Effects of Agricultural Burning on Nesting Waterfowl

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Abstract. Agricultural burning in an intensively farmed region within Manitoba's pothole district is shown to affect the nesting activities of ground-nesting ducks. All species, except Blue-winged Teal (*Anas discors*), preferred unburned nest cover, although success was higher in burned areas, where predators may have exerted less influence. Attitudes of farmers, burning chronology, and nest destruction by fires are also reported.

Introduction

Attention has been given recently to the importance of adequate nest cover for the management of dabbling ducks, particularly with regard to man's use of the land (Martz 1967; Kirsch 1969; Dwyer 1970; Oetting and Cassel 1971; Jarvis and Harris 1971; Page and Cassel 1971). Agricultural practices in many instances are detrimental to the welfare of waterfowl. Just as drainage has reduced the number of wetlands available for waterfowl, farming operations such as grazing, mowing, and burning can also diminish the quantity and quality of upland cover available for ground-nesting ducks.

It is important to document the impact on upland nesting waterfowl of the frequent burning of fields, slough edges, fencerows, roadsides, and other waste areas. The objectives of this study, which was conducted during the spring and summer of 1970 and 1971, were to (1) determine the chronology and the amount of agricultural burning in the Minnedosa, Manitoba area, (2) investigate attitudes of farmers concerning burning as an agricultural practice, (3) evaluate areas burned in fall and spring as nest cover, and (4) compare nesting success in burned and unburned cover.

Study Area

The study area, located south of Minnedosa, Manitoba (part of a region where waterfowl studies have been conducted for over 20 years) consists of rolling terrain characterized by a mosaic of small wetlands, groves of aspen (*Populus* spp.) and oak (*Quercus* spp.), and cultivated fields. Cereal grain farming is the principal land use; cattle raising is of less importance. The upland vegetation consists primarily of smooth brome (*Bromus inermis*), slender wheatgrass (*Agropyron trachycaulum*), wolfberry (*Symphoricarpos occidentalis*), wiid prairie rose (*Rosa arkansana*), and other grasses and forbs. Common wetland emergents are cattail (*Typha latifolia*), bulrush (*Scirpus* spp.) and whitetop (*Scolochloa festucacea*). Detailed descriptions of the area may be found in articles by Bird (1930) and Evans et al. (1952).

A 4-square-mile study area characteristic of the surrounding landscape was selected for intensive nest studies. On 1 May 1970, it included approximately 640 permanent, semi-permanent, and temporary potholes totalling over 300 acres of water. Narrow bands of upland vegetation surrounded these wetlands on which cultivation was impossible.

Only a few wetland areas were enclosed by upland cover totalling more than 1 acre. Mowing of slough edges and roadsides was insignificant throughout the duration of the study. Light grazing was observed only once. It occurred in early 1971 before the growing season began.

Methods

A 42-square-mile block was surveyed once each year in early spring to estimate the extent of fall burning done by farmers. It was subsequently surveyed at weekly intervals throughout the study to determine the amount of burning done in the spring. From the roads that criss-crossed the area, the acreage of each burn and the number of slough edges involved were described and estimated.

During the two-year study, farmers were interviewed informally to determine the justification and techniques they used for burning cropland, slough edges, and waste areas. Questionnaires relating to burning, agricultural techniques, and wildlife values were sent to 100 farmers during the fall of 1970.

Two censuses of breeding pairs and brood beat-outs (Blankenship et al. 1953) were conducted each year along a transect (⅛ × 8 miles) adjacent to roads throughout the study area. The data collected gave insight into breeding populations and served as a check on production data obtained from nest studies.

When burning occurred on the 4-square-mile area, all burned vegetation, except stubble, was searched for burned nests. Destroyed nests were extremely difficult to locate because most of the burning was done in the afternoon when laying hens were off their nests and the eggs were covered with vegetation. Consequently, the number of burned nests discovered represents a fraction of those actually present. Burned areas off the study area were searched occasionally.

Potential duck nesting cover was measured by the use of aerial photos and a Bryan Modified Acreage Grid, as well as by personal observations and estimates.

