Characteristics of wetlands used by migrant dabbling ducks in Oklahoma, USA

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Introduction

Few studies have directly addressed habitat use by waterfowl during migration, especially in spring. Autumnal information on flyway and corridor use is based mainly on recovery data derived from hunting returns. While isolated descriptions of habitat use by migrant ducks are in the literature, few studies excepting Bellrose *et al.* (1979) provide data on wetland dynamics, characteristics of wetlands used, or habitat selection. During autumn, movements by some waterfowl may simply be shifts between refuges and large wetland complexes where concentrations form (e.g. Hamilton & Watt 1970). Spring migrants, especially dabbling ducks, are less concentrated and often use smaller scattered wetlands.

Specific weather conditions, habitat types, and geographical locations used by spring migrant waterfowl may influence nutrient reserve acquisition, stopover lengths, and eventual reproduction (Hanson 1962; Richardson 1978; Raveling 1979; Wypkema & Ankney 1979; Heitmeyer & Fredrickson 1981). Furthermore, birds often concentrate immediately after a migratory flight on habitats different from those they select to feed in and fatten (Cherry 1982). For example, small natural floodplain wetlands in Oklahoma are selected by paired Mallard *Anas platyrhynchos* as feeding sites in late winter while unpaired Mallard form loafing concentrations on large reservoirs and unvegetated basins (Heitmeyer & Vohs 1984).

The objectives of this study were to investigate the characteristics of small scattered wetlands used by migrant dabbling ducks in Oklahoma.

Methods

A stratified random sample of ¼-sections (0.65 km^2) of land distributed proportionately to the area of the six physiographic provinces in Oklahoma (Fig. 1) was used to sample wetland habitats and migrant dabbling ducks. This ¼-section design did not sample large bodies of water (> 445 ha) nor National Wildlife Refuges (NWR's). Weekly aerial and ground surveys of waterfowl present on Optima, Salt Plains, Washita, Sequoyah, and Tishomingo NWR's were conducted by refuge personnel from October to March of both 1978–79 and 1979–80; and similar surveys of selected large reservoirs were conducted by personnel of the Oklahoma Department of Wildlife Conservation and the Oklahoma Cooperative Wildlife Research Unit. These data were compared with data on distribution of different species from the ¼-sections to assess habitat preferences among species.

We sampled 448 ¼-sections (29,009 ha) containing 340 wetland basins with water present during spring 1979 (12 Mar–2 Apr), 518 ¼-sections (33,542 ha) containing 431 wetlands during autumn 1979 (31 Oct–7 Nov), and 518 ¼-sections (33,542 ha) containing 448 wetlands during spring 1980 (3 Mar–22 Mar). Initially, 492 ¼-sections were randomly drawn for sampling. These areas were visited repeatedly during all surveys, but permission for access was occasionally denied, and 64 new ¼-sections were added for the autumn 1979 and spring 1980 surveys, hence the variability in sample sizes. No bias was caused by adding the new sections (Heitmeyer & Vohs 1981). The number of basins containing water varied within and between years according to changes in precipitation and hydrological conditions. Further information on sampling design (Stewart & Kantrud 1972) and on distribution and composition of wetlands is found in Heitmeyer and Vohs (1981, 1984).

The species of ducks on wetlands present on ¼-sections were determined and, if ducks were observed undisturbed for at least 5 minutes, their activity. Activity (feeding, loafing, and courtship) classification followed Tamisier (1976) and Skead (1977).

