The Effects of Management Practices on Grassland Birds—Marbled Godwit (*Limosa fedoa*)

Chapter H of

The Effects of Management Practices on Grassland Birds

Professional Paper 1842–H

U.S. Department of the Interior
U.S. Geological Survey

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By Jill A. Shaffer,[1] Lawrence D. Igl,[1] Douglas H. Johnson,[1] Marriah L. Sondreal,[1] Christopher M. Goldade,[1,2] Melvin P. Nenneman,[1,3] and Betty R. Euliss[1]

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The Effects of Management Practices on Grassland Birds

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U.S. Department of the Interior
U.S. Geological Survey

U.S. Department of the Interior
DAVID BERNHARDT, Secretary

U.S. Geological Survey
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Conversion Factors

International System of Units to U.S. customary units

Multiply	By	To obtain
	Length	
centimeter (cm)	0.3937	inch (in.)
meter (m)	3.281	foot (ft)
kilometer (km)	0.6214	mile (mi)
	Area	
square meter (m^2)	0.0002471	acre
hectare (ha)	2.471	acre
square kilometer (km^2)	247.1	acre
square meter (m^2)	10.76	square foot (ft^2)
hectare (ha)	0.003861	square mile (mi^2)
square kilometer (km^2)	0.3861	square mile (mi^2)

Abbreviations

n.d. no date

PPR Prairie Pothole Region

Acknowledgments

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Capsule Statement

Keys to Marbled Godwit (*Limosa fedoa*) management include providing large expanses of short, sparsely to moderately vegetated landscapes that include native grasslands and wetland complexes. Optimal wetland complexes should contain a diversity of wetland classes and sizes, such as ephemeral, temporary, seasonal, semipermanent, permanent, and alkali wetlands (wetland classifications based on Stewart and Kantrud, 1971), as well as intermittent streams. Marbled Godwits use wetlands of various salinities. The species has been reported to use habitats with less than or equal to 70 centimeters (cm) average vegetation height, 4–23 cm visual obstruction reading, and 1–9 cm litter depth. The descriptions of key vegetation characteristics are provided in table H1 (after the "References" section). Vernacular and scientific names of plants and animals follow the Integrated Taxonomic Information System (https://www.itis.gov).

Marbled Godwit. Illustration by Patsy D. Renz, used with permisson.

Breeding Range

Marbled Godwits breed from central Alberta through central Manitoba and along James Bay; south through Montana, North Dakota, east-central South Dakota, and north-central Nebraska; and east to north-central Minnesota (National Geographic Society, 2011). The relative densities of Marbled Godwits in the United States and southern Canada, based on North American Breeding Bird Survey data (Sauer and others, 2014), are shown in figure H1 (not all geographic places mentioned in report are shown on figure).

Suitable Habitat

Breeding Marbled Godwits require large expanses of short, sparsely to moderately vegetated uplands for nesting and foraging, and wetland complexes for foraging (Stewart, 1975; Ryan, 1982; Ryan and others, 1984; Kantrud and Higgins, 1992; Niemuth and others, 2012). 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 upland and wetland habitats, tall, dense cover is avoided (Nowicki, 1973; Higgins and others, 1979; Ryan, 1982; Renken, 1983; Ryan and others, 1984; Renken and Dinsmore, 1987). In Manitoba, Montana, North Dakota, and South Dakota, Marbled Godwits used areas with less than (<) 40 percent dead vegetation, and they avoided areas with 100 percent visual obstruction above 10 cm and areas with greater than (>) 35 cm effective cover height (average maximum height of leaf canopy) (Kantrud and Higgins, 1992). Marbled Godwits with broods use somewhat taller (15–60 cm) and denser grass cover than do nesting pairs (Ryan and others, 1984). Foraging occurs in water 5–13 cm deep (Gratto-Trevor, 2000).

[1]U.S. Geological Survey.

[2]South Dakota Game, Fish and Parks (current).

[3]U.S. Fish and Wildlife Service (current).