Searches for active nests were made daily between 0700 and 1300 hours through a portion of the study area. All potential cover, except cultivated fields and stubble, was traversed by individuals thrashing vegetation with sticks or dragging a rope strung with tin cans between them. A Chesapeake Bay Retriever usually accompanied one of the field workers and aided in flushing hens and finding hatched or destroyed nests. Areas burned during each nesting season or during the previous fall were searched more regularly than unburned areas to insure complete coverage.

Each nest was marked by attaching surveyor's flagging to vegetation or by placing stakes 10 to 20 feet from the site. All nests were examined to determine location, species, number of eggs, stage of incubation, cover type, cover condition, and distance to water. The calculated hatching date being used as a guide, nests were reexamined to determine their fate.

Small mammal populations, as an indicator of prey density, were surveyed in burned and unburned areas from May through July 1971. From 35 to 50 mousetraps were set 3 or 4 nights a week in comparable burned and unburned cover. The number and species of the catch were recorded.

Results and Discussion

Amount of Burning

The survey of 42 square miles showed that approximately 2,928 and 577 acres of cropland, roadsides, fencerows, slough edges, and miscellaneous areas were burned during the springs of 1970 and 1971 respectively. Approximately 275 slough edges were burned in 1970 compared with 230 in 1971. The reduction in the total amount of burning done in spring 1971 was due to extremely wet weather in late May and June. In addition, a late fall in 1970 permitted farmers to burn an estimated 3,225 acres, including 581 slough edges. Comparable data were not collected on the 42 square miles in the fall of 1969; however, a substantial increase in fall burning was observed during the two years. Data from the 4-square-mile study area indicated 220 acres and 31 slough edges were burned in the fall of 1969, while 550 acres and 97 slough edges were burned in the fall of 1970.

Three hundred acres of the 4-square-mile study area indicated 220 acres and 31 slough and 700 acres burned in the springs of 1970 and 1971 respectively, 50 acres were idle. Similar proportions of idle to cultivated land and burned to unburned land were present in the surrounding area.

Chronology of Burning

The timing of burning and of nest initiation for an early-nesting species, the Mallard (*Anas platyrhynchos*), and a late-nesting species, the Blue-winged Teal (*Anas discors*), in 1970 are compared in Figure 1. The extremely late spring in 1970 delayed breeding as well as burning activity. Comparable data for 1971 are presented in Figure 2.

During the study, most burning occurred after the peak of first nest initiation by Mallards and Pintails (*Anas acuta*), and before most Blue-winged Teal nesting activity. It appears that early-nesting ducks are more susceptible to destruction of nests by fire than later-nesting species. Mallards often prefer heavy, rank growth as nest sites, and Pintails often nest in stubble fields (Milonski 1958). Because

