Canvasback Food Density in the Mississippi River Delta, Louisiana: Habitat and Temporal Differences

Ronald R. Bielefeld,[1] *School of Forestry, Wildlife and Fisheries, Louisiana State University, Baton Rouge, LA 70803, and U. S. Fish and Wildlife Service, National Wetlands Research Center, Lafayette, LA 70506*

Alan D. Afton, *U.S. Fish and Wildlife Service, Louisiana Cooperative Fish and Wildlife Research Unit, Louisiana State University, Baton Rouge, LA 70803*

Abstract: Wildlife managers have been creating deltaic splays in the Mississippi River Delta to promote marsh regeneration, but little is known of the quality of splays as waterfowl foraging habitat. Consequently, we compared densities of important canvasback (*Aythya valisineria*) foods in splays and open-water ponds during winter 1990–91. Biomass (g/m^2) of grassy arrowhead (*Sagittaria graminea*) tubers differed between splay mudflats and ponds, but the difference was not consistent between months. In November 1990, splay mudflats (mean ± SE = 123.7 ± 2.9) supported a greater biomass of tubers than did ponds (43.8 ± 2.9). In March 1991, tuber biomass was similar between habitats (splays = 12.6 ± 2.9, ponds = 23.7 ± 2.9) because of a marked decrease in tubers in splay mudflats between sampling periods. American bulrush (*Scirpus americanus*) rhizomes were not present in samples from ponds. Mean ± SE rhizome biomass (g/m^2) in splay mudflats declined from 63.4 ± 14.2 in November 1990 to 20.0 ± 14.2 in March 1991. Mudflats accounted for the greatest percentage of the total area of splays (mean ± SE = 66.4% ± 4.6), followed by high banks (6.7% ± 2.6) and channels (5.4% ± 0.8). Splay mudflats supported more extensive above ground patches of the 2 plant species (mean percent coverage ± SE = 70.6% ± 14.7) than did channels (30.2% ± 9.1), high banks (6.3% ± 2.1), or ponds (9.6% ± 3.4). Our results indicate that splays are superior foraging habitats as compared to ponds, and continued construction of splays should improve the suitability of the Mississippi River Delta for wintering canvasbacks.

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[1] Present address: Indiana Department of Natural Resources, 3900 Soldier's Home Road, W. Lafayette, IN 47906.

The Mississippi River Delta (MRD) is an important wintering area for canvasbacks in the Mississippi Flyway (Hohman and Rave 1990, Hohman et al. 1990*b*). Grassy arrowhead tubers and American bulrush rhizomes are the most important foods of canvasbacks in the MRD, comprising 74% of their diets (Hohman et al. 1990*a*). From 1956 to 1978, coastal erosion degraded >39,000 ha (51%) of shallow wetlands in the MRD (Turner 1987), resulting in a dramatic increase in open-water ponds. Managers have been creating deltaic splays (i.e., areas of accreting sediment associated with a cut in a bank of a river pass) on the MRD to promote marsh regeneration (White 1989).

Little comparative information is available on the quality of splays and ponds as waterfowl foraging habitat. Our objectives were: 1) to compare biomasses of grassy arrowhead tubers and American bulrush rhizomes on splay mudflats and ponds before arrival and after departure of canvasbacks in the MRD, 2) to estimate aboveground coverage of these plants in splays and ponds, and 3) to describe splay microhabitats.

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Methods

The study area included the entire active MRD located in southeastern Louisiana (29°15'N, 89°15'W). The MRD is a dynamic wetland system (Bahr et al. 1983) which includes Pass-a-Loutre WMA (19,750 ha) and Delta NWR (26,710 ha). Detailed descriptions of plant communities in the MRD are provided in Chabreck (1972, 1988) and Hohman et al. (1990*a*).

