

WATERFOWL STUDIES
ON THE LOWER SOURIS REFUGE
IN 1937

BY

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Introduction.

This report is one of a continuing study, the purposes and technique of which have already been set forth. It had its origin in Saskatchewan, Canada, in 1934; it was continued in Alberta in 1935. The results of those first two years' work have appeared in printed form, USDA Circular 433, Crow-waterfowl Relationships, under date of *June, 1937.*

In 1936 the scene of the studies was shifted to the Lower Souris Refuge in North Dakota. Their character likewise was altered and enlarged. Less exclusively a study of the relation of the crow to nesting waterfowl, it became a broad program of research into all factors and conditions that affected the welfare of nesting waterfowl, coupled with an appraisal of the wildfowl production capacities of that area. A manuscript report on the results of that year's work has been submitted.

This contribution to the continuing study discusses the results of field work of the spring and summer of 1937. In submitting it, the writer wishes to acknowledge the great help given by Mr. M. C. Hammond, Biological Aide, stationed at the Lower Souris Refuge who shared equally the duties of nest inspection and recording and at the close of the work prepared his own report on the summer's work which was transmitted to the Migratory Waterfowl Division. Two tables appearing in Mr. Hammond's report have also been incorporated in this manuscript. With respect to figures in certain other tables presented here it may be explained that they may be somewhat at variance with similar data submitted by Mr. Hammond. This has come about through a review of all original evidence and notes gathered during the past summer, resulting in some changes of interpretation here and there. In no case, however, do the altered figures greatly change the conclusions reached.

Full acknowledgement also is being made of help rendered by Mr. Henry

and the rest of the Refuge personnel as well as the C.C.C. boys, without whom only a small fraction of the nests could have been located.

Relative Abundance of Species of Nesting Ducks.

In Table 1 are presented data showing the relative abundance of the several species, as they appeared both in 1936 and 1937 on the Lower Souris Refuge. Of the six species best represented, it will be noted that the pintail, mallard, and widgeon showed increased in 1937 over 1936 while the blue-winged teal, gadwall, and shoveler were represented by relatively fewer nests. Outstanding in these fluctuations is the notable increase in the number of pintails which rose from a recorded 17.5 percent of the total in 1936 to 27.5 in the following year, thus permitting this species to displace the blue-winged teal as the leading species on the Refuge. Of interest also is the marked increase in the relative number of mallards even though this species rose only one place (5th to 4th) in the order of abundance. Of the leading species the shoveler showed the most pronounced decrease in relative abundance, its nests comprising only 10.4 percent of the total in 1937 as against 20.0 percent in 1936, with a resultant drop of this species from the second to the fifth place in order of abundance.

The early use of a nest-hunting crew in 1937 had an important influence on the marked increase in the total number of pintail nests found in that year, yet even when the results are appraised on a percentage basis it is noted that, proportionately more pintail nests were found during the period May 18 to June 19 in 1937 than in the same period in 1936. In the earlier year 23 of 85 or 27.1 percent of the nests found were of pintails while in 1937, 144 of 406, or 35.4 percent of the nests located in the same early-season period, were of pintails. It is quite possible that the pronounced shift of the duck-nesting area in 1937, discussed on page ____ also played some part in the relative abundance of the species by providing environments and nesting conditions better suited to those species that showed an increase in relative abundance. The more thorough coverage of the refuge by the nest-hunting crew in 1937 gave results that represent a truer picture than that obtained in the previous year.

TABLE I. -- Relative abundance of species of nesting ducks

1936							1937	
Number of Nests	% of Total	Order of Abundance	Species	Order of Abundance	Number of Nests	% of Total		
69	17.5	4	Pintail	1	146	27.5		
84	21.3	1	B.-w. Teal	2	93	17.5		
72	18.5	3	Gadwall	3	91	17.1		
35	9.0	5	Mallard	4	87	16.4		
78	20.0	2	Shoveler	5	55	10.4		
23	5.7	6	Widgeon	6	40	7.6		
9	2.2	8	Gr.-w. Teal	7	8	1.5		
13	3.3	7	Redhead	8	4	.8		
8	2.0	9	Canvasback	9	3	.6		
2	0.5	10	L. Scaup	10	2	.4		
0	0.0	11	G. Scaup	11	1	.2		
<u>398*</u>	<u>100.0%</u>				<u>530**</u>	<u>100.0%</u>		

 */The gross number of which complete or partial histories were obtained.

*/The number of nests at which histories were completed.

Distribution of Species on the Refuge.

A perusal of the data obtained during the seasons of 1936 and 1937 fails to disclose any marked segregation of individuals of the same species in particular areas further than ~~the fact~~ that the deep water species nested close to water channels or deeply flooded sections. Of the shoal-water species one usually found a general mixture of species in each of the major nesting areas. For instance, of the 142 nests located in the expansive area opposite Headquarters and south and southeast of Highway 14, during the summer of 1937, 57 were of pintails, 19 of mallards, 21 of gadwalls, 17 of shovelers, 14 of widgeons, and 14 of blue-winged teal. In 1936 this same area was the site of 19 nests of which 8 were of pintails, 8 of shovelers and 3 of redheads.

What was known as Brandt's field harbored, in 1937, the nests of 11 pintails, 6 mallards, 4 gadwalls, 3 shovelers, and 1 each of widgeon and blue-winged teal. In 1936 this same field contained the nests of the following: 12 gadwalls, 8 pintails, 3 shovelers, 3 blue-winged teal, 2 mallards and 1 widgeon.

In the area designated "west of patrol road", there were studied in 1937 the nests of 32 pintail, 11 mallards, 10 shovelers, 8 gadwall, 5 blue-winged teal and 2 widgeons. In 1936 this same area supported the nests of 7 shovelers, 7 pintails, 3 widgeons, 3 redheads, 2 blue-winged teal and 1 each of lesser scaup and mallard.

"Isen Island", under the conditions of extreme aridity in 1937 supported the nests of only 6 gadwalls, 4 blue-winged teal and 1 each of gadwall and widgeon. In 1936, under favorable water level conditions there were present the nests of 14 blue-winged teal, 8 gadwall, 7 pintail,

5 mallards, 4 shovelers, 3 widgeons, and 1 green-winged teal.

"Newburgh Island" harbored the nests of only 2 gadwalls, 1 shoveler and 1 blue-winged teal in 1937. In 1936 there were recorded nests of 21 shovelers, 14 gadwalls, 14 mallards, 11 blue-winged teal, 10 pintail, 3 widgeon, and 1 each of redhead, lesser scaup and green-winged teal.

In the sweet clover field west of the C.C.C. camp, where there was a greater uniformity of cover type, a similar diversity of duck inhabitants appeared. In 1937 the nests studied there consisted of 7 blue-winged teal, 3 gadwall, 3 shovelers, 2 mallards, and 1 pintail, while in the previous year there was an even greater variety of nesters, including 8 mallards, 6 gadwall, 5 blue-winged teal, 3 pintail, 3 shovelers, 1 widgeon and 1 green-winged teal.

