



Foraging Habitat for Bird Species or Bird Diversity in Wetland Design

PURPOSE: This technical note provides guidelines for creating, restoring, or enhancing wetlands with foraging habitat intended to 1) support selected bird species, or 2) maximize bird diversity. Information in this technical note is applicable to wetlands ranging from damp or shallowly flooded terrestrial areas to deeper semi-permanent and permanent wetlands, including ponds and lakes. This technical note also lists a number of publications with information about designing wetlands intended to support birds. Information in this technical note is not relevant to forested wetlands.

BACKGROUND: Although less than 5 percent of the land area of the contiguous United States is classified as wetlands, almost a third of the region's bird species inhabit wetlands. As wetland area has declined over the past 200 years, the abundance of wetland bird life has also declined, in many cases at rates exceeding 1-2 percent per year and in some recently documented cases by rates that exceed 5 percent per year. Of the 29 federally endangered and threatened bird species in the contiguous United States, 16 are wetland and coastal inhabitants.

Different kinds of wetland birds have different habitat requirements, including various requirements for wetland size, water depth, and vegetative cover. When wetland projects set objectives calling for support of specific kinds of birds or high bird diversity, these habitat requirements should be considered.

Information in this technical note is based primarily on long-term observations compiled by the Manomet Center for Conservation Sciences.

DESIGNING WETLANDS FOR SELECTED SPECIES: Table 1 summarizes information about foraging habitat preferences for 151 species of wetland birds, including information on type of water (marine or nonmarine) and water depth, vegetation density, and wetland size. If providing foraging habitat for selected bird species is identified as a wetland project objective, information in Table 1 may be useful.

Type of water and water depth. Many bird species listed in Table 1 prefer either marine or nonmarine (primarily freshwater) habitats, but some species are equally likely to use either marine or nonmarine habitats. Many wetland birds prefer water less than 5 in. deep. For example, 75 of the 151 species listed in Table 1 commonly use water less than 5 in. deep; this includes all of the sandpipers and plovers, 4 of the 5 kinds of rails, and all 9 kinds of dabbling ducks. Other groups, such as grebes, loons, and diving ducks, prefer deeper water but sometimes will use intermediate depths. Some species may switch preferences seasonally. Because changes in water depths of only a few inches will affect site use, establishing appropriate water levels is critical. Where water control structures are part of site design, structures that allow very small (1- to 2-in.) changes in water levels should be considered.

Vegetation. Many kinds of wetland birds use different vegetation types for breeding and nonbreeding seasons. During nonbreeding season most species (especially shorebird species) prefer habitats with less than 25 percent vegetative cover, unless the vegetation is short and visibility of surrounding horizons is not obscured. Nevertheless, some species, such as Clapper Rails, prefer thickly vegetated wetlands at all times.

Wetland size. Some bird species, such as the Solitary Sandpiper, favor small wetlands, whereas others, such as Dunlins, prefer large wetlands. Still other species use coastal wetlands. Some species prefer one size for breeding and another size for wintering.

DESIGNING WETLANDS FOR HIGH DIVERSITY: Supporting high bird diversity, rather than selected species, is sometimes identified as a wetland project objective. By designing sites with various combinations of water depths and vegetation densities, bird diversity can be increased. Figure 2, based on selected data from Table 1, illustrates the effect of including various combinations of water depth and vegetation on diversity, as well as the effect of season on bird diversity. Including combinations of water depth and vegetation densities can increase diversity beyond that which would occur through including either various water depths or various vegetation densities alone, as illustrated in Figure 2.

OTHER CONSIDERATIONS: This technical note describes the effect of water type and depth, vegetation density, and wetland size on bird foraging habitat, but other factors will also influence foraging by birds. For example, substrate type (e.g., clay, loam, sand, and gravel) will affect the ability of some bird species to forage. Many species, especially shorebirds and some waders, probe in the substrate, and difficult-to-penetrate substrates are not useful to them. For birds that hunt visually for prey on the bottom and/or in the water column, substrates resulting in high turbidity will limit foraging success. Furthermore, substrate type may have secondary effects on bird foraging. For example, fine substrates tend to support higher invertebrate densities, which in turn attract many bird species.

