1974

Evaluation of Duck Production On Waterfowl Production Areas in Northeast North Dakota

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EVALUATION OF DUCK PRODUCTION ON WATERFOWL PRODUCTION AREAS IN NORTHEAST NORTH DAKOTA

BY

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A thesis submitted
in partial fulfillment of the requirements for the
degree Master of Science, Major in
Wildlife Biology,
South Dakota State University

1974

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This thesis is approved as a creditable and independent investigation by a candidate for the degree, Master of Science, and is acceptable for meeting the thesis requirements for this degree. Acceptance of this thesis does not imply that the conclusions reached by the candidate are necessarily the conclusions of the major department.

ACKNOWLEDGEMENTS

I wish to thank the Bureau of Sport Fisheries and Wildlife and South Dakota State University for the financial and technical support given during this investigation.

My deepest appreciation goes to J. M. Gates for his technical guidance and for his assistance in preparing this manuscript.

I thank H. F. Duebbert for his technical advice and for collecting field data in 1970.

I would like to thank L. D. Flake and R. L. Linder for assisting with the completion of this manuscript.

My appreciation goes to the Northern Prairie Wildlife Research Center and the Devils Lake Wetlands Management District for providing equipment and field assistance.

A special thanks to O. N. Swenson and R. F. Friese for their cooperation and to R. A. Warhurst for collecting field data in 1971.

EVALUATION OF DUCK PRODUCTION ON WATERFOWL PRODUCTION AREAS IN NORTHEAST NORTH DAKOTA

Abstract

Gerald L. Heismeyer

An investigation of duck production on six Waterfowl Production Areas (WPA's) in northeastern North Dakota was conducted during 1970-73. This investigation was conducted in conjunction with a habitat-manipulation study by the Northern Prairie Wildlife Research Center that entailed prescribed burning of three WPA's. Wetland habitat conditions, breeding populations and nesting were evaluated all four years. Brood observations were made during the last three years and nesting cover was evaluated during the last two years of investigation.

Wetland habitat conditions were generally favorable during the first three years of investigation but in 1973 wetland conditions were extremely poor due to low precipitation amounts. Wetland drainage was a prominent factor on two of the study units.

Breeding populations did not fluctuate greatly on the WPA's during the investigation. The highest number of breeding pairs observed was 291 in 1972 and the lowest number was 173 in 1970. Breeding pairs observed on the entire study area were highest in 1972 and lowest in 1973 with 1517 pairs and 576 pairs, respectively. Water in wetlands declined by 64 percent from 1972 to 1973.

Nesting habitat was generally poor during the investigation. Native grass species were dominant on the WPA's and exhibited varied response to burning. Land use on the surrounding private land was

largely cropland used to grow small grains. Much of the cropland was maintained in a fallow condition during the nesting season. Agricultural operations probably exhibited an adverse effect on early-nesting species using private land as nest sites.

Nest densities on the WPA's were generally low ranging from one nest per 4.8 acres in 1971 to one nest per 17.8 acres in 1973. A Cropland Adjustment Program (CAP) tract on the Sahl study unit had higher nest densities than did the Sahl WPA due to a difference in cover types. Nest success for the study was 32 percent. The highest nest success was observed in 1971 at 35 percent and the lowest in 1973 at 25 percent. The CAP tract had a nest success rate of 40 percent in 1972-73. Nest failure was due mainly to mammalian predation.

Brood observations made during the last three years of investigation yielded a total of 387 broods. The Becker and Erickson study units had the fewest broods observed. Hatching curves constructed for 1972 and 1973 brood data exhibited hatching peaks after mid-July and in 1972 a smaller peak occurred in early July.

On the WPA's, breeding populations were higher and more stable than on private lands. The potential for duck production on the WPA's in the study area was high but actual production was far below potential. Native grasses in a degenerate condition appeared to be inadequate in providing nest security necessary to attract nesting hens and to yield high nest success rates.

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INTRODUCTION

Idled land may hold the key to future duck production in the United States. Increased production of grain crops has brought about a reduction in idled lands and has resulted in a long-term decline in nesting success since the 1930's (Miller 1971). Land-use changes have made duck production increasingly dependent on areas specifically managed for wildlife production, such as, Waterfowl Production Areas (WPA's).

North Dakota has been important both for duck production and cereal grain production. This area has also been the site of a concentrated effort to maintain areas for future duck production under the Wetlands Acquisition Program of 1961. The purpose of this study was to (a) determine whether breeding pairs of ducks used WPA's at a higher rate than surrounding privately-owned cropland and (b) determine nest-success rates that occurred on these same WPA's.

STUDY AREA

The study area is located on the drift plain of northeastern North Dakota. The drift plain is characterized by low-relief terrain resulting in numerous Class I and III wetland basins that are shallow and temporary in nature (Stewart and Kantrud 1971). Soils in the region range from loamy to sandy chernozem soils (Norum et al. 1957). Annual precipitation for the general area (centrally located at Devils Lake) is 17 inches, with almost 50 percent of the total falling during the months of May, June and July (Bavendick 1941).

Climate and soil conditions of the area are well suited for production of cereal grains. Increased demand for cereal grains in recent years has caused intensification of farming methods and wetland drainage. New agricultural equipment has increased the farmer's capability to drain wetlands and bring even more land into crop production. Fall plowing and summer fallow also characterize the intensification of farming practices in this area.

The six study units selected for this investigation were all 160-acre Waterfowl Production Areas (WPA's) purchased under the Wetlands Acquisition Program of 1961. Each unit was identified by the name of its former owner from whom the tract was purchased, viz., the Brudevig and Pung WPA's (Cavalier County), the Becker WPA (Ramsey County), and the Sahl, Erickson and Michigan WPA's (Nelson County). The tracts had an average of 100 acres of upland cover, ranging from a low of 74 acres to a high of 124 acres. Each tract was characterized by one large, permanent Class IV or V wetland (Stewart and

Kantrud 1971). Numerous temporary Class I and III wetlands also existed on each WPA. Figure 1 shows the Becker WPA as an example with the wetland classification indicated for each wetland basin.

Upland portions of the study units were seeded in the early 1960's by personnel of the Fish and Wildlife Service. The plantings consisted mainly of native grass species but were also supplemented by introduced species of grasses and legumes. Main native grass species seeded were green needlegrass (Stipa viridula),[1] switchgrass (Panicum virgatum), big bluestem (Andropogon gerardi), little bluestem (A. scoparius), indiangrass (Sorghastrum nutans), and side-oats grama (Bouteloua curtipendula). Alfalfa (Medicago sativa) and yellow sweet clover (Melilotus officinalis) were legumes seeded on some of the tracts. Introduced grass species included slender wheatgrass (Agropyron trachycaulum), and crested wheatgrass (A. cristatum). Most of the species listed above persisted on the tracts in varying degrees of abundance during the present study. Invader species of plants present on the tracts were Kentucky bluegrass (Poa pratensis), quackgrass (Agropyron repens), and smooth bromegrass (Bromis inermis). Goldenrod (Solidago spp.) and aster (Aster spp.) were also found on the study units.