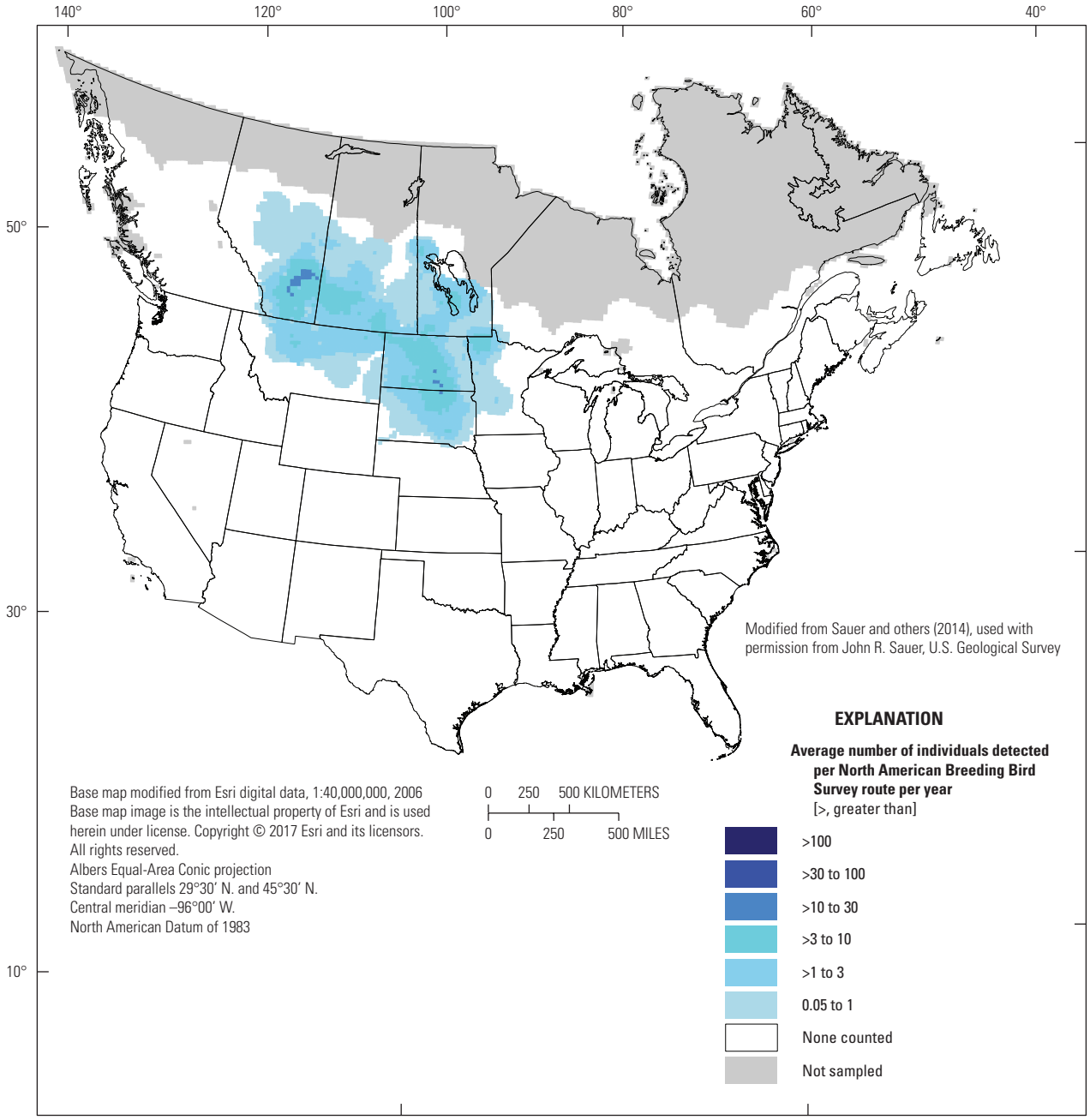

Figure H1. Breeding distribution of the Marbled Godwit (*Limosa fedoa*) in the United States and southern Canada, based on North American Breeding Bird Survey (BBS) data, 2008–12. The BBS abundance map provides only an approximation of breeding range edges.

