

ESTABLISHMENT OF A RESIDENT BREEDING FLOCK OF CANADA GEESE IN LOUISIANA¹

by

Robert H. Chabreck
School of Forestry and Wildlife Management
Louisiana State University
Baton Rouge, Louisiana 70803

Howard H. Dupuie
Louisiana Wildlife & Fisheries Commission
Grand Chenier, Louisiana 70643

Donald J. Belsom
Louisiana Cooperative Wildlife Research Unit
Louisiana State University
Baton Rouge, Louisiana 70803

ABSTRACT

Canada Geese were released on Rockefeller Refuge in Louisiana in 1960 in hopes of establishing a resident, non-migratory flock. One nest was constructed in 1961; however, the number of nests increased each year and by 1973, 265 nests were located on the refuge. The geese became acclimated to the warmer southern temperatures and adjusted their nesting season accordingly. They tended to nest earlier in the year with succeeding nesting seasons. The earliest nesting date on the refuge was February 19, 1968.

Parent geese were allowed to incubate the majority of the nests; however, eggs were confiscated from 187 nests and placed in an artificial incubator in an attempt to increase production. Approximately 48.5 percent of the eggs naturally incubated hatched, whereas, only 26.8 percent of those artificially incubated hatched. The greatest loss of eggs incubated by parent geese was attributed to infertility and embryonic death.

Sixty percent of the nests which were allowed to incubate naturally produced at least one gosling. Early nests appeared to be slightly more successful than late ones. Predation and desertion each account for 13.4 percent of nest loss. Approximately 13.2 percent of the nests failed to produce young because of faulty eggs.

INTRODUCTION

Louisiana at one time was a major wintering area for Canada Geese (*Branta canadensis*) and prior to 1944 wintered more Canada Geese than any other state in the Mississippi Flyway, according to the midwinter survey reports (Hankla and Rudolph, 1967). From the late 1930's to the mid-1950's, the reports show that Canada Goose populations in Louisiana dropped from a high of 88,250 to a low of 5,200.

Because of the greatly reduced numbers of migrant Canada Geese in Louisiana, a plan was initiated in 1960 for establishing local nesting flocks within the state. Little information was available on Canada Goose nesting along the Gulf Coast. Previous reports on establishing local nesting populations dealt mostly with attempts in north central and northeastern states (U. S. Department of the Interior 1958; Clark and Nightingale 1960). Therefore, much of the earlier work on this project was experimental in nature.

In October, 1960, 27 Canada Geese were obtained from the Wisconsin Conservation Department and placed in a 3-acre enclosure on the Rockefeller Wildlife Refuge in southwestern Louisiana. In February 1961, an additional 34 birds were obtained from Wisconsin and released in the same area. The geese were mostly cripples picked up on public shooting areas and were of mixed ages. One pair nested during the Spring, 1961, and 3 young were reared (Table 1). Five pairs nested during 1962 and 25 young hatched.

The project appeared favorable and plans were made to add new enclosures and increase the size of the breeding population. Four goose pastures were constructed in the vicinity of the refuge headquarters. The area of the four pastures totaled about 300 acres and involved the draining, mowing and fencing of marsh areas.

Two programs were initiated in an effort to increase the breeding population. One method was the removal of all eggs from early nests and hatching the eggs in an electric

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incubator. The geese would then renest, thereby producing two clutches per year. The other method was to obtain additional geese from outside sources.

During the Fall, 1962, 60 immature Canada Geese (*B. c. interior*) were live trapped in Saskatchewan and Missouri, pinioned, and released on the refuge. In 1963, 1500 adult geese were captured in Missouri, wing-clipped, and released on the refuge. During 1966 and 1967, 380 hand-reared immature, giant Canadas (*B. c. maxima*) were purchased in Minnesota for use as breeders; and in 1968, 500 eggs were collected from nests of wild Canada Geese in Saskatchewan, incubated, and the newly hatched young shipped to Rockefeller Refuge. The young were reared in a brooder then released when able to fly.

