

I. INTRODUCTION

The proposed Maquam Bog Research Natural Area (RNA) is located within the Maquam Swamp portion of the Missisquoi National Wildlife Refuge (NWR). The site is a fine example of an acid, sphagnum bog, normally found in the coastal plains of the northeastern United States from Maine to New Jersey. This proposed RNA includes the bog itself, and the surrounding silver maple, blueberry, buttonbush and huckleberry swamp. The pitch pine and shrub communities found therein also replicate the bogs of the Atlantic coastal plains. The presence of this acid-loving community so close to the nutrient-loving communities on the Missisquoi River delta, is unique to this area.

The Maquam Bog is the largest known bog of its type in Vermont. It houses a large concentration of the Vermont State Threatened plant species, the Virginia chain fern, and the largest population of the shrub, rhodora, in Vermont. Numerous other plant and animal communities also exist there which merit further study and identification.

The uniqueness of the Maquam Bog qualifies it to be designated as a RNA to preserve it intact for future research needs and analysis.

II. LOCATION

The proposed RNA is located within the 5,839 acre Missisquoi NWR, in Franklin County, northwestern Vermont. The refuge is owned and staffed by the U.S. Fish and Wildlife Service. The 890 acre Maquam Bog sits in the middle of the approximately 1,600 acre Maquam Swamp portion of the southern one-third of the federal wildlife refuge. It is bordered on the west and north by Charcoal Creek and State Highway 78; on the east by Maquam Creek; on the south by Maquam Bay; and on the west by Tabor Road (Ref. Figures #1a and #1b); and is located in western Swanton Town. It lies at 44°57' N. latitude and 73°11' W. longitude; and ranges from approximately 96.00' to 99.00' above mean sea level (MSL).

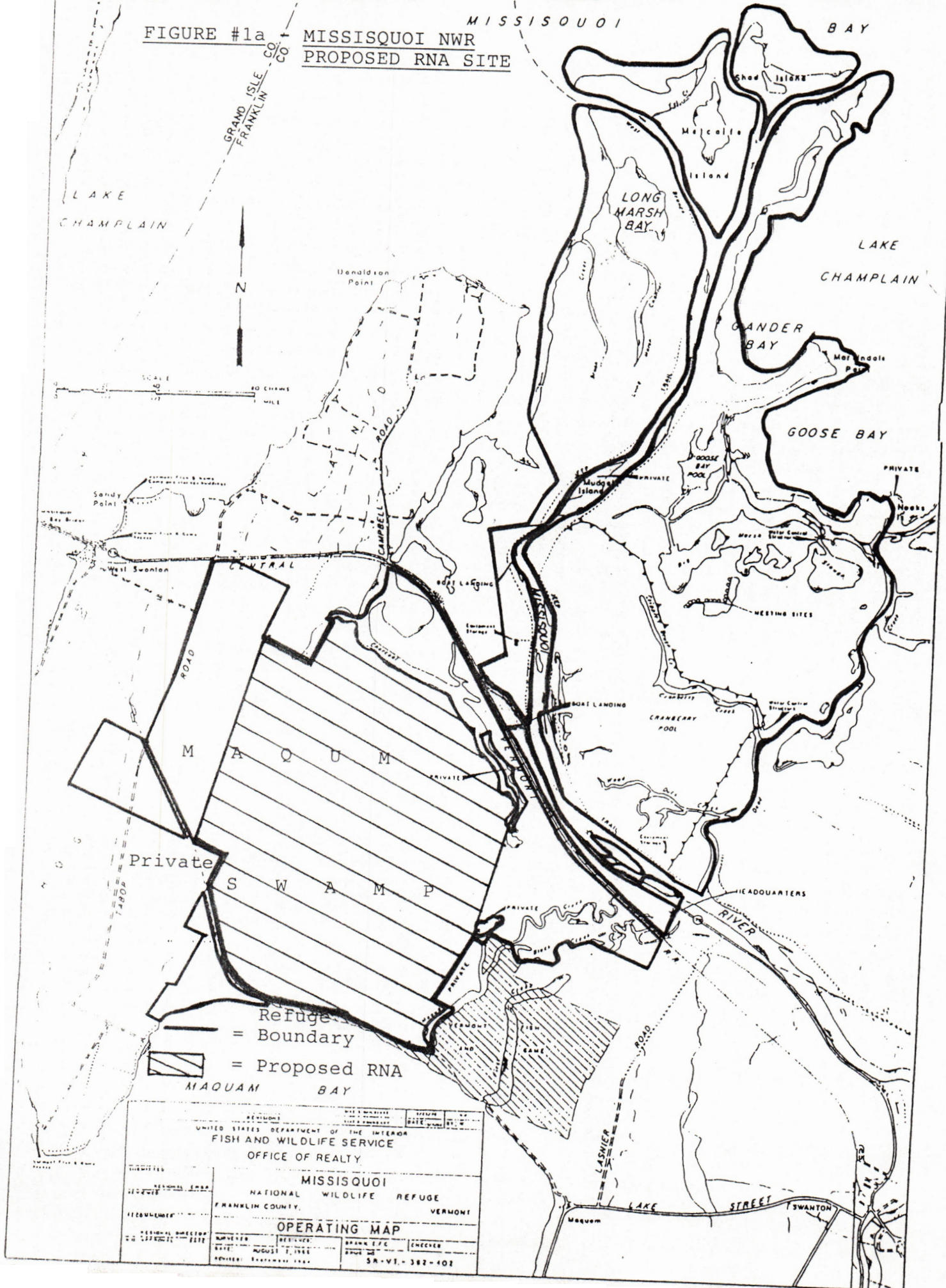
MISSISSOUI  
GRAND ISLE  
CO. CO.

