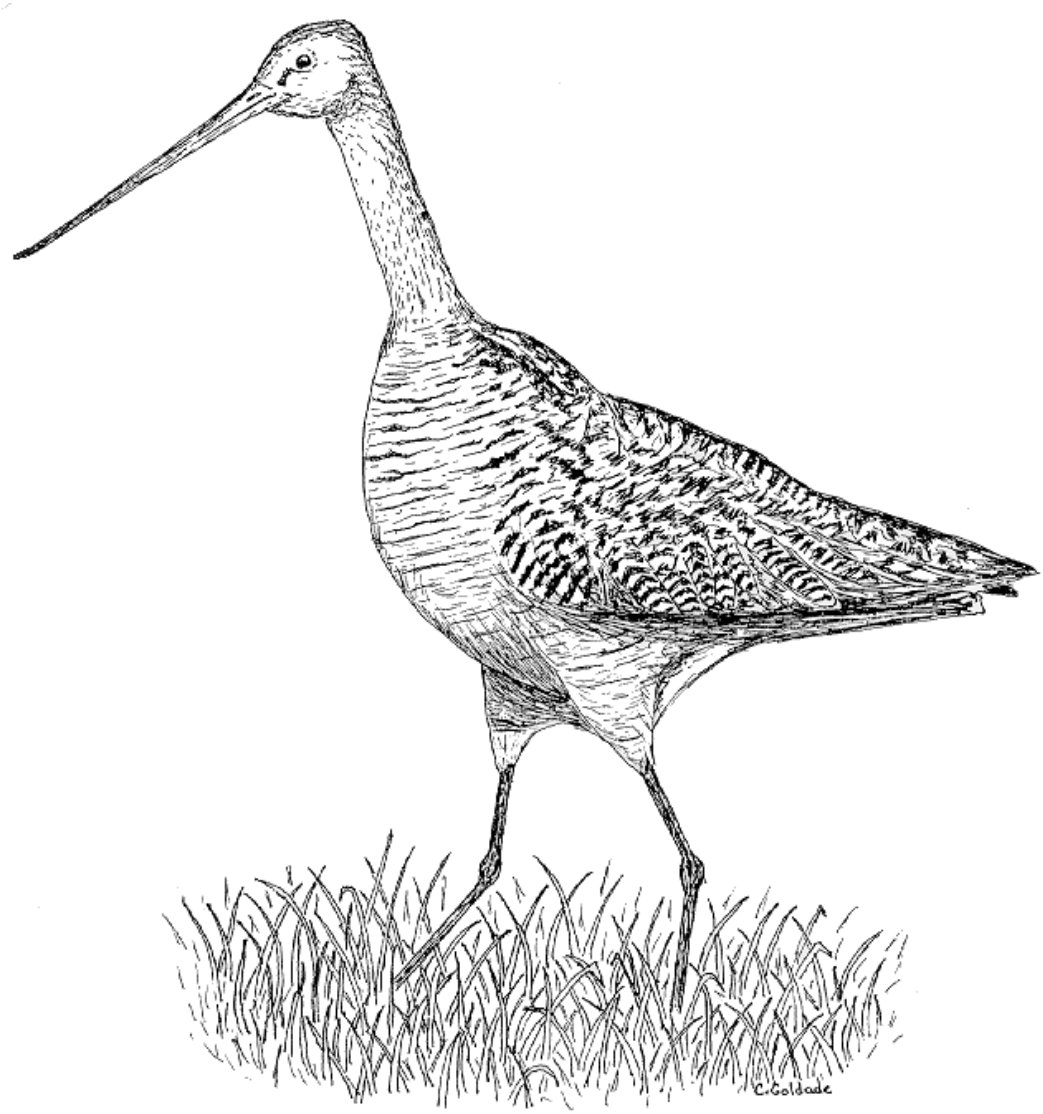
EFFECTS OF MANAGEMENT PRACTICES ON GRASSLAND BIRDS:

MARBLED GODWIT



Grasslands Ecosystem Initiative
Northern Prairie Wildlife Research Center
U.S. Geological Survey
Jamestown, North Dakota 58401

This report is one in a series of literature syntheses on North American grassland birds. The need for these reports was identified by the Prairie Pothole Joint Venture (PPJV), a part of the North American Waterfowl Management Plan. The PPJV recently adopted a new goal, to stabilize or increase populations of declining grassland- and wetland-associated wildlife species in the Prairie Pothole Region. To further that objective, it is essential to understand the habitat needs of birds other than waterfowl, and how management practices affect their habitats. The focus of these reports is on management of breeding habitat, particularly in the northern Great Plains.