Marbled Godwits nest on the ground, often in grasslands and well away from water edges (Gratto-Trevor, 2000). In southern Alberta, average distance between 62 nest sites and water was 239 meters (m) near managed wetlands and 258 m for three nest sites near natural wetlands (Gratto-Trevor, 2000). In the same study area in southern Alberta, Gratto-Trevor (2006) reported that Marbled Godwits nested in managed wetlands more than natural wetlands, possibly owing to low water levels in the natural wetlands. In Saskatchewan, Marbled Godwits nested in uplands and wetland margins with denser, taller, and more homogeneous vegetation than random sites (Colwell and Oring, 1990). In Alberta, Saskatchewan, and Manitoba, Marbled Godwits selected nesting habitat in proportion to what was available, with cropland and idle native prairies selected more often than grazed prairies or wetlands (Garvey and others, 2013). 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 foraged in dry uplands, wet and dry areas of wet meadow, roadside ditches, and open water (Nowicki, 1973). In another North Dakota study, hatching success was similar between nests in cultivated fields and nests in native grasslands (Higgins and others, 1979).

Marbled Godwits prefer native grass cover to tame vegetation (Stewart, 1975; Ryan, 1982; Ryan and others, 1984; Kantrud and Higgins, 1992; Prescott and others, 1995; Prescott, 1997). Pastures, idle grasslands, and haylands often are used for nesting (Higgins and others, 1979; Ryan and others, 1984; Kantrud and Higgins, 1992; Garvey and others, 2013). Although tilled lands usually are avoided (Weber, 1978; Ryan and others, 1984), nests also have been reported in cropland, including small grains, common flax (*Linum usitatissimum*), and stubble fields (Stewart, 1975; Higgins and others, 1979; Kantrud and Higgins, 1992; Garvey and others, 2013). In the northern prairie and aspen parkland regions of Alberta, Marbled Godwits were most abundant in idle mixed-grass pastures, followed by sandhills (mixed-grass prairie containing sandy soils), hayland (planted to unspecified grasses or alfalfa [*Medicago sativa*]), fallow cropland, and tame pastures (Prescott and others, 1995; Prescott, 1997). In the aspen parkland uplands, Marbled Godwits were most abundant on idle mixed-grass pastures, followed by mixed-grass pastures grazed season long (Prescott and others, 1995). They were not found in idle tame grassland, tame dense nesting cover, tame pastures, deferred (mowed after July 15) tame hayland, deferred mixed-grass pastures (grazed after July 15), idle parkland, season-long grazed parkland, native dense nesting cover, hayland, or cropland.

Soil types may affect the availability of preferred habitats. 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-percent slope, grassy cover, low shrub cover, and moderate-to-high litter cover. Shallow-to-gravel range sites were characterized by sparse cover and reduced litter.

Niemuth and others (2012) observed seasonal shifts in habitat use between wetlands and uplands in that the detections of Marbled Godwits over a 7-week survey period spanning mid-May to late June were initially high in upland habitats but decreased with concomitant increases in wetland habitats. Shifts in wetland use occur seasonally and during climatic extremes, as breeding Marbled Godwits use less-permanent wetlands early in the breeding season and move to semipermanent and alkali wetlands later in summer or during drought (Ryan and others, 1984; Gratto-Trevor, 2000).

