Waterbird Use of Open Marsh Water Management Ponds in Maryland

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Abstract: During autumn 1985, we investigated waterbird use of Open Marsh Water Management (OMWM) ponds and use of natural ponds in an adjacent impoundment in Maryland. Dabbling ducks used ponds with dense widgeongrass (*Ruppia maritima*) more than ponds with sparse or no widgeongrass ($P < 0.01$). Wading birds and shorebirds used the natural ponds more than the OMWM ponds ($P < 0.01$), mainly because the OMWM ponds had vertical sides and were too deep ($\bar{x} = 0.42$ m) to allow foraging. Pond surface areas were positively correlated with numbers of birds ($P < 0.05$) and inversely correlated with densities of birds ($P < 0.01$).

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Open Marsh Water Management (OMWM) is an increasingly common mosquito control practice in Atlantic Coast states. In OMWM, ponds and ditches are constructed that flood the exposed mud breeding sites of the salt marsh mosquito (*Aedes sollicitans*), thereby preventing egg laying. Ponds and ditches also provide habitat for fish that prey on mosquito larvae, including the larvae of species that lay their eggs on the water's surface. The ponds and ditches do not drain OMWM marshes, but collect and store the water at a slightly lower level than in the original marsh. Exchanges between the marsh and the estuary (e.g., water and fish) occur irregularly when heavy rains, spring tides, and/or storm tides flood the marsh. Unlike historic drainage programs, OMWM increases open water areas in tidal marshland and improves habitat for many waterbirds (Burger et al. 1978, 1982), yet it allows

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effective mosquito control (Erwin 1986) without the repeated use of costly insecticides (Ofiara and Allison 1986), which may pose ecological problems.

In this study we surveyed OMWM ponds and ponds in an adjacent impoundment to identify characteristics that influenced use of ponds by waterbirds. In particular, we focused on the size, shape, bank type, age, and submerged aquatic vegetation (SAV) of ponds.

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Methods

The study area was a 1,300-ha section of Deal Island Wildlife Management Area (38°10′N, 75°53′W), Somerset County, Maryland. OMWM ponds were small, rectangular, and constructed with vertical sides and flat bottoms (mean depth = 0.42 m). Impounded ponds had sloping sides, and varied in size and shape. Both OMWM (N = 16) and impoundment (N = 22) ponds were in high marsh dominated by saltmeadow hay (*Spartina patens*), saltgrass (*Distichlis spicata*), black needlerush (*Juncus roemerianus*), saltmarsh bulrush (*Scirpus robustus*), and Olney threesquare (*S. olneyi*).

Post-breeding and migrating waterfowl, wading birds, and shorebirds using study ponds were counted from 30 July to 31 October 1985. Each pond was censused twice weekly with 1 randomly timed count in the morning sometime between 0600 and 1130 hours and 1 in the afternoon sometime between 1300 and 2000 hours. Most ponds were surveyed 26 or 27 times. During counts, birds using a pond were identified to species if possible and to family otherwise. Blue-winged teal (*Anas discors*) made up the majority of total ducks, so the category "ducks other than teal" was used to determine if the relationships found for "total ducks" were simply due to teal.

Areas and shoreline lengths of study ponds were measured from aerial photographs. Shoreline development (D) of ponds, an edge index, was calculated according to the formula:

$$D = L/2(\pi A)^{0.5}$$

where L = shoreline length and A = surface area (Wetzel 1983:32). The 2 dominant submerged aquatic plants, widgeongrass and dwarf spikerush (*Eleocharis parvula*), were visually classified as dense (>25% coverage), sparse (1%–25% coverage), or absent. In addition, presence or absence of an island (islands were <0.1 ha), pond age (new ponds = 0–1 year old; old ponds = 4–5 years old), and the type of bank (vegetated = low, densely vegetated banks; spoil = high, sparsely vegetated banks; flooded mud = low, sparsely vegetated banks that were frequently flooded) were recorded for OMWM ponds.

