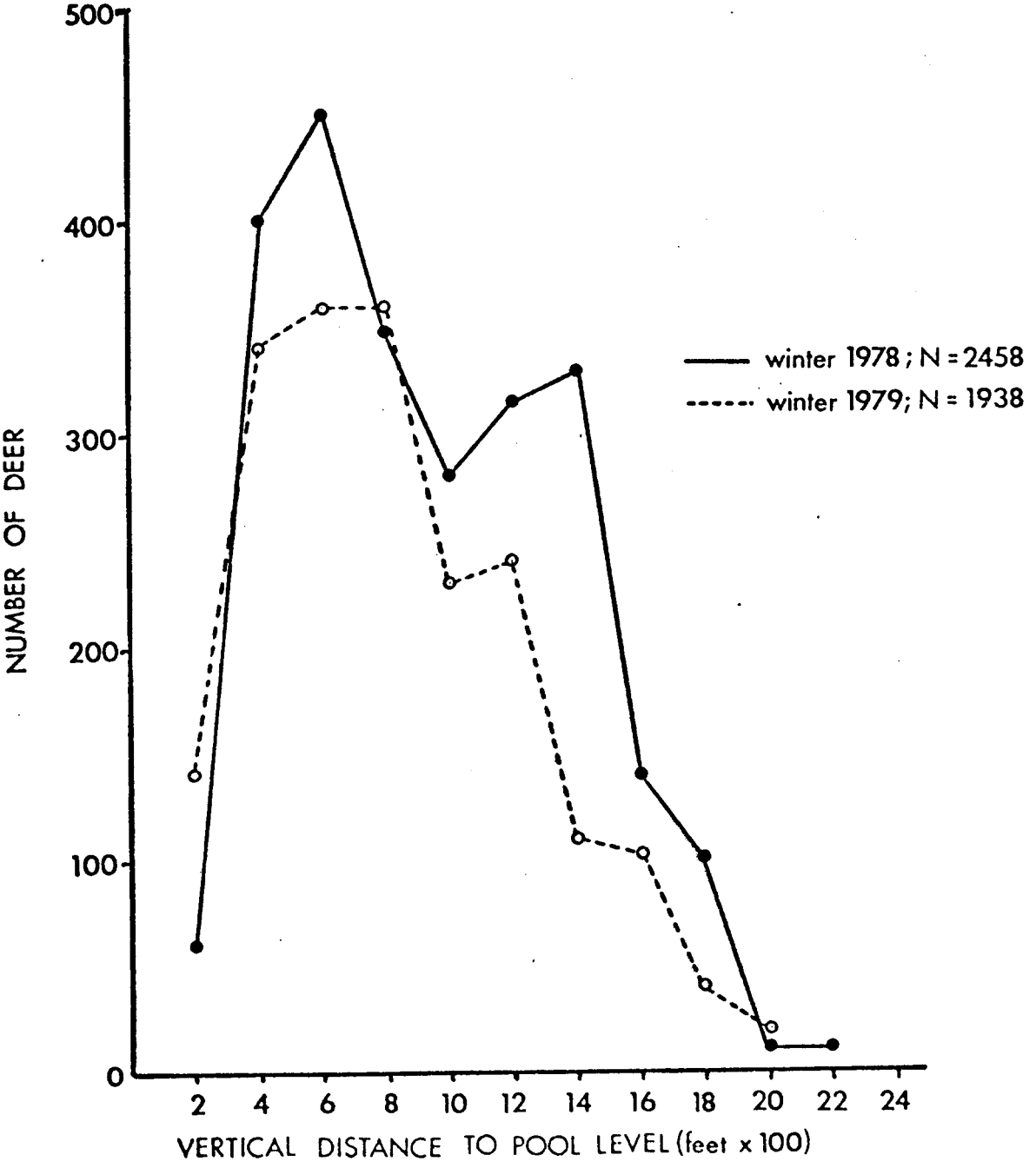


Figure 3. Deer observed by elevational contour, Lower Snake River Study, 1978-79.

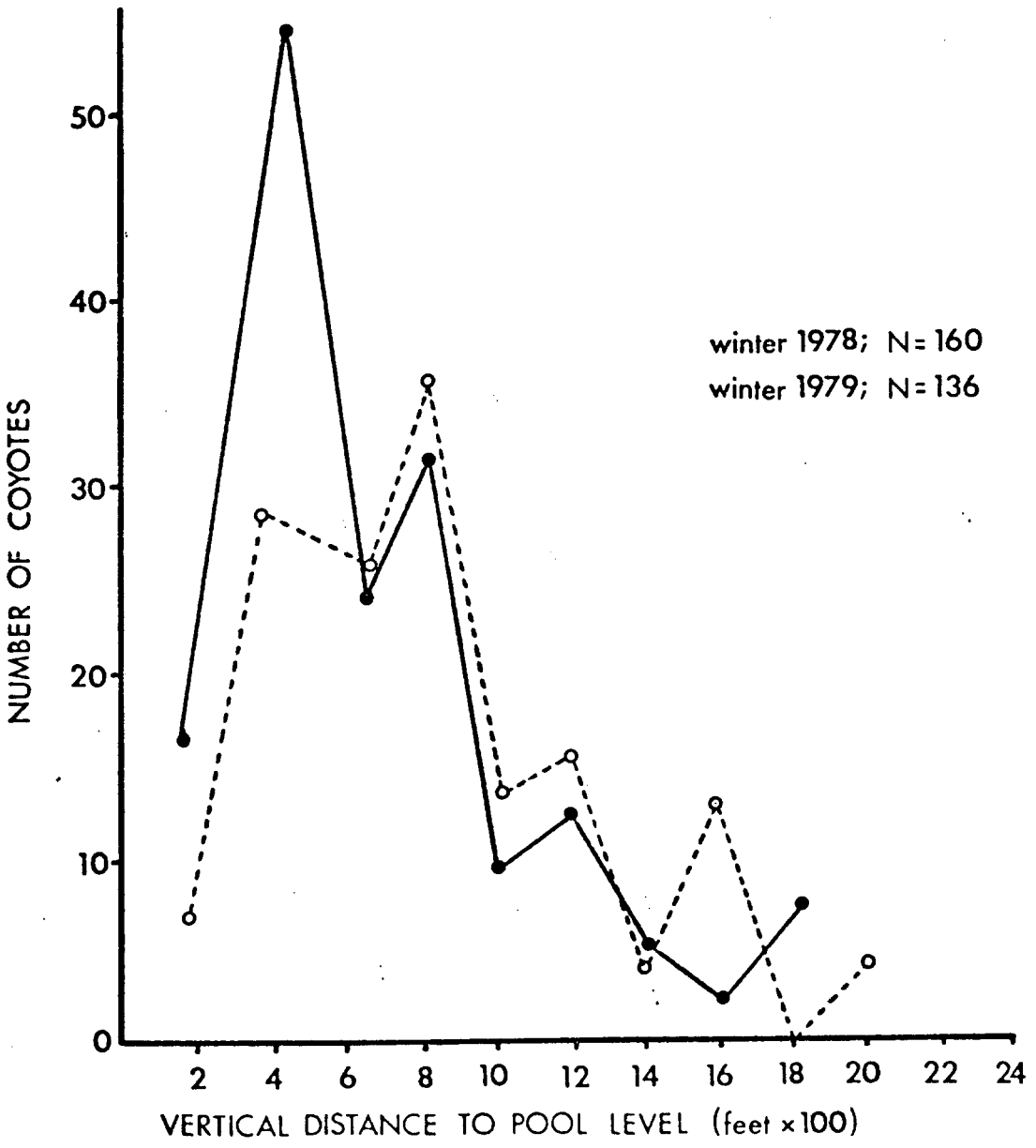


Figure 4. Coyotes observed by elevational contour, Lower Snake River Study, 1978-79.

Table 28. Comparison of post-hunting mule and white-tailed deer sex and age ratios, Lower Snake River Study, 1979.

Species	♂/♀/Fawn	Source
Mule	4/100/50	Present study, lower Snake River.
White-tailed	7/100/61	December 1979.
Mule	4/100/89	Present study, lower Snake River.
White-tailed	6/100/95	December 1978.
Mule	3/100/58	Blue Mountains, Washington. Winter 1979-80.
White-tailed	4/100/60	Pat Fowler, Washington Department of Game.
Mule	6/100/78	Blue Mountains, Washington. Winter 1978-79.
White-tailed	3/100/77	Pat Fowler, Washington Department of Game.
Mule	9/100/71	Okanogan County, Washington. 1962-75, average. Ziegler 1978:67.
Mule	12/100/31	Snake River, Wallowa County, Oregon. Winter 1979-80. Paul Ebert, Oregon Fish and Wildlife.
Mule	12/100/45	Snake River, Wallowa County, Oregon. Winter 1978-79. Oregon Fish and Wildlife.
Mule	14/100/57	Snake River, Hells Canyon area, Idaho. Winter 1979-80. Jerry Theison, Idaho Fish and Game (IF&G).
Mule	13/100/66	Snake River, Hells Canyon area, Idaho. Winter 1978-79. IF&G.
Mule	58/100/60	Snake River south of Lewiston, Idaho. Winter 1979-80. IF&G.
Mule	33/100/73	Snake River south of Lewiston, Idaho. Winter 1978-79. IF&G.

Surveys of Bird Density

Bird density surveys were conducted from 6 June to 11 July 1979 (breeding season) and from 27 November 1979 to 22 February 1980 (winter season). Generally, the results were very similar to last year's results.

During the breeding season, Chief Timothy, Hollebeke, and New York Bar supported the greatest bird densities; Skookum, Wilma, and Big Flat supported the lowest bird densities (Table 29). Diversity was highest at Chief Timothy, lowest at Big Flat. Our data shows that Chief Timothy supported the greatest and most diverse bird population in the breeding season, and Big Flat supported the sparsest and least diverse bird population. This was true in 1978 also.

During the winter season, Wilma and Swift Bar supported the greatest bird densities; 55-Mile and Skookum supported the lowest densities (Table 30). Diversity was highest at Wilma and lowest at Skookum and New York Bar. Again, this was very similar to our 1978 results. Bird density and diversity at Chief Timothy declined this winter because the site was cleared in preparation for habitat plantings. Prior to this site clearing, Chief Timothy was the best bird wintering area studied and Skookum was the poorest.

Table 29. Measurements of bird abundance by study site, breeding bird census, Lower Snake River Study, 1979.

Study Site	Density (Birds/ Km^2)	Population	Diversity		Evenness		Richness	
Big Flat	233	872	1.05		0.59		6	
Hollebeke	478	472	1.49	2.25[a]	0.72	0.81[a]	8	16[a]
Skookum	183	352	1.62		0.74		9	
55-Mile	346	469	1.82		0.73		12	
New York Bar	465	302	1.60		0.82		7	
Swift Bar	299	164	1.83		0.74		12	
Chief Timothy	1088	206	2.23	2.34[b]	0.76	0.76[b]	19	22[b]
Wilma	211	86	1.99		0.86		10	

[a]Includes riparian transect.

[b]Includes riparian plots.

Table 30. Measurements of bird abundance by study site, winter bird census, Lower Snake River Study, 1979-80.

Study Site	Density (Birds/ Km^2)	Population	Diversity		Evenness		Richness	
Big Flat	175	655	0.62	1.77[a]	0.56	0.74[a]	3	11[a]
Hollebeke	313	317	1.54	2.01[b]	0.96	0.71[b]	6	17[b]
Skookum	135	261	0.00		0.00		1	
55-Mile	122	165	0.94		0.68		4	
New York Bar	168	109	0.12		0.18		2	
Swift Bar	526	288	1.24		0.64		7	
Chief Timothy	280	53	0.74	1.00[c]	0.53	0.56[c]	7	9[c]
Wilma	555	226	1.76		0.71		12	

[a]Includes irrigated transects.

[b]Includes riparian transect.

[c]Includes riparian plots.

Bird density, standard deviation of density, diversity, evenness, and richness of each future cover type during the breeding and winter seasons are presented in Appendix Q. These data will be combined with the future cover type data from 1978 to establish base line bird use of the future cover types. This base line will be used in future years to determine the success of individual planting associations (i.e. legume, meadow, etc.)

Bird density estimates by individual species for each future cover type, additional riparian transects, and additional irrigated habitat transects are reported in Appendix R.

Density for each species in each existing cover type is presented in Appendix S. Riparian vegetation supported the greatest densities and the greatest number of species. Mature riparian vegetation supported from 10 to 200 times as many birds as the adjacent rabbitbrush-grassland cover types. Riparian vegetation (cover types 342, 327, and 316) included trees, shrubs, vines, cat-tails, and sedges. Perennial bunchgrass (cover type 314) supported the fewest birds. Annual grass and forb mixtures (cover type 312.3) also supported few birds. The irrigated sunflower plantings at Big Flat

supported an average of 871 birds/km^2 in winter. Prior to the sunflower plantings the existing cover type was annual grasses and forbs (cover type 312.3) which supported 0 birds/km^2. Thus, in the first year following planting the winter bird density of this area increased from 0 birds/km^2 to 871 birds/km^2. The bubbler-irrigated tree-shrub planting at Big Flat supported 126 birds/km^2. Prior to the tree-shrub planting the existing cover type was rabbitbrush (cover type 325.1) which supported 91 birds/km^2. The sunflower planting is 4.8 hectares and increased the winter bird population at Big Flat by 42 birds. The tree-shrub planting is 0.2 hectares and increased the winter bird population by less than one bird. However, this tree-shrub planting is only a few years old and will not become very productive for a few more years.

The indices of density, diversity, evenness, and richness from Tables 29 and 30 and Appendices Q and S were tested by analysis of variance to determine whether any significant differences existed between years, pooled projects, study sites, existing cover types, future cover types, or sample period (see Appendix F, Tables 3 and 4). There were no significant differences ($P > 0.05$) between pooled projects, between future cover types, or between years. The F values between years were extremely low, indicating that the data from the two years were very similar. Significant differences were found between study sites, between existing cover types, and between sample periods (breeding season compared to winter season). The F values between existing cover types were very large (especially density, diversity, and richness), indicating that bird populations in the different cover types were quite different. The riparian cover types were responsible for this difference between existing cover types.

Revised diversity and evenness values were calculated from last year's data and are reported in Appendix T. Last year these values were calculated from the number of bird sightings as was requested by the Corps to make the data comparable with Asherin and Claar (1976). This year the values were calculated from bird density, making the values more meaningful.

Seasonal occurrence, earliest and latest sighting, and scientific names of all bird species observed between 1 March 1978 and 31 March 1980 are reported in Appendix U. A total of 148 bird species were observed.

Bird surveys were also conducted at Levey Landing, Lost Island, Ayer, Beckwith Bar, and Granite Goose Pasture to determine changes in bird populations caused by habitat improvement fencing. Bird density on the ungrazed areas increased an average of 26 percent when both seasons and pooled projects were combined. Except for the winter season in Ice Harbor/

Lower Monumental, the Corps of Engineers' land protected from livestock grazing by fences supported more birds and a more diverse bird population in almost every comparison (Table 31). Significant differences were found between the breeding and winter season for density, diversity, evenness, and richness (see Appendix F, Table 3). Most of the areas studied have only been protected from grazing for a few years. Bird density estimates for each species at each ungrazed-grazed study site are presented in Appendix V.

Table 31. Bird density, diversity, evenness, and richness of ungrazed versus grazed areas, Lower Snake River Study, 1979-80.

Pooled Project	Density		Diversity		Evenness		Richness	
	Ung.	Gr.	Ung.	Gr.	Ung.	Gr.	Ung.	Gr.
Breeding Season								
Ice Harbor/ Lower Monumental	210	125	2.04	2.07	0.82	0.90	12	10
Little Goose/ Lower Granite	446	376	1.77	1.91	0.74	0.83	11	10
Winter Season								
Ice Harbor/ Lower Monumental	65	99	1.17	1.37	0.73	0.85	5	5
Little Goose/ Lower Granite	132	79	1.05	0.67	0.59	0.48	6	4

Cottontail rabbit (Sylvilagus sp.) sightings were recorded during all bird survey transects and densities were calculated exactly as bird densities were calculated. The coefficient of detectability for cottontails was 0.157. This is indicative of their reclusive behavior. Only five cottontails were detected during the breeding survey and six during the winter survey. Cottontail density estimates are reported in Table 32 for those study sites and transects where cottontails were observed. Riparian areas supported the greatest cottontail densities.

Table 32. Cottontail density estimates, Lower Snake River Study, 1979-80.

PROJECT Study Site Cover Type	Density (Cottontails/Km^2)
Breeding Season	
ICE HARBOR	
Hollebeke	
Riparian	2303
LOWER GRANITE	
Chief Timothy	
Save	303
Wilma	
Legume	212
Winter Season	
ICE HARBOR	
Hollebeke	
Save	212
Riparian	768
LOWER GRANITE	
Wilma	
Meadow	425
Save	459

Searches for Upland Nests

Twenty-two upland nests (19 on the intensive study sites, three on the grazed-ungrazed study sites) were found during the 1979 search. Bird nests of nine different species were found.

Reproductive data from nest searches in intensive study sites and grazed-ungrazed sites are listed in Table 33 and 34, respectively. Location, cover type (existing and future), species, dates and contents of nests for each upland nest studied in 1978 and 1979 are listed in Appendix W. Comparative data from a literature review are listed in Table 35.

Nest densities by future cover type are compared in Appendix W, Table 3.

Nesting densities were low for most species but they seemed to be representative of bird populations on the study sites. Analysis of variance indicated no difference ($P > 0.05$) in nesting densities between years, cover types, study sites, or pooled projects. No difference ($P > 0.05$) was found between the grazed and ungrazed areas, or between pooled projects in the grazed versus ungrazed study.

Estimated production of young, nest success, and hatching success values were not statistically analyzed because of the limited data available. Analysis may be possible as data increase in future years.

Table 33. Productivity data obtained from two searches of 48 0.25 ha plots on intensive study sites, Lower Snake River Study, 1979.

Species	No. Nests Found	No. Nest/ 100 Acres	Nesting Success (%)	Mean Clutch Size (± SD)	No. Eggs Inspected	Hatching Success (%)	Estimated Young/Produced 100 Acres
Mallard	1	3.4	100	9	9	100	30.6
Spotted sandpiper	1	3.4	100	4	4	100	13.6
House sparrow	1	3.4	100	6	6	100	20.2
Northern oriole	1	3.4	-[a]	-	-	-	-
Brewer's blackbird	6	20.2	100	3.5(±1.9)	21	100	70.7
Brewer's blackbird	8	27.2	-	-	-	-	-
Brown-headed cowbird	-[b]	-	0	1	1	0	0

[a]Data missing due to incomplete nest histories.

[b]One brown-headed cowbird egg found in Brewer's blackbird nest.

Table 34. Productivity data obtained from two searches of ten ungrazed and ten grazed plots, Lower Snake River Study, 1979.

TREATMENT Species	No. Nests Found	No. Nests/ 100 Acres	Nesting Success (%)	Mean Clutch Size (± SD)	No. Eggs Inspected	Hatching Success (%)	Estimated Young Produced/ 100 Acres
UNGRAZED							
Ring-necked pheasant	1	16.2	100	8	8	100	129.6
Western meadowlark	1	16.2	100	5	5	100	81.0
GRAZED							
Ring-necked pheasant	1	16.2	100	12	12	100	194.4

Table 35. Productivity data obtained from a literature review involving species which nested on Lower Snake River Study sites, 1979.

Species	Nesting[a] Density	Nesting Success(%)	Clutch Size	Hatching Success(%)	Authority
Mallard		46	9.0	93	Bellrose 1976
	61 nests	43		86	Palmer 1976
Ring-necked pheasant				88	Chesness et al. 1968
		52	12.6		Knott et al. 1943
	29 nests				Smith 1947
	12 nests	58			Strode & Leedy 1940
Spotted Sandpiper			4.0		Bent 1929
House sparrow	b				Summers-Smith 1958
			4.0	88	Seel 1968
Western meadowlark	7-33 terr.	35	3-7	68	Bent 1958 Lanyon 1957
Northern oriole			4-5		Harrison 1978
Brewer's blackbird	700 nests		5-6	35-40	Harrison 1978 LaRivers 1944

[a]Density values given as nests, pairs, males, or territories per 100 acres in the literature.

[b]House sparrows are colonial nesters, building nests 2 to 3 feet apart (Summers-Smith, 1958).

Observations of Guzzler Use

Observations of wildlife use at guzzler and control sites are summarized in Tables 36 through 39. In addition to the guzzler observation sites established on the irrigated development areas, new guzzler sites were selected on eight dryland development areas. No development had occurred at any guzzler sites so no water or special habitat was available. Observations were made this year to determine use of guzzler sites prior to installation of guzzlers. No mammals were observed using the areas, but small mammals may have been present and unobserved. Bird use consisted of feeding and social activities.

Wildlife made little use of guzzler and control sites in general. On the irrigated development areas, guzzler sites received use from more individual animals and more total minutes of wildlife use than control sites. On the dryland development areas, the control sites had more activity than guzzler sites. Data were highly variable and analysis of variance indicated no difference ($P > 0.05$) in minutes of wildlife use between guzzler and control sites, years, pooled projects, or development.

Table 36. Wildlife use of guzzler sites on irrigated development areas, Lower Snake River Study, 1979.

PROJECT Management Unit	Species	Animal-Use Minutes[a]	Observation Period
ICE HARBOR			
Big Flat	Western meadowlark	6.8	6[b]
Hollebeke	Western meadowlark	7.0	5
	Western meadowlark	3.5	6
LOWER MONUMENTAL			
Skookum	None	0.0	
55-Mile	Western meadowlark	3.4	2
LITTLE GOOSE			
New York Bar	None	0.0	
Swift Bar	Brewer's blackbird	7.3	2
	Starling	20.0	4
	Song sparrow	1.0	4
LOWER GRANITE			
Chief Timothy	California quail	18.0	5
	California quail	0.2	6
Wilma	Mourning dove	11.0	3
	Western meadowlark	0.6	4
Total		78.8[c]	

[a]Number of individuals times duration of visit.

[b]Numbers 1 to 6 indicate during which observation between 15 July and 1 October the observations were made.

[c]Total minutes of individual animal-use.

Table 37. Wildlife use of control sites on irrigated development areas, Lower Snake River Study, 1979.

PROJECT Management Unit	Species	Animal-Use Minutes[a]	Observation Period
ICE HARBOR			
Big Flat	None	0.0	
Hollebeke	Ring-necked pheasant	6.0	3[b]
	Western meadowlark	2.3	5
	Western meadowlark	6.0	6
LOWER MONUMENTAL			
Skookum	None	0.0	
55-Mile	Horned lark	1.8	2
LITTLE GOOSE			
New York Bar	Western meadowlark	2.0	3
Swift Bar	White-crowned sparrow	0.5	5
LOWER GRANITE			
Chief Timothy	Chukar	1.0	1
	California quail	38.0	6
Wilma	None	0.0	
Total		57.6[c]	

[a]Number of individuals times duration of visit.

[b]Numbers 1 to 6 indicate during which observation period between 15 July and 1 October the observations were made.

[c]Total minutes of individual animal-use.

Table 38. Wildlife use of guzzler sites on dryland development areas, Lower Snake River Study, 1979.

PROJECT Management Unit	Species	Animal-Use Minutes[a]	Observation Period
ICE HARBOR			
Charbonneau	Horned lark	8.0	2[b]
	Western meadowlark	10.5	4
Walker	None	0.0	
LOWER MONUMENTAL			
Tucannon	None	0.0	
Texas Rapids	None	0.0	
LITTLE GOOSE			
L. Goose Rec. Area	None	0.0	
Illia	White-crowned sparrow	14.8	6
LOWER GRANITE			
G. Goose Pasture	Black-billed magpie	0.6	2
Moses	None	0.0	
Total		33.9[c]	

[a]Number of individuals times duration of visit.

[b]Numbers 1 to 6 indicate during which observation period between 15 July and 1 October the observations were made.

[c]Total minutes of individual animal-use.

Table 39. Wildlife use of control sites on dryland development areas, Lower Snake River Study, 1979.

PROJECT Management Unit	Species	Animal-Use Minutes[a]	Observation Period
ICE HARBOR			
Charbonneau	None	0.0	
Walker	California quail	22.7	1[b]
LOWER MONUMENTAL			
Tucannon	Western kingbird	28.0	2
Texas Rapids	Horned lark	0.7	1
LITTLE GOOSE			
L. Goose Rec. Area	None	0.0	
Illia	White-crowned sparrow	15.0	5
	White-crowned sparrow	7.3	6
LOWER GRANITE			
G. Goose Pasture	Chukar	8.0	1
Moses	None	0.0	
Total		81.7[c]	

[a]Number of individuals times duration of visit.

[b]Numbers 1 to 6 indicate during which observation period between 15 July and 1 October the observations were made.

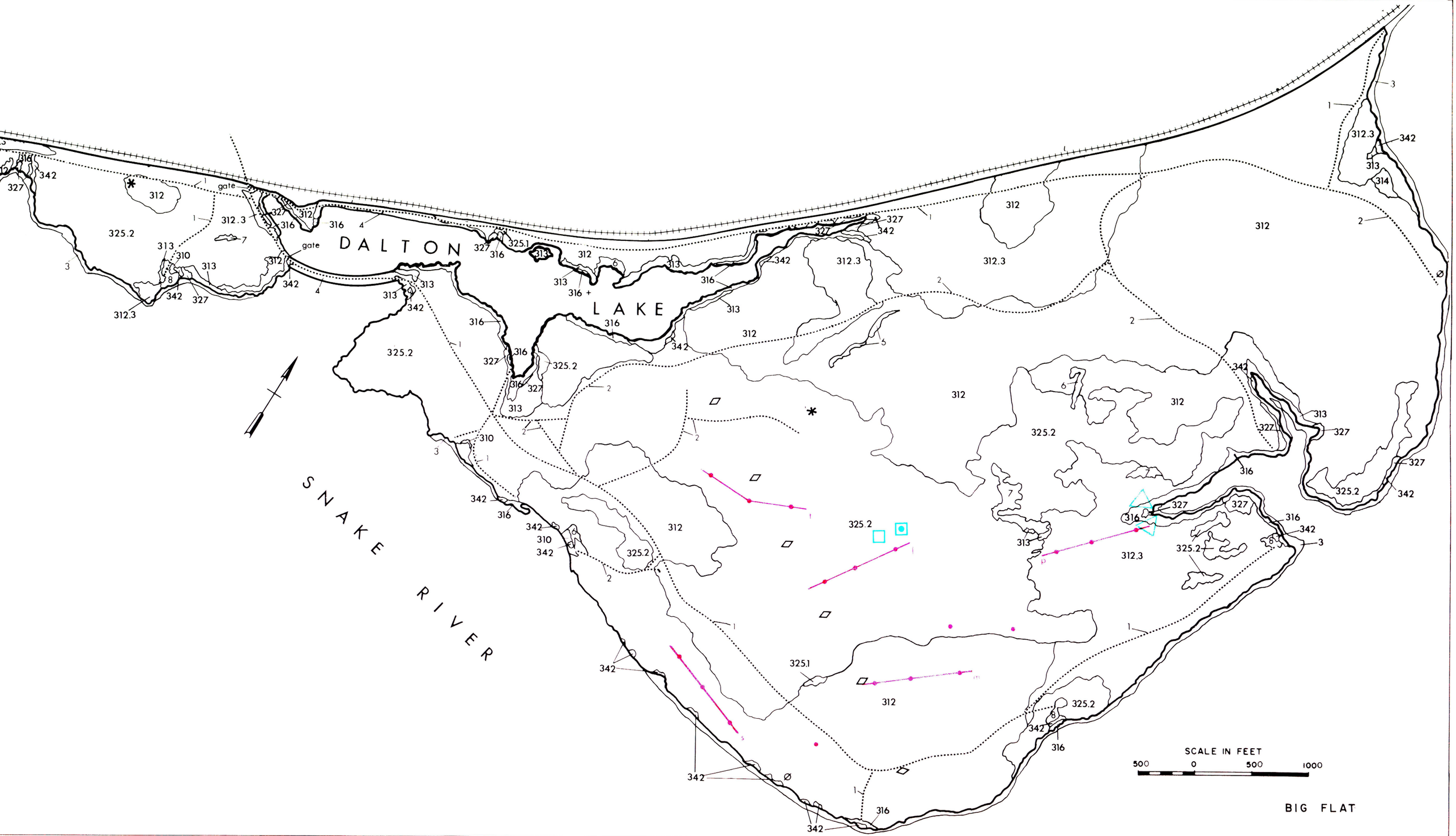
[c]Total minutes of individual animal-use.

