THE ECOLOGY AND DISTRIBUTION OF BANANA WATERLILY AND ITS UTILIZATION BY CANVASBACK DUCKS

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Abstract: The ecology and distribution of banana waterlily (*Nymphaea mexicana*) and its utilization by canvasback ducks (*Aythya valisineria*) was studied in South Carolina and the southeast during 1977-78. A high preference by canvasbacks for banana waterlily was found based on field research and questionnaires sent to land managers. Results of water chemistry and soil analyses showed that banana waterlily preferred alkaline or slightly brackish impoundments, especially near coastal waters. Land managers should be encouraged to identify suitable banana waterlily habitat and propagate this high quality canvasback food.

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Banana waterlily (formerly *Castalia flava*) is an aquatic vascular plant of the family Nymphaeceae native to Central America and Mexico. It was first collected in the United States in Florida by E.F. Leitner in the 1800's (Rickett 1969). Audubon included the species in his painting of the whistling swan (*Cygnus columbianus*) and created a controversy among naturalists who insisted that waterlilies did not have yellow flowers. The plant apparently remained unnoticed until the beginning of the 20th century, when it was rediscovered (Rickett 1969).

Regional botanical manuals list banana waterlily as uncommon with a spotty distribution in the southeast and Gulf states. Radford et al. (1968) reported the habitat and range as pools and streams in Johnston and Perquinans Counties, North Carolina, Charleston and Horry Counties, South Carolina, and Georgia, Florida, Alabama, and Mississippi. Small (1933) listed it as occurring in lakes, ponds, and slow streams of peninsular Florida. Rickett (1969) gave its range as South Carolina, Florida, and eastern and northern Texas. Correll and Correll (1975) gave its range in the southeast as eastern and southern Texas and Pinal County, Arizona. At many of these locations banana waterlily has been introducted (Beal 1977, W.P. Baldwin, personal communication).

Banana waterlily's importance as a canvasback food was first reported by W.L. McAtee (1917) who found this food in over 70% of the canvasbacks collected from Lake Surprise, Texas. Banana waterlily has since been recognized as an important waterfowl food, particularly for canvasbacks, by wildlife biologists in the southeastern and Gulf states. However, few studies concerning banana waterlily ecology have been published.

During the winters of 1976 and 1977 the distribution and feeding ecology of canvasbacks along the South Carolina coast were studied. A strong preference by canvasbacks for banana waterlily was found in this portion of its wintering range. Despite the fact that banana waterlily was scarce in South Carolina (known to occur in only 40 ha of the 28,350 ha of impoundments found in the coastal area), 37% of the estimated 2000 canvasbacks overwintering in the state in 1977 fed on banana waterlily (Cely 1980). This figure would undoubtedly have been higher except that canvasbacks saturated the limited amount of banana waterlily impoundments available. Canvasbacks fed primarily on the starch-rich tubers (referred to as hibernacula by some authors) of the plant, which resembled small clumps of bananas. These tubers grew in soft bottom sediments and were accessible only to canvasbacks and ring-necked ducks (*A. collaris*). Banana waterlily distribution and habitat characteristics were studied to determine the geographic range of this high quality canvasback food and to develop recommendations for proper management and/or establishment.

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STUDY AREAS

Andersonville Pond, Charleston County, was a diked tidal creek 1.2 ha in size and averaged 1 m in depth. Banana waterlily was the dominant aquatic and cattail (*Typha* sp.) was the dominant emergent. Fairfield Pond on Arcadia Plantation, Georgetown County, was a 8 ha, 1.5 m deep impoundment adjacent to abandoned rice fields on the Waccamaw River. Characteristic emergent plants were cattail, cut-grass (*Zizaniopsis miliacea*), and smartweeds (*Polygonum* sp.). Dominant aquatics were coontail (*Ceratophyllum demersum*), fanwort (*Cabomba caroliniana*), banana waterlily, water primrose (*Ludwigia* sp.) and bladderwort (*Utricularia* sp.). Middleton Pond on Arcadia Plantation, Georgetown County, was a former tidal creek 13 ha in size and 1 m in depth. Important aquatics were banana waterlily, southern naiad (*Najas quadalupensis*), muskgrass (*Chara* sp.), and coontail. Important emergents were cattail and lotus (*Nelumbo lutea*). Huntington Beach State Park Pond, Georgetown County, was a former tidal creek 13 ha in size and 1 m in depth. Important aquatics were banana waterlily and muskgrass while cattail was the dominant emergent. Alexander and Hair (1977) documented the importance of these impoundments as waterfowl feeding areas in an earlier study.

