

MUD LAKE

NARRATIVE REPORTS

JANUARY-DECEMBER 1947

ROUTING SLIP

DIVISION OF WILDLIFE REFUGES

DATE:        194       

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REMARKS:

MUD LAKE NARRATIVE REPORT

SEPTEMBER-DECEMBER 1947

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NR FORMS

# MUD LAKE NATIONAL WILDLIFE REFUGE

## Narrative Report

September-December, 1947

### I. GENERAL

#### A. Weather Conditions

The table following indicates weather conditions for this past period, 1947, as compared with the same period for 1946:

	Snowfall		Precipitation		Max. Temp.		Min. Temp.	
	1946 -	1947	1946 -	1947	1946 -	1947	1946 -	1947
September	0.0	0.0	1.96	2.33	81	90	32	21
October	0.0	0.0	1.06	1.28	76	84	18	25
November	Trace	3.00	2.18	.30	58	50	-11	-17
December	11.00		.63	2.00	38	34	-32	-27

Even though we are located but 12 miles from the official U. S. Weather Bureau Station in Thief River Falls, there seems to be a considerable variation, at times, in the amount of snowfall and precipitation at that point, and here on the refuge area.

It will be noticed that only three inches of snow is indicated for November, 1947, whereas snow depths throughout the refuge area averaged well over a foot during the last half of November.

Snow levels at this time will average about 14 inches.

We have not as yet experienced any prolonged periods of severe cold, although we have had temperatures in the minum twenties for several days.

#### B. Water Conditions.

Water levels (ice levels) of the various pools at this time are as follows:

Mud Lake	.46 low	South	.2 low
Green Stump	.45 low	East	approx. at level
Headquarters	.85 low	CCC	.3 low
Madsen	.4 low	Mud River	1.3 low
Northwest	.3 low	Webster	approx. at level

Anticipating a heavy spring run-off, as a result of heavy snows to date, and recently completed ditch-cleaning jobs on ditches entering the refuge drainage system, we have dropped Mud Lake, Green Stump, and Madsen Pools.



Headquarters pool invariably recedes on its own; Mud River was dropped in the summer to facilitate dike work and repairs on the control structures. Controls on the remaining structures have not been manipulated as there is no need for further lowering of levels. As mentioned in previous reports we have no controls on the Northwest pool, and can do little else than hope for a minimum of damage to dikes and spillway in the event of a heavy run-off.

Although we are expecting a little difficulty in handling the spring run-off, it is believed that we can dispose of surplus waters without too much damage, providing break-up is completed before the heavy spring rains commence. If both occur during a short period we may have Thief River out of the channel below the refuge.

### C. Fires

One short period of relatively high fire hazard occurred during the latter part of October. Intermittent rains throughout the period reduced the fire hazard greatly. Dense vegetation resulting from an excellent growing season, however, created a potential danger of severe fires - we were fortunate in receiving sufficient rainfall at just the right time.

We did have one fire which entered the refuge from the east, and burned a total of 845 acres of grazing lands, 30 acres of "timber" under 4 inches, 400 acres of willow and aspen brush lands, and 200 acres of abandoned field. Last minute construction of fire line, and backfiring saved possible destruction of some of our heaviest timber growths in the Blue and Dahl Grove areas.

A small number of deer were forced from the burned area, but this fire progressed at only a moderate speed, and we are certain there was no serious loss of wildlife.

## II. WILDLIFE

### A. Migratory Birds

#### 1. Population and Behavior

Although the summer waterfowl census indicated a 31 per cent decrease in resident ducks and a 73 per cent decrease in the production of young ducks, some improvement in population came with the fall migration. Mild weather conditions throughout October caused the fall movement of waterfowl unto the refuge to occur in a fairly uniform distribution spread over the entire migratory period. Large influxes moved from the north by the usual sudden cold periods were decidedly less pronounced this year. It is believed favorable weather conditions delayed the migration of some species from the refuge and allowed a high peak concentration in relation to the total number of waterfowl using the refuge for the period. Peak populations were attained from one to two weeks later than last year.

Influxes of some shore birds, Coots, Cormorants, and Grebes began the third week in August. Freezing weather did not develop until November 8. By mid-November most water areas were closed by ice and waterfowl populations were reduced to infrequent and scattered observations of a few Mallards and Lesser Scaup.

In general the "peak concentration" of ducks was down approximately 25 per cent. The "total population using the refuge for the period" was down approximately 45 per cent. Species evincing the greatest decline in population were Blue-winged teal, Shoveller, Ruddy duck, and Coot.

Similar to the year 1946 large influxes of Gadwalls and Baldpates occurred in October. The Coot population, reduced to a point of rare observations in the summer months, improved with the fall migration to within approximately 50 per cent of last year's population.

A slight increase in populations of Canada, Blue, and Hutchins' geese was noted. A few Whistling Swans, Sandhill Cranes, and approximately four pelicans used the refuge for a brief period.

Although the duck population was down, it is believed hunters were successful in obtaining a somewhat larger kill this year than in 1946. A high peak concentration in relation to total number of ducks using the refuge and more water on the outside periphery of the refuge boundaries enlarged the waterfowl habitat, enabling hunters to shoot over "burn-outs" which had been dry in the fall of 1946.

Undoubtedly the late opening and early closing of shooting hours aided in conserving many ducks. After the first two or three days of shooting, the ducks became "educated" quickly and thereafter adjusted their forays on the outside of the refuge to correspond in time to non-shooting hours. Large flocks of Mallards regularly left the refuge area almost immediately at the close of the afternoon's shooting to feed off of grain fields to the west and south of the refuge.

## 2. Food and Cover

Of the aquatic foods, the refuge offered no wildrice, zizania aquatica, this year. Ditch 11, the only location where wildrice has grown on the refuge, suffered considerable fluxation in water levels during the high water conditions in early summer, and it is believed this factor prevented development of the plants. Other aquatic plant and animal foods remained in a fairly stabled condition and their dispersal, locations, and areas corresponded satisfactorily with the fall of 1946. Better success was obtained this year with waterfowl utilizing refuge farming areas. At least, two grain areas along Ditch 11 were utilized frequently and intensively.

B. Upland Game Birds

1. Population and Behavior

There has been little opportunity, this past period for undertaking any kind of systematic census of upland game birds, and we should not attempt a numerical estimate until we have completed strip census work as planned for the January-April period.