The nesting success of Canada Geese from different sources and age groups was presented in an earlier paper (Chabreck and Dupuie 1972). Nesting among geese which were transported to Rockefeller Refuge as immatures equaled that of geese which were hatched and reared on the refuge. Canada Geese brought to the refuge as adults failed to nest.

MATERIALS AND METHODS

The four enclosures were surrounded with field fencing 5 feet high and located at the headquarters site on Rockefeller Refuge. Two enclosures were 35 acres, one was 60 acres and the other 170 acres. Seven flight pens, 60 feet by 60 feet, were constructed to temporarily hold geese to be wing-clipped after the post-nuptial molt.

Attempts were made to locate all nests within the 300 acres of goose pastures. As each nest was located, a number marker was placed nearby. The nests were checked at 2 or 3-day intervals until nesting terminated and the condition of the nest recorded. Eggs were collected from most nests found in February and March and placed in an incubator for hatching. This was done with the idea that the geese would renest, thereby increasing egg production from the flock.

RESULTS AND DISCUSSION

Nesting Dates

The initial dates of nesting were recorded for each Canada Goose nest constructed on the Rockefeller Refuge throughout the 13 year study period. The first nesting season on the refuge began in April, 1961. In the succeeding nesting seasons, the geese began nesting in March; however, in 1967, 1968, and 1973, the geese began nesting as early as February (Table 1). The distribution of nesting dates showed that nesting was spread out over a period of eight weeks with a peak mostly occurring during the last week of March (Figure 1). Similar peak nesting dates were reported by Naylor (1953), Geis (1956) and Hanson and Eberhardt (1971). The nesting season gradually extended earlier into the year. This shift in the nesting season was presumably a response to the warmer temperatures of the south. Hanson and Eberhardt (1971) reported that the Canada Geese nesting on the Columbia River in Washington adjusted their nesting season to the average daily temperatures. They stated that most nests were begun when the average daily temperatures remained above 40° F for a long period of time. The two earliest nesting dates for the geese on Rockefeller Refuge occurred on February 19, 1968 and February 20, 1973. These dates are much earlier than those reported in the literature by other researchers (Table 2).

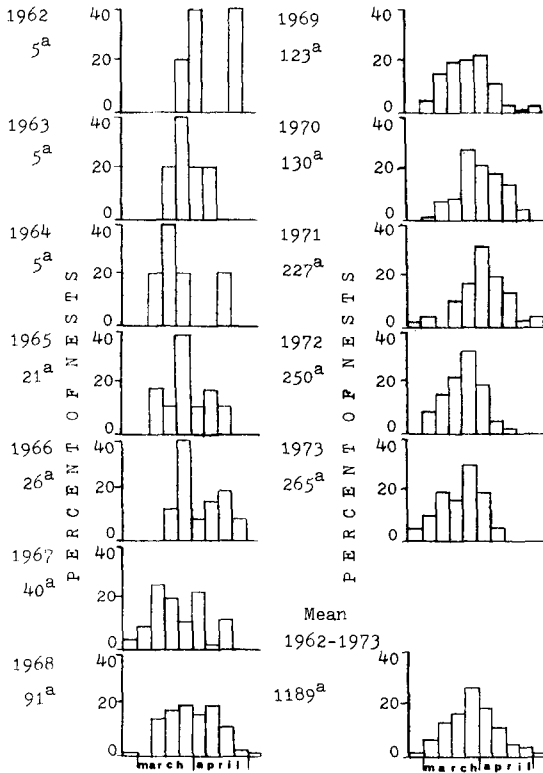
Table 1. History of Canada Goose production on Rockefeller Refuge, 1961-1973.

