CHARACTERISTICS OF SELECTED PINE BARRENS TREEFROG PONDS IN THE NEW JERSEY PINELANDS

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Introduction

This report presents data on the vegetation, anurans, water chemistry, and physical properties of selected natural and excavated Pinelands ponds that are known to support breeding populations of Pine Barrens treefrogs (*Hyla andersonii*). The 13 ponds (Figure 1, Table 1) were initially selected to study frog and toad adult and larval species composition relative to site-specific, local, and regional environmental variables (Bunnell and Zampella 1999). More recently, the vegetation structure, plant-species composition, and environmental attributes of these same ponds were examined (Zampella and Laidig 2001). The 13 ponds have been the subject of research and monitoring since 1996 and are part of the Pinelands Commission's network of long-term environmental-monitoring program sites. The purpose of this report is to characterize the habitat of known Pine Barrens treefrog breeding populations. The information presented here also provides a baseline data set against which future comparisons of selected biological and environmental attributes can be made.

Methods

Study Sites

The 13 ponds were assigned the names originally given by Bunnell and Zampella (1999). Nine of the 13 ponds are found in what appear to be naturally occurring depressions. These ponds are fairly representative of natural depressions found throughout the central Pinelands. The remaining four ponds (Chew, Hampton, Furnace, and Sphagnum) are found in excavated basins that were probably mined for fill material. County soil surveys indicate that all but one pond (Price) are associated with sandy soils of the Lakewood catena (Tedrow 1979). These soils include the Lakehurst (Haplaquodic Quartzipsamments), Atsion (Aeric Haplaquods), and Berryland (Typic Haplaquods) soil types. Price pond is associated with Fallsington (Typic Ochraquults) sandy-loam soils.

Environmental Characteristics

Data were collected for several morphometric, water quality, and landscape variables. In March 1998, a global positioning system (GPS) was used to delineate the shoreline of each pond. The delineations were completed in March because this month generally represents the period of greatest pond-surface area and water depth. Water depth was measured along four transects passing through the center of each pond and aligned with the major compass directions (N-S, E-W, NE-SW, and NW-SE). The ends of each transect were registered with the GPS. Within 2.5 m of the shoreline, water depth was measured every 0.5 m. All other water-level measurements were made at 2.5-m intervals. From April - September 1996, April - October 1997, and March - October 1998, monthly growing-season staff-gage readings were taken at a single point in each pond. Using the monthly staff-gage measurements in conjunction with the March 1998 point measurements, mean water level, surface-water area, and area of exposed substrate were calculated for each month. Shoreline-depth measurements were used to calculate mean shore slope. Mean slopes were based on the average 0.5 m interval slope for the first 2.5 m of each transect. Bathymetric maps were created for each pond using the GPS-registered water-level data and ARC/INFO software.

Specific conductance and pH were measured during each staff-gage monitoring round from March - June 1998, with an Orion model 122 conductivity meter and an Orion model 250A pH meter. Median pH and specific conductance values were calculated for this sampling period. Water samples were collected for laboratory analysis of total organic carbon (TOC) in June, July, and August 1998. All TOC water samples were collected at a depth of 10 cm at the center of each pond, transported to the lab on ice, and analyzed using a Dohrman DC-80 organic carbon analyzer. Since most ponds were dry in August, average TOC values were calculated using the June and July values ($n = 2$, except for Albertson and Price, where $n = 1$).

To characterize the landscape setting of the ponds, the dominant forest types were subjectively described within the four quarters of a circular buffer surrounding each site by walking around its perimeter and inspecting recent color-infrared photography. Forest types included Atlantic white cedar (*Chamaecyparis thyoides*) swamp, shrub wetlands, wet and dry pitch pine (*Pinus rigida*) lowlands, and upland pitch pine and oak (*Quercus* spp.) forest. Wet and dry pitch pine lowlands represent transitional vegetation types that grade from upland pitch pine forests to swamp forests (Roman et al. 1985, Zampella et al. 1992).

Vegetation Composition and Patch Structure

Comprehensive plant species lists were completed for each pond based on visits made throughout the

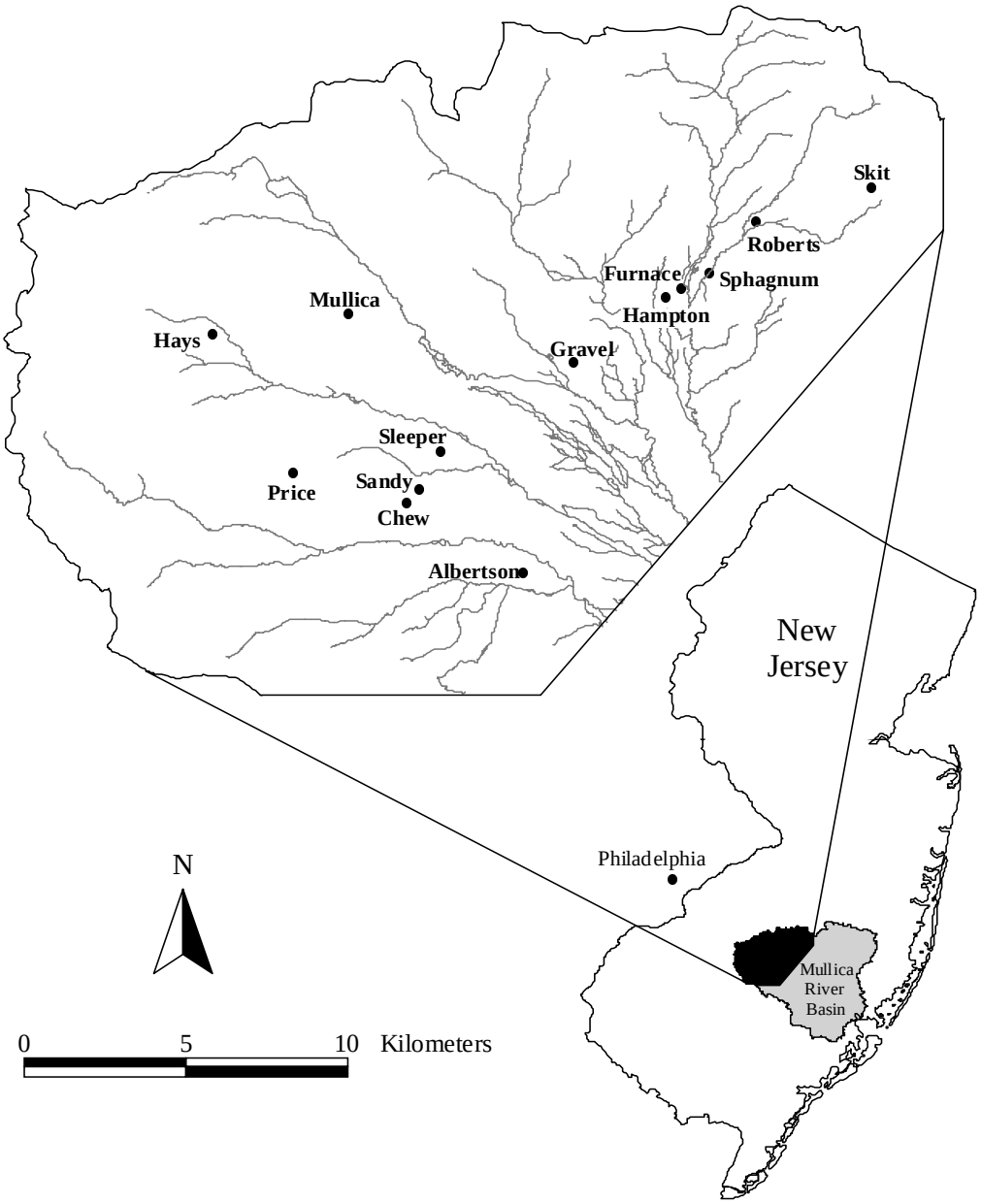

Figure 1. Location of thirteen Pine Barrens treefrog ponds in the Mullica River basin of the New Jersey Pinelands.

1998 growing season. The herbaceous-plant inventory was limited to the area within the pond shoreline. The woody-plant inventory included those found throughout the pond and within a two-meter band surrounding each pond. Taxonomic nomenclature follows Gleason and Cronquist (1991). Boundaries of tree-, shrub-, herbaceous, and *Sphagnum*-dominated patches within the margins of the 13 study ponds were delineated using the GPS. Each patch represented an area of homogenous plant cover ≥ 1 m^2. Tree and shrub patches were delineated in March and herbaceous patches were delineated in June. Herbaceous-patch boundaries were reviewed in September and, where necessary, new boundaries were delineated to reflect major changes in plant cover that occurred since the June survey. The Braun-Blanquet cover scale (Mueller-Dombois and Ellenberg 1974) was used to estimate cover of plant species within each patch. For each patch, only species with cover greater than 5% were tallied. All cover estimates were made in June and September. The large

number of initial detailed-cover types was reduced by classifying and merging patches based on the dominant species present. For cases with more than one dominant species, trees species were considered before shrub species and shrub species were considered before herbaceous species. *Sphagnum* cover was always subordinate to vascular-species cover. Based on the dominant species present, fourteen cover types were derived. ArcView software and the GPS data were used to create cover-type maps and calculate pond and cover-type area for each pond.

Anuran Composition

Surveys of vocalizing, adult anurans were conducted from 1996-1999. Each year, nighttime (dusk to midnight) surveys were conducted at least once per month during the breeding season (late February/early March through June). Survey dates were chosen based on species-specific breeding phenology and weather conditions suitable for anuran vocalizations. The number of vocalizing adults for each species was estimated during a 5-minute period using a ranking scheme where 0 = none, 1 = 1, 2 = 2-5, 3 = 6-10, and 4 = >10 calling individuals.

Data Presentation

To facilitate comparisons between ponds, data on vegetation and anuran composition and environmental charactersitics of the ponds are presented in summary tables. The complete list of herbaceous and woody plant species found at the 13 ponds is presented in Table 2. Maximum calling ranks for anuran species and the number of years a species was heard at a pond are found in Table 3. Pond-water quality, pond morphometry, and vegetation cover-type data are presented in Table 4. Each pond description includes a map of the distribution, configuration, and percent cover of vegetation cover types, lists of the plant and anuran species present, a figure of pond bathymetry showing March 1998 hydrologic conditions, a hydrograph depicting monthly mean water depth for the 1996-1998 growing seasons, and water-quality and pond-morphometry summary statistics. The initial, detailed-cover estimates and the final cover-type designations for all pond-vegetation patches are listed in the Appendix.

Literature Cited

Anderson, K. 1989. A check list of the plants of New Jersey. New Jersey Audubon Society, Rancocas Nature Center, Mount Holly, New Jersey.

Bunnell, J. F. and R. A. Zampella. 1999. Acid water anuran pond communities along a regional forest to agro-urban ecotone. *Copeia* 1999:614-627.

Conant, R. and J. T. Collins. 1998. A field guide to reptiles and amphibians: eastern and central North America, 3rd Edition. Houghton Mifflin Co., Boston, Massachusetts.

Gleason, H. A., and A. Cronquist. 1991. Manual of vascular plants of northeastern United States and adjacent Canada, 2nd Edition. New York Botanical Garden, Bronx, New York.

Mueller-Dombois, D. and H. Ellenberg. 1974. Aims and methods of vegetation ecology. John Wiley and Sons, New York, New York.

Roman, C. T., R. A. Zampella, and A. Z. Jaworsksi, 1985. Wetland boundaries in the New Jersey Pinelands: ecological relationships and delineation. Water Resources Bulletin 21:1005-1011.

Tedrow, J. C. F. 1979. Development of Pine Barrens soils. p. 61-79. *In* R. T. T. Forman (ed) Pine Barrens: Ecosystem and Landscape. Academic Press, New York, New York.

Zampella, R. A. and K. J. Laidig. 2001. Species composition and patch structure of coastal plain vegetation in Pinelands ponds: a comparison of natural and excavated basins. Pinelands Commission, New Lisbon, New Jersey.

Zampella, R. A., G. A. Moore, and R. E. Good. 1992. Gradient analysis of Pitch Pine (*Pinus rigida* Mill.) lowland communities in the New Jersey Pinelands. Bulletin of the Torrey Botanical Club 119:253-261.

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Table 1. Selected Pine Barrens treefrog ponds in the New Jersey Pinelands. Latitude, longitude, and USGS 7.5 minute topographic quadrangle names are given in parentheses.