Cover Mapping

Cover maps of nine study sites begin on page 62. Dominant plant species in each type were reported in our 31 May 1979 report. Areal extent of cover types on each study site are presented in Table 40.

VEGETATIVE AND LAND FORM LEGEND

▬▬	Shoreline or project boundary
———	Habitat type boundary
325.1	Upland woody perennials greater than 1.5 meters tall
325.2	Upland woody perennials less than 1.5 meters tall
314	Perennial grasses
310	Perennial forbs
312	Annual grasses
313	Annual forbs
312.3	Co-dominant annual grasses and forbs
342	Riparian woody perennials greater than 3 meters tall
327	Riparian woody perennials less than 3 meters tall
316	Riparian vegetation tolerant to high water level
1.	Improved road
2.	Unimproved road
3.	Mudflats
4.	Rip-rap or rocky shore
5.	Culvert pond or embayment
6.	Talus or rock cliffs
7.	Bare soil or sand
8.	Recreation area
9.	Gravel pit
▬▬▬	State highway or county road
⊢⊢⊢⊢	Railroad tracks
▬ ▬ ▬	Parallel road and railroad tracks
⌀	Navigation aid
◇	Power line structure
+	Floating goose nest platform
×—×—×	Fence
✱	Windmill
×	Outhouse
△	Goose dropping transect
◉	Guzzler complex observation site
□	Guzzler control observation site
—l	Legume bird survey transect
—m	Meadow bird survey transect
—p	Pasture bird survey transect
—s	Save bird survey transect
—t	Shrub bird survey transect
●	Food plot, variable sample plot, upland nest search plot marker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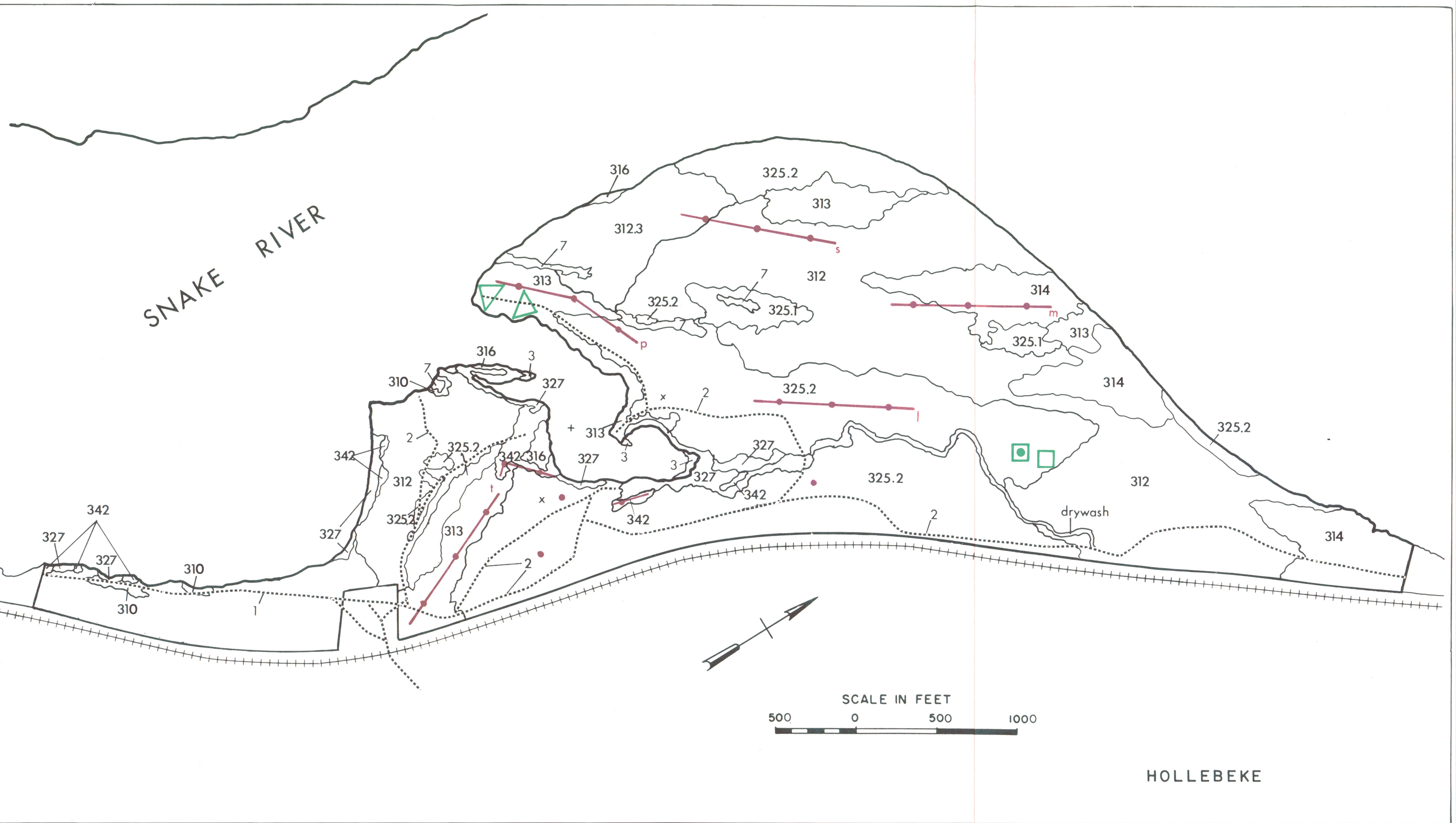
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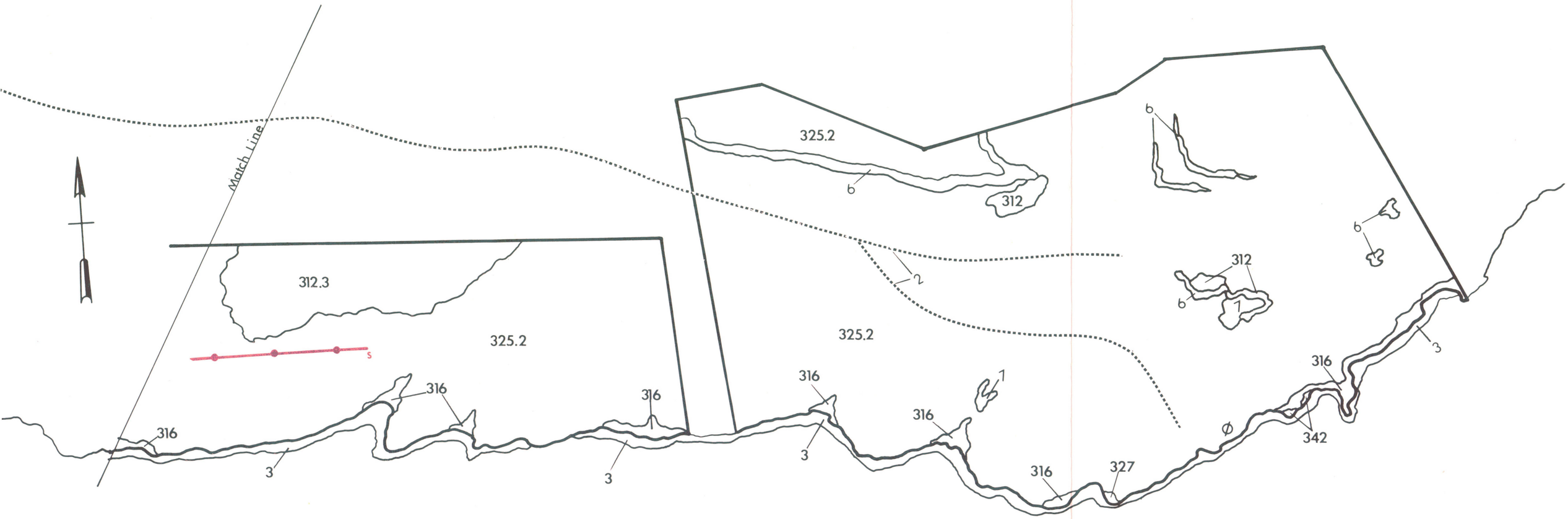

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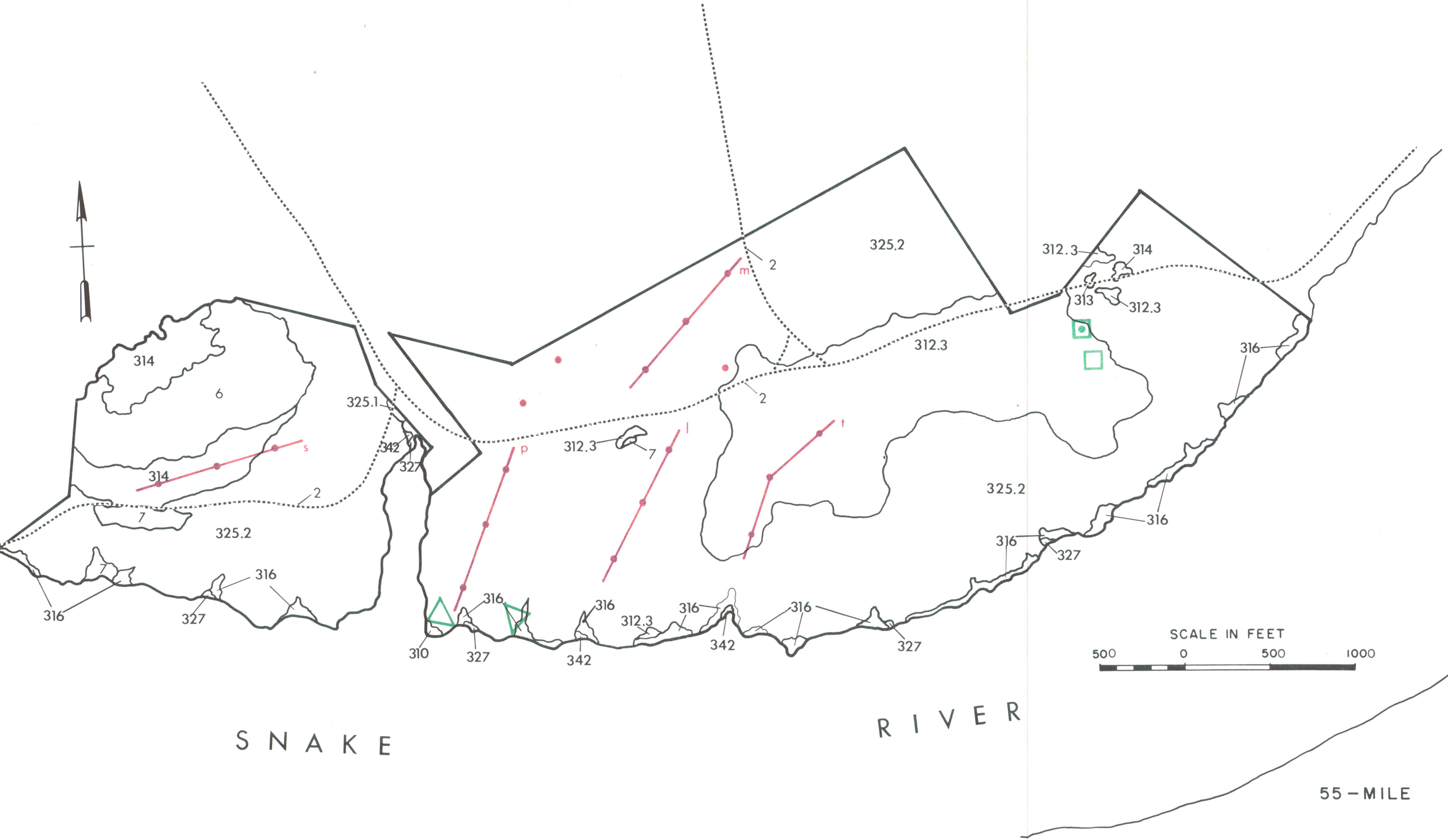
SKOOKUM UPSTREAM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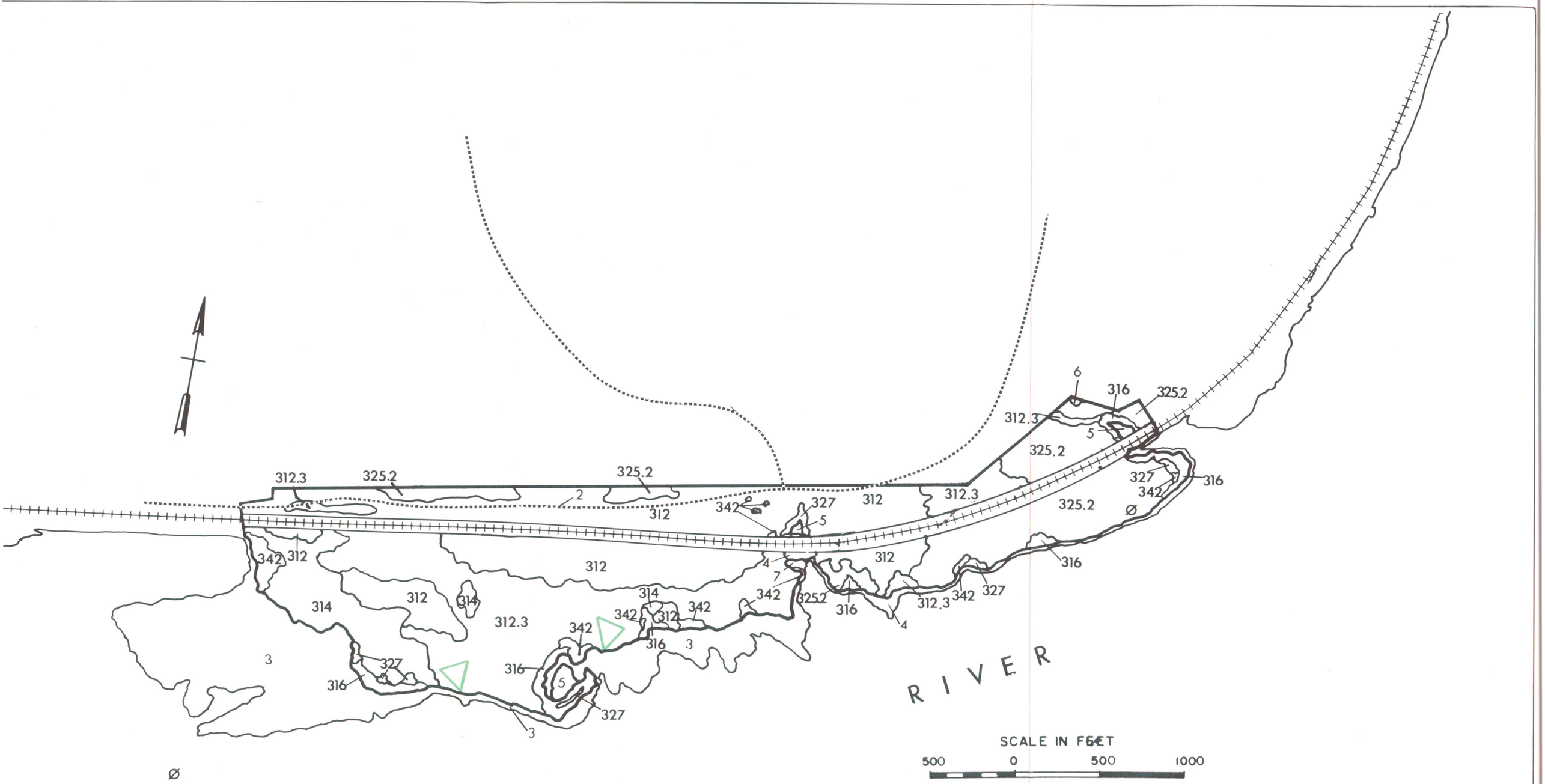
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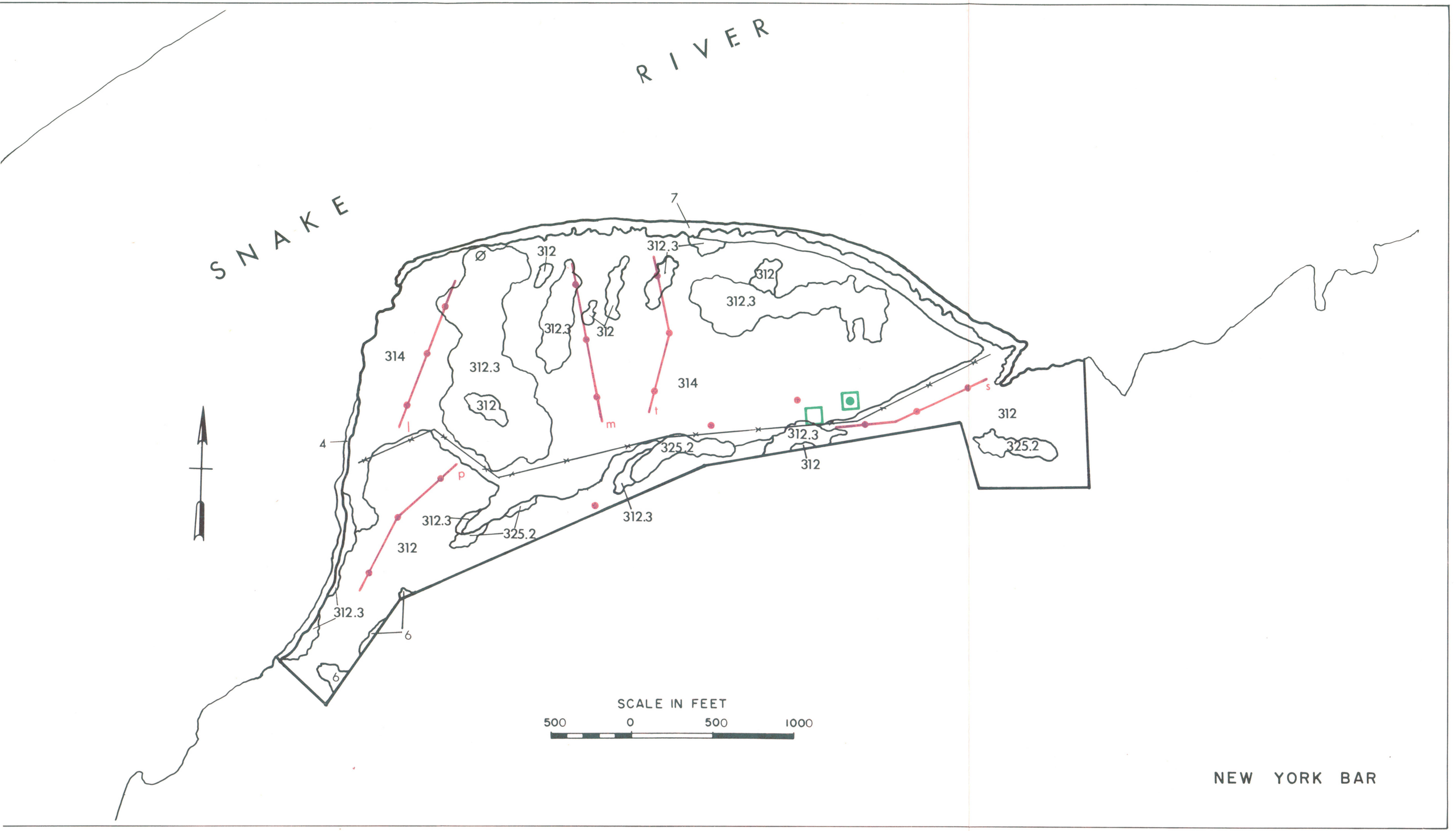
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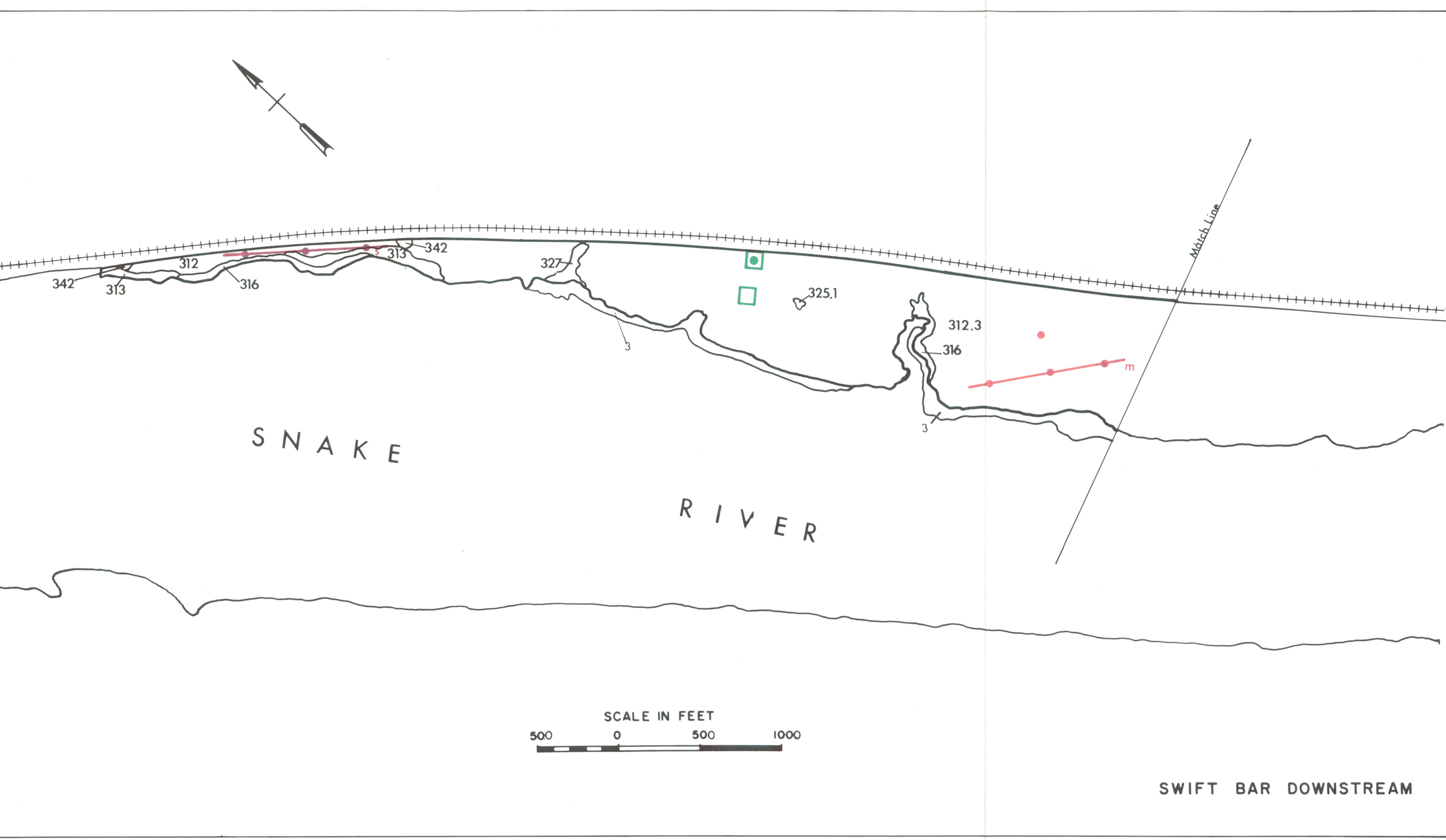
NEW YORK BAR