In general we can state that populations are as follows: Ruffed grouse are possibly increasing; sharptails are holding at about the same numbers, or possibly a slight increase over a year ago; pinnated chickens are decreasing; ring-necked pheasant have disappeared from the refuge area entirely, or at best are represented by no more than 6-10 birds; Hungarian partridge are decreasing, or barely holding.

Considering remaining populations there should be no competition between species.

2. Food and Cover.

Heavy snows to date would result in difficult feeding possibilities for pheasants, Hungarians, and the pinnated grouse. There should be no difficulties in the sharptail and ruffed grouse obtaining sufficient quantities and varieties of fall and winter foods, considering available food types such as aspen, bog birch, etc. Feeding in refuge grain fields (by sharptails) was observed fairly regularly into November. Deep snow will no doubt preclude any further utilization of cultivated grain left as food patches.

3. Disease. No evidence.

C. Big Game Animals.

1. Population and Behavior.

Moose.

Observations on moose this past period have been almost as frequent as during the same period a year ago. One cow with twins was observed on at least two occasions, and a cow, bull and yearling twins was observed just outside the east boundary fence during the deer season. Singles and mated pairs were observed on a number of occasions.

"Wandering" of the moose became apparent early in September - they were observed in most all parts of the refuge. By mid-October observations were less frequent, and it was therefore assumed that the annual rut was about finished.

NR-3 mg.



As will be brought out in our report on proposed management of big game in the Mud Lake Refuge, there is little possibility of severe competition between deer and moose, as far as food, cover, and range in general is concerned (in the immediate future). While willow is a preferred winter browse for moose, and is also the staple for deer on this area, the vast acreage of willow growths, the tendency to "spread" throughout the entire refuge area, the ability of moose to utilize large quantities of willow browse out of reach for deer, and our belief that, as yet, we are not over-populated with either species, should preclude any immediate possibilities of severe competition.

We hope to complete an aerial count of big game early in January, and an additional inventory late in February, in order to determine actual populations. Pending completion of the plane census it is our belief that the moose population is between 30-40 animals.

#### Deer

##### 1. Population and Behavior

We are quite positive that the deer populations has decreased from the 742 animals counted during the census of February, 1947. Observations of deer have not been as frequent, nor have they been seen in large groups as was the case during the late fall of 1946. From all reports the deer population in the vicinity of the refuge was also less this year. There are some authentic reports of an influx of deer into the country west of the refuge - country in which deer, in the past, have been quite scarce. By and large hunters reports a noticeable decrease in areas which were well populated during the fall of 1946. There have been no reports of any type of abnormal mortality from any specific cause, and it is a little difficult to offer an attempt at an explanation for the general decrease as apparent at this time. We have not had the opportunity of checking more remote parts of the refuge area, but localities which have been checked indicate a very considerable decrease in numbers of deer over last year. It is barely possible that the deer are tending to congregate in a relatively few favorable localities this year, rather than spread throughout the entire refuge as they did last year.

##### 2. Food and Cover.

Sufficient food and cover are present within the refuge area, for present populations plus - of that we are certain. Results of browse surveys completed during the late spring of 1947, checks on mortality, plane inventories, and checks on areas of concentrations, etc. revealed that the refuge area provided sufficient food and cover for the most part. There, of course, will always be the question of the ability of the deer to move around to utilize present sources, in the event of a winter with severe cold and deep snows prevailing.



It is possible we have just such a winter in the making. Refuge personnel will spend considerable time and effort in an attempt to determine answers to such problems as movement, food supplies, available cover, winter losses, etc. during the next three months.

3. Disease. No evidence.

D. Fur Animals, Predators, Rodents, and other Mammals.

It now appears that we have had a general decrease in the numbers of most fur-bearers, predators and rodents. One exception to this is beaver - we have had a sizeable increase in the number of beaver, but as yet there is no great need for control.

Mink.

Mink have decreased to some extent over the 1946-47 population. It is our opinion that there was some loss of young during the extended period of high water in June. It is also possible that presence of water in drainage ditches, streams, and marsh areas outside the refuge resulted in a more general spread of mink throughout the general area, rather than a concentration of animals within refuge waters, as occurred in 1946, when the refuge offered the only suitable habitat in this territory. Trapping to date indicates a considerable decrease in the "take" - it will approximate less than half the take for the 1946-47 season.

Muskrat.

Muskrat have likewise shown a very decided decrease in numbers as compared with the population in the fall of 1946. Where we had a total of 2550 houses in 1946, we had but 425 during the plane count taken in November this year. We do know that a number of kits were drowned during the high water levels of June, and it is possible that such loss of the year's young accounted for some of the over-all decrease in the muskrat population.

The total acreage of marsh habitat was considerably increased by completing the Madsen pool structure, resulting in re-flooding of marsh areas which had not held a stable water level since 1942. Completion of the Northwest dike also added to the available marsh area, although this impoundment will never be too good a rat area, because of the large area supporting little vegetation, and too little depth for withstanding the usual deep winter freezing.

Trapping of muskrats was, of course, not attempted this year, as the low population should mean little damage to dikes, while at the same time we want to maintain a reasonable population and maintenance of open areas in the extensive growths of emergent vegetation - mostly cattail.

Skunk.

We expected a noticeable increase in the number of skunk this past year, but find that the population now appears to be less than anticipated. These animals were again observed fairly regularly, prior to freeze-up, but were definitely not as numerous as in 1946. An early freeze-up and subsequent early denning of the skunk prevented trapping - we failed to take a single skunk, even though the trappers were to operate on a "take all" basis. At any rate, it is fortunate that the skunk population has taken a downward trend, as this should result in more successful nesting of waterfowl and upland game birds this next season.

Weasel.

As with other fur-bearers, there has been an evident decrease in the number of weasel. It is possible that our control during the 1946-47 season knocked off the peak, but it is believed some other factor has also entered the picture.

We do know that we did not have the excessive population of field mice which existed last year, and which could have made the area less attractive for the weasel.

Fox. The red fox population is quite low. There should be little loss to the present game bird population from this animal - at least for the next year or so.

Coyote. Control operations during 1946-47 resulted in removal of 18 coyote - this from an estimated 20-30 coyotes at the beginning of the fall trapping season. To date, this year we have taken only 3 coyotes, and it is apparent that this predator is not now present within the refuge area in numbers dangerous to game propagation, or raising of livestock in the immediate vicinity.

Timber Wolf. As yet we have had no authenticated reports of the presence of this animal.