Site Name and Location
Albertson Pond
Hammonton Twp., Atlantic Co. (lat 39°41'10.44", long 74°44'22.75", Atsion quad). Eastern side of Route 206, between Great Swamp Branch and Albertson Brook.
Chew Pond
Waterford Twp., Camden Co. (lat 39°42'22.88", long 74°46'52.74", Hammonton quad). Northern side of Chew Road (Route 536), between Sandy Causeway Road and railroad.
Furnace Pond
Shamong Twp., Burlington Co. (lat 39°46'07.15", long 74°40'57.67", Indian Mills quad). Northern side of Hampton Road, near Hampton Furnace.
Gravel Pond
Shamong Twp., Burlington Co. (lat 39°44'49.13", long 74°43'15.80", Atsion quad). Northern side of Hampton Road, near excavated area between Route 206 and Stokes Road (Route 541).
Hampton Pond
Shamong Twp., Burlington Co. (lat 39°45'56.83", long 74°41'16.29", Indian Mills quad). Southern side of Hampton Road, between Deep Run tributary and Hampton Furnace.
Hays Pond
Waterford Twp., Camden Co. (lat 39°45'17.65", long 74°51'06.62", Medford Lakes quad). Southern side of sand road on southern side of Hays Mill Creek, west of Tremont Avenue.
Mullica Pond
Waterford Twp., Camden Co. (lat 39°45'39.37", long 74°48'09.27", Medford Lakes quad). South of Old Jackson-Atsion Road and west of the Mullica River.
Price Pond
Waterford Twp., Camden Co. (lat 39°42'51.74", long 74°49'20.20", Hammonton quad). South of Chew Road (Route 536), between Pestleton Road and Clark Branch.
Roberts Pond
Tabernacle Twp., Burlington Co. (lat 39°47'16.86", long 74°39'21.64", Indian Mills quad). Northern side of middle sand road between Skit and Roberts (Tom Roberts) Branches, upstream from Carranza Road.
Sandy Pond
Waterford Twp., Camden Co. (lat 39°42'35.35", long 74°46'36.80", Hammonton quad). Western side of Sandy Causeway Road, between Chew Road (Route 536) and railroad.
Skit Pond
Tabernacle Twp., Burlington Co. (lat 39°47'51.53", long 74°36'51.42", Chatsworth quad). South of Tabernacle-Chatsworth Road (Route 532), north of railroad, east of Skit Branch.
Sleeper Pond
Waterford Twp., Camden Co. (lat 39°43'16.89", long 74°46'09.29", Hammonton quad). North of Fleming Pike, east of Burnt House Road, south of Sleeper Branch.
Sphagnum Pond
Shamong Twp., Burlington Co. (lat 39°46'22.15", long 74°40'20.70", Indian Mills quad). Upstream from Hampton Road, adjacent to dike, on eastern side of Skit Branch.

Table 2. Plant species present (1998) at selected Pine Barrens treefrog ponds in the New Jersey Pinelands. Filled circles indicate a species was present at a pond. Nomenclature follows Gleason and Cronquist (1991) and Anderson (1989) for scientific and common names, respectively.

Scientific Name	Common Name	Ponds												
		Albertson	Chew	Furnace	Gravel	Hampton	Hays	Mullica	Price	Roberts	Sandy	Skit	Sleeper	Sphagnum
Herbaceous plants:														
Andropogon virginicus var. abbreviatus	bushy beard-grass	-	•	-	-	-	-	-	-	-	-	-	-	-
Aristida longespica	slender three-awn	-	•	-	-	-	-	-	-	-	-	-	-	-
Carex striata	Walter's sedge	•	-	-	•	-	-	•	•	-	•	•	•	-
Cladium mariscoides	twig-rush	-	-	-	-	-	-	-	-	-	-	-	-	•
Cyperus dentatus	toothed cyperus	-	•	-	-	-	-	-	-	-	-	-	-	•
Cyperus retrorsus	Pine Barrens cyperus	-	-	-	-	-	-	-	-	•	-	-	-	-
Decodon verticillatus	swamp loosestrife	-	-	-	•	-	•	•	-	-	-	-	-	-
Drosera filiformis	thread-leaved sundew	-	•	-	-	-	-	-	-	-	-	-	-	-
Drosera intermedia	spatulate-leaved sundew	•	•	•	-	•	-	-	-	•	-	•	-	•
Drosera rotundifolia	round-leaved sundew	-	-	-	-	-	-	-	-	•	-	-	-	-
Dulichium arundinaceum	Dulichium or three-way sedge	•	-	-	•	-	•	-	•	-	-	•	•	•
Eleocharis flavescens var. olivacea	green spike-rush	-	-	-	•	-	•	•	•	•	-	-	•	-
Eleocharis microcarpa	small-fruited spike-rush	-	•	•	-	•	-	•	•	-	-	-	-	-
Eleocharis robbinsii	Robbin's spike-rush	-	-	-	-	-	-	-	-	-	-	-	-	•
Eleocharis tenuis	slender spike-rush	-	-	•	-	•	-	-	-	-	-	-	-	-
Eleocharis tricostata	three-ribbed spike-rush	-	•	-	-	-	•	-	-	-	-	-	-	-
Eleocharis tuberculosa	tubercled spike-grass	-	-	-	-	-	-	-	-	-	-	-	-	•
Erianthus giganteus	plume-grass	-	-	-	-	•	-	-	-	-	-	-	-	-
Euthamia tenuifolia	slender-leaved goldenrod	-	•	-	-	-	-	-	-	-	-	-	-	-
Gratiola aurea	golden hedge hyssop	-	•	-	-	-	-	-	-	-	-	-	-	-
Hypericum canadense	Canada Saint John's-wort	-	•	-	-	-	-	-	-	-	-	-	-	-
Hypericum mutilum	dwarf Saint John's-wort	-	•	-	-	-	-	-	-	-	-	-	-	-
Juncus pelocarpus	brown-fruited rush	-	•	•	-	•	-	-	•	-	-	-	•	•
Lachnanthes caroliniana	redroot	-	-	-	-	-	-	-	-	-	•	-	-	•
Lycopodium appressum	southern bog clubmoss	-	•	-	-	•	-	-	-	-	-	-	-	-
Muhlenbergia torreyana	Torrey's dropseed	-	•	-	-	-	-	-	-	-	-	-	-	-
Nuphar variegata	bullhead lily	-	-	-	-	-	-	-	-	-	-	-	-	•
Nymphaea odorata	white water lily	-	-	-	-	-	-	-	-	-	-	-	•	•
Orontium aquaticum	golden club	-	-	-	-	-	-	-	-	-	-	-	-	•
Osmunda regalis	royal fern	-	•	-	-	-	-	-	-	-	-	-	-	-
Panicum longifolium	long-leaved panic-grass	-	•	•	-	-	-	-	•	-	-	-	-	-
Panicum spretum	Eaton's panic-grass	-	•	•	-	-	-	-	-	-	-	-	-	-
Panicum verrucosum	warty panic-grass	•	•	•	-	•	•	•	•	•	-	•	•	•
Panicum virgatum	switchgrass	-	-	-	-	•	-	-	-	-	-	-	-	-
Peltandra virginica	arrow arum	-	-	-	-	-	-	-	-	-	-	-	-	•
Proserpinaca pectinata	cut-leaved mermaid-weed	•	•	•	-	•	-	-	-	-	-	-	-	-
Rhexia virginica	Virginia meadow beauty	•	•	-	-	•	-	-	•	•	-	-	-	•
Rhynchospora alba	white beaked-rush	-	-	-	•	-	-	-	-	-	-	•	-	-
Rhynchospora capitellata	small-headed beaked-rush	-	•	-	-	-	-	-	-	-	-	-	-	-
Rhynchospora chalarocephala	loose-headed beaked-rush	-	•	-	-	-	-	-	-	-	-	-	-	-
Sarracenia purpurea	pitcher plant	-	-	-	•	-	-	-	-	-	-	-	-	-

Scientific Name	Common Name	Ponds												
		Albertson	Chew	Furnace	Gravel	Hampton	Hays	Mullica	Price	Roberts	Sandy	Skit	Sleeper	Sphagnum
Scirpus cyperinus	wool-grass	-	-	-	-	•	-	-	•	-	-	-	-	-
Scirpus subterminalis	water club-rush	-	-	-	-	-	-	-	-	-	-	-	-	•
Triadenum virginicum	marsh Saint John's-wort	-	-	•	-	-	-	•	•	-	-	-	-	•
Utricularia fibrosa	fibrous bladderwort	-	-	-	•	-	-	-	•	-	•	-	-	-
Utricularia geminiscapa	hidden-fruited bladderwort	•	•	-	-	-	-	-	•	-	-	-	•	-
Utricularia purpurea	purple bladderwort	-	-	-	-	-	-	-	-	-	-	-	-	•
Utricularia sp.	bladderwort species	-	-	•	-	-	•	-	-	-	-	-	-	-
Viola lanceolata	lance-leaved violet	-	•	-	-	-	-	-	-	-	-	-	-	-
Woodwardia virginica	Virginia chain fern	•	-	-	•	-	-	•	-	•	•	-	•	-
Xyris difformis	yellow-eyed grass	-	•	•	-	-	-	-	-	-	-	-	•	•
Xyris smalliana	Small's yellow-eyed grass	-	-	-	-	•	-	-	-	-	-	-	-	-
Woody plants:														
Acer rubrum	red maple	•	•	•	•	•	•	•	•	•	•	•	•	-
Amelanchier canadensis	oblongleaf juneberry	-	•	-	•	-	-	-	-	-	-	-	-	-
Aronia arbutifolia	red chokeberry	•	•	-	•	•	•	-	-	-	•	•	-	-
Betula populifolia	gray birch	-	•	-	•	-	-	-	-	-	-	-	-	-
Cephalanthus occidentalis	buttonbush	-	-	-	-	-	-	-	•	-	-	-	-	-
Chamaecyparis thyoides	Atlantic white cedar	-	-	-	•	-	-	-	-	•	•	-	-	•
Chamaedaphne calyculata	leatherleaf	•	•	•	•	•	•	•	•	•	•	-	•	•
Clethra alnifolia	sweet pepperbush	•	-	•	-	-	-	-	•	-	•	-	•	-
Comptonia peregrina	sweet fern	-	•	-	-	-	-	-	-	-	-	-	-	-
Eubotrys racemosa	fetterbush	•	•	•	•	•	•	-	•	•	•	•	•	•
Gaultheria procumbens	wintergreen	-	•	•	-	•	-	-	-	-	-	-	-	-
Gaylussacia baccata	black huckleberry	-	•	•	-	•	-	-	-	-	-	-	-	-
Gaylussacia dumosa	dwarf huckleberry	-	-	-	-	-	-	-	-	-	-	-	-	•
Gaylussacia frondosa	dangleberry	•	-	•	•	•	-	•	-	-	-	•	•	•
Hudsonia ericoides	golden heather	-	-	-	-	•	-	-	-	-	-	-	-	-
Ilex glabra	inkberry	-	•	•	-	•	-	-	-	-	-	-	•	-
Ilex opaca	American holly	-	-	•	•	-	-	-	-	-	-	-	-	-
Kalmia angustifolia	sheep laurel	•	•	•	•	•	-	•	•	•	•	•	•	•
Kalmia latifolia	mountain laurel	-	•	-	-	-	-	-	-	-	-	-	-	-
Leiophyllum buxifolium	sand myrtle	-	•	•	-	•	-	-	-	-	-	-	-	-
Lyonia mariana	staggerbush	•	•	•	-	•	•	•	•	-	-	-	•	-
Magnolia virginiana	sweet bay	-	-	-	•	-	-	-	-	-	-	-	-	-
Myrica pensylvanica	bayberry	-	-	•	-	•	-	-	-	-	-	-	-	-
Nyssa sylvatica	sour gum	•	•	•	-	•	•	-	-	-	-	-	•	-
Pinus rigida	pitch pine	•	•	•	•	•	•	•	•	•	•	•	•	-
Quercus ilicifolia	scrub oak	-	•	•	-	•	-	-	-	-	-	-	-	-
Quercus marilandica	black-jack oak	-	-	•	-	•	-	-	-	-	-	-	-	-
Rhododendron viscosum	swamp azalea	-	-	•	•	-	-	-	-	-	-	-	-	-
Sassafras albidum	sassafras	-	•	-	-	-	-	-	-	-	-	-	-	-
Smilax glauca	glaucous greenbrier	-	-	•	-	•	-	-	-	•	-	-	•	-
Smilax rotundifolia	common greenbrier	•	•	•	-	-	•	•	•	-	•	-	•	•
Toxicodendron radicans	poison ivy	-	-	-	-	-	-	•	-	-	-	-	-	-
Vaccinium corymbosum	highbush blueberry	•	•	•	•	•	•	•	•	•	•	•	•	•
Vaccinium macrocarpon	large cranberry	-	•	•	•	•	-	-	-	-	•	-	-	•

Table 3. Anuran species present (1996-1999) at selected Pine Barrens treefrog ponds in the New Jersey Pinelands. Maximum calling ranks for the period of record are listed. Calling ranks are as follows: 1 = 1, 2 = 2-5, 3 = 6-10, and 4 = >10 calling individuals. The number of years (maximum of four) that a species was heard at a pond is given in parentheses. Nomenclature follows Conant and Collins (1998).