Suggested citation:

Dechant, J. A., M. L. Sondreal, D. H. Johnson, L. D. Igl, C. M. Goldade, M. P. Nenneman, and B. R. Euliss. 1998 (revised 2001). Effects of management practices on grassland birds: Marbled Godwit. Northern Prairie Wildlife Research Center, Jamestown, ND. 11 pages.

Species for which syntheses are available or are in preparation:

American Bittern
Mountain Plover
Marbled Godwit
Long-billed Curlew
Willet
Wilson's Phalarope
Upland Sandpiper
Greater Prairie-Chicken
Lesser Prairie-Chicken
Northern Harrier
Swainson's Hawk
Ferruginous Hawk
Short-eared Owl
Burrowing Owl
Horned Lark
Sedge Wren
Loggerhead Shrike
Sprague's Pipit
Grasshopper Sparrow
Baird's Sparrow
Henslow's Sparrow
Le Conte's Sparrow
Nelson's Sharp-tailed Sparrow
Vesper Sparrow
Savannah Sparrow
Lark Sparrow
Field Sparrow
Clay-colored Sparrow
Chestnut-collared Longspur
McCown's Longspur
Dickcissel
Lark Bunting
Bobolink
Eastern Meadowlark
Western Meadowlark
Brown-headed Cowbird

EFFECTS OF MANAGEMENT PRACTICES ON GRASSLAND BIRDS:

MARBLED GODWIT

Jill A. Dechant, Marriah L. Sondreal, Douglas H. Johnson, Lawrence D. Igl,
Christopher M. Goldade, Melvin P. Nenneman, and Betty R. Euliss

Series Coordinator: Douglas H. Johnson
Series Assistant Coordinator: Lawrence D. Igl

Reviewer: Mark R. Ryan

Range Map: Jeff T. Price

Cover Art: Christopher M. Goldade

Major Funding: Prairie Pothole Joint Venture, U.S. Fish and Wildlife Service
U.S. Geological Survey

Funding also provided by: U.S. Forest Service

Collaborators:

Louis B. Best, Iowa State University
Carl E. Bock, University of Colorado
Brenda C. Dale, Canadian Wildlife Service
Stephen K. Davis, Saskatchewan Wetland Conservation Corporation
James J. Dinsmore, Iowa State University
James K. Herkert, Illinois Endangered Species Protection Board
Fritz L. Knopf, Midcontinent Ecological Science Center
Rolf R. Koford, Iowa Cooperative Fish and Wildlife Research Unit
David R. C. Prescott, Alberta NAWMP Centre
Mark R. Ryan, University of Missouri
David W. Sample, Wisconsin Department of Natural Resources
David A. Swanson, Ohio Division of Wildlife
Peter D. Vickery, Massachusetts Audubon Society
John L. Zimmerman (retired), Kansas State University

February 1998
(revised January 2001)

ORGANIZATION AND FEATURES OF THIS SPECIES ACCOUNT

Information on the habitat requirements and effects of habitat management on grassland birds were summarized from information in more than 4,000 published and unpublished papers. A ***range map*** is provided to indicate the relative densities of the species in North America, based on Breeding Bird Survey (BBS) data. Although birds frequently are observed outside the breeding range indicated, the maps are intended to show areas where managers might concentrate their attention. It may be ineffectual to manage habitat at a site for a species that rarely occurs in an area. The species account begins with a brief ***capsule statement***, which provides the fundamental components or keys to management for the species. A section on ***breeding range*** outlines the current breeding distribution of the species in North America, including areas that could not be mapped using BBS data. The ***suitable habitat*** section describes the breeding habitat and occasionally microhabitat characteristics of the species, especially those habitats that occur in the Great Plains. Details on habitat and microhabitat requirements often provide clues to how a species will respond to a particular management practice. A ***table*** near the end of the account complements the section on suitable habitat, and lists the specific habitat characteristics for the species by individual studies. A special section on ***prey habitat*** is included for those predatory species that have more specific prey requirements. The ***area requirements*** section provides details on territory and home range sizes, minimum area requirements, and the effects of patch size, edges, and other landscape and habitat features on abundance and productivity. It may be futile to manage a small block of suitable habitat for a species that has minimum area requirements that are larger than the area being managed. The Brown-headed Cowbird (*Molothrus ater*) is an obligate brood parasite of many grassland birds. The section on ***cowbird brood parasitism*** summarizes rates of cowbird parasitism, host responses to parasitism, and factors that influence parasitism, such as nest concealment and host density. The impact of management depends, in part, upon a species' nesting phenology and biology. The section on ***breeding-season phenology and site fidelity*** includes details on spring arrival and fall departure for migratory populations in the Great Plains, peak breeding periods, the tendency to renest after nest failure or success, and the propensity to return to a previous breeding site. The duration and timing of breeding varies among regions and years. ***Species' response to management*** summarizes the current knowledge and major findings in the literature on the effects of different management practices on the species. The section on ***management recommendations*** complements the previous section and summarizes specific recommendations for habitat management provided in the literature. If management recommendations differ in different portions of the species' breeding range, recommendations are given separately by region. The ***literature cited*** contains references to published and unpublished literature on the management effects and habitat requirements of the species. This section is not meant to be a complete bibliography; a searchable, annotated bibliography of published and unpublished papers dealing with habitat needs of grassland birds and their responses to habitat management is posted at the Web site mentioned below.