Other instances might be cited to show that the several species of shoal-water ducks on the Lower Louris refuge are not partial to particular areas. At the present time the process of reverting to natural cover types has just started. Everywhere there is a great diversity of plant growth on nesting grounds for these species, -much of this growth being of weeds that came in with agriculture. It is possible therefore that when distinct cover types and more uniform plant associations again become established, we may find a certain segregation of species not now apparent.

Shift of Principal Nesting Areas from 1936 to 1937.

Water Levels

Hammond, in his manuscript report on the "Duck-nesting Studies on the Lower Souris Refuge, 1937," has discussed in some detail the marked shift in the location of the principal nesting areas in 1937 compared with those of 1936. This shift is clearly shown in the dual map attached to this report. Despite the fact that coverage of the areas in the two years was not identical, there is no question but that the observed shift in the principal nesting areas was a real one, and not one resulting from variations in the degree of thoroughness with which the areas were searched in the two years.

The relative scarcity of nests in 1937 in the areas known as Ison Island and Newburgh Island, it is believed was directly associated with the low water level prevailing in Unit 341 in that year. In 1936 levels were at a higher and more favorable point and created, of these two areas, two long islands bordered, on the one side, by the river and, on the other by a slough adjacent to the bluff.

Insofar as water levels may have had a bearing on the matter of nest location, those prevailing in 1937 at the southern end of Unit 326 appear to have been close to the optimum. Unit 332, as a whole, however, might be made more attractive for nesting shoal-water ducks if its water level were lowered several inches, thus producing more nesting area in Sections 29, 28, 32 and 33.

When the gates in structure 326 are eventually closed and the Unit flooded, nesting shoal-water ducks will be compelled to move southeastwardly to points where suitable sites again will be created.

The notable shift in the location of nests from the Ison and Newburgh Island areas to that near structure #326 may have had an influence on the higher degree of success attained in 1937 by its having removed many nesters from the areas mentioned which were heavily infested with skunks in 1936.

Density of Nests.

On the basis of the number of nests actually found on 1490 acres of prime nesting area on the Lower Souris Refuge in 1936 a nest density of one to every 5.8 acres was computed. Assuming that only half of the nests were found by the searching crews an estimated density for these areas of one nest for every 2.9 acres was considered a conservative appraisal. This estimate was made for limited, and what were considered the most densely populated portions of the refuge during that year. Had the estimate been extended to include the thinly populated sections, or those wholly devoid of ducks, the number of acres per nest would have been much greater.

In this connection the personal opinion of the writer was ventured to the effect that "should the time ever come when the Lower Souris Refuge (or any other similar refuge) will harbor, within its boundary, duck nests in the density of one nest per five acres the area will have reached a production capacity far beyond my expectations".

In discussing ~~our studies of~~ nest concentration in 1937 I have taken the liberty to make use of two tables prepared by Mr. Hammond, which appeared in his report. The first of these, (Hammond's Table III), table II of this report, discloses the number of nests and the acreage of five prime nesting areas of that year. In the aggregate there were 343 nests on 1360 acres of land, an average of one nest found on every 3.9 acres. If the assumption is essentially correct that, after thorough search, only half of the nests are found, these prime nesting areas would have supported, in 1937, one nest on about every two acres, as against one for about every three acres in 1937.

An appraisal of larger units of land, including nevertheless all the important nesting areas, brings forth the interesting information found in Table III (Hammond's Table I, with certain additions). Here sections or

portions of sections are used as a basis of appraisal and the same allowance is made for the number of nests overlooked by the crew. Totals at the bottom of this table show that 3560 acres of nesting ground supported 275 discovered nests, a ratio of 12.9 acres per nest, or, if half of the nests had been overlooked by the crew, a ratio of near 6.5 acres per nest.

Taking into consideration all the land of the refuge embraced in these several sections we find a total acreage of 5900 involved which supported a computed 550 nests or 1 nest for every 10.9 acres.

Table II.

(Hammond's Table III)

Nesting Concentration on Prime Nesting Areas, 1937.

Area	No. Acres	No. Nests
West of Patrol Road	230	76
Section 3 (T159N R78W), eliminating $\frac{1}{4}$ as water and under cultivation	480	167
Brandt's field	240	27
Section 2, $\frac{1}{2}$ (T159N R78W)	320	49
Area east of river and between dam #332 and highway (T161N R79W, sect.19)	90	22
	<u>1360</u>	<u>343</u>

Table 11.1

(Hammond's Table I, with additions)

Nesting Concentration on All Nesting Areas Surveyed.

Township	Section	No. acres of nesting ground in section*	Total nests found	Acres per nest found	Computed acres per nest	Total acres in Refuge boundary	Computed acres per nest	Notes
T161N R79W	13	320	7	46	23	420	30	#341 dam
T161N R79W	24	320	10	32	16	640	32	"
T161N R79W	19	320	3	107	54	320	54	"
T161N R79W	30	320	14	23	12	560	20	"
T161N R79W	31	320	6	53	27	640	53	"
T160N R79W	2	160	2	80	40	360	90	"
T160N R79W	1	200	4	50	25	240	30	"
T160N R79W	12	400	4	100	50	600	75	"
T160N R79W	13	80	2	40	20	240	60	"
T160N R78W	18	320	5	64	32	600	60	"
T159N R78W	3	480	167	2.8	1.4	640	1.9	#332 & 326 dams
T159N R78W	2	320	61	6.2	3.1	640	6.2	#326 dam
TOTALS		3560	275	12.9	6.5	5900	10.9	

* estimated

The Effect of Human Intrusion.

The possibility that intrusion by the observer may tend to increase nest destruction by predators is a matter of utmost importance in nest-history studies. It was given serious consideration both in the Canadian studies of 1934 and 1935 and in the work done on the Lower Souris refuge in 1936. In the latter year a comparison was made of the extent of damage by skunks in the nests under regular observation with the extent of similar fate at nests that had been terminated when first found and hence unaffected by the nest observing activities. Notes taken at 46 duck nests, the histories of which had been completed when discovered indicated that 39 percent of them had been destroyed by skunks. On the other hand, 30.4 percent of the nests that had been under observation were destroyed by these mammals.

During 1937 careful note likewise was kept of nests that had terminated when discovered. Of a total of 107 nests so discovered, 34 or 31.7 percent had hatched, indicating a degree of success far below that attained at the nests under regular observation where 69.3 percent were hatched.

With respect to depredations by skunks, a loss of 27.8 percent was recorded at nests terminated when found and a loss of only 6.4 percent at the nests studied. At present there is insufficient evidence on which to make any reliable deductions with respect to the effect of human intrusion on depredations by foxes, mammals that made their first noticeable inroad on duck nests on the Lower Souris refuge in 1937. It is quite possible that, in the case of predators that hunt largely by scent, we may eventually find that intrusion by observers has an influence. At present, however, the extent of fox depredations on the Lower Souris refuge is not outstanding

and until it does reach larger proportions, the effect of such intrusion will have little effect on the duck population as a whole.