Year	Estimated Number of Geese Presenta	Number of Nest Present	Number of Eggs Laid	Number of Eggs Hatched	Date First Eggs Laid
1961	61	1	7	3	4/61
1962	64	5	33	25	3/28/62
1963	144	5	28	19	3/16/63
1964	157	5	25	23	3/12/64
1965	165	21	96	22	3/ 8/65
1966	172	26	121	47	3/18/66
1967	329	40	184	39	2/28/67
1968	585	91	367	156	2/19/68
1969	1180	123	511	216	3/ 4/69
1970	1280	130	589	314	3/11/70
1971	1465	227	1012	557	3/ 1/71
1972	1875	250	1177	657	3/ 1/72
1973	2250	265	1107	380	2/20/73
Total		1189	5257	2368	

a)Does not include 1500 adult Canada Geese brought to the study area in 1963.

Table 2. Clutch size of Canada Geese reported by other researchers.

Authority	State	Nesting Season	No. of Nests	Average Clutch Size
Craighead and Craighead (1949)	Wyoming	1947	17	4.6
Dow (1943)	California	1943	215	5.1
Kossack (1950)	Illinois	1945	67	4.6
		1946	73	5.4
Naylor (1953)	California	1951	360	5.5
Steel et al. (1957)	Idaho	1949	36	4.6
		1950	189	5.2
		1951	139	5.2
Weigand et al. (1968)	Michigan	1953-61		5.6



^aThis figure represents total number of nests located in the given year.

Figure 1. Time of initiation of nesting of Canada Goose nests on Rockefeller Refuge, Louisiana, 1962-1973.

Clutch Size

Data on the frequency of clutch size and mean clutch size for all nests found on the refuge are presented in Table 3. Refuge personnel located a total of 1,189 nests, containing 5,257 eggs, on the refuge throughout the entire study period. The average annual clutch size ranged from a high of 7.00 in 1961 to a low of 4.15 in 1969. The mean clutch size of the 1,189 nests was 4.42. This figure is somewhat below the average clutch size reported by other researchers (Table 2). The clutch size varied from 1 to 9 eggs, with a majority of nests containing 6 eggs or less. Over 300 nests contained clutches of 2, 3, or 4 eggs; whereas, only 120 nests contained clutches of 7, 8, or 9 eggs.

There was some variation in the average clutch size throughout the study period. Hanson and Eberhardt (1971) reported that, "average clutch tended to increase and decrease in proportion to the number of nests." However, this condition was not observed on Rockefeller Refuge. A correlation of the number of nests with average clutch size was significant ($r = -.573$, $P 0.05$), which indicated that average clutch decreased with an increase in nesting activity. This trend is what would be expected since any increase in competition for nest sites would increase population stress and ultimately result in a lower productivity.

Some of the nests were collected early in the nesting season and the eggs placed in an artificial incubator to encourage renesting and increase overall egg production. No attempt was made to determine whether clutch size was affected by renesting. However, Weigand et al. (1968) and Atwater (1959) reported that there was no significant difference between the clutch size of original nests and re-nests. The variation in average clutch size was probably the result of the different age classes of geese in the population. Younger birds probably tended to produce fewer large clutches (Munro 1958, and Kossack 1950). The progressive annual increase in the number of nests on Rockefeller Refuge mostly reflected the nesting of young geese produced on the refuge two to three years earlier.

Fate of Eggs

A total of 5,257 eggs was found on the refuge during the entire study period, and of these eggs, 2,368 (45.0 percent) hatched (Table 1). The majority of eggs which hatched were incubated by the parent geese; however, some eggs were placed in an artificial incubator in an attempt to increase production. The fates of the eggs naturally and artificially incubated are summarized in Tables 4 and 5, respectively.

Eggs incubated by the parent geese were subdivided into four categories: abandoned, destroyed, faulty, and hatched. Eggs which were infertile, broken or contained dead embryos were classified as faulty. The percent of eggs hatched was determined by dividing the number of goslings hatched by the total number of eggs laid.