SWIFT BAR DOWNSTREAM

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SNAKE RIVER

SCALE IN FEET

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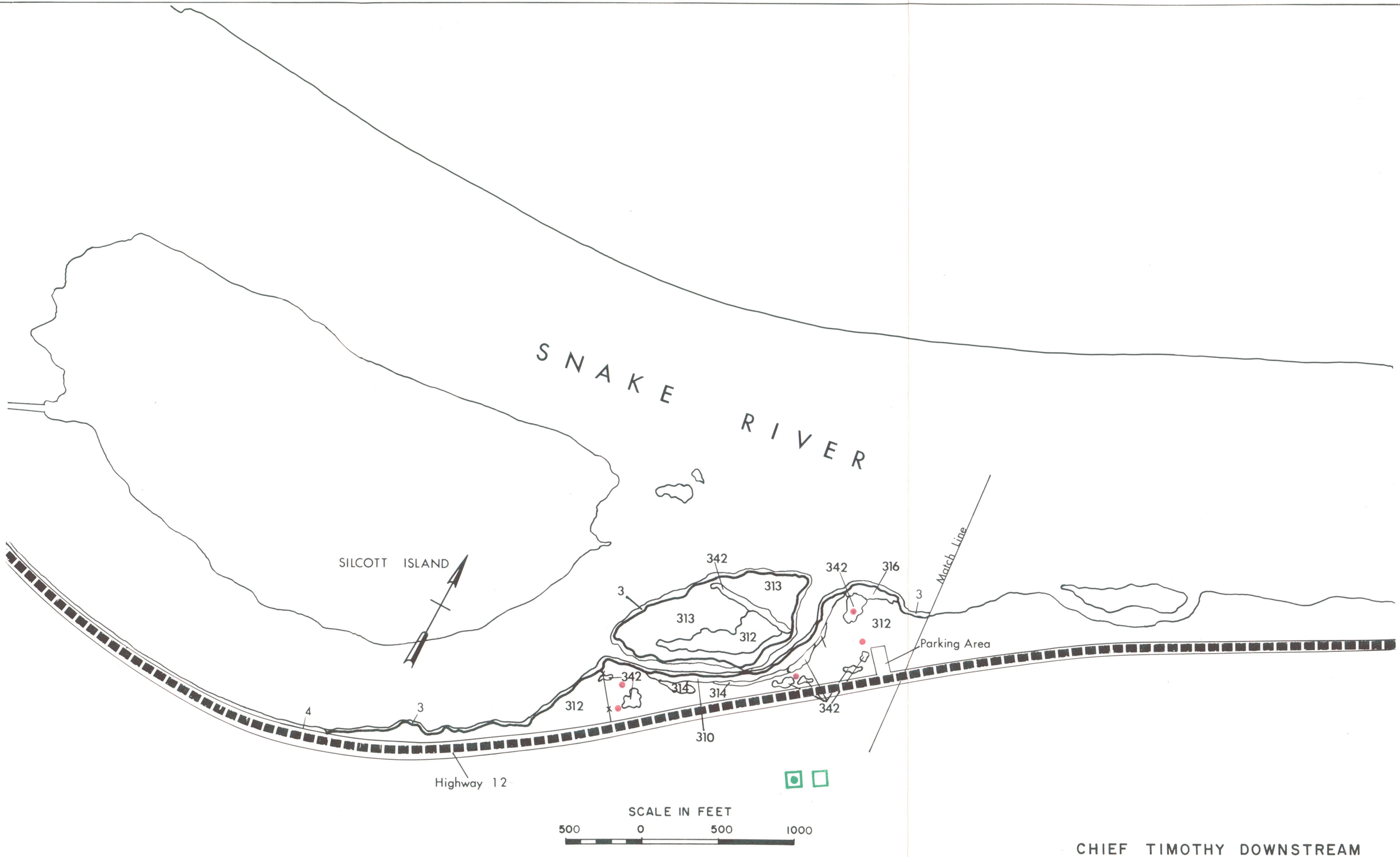
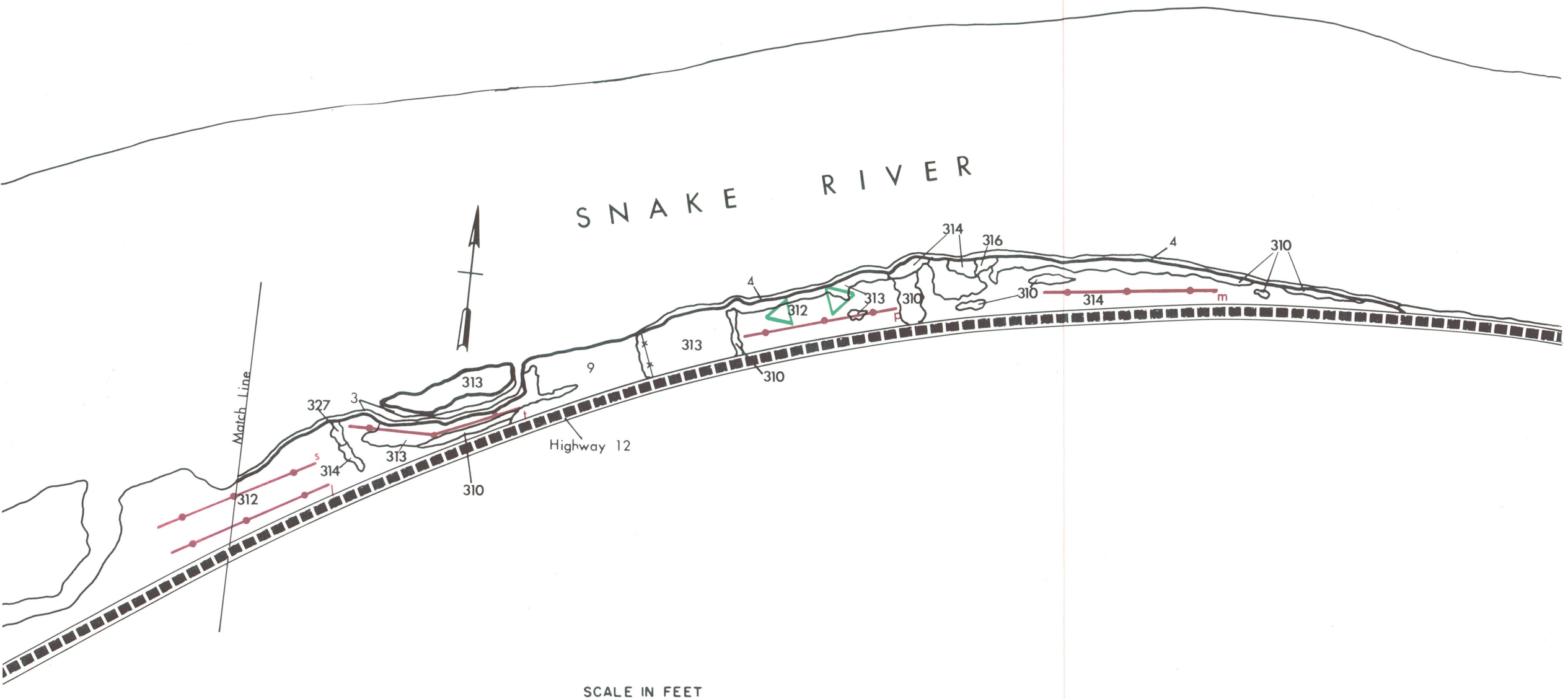
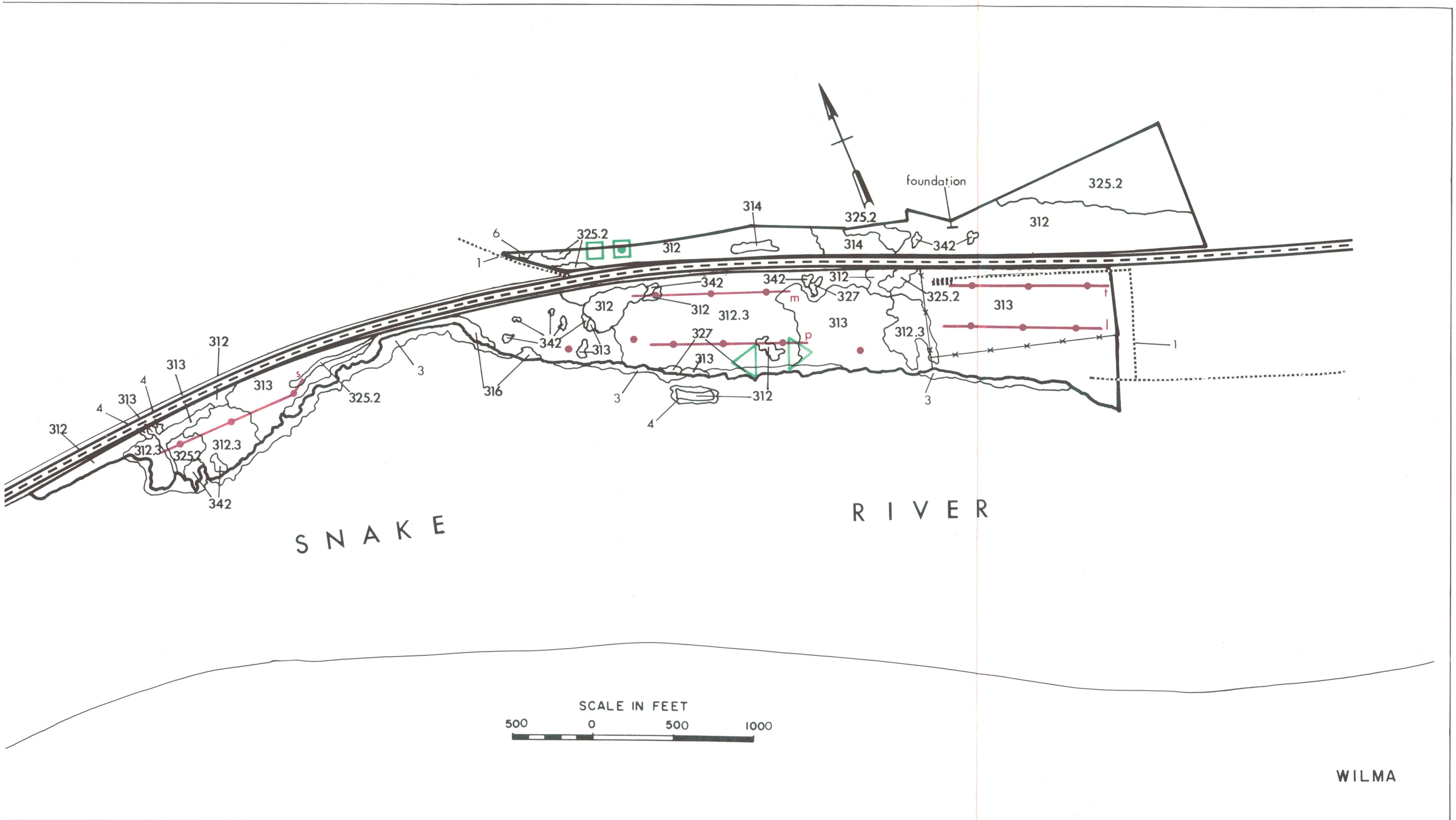
SWIFT BAR UPSTREAM



CHIEF TIMOTHY DOWNSTREAM



CHIEF TIMOTHY UPSTREAM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WILMA

Table 40. Areal extent in hectares[a] of existing cover types on each study site, Lower Snake River Study, 1979.

Existing Cover Type[b]	Big Flat	Hollebeke	Ice Harbor Subtotal	Skookum	55-Mile	Lower Monumental Subtotal
325.1	0.07	1.87	1.94	-	0.04	0.04
325.2	129.96	44.24	174.20	122.87	109.48	232.35
314	0.32	5.79	6.11	1.19	3.64	4.83
310	-	0.22	0.22	-	-	-
312	156.74	34.99	191.73	0.76	-	0.76
313	8.69	5.83	14.52	7.06	-	7.06
312.3	66.23	5.40	71.63	58.75	20.34	79.09
342	3.28	2.23	5.51	0.07	-	0.07
327	1.12	1.19	2.31	0.04	0.04	0.08
316	7.99	2.16	10.15	2.12	1.91	4.03
Mudflat	78.05	0.25	78.30	6.73	-	6.73
Rock-talus	0.47	0.36	0.83	7.52	6.84	14.36
Rip-rap	0.65	-	0.65	-	-	-
Gravel	-	-	-	-	-	-
Rocky shore	-	-	-	-	-	-
Culvert pond	-	-	-	-	-	-
Sand	1.22	1.98	3.20	0.36	0.86	1.22
Drywash	-	0.68	0.68	-	-	-
Total	454.79	107.19	561.98	207,47	143.15	350.62

Table 40. (Cont.)

Existing Cover Type	Ridpath	New York Bar	Swift Bar	Little Goose Subtotal	Chief Timothy	Wilma	Lower Granite Subtotal	Total Study Units
325.1	-		0.04	0.04	-	-	-	2.02
325.2	7.16	1.26	-	8.42	-	7.96	7.96	422.93
314	4.18	31.64	-	35.82	1.44	0.68	2.12	48.88
310	-	-	-	-	2.30	-	2.30	2.52
312	13.90	21.02	1.17	36.09	7.85	8.93	16.78	245.36
313	-	-	15.98	15.98	6.01	13.39	19.40	56.96
312.3	11.09	11.09	35.50	57.68	-	9.40	9.40	217.80
342	0.29	-	0.07	0.36	0.83	0.36	1.19	7.13
327	0.18	-	-	0.18	-	0.04	0.04	2.61
316	1.66	-	2.02	3.68	0.50	-	0.50	18.36
Mudflat	27.11	-	3.96	31.07	3.28	1.62	4.90	121.00
Rock-talus	-	0.14	-	0.14	-	-	-	15.3?
Rip-rap	-	-	-	-	-	-	-	0.65
Gravel	-	-	-	-	1.76	-	1.76	1.76
Rocky shore	-	0.65	0.90	1.55	1.04	0.18	1.22	2.77
Culvert pond	0.32	-	-	0.32	-	-	-	0.32
Sand	-	2.63	-	2.63	-	-	-	7.05
Drywash	-	-	-	-	-	-	-	0.68
Total	65.89	68.43	59.64	193.96	25.01	42.56	67.57	1174.13

[a]1.0 hectare equals 2.5 acres.

[b]See cover map legend for explanation of cover type numbering system.

The areal extent of fenced areas, naturally revegetated riparian cover, and tree and shrub plantings in parks along the river are reported in Table 41. The areal extent of fenced areas was determined from maps included in contract drawings for the Wildlife Habitat Development, Operations and Maintenance Contract (U.S. Army Engineer District, Walla Walla 1980). The estimated extent of naturally revegetated riparian cover and percent tree cover in parks was determined from cover maps completed by Asherin and Claar (1976) and ground-truthing. This new riparian cover is primarily young plants and is not capable of supporting as much wildlife as the mature pre-project riparian cover.

The primary purpose of fences along the Snake River is to restrict livestock trespass. Fences have been erected along railroads and highways, and along some Corps' property boundaries. All of these were funded directly or indirectly by the Corps and all have improved wildlife habitat to some degree because of reduced livestock grazing. A total of 4467.4 ha (11,038 acres) has been fenced.

Table 41. Areal extent (in hectares) of habitat improvement fencing areas, naturally revegetated riparian areas, and park trees on the lower Snake River, 1980.

Project	Area Fenced	Revegetated Riparian Cover	Area of Park Trees	Pre-project Riparian Cover[a]
Ice Harbor	1168.9	49.6	7.7	144.1
Lower Monumental	1660.2	42.9	0.6	37.2
Little Goose	1042.4	6.4	2.7	62.7
Lower Granite	595.9	0.0	0.0	210.4
Total	4467.4	98.9	11.0	454.4

[a]From U.S. Army Engineer District, Walla Walla (1975a:5b).

Beaver damage to willow and Russian olive trees has been observed at Hollebeke, Big Flat, Walker, and Alpowa. A large Russian olive grove planted by the Game Department in the 1950's at Hollebeke was used heavily by the beavers this past winter. Thirty-seven trees were damaged by beavers, and 20 of them were cut completely down.

Habitat Diversity Index

The amount of edge per unit area (meters/hectare)on each study site was determined from measured edge (Table 42). Analysis of variance indicated no difference existed between projects in amount of edge per unit area ($P > 0.05$, see Appendix F, Table 1).

Linear correlations were calculated to determine if linear relationships existed between the amount of habitat diversity and bird density, diversity, evenness, and richness on each site for both the breeding bird and winter bird censuses (Table 43). A strong linear relationship existed between habitat diversity and breeding bird density, breeding bird richness, and winter bird richness. Correlation coefficients between habitat diversity and winter bird density, breeding bird diversity, and winter bird diversity were very close to significance at $P < 0.05$. There was no linear relationship between habitat diversity and bird evenness. In summary, as habitat diversity increases, the number of birds and number of species also increase. Figures 3 and 4 depict the relationship between habitat diversity and bird density for the breeding and winter seasons.

Table 42. Total edge per unit study area (meters/hectare)on intensive study sites, Lower Snake River Study, 1979.

PROJECT Study Site	Edge (m)	Area (ha)	Edge/Area (m/ha)
ICE HARBOR	71,124	562.0	126.6
Big Flat	49,794	454.8	109.5
Hollebeke	21,330	107.2	199.0
LOWER MONUMENTAL	32,952	350.6	94.0
Skookum	19,680	207.5	94.8
55-Mile	13,272	143.1	92.7
LITTLE GOOSE	20,760	128.0	162.2
New York Bar	11,136	68.4	162.8
Swift Bar	9,624	59.6	161.5
LOWER GRANITE	18,588	67.6	275.0
Chief Timothy	10,608	25.0	424.3
Wilma	7,980	42.6	187.3

Table 43. Correlation coefficients and regression equations between habitat diversity and bird density, diversity, evenness and richness for both breeding and winter bird censuses, Lower Snake River Study, 1979-80.

	Breeding Census		Winter Census	
	Correlation Coefficient(r)	Regression Equation	Correlation Coefficient(r)	Regression Equation
Bird Density	0.92[a]	y=2.5x - 41.4	0.69[c]	y=2.8x - 123.1
Bird Diversity	0.70	y=0.003x + 1.3	0.70[c]	y=0.01x - 0.8
Bird Evenness	0.29	y=0.0002x + 0.7	0.40[c]	y=0.003x + 0.1
Bird Richness	0.84[a]	y=0.04x + 4.4	0.81[bc]	y=0.1x - 8.8

[a]Significant at $P < 0.01$.

[b]Significant at $P < 0.05$.

[c]Chief Timothy study site deleted because of vegetation removal prior to habitat plantings.

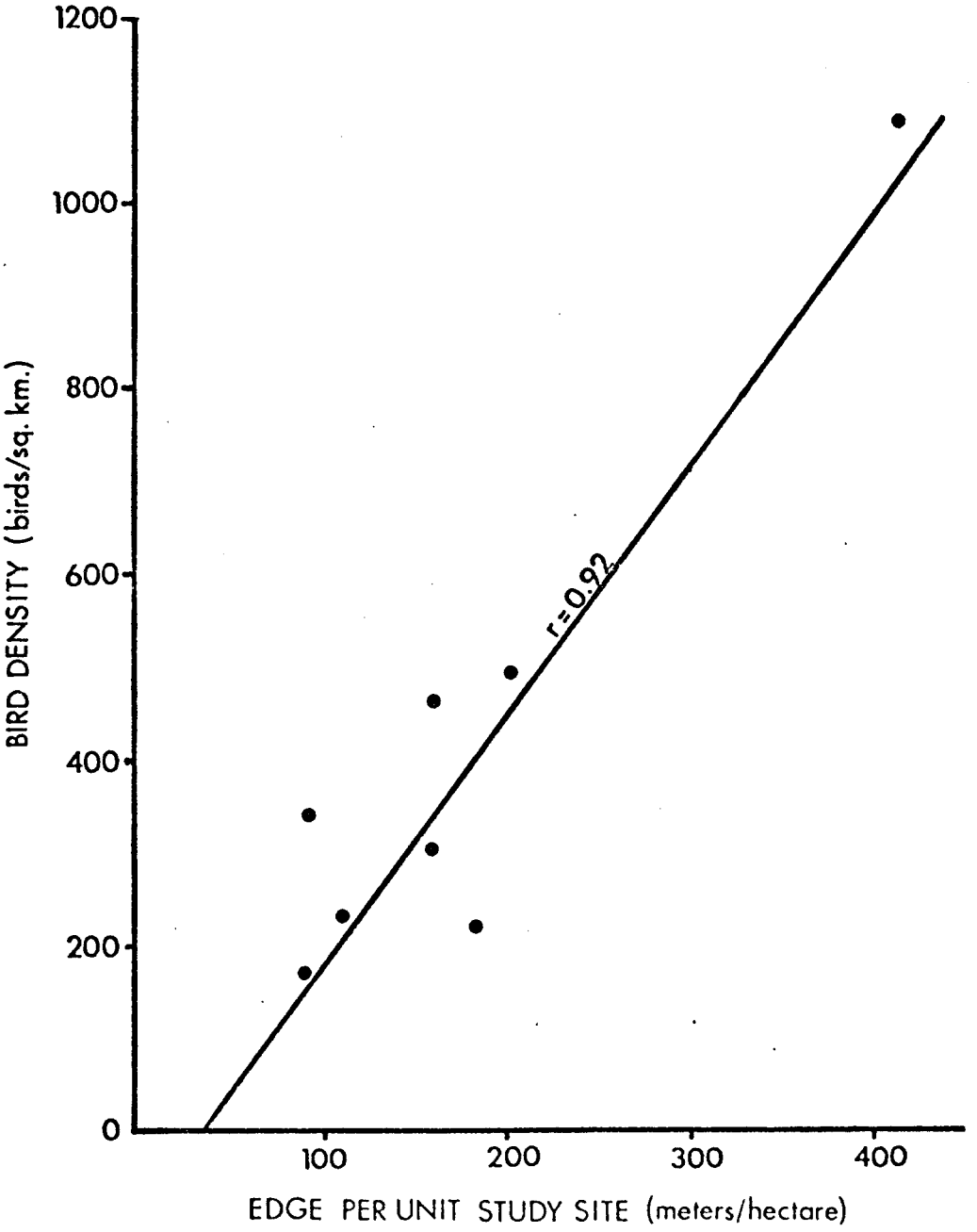

Figure 5. Linear correlation between breeding bird density and edge per unit study site, Lower Snake River Study, 1980.

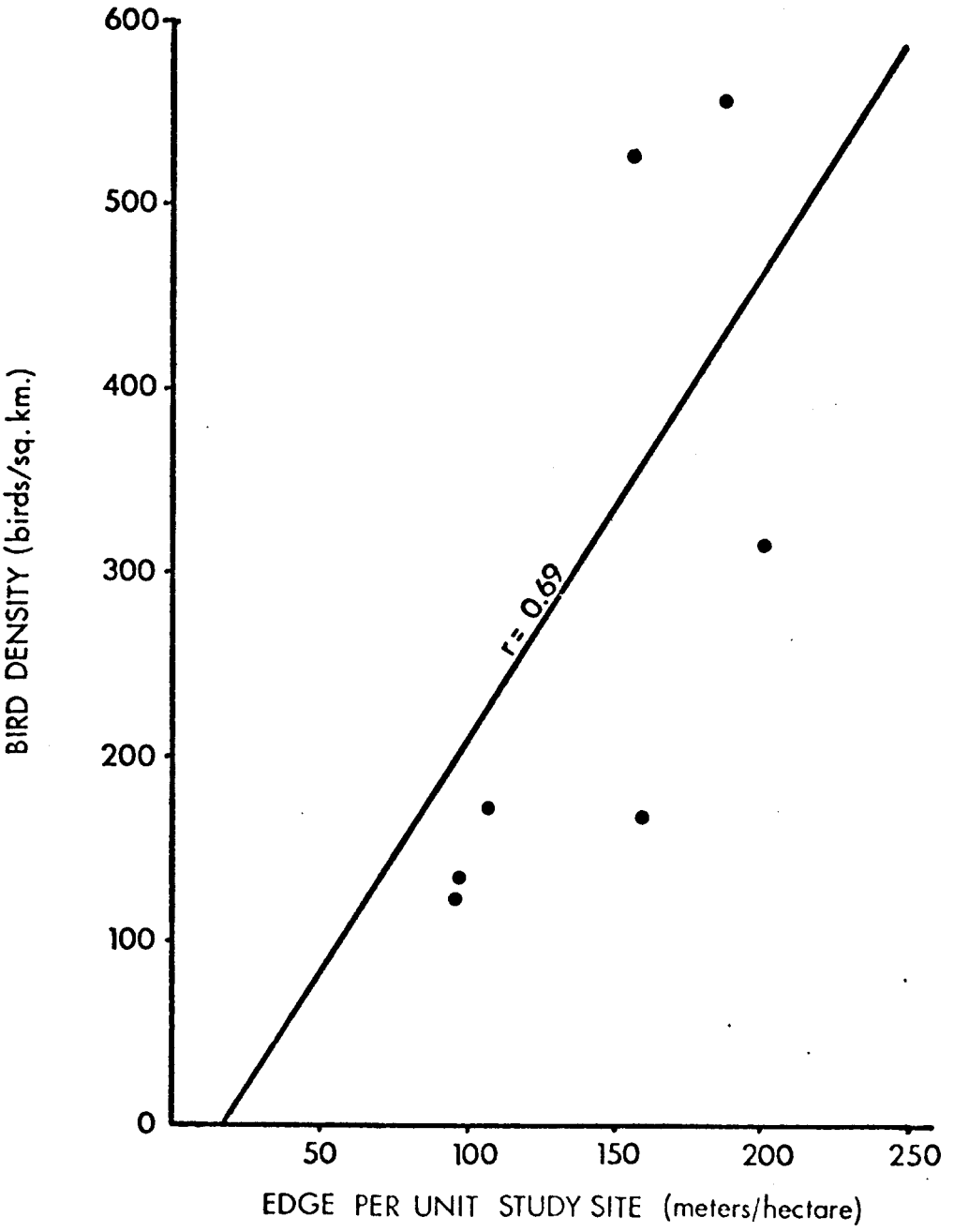

Figure 6. Linear correlation between winter bird density and edge per unit study site, Lower Snake River Study, 1980.

Compensation Progress

The current level of compensation progress was determined by totalling the increase in wildlife populations due to habitat improvement fencing, park trees, natural revegetation of riparian cover along shorelines, bunchgrass plantings, irrigated habitat development at Big Flat, creation of goose nesting islands, and artificial nesting structures for geese.

Riparian cover is slowly returning to the Snake River shorelines. Approximately 99 ha (244 acres) have naturally revegetated, primarily in Ice Harbor and Lower Monumental projects which have been in place 14 to 18 years. This is compared with 454 ha (1123 acres) of riparian cover which were lost to the four projects (see Table 41). Riparian cover has most successfully returned to the shorelines along the mouth of tributaries (i.e. Tucannon and Palouse rivers) and small embayments.

Approximately 11 ha (27 acres) of tree and shrub cover have been established in parks along the river. Non-game birds have benefitted from these plantings so we believe it is appropriate to include them as wildlife compensation.

About 4.8 ha (11.9 acres) of wildlife cover have been planted and irrigated at Big Flat. Trees, shrubs, sunflowers, grasses, and clover were planted. We sampled this area during the winter of 1979-80 and included this area in our measurement of compensation progress.

A number of habitat development programs have been directed toward improving Canada goose production. Bunchgrass was planted on New York Island in the early 1970's, three goose nesting islands have been created from dredged material, at least six islands were created by severing them from the mainland with construction equipment prior to inundation, and about 39 artificial nesting structures (8 floating, 28 tripod, and 3 hay bale) were installed. The bunchgrass planting on New York Island has provided excellent nesting cover and goose production has increased dramatically. The dredge islands have supported a total of one to three goose nests each year in recent years. The islands created by severence from the mainland have supported a total of three nests each year in recent years. Artificial nesting structures have supported a total of one to two nests each year in recent years.

Wildlife losses along the Snake River and the current level and percentage of compensation are reported in Table 44. A breakdown by type of habitat improvement is provided in Appendix X. Canada geese have shown the most improvement (86 percent compensation), primarily because of the large

number of nests on New York Island. We previously reported 100 percent compensation for geese but have since discovered that that estimate was incorrect. We had defined gosling production as the number of goslings hatched, but the U.S. Fish and Wildlife Service report included in the Lower Snake River Fish and Wildlife Compensation Plan (U.S. Army Engineer District, Walla Walla 1975a:App. A, 20) states there were an estimated 600 goslings "reared to flight stage" prior to dam construction.

Table 44. Wildlife losses due to dam construction and a current estimate of compensation progress, Lower Snake River Study, 1980.

Wildlife	Losses	Compensation	Percent of Compensation
Upland game[a]	66,800	1,303	2
Chukars	39,600	0	0
Mourning doves	14,400	454	3
Furbearers	13,400	-[b]	-
Deer	1,200	0	0
Canada geese	600[c]	514[c]	86
GAME SPECIES SUBTOTAL	136,000	2,271	2
Non-game birds			
Breeding	33,400	5,806	17
Wintering	92,500	2,823	3
TOTAL WILDLIFE	261,900	10,900	4

[a]Includes ring-necked pheasant, California quail, gray partridge, and cottontail.

[b]Not studied.

[c]Goslings reared to flight stage.