At present we have before us the results of two years' comparative appraisal of the fate of nests under observation with those that had terminated before the observer had discovered them. In each case evidence pointed to a greater degree of destruction at the latter group of nests and in 1937 the difference was marked.

Whether we are warranted in accepting this evidence as thoroughly convincing and applicable still is open to some question. This is brought about by the fact that destroyed nests usually are more conspicuous than those at which there has been a successful hatch. The scattered egg shells and the disrupted nest and down are more readily caught by the eye than the nest from which the young have left in a normal manner and in which the egg shells may be nearly as well concealed as before the hatch. Possibly a careful check at the close of the nesting season of all nests in an area selected as being comparable to one on which nest studies are being conducted will give a better answer to the effect of intrusion by observers. Such a program can be carried out satisfactorily only with the aid of crews carefully searching every square yard.

Results of Nest Observations

In 1937 a total of 572 duck nests were under observation on the Lower Souris Refuge. At 566 of these nests histories were completed and the data there obtained from the basis of discussion for most of this report.

In table IV is presented in condensed form an analysis of the fate of these 566 nests with similar data obtained from 351 nests studied on the same area in 1936.

Hatchings. -- Hatchings took place at 392 of the 566 nests (69.3 per cent), indicating a substantial improvement over the hatchings of the previous year (544 per cent). In recording success at these nests it must be explained that not all the eggs present in these "successful" nests produced young. There were cases of infertility, embryos dying, losses of one or more eggs to predators, accidental breakage and other factors that tended to keep the results even at "successful" nests something less than 100 per cent hatch of the eggs laid.

In the 392 successful nests a total of ~~3230~~⁴⁵⁰⁵ eggs were laid of which 2850, or 88.5 per cent, produced young. The loss of 11.5 per cent of the eggs in successful nests was somewhat greater than that recorded in the successful nests in 1936 when an egg loss of 9.6 per cent was noted. ~~See~~
~~table~~

Appraising the results of the season's hatch on the percentage of young produced from all eggs laid (both in successful and unsuccessful nests) a hatch of 2850 out of 4505 eggs, or a percentage ⁸⁰63.3, was recorded. Fate of the eggs laid by the various species is presented in Table V, where it will be seen that the success of the six best-represented species as determined by the percentage of eggs hatched, follows closely the results obtained by appraising the success or failure of the nest as a unit. (Compare with Table IV.)

Table 2K. Outcome of 566 duck-nest histories recorded on the Lower
Souris Refuge in 1937 compared with similar data obtained in 1936 on the same
Refuge.

Outcome	Number (1937)	Percentage (1937)	Number (1936)	Percentage (1936)
Hatched (some with reduced broods)	392	69.3	191	54.4
Destroyed by skunks	36	6.4	107	30.4
Destroyed by crows	20	3.5	6	1.7
Destroyed by foxes	12	2.1	*/	*/
Destroyed by miscellaneous causes	7	1.2	3	1.0
Destroyed by unknown causes	51	9.0	25	7.0
Deserted	44	7.8	12	3.4
Unknown fate	4	.7	7	2.0
Totals and averages	566	100.0	351	100.0

*/ No definite evidence of destruction by foxes was recorded in 1936.

Destruction by Skunks.--- Returning now to further consideration of the data in Table IV, it will be noted that, although the single outstanding predator of 1936, the skunk, still held that position in 1937, its destructiveness was considerably lowered. Only about $6\frac{1}{2}$ per cent of the nests were destroyed by skunks in 1937 as against 30.4 per cent during 1936. One, and possibly two, circumstances may have contributed to this lessened skunk pressure. One was the removal by trapping during the fall, winter, and early spring of 1936-37 of 42³ skunks from portions of the Lower Souris Refuge. This was done with the definite purpose of learning, experimentally, what effect such trapping would have on waterfowl production.

The other factor having a possible bearing on lowered skunk pressure is the fact that two expansive areas known as Ison Island and Newburgh Island which harbored most of the nesting ducks in 1936, were only sparsely populated in 1937. It was there where much of the destruction by skunks took place in the earlier year.

On Ison Island these egg-eating mammals had destroyed more than 57 per cent of the 42 duck nests in 1936. In 1937 there was only a scant dozen nests located on Ison Island. In the other area, located on the west side of the Souris River and extending from the Soo Line Railroad bridge north to the Newburgh Bridge 77 nests were studied in 1936, of which 33.8 per cent were destroyed by skunks. In 1937 only 7 nests were found there.

One cannot therefore fully evaluate the benefits of skunk control until more nearly comparable areas and similar conditions of duck distribution present themselves. By all means the experimental control of skunks and pertinent nest observations should be continued at this refuge.

Table V. Fate of the eggs laid by various species of ducks, including those in both successful and unsuccessful nests.

	Eggs laid	Eggs Hatched	Eggs destroyed or failing to hatch	Percentage producing young
Pintail	1005	613	392	61.0
Blue-winged teal	852	640	212	75.1
Gadwall	753	533	220	70.8
Mallard	669	373	296	53.3
Shoveler	497	290	207	58.3
Widgeon	301	187	114	62.1
Green-winged Teal	70	38	32	54.3
Redhead	36	10	26	27.8
Canvasback	38	5	33	13.2
Lesser Scaup	16	16	0	100.0
Greater Scaup	10	10	0	100.0
Unidentified ducks	258	135	123	52.3
TOTAL	4505	2850	1655	63.3

Destruction by crows. -- An increase in the percentage of nests pilfered by crows in 1937 (3.5 as against 1.7 in 1936) apparently is a reflection of a lessened effort made to keep these birds under close control. The shift in the nesting area also may have had some effect as has been surmised in connection with skunk depredations. Even with the decreased attention being paid to the control of crows this year, their depredations were not outstanding on the Lower Souris Refuge. A real test of the importance of crows in waterfowl production on this Refuge will come only when water-supplies will permit the flooding and the occupation by ducks of areas close to timbered tracts in the southern part of the refuge.

Destruction by Foxes. -- Although foxes were known to be present on the Lower Souris Refuge in 1936, no one connected with the nest studies in that year had seen any fox during the summer season. Neither was any incriminating evidence uncovered to indicate that these mammals were feeding on duck eggs. During the winter of 1936-37, however, a number were trapped on and about the refuge and throughout the summer of 1937 red foxes and their tracks were seen frequently, both by those conducting these studies and others working on the refuge. One den containing 5 pups was found in an area where many ducks had nested in 1936 (Newburgh Island). It was the consensus of opinion of residents in the vicinity of the refuge that foxes were increasing.