As shown in Table 4, the percent of eggs hatched by means of natural incubation ranged from a low of 22.9 percent in 1965 to a high of 92.0 percent in 1964. The mean percent of goslings hatched by the parent geese during the study period was 48.5 percent. This was well below the hatching success reported by Hanson and Elberhardt in 1971 (88.7 percent) and by Geis in 1956 (86.0 percent). However, these researchers based hatching success upon the percent of eggs hatched in successful nests. A successful nest was one in which at least one egg hatched. Computations of the hatching success based only on eggs incubated for the full incubation period (excluding eggs lost to predators or abandoned), showed that the hatching success of the Rockefeller flock was comparable to the ones cited by Hanson and Eberhardt (1971) and Geis (1956) (Table 6).

Over 51 percent of the eggs which were permitted to be incubated naturally did not hatch (Table 4). Faulty eggs were responsible for a large proportion (27.3 percent) of egg loss. Predators, which destroyed 362 eggs (10.9 percent), were the second most important cause of egg loss. The main predators on the Canada Goose nests were alligators (*Alligator mississippiensis*) and raccoons (*Procyon lotor*) and, to a lesser extent, opossums (*Didelphis virginiana*) and striped skunks (*Mephitis mephitis*) (Table 7). Fallow deer (*Dama dama*) destroyed seven eggs when they bedded down on two goose nests. Approximately 263 eggs (7.9 percent) did not hatch as a result of nest abandonment.

Natural incubation was responsible for the production of 2,145 goslings. The average brood size, resulting from natural incubation, varied from 5.75 in 1962 to 2.75 in 1965, with a mean of 4.12 (Table 4). The brood size was determined by dividing the number of eggs hatched by the number of successful nests which were incubated by the parent geese. This method, however, excluded goslings which were lost after hatching; therefore, the actual mean brood size was slightly below 4.12. Also excluded from this figure were goslings hatched in the artificial incubator.

Table 3. Frequency of clutch size for all Canada Goose nests found on Rockefeller Refuge, 1961-1973.

Year	No. of Nests	Number of Eggs per Nest									Average Clutch Size		
		1	2	3	4	5	6	7	8	9			
1961	1							1					7.00
1962	5									3		1	6.60
1963	5									2		1	5.60
1964	5									1			5.00
1965	21		2	2						2		3	4.57
1966	26		1	3						5		2	4.62
1967	40	2	2	5	5					8		5	4.73
1968	91	8	9	12	15					21		4	4.25
1969	123	21	15	7	11					32		11	4.15
1970	130	11	10	11	24					34		13	4.53
1971	227	18	17	27	39					50		13	4.46
1972	250	19	17	26	25					69		20	4.70
1973	265	36	37	32	29					42		27	4.18
Total	1189	115	110	124	167					275		100	4.44

Table 4. The fate of 4,418 eggs incubated by parent birds on Rockefeller Refuge, 1961-1973.

Year	Eggs Abandoned		Destroyed by Predators		Eggs Faulty ^a		Eggs Hatched		Average Brood Size
	No.	%	No.	%	No.	%	No.	%	
1961	0	0.0	0	0.0	4	57.1	3	42.9	3.00
1962	0	0.0	0	0.0	4	14.8	23	85.2	5.75
1963	0	0.0	0	0.0	9	32.1	19	67.9	3.80
1964	0	0.0	0	0.0	2	8.0	23	92.0	4.60
1965	21	21.9	24	25.0	29	30.2	22	22.9	2.75
1966	20	16.5	31	25.6	23	19.0	47	38.8	3.77
1967	7	6.7	39	37.5	19	18.3	39	37.5	3.55
1968	8	5.8	23	16.8	32	23.4	74	54.0	3.90
1969	3	.9	6	1.8	163	47.9	168	49.4	3.90
1970	53	10.3	64	12.5	129	25.1	268	52.1	3.62
1971	74	8.3	157	17.6	150	16.8	510	62.5	4.21
1972	77	7.5	18	1.8	359	35.2	567	55.5	4.30
1973	--	--	--	--	--	--	380	34.3	3.72
Total	263b	7.9b	362b	10.9b	904b	27.3b	2143	48.5	4.12

^aIncludes eggs which were infertile, contained dead embryos, broken or missing.

