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To the Graduate Council:

I am submitting herewith a thesis written by David Estes Watts, entitled "An Evaluation of Some Components of Wood Duck Habitat at John Sevier Lake, Hawkins County, Tennessee." I recommend that it be accepted for nine quarter hours of credit in partial fulfillment of the requirements for the degree of Master of Science, with a major in Forestry.

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AN EVALUATION OF SOME COMPONENTS OF WOOD DUCK HABITAT AT JOHN SEVIER LAKE, HAWKINS COUNTY, TENNESSEE

A Thesis

Presented to

the Graduate Council of

The University of Tennessee

In Partial Fulfillment

of the Requirements for the Degree

Master of Science

---

by

David Estes Watts

August 1968

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ABSTRACT

The study was conducted on John Sevier Lake, a small Tennessee Valley Authority impoundment near Rogersville, Tennessee. The lake is 5.5 miles in length and covers about 810 acres.

The objectives of this study were: (1) to describe the aquatic and emergent vegetation of John Sevier Lake, and (2) to relate the distribution of wood ducks (Aix sponsa) on the study area to the various components of the habitat. Field work was begun in March, 1967, and concluded in June, 1968.

Five aquatic and five emergent plant communities were designated by visual inspection. A map showing the location of the aquatic communities was prepared.

Aquatic vegetation was important in the diet of wood ducks. Biomass of each aquatic community was estimated in pounds per acre. Mil-acre plots were taken in areas where the water was less than five feet deep, while 0.1-mil-acre plots were taken in deeper areas. A sampling device was improvised for use in these deeper areas.

In the emergent communities, square-meter quadrats were taken along systematically established transect lines. Density, basal area, crown cover, and maximum height of vegetation were recorded. Cattail and blue-stemmed bulrush were the most prevalent emergent species. Results indicated that the best cover was found where varied species composition and varied plant sizes prevailed.

The abundance of floating masses of uprooted aquatic plants produced in the Holston River upstream from the study area was the primary attractant for wood ducks at John Sevier Lake.

Shoreline cover significantly affected the distribution of the ducks. Wooded shorelines received the highest use, while shorelines adjacent to cultivated or idle fields were avoided. Emergent vegetation was neither preferred nor avoided by wood ducks at John Sevier Lake.

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CHAPTER I

INTRODUCTION

A meaningful evaluation of wildlife habitat should include both quantitative and qualitative appraisals of vegetation. Also, the local distribution of a wildlife species with respect to vegetation should be studied to determine the relative importance of various floral complexes to the species. An understanding of these factors is a desirable prerequisite to management, but is generally lacking for wood ducks and their habitat.

The wood duck (Aix sponsa) utilizes a variety of habitats throughout its range in eastern North America. Typically the habitat consists of lowland hardwood forests which can satisfy nesting, rearing, and food requirements of the species (Martin, 1959; Benson and Bellrose, 1964). No specific set of conditions seems to fit all situations, however, for Hawkins and Addy (1966) reported that in some areas, upland forest were commonly used as nesting sites with nearby lakes and streams furnishing rearing habitat.

John Sevier Lake, a Tennessee Valley Authority impoundment in east Tennessee, lacks lowland hardwood forests adjacent to the shoreline. Subsidiary ponds, marshes, and other types of wetlands are also lacking. However, the lake annually serves as a major brood-rearing area for wood ducks. This study was initiated to determine what features of this impoundment were related to its attractiveness to wood ducks. The major

objectives of this study were: (1) to describe the aquatic and emergent communities of John Sevier Lake, and (2) to relate the distribution of wood ducks on the study area to various components of the habitat. Field work was conducted from March, 1967, to June, 1968.

CHAPTER II

DESCRIPTION OF THE STUDY AREA

I. LOCATION AND REGIONAL PHYSIOGRAPHY

John Sevier Lake, a small reservoir on the Holston River, lies within the Valley and Ridge Province of the Great Valley of east Tennessee. The lake (Figure 1) lies four miles southeast of Rogersville, in Hawkins County, Tennessee. Two ridges, the Bays Mountains and the Clinch Mountains, rise to elevations of 2,200 feet above sea level on either side of the valley in which the lake resides (Matzek, 1953). Elevation at John Sevier Steam Plant is 1,081 feet (R. A. Laurence, U. S. Geological Survey, Personal Communication, 1968).

The underlying rock formation of the river valley is Sevier Shale, consisting of local combinations of limestone, shale, and shaly limestone. Origins of soils are shaly limestone and alluvium (R. A. Laurence, Personal Communication, 1968). Alluvial deposits consist of numerous dolomites, sandstones, shales, and limestones (Rodgers, 1953).

II. CLIMATE

The climate of Hawkins County is temperate and continental, with short, moderate winters and long, warm summers. Abundant rainfall and lack of prolonged drought make the region well-suited to farming (Matzek, 1953). The highest temperature recorded at nearly Rogersville was

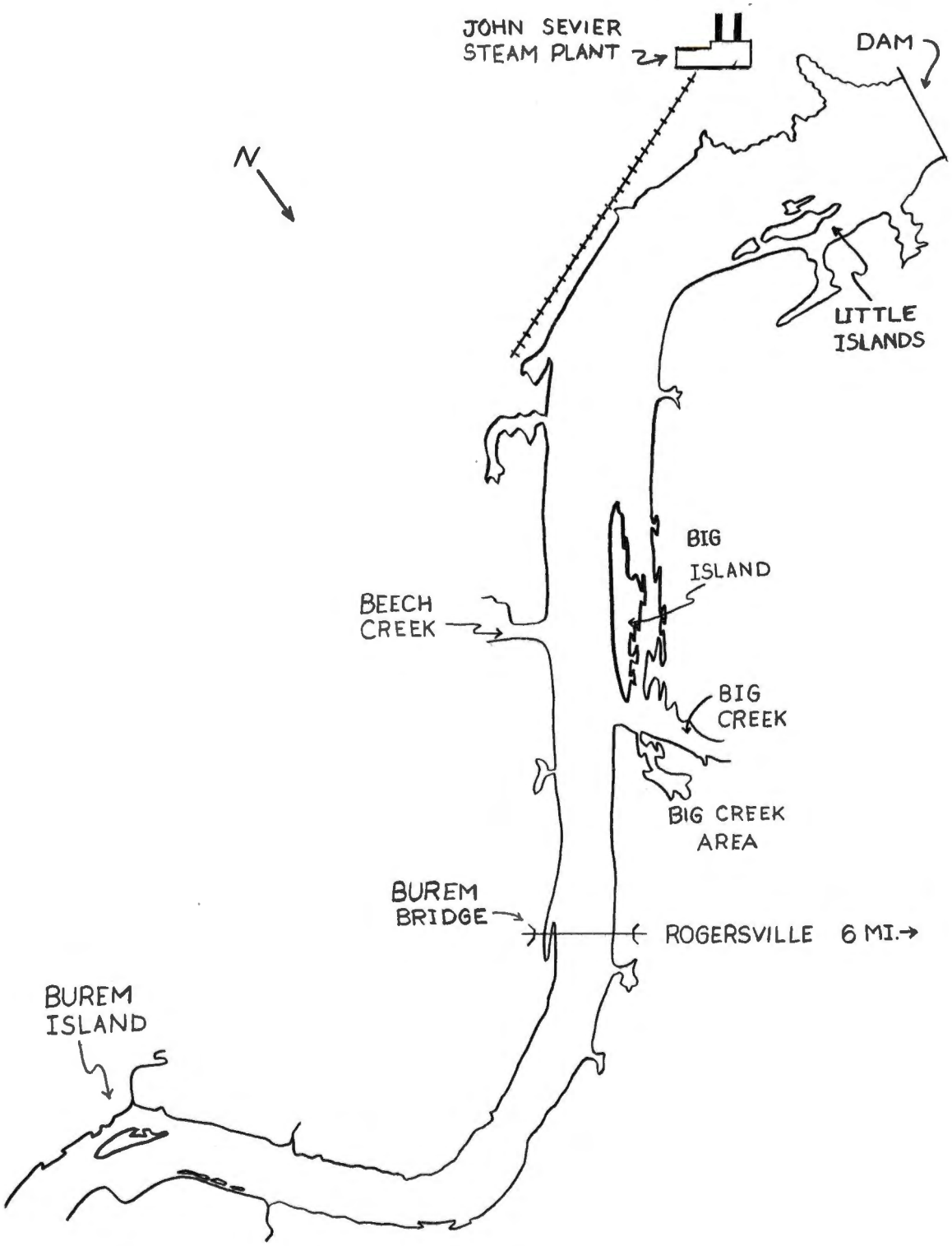


Figure 1. Map of the study area, John Sevier Lake, Hawkins County, Tennessee.

103° F. and the lowest was -18° F. During 1967, temperature extremes were 90° F. on June 21, and 6° F. on February 8 (U. S. Weather Bureau, 1967) (Table I). The average frost-free period is 187 days (April 16--October 21) (Matzek, 1953).

III. VEGETATION

Varied habitats exist in the vicinity of the study area. Wolfe (1956), in a study of the vegetation of Hawkins County, noted that north-facing slopes and coves are dominated by beech (Fagus grandifolia)[1], northern red oak (Quercus rubra), yellow poplar (Liriodendron tulipifera) and sugar maple (Acer saccharum). South-facing slopes and ridgetops are characterized by chestnut oak (Q. prinus), pignut hickory (Carya glabra), black oak (Q. velutina), red cedar (Juniperus virginiana), chinkapin oak (Q. muehlenbergii), white oak (Q. alba), post oak (Q. stellata), and some Virginia pine (Pinus virginiana). Box elder (Acer negundo), black willow (Salix nigra), maple (Acer saccharinum), and sycamore (Platanus occidentalis) are common shoreline taxa. Herbaceous emergent and moist-site species are common along the shoreline of John Sevier Lake, and several species of aquatic vascular plants are abundant in shallow areas of the lake.

IV. THE IMPOUNDMENT

John Sevier Lake was constructed by the Tennessee Valley Authority in 1955 for the production of electric power. There is no provision

---

[1] Nomenclature follows Harlow and Harrar (1958).

TABLE I

TEMPERATURE AND PRECIPITATION DATA FOR 1967 AT ROGERSVILLE, TENNESSEE, RADIO STATION WRGS (U. S. WEATHER BUREAU, 1967)

Year	Month	Mean Temp.	Departure From Mean	Total Precipitation	Departure From Mean
1967	Jan.	39.3	-0.7	3.15	-1.25
	Feb.	34.7	-8.2	4.82	0.51
	Mar.	52.6	4.5	4.92	0.32
	Apr.	60.5	2.4	3.52	-0.10
	May	61.8	-4.6	6.45	2.90
	June	70.9	-3.0	3.26	0.08
	July	71.5	-5.2	7.09	2.29
	Aug.	71.5	-4.5	3.23	-0.26
	Sep.	63.6	-7.3	2.25	-0.36
	Oct.	55.6	-4.5	2.46	0.19
	Nov.	42.8	-4.8	2.03	-1.16
	Dec.	42.7	2.6	7.74	3.93
Annual		55.6	-2.7	50.92	7.09

The Tennessee Valley Authority regulates water levels in the Upper Holston River for safe distribution of excess water from the watershed during flood danger periods, for the production of electric power, and for the control of mosquito populations.

In appearance, John Sevier Lake resembles the river from which it was formed. The major differences were noted in the low flood-plain areas. These lands were cultivated before impoundment, and thus there is no old growth vegetation along the shoreline. The gentle gradient and shoals along much of the river valley dictates that John Sevier Lake is quite shallow in most places. Depths of six feet or less are common at distances of 100 yards from shore near the dam.

Two major tributaries empty into the channel of John Sevier Lake. Beech Creek is navigable by canoe for about two miles from its mouth and furnishes a boat-access point to John Sevier Lake. Big Creek is navigable for one-half mile. These creeks flow through good wood duck nesting habitat.