The evidence on which the destruction of 2.1 percent of the nests is credited to foxes is, because of the difficulty of identifying their tracks and signs in a marsh area, not as reliable as it might be. Circumstantial evidence and the frequency of certain types of nest-destruction found in areas where foxes were known to exist had a bearing on the decisions. The total absence of tracks on other signs or egg shells, with little or no disruption of the nest down, came to be looked upon with suspicion in areas where foxes had been seen. The tendency of a young captive fox, at refuge headquarters, to carefully pick up hens' eggs and remove them to a corner where they were buried without being

broken strengthened the belief that red foxes were to blame for egg removal at nests where there were no conspicuous signs nor other incriminating evidence.

An attempt to apprehend the predator in this type of destruction by means of a photographic flash-light apparatus was conceived too late in the season to be used during the period when such depredations prevailed.

Destroyed by Miscellaneous Causes. -- Seven of the 566 nests (1.2 percent) were destroyed by a variety of miscellaneous causes. In two instances the eggs were accidentally stepped on by the observers seeking the location of the nest; livestock trampled another ^{nest} and a truck ran over a fourth. A mink killed the incubating female of one nest; a rise in water level flooded one nest; and a community nest into which fully 20 eggs were laid was the interpretation placed on the last of these nests that came to naught for miscellaneous reasons. Even in the aggregate these factors have no material bearing on the general welfare of waterfowl on the Lower Souris Refuge and in the two years of study they held about the same insignificant position.

Destroyed by Unknown Causes. -- The proportion of nests falling in this category in 1937 (9.0 percent) is slightly greater than the similar group of the preceding year. This circumstance may have its origin in the fact that much uncertainty was attached to the work of foxes in the latter year. Besides instances of suspected but undemonstrated destruction by foxes ^{which} ~~that, of necessity,~~ had to be placed in the class of "destroyed by unknown causes", there were similar cases in which the evidence pointed vaguely to the work of skunks or crows.

Deserted Nests. -- An increase in the percentage of nests deserted (7.8 percent as against 3.4 percent in 1936) appeared to be largely attributable to a severe wind and rain storm that swept the area from June 3 to June 6. From 4-5 inches of rain fell during this period while high north winds prevailed throughout.

As Hammond has computed* "It was found that 17 nests were destroyed directly or indirectly by this one storm.*** At 24 other nests there had been predator destruction of some sort by the time of our first visit after the storm. It is plausible to assume that many of these nests were deserted during the storm and left exposed to predators."

Because of an inability to determine what happened prior to destruction by a predator it is not unreasonable to conclude that a portion of the nest destruction credited to predators may in fact have been nothing more serious than a cleanup of eggs that were destined to decay in the deserted nest. That is one of the recognized weaknesses of nest-history studies, however worthwhile and enlightening they may be otherwise.

Unknown Fate.--With a limited number of nests circumstances so shaped themselves that the fate of the nest, whether it had been destroyed or a hatch had resulted, could not be told. This occurred usually when a considerable interval of time had lapsed between the termination of the nest history and the making of the final observation. The few nests so involved and the variety of fates that might have befallen them makes this group of nests of little concern in this analysis.

* M. C. Hammond: Manuscript report on Duck-nesting Studies on the Lower Souris Refuge, 1937.

Fate of the Nests of the Various Species

Analysis of the fate of nests by species brings to light some facts that are of particular interest when comparisons are made between the results obtained in 1937 with those obtained on the same area in 1936. Although in ^{the} former years the six best represented species, when placed in the order of their success in hatching, were the gadwall (64.0% hatch), pintail 62.7%), Shoveler (58.9%), widgeon (58.0%), mallard (46.9%), and blue-winged teal (35.1)%, in 1937 the order was markedly different. (See Table VI)

From the standpoint of success in producing young the blue-winged teal, last in 1936, now occupied first place with hatchings taking place at 80.5 per cent of the nests. The gadwall, most successful in 1936, was second with a 75.8% hatch. The widgeon, 4th in 1936, was third with a hatch at 72.5% of its nests. The pintail, second in 1936, was fourth (67.8%); the mallard (62.2% hatch) was fifth as in the preceding year; and the shoveler, third in 1936, was the last of the six best represented species with hatchings taking place at 61.9% of its nests.

Subjecting the data to further analysis one is led to believe that the marked improvement in the success of the blue-winged teal in 1937 over 1936 was due to reduced skunk pressure. In the former year the blue-wing suffered heavily, losing 48.0% of its nests through predation by skunks, while in 1937 only 5.4% met that same fate. This reduced skunk pressure no doubt came about through control operations carried out on parts of the refuge in the fall and winter of 1936-37 and, possibly also by the fact that lowered water levels in 1937 forced many ducks out of certain areas heavily infested by skunks in 1936. In 1936 heaviest skunk pressure was experienced by ducks

nesting on Ison Island (57.1% loss) and Newburgh Island (38.8%). In these two areas a total of 119 nests were under observation in 1936; in 1937 only 16 nests were located in these same areas.

Aside from the marked improvement in the welfare of the blue-winged teal in 1937, the variations disclosed in the fate of nests of the several species in the two years, probably would fall within the range of normal fluctuations from year to year and hence may not call for explanation. Continued study on the Lower Souris Refuge will eventually establish this fact.

Table V. Résumé of the Results of Nest-history Studies on the Lower Souris Refuge (1937).

Arranged by Species

Species	No. of Nests	Hatched	Destroyed by crows	Destroyed by skunk	Destroyed by fox	Destroyed by misc. causes	Destroyed by Unknown causes	Deserted	Unknown Fate
Pintail	146	99-67.8%	3-5.5%	7-4.8%	2-1.4%	0-0.0%	16-10.9%	12-8.2%	2-1.4%
Blue-winged Teal	93	75-30.6%	1-1.1%	5-5.4%	1-1.1%	3-3.2%	4-4.3%	4-4.3%	0-0.0%
Gadwall	91	69-75.8%	0-0.0%	6-6.6%	2-2.2%	0-0.0%	7-7.7%	6-6.6%	1-1.1%
Mallard	87	54-62.2%	3-3.4%	7-8.0%	4-4.6%	0-0.0%	11-12.6%	3-3.4%	0-0.0%
Shoveler	55	34-61.9%	6-10.9%	2-3.6%	2-3.6%	1-1.8%	4-7.3%	5-9.1%	1-1.8%
Widgeon	40	29-72.5%	0-0.0%	2-5.0%	0-0.0%	0-0.0%	2-5.0%	7-17.5%	0-0.0%
Green-winged Teal	3	6-	0-	1-	0-	0-	1-	0-	0-
Redhead	4	2-	0-	0-	0-	1-	0-	1-	0-
Canvasback	3	1-	0-	0-	0-	1-	0-	0-	0-
Lesser Scaup	2	2-	0-	0-	0-	0-	0-	0-	0-
Greater Scaup	1	1-	0-	0-	0-	0-	0-	0-	0-
Unidentified Ducks	36	20-	2-	0-	1-	1-	5-	1-	0-
	566	392-69.3%	20-3.5%	29-5.1%	12-2.1%	7-1.2%	51-9.0%	44-7.8%	4-.7%

Comparison of Early and Late Nestings.