The surrounding agricultural land was included in the study for the purpose of breeding-pair censuses and brood observations. This area was determined by drawing a circle around each of the WPA's

[1] Nomenclature according to Gleason and Cronquist (1963).

Fig. 1. The Becker Waterfowl Production Area with wetland classification indicated, 1972.

(Fig. 2). The radius of each circle was 1.0 mile measured from the center of the WPA, and the total area of each study unit was accordingly 3.14 square miles. Cropland accounted for more than 70 percent of the total land area including the WPA's. Wetland basins made up a total of 13 percent of the total as an average figure.

Fig. 2. The Becker study unit with the Waterfowl Production Area indicated at the center, 1972.

METHODS AND MATERIALS

Vegetative Analysis

Vegetative-analysis transects were established in the spring of 1972 for evaluating cover quality before and after experimental prescribed burning. Burning was conducted on the Brudevig, Sahl and Erickson WPA's in May of 1972. Data from these transects were used in the present report only to describe vegetation that existed in the springs of 1972-73. Each transect was 1,400 feet long with 1.0 meter-square plots located at 100-foot intervals. Transects were marked at each end by steel fenceposts and plots were marked on at least three corners with flags or short pieces of heavy-gauge wire.

Breeding-pair Counts

Breeding-pair counts were conducted from mid-May to early June. Only one count was made for each unit. Totals obtained from the use of one count were used as an index of the breeding populations and not pure totals of breeding pairs.

The basic method of breeding-pair counts consisted of visiting each wetland basin to determine whether it contained water. Wetland basins containing water and free of emergent cover were counted at a distance if shorelines were also free of vegetation. This was done to eliminate unnecessary disturbance of breeding pairs. Wetlands that contained emergent cover extending into the basin were counted by flushing pairs. All wetlands were completely covered with the exception of the large Class IV wetland located on the Erickson WPA.

This tract was counted with a 20-power spotting scope from an elevated vantage point after which the shoreline was walked.

Data were recorded on field maps (Fig. 3). All ducks observed were recorded, including pairs, lone drakes, groups of drakes, lone females, and mixed flocks. Also recorded on each field map was an estimate of the amount of water in each wetland basin indicated with blue pencil (Hammond 1969). Land use data were also recorded on the maps, along with any other pertinent observations, e.g., predator sign or sightings, other wildlife species, and drainage ditches.

Pair counts were conducted between 8:00 a.m. and 5:30 p.m.. Counts were not conducted on days of heavy rain or strong winds (Hammond 1969).

Breeding-pair tabulations were conducted using Hammond's (1969) method. Not tabulated as pairs were ducks flying overhead or onto the study unit during counts. Other ducks not tabulated as pairs included late-nesting species not settled on home ranges, lone females, and dabbling-duck drakes in groups of more than five. Only lone drakes of American widgeon (Anas americana), and shoveler (A. clypeata) were tabulated as pairs. Pairs, lone drakes and diving-duck females in courting parties were tabulated as pairs.

Nest Searches

Nest searches were conducted on each WPA in mid-June and again in mid-July. These searches were primarily designed to locate the nests of upland-nesting ducks. Species of upland-nesting ducks

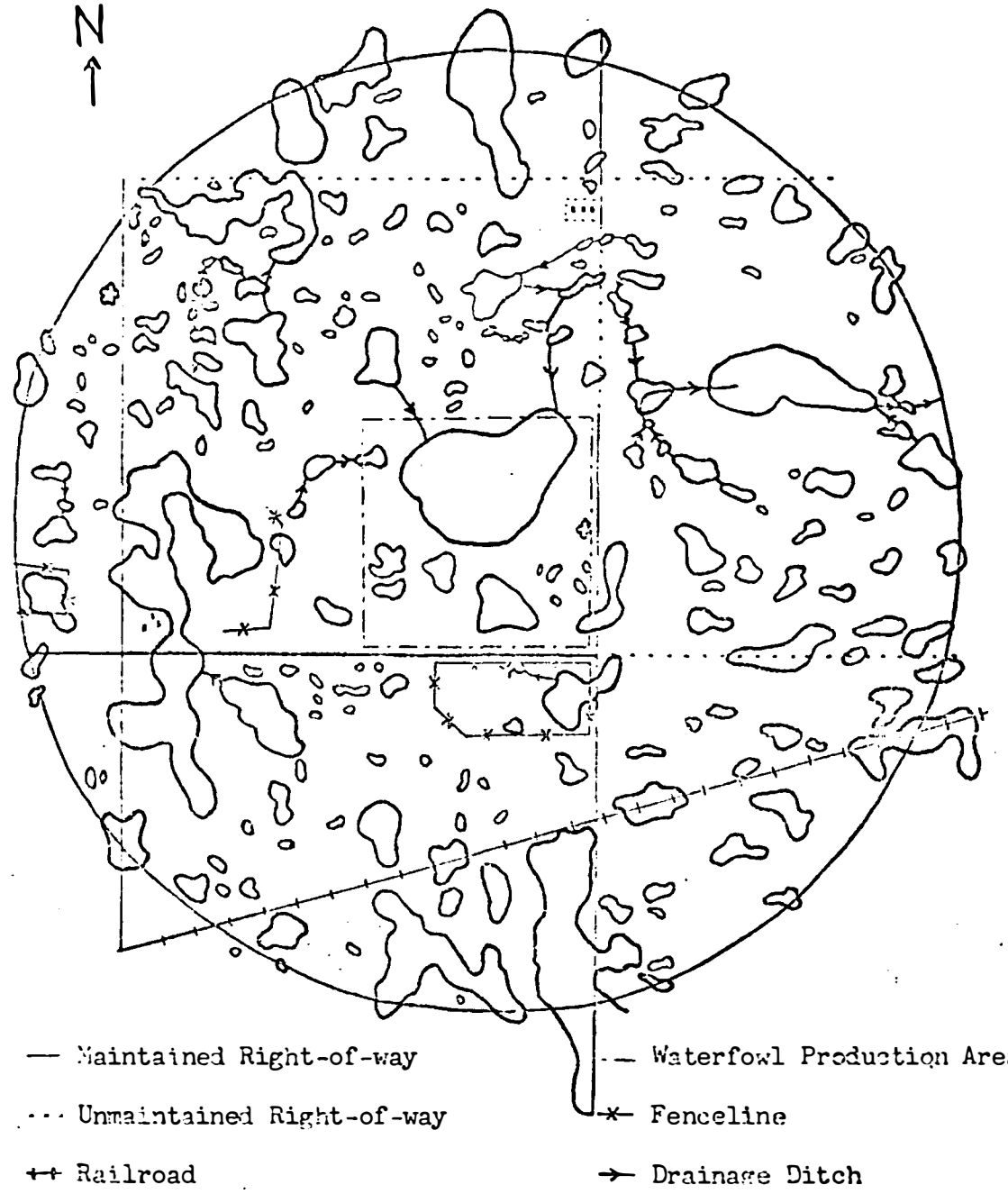

Fig. 3. Field map of the Becker study unit used for recording breeding-pair, land use and brood data. The circle's radius equals one mile.