Data were not normally distributed (Shapiro-Wilk statistic, SAS Inst. 1985), so nonparametric statistics were used for all tests, with statistical significance set at $P \leq 0.05$. Means are reported ± 1 SE. We pooled morning and afternoon counts because they did not differ significantly (Wilcoxon's signed-ranks test, $P > 0.05$). The influence of pond types, bank types, SAV, and islands on bird abundance were evaluated with Mann-Whitney U-tests and Kruskal-Wallis tests. Spearman rank correlations were used to examine the relationships between mean numbers and densities of birds and surface area, shoreline length, and shoreline development of ponds. Ponds with no use were excluded from these correlations to minimize the effects of variables other than size and shape.

Results

Seven species of ducks, 9 species of wading birds, and 10 species of shorebirds were recorded on study ponds. Densities of ducks did not differ significantly between impoundment and OMWM ponds (Table 1). Wading bird and shorebird densities were significantly higher on impoundment ponds than on OMWM ponds (Table 1).

Waterfowl densities were higher ($P < 0.01$) on ponds with dense widgeongrass (7.3 ± 2.30 birds/ha/count) than on ponds where widgeongrass was sparse (5.4 ± 3.47) or absent (1.8 ± 0.66). Wading birds and shorebirds were not influenced by the amount of widgeongrass (all $P > 0.05$). Dwarf spikerush did not effect ($P > 0.05$) the density of any bird group.

Densities of shorebirds were greater ($P < 0.05$) on the OMWM ponds with flooded mud banks (1.7 ± 0.84) than on OMWM ponds with vegetated (0.0) or

Table 1. Mean densities (birds/ha) of birds on impoundment ponds ($N = 22$) and mosquito control (OMWM) ponds ($N = 16$) in Maryland, 1985.

	Pond type	
Species	Impoundment ($\bar{x} \pm 1$ SE)	OMWM ($\bar{x} \pm 1$ SE)
Blue-winged teal (*Anas discors*)	1.8 ± 1.16	0.8 ± 0.41
Ducks other than teal	1.1 ± 0.33	1.0 ± 0.37
American black duck (*Anas rubripes*)	0.8 ± 0.29	0.9 ± 0.36
Total ducks	5.0 ± 1.91	4.3 ± 1.92
Great egret[a] (*Casmerodius albus*)	0.3 ± 0.08	0.1 ± 0.03
Snowy egret[a] (*Egretta thula*)	0.2 ± 0.07	0.1 ± 0.09
Tricolored heron (*Egretta tricolor*)	0.2 ± 0.10	0.1 ± 0.04
Total wading birds[a]	0.8 ± 0.21	0.3 ± 0.13
Yellowlegs[a]	0.8 ± 0.16	0.2 ± 0.09
Calidris spp.[a]	0.7 ± 0.38	0.2 ± 0.17
Total shorebirds[a]	1.6 ± 0.45	0.6 ± 0.26

[a] $P < 0.01$.

spoil banks (0.3 ± 0.10). Shorebirds also used new ponds (0.8 ± 0.33) at higher densities ($P < 0.05$) than old ponds (0.0). Band type and pond age did not influence waterfowl or wading bird densities (all $P > 0.05$). Presence or absence of an island did not influence pond use by any group (all $P > 0.5$).

Impoundment ponds ranged from 0.1 to 6.0 ha ($\bar{x}$ = 1.1 ha), and OMWM ponds ranged from 0.1 to 0.5 ha ($\bar{x}$ = 0.2 ha). Numbers of ducks, wading birds, and shorebirds were positively correlated with pond surface area (Table 2). Blue-winged teal, great egrets (*Casmerodius albus*), and yellowlegs (*Tringa* spp.) were the primary species influencing these correlations. In contrast to numbers, densities of all groups were inversely related to pond surface area (Table 2). Shoreline length was inversely related to densities of all groups (Table 2). Shoreline development was inversely correlated with densities of total ducks (Table 2).

Discussion

Waterfowl densities did not differ significantly between impoundment and OMWM ponds in this study. In contrast, fall waterfowl densities on OMWM ponds in Delaware were only half as high as on adjacent natural ponds (Meredith and Saveikis 1987). This result may reflect the dramatic difference in size between OMWM and natural ponds in their study.

The occurrence of widgeongrass was the most important pond characteristic we measured that determined use by ducks. This was predictable, because most dabbling ducks rely on plant matter during fall (Paulus 1982), and widgeongrass is heavily consumed by ducks (Landers et al. 1976, Prevost et al. 1978, Paulus 1982, Swiderek et al. 1988).

