UNIVERSITY OF MANITOBA

AN ANALYSIS OF USE OF NEST BOXES BY MOUNTAIN BLUEBIRDS IN SOUTHWESTERN MANITOBA

by

Hugh L. Munro

A Thesis Submitted to the Faculty of Graduate Studies in Partial Fulfillment of the Requirements for the Degree of Master of Arts

Department of Geography

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ABSTRACT

Surface cover types and nest box properties characteristic of nest sites used and not used by mountain bluebirds nesting in southwestern Manitoba were investigated. Twenty-six variables considered pertinent to secondary cavity nesting passerines were evaluated at 1169 nest boxes on 28 nest box lines in 1980. Stepwise discriminant function analysis was used to determine which variables were important in discriminating between nest sites used and not used in 1) the first nesting period and 2) both nesting periods of mountain bluebirds. Variables unsuitable for inclusion in discriminant analysis were analyzed by chi-square criteria.

Nest sites were used in a variety of habitats, but were associated positively with grass and wooded pasture and negatively with shrub pasture, long grass, and fallow field. When surface cover characteristics were analyzed as a separate set of variables, wooded pasture was the most important variable separating nest sites used or not used in the first nesting period, and long grass was predominant in separating sites used or unused in both nesting periods.

Distance to the nearest building, entrance hole diameter, box depth, and line age were the important discriminating variables when nest box properties were analyzed separately. Nest box properties were superior to surface cover characteristics in separating used and unused sites. When surface cover and nest box variables were

analyzed together distance to nearest building, entrance hole diameter, and box depth were the important discriminating variables.

Entrance hole orientation, directional location of the nest box from the road, type of supporting structure, box condition, and land use and disturbance in the vicinity of the nest box had no impact on use by mountain bluebirds. Position of the entrance hole with respect to the road, road type, nest box color, and presence of utility lines and livestock did affect use.

My analyses reveal that mountain bluebirds are eurytopic in their use of breeding sites, but appear to prefer grass and wooded pasture and avoid shrub pasture and heavily cultivated areas. Characteristics of the nest box are more operative than surface cover characteristics in determining use by this species.

FOR DONITA

My Wife and Friend

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CHAPTER ONE

INTRODUCTION

1.1 Objectives

Many observers believe that mountain bluebirds (Sialia currucoides) have been declining in numbers over much of their range during the past several decades (Power 1966, Zeleny 1976). A similar trend in populations of eastern bluebirds (Sialia sialis) prompted speculation that elimination of natural nest cavities was a major factor in the decline (Wallace 1959). Bluebirds are secondary (non-excavating) cavity nesters. Availability of nest cavities is often the most important limiting factor for such species (Haartman 1957).

The perceived bluebird population decline and its suspected cause stimulated naturalists throughout North America to establish nest box lines by placing nest boxes along fence and utility lines (Zeleny 1976). Although thousands of man-made nest boxes are currently in place, few quantitative studies have been attempted on their use by nesting passerines.

The purpose of this study is to investigate habitat characteristics and nest box properties that separate nest sites used and not used by mountain bluebirds nesting in southwestern Manitoba. Specific objectives include: 1) identifying factors that may affect use of nest sites, 2) determining which habitat characteristics and nest box properties are most operative in discriminating between

used and unused sites, and 3) discussing the biological significance of discerned differences.

1.2 Background

In Manitoba, mountain bluebirds were common in the Spruce Woods Forest Reserve in 1890 (Criddle 1904). By the turn of the century nest boxes were being installed to attract bluebirds into more settled areas (Criddle 1927).

In 1959, the late Dr. John Lane initiated a project designed to increase populations of both bluebird species in southwestern Manitoba. Lane's efforts produced the largest nest line complex in North America (Zeleny 1976). Since Lane's death in 1975 this project has been continued by the Brandon-based "Friends of the Bluebird" coordinated by Norah Lane.

Approximately 5000 nest boxes have been erected along hundreds of miles of fence and utility lines in southwestern Manitoba, but many are either no longer in place or are unuseable because of the effects of time, weather, and human interference (Lane et al. 1980). Between 800 and 1500 nest boxes are monitored each year.