Upland game and mourning dove compensation is currently two and three percent, respectively. Cottontails provided the majority of the upland game compensation. Zero compensation was measured for chukars. Most of the chukar losses occurred in Little Goose and Lower Granite projects. Very little riparian cover has returned in these projects. Also, chukar

populations are no greater on the fenced areas than the unfenced areas.

Zero compensation was measured for deer populations, also. The scattered, thin strips of riparian cover now present in Ice Harbor and Lower Monumental projects apparently are not large enough individually to allow the deer populations to increase. The fact that the Lower Snake River Fish and Wildlife Compensation Plan lists the post-project deer population at 600 and our helicopter counts were 2458 deer in 1979 and 1938 deer in 1980 does not indicate that the deer population has increased by 1338 to 1858. All it indicates is that two entirely different methods were used to obtain the population estimates. The original post-project estimate of 600 was derived from autumn hunter surveys and estimated the population in a one-mile wide corridor (0.5 mile each side). Our base line estimate was derived from actual deer counts in winter made from a helicopter and covered a three-mile wide corridor (1.5 miles each side). Our base line counts are greater than the original post-project estimate because they are actual counts, not estimates, they came from an area three times as large, and they were conducted in winter when deer were concentrated in the Snake River Canyon.

Full compensation is defined as including the maintenance of non-game animals at pre-project levels (U.S. Army Engineer District, Walla Walla 1975a:81). To restore non-game bird populations to pre-project levels, the losses identified in Appendix Y have to be compensated. Currently, 17 percent of the breeding non-game birds and three percent of the wintering non-game birds have returned. Breeding non-game bird populations are returning because of the revegetation of some riparian cover and the improvement in nesting habitat due to control of livestock grazing through fencing. Wintering non-game birds have not shown as much improvement as breeding birds. Good winter cover such as thickets and evergreen shrubs have not been established yet. While nesting habitat has improved on the fenced areas because of the improved growth of grasses and legumes, these areas are not providing good winter cover. As shrubs return to these fenced areas in future years, winter bird populations should increase.

Base Line Measurements

We have now reported two years of wildlife measurements for which we were contracted in 1978. We have reported one year of wildlife measurements for items added to our scope-of-work in 1979. In this section we will present averages of the measurements which were taken for two years. Wildlife cover was disturbed by installation of irrigation systems on some of our study sites (Big Flat, Hollebeke, 55-Mile, New York Bar, Swift Bar, and Chief Timothy) during 1979-80. If five percent or more of the cover in any transect or study plot was disturbed we did not use those data in calculating the base line. For the measurements taken in one study year only, we will refer the reader to the table in this report which is most appropriate to use for the base line.

Sex Composition of Pheasants -- The mean of the 1979 and 1980 ratios is 5.2 hens per cock.

Counts of Wintering Upland Game -- Table 8 lists the base line counts on 10 irrigated sites and 10 dryland sites.

Counts of Pheasant, Dove, Quail, and Chukar Calls -- We recommend that the counts of wintering upland game be used as base line information in lieu of call counts. Call counts are only an index and no accurate population figure can be determined from them. To determine compensation progress in the future we will have to be able to estimate population changes. Data from the call counts will show population trends but not population numbers.

Aerial Surveys of Chukar -- Table 13 lists the base line chukar counts from helicopter. Since we have data from only one year we recommend one more helicopter flight to count chukars in December 1980.

Counts of Upland Game Bird Production -- Ring-necked pheasants: 88 percent of hens have broods, 5.5 juveniles per brood; Gray partridge: 51 percent of adults had broods, 8.4 juveniles per brood, 4.5 juveniles per adult; Chukar: 70 percent of adults had broods, 12.2 juveniles per brood, 3.2 juveniles per adult; California quail: 44 percent of adults had broods, 9.4 juveniles per brood, 2.8 juveniles per adult.

Searches for Goose Nests -- The total number of goose nests was 116 (1978 data excluded because no helicopter search for cliff nests was conducted), mean clutch size was 5.6, nest success was 94 percent, hatching success was 98 percent, and the estimated number of goslings produced to flight stage was 514 (1978 data excluded).

Index of Goose Use -- Table 45 lists the base line counts of goose use on the study sites.

Aerial Surveys of Deer and Coyotes -- The mean total number of deer was 2198, mean total mule deer was 1728, and mean total white-tailed deer was 470. The mean mule deer ratios were: 4.1 bucks per 100 does, and 69.3 fawns per 100 does. The mean white-tailed deer ratios were: 6.6 bucks per 100 does, and 77.8 fawns per 100 does. The mean number of coyotes counted was 148.

Surveys of Bird Density -- Tables 46 and 47 list base line bird density, population, diversity, evenness, and richness by study site for the breeding and winter censuses, respectively. Table 48 lists base line estimates of bird density by future cover type.

Table 45. Base line measurements of goose use on study sites, Lower Snake River Study, 1978-80.

PROJECT Study Site	Goose Droppings/ Day/Hectare		Goose-Use Days/Hectare	
	Spring[a]	Winter	Spring[a]	Winter
ICE HARBOR				
Big Flat	19	30	43	56
Hollebeke	19	10	43	18
LOWER MONUMENTAL				
Skookum	19	71	43	122
55-Mile	6	40	11	67
LITTLE GOOSE				
Ridpath	102	134	250	214
Swift Bar	0	0	0	0
LOWER GRANITE				
Chief Timothy	0	0[b]	0	0[b]
Wilma	0	6	0	11

[a]1979 data only; 1978 counts were primarily a preparation of study plots for subsequent surveys.

[b]1978-79 data only; counts were not completed at Chief Timothy in winter 1979-80 because of vegetation removal and study plot marker removal caused by clearing for habitat development.

Table 46. Base line estimates of bird abundance by study site, breeding bird censuses, Lower Snake River Study, 1978-80.

Study Site	Density (Birds/ Km^2)	Population	Diversity	Evenness	Richness
Big Flat	182	680	1.30	0.65	8
Hollebeke	374	372	1.28	0.64	8
Skookum	171	330	1.55	0.70	9
55-Mile[a]	190	258	1.77	0.74	11
New York Bar	386	251	1.48	0.72	8
Swift Bar	533	292	1.70	0.70	12
Chief Timothy[a]	1167	221	1.88	0.66	17
Wilma	248	101	1.85	0.78	10

[a]Study sites which had over 5% habitat disturbance in 1979 census were not used in base line estimates; data taken from 1978 census only.

Table 47. Base line estimates of bird abundance by study site, winter bird censuses, Lower Snake River Study, 1978-80.

Study Site	Density (Birds/ Km^2)	Population	Diversity	Evenness	Richness
Big Flat[a]	170	636	0.82	0.75	3
Hollebeke[a]	782	791	2.28	0.86	14
Skookum	142	275	0.36	0.32	2
55-Mile[a]	113	153	0.87	0.45	7
New York Bar[a]	146	95	0.00	0.00	1
Swift Bar[a]	655	359	1.73	0.83	8
Chief Timothy[a]	1918	363	1.00	0.48	8
Wilma	526	214	1.43	0.64	10

[a]Study sites which had over 5% habitat disturbance in 1979-80 census were not used in base line estimates; data taken from 1978-79 census only.

Table 48. Base line estimates of bird densities for each future cover type and riparian areas, breeding and winter censuses, Lower Snake River Study, 1978-1980.

PROJECT Study Site Future Cover Type	Breeding Season	Winter Season
ICE HARBOR		
Big Flat		
Legume	56[a]	100[a]
Meadow	17[a]	133[a]
Pasture	119[a]	53[a]
Save	125	43
Shrub	116	45[a]
Food Plots	205	273[a]
Hollebeke		
Legume	526	1234
Meadow	329	69[a]
Pasture	126	75[a]
Save	162	7
Shrub	93[a]	109[a]
Food Plots	277	243[a]
Riparian	4676	5595
LOWER MONUMENTAL		
Skookum		
Legume	120	89
Meadow	184	207
Pasture	259	0
Save	145	236
Shrub	266	133
Food Plots	186	467
55-Mile		
Legume	144[a]	55
Meadow	193	87
Pasture	262[a]	11[a]
Save	107	586
Shrub	132[a]	200[a]
Food Plots	223	273[a]

Table 48. (Cont.)

PROJECT Study Site Future Cover Type	Breeding Season	Winter Season
LITTLE GOOSE		
New York Bar		
Legume	432	178[a]
Meadow	180	261[a]
Pasture	1233	209
Save	79	34
Shrub	216	55[a]
Food Plots	367	215[a]
Swift Bar		
Legume	278	0[a]
Meadow	31	6[a]
Pasture	366	322
Save	1285	1702
Shrub	1194	1441[a]
Food Plots	140	266
LOWER GRANITE		
Chief Timothy		
Legume	278[a]	17[a]
Meadow	744[a]	49[a]
Pasture	1097[a]	580[a]
Save	1093[a]	2939[a]
Shrub	1771[a]	5515[a]
Food Plots	1228[a]	1970[a]
Riparian	4348	329[a]
Wilma		
Legume	245	672
Meadow	133	377
Pasture	212	63
Save	348	1166
Shrub	118	977
Food Plots	200	1687

[a]Transects and plots had greater than 5% disturbance during 1979-80 census. Densities taken from 1978-79 census.

Searches for Upland Nests -- Table 49 lists base line upland nest densities by study site and future cover type.

Observations of Guzzler Use -- Table 50 lists base line wildlife use at future guzzler sites.

Cover Mapping -- Table 40 lists the base line measurements of existing cover types on each study site and project.

Habitat Diversity Index -- Table 41 lists the base line measurements of total edge per unit study area for each study site and project.

Table 49. Base line upland nest densities (nests per hectare) by study site and future cover type, Lower Snake River Study, 1978-80.

Study Site	Food Plots	Legume	Meadow	Pasture	Save	Shrub
Big Flat	0.0	0.0	0.0	0.7	0.0	0.0
Hollebeke	0.0	0.0	0.0	0.0	0.7	0.0
Skookum	0.7	0.0	0.0	0.0	0.0	0.7
55-Mile	0.0	0.0	0.0	0.0	0.0	0.0
New York Bar	0.0	0.0	0.0	0.0	0.0	0.0
Swift Bar	0.0	0.0	0.0	0.0	2.0	4.0
Chief Timothy	45.0	1.3	2.0	2.7	2.0	0.0
Wilma	2.7	0.0	1.3	0.0	0.0	0.0

Table 50. Base line measurement of proposed guzzler site use on irrigated and dryland management units, Lower Snake River Study, 1978-80.

IRRIGATED DEVELOPMENT		DRYLAND DEVELOPMENT	
Study Site	Animal-Use Minutes[a]	Study Site	Animal-Use Minutes[ab]
Big Flat	4.2	Charbonneau	9.2
Hollebeke	9.0	Walker	11.4
Skookum	0.0	Tucannon	14.0
55-Mile	1.3	Texas Rapids	0.4
New York Bar	0.5	L. Goose Rec. Area	0.0
Swift Bar	20.5	Illia	18.6
Chief Timothy	14.8	G. Goose Pasture	4.3
Wilma	2.9	Moses	0.0
Total	53.2	Total	57.8

[a]Guzzler and control observations are averaged.

[b]1979 data only.

RECOMMENDATIONS

The following recommendations are based upon the results of two years of study and review of the "Design Memorandum for Wildlife Habitat Development - Supplement No. 1 - Lower Snake River Project."

Habitat Development

1. We suggest the amount of edge on management units be maximized. Our studies found a strong relationship between amount of edge and number of birds on our study areas.

2. We suggest tree and shrub plantings be maximized on irrigated and dryland units. Our studies found bird densities almost 100 times greater in mature trees than adjacent rabbitbrush-grassland cover types. Dryland unit plantings could be watered for a few years using a portable pump to draw water from the adjacent reservoir, or from a water tanker truck.

3. We suggest the majority of the pasture plantings identified in the draft supplemental design memorandum for wildlife habitat development not be managed as pastures but as nesting and cover areas. Preliminary figures show the 313 acres of pasture planned would be able to support 100,000 geese. Primary goose losses to the dam impoundments were from lost nesting and brooding areas.

4. We suggest brush piles be added as one of the habitat development components. Tree limbs may be obtainable for free from orchards and cities such as Clarkston, Pasco, and Walla Walla. Brush piles require no maintenance and make excellent escape and winter cover for quail, pheasants, cottontails, and non-game species.

5. We suggest the amount of irrigated habitat development that was recently cut at Skookum be replaced at Illia. The downstream portion of Illia would make a fine habitat development site and would place one habitat development site within easy travel distance of Pullman and Colfax.

6. We suggest more evergreen trees and shrubs (particularly juniper) be planted to provide winter cover for birds.

7. We suggest that some of the bird watering cisterns be placed in areas where a long expanse of rip-rap covers the shoreline. Currently, all of the cisterns are to be placed on management units which will be irrigated or have an accessible water approach for birds. We believe that crossing the rip-rap may cause mortality of juvenile upland game birds and placement of cisterns in these areas may increase survival.

Habitat Evaluation

8. We suggest that pheasant, dove, quail, and chukar call counts be dropped from future studies and winter flushing counts and breeding and winter season transect data be used to measure upland bird populations.

9. We suggest that since only one count of chukars was made from helicopter that an additional count be made in December 1980. This would serve as a base line for on-project studies and Element Y of off-project studies.

10. We suggest Canada goose cliff nest searches be conducted only from helicopter in the future. Revisits should continue to be done from boat.

11. We suggest dropping species diversity and evenness from bird survey calculations in future study years. These calculations require an inordinate amount of time and are of marginal value.

12. We suggest dropping the control sites from observations of guzzler use in future study years. We have already determined the base line use prior to guzzler installation and that will serve as the control.

13. We suggest that goose use on the irrigated management units be monitored closely. A large amount of pasture is planned which may create a situation where geese will move from the lower Snake River to these pastures, which are both closed to waterfowl hunting. This may eliminate the need for geese to feed in their traditional areas (wheat fields and irrigated crop lands) which are open to hunting.

14. We suggest that a study of furbearer base line populations be initiated and a current estimate of furbearer compensation progress be measured.

15. We suggest continued monitoring of nest box use, artificial goose nesting structures (including use of different nest materials), and selected habitat plantings (meadow, food plots, etc.)

Hunting Management

16. We suggest that the upstream end of Charbonneau be opened to hunting (excluding waterfowl). This unit has excellent potential for mourning dove hunting and some potential for upland game hunting. This could be a potential game farm bird release site, also.

17. We suggest that the restrictions on hunting with a rifle at Big Flat be removed. We have been contacted by individuals who wished to deer hunt in the area with a rifle.

18. We suggest that the Washington Department of Game and U.S. Fish and Wildlife Service consider removing the waterfowl hunting closures on Lower Monumental, Little Goose, and Lower Granite projects. We believe that waterfowl hunting pressure would remain low and would not adversely affect waterfowl populations. We recommend that the reach of river between the mouth and Lower Monumental Dam remain closed to waterfowl hunting to protect the large waterfowl concentrations wintering there.

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LITERATURE CITED

1. Anthony, R. 1970. Ecology and reproduction of California quail in southeastern Washington. Condor. 72:276-287.

2. Asherin, D.A. and J.J. Claar. 1976. Inventory of riparian habitats and associated wildlife along the Columbia and Snake Rivers. University of Idaho, Moscow. 551 pp. (pp. 36-89, Appendix B).

3. Bellrose, F.C. 1976. Ducks, geese and swans of North America. Stackpole Books, Harrisburg, Pennsylvania. 544 pp.

4. Bent, A.C. 1929. Life histories of North American shore birds. Order: Limicolae (Part 2), U.S. Natl. Mus. Bull. 146. U.S. Gov. Printing Office, Washington D.C. 412 pp.

5. _____. 1958. Life histories of North American blackbirds, orioles, tanagers, and their allies. Order: Passeriformes. Families: Ploceidae, Icteridae, and Thraupidae. U.S. Natl. Mus. Bull. 211. U.S. Gov. Printing Office, Washington,D.C. 549 pp.

6. Chesness, R.A., M.M. Nelson, and W.H. Longley. 1968. The effect of predator removal on pheasant reproductive success. J. Wildl. Manage. 32(4):683-697.

7. Culbertson, J.L., L.L. Cadwell, and I.O. Buss. 1971. Nesting and movements of Canada geese on the Snake River in Washington. Condor. 73:230-236.

8. Eberhardt, L.L. 1978. Appraising variability in population studies. J. Wildl. Manage. 42(2):207-238.

9. Emlen, J.T. 1971. Population densities of birds derived from transect counts. Auk. 88(2):323-342.

10. _____. 1977. Estimating breeding season bird densities from transect counts. Auk. 94(2):455-468.

11. Hanson, W.C. and L.L. Eberhardt. 1971. A Columbia River Canada goose population. Wildl. Monogr. 28. 61 pp.

12. Harrison, C. 1978. A Field Guide To The Nests, Eggs, and Nestlings Of North American Birds. Collins, Cleveland, Ohio. 416 pp.

13. Hitchcock, C.L. and A. Cronquist. 1973. Flora of the Pacific Northwest. University of Washington Press, Seattle. 730 pp.

14. Kimball, J.W. 1949. The crowing count pheasant census. J. Wildl. Manage. 13(1):101-120.

15. _____, E.L. Kozicky and B.A. Nelson. 1956. Pheasants of the plains and prairies. pp 204-263. The Stackpole Co., Harrisburg, Pa. and Wildl. Manage. Inst. Washington, D.C. 490 pp. in Pheasants in North America Durward Allen, ed.

16. Knott, N.P., C.C. Ball, and C.F. Yocom. 1943. Nesting of the hungarian partridge and ring-necked pheasant in Whitman County, Washington. J. Wildl. Manage. 7(3):283-297.

17. Lanyon, W.E. 1957. The comparative biology of the meadowlarks (Sturnella) in Wisconsin. Publ. of the Nuttall Ornithological Club No. 1. Cambridge, Massachusetts. 67 pp.

18. LaRivers, I. 1944. Observations on the nesting mortality of the brewer blackbird, Euphagus cyanocephalus. Am. Midl. Nat. 32(2):417-437.

19. Lewke, R.E. 1975. Preimpoundment Study of Vertebrate Populations and Riparian Habitat behind Lower Granite Dam on the Snake River in Southeastern Washington. Washington State Univ., Pullman, Ph.D. thesis. 242 pp.

20. Mudd, D.R. and C.R. Merker. 1977. Mitigation and compensation of game fish and wildlife impacted by Bonneville Second Powerhouse construction and related relocations. Washington Department of Game, Olympia. 76 pp.

21. Odum, E.P. 1971. Fundamentals of Ecology. W.B. Saunders Co., Philadelphia. 574 pp.

22. Oelklaus, W.F. 1976. Chukar partridge dispersion along the middle and lower Snake and Columbia rivers. M.S. Thesis. Univ. of Idaho, Moscow. 56 pp.

23. Owen, M. 1971. The selection of feeding site by white-fronted geese in winter. J. Appl. Ecol. 8(3)905-917.

24. Palmer, R.S. (Ed). 1976. Handbook of North American birds. Vol. 2. New Haven and London, Yale Univ. Press. 521 pp.

25. Robson, D.S. and H.A. Regier. 1964. Sample size in Peterson mark-recapture experiments. Trans. Am. Fish. Soc. 93(3):215-226.

26. Schuerholz, G. 1974. Quantitative evaluation of edge from aerial photographs. J. Wildl. Mgmt. 38(4):913-920.

27. Seel, D.C. 1968. Clutch-size, incubation and hatching success in the house sparrow and tree sparrow Passer spp. at Oxford. Ibis 110(3):270-282.

28. Shields, W.M. 1977. The effect of time of day on avian census results. Auk. 94(2):380-383.

29. Snedecor, G.W. and W.G. Cochran. 1967. Statistical Methods, 6th ed. Iowa State University Press, Ames, Iowa. 593 pp.

30. Summers-Smith, D. 1958. Nest-site selection, pair formation and territory in the house sparrow Passer domesticus. Ibis 100(2):190-203.

31. Taylor, W.H. 1957. Utilization, preference, and nutritional value of winter green agricultural crops for goose food. M. Sc. thesis, Virginia Polytechnic Institute. Taken from Owen. 1971. J. Applied Ecol. 8(3):905-917.

32. U.S. Army Engineer District, Walla Walla. 1975a. A special report: Lower Snake River Fish and Wildlife Compensation Plan. Dept. of Army. Walla Walla District, Corps of Engineers. 95 pp and appendices.

33. _____. 1975b. Design Memorandum for Wildlife Habitat Development on Project Lands: Lower Snake River Project. Dept. of Army. Walla Walla District, Corps of Engineers. 125 pp and appendices.

34. _____. 1979. Design Memorandum for Wildlife Habitat Development: Lower Snake River Project. Supplement No. 1. Dept. of Army. Walla Walla District, Corps of Engineers. 78 pp and appendices.

35. _____. 1980. Wildlife Habitat Development, Operations and Maintenance Contract. Lower Snake River Project. 77 pp.

36. U.S. Fish and Wildlife Service. 1973. Instruction for mourning dove call-count survey. Office of Migratory Bird Management, Laurel, Maryland. 2 pp.

37. Williams, H.W. 1961. The influence of physical and biological factors on the rally call of the chukar partridge (Alectoris graeca) with regard to use of the call as a census method. Proc. Ann. Conf. W. Assoc. State Game and Fish Comm. 41:117-129.

38. Zeigler, D.L. 1977. Evaluation of the breeding habitat of the mourning dove in eastern Washington. Washington Game Department project W-70-R-16, Study VIII. 23 pp.

39. Zeigler, D.L. 1978. The Okanogan mule deer. Washington Game Department Biol. Bull. No. 15. Olympia. 106 pp.

APPENDIX A

FORMULAE AND EXAMPLE OF PHEASANT BREEDING POPULATION DENSITY CALCULATIONS, LOWER SNAKE RIVER STUDY, 1979[a].

$C \times .311 = c$ (cocks per square mile)

$c \times \frac{100}{SR} = h$ (hens per square mile)

$c + h = P$ (pheasants per square mile)

where C= Mean call count per unit
SR= Sex ratio of cocks per 100 hens

Sample data for Swift Bar density calculations:

	Downstream Station	Central Station	Upstream Station	Mean
Swift Bar	1/3	6/1	1/3	2.50

$2.50 \times 2^{b}(.311) = 1.56$ cocks per square mile

$\frac{1.56}{6.4} = 0.24$ cocks per 100 acres

$0.24 \times 4.1 + 0.24 = 1.22$ pheasants per 100 acres

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[a]Formulae from Kimball (1949).

[b]Datum multiplied by two as only a semi-circle was surveyed.

APPENDIX B

AGE CHARACTERISTICS OF JUVENILE RING-NECKED PHEASANTS,[a] LOWER SNAKE RIVER STUDY, 1979.

Size of Meadowlark or Smaller			
1 Week	2 Weeks	3 Weeks	4 Weeks
Three dark stripes on back.	One dark stripe on back. Flight: short hops.	Tail: less than 2 inches. Flight: rapid and sparrow-like.	Tail: about 2 inches. Size of meadowlark.
Larger Than Meadowlark - Smaller than Crow			
5 Weeks	6 Weeks	7 Weeks	8 Weeks
Pinfeathery appearance: head and upper neck. Tail: 3 inches.	Upper parts of body darker than sides. Tail: 3½ inches.	Neck and upper back dark brown. Tail: about 4 inches.	Dark brown extends to upper breast and tail. Tail: 4 inches.
About Size of Crow or Larger			
9 Weeks	10 Weeks	11 Weeks	12 Weeks
Red between eye and bill in cocks. Slightly smaller than crow.	Color showing on breast, back, and neck. Size of crow. Tail: 4 inches.	More color showing on breast, back and neck. Tail: about 5 inches.	Size near adult hen. Tailbars show well. Tail: 6 inches.

[a]Taken from reprint furnished by Wendell Oliver (Washington Department of Game). We were unable to determine the original source.

APPENDIX C

CALCULATION OF BIRD DENSITY, DIVERSITY, AND EVENNESS, LOWER SNAKE RIVER STUDY, 1979.

Coefficient of Detectability

Coefficients of detectability were calculated from histograms. The point of inflection of the histogram was determined to ascertain the distance from the observer at which bird observations began to decline. The point of inflection was that band from which the number of birds sighted decreased and never returned to at least one-half the peak. The following histogram represents the total sightings of a single species on three surveys within the same cover type.

0-5	6-10	11-15	16-20	21-25	26-30	31-35	36-40	41-45	46-50
3	2	4	5	5	5	4	8	2	3

The point of inflection in this example is the 36-40 m band.

$$\text{C.D.} = \frac{\text{No. birds of this species detected}}{\text{No. birds in bands from 0 to pt. of inflection} \div \text{No. bands from 0 to pt. of inflection} \times \text{Total No. of bands (10)}}$$

$$= \frac{41}{36 \div 8 \times 10}$$

$$= 0.911$$

Bird Density

Bird density was calculated from the following formula:

$$\text{Density} = \frac{\text{No. birds of this species detected} \times 100}{\text{C.D.} \times \text{Area of transect or plot}}$$

$$\text{Density} = \frac{41 \times 100}{0.911 \times 22.2 \text{ acres}}$$

$$\text{Density} = 203 \text{ birds/100 acres}$$

APPENDIX C (Cont.)

Species Diversity

Diversity (Odum 1971:144) was calculated from bird density:

$$\text{Species diversity} = - \sum_{i=1}^{s} P_i \log_e P_i$$

Where s = species and P_i = proportion of individuals belonging to the i^{th} species.

Species Evenness

Evenness was calculated using the following formula from Odum (1971:144):

$$\text{Evenness} = \frac{\text{Species Diversity}}{\log_e S}$$

Where S = number of species.

APPENDIX D

NUMBERS OF PHEASANTS FLUSHED AND AREAS SEARCHED DURING SEX COMPOSITION COUNTS OF RING-NECKED PHEASANTS BETWEEN 5 FEBRUARY AND 4 APRIL 1979 AND 8 FEBRUARY AND 20 MARCH 1980, LOWER SNAKE RIVER STUDY.

PROJECT Development Type Management Unit	1979			1980		
	Cocks	Hens	Unc[a]	Cocks	Hens	Unc
ICE HARBOR						
Irrigated						
Big Flat	0	6	0	4	15	1
Lost Island	2	1	0	3	7	3
Hollebeke	1	13	1	4	38	1
Dryland						
Charbonneau	1	0	0	5	4	0
Walker	0	0	0	0	2	0
Couch Landing	2	2	0	1	0	1
Other I.H. Project						
River Mile 10S	1	0	0	-[b]	-	-
Levey Landing	0	3	0	0	1	0
Votaw	-	-	-	1	0	0
Snake River Jct.	0	0	0	-	-	-
Burr Canyon	0	0	0	-	-	-
Windust	0	0	0	-	-	-
LOWER MONUMENTAL						
Irrigated						
Skookum	0	0	0	0	0	0
55-Mile	0	0	1	0	4	0
Dryland						
Ayer	0	1	0	6	14	0
Joso	0	0	0	0	0	0
Other L.M. Project						
Tranquility	0	0	0	-	-	-
Magallon	0	0	0	-	-	-
Lyon's Ferry	0	3	0	0	9	0
Sargent	0	0	0	-	-	-
Tucannon	1	6	0	6	34	6
Texas Rapids	0	0	0	0	0	0
Riparia	0	1	0	-	-	-

APPENDIX D (Cont.)