Additional factors that may affect use of sites for foraging include landscape position relative to other bird habitat, timing of weed control and other site maintenance activities, and presence of automobiles, dogs, humans, or other disturbances. Still other factors, such as rapid changes in water levels, may not affect use of sites for foraging but may affect breeding. For example, rapid increases in depth can inundate nests, while rapid drawdown can increase accessibility of nests to predators before young birds fledge.

While information in this technical note provides guidelines regarding design of foraging habitat, situations will differ regionally as well as with soil, landscape, and hydrological conditions. Other sources of information, including expert opinion and technical references, should not be overlooked. This technical note includes a brief list of useful technical references (Table 2).

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Table 1. Foraging Habitat Water Type and Depth, Vegetation Density, and Wetland Size Preferences for 151 Water Bird Species in the Contiguous United States¹				
Bird Species	Water Type and Depth	Vegetation Density	Preferred Wetland Size	
Mute Swan	Fd	s, m	l	
Eurasian Wigeon	Fd	s	l	F = Fresh/Nonmarine M = Marine
Red-throated Loon*	Md, Fd	o	c	
Arctic Loon*	Md, Fd	o	c	
Pacific Loon*	Md, Fd	o	c	WATER DEPTHS d = deep > 10" m = moderate 5-10" s = shallow < 5"
Common Loon	Md, Fd, Fd	o	c	
Yellow-billed Loon*	Md, Fd	o	c	
Least Grebe	Fmd	s, m	s	
Pied-billed Grebe	Fd	s, m	s, l	VEGETATION s = sparse m = moderate d = dense o = open water
Horned Grebe	Md, Fd, Fd	s	c	
Red-necked Grebe	Md, Fd, Fd	s	c, s, l	
Eared Grebe	Md, Fd, Fd	s	c, l	
Western Grebe	Md, Fd, Fd	s	c, l	
Clark's Grebe	Md, Fd, Fd	s	c, l	WETLAND SIZE s = small (< 5 acres) l = large (> 5 acres) c = coastal waters
American White Pelican	Md, Fd, Fd	s	c, l	
Brown Pelican	Md	o	c	
Brandt's Cormorant	Md	o	c	
Neotropic Cormorant	Md	o	c	* = species breeding outside the lower 48 United States
Double-crested Cormorant	Md, Fd	o	c, l	
Great Cormorant*	Md	o	c	
Anhinga	Fd	s	s, l	
American Bittern	Fsm	d	s, l	
Least Bittern	Fd	d	l	
Great Blue Heron	Md, Fd	s, m	s, l	
Great Egret	Fd	s, m	s, l	
Snowy Egret	Fm, Msm	s, m	s, l	

¹ Where data are available on known differences between breeding and nonbreeding seasons for water type and depth, bold typeface indicates preferences during breeding season. Where more than one preference is listed, but no preference is marked by bold typeface, seasonal changes in preferences are not known. Note that these are preferences, and that birds may also forage in other habitats. Figure 1 illustrates examples of different plant densities in the context of this technical note.

Table 1. (continued)				
Bird Species	Water Type and Depth	Vegetation Density	Preferred Wetland Size	
Little Blue Heron	Fm	s, m	s, l	
Tricolored Heron	Fsm, Msm	s, m	l	F = Fresh/Nonmarine M = Marine
Reddish Egret	Mmd	s	c	
Green Heron	Fs	s	s, l	
Black-crowned Night-Heron	Ms, Fs	s, m	s, l	WATER DEPTHS d = deep > 10" m = moderate 5-10" s = shallow < 5"
Yellow-crowned Night-Heron	Ms	s, m	c, s, l	
White Ibis	Fs	s, m	s, l	
Glossy Ibis	Fs	s, m	s, l	
White-faced Ibis	Fs	s, m	s, l	VEGETATION s = sparse m = moderate d = dense o = open water
Roseate Spoonbill	Msm	s	c	
Wood Stork	Fmd	s	s, l	
Black-bellied Whistling-Duck	Fsmd	s	l	
Fulvous Whistling-Duck	Fsmd	s	l	
Greater White-fronted Goose*	Fmd	s, m	l	WETLAND SIZE s = small (< 5 acres) l = large (> 5 acres) c = coastal waters
Emperor Goose*	Fmd	s, m	l	
Snow Goose*	Fmd	s, m	l	
Ross's Goose*	Fsmd	s, m	l	
Canada Goose	Fd	s, m, o	s, l	* = species breeding outside the lower 48 United States
Brant*	Mmd	s, m	c	
Trumpeter Swan	Fd	s, m	l	
Tundra Swan*	Md	s	l	
Whooper Swan*	F		l	
Wood Duck	Fmd	s, m	s	
Gadwall	Fmd	s, m	s, l	
American Wigeon	Fd	s	l	
American Black Duck	Fsm, Msmd	s, m	s, l	
Mallard	Fsmd, Ms, Fsm	s, m	s, l	
Mottled Duck	Fmd, Mmd, Fmd	s, m	s, l	
Blue-winged Teal	Fsm	s, m	s, l	
Cinnamon Teal	Fsm	s, m	s, l	