Deltaic splays were defined as complexes (1–70 ha) of accreting mudflats, channels, and high banks associated with man-made or natural cuts in the bank of a river pass (White 1989, Hohman et al. 1990*a*). The mudflats receive shallow, intermittent flooding and support dense growths of emergent aquatic plants, primarily American bulrush, grassy arrowhead, and common arrowhead (*Sagittaria latifolia*). Open-water ponds were defined as any open-water area (1–100 ha) not associated with a cut in a bank of a river pass or connected to the Gulf of Mexico (Bielefeld 1992). Ponds were subject to semipermanent or permanent flooding and vegetated primarily by submergent aquatic plants (watermilfoil, *Myriophyllum* spp.) with a few scattered stands of emergent plants (common reed, *Phragmites communis;* grassy arrowhead). Ponds generally were deeper than splays (except channels); however, shallow areas similar to splay mudflats did occur in ponds. To delineate splays and ponds, we used color infra-red aerial photographs taken during low water periods (1:18,000 scale in September 1988; 1:10,000 scale in September 1990). Water levels in both habitats were affected daily and seasonally by tide, river stage, and wind conditions (Hohman and Rave 1990).

We collected 20 core samples at each of 6 splays (mudflats only) and 6 ponds from 30 October to 3 November 1990 (hereafter November) and then again from 26 to 30 March 1991 (hereafter March). Sampled splays and ponds (i.e., sites) were selected randomly from 12 splays and 10 ponds on which canvasbacks were observed foraging during winter 1989–90 (Bielefeld 1992). We placed a transparent grid (each numbered square represented 25 m^2) on a color infra-red photograph of each site and then randomly selected 20 sampling locations. Samples were collected using a 14.1-cm diameter core sampler (Swanson 1978) to a depth of 50 cm (Hohman et al. 1990*a*). Samples were immediately washed in a mesh bag (mesh size = 3 mm) and then stored in plastic bags. Samples were later identified (Martin and Uhler 1939) and dried to constant mass (± 0.01 g) at 60° C.

We analyzed biomass (g/m^2) of grassy arrowhead tubers using a split-plot analysis of variance (PROC ANOVA, SAS Inst. 1987) because the covariance matrix of our repeated measures design satisfied the Huynh-Feldt condition (Huynh and Feldt 1970). We compared means from this analysis using LSD tests (Milliken and Johnson 1984:329–331). American bulrush rhizomes were not present in samples from ponds. Consequently, we analyzed rhizome biomass (g/m^2) using a mixed model analysis of variance (Anderson and McLean 1974:56–59) in which sites (i.e., the 6 splays) were random and months were fixed. We used model based means ± SE to describe tuber and rhizome biomasses.

We estimated percent area of the 6 splays comprised of mudflats, channels, and high banks, and percent cover of grassy arrowhead and American bulrush on each splay using color infra-red aerial photographs (1:10,000 scale) and a dot grid (Mosby 1980). We used the same technique to estimate percent cover of both plants on the 6 ponds. Photographs were ground-truthed to verify identification of plant species.

Results

A total of 548 tubers and 180 rhizome segments were recovered from splay mudflats (N = 240 core samples), and 146 tubers and 0 rhizome segments were recovered from ponds (N = 240 core samples). Mean ± SE dry masses of tubers (N = 694) and rhizomes (N = 180) were 0.47 ± 0.10 g and 0.48 ± 0.13 g, respectively.

Tuber biomass (g/m^2) differed between splay mudflats and ponds, but the difference was not consistent between months (Habitat*Month interaction, Table 1). In November 1990, splay mudflats (mean ± SE = 123.7 ± 2.9) contained a greater

Table 1. Summary of analyses of variance for biomasses (g/m^2) of grassy arrowhead tubers and American bulrush rhizomes recovered from deltaic splays and open-water ponds during winter 1990–91 on the Mississippi River Delta, Louisiana.

	Tubers[a]					Rhizomes[b]			
Source	df	MS	F	P	Source	df	MS	F	P
Habitat	1	34.529	3.80	0.0798	Site	5	3.964	7.77	0.0001
Site(Habitat)	10	9.084			Month	1	27.527	13.53	0.0143
Month	1	125.870	28.41	0.0003	Site*Month	5	2.035	3.99	0.0017
Habitat*Month	1	60.648	13.69	0.0041	Residual	228	0.510		
Site(Habitat)*Month	10	4.430							
Residual	456	1.414							

[a]Habitat = splay or pond; Month = November 1990 or March 1991. Habitat was tested with Site(Habitat); Month and Habitat*Month were tested with Site(Habitat)*Month.
[b]Site = 6 randomly selected splays; Month = November 1990 or March 1991. Site and Site*Month were tested with Residual; Month was tested with Site*Month.