The major recreational uses of John Sevier Lake are fishing and hunting. Fishing pressure is not particularly heavy, and it results in little disturbance of wood ducks. Waterfowl hunting pressure is heavy on the Holston River and John Sevier Lake. Wood ducks are little affected by this hunting, since they emigrate from the region before the hunting season opens and immigrate into the region long after the season closes.

CHAPTER III

METHODS

An effort was made to collect, preserve, and identify specimens of all emergent and aquatic species of vascular plants occurring at John Sevier Lake prior to initiating a quantitative description of plant communities. References for identification of the flora included Fassett (1957); Hotchkiss (1964); Eyles and Robertson (1944); Britton and Brown (1913). Final verification of the identity of some species was made by comparing the plants with specimens in the herbarium of the Department of Botony of The University of Tennessee.

Preliminary mapping of major plant communities and other vegetational complexes was accomplished with the aid of aerial photographs taken specifically for this study, and by visual inspection at ground level.

I. VEGETATIONAL ANALYSIS

The Aquatic Zone

The selection of a method for describing aquatic vegetation quantitatively is influenced by the plant species, water depth, current, and turbidity. Most studies of aquatic plants have been made in the shallow marshes or ponds where little current prevails (Knight, 1965; Robel, 1961, 1962, 1963; Keith, 1961).

Measuring aquatic communities in deep water has been accomplished by swimming or by use of diving equipment (Low and Bellrose, 1944; Swindale and Curtis, 1957). In situations where swimming is impractical because of turbidity or safety factors, other methods must be utilized. Keith (1961), for example, used a long pole swirled in a two-foot circle to collect aquatics from deep water.

At John Sevier Lake, many rooted aquatic plants were located near the upstream end of the reservoir. Significant current and water depths of six to ten feet prevailed in this area. A device was improvised which permitted sampling of the vegetation along a transect line while remaining in a boat (Figure 2). This device consisted of a long pole with a 2.4-foot blade attached perpendicularly to one end. Theoretically, one complete swirl removed a 0.0001-acre sample of vegetation. Three small dowels were spaced along the pole to entangle the leaves of the plants. Household cup-hanger hooks were attached at frequent intervals. The device was rotated with its pivot on the stream bottom. The accumulated vegetation was pulled into the boat. The vegetation was separated according to species and air-dried on lines strung between trees. In the laboratory the samples were oven-dried for 48 hours at 70° C. The oven-dried weight was recorded in grams per 0.0001-acre, and data were expanded to pounds per surface-acre of water.

In shallower areas of John Sevier Lake, 0.001-acre plots were established along transect lines by using four 6.6-foot canes as sides of a floating frame. Two stakes pushed into the substratum and lashed to two corners anchored the frame. Vegetation was removed from the

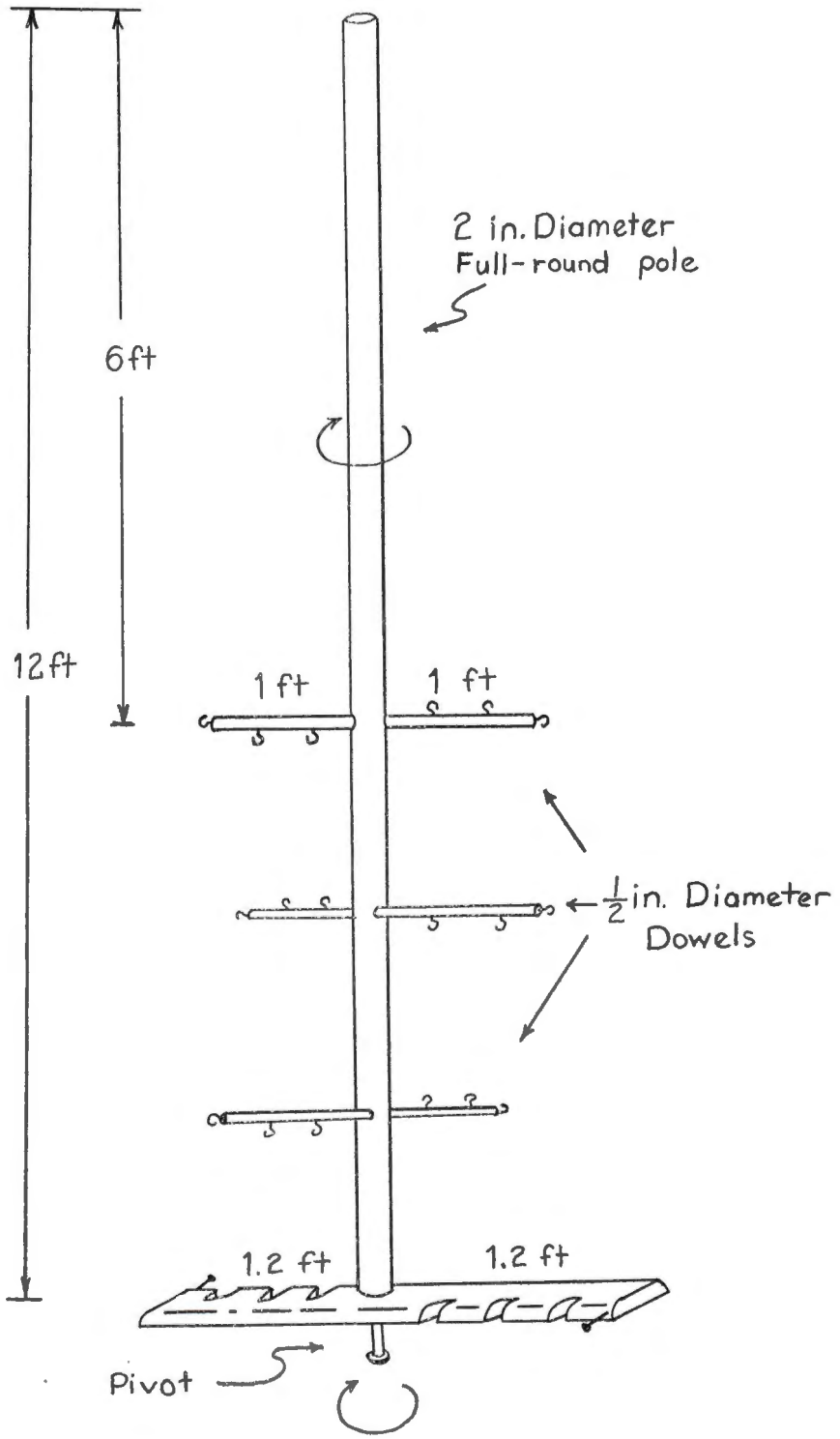


Figure 2. Device used for sampling aquatic vegetation in deep water.

quadrat either by a garden rake or with the hands. Drying and weighing were accomplished as stated above.

The Emergent Zone

To evaluate the major swales of emergent vegetation, square-meter quadrats (0.000247 acres) were placed along transect lines established across emergent areas. The first transect line at each area was established randomly at one extremity of the area, and all others were placed at 100-pace intervals. The first quadrat on each line was established at the water's edge, and the other quadrats along that line were established at 10-pace intervals. Criteria for density, basal area, crown cover, and maximum height as defined by deVos and Mosby (1965) were used.

Vegetation Mapping

A detailed map showing the location and size of the aquatic communities in John Sevier Lake was made (Appendix A). A large community of water primrose (Jussiaea diffusa) was included in the map since the community existed in a largely aquatic environment.

Fourteen permanent stakes were established on the study area in strategic locations which permitted adequate measurements of the aquatic communities. Compass lines were sighted across the aquatic communities from the stakes. A lightweight, plastic cord was marked at 6.6-foot (0.1 chain) intervals with red plastic tape. The cord was stretched from the permanent stake, along the compass line, to the outer edge of aquatic growth, and the distance was recorded. The distances

were included in the diagrams of the communities in Appendix A.

II. OBSERVATIONS OF WOOD DUCK ACTIVITIES

Censuses were conducted throughout the period of study to detect changes in the population size, structure, and distribution of wood ducks. Float counts were generally made from a 14-foot fiberglass, cathedral-hull boat propelled at low speed by an 18-horsepower outboard motor. Occasionally a motor-propelled canoe was used for censusing. A 7 X 50X binocular was used to aid in observation. Censuses were made at various times of the daylight hours during the first year of study. During the second year, censuses were begun at dawn. Other investigators also have found that censuses taken early in the morning yield more reliable results (Mumford, 1952; Minser, 1968).

Wood duck behavior and distribution also were observed from several vantage points around the lake. This method was helpful for determining wood duck utilization of such areas as the slough east of Big Island and the coves on the north side of the lake above the dam where censusing by boat was difficult.

CHAPTER IV

RESULTS AND DISCUSSION

I. VEGETATIONAL ANALYSIS

A total of 48 herbaceous species representing 23 families of aquatic and shoreline plants was recorded at John Sevier Lake (Table II). Five communities of submerged aquatics and five communities of emergents were recognized (Table III). Quantitative measurements were taken in all communities.

The Aquatic Zone

Floristic description of communities. Aquatic communities occurred in several areas of John Sevier Lake. The number of species in these communities ranged from two to six (Table IV).

Mixed aquatic. A community comprised of stargrass, tapegrass, longleaf pondweed, and Sago pondweed occupied the entire river channel from the upstream boundary of the study area to the center of Burem Island. The aquatic vegetation was dense enough to support small shorebirds which occasionally were observed walking on the plants. Stargrass produced an aerial carpet of bright yellow flowers in June. Longleaf pondweed produced large floating leaves, and also spike inflorescences that occasionally stood erect from the water. The structures that were in contact with the water surface served as rests for flying terrestrial

TABLE II

SHORELINE AND AQUATIC VASCULAR PLANT SPECIES FOUND AT JOHN SEVIER LAKE

Family	Scientific Name	Common Name	Abundance Rating*
Equisetaceae	Equisetum arvense	Horsetail	Rare
Typhaceae	Typha latifolia	Cattail	Abundant
Zosteraceae	Potamogeton pectinatus	Sago Pondweed	Common
	P. crispus	Curly Pondweed	Common
	P. americanus	Longleaf Pondweed	Common
Alismataceae	Alisma subcordatum	Water Plantain	Rare
	Sagittaria latifolia	Arrowleaf	Common
Hydrocharitaceae	Elodea canadensis	Waterweed	Common
	Vallisneria americanus	Tapegrass	Common
Gramineae	Arundinaria tecta	Switch Cane	Rare
	Bromus sp.	Brome Grass	Common
Cyperaceae	Cyperus strigosus	Straw-colored Sedge	Common
	Eleocharis quadrangulata	Square-stemmed Spikerush	Rare
	E. obtusa	Blunt Spikerush	Common
	E. ovata	Round Spikerush	Rare
	Scirpus americanus	Three-square Bulrush	Rare
	S. validus	Blue-stemmed Bulrush	Abundant
	S. etuberculatus	Canby's Bulrush	Rare
	S. fluviatilis	River Bulrush	Rare
	S. lineatus	Slender Bulrush	Rare
	Carex stipata	Awl-fruited Sedge	Rare
	C. hystericina	Bristly Sedge	Rare
	C. lurida	Sallow Sedge	Rare
Lemnaceae	Spirodela polyrhiza	Big Duckweed	Rare
	Lemna minor	Little Duckweed	Common

TABLE II (continued)

Family	Scientific Name	Common Name	Abundance Rating*
Pontederiaceae	*Heteranthera reniformis*	Mud Plantain	Rare
	H. dubia	Stargrass	Abundant
Juncaceae	*Juncus coriaceus*	Common Rush	Rare
	J. effusus	Soft Rush	Common
	Juncus marginatus	Grass-leaved Rush	Rare
	J. debilis	Small Rush	Rare
Iridaceae	*Iris pseudocorus*	European Yellow Iris	Rare
Saururaceae	*Saururus cernuus*	Lizard's Tail	Rare
Urticaceae	*Urtica dioica*	Stinging Nettle	Common
Polygonaceae	*Rumex verticillatus*	Swamp Dock	Rare
	R. crispus	Curly Dock	Common
	Polygonum pensylvanicum	Smartweed	Common
	P. lapathifolium	Nodding Smartweed	Rare
Malvaceae	*Hibiscus incanus*	Rose-mallow	Common
Lythraceae	*Decodon verticillatus*	Water Willow	Rare
Onagraceae	*Jussiaea diffusa*	Water Primrose	Common
Haloragaceae	*Myriophyllum spicatum*	Eurasian Watermilfoil	Rare
Primulaceae	*Lysimachia numularia*	Moneywort	Common
Labiatae	*Lycopus lanceolata*	Mint	Common
Solanaceae	*Solanum dulcamara*	Nightshade	Common
Rubiaceae	*Cephalanthus occidentalis*	Buttonbush	Common
Compositae	*Ambrosia trifida*	Giant Ragweed	Rare
	Bidens sp.	Beggarticks	Rare

*Based on author's observations of comparative frequency.