	Ponds												
Scientific Name/Common Name	Albertson	Chew	Furnace	Gravel	Hampton	Hays	Mullica	Price	Roberts	Sandy	Skit	Sleeper	Sphagnum
Acris crepitans crepitans northern cricket frog	-	-	-	-	-	1(1)	-	-	-	-	-	-	-
Bufo woodhousii fowleri Fowler's toad	-	1(1)	1(1)	-	1(1)	-	4(2)	1(1)	-	-	2(1)	-	-
Hyla andersonii Pine Barrens treefrog	2(4)	4(4)	3(3)	2(4)	4(4)	4(4)	4(4)	3(4)	3(3)	4(4)	4(3)	4(4)	4(4)
Hyla versicolor northern gray treefrog	-	2(2)	-	-	-	-	2(2)	1(2)	-	-	-	1(1)	-
Pseudacris crucifer crucifer northern spring peeper	3(1)	4(4)	4(4)	2(3)	4(4)	4(4)	4(4)	4(4)	2(2)	4(4)	4(4)	4(4)	4(4)
Pseudacris triseriata kalmi New Jersey chorus frog	-	4(4)	-	-	-	2(2)	-	-	-	2(1)	-	2(2)	-
Rana catesbeiana bullfrog	-	-	-	-	-	-	-	1(1)	-	-	-	-	-
Rana clamitans melanota green frog	1(1)	2(4)	2(1)	2(3)	2(3)	2(3)	1(2)	4(3)	1(1)	3(2)	2(1)	2(3)	2(4)
Rana sylvatica wood frog	4(1)	2(2)	2(1)	-	1(1)	2(1)	2(2)	4(3)	-	2(2)	-	1(1)	-
Rana utricularia southern leopard frog	4(2)	2(4)	2(3)	3(3)	3(4)	2(4)	2(3)	3(4)	-	4(4)	2(3)	4(4)	2(4)
Rana virgatipes carpenter frog	-	-	1(1)	3(4)	1(4)	-	1(1)	-	-	3(4)	1(3)	1(1)	2(4)
Total anuran species	5	8	7	5	7	7	8	8	3	7	6	8	5

Table 4. Attributes of selected Pine Barrens treefrog ponds in the New Jersey Pinelands. Refer to Methods for explanation of variables.

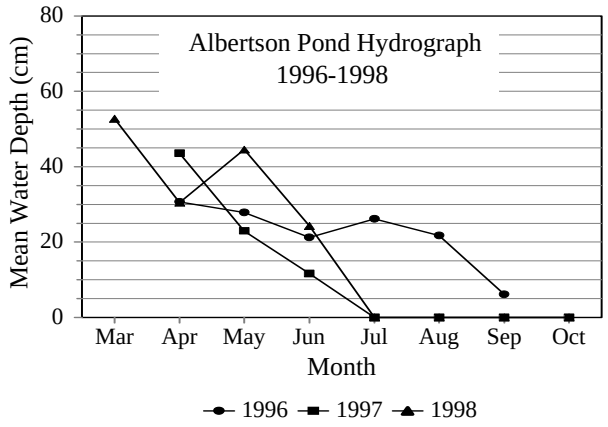
Attribute	Albertson	Chew	Furnace	Gravel	Hampton	Hays	Mullica	Price	Roberts	Sandy	Skit	Sleeper	Sphagnum
Water Quality (March-June 1998)													
median pH	4.0	4.5	4.4	3.9	4.6	3.9	3.8	4.0	3.8	3.9	3.8	4.0	4.3
med. specific conductance (µS/cm)	59	44	28	63	23	63	69	63	83	75	76	48	33
med. total organic carbon (mg/L)	34	8	10	38	11	36	31	27	41	25	53	30	4
Morphometry (March 1998)													
total pond area (m^2)	820	2148	153	2638	420	1536	5119	2426	412	7808	2973	3266	336
open water area (m^2)	387	2148	153	1574	420	616	2420	1776	168	5409	1166	2159	336
mean water depth (cm)	53	63	65	31	51	54	30	57	30	37	33	46	56
maximum water depth (cm)	66	124	81	56	79	94	55	115	55	55	62	75	88
mean shore slope (rise/run)	0.08	0.31	0.21	0.08	0.26	0.09	0.04	0.05	0.04	0.01	0.06	0.08	0.21
Vegetation (1998)													
herbaceous species richness	8	25	11	8	12	6	7	12	7	4	5	9	18
woody species richness	12	21	22	15	20	9	9	10	8	11	7	13	9
number of vegetation patches	21	4	5	19	8	11	39	52	5	14	14	13	9
number of vegetation cover-types	4	2	3	7	3	5	7	10	4	5	4	5	3
percentage of pond area of the following cover types:													
Acer rubrum	38.3	-	-	-	-	-	1.3	12.0	-	0.8	-	4.8	-
Aquatic vegetation	-	-	-	-	-	-	-	-	-	-	-	-	69.2
Bare substrate	-	-	-	3.3	-	-	-	24.9	5.0	-	-	-	21.1
Carex striata	-	-	-	28.0	-	-	1.4	7.3	-	63.7	4.8	45.4	-
Chamaedaphne calyculata	21.4	-	-	45.5	-	4.6	48.6	33.8	1.1	35.0	-	30.2	-
Chamaecyparis thyoides	-	-	-	-	-	-	-	-	-	0.3	-	-	-
Decodon verticillatus	-	-	-	0.1	-	3.8	3.3	2.7	-	-	-	-	-
Dulichium arundinaceum	2.4	-	-	2.0	-	-	-	3.1	-	-	-	-	-
Emergent herb	-	96.8	62.6	-	84.5	-	-	-	-	-	-	17.0	-
Panicum verrucosum	-	-	-	-	-	8.5	-	8.0	-	-	9.6	-	-
Panicum longifolium/P. virgatum	-	3.2	4.3	-	8.9	-	-	2.5	-	-	-	-	-
Pinus rigidia	-	-	-	0.2	-	-	3.1	-	-	-	-	-	-
Sphagnum sp.	37.9	-	33.1	20.9	6.6	27.8	41.5	5.7	34.7	-	24.6	2.6	9.7
Vaccinium corymbosum	-	-	-	-	-	55.4	0.8	0.1	59.2	0.1	60.9	-	-

POND DESCRIPTIONS

Albertson pond is a natural depression located between Great Swamp Branch and Albertson Brook, east of Route 206, in Hammonton Township, Atlantic County (Latitude 39°41'10.44" Longitude 74°44'22.75"). The surrounding vegetation communities consist of pine-oak upland and dry to wet pine lowlands. Vegetation toward the perimeter of the pond consists of patches dominated by leatherleaf or red maple with a leatherleaf understory. The open water portion of the pond supports floating *Sphagnum* species. Substrate exposed during the draw-down period of late summer supports patches of three-way sedge. Low numbers of Pine Barrens treefrogs are consistently detected at Albertson pond. Large choruses of wood frogs and leopard frogs are occasionally heard.

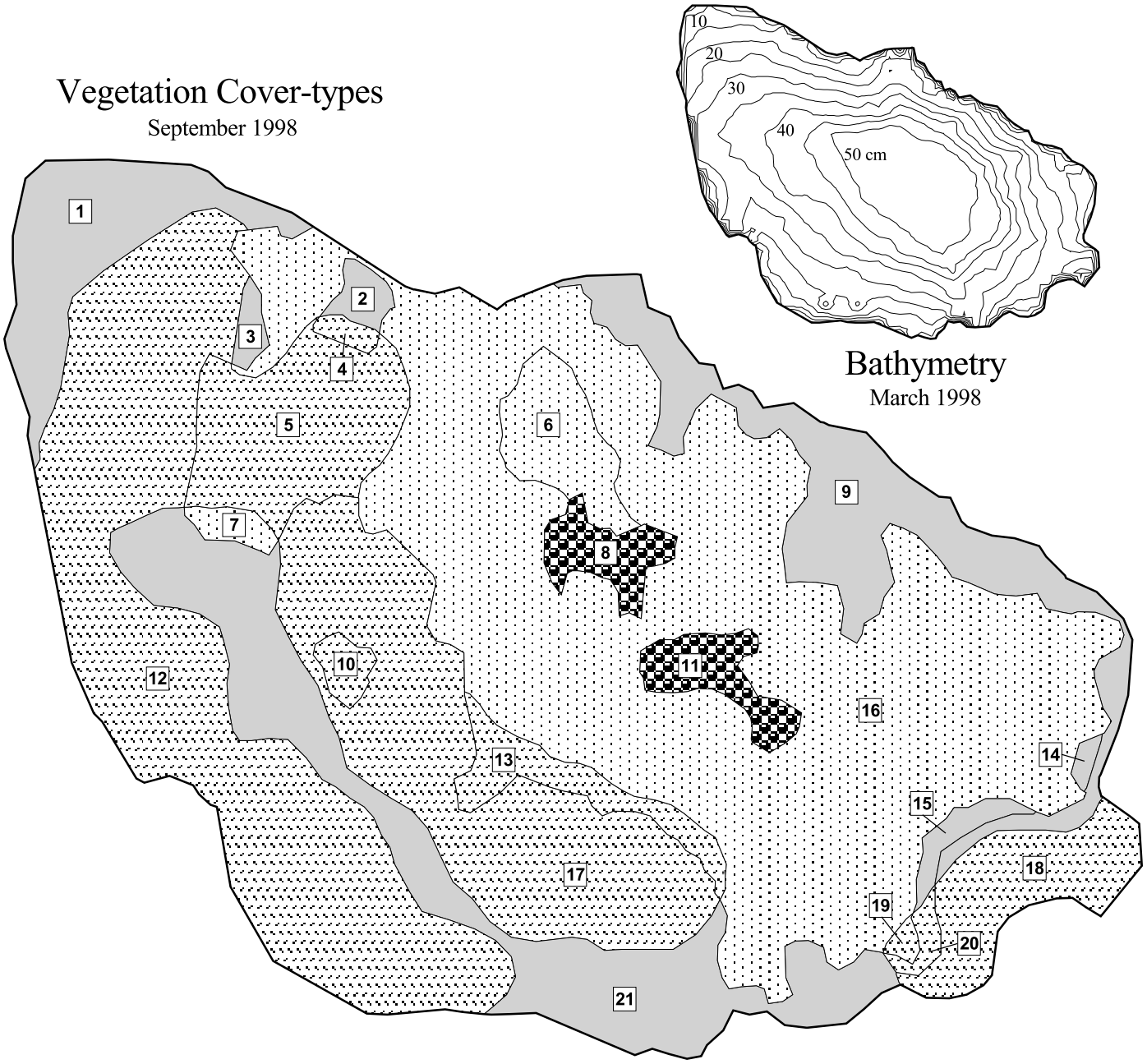
Plant species present in 1998
Herbaceous plants:
Carex striata
Drosera intermedia
Dulichium arundinaceum
Panicum verrucosum
Proserpinaca pectinata
Rhexia virginica
Utricularia geminiscapa
Woodwardia virginica
Woody plants:
Acer rubrum
Aronia arbutifolia
Chamaedaphne calyculata
Clethra alnifolia
Eubotrys racemosa
Gaylussacia frondosa
Kalmia angustifolia
Lyonia mariana
Nyssa sylvatica
Pinus rigida
Smilax rotundifolia
Vaccinium corymbosum

Environmental attributes	
Water Quality (March-June 1998)	
median pH	4.0
med. specific conductance (µS/cm)	59
med. total organic carbon (mg/L)	34
Morphometry (March 1998)	
total pond area (m^2)	820
open water area (m^2)	387
mean water depth (cm)	53
maximum water depth (cm)	66
mean shore slope (rise/run)	0.08



Anuran species present in 1996-1999.	
Hyla andersonii	Pine Barrens treefrog
Pseudacris c. crucifer	northern spring peeper
Rana clamitans melanota	green frog
Rana sylvatica	wood frog
Rana utricularia	southern leopard frog

Albertson



Major Vegetation Cover-types
(Percentage of Pond Area)

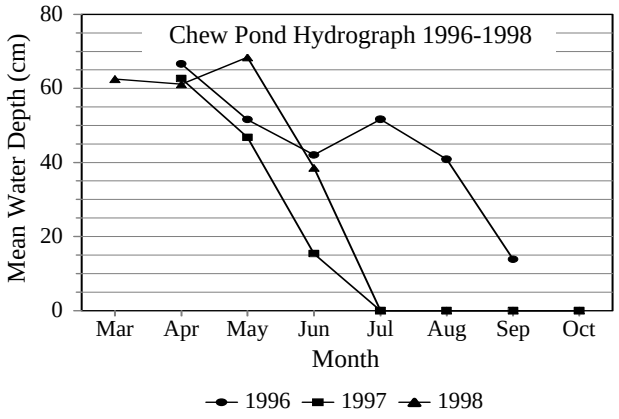
	Acer rubrum	(38.3%)
	Chamaedaphne calyculata	(21.4%)
	Dulichium arundinaceum	(2.4%)
	Sphagnum species	(37.9%)

1 refer to the Appendix for vegetation cover details of individual patches

Chew pond is an excavated basin located on the northern side of Chew Road, between Sandy Causeway Road and a railroad, in Waterford Township, Camden County (Latitude 39˚42'22.88" Longitude 74˚46'52.74"). The surrounding vegetation consists of pine-scrub oak upland. Chew pond lacks a perimeter shrub zone and exhibits steep shore slopes. This pond supports the highest plant-species richness of the 13 study ponds. Chew Pond supports high anuran-species richness, with Pine Barrens treefrogs, spring peepers, chorus frogs, wood frogs, and leopard frogs regularly detected.