 Please direct comments and suggestions to Douglas H. Johnson, Northern Prairie Wildlife Research Center, U.S. Geological Survey, 8711 37th Street SE, Jamestown, North Dakota 58401; telephone: 701-253-5539; fax: 701-253-5553; e-mail: Douglas_H_Johnson@usgs.gov.

MARBLED GODWIT
(*Limosa fedoa*)

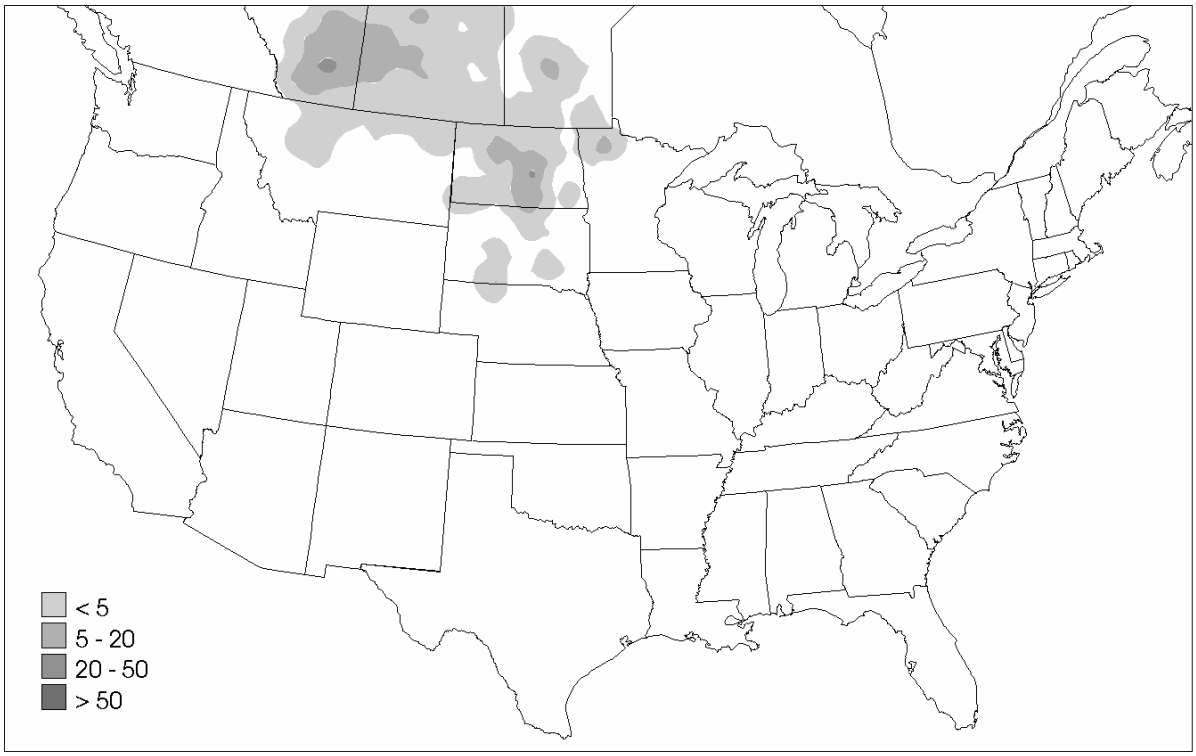


Figure. Breeding distribution of the Marbled Godwit in the United States and southern Canada, based on Breeding Bird Survey data, 1985-1991. Scale represents average number of individuals detected per route per year. Map from Price, J., S. Droege, and A. Price. 1995. The Summer Atlas of North American Birds, Academic Press, London, England. 364 pages.

Keys to management include providing large expanses of short, sparse to moderately vegetated landscapes that include native grasslands and wetland complexes. Wetland complexes contain a diversity of wetland classes and sizes, such as ephemeral, temporary, seasonal, semipermanent, and permanent wetlands, as well as intermittent streams. Marbled Godwits use wetlands of various salinities.