TABLE III

EMERGENT AND AQUATIC COMMUNITIES AT JOHN SEVIER LAKE

Community	No. Units		Area (Acres) Total		Mean	Range
Emergent						
Cattail	5		13.6		2.7	0.1-8.7
Blue-stemmed Bulrush	3		4.2		1.4	0.6-2.2
Cattail--Blue-stemmed Bulrush	2		2.6		1.3	0.9-1.7
Mixed Moist-site Species	19		14.2		0.7	0.05-7.4
Water Primrose	3		1.5		0.5	0.2-1.1
Subtotal	32	32	36.1	36.1		
Aquatic						
Mixed Aquatic	1		7.7		7.7	---
Waterweed--Curly Pondweed	1		1.1		1.1	---
Stargrass	12		15.7		13.0	0.1-2.8
Sago Pondweed	1		3.5		3.5	---
Curly Pondweed	3		0.6		0.2	0.05-0.4
Subtotal	18	18	28.6	28.6		
Total		50		64.7		

TABLE IV

TAXONOMIC COMPOSITION OF AQUATIC COMMUNITIES AT JOHN SEVIER LAKE

	Community				
Species	Mixed Aquatic	Curly Pondweed Waterweed	Stargrass	Curly Pondweed	Sago Pondweed
Stargrass	X	X	X		X
Tapegrass	X				
Longleaf Pondweed	X		X		
Sago Pondweed	X				X
Waterweed	X	X	X	X	
Curly Pondweed	X	X	X	X	

insects, an important food source for juvenile wood ducks (Hocutt, 1968). The ducks fed to a considerable extent on leaves of stargrass. The remaining three species in this community were not utilized by wood ducks (Hocutt, 1968). All species, however, served to some extent as impediments to masses of uprooted aquatics floating into the lake. The rooted aquatics thus indirectly improved certain parts of the lake as feeding areas for the ducks.

Curly pondweed--waterweed. A community containing these two species plus stargrass was found beneath Burem Bridge in a shallow area with a substratum of deep silt and decaying organic matter. There was negligible current in this area and the plants were rarely uprooted.

A noticeable difference in the relative species composition of this community occurred during the growing season. Early in the spring, waterweed was the most common plant, with only a few stems of curly pondweed present. As the season progressed, curly pondweed replaced the waterweed, and by August waterweed had nearly disappeared. Stargrass was represented by a number of clumps throughout the season, but never dominated the community.

Plants growing in this community were infrequently utilized by wood ducks. The plants were available only when the lake level was abnormally low. Stargrass was utilized to some extent, but was not present in great quantity. Floating detritus accumulated in the general area of this community and was heavily utilized by several broods of wood ducks. The rooted species may have slowed the movement

of these floating masses as they did in the mixed community near Burem Island.

Stargrass. This community was the most prevalent one at John Sevier Lake (Table III, page 17) and appeared to be the most adaptable to various habitat conditions. It was found growing in isolated clumps or larger units in almost every shallow part of the lake. It appeared to begin rooted growth from log jams or in areas protected from the current where uprooted floating masses of aquatic plants were detained. Other species which were generally present in the floating detritus did not establish as readily as this species.

Wood ducks fed heavily on stargrass in the mixed community at Burem Island (Hocutt, 1968), but seemed to steadily refuse the plants downstream. Generally the stargrass remained beneath the surface and was less available to surface-feeding wood ducks in the slow-moving water from Burem Bridge to the dam. The lack of flowers on these plants suggests that the entire plants remained submerged most of the time. In addition, there was usually an abundant supply of floating detritus in lower areas of the lake, and wood ducks could have preferred the foodstuffs in these masses to the rooted stargrass. Floating detritus remained available for a longer period of time downstream than in the area near Burem Island because of the slow current. In that area, wood ducks fed on rooted stargrass to a considerable extent.

Curly pondweed. The only pure stand of this species of appreciable size occurred in a slough on the south side of Burem Island. Here

TABLE VII

BIOMASS OF FOUR SPECIES OF AQUATICS IN A MIXED AQUATIC COMMUNITY AT JOHN SEVIER LAKE, 1967*

Species	Biomass (Pounds Per Acre)**	Percent by weight
Stargrass	10,898.90	49.6
Longleaf Pondweed	6,240.50	28.4
Tapegrass	4,538.54	20.7
Sago Pondweed	285.66	1.3
Total	21,973.60	100.0

*The mean, based on 10 samples, over the four species was 291.5 grams per 0.0001-acre plot (Standard Error = 153.78 grams; Coefficient of Variation = 48.60 percent).

**Oven-dried weights.

Sevier Lake--the impounded water remaining slightly more turbid than the flowing river water. Thus depth, turbidity, and stream flow interact to affect light penetration in a highly variable and complex interaction.

Local concentrations of carp (Cyprinus carpio) had an apparent effect on the distribution of aquatic plants in John Sevier Lake. Several authors have concluded that carp and luxurious aquatic plant growth are incompatible (Wiebe, 1946; Tryon, 1954; Robel, 1963; Nelson, 1954; Threinen and Helm, 1954). Carp apparently do not eat vascular aquatic plants, but uproot them and otherwise damage them during spawning activities. They also root in the mud for aquatic invertebrates (Tryon, 1954; Nelson, 1954). These activities result in high water turbidity which is not conducive to re-establishment of uprooted plants (Nelson, 1954). Robel (1963) reported a reduction of about one-third in the total amount of food plants important to waterfowl in a Utah marsh coinciding with the establishment of a high carp population. At John Sevier Lake some shallow coves, which appeared to be ideally suited for the growth of aquatic plants, contained none. It is possible that the activities of carp in these areas prohibited the establishment of aquatic plants. In a large cove near the dam, curly pondweed was found in abundance in small water areas which were naturally barricaded from the open cove by muskrat houses. In the open cove, just a few feet distant, aquatics were absent though water depths and temperatures were about the same. Carp were active in the cove regularly from April to

The Emergent Zone

To investigate the relationship between cover and wood duck distribution, shoreline vegetation was studied. In the emergent zone, five communities were recognized (Table III, page 17; Figure 3). These occurred in three major areas of the lake: (1) Big Creek Area, (2) Big Island, and (3) a series of islands collectively referred to as Little Islands. Emergent growth in other areas of the lake was spotty, and only qualitative descriptions were necessary.

Floristic description of communities. Generally, the emergent plants at John Sevier Lake were perennial from rhizomes. Seed production was high, increasing the potential for rapid community establishment and expansion.

Cattail. Cattail was common along the shoreline of John Sevier Lake. Pure communities covering large areas were present on Big Island and in the Big Creek area, but density within the communities was variable. The soil was usually bare except for the cattail. The overlapping of the long linear leaves resulted in tight crown closure, and much shading. The presence of young sprout-growth throughout the summer made most stands variable in both stem size and height. Spike inflorescences were found at heights ranging from three to seven feet.

Blue-stemmed bulrush. This species was also abundant at John Sevier Lake. Communities were designated for study on Big Island, Big Creek Area, and Little Islands. Density was variable in all areas.

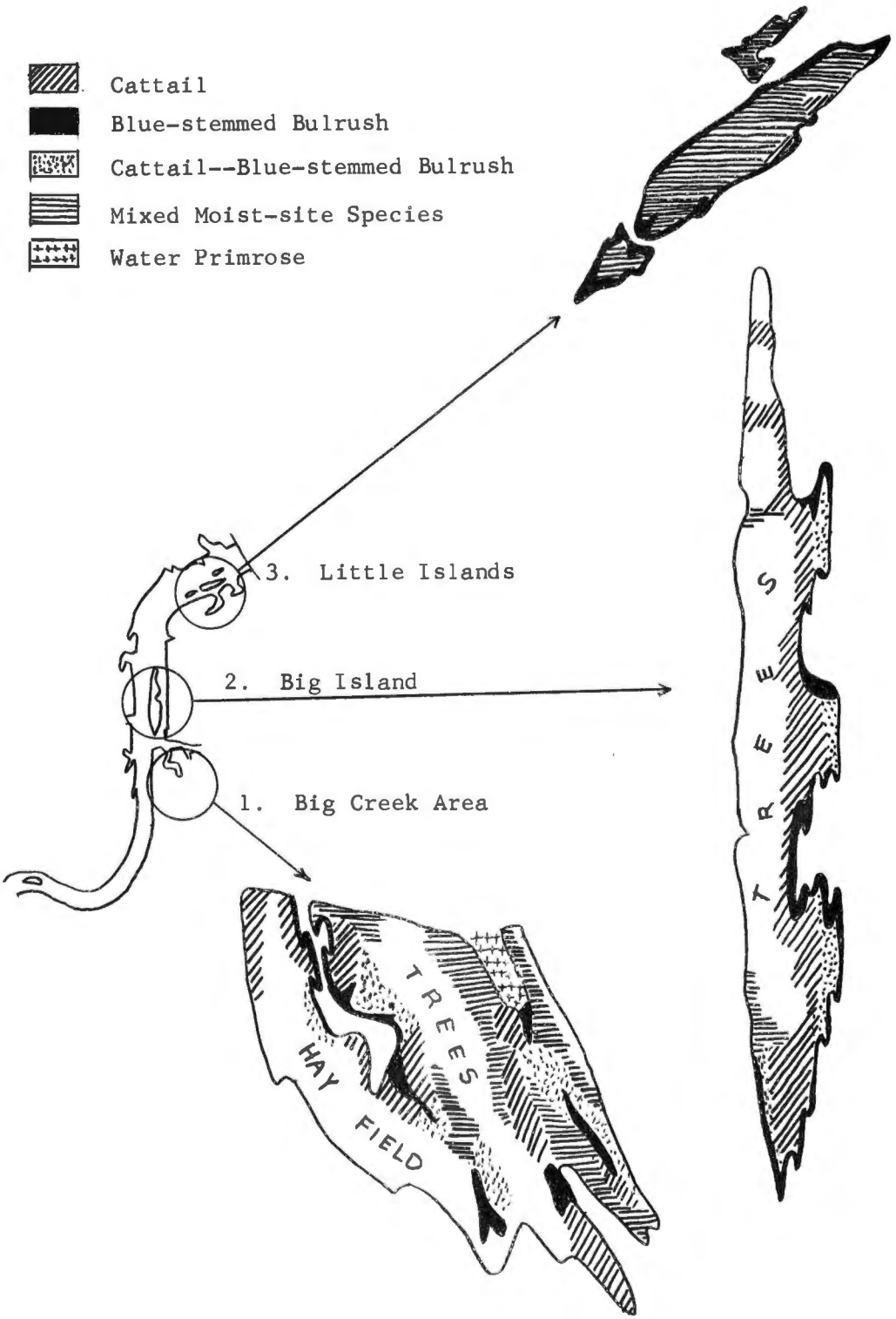


Figure 3. Distribution of emergent communities in three major areas of John Sevier Lake.

No stools occurred and each culm rose separately along the rhizome. The round stems maintained erect posture regardless of height, although slight bending was evident on unusually tall specimens. Stems generally were about four feet tall and one-third inch in diameter. In the Big Creek Area, the plants often attained heights of 7-1/2 feet and diameters of one inch. The soil surface was relatively bare except for occasional spikerush and water primrose.