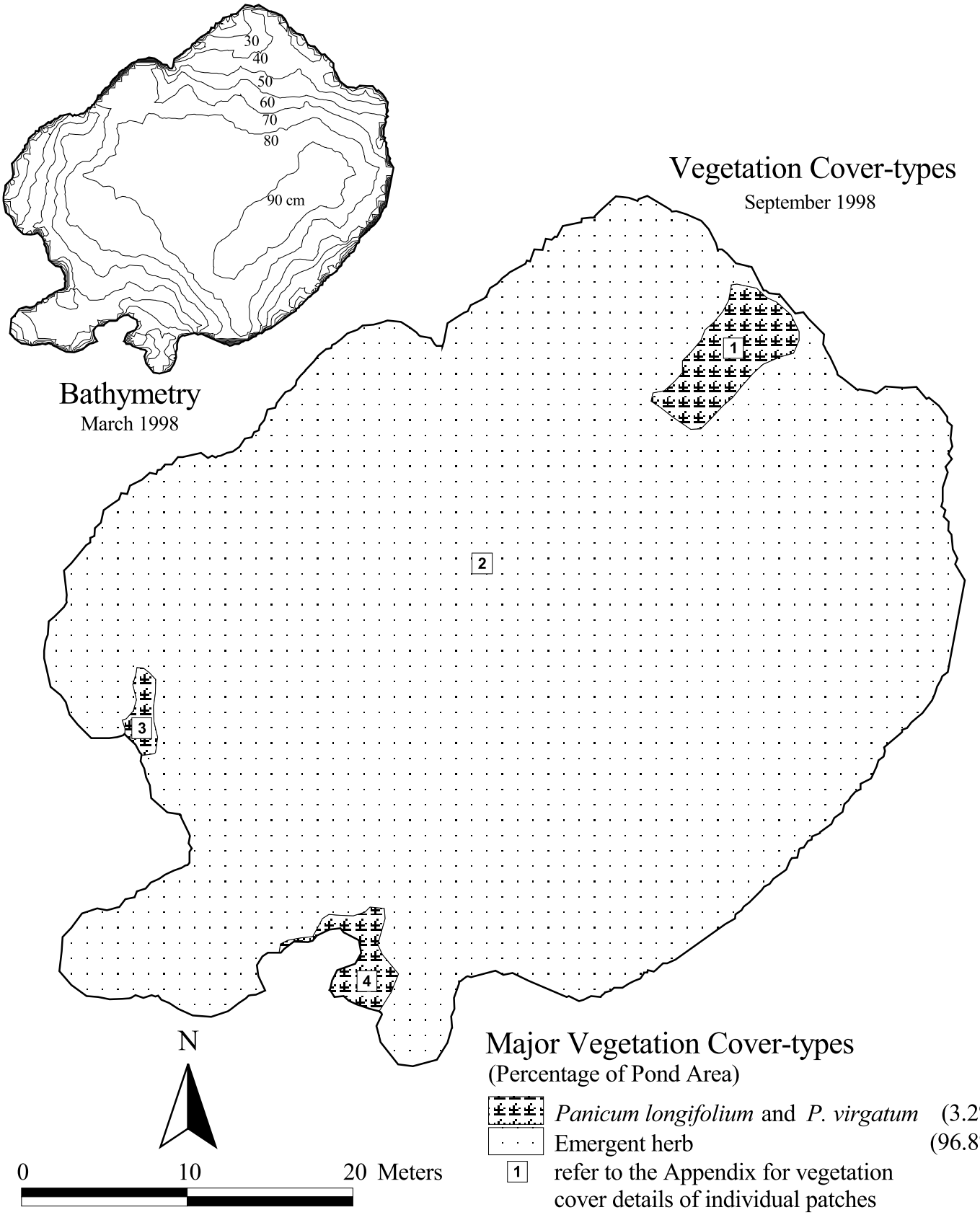
Plant species present in 1998
Herbaceous plants:
Andropogon virginicus var. abbreviatus
Aristida longespica
Cyperus dentatus
Drosera filiformis
Drosera intermedia
Eleocharis microcarpa
Eleocharis tricostata
Euthamia tenuifolia
Gratiola aurea
Hypericum canadense
Hypericum mutilum
Juncus pelocarpus
Lycopodium appressum
Muhlenbergia torreyana
Osmunda regalis
Panicum longifolium
Panicum spretum
Panicum verrucosum
Proserpinaca pectinata
Rhexia virginica
Rhynchospora capitellata
Rhynchospora chalarocephala
Utricularia geminiscapa
Viola lanceolata
Xyris difformis
Woody plants:
Acer rubrum
Amelanchier canadensis
Aronia arbutifolia
Betula populifolia
Chamaedaphne calyculata
Comptonia peregrina
Eubotrys racemosa
Gaultheria procumbens
Gaylussacia baccata
Ilex glabra
Kalmia angustifolia
Kalmia latifolia
Leiophyllum buxifolium
Lyonia mariana
Nyssa sylvatica
Pinus rigida
Quercus ilicifolia
Sassafras albidum
Smilax rotundifolia
Vaccinium corymbosum
Vaccinium macrocarpon

Environmental attributes	
Water Quality (March-June 1998)	
median pH	4.5
med. specific conductance (µS/cm)	44
med. total organic carbon (mg/L)	8
Morphometry (March 1998)	
total pond area (m^2)	2148
open water area (m^2)	2148
mean water depth (cm)	63
maximum water depth (cm)	124
mean shore slope (rise/run)	0.31



Anuran species present in 1996-1999.	
Bufo woodhousii fowleri	Fowler's toad
Hyla andersonii	Pine Barrens treefrog
Hyla versicolor	northern gray treefrog
Pseudacris c. crucifer	northern spring peeper
Pseudacris triseriata kalmi	New Jersey chorus frog
Rana clamitans melanota	green frog
Rana sylvatica	wood frog
Rana utricularia	southern leopard frog

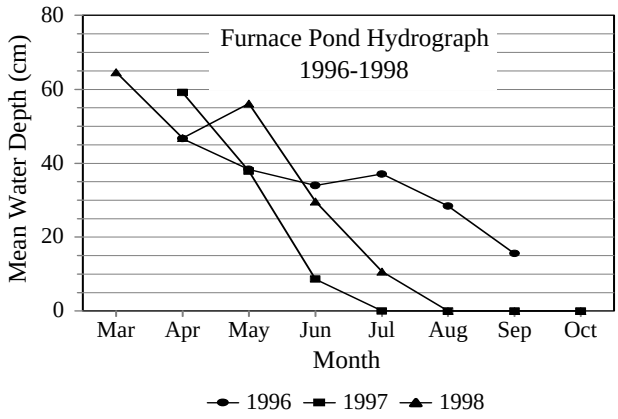
Chew


30
40
50
60
70
80
90 cm
Bathymetry
March 1998
Vegetation Cover-types
September 1998
1
2
3
4
N
0
10
20 Meters
Major Vegetation Cover-types
(Percentage of Pond Area)
Panicum longifolium and P. virgatum (3.2%)
Emergent herb (96.8%)
1 refer to the Appendix for vegetation cover details of individual patches

Furnace pond is a small borrow pit located on the northern side of Hampton Road, near Hampton Furnace, in Shamong Township, Burlington County (Latitude 39˚46'07.15" Longitude 74˚40'57.67"). The pond is situated in a dry to wet pitch pine lowland. Scattered emergent, herbaceous plants dominate the flora. The cut banks and lack of perimeter shrub zone are typical features of an excavated basin. Pine Barrens treefrogs, spring peepers, and leopard frogs have been detected in three or more survey years.

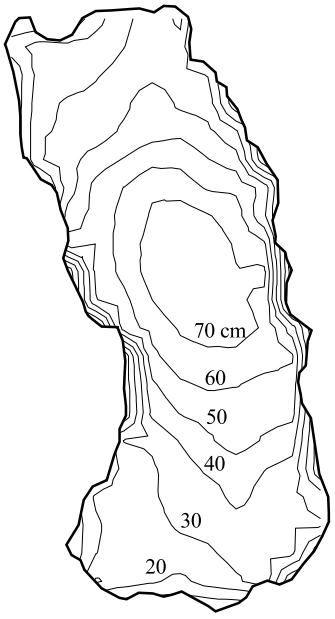
Plant species present in 1998
Herbaceous plants:
Drosera intermedia
Eleocharis microcarpa
Eleocharis tenuis
Juncus pelocarpus
Panicum longifolium
Panicum spretum
Panicum verrucosum
Proserpinaca pectinata
Triadenum virginicum
Utricularia sp.
Xyris difformis
Woody plants:
Acer rubrum
Chamaedaphne calyculata
Clethra alnifolia
Eubotrys racemosa
Gaultheria procumbens
Gaylussacia baccata
Gaylussacia frondosa
Ilex glabra
Ilex opaca
Kalmia angustifolia
Leiophyllum buxifolium
Lyonia mariana
Myrica pensylvanica
Nyssa sylvatica
Pinus rigida
Quercus ilicifolia
Quercus marilandica
Rhododendron viscosum
Smilax glauca
Smilax rotundifolia
Vaccinium corymbosum
Vaccinium macrocarpon

Environmental attributes	
Water Quality (March-June 1998)	
median pH	4.4
med. specific conductance (µS/cm)	28
med. total organic carbon (mg/L)	10
Morphometry (March 1998)	
total pond area (m^2)	153
open water area (m^2)	153
mean water depth (cm)	65
maximum water depth (cm)	81
mean shore slope (rise/run)	0.21



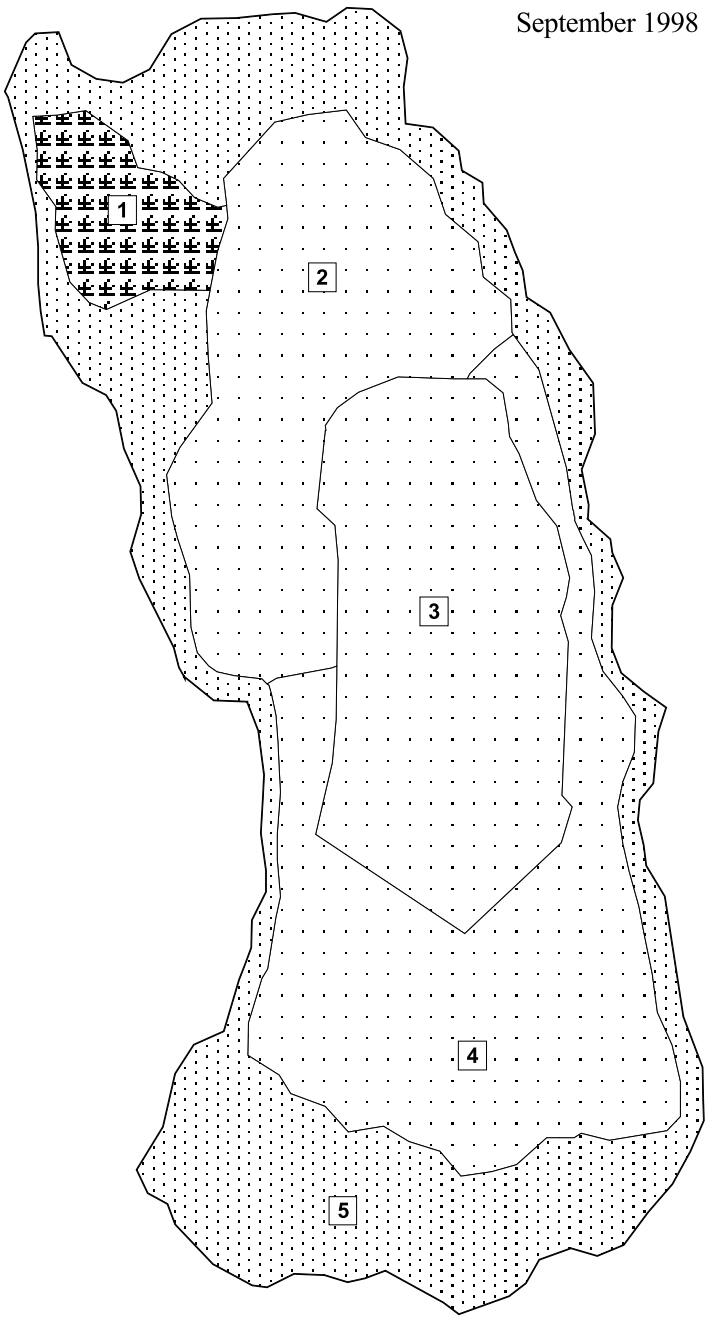
Anuran species present in 1996-1999.	
Bufo woodhousii fowleri	Fowler's toad
Hyla andersonii	Pine Barrens treefrog
Pseudacris c. crucifer	northern spring peeper
Rana clamitans melanota	green frog
Rana sylvatica	wood frog
Rana utricularia	southern leopard frog
Rana virgatipes	carpenter frog