Thirty-six physical, chemical, and vege-

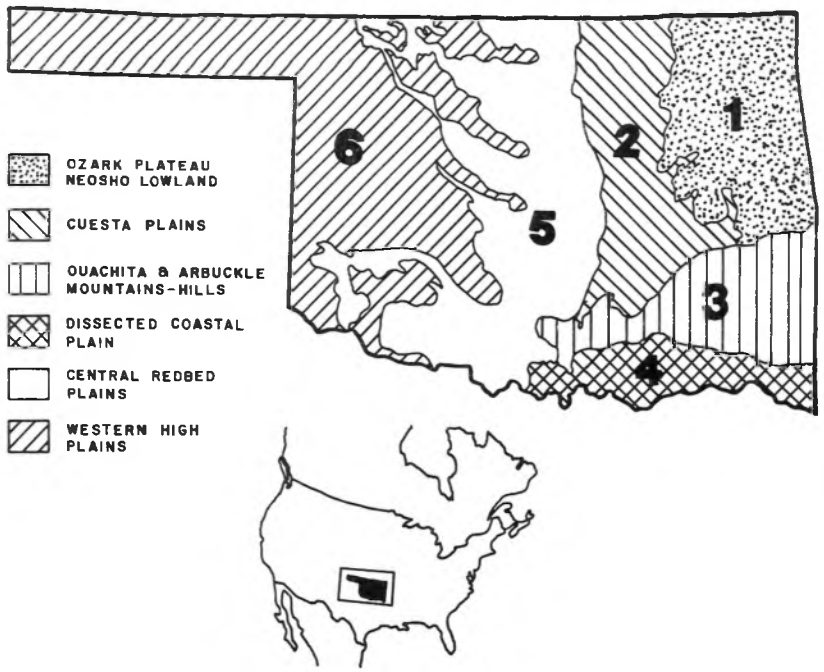

Figure 1. Physiographic provinces of Oklahoma.

tational variables were measured at each wetland basin containing water during each visit (Heitmeyer & Vohs 1981). All wetland basins were individually classified using the classification system of Cowardin *et al.* (1979).

Habitat use was summarised as the percentage of ducks by species observed on each wetland type. The available wetland types[1] were: (1) riverine – (2) small lacustrine – excluding large (> 445 ha) reservoirs, (3) palustrine mud – unconsolidated bottom or shore – (4) palustrine vegetated – aquatic bed or emergent vegetation (5) palustrine bottomland – scrub/shrub or forested, and riparian floodplains. All lacustrine wetlands and most palustrine mud wetlands were man-made, but many palustrine vegetated and palustrine bottomland wetlands were natural. Over 90% of the natural wetlands were semi-permanently or seasonally flooded (Heitmeyer & Vohs 1981).

The timing of all surveys directly corresponded with peak numbers of dabbling ducks migrating through Oklahoma as determined from weekly aerial and ground surveys of reservoirs and NWR's. However, many Mallard had already moved through Oklahoma by early March in 1979, and both the spring surveys were conducted before peak Blue-winged Teal *Anas discors* migrations. The autumn survey was conducted during a 4-week split in the 1979 Oklahoma waterfowl hunting season, therefore the influence of hunter disturbance on habitat selection by migrant waterfowl should have been partialy reduced. Temperatures were near normal during the study (US Department of Commerce 1979–80).

All data were analysed using chi-square, *t*-test, and multivariate programs in the Statistical Analysis System (Barr *et al.* 1979). Unless otherwise noted, all probability levels refer to the chi-square tests.

[1] Riverine wetlands refer to those contained within a channel such as creeks, rivers, and streams; Lacustrine wetlands refer to those larger and deeper lakes that lack vegetation with greater than 30% areal coverage; and Palustrine wetlands refer to marshes and smaller, often semi-permanently or seasonally flooded, ponds. Modifiers of Palustrine systems (e.g. mud – unconsolidated bottom) indicate the predominant substrate and vegetative characteristics of the basin.

Results

Geographical distribution

Few Shoveler *Anas clypeata,* Green-winged Teal *A. crecca,* Blue-winged Teal, or Wood Duck *Aix sponsa* were observed on reservoirs or NWR's during either fall or spring migration and few Mallard or American Wigeon *Anas americana* during spring. This suggests that small wetlands provide a significant portion of the available and used habitat for migrant dabbling ducks in Oklahoma.