Black Bear. None in the area so far as we know. Removal of a number of bear around the refuge boundaries during the summer and fall of 1946, we believe, has reduced the bear population to a safe minimum.

Raccoon and Badger. The raccoon population may be increasing slowly, as it is believed more sign was in evidence this past period than a year ago. As yet, however, they are not present in sufficient number to prove a limiting factor to game species.

Badger are also present on the refuge area, but in relatively small numbers, and as yet are not in need of control.

Snowshoe, cottontail, and jack rabbits seem to be increasing slowly. As yet there is little evidence of undue damage to vegetable growth, and a higher population of all species would be desirable from the standpoint of providing "buffer" foods for larger predators, with a subsequent lowering pressure on game species.

Porcupine. There has undoubtedly been a slight increase in the porcupine population since last spring. Removal of 12 of these animals from the spruce tamarac stands during the winter of 1947, however, reduced the damage potential a great deal. A further check will be made in the spruce swamps within the next several months, and any additional removals will be taken care of.

- E. Predaceous Birds, including Crows, Ravens, and Magpies. There has been nothing unusual to report in this category. The fall migration indicated the usual numbers and species of hawks moving through the area, red-tailed, marsh, rough-leg, etc. We did observe a single Goshawk during the first week in December. Several duck kills were found, which could have been the work of either hawks or owls, but there was nothing to indicate any abnormal mortalities.

Great-horned owls are present on the area, and could perhaps be termed as fairly common. A limited control of these birds will be attempted.

Crows, selected several sites for nightly roosting and gathering places. Crow hunting contests put on by local Sportsmen Clubs in this general area may have resulted in movement of these birds into the refuge area to some extent. Their presence in the refuge during the fall of the year, however, is little cause for concern.

- F. Fish. A more or less steady flow of water in the Thief River channel throughout the greater part of the period resulted in a movement of northern pike up as far as the Thief Lake dam. We also noted the presence of pike (from 10-16") in refuge waters, and in Ditch 11 east of the refuge boundary. It is quite possible that a good many northern pike, suckers, bullhead, and sheepshead entered the refuge pools during the extended periods that the Ditch 11 and Thief River controls were discharging. It would be very unusual if the great majority of these fish did not succumb during the winter. NR-6  
mg.

### III. REFUGE DEVELOPMENT MAINTENANCE

#### A. Physical Development

Construction. Due to concentration of refuge personnel toward completing the large construction program a minimum of time was available for other work and studies. Following is listed accomplishments under this category during this past period:



1. Mud River (Job 4970) Approximately 2,000 linear feet of dike completed (old dike built up) on the Mud River section - the dragging placing 2,400 yards of fill. The stop-log control was also renovated, by raising headwalls, driving 24 linear feet of Wakefield piling, pouring new footings, and constructing new wing and retaining walls (8.1 yards concrete poured).

The new fill was too soft to work at the time of freeze-up, but we were able to dress the crown enough for traffic by dragging the bulldozer. Surfacing of this section of dike with pit run gravel will be accomplished prior to July 1, 1948.

The Webster Creek section of dike (approximately 2,500 feet was raised according to plans. 4,840 yards of dirt fill, including fill used for the plug in the ditch connecting Mud River and Webster Creek pools, was placed by truck haul, and using the dragline for loading. Surfacing of the crown with pit-run gravel was not completed, but remaining work will be accomplished prior to July 1, 1948.

The control structure was renovated in the same fashion as Mud River - raising headwalls, new wing and retaining walls, 24 linear feet of Wakefield piling. Eight yards of riprap was placed as per plans on each structure.

2. Northwest (Job 4971). Hauling and laying of 23 yards of riprap on the spillway constructed during the past summer completed this job. The total job consisted of rebuilding approximately 7,000 linear feet of dike, or placing 23,000 yards of fill, and construction of a 100 foot emergency spillway.

3. Madsen (Job 4972). With the exception of dressing the spoil banks on either side of the outlet channel, all work connected with the structure was completed this period, with the placing of approximately 45 yards of riprap at the toe of the apron.

This job was commenced in April of this year, and consisted of constructing a six-bay stop-log control structure, outlet channel to Thief River - also a 50 foot row of Wakefield piling, fortified by 40 yards of riprap just above the junction of the channel outlet and the river channel. It was necessary to move a total of 5,900 yards of dirt, place approximately 160 linear feet of Wakefield piling, place 85 yards of riprap, and form about 11,900 linear feet of re-inforcing rod in completing this job - a total of 85 yards of concrete were poured.

About 1 acre of dike, immediately adjacent to the structure was seeded with fall rye, and about 2 acres of old dike were cleared of brush in preparation for dike work to be commenced in the spring. We have yet about 7,000 yards of fill to place on sections of old dike along the Thief River channel.

4. County Road "E" (Job 5062). This job originally called for raising about 1 mile of County Road "E" (which also functions as a dike between the Headquarters and South pools, and involved placing of 3,000 yards of earth fill, and surfacing with gravel. We were fortunate in completing the fill required for the crown of the road, just a jump ahead of the County graveling operations. About 1,800 yards of earth fill were placed by refuge personnel, and the County placed approximately 400 yards of gravel over this same section of road.

We might also add that the County graveled the entire stretch of County Road "E" (11 miles) extending through the refuge at the same rate of 400 yards per mile.

We expect to complete placing of required fill on the road shoulders (or dike slopes) prior to July 1, 1948.

5. Ditch Improvement (Job 5061). This job involved removal of 12,300 yards of materials from the 2 mile stretch of ditch extending through the center of Section 30, T. 157 N., R. 40 W., and  $\frac{1}{2}$  mile of ditch extending south along the Secondary road from the west line of Section 25.

Utilization of three shifts, and 24 hour per day operation of the dragline made possible completion of the job in 10 days time.

#### Maintenance

##### Dikes, and dike roads

1. 190 yards pit-run gravel placed on surface of Green Stump dike road between County Road "E" and the control structure. Completion of this job should make the road passable at all times. In the past a heavy dew would stop traffic.

2. 305 yards pit-run gravel placed on sections of badly deteriorated road between the primary and secondary headquarters.

3. 190 yards pit-run gravel placed on sections of poor road between headquarters and the Thief River Control.

4. 80 yards pit-run gravel placed on the long spillway of CCC pool.

5. 600 yards of material excavated from road ditch connecting CCC Bay and CCC pool to facilitate flow into CCC Bay.

