Effects of Haying and Grazing on Duck Production in the Blitzen Valley (Unit 12) of Malheur National Wildlife Refuge, 1979

Gary Ivey - August 1979

STUDY AREA

This study was conducted in the Blitzen Valley (Unit 12) of Malheur National Wildlife Refuge in southeastern Oregon (Figure 1). Data was collected during the 1979 breeding season. The study area consisted of 650 hectares delineated by J. P. Clark in 1974 (Clark 1977). The area contains three fields: South Little Juniper Field, North Little Juniper Field, and Knox Field. Data presented here was sampled from twelve of Clark's eighteen 9-hectare plots, four within each field (Figure 2).

METHODS

Three patterns of management (treatments) were applied to the study area during the course of this research:

1. Traditional agricultural use of mowing and bunching hay in meadows during late summer and grazing with cattle during fall and winter (mowed and grazed).

2. Grazing prohibited, with late summer mowing of meadows, leaving the brushy uplands undisturbed (partially mowed).

3. Mowing and grazing prohibited (idle).

Four plots (36 ha) were under the mowed and grazed treatment in South Little Juniper Field, two plots (18 ha) were under the partially mowed treatment in North Little Juniper Field, two plots (18 ha) were under the idle treatment

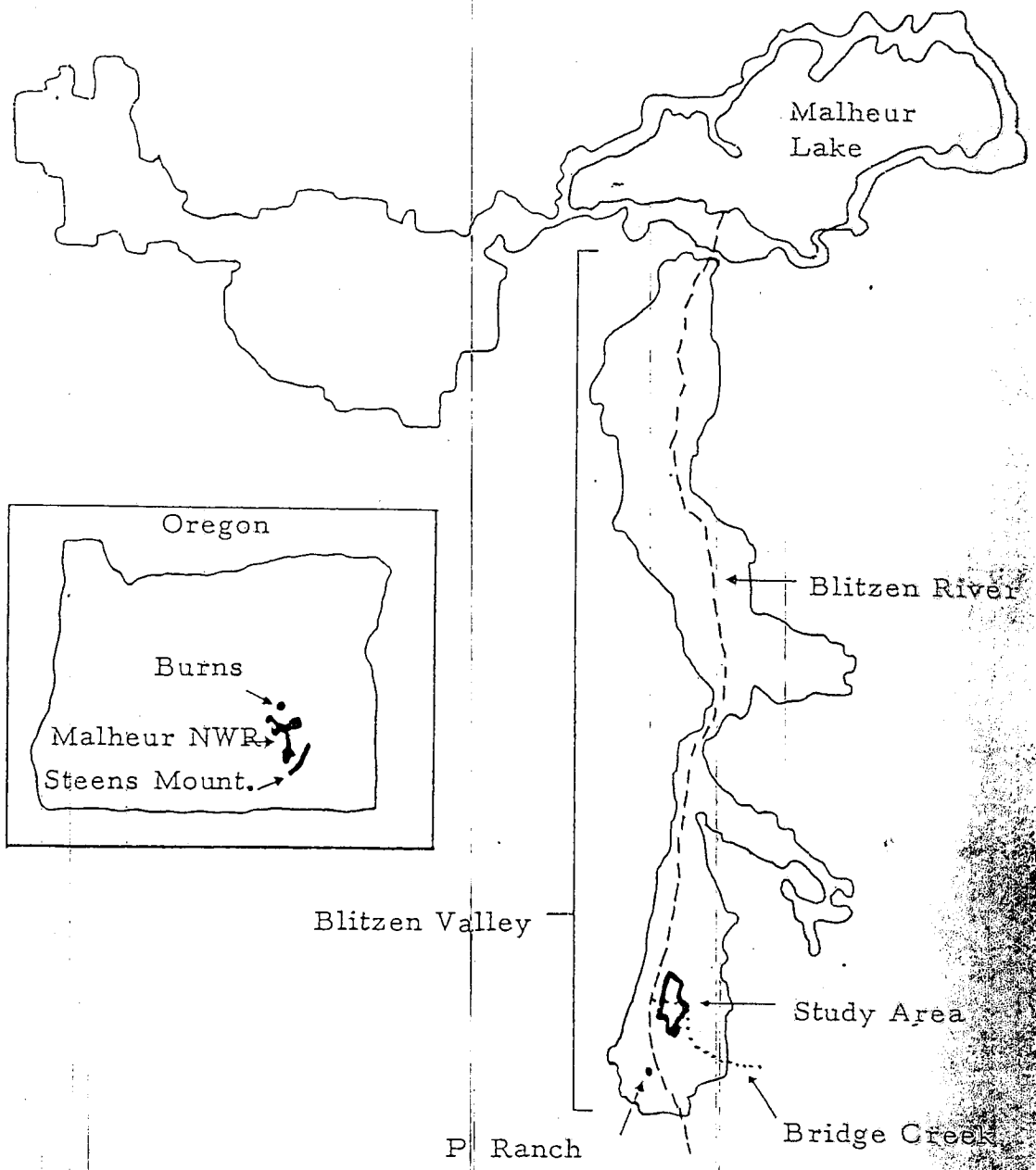


Figure 1. Location of study area on Malheur National Wildlife Refuge.

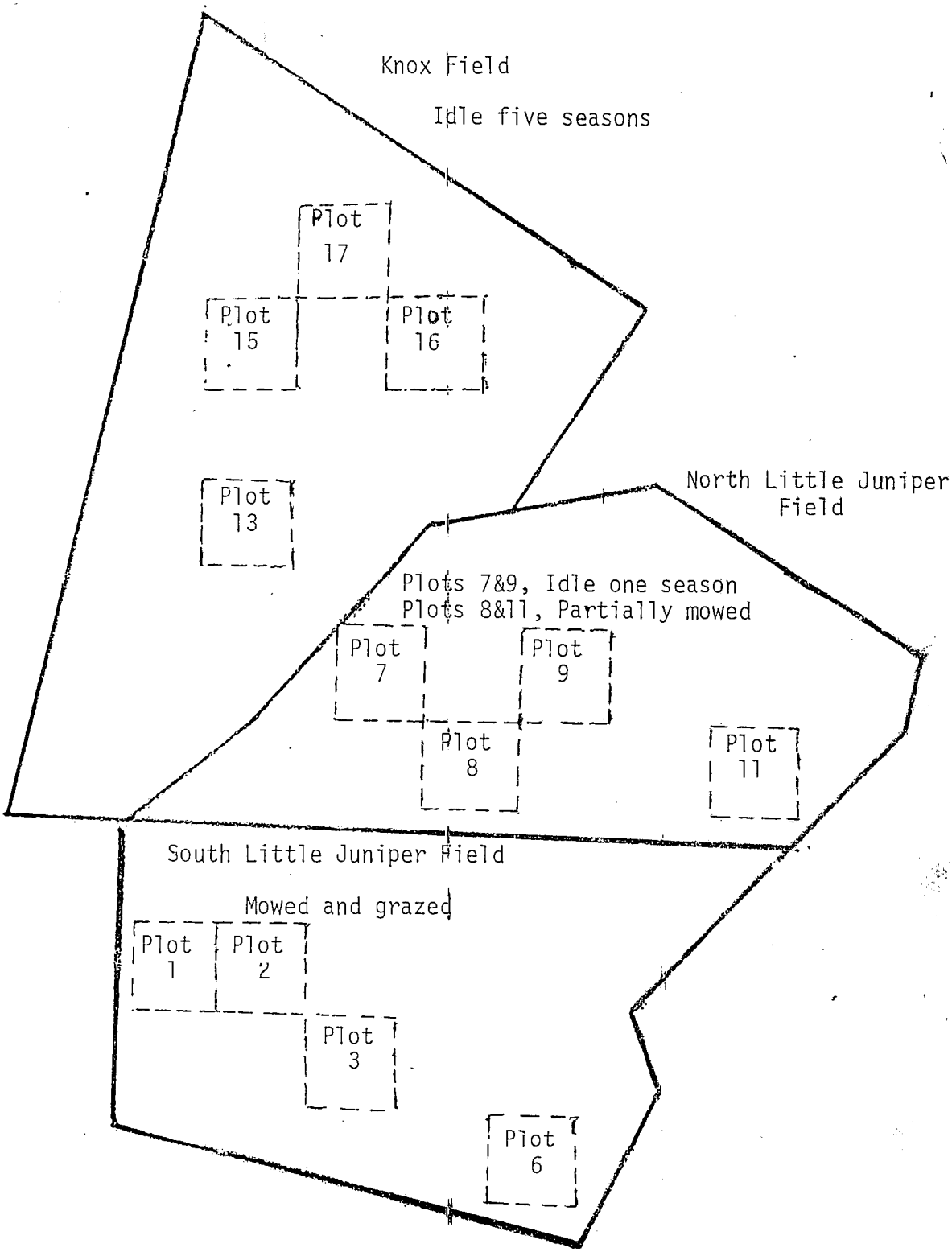


Figure 2. Study Area, fields, plots and treatments for the 1979 study.