represented in northeastern North Dakota were mallard (A. platyrhynchos), pintail (A. acuta), blue-winged teal (A. discors), gadwall (A. strepera), green-winged teal (A. carolinensis), American widgeon, and shoveler.

Nest searches were conducted with a cable-chain drag (Higgins et al. 1969). A 175-foot 5/8-inch cable was towed between two, 4-wheel drive vehicles with a 5/16-inch chain trailed behind the cable. The cable-chain was towed at speeds of 3-5 miles per hour, depending on cover density. A spotter located in one of the vehicles watched the area covered by the cable-chain and visually marked any flushed ducks. The drivers then located the nest site. Nest locations were marked with 4- or 5-foot willow branches placed one branch length from the nest.

Data were recorded on 5- x 8-inch unisort computer cards at each nest site as quickly as possible to minimize disturbance. Nests were aged by candling the eggs with a 6-inch section of automobile radiator hose (Weller 1956). Nest-initiation dates were determined by back dating the eggs. Nest locations were also recorded on field maps with a scale of 8 inches to the mile (Fig. 4).

Brood Observations

Brood observations were conducted during late July and early August in 1971-73 (Fig. 5). The lateness of the brood observations made it probable that early-hatched broods already capable of flight were not counted. The basic method used for counting was the walk-and-wade method adapted from Hammond's (1969) method of censusing

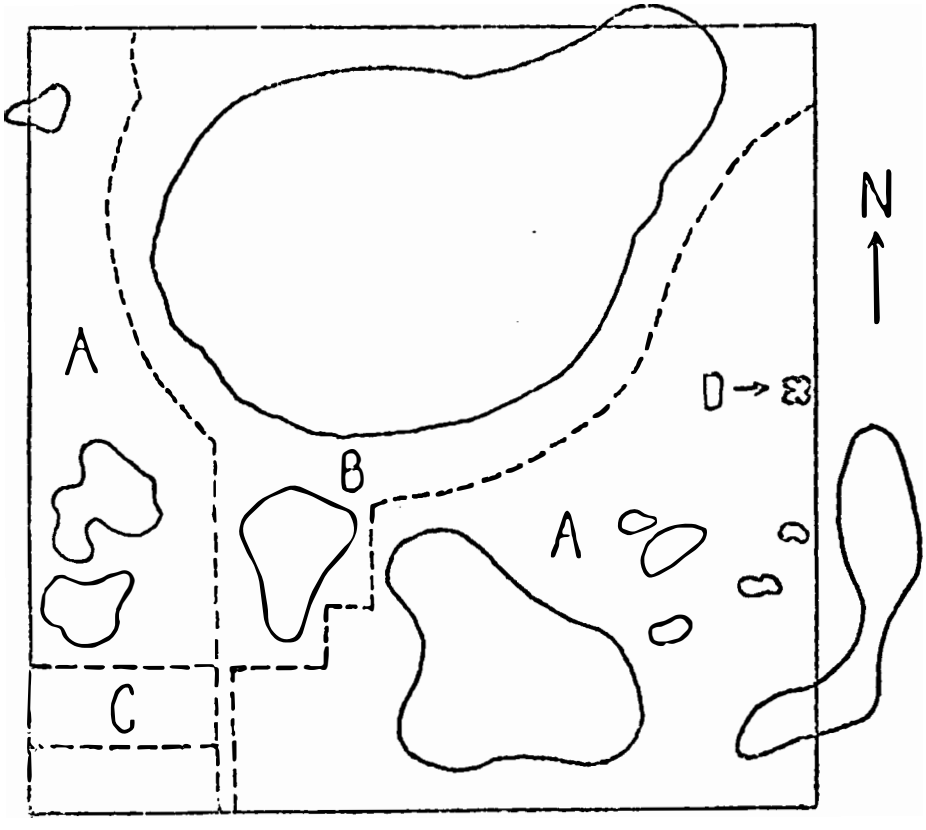

Fig. 4. Field map of the Becker Waterfowl Production Area used for recording nest locations. A represents seeded upland cover, B represents unseeded wetland margins, C represents a young tree planting, and D represents a grove of old trees.

Fig. 5. Blue-winged teal brood observed in 1973.

Fig. 6. Typical surface ditch commonly used for wetland drainage in northeastern North Dakota.

breeding pairs. Broods were aged by the system of Gollop and Marshall (1954). Ages were used to determine hatching dates from which hatching-chronology curves were constructed.

RESULTS

Wetland Habitat

Wetland classification. Wetlands within the six study units were inventoried in 1970 and revised in 1972. All wetlands were classified according to the system devised by Stewart and Kantrud (1971). The following wetland types occurred on the study units:

Class I - Ephemeral Ponds.

Class III - Seasonal Ponds and Lakes.

Class IV - Semipermanent Ponds and Lakes.

Class V - Permanent Ponds and Lakes.

Road ditches were classified only when associated with a natural wetland basin. Three dugouts existed within three different wetland basins as of 1972 and two additional dugouts were constructed during the fall of 1972. The dugouts were not classified as separate wetlands for this study. A summary of the wetland classification including acreages and percent composition of wetland types is contained in Table 1.

Wetland drainage. Extensive wetland drainage has occurred on private land within two of the study units. Over 20 percent of the wetland basins on private land surrounding the Brudevig and Becker WPA's have been drained. Drained wetland basins within the Pung study unit comprised 7 percent of the basins present. Little or no drainage had occurred on the remaining three study units. Most wetland drainage was accomplished by surface ditching (Fig. 6). Additional drainage occurred throughout the years of the investigation.

Table 1. Classification and acreages of wetlands within the 3.14 square-mile circular study units in northeastern North Dakota, 1970.