Furnace



Bathymetry
March 1998

Vegetation Cover-types
September 1998



N

0 3 6 Meters

Major Vegetation Cover-types
(Percentage of Pond Area)

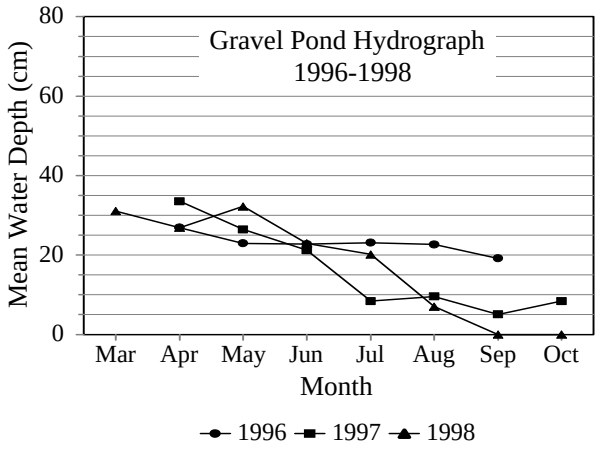
- *Panicum longifolium* and *P. virgatum* (4.3%)
- *Sphagnum* species (33.1%)
- Emergent herb (62.6%)

1 refer to the Appendix for vegetation cover details of individual patches

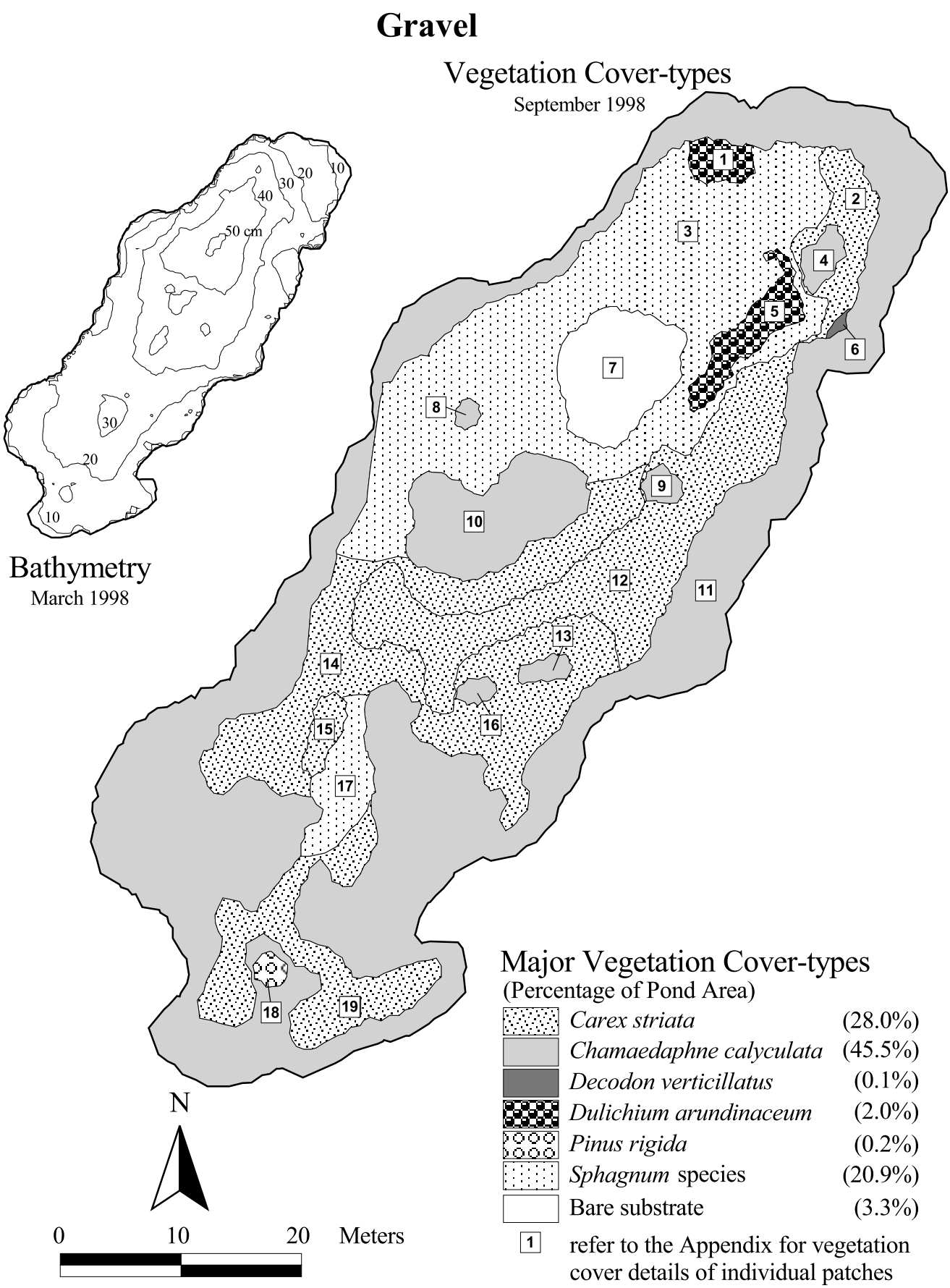
Gravel pond is a natural depression located on the northern side of Hampton Road, between Route 206 and Stokes Road, in Shamong Township, Burlington County (Latitude 39˚44'49.13"Longitude 74˚43'15.80"). Gravel Pond is contained within a larger, circular wetland dominated by shrubs and scrub red maple. A portion of the pond is bordered by a pine-hardwood swamp. Leatherleaf dominates the outer vegetation zone and Walter's sedge dominates much of the rest of the pond. Each of the five anuran species listed below have been detected in at least three survey years, though not in large numbers.

Plant species present in 1998
Herbaceous plants:
Carex striata
Decodon verticillatus
Dulichium arundinaceum
Eleocharis flavescens var. olivacea
Rhynchospora alba
Sarracenia purpurea
Utricularia fibrosa
Woodwardia virginica
Woody plants:
Acer rubrum
Amelanchier canadensis
Aronia arbutifolia
Betula populifolia
Chamaecyparis thyoides
Chamaedaphne calyculata
Eubotrys racemosa
Gaylussacia frondosa
Ilex opaca
Kalmia angustifolia
Magnolia virginiana
Pinus rigida
Rhododendron viscosum
Vaccinium corymbosum
Vaccinium macrocarpon

Environmental attributes	
Water Quality (March-June 1998)	
median pH	3.9
med. specific conductance	63
med. total organic carbon (mg/L)	38
Morphometry (March 1998)	
total pond area (m^2)	2638
open water area (m^2)	1574
mean water depth (cm)	31
maximum water depth (cm)	56
mean shore slope (rise/run)	0.08



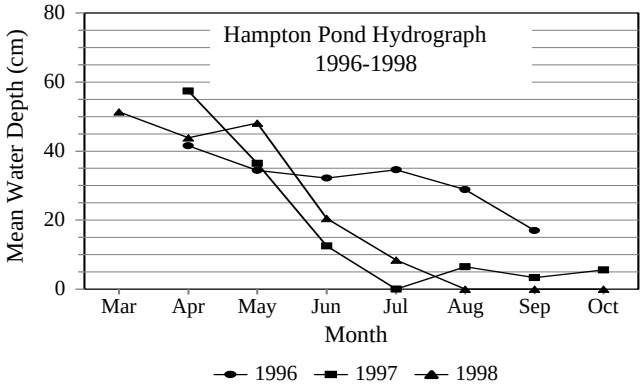
Anuran species present in 1996-1999.	
Hyla andersonii	Pine Barrens treefrog
Pseudacris c. crucifer	northern spring peeper
Rana clamitans melanota	green frog
Rana utricularia	southern leopard frog
Rana virgatipes	carpenter frog


Gravel
Vegetation Cover-types
September 1998
Bathymetry
March 1998
10
20
30
40
50 cm
30
20
10
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
N
0
10
20
Meters
Major Vegetation Cover-types
(Percentage of Pond Area)
Carex striata (28.0%)
Chamaedaphne calyculata (45.5%)
Decodon verticillatus (0.1%)
Dulichium arundinaceum (2.0%)
Pinus rigida (0.2%)
Sphagnum species (20.9%)
Bare substrate (3.3%)
1 refer to the Appendix for vegetation cover details of individual patches

Hampton pond is a small borrow pit located on the southern side of Hampton Road, between Deep Run tributary and Hampton Furnace, in Shamong Township, Burlington County (Latitude 39˚45'56.83" Longitude 74˚41'16.29"). The surrounding vegetation consists of dry to wet pine lowlands. This excavated basin has steep shore slopes and lacks a perimeter shrub zone. Emergent and wetland herbs dominate the plant community. Pine Barrens treefrogs, spring peepers, and leopard frogs are consistently heard at this pond.

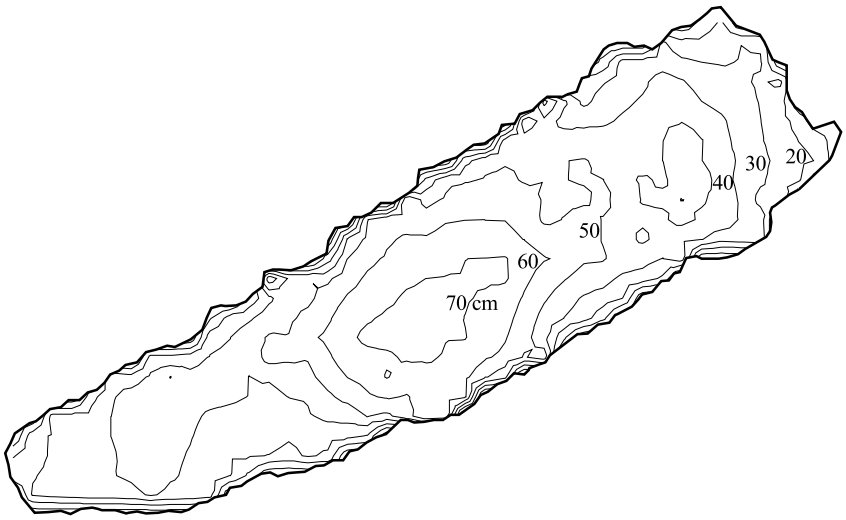
Plant species present in 1998
Herbaceous plants:
Drosera intermedia
Eleocharis microcarpa
Eleocharis tenuis
Erianthus giganteus
Juncus pelocarpus
Lycopodium appressum
Panicum verrucosum
Panicum virgatum
Proserpinaca pectinata
Rhexia virginica
Scirpus cyperinus
Xyris smalliana
Woody plants:
Acer rubrum
Aronia arbutifolia
Chamaedaphne calyculata
Eubotrys racemosa
Gaultheria procumbens
Gaylussacia baccata
Gaylussacia frondosa
Hudsonia ericoides
Ilex glabra
Kalmia angustifolia
Leiophyllum buxifolium
Lyonia mariana
Myrica pensylvanica
Nyssa sylvatica
Pinus rigida
Quercus ilicifolia
Quercus marilandica
Smilax glauca
Vaccinium corymbosum
Vaccinium macrocarpon

Environmental attributes	
Water Quality (March-June 1998)	
median pH	4.6
med. specific conductance (µS/cm)	23
med. total organic carbon (mg/L)	11
Morphometry (March 1998)	
total pond area (m^2)	420
open water area (m^2)	420
mean water depth (cm)	51
maximum water depth (cm)	79
mean shore slope (rise/run)	0.26