The geographical distribution of dabbling ducks on the small wetlands was different between autumn and spring and between spring 1979 and 1980. More Mallard, Pintail *Anas acuta,* American Wigeon, Green-winged Teal, and total dabblers were present on small wetlands in province 5 (Fig. 1) during autumn than was expected in relation to the percentage of the state water area occurring in that province (Table 1). Shoveler were more abundant in province 1, Gadwall *Anas strepera* and Blue-winged Teal more abundant in province 2, and Wood Duck more abundant than expected in provinces 3 and 4 during the autumn survey, when ducks were seldom seen in province 6.

In contrast to the autumn, more total dabbling ducks used small wetlands in provinces 4 and 6 during the springs (Table 1). In spring 1979 Pintail, Gadwall, and Shoveler were more abundant in province 5, Green-winged Teal and American Wigeon were more abundant in provide 4, Mallard and Gadwall were more abundant in province 3, and Mallard, Gadwall, American Wigeon, Shoveler and Green-winged Teal were more abundant in province 6. Fewer duck species were present in province 6, and more were observed in provinces 4 and 5 during spring 1980.

Differences in habitat use

Differences in habitat use (% use vs. % of statewide water area occurring in the habitat type) were noted between species and seasons of this study (Table 2). More dabbling ducks used lacustrine habitats in autumn, but more used palustrine wetlands in spring. During the wetter spring of 1980, palustrine mud and palustrine vegetated wetlands received much greater use than during spring 1979, when palustrine bottomland (and to a lesser extent lacustrine wetlands) received the greatest use.

Shoveler seemed to select (i.e. observed frequencies were higher than expected values) palustrine mud wetlands, Pintail lacustrine wetlands, Gadwall vegetated wetlands, and Wood Duck riverine or palustrine bottomland wetlands in all seasons (Table 2). Other species used habitats largely in response to wetland conditions within the respective habitat types.

Dabbling ducks selected natural wetlands in provinces 4 and 6 during all seasons (Table 3). These 2 provinces consistently had the highest percentage of natural basins. Natural wetlands were selected in province 3 during both springs and in province 5 during spring 1980. Natural wetlands were used statewide by dabblers more in spring than during autumn.

Habitat variables related to duck use

Sixteen of the 36 habitat variables measured at wetland basins were significantly different between basins used and basins not used by Mallard, Gadwall, American Wigeon, and Green-winged Teal (Table 4). We also analysed the 36 variables using principal component and multivariate analysis of variance techniques (see Heitmeyer 1980) to determine cues used in habitat selection by different species. We interpret these data as follows: Wetlands used by Mallard during 1979 were large clear floodplain basins containing emergent and moist soil vegetation; while wetlands used by Mallard in spring 1980 were close to floodplains, received detrital input from nearby forests, and were highly productive both chemically and vegetatively. Wetlands used by Gadwall in autumn 1979 were close to reservoirs and contained submergent vegetation; while those used in spring received light grazing pressure, were clear, and contained abundant submergent and emergent vegetation. Wetlands used by American Wigeon during spring 1980 had large littoral zones, received light grazing pressure, were clear, and contained abundant moist-soil and submergent vegetation. Wetlands used by Green-winged Teal were large, close to floodplains, highly productive, and contained abundant moist soil, emergent, and submergent vegetation. Wetlands used by Wood Ducks in spring

Table 1. Percentage of dabbling ducks observed on random ¼-section wetlands that were present in the 6 physiographic provinces of Oklahoma during autumn 1979 (A79), spring 1979 (S79), and spring 1980 (S80).