Table 1. (continued)				
Bird Species	Water Type and Depth	Vegetation Density	Preferred Wetland Size	
Northern Shoveler	Fsm	s, m	s, l	
Northern Pintail	Fsm	s, m	s, l	
Green-winged Teal	Fsm, Msm, Fsm	s, m	s, l	F = Fresh/Nonmarine M = Marine
Canvasback	Fd, Md, Fmd	s	l	
Redhead	Fd, Md, Fmd	s	l	WATER DEPTHS d = deep > 10" m = moderate 5-10" s = shallow < 5"
Ring-necked Duck	Fd, Fmd	s	l	
Greater Scaup*	Md	s	c, l	
Lesser Scaup*	Fd	s	c, l	
King Eider*	Md	o	c	VEGETATION s = sparse m = moderate d = dense o = open water
Common Eider	Md, Md	o	c	
Harlequin Duck	Md, Fm	o	c	
Surf Scoter*	Md	o	c	
White-winged Scoter*	Md	o	c	
Black Scoter*	Md	o	c	WETLAND SIZE s = small (< 5 acres) l = large (> 5 acres) c = coastal waters
Oldsquaw*	Md	o	c	
Bufflehead	Fd, Md, Fmd	o	c, s, l	
Common Goldeneye*	Fd, Md, Fmd	o	c, l	
Barrow's Goldeneye	Fd, Md, Fmd	o	c, l	* = species breeding outside the lower 48 United States
Hooded Merganser	Fd, Fd	s, m	s, l	
Common Merganser	Fd, Fmd	s	l	
Red-breasted Merganser	Md, Fmd		c, l	
Masked Duck	Fm, Fd	s	l	
Ruddy Duck	Fm, Fd	s	l	
Black Rail	Fs	d	l	
Clapper Rail	Ms, Ms, Fs	d	c, l	
King Rail	Fmd	d	l	
Virginia Rail	Fs	d	s, l	
Sora	Fs	d	s, l	
Purple Gallinule	Fd	s, m	s, l	
Common Moorhen	Fmd	s, m	s, l	
American Coot	Fd	s, m	l	

Table 1. (continued)				
Bird Species	Water Type and Depth	Vegetation Density	Preferred Wetland Size	
Limpkin	Fmd	m, d	s, l	F = Fresh/Nonmarine M = Marine
Sandhill Crane	Fd	m, d	s	
Whooping Crane*	Msm	s, m, d	c, l	
Black-bellied Plover*	Ms	s	c, l	WATER DEPTHS d = deep > 10" m = moderate 5-10" s = shallow < 5"
American Golden-Plover*	Fs	s		
Pacific Golden-Plover*	Ms	s		
Snowy Plover	Ms, Fs	s	c, l	
Wilson's Plover	Ms	s	c	VEGETATION s = sparse m = moderate d = dense o = open water
Semipalmated Plover*	Ms, Fs	s	c, s, l	
Piping Plover	Ms	s	c	
Killdeer	Ms, Fs	s	s, l	
American Oystercatcher	Ms	s	c	
Black Oystercatcher	Ms	s	c	WETLAND SIZE s = small (< 5 acres) l = large (> 5 acres) c = coastal waters
Black-necked Stilt	Fsm	s, m	l	
American Avocet	Fsm, Msm, Fsm	s, m	l	
Northern Jacana	Fm		s, l	
Greater Yellowlegs*	Fsm, Msm	s, m	l	* = species breeding outside the lower 48 United States
Lesser Yellowlegs*	Fsm, Msm	s, m	s, l	
Solitary Sandpiper*	Fs	s, m	s	
Willet	Fsm, Msm	s, m	l	
Wandering Tattler*	Ms	s	c	
Spotted Sandpiper	Fsm, Msm, Fsm, Ms	s, m	s	
Upland Sandpiper	Fs	d		
Eskimo Curlew*	Fm			
Whimbrel*	Ms, Fs	s, m	c	
Bristle-thighed Curlew*	Ms	s	c	
Long-billed Curlew	Ms	s, m	c, l	
Hudsonian Godwit*	Fsm, Msm	s	c, l	
Marbled Godwit	Fsm, Msm, Fs	s, m	s, l	