Cattail--blue-stemmed bulrush. An ecotone often occurred between cattail and blue-stemmed bulrush communities. However, in some locations the transition appeared to be sufficiently distinct to permit community designation. Stands possessed characteristics of both single species communities. Crown cover was relatively complete due to cattail. Basal area was generally greater due to the more numerous and generally smaller stems of blue-stemmed bulrush. Large stands of this community occurred in Big Creek Area and on the west side of Big Island.

Mixed moist-site species. In low-lying areas near the water where inundation was infrequent, the mixed moist-site species community was found. Species were generally herbaceous, although woody plants were locally common.

The community was found in pastures near the dam, on the edges of idle fields near Beech Creek and Big Creek, and on steeper shorelines upstream from Burem Bridge. In grazed areas, the community was characterized by low, dense mint, spikerush, moneywort, and brome grass. Among these shorter plants, sparse growth of blue-stemmed bulrush and

soft rush was noted. Cover was good only to heights of about one foot.

Along the edges of idle fields, the major species were rose mallow, buttonbush, spikerush, and smartweed. Often the community comprised the understory of willow and silver maple stands. The trees, along with the tangled, rigid branches of buttonbush and the shading effects of smartweed provided particularly good quality cover.

On the more abrupt river banks evident near Burem Island, smartweed, stinging nettle, and occasionally giant ragweed and beggarticks, formed a dense crown closure at an average height of about four feet. The ground beneath was shaded, cool, and relatively free of restrictive plant growth. The presence of trees adjacent to the community provided additional seclusion.

Water primrose. This community is classified as emergent, but it approximates a floating-leaved community in its site preferences. The species was found in several locations at John Sevier Lake, forming large communities in three places: (1) beneath Burem Bridge, (2) in a cove downstream from the mouth of Beech Creek, and (3) along the east shoreline downstream from Burem Island.

The stems have long roots extending from each node, and the creeping growth results in a tangled web of stems. Each node is capable of starting new growth if it is broken loose from the plant and drifts to a suitable site.

Dead stems remain rooted to the bottom of shallow pools, and in the spring new stems arise from the nodes. The bright green, leathery leaves are not formed until the stems have almost reached the surface. By June, during each year of study, the entire area occupied by the community is brilliant green, and in July, thousands of bright yellow flowers cover the top of the community. The plants produce dense mats reaching two or three feet above the water level. Crown closure is invariably 100 percent over the entire community. Many aquatic invertebrates reside in the dense growth.

Occasionally a few stems were found growing on wet mudflats out of the water. However, these plants never attained the vigor of those in the aquatic environment. Other than duckweeds, no vascular plants grew in dense water primrose communities, but locally abundant concentrations of algae (Spirogyra sp.) were common.

Quantitative description of communities. Emergent communities were studied to evaluate their usefulness as cover for wood ducks. Sampling was confined to emergent and moist-site herbaceous growth at three locations. The frequency of occurrence of the communities in each area are presented in Table IX. Cattail and blue-stemmed bulrush were the most prevalent species on Big Island and in the Big Creek Emergent Area, and the mixed moist-site species prevailed on Little Islands. Each community was represented in all three locations with the exception of the cattail--blue-stemmed bulrush community which was absent from Little Islands. The water primrose community was present in negligible quantity.

TABLE IX

FREQUENCY OF OCCURRENCE FOR EMERGENT COMMUNITIES AT THREE LOCATIONS ON JOHN SEVIER LAKE

	AREA					
	Big Island		Big Creek Area		Little Islands	
Community	Freq. of Occurrence	No. of Quad-rats taken	Freq. of Occurrence	No. of Quad-rats taken	Freq. of Occurrence	No.of Quad-rats taken
Cattail	41.5	17	15.4	10	6.9	2
Blue-stemmed Bulrush	19.5	8	20.0	13	34.4	10
Cattail--blue-stemmed bulrush	18.1	7	27.7	18	0.0	--
Mixed moist-site species	21.9	9	36.9	24	58.7	17
Total	100.0	41	100.0	65	100.0	29

Characteristics of the communities which were studied included the relationships between basal area (percent of ground surface per quadrat occupied by a species) and density (number of stems per quadrat), and the relationship between maximum height and crown cover (vertical projection of the aerial plant parts onto the ground)(Tables X and XI). These relationships were thought to be important in assessing the value of the communities as cover for wood ducks. Correlations of the variables were tested only in stands of highly uniform species composition; namely, the cattail and blue-stemmed bulrush communities. Means and ranges of all variables for each community except water primrose are listed in Table XII.

The optimum density of cattail or blue-stemmed bulrush for wood duck cover is not known. It must be sparse enough to allow the ducks to quickly penetrate the stand, yet dense enough to provide concealment from both avian (vertical axis) and ground-level predators (horizontal axis). Beard (1953) used ease with which ducks could penetrate a stand as the criterion for designating density (sparse, medium, dense) of emergent vegetation in marshes of the Seney National Wildlife Refuge. However, her data were not recorded by plant species, and it is not possible to compare her results with those of this study concerning the density of blue-stemmed bulrush and cattail at John Sevier Lake. She suggested that cover for ducks is better if stem counts (mixture of plant species) along a 36-inch line are between 160 and 290. Berg (1956) measured the density and height of emergent vegetation in much the

TABLE X

UNIFORMITY[a] OF BLUE-STEMMED BULRUSH AND CATTAIL AS REPRESENTED BY MEAN DENSITY, MEAN BASAL AREA, AND CORRELATION COEFFICIENTS (r) AT THREE SITES ON JOHN SEVIER LAKE

Location	Blue-stemmed Bulrush					Cattail				
	Density		Percent Basal Area		Corr. Coeff.	Density		Percent Basal Area		Corr. Coeff.
	Mean	Range	Mean	Range		Mean	Range	Mean	Range	
Big Island	157.3	30–390	13.8	5–30	0.57 NS	23.1	5–42	11.6	2–20	0.28 NS
Big Creek Area	140.8	50–290	28.1	10–40	-0.02 NS	26.0	14–41	20.5	10–30	0.91 HS
Little Islands	149.8	50–350	13.0	5–20	0.80 HS	28.0	24–32	20.0	0	--[b]

[a]Theoretically a perfect correlation (r = 1.0) between density and basal area would denote uniform stem diameter.

[b]Cattail was not present in quantity sufficient for meaningful correlation. (See Table IX, page 35).

NOTE: HS = Highly Significant (0.10)
NS = Not Significant

TABLE XI

THE CORRELATION BETWEEN MAXIMUM PLANT HEIGHT AND CROWN COVER FOR BLUE-STEMMED BULRUSH AND CATTAIL COMMUNITIES AT THREE SITES ON JOHN SEVIER LAKE

Location	Blue-stemmed Bulrush					Cattail				
	Percent Crown Cover		Max. Height in Feet		Corr. Coeff.	Percent Crown Cover		Max. Height in Feet		Corr. Coeff.
	Mean	Range	Mean	Range		Mean	Range	Mean	Range	
Big Island	21.9	5-50	3.6	3.0-4.0	0.21 NS	21.9	5-40	4.8	410-6.0	0.52 HS
Big Creek Area	38.5	30-55	5.7	4.5-7.5	0.71 HS	27.5	10-40	5.5	4.0-6.5	0.83 HS
Little Islands	22.5	10-35	3.2	2.5-4.0	0.32 NS	32.5	30-35	5.5	0	--[a]

[a]Cattail was not present in quantity sufficient for meaningful correlation.

NOTE: HS = Highly significant (0.10)
NS = Not significant

TABLE XII

DENSITY, BASAL AREA, CROWN COVER, AND MAXIMUM HEIGHT OF VEGETATION IN FOUR COMMUNITIES IN THREE SITES OF EMERGENT VEGETATION, JOHN SEVIER LAKE, 1967

Site and Community	Density (No. Stems per meter[b]) Mean	Density Range	Basal Area (%) Mean	Basal Area Range	Crown Cover (%) Mean	Crown Cover Range	Max. Height (Ft.) Mean	Max. Height Range
Big Island								
Cattail	23.1	5- 42	11.6	2-20	21.9	5-40	4.8	4.0-6.0
Blue-stemmed bulrush	157.3	20-390	13.8	5-30	21.9	5p50	3.6	3.0-4.0
Cattail--blue-stemmed bulrush	183.8	58-327	20.7	10-30	35.0	25-65	5.6	4.5-7.0
Mixed moist-site species	43.1	7- 62	13.1	5-30	54.4	30-75	3.3	2.0-4.5
Big Creek Area								
Cattail	26.0	14- 41	20.5	10-30	27.5	10-40	5.5	4.0-6.5
Blue-stemmed bulrush	140.8	50-290	28.1	10-40	38.5	30-55	5.7	4.5-7.0
Cattail--blue-stemmed bulrush	123.5	37-312	33.0	15-40	45.0	30-65	5.8	4.5-7.0
Mixed moist-site species	87.2	13-306	11.9	3-20	35.0	10-45	3.0	1.0-4.0
Little Islands								
Cattail[a]	28.0	24- 32	20.0	0	32.5	30.34	5.5	0
Blue-stemmed bulrush	149.8	50-350	13.0	5-20	22.5	10-35	3.2	2.5-4.0
Cattail--blue-stemmed bulrush[b]	----	----	----	----	----	----	----	------
Mixed moist-site species	318.1	28-530	22.0	2-35	36.1	10-60	2.1	1.0-3.0

[a]Appeared in only two samples.

[b]Not present.

same way as in the present study, but he did not correlate any of the measured variables.

Emergent cover for wood ducks at John Sevier Lake appears to be good. To meet the specifications of good cover as described above, it is necessary that a zone have varying sizes of plants with varying species composition. These conditions were evident in the emergent zone of John Sevier Lake. Mixed species communities were as dense as single species communities, and they yielded greater basal area and crown cover (Table XII).

The most effective cover for wood ducks of all ages appeared to be that in the cattail--blue-stemmed bulrush community on Big Island and in parts of the Big Creek Area. Cattail provided good crown cover at any height at which it occurred, while the blue-stemmed bulrush afforded ground level cover without being too dense for duck penetration. Without cattail, cover was less complete, since crown cover was significantly related to height only when the blue-stemmed bulrush was taller than 4-1/2 feet (Table XI, page 38). Blue-stemmed bulrush attained this height only in one small location in the Big Creek Area.

The dense growth of small diameter blue-stemmed bulrush on Little Islands in some instances appeared restrictive to the movements of older ducks. However, the low density of large blue-stemmed bulrush in the Big Creek Area appeared to be ineffective for concealing ducks from ground-level predators.

At Little Islands, cattail comprised only 6.9 percent of the emergent vegetation, and the cattail--blue-stemmed bulrush community was

absent (Table IX, page 35). In this area cattle grazed on lands adjacent to the lake, and their feeding may have restricted these plants. However, observations indicated that cover on Little Islands was moderately good, because mixed moist-site community was well-represented. The plants of the mixed community partially compensated for the lack of cattail in the crown. Concealment was good for young ducklings which were able to maneuver in the low, dense ground cover typical of Little Islands (Table XII, page 39).

It is apparent that unless the emergent zone is nonuniform in species composition and plant size, cover will generally be unsatisfactory for concealing wood duck adults and/or broods. Assuming that the emergent cover at John Sevier Lake is generally good for concealing wood ducks, the means of the variables listed in Table XII may be reasonably useful standards for evaluating cover in areas with similar species and environmental conditions.

Ecological factors affecting distribution. The moisture content of the soil is important in the emergent zone. True emergent plants were found growing only in soft, moist silt deposits near the water. Some species such as smartweed and mint tolerated dryness to a far greater extent than true emergents and were often found growing alongside cultivated crops. However, these plants were not true emergents and were grouped into the mixed moist-site community. The list of nonaquatic species in Table II, page 15, indicates the potential diversity of the mixed moist-site community.