CANADA  
UNITED STATES

MISSISSOUI  
FRANKLIN  
CO. CO.

QUEBEC  
VERMONT

FIGURE #1a  
MISSISSOUI NWR  
PROPOSED RNA SITE



Refuge Boundary  
 = Proposed RNA  
 MAQUAM BAY

UNITED STATES DEPARTMENT OF THE INTERIOR  
 FISH AND WILDLIFE SERVICE  
 OFFICE OF REALTY

MISSISSOUI  
 NATIONAL WILDLIFE REFUGE  
 FRANKLIN COUNTY, VERMONT

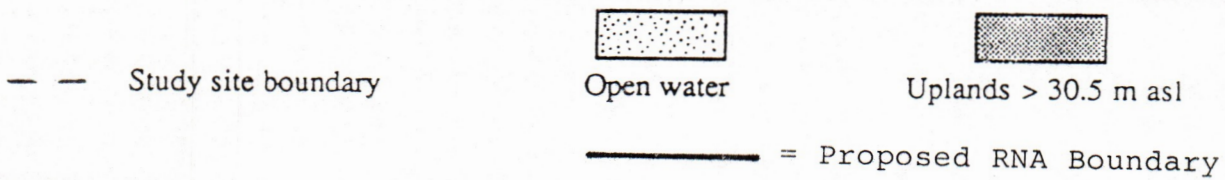
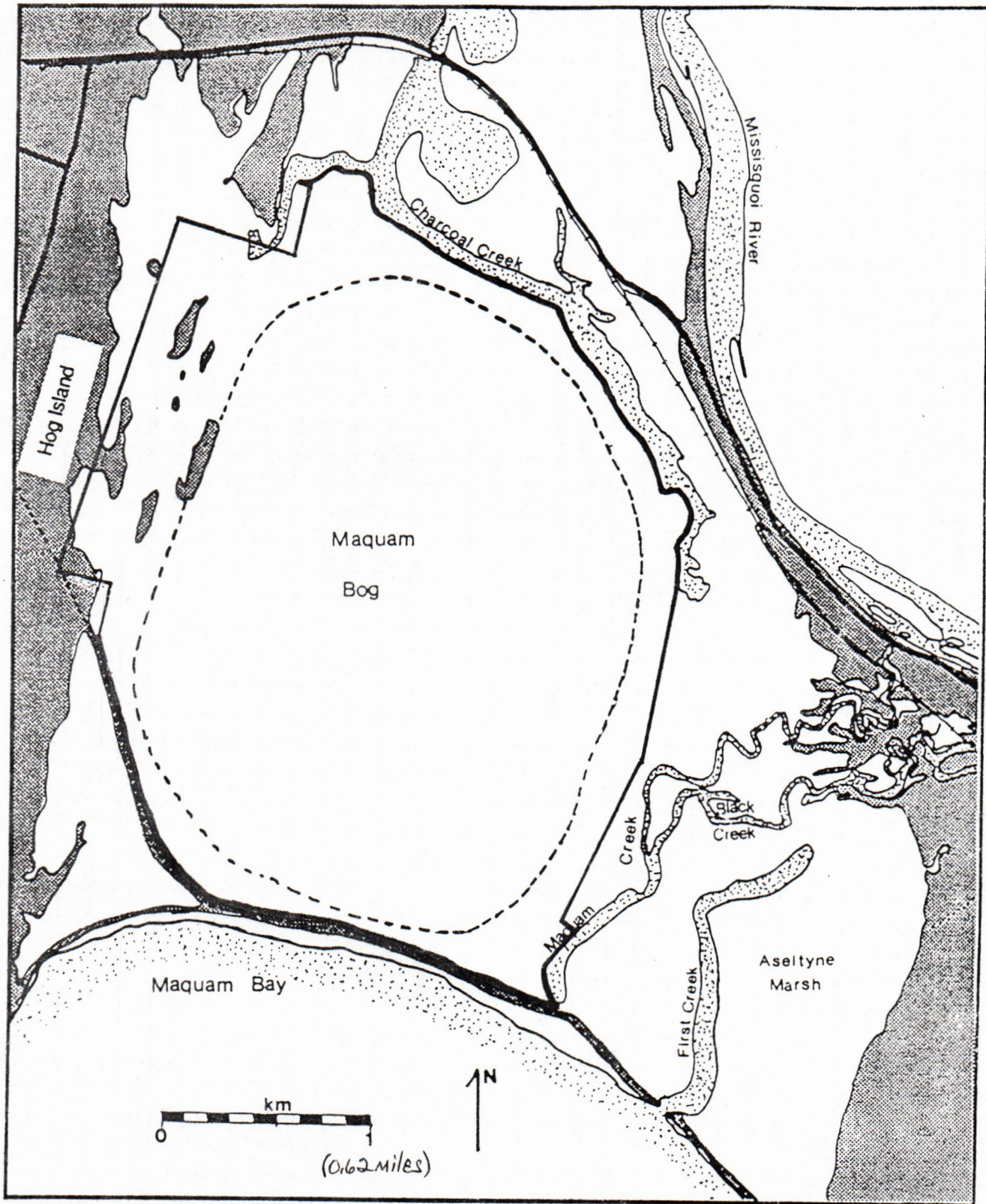
OPERATING MAP

APPROVED	REVISIONS	DATE	BY
REVISIONS	DATE	BY	
REVISIONS	DATE	BY	
REVISIONS	DATE	BY	
REVISIONS	DATE	BY	

AUGUST 7, 1955  
 5R-VI-382-402

Proposed  
Figure 1b. MAQUAM BOG RNA

(From STRIMBECK - Fire, Flood and Famine:  
Pattern and Process In a Lakeside Bog, 1988)



### III. ENVIRONMENT

The Maquam Bog is located in an abandoned channel of the Missisquoi River (FILLON, 1970) and overlies the depositional processes of the Missisquoi River delta. The displacement of the river away from the existing bog area resulted in the isolation of the area from the sediment supply and the accumulation of peat. Peat accumulation eventually brought the surface levels above all but flood levels, favoring the establishment of acid conditions and the growth of bog vegetation (Strimbeck, 1988, P. 8). The bog is now separated from the Missisquoi River by Charcoal and Maquam Creeks, which also serve to channel the flow of river water away from the bog when the floods of each spring begin to subside. However, these two creeks probably also serve as avenues for Lake Champlain waters to enter the bog during the spring high-water period. Spring lake levels sometimes approach 99.00' MSL annually, which is high enough to cover the area. However, the bog is usually isolated throughout the growing season, allowing the establishment of low pH gradients therein. During the summer, fall and winter, precipitation is the only water source for this system.

The climate of this site is influenced by its proximity to Lake Champlain, making the weather less severe during the later fall and early winter than further east. Climatic data from files at the refuge headquarters are illustrated below in Table 1.