Breeding range:

Marbled Godwits breed from central Alberta through central Manitoba and along St. James Bay, south through Montana, North Dakota, eastcentral South Dakota, and northcentral Nebraska, and east to northcentral Minnesota (National Geographic Society 1987). (See figure for the relative densities of Marbled Godwits in the United States and southern Canada, based on Breeding Bird Survey data.)

Suitable habitat:

Breeding Marbled Godwits require large expanses of short, sparse to moderately vegetated uplands for nesting and foraging, and wetland complexes for foraging (Stewart 1975, Ryan 1982, Ryan et al. 1984, Kantrud and Higgins 1992). Marbled Godwit territories are characterized by a high percentage of grass cover, many wetlands, and high wetland diversity

(Stewart 1975, Ryan 1982, Kantrud and Higgins 1992). In both upland and wetland habitat, tall, dense cover is avoided (Nowicki 1973, Higgins et al. 1979, Ryan 1982, Renken 1983, Ryan et al. 1984, Renken and Dinsmore 1987). Marbled Godwits with broods use somewhat taller (15-60 cm), denser grass cover than do nesting pairs (Ryan et al. 1984). Foraging occurs in water 5 to 13 cm deep (Gratto-Trevor 2000).

Marbled Godwits prefer native grass cover to tame vegetation (Stewart 1975, Ryan 1982, Ryan et al. 1984, Kantrud and Higgins 1992). Pastures, idle grasslands, and haylands are often used for nesting, and pastures that are idle during the nesting season may be particularly attractive (Higgins et al. 1979, Ryan et al. 1984, Kantrud and Higgins 1992). Although tilled lands usually are avoided (Weber 1978, Ryan et al. 1984), nests also have been reported in cropland, including cereal grains, flax, and stubble fields (Stewart 1975, Higgins et al. 1979, Kantrud and Higgins 1992). In the northern prairie and aspen parkland regions of Alberta, mean numbers of birds/site was nonstatistically compared among several habitat types (Prescott et al. 1995, Prescott 1997). In the prairie region, Marbled Godwits were most abundant in idle mixed-grass followed by sandhills, hayland, fallow cropland, and tame pasture (Prescott 1997). Sandhills were defined as mixed-grass containing sandy soils. Hayland was planted to grasses (species not specified) or alfalfa (*Medicago sativa*). In aspen parkland uplands, Marbled Godwits were most abundant on idle mixed-grass followed by continuously grazed mixed-grass (Prescott et al. 1995). They were not found in idle tame grassland, tame DNC, tame pasture, tame hayland mowed after 15 July (deferred), deferred mixed-grass pasture, idle parkland, continuously grazed parkland, native DNC, hayland, or cropland.

In North Dakota, Marbled Godwits were associated with silty range, thin upland range, and shallow-to-gravel range sites (Messmer 1990, Sedivec 1994). Silty range and thin upland range sites were characterized by thin topsoil, loamy soil, 1-25% slope, grassy cover, low shrub cover, and moderate to high litter cover. Maximum vegetation height ranged from 50 to 70 cm and average litter depth ranged from 3.8 to 9.1 cm. Shallow-to-gravel range sites were characterized by sparse cover and reduced litter.

Within wetland habitats, Marbled Godwits avoided dense emergent vegetation, preferring shallow water areas with short, sparse to moderately dense shoreline vegetation (Ryan 1982, Ryan et al. 1984, Eldridge 1992). Suitable wetlands ranged in salinity from fresh to highly saline, and varied widely in size and permanence (Stewart and Kantrud 1965, Stewart 1975, Ryan et al. 1984, Eldridge 1992, Prescott et al. 1995). Semipermanent wetlands were used most often, but ephemeral, alkali, and temporary ponds were preferred relative to their availability (Ryan et al. 1984). Kantrud and Stewart (1984) observed 57% of breeding Marbled Godwits using seasonal wetlands, but their density was highest on temporary wetlands. Shifts in wetland use occurred seasonally and during climatic extremes, as breeding Marbled Godwits used less-permanent wetlands early in the breeding season and moved to semipermanent and alkali wetlands later in summer or during drought (Ryan et al. 1984, Gratto-Trevor 2000). In North Dakota, Marbled Godwits nested in wet and dry areas of wet meadow, upland areas of short (<30 cm) grass, and idle mixed-grass hayland; they fed in dry uplands, wet and dry areas of wet meadow, roadside ditches, and open water (Nowicki 1973). In southern Alberta, average distance between nest sites and water was 239 m in managed wetlands and 258 m in natural wetlands (Gratto-Trevor 2000). In Saskatchewan, Marbled Godwits nested in wetland margins and uplands with denser, taller, and more homogeneous vegetation than random sites (Colwell and Oring 1990). A table near the end of the account lists the specific habitat characteristics for Marbled Godwits by study.