(idle one season) in North Little Juniper Field and four plots (36 ha) were under the idle treatment (idle five seasons) in Knox Field (Figure 2).

Intensity of grazing by cattle between the 1978 and 1979 growing seasons was 8.2 AUM/ha on South Little Juniper Field.

Locations of major types of cover were determined by the use of aerial photos and reconnaissance mapping. Areas of each cover type were determined by weighing areas mapped of each cover type calculating percent of the total weight of the plot map. These percentages were used to calculate areas of each cover type on each plot.

Four searches were conducted on each plot at intervals of three weeks. Searches were conducted on foot by the investigator with approximately equal effort. Located nests were marked with plastic flagging at various distances north of the nest site. Nests were re-visited after their calculated hatching dates to determine their fate.

Numbers of ducklings produced were derived from counts of hatched eggs. For successful nests found before completion of laying, the number hatched could not be determined. These nests were treated as having produced the average clutch size (Bellrose 1976) for their species, minus any unhatched eggs. A few nests were found after they had successfully hatched. These were treated as having produced the average clutch size for all ducks.

Breeding pairs of ducks were counted on each plot during each search. Lone drakes, lone hens, and pairs were tallied as breeding pairs (Hanson & Hawkins 1976)

Water levels were measured weekly at permanent markers within each plot. Flooded areas were sketch mapped and the area flooded on each plot determined.

Indices of selectivity (Hirts 1975:16) were calculated by dividing the density of nests in a particular type of cover by the density of nests in all types of cover. An index value of greater than 1 indicates selection, less than 1 indicates avoidance, and 1 indicates neither selection or avoidance.

RESULTS

Cover

Seven types of cover were present on the study areas as described by Clark (1977). These included tall grass, short grass, brush with tall grass, brush with short grass, bulrush-cattail, burreed, and willow thickets. (Table 1). Duck nests were found in all types but burreed. Only one nest each was found in short grass and willow thicket types.

Open water accounted for 2.6 percent of the area of mowed and grazed plots in South Little Juniper Field, 2.3 percent on partially mowed plots in North Little Juniper Field, 1.2 percent on plots idle one season in North Little Juniper Field, and .7 percent on plots idle five seasons in Knox Field (Table 2). Tall grass was the most abundant type of cover on all transects.

Table 1. Types of cover on the study area, Malheur National Wildlife Refuge, 1979.

TYPE OF COVER	DOMINANT PLANT SPECIES
Tall Grass	Creeping wild rye (Elymus triticoides), rushes (Juncus spp), sedges (Carex spp.) bluegrass (Poa spp.), Timothy (Phleum sp.).
Short Grass	Saltgrass (Distichlis stricta).
Brush with Tall Grass	Rabbitbrush (Chrysothamnus spp.), greasewood (Sarcobatus vermiculatus), creeping wild rye, giant wild rye (Elymus cinereus), sedges.
Brush with Short Grass	Greasewood and saltgrass.
Bulrush-cattail	Hardstem bulrush (Scirpus acutus), Cattail (Typha latifolia).
Willow Thickets	Willows (Salix spp.), creeping wild rye, sedges, rushes, bluegrass.

Table 2. Types, areas, and percentages of cover on study plots within each treatment, Malheur National Wildlife Refuge, 1979.

	Mowed & Grazed[1]		Partially Mowed[2]		Idle One Season[2]		Idle Five Seasons[1]		All Plots	
Type of Cover	Area(ha)	%	Area(ha)	%	Area(ha)	%	Area(ha)	%	Area(ha)	%
Tall Grass	16.38	45.5	8.11	45.1	5.66	31.4	20.17	56.0	50.32	44.5
Short Grass	1.26	3.5	.69	3.8	1.02	5.6	.31	.9	3.28	3.5
Brush with Tall Grass	2.88	8.0	3.22	17.9	3.90	21.7	4.25	11.8	14.25	14.9
Brush with Short Grass	3.65	10.1	2.90	16.1	4.76	26.4	4.79	13.3	16.10	16.5
Bulrush-Cattail	5.65	15.7	1.12	6.2	1.11	6.2	2.40	6.7	10.28	8.7
Burreed	4.88	13.6	1.69	9.4	1.29	7.2	3.77	10.5	11.63	10.2
Willow Thickets	.26	.7	0.00	0.0	.06	.3	.10	.3	.42	.3
Open Water	.95	2.6	.41	2.3	.21	1.2	.24	.7	1.81	1.7

1 Area on these plots totaled 36 ha
2 Area on these plots totaled 18 ha

Water

Area flooded differed considerably amont the plots within each treatment. Plots in South Little Juniper Field (mowed and grazed) were 57.8% flooded, plots in North Little Juniper Field (partially mowed) were 28.9% flooded, plots in North Little Juniper Field (idle one season) were 17.8% flooded, and plots in Knox Field (idle five seasons) were 45.6% flooded (Table 3).

Table 3. Area and percentage flooded of the study plots within each treatment, Malheur National Wildlife Refuge, 1979.

Treatment	Mowed & Grazed[1]	Partially Mowed[2]	Idle One Season[2]	Idle Five Seasons
Area Flooded (ha)	20.8	5.2	3.2	16.4
Percent Flooded	57.8	28.9	17.8	45.6

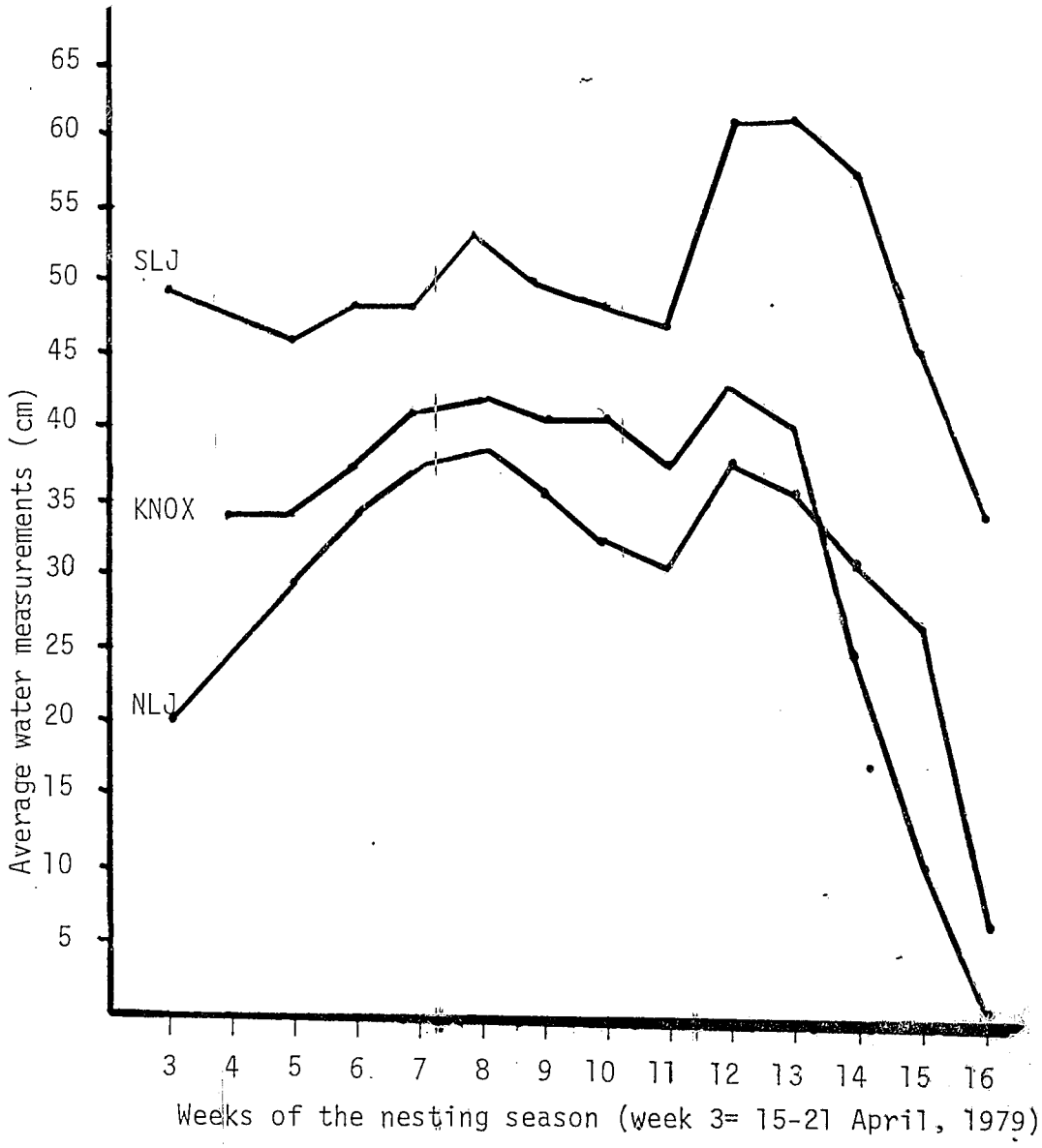
1 Areas in these plots totaled 36 ha.