PROJECT Development Type Management Unit	1979 Cocks	Hens	Unc[a]	1980 Cocks	Hens	Unc
LITTLE GOOSE						
Irrigated						
Ridpath	1	12	0	2	11	2
New York Bar	0	0	0	1	0	0
Swift Bar	3	57	1	21	100	20
Dryland						
Little Goose Rec. Area	0	0	0	1	2	1
Purrington	1	2	2	0	6	3
Schultz Bar	1	3	0	9	33	0
Other L. Goose Project						
Flagpole Gulch	0	0	0	-	-	-
Dry Gulch	0	0	0	-	-	-
River Mile 82S	-	-	-	2	0	0
Central Ferry	1	0	0	-	-	-
Lower Deadman	1	1	0	-	-	-
Penewawa	1	9	0	-	-	-
Beckwith Bar	2	15	1	2	6	0
Illia	4	19	0	-	-	-
Almota	3	4	0	-	-	-
LOWER GRANITE						
Irrigated						
Chief Timothy	2	4	0	0	0	0
Wilma	4	28	1	6	45	0
Dryland						
Granite Goose Pasture	1	0	1	0	7	6
Moses	3	18	0	1	28	0
Other L. Granite Project						
Offield	2	4	0	-	-	-
Wawawai	1	6	0	-	-	-
Knoxway Canyon	3	10	0	-	-	-
Mile 123S	0	0	0	-	-	-
Asgar	0	0	0	-	-	-
Alpowa	0	0	0	3	18	0
Total	42	228	8	78	384	44

[a]Pheasants were unclassified as to sex.

[b]Area was not searched.

APPENDIX E

NUMBER OF RING-NECKED PHEASANT CALLS HEARD PER TWO-MINUTE PERIOD AT 60 LISTENING STATIONS ALONG LOWER SNAKE RIVER 25 APRIL TO 10 MAY 1979.

PROJECT Development Type Management Unit	Number of calls per two-minute period Downstream Station	Central Station	Upstream Station	Mean	Standard Deviation
ICE HARBOR					
Irrigated					
Big Flat	2/2[a]	2/2	0/0	1.3	1.2
Lost Island	0/2	2/0	0/0	0.7	0.6
Hollebeke	4/2	8/2	4/8	4.7	1.5
Dryland					
Charbonneau	8/12	6/2	4/0	5.3	4.2
Walker	0/0	2/2	0/0	0.7	1.2
Couch Landing	2/2	2/0	0/0	1.0	1.0
LOWER MONUMENTAL					
Irrigated					
Skookum	0/0	0/0	0/0	0.0	0.0
55-Mile	0/0	0/2	0/0	0.3	0.6
Dryland					
Ayer	4/8	4/4	4/0	4.0	2.0
Joso	0/2	0/0	0/2	0.7	0.6
LITTLE GOOSE					
Irrigated					
Ridpath	2/4	2/2	0/0	1.7	1.5
New York Bar	0/0	0/2	2/0	0.7	0.6
Swift Bar	0/8	8/0	4/4	4.0	0.0
Dryland					
L. Goose Rec. Area	0/0	2/4	2/0	1.3	1.5
Purrington	6/6	2/2	0/0	2.7	3.1
Schultz Bar	2/0	0/2	4/2	1.7	1.2

APPENDIX E (Cont.)

PROJECT Development Type Management Unit	Number of calls per two-minute period Downstream Station	Central Station	Upstream Station	Mean	Standard Deviation
LOWER GRANITE					
Irrigated					
Chief Timothy	6/10	2/0	0/0	3.0	4.6
Wilma	2/4	4/4	6/2	3.7	0.6
Dryland					
G. Goose Pasture	0/0	4/2	0/0	1.0	1.7
Moses	0/0	0/0	0/0	0.0	0.0

[a]Call counts were multiplied by two as only a semi-circle was surveyed. Two two-minute counts were taken at each station and are separated by a slash. The average of the two counts was used in computing the mean and standard deviation of the management unit.

APPENDIX F

F AND CHI-SQUARE VALUES AND ASSOCIATED STATISTICS, LOWER SNAKE RIVER STUDY, 1979.

Table 1. F values, sums of squares, mean squares, and degrees of freedom from analysis of variance, Lower Snake River Study, 1979.

Type of Data	Source of Variation	F Value	Sum of Squares	Mean Square	Degrees of Freedom
Pheasant call counts	Years (1978 vs. 1979)	38.89[c]	3.50	3.50	1, 2
	Pooled projects within years[a]	0.07	0.18	0.09	2, 4
	Development within projects[a]	0.76	5.20	1.30	4, 32
	Pooled projects[b]	0.02	0.04	0.04	1, 2
	Development within projects[b]	1.10	4.65	2.32	2, 16
Dove call counts	Years (1978 vs. 1979)	80.63[c]	34.67	34.67	1, 2
	Pooled projects within years[a]	0.03	0.86	0.43	2, 4
	Development within projects[a]	2.08	65.70	16.42	4, 32
	Pooled projects[b]	0.04	0.04	0.04	1, 2
	Development within projects[b]	0.31	1.95	0.98	2, 16
Quail call counts					
25 April - 10 May	Pooled projects[b]	1.06	0.18	0.18	1, 2
	Development within projects[b]	1.00	0.17	0.08	2, 16

APPENDIX F (Cont.)

Table 1. (Cont.)

Type of Data	Source of Variation	F Value	Sum of Squares	Mean Square	Degrees of Freedom
Quail call counts (Cont.)					
6 June - 15 June	Pooled projects[b]	1.00	0.15	0.15	1, 2
	Development within projects[b]	1.00	0.30	0.15	2, 16
Chukar call counts					
25 April - 10 May	Pooled projects[b]	3.51	23.44	23.44	1, 2
	Development within projects[b]	1.98	13.35	6.68	2, 16
6 June - 15 June	Pooled projects[b]	4.09	26.01	26.01	1, 2
	Development within projects[b]	0.76	12.71	6.36	2, 16
6 Sept - 13 Sept	Pooled projects[b]	0.47	16.01	16.01	1, 2
	Development within projects[b]	1.32	34.09	17.05	2, 16
	Count period (April-May vs. June vs. Sept)[b]	0.37	1481.34	740.67	2,177
Index of goose use	Years (Feb 1979 vs. Feb 1980)	3.09	187.60	187.60	1,158
	Pooled projects	0.11	1234.48	1234.48	1,208
	Sample period (Sept 1979 vs. Feb 1980)	0.16	3703.09	3703.09	1,148

APPENDIX F (Cont.)

Table 1. (Cont.)

Type of Data	Source of Variation	F Value	Sum of Squares	Mean Square	Degrees of Freedom
Searches for upland nests					
Study sites	Year	0.02	353.66	353.66	1, 94
	Pooled projects	1.27	251.25	251.25	1, 46
	Study site	1.13	251.25	35.89	7, 40
	Cover type	1.12	251.25	50.25	5, 42
Grazed-ungrazed sites	Development	0.36	2.55	2.55	1, 18
Observations of guzzler use	Years	1.31	1522.77	1522.77	1, 86
	Pooled projects	0.88	1320.08	1320.08	1, 94
	Development	1.52	1320.08	1320.08	1, 94
Habitat diversity	Projects	1.98	80804.14	26934.71	3, 4

[a]1978 and 1979 data.

[b]1979 data only.

[c]Significant at $P < 0.025$, all other F values are not significant.

APPENDIX F (Cont.)

Table 2. Chi-square values and degrees of freedom, Lower Snake River Study, 1979.

Type of Data	Source of Variation	Degrees of Freedom	Chi-square Value[a]
Searches for goose nests	Island nesting success between projects	3	4.71
	Cliff nesting success between projects	3	0.49
	Artificial structure nesting success between projects	-[b]	-
	Island hatching success between projects	3	7.04
	Cliff hatching success between projects	3	1.80
	Artificial structure hatching success between projects	-[b]	-
	Island nesting success between years	1	0.35
	Cliff nesting success between years	1	0.05
	Artificial structure nesting success between years	1	0.00

APPENDIX F (Cont.)

Table 2. (Cont.)

Type of Data	Source of Variation	Degrees of Freedom	Chi-square Value[a]
Searches for goose nests (Cont.)	Island hatching success between years	1	0.01
	Cliff hatching success between years	1	0.02
	Artifical structure hatching success between years	1	3.57

[a]No values were significant ($P > 0.05$)

[b]Chi-square values could not be calculated as only Little Goose Project had a nesting structure used in 1979.

APPENDIX F (Cont.)

Table 3. F values, sums of squares, mean squares, and degrees of freedom for bird density and richness between pooled projects, study sites, existing cover types, future cover types, and survey periods, Lower Snake River Study, 1978-1980.

	Density			Richness			Degrees of Freedom
	F	Sum of Squares	Mean Square	F	Sum of Squares	Mean Square	
Breeding Season (1979)							
Pooled projects	0.97	606,142	606,142	1.31	117.88	117.88	1, 6
Study sites	7.71[c]	2,891,921	413,131	6.44[b]	167.96	23.99	7,16
Existing cover types	32.40[g]	49,816,959	7,116,708	28.44[f]	91.77	13.11	7,16
Future cover types	0.66	7,168,336	1,433,667	0.65	189.31	37.86	5,42
Winter Season (1979-80)							
Pooled projects	4.27	208,251	208,251	2.33	87.50	87.50	1, 6
Study sites	4.77[b]	680,246	97,178	5.98[b]	122.96	17.57	7,16
Existing cover types	9.96[d]	76,297,090	10,899,584	40.29[h]	61.10	8.73	7,16
Future cover types	2.33	13,181,066	2,626,213	0.50	145.92	29.18	5,42
Breeding Season (1979) vs. Winter Season (1979-80)							
Study sites	1.03	874,541	874,541	7.16[a]	310.44	310.44	1,14
Breeding Season (1978) vs. Breeding Season (1979)							
Study sites	0.0004	1,542,321	1,542,321	0.005	179.94	179.94	1,14
Winter Season (1978-79) vs. Winter Season (1979-80)							
Study sites	1.39	3,083,941	3,083,941	0.006	137.44	137.44	1,14

APPENDIX F (Cont.)

Table 3. (Cont.)

	Density			Richness			Degrees of Freedom
	F	Sum of Squares	Mean Square	F	Sum of Squares	Mean Square	
Breeding and Winter Seasons (1978-1979) vs. Breeding and Winter Seasons (1979-1980)							
Study sites	0.53	1,854,791	1,854,791	0.008	114.25	114.25	1,14
Grazed vs. Ungrazed, Breeding Season 1979	0.70	7,597,336	7,597,336	1.10	108.18	108.18	1,58
Grazed vs. Ungrazed, Winter Season 1979-80	0.05	1,866,897	1,866,897	-2.9×10^{-11}	39.93	39.93	1,58
Ungrazed Breeding Season (1979) vs. Ungrazed Winter Season (1979-80)	8.90[b]	5,781,044	5,781,044	33.87[e]	126.98	126.98	1,58

[a]Significant ($P < 0.05$), all other F values not footnoted are not significant.

[b]Significant ($P < 0.005$).

[c]Significant ($P < 0.0005$).

[d]Significant ($P < 0.0001$).

[e]Significant ($P < 0.000001$).

[f]Significant ($P < 0.0000001$).

[g]Significant ($P < 0.00000005$).

[h]Significant ($P < 0.00000001$).

APPENDIX F (Cont.)

Table 4. F values, sums of squares, mean squares, and degrees of freedom for bird diversity and evenness between pooled projects, study sites, existing cover types, future cover types, and survey periods, Lower Snake River Study, 1978-1980.

	Diversity			Evenness			Degrees of Freedom
	F	Sum of Squares	Mean Square	F	Sum of Squares	Mean Square	
Breeding Season (1979)							
Pooled projects	3.94	0.88	0.88	5.00	0.04	0.04	1, 6
Study sites	4.44[b]	2.82	0.40	1.08	0.22	0.03	7,16
Existing cover types	22.62[f]	4.68	0.67	3.37[a]	0.82	0.12	7,16
Future cover types	0.29	9.47	1.89	0.26	3.09	0.62	5,42
Winter Season (1979-80)							
Pooled projects	0.16	2.78	2.78	0.02	0.66	0.66	1, 6
Study sites	6.58[d]	7.58	1.08	3.49[a]	3.29	0.47	7,16
Existing cover types	5.79[c]	2.97	0.42	2.23	1.86	0.27	7,16
Future cover types	0.24	12.09	2.42	0.20	8.37	1.67	5,42
Breeding Season (1979) vs. Winter Season (1979-80)							
Study sites	10.63[b]	6.44	6.44	3.61	0.88	0.88	1,14
Breeding Season (1978) vs. Breeding Season (1979)							
Study sites	0.12	1.23	1.23	0.26	0.10	0.10	1,14
Winter Season (1978-79) vs. Winter Season (1979-80)							
Study sites	0.0004	3.88	3.88	0.004	1.17	1.17	1,14

APPENDIX F (Cont.)

Table 4. (Cont.)

	Diversity			Evenness			Degrees of Freedom
	F	Sum of Squares	Mean Square	F	Sum of Squares	Mean Square	
Breeding and Winter Seasons (1978-1979) vs. Breeding and Winter Seasons (1979-1980)							
Study sites	0.02	1.59	1.59	0.08	0.32	0.32	1,14
Grazed vs. Ungrazed, Breeding Season 1979	0.54	11.80	11.80	0.05	10.09	10.09	1,58
Grazed vs. Ungrazed, Winter Season 1979-80	0.004	2.68	2.68	0.13	3.53	3.53	1,58
Ungrazed Breeding Season (1979) vs. Ungrazed Winter Season (1979-80)	29.00[e]	11.04	11.04	28.31[e]	9.72	9.72	1,58

[a]Significant ($P < 0.05$), all other F values not footnoted are not significant.

[b]Significant ($P < 0.01$).

[c]Significant ($P < 0.005$).

[d]Significant ($P < 0.001$).

[e]Significant ($P < 0.00001$).

[f]Significant ($P < 0.0000005$).

APPENDIX G

ESTIMATES OF RING-NECKED PHEASANT BREEDING POPULATIONS ALONG LOWER SNAKE RIVER, 1979

PROJECT Development Type Management Unit	Cocks/ 100 Acres	Cocks/ Km^2	Pheasants/ 100 Acres	Pheasants/ Km^2
ICE HARBOR				
Irrigated				
Big Flat	0.07	0.17	0.44	1.08
Lost Island	0.03	0.07	0.19	0.46
Hollebeke	0.22	0.55	1.44	3.55
Dryland				
Charbonneau	0.26	0.65	1.69	4.17
Walker	0.03	0.07	0.19	0.46
Couch Landing	0.05	0.12	0.31	0.77
LOWER MONUMENTAL				
Irrigated				
Skookum	0.00	0.00	0.00	0.00
55-Mile	0.02	0.05	0.12	0.31
Dryland				
Ayer	0.19	0.48	1.25	3.09
Joso	0.03	0.07	0.19	0.46
LITTLE GOOSE				
Irrigated				
Ridpath	0.08	0.19	0.50	1.24
New York Bar	0.03	0.07	0.19	0.46
Swift Bar	0.19	0.48	1.25	3.09
Dryland				
L. Goose Rec. Area	0.07	0.17	0.44	1.08
Purrington	0.13	0.31	0.81	2.01
Schultz Bar	0.08	0.19	0.50	1.24

APPENDIX G (Cont.)

PROJECT Development Type Management Unit	Cocks 100 Acres	Cocks/ Km^2	Pheasants/ 100 Acres	Pheasants/ Km^2
LOWER GRANITE				
Irrigated				
Chief Timothy	0.15	0.36	0.94	2.32
Wilma	0.17	0.43	1.12	2.78
Dryland				
G. Goose Pasture	0.05	0.12	0.31	0.77
Moses	0.00	0.00	0.00	0.00

APPENDIX H

NUMBER OF MOURNING DOVE CALLS HEARD PER THREE-MINUTE PERIOD AT 60 LISTENING STATIONS ALONG LOWER SNAKE RIVER, 6 JUNE TO 15 JUNE 1979.

PROJECT Development Type Management Unit	Number of calls per three-minute period Downstream Station	Central Station	Upstream Station	Mean	Standard Deviation
ICE HARBOR					
Irrigated					
Big Flat	0/0[a]	0/0	0/0	0.0	0.0
Lost Island	0/0	0/4	0/0	0.7	1.2
Hollebeke	18/20	0/0	0/0	6.3	11.0
Dryland					
Charbonneau	0/0	0/0	0/0	0.0	0.0
Walker	0/0	0/0	0/0	0.0	0.0
Couch Landing	0/0	0/0	0/0	0.0	0.0
LOWER MONUMENTAL					
Irrigated					
Skookum	0/0	0/0	0/0	0.0	0.0
55-Mile	0/0	0/0	0/0	0.0	0.0
Dryland					
Ayer	12/14	0/0	0/0	4.3	7.5
Joso	0/0	0/0	0/0	0.0	0.0
LITTLE GOOSE					
Irrigated					
Ridpath	0/4	6/10	0/0	3.3	4.2
New York Bar	0/0	0/0	0/0	0.0	0.0
Swift Bar	0/0	0/0	2/2	0.7	1.2
Dryland					
L. Goose Rec. Area	0/0	4/0	0/0	0.7	1.2
Purrington	0/0	0/0	2/14	2.7	4.6
Schultz Bar	0/0	0/0	0/4	0.7	1.2

APPENDIX H (Cont.)

PROJECT Development Type Management Unit	Number of calls per three-minute period Downstream Station	Central Station	Upstream Station	Mean	Standard Deviation
LOWER GRANITE					
Irrigated					
Chief Timothy	0/0	0/0	0/0	0.0	0.0
Wilma	0/0	0/0	0/0	0.0	0.0
Dryland					
G. Goose Pasture	0/0	0/0	0/0	0.0	0.0
Moses	6/8	4/2	2/4	4.3	2.3

[a]Call counts were multiplied by two as only a semi-circle was surveyed. Two three-minute counts were taken at each station and are separated by a slash. The average of the two counts was used in computing the mean and standard deviation of the management unit.

APPENDIX I

NUMBER OF CALIFORNIA QUAIL CALLS HEARD PER TWO-MINUTE PERIOD AT 60 LISTENING STATIONS ALONG LOWER SNAKE RIVER, 25 APRIL TO 10 MAY 1979.

PROJECT Development Type Management Unit[a]	Number of calls per two-minute period Downstream Station	Central Station	Upstream Station	Mean	Standard Deviation
ICE HARBOR					
Dryland					
Couch Landing	0/0[b]	4/0	0/0	0.7	1.2
LOWER GRANITE					
Dryland					
G. Goose Pasture	0/0	2/10	0/0	2.0	3.5

[a]Only those units where calls were heard are listed.

[b]Call counts were multiplied by two as only a semi-circle was surveyed. Two two-minute counts were taken at each station and are separated by a slash. The average of the two counts was used in computing the mean and standard deviation of the management unit.

APPENDIX J

NUMBER OF CALIFORNIA QUAIL CALLS HEARD PER THREE-MINUTE PERIOD AT 60 LISTENING STATIONS ALONG LOWER SNAKE RIVER 6 JUNE TO 15 JUNE 1979.

PROJECT Development Type Management Unit[a]	Number of calls per three-minute period Downstream Station	Central Station	Upstream Station	Mean	Standard Deviation
ICE HARBOR					
Dryland					
Walker	0/0[b]	12/0	0/0	2.0	3.5

[a]Only that unit where calls were heard is listed.

[b]Call counts were multiplied by two as only a semi-circle was surveyed. Two three-minute counts were taken at each station and are separated by a slash. The average of the two counts was used in computing the mean and standard deviation of the management unit.

APPENDIX K

NUMBER OF CHUKAR RESPONSES AND COVEYS HEARD PER TEN-MINUTE PERIOD AT 60 LISTENING STATIONS, AND ESTIMATED DENSITIES ALONG LOWER SNAKE RIVER, 6 SEPTEMBER TO 13 SEPTEMBER 1979.

PROJECT Development Management Unit	Downstream Station		Central Station		Upstream Station		Mean		No.	Chukars/
	Resp.[a]	Cov.[b]	Resp.	Cov.	Resp.	Cov.	Resp.	S.D.	Chukars	100 Acres
ICE HARBOR										
Irrigated										
Big Flat	0	0	0	0	0	0	0	-	0	0
Lost Island	0	0	0	0	0	0	0	-	0	0
Hollebeke	0	0	0	0	0	0	0	-	0	0
Dryland										
Charbonneau	0	0	0	0	0	0	0	-	0	0
Walker	0	0	0	0	0	0	0	-	0	0
Couch Landing	0	0	0	0	0	0	0	-	0	0
LOWER MONUMENTAL										
Irrigated										
Skookum	1	1	0	0	14	1	5.0	7.8	34.2	27.7
55-Mile	0	0	0	0	0	0	0	-	0	0
Dryland										
Ayer	0	0	0	0	0	0	0	-	0	0
Joso	0	0	0	0	1	1	0.3	0.6	0.7	0.6

APPENDIX K (Cont.)

PROJECT Development Management Unit	Downstream Station Resp.	 Cov.	Central Station Resp.	 Cov.	Upstream Station Resp.	 Cov.	Mean Resp.	S.D.	No. Chukars	Chukars/ 100 Acres
LITTLE GOOSE										
Irrigated										
Ridpath	0	0	0	0	0	0	0	-	0	0
New York Bar	0	0	0	0	0	0	0	-	0	0
Swift Bar	0	0	0	0	0	0	0	-	0	0
Dryland										
L. Goose Rec. Area	0	0	3	1	0	0	1.0	1.7	5.7	4.6
Purrington	0	0	0	0	0	0	0	-	0	0
Schultz Bar	0	0	0	0	1	0	0.3	0.6	0.7	0.6
LOWER GRANITE										
Irrigated										
Chief Timothy	2	1	0	0	0	0	0.7	1.2	3.2	2.6
Wilma	0	0	0	0	0	0	0	-	0	0
Dryland										
G. Goose Pasture	11	2	19	3	8	1	12.7	5.7	90.6	73.5
Moses	0	0	2	1	1	1	1.0	1.0	3.9	3.2

[a]Response is defined as a rally call of an individual chukar.

[b]Covey is defined as a group of birds calling from the same proximity.

APPENDIX L

NUMBER OF CHUKAR CALLS HEARD AT 60 LISTENING STATIONS ALONG LOWER SNAKE RIVER, 1979.

Table 1. Number of chukar calls heard in conjunction with pheasant call counts (two-minute listening period), 25 April to 10 May 1979.

PROJECT Development Type Management Unit[a]	Downstream Station	Central Station	Upstream Station	Mean	Standard Deviation
ICE HARBOR/ LOWER MONUMENTAL					
Dryland					
Joso	0/0[b]	0/0	1/0	0.2	0.3
LITTLE GOOSE/ LOWER GRANITE					
Irrigated					
Ridpath	1/1	0/0	0/0	0.3	0.6
Swift Bar	1/1	0/0	0/0	0.3	0.6
Wilma	2/3	2/1	1/5	2.3	0.8
Dryland					
Purrington	0/0	0/2	0/0	0.3	0.6
Schultz Bar	5/6	0/0	10/7	4.7	4.3
G. Goose Pasture	0/0	7/6	0/0	2.2	3.8
Moses	3/0	1/4	3/4	2.5	1.0

[a]Only those units where calls were heard are listed.

[b]Two two-minute counts were taken at each station and are separated by a slash. The average of the two counts was used in computing the mean and standard deviation of the management unit.

APPENDIX L (Cont.)

Table 2. Number of chukar calls heard in conjunction with dove call counts (three-minute listening period), 6 June to 15 June 1979.

PROJECT Development Type Management Unit[a]	Downstream Station	Central Station	Upstream Station	Mean	Standard Deviation
LOWER MONUMENTAL					
Dryland					
Joso	0/2[b]	0/0	0/0	0.3	0.6
LITTLE GOOSE					
Dryland					
Schultz Bar	0/0	0/0	0/1	0.2	0.3
LOWER GRANITE					
Irrigated					
Chief Timothy	0/0	0/0	0/2	0.3	0.6
Wilma	0/0	10/8	0/1	3.2	5.1
Dryland					
G. Goose Pasture	0/0	18/24	0/0	7.0	12.1
Moses	0/0	12/4	0/1	2.8	4.5

[a]Only those units where calls were heard are listed.

[b]Two three-minute counts were taken at each station and are separated by a slash. The average of the two counts was used in computing the mean and standard deviation of the management unit.

APPENDIX M

COUNTS OF CHUKAR FROM HELICOPTER AT EACH MANAGEMENT UNIT, LOWER SNAKE RIVER STUDY, DECEMBER 1979.

PROJECT Development Type Management Unit	River-Miles Counted	Number of Chukar
ICE HARBOR/LOWER MONUMENTAL		
Irrigated		
Big Flat	15-17 N	0
Lost Island	22-24 N	18
Hollebeke	24-26 S	0
Skookum	48-50 N	63
55-Mile	54-56 N	16
Dryland		
Charbonneau	11-13 S	0
Walker	30-32 S	0
Couch Landing	31-33 N	27
Ayer	53-55 S	0
Joso	56-58 S	15
LITTLE GOOSE/LOWER GRANITE		
Irrigated		
Ridpath	75-77 N	58
New York Bar	79-81 S	50
Swift Bar	94-96 N	78
Chief Timothy	131-133 S	206
Wilma	134-136 N	229
Dryland		
L. Goose Rec. Area	71-73 S	16
Purrington	84-86 N	38
Schultz Bar	99-101 N	180
G. Goose Pasture	118-120 S	730
Moses	129-131 N	265

APPENDIX N

OBSERVED PRODUCTION OF RING-NECKED PHEASANT, GRAY PARTRIDGE, CHUKAR, AND CALIFORNIA QUAIL ALONG LOWER SNAKE RIVER, JUNE TO SEPTEMBER 1979.

Table 1. Observed ring-necked pheasant production along lower Snake River, 1979.

PROJECT Development Type Management Unit	No. Hens	Hens with Broods (%)	No. Broods	No. Juveniles Per Brood
ICE HARBOR				
Irrigated				
Lost Island	4	100	4	9.3
Hollebeke	6	100	6	7.8
Dryland				
Charbonneau	4	75	3	5.7
Other I.H. Project				
Roger's Reef	2	50	2	4.0
Levey Landing	2	100	2	3.0
LOWER MONUMENTAL	0		0	
LITTLE GOOSE				
Other L.Go. Project				
Beckwith Bar	1	100	1	1.0
Illia	2	100	3	7.3
Almota	2	100	2	4.5
LOWER GRANITE				
Irrigated				
Chief Timothy	1	100	1	13.0
Wilma	3	67	2	1.5
Dryland				
G. Goose Pasture	1	100	1	7.0
TOTAL LOWER SNAKE RIVER	28	89%	27	6.3

APPENDIX N (Cont.)