Table 1 - Missisquoi NWR Climatic Data\*

Annual Averages	Temp./Precip.
Temperature (1979-1989 Severity Indices)	43.2° F.
January Temperature (1984-89)	12.2° F.
July Temperature (1984-89)	69.2° F.
Minimum Temperature (1979-89)	27.2° F.
Maximum Temperature (1979-89)	90.0° F.
Rainfall (1979-89)	30.60"
June - August Rainfall (1979-89)	10.14"
Snowfall (1979-89)	52.93"

\*From Missisquoi NWR Annual Narrative Reports

IV. SIGNIFICANT FEATURES

The proposed Maquam Bog RNA represents a dome-shaped, open, acid, lakeside bog surrounded by a "moat" of water, shrubs, silver maple swamp, and (along the western side) upland woods, several rock "islands" and hayfields. The bog itself is completely owned by the U.S. Fish and Wildlife Service, although several small sections of the surrounding Maquam Swamp remain in private ownership (Ref. Figure #1a). Those private wetlands are used for hunting and/or trapping by the landowners. No alterations or structures exist on the proposed RNA or in the surrounding Maquam Swamp.

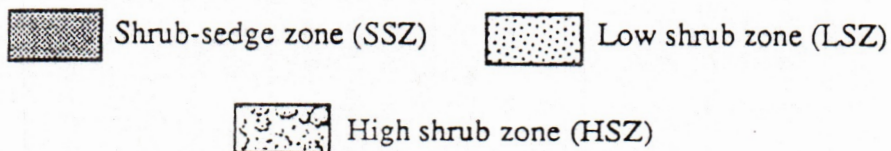
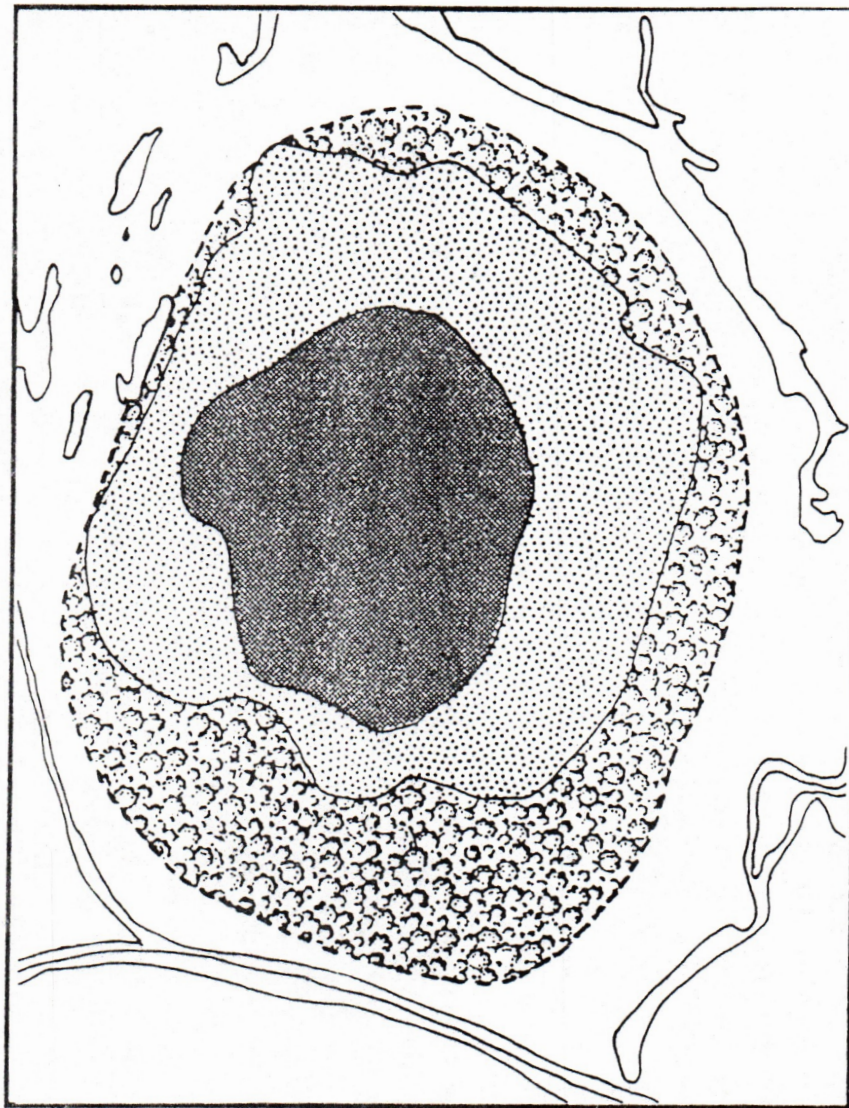
The vegetation of the Maquam Swamp is typical of an acidic, sphagnum bog. The ground cover consists of six known species of sphagnum moss that carpet from 50%-95% of the entire area, together with a species of hairy-cap moss. Common shrubs include leatherleaf, rhodora, cranberry, blueberry, huckleberry, sweetgale, black chokeberry and mountain holly. In addition, the sedges, Eriophorum spissum, Carex oligosperma and E. virginianum, are distributed throughout the bog, with lesser populations of sundews. Strimbeck (1988) noted three vegetational zones within the bog that focussed primarily on shrub species compositions (Ref. Figure #2). Stands of multistemmed red maples and gray birch are scattered throughout the bog, together with scattered individuals and small groves of pitch pine, black spruce and tamarack. The Virginia chain fern - a Vermont State Threatened Species - occurs in abundance in a one acre area of the south-central bog, and may be found in more scattered numbers throughout the low shrub zone (Ref. Figure #2) and adjacent wooded swamp areas. (Scientific names of the above named species are included in Appendix I.)