^bThis figure does not include 1973 data.

Table 5. Fate of 839 eggs artificially incubated on Rockefeller Refuge, 1962-1972.

Year	No. of Eggs Incubated	Eggs Hatched	
		No.	%
1962	6	2	33.3
1967	80	0 ^a	0.0
1968	230	82	35.7
1969	171	48	28.1
1970	75	46	61.3
1971	121	47	38.8
1972	156	0 ^a	0.0
Total	839	225	26.8

^aAbsence of hatching resulted from faulty incubator.

Table 6. Hatching success of Canada Goose eggs incubated for the full incubation period by parent geese on Rockefeller Refuge, 1961-1972.

Year	No. of Eggs Incubated	No. of Eggs Hatched	Percenta Hatching
1961	7	3	42.9
1962	27	23	85.2
1963	28	19	67.9
1964	25	23	92.0
1965	18	11	61.1
1966	70	47	67.1
1967	58	39	67.2
1968	104	74	71.2
1969	334	168	50.3
1970	389	268	68.8
1971	544	510	93.8
1972	921	567	61.5
Total	2525	1752	69.4

^aDoes not include eggs lost to predators or abandoned.

Table 7. Predation of Canada Goose eggs on Rockefeller Refuge.

Year	No. of Eggs Lost	Predators					
		Alligator	Raccoon	Opossum	Deer	Skunk	Unknown
		Percent					
1965	24	0.0	0.0	0.0	0.0	0.0	100.0
1966	31	35.5	41.9	0.0	22.6	0.0	0.0
1967	39	10.3	12.8	0.0	0.0	0.0	76.9
1968	23	17.4	0.0	0.0	0.0	0.0	82.6
1969	6	100.0	0.0	0.0	0.0	0.0	0.0
1970	64	84.5	6.3	3.1	0.0	0.0	3.1
1971	157	26.8	3.2	3.8	0.0	2.5	63.7
1972	18	38.9	55.6	5.6	0.0	0.0	0.0
Total	362	35.9	10.2	2.5	1.9	1.1	48.3

aThis figure represents total number of nests located in the given year.
 aComplete histories of nests were not recorded for the 1973 nesting season.

The hatching success of eggs artificially incubated was very poor (Table 5). Of the 839 eggs which were placed into the incubator, 614 failed to hatch. The mean hatching success of these eggs over a 7-year period was 26.8 percent. This low hatching success, according to other researchers, was not unusual. Weigand et al. (1968) reported that almost two-thirds of all artificially incubated Canada Goose eggs fail to hatch.

The highest hatching success experienced with the incubator occurred in 1970 when 61.3 percent of the eggs hatched. A faulty incubator was responsible for a zero hatching rate in 1967 and 1972, and resulted in the combined loss of 236 eggs. These eggs represented 38 percent of all eggs which failed to hatch in the incubator. A mean hatching success of 32.3 percent would have resulted had the 1967 and 1972 data on artificial incubation been excluded. This hatching success, therefore, would have been very similar to that reported by Weigand et al. (1968) for artificial incubation.

Nesting Success

The fate of 737 nests during the period of 1961 to 1972 is shown in Figure 2. The overall nesting success, expressed as a percentage of the nests which produced at least one gosling, was 60 percent. A similar nesting success was recorded by Hanson and Eberhardt (1971) for Canada Geese nesting on the Hanford Reservation in southeast Washington. The aggregate nesting success of the Rockefeller geese was calculated only for nests which were permitted to be incubated by the parent geese; nests in which the eggs were placed in an incubator were excluded. Nests constructed in 1972 were also excluded from the mean nesting success because of incomplete nest histories.