Species, season, and (sample size)	Province 1	2	3	4	5	6
Mallard						
A79 (111)	3.6	-	-	9.9	82.9*	3.6
S79 (29)	6.9	-	6.9*	-	20.7	65.5*
S80 (118)	0.8	9.3	5.1	38.1*	33.9*	12.7*
Pintail						
A79 (71)	-	-	-	1.4	98.6*	-
S79 (17)	-	-	-	-	100.0*	-
S80 (4)	25.0	25.0	50.0	-	-	-
Gadwall						
A79 (99)	-	58.6*	-	6.1	35.4	-
S79 (32)	-	-	34.4*	-	31.2*	34.4*
S80 (26)	7.7	-	-	23.1*	69.2*	-
American Wigeon						
A79 (340)	-	8.2	-	-	88.2*	-
S79 (32)	-	-	-	-	-	100.0*
S80 (52)	-	1.9	-	13.5	80.8*	3.8
Shoveler						
A79 (31)	80.6*	16.1	-	-	-	3.2
S79 (16)	25.0	12.5	-	-	37.5*	25.0*
S80 (24)	100.0*	-	-	-	-	-
Blue-winged Teal						
A79 (86)	9.3	50.0*	-	-	32.6	8.1
S79 (4)	-	-	-	50.0	50.0	-
S80 (14)	78.6*	-	-	14.3	7.2	-
Green-winged Teal						
A79 (342)	-	-	-	0.8	99.2*	-
S79 (379)	0.5	4.0	0.5	68.6*	9.5	16.9*
S80 (101)	-	12.9	-	28.7*	50.5*	7.9*
Wood Duck						
A79 (15)	-	-	40.0*	60.0*	-	-
S79 (12)	16.7	-	-	75.0*	16.7	-
S80 (8)	25.0	-	25.0	25.0	25.0	-
Total dabblers						
A79 (1095)	3.4	12.2	0.6	2.6	79.0*	2.2
S79 (521)	1.9	3.3	2.9	51.8*	15.2	24.9*
S80 (347)	11.8	7.5	2.9	26.2*	44.4*	7.2*
% state water area in the province						
A79	24.4	16.8	4.8	18.2	32.7	4.2
S79	20.8	26.7	5.6	25.6	19.2	2.2
S80	20.6	23.5	4.4	21.3	26.3	4.0
% state land area in the province	13.6	14.0	10.4	6.4	24.5	31.3

* Observed percentages were significantly ($P < 0.05$) higher than expected in relation to the percentage of the state water area occurring in that province.

Table 2. Percentage of dabbling ducks observed on random ¼-section plots that were present on 5 wetland habitat types in Oklahoma during autumn 1979 (A79), spring 1979 (S79), and spring 1980 (S80).

Species, season, and (sample size)	Wetland habitat type				
	Riverine	Lacustrine	Palustrine mud	Palustrine vegetated	Palustrine bottomland
Mallard					
A79 (111)	-	84.7*	3.6	5.4	6.3
S79 (29)	6.9	58.6*	27.6*	6.9*	-
S80 (118)	5.1	1.7	24.6	36.4*	32.2*
Pintail					
A79 (71)	-	98.6*	1.4	-	-
S79 (17)	-	100.0*	-	-	-
S80 (4)	-	50.0	50.0	-	-
Gadwall					
A79 (99)	-	48.5*	-	51.5*	-
S79 (32)	-	59.4*	6.2	34.4*	-
S80 (26)	-	15.4	-	23.1*	61.5*
American Wigeon					
A79 (340)	-	97.1*	-	2.9	-
S79 (32)	-	100.0*	-	-	-
S80 (52)	-	-	25.0	63.5*	11.5
Shoveler					
A79 (31)	-	16.1	80.6*	3.2	-
S79 (16)	-	-	100.0*	-	-
S80 (24)	-	-	100.0*	-	-
Blue-winged Teal					
A79 (86)	-	90.7*	-	9.3	-
S79 (4)	-	50.0	-	50.0	-
S80 (14)	-	71.4*	14.3	-	14.3*
Green-winged Teal					
A79 (342)	-	99.4*	-	-	0.6
S79 (379)	3.4	17.2	7.1	5.3	67.1*
S80 (101)	-	-	61.4*	19.8*	18.8*
Wood Duck					
A79 (15)	93.3*	-	-	-	6.7
S79 (12)	-	-	16.7	33.4*	50.0*
S80 (8)	25.0	-	50.0*	-	25.0*
Total dabblers					
A79(1095)	1.3	88.1*	2.7	6.9	0.9
S79 (521)	2.3	29.2*	10.6	7.5*	49.9*
S80 (347)	2.3	5.2	39.2*	29.4*	23.9*
% of water area in the habitat type					
A79	36.5	25.6	24.9	5.5	7.6
S79	51.5	20.7	12.3	5.0	10.3
S80	41.6	19.9	21.6	6.4	10.5