Hummocks and hollows are common throughout the bog, with shrubs growing densely atop them, and sphagnum in the hollows between. Travel in many parts of the bog can be quite difficult because of this type of terrain.

A separate listing of flora and fauna is included in Appendix I and has been compiled from several research papers done by University of Vermont Field Naturalist students Virginia Scharf (1987), Mark Gershman (1987) and Rick Strimbeck (1987). Of particular interest is the presence of northern harriers and short-eared owls in the bog during the breeding season. Since the bog typifies their breeding habitat, it is likely that these two "Species of Special Concern" (Vermont State classification) do breed here.

(From STRIMBECK - Fire, Flood and Famine: Pattern and Process in a Lakeside Bog, 1988)

Figure 2. Vegetation zones of Maquam Bog, based on aerial photographs and ground checks.



V. RESEARCH

Research has been ongoing within the Maquam Bog since 1986, when refuge staff first informed University of Vermont professor, Dr. Daniel Mann, of the research potential there and the refuge's need for better understanding in managing this area. Although no studies are currently ongoing, previous research papers are detailed in the "Literature Cited" section of this report. In addition to this work, representatives from the Vermont Nongame and Natural Heritage Program (Fish & Wildlife Department) and several University of Vermont professors and graduate students have visited the bog during the last three years to survey the resources there. Most of these individuals have expressed a great deal of interest in seeing that the area is nominated as a Research Natural Area, as soon as possible. They have also suggested the formation of an advisory committee of representatives from the U.S. Fish and Wildlife Service, University of Vermont, Fish & Wildlife Nongame and Natural Heritage Program. Correspondence dealing with this issue is included in Appendix II.

The proposed RNA offers a wide spectrum of research possibilities because of its size and the rarity of these habitat types in Vermont. Entomological, ornithological, botanical, hydrological, water quality, etc. analyses in this pristine environment would provide a great deal of knowledge and outdoor classroom experiences while also protecting this fragile ecosystem. The Maquam Bog will be a valuable addition to the RNA system.

VI. LITERATURE CITED

FILLON, R.M. - 1970. The Sedimentation and Recent Geologic History of the Missisquoi Delta. MS Thesis, Univ. of Vermont. 112 Pages.

GERSHMAN, Mark - 1987. A Study of the Maquam Peatland. Unpublished report for the Field Naturalist Practicum on file at the Missisquoi NWR, Swanton, Vermont. 42 Pages.

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SCHARF, Virginia R.-1987. The Natural History of Maquam Bog, Missisquoi River Delta, Franklin County, Vermont. Unpublished report. Final examination for the Field Naturalist Program, Botany Department, University of Vermont. On file at Missisquoi NWR, Swanton, Vermont. 67 Pages.