6. 160 yards fill placed on badly eroded sections of Headquarters dike. This accomplished when the dragline was moved in from CCC pool job to headquarters for shipment to Upper Souris.

7. 84 yards of fill placed on eroded sections of the "narrow dike". This job accomplished by use of trucks and small scraper during one of the rare dragline breakdowns.

8. About 45 miles of grading accomplished.

9. 120 miles of mowing accomplished on roads and trails. This mileage represents two swaths on some sections, 3 swaths on some, and in a few cases a total of four swaths on both sides of the road was necessary. Reduction of snow drifting is one of the chief objectives in late fall mowing.

10. The bridge located on the Secondary road, west boundary of section 25, T. 157 N., R. 41 W. was completely re-decked with 2-inch creosoted pine - bridge decking measures 16 x 16 feet.

11. A four-foot culvert was installed at the junction of the Kelly-Ridge, Stub-tower road.

#### Building Maintenance.

1. Interior of clerk's dwelling completely re-decorated (excepting trim) - by the clerk.

2. Kitchen, bathroom, combined living-room and dining-room of the secondary residence completely re-decorated - by the patrolman.

3. Office, laboratory, and shower-room floors painted.

4. Storm windows for Secondary painted.

5. Renovation of furhouse completed this period - involving removal of all old partitions, moving wire netting separating skinning and drying sections, moving pelt lines, removing old wood burning stove, and setting up new coal burner, constructing new entry at east end of building, placing battens, and other missing siding.

6. Installing new oil heater, and connecting with outside storage tanks for bunkhouse.

7. Cleaned all chimneys, and furnaces.

8. Replaced shingles on Service Building, equipment shed and barn (shingles torn off by high winds.)

#### Equipment Maintenance.

The four dump trucks in use throughout the entire working season (construction) were transferred to the Upper Souris Refuge before any overhaul could be accomplished. It is expected that these units will be placed in good operating condition prior to transfer back to the Mud Lake Refuge.

The dragline was also transferred to Upper Souris during the first week in November, so there was no opportunity to work on this unit.



Maintenance work accomplished has been pretty much limited to minor jobs with the exception of the 5 KW light plant - a complete overhaul was given this unit.

22 Caterpillar tractor - magneto overhaul.

1938 pick-up truck - this unit to be used as trade-in on new truck, It is not in use at the present.

The balance of the maintenance of equipment and motor vehicles consisted of only minor repairs. Major equipment repairs to be accomplished during the period January-April.

Miscellaneous.

1. Three trips made to Norris Camp, Beltrami Island Project, for the purpose of transferring surplus property, and for taking board of survey action on unserviceable items. Transferred items stored.

2. All recognition signs, directional signs, etc. dismantled for the purpose of repairs, painting, etc. Work will be accomplished during inclement weather.

3. Deer trap sites checked, and baited in preparation for trapping operations to commence after January 1.

4. 5 man-days spent on maintenance of telephone line - line needs complete check and many repairs.

5. Two dump trucks returned to Sand Lake Refuge.

6. Snow removed from Secondary once by R-5 tractor w/bulldozer and grader, and once by County plowing equipment.

B. Plantings

1. Aquatics and Marsh Plants. None

2. Trees and Shrubs. None

3. Upland Herbaceous Shrubs. None

4. Cultivated Crops.

Although nine cooperative Farming permits were in effect for this period, only five permittees actually made use of their permits. A late spring breakup, and, in one case, physical disability hindered the initiation of farming operations. Of the five Cooperative Farming permits utilized, approximately 396 acres were seeded to such grains as flax, barley, proso millet, and corn. Approximately 120 of the 396 acres were lost due to flooding in the early summer. This left approximately 72 acres of small grains

for the refuge share to augment available food for waterfowl and upland game birds. Average yields of the principal crops seeded follow: Flax, 4.6 bushels per acre; barley, 3.4 bushels per acre.

C. Collections

1. Seed or other Propagules. Approximately 8184 pounds of sweet clover seed was harvested under special use permits this period. This compares with 1006 pounds harvested in 1946. Remuneration to the government was at \$.05 per pound. Total revenue amounted to \$409.20.

2. Specimens. None

D. Receipts of Seed and Nursery Stock. None

IV. ECONOMIC USE OF REFUGE

A. Grazing.

291.55 animal use months utilized approximately 4,738 acres for this period. Cash returns from grazing permits amounted to \$148.21. This compares with 331.5 animal use months on approximately 4,553 acres and cash returns of \$167.95 for 1946. Although the demand for grazing was comparable to 1946, actual utilization was less due to increased fly, mosquito, and tick activity. Some permittees were forced to take their cattle out of refuge grazing units in mid-July due to these pests. There were no conflicts observed between grazing livestock and wildlife.

B. Haying.

The demand for hay was considerably greater this year than in 1946. The production of hay per acre was, also greater this year than in 1946. On approximately 475.3 acres, 617.4 tons of hay were harvested, bringing cash returns of \$581.07. This compares with harvest of 289.02 tons of hay from approximately 432 acres in 1946. Cash returns from hay in 1946 amounted to only \$273.87.

Haying and Grazing.

Two permits were in effect for combination haying and grazing on units approved in the Economic Use Plan. Acreage involved are two 80-acre tracts. Each permit is written on an annual basis, entailing a payment of \$20.00 per annum.

C. Fur Harvest.

Only seven predator trapping permits were issued this year. Comparison of "take" to date with the "take" for a similar period in 1946 follows:

Species	Number Taken	
	1946	1947
Muskrat	4701	none
Mink	240	107
Skunk	91	none
Weasel	161	27
Bobcat	5	none

Although higher prices for mink will partially off-set the decline in the fur harvest, there will be a considerable decrease in revenue this year. Due to an extremely low population of muskrats, no permits were issued for trapping this species.

D. Timber Removal.

To date, 10.5 cords of fire wood have been removed this year. Total revenue from this source amounted to \$5.25.

E. Beekeeping.

A total of 60 beekeeping stands were placed on the refuge this year, bringing cash returns of \$10.00.

V. FIELD INVESTIGATION OF APPLIED RESEARCH

A. Progress Report.

We had planned on submitting a progress report on results of studies accomplished to date toward our Big Game management plan. We have data on browse surveys, winter mortality, populations, availability and preference of browse species present, deer banding operations, areas of concentrations, etc., but it is believed we should now delay submission of a progress report until we have completed the second year's study, and gathering of information. It may be possible to submit such a report in the late spring.