Water depth controls the advance of emergent plants from the shoreline into the lake. Berg (1956) found that unstable water level was the greatest single limiting factor in the establishment and maintenance of emergent vegetation on small ponds in Montana. At John Sevier Lake, the irregular fluctuation (about one to two feet daily) introduced a problem in measuring the exact depth to which the emergents could survive. Blue-stemmed bulrush withstood the greatest depths (about one-third of its average height or about 1-1/2 feet), with cattail doing best when on exposed mud-flats or in only one or two inches of water. This order meant that generally a dense emergent area containing these two species was stratified--the blue-stemmed bulrush following the water's edge and the cattail entering into a transitional stratum behind the bulrush (cattail--blue-stemmed bulrush community) and finally a backdrop of pure cattail. Such an arrangement was particularly noticeable on the west side of Big Island. Steeper shorelines, as were present on the southeast shoreline of the lower half of the lake and on both shorelines of the upper half of the lake, were not suited to growth of emergent vegetation. In these areas trees and upland undergrowth prevailed. Less than 10 percent of the entire shoreline of John Sevier Lake was occupied by emergent growth.

Some potentially good emergent sites were poorly represented by the common emergents. One probable reason for their absence was grazing on lands adjacent to the lake. This was particularly evident along the northwest shoreline upstream from the dam in the vicinity of the large coves and Little Islands. Cattle moved freely onto the islands, and

their effects were obvious. Cattail was practically nonexistent in this entire area, compared with dense growth on the unpastured Big Island and Big Creek emergent area. Blue-stemmed bulrush was common in the grazed areas, but the tops were often cropped by cattle. Other members of the Cyperaceae which occurred in the mixed moist-site community were similarly preferred by cattle. Water primrose and mints were not eaten. Trampling of the plants and soil-compaction were also possible inhibitors to the expansion of emergent communities.

The effect of carp on emergent plants may be measurable, but it is not believed to be important. Blue-stemmed bulrush and water primrose, which are the only emergents at John Sevier Lake that advance any distance from the shoreline, are firmly rooted and probably are not greatly affected by carp activity.

The muskrat (Ondatra zibethicus) population at John Sevier Lake was substantial and may have affected the abundance of emergent plants. These mammals eat emergent and aquatic plants and use plants in the construction of their large houses (Yeager, 1964). There was little evidence of muskrat damage to the communities in the lower half of the lake, although observations indicated that the animals removed many plants. In the upper half of the lake the number of muskrat tunnels in the banks indicated greater numbers of the animals in this section than in the lower half. However, there were few favorable sites for emergents due to the more abrupt shoreline. It was believed that floating masses of uprooted aquatics furnished food for muskrats in this area. Houses

were unnecessary in the upstream half of the lake, since the steeper banks were suitable for dens.

Value of emergent communities to wood ducks. Although wood ducks utilized a few seeds from some of the emergent plants (Hocutt, 1968), the primary value of the emergent zone was for cover. Emergent communities served as cover in areas where the water table was high, and where trees and cultivated lands were absent. Emergent vegetation was especially important cover for broods of wood ducks.

II. DISTRIBUTION OF WOOD DUCKS ACCORDING TO HABITAT COMPONENTS

The primary value of John Sevier Lake to wood ducks of all ages was as a feeding area. The principal foods utilized were present in the floating masses of uprooted aquatic plants that drifted into the lake. The negligible current in the lake allowed these masses of plants to remain available in a given area for long periods of time. Occasionally some of the plants, particularly stargrass, became rooted in areas protected from the current. Log jams and fallen trees also collected the drifting masses along certain segments of the shoreline, providing additional food.

Infrequently a large volume of water was released from Fort Patrick Henry Dam, and much aquatic vegetation in the Holston River was uprooted in a short period of time. The accumulation of these masses near John Sevier Dam sometimes was so dense that the area was impassable

by boat. Many wood ducks scampered freely about on these masses, feeding on various plant parts and invertebrates. Tubers of Sago pondweed were particularly heavily utilized (Hocutt, 1968).

The abundance of aquatic foodstuffs on John Sevier Lake during the time wood ducks were present apparently compensated for the lack of other characteristics typical of wood duck habitat. For example, agricultural practices and fishing in the vicinity of John Sevier Lake precluded seclusion, and lowland hardwood forest, typically an important component of their habitat, was absent. Yet despite these absences, wood ducks used the lake intensively.

Wood Duck Population

The numbers of wood ducks at John Sevier Lake at any point in time during the period of study varied from 0 to 269 (Figure 4). Pairs of wood ducks began arriving at John Sevier Lake during the latter part of February, and the numbers steadily increased until the onset of the nesting phase of the annual cycle (Table XIII). The slight reduction in census figures during this phase may indicate that several hens were nesting. Drakes congregated along the shoreline in small groups.

Soon after the start of the brood-rearing phase of the annual cycle, censuses indicated that the number of adults declined. However, the adults were probably undergoing the post-breeding molt, and were so secretive that censuses failed to detect their presence. The number of juveniles reached a peak in the third week of May and then declined sharply.

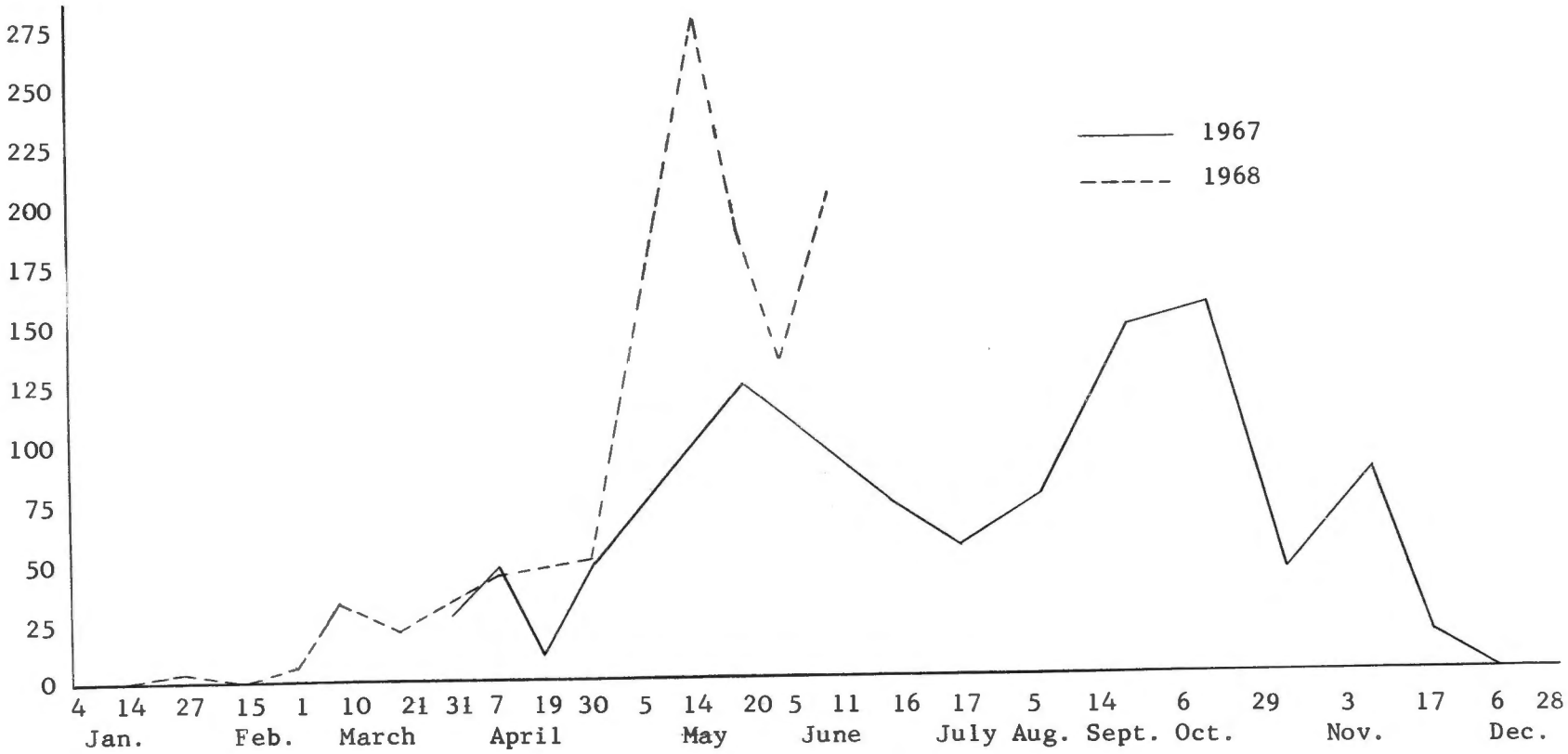


Figure 4. Total numbers of wood ducks censused on John Sevier Lake, March, 1967, to June, 1968.

TABLE XIII

REPRESENTATIVE NUMBERS OF WOOD DUCKS PRESENT ON JOHN SEVIER LAKE DURING VARIOUS PHASES OF THE ANNUAL CYCLE, 1967-1968

Phase	Numbers	
	1967	1968
Pre-nesting	20	26
Nesting	12	15
Brood-rearing	140	269
Flocking	102	--
Migrating	45	--

In mid-July, the wood duck population again increased. Most of the juveniles were flying, and several wood ducks from surrounding areas moved onto John Sevier Lake. Flocks of 25-50 juveniles were commonly observed. Most of the birds censused during the flocking phase were present in the vicinity of Burem Island. During this time the distribution pattern of wood ducks was influenced greatly by their attraction to trapping bait dispensed by the U. S. Fish and Wildlife Service. The agency has banded wood ducks at John Sevier Lake since 1966, normally attracting about 150 or more ducks to the trapping site.

Ingress of wood ducks reached a peak in the first week of October and numbers then declined rapidly. By the first of December all wood ducks had emigrated from John Sevier Lake.

Distribution of Wood Ducks

Wood duck usage of any given locality at John Sevier Lake was closely, although not entirely, related to the food supply. The quality of cover was also important. Data are presented in Table XIV showing the number and percent of wood duck observations associated with the three types of shoreline cover. These types are: (1) hardwood, either upland or stream-side, (2) emergent vegetation, and (3) idle or cultivated fields. A chi-square test indicated that the distribution of the ducks was biased with respect to the adjacent shoreline cover type (0.01α level $X^2 = 39.544$).

Apparently wood ducks at John Sevier Lake neither preferred nor avoided emergent cover. However, the ducks did not frequent shorelines

TABLE XIV

NUMBER AND PERCENT OF OBSERVATIONS* OF WOOD DUCKS ACCORDING TO SHORELINE COVER

Shoreline Cover	Miles of Shore-line	% of Total	No. of Obser-vations	% of Total
Hardwood	6.6	49.88	248	77.01
Emergent vegetation	2.9	21.49	63	19.57
Cultivated or idle fields	4.0	29.63	11	3.42
Total	13.5	100.00	322	100.00

*Individual sightings of wood ducks of all ages throughout the period of study.

adjacent to cultivated or idle fields which had very little concealment value. It is not known whether wood ducks actually preferred wooded shorelines, but the data demonstrate that usage of such areas was high (Table XIV, Figure 5). Wooded shorelines of John Sevier Lake were shaded and comparatively cool during the warm parts of the day. Low limbs near the water furnished excellent cover, and the exposed roots formed a labyrinth of possible escape routes under the eroded banks.

The floating masses of uprooted aquatic vegetation were found in practically all parts of the lake at various times, except in the slough west of Big Island. Very little food was available there, and very few wood ducks were observed in this slough.

It is apparent that substantial numbers of wood ducks are present at John Sevier Lake because of the abundant food supply. The distribution of the ducks on the lake is influenced by adjacent shoreline cover type, assuming that food is randomly distributed.