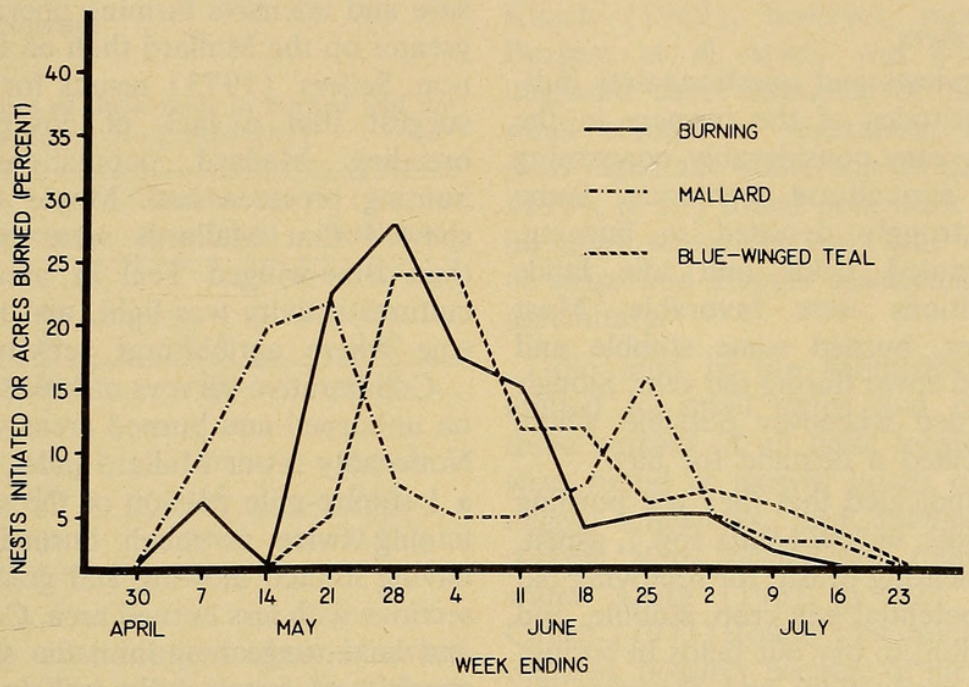

FIGURE 1. Chronology of burning and nest initiation of Mallards and Blue-winged Teal, 1970.

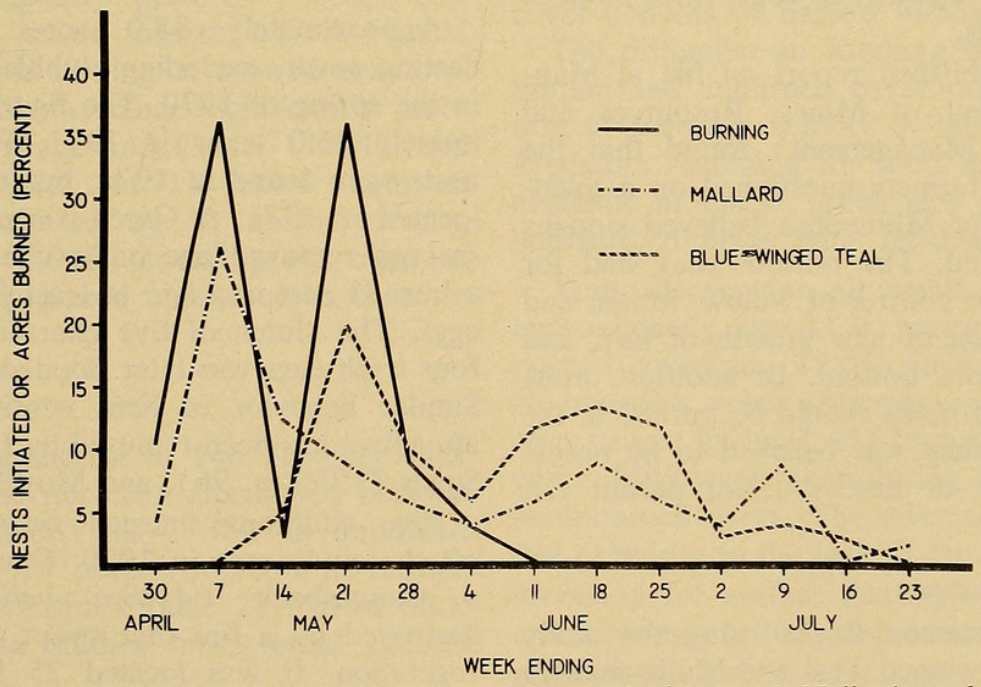

FIGURE 2. Chronology of burning and nest initiation of Mallards and Blue-winged Teal, 1971.

both of these types of cover are subject to heavy burning, Mallard and Pintail nests are highly susceptible to fire destruction. Blue-winged Teal are capable of, perhaps even prefer, nesting in short, often sparse vegetation (Glover 1956; Burgess et al. 1965). Such scant cover is not intentionally ignited as often as heavy cover. As a result, the nests of the late-nesting teal are less subject to fire destruction.

Attitudes of Farmers

Informal interviews and questionnaires indicate that the attitudes of the farmers in the Minnedosa area vary considerably concerning burning as an agricultural technique. Some farmers were strongly opposed to burning, while others ignited fields and idle lands whenever conditions were favorable. Most farmers, however, burned some stubble and associated upland cover during the year. Slough edges were burned whenever possible where cattle-raising created a demand for hay.

The farmers indicated that they use burning to control wild oats, willow (*Salix* spp.), aspen, and weeds; for clearing brush; for removing old bottom from a potential hay crop, stubble, and roadside vegetation; to dry out fields in spring; to increase hay production; and "because my father did it." The local agricultural extension agent appraised the prevalent burning practices as the farmers' "inability to cope" with modern farming methods.