Table 2. Observed gray partridge production along lower Snake River, 1979.

PROJECT Development Type Management Unit	No. Adults	Adults with Broods(%)	Juveniles per Adult	No. Broods	Juveniles per Brood
ICE HARBOR					
Irrigated					
Hollebeke	6	83	5.2	3	10.3
LOWER MONUMENTAL	0			0	
LITTLE GOOSE	0			0	
LOWER GRANITE					
Dryland					
G. Goose Pasture	6	0	0.0	0	
TOTAL LOWER SNAKE RIVER	12	42%	2.6	3	10.3

APPENDIX N (Cont.)

Table 3. Observed chukar production along lower Snake River, 1979.

PROJECT Development Type Management Unit	No. Adults	Adults with Broods(%)	Juveniles per Adult	No. Broods	Juveniles per Brood
ICE HARBOR					
Irrigated					
Lost Island	1	100	12.0	1	12.0
LOWER MONUMENTAL					
Irrigated					
55-Mile	3	100	1.0	1	3.0
Other L.M. Project					
Lyon's Ferry	1	100	9.0	1	9.0
Texas Rapids	1	100	9.0	1	9.0
LITTLE GOOSE					
Other L. Go. Project					
Illia	1	100	10.0	1	10.0
LOWER GRANITE					
Irrigated					
Chief Timothy	14	57	1.1	2	7.5
Wilma	17	41	3.5	5	12.0
Dryland					
G. Goose Pasture	6	0		0	
Moses	11	91	4.6	3	17.0
Other L. Gr. Project					
River Mile 128N	4	0		0	
TOTAL LOWER SNAKE RIVER	59	54%	2.9	15	11.3

APPENDIX N (Cont.)

Table 4. Observed California quail production along lower Snake River, 1979.

PROJECT Development Type Management Unit	No. Adults	Adults with Broods(%)	Juveniles per Adult	No. Broods	Juveniles per Brood
ICE HARBOR					
Irrigated					
Hollebeke	1	0		0	
LOWER MONUMENTAL	0			0	
LITTLE GOOSE	0			0	
LOWER GRANITE					
Irrigated					
Chief Timothy	1	0		0	
Dryland					
G. Goose Pasture	4	50	5.0	2	10.0
TOTAL LOWER SNAKE RIVER	6	33%	3.3	2	10.0

APPENDIX O

LOCATIONS OF ISLANDS AND ARTIFICIAL NESTING STRUCTURES FOR CANADA GEESE, SIZE AND NESTING DENSITIES ON ISLANDS, AND NUMBER OF NESTS FOUND LOWER SNAKE RIVER STUDY, 1979.

Table 1. Locations, size, number of goose nests, and nesting densities of islands on the lower Snake River, 1979.

Project	River Mile	Description	Area in hectares[a]	No. of Nests	Density (Nests/ha.)
Ice Harbor	15.0	Dalton Lake Island	0.02	0	0
	17.5	Fishhook Island	0.03	3	100
	40.0	Matthews Dredge Island	0.06	0	0
Lower Monumental	41.8	No Name	0.29	0	0
	52.4	Ayer Island #1	0.47	0	0
	53.0	Ayer Island #2	0.32	1	3
	53.3	Ayer Island #3	0.10	1	10
	53.4	Ayer Island #4	0.08	1	12
	58.5	Lyons Ferry Island	0.10	0	0
	59.0	Palouse River Island #1	0.12	0	0
	59.0	Palouse River Island #2	0.28	0	0
	60.0	No Name	0.08	0	0
	60.0	No Name	0.01	0	0
	63.0	Tucannon Island	0.11	0	0
	67.0	Alkali Creek Island	0.02	1	50
Little Goose	78.0	New York Island	19.7	67	3
	94.5	Swift Bar Dredge Island	0.07	1	14
Lower Granite	113.5	Granite Point Island	0.14	0	0
	131.5	Chief Timothy Island #1	0.16	0	0
	131.5	Chief Timothy Island #2	0.02	1	50
	132.0	Chief Timothy Island #3	1.12	0	0
	132.0	Silcott Island	5.15	0	0
	134.0	Wilma Dredge Island	0.08	2	25

[a]1.0 hectare equals 2.5 acres.

APPENDIX O (Cont.)

Table 2. Locations of artificial nesting structures for geese on the lower Snake River, 1979.

Project	River Mile	Shore	Description
Ice Harbor	24.6	S[a]	Floating structure in Hollebeke embayment.
Lower Monumental	45.4	N	Floating structure in inlet near Tranquility.
	45.4	N	Tripod structure in inlet near Tranquility.
	48.5	N	Tripod structure at Skookum.
	49.5	N	Tripod structure at Skookum.
	50.2	N	Tripod structure at Skookum
	52.5	N	Tripod structure in small inlet.
	53.7	S	Two tripod structures at upstream Ayer.
	56.6	S	Two tripod structures at central Joso.
	57.3	N	Tripod structure in small inlet near navigation aid #27.
	57.5	N	Tripod structure below hatchery site.
Little Goose	78.0		Five tripod structures on New York Island.
	98.2	S	Tripod structure on shore of Beckwith Bar.
	99.0	S	Tripod structure inland on Beckwith Bar.
Lower Granite	NONE		

[a]"N" denotes north shore; "S" denotes south shore.

APPENDIX P

DENSITIES (ANIMALS PER SQUARE MILE) OF POOLED SEX AND AGE CLASSES OF MULE AND WHITE-TAILED DEER ALONG LOWER SNAKE RIVER, WINTER 1979-80.

Project	Mule deer					White-tailed deer				
	Adult Buck	Yearling Buck	Doe	Fawn	Total	Adult Buck	Yearling Buck	Doe	Fawn	Total
Ice Harbor (93 Sq. Miles)	0.02	0.00	0.43	0.20	0.65	0.00	0.00	0.01	0.00	0.01
Lower Monumental (87 Sq. Miles)	0.07	0.02	1.15	0.84	2.08	0.00	0.00	0.05	0.01	0.06
Little Goose (111 Sq. Miles)	0.10	0.01	4.39	2.22	6.72	0.08	0.02	1.72	1.05	2.86
Lower Granite (96 Sq. Miles)	0.22	0.03	4.20	1.83	6.28	0.03	0.00	0.11	0.09	0.23
Lower Snake River (387 Sq. Miles)	0.10	0.02	2.66	1.33	4.11	0.03	0.01	0.53	0.33	0.90

APPENDIX Q

MEASUREMENTS OF BIRD ABUNDANCE AND DIVERSITY ON FUTURE COVER TYPES, LOWER SNAKE RIVER STUDY, 1979-80.

Table 1. Density, standard deviation of density, diversity, evenness, and richness, breeding bird census, 1979.

PROJECT Study Site Future Cover Type	Density (Birds/ Km^2)	Standard Deviation	Diversity	Evenness	Richness
ICE HARBOR					
Big Flat					
Legume	237	99	0.51	0.46	3
Meadow	39	26	0.97	0.88	3
Pasture	171	58	1.34	0.97	4
Save	168	58	0.54	0.39	4
Shrub	165	75	0.52	0.75	2
Food Plots	173[a]	-	0.65	0.94	2
Hollebeke					
Legume	692	1127	0.78	0.71	3
Meadow	519	656	0.83	0.60	4
Pasture	72	9	0.00	0.00	1
Save	317	292	0.24	0.22	3
Shrub	108	9	1.14	0.82	4
Food Plots	321[a]	-	0.47	0.43	3
LOWER MONUMENTAL					
Skookum					
Legume	120	56	1.25	0.91	4
Meadow	184	243	0.83	0.75	3
Pasture	259	249	0.79	0.72	3
Save	145	49	1.20	0.86	4
Shrub	266	152	0.92	0.51	6
Food Plots	186[a]	-	1.45	0.90	5
55-Mile					
Legume	161	68	1.32	0.96	4
Meadow	178	66	1.26	0.91	4
Pasture	395	319	0.67	0.37	6
Save	76	41	0.55	0.80	2
Shrub	612	377	1.37	0.77	6
Food Plots	193[a]	-	0.92	0.84	3

APPENDIX Q (Cont.)

Table 1. (Cont.)

PROJECT Study Site Future Cover Type	Density (Birds/ Km^2)	Standard Deviation	Diversity	Evenness	Richness
LITTLE GOOSE					
New York Bar					
Legume	404	122	1.06	0.77	4
Meadow	132	131	1.41	0.88	5
Pasture	1785	1556	1.23	0.63	7
Save	78	84	0.52	0.76	2
Shrub	141	92	1.04	0.75	4
Food Plots	242[a]	-	1.27	0.91	4
Swift Bar					
Legume	35	60	0.00	0.00	1
Meadow	44	77	0.00	0.00	1
Pasture	149	125	1.03	0.94	3
Save	668	242	1.15	0.64	6
Shrub	1410	319	1.14	0.64	6
Food Plots	126[a]	-	0.69	1.00	2
LOWER GRANITE					
Chief Timothy					
Legume	852	719	1.52	0.73	8
Meadow	678	188	1.55	0.79	7
Pasture	1251	521	1.26	0.65	7
Save	459	59	1.83	0.80	10
Shrub	981	472	1.63	0.84	7
Food Plots	1176[a]	-	0.79	0.40	7
Wilma					
Legume	223	181	0.63	0.92	2
Meadow	72	25	0.59	0.54	3
Pasture	134	27	1.41	0.88	5
Save	300	259	1.82	0.93	7
Shrub	90	90	1.20	0.87	4
Food Plots	241[a]	-	0.81	0.74	3

[a]Computed from plot density using $y = 0.95x + 99.3$ (breeding bird census, 1978).

APPENDIX Q (Cont.)

Table 2. Density, standard deviation of density, diversity, evenness, and richness, winter bird census, 1979-80.

PROJECT Study Site Future Cover Type	Density (Birds/ Km^2)	Standard Deviation	Diversity	Evenness	Richness
ICE HARBOR					
Big Flat					
Legume	124	110	0.00	0.00	1
Meadow	23	39	0.00	0.00	1
Pasture	0	0	0.00	0.00	0
Save	85	60	1.00	0.91	3
Shrub	58	68	0.59	0.86	2
Food Plots	328[a]	-	0.00	0.00	1
Hollebeke					
Legume	53	55	0.68	0.98	2
Meadow	16	28	0.00	0.00	1
Pasture	56	50	0.68	0.98	2
Save	0	0	0.00	0.00	0
Shrub	258	375	1.38	0.86	5
Food Plots	1487[a]	-	0.75	0.47	5
LOWER MONUMENTAL					
Skookum					
Legume	89	45	0.00	0.00	1
Meadow	207	51	0.00	0.00	1
Pasture	0	0	0.00	0.00	0
Save	236	142	0.00	0.00	1
Shrub	133	44	0.00	0.00	1
Food Plots	467[a]	-	0.00	0.00	1
55-Mile					
Legume	99	90	0.69	0.99	2
Meadow	129	132	0.57	0.82	2
Pasture	51	45	0.69	0.99	2
Save	34	59	0.00	0.00	1
Shrub	112	105	0.00	0.00	1
Food Plots	411[a]	-	0.00	0.00	1

APPENDIX Q (Cont.)

Table 2. (Cont.)

PROJECT Study Site Future Cover Type	Density (Birds/ Km^2)	Standard Deviation	Diversity	Evenness	Richness
LITTLE GOOSE					
New York Bar					
Legume	145	156	0.00	0.00	1
Meadow	248	64	0.31	0.45	2
Pasture	242	181	0.00	0.00	1
Save	0	0	0.00	0.00	0
Shrub	227	143	0.00	0.00	1
Food Plots	243[a]	-	0.00	0.00	1
Swift Bar					
Legume	127	102	1.29	0.80	5
Meadow	82	72	0.93	0.85	3
Pasture	40	36	0.68	0.98	2
Save	1709	675	1.14	0.82	4
Shrub	73	73	0.00	0.00	1
Food Plots	289[a]	-	0.00	0.00	1
LOWER GRANITE					
Chief Timothy					
Legume	0	0	0.00	0.00	0
Meadow	208	83	0.84	0.76	3
Pasture	0	0	0.00	0.00	0
Save	143	143	0.94	0.85	3
Shrub	549	851	0.45	0.65	2
Food Plots	208[b]	-	1.36	0.85	5
Wilma					
Legume	737	746	1.13	0.82	4
Meadow	185	52	0.46	0.42	3
Pasture	84	87	0.83	0.76	3
Save	1590	805	1.77	0.80	9
Shrub	667	128	1.13	0.82	4
Food Plots	2766[a]	-	0.90	0.82	3

[a]Computed from plot density using y=1.98x + 215.4 (winter bird census, 1978-79).

[b]Disturbance allowed 100% detection; regression equation was not used.

APPENDIX R

BIRD DENSITY ESTIMATES (B/KM^2) FOR EACH SPECIES IN EACH COVER TYPE, LOWER SNAKE RIVER STUDY, 1979-80.

STUDY SITE Future Cover Type	Species	Breeding Census	Winter Census
BIG FLAT			
Legume	Horned lark	202	124
	Western meadowlark	24	-
	Bank swallow	11	-
Meadow	Western kingbird	11	-
	Horned lark	-	23
	Bank swallow	6	-
	Western meadowlark	22	-
Pasture	Killdeer	23	-
	Horned lark	37	-
	Bank swallow	44	-
	Swallow sp.	11	-
	Western meadowlark	56	-
Save	Ring-necked pheasant	-	23
	Horned lark	145	45
	Bank swallow	6	-
	Cliff swallow	6	-
	Western meadowlark	11	16
Shrub	Horned lark	130	41
	Western meadowlark	35	16
Food Plots	Horned lark	126[a]	328[b]
	Bank swallow	147	-
HOLLEBEKE			
Legume	Ring-necked pheasant	499	-
	Bank swallow	72	-
	Black-billed magpie	121	-
	Western meadowlark	-	16
	White-crowned sparrow	-	23
	Unidentified sp.	-	14
Meadow	Gray partridge	359	-
	Bank swallow	122	-
	Black-billed magpie	13	-
	Western meadowlark	25	16

APPENDIX R (Cont.)

STUDY SITE Future Cover Type	Species	Breeding Census	Winter Census
HOLLEBEKE (Cont.)			
Pasture	Ring-necked pheasant	-	23
	Bank swallow	72	-
	Western meadowlark	-	33
Save	Bank swallow	300	-
	Cliff swallow	5	-
	Western meadowlark	12	-
Shrub	Ring-necked pheasant	-	93
	Killdeer	23	-
	Bank swallow	61	-
	Black-billed magpie	13	-
	Western meadowlark	11	16
	Dark-eyed junco	-	72
	White-crowned sparrow	-	11
	Song sparrow	-	65
Food Plots	Bank swallow	281[a]	-
	Western meadowlark	113	243[b]
	American goldfinch	-	299
	Dark-eyed junco	-	251
	White-crowned sparrow	-	1231
	Song sparrow	113	324
	Unidentified sp.	113	-
SKOOKUM			
Legume	Horned lark	18	89
	Cliff swallow	44	-
	Western meadowlark	44	-
	Brewer's blackbird	12	-
Meadow	Horned lark	55	206
	Cliff swallow	117	-
	Brewer's blackbird	12	-
Pasture	Mourning dove	182	-
	Horned lark	55	-
	Cliff swallow	22	-

APPENDIX R (Cont.)

STUDY SITE Future Cover Type	Species	Breeding Census	Winter Census
SKOOKUM (Cont.)			
Save	Horned lark	73	236
	Bank swallow	11	-
	Cliff swallow	28	-
	Western meadowlark	33	-
Shrub	Horned lark	201	133
	Barn swallow	6	-
	Cliff swallow	11	-
	Western meadowlark	11	-
	Brewer's blackbird	12	-
	Brown-headed cowbird	25	-
Food Plots	Western kingbird	106[a]	-
	Horned lark	126	467[b]
	Cliff swallow	106	-
	Swallow sp.	106	-
	Rock wren	126	-
	Brewer's blackbird	113	-
55-MILE			
Legume	Canada goose	-	44
	Mourning dove	46	-
	Horned lark	43	55
	Cliff swallow	17	-
	Swallow sp.	6	-
	Western meadowlark	47	-
Meadow	Horned lark	72	97
	Western meadowlark	47	33
	Grasshopper sparrow	33	-
	Song sparrow	15	-
	Sparrow sp.	11	-
Pasture	Ring-necked pheasant	-	23
	Horned lark	14	28
	Bank swallow	11	-
	Rough-winged swallow	6	-
	Cliff swallow	6	-
	Swallow sp.	17	-
	Starling	22	-
	Western meadowlark	319	-

APPENDIX R (Cont.)

STUDY SITE Future Cover Type	Species	Breeding Census	Winter Census
55-MILE (Cont.)			
Save	Cliff swallow	17	-
	Swallow sp.	6	-
	Rock wren	53	-
	Western meadowlark	-	34
Shrub	Mourning dove	182	-
	Burrowing owl	29	-
	Horned lark	285	113
	Bank swallow	17	-
	Western meadowlark	58	-
	Brewer's blackbird	44	-
Food Plots	Horned lark	113[a]	411[b]
	Cliff swallow	119	-
	Swallow sp.	106	-
	Grasshopper sparrow	153	-
NEW YORK BAR			
Legume	Horned lark	161	145
	Cliff swallow	28	-
	Western meadowlark	193	-
	Grasshopper sparrow	22	-
Meadow	Ring-necked pheasant	-	23
	Horned lark	49	224
	Bank swallow	17	-
	Cliff swallow	44	-
	Western meadowlark	11	-
	Grasshopper sparrow	11	-
Pasture	Canada goose	649	-
	Horned lark	813	242
	Bank swallow	6	-
	Cliff swallow	25	-
	Western meadowlark	112	-
	Brewer's blackbird	166	-
	Grasshopper sparrow	12	-
Save	Bank swallow	61	-
	Cliff swallow	17	-

APPENDIX R (Cont.)

STUDY SITE Future Cover Type	Species	Breeding Census	Winter Census
NEW YORK BAR (Cont.)			
Shrub	Horned lark	86	227
	Bank swallow	11	-
	Cliff swallow	33	-
	Grasshopper sparrow	11	-
Food Plots	Horned lark	-	243[b]
	Bank swallow	119[a]	-
	Cliff swallow	119	-
	Brewer's blackbird	162	-
	Grasshopper sparrow	139	-
SWIFT BAR			
Legume	Ring-necked pheasant	-	24
	Black-billed magpie	-	6
	Western meadowlark	35	17
	White-crowned sparrow	-	12
	Song sparrow	-	68
Meadow	American kestrel	-	22
	Western meadowlark	44	-
	White-crowned sparrow	-	11
	Song sparrow	-	49
Pasture	Marsh hawk	44	-
	Ring-necked pheasant	71	23
	Bank swallow	28	-
	Swallow sp.	6	-
	Song sparrow	-	16
Save	Red-tailed hawk	18	-
	Ring-necked pheasant	-	559
	Western kingbird	125	-
	Cliff swallow	383	-
	Northern shrike	-	18
	Red-winged blackbird	20	-
	Lazuli bunting	46	-
	White-crowned sparrow	-	585
	Song sparrow	23	469
	Sparrow sp.	53	78
Shrub	Ring-necked pheasant	297	73
	Spotted sandpiper	54	-
	Cliff swallow	29	-

APPENDIX R (Cont.)

STUDY SITE Future Cover Type	Species	Breeding Census	Winter Census
SWIFT BAR (Cont.)			
Shrub (Cont.)	American robin	23	-
	Red-winged blackbird	855	-
	Song sparrow	151	-
Food Plots	Cliff swallow	113[a]	-
	Red-winged blackbird	113	-
	Song sparrow	-	289[b]
CHIEF TIMOTHY			
Legume	Eastern kingbird	45	-
	Cliff swallow	43	-
	Starling	426	-
	Western meadowlark	34	-
	Red-winged blackbird	50	-
	Brewer's blackbird	189	-
	Brown-headed cowbird	19	-
	Song sparrow	44	-
Meadow	American kestrel	-	8
	Spotted sandpiper	55	-
	Bank swallow	8	-
	Cliff swallow	8	-
	Red-winged blackbird	52	-
	Brewer's blackbird	173	-
	Brown-headed cowbird	139	-
	White-crowned sparrow	-	64
	Song sparrow	243	91
	Sparrow sp.	-	46
Pasture	American kestrel	16	-
	Chukar	341	-
	Mourning dove	650	-
	Bank swallow	8	-
	Swallow sp.	8	-
	Western meadowlark	16	-
	Brewer's blackbird	88	-
	Song sparrow	124	-
Save	California quail	32	-
	Spotted sandpiper	16	-
	Mourning dove	65	-
	Eastern kingbird	21	-
	Bank swallow	8	-
	Cliff swallow	24	-

APPENDIX R (Cont.)

STUDY SITE Future Cover Type	Species	Breeding Census	Winter Census
CHIEF TIMOTHY (Cont.)			
Save (Cont.)	Swallow sp.	8	-
	American robin	16	-
	Warbler sp.	16	-
	Red-winged blackbird	190	-
	Dark-eyed junco	-	16
	White-crowned sparrow	-	79
	Song sparrow	63	48
Shrub	Spotted sandpiper	78	-
	Violet-green swallow	39	-
	Cliff swallow	118	-
	Swallow sp.	39	-
	Western meadowlark	78	-
	Brewer's blackbird	196	-
	Brown-headed cowbird	39	-
	White-crowned sparrow	-	392
	Song sparrow	392	78
	Sparrow sp.	-	78
Food Plots	Killdeer	-	38[c]
	Common flicker	-	19
	Western kingbird	135[a]	-
	Bank swallow	153	-
	Cliff swallow	117	-
	American robin	117	-
	Yellow-rumped warbler	-	19
	House sparrow	117	-
	Brewer's blackbird	977	-
	White-crowned sparrow	-	19
	Song sparrow	153	94
	Sparrow sp.	-	19
WILMA			
Legume	Ring-necked pheasant	-	349
	Bank swallow	50	-
	Swallow sp.	72	-
	Western meadowlark	-	16
	White-crowned sparrow	-	194
	Song sparrow	101	179
Meadow	Marsh hawk	56	-
	Common flicker	-	11
	Bank swallow	6	-

APPENDIX R (Cont.)

STUDY SITE Future Cover Type	Species	Breeding Census	Winter Census
WILMA (Cont.)			
Meadow (Cont.)	Cliff swallow	6	-
	Swallow sp.	6	-
	Dark-eyed junco	-	12
	Song sparrow	-	162
Pasture	Marsh hawk	13	13
	Killdeer	14	-
	Spotted sandpiper	15	-
	Common flicker	-	13
	Bank swallow	59	-
	Cliff swallow	33	-
	Song sparrow	-	58
Save	Mallard	-	48
	Cooper's hawk	-	12
	Marsh hawk	-	6
	Ring-necked pheasant	-	251
	Killdeer	50	-
	Mourning dove	-	159
	Cliff swallow	48	-
	Starling	24	-
	Red-winged blackbird	27	-
	Northern oriole	60	-
	Brewer's blackbird	13	-
	House finch	-	528
	American goldfinch	-	68
	White-crowned sparrow	-	185
	Song sparrow	78	281
	Sparrow sp.	-	35
	Passerine sp.	-	18
Shrub	Ring-necked pheasant	-	116
	Bank swallow	6	-
	Cliff swallow	11	-
	Swallow sp.	11	-
	Starling	33	-
	House finch	-	25
	White-crowned sparrow	-	330
	Song sparrow	29	179
	Passerine sp.	-	16
Food Plots	Marsh hawk	106[a]	-
	Bank swallow	147	-

APPENDIX R (Cont.)

STUDY SITE Future Cover Type	Species	Breeding Census	Winter Census
WILMA (Cont.)			
Food Plots (Cont.)	Cliff swallow	187	-
	House finch	-	1756[b]
	White-crowned sparrow	-	495
	Song sparrow	-	946

[a]Computed from plot density using y=0.95x + 99.3 (breeding census 1978).

[b]Computed from plot density using y=1.98x + 215.4 (winter census 1978-79).

[c]Disturbance allowed 100% detection; regression equation was not used.

APPENDIX S

COMPARISON OF BIRD DENSITIES OF EXISTING COVER TYPES FOR BREEDING AND WINTER BIRD CENSUSES, LOWER SNAKE RIVER STUDY, 1978-80.

STUDY SITE Existing Cover Type	Species	1978-79 Density (Birds/Km2) Breeding	1978-79 Density (Birds/Km2) Winter	1979-80 Density (Birds/Km2) Breeding	1979-80 Density (Birds/Km2) Winter
BIG FLAT					
325.1, 325.2, 314	Horned lark	45	62	166	83
	Bank swallow	-	-	6	-
	Swallow sp.	6	-	-	-
	Western meadowlark	11	-	30	8
	Unidentified sp.	-	11	-	-
	Total	62	73	202	91
312	Ring-necked pheasant	-	-	-	12
	Western kingbird	16	-	6	-
	Horned lark	25	6	73	34
	Bank swallow	6	-	6	-
	Cliff swallow	3	-	3	-
	Western meadowlark	-	61	17	8
	Total	50	67	105	54
313	313 Swift Bar	584	603	149	39
312.3	Killdeer	-	-	23	-
	Horned lark	-	-	37	-
	Bank swallow	22	-	44	-
	Swallow sp.	11	-	11	-
	Black-billed magpie	6	-	-	-
	Western meadowlark	68	-	56	-
	Red-winged blackbird	12	-	-	-

APPENDIX S (Cont.)

STUDY SITE Existing Cover Type	Species	1978-79 Density (Birds/Km²) Breeding	 Winter	1979-80 Density (Birds/Km²) Breeding	 Winter
BIG FLAT (Cont.)					
312.3 (Cont.)	Song sparrow	-	35	-	-
	Sparrow sp.	-	18	-	-
	Total	119	53	171	0
342	342 Hollebeke	3597	3818	4676	7310
327, 316	316 Swift Bar	1304	2885	1836	2386
Irrigated #1 (Big Gun)	Ring-necked pheasant	a	a	a	31
	Western meadowlark				22
	Red-winged blackbird				15
	Tree sparrow				30
	White-crowned sparrow				577
	Song sparrow				152
	Sparrow sp.				43
	Unidentified sp.				43
	Total				913
Irrigated #2 (Windmill-bubbler)	Ring-necked pheasant	a	a	a	126
Irrigated #3 (Big Gun)	Marsh hawk	a	a	a	6
	Ring-necked pheasant				46
	Short-eared owl				23
	Northern shrike				11
	Total				86

APPENDIX S (Cont.)