2 Areas in these plots totaled 18 ha.

Water level fluctuations basically followed the same trends in each of the fields on the study area (Figure 3). South Little Juniper Field (mowed and grazed) continued to have good water while the other fields on the study area were rapidly drying at the end of the nesting season.

Breeding Pairs

Breeding pair counts showed Cinnamon Teal (Anas cyanoptera) to be the most abundant species on the study area in 1979 (Table 4). Mallards (Anas platyrhynchos) and Gadwalls (Anas strepera) were also present in high numbers. Other ducks recorded on the counts in terms of relative abundance



SLJ= South Little Juniper Field
NLJ= North Little Juniper Field
KNOX= Knox Field

Figure 3. Weekly fluctuations of water levels on the fields in the study area, Malheur National Wildlife Refuge, 1979.

were: Redheads (Athya americana), Shovelers (Anas clypeata), Canbasbacks (Athya valisineria), Green-winged Teal (Anas crecca), Pintails (Anas acuta), Wigeon (Anas americana), Blue-winged Teal (Anas discors), Ruddy ducks (Oxyura jamaicensis), and Ring-necked ducks (Athya collaris).

Densities of breeding pairs per wetland hectare were calculated for plots within each treatment (Figure 4). The plots idle for one season showed significantly higher densities of breeding pairs than plots in the other treatments. Comparing breeding pair densities for the third week of May (Week 7), when the refuge breeding pair counts were done, densities on plots idle for one season were more than 2.5 times greater than plots in other treatments (Table 5).

Table 4. Composition of species of breeding pairs of ducks counted on plots within each treatment on the study area, Malheur National Wildlife Refuge, 1979.

	Mowed & Grazed		Partially Mowed		Idle One Season		Idle Five Seasons		All Plots Combined	
Species	N	%	N	%	N	%	N	%	N	%
Mallard	11	16.2	5	22.7	6	17.1	12	19.0	34	18.1
Cinnamon Teal	18	26.5	7	31.8	20	57.1	17	27.0	62	33.0
Gadwall	19	27.9	6	27.3	6	17.1	12	19.0	43	22.9
Redhead	7	10.3	3	13.6	0	0.0	11	17.5	21	11.2
Shoveler	5	7.4	1	4.5	2	5.7	5	7.9	13	6.9
Others[1]	8	11.8	0	0.0	1	2.9	6	9.5	15	8.0
TOTAL	68									

1 Others includes: Green-winged Teal, Pintail, Wigeon, Blue-winged Teal, Canvasback, Ring-necked Duck, and Ruddy Duck.

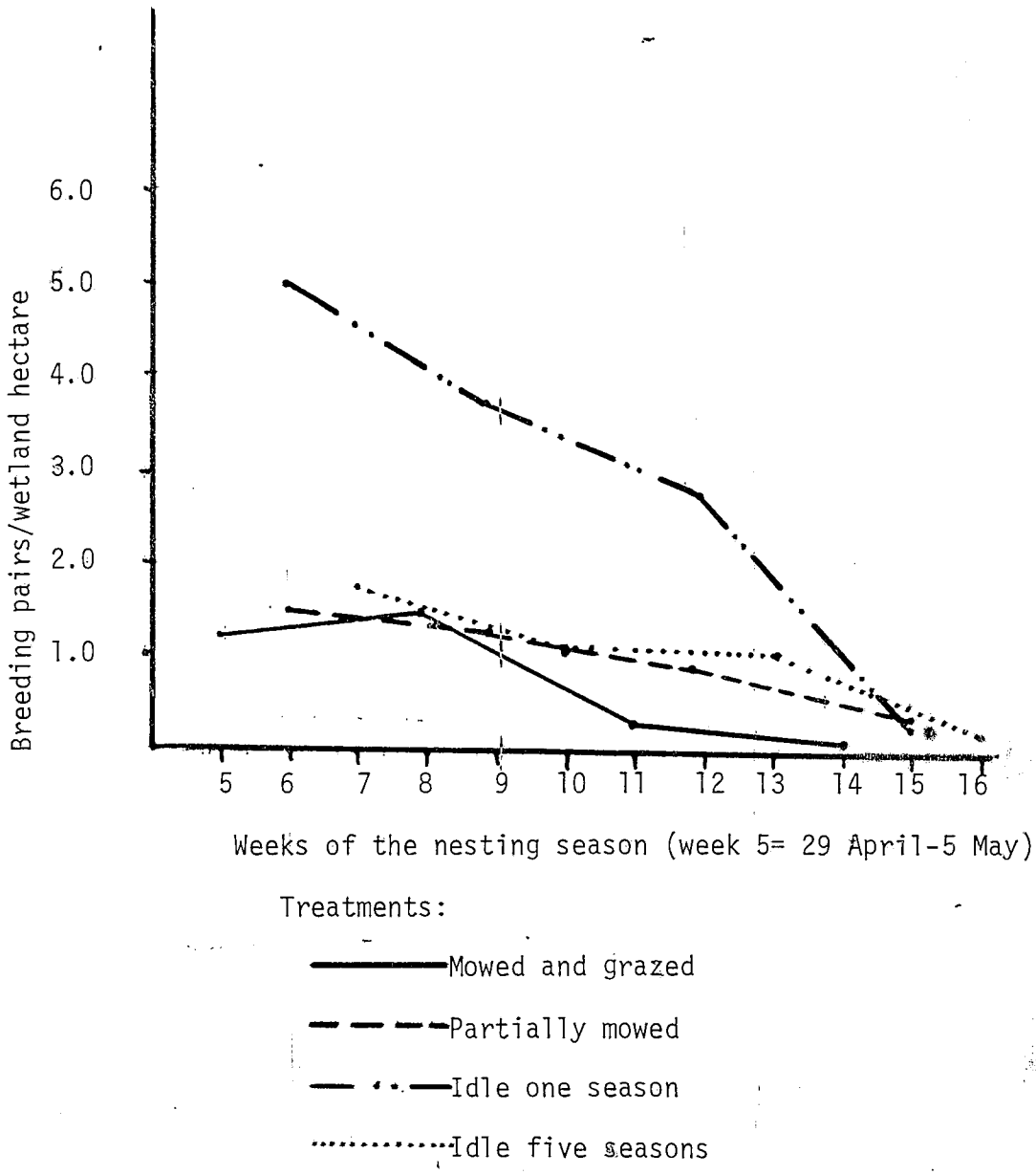


Figure 4. Breeding pairs of ducks per wetland hectare through the nesting season, by treatment, Malheur National Wildlife Refuge, 1979.

Table 5. Comparison of breeding pairs of ducks per wetland hectare during week 7 (13-19 May) on plots within each treatment on the study area, Malheur National Wildlife Refuge.

	Mowed & Grazed	Partially Mowed	Idle One Season	Idle Five Seasons
Pairs/Wetland ha	1.5	1.4	4.7	1.8

Nests

Fifty-eight duck nests were found on the study area in 1979. Of these, 48 nests were located on the study plots. Cinnamon Teal, Mallards, and Gadwalls were the most common nesting ducks on the study plots in 1979 (Table 6). Gadwall nests were found only on plots under idle treatments.

Species composition of nests (Table 6) followed the same pattern as species composition of breeding pairs (Table 4) except that more Mallard nests were found than Gadwall nests, and no Gadwall nests were found on mowed and grazed, and partially mowed plots. One Gadwall nest was found off the plots in the mowed-grazed field.