Earlier work in Canada, reported upon in Circular 433, and that done on the Lower Souris Refuge in 1936 disclosed a lessened pressure by predators and other factors on nesting ducks during the latter half of the nesting season. In the Canadian studies (1934-35) explanation of this was apparent in the lessened pressure by crows which had forsaken the nesting environment of ducks and were securing food for themselves and their young in grain stubble and hay fields.

A decrease in the pressure exerted by skunks, the leading predator, on the Lower Souris Refuge in 1936, also was noted during the second half of that season and miscellaneous and unknown suppressive factors likewise became less potent as the season advanced. The crow, accountable for only limited nest destruction in that year (1.7%), maintained an equal pressure throughout the season, while the factor of desertion was responsible for an increase (4% as against 2.8%) in nest destruction during the second half of that year.

In 1937, with its more favorable nesting conditions, an increase in the success of nests again was noted as the season advanced. (see table VI) With the exception of slight increases observed under the categories of nests destroyed by miscellaneous causes and those deserted, a uniform improvement with respect to wildfowl production was noted ~~throughout~~ with the advance of the season. Crows again revealed their pronounced tendency toward early-season pressure and skunks and foxes, reacted similarly but to a less marked degree. The 321 nests segregated in the second half of the season disclosed a hatching percent of 78.8 as against 69.3 for the 566 during the entire season and 56.8 for the 245 nests that terminated during the first half.

Table Viii. Comparison of Early and Late Nestings.

In segregating these data a division was made at about midway (end of June 24) in the period (May 11-August 6) during which nest histories were being terminated. In each instance the termination (rather than the discovery) date of the nest was used to place it in its respective group.

	First Half of Season (Through June 24)		Second Half of Season (After June 24)	
	No.	Percent	No.	Percent
Hatched	139	56.8	253	78.8
Destroyed by crows	19	7.7	1	0.3
" " skunks	19	7.7	17	5.3
" " foxes	9	3.7	3	0.9
" " miscellaneous				
causes	5	1.2	4	1.3
" " unknown cause	34	13.9	17	5.3
Deserted	19	7.7	25	7.8
Unknown fate	8	1.2	1	0.3
Totals	245	100.0%	321	100.0%

Relation of Concealment to the Fate of Nests.

Data obtained in Canada in 1934 and 1935 indicated that, at least under the conditions prevailing there, the factor of adequate concealment played no favorable role in the protection of nests against predator attack or other misfortune. In fact nests "poorly" concealed were more successful than those possessing "fair", "good", or even "excellent" concealment.

On the Lower Souris Refuge in 1936, however, results that might be considered more logical were obtained. The poorly concealed nests fared the worst with respect to successful hatching while those excellently concealed produced the greatest number of young. Nests having "fair" and "good" concealment, held intermediate positions with respect to success in hatching.

Analysis of the element of concealment as revealed in the data obtained on the Lower Souris Refuge in 1937, a year in which nestings were generally more successful, gave indication of only limited and not thoroughly consistent benefits. From Table VIII it will be seen that in that year, 68 per cent of the poorly concealed nests produced young birds while those excellently concealed were only slightly more successful (72%).

View^{ed} from the angle of nests destroyed by various agencies it would seem that (although based on limited data) destruction by crows was more prevalent among the less effectively concealed nests. With respect to destruction by skunks the reverse was true but not in emphatic terms. Losses by unknown causes were more prevalent among the poorly concealed nests while those deserted failed to show any advantage accruing by reason of concealment. On the whole the results obtained in 1937 produced nothing particularly convincing with respect to the advantages accruing to nesting ducks by reason of adequate concealment, as appraised through human eyes, and according to human standards.

They might be considered more logical than the unusual and unexpected results secured in Canada in 1934 and 1935 yet they did not indicate the apparent advantages of concealment disclosed in the studies of 1936 on the same area. (See Table VIII). All in all, our work has not shown that the element of abstract concealment, concealment as indicated by viewing the nest from point above or from a point to one side yet at an altitude of several feet plays an important part in the fate of the nest. Possibly further studies, creating other standards more adequately descriptive of the element of concealment as it affects the welfare of nests, will bring to light more ^a consistent formula with which to appraise its role.

Table V. Relation of Concealment to the Fate of Nests

A comparison of the data obtained on the Lower Souris Refuge in 1936 and 1937 with that secured in Canada in 1934 and 1935. Percentages have been adjusted to the nearest whole digit.

	Total No. of nests			Percentage Hatched			Percentage des- troyed by crows			Percentage des- troyed by skunks			Percentage des- troyed by un- known cause			Percentage deserted			Percentage misc.fates		
Degree of Concealment	Canada '34-'35	Souris '36	Souris '37	Canada '34-'35	Souris '36	Souris '37	Canada '34-'35	Souris '36	Souris '37	Canada '34-'35	Souris '36	Souris '37	Canada '34-'35	Souris '36	Souris '37	Canada '34-'35	Souris '36	Souris '37	Canada '34-'35	Souris '36	Souris '37
Poor	137	71	97	63	52	68	25	3	4	0	27	6	7	11	11	3	1	7	4	6	4
Fair	126	128	222	42	55	68	30	2	4	0	23	6	14	3	12	10	4	7	4	3	3
Good	175	135	189	40	54	73	35	2	2	0	35	7	14	4	6	10	4	8	1	1	4
Excellent	57	17	61	54	65	72	32	0	2	0	29	7	7	0	5	7	6	13	0	0	1

Degree of Concealment Sought by Several Species

The pintail is notoriously careless or unconcerned with respect to its nest concealment; while the blue-winged teal (at least the late nesters of this species) avail themselves of this element of protection to a high degree. These single facts impress themselves on even casual observers of nesting ducks.

Table IX shows the number and percentage of nests of six species of puddle ducks, pintails, mallards, shovelers, widgeons, gadwalls, and blue-winged teal, classified under the categories of poor, fair, good and excellent with respect to their concealment. In this same table comparison also is made of these appraisals recorded in 1936 with similar ones made in 1937. An indication of a general improvement in concealment in 1937 over that prevailing in 1936 is reflected in the percentages of poorly concealed nests recorded for each of the six species in these two years. In each instance a lower percentage of poorly concealed nests was recorded in the later year. With respect to nests possessing "fair" and "good" concealment the records for the two years indicate an improvement in some instances and the reverse in others. Such was to be expected with these groups of nests possessing intermediate degrees of concealment. At the other extreme, the nests possessing excellent concealment gave indication of improvement (higher percentage) in 1937 over 1936 with every species except the mallard where the issue may have been distorted by a paucity of material.