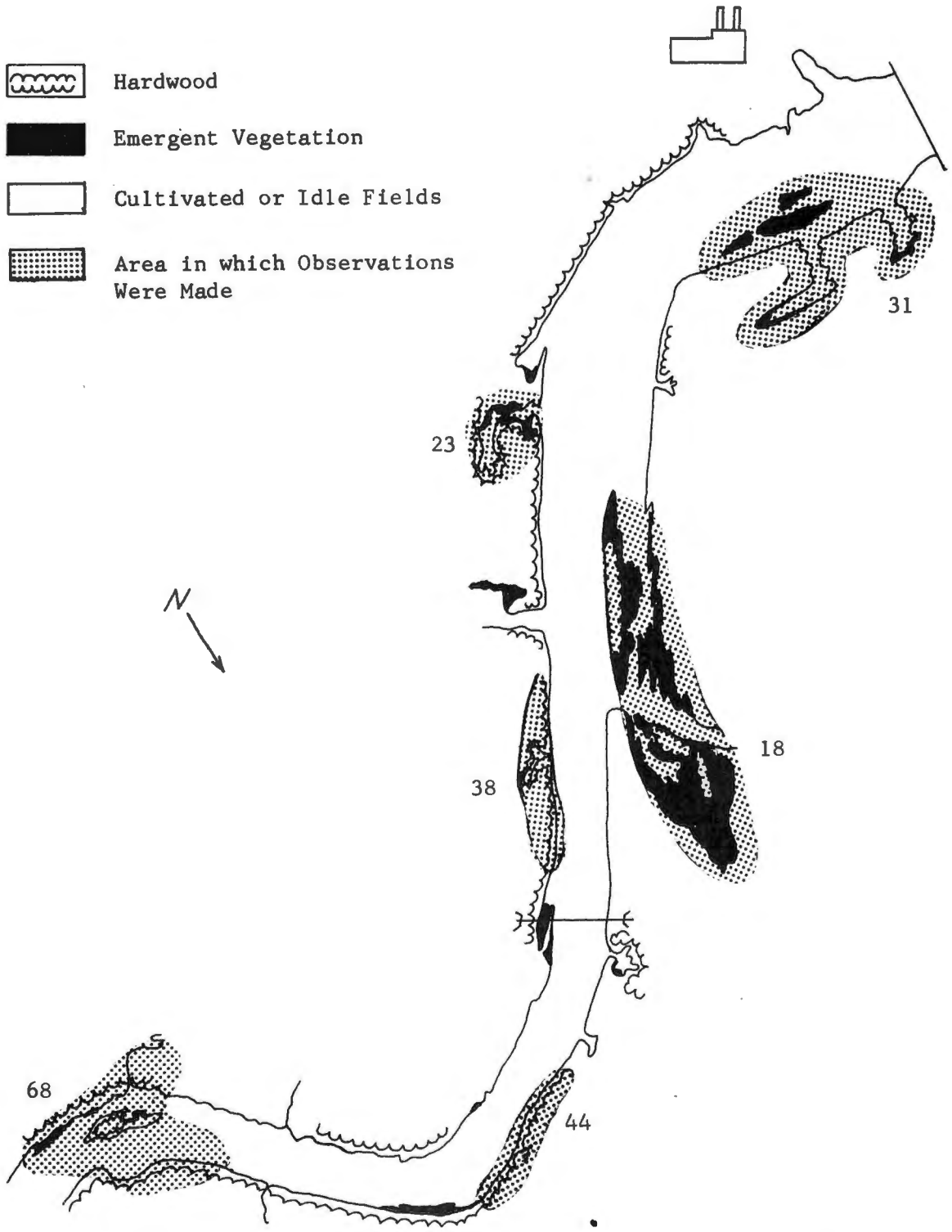


Figure 5. Numbers of wood duck sightings in high-use areas according to cover type.

CHAPTER V

RECOMMENDATIONS

Results from the evaluation of wood duck habitat at John Sevier Lake indicated several desirable management practices. The primary value of John Sevier Lake to waterfowl is the aquatic vegetation which serves as food. Maintenance of this food is of primary importance. As much of the food used by waterfowl on John Sevier Lake is produced upstream in the Holston River, it is essential that management include this river as part of a total management unit. At this time, protection of this vegetation is sufficient management. Aerial photographs taken each year in late summer would permit detection of changes and trends in the surface area occupied by aquatic plants.

The distribution of food with respect to cover can be improved by placing barriers to floating masses of uprooted aquatic vegetation at favorable locations along the shoreline. Felling a few trees into the water according to the recommendations of Minser (1968) would result in an accumulation of food. Short wire fences erected perpendicular to the shoreline in shallow, unnavigable areas of the lake similarly would form attractive feeding areas for wood ducks.

To improve cover for wood ducks, the cultivation of lakeside property should be restricted sufficiently to allow a narrow strip of emergent and/or woody plant growth to establish. Narrow ditches could be dredged and fenced in practical areas if cost was justified,

especially in the large pastures which offer no concealment to wood ducks. The plants that would establish along the banks of these channels would be very desirable for cover. Aquatic plants that become established in the ditches would provide additional food for the ducks.

The relationship existing between hardwood cover, emergent cover, and food supply suggests that efforts should be directed toward interspersion of these whenever possible. The resulting habitat condition would be highly attractive to wood ducks of all ages and to other species of waterfowl as well.

Before other recommendations for habitat improvement can be made, further research is needed. Although heavy grazing was believed detrimental to the establishment and maintenance of good emergent cover, moderate grazing may improve it. A study to determine the effects of controlled grazing on emergent vegetation would provide some insight into this problem. Similarly, studies to determine the effect of carp on aquatic vegetation would be useful. Basic to all these studies is the need for improved techniques for measuring aquatic and emergent vegetation.

CHAPTER VI

SUMMARY AND CONCLUSIONS

The objectives of this study were: (1) to describe the aquatic and emergent communities of John Sevier Lake, and (2) to relate the distribution of wood ducks to the various components of the habitat. The study was initiated in the spring of 1967, and was terminated in the summer of 1968.

The study area consisted of a 5.5-mile-long T. V. A. reservoir on the Holston River near Rogersville, Tennessee. The entire study area lies within Hawkins County, Tennessee.

Aquatic plant communities were designated by visual inspection, and a map of their distribution was prepared. Sampling within the communities was conducted to determine the biomass per acre. Standing crop in the mixed aquatic community near Burem Island was estimated at about 22,000 pounds per acre, but this estimate is believed to be too high due to bias introduced by sampling techniques. Stargrass was the most widespread aquatic plant at John Sevier Lake. Stargrass communities occurred at about 1,000 pounds per acre. Sago pondweed occurred in one large community at about 1,700 pounds per acre, and curly pondweed in small communities at about 500 pounds per acre. Waterweed-curly pondweed biomass was estimated at 3,700 pounds per acre.

Emergent communities were described in terms of the cover they supplied wood ducks. Of the five communities designated, cattail and

blue-stemmed bulrush were the most prevalent. The other communities were cattail--blue-stemmed bulrush, mixed moist-site species, and water primrose. Emergent communities consisting of more than one species, and of varying stem sizes were most desirable for concealing wood ducks of all age groups. Low, dense vegetation such as in the water primrose community and in most units of the mixed moist-site community was valuable only to young ducks. Tall, sparse cattail or blue-stemmed bulrush offered good crown closure and easy penetration for larger ducks. However, these tall open communities provided little concealment from ground-level predators.

During the study the number of wood ducks using John Sevier Lake at any point in time varied from 0 to 269. Wood ducks arrived in late February and reared their young during May and June. All ducks had emigrated from the lake by early December.

The distribution of wood ducks according to the vegetation was studied. Wooded shorelines received more use than emergent swales. Cultivated or idle farmland received practically no use. Distribution of wood ducks at John Sevier Lake is skewed away from cultivated shoreline, a cover type occupying approximately 30 percent of the shoreline.

Apparently, wood ducks are present at John Sevier Lake because of the large supply of floating masses of uprooted aquatic vegetation produced in the Holston River upstream from the study area. The distribution of the ducks was related to the shoreline cover, assuming that food was uniformly distributed.

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APPENDIXES

APPENDIX A

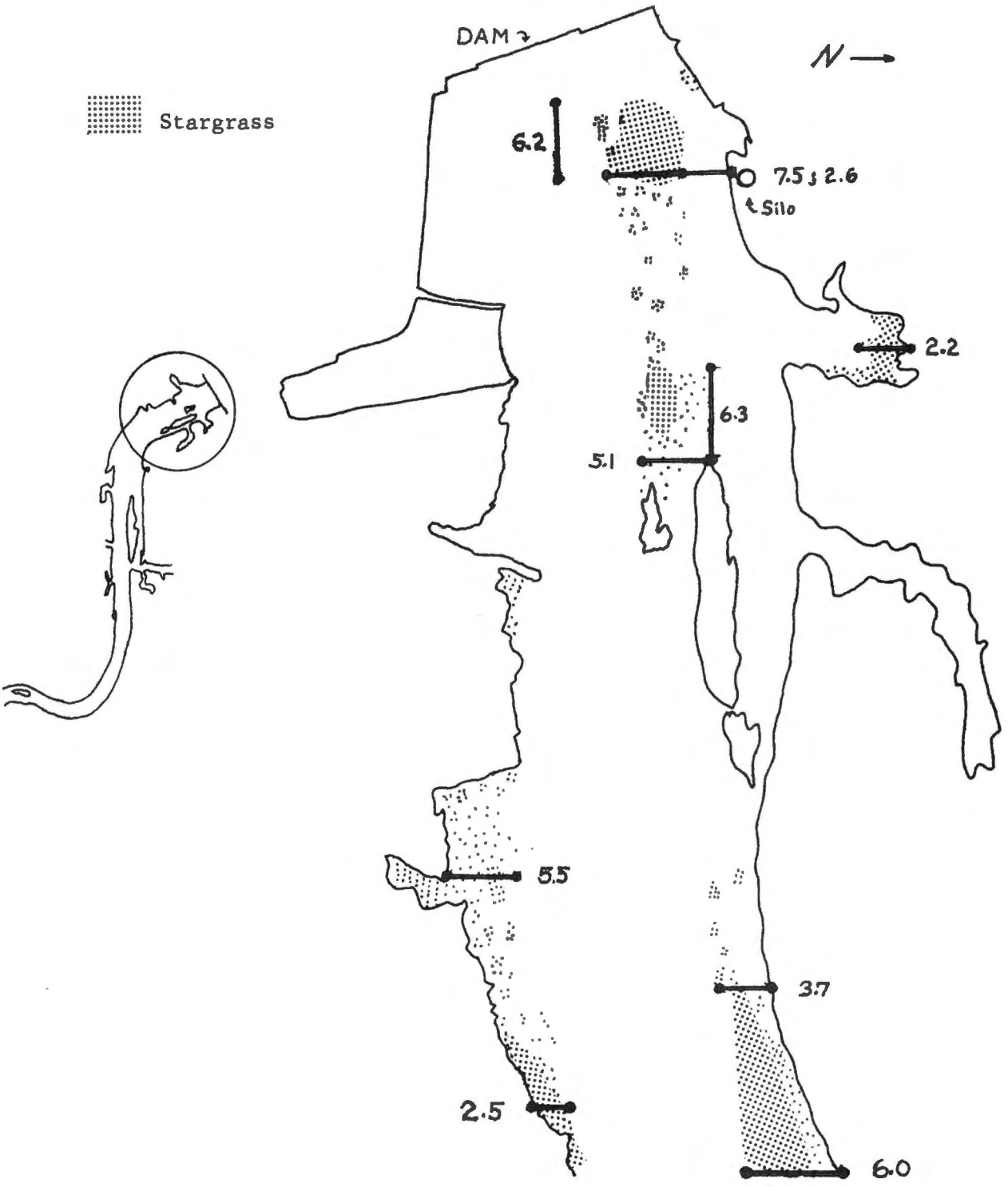


Figure 6. Distribution of aquatic communities in John Sevier Lake. All numerals are in chains (66-feet).