Data compiled from annual reports indicate that the percentage of nest boxes used by mountain bluebirds increased steadily between 1963 and 1970 in Manitoba (Fig. 1). The population remained relatively stable during the next four breeding seasons. In 1975 and 1976, 277 bluebirds were not identified to species (see Lane and Black 1975, Lane et al. 1976), and calculation of percent

occupancy for these years would be unreliable. Data from 1977 to 1980 have been adjusted because in these years reports included the number of nestings rather than the number of boxes used. Use of nest boxes by mountain bluebirds peaked in 1978 at 38.2% of all monitored boxes. A population decline occurred in 1979 and was attributed to a late cold spring followed by a hot dry summer that resulted in heavy mortality and nest failure (Lane et al. 1980). The population subsequently increased in 1980.

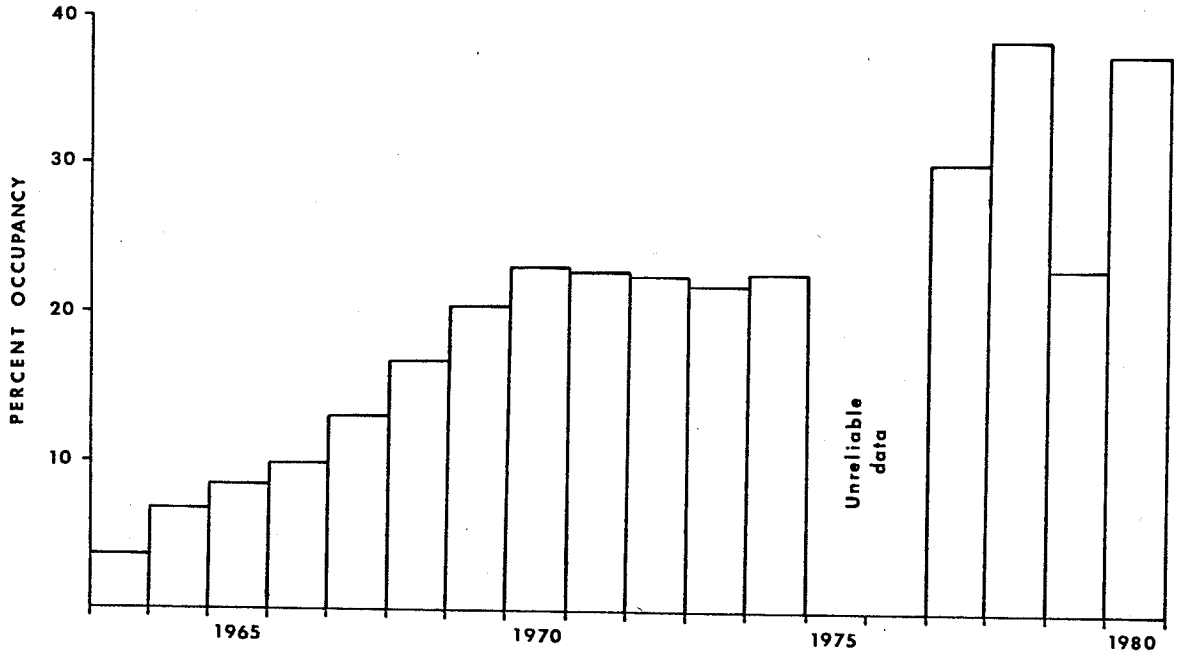

Fig. 1. Percentage of nest boxes occupied by nesting mountain bluebirds in southwestern Manitoba, 1963-1980 (compiled from annual reports from Brandon to the Blue Jay, Vols. 21-39).

Miller (1970) interpreted the increase in nest box use by mountain bluebirds between 1963 and 1968 as evidence that nest sites were limiting in Manitoba. Some species, however, appear to prefer nest boxes to natural cavities (wood ducks (Aix sponsa), Strange et al. 1971; eastern

bluebirds, Pinkowski 1976). Caution must be exercised, therefore, in interpreting increased occupancy of nest boxes in absence of data on birds nesting in natural cavities.

1.3 Study Area

The study area (Fig. 2), which lies within a 140km radius of Brandon, Manitoba (49°50'N, 100°00'W), is near the eastern periphery of mountain bluebird breeding range (see Bent 1964). Elevation ranges from 350m to 550m and topography is generally flat. River valleys and fluvio-glacial deposits provide variation in the landscape.

Surface cover is dominated by cultivated grain and hay, fallow fields, and pastureland. Native grassland, marshes, and mature stands of trembling aspen (Populus tremuloides) or bur oak (Quercus macrocarpa) occur in areas unsuitable for agriculture. White spruce (Picea glauca), black spruce (P. mariana), and jack pine (Pinus banksiana) grow in scattered shelter belts and forest reserves.