Within wetland habitats, Marbled Godwits avoid dense emergent vegetation, preferring shallow water areas with short and sparse vegetation or moderately vegetated shorelines (Ryan, 1982; Ryan and others, 1984; Eldridge, 1992). Suitable wetlands range in salinity from fresh to highly saline and vary widely in size and permanence (Stewart and Kantrud, 1965; Stewart, 1975; Ryan and others, 1984; Eldridge, 1992; Prescott and others, 1995). In a survey of 1,190 wetlands throughout the Prairie Pothole Region (PPR) of North Dakota and South Dakota, Marbled Godwits were observed in a higher proportion of alkali or permanent wetlands than in temporary, seasonal, or semipermanent wetlands (Igl and others, 2017). Marbled Godwits were observed in 44 wetlands, which were characterized as having an average of 59 percent open water, 18 percent emergent vegetation, 16 percent wet meadow, and 5 percent shore/mudflat. Within wetlands in the PPR of North Dakota, Kantrud and Stewart (1984) most frequently observed breeding Marbled Godwits in seasonal wetlands, followed by semipermanent, temporary, and alkali wetlands, but their density was highest on temporary wetlands. In east-central North Dakota, semipermanent wetlands were used most often, but ephemeral, alkali, and temporary wetlands were used relative to their availability (Ryan and others, 1984).

Niemuth and others (2008) devised a conceptual model to predict Marbled Godwit habitat quality in the northern Great Plains. The model indicated that high-quality habitat consisted of at least 1.6 hectares (ha) of temporary or saturated wetlands per 130-ha patch, with a patch size that is at least 130 ha and at least 400 m wide (800 m preferred), >100 m from trees, in a landscape (3.2 kilometer [km] radius) with at least 10–30 percent grassland (>30 percent better), and with less than or equal to 3 percent average slope within a 535-m radius. The essential elements from this model were then formalized into rules. From these rules, maps were developed to depict areas of high predicted occurrence of Marbled Godwits in North Dakota and South Dakota. High occurrences of Marbled Godwits generally coincided with areas of high potential waterfowl densities, and waterfowl densities increased from south to north and east to west for all wetland classes examined, with higher waterfowl densities occurring on smaller wetlands. In the PPR of eastern Montana, North Dakota, and South Dakota, Niemuth and others (2012) evaluated wetland characteristics that influenced the detection and number of Marbled Godwits. The detection of Marbled Godwits exhibited a curvilinear relationship with wetland perimeter, and detections increased as the proportion of wetland surrounded by a grass buffer increased. Moreover, detections of Marbled Godwits were positively related to characteristics indicative of wetlands with low amounts of emergent vegetation: the amount of open water or bare soil covering >95 percent of the wetland area, the proportion of wetland covered by water, and the width of mudflats. Detections and number of Marbled Godwits were positively related to brackish or saline wetlands. In North Dakota and South Dakota, Niemuth and others (2013) reported that Marbled Godwit detections increased curvilinearly with the proportion of the wetland basin containing water. However, in South Dakota, Marbled Godwit presence was positively associated with wetlands containing dense stands of emergent vegetation, with open water or bare soil covering <5 percent of the wetland, and with adjacent uplands of alfalfa hayland; presence was negatively associated with wetlands that had adjacent tilled fields (Weber, 1978; Weber and others, 1982).

Area Requirements and Landscape Associations

Marbled Godwit territories are large and include feeding and nesting areas. Areas must be large enough to provide upland habitat and a diverse range of wetland types (Kantrud and Stewart, 1984; Ryan and others, 1984; Colwell and Oring, 1988a). In North Dakota, mean territory size was 90 ha (Ryan and others, 1984). Marbled Godwits may be area sensitive, rarely occurring on blocks of contiguous grassland <50 ha in the northern Great Plains (Johnson and Igl, 2001). Of 44 wetlands in the PPR of North Dakota and South Dakota in which Marbled Godwits were observed, average wetland size was 21 ha (Igl and others, 2017). Landscape composition within 800 m of these wetlands was 61 percent grassland, 18 percent wetland, 16 percent agricultural, and 5 percent other; average number of wetlands within 800 m was 22. In tallgrass prairies in southeastern North Dakota, occurrence of Marbled Godwit was positively associated with wetland cover at the 100-m scale, negatively associated with woodland cover at the 100-m scale, and negatively associated with tree cover at the 400-m and 800-m scales (Cunningham and Johnson, 2006). In the PPR of Montana, North Dakota, and South Dakota, detections of Marbled Godwits were positively related to the percentage of an 800-m buffer around survey points consisting of a mixture of native grass, forb, or scattered low shrub species on untilled prairie and to the percentage of area within the buffer consisting of temporary, seasonal, semipermanent, and permanent wetlands (Niemuth and others, 2012). In a preliminary effort to model Marbled Godwit occurrence and habitat associations in the Prairie Habitat Joint Venture region in Canada, Marbled Godwit occurrence was positively related to the presence of grassland and wetland areas in the landscape within 1,200 square meters of godwit observations; Marbled Godwit occurrence was negatively associated with the presence of roads and trees (S. Davis, pers. commun. [n.d.] in Melcher and others, 2010).