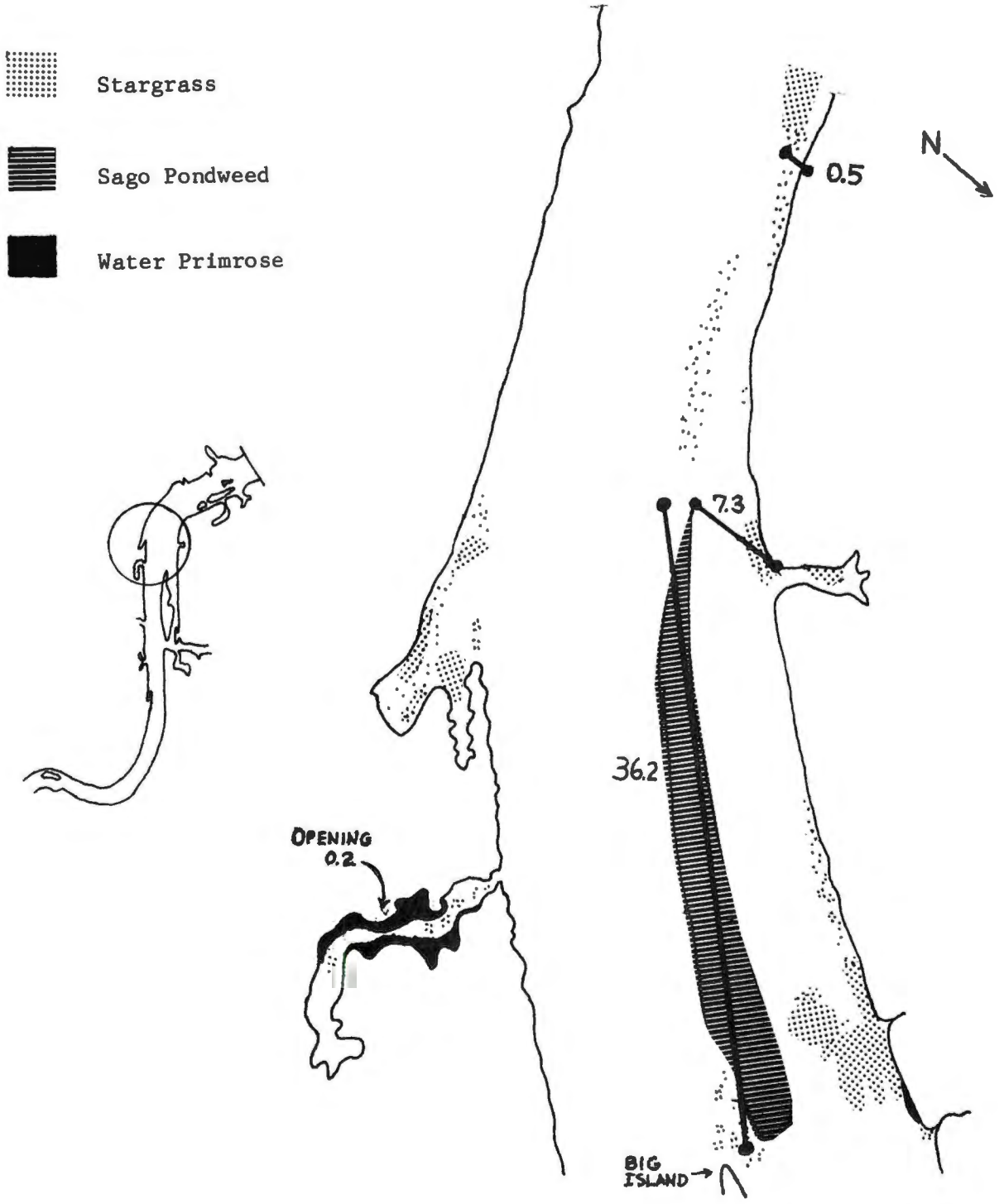


Figure 6 (continued).

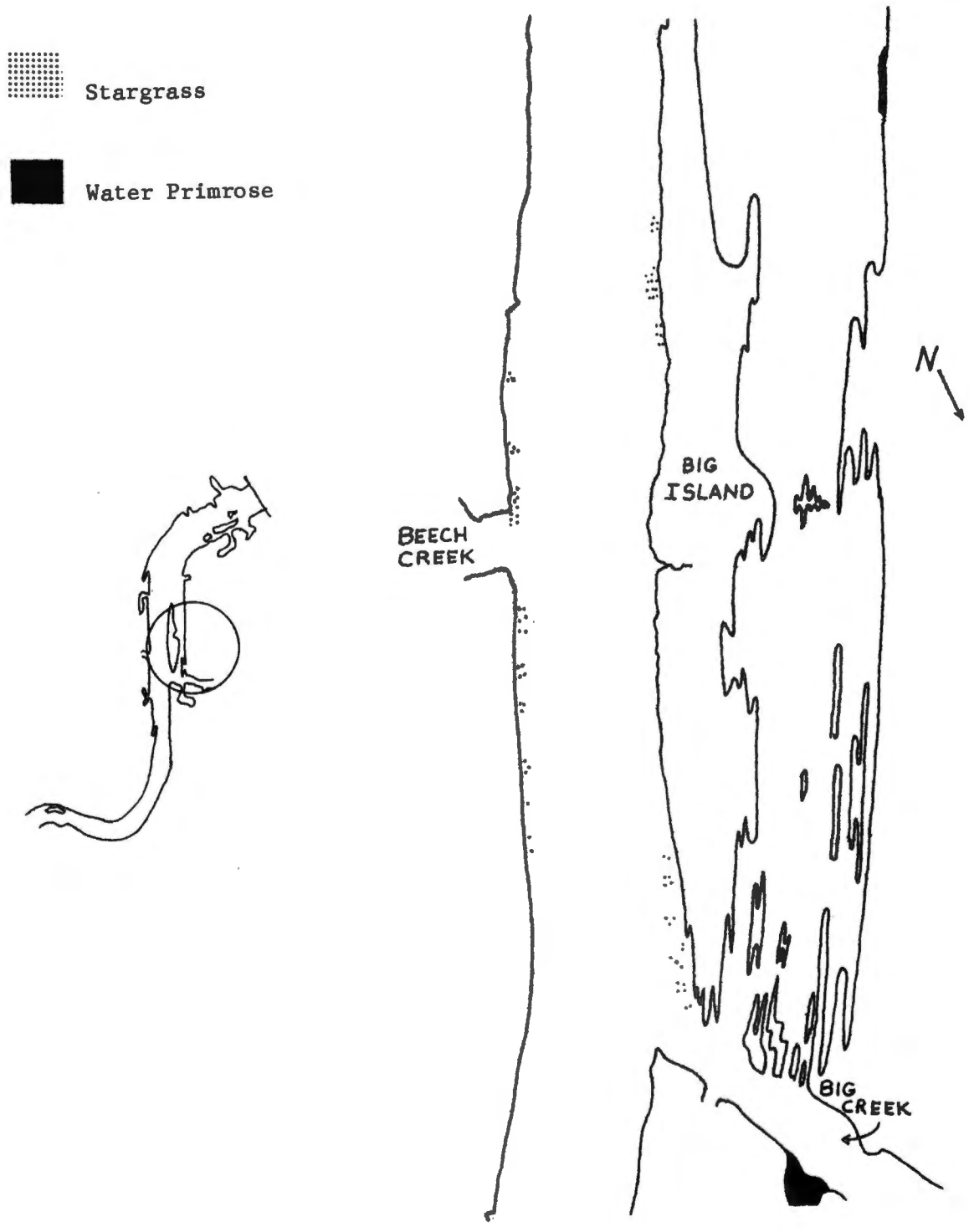


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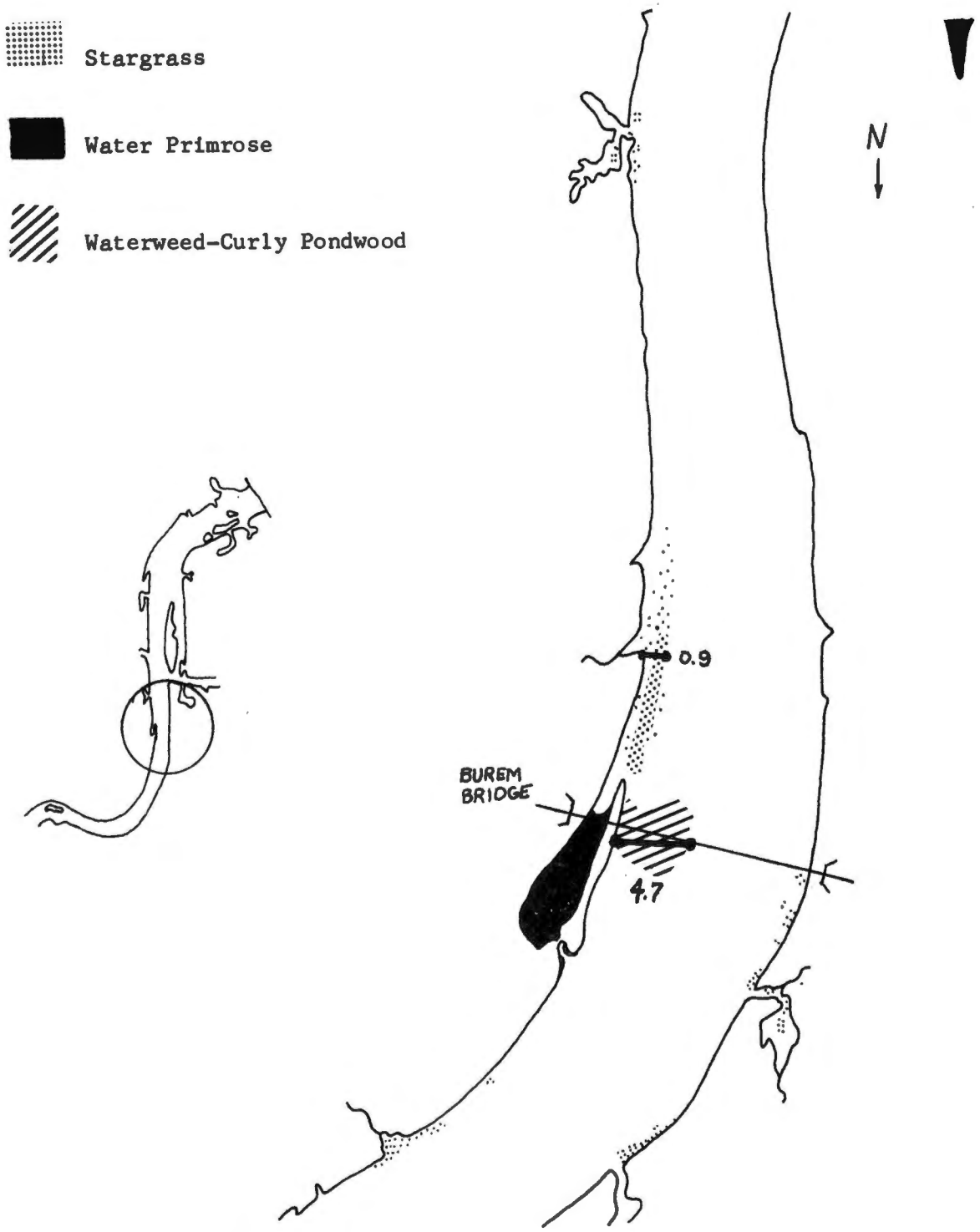