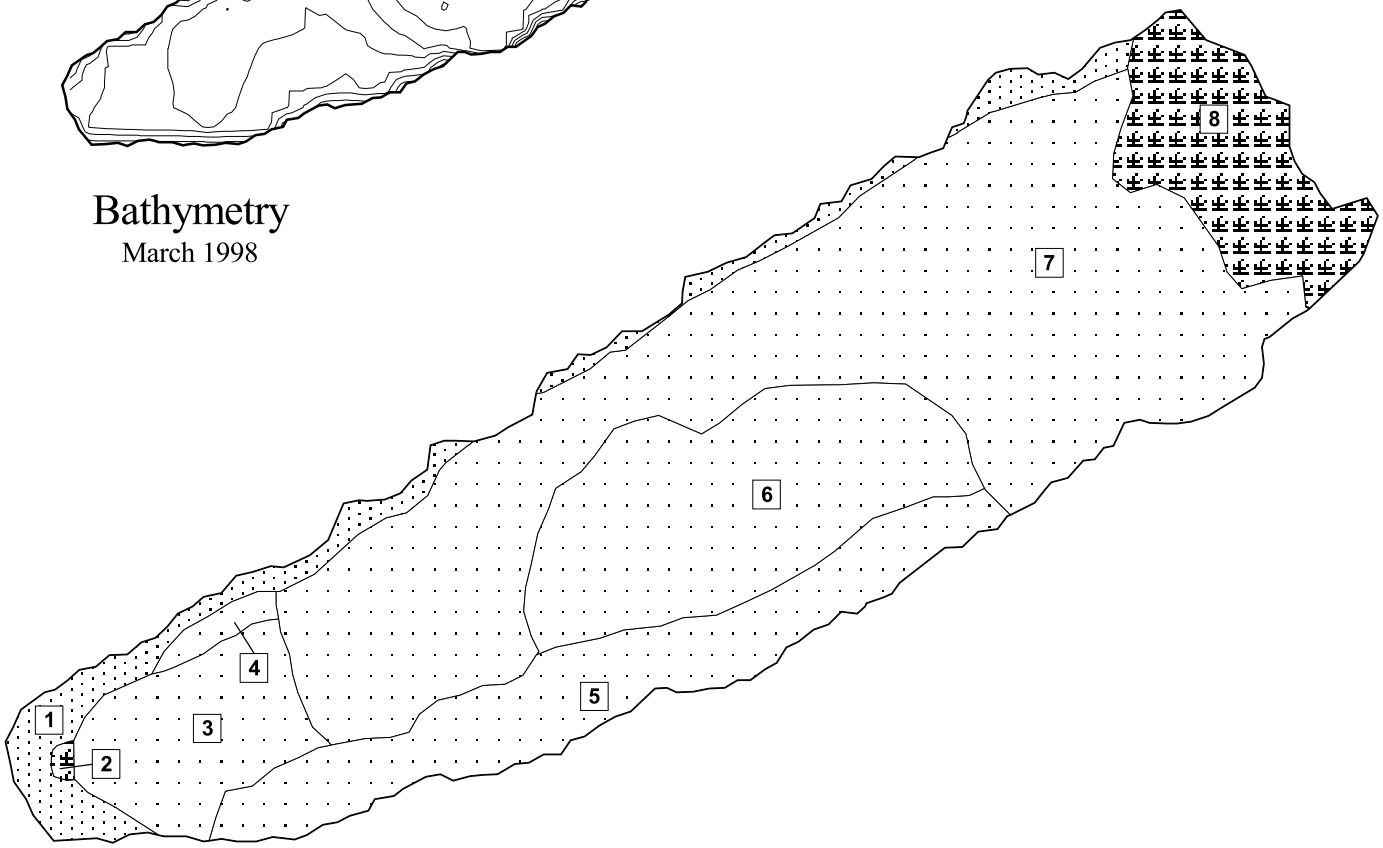
Anuran species present in 1996-1999.	
Bufo woodhousii fowleri	Fowler's toad
Hyla andersonii	Pine Barrens treefrog
Pseudacris c. crucifer	northern spring peeper
Rana clamitans melanota	green frog
Rana sylvatica	wood frog
Rana utricularia	southern leopard frog
Rana virgatipes	carpenter frog

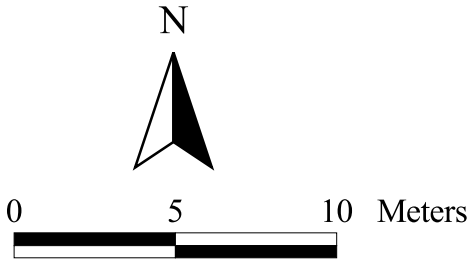
Hampton



Bathymetry
March 1998

Vegetation Cover-types
September 1998





Major Vegetation Cover-types

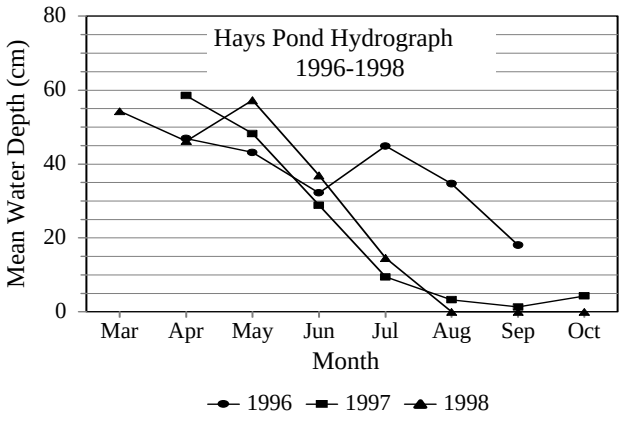
(Percentage of Pond Area)

	Panicum longifolium and *P. virgatum*	(8.9%)
	Sphagnum species	(6.6%)
	Emergent herb	(84.5%)
1	refer to the Appendix for vegetation cover details of individual patches	

Hays pond is a natural depression located near a sand road on the southern side of Hays Mill Creek, west of Tremont Avenue, in Waterford Township, Camden County (Latitude 39˚45'17.65" Longitude 74˚51'06.62"). The pond is surrounded by pine-oak upland and wet pine lowland. A broad shrub zone dominated by highbush blueberry is present along the perimeter. Substrate exposed during the draw-down period of late summer supports significant areas of warty panic-grass. Pine Barrens treefrogs, spring peepers, and leopard frogs are regularly detected here. Hays pond is the only site where cricket frogs were encountered.

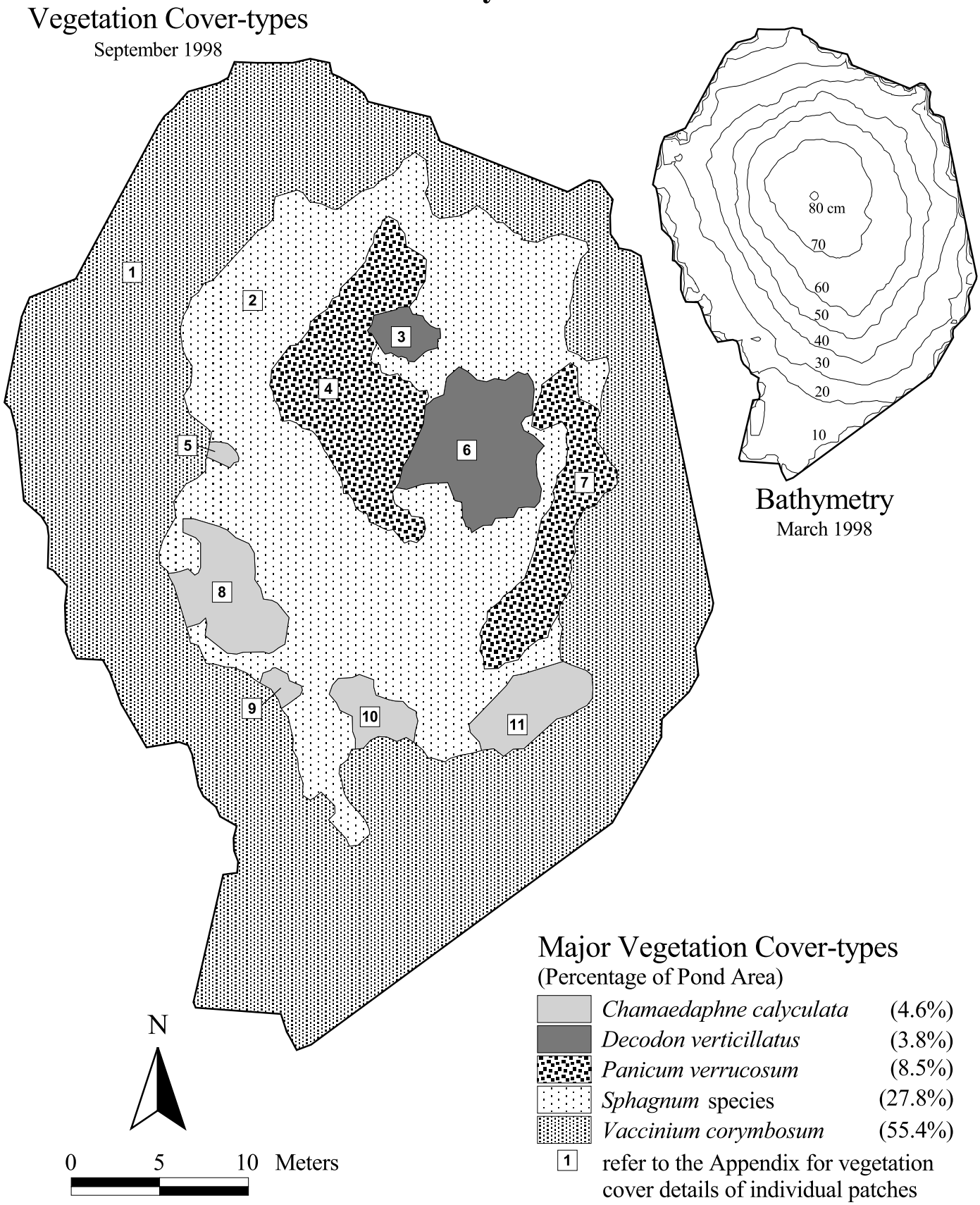
Plant species present in 1998
Herbaceous plants:
Decodon verticillatus
Dulichium arundinaceum
Eleocharis flavescens var. olivacea
Eleocharis tricostata
Panicum verrucosum
Utricularia sp.
Woody plants:
Acer rubrum
Aronia arbutifolia
Chamaedaphne calyculata
Eubotrys racemosa
Lyonia mariana
Nyssa sylvatica
Pinus rigida
Smilax rotundifolia
Vaccinium corymbosum

Environmental attributes	
Water Quality (March-June 1998)	
median pH	3.9
med. specific conductance (µS/cm)	63
med. total organic carbon (mg/L)	36
Morphometry (March 1998)	
total pond area (m^2)	1536
open water area (m^2)	616
mean water depth (cm)	54
maximum water depth (cm)	94
mean shore slope (rise/run)	0.09



Anuran species present in 1996-1999.	
Acris crepitans crepitans	northern cricket frog
Hyla andersonii	Pine Barrens treefrog
Pseudacris c. crucifer	northern spring peeper
Pseudacris triseriata kalmi	New Jersey chorus frog
Rana clamitans melanota	green frog
Rana sylvatica	wood frog
Rana utricularia	southern leopard frog

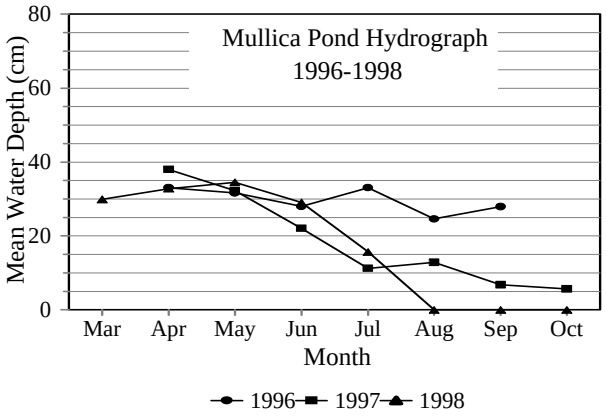
Hays


Vegetation Cover-types
September 1998
1
2
3
4
5
6
7
8
9
10
11
N
0 5 10 Meters
80 cm
70
60
50
40
30
20
10
Bathymetry
March 1998
Major Vegetation Cover-types
(Percentage of Pond Area)
Chamaedaphne calyculata (4.6%)
Decodon verticillatus (3.8%)
Panicum verrucosum (8.5%)
Sphagnum species (27.8%)
Vaccinium corymbosum (55.4%)
1 refer to the Appendix for vegetation cover details of individual patches