STUDY SITE Existing Cover Type	Species	1978-79 Density (Birds/Km^2) Breeding	 Winter	1979-80 Density (Birds/Km^2) Breeding	 Winter
HOLLEBEKE					
325.1, 325.2	California quail	94	1067	-	-
	Ring-necked pheasant	35	39	240	-
	Killdeer	-	-	1	-
	Horned lark	-	5	-	-
	Bank swallow	8	-	181	-
	Cliff swallow	-	-	2	-
	Black-billed magpie	-	-	59	-
	Western meadowlark	11	13	6	8
	Red-winged blackbird	24	-	-	-
	Lazuli bunting	7	-	-	-
	Dark-eyed junco	-	3	-	-
	White-crowned sparrow	-	41	-	12
	Song sparrow	-	-	-	6
	Sparrow sp.	-	1	-	-
	Unidentified sp.	-	-	-	7
	Total	179	1169	489	33
314	Ring-necked pheasant	73	-	-	-
	Gray partridge	-	-	359	-
	Horned lark	-	56	-	-
	Bank swallow	28	-	122	-
	Black-billed magpie	-	-	13	-
	Western meadowlark	37	14	25	16
	Total	138	70	519	16
310	316 Swift Bar	1304	2885	1836	2386

APPENDIX S (Cont.)

STUDY SITE Existing Cover Type	Species	1978-79 Density (Birds/Km^2) Breeding	1978-79 Density (Birds/Km^2) Winter	1979-80 Density (Birds/Km^2) Breeding	1979-80 Density (Birds/Km^2) Winter
HOLLEBEKE (Cont.)					
312	Ring-necked pheasant	-	-	-	46
	Bank swallow	106	-	72	-
	Western meadowlark	-	-	-	66
	White-crowned sparrow	-	150	-	-
	Total	106	150	72	112
313	Ring-necked pheasant	-	-	-	93
	Killdeer	-	-	23	-
	Bank swallow	56	-	61	-
	Black-billed magpie	-	-	13	-
	Western meadowlark	37	14	11	16
	Dark-eyed junco	-	64	-	72
	White-crowned sparrow	-	-	-	11
	Song sparrow	-	-	-	65
	Sparrow sp.	-	32	-	-
	Total	93	110	108	257
312.3	Ring-necked pheasant	146	-	-	-
	Bank swallow	106	-	72	-
	Western meadowlark	-	-	-	-
	Total	252	0	72	0
342	Sharp-shinned hawk	-	-	-	62
	Marsh hawk	-	-	-	124
	California quail	-	442	-	62
	Ring-necked pheasant	-	442	-	248
	Mourning dove	492[b]	-	681	-
	Barn owl	-	-	557	186

APPENDIX S (Cont.)

STUDY SITE Existing Cover Type	Species	1978-79 Density (Birds/Km^2) Breeding	1978-79 Density (Birds/Km^2) Winter	1979-80 Density (Birds/Km^2) Breeding	1979-80 Density (Birds/Km^2) Winter
HOLLEBEKE (Cont.)					
342 (Cont.)	Long-eared owl	-	241	124	124
	Owl sp.	-	-	124	-
	Common flicker	61	40	-	372
	Eastern kingbird	381	-	-	-
	Western kingbird	-	-	62	-
	Cliff swallow	20	-	-	-
	Bank swallow	177	-	464	-
	Swallow sp.	3	-	-	-
	Black-billed magpie	-	121	557	248
	American robin	-	281	-	186
	Varied thrush	-	201	-	186
	Kinglet sp.	-	-	-	62
	Northern shrike	-	40	-	-
	Starling	222	402	1301	62
	Yellow warbler	-	-	62	-
	Western meadowlark	-	-	62	-
	Red-winged blackbird	1541	-	62	-
	Northern oriole	700	-	124	-
	American goldfinch	-	-	-	805
	Dark-eyed junco	-	603	-	372
	White-crowned sparrow	-	723	-	3406
	Song sparrow	-	282	248	619
	Passerine sp.	-	-	124	186
	Unidentified sp.	-	-	124	-
	Total	3597	3818	4676	7310
327, 316	316 Swift Bar	1304	2885	1836	2386

APPENDIX S (Cont.)

STUDY SITE Existing Cover Type	Species	1978-79 Density (Birds/Km^2) Breeding	1978-79 Density (Birds/Km^2) Winter	1979-80 Density (Birds/Km^2) Breeding	1979-80 Density (Birds/Km^2) Winter
SKOOKUM					
325.2	Marsh hawk	2	-	-	-
	Mourning dove	6	45	91	-
	Horned lark	53	81	37	78
	Bank swallow	3	-	-	-
	Cliff swallow	3	-	22	-
	Rock wren	9	-	-	-
	Western meadowlark	36	14	-	-
	Lark sparrow	8	-	-	-
	Grasshopper sparrow	8	-	-	-
	Total	128	140	150	78
314	314 Hollebeke	138	70	519	16
312, 313, 312.3	Horned lark	145	67	87	166
	Bank swallow	-	-	4	-
	Cliff swallow	-	-	50	-
	Western meadowlark	11	14	22	-
	Brewer's blackbird	-	-	9	-
	Brown-headed cowbird	-	-	6	-
	Grasshopper sparrow	22	-	-	-
	Total	178	81	178	166
342	342 Hollebeke/ Chief Timothy	3597[c]	2288[d]	5849[d]	7310[c]
327, 316	316 Swift Bar	1304	2885	1836	2386

APPENDIX S (Cont.)

STUDY SITE Existing Cover Type	Species	1978-79 Density (Birds/Km²) Breeding	1978-79 Density (Birds/Km²) Winter	1979-80 Density (Birds/Km²) Breeding	1979-80 Density (Birds/Km²) Winter
55-MILE					
325.1, 325.2	Canada goose	-	-	-	12
	Ring-necked pheasant	-	-	-	6
	Mourning dove	-	-	62	-
	Burrowing owl	17	-	8	-
	Horned lark	12	15	45	72
	Bank swallow	5	-	5	-
	Rough-winged swallow	-	-	2	-
	Cliff swallow	6	-	7	-
	Swallow sp.	-	-	7	-
	Common raven	1	-	-	-
	Starling	-	-	6	-
	Western meadowlark	98	-	125	9
	Red-winged blackbird	18	3	-	-
	Brewer's blackbird	-	-	12	-
	Grasshopper sparrow	6	-	9	-
	Lark sparrow	9	-	-	-
	Dark-eyed junco	-	11	-	-
	Song sparrow	-	-	4	-
	Sparrow sp.	-	-	3	-
	Unidentified sp.	4	-	-	-
	Total	176	29	295	99
314	Cliff swallow	-	-	17	-
	Swallow sp.	-	-	6	-
	Lark sparrow	158	-	-	-
	Total	158	0	23	0
312.3	Gray partridge	-	322	-	-
	Horned lark	66	-	511	60
	Bank swallow	-	-	17	-

APPENDIX S (Cont.)

STUDY SITE Existing Cover Type	Species	1978-79 Density (Birds/Km²) Breeding	1978-79 Density (Birds/Km²) Winter	1979-80 Density (Birds/Km²) Breeding	1979-80 Density (Birds/Km²) Winter
55-MILE (Cont.)					
312.3 (Cont.)	Common raven	6	-	-	-
	Western meadowlark	68	-	23	-
	Brewer's blackbird	50	-	-	-
	Total	190	322	551	60
327, 316	316 Swift Bar	1304	2885	1836	2386
NEW YORK BAR					
325.2	American kestrel	11	-	-	-
	Horned lark	-	33	-	-
	Bank swallow	6	-	61	-
	Cliff swallow	17	-	17	-
	Swallow sp.	28	-	-	-
	Rock wren	17	-	-	-
	Total	79	33	78	0
314	Ring-necked pheasant	-	-	-	9
	Horned lark	137	135	149	190
	Cliff swallow	112	-	34	-
	Bank swallow	15	-	9	-
	Swallow sp.	10	-	-	-
	Western meadowlark	21	-	60	-
	Grasshopper sparrow	49	-	16	-
	Total	344	135	268	199
312.3	Horned lark	86	267	19	182
	Cliff swallow	46	-	33	-
	Bank swallow	13	-	24	-

APPENDIX S (Cont.)

STUDY SITE Existing Cover Type	Species	1978-79 Density (Birds/Km²) Breeding	1978-79 Density (Birds/Km²) Winter	1979-80 Density (Birds/Km²) Breeding	1979-80 Density (Birds/Km²) Winter
NEW YORK BAR (Cont.)					
312.3 (Cont.)	Swallow sp.	18	-	-	-
	Western meadowlark	-	-	100	-
	Grasshopper sparrow	-	-	17	-
	Total	161	267	193	182
312	Canada goose	-	-	324	-
	American kestrel	6	-	-	-
	Horned lark	208	104	406	121
	Bank swallow	19	-	34	-
	Cliff swallow	59	-	21	-
	Swallow sp.	14	-	-	-
	Rock wren	8	-	-	-
	Western meadowlark	34	-	56	-
	Brewer's blackbird	-	-	84	-
	Grasshopper sparrow	6	-	6	-
	Sparrow sp.	18	-	-	-
	Unidentified sp.	8	-	-	-
	Total	380	104	931	121
SWIFT BAR					
325.1	316 Swift Bar	1304	2885	1836	2386
312	Ring-necked pheasant	-	-	239	70
	Cliff swallow	17	-	29	-
	Red-winged blackbird	177	-	608	-
	Song sparrow	587	-	85	-
	Total	781	0	961	70

APPENDIX S (Cont.)

STUDY SITE Existing Cover Type	Species	1978-79 Density (Birds/Km^2) Breeding	1978-79 Density (Birds/Km^2) Winter	1979-80 Density (Birds/Km^2) Breeding	1979-80 Density (Birds/Km^2) Winter
SWIFT BAR (Cont.)					
313	Marsh hawk	-	-	44	-
	Ring-necked pheasant	363	564	71	23
	Bank swallow	-	-	28	-
	Cliff swallow	56	-	-	-
	Swallow sp.	-	-	6	-
	Red-winged blackbird	101	-	-	-
	Song sparrow	64	39	-	16
	Total	584	603	149	39
312.3	Red-tailed hawk	-	-	6	-
	Marsh hawk	-	2	-	-
	American kestrel	-	-	-	7
	Ring-necked pheasant	346	-	-	194
	Common flicker	-	18	-	-
	Western kingbird	-	-	42	-
	Cliff swallow	47	-	128	-
	Black-billed magpie	-	-	-	2
	Northern shrike	-	-	-	6
	Yellow warbler	8	-	-	-
	Western meadowlark	-	-	26	6
	Red-winged blackbird	231	6	7	-
	Lazuli bunting	8	-	15	-
	American goldfinch	15	291	-	-
	Dark-eyed junco	-	17	-	-
	White-crowned sparrow	-	26	-	203
	Song sparrow	158	187	8	195
	Sparrow sp.	-	20	18	26
	Total	813	567	250	639

APPENDIX S (Cont.)

STUDY SITE Existing Cover Type	Species	1978-79 Density(Birds/Km²) Breeding	1978-79 Density(Birds/Km²) Winter	1979-80 Density(Birds/Km²) Breeding	1979-80 Density(Birds/Km²) Winter
SWIFT BAR (Cont.)					
342	Hollebeke/ Chief Timothy	3597[c]	2288[d]	5849[d]	7310[c]
316	Ring-necked pheasant	-	2353	297	679
	Spotted sandpiper	93	-	108	-
	Cliff swallow	17	-	29	-
	Northern shrike	-	-	-	40
	Red-winged blackbird	578	212	1160	-
	White-crowned sparrow	-	-	-	946
	Song sparrow	550	316	242	721
	Sparrow sp.	66	-	-	-
	Total	1304	2885	1836	2386
CHIEF TIMOTHY					
314, 310	American kestrel	-	-	-	8
	Spotted sandpiper	31	-	55	-
	Mourning dove	17	-	-	-
	Bank swallow	-	-	8	-
	Cliff swallow	31	-	8	-
	Western meadowlark	17	-	-	-
	Red-winged blackbird	188	-	52	-
	Brewer's blackbird	347	-	173	-
	Brown-headed cowbird	-	-	139	-
	White-crowned sparrow	-	-	-	64
	Song sparrow	89	-	243	91
	Sparrow sp.	-	49	-	46
	Unidentified sp.	20	-	-	-
	Total	740	49	678	209

APPENDIX S (Cont.)

STUDY SITE Existing Cover Type	Species	1978-79 Density (Birds/Km²) Breeding	1978-79 Density (Birds/Km²) Winter	1979-80 Density (Birds/Km²) Breeding	1979-80 Density (Birds/Km²) Winter
CHIEF TIMOTHY (Cont.)					
312	Marsh hawk	-	8	-	-
	American kestrel	-	-	8	-
	California quail	37	-	-	-
	Chukar	37	-	171	-
	Killdeer	32	-	-	-
	Spotted sandpiper	19	-	-	-
	Mourning dove	-	-	336	-
	Eastern kingbird	-	-	20	-
	Bank swallow	-	-	6	-
	Cliff swallow	29	-	17	-
	Swallow sp.	-	-	6	-
	Starling	-	-	213	-
	Western meadowlark	28	-	25	-
	Red-winged blackbird	330	-	42	-
	Brewer's blackbird	70	-	91	-
	Brown-headed cowbird	15	-	-	-
	Dark-eyed junco	-	-	-	4
	White-crowned sparrow	-	1394	-	118
	Song sparrow	169	327	62	32
	Sparrow sp.	-	-	-	20
	Unidentified sp.	8	-	-	-
	Total	774	1729	997	174
313	California quail	153	1307	28	-
	Killdeer	32	-	-	-
	Spotted sandpiper	63	-	73	-
	Violet-green swallow	-	-	29	-
	Cliff swallow	34	-	95	-
	Swallow sp.	-	-	31	-

APPENDIX S (Cont.)

STUDY SITE Existing Cover Type	Species	1978-79 Density (Birds/Km²) Breeding	1978-79 Density (Birds/Km²) Winter	1979-80 Density (Birds/Km²) Breeding	1979-80 Density (Birds/Km²) Winter
CHIEF TIMOTHY (Cont.)					
313 (Cont.)	American robin	-	-	14	-
	Warbler sp.	-	-	14	-
	Western meadowlark	-	-	59	-
	Red-winged blackbird	774	-	143	-
	Brewer's blackbird	-	-	147	-
	Brown-headed cowbird	-	-	29	-
	Dark-eyed junco	-	-	-	4
	White-crowned sparrow	-	1915	-	118
	Song sparrow	510	541	349	32
	Sparrow sp.	33	-	-	20
	Unidentified sp.	-	-	-	-
	Total	1599	3763	1011	174
342	California quail	-	713[e]	-	2142[g]
	Mourning dove	492[b]	-	-	-
	Common nighthawk	-	-	190[f]	-
	Common flicker	61	-	-	-
	Eastern kingbird	381	-	190	-
	Western kingbird	-	-	281	-
	Flycatcher sp.	-	-	190	-
	Bank swallow	177	-	-	-
	Cliff swallow	20	-	168	-
	Swallow sp.	3	-	122	-
	American robin	-	-	461	-
	Starling	222	530	1595	190
	Yellow warbler	-	-	190	-
	Warbler sp.	-	-	145	-
	House sparrow	-	-	145	-
	Red-winged blackbird	1541	-	-	-

APPENDIX S (Cont.)

STUDY SITE Existing Cover Type	Species	1978-79 Density (Birds/Km^2) Breeding	1978-79 Density (Birds/Km^2) Winter	1979-80 Density (Birds/Km^2) Breeding	1979-80 Density (Birds/Km^2) Winter
CHIEF TIMOTHY (Cont.)					
342 (Cont.)	Northern oriole	700	-	281	-
	Brewer's blackbird	-	-	1186	-
	Brown-headed cowbird	-	-	325	-
	Song sparrow	-	1045	235	95
	Unidentified sp.	-	-	145	-
	Total	3597	2288	5849	2427
316	316 Swift Bar	1304	2885	1836	2386
WILMA					
325.2[h]	Canada goose	-	-	-	9
	California quail	95	-	-	-
	Ring-necked pheasant	-	-	-	21
	Cooper's hawk	-	-	-	8
	Marsh hawk	-	-	-	2
	American kestrel	-	16	-	-
	Mourning dove	-	-	47	107
	Burrowing owl	8	-	6	-
	Eastern kingbird	46	-	-	-
	Horned lark	6	7	34	54
	Bank swallow	8	-	4	-
	Rough-winged swallow	-	-	2	-
	Cliff swallow	54	-	17	-
	Swallow sp.	-	-	5	-
	Common raven	1	-	-	-
	Starling	-	-	21	-
	Western meadowlark	49	-	94	7
	Red-winged blackbird	9	2	-	-

APPENDIX S (Cont.)

STUDY SITE Existing Cover Type	Species	1978-79 Density(Birds/Km^2) Breeding	1978-79 Density(Birds/Km^2) Winter	1979-80 Density(Birds/Km^2) Breeding	1979-80 Density(Birds/Km^2) Winter
WILMA (Cont.)					
325.2^h (Cont.)	Northern oriole	-	-	41	-
	Brewer's blackbird	18	-	9	-
	Lazuli bunting	22	-	-	-
	House finch	-	45	-	27
	American goldfinch	-	-	-	46
	Grasshopper sparrow	3	-	7	-
	Lark sparrow	4	-	-	-
	Dark-eyed junco	-	34	-	-
	White-crowned sparrow	-	-	-	83
	Song sparrow	-	156	45	36
	Sparrow sp.	-	-	2	24
	Passerine sp.	-	-	-	12
	Unidentified sp.	2	-	-	-
	Total	325	260	334	432
314, 312	Marsh hawk	-	-	56	-
	Common flicker	-	-	-	11
	Western kingbird	32	-	-	-
	Bank swallow	11	-	6	-
	Cliff swallow	22	-	6	-
	Swallow sp.	128	-	6	-
	Dark-eyed junco	-	16	-	12
	White-crowned sparrow	-	62	-	-
	Song sparrow	-	491	-	162
	Total	193	569	74	185
313	Mallard	-	-	-	12
	Cooper's hawk	-	-	-	3
	Marsh hawk	-	4	3	5

APPENDIX S (Cont.)

STUDY SITE Existing Cover Type	Species	1978-79 Density (Birds/Km²) Breeding	1978-79 Density (Birds/Km²) Winter	1979-80 Density (Birds/Km²) Breeding	1979-80 Density (Birds/Km²) Winter
WILMA (Cont.)					
313 (Cont.)	American kestrel	-	3	-	-
	California quail	18	-	-	-
	Ring-necked pheasant	-	80	-	179
	Killdeer	56	-	16	-
	Spotted sandpiper	24	-	4	-
	Mourning dove	3	-	-	40
	Common flicker	-	-	-	3
	Eastern kingbird	8	-	-	-
	Bank swallow	15	-	29	-
	Cliff swallow	53	-	23	-
	Swallow sp.	34	-	21	-
	Starling	-	-	14	-
	Western meadowlark	-	-	-	4
	Red-winged blackbird	-	-	7	-
	Northern oriole	-	-	15	-
	Brewer's blackbird	42	-	3	-
	Lazuli bunting	4	-	-	-
	House finch	-	8	-	138
	American goldfinch	-	-	-	17
	Dark-eyed junco	-	5	-	-
	White-crowned sparrow	-	156	-	177
	Song sparrow	17	408	52	174
	Sparrow sp.	-	10	-	9
	Passerine sp.	-	3	-	8
	Total	274	676	187	769
312.3	Marsh hawk	-	1	28	6
	California quail	-	-	-	-
	Ring-necked pheasant	-	-	-	90

APPENDIX S (Cont.)

STUDY SITE Existing Cover Type	Species	1978-79 Density (Birds/Km^2) Breeding	1978-79 Density (Birds/Km^2) Winter	1979-80 Density (Birds/Km^2) Breeding	1979-80 Density (Birds/Km^2) Winter
WILMA (Cont.)					
312.3 (Cont.)	Killdeer	5	-	26	-
	Spotted sandpiper	16	-	6	-
	Mourning dove	-	-	-	-
	Common flicker	-	-	-	10
	Western kingbird	13	-	-	-
	Bank swallow	15	-	26	-
	Cliff swallow	69	-	25	-
	Swallow sp.	93	-	2	-
	Brewer's blackbird	33	-	-	-
	Lazuli bunting	-	-	-	-
	House finch	-	-	-	203
	Dark-eyed junco	-	6	-	5
	White-crowned sparrow	-	78	-	26
	Song sparrow	14	289	-	156
	Sparrow sp.	-	16	-	-
	Total	258	399	113	496
342	342 Hollebeke/ Chief Timothy	3597[c]	2288[d]	5849[d]	7310[c]
327	316 Swift Bar	1304	2885	1836	2386

[a]Existing cover type was not sampled.

[b]Densities were derived from sampled areas adjacent to shrub and tree transect (Lost Island) and meadow transect (Tucannon) which typified cover type 342.

[c]Density taken from Hollebeke (cover type 342).

[d]Density taken from Chief Timothy (cover type 342).

[e]Computed from sample plot density using y=0.95x + 99.3

[f]Computed from sample plot density using y=1.98x + 215.4

[g]Ground cover disturbance allowed 100% detection; regression equation was not used.

[h]Data from cover type 325.2 (55-Mile) was combined with sample of data from cover type 325.2 (Wilma) to more accurately represent cover type 325.2 at Wilma.

APPENDIX T

REVISED DIVERSITY AND EVENNESS VALUES FOR TRANSECTS AND PLOTS, BREEDING AND WINTER BIRD CENSUSES, LOWER SNAKE RIVER STUDY, 1978-79.

PROJECT Study Site Future Cover Type	Breeding Census				Winter Census			
	Diversity		Evenness		Diversity		Evenness	
	Tr.	Plot	Tr.	Plot	Tr.	Plot	Tr.	Plot
ICE HARBOR								
Big Flat								
Legume	0.49	0.54	0.71	0.78	0.53	0.00	0.76	0.00
Meadow	0.65	0.99	0.94	0.90	0.29	0.00	0.42	0.00
Pasture	1.23	1.09	0.89	0.68	0.64	0.00	0.92	0.00
Save	0.67	0.67	0.97	0.97	0.00	0.00	0.00	0.00
Shrub	0.63	0.56	0.91	0.81	0.00	0.00	0.00	0.00
Food Plots	-	1.19	-	0.86	-	0.00	-	0.00
Lost Island								
Legume	0.67	0.22	0.97	0.32	0.44	0.00	0.63	0.00
Meadow	0.30	0.87	0.27	0.79	0.67	0.69	0.97	1.00
Pasture	0.68	0.90	0.98	0.65	0.82	0.97	0.75	0.88
Save	1.22	0.56	0.88	0.81	0.45	0.00	0.65	0.00
Shrub	1.15	1.06	0.71	0.96	0.93	1.26	0.85	0.91
Food Plots	-	0.00	-	0.00	-	0.00	-	0.00
Hollebeke								
Legume	1.23	0.56	0.69	0.81	0.36	1.07	0.22	0.97
Meadow	1.01	0.69	0.92	1.00	0.50	0.00	0.72	0.00
Pasture	0.68	0.24	0.98	0.35	0.00	0.69	0.00	1.00
Save	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Shrub	0.67	0.62	0.97	0.89	0.94	0.00	0.86	0.00
Food Plots	-	0.94	-	0.68	-	0.00	-	0.00
Riparian	-	-	-	-	2.26	1.96	0.91	0.85
LOWER MONUMENTAL								
Skookum								
Legume	1.14	1.53	0.82	0.85	0.00	0.60	0.00	0.87
Meadow	0.60	0.89	0.55	0.81	0.46	0.00	0.66	0.00
Pasture	0.99	0.98	0.71	0.61	1.00	0.64	0.91	0.92
Save	1.59	1.21	0.89	0.87	0.00	0.00	0.00	0.00
Shrub	0.65	0.90	0.94	0.82	0.00	0.44	0.00	0.63
Food Plots	-	1.38	-	0.86	-	0.56	-	0.81

APPENDIX T (Cont.)

PROJECT Study Site Future Cover Type	Breeding Census Diversity Tr.	 Plot	 Evenness Tr.	 Plot	Winter Census Diversity Tr.	 Plot	 Evenness Tr.	 Plot
LOWER MONUMENTAL (Cont.)								
55-Mile								
Legume	1.03	1.33	0.74	0.96	0.00	0.00	0.00	0.00
Meadow	1.46	1.46	0.81	0.91	0.00	0.00	0.00	0.00
Pasture	0.95	1.71	0.69	0.95	0.00	0.00	0.00	0.00
Save	0.69	1.10	1.00	0.79	0.45	1.04	0.32	0.95
Shrub	1.37	1.38	0.85	0.86	0.49	0.00	0.71	0.00
Food Plots	-	1.42	-	0.79	-	0.00	-	0.00
Tucannon								
Legume	1.45	0.36	0.75	0.33	0.32	0.00	0.46	0.00
Meadow	2.08	1.91	0.81	0.83	0.74	0.99	0.67	0.90
Pasture	1.57	2.02	0.81	0.84	1.57	1.05	0.76	0.96
Save	0.68	1.62	0.42	0.90	0.98	1.02	0.71	0.74
Shrub	2.27	1.81	0.86	0.82	1.40	1.00	0.87	0.72
Food Plots	-	1.77	-	0.85	-	1.15	-	0.83
Perennial grasses	-	-	-	-	0.00	0.00	0.00	0.00
LITTLE GOOSE								
Ridpath								
Legume	1.44	1.40	0.89	0.78	1.07	0.94	0.97	0.86
Meadow	0.62	1.19	0.56	0.86	0.00	0.00	0.00	0.00
Pasture	1.21	1.01	0.75	0.92	0.00	0.00	0.00	0.00
Save	1.44	1.57	0.80	0.88	0.00	0.00	0.00	0.00
Shrub	1.20	0.67	0.75	0.48	0.45	0.00	0.65	0.00
Food plots	-	1.06	-	0.76	-	0.00	-	0.00
Perennial grasses	-	-	-	-	1.70	0.89	0.95	0.81
New York Bar								
Legume	1.53	1.13	0.89	0.63	0.00	0.00	0.00	0.00
Meadow	1.40	1.03	0.56	0.64	0.00	0.00	0.00	0.00
Pasture	1.36	1.73	0.75	0.83	0.00	0.00	0.00	0.00
Save	1.50	0.66	0.80	0.60	0.00	0.00	0.00	0.00
Shrub	1.03	0.96	0.75	0.87	0.00	0.00	0.00	0.00
Food Plots	-	1.22	-	0.63	-	0.00	-	0.00

APPENDIX T (Cont.)