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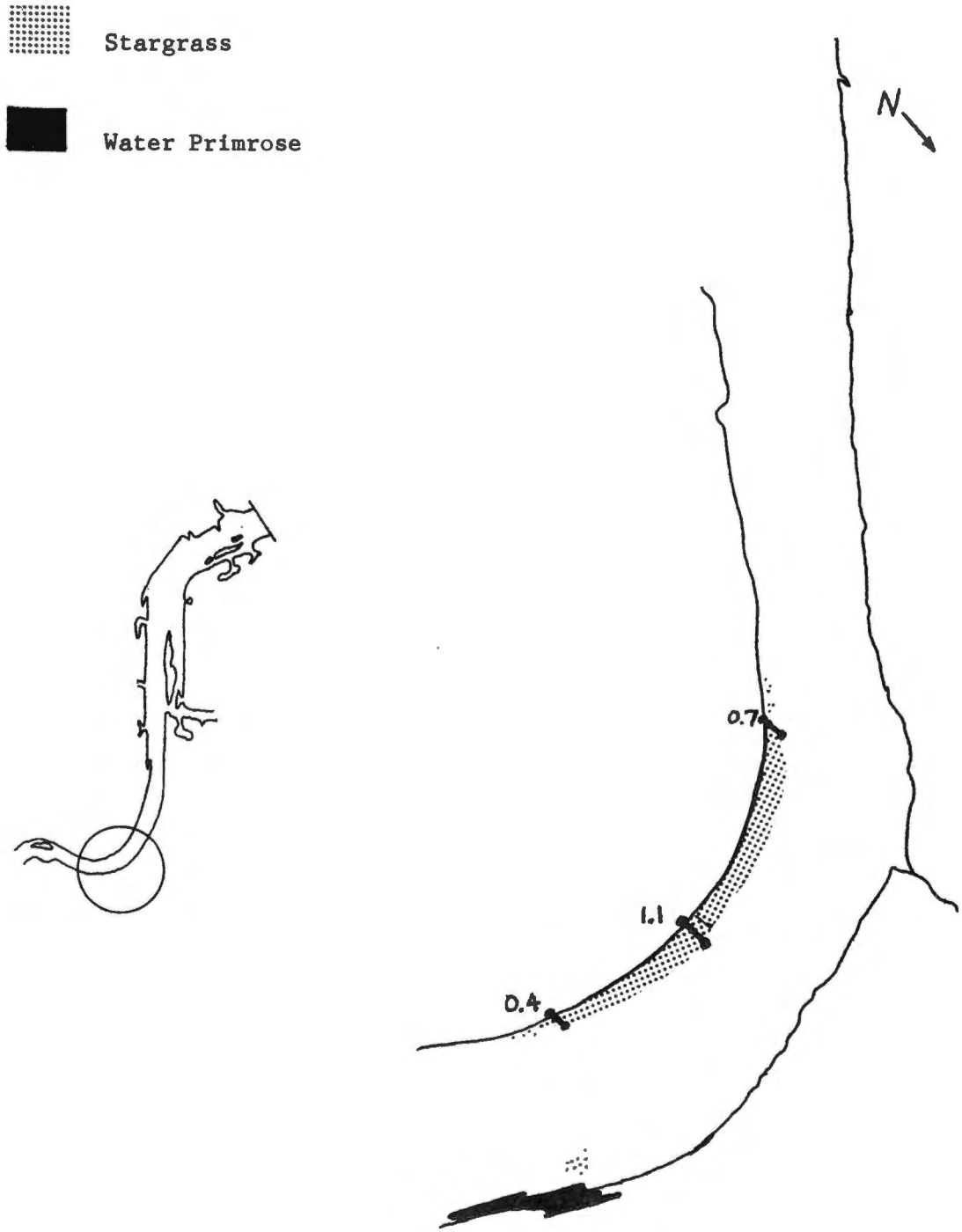


Figure 6 (continued)

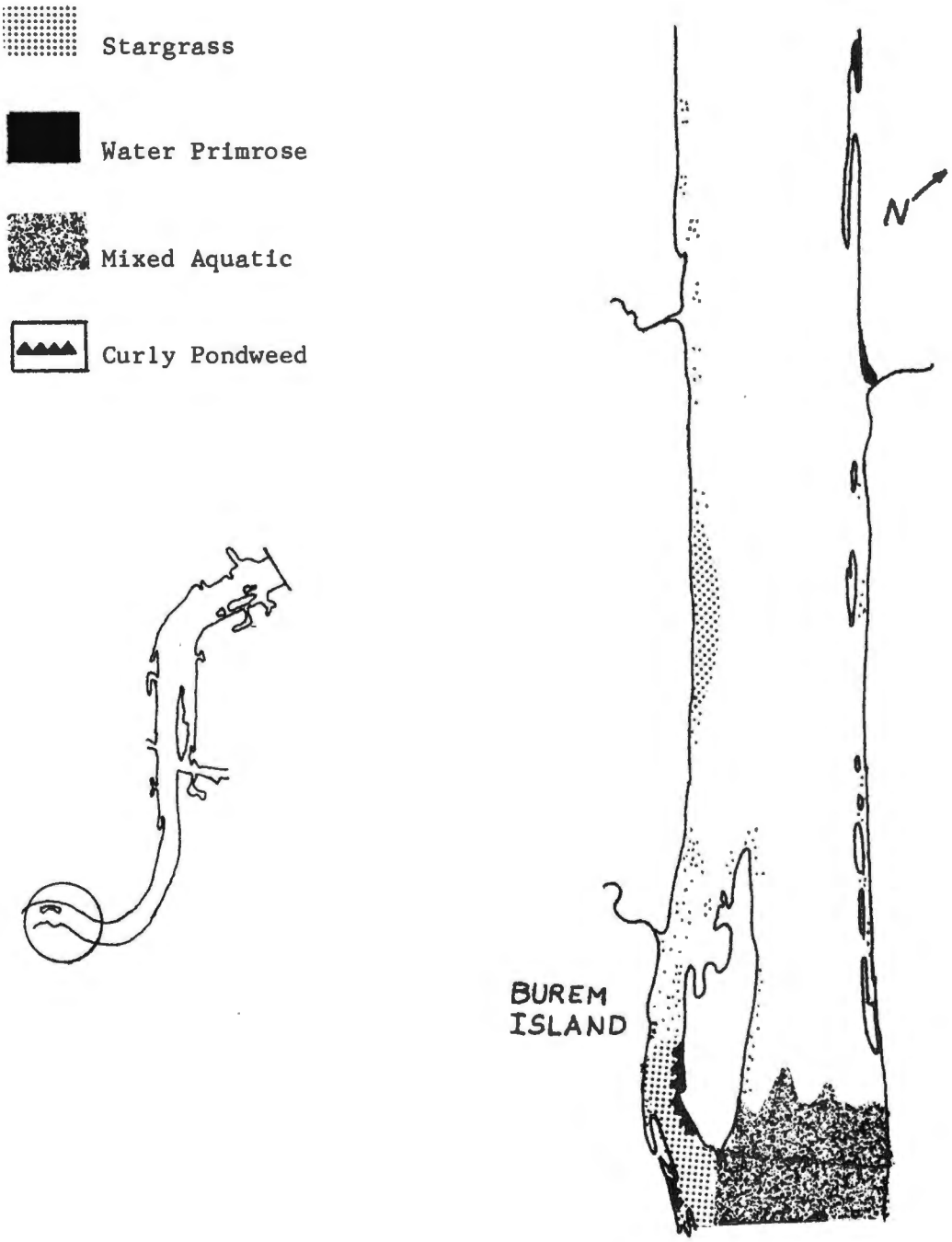


Figure 6 (continued)

APPENDIX B

A LIST OF WATERFOWL AND WATERBIRDS OBSERVED ON JOHN SEVIER LAKE 1967-68.

Authority: Peterson (1947).

American Goldeneye	*Glaucionetta clangula*
American Merganser	*Mergus merganser*
Baldpate	*Mareca americana*
Black Duck	*Anas rubripes*
Blue Goose	*Chen caerulescens*
Blue-winged Teal	*Anas discors*
Bufflehead	*Glaucionetta albeola*
Canada Goose	*Branta canadensis*
Canvas-back	*Aythya valisineria*
Coot	*Fulica americana*
Double-crested Cormorant	*Phalacrocorax auritus*
Gadwall	*Anas strepera*
Greater Scaup Duck	*Aythya marila nearctica*
Green-winged Teal	*Anas carolinensis*
Hooded Merganser	*Lophodytes cucullatus*
Horned Grebe	*Colymbus auritus*
Lesser Scaup Duck	*Aythya affinis*
Mallard	*Anas platyrhynchos*
Pied-billed Grebe	*Podilymbus podiceps*
Pintail	*Anas acuta*
Purple Gallinule	*Porphycula martinica*

Redhead	*Aythya americana*
Ring-necked Duck	*Aythya collaris*
Ruddy Duck	*Erismatura jamaicensis*
Shoveler	*Spatula clypeata*
Surf Scoter	*Melanitta perspicillata*

APPENDIX C

TABLE XV

NUMBERS OF WATERFOWL AND OTHER WATERBIRDS (EXCEPT WOOD DUCKS) OBSERVED ON JOHN SEVIER LAKE, APRIL 1967 - JUNE 1968

Species	Number Counted Per Census Date								
	April 19	May 5,	May 20	June 16	July 24	Aug. 5,	Aug. 27	Sept. 14,	Sept. 21
American Goldeneye				2					
American Merganser	2	3							
Baldpate			6	2	3				
Black Duck	1								
Blue Goose									
Blue-winged Teal	35	18	7			1	25	33	22
Bufflehead									
Canada Goose									8
Canvasback				1					
Coot	300	155	56	21	3	12			8
Double-crested Cormorant									
Gadwall		1							
Greater Scaup Duck									
Green-winged Teal				1					
Hooded Merganser									
Horned Grebe									
Lesser Scaup Duck	50	40	17	2					
Mallard	20	9	2	8	8	2	4	4	12
Pied-billed Grebe									
Pintail					1	1	1		
Purple Gallinule		1							
Redhead									
Ring-necked Duck				2	1			1	
Ruddy Duck									
Shoveller	2							2	3
Surf Scoter	1								
Total	413	227	88	39	16	16	30	42	54

TABLE XV (continued)

Species	Number Counted Per Census Date									
	Oct.		Nov.		Dec.		Jan.		Feb.	March
	6,	19	1,	17	6,	28	14,	27	15	10
American Goldeneye		1								10
American Merganser				6					1	
Baldpate		10	59	37			33	7	12	59
Black Duck	3	1	110	121	10	2	418	658	390	436
Blue Goose			1							
Blue-winged Teal	62	11	3						1	
Bufflehead				3				5	10	7
Canada Goose	3	11							3	
Canvasback					6	15			11	2
Coot	150	602	1595	995	540	595	1475	1027	930	1027
Double-crested Cormorant										
Gadwall		5	3			22	20	15	75	
Greater Scaup Duck				6						30
Green-winged Teal		50	65	56			5	10	3	25
Hooded Merganser									1	
Horned Grebe		1								
Lesser Scaup Duck		1					21		95	540
Mallard	6	13	144	111	83	4	487	747	500	524
Pied-billed Grebe	12	8	7	8			5		11	7
Pintail							22	150	40	6
Purple Gallinule										
Redhead				5				7		10
Ring-neck Duck					125	50		57	30	
Ruddy Duck				4						
Shoveller				4		2		3		
Surf Scoter										
Total	236	718	1988	1345	764	668	2488	2691	2053	2749

TABLE XV (continued)

Species	Number Counted Per Census Date				
	April		May		June
	7,	30	14,	20	11
American Goldeneye					
American Merganser					
Baldpate	26				
Black Duck	13				
Blue Goose					
Blue-winged Teal	20	10	12	1	
Bufflehead					
Canada Goose					
Canvasback					
Coot	1435	170	42	60	48
Double-crested Cormorant		1			
Gadwall					
Greater Scaup Duck					
Green-winged Teal					
Hooded Merganser					
Horned Grebe					
Lesser Scaup Duck	522	100	10	4	
Mallard	29	16	8	4	10
Pied-billed Grebe	10				
Pintail					
Purple Gallinule					
Redhead					
Ring-neck Duck					
Ruddy Duck					
Shoveller	12				
Surf Scoter					
Total	2067	307	72	69	58

VITA

David Estes Watts, son of Charles Estes Watts, and Lorena (Tyree) Watts, was born in Madison, Tennessee, on August 2, 1943. He attended elementary school in Old Hickory, Tennessee, and graduated from DuPont High School in 1961. He entered college in 1961 and received the degree of Bachelor of Science in Biology in June 1965 from Tennessee Technological University. Upon receiving his degree he was employed as a Supervisory Trainee by E. I. DuPont de Nemours and Company, Inc., at Old Hickory. In January 1966, he began graduate work in Biology at Tennessee Technological University, transferring the the Department of Forestry at The University of Tennessee in September of 1966. He received his Master of Science in Forestry from the University of Tennessee in August 1968. He is married to the former Jane Cash of Maryville, Tennessee.