Dixon (unpublished report on file at Manitoba Department of Mines, Resources and Environmental Management) found that the majority of 40 farmers questioned on a township southwest of Minnedosa believed sloughs should be burned. The reasons they had for burning were for control of willow, aspen, and weeds; generation of new growth of hay; and elimination of old bottom. In addition, most farmers believed fields should be burned in the fall. Spring burning was believed to be necessary if weather or time did not permit fall burning.

Breeding Populations

The most common ducks using the study area were Blue-winged Teal and Mallards with 36 and 10 pairs per square mile respectively. Data compiled by Stoudt (1967) showed a shift in species composition had occurred in the Minnedosa area from the period 1949–1955 to 1964–1967. Mallards were the most abundant breeders during the former period, while Blue-winged Teal were the most numerous during the latter. During this study, teal continued to flourish while Mallard populations remained low. One explanation (Stoudt 1967) is that the impact of increased hunting pressure and intensive farming operations has been greater on the Mallard than on the teal population. Sellers' (1973) results for the same area suggest that a lack of cover had affected breeding Mallard populations more than hunting pressure had. Moyle (1964, p. 16) showed that Mallards were more successful than Blue-winged Teal in areas where agricultural activity was light, and the reverse was true where agricultural activity was intense.

Comparative surveys of breeding populations on unburned and burned areas were not made. Noticeably fewer Mallard pairs, however, used a 1-square-mile portion of the study area containing twice as much burned acreage, and having limited mowing and grazing, than used sections with less burned area. Cover conditions and land usage may limit the species of duck capable of successfully utilizing a particular area for breeding activities.

Nest Destruction by Fire

Approximately 38.0 acres of potential nesting cover, excluding stubble, were burned in the spring of 1970. The figure was approximately 26.0 acres in 1971. Fifteen burned nests were found in 1970, but only four were located in 1971. A Green-winged Teal (*Anas crecca*) removed one badly charred egg from a burned nest and laid at least four additional eggs. The clutch of five charred and at least four fresh eggs was later flooded and deserted. Similar behavior of hens continuing to nest after fires has been reported by Leedy (1950), Sowls (1955, p. 96), and Moyle (1964).

Five additional burned nests were found off the study area in 1970. One of these was a Canvasback (*Aythya valisineria*) nest destroyed by a fire that swept over emergent vegetation. It was located 25 feet from dry land in 24 inches of water.

Nest Densities

Uncultivated nest cover contained 0.19 nest per acre on burned areas and 0.49 nest per acre on unburned areas (Table 1). These densities differ significantly ($P < 0.01$) when tested against an expected 50:50 ratio by *chi*-square methods. Other studies have shown limited duck nesting in burned cover (Glover 1956; Keith 1961, p. 51; Ward 1968). Page and Cassel (1971) found no nests in burned railroad rights-of-way.

TABLE 1 — Densities of duck nests in burned and unburned idle nesting cover, 1970–1971

Cover type	Acreage	Number of nests found	Nest/acre
Burned			
1970	50	4	0.08
1971	50	15	0.30
Total or average	100	19	0.19
Unburned			
1970	250	80	0.32
1971	250	166	0.66
Total or average	500	246	0.49

Sixteen of 19 nests found in burned areas were Blue-winged Teal nests. Teal did not show a significant preference for either burned or unburned cover. All other species combined, however, significantly preferred ($P < 0.05$) unburned nest cover. Martz (1967) found Blue-winged Teal nesting in mowed meadows on a North Dakota refuge significantly more than expected. Page and Cassel (1971) and Oetting and Cassel (1971) found unmowed areas were preferred by all upland nesting ducks. Kirsch (1969) found more nests of all species on ungrazed upland cover than on grazed areas.