PROJECT Study Site Future Cover Type	Breeding Census Diversity Tr.	 Plot	 Evenness Tr.	 Plot	Winter Census Diversity Tr.	 Plot	 Evenness Tr.	 Plot
LITTLE GOOSE (Cont.)								
Swift Bar								
Legume	0.38	1.13	0.55	0.63	0.00	0.00	0.00	0.00
Meadow	0.00	1.03	0.00	0.64	0.00	0.00	0.00	0.00
Pasture	1.07	1.73	0.77	0.83	0.24	0.00	0.35	0.00
Save	1.44	0.66	0.74	0.60	1.23	0.86	0.63	0.78
Shrub	1.03	0.96	0.64	0.87	0.60	0.63	0.55	0.91
Food Plots	-	1.22	-	0.63	-	0.00	-	0.00
LOWER GRANITE								
Granite Goose Pasture								
Legume	0.95	0.51	0.69	0.74	0.00	0.00	0.00	0.00
Meadow	0.81	0.72	0.74	0.66	0.58	0.00	0.84	0.00
Pasture	1.43	1.43	0.89	0.80	0.00	0.00	0.00	0.00
Save	1.36	0.47	0.85	0.68	0.00	0.00	0.00	0.00
Shrub	1.59	0.98	0.89	0.71	0.00	0.00	0.00	0.00
Food Plots	-	1.68	-	0.86	-	-	-	0.00
Riparian	-	-	-	-	1.33	0.68	0.96	0.98
Chief Timothy								
Legume	1.08	0.76	0.67	0.69	0.00	0.69	0.00	1.00
Meadow	1.49	1.19	0.72	0.66	0.00	0.00	0.00	0.00
Pasture	1.72	1.50	0.83	0.84	0.60	0.00	0.55	0.00
Save	1.30	1.58	0.73	0.81	0.30	0.00	0.43	0.00
Shrub	1.23	1.30	0.69	0.73	0.97	0.00	0.88	0.00
Food Plots	-	1.06	-	0.46	-	1.10	-	0.61
Wilma								
Legume	1.39	1.22	0.78	0.76	0.68	0.64	0.62	0.92
Meadow	0.98	0.28	0.71	0.40	0.47	0.67	0.43	0.61
Pasture	1.48	0.83	0.83	0.52	0.00	0.00	0.00	0.00
Save	1.84	1.63	0.88	0.74	1.02	1.03	0.57	0.64
Shrub	1.16	1.17	0.84	0.73	1.01	0.84	0.63	0.76
Food Plots	-	0.69	-	1.00	-	0.68	-	0.98

APPENDIX U

SEASONAL OCCURRENCE OF BIRDS OBSERVED IN LOWER SNAKE RIVER CANYON, 1 MARCH 1978 TO 31 MARCH 1980.

Legend:

Sp = ... March-May
Su = ... June-August
Au = ... September-November
Wi = ... December-February

a = abundant--very numerous, use many habitats

c = common--likely to be detected in suitable habitat

u = uncommon-sometimes detected in suitable habitat

o = occasional-- detected only a few times during season

r = rare--probably detected only once every few years

x = accidental--rarely-seen birds which have wandered from their usual range

Common Name	Scientific Name	Sp	Su	Au	Wi	Earliest Sighting	Latest Sighting
Common loon	Gavia immer	o	-	o	-	26 Oct	17 May
Horned grebe	Podiceps auritus	o	o	o	o	9 Jun	10 May
Eared grebe	Podiceps nigricollis	o	-	o	o	21 Sep	10 May
Western grebe	Aechmophorus occidentalis	o	u	u	o	--	--
Pied-billed grebe	Podilymbus podiceps	o	-	o	o	11 Sep	16 Apr
Double-crested cormorant	Phalacrocorax auritus	o	-	o	-	1 May	24 Sep
Great blue heron	Ardea herodias	u	u	u	u	--	--
Black-crowned night heron	Nycticorax nycticorax	o	o	o	-	11 Apr	12 Sep
American bittern	Botaurus lentiginosus	r	-	-	-	20 Mar[a]	--
Whistling swan	Olor columbianus	o	-	-	-	10 Apr	15 Apr
Canada goose	Branta canadensis	c	c	a	a	--	--
Snow goose	Chen caerulescens	o	-	-	o	2 Dec	26 May
Mallard	Anas platyrhynchos	c	c	c	c	--	--

APPENDIX U (Cont.)

Common Name	Scientific Name	Sp	Su	Au	Wi	Earliest Sighting	Latest Sighting
Gadwall	Anas strepera	o	-	o	o	15 Nov	21 May
Pintail	Anas acuta	u	u	u	u	--	--
Green-winged teal	Anas crecca	u	o	u	-	21 Mar	24 Sep
Blue-winged teal	Anas discors	o	o	o	-	3 May	5 Nov
Cinnamon teal	Anas cyanoptera	o	o	o	-	12 Apr	24 Sep
American wigeon	Anas americana	u	o	u	u	--	--
Northern shoveler	Anas clypeata	u	o	o	-	12 Apr	19 Sep
Wood duck	Aix sponsa	o	-	-	-	13 Apr[a]	--
Redhead	Aythya americana	o	-	-	o	15 Dec	18 May
Ring-necked duck	Aythya collaris	-	-	-	o	23 Feb	24 Feb
Canvasback	Aythya valisineria	-	-	o	o	5 Nov	23 Feb
Lesser scaup	Aythya affinis	u	o	-	o	7 Dec	14 Jun
Common goldeneye	Bucephala clangula	u	-	o	c	15 Nov	3 May
Barrow's goldeneye	Bucephala islandica	o	-	o	u	5 Nov	20 May
Bufflehead	Bucephala albeola	u	o	o	o	--	--
White-winged scoter	Melanitta deglandi	-	-	r	-	26 Oct	5 Nov
Surf scoter	Melanitta perspicillata	-	-	r	-	24 Sep[a]	--
Ruddy duck	Oxyura jamaicensis	u	o	o	-	3 May	14 Sep
Hooded merganser	Lophodytes cucullatus	o	-	-	o	7 Dec	14 Apr
Common merganser	Mergus merganser	u	u	u	u	--	--
Red-breasted merganser	Mergus serrator	o	-	-	-	15 Apr	20 May
Sharp-shinned hawk	Accipiter striatus	o	-	o	o	13 Sep	3 Apr
Cooper's hawk	Accipiter cooperii	-	o	o	o	24 Aug	15 Jan
Swainson's hawk	Buteo swainsoni	-	-	-	r	17 Dec[a]	--
Red-tailed hawk	Buteo jamaicensis	c	c	c	c	--	--
Rough-legged hawk	Buteo lagopus	o	-	o	o	13 Oct	4 Apr
Ferruginous hawk	Buteo regalis	r	-	-	-	3 Apr[a]	--
Golden eagle	Aquila chrysaetos	o	-	-	u	7 Dec	14 Apr
Bald eagle	Haliaeetus leucocephalus	o	-	-	o	2 Feb	24 Mar
Marsh hawk	Circus cyaneus	c	u	u	c	--	--
Osprey	Pandion haliaetus	o	o	o	-	10 Apr	20 Oct
Prairie falcon	Falco mexicanus	u	u	u	u	--	--
Merlin	Falco columbarius	o	o	-	o	6 May	7 Dec

APPENDIX U (Cont.)

Common Name	Scientific Name	Sp	Su	Au	Wi	Earliest Sighting	Latest Sighting
American kestrel	Falco sparverius	u	u	u	u	6 May	7 Dec
California quail	Lophortyx californicus	u	u	u	u	--	--
Ring-necked pheasant	Phasianus colchicus	c	c	c	c	--	--
Chukar	Alectoris chukar	c	c	c	c	--	--
Gray partridge	Perdix perdix	u	u	u	u	--	--
Virginia rail	Rallus limicola	o	o	-	-	30 Mar	6 Jun
American coot	Fulica americana	c	o	u	c	--	--
Semipalmated plover	Charadrius semipalmatus	r	-	-	-	25 Apr[a]	--
Snowy plover	Charadrius alexandrinus	x	-	-	-	17 May[a]	--
Killdeer	Charadrius vociferus	c	c	u	u	--	--
Common snipe	Capella gallinago	o	-	-	o	23 Feb	21 Mar
Long-billed curlew	Numenius americanus	o	o	-	-	30 Mar	6 Jun
Spotted snadpiper	Actitis macularia	u	c	u	-	3 May	20 Sep
Solitary sandpiper	Tringa solitaria	-	r	-	-	3 Aug[a]	--
Greater yellowlegs	Tringa melanoleuca	o	o	-	-	15 Apr	23 Jul
Lesser yellowlegs	Tringa flavipes	o	-	-	-	12 Apr	15 Apr
Western sandpiper	Calidris mauri	r	-	-	-	22 Jul[a]	--
Least sandpiper	Calidris minutilla	o	-	-	o	17 May	25 Sep
Baird's sandpiper	Calidris bairdii	-	-	r	-	14 Sep[a]	--
Pectoral sandpiper	Calidris melanotos	-	-	r	-	19 Sep[a]	--
Marbled godwit	Limosa fedoa	o	-	-	-	26 Apr[a]	--
American avocet	Recurvirostra americana	o	o	o	-	12 Apr	6 Sep
Herring gull	Larus argentatus	-	-	-	r	22 Jan[a]	--
California gull	Larus californicus	u	u	u	c	--	--
Ring-billed gull	Larus delawarensis	c	c	c	c	--	--
Bonaparte's gull	Larus philadelphia	r	-	-	-	15 May[a]	--
Forster's tern	Sterna forsteri	o	o	o	-	15 May	18 Sep
Caspian tern	Sterna caspia	o	o	o	-	21 Apr	12 Sep
Rock dove	Columba livia	c	c	c	c	--	--
Mourning dove	Zenaida macroura	u	c	u	u	--	--
Barn owl	Tyto alba	u	u	o	o	--	--
Screech owl	Otus asio	o	-	-	-	8 Mar[a]	--
Great horned owl	Bubo virginianus	o	o	o	-	17 Mar	5 Oct

APPENDIX U (Cont.)

Common Name	Scientific Name	Sp	Su	Au	Wi	Earliest Sighting	Latest Sighting
Burrowing owl	Athene cunicularia	o	o	-	-	26 Mar	30 Aug
Long-eared owl	Asio otus	u	o	o	u	--	--
Short-eared owl	Asio flammeus	o	o	o	o	28 Nov	18 Jun
Saw-whet owl	Aegolius acadius	o	-	-	-	17 Mar	5 Apr
Common nighthawk	Chordeiles minor	o	c	o	-	30 May	7 Sep
Swift sp.	--	o	-	o	-	10 May	12 Sep
Rufous hummingbird	Selasphorus rufus	-	-	o	-	27 Aug[a]	--
Belted kingfisher	Megaceryle alcyon	u	u	u	o	--	--
Common flicker	Colaptes auratus	u	u	u	u	--	--
Eastern kingbird	Tyrannus tyrannus	o	u	-	-	26 May	23 Aug
Western kingbird	Tyrannus verticalis	u	u	o	-	1 May	2 Sep
Ash-throated flycatcher	Myiarchus cinerascens	-	r	-	-	23 Jun[a]	--
Say's phoebe	Sayornis saya	u	u	o	o	22 Feb	6 Sep
Willow flycatcher	Empidonax traillii	-	r	-	-	28 Jun	--
Western wood pewee	Contopus sordidulus	-	o	-	-	20 Jun	23 Jul
Horned lark	Eremophila alpestris	c	c	c	a	--	--
Violet-green swallow	Tachycineta thalassina	o	o	o	-	30 Mar	19 Sep
Tree swallow	Iridoprocne bicolor	o	-	-	o	29 Mar	15 Apr
Bank swallow	Riparia riparia	u	c	u	-	3 May	4 Oct
Rough-winged swallow	Stelgidopteryx ruficollis	-	o	-	-	6 Jun	Aug
Barn swallow	Hirundo rustica	u	u	u	-	17 Apr	25 Sep
Cliff swallow	Petrochelidon pyrrhonota	c	a	o	-	29 Mar	24 Sep
Black-billed magpie	Pica pica	c	c	c	c	--	--
Common raven	Corvus corax	u	u	u	u	--	--
Black-capped chickadee	Parus atricapillus	o	o	u	u	--	--
House wren	Troglodytes aedon	o	o	o	-	4 May	11 Sep
Bewick's wren	Thyromanes bewickii	o	o	-	-	10 Mar	20 Jun
Canyon wren	Catherpes mexicanus	u	c	u	u	--	--
Rock wren	Salpinctes obsoletus	u	c	u	-	3 Mar	15 Nov
American robin	Turdus migratorius	c	u	u	u	--	--
Varied thrush	Ixoreus naevius	o	-	o	o	24 Sep	10 Apr
Hermit thrush	Catharus guttatus	-	-	r	-	20 Oct[a]	--
Western bluebird	Sialia mexicana	o	o	-	-	19 May	23 Jun
Mountain bluebird	Sialia currocoides	o	-	-	o	22 Feb	4 Apr

APPENDIX U (Cont.)

Common Name	Scientific Name	Sp	Su	Au	Wi	Earliest Sighting	Latest Sighting
Townsend's solitaire	Myadestes townsendi	-	-	r	-	24 Sep[a]	--
Golden-crowned kinglet	Regulus satrapa	o	-	-	o	10 Dec	29 Mar
Ruby-crowned kinglet	Regulus calendula	o	-	o	-	24 Sep	May
Bohemian waxwing	Bombycilla garrulus	-	-	-	r	4 Dec[a]	--
Northern shrike	Lanius excubitor	-	-	o	u	27 Nov	24 Feb
Loggerhead shrike	Lanius ludovicianus	o	o	o	o	15 Jan	26 Oct
Starling	Sturnus vulgaris	c	c	u	c	--	--
Yellow warbler	Dendroica petechia	o	o	o	-	18 May	18 Sep
Yellow-rumped warbler	Dendroica coronata	o	-	o	o	8 May	2 Dec
Townsend's warbler	Dendroica townsendi	-	-	r	-	18 Sep[a]	--
Common yellowthroat	Geothlypis trichas	-	o	o	-	6 Jun	20 Sep
Yellow-breasted chat	Icteria virens	-	o	-	-	6 Jun	24 Jul
House sparrow	Passer domesticus	o	o	o	o	--	--
Western meadowlark	Sturnella neglecta	c	c	c	c	--	--
Yellow-headed blackbird	Xanthocephalus xanthocephalus	o	o	-	-	2 May	19 Jun
Red-winged blackbird	Agelaius phoeniceus	c	c	u	u	--	--
Northern oriole	Icterus galbula	o	u	-	-	18 May	Aug
Brewer's blackbird	Euphagus cyanocephalus	u	c	o	o	--	--
Brown-headed cowbird	Molothrus ater	o	u	-	-	18 May	7 Jul
Western tanager	Piranga ludoviciana	o	o	-	-	19 May	7 Jun
Black-headed grosbeak	Pheucticus melanocephalus	-	r	-	-	28 Jun[a]	--
Lazuli bunting	Passerina amoena	o	o	-	-	24 May	Aug
House finch	Carpodacus mexicanus	u	u	u	u	--	--
American goldfinch	Carduelis tristis	u	u	u	u	--	--
Rufous-sided towhee	Pipilo erythrophthalmus	o	o	o	-	9 Mar	25 Sep
Savannah sparrow	Passerculus sandwichensis	o	-	o	-	26 Apr	4 Oct
Grasshopper sparrow	Ammodrammus savannarum	o	u	-	-	25 Apr	4 July
Vesper sparrow	Pooecetes gramineus	-	o	o	-	2 May	11 Sep
Lark sparrow	Chondestes grammacus	o	u	o	-	20 May	12 Sep
Dark-eyed junco	Junco hyemalis	u	-	u	c	12 Sep	Apr
Tree sparrow	Spizella arborea	-	-	-	o	5 Feb	24 Feb

APPENDIX U (Cont.)

Common Name	Scientific Name	Sp	Su	Au	Wi	Earliest Sighting	Latest Sighting
Chipping sparrow	Spizella passerina	o	o	-	-	16 May	2 Aug
Brewer's sparrow	Spizella breweri	-	r	-	-	22 Jun[a]	--
White-crowned sparrow	Zonotrichia leucophrys	u	o	u	c	--	--
Song sparrow	Melospiza melodia	c	c	c	c	--	--

[a]Single sighting.

APPENDIX V

BIRD DENSITY ESTIMATES (Birds/Km^2) FOR EACH SPECIES ON GRAZED AND UNGRAZED SITES, LOWER SNAKE RIVER STUDY, 1979-80.

SITE	Species	Breeding Census		Winter Census	
		Ungrazed	Grazed	Ungrazed	Grazed
LEVEY LANDING/ AYER[a]	Red-tailed hawk	-	9	-	-
	Ring-necked pheasant	36	-	-	-
	Western kingbird	6	6	-	-
	Horned lark	-	-	-	47
	Bank swallow	334[b]	125[b]	-	-
	Cliff swallow	3	-	-	-
	Black-billed magpie	-	-	2	-
	Western meadowlark	95	64	48	-
	Brewer's blackbird	93	31	-	-
	House finch	49	10	-	-
	Sparrow sp.	28	-	-	-
	Unidentified sp.	-	-	6	-
LOST ISLAND	Ring-necked pheasant	-	24	60	15
	Gray partridge	-	-	9	45
	Horned lark	-	24	10	37
	Bank swallow	24	22	-	-
	Cliff swallow	4	-	-	-
	Black-billed magpie	4	9	-	-
	Starling	30	-	-	-
	Western meadowlark	64	42	-	74
	Northern oriole	5	-	-	-
	Red-winged blackbird	5	-	-	6
	Grasshopper sparrow	-	7	-	-
	Unidentified sp.	4	-	-	-
BECKWITH BAR	Killdeer	12	35	-	-
	Western kingbird	39	6	-	-
	Cliff swallow	31	14	-	-
	Starling	-	11	-	-
	Western meadowlark	32	16	-	-
	Brown-headed cowbird	-	16	-	-
	Grasshopper sparrow	6	-	-	-
	Lark sparrow	29	-	-	-
	Dark-eyed junco	-	-	-	11
	Sparrow sp.	17	-	-	-

APPENDIX V (Cont.)

SITE	Species	Breeding Census		Winter Census	
		Ungrazed	Grazed	Ungrazed	Grazed
GRANITE GOOSE PASTURE	Sharp-shinned hawk	-	-	-	2
	California quail	-	96	-	-
	Ring-necked pheasant	-	-	50	-
	Gray partridge	119	-	-	-
	Mourning dove	30	30	-	-
	Common flicker	-	-	-	7
	Eastern kingbird	10	-	-	-
	Western kingbird	11	4	-	-
	Cliff swallow	285	265	-	-
	Black-capped chickadee	-	-	4	-
	Starling	-	4	-	-
	Western meadowlark	53	85	5	5
	Northern oriole	14	65	-	-
	Brewer's blackbird	-	10	-	-
	House finch	6	-	-	-
	Finch sp.	-	-	4	-
	Dark-eyed junco	-	-	140	111
	Song sparrow	-	-	17	-
	Unidentified sp.	8	4	-	-

[a]Levey Landing was censused during the breeding season and Ayer during the winter season.

[b]Because of the proximity of a large bank swallow colony to the transects at Levey Landing, data for this species were not used in comparison of grazed-ungrazed sites.

APPENDIX W

UPLAND NEST SEARCH DATA, LOWER SNAKE RIVER STUDY, 1979.

Table 1. Locations, species, dates, and contents of nests found during upland nest searches, Lower Snake River Study, 1979.

PROJECT Study Site	Future Cover Type	Existing Cover Type	Species	No. Nests	Date Discovered	Nests Contents[a]
ICE HARBOR				NONE		
LOWER MONUMENTAL				NONE		
LITTLE GOOSE				NONE		
LOWER GRANITE						
Chief Timothy	Food Plot	342	House sparrow	1	25 June	Eggs (6)
Chief Timothy	Food Plot	342	Northern oriole	1	3 May	Unknown[b]
Chief Timothy	Food Plot	342	Brewer's blackbird	6	3 May	Eggs (6,3[c] 1,2,5,4)
Chief Timothy	Food Plot	342	Brewer's blackbird	8	3 May	Unknown[b]
Chief Timothy	Meadow	314	Spotted sandpiper	1	25 June	Eggs (4)
Wilma	Food Plot	312.5	Mallard	1	9 May	Eggs (9)

[a]Number of eggs in parentheses.

[b]Could not examine nest contents.

[c]Also contained one brown-headed cowbird egg.

APPENDIX W (Cont.)

Table 2. Locations, species, dates, and contents of nests found during upland nest searches, Lower Snake River Study, 1979.

PROJECT Study Site	Future Cover Type	Existing Cover Type	Species	No. Nests	Date Discovered	Nests Contents[a]
ICE HARBOR						
Big Flat	Pasture	312.3	Western meadowlark	1	21 April	Eggs (5)
Lost Island	Meadow	312.3	Vesper sparrow	1	2 May	Eggs (4)
Lost Island	Meadow	312.3	Red-winged blackbird	1	1 June	Empty
Hollebeke	Save	312	Gray partridge	1	25 May	Egg shells[b]
LOWER MONUMENTAL						
Skookum	Food plots	312.3	Horned lark	1	8 May	Eggs (4)
Skookum	Shrub	325.2	Horned lark	1	7 May	Eggs (2)
Tucannon	Shrub	342	Red-tailed hawk	1	4 May	Unknown[c]
Tucannon	Shrub	312	Ring-necked pheasant	1	4 May	Destroyed[d]
Tucannon	Shrub	312	Chukar	1	4 May	Eggs (18)
Tucannon	Shrub	342	House wren	1	4 May	Unknown[c]
Tucannon	Shrub	342	Starling	1	4 May	Nestlings[c]
LITTLE GOOSE						
Ridpath	Food plots	312	Mallard	1	14 June	Eggs (7)
Swift Bar	Save	312.3	Red-winged blackbird	1	12 May	Eggs (2)
Swift Bar	Save	313	Red-winged blackbird	1	7 June	Eggs (4)
Swift Bar	Save	313	Red-winged blackbird	1	7 June	Eggs (3)
Swift Bar	Shrub	316	Song sparrow	1	18 May	Eggs (4)
Swift Bar	Shrub	316	Song sparrow	1	27 June	Eggs (2)
Swift Bar	Shrub	316	Red-winged blackbird	1	27 June	Eggs (2)
Swift Bar	Shrub	316	Red-winged blackbird	3	27 June	Empty

APPENDIX W (Cont.)

Table 2. (Cont.)

PROJECT Study Site	Future Cover Type	Existing Cover Type	Species	No. Nests	Date Discovered	Nest Contents[a]
LOWER GRANITE						
Granite Goose	Pasture	342	Mourning dove	1	7 June	Nestlings (2)
Granite Goose	Pasture	342	Red-winged blackbird	1	7 June	Eggs (4)
Chief Timothy	Food plots	342	Brewer's blackbird	1	29 June	Eggs (3)[e]
Chief Timothy	Food plots	342	Brewer's blackbird	1	29 June	Nestlings (2)
Chief Timothy	Food Plots	342	Brewer's blackbird	14	29 June	Unknown[c]
Chief Timothy	Food plots	342	Brewer's blackbird	1	5 May	Eggs (3)
Chief Timothy	Food plots	342	Brewer's blackbird	2	5 May	Empty
Chief Timothy	Food plots	312	Western meadowlark	1	5 May	Eggs (4)
Chief Timothy	Legume	312	Ring-necked pheasant	1	15 June	Eggs (9)
Chief Timothy	Legume	312	Red-winged blackbird	1	7 May	Eggs (5)
Chief Timothy	Pasture	313	Spotted sandpiper	1	8 June	Eggs (4)
Chief Timothy	Pasture	313	Spotted sandpiper	1	8 June	Eggs (4)
Chief Timothy	Pasture	313	Red-winged blackbird	1	8 June	Eggs (2)
Chief Timothy	Pasture	313	Red-winged blackbird	1	8 June	Eggs (2)[f]
Chief Timothy	Save	312	Mallard	1	29 June	Eggs (9)
Chief Timothy	Save	312	Mallard	1	6 May	Eggs (11)
Chief Timothy	Save	312	Red-winged blackbird	1	15 June	Eggs (3)
Wilma	Food plots	313	Ring-necked pheasant	1	27 June	Egg shells[b]
Wilma	Meadow	312.3	Mallard	1	18 May	Eggs (9)
Wilma	Meadow	312.3	Mallard	1	18 May	Eggs (9)

[a]Number of eggs or nestlings in parentheses.

[b]Appeared to have hatched.

[c]Could not examine nest contents.

[d]Egg shells scattered by avian predator.

[e]Also contained three brown-headed cowbird eggs.

[f]Also contained one brown-headed cowbird egg.

APPENDIX W (Cont.)

Table 3. Locations, species, dates, and contents of nests found during upland nest searches on ungrazed and grazed plots, Lower Snake River Study, 1979.

POOLED PROJECT Study Site	Treatment	Species	No. Nests	Date Discovered	Nest Contents[a]
ICE HARBOR/ LOWER MONUMENTAL					
Levey Landing	Ungrazed	NONE			
	Grazed	Ring-necked pheasant	1	21 June	Eggs (8)
Lost Island	Ungrazed	Ring-necked pheasant	1	22 June	Eggs (12)
	Grazed	Western meadowlark	1	22 June	Eggs (5)
LITTLE GOOSE/ LOWER GRANITE					
Beckwith Bar	Ungrazed	NONE			
	Grazed	NONE			
Granite Goose Pasture	Ungrazed	NONE			
	Grazed	NONE			

[a]Number of eggs in parentheses.

APPENDIX W (Cont.)

Table 4. Upland nest densities (nests per 100 acres) by study site and future cover type, Lower Snake River Study, 1979.

Study Site	Food Plots	Legume	Meadow	Pasture	Save	Shrub
Big Flat	0	0	0	0	0	0
Hollebeke	0	0	0	0	0	0
Skookum	0	0	0	0	0	0
55-Mile	0	0	0	0	0	0
New York Bar	0	0	0	0	0	0
Swift Bar	0	0	0	0	0	0
Chief Timothy	2590	0	162	0	0	0
Wilma	162	0	0	0	0	0

APPENDIX X

COMPENSATION PROGRESS BY TYPE OF HABITAT IMPROVEMENT, LOWER SNAKE RIVER STUDY, 1980.

Wildlife	Riparian	Fenced Areas	Park Trees	Big Flat Irrigation	Total
Non-game Birds					
Breeding	2005	3293	508	-[a]	5806
Wintering	2792	-670	664	37	2823
Upland Game	886	417	0	-[a]	1303
Chukars	0	0	0	-[a]	0
Mourning doves	362	0	92	-[a]	454
Deer	0	0	0	-[a]	0

[a]Area studied during winter 1979-80 only. Incomplete data available to calculate compensation progress.

APPENDIX Y

NON-GAME BIRD LOSSES CAUSED BY DAM CONSTRUCTION ALONG THE LOWER SNAKE RIVER.

Project	Cover Type[a]	Hectares[b]	Losses[c]	
			Breeding	Winter
Ice Harbor	Riparian	144.1	6,483	10,684
	Weedy-floodplain	1172.4	2,810	12,805
	Ice Harbor Subtotal		9,293	23,489
Lower Monumental	Riparian	37.2	1,675	2,761
	Weedy-floodplain	1206.4	2,892	13,176
	Lower Monumental Subtotal		4,567	15,937
Little Goose	Riparian	62.7	2,823	4,652
	Weedy-floodplain	1896.0	4,544	20,708
	Little Goose Subtotal		7,367	25,360
Lower Granite	Riparian	210.4	9,469	15,605
	Weedy-floodplain	1108.9	2,658	12,111
	Lower Granite Subtotal		12,127	27,716
	TOTAL LOWER SNAKE RIVER		33,354	92,502

[a]From Lewke (1975).

[b]Adapted from U.S. Army Engineer District, Walla Walla (1975a:56).

[c]Computed from data presented in Lewke (1975:107-113) and U.S. Army Engineer District, Walla Walla (1975a:56).