METHODS

Twenty-four questionnaires were sent to the major federal, state, and private wildlife refuge managers and other biologists in the southeastern and Gulf states to determine the distribution of banana waterlily and the extent to which it was utilized by canvasbacks.

Four banana waterlily impoundments in coastal South Carolina were selected and 1 monthly water sample from each was taken in February, March, and April. A Hach field kit was used to analyze total alkalinity, nitrate, nitrite, orthophosphate, and sulfate. A Colemen model 38A pH meter was used for pH while dissolved oxygen was determined by a Beckman Fieldlab oxygen analyzer. An American Optical Refractometer was used for salinity readings. One soil sample was taken from each impoundment (except Andersonville) and analyzed by the State Soil Testing Laboratory at Clemson University for phosphorus, potassium, calcium, magnesium, pH, soil pH, and soluble salts.

RESULTS AND DISCUSSION

Twenty-two of the 24 biologists (91%) responded to the questionnaire. Apparently banana waterlily has a restricted distribution in the south (Fig. 1) and is most abundant in peninsular Florida. Mississippi and Alabama reported no known locations of banana waterlily. Evidently the plant has not been a successful pioneer species, showing little range extension in the last 100 years.

Canvasback Utilization of Banana Waterlily.

Most biologists indicated a strong preference by canvasbacks for banana waterlily. J.R. Walther, refuge manager at Sabine National Wildlife Refuge, Louisiana, indicated a direct relationship between the canvasback population and the amount of banana waterlily present. W.P. Baldwin, former refuge manager at Cape Romain National

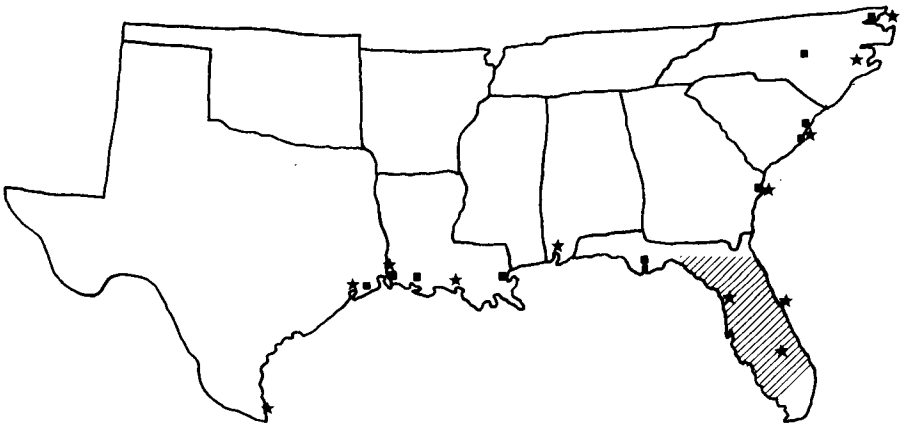

Fig. 1. A map of the southeastern and Gulf states showing the distribution of banana waterlily (■) and areas of canvasback concentration (★) . Hatching represents area in which banana waterlily is found sporadically. Data from mail surveys and Bellrose (1976).

Wildlife Refuge, South Carolina, noted that canvasbacks invariably concentrated on the refuge banana waterlily impoundments. In Georgia, J. Davis reported that several hundred canvasbacks utilized the banana waterlily found on Blackbeard Island. Lake Surprise, Texas, where W.L. McAtee first reported canvasbacks feeding on banana waterlily, has been degraded to the extent that little plant growth is present and canvasbacks no longer occur there (C.D. Stutzenbaker, personal communication). Laguna Atascosa National Wildlife Refuge in Texas supported a peak of 7000-8000 canvasbacks. Banana waterlily did not occur on the area and canvasbacks fed primarily on widgeon grass (*Ruppia maritima*) and muskgrass (R.H. Stratton, personal communication). Merritt Island National Wildlife Refuge in Florida overwintered from 500 to 3500 canvasbacks and had banana waterlily but the refuge manager (S.R. Vehrs, personal communication) reported the plants were inaccessable to canvasbacks. They fed primarily on widgeon grass, muskgrass, manatee grass (*Syringodium filigormis*), and invertebrates.