STRIMBECK, G. Richard - 1988. Fire, Flood and Famine: Pattern and Process in a Lakeside Bog. Unpublished report on file at the Missisquoi NWR, Swanton, Vermont and the University of Vermont, Burlington, Vermont. 66 Pages.

STRIMBECK, George Richard - 1987. A Natural History of Maquam Bog. Unpublished report prepared for Missisquoi NWR and the Field Naturalist Program at the University of Vermont. On file at the Missisquoi NWR, Swanton, Vermont. 35 Pages.



APPENDIX I  
LISTING OF FLORA AND FAUNA OF THE MAQUAM BOG

I. PLANTS OF MAQUAM BOG

A. TREES

Silver maple  
Swamp maple  
Red maple  
White ash  
Swamp white oak  
Common cottonwood  
Black willow  
Gray birch  
Pitch pine  
Black spruce  
Northern white cedar  
Tamarack

Acer saccharinum  
Acer fremanii  
Acer rubrum  
Fraxinus americana  
Quercus bicolor  
Populus deltoides  
Salix nigra  
Betula populifolia  
Pinus rigida  
Picea mariana  
Thuja occidentalis  
Larix laricina

B. SHRUBS

Small cranberry  
Large cranberry  
Lowbush blueberry  
Highbush blueberry  
Buttonbush  
Red alder  
Black alder  
Mountain holly  
Leatherleaf  
Labrador tea  
Rhodora  
Sweet gale  
Water willow  
Northern wild raisin  
Willow  
Meadowsweet  
Sheep laurel  
Mountain laurel  
Swamp laurel  
European white alder

Vaccinium oxycoccus  
Vaccinium macrocarpon  
Vaccinium stamineum  
Vaccinium corymbosum  
Cephalanthus occidentalis  
Alnus rugosa  
Ilex verticillata  
Nemopanthus mucronata  
Chamaedaphne calyculata  
Ledum groenlandicum  
Rhododendron canadense  
Myrica gale  
Decodon verticillatus  
Viburnum cassinoides  
Salex sp.  
Spiraea latifolia  
Kalmia angustifolia  
Kalmia latifolia  
Kalmia polifolia  
Alnus incana

C. FERNS

Chain fern  
Crested shield fern  
Cinnamon fern

Woodwardia virginica  
Dryopteris cristata  
Osmunda cinnamomea

D. MOSESSES

A sphagnum  
A sphagnum  
A sphagnum  
A sphagnum  
A sphagnum  
A sphagnum  
Hairy-cap moss

Sphagnum capillifolium  
S. centrale  
S. fimbriatum  
S. teres  
S. magellanicum  
S. recurvum  
Polystrichum sp.

E. GRAMINOIDS

Sedges	<u>Carex sp./Eleocharis sp./</u> <u>Dulichium arundinaceum</u>
Cottongrass	<u>Eriophorum sp.</u>
Wild rice	<u>Zizania aquatica</u>
Burreed	<u>Sparganium sp.</u>
Cattail	<u>Typha sp.</u>

F. AQUATICS

Coontail	<u>Ceratophyllum demersum</u>
Pondweeds	<u>Potamogeton spp.</u>
Pickerelweed	<u>Pontederia cordata</u>
Arrowhead	<u>Sagittaria spp.</u>