Brood Parasitism by Cowbirds and Other Species

The Marbled Godwit is an unsuitable host of the Brown-headed Cowbird (*Molothrus ater*), and no known records of brood parasitism exist (Shaffer and others, 2019).

Breeding-Season Phenology and Site Fidelity

The Marbled Godwit 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 April 17 (Stewart, 1975), with most nests initiated during mid- to late May (Maher, 1973; Kantrud and Higgins, 1992; Sedivec, 1994). Kantrud and Higgins (1992) reported a late hatching date of June 27, and Stewart (1975) observed a dependent brood on July 18. One brood is produced per season (Gratto-Trevor, 2000). Although Higgins and others (1979) reported that Marbled Godwit pairs appeared to make only one nesting attempt per breeding season, Ryan and others (1981) and Gratto-Trevor (2000) reported that renesting occurred after failure of the initial nest. Large postbreeding flocks of Marbled Godwits begin forming in late June and early July in central North Dakota (L.D. Igl, U.S. Geological Survey, unpub. data) to mid- to late July in Saskatchewan (Maher, 1973), and most flocks depart for the wintering grounds by late August (Ryan and others, 1984). In Saskatchewan and Alberta, Marbled Godwits exhibited breeding-site fidelity (Colwell and Oring, 1988b; Gratto-Trevor, 2000).

Species' Response to Management

Although burning, mowing, or grazing are necessary to maintain suitable habitat for Marbled Godwits (Ryan and others, 1984), few studies have examined the influence of burning or mowing on this species. In North Dakota mixed-grass prairies, Marbled Godwit densities were highest during the first 2 years after a burn (Johnson, 1997). Ryan and others (1984) indicated that fall burning or haying could provide suitable 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 and others, 1984; Kantrud and Higgins, 1992). Direct or indirect adult mortalities associated with haying, mowing, and other land-management operations are likely minimal because godwits are not known to make frequent use of habitats likely to be mowed during the breeding season (C.L. Gratto-Trevor, pers. commun. [n.d.] in Melcher and others, 2010). More information is needed to determine whether these activities represent a significant source of godwit nest failure or chick mortality.

Grazing can be used in upland and wetland habitats to maintain the short, moderately dense vegetation preferred by Marbled Godwits (Ryan and others, 1984). Grazed or recently grazed uplands often are more attractive to breeding Marbled Godwits than are other land-use types (Ryan and others, 1984; Renken and Dinsmore, 1987; Kantrud and Higgins, 1992; Sedivec, 1994). In Saskatchewan, no significant difference in godwit abundance was found between lightly grazed mixed-grass pastures and lightly grazed stands of crested wheatgrass (*Agropyron cristatum*) (Sutter and Brigham, 1998). In Manitoba mixed-grass prairies, Marbled Godwits occurred in season-long (grazed from May through October) and twice-over rotational-grazed (grazed from June to mid-October with cattle rotated between 3 and 6 pastures) pastures, but avoided