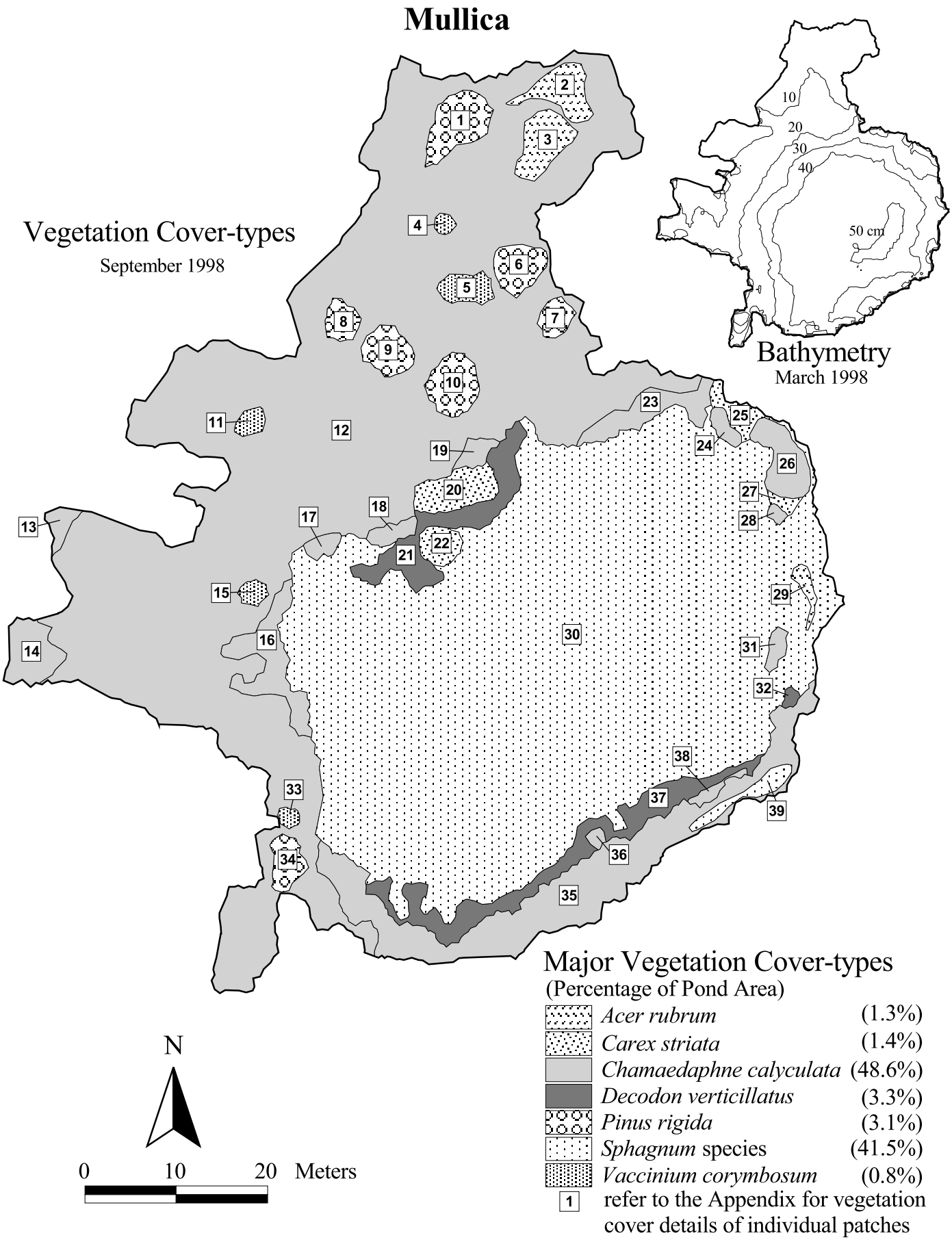
Mullica pond is a natural depression located south of Old Jackson-Atsion Road and west of the Mullica River, in Waterford Township, Camden County (Latitude 39˚45'39.37" Longitude 74˚48'09.27"). Most of the pond is surrounded by wet pine lowland. A narrow to very broad zone of leatherleaf dominates the pond perimeter. Swamp loosestrife occurs in two narrow areas between the leatherleaf and open water zones. Mullica pond supports high anuran-species richness, with Pine Barrens treefrogs and spring peepers evident each of the survey years.

Plant species present in 1998
Herbaceous plants:
Carex striata
Decodon verticillatus
Eleocharis flavescens var. olivacea
Eleocharis microcarpa
Panicum verrucosum
Triadenum virginicum
Woodwardia virginica
Woody plants:
Acer rubrum
Chamaedaphne calyculata
Gaylussacia frondosa
Kalmia angustifolia
Lyonia mariana
Pinus rigida
Smilax rotundifolia
Toxicodendron radicans
Vaccinium corymbosum

Environmental attributes	
Water Quality (March-June 1998)	
median pH	3.8
med. specific conductance (µS/cm)	69
med. total organic carbon (mg/L)	31
Morphometry (March 1998)	
total pond area (m^2)	5119
open water area (m^2)	2420
mean water depth (cm)	30
maximum water depth (cm)	55
mean shore slope (rise/run)	0.04



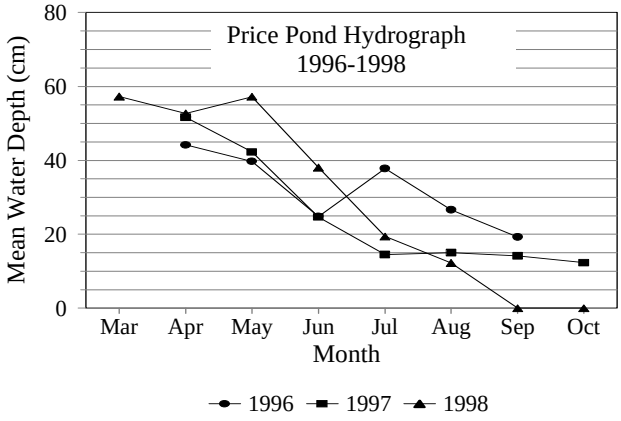
Anuran species present in 1996-1999.	
Bufo woodhousii fowleri	Fowler's toad
Hyla andersonii	Pine Barrens treefrog
Hyla versicolor	northern gray treefrog
Pseudacris c. crucifer	northern spring peeper
Rana clamitans melanota	green frog
Rana sylvatica	wood frog
Rana utricularia	southern leopard frog
Rana virgatipes	carpenter frog


Mullica
Vegetation Cover-types
September 1998
Bathymetry
March 1998
10
20
30
40
50 cm
N
0 10 20 Meters
Major Vegetation Cover-types
(Percentage of Pond Area)
Acer rubrum (1.3%)
Carex striata (1.4%)
Chamaedaphne calyculata (48.6%)
Decodon verticillatus (3.3%)
Pinus rigida (3.1%)
Sphagnum species (41.5%)
Vaccinium corymbosum (0.8%)
1 refer to the Appendix for vegetation cover details of individual patches

Price pond is a natural depression located south of Chew Road, between Pestleton Road and Clark Branch, in Waterford Township, Camden County (Latitude 39˚42'51.74" Longitude 74˚49'20.20"). This pond is surrounded by oak, oak-pine, and pine-oak uplands. Price pond supports the highest vegetation cover-type richness of the 13 ponds studied. Distinct vegetation zonation occurs especially along the eastern pond perimeter where leatherleaf, Walter's sedge, and warty panic-grass zones are clearly evident. Price pond also exhibits high anuran-species richness and is noted for large choruses of spring peepers, green frogs, and wood frogs. Pine Barrens treefrogs and leopard frogs are also consistently detected here. Price pond is the only site where bullfrogs were encountered.

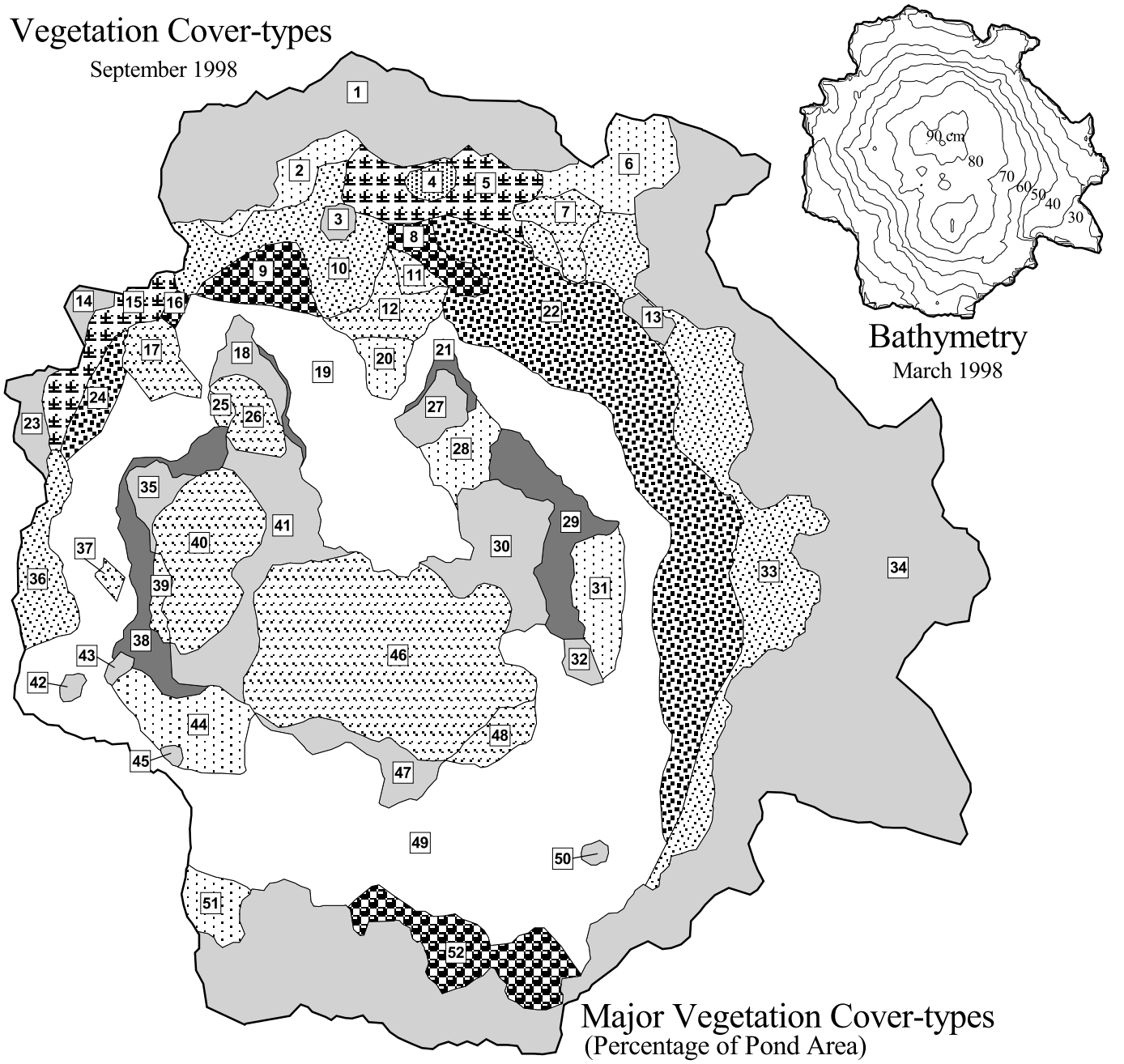
Plant species present in 1998
Herbaceous plants:
Carex striata
Dulichium arundinaceum
Eleocharis flavescens var. olivacea
Eleocharis microcarpa
Juncus pelocarpus
Panicum longifolium
Panicum verrucosum
Rhexia virginica
Scirpus cyperinus
Triadenum virginicum
Utricularia fibrosa
Utricularia geminiscapa
Woody plants:
Acer rubrum
Cephalanthus occidentalis
Chamaedaphne calyculata
Clethra alnifolia
Eubotrys racemosa
Kalmia angustifolia
Lyonia mariana
Pinus rigida
Smilax rotundifolia
Vaccinium corymbosum

Environmental attributes	
Water Quality (March-June 1998)	
median pH	4.0
med. specific conductance (µS/cm)	63
med. total organic carbon (mg/L)	27
Morphometry (March 1998)	
total pond area (m^2)	2426
open water area (m^2)	1776
mean water depth (cm)	57
maximum water depth (cm)	115
mean shore slope (rise/run)	0.05



Anuran species present in 1996-1999.	
Bufo woodhousii fowleri	Fowler's toad
Hyla andersonii	Pine Barrens treefrog
Hyla versicolor	northern gray treefrog
Pseudacris c. crucifer	northern spring peeper
Rana catesbeiana	bullfrog
Rana clamitans melanota	green frog
Rana sylvatica	wood frog
Rana utricularia	southern leopard frog

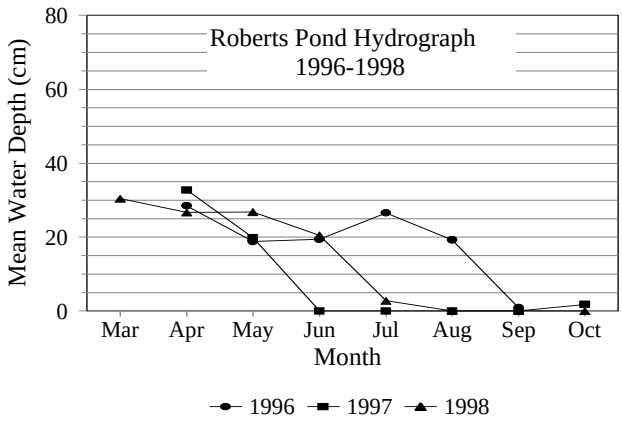
Price


Vegetation Cover-types
September 1998
Bathymetry
March 1998
90 cm
80
70
60
50
40
30
N
0
10
20 Meters
Major Vegetation Cover-types
(Percentage of Pond Area)
Acer rubrum (12.0%)
Carex striata (7.3%)
Chamaedaphne calyculata (33.8%)
Decodon verticillatus (2.7%)
Dulichium arundinaceum (3.1%)
Panicum longifolium and P. virgatum (2.5%)
Panicum verrucosum (8.0%)
Sphagnum species (5.7%)
Vaccinium corymbosum (0.1%)
Bare substrate (24.9%)
1 refer to the Appendix for vegetation cover details of individual patches

Roberts pond is a natural depression located on the northern side of a sand road between Skit and Roberts (Tom Roberts) Branches, upstream from Carranza Road, in Tabernacle Township, Burlington County (Latitude 39˚47'16.86" Longitude 74˚39'21.64"). Atlantic white cedar, pine lowland, and pine-scrub oak upland surround this pond. The Roberts pond perimeter supports a shrub zone dominated by highbush blueberry and scattered leatherleaf. This pond is characterized by low plant-species richness and the lowest anuran-species richness (three) of the 13 ponds.