Distribution of Nests Among Types of Cover

Tall grass was the most frequently used nesting cover on all study plots, followed by bulrush-cattail and brush with tall grass (Table 7). Tall grass in the plots idle one season had the highest index of selectivity of tall-grass cover on all treatments (Table 7). This was due to higher selection for this cover type under the idle one-season treatment by Mallards, Gadwalls, and Cinnamon Teal (Tables 8,9,10 and 11).

Table 6. Densities and species composition of nests on the study plots within each treatment, Malheur National Wildlife Refuge, 1979.

	Mowed and Grazed			Partially Mowed			Idle One Season			Idle Five Seasons			All Plots Combined		
Species	N	Nests/ha	%	N	Nests/ha	%	N	Nests/ha	%	N	Nests/ha	%	N	Nests/ha	%
Mallard	3	.08	25.0	2	.11	28.6	4	.22	33.3	2	.06	11.8	11	.10	22.9
Cinnamon Teal	4	.11	33.3	3	.17	42.9	4	.22	33.3	3	.08	17.6	14	.13	29.2
Gadwall	0	0	0	0	0	0	2	.11	16.7	4	.11	23.5	6	.06	12.5
Redhead	1	.03	8.3	1	.06	14.3	0	0	0	2	.06	11.8	4	.04	8.3
Others[3]	4	.11	33.3	1	.06	14.3	2	.11	16.7	6	.17	35.3	13	.12	27.0
All Species	12	.33	99.9	7	.39	100.1	12	.67	100.0	17	.47	100.0	48	.44	99.9

1 Area on these plots totaled 36 ha.

2 Area on these plots totaled 18 ha.

3 Others includes: Canvasback, Shoveler and unidentified nests.

Table 7. Distribution of duck nests among types of cover, densities, and indices of selectivity[1] for nesting cover on study plots in 1979, Malheur National Wildlife Refuge

	TYPE OF COVER																	
	Tall Grass			Short Grass			Brush with Tall Grass			Brush with Short Grass			Bulrush-Cattail			Willow Thickets		
	N	Nests/ ha	S. Index[2]	N	Nests/ ha	S. Index	N	Nests/ ha	S. Index	N	Nests/ ha	S. Index	N	Nests/ ha	S. Index	N	Nests/ ha	S. Index
Mowed & Grazed	7	.43	.97	0	0	0	0	0	0	0	0	0	5	1.02	2.30	0	0	0
Partially Mowed	4	.49	1.10	0	0	0	1	.31	.70	1	.34	.77	1	.89	2.00	0	0	0
Idle One Season	8	1.41	3.17	1	.98	2.21	1	.26	.59	1	.21	.47	1	.90	2.03	0	0	0
Idle Five Seasons	8	.40	.90	0	0	0	5	1.88	4.23	1	.21	.47	2	.83	1.87	1	1.43	3.22
All Plots	27	.54	1.22	1	.30	.68	7	.49	1.11	3	.19	.42	9	.87	1.99	1	2.38	5.41

1 Indices of selectivity were calculated by dividing the density of nests within each cover type under each treatment by the total density of duck nests in all cover types under all treatments (.444 nests/ha).

2 Selectivity index.

Table 8. Distribution of duck nests among types of cover and indices of selectivity[1] for nesting cover on plots under the mowed and grazed treatment, South Little Juniper Field, Malheur National Wildlife Refuge, 1979.

	TYPE OF COVER											
	Tall Grass		Short Grass		Brush with Tall Grass		Brush with Short Grass		Bulrush-Cattail		Willow Thickets	
Species	N	S. Index[2]	N	S. Index	N	S. Index	N	S. Index	N	S. Index	N	S. Index
Mallard	2	.68	0	0	0	0	0	0	1	.29	0	0
Cinnamon Teal	4	1.37	0	0	0	0	0	0	0	0	0	0
Gadwall	0	0	0	0	0	0	0	0	0	0	0	0
Others[3]	1	.61	0	0	0	0	0	0	4	1.04	0	0
All Species	7	.79	0	0	0	0	0	0	5	1.02	0	0

1 Indices of selectivity were calculated by dividing the density of a duck species nests in a particular cover type under one treatment by the density of that species nests in that particular cover type in all treatments.

2 Selectivity index.

3 Others includes: Redhead, Canvasback and unidentified nests.

Table 9. Distribution of duck nests among types of cover and indices of selectivity[1] for nesting cover on study plots under the partially mowed treatment in North Little Juniper Field, Malheur National Wildlife Refuge, 1979.

	TYPE OF COVER											
	Tall Grass		Short Grass		Brush with Tall Grass		Brush with Short Grass		Bulrush-Cattail		Willow Thickets	
Species	N	S. Index[3]	N	S. Index	N	S. Index	N	S. Index	N	S. Index	N	S. Index
Mallard	2	1.38	0	0	0	0	0	0	0	0	0	0
Cinnamon Teal	1	.69	0	0	1	4.43	1	2.78	0	0	0	0
Gadwall	0	0	0	0	0	0	0	0	0	0	0	0
Others[2]	0	0	0	0	1	.89	0	0	1	1.31	0	0
All Species	3	.69	0	0	2	1.26	1	1.81	1	1.03	0	0

1 Indices of selectivity were calculated by dividing the density of a duck species nests in a particular cover type under one treatment by the density of that species nests in that particular cover type in all treatments.

2 Others include: Shoveler and Redhead.

3 Selectivity index.

Table 10. Distribution of duck nests and indices of selectivity[1] for nesting cover on the study plots within the idle one season treatment, North Little Juniper Field, Malheur National Wildlife Refuge, 1979.

	TYPE OF COVER											
	Tall Grass		Short Grass		Brush with Tall Grass		Brush with Short Grass		Bulrush-Cattail		Willow Thickets	
Species	N	S. Index	N	S. Index	N	S. Index	N	S. Index	N	S. Index	N	S. Index
Mallard	3	2.96	0	0	0	0	0	0	1	1.47	0	0
Cinnamon Teal	2	1.98	1	3.22	0	0	1	1.69	0	0	0	0
Gadwall	1	2.96	0	0	1	1.83	0	0	0	0	0	0
Others[3]	2	3.56	0	0	0	0	0	0	0	0	0	0
All Species	8	2.63	1	.98	1	.52	1	1.11	1	1.04	0	0

1 Indices of selectivity were calculated by dividing the density of a duck species nests in a particular cover type under one treatment by the density of that species nests in that particular cover type in all treatments.

2 Selectivity index.

3. Others are unidentified nests.

Table 11. Distribution of duck nests among types of cover and indices of selectivity[1] for nesting cover on the study plots in the idle five seasons treatment, Knox Field, Malheur National Wildlife Refuge, 1979.

	TYPE OF COVER											
	Tall Grass		Short Grass		Brush with Tall Grass		Brush with Short Grass		Bulrush-Cattail		Willow Thickets	
Species	N	S. Index[2]	N	S. Index	N	S. Index	N	S. Index	N	S. Index	N	S. Index
Mallard	2	.55	0	0	0	0	0	0	0	0	0	0
Cinnamon Teal	2	.55	0	0	0	0	0	0	0	0	0	0
Gadwall	2	1.66	0	0	1	1.68	0	0	0	0	1	4.2
Others[3]	2	1.00	0	0	4	2.68	1	3.36	2	1.22	0	0
All Species	8	.73	0	0	5	2.40	1	1.1	2	.96	1	4.2

1 Indices of selectivity were calculated by dividing the density of a duck species nests in a particular cover type under one treatment by the density of that species nests in that particular cover type in all treatments.

2 Selectivity index.

3 Others includes: Redheads and unidentified ducks.

Timing of the Nesting Season

Dates on which the first eggs were laid in the two earliest duck nests were 6 and 18 April, 1979. Peak nesting occurred during week 5 (29 April to 5 May) in 1979 (Figure 5).

Mallards were the earliest nesters on the study area followed by Cinnamon Teal and Gadwalls (Figure 6).

Ducks nested later and had a shorter nesting season on plots within the mowed and grazed treatment, and ducks nested earlier and longer through the nesting season on plots idle for five seasons (Figure 7).

No significant trends were evident in treatment selection by early nesting Mallards, Cinnamon Teal, and Gadwalls (Figures 8, 9 and 10).

Nest Density

Densities of duck nests found on plots within the four treatments appear in Table 6. The density of nests on all plots combined was .44 nests/ha. Nesting densities were lower on mowed and grazed, and on partially mowed plots than they were on idle plots. Plots idle for one season had the highest nesting density (.67 nests/ha).