idle pastures (Ranellucci, 2010). In North Dakota, density of Marbled Godwits did not differ among season-long, short-duration pastures (rotated through a grazing schedule of about 1 week grazed and 1 month ungrazed, repeated throughout the season), twice-over rotation pastures (grazing twice per season, with about a 2-month rest between grazing), and idle pastures (Messmer, 1990). In south-central North Dakota mixed-grass prairies, Marbled Godwits only occurred in heavily and extremely grazed pastures (20–35 percent of forage produced in an average year remained, equating to an average grazing rate of 4.2–6.8 animal unit months per ha) and not in lightly or moderately grazed pastures (50–65 percent, 1.1–2.4 animal unit months per ha) (Salo and others, 2004). Occurrence and densities increased as grazing intensity increased. In South Dakota mixed-grass prairies, Ahlering and Merkord (2016) reported no relationship between grazing intensity or burning activity and Marbled Godwit abundance; abundance did increase with greater variability in litter depth unrelated to grazing intensity.

Marbled Godwits may be affected by energy development and habitat edges. Niemuth and others (2013) examined the influence of two wind facilities in North Dakota and South Dakota on Marbled Godwit for 3 years. The species did not appear to avoid wetland basins within 805 m of wind turbines at either facility, although occurrence was slightly and consistently lower at one facility, possibly because that facility was located primarily in cropland and the other facility in grassland. In Alberta, Marbled Godwit abundance decreased by 25 percent within 0.1 km of roads and within 1 km of wetland edges; no effect was found for distance to cropland edges (Sliwinski and Koper, 2012). Godwit injury and mortality have been reported where powerlines bisect shallow wetlands (Melcher and others, 2010).

Management Recommendations from the Literature

Melcher and others (2010) identified habitat loss and fragmentation attributed to agricultural conversion of native prairies and wetlands as the greatest threat to Marbled Godwit populations in their midcontinental breeding range. Habitat protection is thus the highest conservation priority for this species. Protecting and restoring wetlands that are part of large, contiguous grasslands are important for maintaining suitable breeding habitat for Marbled Godwits. Providing a diverse complex of wetlands may be beneficial to breeding Marbled Godwits (Kantrud and Stewart, 1984; Ryan and others, 1984; Colwell and Oring, 1988a). Marbled Godwits use wetlands of widely varying types and salinities and may need to utilize larger, more-permanent wetlands during droughts or late in summer (Ryan and others, 1984; Melcher and others, 2010). Shallow-water ponds with little or no emergent vegetation are useful for pre- and postbreeding flocks, and shallow-water ponds with margins of emergent vegetation are useful for broods (Gratto-Trevor, 2000). Natural wetlands should be protected from drainage (Ryan and others, 1984), and drained wetlands should be restored (Berkey and others, 1993; Johnson, 1996). Managed wetlands are important, especially in dry years during the breeding season, when they could be the only suitable habitat in the grassland for nesting or foraging (Gratto-Trevor, 2006). Protected habitats should be extensive enough (larger than 100 ha) to provide both upland habitat and a diverse range of wetland types (Stewart, 1975; Colwell and Oring, 1988a; Kantrud and Higgins, 1992; Gratto-Trevor, 2000; Melcher and others, 2010). Territories averaged 90 ha in North Dakota (Ryan and others, 1984), and Marbled Godwits may require large (>50 ha) blocks of contiguous grassland habitat (Johnson and Igl, 2001).

Native grassland habitat should be provided for upland nesting and foraging (Ryan and others, 1984; Eldridge, 1992; Kantrud and Higgins, 1992; Gratto-Trevor, 2000). Grassland restoration of agricultural fields through programs such as the Conservation Reserve Program are beneficial to Marbled Godwits, and the continuation and expansion of agricultural policies with grassland wildlife components are essential for maintaining populations of Marbled Godwits (Niemuth and others, 2008). Efforts to conserve waterfowl also will benefit Marbled Godwits owing to preferences for similar landscapes (Niemuth and others, 2008). Cunningham and Johnson (2006) recommended removal of trees to improve grassland habitats.