Area requirements:

Territories are large, and include both feeding and nesting areas. Areas must be large enough to provide both upland habitat and a diverse range of wetland types (Ryan et al. 1984, Colwell and Oring 1988*a*, Kantrud and Stewart 1984). In North Dakota, mean territory size was 90 ha (Ryan et al. 1984). Marbled Godwits may be area sensitive, rarely occurring on blocks of contiguous grassland <100 ha in the northern Great Plains (D. H. Johnson, *unpublished data*).

Brown-headed Cowbird brood parasitism:

No known records of brood parasitism by Brown-headed Cowbirds (*Molothrus ater*) exist.

Breeding-season phenology and site fidelity:

The breeding season extends from mid-April through late July (Maher 1973, Stewart 1975, Kantrud and Higgins 1992, Sedivec 1994, Gratto-Trevor 2000). The earliest reported nest with eggs was 17 April (Stewart 1975), with most nests initiated during mid- to late May (Maher 1973, Kantrud and Higgins 1992, Sedivec 1994). Kantrud and Higgins (1992) report a late hatching date of 27 June, and Stewart (1975) observed a dependent brood 18 July. One brood is produced per season (Gratto-Trevor 2000). Although Higgins et al. (1979) reported that Marbled Godwit pairs appeared to make only one nesting attempt per breeding season, Ryan et al. (1981) and Gratto-Trevor (2000) reported that renesting occurred after failure of the initial nest. Marbled Godwits begin flocking in mid- to late July (Maher 1973), and most flocks depart by late August (Ryan et al. 1984). In Saskatchewan and Alberta, Marbled Godwits exhibited breeding-site fidelity (Colwell and Oring 1988*b*, Gratto-Trevor 2000).

Species' response to management:

Marbled Godwit densities were highest during the first 2 yr after a burn in North Dakota grasslands (Johnson 1997). Ryan et al. (1984) suggested that fall burning or haying could provide nesting habitat the following spring, and the denser, taller regrowth (15-60 cm) could provide suitable habitat for broods. Haylands are readily used by breeding Marbled Godwits (Ryan et al. 1984, Kantrud and Higgins 1992).

Grazing can be used in both upland and wetland habitats to maintain the short, moderately dense vegetation preferred by Marbled Godwits (Ryan et al. 1984). Grazed or recently grazed uplands are often more attractive to breeding Marbled Godwits than are other land-use types (Ryan et al. 1984, Renken and Dinsmore 1987, Kantrud and Higgins 1992, Sedivec 1994). In Saskatchewan, no significant difference in abundance was found between lightly grazed mixed-grass and lightly grazed stands of crested wheatgrass (*Agropyron cristatum)* (Sutter and Brigham 1998). In North Dakota, density of Marbled Godwits was not significantly different among several rotational grazing systems and idle pastures (Messmer 1990). The rotational systems were season-long pasture, short-duration (involves a system of pastures rotated through a grazing schedule of about 1 wk grazed and 1 mo ungrazed, repeated throughout the season), and twice-over rotation (involves grazing a number of pastures twice per season, with about a 2-mo rest between grazing).

Management Recommendations:

Maintain a diverse complex of wetlands (Kantrud and Stewart 1984, Ryan et al. 1984, Colwell and Oring 1988*a*). Marbled Godwits used wetlands of widely varying types and salinities, and may need to utilize larger, more-permanent wetlands during droughts or late in summer (Ryan et al. 1984). Maintain shallow-water ponds with little or no emergent vegetation for pre- and post-breeding flocks and shallow-water ponds with margins of emergent vegetation for broods (Gratto-Trevor 2000).

Protected habitats should be extensive enough (>1 km^2) to provide both upland habitat and a diverse range of wetland types (Stewart 1975, Colwell and Oring 1988*a*, Kantrud and Higgins 1992, Gratto-Trevor 2000). Territories averaged 90 ha in North Dakota (Ryan et al. 1984), but Marbled Godwits may require larger (>100 ha) blocks of contiguous grassland habitat (D. H. Johnson, *unpublished data*).

Protect wetlands from drainage (Ryan et al. 1984).

Restore drained wetlands (Berkey et al. 1993, Johnson 1996).

Provide native grassland habitat for upland nesting and foraging (Ryan et al. 1984, Eldridge 1992, Kantrud and Higgins 1992, Gratto-Trevor 2000).

Burning, mowing, and grazing can be used to provide areas of shorter, sparser vegetation (Ryan et al. 1984, Eldridge 1992, Berkey et al. 1993).

Fall burning or mowing of upland sites and wetland edges can produce suitable cover for the following spring (Ryan et al. 1984). Moderate to dense regrowth in burned areas may be too dense for nesting, but can provide the denser, taller cover used by broods (Ryan et al. 1984).