1.4 Literature Review

1.4.1 Factors Affecting Distribution of a Species Within its Breeding Range

Distribution of an avian species within its breeding range may be affected by a number of factors. In an ecologically isolated situation individuals are expected to settle in the most suitable habitat available (Orians 1971). Birds are guided in the choice of a breeding site by instinctive responses to stimuli from the physical

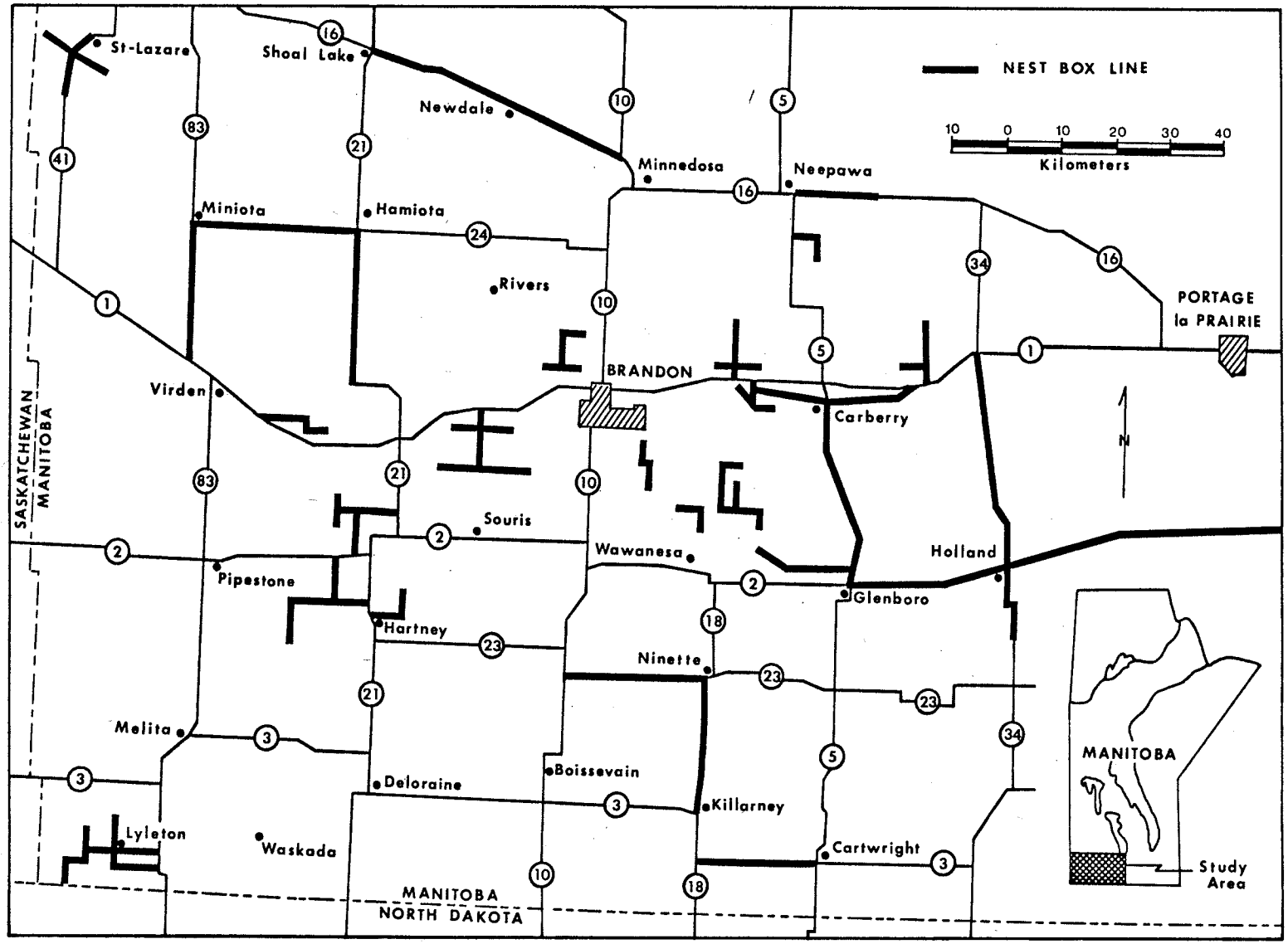

Fig. 2. Location of nest box lines within the study area.

environment (Hildén 1965).