Since some types of nesting cover are used more frequently for nesting than others (Table 7), and since areas of each cover type varied among plots under each treatment (Table 2), comparisons of nest densities in Table 6 are biased. To correct for bias due to inequalities of areas of cover types, the following formula was developed:

$$D = \sum_{i}^{n} X_i \ (Y_i)$$

where D = overall density of nests on the treatment.

X = the density of nests within each cover type on the treatment (Table 8).

Y = the percentage of each cover type on the treatment (Table 2).

This formula can be used to generate overall nest densities for each treatment as reported in Table 6. To adjust for bias due to inequalities in the areas of each cover type between treatments, the mean percentage of each cover type for all plots combined (Table 2) can be substituted for Y in the equation. This has the effect of equalizing the areas of each cover type sampled from each treatment, and is an improved estimation of nesting density for comparison between the treatments.

Table 12. Adjusted duck nest densities for equalized areas of cover types among the different treatments, Malheur National Wildlife Refuge, 1979.

	Mowed & Grazed	Partially Mowed	Idle One Season	Idle Five Seasons
Nests/ha	.28	.40	.81	.50

All duck nests found on partially mowed plots were in unmowed vegetation. Table 13 shows calculated nesting densities for all grazed and/or mowed vegetation and all idle vegetation. Nest densities in idle vegetation were higher than nest densities in grazed and/or mowed vegetation.

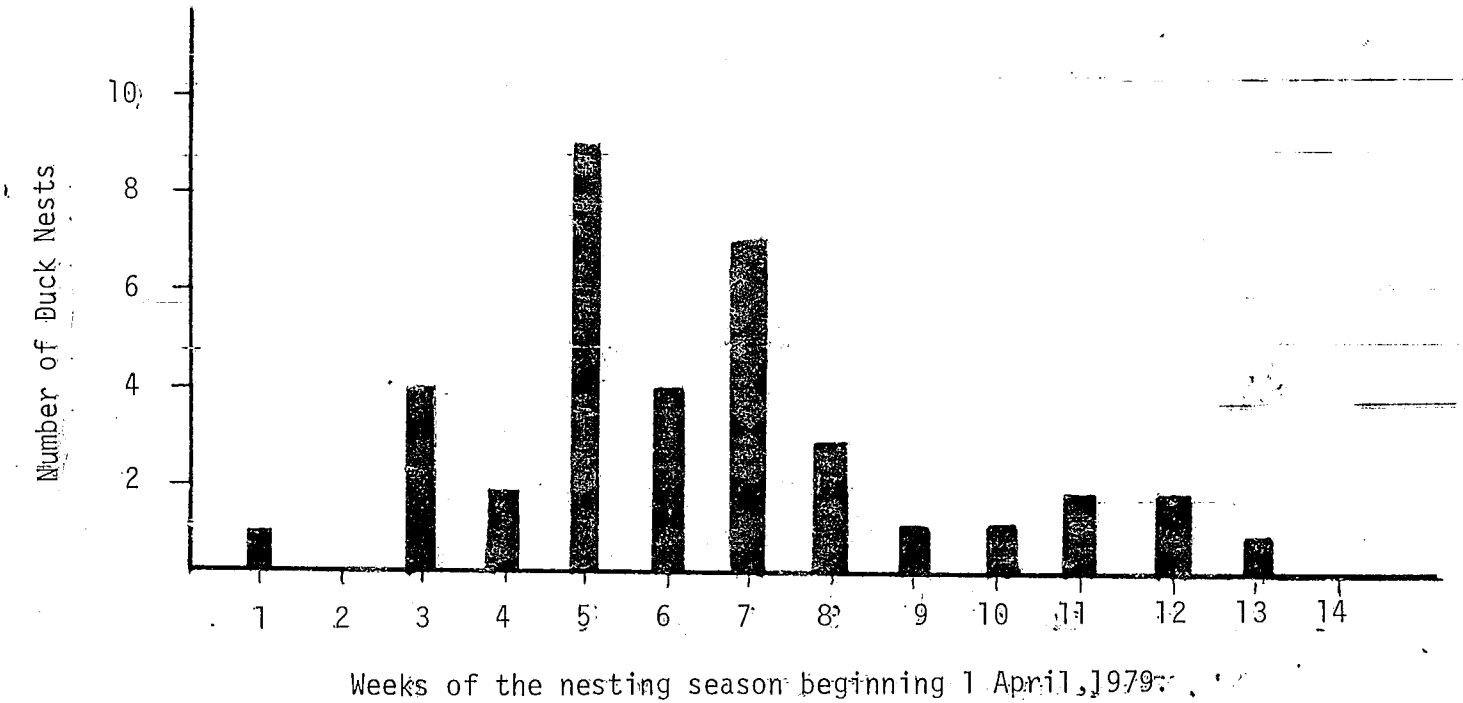


Figure 5. Dates on which the first eggs were laid in duck nests on the study area in 1979, Malheur National Wildlife Refuge.

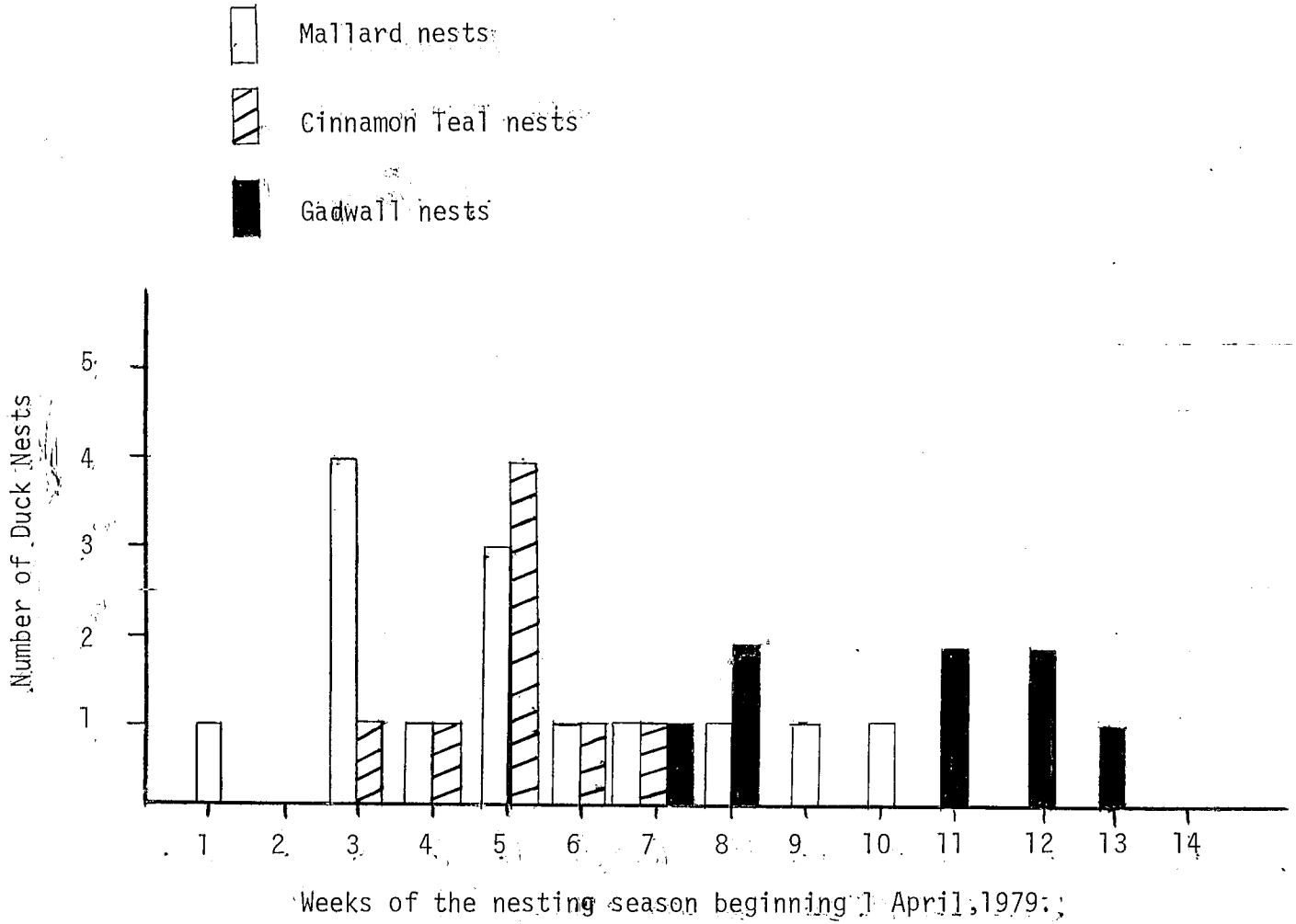


Figure 6. Dates on which first eggs were laid in Mallard, Cinnamon Teal, and Gadwall nests on the study area in 1979, Malheur National Wildlife Refuge.