Nest Success

The hatching success of 246 dabbling duck nests, which had not been abandoned because of my disturbance, was 15.0% in unburned cover. Five of 13 nests (38.5%) in burned cover were successful (Table 2).[1] Most duck nesting-land use studies have found success higher in idle undisturbed areas with adequate residual growth than in disturbed areas with sparse cover (Moyle 1964, p. 17; Martz 1967; Kirsch 1969; Page and Cassel 1971; Oetting and Cassel 1971). Glover (1956) found that Blue-winged Teal nests located in light to sparse cover were more successful than those in heavier cover. Burgess et al. (1965) found the nest success of Blue-winged Teal was 47% on grazed areas and 14% on ungrazed areas. Kirsch (1969), however, reported that the Burgess et al. study was conducted where ungrazed cover consisted of narrow strips or small clumps of vegetation, rendering duck nests especially vulnerable to predators. Moyle (1964, p. 16) found poor duck nesting success in areas where the only idle cover consisted of strips and clumps associated with intensive agriculture.

Idle land in the Minnedosa area is also limited to small strips and clumps. Eighty-three percent of all nests located in the study were found in narrow bands of cover, slough edges, fencerows, and roadsides. Sixty-nine percent were located less than 50 feet from water. Keith (1961, p. 62) and Page and Cassel (1971) found that nesting success was reduced, possibly because of increased predator activity, when nest-to-water distance was decreased. The present study further illustrates that predators are extremely effective where cover consists of narrow bands of vegetation.

The difference in hatching success between burned and unburned cover suggests a reduction of predator activity in the burned areas. Predators searching for food may find it less available in sparse, green new growth than in undisturbed areas with residual growth.

Trap success for all small mammals was approximately equal. It averaged 10.8% in burned cover and 12.6% in unburned cover. No meadow voles (*Microtus pennsylvanicus*) were caught during 1,474 trap-nights in burned cover. Fifty were taken during 961 trap-nights in unburned areas. The absence of voles was due primarily to the lack of residual vegetation necessary for surface runways. Cook (1959) and Schramm (1968) also found *Microtus* spp. populations severely decreased by burning of grassland vegetation.

[1] Excludes six nests deserted by laying hens.

TABLE 2 — Fates of 265 dabbling duck nests in burned and unburned idle nesting cover, 1970–1971.

	Number of nests	Deserted	Hatched	Destroyed			
				Predators	Flood	Fire	Farming operations
1970							
Unburned	80	9	11(15.5)[a]	45(63.4)	—	15(21.1)	—
Burned	4	1	2(66.7)	1(33.3)	—	—	—
1971							
Unburned	166	17	22(14.8)	118(79.2)	6(4.0)	3(2.0)	—
Burned	15	5	3(30.0)	5(50.0)	—	—	2(20.0)

[a] Figures in parentheses are percentages.

Meadow voles are a preferred food for some carnivorous mammals. Scott (1947) reported that red foxes (*Vulpes vulpes*) favored voles over deer mice (*Peromyscus maniculatus*). Errington (1967, p. 30) said that foxes "relished" voles. Most fox food-habits studies indicate a high consumption of voles. Red foxes, and perhaps other important nest predators in the Minnedosa area, such as raccoons (*Procyon lotor*) and striped skunks (*Mephitis mephitis*), may avoid burned areas when hunting. They may concentrate their activity on undisturbed areas that contain more voles and duck nests, and that perhaps afford more concealment. Keith (1961, p. 62) and Milonski (1958) found that heavy cover is traversed extensively by striped skunks, and suggest that concealment is an important influence in their movements.

Conclusion

Relatively thick cover with adequate residual vegetation is necessary for the successful nesting of most dabbling ducks. Idle land, described by Duebbert (1969), in the Cropland Adjustment Program demonstrates the effectiveness of predator-proof nesting cover. Such cover is essential for increased duck production in agricultural areas where the only available cover occurs in narrow strips easily and efficiently searched by predators.

Controlled burning is an efficient tool in wildlife habitat management. The aspen parklands of Canada are ecotonal in nature and have been subject to periodic burning for centuries. Natural events, including fire, controlled the fluctuations of the forest-prairie edge (Bird 1930). Indiscriminate annual burning, however, reduces the quantity and quality of suitable nesting cover for adequate duck production. The isolated islands of upland cover remaining around sloughs and other waste areas should be left undisturbed for several years where high quality nest cover is reduced by agricultural practices.