Partridge (1974) demonstrated that habitat preference of blue tits (Parus caeculeus) and coal tits (P. ater) was predominantly under genetic control. Berndt and Winkel (in Brewer 1979) found similar results while working with the pied flycatcher (Ficedula hypoleuca). Genetic influence on habitat preference, however, may be modified by learning. For example, site tenacity and imprinting on the rearing environment are known to affect the distribution of some species (Hildén 1965).

Some birds exhibit breeding site tenacity regardless of habitat changes that occur over time (Hildén 1965). Limited data suggest that once a mountain bluebird has nested in an area, it returns to the same general area for subsequent nesting seasons (Scott 1974, Pinel 1980, Stiles 1980). The impact of habitat change on this trend has not been studied.

Site tenacity by double-brooded mountain bluebirds during a breeding season is not well documented. Miller (1970) states that this species generally renests in the same nest box used for first broods. Power (1966) found that of five pairs of double-brooded mountain bluebirds in Montana, two used the same nest site to raise both broods, while three did not. In the latter three cases Power had removed the nest from the nest box after first broods had fledged. Eastern bluebirds remain at the same site to renest unless the first nesting attempt was unsuccessful

or the nest site was disturbed (Laskey 1939,1940; Thomas 1946). Low (1934) found that eastern bluebirds raised two broods in nest boxes located in suitable habitat more often than in nest boxes placed where habitat was not as favorable. Since eastern and mountain bluebirds are similar in behavior (Bent 1964, Pinkowski 1975), it is likely that mountain bluebirds will remain at the same nest box to raise both broods provided that the nest site is suitable.

Imprinting on the rearing environment by young birds may at least temporarily modify habitat preference in some species (Klopfer 1963). Imprinting studies have not been done on mountain bluebirds, but neither imprinting nor postfledging experience are important influences on nest site selection by other secondary cavity nesting passerines (house sparrows (Passer domesticus), Cink 1976; eastern bluebirds, Pinkowski 1979a).

Birds seldom are able to choose breeding sites in ecological isolation. Topographic distribution of a species, therefore, is influenced by additional factors. Disease or depredation can selectively remove individuals from certain areas (Partridge 1978). For example, in 1974 many first broods of mountain bluebirds to the south and west of Brandon, Manitoba suffered heavy mortality from an infestation of black flies (Simulium venustum) (Lane and Burton 1974).

Intraspecific competition during periods of high population density may force individuals into less preferred

habitat (Kluyver and Tinbergen 1953, Hildén 1965). In Manitoba, the practice of placing nest boxes 400m apart allows sufficient space for the territorial requirements of mountain bluebirds (see Power 1966). Individuals, however, do compete for possession of either territories or mates or both (pers. observ.).

An animal also can be restricted to certain areas by interspecific competition (Grinnel 1904, Caccamise 1974). In Manitoba, the most common competitors of mountain bluebirds for nest sites are tree swallows (Iridoprocne bicolor), house sparrows, house wrens (Troglodytes aedon), eastern bluebirds, mice (Peromyscus spp.), and red squirrels (Tamiasciurus hudsonicus). Nest boxes occasionally are occupied by starlings (Sturnus vulgaris), black-capped chickadees (Parus atricapillus), flying squirrels (Glaucomys volans), and eastern chipmunks (Tamias striatus) (Lane 1971, Lane and Bauman 1972, Lane et al. 1981).

On the Canadian prairies, early spring arrival and nesting give mountain bluebirds an advantage over tree swallows in obtaining nest sites (Miller 1970, Pinel 1980). If inclement weather delays first nesting attempts by mountain bluebirds, however, competition with tree swallows may become significant (Pinel and Robinson 1975). Tree swallows also may become a factor in second nesting attempts by mountain bluebirds.

Analysis of reports from areas where the two species are sympatric reveals that the number of mountain bluebirds

using nest boxes increases relative to the number of tree swallows over time (see Scott 1969, Miller 1970, Burns et al. 1973, Houston 1974, Carter 1979, Pinel 1980). This supports the belief by Bent (1964) that mountain bluebirds are competitively superior to tree swallows.