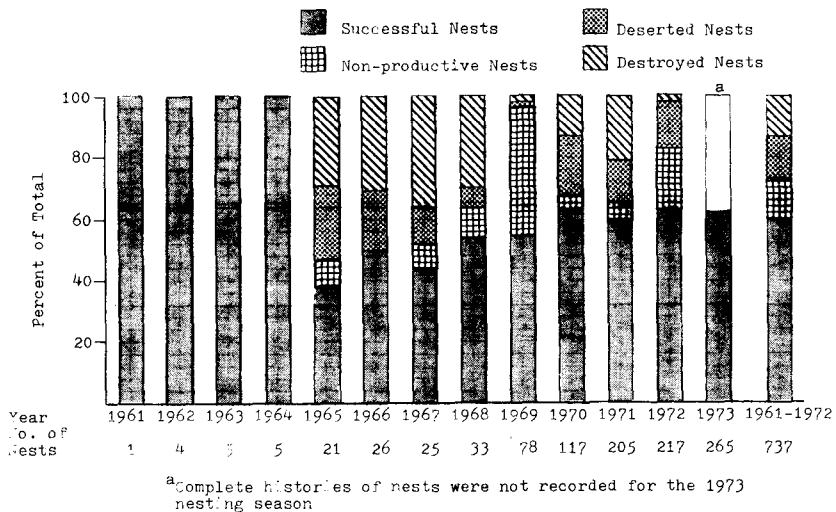


Figure 2. Fate of naturally incubated Canada Goose nests on Rockefeller Refuge, Louisiana 1961-1972.

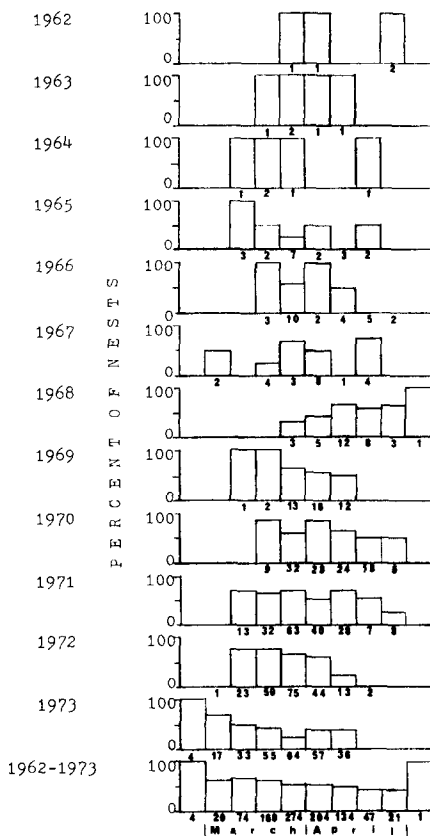


Figure 3. Weekly nest success (percent) of naturally incubated Canada Goose nests on Rockefeller Refuge, Louisiana, 1962-1973 (Number of nests indicated along horizontal axis).

The success of nests constructed during each week of the nesting season, excluding nests which were robbed by refuge personnel, was computed to ascertain whether time of nesting affected nest success. As shown in Figure 3, the composite weekly nesting success fluctuated very little, but it did indicate that early nests were slightly more successful than the nests which were constructed in the latter part of the nesting season. Over 64 percent of the nests constructed in the second week of March were successful, but this percentage gradually declined to 42.9 percent by the last week in April. Considerable variation in the weekly nesting success was observed within most of the nesting seasons, with the exceptions occurring in 1962, 1963, 1964, and 1971. The 1968 nesting season was the only instance in which the highest nest success occurred in the last week of April.