Wetland Types	Study Units					
	Pung	Brudevig	Becker	Sahl	Michigan	Erickson
Class I						
Number	59	57	90	49	108	116
Percent	43	36	52	58	55	55
Acres	16	18	23	25	34	22
Percent	7	9	10	13	11	7
Class III						
Number	70	99	80	34	78	87
Percent	51	62	46	40	40	41
Acres	146	165	148	126	104	193
Percent	65	81	62	63	35	58
Class IV						
Number	7	4	2	2	8	9
Percent	5	2	1	2	4	4
Acres	48	21	28	47	79	117
Percent	21	10	11	24	27	35
Class V						
Number	1	0	1	0	1	0
Percent	1	-	1	-	1	-
Acres	15	0	41	0	80	0
Percent	7	-	17	-	27	-
Totals						
Number	137	160	173	85	195	212
Acres	225	204	240	198	297	332

Habitat conditions. Wetland habitat conditions in spring varied from very good to very poor. Water levels in 1970 and 1971 remained relatively stable because annual precipitation levels were near or above normal (Fig. 7). Wet snows in late March and early April of 1972 provided better than average spring runoff creating high water levels. Wetland basins containing water in late May and early June of 1972 comprised 69 percent of the total number. The 1973 water levels were much lower than those of 1972 with only 13 percent of the wetland basins containing water during the same period as in 1972. The poor wetland conditions in 1973 were due to dry conditions from June, 1972 through April, 1973. Precipitation during that period was 5.32 inches below normal.

Summer wetland conditions again were relatively stable during 1970 and 1971 and began to deteriorate in 1972. Brood habitat was still available in adequate amounts in 1972 but in 1973 drought conditions reduced much of the brood habitat. Only Class V and some Class IV wetlands contained any water in late July of 1973. Water levels were noticeably lower in those wetlands containing water. Low precipitation amounts coupled with warm, windy weather conditions caused the deterioration of brood habitat in the summer of 1973. Monthly precipitation amounts for the period of investigation are summarized in Figure 7.

Breeding-pair Counts

WPA's only. Breeding pairs of ducks were counted and tabulated for all study units each of the four years of the investigation.

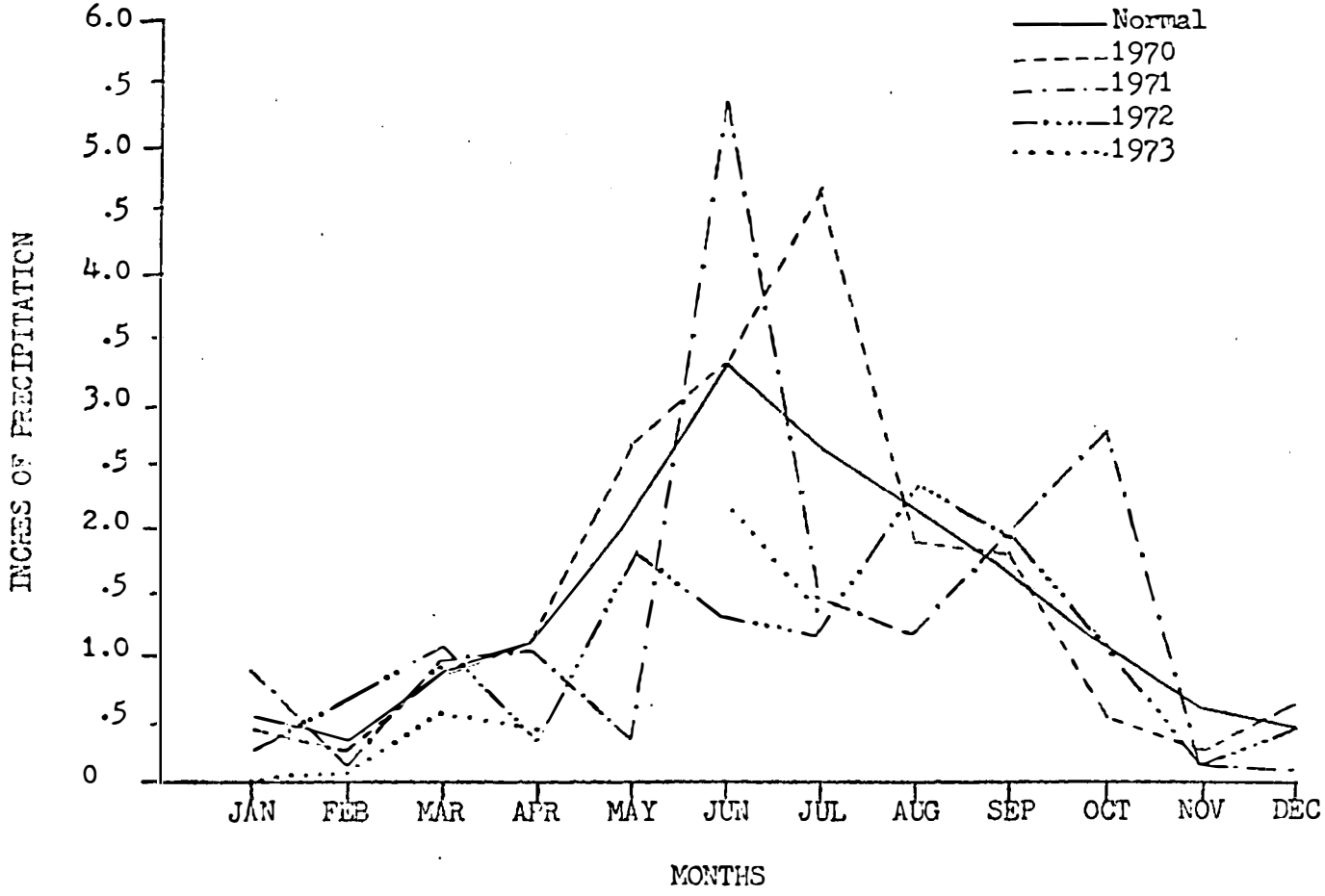

Fig. 7. Annual precipitation amounts in monthly increments as recorded at Devils Lake, North Dakota, 1970-1973 (U. S. Dept. of Commerce, 1970, 1971, 1972, 1973).

Breeding-pair totals were obtained from one count each year and conducted over a three-week period from mid-May to early June. Totals obtained from these counts provided more of an index than a true breeding-pair total.

Breeding-pair totals were broken down by study units and yearly totals in Table 2. Pairs observed on WPA's only were separated from the total pairs also. Over the four-year period, the total number of pairs observed on the WPA's and their associated wetlands averaged 233 pairs per year. The lowest total was 173 pairs in 1970 and the highest total was 291 pairs in 1972. The high total corresponded to the excellent wetland conditions in spring of 1972. A total of 225 breeding pairs was observed in 1973 which was higher than the total in 1970, even though, the habitat conditions were better in 1970. This situation may have been caused by the concentration of breeding pairs on the WPA's because of the more stable water conditions found on them.