($P < 0.05$) biomass of tubers than did ponds (43.8 ± 2.9). In March 1991, tuber biomass did not differ ($P > 0.05$) between habitats (splay = 12.6 ± 2.9, ponds = 23.7 ± 2.9) because of a significant ($P < 0.05$) decrease in biomass in splay mudflats between sampling periods. Tuber biomass in ponds did not differ ($P > 0.05$) between sampling periods.

Rhizome biomass (g/m^2) differed between months on splay mudflats (Table 1); mean ± SE biomass declined from 63.4 ± 14.2 in November 1990 to 20.0 ± 14.2 in March 1991. Although rhizome biomass decreased between sampling periods for all sites, variation in initial biomass (Range of means = 8.4–90.3 g/m^2) and magnitude of decline (Range = 28–100%) resulted in a significant Site*Month interaction (Table 1).

Mudflats accounted for the largest percent cover of the total area of splays (mean ± SE = 66.4% ± 4.6), followed by high banks (6.7% ± 2.6), and channels (5.4% ± 0.8). Splay mudflats supported more extensive above ground patches of grassy arrowhead and American bulrush (mean percent cover ± SE = 70.6% ± 14.7) than did channels (30.2% ± 9.1) or high banks (6.3% ± 2.1). On average, 9.6% ± 3.4 of the total area of ponds supported above ground patches of these plant species.

Discussion

Before arrival of canvasbacks on the MRD, splay mudflats supported greater biomasses of grassy arrowhead tubers and American bulrush rhizomes than did ponds. Although core samples were not taken from high banks and channels of splays, foliar cover estimates (Kelley 1990) suggest that tuber and rhizome biomasses on these microhabitats are lower than that in splay mudflats.

Grassy arrowhead grows best in permanently waterlogged soils (Uhler and Hotchkiss 1968). On high banks, soils often were unsaturated and other plant species (e.g., black willow [*Salix nigra*], rattlebox [*Sesbania drummondii*]) may have competed with grassy arrowhead and American bulrush. Splay channels and ponds generally were flooded deeply except during periods of low water. Splay channels also were characterized by strong currents. Tuber production by arrowhead species is reduced by constant flooding (Chabreck et al. 1983) and strong currents (Schulthorpe 1967). Splay mudflats supported little or no potentially competing vegetation, were periodically flooded, and had constantly saturated soils. Thus, environmental conditions in splay mudflats were most favorable for growth of grassy arrowhead.

Biomasses of grassy arrowhead tubers and American bulrush rhizomes decreased on splay mudflats between autumn and early spring; tuber biomass remained unchanged in ponds between sampling periods. Canvasbacks on splays spend more time foraging than those on ponds during winter (Bielefeld 1992). Moreover, these 2 food items comprise the majority of their diets (Hohman et al. 1990*a*). Consequently, we conclude that foraging canvasbacks were a major, but probably not the only, cause of the reduction in tubers and rhizomes on splay mudflats. Foraging waterfowl and nutria (*Myocastor coypus*) reportedly reduced the biomass of grassy arrowhead tubers on the MRD during an earlier study (Chabreck et al. 1983). We observed 5 other waterfowl species foraging on tubers and rhizomes: ring-necked ducks (*Aythya collaris*), northern pintails (*Anas acuta*), blue-winged teal (*Anas discors*), mottled ducks (*Anas fulvigula*), and especially lesser snow geese (*Chen caerulescens*).

Although food densities in high banks and channels may be less than that in mudflats, these splay microhabitats are important habitat components for canvasbacks (Bielefeld 1992). On the MRD, canvasbacks forage predominantly by tipping-up (Hohman and Rave 1990, Bielefeld 1992). When water depths prevented tipping-up on splay mudflats, canvasbacks tipped-up on high banks (during high water periods) or channel edges (during low water periods) (Bielefeld 1992). Also, when high water prevented birds from tipping-up on ponds, foraging time on ponds decreased (Bielefeld 1992). These shifts in habitat use and behavior strongly suggest that energy savings, not food density, dictate foraging site selection by canvasbacks on the MRD.

Our results indicate that splays are superior foraging habitats as compared to ponds, and continued construction of splays should improve the suitability of the MRD for wintering canvasbacks. Future studies should attempt to quantify densities of canvasback foods in high banks and channels of splays and determine whether food densities are reduced in these microhabitats during winter.

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