II. BIRDS OF MAQUAM BOG

Black duck	<u>Anas rubripes</u>
Mallard	<u>Anas platyrhynchos</u>
Wood duck	<u>Aix sponsa</u>
Crow	<u>Corvus racyrhynchos</u>
Ring-billed gull	<u>Larus delawarensis</u>
Red-winged blackbird	<u>Agelaius phoeniceus</u>
Short-eared owl	<u>Asio flammeus</u>
Hairy woodpecker	<u>Picoides villosus</u>
Downy woodpecker	<u>Picoides pubescens</u>
Pileated woodpecker	<u>Dryocopus pileatus</u>
Common goldeneye	<u>Bucephala clangula</u>
Canada goose	<u>Branta canadense</u>
Great blue heron	<u>Ardea herodias</u>
Killdeer	<u>Charadrius vociferus</u>
Common snipe	<u>Gallinago gallinago</u>
Ruffed grouse	<u>Bonasa umbellus</u>
Northern harrier	<u>Circus cyaneus</u>
Rough-legged hawk	<u>Buteo lagopus</u>
Northern raven	<u>Corvus corax</u>
Black-capped chickadee	<u>Parus atricapillus</u>
American robin	<u>Turdus migratorius</u>
Eastern meadowlark	<u>Sturnella magna</u>
European starling	<u>Sturnus vulgaris</u>
Song sparrow	<u>Melospiza melodias</u>
Great horned owl*	<u>Bubo virginianus</u>
Olive sided flycatcher*	<u>Contopus borealis</u>
Black billed cuckoo*	<u>Coccyzus erythrophthalmus</u>
Red breasted nuthatch*	<u>Sitta canadensis</u>
Brown creeper*	<u>Certhia americana</u>
Nashville warbler*	<u>Vermivora ruficapilla</u>
Palm warbler*	<u>Dendroica palmarum</u>
Black and white warbler*	<u>Mniotilta varia</u>
Common yellowthroat*	<u>Geothlypis trichas</u>
Swamp sparrow*	<u>Melospiza georgiana</u>

\*Not seen but suspected in Maquam Bog

III. AMPHIBIANS/REPTILES OF MAQUAM BOG

Wood frog*	<u>Rana sylvatica</u>
Green frog*	<u>Rana clamitans</u>
Mink frog*	<u>Rana septentrionalis</u>
Pickerel frog*	<u>Rana palustris</u>
Grey treefrog*	<u>Hyla versicolor</u>
Spring peeper*	<u>Hyla crucifer</u>
American toad*	<u>Bufo americanus</u>
Eastern newt*	<u>Notophthalmus viridescens</u>
Blue spotted salamander*	<u>Ambystoma laterale</u>
Red backed salamander*	<u>Plethodon cinereus</u>
Four toed salamander*	<u>Hemidactylium scutatum</u>
Northern spring salamander*	<u>Gyrinophilus p. porphyriticus</u>
Eastern spiny softshelled turtle	<u>Trionyx spiniferus</u>
Bog turtle**	<u>Clemmys muhlenbergi</u>
Painted turtle*	<u>Chrysemys marginata</u>
Common garter snake*	<u>Thamnophis sirtalis</u>
Red-bellied snake*	<u>Storeria occipitomaculata</u>
Northern water snake*	<u>Natrix sipedon</u>

\*Not seen but suspected of occurring in Maquam Bog.

\*\*Suitable habitat, although its range lies far to the south.

IV. INSECTS OF MAQUAM BOG

Bog elfin	<u>Incisalia lanoraieensis</u>
Whirligig beetle	<u>Dineutes sp.</u>

V. MAMMALS OF MAQUAM BOG

Deer	<u>Odocoileus virginianus</u>
Coyote	<u>Canis latrans</u>
Red squirrel	<u>Tamiasciurus hudsonicus</u>
Meadow vole	<u>Microtus pennsylvanicus</u>
Beaver	<u>Castor canadensis</u>
Masked shrew*	<u>Sorex cinereus</u>
Water shrew*	<u>Sorex palustris</u>
Smokey shrew*	<u>Sorex fumeus</u>
Pygmy shrew*	<u>Sorex hoyi</u>
Short tailed shrew*	<u>Blarina brevicauda</u>
Snowshoe hare*	<u>Lepus americanus</u>
Red backed vole*	<u>Clethrionomys gapperi</u>
Bog lemming	<u>Synaptomys borealis</u>
Raccoon*	<u>Procyon lotor</u>
Fisher*	<u>Martes pennanti</u>
Mink*	<u>Mustela vison</u>
N. flying squirrel	<u>Glaucomys volans</u>

\*Not seen but suspected of occurring in Maquam Bog

VI FISH OF MAQUAM BOG

Walleye*	<u>Stizostedion vitreum</u>
Pickereel*	<u>Esox sp.</u>
Bass*	<u>Micropterus sp.</u>
Muskellunge*	<u>Esox masquinongy</u>
Northern pike*	<u>Esox sp.</u>

\*Not seen but suspected of occurring in Maquam Bog.