Entire study area. Breeding-pair counts were made on private land within the 3.14 square-mile circular area of each study unit. These areas gave a good sample of the privately-owned wetlands in the northeastern North Dakota region. The highest total of breeding pairs for one year was in 1972 with the lowest total observed in 1973 (Table 2). These high and low totals of pairs corresponded to the wetland conditions. The low total for the complete study area did not correspond with the low total observed on the WPA's. The total breeding pairs for 1970 was 713 compared with only 576 for 1973.

Table 2. Breeding pairs observed on the six Waterfowl Production Areas and the entire study units, 1970-1973.

Study Units	Pair Totals							
	1970		1971		1972		1973	
	WPA	Total	WPA	Total	WPA	Total	WPA	Total
Pung	12	73	24	183	13	93	17	75
Brudevig	36	93	35	118	20	64	51	61
Becker	32	102	54	315	65	319	37	83
Sahl	32	154	57	319	72	384	34	125
Michigan	45	144	86	302	78	343	62	143
Erickson	16	147	18	187	43	314	24	89
Totals	173	713	246	1419	291	1517	225	576

More pairs were using the WPA's in 1973 but fewer were observed on the privately-owned wetlands than in 1970.

The data from 1972 and 1973 were analyzed further to determine the actual change in available wetland habitat and how totals of breeding pairs varied between the two years. Shoreline distance estimates measured on aerial photograph maps were used as indices of wetland habitat changes (Table 3). There were 1.7 miles of wetland shoreline per square mile of study area in 1973 compared with 8.9 miles in 1972. This represented a decline of 78 percent in shoreline habitat from 1972 to 1973. The decline in total observed pairs was 62 percent, (1517 pairs in 1972 to 576 pairs in 1973) for the same period. Shoreline habitat data were not tabulated for 1970 and 1971, but wetland habitat changes between the two years were not as great as those between 1972 and 1973. The available data on the wetland conditions could not adequately explain the 97 percent (713 pairs in 1970 to 1419 pairs in 1971) increase in observed breeding pairs.

The annual differences between breeding pairs using private land and those using the WPA's were highly significant ($P \leq .01$) using the Student's t test (Steele and Torrie 1960). The average breeding pairs per square mile over the four-year period were 47 for private land and 156 for the WPA's. Again, shoreline habitat was used to detect reasons for the pair-use differences in 1972 and 1973. The decline in available shoreline habitat was 80 percent on the private land and 59 percent on WPA's from 1972 to 1973 (Table 3). Breeding pairs exhibited a decline of 71 percent on private land and 23 percent on the WPA's for the same period. This provided some evidence

Table. 3. Shoreline habitat on the study area as estimated from aerial photograph maps, 1972-1973.

Year	Shoreline Habitat					
	Private		WPA		Total	
	Total Mileage	Miles Per Square Mile	Total Mileage	Miles Per Square Mile	Total Mileage	Miles Per Square Mile
1972	133.3	7.6	25.6	17.1	168.9	8.9
1973	22.4	1.3	9.3	6.2	31.7	1.7

that breeding pairs were attracted to the more stable water conditions on the WPA's when wetland conditions deteriorated on the surrounding private land.

Species encountered. All duck species were included in breeding-pair counts. The three major species encountered on the study area were blue-winged teal, pintail, and mallard (Table 4). Blue-winged teal was the most commonly encountered species comprising 33 percent of the total pairs observed over the four-year period. The most common diving duck species on the study area was the redhead (Aythya americana) followed closely by the ruddy duck (Oxyura jamaicensis). Species composition remained relatively constant throughout the investigation with only the shoveler declining noticeably in percent of composition.

Nesting

Nesting cover on the WPA's. Upland-nesting cover was analyzed in 1972 and 1973. Excluding the Michigan WPA, cover on all of the WPA's was predominantly native grass species. Green needlegrass was the most common cool-season native grass present on the areas while big bluestem and switchgrass were the most common warm-season native grass species. These native grasses were dominant on much of the upland portions of the WPA's but nowhere did they grow in exceptionally dense stands (Figs. 8 and 9). Introduced grass species persisted on the WPA's but only slender wheatgrass was present as a dominant species in small patches. Smooth bromegrass was present on all six WPA's and was dominant over about 24 acres of the Michigan WPA. Quackgrass

Table 4. Breeding pairs of waterfowl on the study area, 1970-1973.

Species	Year									
	1970		1971		1972		1973		Totals	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Blue-winged Teal	239	34	460	32	537	35	154	27	1390	33
Pintail	115	16	285	20	213	14	84	15	697	16
Mallard	80	11	221	16	204	13	102	18	607	14
Gadwall	60	8	121	9	126	8	81	14	388	9
Shoveler	88	12	139	10	82	5	37	6	346	8
Green-winged Teal	12	2	21	1	38	2	15	3	86	2
Redhead	45	6	85	6	110	7	47	8	287	7
Canvasback	23	3	6	1	19	1	13	2	61	1
Ruddy Duck	44	6	49	3	120	8	21	4	234	6
Widgeon	7	1	16	1	24	2	5	1	52	1
Other[1]	0	-	16	1	44	4	17	3	77	2
Totals	713	100	1419	100	1517	100	576	100	4225	100

[1]Includes Ringneck Duck, Lesser Scaup, Black Duck, and Wood Duck

Fig. 8. Vegetative-analysis plot on the Erickson Waterfowl Production Area dominated by big bluestem (Andropogon gerardi), 1973.

Fig. 9. Nesting cover on the Erickson Waterfowl Production Area in the second season after burning, 1973.

dominated many of the lower areas on all of the WPA's replacing the original native grass plantings. A very dense stand of quackgrass existed on the Sahl WPA in a tree planting of about 10 acres that had been cultivated then left idle for at least three years. Kentucky bluegrass was becoming increasingly prominent on most of the WPA's. Small plots of Kentucky bluegrass were noted growing in size and encroaching on surrounding plant species. Yellow sweet clover was found on all of the WPA's except the Erickson and Michigan WPA's. The quantity of sweet clover varied annually but was dominant only on the Becker WPA and then only in small patches. Alfalfa was present in quantity only on the Michigan WPA and then mainly in conjunction with smooth bromegrass. The western half of the Michigan WPA was essentially a bromegrass-alfalfa complex and represented the best nesting cover of all of the WPA's.

This study was conducted in conjunction with a habitat-manipulation study by the Fish and Wildlife Service. Three WPA's were burned in May of 1972 as part of the habitat-manipulation study. The Sahl WPA was burned on May 4 and the Brudevig and Erickson WPA's were burned on May 8.