Marbled Godwits prefer previously grazed areas that are idle during the current breeding season (Kantrud and Higgins 1992). If grazing is used, choose rotational grazing over season-long grazing (Sedivec 1994). When implementing a rotational grazing system, avoid grazing until late May or late June (Sedivec 1994, Gratto-Trevor 2000); when using season-long grazing, delay grazing until mid-June (Sedivec 1994). Berkey et al. (1993) suggested that short-term grazing (2-4 wk in May) may be beneficial to Marbled Godwits in North Dakota.

Protect upland habitat from tilling (Ryan et al. 1984). Encourage no-tillage and minimum-tillage practices on cropland (Kantrud and Higgins 1992).

Table. Marbled Godwit habitat characteristics.

Author(s)	Location(s)	Habitat(s) Studied*	Species-specific Habitat Characteristics
Colwell and Oring 1990	Saskatchewan	Mixed-grass/tame pasture, wetland, wet-meadow pasture	Nested in wetland margins and uplands with denser, taller, and more homogeneous vegetation than random sites
Gratto-Trevor 2000	Alberta	Shortgrass pasture, wetland	Average distance between nest sites and water was 239 m in managed wetlands and 258 m in natural wetlands
Higgins et al. 1979	North Dakota	Burned mixed-grass, cropland, idle mixed-grass, idle tame, mixed-grass pasture	Nested in short (usually <15 cm) grassy cover; nested in cultivated fields, tame grassland, native pasture, burned native grassland, and idle native grasslands; hatching success was similar between cultivated and native grassland nests
Johnson 1997	North Dakota	Burned mixed-grass, burned tame, idle mixed-grass	Occurred at highest densities during the first 2 yr after burning
Kantrud and Higgins 1992	Manitoba, Montana, North Dakota, South Dakota	Burned mixed-grass, cropland, hayland, idle mixed-grass, idle tame, mixed-grass pasture	Nested in native grassland, were most common in pastures idle during current growing season; nest sites were characterized by short to intermediate vegetation height and density; used areas with <40% dead vegetation; avoided areas with 100% visual obstruction >10 cm and areas with >35 cm effective cover height (average maximum height of leaf canopy); average effective cover height at nests was 17 cm
Kantrud and Stewart 1984	North Dakota	Wetland complex	Breeding distribution among wetland classes was 57% seasonal, 37% semipermanent, 3% temporary, and 3% alkali; density (pairs/km^2) was highest on temporary wetlands, followed by seasonal wetlands and fens
Messmer 1990	North Dakota	Idle mixed-grass/tame,	No significant difference in density between grazing

		mixed-grass/tame hayland, mixed-grass/tame pasture, wet- meadow pasture	treatments, although short-duration (system of pastures rotated through a grazing schedule of about 1 wk) and twice-over deferred (pastures grazed twice per season with 2-mo rest between grazing) grazing systems had higher densities than season-long grazing system (leaving cattle on the same pasture all season); nested on silty, thin upland, and shallow-to-gravel range sites
Nowicki 1973	North Dakota	Cropland, idle mixed-grass hayland, idle mixed-grass pasture, mixed-grass pasture, tame hayland, wetland, wet meadow	Nested in wet and dry areas of wet meadow, upland areas of short (<30 cm) grasses, and idle mixed-grass hayland; foraged in dry grasslands, wet and dry areas of wet meadows, in roadside ditches, and in open water
Prescott 1997	Alberta	Cropland, hayland, mixed-grass pasture, shrubland, tame pasture, woodland	Were most abundant in mixed-grass pasture followed by cropland, hayland, and tame pasture
Prescott et al. 1995	Alberta	Cropland; dense nesting cover (DNC; idle seeded-native, idle tame), idle mixed-grass, idle parkland, idle tame, mixed-grass pasture, parkland pasture, tame hayland, tame pasture, wetland, woodland	In wetlands, were most abundant in large saline wetlands and were also found in large fresh, small saline, and medium fresh wetlands; in uplands, were most abundant in idle native grassland and continuously grazed native grassland
Renken 1983, Renken and Dinsmore 1987	North Dakota	DNC (idle tame), idle mixed-grass, mixed-grass pasture	Preferred grazed habitats; territories were located in areas with less vegetative cover and sparser, shorter vegetation than unused areas; mean vegetation values for used areas were