VI. PUBLIC RELATIONS

A. Recreational Uses. None on this area.

B. Refuge Visitors. Following is a tabulation of visitors:

Name	Station or residence	Purpose	Date
Dr. E. Bratrud	Thief River Falls, Minn.	See refuge	9/1
Senator Lucken	Gloton, N. Dak.	" "	9/1
Dr. & Mrs. R. T. Gammell	Kenmare, N. Dak.	" "	9/13-14
State Warden Borchert	Thief River Falls, Minn.	Law Enforc.	10/9-13
Mr. Arthur Huey	R.O. Mpls.	Inspection	10/27
Mr. Ed. Wellein	Lower Souris Refuge	Muskrat survey	11/10-11-12
Mr. F. C. Gillett	R.O. Mpls.	Inspection	11/21-22-23
Visitors, permittees (80-100)	local	business, etc.	
Hunters (50-100)	local & state-wide	information	



C. Refuge Participation.

With the exception of attending and taking part in one program put on by the Holt Sportsmen Club, we have attempted little in the way of outside activity.

A radio script had been prepared for broadcast from the local station KTRF, but this plan has now been abandoned. We have made arrangements with the Thief River Falls paper for publishing a series of articles concerning refuge activities, and hope to enlighten some of our critics by this means.

D. Hunting.

No hunting of any kind permitted in the Mud Lake Refuge.

Waterfowl hunting in the immediate vicinity of the refuge was fair, considering the entire season. With the exception of several miles along our west boundary, several large grain fields located from two to four miles south of the south boundary, and a short stretch along our north boundary there was very little hunting in adjacent areas. Hunting was good the first two or three days, and then was only sporadic - at such times as a flight entered the refuge. More geese were taken along the west boundary than in the past several years, as the geese (mostly Canada) remained in the refuge for a much longer period of time, and presented greater opportunity to the hunters, as they left the refuge for feeding.

E. Fishing. None.

F. Violations. Opportunities for violations (hunting within the refuge) of waterfowl regulations are greatly limited on this area. With the exception of the west boundary, where refuge marshes extend to the fence along a three mile stretch, it is almost impossible for hunters to gain access to areas utilized by waterfowl without long hikes, or unless a boat of some sort is used. We do have marsh areas along County Road "E", but the heavy traffic on this road, prominent posting, and due to the practically no opportunity for a hunter to poach with the help of cover, we have never observed any attempts at hunting in this particular locality.

The east and south boundaries are heavy brush or timber. The north boundary offers some temptation for possible poachers, in that there are fairly regular flights across the boundary fence into grain fields lying outside the refuge boundaries. There, however, is only a mile or two of this boundary where such flights occur, and after the first week or so of hunting there is very little activity in this area.

We did apprehend one individual on this stretch, and obtained a conviction on possession of sharptail grouse out of season.

We should have spent more time on patrol outside the refuge as we do know there was considerable early, and later shooting in some localities. Apprehensions are very difficult due to excellent cover for the hunters - almost every grain field is surrounded, or partly surrounded by dense timber lots, or large patches of brush - the hunters use these as combination "blinds" and escape cover.

We did, however, patrol refuge boundaries regularly, and believe that we checked possible violations to a considerable extent in this respect. We also made a number of checks in a "hot" area south of the refuge boundaries, in company with State Warden Borchert. One man was apprehended hunting without a license or duck stamp - the case was dropped when Warden Borchert confirmed the man's story, that he had purchased both, but had forgotten to take them with him. Unsigned duck stamps were found on numerous occasions, but we simply had the individual sign them in our presence, and did not attempt to make a case. A number of cases could have been made on early shooting, if we had called the hunters on the minute - we allowed 15 minutes margin, however, and lectured the hunter who had jumped the legal shooting time. Many bags were checked and no infractions of possession limits were discovered.

#### VII. OTHER ITEMS

##### A. Items of Interest.

Of thirty-five ducks banded on the refuge this year, at least, one of the banded birds went into a hunter's bag. Band number 40-688167 was placed on a juvenile Mallard on September 25, 1947. The duck was shot along the south boundary on October 9, 1947.

A Mallard wearing band number 42-645082 was captured in a refuge trap and released. The bird had been banded at Jasper-Pulaski Game Preserve, Rensselaer, Indiana on November 20, 1944.

Band number 39-642140 was returned to this station by a local hunter. The band had been taken from a Mallard shot along the west refuge boundary. The bird had been banded on the refuge August 17, 1941 and shot in the near vicinity of banding six years later.

##### B. Photographs. None

APPROVED:

Actin

REGIONAL DIRECTOR

JAN 12 1948

Robley W. Hunt  
Refuge Manager

*Robley W. Hunt (w/ help of Mr. Burt)*



# WATERFOWL

Refuge Mad Lake Months of Sept. to Dec. 194 7

(1) Species Common Name	(2) First Seen		(3) Peak Concentration		(4) Last Seen		(5) Young Produced		(6) Total
	Number	Date	Number	Date	Number	Date	Broods Seen	Estimated Total	Estimated for Period
I. <u>Swans:</u> Whistling swan			20	10/25	2	11/1			20
II. <u>Geese:</u> Canada goose			500	10/26	10	11/8			1,100
Cackling goose									
Brant									
White-fronted goose									
Snow goose									
Blue goose			50	10/10	12	10/26			100
Hutchins' Goose			200	10/26	6	11/1			300
III. <u>Ducks:</u> Mallard			100,000	10/25	1	12/2			150,000
Black duck			200	10/19	2	11/6			300
Gadwall			15,000	10/19	4	11/6			16,000
Baldpate			35,000	10/19	1	11/6			40,000
Pintail			6,000	10/24	1	11/6			6,000
Green-winged teal			50	10/7	1	10/25			100
Blue-winged teal			2,000	9/16	2	11/1			2,500
Cinnamon teal									
Shoveller			1,000	10/19	1	11/1			1,500
Wood duck			100	10/2	1	10/19			100
Redhead			1,000	10/24	2	11/6			1,000
Ring-necked duck			200	10/24	1	11/5			200
Canvas-back			100	10/24	1	11/1			100
Scaup			3,000	10/24	1	12/2			2,000
Golden-eye			1,000	10/25	1	11/1			1,000
Buffle-head									
Ruddy duck			100	10/19	5	10/25			100
IV. <u>Coots:</u>			8,000	10/19	2	11/6			15,000