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Literature Cited

Bird, R. H. 1930. Biotic communities of the aspen parkland of central Canada. Ecology 11(2): 356–443.

Blankenship, L. H., C. D. Evans, M. H. Hammond, and **A. S. Hawkins.** 1953. Techniques for brood production studies. Contribution for the Mississippi Flyway Council Technical Committee. Mimeograph. 14 pp.

Burgess, H. H., H. H. Prince, and **D. L. Trauger.** 1965. Blue-winged Teal nesting success as related to land use. Journal of Wildlife Management 29(1): 89–95.

Cook, S. F., Jr. 1959. The effects of a fire on a population of small rodents. Ecology 40(1): 102–108.

Duebbert, H. F. 1969. High nest density and hatching success of ducks on South Dakota CAP land. Transactions of the North American Wildlife and Natural Resource Conference 34: 218–228.

Dwyer, T. J. 1970. Waterfowl breeding habitat in agricultural and non-agricultural land in Manitoba. Journal of Wildlife Management 34(1): 130–136.

Errington, P. L. 1967. Of predation and life. Iowa State University Press, Ames. 277 pp.

Evans, C. D., A. S. Hawkins, and **W. H. Marshall.** 1952. Movements of waterfowl broods in Manitoba. United States Fish and Wildlife Service, Special Scientific Report, Wildlife, Number 16. 47 pp.

Glover, F. A. 1956. Nesting and production of the Blue-winged Teal (*Anas discors* Linnaeus) in northeast Iowa. Journal of Wildlife Management 20(1): 28–46.

Jarvis, R. L. and **S. W. Harris.** 1971. Land-use patterns and duck production at Malheur National Wildlife Refuge. Journal of Wildlife Management 35(4): 767–773.

Keith, L. B. 1961. A study of waterfowl ecology on small impoundments in southeastern Alberta. Wildlife Monograph 6. 88 pp.

Kirsch, L. M. 1969. Waterfowl production in relation to grazing. Journal of Wildlife Management 33(4): 821–828.

Leedy, D. L. 1950. Ducks continue to nest after brush fire at Castalia, Ohio. Auk 67(2): 234.

Martz, G. F. 1967. Effects of nesting cover removal on breeding puddle ducks. Journal of Wildlife Management 31(2): 236–247.

Milonski, M. 1958. The significance of farmland for waterfowl nesting and techniques for reducing losses due to agricultural practices. Transactions of the North American Wildlife Conference 23: 215–227.

Moyle, J. B. 1964. Ducks and land use in Minnesota. Minnesota Department of Conservation Technical Bulletin 8. 140 pp.

Oetting, R. B. and **J. F. Cassel.** 1971. Waterfowl nesting on interstate highway right-of-way in North Dakota. Dakota. Journal of Wildlife Management 35(4): 774–781.

Page, R. D. and **J. F. Cassel.** 1971. Waterfowl nesting on a railroad right-of-way in North Dakota. Journal of Wildlife Management 35(3): 544–550.

Scott, T. G. 1947. Comparative analysis of red fox feeding trends on two central Iowa areas. Iowa Agricultural Experiment Station Bulletin 353: 427–487.

Sellers, R. A. 1973. Mallard releases in understocked prairie pothole habitat. Journal of Wildlife Management 37(1): 10–22.

Schramm, P. 1968. Effects of fire on small mammal populations in a restored tall-grass prairie. *In* Proceedings of a Symposium on Prairie and Prairie Restoration. *Edited by* P. Schramm. Knox College, Galesburg, Illinois. pp. 39–41.

Sowls, L. K. 1955. Prairie ducks, a study of their behaviour, ecology and management. Stackpole Company, Harrisburg, Pennsylvania. 193 pp.

Stoudt, J. H. 1967. A preliminary report on the status of mallard populations in the pothole region of Manitoba, Saskatchewan and the Dakotas. A paper presented at Waterfowl Seminar, Delta Waterfowl Research Station, Delta, Manitoba, August 17–18, 1967. Mimeograph. 12 pp.

Ward, P. 1968. Fire in relation to waterfowl habitat of the Delta Marshes. Proceedings of the Tall Timbers Fire Ecology Conference, Tallahassee, Florida 8: 255–267.

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