Habitat loss and degradation attributed to agricultural conversion is a significant threat to breeding populations of Marbled Godwits (Melcher and others, 2010). Upland and wetland habitats should be protected from tilling (Ryan and others, 1984; Melcher and others, 2010). Encouraging no-tillage and minimum-tillage practices on cropland may benefit Marbled Godwits (Kantrud and Higgins, 1992). Burning, mowing, or grazing can be used to provide areas of shorter, sparser vegetation (Ryan and others, 1984; Eldridge, 1992; Berkey and others, 1993). Fall burning or mowing of upland sites and wetland edges may produce suitable cover during the following spring (Ryan and others, 1984). Moderate-to-dense regrowth in burned areas may be too dense for nesting but may provide the denser, taller cover used by broods (Ryan and others, 1984).

Marbled Godwits tolerate a range of habitat disturbances, including burning, mowing, and grazing, but no clear management guidelines are evident from current studies. Burning or mowing prior to the breeding season may be preferable so that nests will not be destroyed by mechanical equipment. Results of studies on the effect of grazing on Marbled Godwits vary from no effect of grazing intensity (Ahlering and Merkord, 2016), to no differences among grazing systems (Messmer, 1990), to the species preferring extremely grazed pastures (Salo and others, 2004). The short, sparsely to moderately vegetated landscapes preferred by the species could be created by short-term grazing (2 to 4 weeks) in May, prior to the onset of breeding (Berkey and others, 1993), allowing birds to settle before implementing season-long grazing in mid-June (for example, Sedivec, 1994), or by deferring grazing until late

May or late June for rotational grazing (Sedivec, 1994; Gratto-Trevor, 2000), although none of these suggestions have been rigorously examined for their effect on Marbled Godwits.

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Table H1. Measured values of vegetation structure and composition in Marbled Godwit (*Limosa fedoa*) breeding habitat by study. The parenthetical descriptors following authorship and year in the "Study" column indicate that the vegetation measurements were taken in locations or under conditions specified in the descriptor; no descriptor implies that measurements were taken within the general study area.

[cm, centimeter; %, percent; --, no data; <, less than; DNC, dense nesting cover]

Study	State or province	Habitat	Management practice or treatment	Vegetation height (cm)	Vegetation height-density (cm)	Grass cover (%)	Forb cover (%)	Shrub cover (%)	Bare ground cover (%)	Litter cover (%)	Litter depth (cm)
Garvey and others, 2013 (nests)	Alberta, Manitoba, Saskatchewan	Multiple	Multiple	--	7[a]	--	--	--	--	--	--
Higgins and others, 1979 (nests)	North Dakota	Mixed-grass prairie	Multiple	<15	--	--	--	--	--	--	--
Kantrud and Higgins, 1992 (nests)	Manitoba, Montana, North Dakota, South Dakota	Multiple	Multiple	--	4[a], 17[b]	--	--	--	--	36[c]	--
Nowicki, 1973 (nests)	North Dakota	Multiple	Multiple	<30	--	--	--	--	--	--	--
Renken, 1983[d]	North Dakota	Tame grass-land (DNC)	Idle, grazed	--	7[a]	49.9	18.8	5.5	0.7	99	2
Ryan and others, 1984 (adults)	North Dakota	Multiple	Multiple	<15	--	--	--	--	--	--	--
Ryan and others, 1984 (adults with broods)	North Dakota	Multiple	Multiple	15–60	--	--	--	--	--	--	--
Salo and others, 2004	North Dakota	Mixed-grass prairie	Heavy grazing intensity	27.1[e]	22.9[a]	--	--	--	--	--	2
Salo and others, 2004	North Dakota	Mixed-grass prairie	Light grazing intensity	17.5[e]	7.9[a]	--	--	--	--	--	0.9
Sedivec, 1994[f]	North Dakota	Mixed-grass prairie	Multiple	50–70	6[a]	--	--	--	--	--	3.8–9.1

[a]Visual obstruction reading (Robel and others, 1970).

[b]Effective vegetation height.

[c]Standing dead vegetation.

[d]The sum of the percentages is greater than 100%, based on the modified point-quadrat technique of Wiens (1969).

[e]Mean grass height.