			49.9% grass cover, 18.8% forb cover, 99.0% litter cover, 5.5% shrub cover, 0.7% bare ground, 7.0 cm effective height (average maximum height of the leaf canopy), and 2.0 cm litter depth
Ryan 1982, Ryan et al. 1984	North Dakota	Cropland, idle tame, mixed-grass hayland, mixed-grass pasture, tame hayland, tame pasture**,** wetland complex	Preferred uplands with short (<15 cm for nesting pairs, 15-60 cm for pairs with broods), sparse to moderately dense native grasses; avoided tilled land; used pasture, grassland and hayfield habitats; used a variety of wetland types characterized by short, sparse to moderately dense shoreline vegetation; used semipermanent ponds most frequently but select ephemeral, alkali and temporary ponds if available; used alkali and semipermanent wetlands more often in dry years; mean territory size was 90 ha; territories contained more wetlands and wetland classes than randomly selected areas
Sedivec 1994	North Dakota	Idle mixed-grass, mixed-grass pasture	Nested in dry upland; were more common in grazed areas than ungrazed areas; nested in sparse vegetation with low height density (<6 cm); native rangeland should not be grazed until late-May to early June when implementing rotational grazing, and season-long grazing should be delayed until mid-June
Stewart 1975	North Dakota	Cropland, idle mixed-grass, idle shortgrass, mixed-grass hayland, shortgrass hayland, tame hayland**,** wetland complex	Nested in native prairie, cropland, and hayland; used a variety of wetland types that varied in salinity from fresh to highly saline
Stewart and Kantrud 1965	North Dakota	Wetland	Highest densities were found on seasonal wetlands with closed stands of emergent cover or with clumps of emergent cover interspersed with open water; on semipermanent wetlands with closed stands of emergent cover, with clumps of emergent cover interspersed with open water, or with

			peripheral bands of emergent cover encircling expanses of open water; and on intermittent saline lakes
Sutter and Brigham 1998	Saskatchewan	Mixed-grass pasture, tame pasture	No significant difference in abundance was found between lightly grazed mixed-grass and lightly grazed stands of crested wheatgrass (*Agropyron cristatum*)
Weber 1978, Weber et al. 1982	South Dakota	Cropland, idle mixed-grass, idle shortgrass, idle tallgrass, mixed-grass pasture, shortgrass pasture, tallgrass pasture, tame hayland, wetland, woodland	Presence was positively associated with wetlands containing dense stands of emergent vegetation, with open water or bare soil covering <5% of the wetland, and with adjacent uplands of alfalfa (*Medicago sativa*)/hayland; presence was negatively associated with wetlands with adjacent tilled fields; were observed on temporary, seasonal, and semipermanent wetlands, on intermittent streams, stock ponds, dugouts, and tilled wetlands, but none were seen on permanent streams

*In an effort to standardize terminology among studies, various descriptors were used to denote the management or type of habitat. "Idle" used as a modifier (e.g., idle tallgrass) denotes undisturbed or unmanaged (e.g., not burned, mowed, or grazed) areas. "Idle" by itself denotes unmanaged areas in which the plant species were not mentioned. Examples of "idle" habitats include weedy or fallow areas (e.g., oldfields), fencerows, grassed waterways, terraces, ditches, and road rights-of-way. "Tame" denotes introduced plant species (e.g., smooth brome [*Bromus inermis*]) that are not native to North American prairies. "Hayland" refers to any habitat that was mowed, regardless of whether the resulting cut vegetation was removed. "Burned" includes habitats that were burned intentionally or accidentally or those burned by natural forces (e.g., lightning). In situations where there are two or more descriptors (e.g., idle tame hayland), the first descriptor modifies the following descriptors. For example, idle tame hayland is habitat that is usually mowed annually but happened to be undisturbed during the year of the study.

LITERATURE CITED

Berkey, G., R. Crawford, S. Galipeau, D. Johnson, D. Lambeth, and R. Kreil. 1993. A review of wildlife management practices in North Dakota: effects on nongame bird populations and habitats. Report submitted to Region 6. U.S. Fish and Wildlife Service, Denver, Colorado. 51 pages.

Colwell, M. A., and L. W. Oring. 1988*a*. Habitat use by breeding and migrating shorebirds in southcentral Saskatchewan. Wilson Bulletin 100:554-566.

Colwell, M. A., and L. W. Oring. 1988*b*. Return rates of prairie shorebirds: sex and species differences. Wader Study Group Bulletin 55:21-24.

Colwell, M. A., and L. W. Oring. 1990. Nest site characteristics of prairie shorebirds. Canadian Journal of Zoology 68:297-302.

Eldridge, J. 1992. Management of habitat for breeding and migrating shorebirds in the Midwest. U.S. Fish and Wildlife Service Leaflet 13.2.14. 6 pages.

Gratto-Trevor, C. L. 2000. Marbled Godwit (*Limosa fedoa*). *In* A. Poole and F. Gill, editors. The birds of North America, No. 492. The Birds of North America, Inc., Philadelphia, Pennsylvania.