3-1750  
(July 1946)

(over)

Form NR-1



# SUMMARIES

## Total Production:

Geese \_\_\_\_\_  
Ducks \_\_\_\_\_  
Coots \_\_\_\_\_

Total waterfowl usage during period 238,420

Peak waterfowl numbers 173,520

Areas used by concentrations Entire Refuge

Water area of 20,000 acres utilized

Principal nesting areas this season \_\_\_\_\_

Reported by \_\_\_\_\_

## INSTRUCTIONS

- (1) Species: In addition to the birds listed on form, other species occurring on refuge during the reporting period should be added in appropriate spaces. Special attention should be given to those species of local and National significance.
- (2) First Seen: The first refuge record for the species during the season concerned in the reporting period, and the number seen. This column does not apply to resident species.
- (3) Peak Concentration: The greatest number of the species present in a limited interval of time.
- (4) Last Seen: The last refuge record for the species during the season concerned in the reporting period.
- (5) Young Produced: Estimated number of young produced based on observations and actual counts on representative breeding areas. Brood counts should be made on two or more areas aggregating 10% of the breeding habitat. Estimates having no basis in fact should be omitted.
- (6) Total: Estimated total number of the species using the refuge during the period. This figure may or may not be more than that used for peak concentrations, depending upon the nature of the migrational movement.

Note: Only columns applicable to the reporting period should be used. It is desirable that the Summaries receive careful attention since these data are necessarily based on an analysis of the rest of the form.

3-1751  
Form NR-1A  
(Nov. 1945)

MIGRATORY BIRDS  
(other than waterfowl)

Refuge Mud Lake

Months of September to December 1947

(1) Species	(2) First Seen		(3) Peak Numbers		(4) Last Seen		(5) Production			(6) Total
Common Name	Number	Date	Number	Date	Number	Date	Number Colonies	Total # Nests	Total Young	Estimated Number
I. Water and Marsh Birds:										
Holboell's Grebe			20	10/19	1	11/1				50
Horned Grebe			10	10/19	1	10/25				20
Pied-billed Grebe			200	9/16	1	10/29				200
Double-crested Cormorant			300	10/2	1	11/6				350
White Pelican			5	10/13	3	10/15				5
American Merganser			100	10/15	2	11/1				100
Hooded Merganser			25	10/5	2	10/20				25
American Bittern			100	10/2	1	11/1				125
Great Blue Heron			200	10/19	1	11/1				250
Sandhill Crane	15	10/5	15	10/5	15	10/5				25
II. Shorebirds, Gulls and Terns:										
Ring-billed Gull			500	9/24	2	10/15				800
Dowitcher			500	9/22	1	11/6				500
Yellow-legs (Greater)			(1000)	9/22	2	11/6				1000
Yellow-Legs (Lesser)			( )	No data	2-6	11/10-15				
Bairds' Sandpiper			No data	"	2	9/1/-9/15				
Spotted Sandpiper			"	"	1	"				
Least Sandpiper			"	"	1	"				
Wilson's Snipe			"	"	1	"				

(over)



(1)	(2)	(3)	(4)	(5)	(6)
III. Doves and Pigeons:					
Mourning dove					
White-winged dove					
IV. Predaceous Birds:					
Golden eagle					
Duck hawk					
Horned owl					
Magpie					
Raven					
Crow					

Still here  
Resident

10/5  
11/1-15

Reported by.....

### INSTRUCTIONS

- (1) Species: Use the correct names as found in the A.O.U. Checklist, 1931 Edition, and list group in A.O.U. order. Avoid general terms as "seagull", "tern", etc. In addition to the birds listed on form, other species occurring on refuge during the reporting period should be added in appropriate spaces. Special attention should be given to those species of local and National significance. Groups: I. Water and Marsh Birds (Gaviiformes to Ciconiiformes and Gruiformes)  
II. Shorebirds, Gulls and Terns (Charadriiformes)  
III. Doves and Pigeons (Columbiformes)  
IV. Predaceous Birds (Falconiformes, Strigiformes and predaceous Passeriformes)
- (2) First Seen: The first refuge record for the species for the season concerned.
- (3) Peak Numbers: The greatest number of the species present in a limited interval of time.
- (4) Last Seen: The last refuge record for the species during the season concerned.
- (5) Production: Estimated number of young produced based on observations and actual counts.
- (6) Total: Estimated total number of the species using the refuge during the period concerned.



3-1752  
Form NR-2  
(April 1946)

# UPLAND GAME BIRDS

1613

Refuge Mud Lake

Months of September to December, 194 7

(1) Species	(2) Density	(3) Young Produced	(4) Sex Ratio	(5) Removals	(6) Total	(7) Remarks	
Common Name	Cover types, total acreage of habitat	Acres per Bird	Number broods obs'd. Estimated Total	Percentage	Hunting For Re- stocking For Research	Estimated number using Refuge	Pertinent information not specifically requested. List introductions here.
Ruffed Grouse	Omitted					230	Estimates based on random observations and last winter's strip census
Prairie Chicken	until an intensive					rare	
Sharptail Grouse	cover survey can					180-270	
Pheasant	be completed					Rare	



# INSTRUCTIONS

Form NR-2 - UPLAND GAME BIRDS.\*

- (1) SPECIES: Use correct common name.
- (2) DENSITY: Applies particularly to those species considered in removal programs (public hunts, etc.). Detailed data may be omitted for species occurring in limited numbers. Density to be expressed in acres per animal by cover types. This information is to be prefaced by a statement from the refuge manager as to the number of acres in each cover type found on the refuge; once submitted, this information need not be repeated except as significant changes occur in the area of cover types. Cover types should be detailed enough to furnish the desired information but not so much as to obscure the general picture. Examples: spruce swamp, upland hardwoods, reverting agriculture land, bottomland hardwoods, short grass prairie, etc. Standard type symbols listed in Wildlife Management Series No. 7 should be used where possible. Figures submitted should be based on actual observations and counts on representative sample areas. Survey method used and size of sample area or areas should be indicated under Remarks.
- (3) YOUNG PRODUCED: Estimated number of young produced, based upon observations and actual counts in representative breeding habitat.
- (4) SEX RATIO: This column applies primarily to wild turkey, pheasants, etc. Include data on other species if available.
- (5) REMOVALS: Indicate total number in each category removed during the report period.
- (6) TOTAL: Estimated total number using the refuge during the report period. This may include resident birds plus those migrating into the refuge during certain seasons.
- (7) REMARKS: Indicate method used to determine population and area covered in survey. Also include other pertinent information not specifically requested.