Other treatments occurred on the WPA's that were not planned. The Erickson and Michigan WPA's were sprayed with 2-4-D mixtures in July of 1972 by personnel of the Devils Lake Wetlands Management District. A neighboring landowner swathed the eastern half of the Sahl WPA in August of 1972 as a measure to control excessive growth of sow thistle (Sonchus sp.). A wild fire occurred over approximately 1/3

of the Brudevig WPA sometime in the fall of 1972 and was not discovered until the following spring. Because of the above unplanned treatments, vegetative data were not analyzed statistically.

Response to the prescribed burning was not uniform and in most cases greatly masked by the dry weather conditions. Big bluestem and switchgrass exhibited a positive response to burning on the Erickson WPA by increased plant height and seed production. Parts of the Sahl WPA had a positive response to burning with increased growth of green needlegrass and sow thistle. The effect of the increased sow thistle growth on nesting-cover quality could not be determined because the area was windrowed. The Brudevig WPA exhibited very little response to burning but again the wild fire made evaluation very difficult. Even when response to burning was positive, however, the quality of the nesting cover was not greatly improved.

Land use. Land use on the private land within the study area was recorded at the time of the breeding-pair counts. Cropland comprised 71 percent of the total land area and during late May and early June, approximately 90 percent of the cropland existed in either a fallow or newly-seeded condition (Table 5). Plowed land made up 22 percent of the total area and another 27 percent was newly-seeded small grain of less than six inches in height. Mulched stubble was also considered fallow land, even though some vegetative matter did exist on the soil. Pasture and hayland made up six percent of the total land area. The study unit containing the most pasture and hayland was the Erickson unit (17 percent). Pastures on the study area

Table 5. Land use on the six study units as recorded in late May and early June, 1970-1973.

Categories of Land Use	Land Use Acreages						Totals	
	Pung	Brudevig	Becker	Sahl	Michigan	Erickson	Acres	Percent
Cropland	1544	1554	1526	1244	1449	1188	8505	71
(Plowed)	(725)	(564)	(468)	(334)	(311)	(282)	(2685)	(22)
(Stubble Mulch)	(326)	(318)	(286)	(213)	(215)	(314)	(1673)	(14)
(Stubble)	(110)	(56)	(203)	(214)	(210)	(118)	(909)	(8)
(Seeded)	(383)	(616)	(569)	(483)	(713)	(474)	(3238)	(27)
Pasture	23	0	32	66	61	277	459	4
Hayland	1	54	35	48	49	61	248	2
Idle Land	100	148	122	318	106	96	890	7
(WPA)	(100)	(124)	(110)	(100)	(74)	(92)	(600)	(5)
(Other)	(0)	(24)	(12)	(218)[1]	(32)	(4)	(290)	(2)
Wetlands	228	204	240	211	297	332	1512	13
Roadsides	36	28	18	60	22	24	188	2
Roads	31	14	11	19	12	18	105	1
Railroads	19	0	19	32	0	0	70	Tr.
Farmsteads	18	7	2	7	8	10	52	Tr.
Shelterbelts	10	1	5	5	6	4	31	Tr.
Totals	2010[2]	2010[2]	2010	2010	2010	2010	12060	100

[1]Included Meldahl Cropland Adjustment Program tract.
[2]Data from 1972 not included in the averages.

were generally in a heavily-grazed condition. Haylands were mainly wild hay fields located in areas not otherwise easily farmed.

The Sahl study unit contained a Cropland Adjustment Program (CAP) tract of 208 acres. The CAP tract was previously Soil Bank land and was dominated by smooth bromegrass and Kentucky bluegrass with alfalfa and yellow sweet clover also present. This tract was the only substantial amount of idled land on the study area except for the WPA's themselves.

Nest densities. Nest searches were conducted in mid-June and mid-July and the total duck nests found during both searches were used to derive nest densities for each WPA (Fig. 10). These densities represented minimum densities because not all nests were found during the searches. A total of 530 acres was searched during the first three years of investigation but 605 acres were searched in 1973 because of dry conditions.

Nest densities were highest in 1971 when duck nests were found giving a density figure of 4.8 acres per nest (Table 6). The lowest density was in 1973 with 17.8 acres per nest. The highest nest densities occurred before and the lowest after the prescribed burning but the annual differences were not statistically significant ($P \leq .01$).

Controlled burning had an effect on nest densities in 1972 and 1973 (Table 7). Densities for the WPA's that were burned in 1972 were just over half of the densities found on the control WPA's. Burning, coupled with drought conditions, acted to reduce cover

Table 6. Densities of duck nests found on the six Waterfowl Production Areas, 1970-1973.

WPA	Nest Density (Acres Per Nest)							
	1970		1971		1972		1973	
	Total	Density	Total	Density	Total	Density	Total	Density
Pung	0	-	9	11.1	12	8.3	13	7.7
Brudevig	13	7.6	8	12.5	3	33.3	0	-
Becker	10	9.0	26	3.5	23	3.9	4	27.5
Sahl	28	3.6	30	3.3	27	3.7	8	14.4
Michigan	21	2.8	21	2.8	14	4.3	6	10.0
Erickson	13	6.1	16	5.0	6	13.3	3	28.3
Totals	85	$\bar{x}$=6.2	110	$\bar{x}$=4.8	85	$\bar{x}$=6.2	34	$\bar{x}$=17.8

Fig. 10. Active mallard nest found with the cable-chain device, 1973.

Table 7. Nest densities on Waterfowl Production Areas before and after prescribed burning in 1972 with areas grouped by burn status, 1970-1973.

Year	Nest Density (Acres Per Nest)			
	Burned WPA's		Control WPA's	
	Total Nests	Density	Total Nests	Density
Before Burning				
1970	54	4.6	31	9.0
1971	54	4.6	56	5.0
Subtotals	108	$\bar{x}$=4.6	87	$\bar{x}$=6.4
After Burning				
1972	36	7.8	49	7.2
1973	11	30.5	23	11.7
Subtotals	47	$\bar{x}$=13.1	72	$\bar{x}$=9.8
Totals	155		159	

quality on the Brudevig WPA to such an extent that no active duck nests were located on the WPA in 1973. Nest density on the Sahl WPA was affected little by burning in 1972. This was due largely to the tree planting that was not burned. The tree planting was cultivated then left idle resulting in a thick stand of quackgrass that offered good nesting habitat. Of the 27 nests found on the Sahl WPA in 1972, six were in the 10-acre tree planting. The tree planting yielded two of the eight nests found on the WPA in 1973, representing a much higher density than for the rest of the WPA. A decline in the number of nests occurred on the Erickson WPA from 1972 to 1973 even though this WPA had the most positive vegetative response to the 1972 burning.