* Observed percentages were significantly ($P < 0.05$) higher than expected in relation to the percentage of the state water area occurring in habitat type.

were large productive bottomland basins with submergent vegetation.

Activities

The activities of Mallard, Gadwall, American Wigeon, and Green-winged Teal were different between wetland types (Table 5). Lacustrine and palustrine mud wetlands were largely used as loafing sites. In contrast, palustrine vegetated and bottomland wetlands were used as feeding sites by most species. Mallard courted more than expected on palustrine mud basins in

Table 3. Percentage of dabbling ducks observed on random ¼-section plots in Oklahoma that were on natural palustrine wetlands and the percentage of basins and surface water area that was natural palustrine during autumn 1979 (A79), spring (S79), and spring 1980 (S80).

Season, province, and (number of dabblers)		% of dabblers on palustrine natural wetlands	% of basins that were palustrine natural	% of surface water area that was natural
A79				
Province 1	(37)	-	2.9	0.8
2	(134)	-	3.2	0.4
3	(6)	-	-	-
4	(29)	48.3*	7.1	35.4
5	(865)	-	3.6	1.6
6	(24)	12.5*	9.7	0.6
Total	(1095)	1.6	3.9	6.2
S79				
Province 1	(10)	-	5.7	1.7
2	(17)	-	4.0	0.3
3	(15)	26.7*	2.0	2.4
4	(270)	99.3*	10.2	38.8
5	(79)	-	2.8	1.7
6	(130)	4.6	17.6	0.2
Total	(521)	53.4*	5.3	10.9
S80				
Province 1	(41)	-	3.8	1.6
2	(26)	-	4.3	0.7
3	(10)	20.0*	2.1	1.3
4	(91)	65.9*	9.8	51.1
5	(154)	9.1	4.1	1.3
6	(25)	20.0*	8.0	0.4
Total	(347)	23.3*	4.9	10.6

* Observed percentages were significantly ($P < 0.05$) higher than expected in relation to both the percentage of basins that were palustrine natural and the percentage of the surface water area that was palustrine natural.

autumn. Gadwall and American Wigeon displayed courtship and Green-winged Teal often loafed on vegetated wetlands.

Discussion

Habitat preferences

The exact number of waterfowl using small wetlands in Oklahoma as migration stopover areas is unknown. The number and species are probably related to continental population dynamics, wetland habitat conditions on both wintering and migration areas and climatic conditions. Likewise, the geographical regions where species stop over is largely influenced by traditional migration corridors, both to and from breeding and wintering areas. However, we often assume that migration corridors have become established in response to the location of suitable habitats. Whatever the exact reasons, small wetlands in Oklahoma do appear to serve a valuable role in maintaining migrant dabbling duck populations in the central United States.

Migration habitats used by dabbling ducks in Oklahoma were different between autumn and spring, between years, and between species. Certain habitat preferences were apparent within a species, however. During autumn, migrants are tightly flocked, gregarious, and seek large and deep lacustrine basins, wetlands with good visibility and little disturbance. Although the autumn survey was conducted during a 4-week split in the waterfowl hunting season, hunting disturbance of migrants prior to their arrival very likely influenced habitat use of dabbling ducks in Oklahoma.

Dabbling ducks tended especially to se-

Table 4. Independent variables that were significantly ($P < 0.05$) different (t-tests) between palustrine wetlands used by a species (W) and wetlands not used by a species (W/O) on random ¼-section plots in Oklahoma during autumn 1979 (A79), spring 1979 (S79), and spring 1980 (S80).