In order to present a single, aggregate evaluation on the element of concealment as resorted to by several species of ducks, arbitrary values of 1, 2, 3, and 4 were assigned to nests with poor, fair, good, and excellent concealment, respectively. This was done with nests of each of the six species under discussion and well represented by material studied on the Lower Souris Refuge both in 1936 and 1937. On the basis of such an evaluation the mathematical

TABLE IX.--Degree of nest concealment sought by six species of ducks on Lower Souris Refuge
(1936 and 1937 compared)

Species	Degree of Concealment									
	No.		Poor		Fair		Good		Excellent	
	1936	1937	1936	1937	1936	1937	1936	1937	1936	1937
Pintail	59	146	24-40.6%	53-35.8%	20-33.8%	69-48.0%	15-25.4%	20-13.5%	0- .0%	4-2.7%
Mallard	32	87	9-28.1%	18-20.2%	15-46.9%	37-42.2%	5-15.6%	30-35.3%	3-9.4%	2-2.3%
Shoveller	73	58	11-15.1%	7-13.5%	32-43.8%	25-45.6%	28-38.4%	16-26.7%	2-2.7%	8-14.2%
Widgeon	19	40	3-15.8%	5-12.5%	8-42.1%	13-32.5%	7-36.8%	17-42.5%	1-5.3%	5-12.5%
Gadwall	64	86	6- 9.4%	2- 2.3%	23-35.9%	41-47.7%	32-50 %	25-28.9%	3-4.7%	18-20.9%
Blue-winged Teal	77	93	10-13.1%	2- 2.2%	21-27.3%	22-22.8%	39-50.6%	49-53.3%	7-9.1%	20-21.7%

expression of the average concealment of the nests of the several species has been presented in Table _____. A comparison of the results obtained in the two successive years is offered.

Two facts of interest reveal themselves in this condensed appraisal of average concealment. One is that the value of the average nest concealment for each of the six species is higher in 1937 than in 1936 with the exception of the pintail, in which case there is little variation. The other fact worthy of note is that the order of the species, arranged with respect to their nest concealment evaluation is the same in the two years. (The concealment of the shoveler and widgeon, however, have the same valuation in 1936).

The utter disregard for the element of concealment on the part of many pintails and the diminutive size of nests of blue-winged teal are factors that will tend to place these two species at opposite ends of any similarly arranged series in many localities. That the lack of concealment in nests of pintails is a reflection of a specific⁶ trait and not entirely the result of early season lack of cover was repeatedly brought out whenever pintails nested late or were engaged in a second attempt to reproduce. They consistently paid less attention to the matter of adequate cover than the other species studied.

Table ~~X~~. Mathematical expression of aggregate concealment of nests
of six species of ducks (1936 and 1937 compared).*

1936			1937	
No. Nests	Av. Concealment		No. Nests	Av. Concealment
59	1.35	Pintail	146	1.83
32	2.06	Mallard	87	2.22
73	2.31	Shoveler	55	2.55
19	2.31	Widgeon	40	2.64
64	2.50	Gadwall	91	2.77
77	2.56	Blue-winged Teal	93	3.01

* To express mathematically the aggregate concealment factor for each of the species, arbitrary values of 1, 2, 3 and 4 were assigned, respectively to nests with poor, fair, good and excellent concealment

Environment and the Fate of Nests.

A second year's study of the relationship of local environment and the fate of nests has tended to complicate, rather than simplify deductions in that direction. In 1936 separate appraisals were made of the fate of nests on (1) Ison Island, (2) Newburgh Island, (3) other island marsh and river-bank environments, (4) sweet clover fields, and (5) other mainland environments. Analysis of the results indicated that greatest success in hatching was had at nests located in sweet clover fields (74.0%) and greatest misfortune befell those on Ison Island.

In 1937 the areas studied, seven in all, were as a rule more precisely defined. These are listed in Table XL. In making the comparisons between 1936 and 1937, set forth in this Table, reference has been made to the original notes on the nests recorded in these respective areas in 1936 and 1937.

Analysis indicates that the outstanding characteristic of those comparisons is the inconstancy and irregularity of the nest fates in the two years on the same areas. In 1936, the lowest degree of success was had at nests located on Ison Island (38.1% hatch); in 1937, the 12 nests studied there disclosed the highest degree of success in any of the areas (91.7% hatch). On the other hand, next to the lowest degree of success in 1937 was had at nests located in Brandt's field (39.3% hatch); in the previous year success was unusually high (87.0%) in this same area. In this particular instance it is felt that the inroads of foxes were responsible for much of the loss in 1937. Even in the area where the degree of success was most nearly uniform (clover field west of C.C.C. camp) there was an 8% increase in successful hatch^{in 1937}.

Turning now to destruction by skunks, the outstanding hazard confronting the ducks on the Lower Souris Refuge in 1936, we find on Ison Island

a reduction of the loss from 57.1% to 3.3%. This was true despite the fact that control operations against skunks in the winter of 1936-7 were not carried out in this area. On Newburgh Island there was a reduction of losses by skunks from 33.8% of the nests in 1936 to none in 1937 (based on only 4 nests studied). However, it may be pointed out that there was a measure of consistency in the comparison of the skunk damage in the two years in these several areas in that, with the exception of one (the Skaar property) there was a decrease in 1937.

Notwithstanding the irregularities that have characterized these comparisons and made logical deductions difficult, they do, it is felt, emphasize one consideration of utmost importance ~~in these studies~~ and that is the danger of drawing sweeping conclusions from limited data. With such variations occurring on the same local areas in successive years, the hazards of predicting results or making specific recommendations for the betterment of wildfowl *on the basis of one year's study become apparent.* ~~through the control of predators become apparent.~~ In the light of the present status of our studies we can at least make one sound recommendation, and that is, to continue this research for a period of years on the areas already selected to determine more nearly a mean ~~with~~ with respect to some of the highly variable elements that have been disclosed.

TABLE X .--Environment and the Fate of Nests, 1936-1937.

Localities	Number of Nests		Percentages Hatched		Percentages destroyed by skunks		Percentages destroyed by crows		Percentages deserted		Percentages destroyed by misc. causes	
	1936-1937		1936-1937		1936-1937		1936-1937		1936-1937		1936-1937	
Ison Is.	42	12	38.1	91.7	57.1	8.3	0.0	0.0	2.4	0.0	2.4	0.0
Newburgh Is.	77	4	54.5	75.0	33.8	0.0	0.0	0.0	3.9	0.0	7.8	25.0
Brandt Field	23	28	87.0	39.3	8.7	7.1	0.0	7.1	0.0	7.1	4.3	39.4
West of Patrol Rd.	21	74	42.8	56.8	28.6	14.8	4.8	8.1	4.8	12.2	19.0	8.1
Across from Headquarters (Part of area)	16	50	87.5	76.0	12.5	0.0	0.0	0.0	0.0	12.0	0.0	12.0
Skaar Property	20	8	60.0	37.5	15.0	25.0	5.0	0.0	10.0	0.0	10.0	37.5
Clover Field W.of Camp	12	25	66.7	72.0	25.0	12.0	0.0	0.0	0.0	12.0	8.3	4.0

Number of Eggs per Set and Ducklings per Brood

Table No. XII presents data pertaining to the size of completed sets of eggs of the various species and permits comparison with similar data obtained in Canada in 1934-35 and on the Lower Souris Refuge in 1936. In the present year's study on the Lower Souris Refuge we may consider that only the pintail, blue-winged teal, gadwall, mallard, shoveler, and widgeon are sufficiently well represented to permit reliable deductions with respect to the size of the sets of eggs. Even among these six species one may find considerable variation in the size of sets from year to year. In only two of the six, those of the pintail and mallard, did the sets average larger in 1937 than in 1936. Tending to offset this decrease in the production of eggs by individual ducks is the fact that, on the basis of hatchings, the birds were appreciably more successful in the latter year.