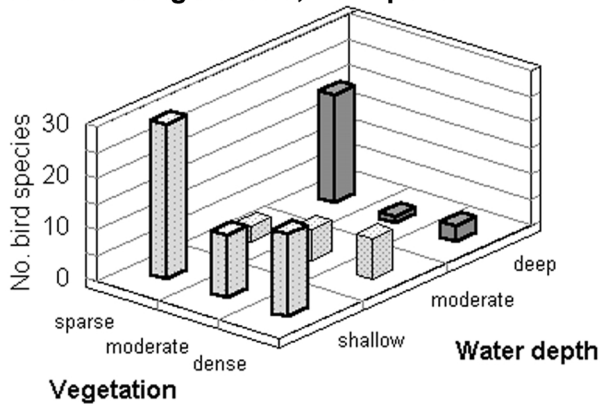
Table 1. (continued)				
Bird Species	Water Type and Depth	Vegetation Density	Preferred Wetland Size	
Ruddy Turnstone*	Ms	s	c	F = Fresh/Nonmarine M = Marine
Black Turnstone*	Ms	s	c	
Surfbird*	Ms	s	c	
Red Knot*	Ms	s	c	WATER DEPTHS d = deep > 10" m = moderate 5-10" s = shallow < 5"
Sanderling*	Ms	s	c	
Semipalmated Sandpiper*	Ms, Fs	s, m	c, l	
Western Sandpiper*	Ms, Fs	s, m	c, l	
Least Sandpiper*	Ms, Fs	s, m	c, s, l	VEGETATION s = sparse m = moderate d = dense o = open water
White-rumped Sandpiper*	Ms, Fs	s, m	c, l	
Baird's Sandpiper	Fs	s, m	s, l	
Pectoral Sandpiper*	Fs	s, m, d	s, l	
Purple Sandpiper*	Ms	s	c	
Rock Sandpiper*	Ms	s	c	WETLAND SIZE s = small (< 5 acres) l = large (> 5 acres) c = coastal waters
Dunlin*	Ms, Fs	s, m	c, l	
Stilt Sandpiper*	Fs	s, m	l	
Buff-breasted Sandpiper*	Fs	s, m, d		
Short-billed Dowitcher*	Ms, Fs	s, m	c, l	* = species breeding outside the lower 48 United States
Long-billed Dowitcher*	Fs	s, m	l	
Common Snipe	Fs	d	s, l	
Wilson's Phalarope	Fsmd	s, m, d	l	
Red-necked Phalarope*	Fs, Fm		s, l	
Franklin's Gull	Fmd	s, m	c, l	
Ring-billed Gull	Ms, Fs, Fs	s	c, l	
California Gull	Fmd, Md, Fsmd	s	c, l	
Herring Gull	Fsmd, Msmd	s	c, l	
Gull-billed Tern	Fd, Md, Fsmd	s	c, l	
Caspian Tern	Fd, Md, Fd	s, m	c, l	
Common Tern	Fd, Md	s	c, l	
Forster's Tern	Fd, Md	s, m	c, l	
Black Tern	Fd, Md, Fd	s, m, d	c, l	

Table 1. (concluded)			
Bird Species	Water Type and Depth	Vegetation Density	Preferred Wetland Size
Belted Kingfisher	Fd, Md	s, m	c, s, l
Sedge Wren	Fs	d	s, l
Marsh Wren	Fmd	d	l
Yellow-headed Blackbird	Fmd	d	s, l
Red-winged Blackbird	Fmd	d	s, l



Figure 1. Densely vegetated (left) and sparsely vegetated (right) wetland habitat