Causes of Nesting Failure

Forty percent of the 737 nests tended by the geese failed to produce a gosling. The main causes of nesting failure were predation, desertion, and faulty eggs. Predation and desertion ranked equally high; both were responsible for the loss of 99 nests (13.4 percent). The amount of nest desertion observed in this study was less than the percent-

tages of desertion found by other researchers: Hanson and Eberhardt (1971), 14 percent; Steel et al. (1957), 15 percent; Gies (1956), 17 percent; and Naylor (1953), 23.9 percent. Nest desertion, however, could have been much higher but not detected prior to nest destruction (Geis 1956). Ninety-seven nests (13.2 percent) which were neither destroyed nor abandoned contained eggs which did not hatch.

In 1969 an effort was made to determine the percentages of eggs, incubated by parent geese, which contained dead embryos and those which failed to undergo embryonic development. The study revealed that of the 331 eggs incubated, 41 eggs (13.2 percent) contained dead embryos, whereas, 104 eggs (33.5 percent) contained no evidence of embryonic development.

Outside Nesters

During the 1968 nesting season, at least three pairs of Canada Geese were believed to have nested outside the nesting enclosure. One pair with four young were found 3 miles northwest of the enclosure and another pair was seen one-half mile northeast of the enclosure. A third pair nested on the levee of an experimental fish pond, located about one-quarter mile southeast of the nesting enclosure, and successfully produced four goslings.

In 1969, five pairs of Canadas were known to have nested off Rockefeller Refuge; however, there were additional reports of other nests off the refuge. The five nests were found within one mile of the nesting enclosure.

Eighteen nests were either examined or reported off the refuge during the 1970 nesting season. Approximately 55 goslings were believed to have been reared off the refuge. On May 19, 1970, an aerial survey was made to determine the number of birds off the refuge and the extent of off-refuge nesting. Only two pairs with broods and a group of three birds were spotted within one mile of the nesting enclosure.

During the 1971 nesting season, reports were made of Canada Geese nesting considerable distances from the refuge. Nesting geese were reported in the Sweet Lake community, located 30 miles northwest of the nesting enclosure on Rockefeller Refuge. Several reports were made of geese nesting within 10 to 20 miles of the refuge, and a number of nesting Canadas were sighted within 2 miles of the Refuge.

Data on Canada Geese nesting off Rockefeller were not available for the 1972 and 1973 nesting seasons. However, it does appear that as the size of the resident flock increases the number of nests constructed off the refuge likewise increases.

SUMMARY AND CONCLUSIONS

Canada Geese were transported to Rockefeller Refuge in 1960 and held in captivity in hopes of establishing a resident breeding flock. Only one nest was constructed in 1961; however, by 1973, 1,189 nests containing 5,257 eggs, had been located on the refuge. The geese became acclimated to the warmer southern temperatures and adjusted their nesting season accordingly. They tended to nest earlier in the year with succeeding nesting seasons. The earliest nesting date on the refuge was February 19, 1968.

Parent geese were allowed to incubate the majority of the nests; however, eggs were confiscated from 187 nests and placed in an artificial incubator in an attempt to increase production. Approximately 48.5 percent of the eggs naturally incubated hatched, whereas, only 26.8 percent of those artificially incubated hatched. The overall hatching success resulting from natural and artificial incubation was 45 percent. The greatest loss of eggs, incubated by parent geese, was attributed to infertility and embryonic death. A faulty incubator accounted for 38 percent of the eggs which were lost during artificial incubation.

Sixty percent of the nests which were allowed to be incubated naturally produced at least one gosling. Early nests appeared to be slightly more successful than late ones. Predation and desertion, each, account for 13.4 percent of nest loss. Approximately 13.2 percent of the nests failed to produce young because of faulty eggs.

The resident flock of Canada Geese on Rockefeller Refuge appears to be steadily increasing. However, if the ultimate aim of this flock is to be achieved, a free-flying, non-migratory, huntable flock, then these birds must be encouraged to nest off the refuge and strong public backing sought for the project. Also, small satellite flocks should be established in the vicinity of Rockefeller Refuge and elsewhere in southwestern Louisiana, using a portion of the Canada Geese hatched on Rockefeller Refuge as a source of breeders.

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