Higgins, K. F., L. M. Kirsch, M. R. Ryan, and R. B. Renken. 1979. Some ecological aspects of Marbled Godwits and Willets in North Dakota. Prairie Naturalist 11:115-118.

Johnson, D. H. 1996. Management of northern prairies and wetlands for the conservation of Neotropical migratory birds. Pages 53-67 *in* F. R. Thompson, III, editor. Management of midwestern landscapes for the conservation of Neotropical migratory birds. U.S. Department of Agriculture, Forest Service General Technical Report NC-187.

Johnson, D. H. 1997. Effects of fire on bird populations in mixed-grass prairie. Pages 181-206 *in* F. L. Knopf and F. B. Samson, editors. Ecology and conservation of Great Plains vertebrates. Springer-Verlag, New York, New York.

Kantrud, H. A., and K. F. Higgins. 1992. Nest and nest site characteristics of some ground-nesting, non-passerine birds of northern grasslands. Prairie Naturalist 24:67-84.

Kantrud, H. A., and R. E. Stewart. 1984. Ecological distribution and crude density of breeding birds on prairie wetlands. Journal of Wildlife Management 48:426-437.

Maher, W. J. 1973. Matador Project: Birds I. Population dynamics. Canadian Committee for the International Biological Programme, Matador Project, Technical Report 34. University of Saskatchewan, Saskatoon, Saskatchewan. 56 pages.

Messmer, T. A. 1990. Influence of grazing treatments on nongame birds and vegetation structure in south central North Dakota. Ph.D. dissertation. North Dakota State University, Fargo, North Dakota. 164 pages.

National Geographic Society. 1987. Field guide to the birds of North America, second edition. National Geographic Society, Washington, D.C. 464 pages.

Nowicki, T. 1973. A behavioral study of the Marbled Godwit in North Dakota. M.S. thesis. Central Michigan University, Mt. Pleasant, Michigan. 109 pages.

Prescott, D. R. C. 1997. Avian communities and NAWMP habitat priorities in the northern Prairie biome of Alberta. NAWMP-029. Land Stewardship Centre of Canada, St. Albert, Alberta. 41 pages.

Prescott, D. R. C., A. J. Murphy, and E. Ewaschuk. 1995. An avian community approach to determining biodiversity values of NAWMP habitats in the aspen parkland of Alberta. NAWMP-012. Alberta NAWMP Centre, Edmonton, Alberta. 58 pages.

Renken, R. B. 1983. Breeding bird communities and bird-habitat associations on North Dakota waterfowl production areas of three habitat types. M.S. thesis. Iowa State University, Ames, Iowa. 90 pages.

Renken, R. B., and J. J. Dinsmore. 1987. Nongame bird communities on managed grasslands in North Dakota. Canadian Field-Naturalist 101:551-557.

Ryan, M. R. 1982. Marbled Godwit habitat selection in the northern prairie region. Ph.D. dissertation. Iowa State University, Ames, Iowa. 108 pages.

Ryan, M. R., J. J. Dinsmore, and R. B. Dahlgren. 1981. Ecology of Willets and Marbled Godwits in the glaciated prairie region. U.S. Fish and Wildlife Service, Northern Prairie Wildlife Research Center, Project 2170. 3 pages.

Ryan, M. R., R. B. Renken, and J. J. Dinsmore. 1984. Marbled Godwit habitat selection in the northern prairie region. Journal of Wildlife Management 48:1206-1218.

Sedivec, K. K. 1994. Grazing treatment effects on and habitat use of upland nesting birds on native rangeland. Ph.D. dissertation. North Dakota State University, Fargo, North Dakota. 124 pages.

Stewart, R. E. 1975. Breeding birds of North Dakota. Tri-College Center for Environmental Studies, Fargo, North Dakota. 295 pages.

Stewart, R. E., and H. A. Kantrud. 1965. Ecological studies of waterfowl populations in the prairie potholes of North Dakota. U.S. Fish and Wildlife Service, Bureau of Sport Fisheries and Wildlife. 1965 Progress Report. 14 pages.

Sutter, G. C., and R. M. Brigham. 1998. Avifaunal and habitat changes resulting from conversion of native prairie to crested wheat grass: patterns at songbird community and species levels. Canadian Journal of Zoology 76:869-875.

Weber, M. J. 1978. Non-game birds in relation to habitat variation on South Dakota wetlands. M.S. thesis. South Dakota State University, Brookings, South Dakota. 54 pages.

Weber, M. J., P. A. Vohs, Jr., and L. D. Flake. 1982. Use of prairie wetlands by selected bird species in South Dakota. Wilson Bulletin 94:550-554.