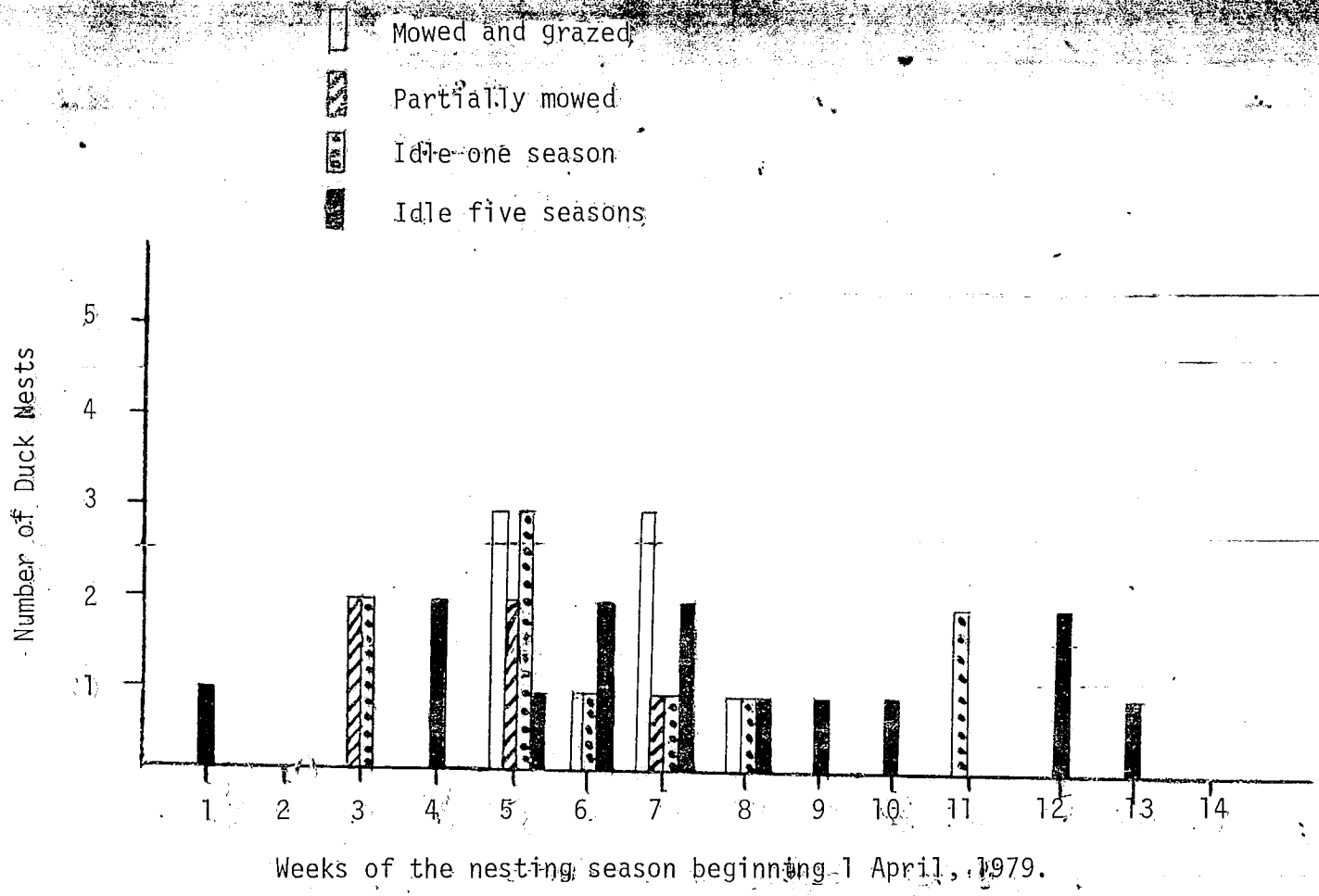


Figure 7. Dates on which the first eggs were laid in duck nests on the study plots in 1979, by treatment, Malheur National Wildlife Refuge.

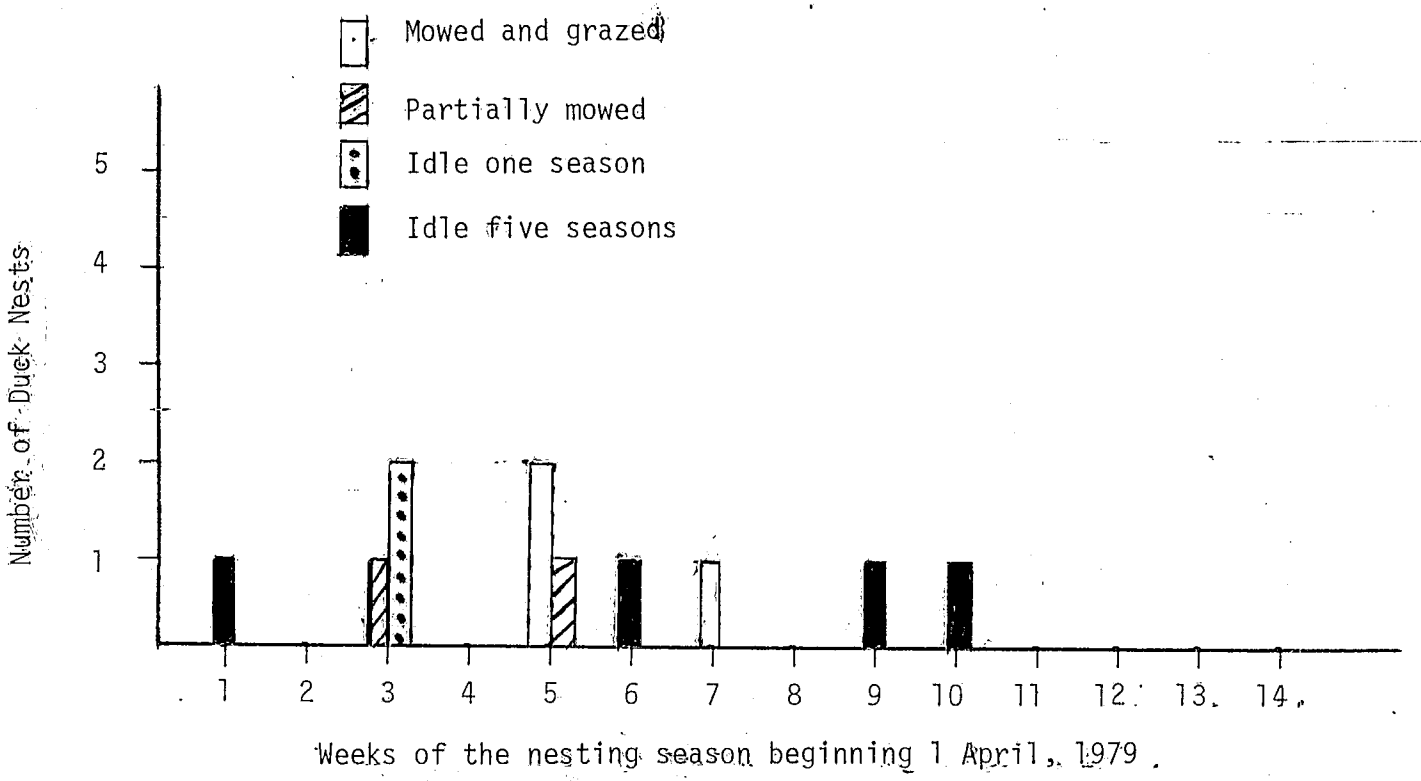


Figure 8. Dates on which the first eggs were laid in Mallard nests on the study plots in 1979, by treatment, Malheur National Wildlife Refuge.