Ecology of Banana Waterlily

In South Carolina, banana waterlily grew well in several coastal ponds that varied in size from 1.2 to 13 ha and in depth from 0.6 to 2.0 m (Table 1). Results from water chemistry analysis (Table 1) indicated that banana waterlily is apparently an alkaline counterpart of its close relative white waterlily (*N. odorata*), which prefers more acid environments. Both species have been found growing together although I seemed to be doing better than the other. W.P. Baldwin (personal communication) reported that banana waterlily and white waterlily hybridize. Alkalinity appears to be the most important factor governing the distribution of banana waterlily; apparently other chemical parameters have little effect on distribution. Banana waterlily can tolerate brackish water (5 ppt at Huntington Beach Pond) although the upper limits of tolerance are not known.

Results of soil analysis (Table 2) revealed no chemical parameter that might be critical in limiting banana waterlily distribution but the physical properties of the soil may be important for its growth. Three of the 4 impoundments studied were former tidal creeks

TABLE 1. Water chemistry analyses of 4 banana waterlily impoundments, coastal South Carolina. All concentrations mg/l except salinity which is ppt. Numbers in parentheses are average water depth in meters followed by size of pond in hectares.

Parameter	Month	Huntington[a] Beach (1,13)	Fairfield (1.5,8)	Middleton[a] (1,13)	Andersonville[b] (1,1.2)
Total	Feb	150	50	90	55
Alkalinity	Mar	170	60	120	
($Ca\ Co_3$)	Apr	180	60	110	
Nitrate	Feb	7.9	4.8	3.1	6.6
	Mar	3.5	1.3	2.2	
	Apr	1.3	1.3	.8	
Nitrite	Feb	0	0	0	0
	Mar	0	0	0	
	Apr	0	0	0	
Orthophosphate	Feb	2.7	5.8	.7	5.0
	Mar	3.5	1.1	1.1	
	Apr	1.3	.7	.7	
Sulfate	Feb	110	26	29	18
	Mar	200	8	12	
	Apr	130	10	10	
pH	Feb	7.2	6.6	6.7	6.8
	Mar	7.9	7.2	7.8	
	Apr	7.6	7.1	7.7	
Dissolved	Feb	[c]	[c]	[c]	[c]
Oxygen	Mar	10	9	9.5	
	Apr	11	12.5	11.0	
Salinity	Feb	2	<1	<1	<1
	Mar	5	<1	<1	
	Apr	2	<1	<1	

[a]Represent best stands of banana waterlily
[b]Taken for February only
[c]Oxygen meter inoperable

with soft bottoms. This, together with the alkaline nature of tidal waters, may help to explain why these sites make excellent banana waterlily impoundments.

Management of Banana Waterlily

Neely and Davison (1971) reported that banana waterlily requires alkaline or slightly brackish water and is "very difficult to establish." Other biologists have reported that banana waterlily is difficult to transplant (W.P. Baldwin, personal communication). However, based on my conversations with landowners in South Carolina, little difficulty was encountered in establishing the plant. It seems that banana waterlily has fairly exacting habitat requirements and that such habitats are relatively scarce in many parts of

TABLE 2. Soil analyses of 3 banana waterlily impoundments, coastal South Carolina. All concentrations ppm..

Location	Phosphorus	Potassium	Calcium	Magnesium	Soil pH	pH	Soluble Salts
Huntington Beach	55.5	136	850	450	5.7	5.7	3000
Fairfield	3	94	3500	90	5.9	7.1	1600
Middleton	14	45	1800	160	4.0	6.5	3500

the south. Refuge managers and landowners could increase the distribution of banana waterlily by identifying suitable impoundments, especially those near tidal creeks and estuaries, and transplanting this species.

Compared to other types of plant management for waterfowl, banana waterlily does not require annual maintenance. None of my study sites were under active management for at least 10 years. However, W.P. Baldwin (personal communication) reports that if left unchecked, cattail will often overrun many impoundments to the exclusion of banana waterlily.

My field work in South Carolina showed that banana waterlily is superior to either widgeon grass or muskgrass as a canvasback food. The spread of banana waterlily in the south would benefit the canvasback, a species that currently has the lowest numbers of any extensively distributed game duck in North America (Bellrose 1976). Further research into factors that limit the spread of banana waterlily should be encouraged. Controlled plots of an experimental nature would be especially useful.

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