Nonbreeding Season, 102 Species



Breeding Season, 75 Species

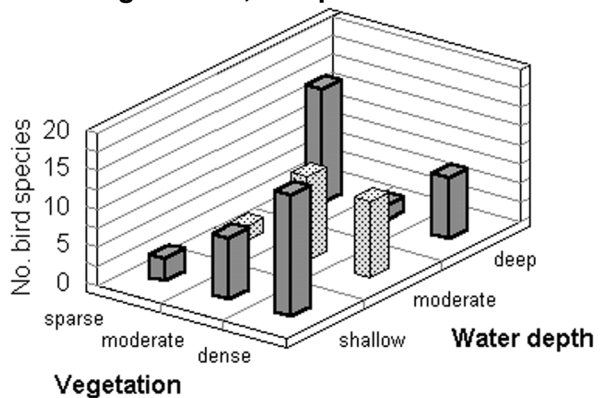


Figure 2. Potential bird diversity in foraging habitat relative to water depth and vegetation density, based on information from Table 1. This figure illustrates the importance of combinations of water depth and vegetation density

Table 2. Potentially Useful Technical References for the Design of Wetland Projects Intended to Support Birds
Colwell, M. A., and Dodd, S. L. (1997). "Environmental and habitat correlates of pasture use by nonbreeding shorebirds." <i>Condor</i> 99: 337-344.
Creighton, J. H., Sayler, R. D., Tabor, J. E., and Monda, J. J. (1997). "Effects of wetland excavation on avian communities in eastern Washington." <i>Wetlands</i> 17: 216-227.
Elphick, C. S., and Oring, L. W. (1998). "Winter management of Californian rice fields for waterbirds." <i>Journal of Applied Ecology</i> 35: 95-108.
Fredrickson, L. H., and Reid, F. A. (1988). "Invertebrate response to wetland management." U.S. Dept. Interior, Fish and Wildlife Service Leaflet 13.3.1. 6pp.
Helmets, D. L. (1992). "Shorebird management manual." Western Hemisphere Shorebird Reserve Network, Manomet, MA. 58pp.
Helmets, D. L. (1993). "Enhancing the management of wetlands for migrant shorebirds." <i>Transactions of the 58th North American Wildlife and Natural Resources Conferences</i> . Pp. 335-344.
Koenen, M. T., Leslie, D. M., Jr., and Gregory, M. (1996). "Habitat changes and success of artificial nests on an alkaline flat." <i>Wilson Bulletin</i> . 108: 292-301.
Nilsson, L. (1997). "Restoring inland shore-meadows for breeding birds." <i>Wader Study Group Bull.</i> 84: 39-44.
Rottenborn, S. C. (1996). "The use of coastal agricultural fields in Virginia as foraging habitat by shorebirds." <i>Wilson Bulletin</i> 108: 783-796.
Rundle, W. D., and Fredrickson, L. H. (1981). "Managing seasonally flooded impoundments for migrant rails and shorebirds." <i>Wildlife Society Bulletin</i> 9: 80-87.
Ryan, M. R., Renkin, B., and Dinsmore, J. J. (1984). "Marbled Godwit habitat selection in the northern prairie region." <i>Journal of Wildlife Management</i> . 48: 1206-1218.
Safran, R. J., Isola, C. R., Colwell, M. A., and Williams, O. E. (1997). "Benthic invertebrates at foraging locations of nine waterbird species in managed wetlands of the northern San Joaquin Valley, California." <i>Wetlands</i> 17: 407-415.
Szekely, T., and Bamberger, Z. (1992). "Predation of waders (Charadrii) on prey populations: an exclosure experiment." <i>Journal of Animal Ecology</i> 61: 447-456.
Velasquez, C. R., and Navarro, R. A. (1993). "The influence of water depth and sediment type on the foraging behavior of Whimbrels." <i>Journal of Field Ornithology</i> 64: 149-157.
Velasquez, C. R. (1992). "Managing artificial salt pans as a waterbird habitat - species responses to water level manipulation." <i>Colonial Waterbirds</i> 15: 43-55.
Vickery, J. A., Sutherland, W. J., O'Brien, M., Watkinson, A. R., and Yallop, A. (1996). "Managing coastal grazing marshes for breeding waders and over wintering geese: Is there a conflict?" <i>Biological Conservation</i> 79: 23-34.