Widgeongrass and other SAV have declined dramatically in the Chesapeake Bay due to excess sediments and nutrients in the water, which reduce light penetration (Flemer et al. 1983). SAV in impoundments and OMWM ponds may have become more important to migrating and wintering waterfowl as these plants have declined in Chesapeake Bay and its tributaries.

To benefit dabbling ducks, OMWM ponds should be constructed to encourage widgeongrass as a food source. Widgeongrass often dies off by mid-winter because of unfavorable environmental conditions and algae competition (Prevost et al. 1978, Swiderek et al. 1988), so alternate duck foods, such as dwarf spikerush, should be available at this time. Although ponds with dwarf spikerush were not heavily utilized during this study, spikerush is an important duck food during late winter (Singleton 1951, Prevost et al. 1978, Paulus 1982). Dwarf spikerush grows in shallow water and on pond banks (Hotchkiss 1972); whereas, widgeongrass grows best at water depths of 20–65 cm in OMWM ponds in Delaware (Mahaffy 1987). Ponds with sloping sides could support both dwarf spikerush and widgeongrass.

A pond design that facilitates growth of SAV is likely to increase the effectiveness of mosquito control in addition to increasing avian use of OMWM ponds. Fish are much more abundant in areas with aquatic plants, because the plants provide food and shelter (Laughlin and Werner 1980, Holland and Huston 1984). Control

Table 2. Spearman correlation coefficients (r) for mean numbers and densities of birds/pond vs. pond area, shoreline length, and shoreline development. Analyses excluded ponds with no bird use.

	Mean numbers			Mean densities		
Species	Surface area	Shoreline length	Shoreline[a] development	Surface area	Shoreline length	Shoreline development
Blue-winged teal (*Anas discors*)	0.47[b]	0.25	−0.49[c]	−0.68[c]	−0.77[c]	−0.38
Ducks other than teal	−0.04	−0.11	−0.06	−0.72[c]	−0.74[c]	−0.23
American black duck (*Anas rubripes*)	−0.13	−0.20	−0.15	−0.76[c]	−0.80[c]	−0.41
Total ducks	0.42[b]	0.26	−0.17	−0.67[c]	−0.74[c]	−0.38[b]
Great egret (*Casmerodius albus*)	0.58[c]	0.37	−0.25	−0.82[c]	−0.84[c]	−0.26
Snowy egret (*Egretta thula*)	−0.14	−0.21	−0.04	−0.88[c]	−0.84[c]	−0.08
Tricolored heron (*Egretta tricolor*)	0.44	0.33	0.07	−0.97[c]	−0.90[c]	−0.04
Total wading birds	0.50[c]	0.38	−0.05	−0.89[c]	−0.85[c]	−0.18
Yellowlegs	0.50[b]	0.39	−0.12	−0.77[c]	−0.76[c]	−0.21
Calidris spp.	0.19	−0.10	−0.54	−0.89[c]	−0.89[c]	−0.49
Total shorebirds	0.43[b]	0.37	−0.11	−0.77[c]	−0.74[c]	−0.28

[a] formula provided in text.
[b] $P < 0.05$.
[c] $P < 0.01$.

of mosquitoes by fish predation may, therefore, be better in ponds with SAV. Macroinvertebrates, a major food of some waterfowl and shorebirds, also are more abundant in vegetated areas than in non-vegetated areas (Gerking 1957, Krull 1970, Teels et al. 1978).

Wading bird and shorebird densities were higher on impoundment ponds than on OMWM ponds, presumably because impoundment ponds were shallower and had sloping banks. These birds could not use the permanent water of the OMWM ponds, which was at least 30 cm deep. The few wading birds and shorebirds seen at OMWM ponds were primarily on mud banks of new ponds.

Large ponds had more birds than small ponds, but bird densities were greater on small ponds. These findings are similar to those for several types of waterfowl breeding habitats (Evans and Black 1956, Lokemoen 1973, Patterson 1976, Godin and Joyner 1981). When choices can be made about the number and size of ponds to be constructed, many small ponds (<0.5 ha) may attract more migrating birds than fewer large ponds (>0.5 ha) of equal area.

Small islands did not influence use of ponds by any species, including waterfowl, unlike results from waterfowl post-breeding areas (Godin and Joyner 1981). OMWM ponds are probably too small to have islands provide safety from predators.

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