\* Only columns applicable to the period covered should be used.







DIRECTIONS FOR PREPARING FORM NR-8  
CULTIVATED CROPS

Cultivated Crops Report Form NR-8 should be prepared on a calendar-year basis for all crops harvested or utilized during the calendar year and submitted with the December 31 refuge report.

Permittee - List each permittee separately. If lands of the refuge are farmed by refuge personnel or hired labor, this should be indicated in the Permittee column.

Permit No. - List the number of the Special Use Permit issued to the individual.

Use or Location - The Unit No. or name specified in the Economic Use Plan should be listed in this column.

Crops Grown - A separate line of the form should be used for each crop grown by each permittee or by refuge personnel. This is important, since if each crop grown by each operator is not specifically enumerated, the report will be of no value for statistical purposes.

Average Yield per Acre - It is important that the average yield per acre of each crop grown by each operator should be shown.

Permittee's Share - Only the number of acres harvested or utilized by the permittee for his own benefit should be shown under the Acres column, and only the number of bushels of farm crops harvested by the permittee for himself should be shown under the Bushels Harvested column. It is requested that all crops harvested be reduced to bushels wherever possible, or, as in the case with the harvesting of seed such as that of sweet clover, alfalfa, brome grass, etc., the total harvested crop in pounds may be shown. Timothy, alfalfa, or other hay harvested by the permittee should be shown on Form NR-10 and should not be shown in the Permittee's Share column.

Government's Share or Return - Harvested - Show the number of bushels harvested for the Government and the acreage from which this share is harvested, both for grain raised by refuge personnel and by permittees. Unharvested - show the exact number of acres of crops allowed to remain unharvested as food and cover for wildlife. An estimate of the number of bushels of grain that is available for the wildlife in such unharvested crops should be shown in the Bushels column.

Compensatory Services, or Cash Revenue - Show other services received by the Government in cooperative farming activities, the number of acres of food strips planted for wildlife, the amount of wildlife crops not otherwise reported that are planted by cooperators for the Service, or the cultivation of wildlife plantations. If the permit is on a fee basis, the total cash revenue received by the Service.







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## REFUGE GRAIN REPORT

Refuge Mud Lake National Wildlife Refuge

Months of Sept. thru Dec. 1947.

(1)	(2)	(3)	(4)	(5)				(6)	(7)		
VARIETY	ON HAND BEGINNING OF PERIOD	RECEIVED DURING PERIOD	TOTAL	GRAIN DISPOSED OF				ON HAND END OF PERIOD	PROPOSED USE		
				TRANS- FERRED	SEEDED	FED	TOTAL		SEED	FEED	SURP.
Barley	25							25			
Speltz	25							25			

- (8) Indicate shipping or collection points.....
- (9) Grain is stored at Mud Lake headquarters site.....
- (10) Remarks Barley and speltz on hand is of inferior germination and it is only suitable for feed.



REFUGEE GRAIN REPORT

NR-8a

REFUGEE GRAIN REPORT

This report should cover all grain on hand, received, or disposed of, during the period covered by this narrative report.

Report all grain in bushels. For the purpose of this report the following approximate weights of grain shall be considered equivalent to a bushel: Corn (shelled)--55 lbs., Corn (ear)--70 lbs., Wheat--60 lbs., Barley--50 lbs., Rye--55 lbs., Oats--30 lbs., Soy Beans--60 lbs., Millet--50 lbs., Cowpeas--60 lbs., and Mixed--50 lbs. In computing volume of granaries, multiply the cubic contents (cu. ft.) by 0.8 bushels.

- (1) List each type of grain separately: Corn, wheat, proso millet, etc. Include only domestic grains; aquatic and other seeds will be listed on NR-9.
- (3) Report all grain received during period from all sources, such as transfer, share-cropping, or harvest from food patches.
- (4) A total of Columns 2 and 3.
- (6) Column 4 less Column 5.
- (7) This is a proposed breakdown by varieties of grain listed in Column 6.
- (8) Nearest railroad station for shipping and receiving.
- (9) Where stored on refuge: "Headquarters grainary", etc.
- (10) Indicate here the source of grain shipped in, destination of grain transferred, data on condition of grain, unusual uses proposed.

Refuge Mud LakeYear 1947

Permittee	Permit No.	Unit or Location	Actual Acreage Utilized	Animal Use Months	Tons of Hay Harvested	Period of Use From - To	Rate	Total Income	Remarks
Roy Sorum	17509 18335	H-11, H-12, A-9	35.5		46.25	7/1/ 11/1	1.00	46.25	
Delmar Hagen	17513	H-1	20.0		25.31	7/1 11/1	1.00	25.31	
Ole Koberg	17510	H-2, A-4	18.0		23.62	7/1 11/1	1.00	23.62	
Ole Tveit	18086	H-14, 15, A-12 13, 14, 15, 16	70.0		90.00	7/1 11/1	1.00	90.00	
Herman Severts	17507	H-6	18.0		23.17	7/1 11/1	1.00	23.17	
Carrall R. Curtiss	17508	A-6	none		none	7/1 11/1	1.00	6.25	
P. A. Jorland	18605	A-13, A-20	20.0		15.1 10.5	7/29 11/1 7/29 11/1	1.00 .50	15.10 5.25	
Art Lunke	18603	A-10	27.5		35.86	8/1 11/1	.50	17.93	
Lloyd J. Johnson	17522	H-3	9.0		11.73	7/1 11/1	1.00	11.73	
Carl Gronvold	18081	H-17	48.5		63.11	7/1 11/1	1.00	63.11	
Arthur Klamar	18084	H-1, A-1	13.6		17.69	7/1 11/1	1.00	17.69	
Bill Bernstein	17511	A-3	7.4		9.98	7/1 11/1	1.00	9.98	

Totals:

Acreage grazed \_\_\_\_\_

Animal use months \_\_\_\_\_

Total income Grazing \_\_\_\_\_

Acreage cut for hay \_\_\_\_\_

Tons of hay cut \_\_\_\_\_

Total income Haying \_\_\_\_\_



## HAYING AND GRAZING

Refuge Mud LakeYear 1947

Permittee	Permit No.	Unit or Location	Actual Acreage Utilized	Animal Use Months	Tons of Hay Harvested	Period of Use From - To		Rate	Total Income	Remarks
Johnnie Nelson	18082	H-9, H-10, A-10	21.0		27.56	7/1	11/1	1.00	27.56	
Fred Herriek	17512	H-7, H-8	19.5		25.38	7/1	11/1	1.00	25.38	
Julian Rodahl	18612	Grazing #3	29.5		38.46	8/7	11/1	1.00	38.46	
	18083	A-11, H-13	42.0		54.89	7/1	11/1	1.00	54.89	
			18.2		23.79	7/1	11/1	.50	11.89	
Oscar Wallin	18339	A-19	46.0		60.00	7/21	11/1	1.00	60.00	
			11.6		15.00			.50	7.50	
Ole Tveit	17533	G-2	400	101	101	6/15	11/1	.50	50.50	
Johnnie Nelson	18085	G-4	138	34		6/15	9/14	.50	17.00	
				33				.35	11.55	
Delmar Hagen	17573	G-1	1900	21.28		6/15	7/25	.50	10.64	
Ralph Hagen	17532	G-1	1900	52		6/15	10/3	.50	26.00	
				41.5				.35	14.52	
Julian Rodahl	17531	G-3	400	6.25		6/15	11/1	.50	18.00	
				2.5				.35		

Totals:

Acreage grazed 4,738Animal use months 291.53Total income Grazing \$148.21Acreage cut for hay 475.3Tons of hay cut 617.40Total income Haying \$581.07

\* Original down payment, balance lost due to lack of utilization.

## TIMBER REMOVAL

Refuge Mud Lake National Wildlife Refuge Year 1947

Permittee	Permit No.	Unit or Location	Acreage	No. of Units Expressed in B.F., ties, etc.	Rate of Charge	Total Income	Reservations and/or Diameter Limits	Species Cut
Arne Rantanen	17514	Sec. 34, T. 156 N., R. 42 W.		10.5	.50	\$5.25		Down and fallen timber

Total acreage cut over \_\_\_\_\_ Total income \$5.25

No. of units removed B. F. \_\_\_\_\_ Method of slash disposal \_\_\_\_\_

Cords 10.5

Ties \_\_\_\_\_

Refuge and Lands Admin. Wildlife Refuge July 1947

Permittee	Permit No.	Unit or Location	Acreage	No. of Units Expressed in A.P. Plan, etc.	Rate of Charge	Total Income	Reservations and/or Diameter Limits	Species Code
Arco Lumber	17514	Sec. 34, T. 128 N., R. 42 W.		10.8	.80	\$8.64		Scots Pine Fir



Total income \$8.64

Total acreage cut over \_\_\_\_\_

No. of units removed R. F. 10.8

Costs \_\_\_\_\_

Profits \_\_\_\_\_

Method of slash disposal \_\_\_\_\_



3-1753  
Form NR-3  
(June 1945)

# BIG GAME

Refuge Mud Lake

Calendar Year 1947

(1) Species	(2) Density	(3) Young Produced	(4) Removals				(5) Losses			(6) Introductions	(7) Estimated Total Refuge Population		(8) Sex Ratio
			Hunting	For Re- stocking	Sold	For Research	Predation	Disease	Winter Loss		At period of Greatest use	As of Dec. 31	
Common Name	Cover types, total Acreage of Habitat	Number								Source			
White-tailed deer	Omitted until accurate information is obtained						No definite information			None	897	897	*3 M to 2 F
Moose										none	35	35	*1 M to 1 F

Remarks:

\*Estimate only

Reported by

Robley W. Hunt



## INSTRUCTIONS

Form NR-3 - BIG GAME

- (1) SPECIES: Use correct common name; i.e., Mule deer, black-tailed deer, white-tailed deer. It is unnecessary to indicate sub-species such as northern or Louisiana white-tailed deer.
- (2) DENSITY: Detailed data may be omitted for species occurring in limited numbers. Density to be expressed in acres per animal by cover types. This information is to be prefaced by a statement from the refuge manager as to the number of acres in each cover type found on the refuge; once submitted, this information need not be repeated except as significant changes occur in the area of cover types. Cover types should be detailed enough to furnish the desired information but not so much as to obscure the general picture. Examples: spruce swamp, upland hardwoods, reverting agriculture land, bottomland hardwoods, short grass prairie, etc. Standard type symbols listed in Wildlife Management Series No. 7 should be used where possible. Figures submitted should be based on actual observations and counts on representative sample areas. Survey method used and size of sample area or areas should be indicated under Remarks.
- (3) YOUNG PRODUCED: Estimated total number of young produced on refuge.
- (4) REMOVALS: Indicate total number in each category removed during the year.
- (5) LOSSES: On the basis of known records or reliable estimates indicate total losses in each category during the year.
- (6) INTRODUCTIONS: Indicate the number and refuge or agency from which stock was secured.
- (7) TOTAL REFUGE POPULATION: Give the estimated population of each species on the refuge at period of its greatest abundance and also as of Dec. 31.
- (8) SEX RATIO: Indicate the percentage of males and females of each species as determined from field observations or through removals.

116008



3-1756  
Form NR-6  
(April 1946)

FISH

Refuge Mud Lake Refuge, Holt, Minn.

Year 1947

Species	Relative Abundance	Sport Fishing		Commercial Fishing		Restocking		Number removed for Restocking
		Man days Fishing	Number Taken	No. of Permits	Pounds Taken	Number Stocked	Area Stocked	
Northern Pike	common							
Sheephead	Fairly common							
Bullhead	common							
Minnows:								
Dace	abundant							
Shiners	"							
Fathead	"							
A heavy run of Northern Pike was noted in Ditch 11 during November 20-30 just east of refuge boundaries								

REMARKS:

PLANTINGS  
(Marsh - Aquatic - Upland)

 Refuge Mud Lake Refuge, Holt, Minn.

 Year 194<sup>7</sup>

Species	Location of Area Planted	Rate of Seeding or Planting	Amount Planted (Acres or Yards of Shoreline)	Amount & Nature of Propagules	Date of Plant- ing	Survival	Cause of Loss	Remarks
<del>Nothing Planted</del> Norway Spruce				500		8570 (8-21)		

## TOTAL ACREAGE PLANTED:

Marsh and aquatic \_\_\_\_\_  
 Hedgerows, cover patches \_\_\_\_\_  
 Food strips, food patches \_\_\_\_\_  
 Forest plantings \_\_\_\_\_