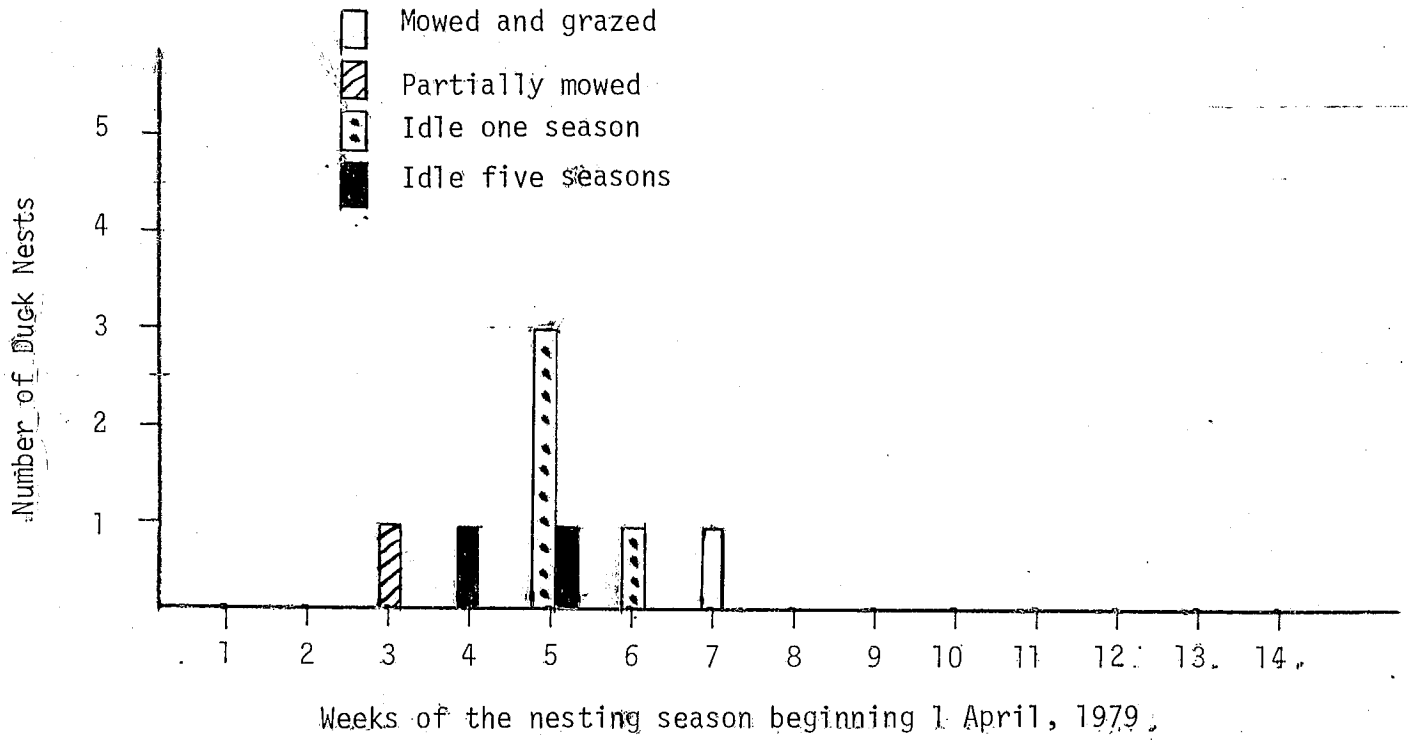


Figure 9. Dates on which the first eggs were laid in Cinnamon Teal nests on the study plots in 1979, by treatment, Malheur National Wildlife Refuge.

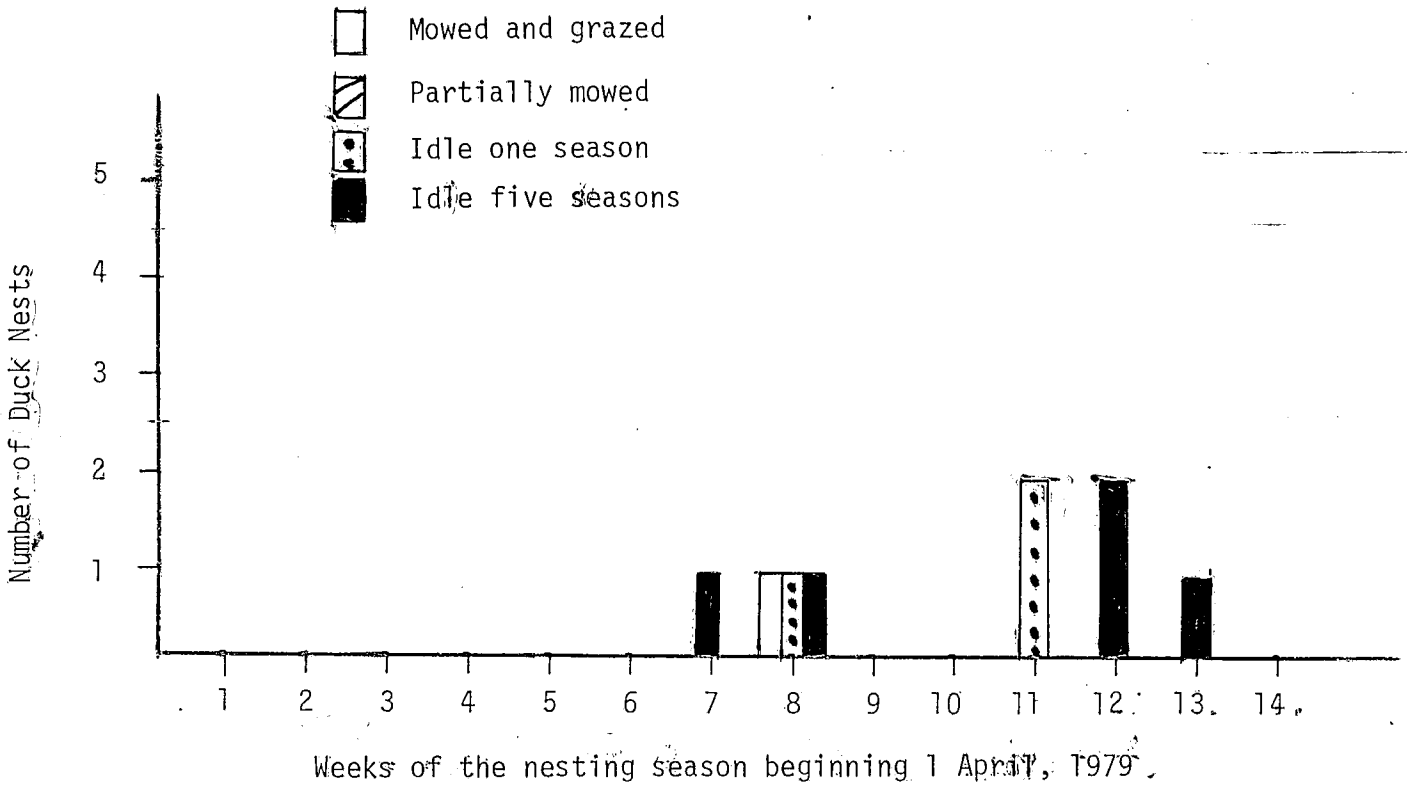


Figure 10. Dates on which the first eggs were laid in Gadwall nests on the study plots in 1979, by treatment, Malheur National Wildlife Refuge.

Table 13. Nest densities in grazed and/or mowed vegetation and idle vegetation on the study plots, Malheur National Wildlife Refuge, 1979.

	Grazed and/or Mowed Vegetation	Idle Vegetation
Area (ha)	40.3	67.7
Nests/ha	.30	.53

Nest Success

Rates of nest success varied among species of ducks and types of management (Table 14). Nests initiated prior to week 7 (13 - 19 May) had about the same rate of success as later nests (Table 15). Plots idle for five seasons showed the highest rate of nest success, while plots mowed and grazed showed the lowest rate of nest success (Table 14).

Miller and Johnson (1978) described the Mayfield method for obtaining better estimates of nesting success. Rates of nest success by the Mayfield method for all duck nests within each treatment are calculated in Table 16. Only nests found active at the time of discovery could be applied to this method. The sample size for these calculations was low (a total of 39 nests), so any conclusions from the results of these calculations should be considered tentative.

According to calculations of nesting success by the Mayfield method, the partially mowed plots had the highest rate of success while the mowed and grazed plots had the lowest rate of success (Table 16).

Table 14. Fate of duck nests found on the study area, by treatment, Malheur National Wildlife Refuge, 1979.

	TREATMENT															
	Mowed and Grazed				Partially Mowed				Idle One Season				Idle Five Seasons			
Species	N	% Success	% Destroyed	% Abandoned	N	% Success	% Destroyed	% Abandoned	N	% Success	% Destroyed	% Abandoned	N	% Success	% Destroyed	% Abandoned
Mallard	4	0	75	25	2	50	50	0	4	50	50	0	4	75	0	25
Cinnamon Teal	3	0	66.6	33.3	3	0	100	0	5	0	100	0	3	33.3	66.0	0
Gadwall	1	0	100	0	0	0	0	0	2	50	50	0	5	20	80	0
Others	7	29	71	0	2	50	0	50	2	0	100	0	10	50	40	0
All Species	15	13.3	73.3	13.3	7	28.6	57.1	14.3	13	23.1	76.9	0	22	45.5	40.9	9.1

Table 15. Fate of active nests by period of initiation[1] and treatments of the study plots, Malheur National Wildlife Refuge, 1979.