Species and significant variables	A79 wetland means		S79 wetland means		S80 wetland means	
	W	W/O	W	W/O	W	W/O
Mallard						
moist soil height (m)	0.07	0.5				
emergent height (m)	0.02	0.5			1.5	2.8
light penetration (cm)	16.2	29.9				
distance to stream (m)	825	4479			3328	4560
no. basins on ¼-section					2.6	3.3
% basins w/*Najas*					30	10
total alkalinity (ppm)					104	79
pH					6.5	6.0
% basins w/forestland					22.7	3.5
Gadwall						
distance to reservoir (km)	7.1	26.0			5.9	25.4
% basins w/*Najas*	100	20			70	10
no. moist soil species			3.0	1.1		
moist soil height (m)			0.07	1.0		
total alkalinity (ppm)					152	80
light penetration (cm)					79.7	32.9
pH					7.2	6.0
% basins w/grazing					17.5	40.2
American Wigeon						
no. moist soil species					3.1	2.3
% basins w/*Ceratophyllum*					40	0.0
% basins w/*Najas*					90	10
light penetration (cm)					67.0	33.0
% of basins < 1m deep					96	91
% basins w/grazing					15.7	40.3
Green-winged Teal						
no. basins on ¼-section			1.6	3.0		
shoreline development index			1.6	1.3		
no. moist soil species			1.8	1.0	3.0	2.3
no. emergent species			1.1	0.3		
total alkalinity (ppm)			174	110	129	78
light penetration (cm)			18.5	29.4		
emergent height (m)					0.2	1.6
% basins w/*Najas*					30	10
pH					6.7	6.0
distance to stream (m)					2477	4607

lect natural wetlands during spring migration. In province 4, where natural wetlands were most abundant, 99% and 66% of spring migrants used natural wetlands in 1979 and 1980, but these natural wetlands made up only 10% and 39%, and 10% and 51%, of the basins and surface water area respectively. Not all natural wetlands were used equally. Small prairie mud basins with little vegetation, and heavily grazed and turbid oxbows were avoided.

American Wigeon and Gadwall were observed on similar habitat types during both autumn and spring migration. Both preferred wetlands with abundant vegetation, especially submergents. Wetland characteristics that influence vegetative aspects of basins (e.g. light penetration, grazing pressure, chemical concentrations) influenced habitat selection for both species. They also show similar habitat selection in winter (White & James 1978). However, important differences occurred in their geographical distribution within Oklahoma. More Gadwall were observed in eastern, and more American Wigeon were observed

Table 5. Positive (+) and negative (−) associations (chi-square tests, $P < 0.05$) between the feeding (F), loading (L), and courtship (C) activity of Mallard, Gadwall, American Wigeon, and Green-winged Teal and wetland types observed on random ¼-section plots during autumn 1979 (A79), spring 1979 (S79), and spring 1980 (S80).

Species and season	Lacustrine			Palustrine mud			Palustrine vegetated			Palustrine bottomland		
	F	L	C	F	L	C	F	L	C	F	L	C
Mallard												
A79			−			++				+	−	
Gadwall												
A79		++	—					—	++			
S79	—	++					+	−				
S80	—	++					+			++	—	
American Wigeon												
A79		+	—				+	−	++			
S79					++	—		−	++			
Green-winged Teal												
S79	−			—	++		+	++		++	—	
S80	—	++			+		+	+		+	−	

- and – indicates > 2 and < 5, and ++ and — indicate ≥ 5 units of the X^2 total.

in western Oklahoma. Some temporal segregation may also occur between these species, at least during spring migration.

Shoveler and Blue-winged Teal showed many similarities in geographical distribution but used markedly different habitats. Shoveler preferred small palustrine and mud basins, while Blue-winged Teal were mostly on larger, deeper basins with vegetation present.