Nest success. Complete histories of 290 duck nests were obtained during the four-year investigation. Ninety three nests were successful for a success rate of 32 percent. Nest success was highest in 1971 at 35 percent and lowest in 1973 at 25 percent (Table 8). The decline in nest success from 1971 to 1973 corresponded to a decline in nest densities for the same period.

The Sahl WPA experienced the highest success rates, as well as nest densities, during the four years with a four-year success rate of 47 percent. The Sahl study unit also contained the Meldahl CAP tract that was previously described. Nest searches were made on the CAP tract in 1972 and 1973 for supplementary data. The success rate of nests found on the Meldahl CAP tract was 40 percent which was lower than that of the Sahl WPA. The nest density on the CAP tract was greater than that of the WPA (6.5 acres per nest on the CAP tract and

Table 8. Nest success rates of duck nests on the six Waterfowl Production Areas, 1970-1973.

WPA	Nest Success Rates														
	1970			1971			1972			1973			Totals		
	Nests			Nests			Nests			Nests			Nests		
	Tot.	Succ.	Pct.	Tot.	Succ.	Pct.	Tot.	Succ.	Pct.	Tot.	Succ.	Pct.	Tot.	Succ.	Pct.
Pung	0	-	-	9	5	56	12	3	25	12	2	17	33	10	30
Brudevig	12	3	25	8	2	25	3	0	0	0	-	-	23	5	22
Becker	8	1	13	25	11	44	21	8	38	4	0	0	58	20	35
Sahl	25	13	52	30	14	47	24	10	42	8	4	50	87	41	47
Michigan	15	1	7	20	3	15	14	6	43	5	1	20	54	11	20
Erickson	10	2	20	16	3	19	6	0	0	3	1	33	35	6	17
Totals	70	20	29	108	38	35	80	27	34	32	8	25	290	93	32

8.3 acres per nest on the WPA). Success rates on the CAP tract may have been affected more by cover disturbance during search operations than the rates of the WPA.

Destruction by predators was the most common cause for nest failure. Of the 197 unsuccessful nests, only six were the result of abandonment by the hen. One nest was destroyed during search operations while the remaining nest failures were due mainly to mammalian predation.

Species of nesting hens. The most common nesting duck on the study area was the blue-winged teal. Of the total nests found, 66 percent were blue-winged teal (Table 9). Mallard, pintail, and gadwall made up another 30 percent of the nests found. Shoveler, green-winged teal, and widgeon were much less commonly encountered. One lesser scaup (Aythya affinis) nest was found in upland cover in 1971. The scaup nest was the only diving-duck nest found and that nest was successful. The remaining nests found were those of upland-nesting species.

Species composition for blue-winged teal and mallard did not change appreciably over the four-year period but some composition changes were noted. Pintail had a decline from 15 percent in 1970 to only three percent composition in 1973 (Table 9). Shoveler also declined in composition during the investigation. Only gadwall exhibited an increase in composition. Gadwall nests made up two percent of the total in 1970 and 22 percent in 1973. The increase from 1972 to 1973 could possibly have been attributed to the presence of dry

Table 9. Species composition of all duck nests found on the six Waterfowl Production Areas, 1970-1973.

Species	Nests and Species Composition									
	1970		1971		1972		1973		Totals	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Blue-winged Teal	53	63	73	67	58	69	22	63	206	65
Mallard	11	13	13	12	7	8	4	12	35	11
Gadwall	2	2	11	10	12	14	7	22	32	10
Pintail	13	15	8	7	6	7	1	3	28	9
Shoveler	5	6	2	2	1	1	0	-	8	3
Green-winged Teal	1	1	1	1	0	-	0	-	2	1
Widgeon	0	-	0	-	1	1	0	-	1	Tr.
Lesser Scaup	0	-	1	1	0	-	0	-	1	Tr.
Totals	85	100	109	100	85	100	34	100	313	100

Class III wetland basins that tended to attract gadwall hens more than hens of other species. One green-winged teal nest was found in each of the first two years of investigation but none were found during the last two years.

Brood Observations

Brood habitat. Brood observations were made on the study area during late July and early August in 1971-73. Each study unit was covered completely. Brood habitat was restricted to Class IV and V wetlands during the three years that brood observations were made. Only 17 wetlands contained water in 1973, representing the poorest habitat conditions experienced during the investigation. Those wetlands containing water had water levels that were noticeably lower than levels during the previous two years.

Broods observed. A total of 387 broods was observed during the three years that brood observations were conducted (Table 10). The Brudevig and Erickson units had substantially fewer broods than the other units. The Brudevig unit had less brood habitat available than any of the other units with only 10 percent of the total wetland acreage being of the Class IV classification (Table 1). The Erickson unit had 35 percent of its wetland acreage classified as Class IV wetlands but much of the Class IV wetland habitat was heavily vegetated making brood visibility poor, as well as being less desirable as brood habitat.

Hatching chronology. Brood observations were made primarily to collect data for constructing hatching-chronology curves. Hatching-

Table 10. Broods observed on the 3.14 square-mile circular study units, 1971-1973.

Study Units	Broods Observed							
	1971		1972		1973		Totals	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Pung	38	22	28	20	8	12	74	19
Brudevig	11	6	7	5	2	3	20	5
Becker	28	15	42	30	16	23	86	22
Sahl	31	17	36	26	32	46	99	26
Michigan	56	32	15	11	11	16	82	21
Erickson	15	8	11	8	0	-	26	7
Totals	179	100	139	100	69	100	387	100

chronology curves were constructed for 1972 and 1973 but not for 1971 because sighting dates for individual broods were not available making it impossible to back date the broods. Two conspicuous hatching peaks were evident in 1972 (Fig. 11), first in early July and the second after the middle of July. The second peak was the highest probably because of renesting due to nest destruction during agricultural activities. Agricultural activities were delayed by wet conditions in 1972 and probably caused much nest destruction of nests on cropland. Only one conspicuous peak occurred in 1973 and that was after mid-July. Renesting hens experienced higher success rates because growing grain provided more cover for nesting during this period. Another factor for the late hatching peaks may have been the time the brood observations were made. Early broods may have been overlooked because of size or because they were already capable of flying. This factor would probably not have altered the curves enough to shift the peaks greatly.