The widgeon showed the greatest variation in the size of egg sets studied in 1936 and 1937. Sixteen sets observed in 1936 averaged 9.06 per set while 29 noted in 1937 averaged only 7.55. On the other hand, the shoveler and the blue-winged teal deviated ^{little} in the average size of their sets of eggs in the two years.

What causes fluctuation in the size of the sets of eggs of the same species in the same area on successive years is not clear. Slight variations may be attributed to the inevitable differences that exist between any two groups of even very similar individuals. Possibly the reduction in the average number of eggs in the sets of widgeons previously alluded to may fall within the range of individual variation that may be expected. Only continued research of a similar character extended over a period of years will determine this fact. Certainly one cannot forcefully contend from this year's data that the reduction in the size of the sets of eggs is a reflection of the

increased desertion of flooded nests resulting in second layings of fewer eggs since the two species most likely to resort to this practice, the pintail and the mallard, both showed increases in the size of sets of eggs.

Brood counts on the Lower Souris Refuge, though not especially reliable because of the tendency towards "scrambling" of the young in this expansive area, show, with few exceptions, a reduction from the numbers recorded in the completed sets of eggs of the respective species. (See right hand column in Table XII).

Table III. Number of Eggs per Set and Ducklings per Brood.

Species	Canada, 1934-5		Lower Souris, 1936		Lower Souris, 1937*		Brood count 1937
	No. of Sets	Av. per Set	No. of Sets	Av. per Set	No. of Sets	Av. per set	
Pintail	39	6.99	36	6.77	118	7.18	4.90
B.-w. teal	41	10.75	45	9.44	83	9.37	6.74
Gadwall	19	10.06	52	9.15	77	8.33	7.71
Mallard	141	8.05	23	7.74	66	8.09	6.83
Shoveler	22	7.85	47	9.35	42	9.30	6.23
Widgeon	3	6.99	16	9.06	29	7.55	7.66
Gr.-w. teal	norecord		4	9.00	5	9.20	**/
Redhead	7	10.13	7	10.30	4	9.00	7.55
Canvasback	21	9.16	5	11.80	2	9.00	6.70
L. Scaup	59	8.46	2	10.00	2	8.00	**/
Gr. Scaup	Norecord		no record		1	10.00	**/
Totals and Averages for all species	352	8.71	237	9.26	429	8.64	

* / Data for 1937 ^{were} taken from report of ^{M.} J. C. Hammond, who assisted in the work.

** / Data insufficient for reliable deductions.

Notes on Skunks and Red Foxes

During the fall, winter and spring of 1935-36, a campaign of mammalian predator control was carried out on portions of the Lower Souris Refuge as part of a general program of management studies from which, it is hoped, more will be learned of the ultimate effect of such handling on the wildfowl production possibilities of the refuge. These mammals were taken largely from an area extending from the Newburgh Bridge south to dam #320. Few or none were removed during the winter from the Ison Island area where, in 1936, there was a loss of 57.1 percent of the nests due to skunks yet in 1937, with no skunk control in that area, there was only an 8.3 percent loss from the same cause. The appended Table XII, showing the catch of skunks and other potential predators on the Refuge, has been compiled from the monthly reports of Mr. C. J. Henry, Refuge Manager.

In only one of the areas compared in Table XIII (the Skaar property) was there an increase in destruction by skunks in 1937 over that in 1936; in some instances the reduction of such damage was outstanding. It is true that the 4 nests observed on Newburgh Island in 1937 is too limited a number from which to make deductions. Had there been more nests, increased skunk depredations might have been revealed. Next to Ison Island, this area gave evidence in 1936 of the greatest destruction by skunks of any area on the Refuge.

With the evidence now available it would appear that removal of the 423 skunks between the nesting seasons of 1936 and 1937 has had a beneficial effect on the nesting of ducks. Whether excessive aridity also tended to drive these mammals out in 1937 or whether the season of 1936 was merely one of excessive abundance remains to be demonstrated by future work.

Further comments on the food habits of skunks on the Lower Souris Refuge will be submitted when stomach material collected has been examined.

A total of 4 red foxes were removed from the Refuge (1 in February, 2 in March and 1 in June), and it was evident to those who spent much time in the field that these mammals were considerably more common in 1937 than in 1936. At no time was incriminating evidence against the fox disclosed in 1936, but in 1937 some positive and considerable circumstantial evidence was brought to light. Removal of eggs without the attendant disruption of the nest so characteristic of skunk work was often considered to be the work of foxes. In a few instances the tracks of foxes were associated with egg removal of this kind. In the area known as Brandt's field, destruction of this kind was prevalent though, in most instances the incriminating evidence rested merely on the knowledge that it was not done by crows or skunks and that foxes were known to be present.

A fox den located near the old La Porte ranch house was occupied by at least five pups on June 10. About the entrance of this den were remains of the following mammals and birds; 13 white-tailed jackrabbits, 1 mink, 1 muskrat, 1 skunk, 1 Richardson's ground squirrel, 2 mallards, 1 blue-winged teal, 1 green-winged teal, 1 pintail, 1 shoveler, 1 coot, 1 pheasant, 1 Hungarian partridge, 1 red-winged blackbird, 1 grebe (sp.), 1 finch, 1 shorebird.

Of interest in connection with attempts to identify the work of foxes in the field were observations on a captive red fox kept at headquarters. This animal, a young female, repeatedly would pick up a hen's or duck's egg dropped onto the straw of its cage and carry it to a corner where it was buried, to be eaten at some later time. The trait of consistently removing the eggs, without breakage, and transporting them to a distant point may be a reflection of the suspected habits of wild foxes in the field, where numerous empty and undisturbed nests were encountered. Another odd mannerism of this captive fox came to light when an egg yolk in a cup was placed in her cage. She picked up the cup by the handle, carried it around her cage, then set it down and lapped up the contents.

TABLE 13.--Predators Removed from Lower Souris Refuge.November 1936 to June 1937

	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	Totals
Skunks	127	52	0	4	113	50	43	34	423
Weasels	54	45	4	14	15	5	2	7	146
House Cat	23	11	0	0	3	4	0	0	41
Mink	2	16	1	0	1*	0	0	0	20
Coyote	1	4	2	2	0	0	0	0	9
Fox	0	0	0	1	2	0	0	1	4
Common rat	2	1	0	0	0	1	1	0	5
TOTALS	209	129	7	21	134	60	46	42	658

 */ Accidentally caught in skunk trap.