[f]Range of average values.

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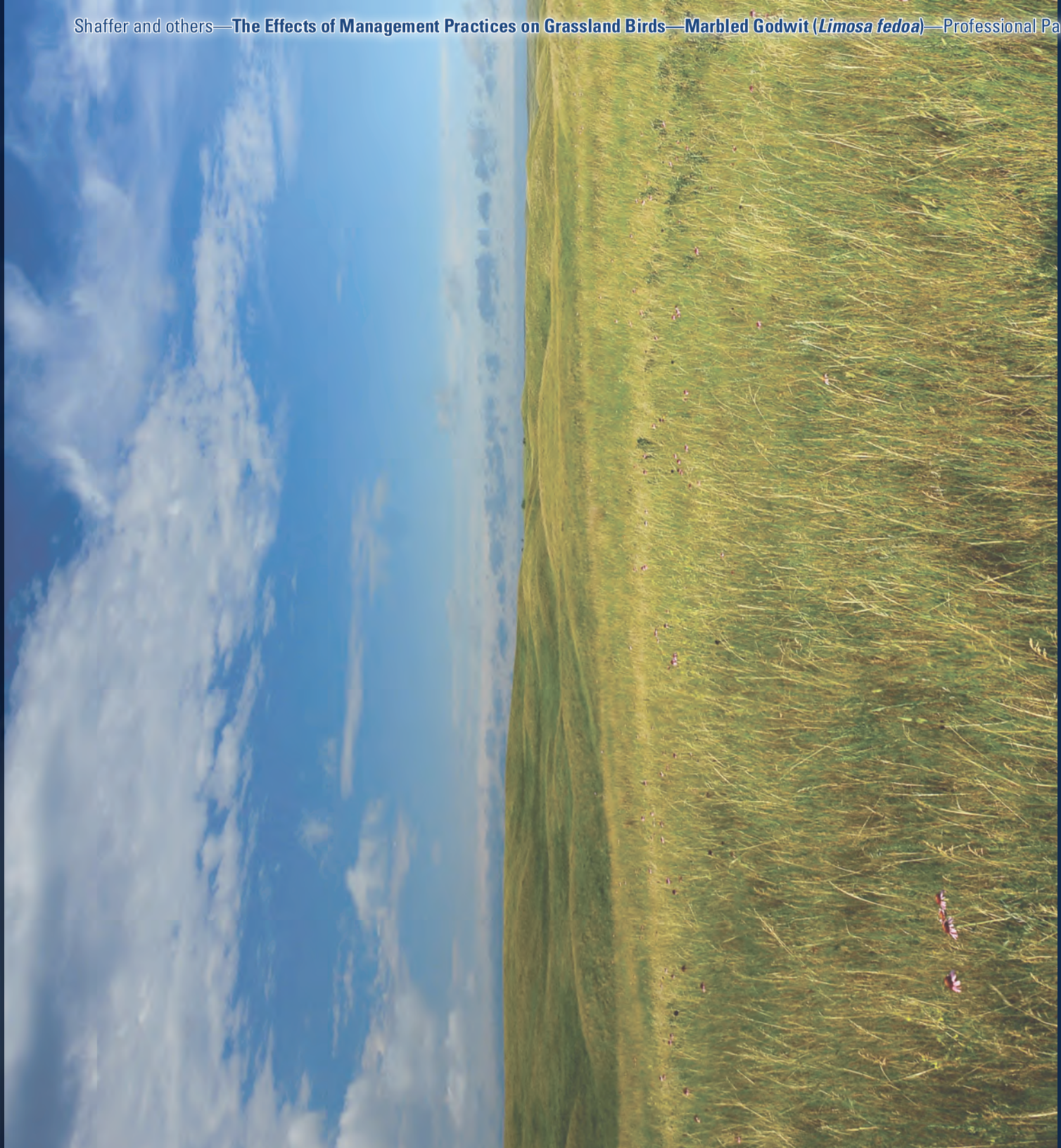

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