Green-winged Teal, Mallard, and Wood Duck also showed many habitat and geographical similarities. Wood Duck were concentrated in southeastern Oklahoma, however, and the size difference in food items between Green-winged Teal and Mallard makes competition between these species unlikely. No species overlapped appreciably in geographical and/or habitat distribution during migration periods, especially during spring. These data tend further to substantiate that some degree of spacial and temporal segregation occurs among dabbling duck during all seasons (see Weller 1975, Bellrose 1979, White & James 1978).

The importance for dabbling duck populations in the mid-continental United States of natural floodplain wetlands containing abundant moist soil vegetation (Bellrose *et al.* 1979; Fredrickson & Taylor 1982) and bottomland hardwoods (Heitmeyer & Fredrickson 1981; Heitmeyer & Vohs 1984) is confirmed by this study. These wetlands provide important feeding, loafing, and courtship sites for dabbling ducks, are close to traditional migratory landmarks (e.g. rivers) and are among the most productive of North American wetlands (Heitmeyer & Vohs 1981).

Wetland dynamics

Wetlands used by waterfowl in North America are highly dynamic during all parts of their annual cycle. The characteristics of, and changes in these wetlands have helped to shape waterfowl species characteristics. Dabbling ducks are adaptable species and respond to wetland dynamics during breeding (Weller 1975), wintering (Heitmeyer & Vohs 1984), and migration (this study).

The shift by dabbling ducks to use wetlands in western Oklahoma (province 6) more in spring, and those in eastern and central Oklahoma more in autumn is in response to the seasonal dynamics of wetlands, reflecting the different hydrological cycles (Heitmeyer & Vohs 1981). Annual flooding of semi-permanent basins in eastern Oklahoma begins in late autumn and continues to a peak in spring; drying of these basins occurs in summer and early autumn. Moist-soil and aquatic vegetation are therefore shallowly flooded and provide optimal habitat for fall migrants (Bellrose *et al.*

1979). In contrast, wetlands in western Oklahoma remain dry from late summer through late winter (Heitmeyer & Vohs 1981). Annual flooding begins in spring and is of shorter duration. Residual seeds (Baldassarre 1980) and a bloom of invertebrates (Sublette & Sublette 1967), resulting from initial flooding do not usually become available to ducks until late winter or spring.

Changes in habitat use within species between the springs of 1979 and 1980 provided an example of the effect of long-term dynamics of wetlands. The number, surface water area, diversity of wetland types, and open water/emergent vegetation interspersion of palustrine basins increased from 1979 to 1980. These were all variables identified in the univariate and multivariate analyses as affecting dabbling duck use of wetlands during migration and explain the increased use of palustrine basins in spring 1980. Mallard, Green-winged Teal, Gadwall, and American Wigeon were all particularly responsive to these changes.

Factors that affect water dynamics and vegetation in wetlands must be considered for management of migration habitat. The periodic drying and flooding of basins allows the continual high productivity (biomass, diversity, and nutritional quality) of plant and animal communities. Land use practices such as grazing, draining, and row cropping basins are especially detrimental to migration habitat.

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Summary

The geographical and habitat distribution, habitat selection factors, and activities of migrant dabbling ducks were studied in autumn 1979 and spring 1979 and 1980 on small scattered wetlands present in Oklahoma. Dabbling duck species were most abundant in provinces that contained the greatest number and quality of preferred habitats. Both seasonal and long-term wetland dynamics influenced habitat availability and habitat selection. American Wigeon *Anas americana* and Gadwall *A. strepera* both selected vegetated wetlands but were spatially separated; Blue-winged Teal *A. discors* and Shoveler *A. clypeata* occurred in similar provinces but used different habitats; and Green-winged Teal *A. crecca,* Wood Duck *Aix sponsa* and Mallard *Anas platyrhynchos* all selected natural floodplain wetlands but either occurred in different provinces or differed ecologically. While the exact number of waterfowl using small wetlands in Oklahoma as migration stopover areas is unknown, these wetlands, especially natural basins, appear to serve an important role in maintaining migrant dabbling duck populations in the central United States.

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