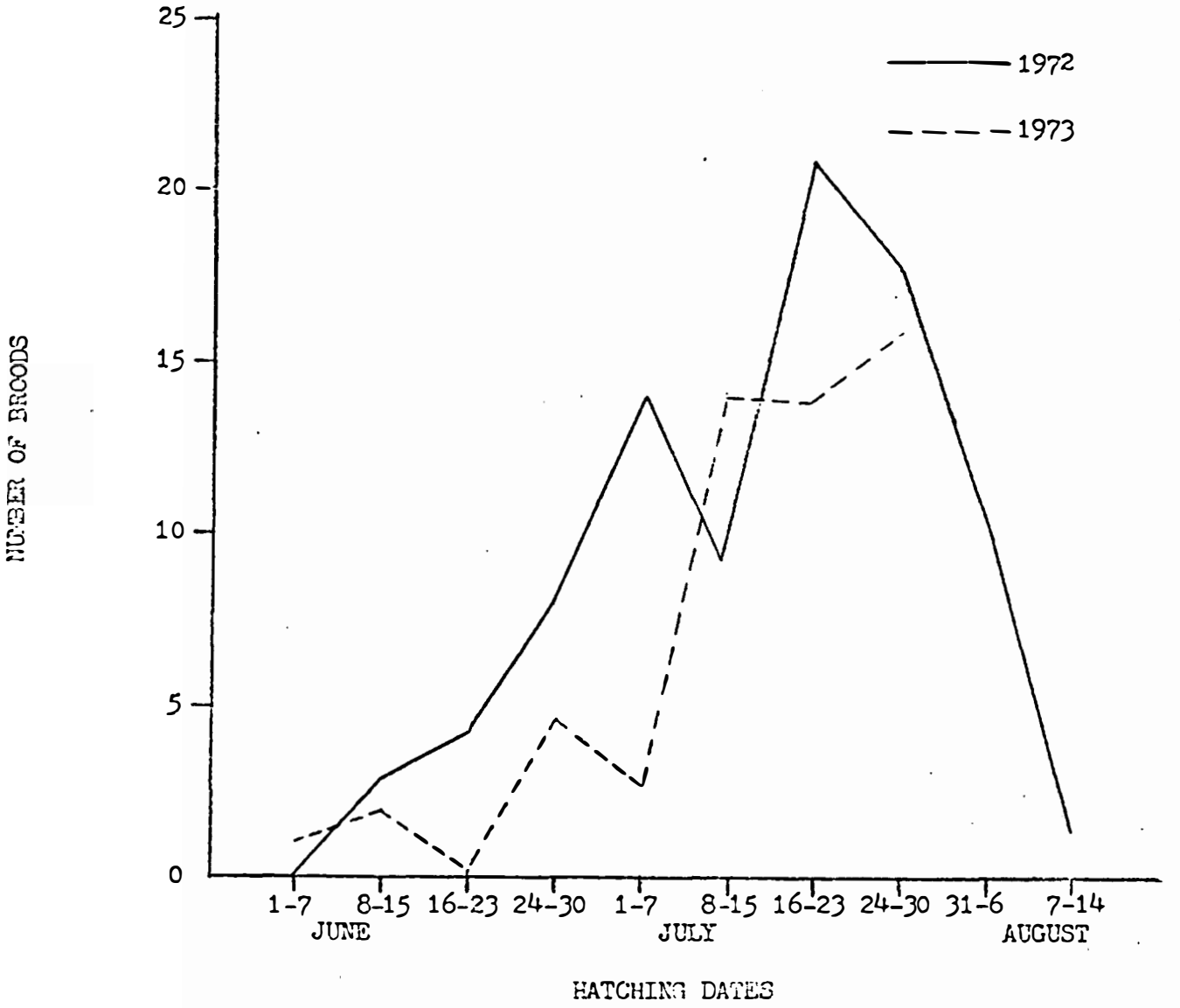

Fig. 11. Hatching chronology curves for broods observed on the study area in northeastern North Dakota, 1972-1973.

DISCUSSION AND CONCLUSIONS

Waterfowl Production Areas (WPA's) studied in northeastern North Dakota were found to have reasonably high breeding populations but low nest densities and success rates. General habitat conditions varied over the years of investigation as did breeding populations and nest densities. Nest success could be considered lower than potential for all years, although some variation occurred between years.

Breeding populations averaged 56.1 pairs per square mile during the investigation. This figure was similar to breeding populations found in South Dakota. Evans and Black (1953) found 57.9 pairs per square mile, and Drewien and Fredrickson (1970) found 57.2 pairs per square mile in South Dakota. Breeding populations found by Wheeler (1972) in the James River Valley area of South Dakota were lower at 37 pairs per square mile.

Nest densities were low, even though on all but one study unit (the Sahl unit containing the Cropland Adjustment Program tract) the WPA represented the only sizable amount of available undisturbed nesting cover within range for nesting hens. Attractiveness of the WPA's was probably reduced because of the generally poor quality of the nesting cover. The predominantly native grass cover was characteristically thin and usually short providing little concealment for nests.

Nest success was 32 percent for all nests found during the investigation. Keith (1961) determined that a nest-success rate of 39 percent was required to maintain a dabbling duck population.

Other studies dealing with nest success on idled land revealed that a success rate of 39 percent or above could be achieved. Duebbert (1969) found 79 percent nest success in South Dakota on Cropland Adjustment Program land dominated by intermediate wheatgrass (Agropyron intermedium) and crested wheatgrass cover. Page and Cassel (1971) found an 83 percent success rate on railroad right-of-way in North Dakota, and Oetting and Cassel (1971) found a 62 percent success rate on unmowed portions of interstate highway right-of-way in North Dakota. These rights-of-way were characterized by stands of dominant smooth bromegrass with Kentucky bluegrass also present.

The main factor causing the low nest success rate on the WPA's studied was heavy mammalian predation due to cover quality. The studies cited above dealt with nesting in cover that was more secure from predation than was true for my study area. Native grass species on the study area did not provide the nest security necessary to reach nest success rates of 60 percent or better.

Brood habitat was adequate in most years because of the number of Class IV and V wetlands present. Wetland habitat did not appear to be a major limiting factor for duck production on the study area.

WPA's must be managed with emphasis on the critical factor of nesting. During this period of vulnerability, secure nesting sites must be provided through management for stands of dense cover. Today's practices in northeastern North Dakota are to seed newly-acquired WPA's to introduced grasses and legumes instead of native grasses seeded on WPA's during the early years of the program. Improvement of the cover on older WPA's, however, is needed to boost their productiveness.

Insufficient data exist to conclude whether controlled burning of native grass stands increases cover quality enough to increase nesting success. Another alternative is to reseed older WPA's to the new seed mixtures now being used providing they are not unplowed native prairie. Cover on WPA's should be both attractive to nesting hens and secure from high rates of predation if the WPA's in northeastern North Dakota are going to realize their duck producing potential.

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