Opinions differ on the competitive superiority between mountain bluebirds, house sparrows, and house wrens. Criddle (1927:43)states:

> Male mountain bluebirds are able to defend their nest against all intruders of their own size, this includes the house sparrow which has somewhat of a reputation for ousting other species. The sparrow, however, is no match for the bluebird..., it has never been observed to get possession of a nesting box occupied by the latter.

Criddle (op. cit.) also stated that he had never observed house wrens interfering with nesting mountain bluebirds. Others, however, regard these two species as serious threats to bluebirds (Miller 1970, Lane 1971, Zeleny 1976, Case 1979).

Early reports suggest that eastern bluebirds expanded their range westward into areas occupied by mountain bluebirds (Thompson 1893). This might indicate that Sialia sialis competes successfully with S. currucoides. The westward dispersal by S. sialis, however, has been erratic and without definite pattern or persistence (Belcher 1966). In fact, evidence suggests that S. currucoides is dominant over S. sialis in interspecific contests (Miller 1970). For example, Criddle (1927:40) states that "the two species continued as neighbours... for several years but as the western birds increased the eastern ones diminished."

Mice and squirrels use nest boxes to rear young in early spring and boxes occupied by these rodents are not available to mountain bluebirds (Lane 1971). Starlings, although formidable competitors of secondary cavity nesters elsewhere (Bent 1964, Erskine and McLaren 1976), are not a serious competitor for nest boxes in Manitoba (Lane and Bauman 1972). Competition with other occasional nest box occupants is insignificant.

Since suitability of a breeding site is affected by competition and predation pressures as well as its intrinsic qualities, an optimal area with regard to survival requirements of the individual may not be one where breeding success is greatest (Hildén 1965). Individuals whose distribution is affected by the foregoing constraints are under selective pressures to choose nest sites where the probability of successfully rearing offspring is maximized (Smith 1974, Gibo et al. 1976).

1.4.2 Habitat Utilization by Mountain Bluebirds

No quantitative studies have been completed concerning habitat utilization by mountain bluebirds. Power (1980) hypothesized that nest site limited species can be expected to be euryvalent because individuals will be under selective pressures to use almost any available nest site. Even nest site limited species, however, should evolve to be more persistent in attempts to enter and more vigorous in defense of habitats in which their fitness is greater (Orians 1971).

Descriptive accounts suggest that mountain bluebirds prefer relatively open areas with scattered bushes or trees (Criddle 1927, Bent 1964, Zeleny 1976). Along nest box lines near Calgary, Alberta mountain bluebirds are restricted to aspen parkland and are not found juxtaposed with cultivated hay or native grassland (Pinel 1980). Power (1980) found that foraging mountain bluebirds prefer to exploit areas where ground cover is sparse or kept short by cutting or grazing. Mountain bluebirds have the widest habitat tolerance within the genus Sialia, possibly because the ability to hover-forage permits utilization of areas with low perch density (Pinkowski 1979b).

Several reports suggest that mountain bluebirds are not fastidious about selecting a nest cavity. For example, Bent (1964) states that almost any cavity will suit them including deserted woodpecker holes, crevaces in cliffs, and holes in river banks. On rare occasions S. currucoides has been known to depart from its customary habit of nesting in cavities (Murie 1934).

1.4.3 Multivariate Studies of Habitat Utilization

Several studies have employed multivariate statistical methods to describe animal distributions in relation to environmental characteristics. James (1971), Anderson and Shugart (1974), and Whitmore (1975) used this approach to describe habitat relationships among avian species in Arkansas, Tennessee, and Utah respectively. Conner and Adkisson (1977) used principal component analysis to compare

nesting habitat of five species of woodpeckers. Titus and Mosher (1981) successfully differentiated between nesting habitat of four species of raptors in Maryland using discriminant analysis. These studies identified habitat differences among species within a particular community.

Other researchers have attempted to quantify differences between habitat used and not used by a single species. Klebenow (1969) used discriminant function analysis in an unsuccessful attempt to distinguish between habitat used and not used by nesting sage grouse (Centrocercus urophasianus). Kaminski and Prince (1977) used the same technique to provide information for predicting potential nest sites of Canada geese (Branta canadensis). Titus and Mosher (1981) were able to define the factors that separate nest sites used and not used in three of the four species of raptors in their study.

CHAPTER TWO

METHODS

2.1 Data Collection

Data were collected between 20 April and 10 August, 1980 from 28 nest box lines that provided a cross section of the study area. I visited each line at least once to obtain data on nest sites. Additional information on nest box occupants and their progress during the breeding season was obtained from individuals who regularly monitor the lines.