Stomach Material Collected.

Of the predators collected on the Lower Souris Refuge during the winter of 1936-37 and the spring and summer of 1937, stomachs were saved of 56 skunks, 4 mink, 12 weasels, and 47 crows. These will be examined and a report thereon submitted as an appendix to this report.

Suggestions for Continued Research in 1938.

In looking forward to future research in this field during 1938 emphasis should be laid on the necessity of continuation on the Lower Souris Refuge where a substantial start has been made.

It is only by study for a period of years on the same areas that we will be able to appraise the element of seasonal variation that enters into so many of the problems arising. Although we should look forward to research in other areas, to neglect or interrupt the work on the Lower Souris during the next few years would result in the loss of much information that never could be secured in the future. This refuge is now undergoing changes in its reversion to nearly a primitive condition after years of agricultural development,--a transformation which will never be witnessed again and which does not have a counterpart either at Bear River, or Tule Lake. On portions of Malheur a somewhat similar reversion is under way,--an argument for the instituting of nesting studies there in 1938.

With a view of obtaining a broader picture of conditions affecting wildfowl, one that would reflect more nearly a continental-wide aspect, it is hoped that our program may be extended to cover similar studies at Bear River Refuge and Lake Malheur Refuge with possibly some work being done at Tule Lake, Calif. if the number of nesting birds are sufficient and a research assistant is available. In anticipation of this enlarged program steps have been taken to have printed notebook sheets that will assure the recording of data similar in character at all points - thus permitting the segregation or comparison of information obtained on the several refuges. Plans also are being made for the manufacture of a number of range finders for nest locating and mapping purposes.

To carry out this program will require at least one resident biologist at each refuge to supervise the work and, in season, a C.C.C. crew of about 10

boys. At Bear River, because of the density of the nesting population, two biologists should be available.

As planned, the enlarged program will call for observations uniform in character at the several refuges and dealing with the following avenues of approach.

1. Nest Histories

1. To disclose nesting hazards due to

1. Predators - crows, magpies, ravens, gulls, skunks, foxes, coyotes.
2. Water fluctuation
3. Climate
4. Livestock
5. Human intrusion (observers)

2. To determine

1. Nest densities - population estimates
2. Trends in abundance of species from year to year
3. Cover types - their value and preference by each species
4. Optimum water levels
5. Productivity of various species
6. Degree of egg fertility, incubation periods, general nesting habits
7. Value of predator control in terms of increased yields of wildfowl
 1. Skunks and crows on Lower Souris
 2. Ravens and coyotes at Malheur
 3. Magpies at Bear River.

2. Saving of stomach material of predators to furnish corroborative evidence of destruction of eggs and young.

3. Banding to learn general drift of birds produced on each Refuge .

4. The laying of the foundation of sound game management that will best meet the particular needs of each Refuge .

Summary

Summarizing the results of the field studies of wildfowl on the Lower Souris Refuge in 1937, the following statements may be made.

1. A marked shift of the nesting population from the Ison-Newburgh Island areas in 1936 to sections contiguous to dam 326 in 1937 appears to have had its primary stimulus in the drop in water level in Unit #341. Optimum levels in that Unit are close to those prevailing there in 1936. The levels in Unit 332 were close to an optimum in 1937 although lack of flow produced dangerously stagnant conditions for a short time. At the lower (northern) end of Unit #326 nesting conditions were very favorable but the slope in this Unit, between dams #326 and #320 will preclude the possibility of making it attractive to shoal-water ducks throughout its area.
2. A noticeable increase in successful hatchings was observed in 1937 (69.3% compared with 54.4% in 1936). Destruction by skunks dropped from 30.4% to 6.4%, while that attributable to crows increased from 1.7% to 3.4%. The introduction of the red fox as a predator of some consequence was observed.
3. The improvement of conditions with respect to nest destruction by skunks is, in the light of evidence now at hand, considered to be a sequel to the removal of 425 of these mammals between the nesting seasons of 1936 and 1937. The noticeable shift in the nesting population also may have played some part in the greater success attained in 1937 through the depopulating of areas highly subject to skunk attack.
4. The blue-winged teal, least successful in hatching its eggs in 1936, was the most successful of the six species best represented in the nests studied in 1937, a fact due, it is felt, largely to lessened skunk pressure.

5. Nest densities on prime areas were greater in 1937 than in 1936. On the basis of 1360 acres placed in this category in 1937, assuming that only half of the nests were discovered, a density of one nest for about every two acres was recorded. In 1936 a density of one nest for every three acres was similarly recorded on 1490 acres of prime nesting ground. Taking into consideration all the land of the refuge embraced in the various sections in which an appreciable number of nests were found (5900 acres), a ratio of a nest for every 10.9 acres was recorded.

6. The fact that the pintail displaced the blue-winged teal as the most abundant nester on the refuge was occasioned partly by the earlier operation of the nest-hunting crew in 1937, and partly by an actual increase of pintails. Of the leading species the shoveler showed the greatest decline in numbers.

7. Appraisal of the element of concealment in its relation to nesting success brought results that might be considered somewhat less consistent than those obtained in 1936, yet more logical than those secured in Canada. All in all, abstract concealment, as generally conceived, has not proved an important element in determining the fate of the nests studied. Of all the shoal-water ducks, the pintail is outstanding in its apparent disregard for the element of nest concealment.

8. Appraisals of the fate of nests terminated when discovered, substantiated the belief that intrusion by careful observers does not afford such predators as crows and skunks a marked advantage. Any advantage that might accrue to predators that hunt largely by scent is yet to be determined.

9. Confirming the results obtained in 1936 as well as those secured in the Canadian studies, success in nesting increases as the season advances. This fact holds true not only with respect to early-season depredations of crows but also to those of skunks as well.

10. Pronounced irregularity characterized the comparisons made of the nesting results obtained in 1936 with those of 1937 on seven of the more important nesting areas, emphasizing the need of long-time studies to overcome seasonal fluctuations.
11. In 1937 no evidence was disclosed showing that any of the shoal-water ducks are partial to particular portions of the refuge.
12. The variation in the size of completed clutches of eggs of the same species from season to season was most pronounced in the widgeon, while the shoveler and blue-winged teal revealed greatest regularity in this respect.
13. A supplement to this report, to be submitted at a future date, will set forth the results of the stomach examination of skunks, mink, weasels and crows collected on the Lower Souris refuge.
14. An expanded program of research to be carried out in a manner that will permit the segregation and comparison of results has been planned for 1938 on the Lower Souris, Bear River and Lake Malheur refuges. The results obtainable at these widely separated points will afford a broader and truer perspective of the hazards besetting waterfowl on our refuges, and furnish the basic information for improved management and increased wildfowl production.

1936



1937



LOWER SOURIS

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