Treatment (period)	N	PERCENT									
			PREDATION BY					ABANDONED			
		Successful	Large Mammal	Small Mammal	Birds	Unknown	All Causes	Investigator	Flooding	Other	All Causes
Mowed & Grazed											
(Early)	3	0.0	0.0	0.0	100.0	0.0	100.0	0.0	0.0	0.0	0.0
(Late)	5	20.0	0.0	20.0	0.0	20.0	40.0	20.0	0.0	20.0	40.0
Partially Mowed											
(Early)	5	40.0	0.0	0.0	20.0	20.0	40.0	0.0	20.0	0.0	20.0
(Late)	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Idle One Season											
(Early)	6	16.7	0.0	33.3	16.7	33.3	83.3	0.0	0.0	0.0	0.0
(Late)	4	50.0	0.0	0.0	0.0	50.0	50.0	0.0	0.0	0.0	0.0
Idle Five Seasons											
(Early)	7	57.1	0.0	0.0	14.3	14.3	28.6	14.3	0.0	0.0	14.3
(Late)	8	25.0	50.0	0.0	12.5	0.0	62.5	12.5	0.0	0.0	12.5
All Treatments											
(Early)	21	28.6	0.0	9.5	33.3	19.0	62.1	4.8	4.8	0.0	9.5
(Late)	18	33.3	27.8	5.5	11.1	5.5	50.0	11.1	0.0	5.5	16.7

1 Early nests are nests initiated before 13 May 1979.
Late nests are nests initiated on or after 13 May 1979.

Table 16. Rates of duck nesting success calculated by the Mayfield method (Miller and Johnson 1978) by treatment, Malheur National Wildlife Refuge, 1979.

	TREATMENT			
	Mowed & Grazed	Partially Mowed	Idle One Season	Idle Five Seasons
Percent Nesting Success	8.3	22.9	14.5	20.0

Comparing rates of nesting success for all areas of grazed and/or mowed vegetation by the Mayfield method (Table 17), the rate of nest success for the idle vegetation was double the rate of nest success for the grazed and/or mowed vegetation.

Table 17. Rates of nest success calculated by the Mayfield method (Miller and Johnson 1978), on grazed and/or mowed vegetation, and on idle vegetation within the study plots, Malheur National Wildlife Refuge, 1979.

	Mowed and/or Grazed Vegetation	Idle Vegetation
Percent Nest Success	8.3	16.6

Unsuccessful Nests

The percentage of nests destroyed by predators was higher for early nesting ducks than for lake nesters, while the percentage of abandoned nests was lower for early nesters than for late nesters (Table 15).

Ravens (Corvus corax) were the major avian predators on the study area in 1979. Crows (Corvus brachyrynchos) and Black-billed Magpies (Pica pica) were present in small numbers and may have destroyed some nests. Small mammalian predators observed on the study area included long-tailed weasels (Mustela frenata) and mink (Mustela vison). Large mammalian predators included coyotes (Canis latrans), raccoons (Procyon lotor), and possibly badgers (Taxidea taxus).

Avian predators accounted for 31.0 percent of the total predation, small mammalian predators accounted for 27.6 percent, large mammalian predators accounted for 20.7 percent, and the causes of 20.7 percent could not be determined (Table 18). Avian predators were the major predators on early nests, and large mammals were the major predators on later nests (Table 15).

Table 18. Percentages of destroyed nests destroyed by different predators on the study area in 1979, by treatment, Malheur National Wildlife Refuge.

	TREATMENT									
	Mowed & Grazed		Partially Mowed		Idle One Season		Idle Five Seasons		Total	
Predators	N	Percent	N	Percent	N	Percent	N	Percent	N	Percent
Birds	4	36.4	1	33.3	2	22.2	2	13.3	9	31.0
Small Mammals	3	27.3	0	0.0	3	33.3	2	13.3	8	27.6
Large Mammals	3	27.3	1	33.3	1	11.1	5	33.3	6	20.7
Unknown	1	9.1	1	33.3	3	33.3	1	6.7	6	20.7

Ducklings Produced

Densities of ducklings produced were highest on plots idle for five seasons, and lowest on mowed and grazed plots (Table 19). Higher densities of Mallards

were produced on plots idle for one season than were on plots in the other treatments, Cinnamon Teal ducklings were produced only on plots idle five seasons, and Gadwall ducklings were produced only on idle plots (Table 19).

Comparing densities of ducklings produced in all grazed and/or mowed vegetation and all idle vegetation (Table 20), more than three times as many ducklings were produced in idle vegetation than in grazed and/or mowed vegetation.

Table 19. Numbers and densities of ducklings hatched from nests on study plots by species and treatments, Malheur National Wildlife Refuge, 1979.

	TREATMENT							
	Mowed & Grazed		Partially Mowed		Idle One Season		Idle Five Seasons	
Species	N	Ducklings/ha	N	Ducklings/ha	N	Ducklings/ha	N	Ducklings/ha
Mallard	0	0.00	8	.44	19	1.06	6	.17
Cinn. Teal	0	0.00	0	0.00	0	0.00	10	.28
Gadwall	0	0.00	0	0.00	7	.39	8	.22
Redhead	0	0.00	6	0.33	0	0.00	13	.36
Canvasback	9	.25	0	0.00	0	0.00	0	0.00
Unidentified	9	.25	0	0.00	0	0.00	35	.97
All Species	18	.50	14	.78	26	1.44	72	2.00

Table 20. Numbers and densities of ducklings produced in grazed and/or mowed vegetation and idle vegetation on the study plots in 1979, Malheur National Wildlife Refuge.

GRAZED AND/OR MOWED VEGETATION		IDLE VEGETATION	
N	Ducklings/ha	N	Ducklings/ha
18	.45	112	1.65

Discussion

The sample size of nests found in this study was low (58 nests). Any conclusions drawn from this data should be regarded as tentative.

Breeding pair counts showed Cinnamon Teal, Gadwalls, and Mallards were the most frequently recorded on the study area in 1979. Densities of breeding pairs were highest on plots idle one season (Figure 2). During week 7 (13 - 19 May), plots idle one season had breeding pair densities more than 2.5 times greater than plots under other treatments (Table 4).

Tall grass was the most frequently used nesting cover on all study plots. Ducks selected tall grass cover on the plots idle one season over tall grass on plots within the other treatments (Tables 8, 9, 10, 11).

The earliest duck nest (6 April 1979) found in this study was initiated on the idle five seasons, Knox Field (Figure 7). Ducks nested earlier and longer through the nesting season on plots idle five seasons, and ducks nested later and had a shorter nesting season on mowed and grazed plots (Figure 7).

Nest densities were highest on plots idle one season than in plots under the other treatments (Tables 7 and 12).

Plots idle for five seasons showed the highest rate of nesting success, while plots mowed and grazed showed the lowest rate of nesting success (Table 14). Using the Mayfield method for determining nest success (Miller and Johnson 1978), plots partially mowed showed the highest rate of success, and plots mowed and grazed showed the lowest rate of nest success (Table 16).

More early nests were destroyed by predators than late nests, while more late nests were abandoned than early nests (Table 15). Avian predators were the major predators on early nests while large mammals were the major predators on later nests (Table 15).

Densities of ducklings produced were highest on plots idle for five seasons, and lowest on mowed and grazed plots (Table 19).

Comparing all areas of grazed and/or mowed vegetation to all areas of idle vegetation; nest densities, nest success, and ducklings produced were higher in all idle vegetation than in all grazed and/or mowed vegetation.

LITERATURE CITED

Bellrose, F. C. 1976. Ducks, geese and swans of North America. Stackpole books, Harrisburg, Pennsylvania. 541 pp.

Clark, J. P. 1977. Effects of experimental management schemes on production and nesting ecology of ducks at Malheur National Wildlife Refuge. M. S. Thesis, Oregon State University. 65 pp.

Hanson, R. C. and A. S. Hawkins. 1975. Counting ducks in duck ponds in Prairie Canada: How and Why? Naturalist 25:8-11.

Hirst, S. M. 1975. Ungulate-habitat relationships in a South African woodland/savanna ecosystem. Wildl. Monogr. 44. 60 pp.

Miller, H. W. and D. H. Johnson. 1978. Interpreting the results of nesting studies. J. Wildl. Manage. 42 (3): 471-476.