Data were collected at 1169 nest boxes. Twenty-six parameters that were considered pertinent to cavity nesting species were evaluated. Measured parameters were divided into three groups: 1) surface cover types, 2) properties of the nest box, and 3) other characteristics of the nest site.

Six classes of surface cover were recorded: 1) forested areas (nongrazed deciduous, coniferous, or mixed forest), 2) wooded pasture, 3) shrub pasture, 4) grass pasture, 5) long grass areas (cropped field, native hay, and native grass), and 6) fallow field. Percent cover was estimated for each class within a 100m radius from the nest box. Power (1980) states that mountain bluebirds usually forage within this distance from the nest. Percentages were converted to m^2 for analysis.

Fourteen characteristics were measured for each nest box: 1) interior box area, 2) box depth from entrance hole to floor, 3) box height from ground to entrance hole,

4) box condition, 5) box color, 6) box age, 7) nest line age, 8) entrance hole diameter, 9) aspect of entrance hole, 10) position of entrance hole with respect to the road, 11) directional location of box from the road, 12) distance to nearest tree or shrub greater than 2m in height, 13) distance to nearest road, and 14) distance to nearest occupied building. Dimensions of the nest box were measured with a tape, and distances were measured with a tape, a 300mm telephoto lens, or an odometer. Box and nest line ages were obtained from Lane's records. Box condition was recorded as good or fair, and box color was categorized as weathered wood, new wood, or painted. Aspect of the entrance hole was determined with a compass and recorded as an azimuth. Entrance holes faced towards, away from, or parallel to the road. Directional location of the nest box from the road was recorded as a cardinal direction.

Other variables recorded at nest sites included: 1) presence of overhead utility lines, 2) presence of livestock, 3) presence of disturbance, 4) type of road near nest box, 5) type of supporting structure for nest box, and 6) general land use in the area. Burning, land clearing, construction, feedlots, and human activity were considered disturbances. Road types were classified as paved, all-weather, internal, rail, or no road (if roads were absent within a 100m radius of a nest box). Nest boxes were mounted on fence posts, non-fence posts, and utility poles. Land use was categorized as farmland or forest reserve.

2.2 Methods of Analysis

Median clutch initiation dates for all avian species were calculated from 1980 field notes. Since a nest box may be used more than once in a breeding season, two nesting periods were calculated: 1) 20 April to 6 June and 2) 7 June to 24 July. The 48 day nesting periods were calculated from the following information on mountain bluebirds: 4 days nest building (Scott 1967), 6 days egg laying (Munro et al. 1981), 14 day incubation period, 20 day nestling stage (Power 1966), and 4 days between fledging a first brood and initiating a second clutch (Scott 1967).

Nesting period dates were derived from data on mountain bluebirds for two reasons. First, they usually began nesting before other passerines. Second, they are double-brooded in Manitoba (Criddle 1927), and can be expected to compete for nest boxes after first broods have fledged.

Stepwise discriminant function analysis (in Nie et al. 1975) was used to define differences between nest sites used and not used by mountain bluebirds during 1) the first nesting period and 2) both nesting periods. The stepwise selection criteria was Wilks' lambda and all default criteria were used.

The 15 variables analyzed by the discriminant method were divided into two sets (Table 1). Surface cover types comprised one set of variables while the other set included variables describing properties of the nest box that were suitable for inclusion in discriminant analysis. Since several discriminant analyses were performed on the data,

Table 1. Description of variables included in stepwise discriminant analyses of nest sites used and not used by nesting mountain bluebirds in southwestern Manitoba.

Mnemonic	Description
1) Surface cover types	
FOREST	Percent cover by deciduous, coniferous, and mixed forest
WPAS	Percent cover by wooded pasture
SPAS	Percent cover by shrub pasture
GPAS	Percent cover by grass pasture
LGRAS	Percent cover by cropped field, native hay, and native grass
FALLO	Percent cover by fallow field
2) Nest box properties	
AREA	Interior area of nest box
HDIAM	Entrance hole diameter
DPTH	Depth from entrance hole to floor
HGHT	Height of entrance hole above ground
BOXAG	Age of nest box
LINAG	Age of nest box line
DSTREE	Distance to nearest tree or shrub greater than 2m in height
DSRD	Distance to nearest road
DSBLDG	Distance to nearest occupied building