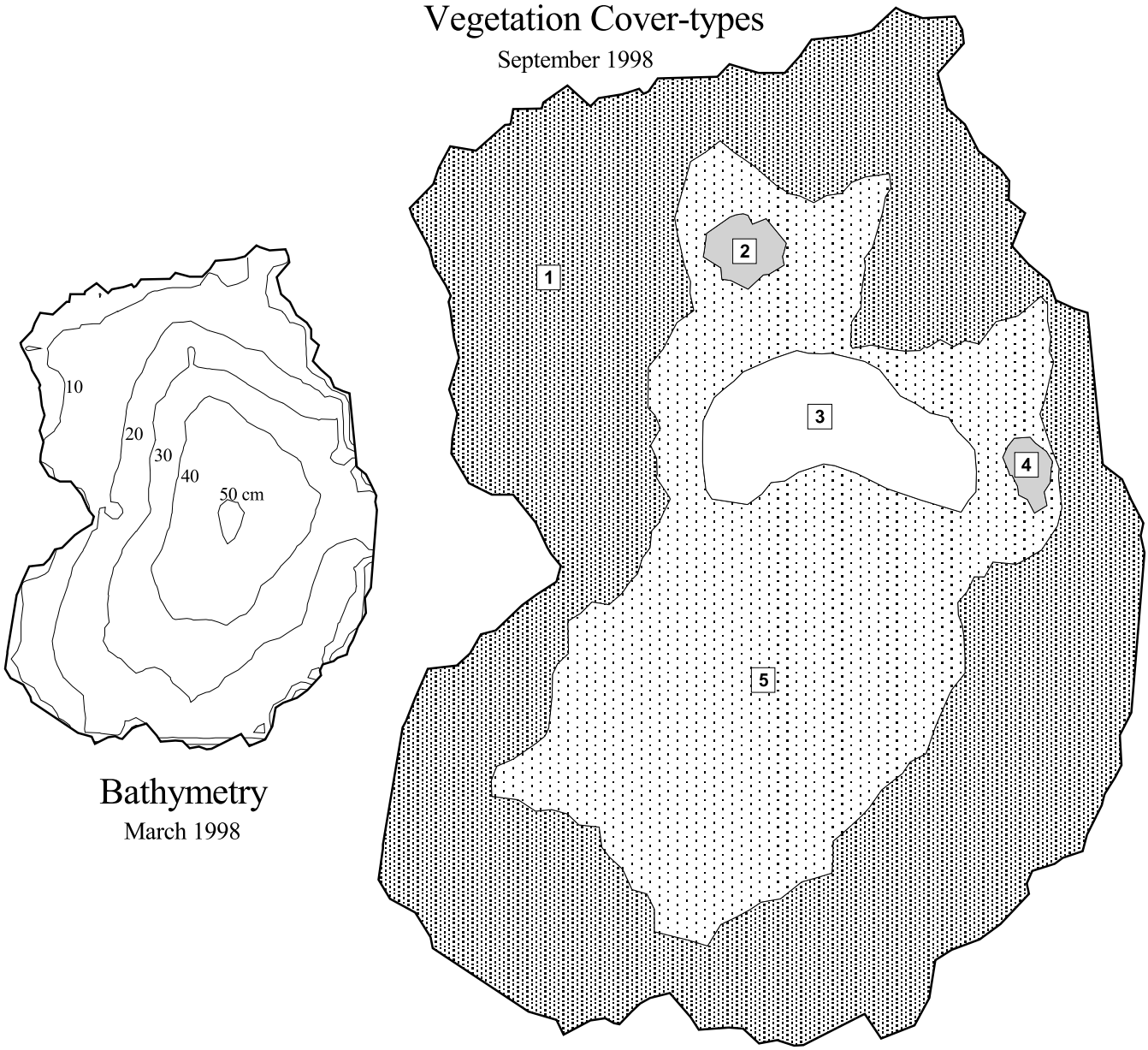
Plant species present in 1998
Herbaceous plants:
Cyperus retrorsus
Drosera intermedia
Drosera rotundifolia
Eleocharis flavescens var. olivacea
Panicum verrucosum
Rhexia virginica
Woodwardia virginica
Woody plants:
Acer rubrum
Chamaecyparis thyoides
Chamaedaphne calyculata
Eubotrys racemosa
Kalmia angustifolia
Pinus rigida
Smilax glauca
Vaccinium corymbosum

Environmental attributes	
Water Quality (March-June 1998)	
median pH	3.8
med. specific conductance (µS/cm)	83
med. total organic carbon (mg/L)	41
Morphometry (March 1998)	
total pond area (m^2)	412
open water area (m^2)	168
mean water depth (cm)	30
maximum water depth (cm)	55
mean shore slope (rise/run)	0.04



Anuran species present in 1996-1999.	
Hyla andersonii	Pine Barrens treefrog
Pseudacris c.crucifer	northern spring peeper
Rana clamitans melanota	green frog

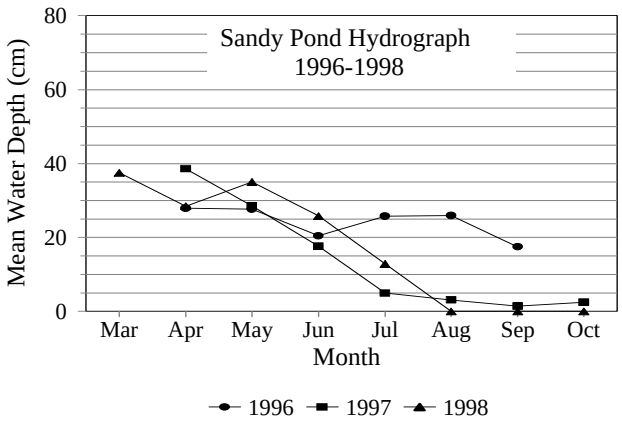
Roberts


Vegetation Cover-types
September 1998
1
2
3
4
5
10
20
30
40
50 cm
Bathymetry
March 1998
N
0
5
10 Meters
Major Vegetation Cover-types
(Percentage of Pond Area)
Chamaedaphne calyculata (1.1%)
Sphagnum species (34.7%)
Vaccinium corymbosum (59.2%)
Bare substrate (5.0%)
1 refer to the Appendix for vegetation cover details of individual patches

Sandy pond is a natural depression located on the western side of Sandy Causeway Road, between Chew Road and a railroad, in Waterford Township, Camden County (Latitude 39˚42'35.35" Longitude 74˚46'36.80"). Adjacent vegetation communities consist of pine and pine-scrub oak uplands, dry pine lowland, and wet pine lowland with Atlantic white cedar. A distinct zone of leatherleaf encircles the entire pond. Walter's sedge dominates most of the rest of the pond. Sandy pond supports high anuran-species richness with large numbers of Pine Barrens treefrogs, spring peepers, and leopard frogs.

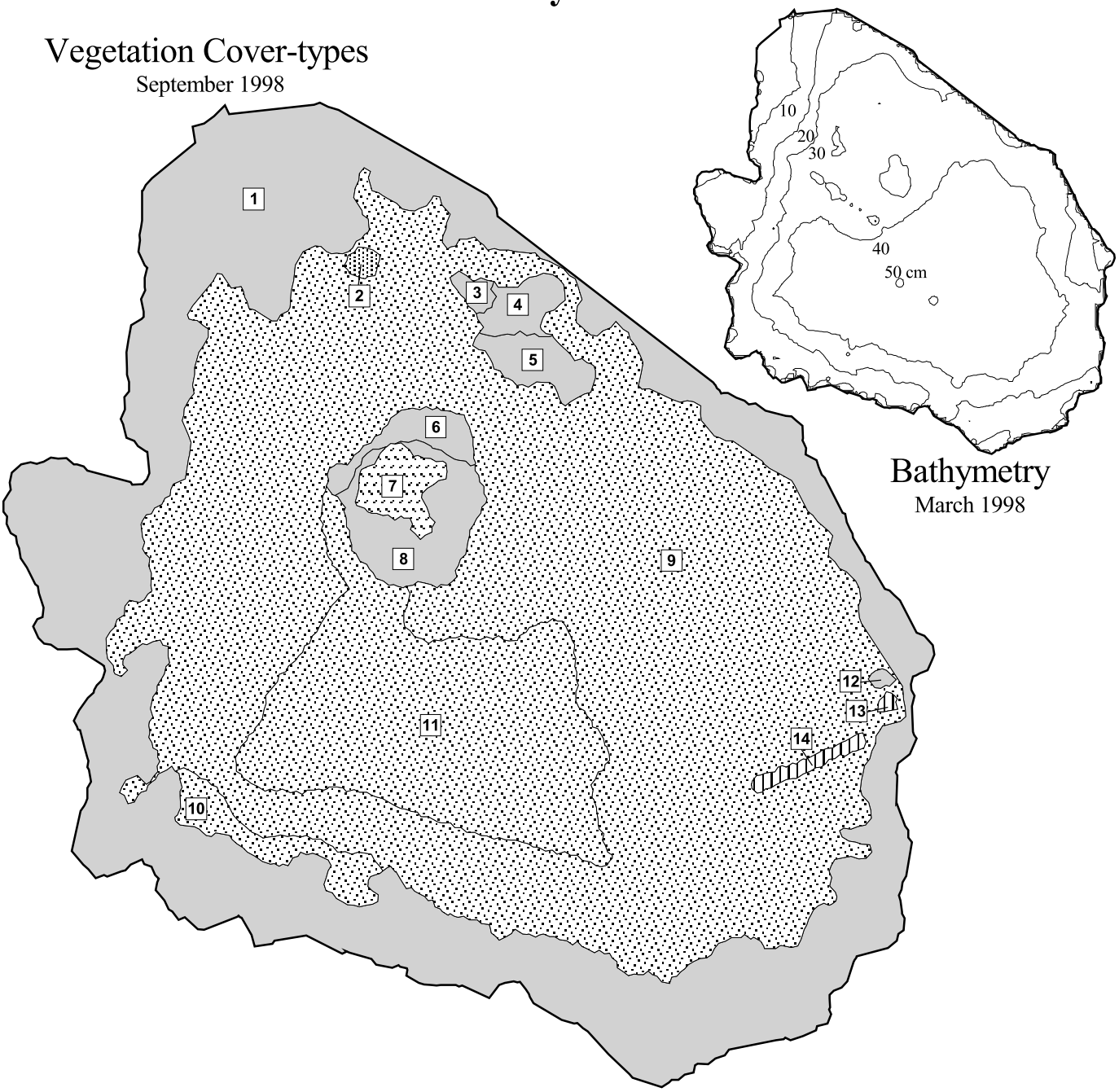
Plant species present in 1998
Herbaceous plants:
Carex striata
Lachnanthes caroliniana
Utricularia fibrosa
Woodwardia virginica
Woody plants:
Acer rubrum
Aronia arbutifolia
Chamaecyparis thyoides
Chamaedaphne calyculata
Clethra alnifolia
Eubotrys racemosa
Kalmia angustifolia
Pinus rigida
Smilax rotundifolia
Vaccinium corymbosum
Vaccinium macrocarpon

Environmental attributes	
Water Quality (March-June 1998)	
median pH	3.9
med. specific conductance (µS/cm)	75
med. total organic carbon (mg/L)	25
Morphometry (March 1998)	
total pond area (m^2)	7808
open water area (m^2)	5409
mean water depth (cm)	37
maximum water depth (cm)	55
mean shore slope (rise/run)	0.01



Anuran species present in 1996-1999.	
Hyla andersonii	Pine Barrens treefrog
Pseudacris c. crucifer	northern spring peeper
Pseudacris triseriata kalmi	New Jersey chorus frog
Rana clamitans melanota	green frog
Rana sylvatica	wood frog
Rana utricularia	southern leopard frog
Rana virgatipes	carpenter frog

Sandy

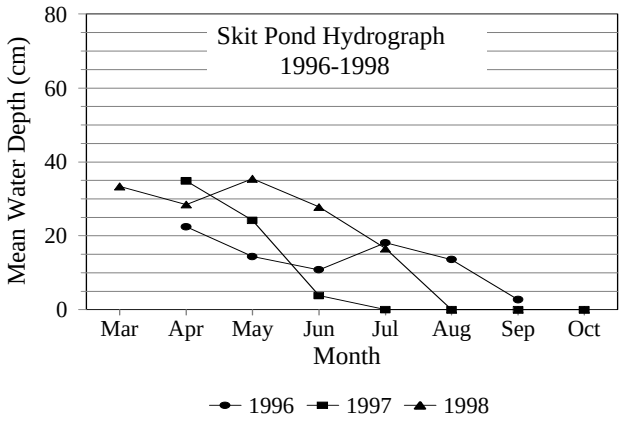

Vegetation Cover-types
September 1998
1
2
3
4
5
6
7
8
9
10
11
12
13
14
10
20
30
40
50 cm
Bathymetry
March 1998
N
0
15
30 Meters
Major Vegetation Cover-types
(Percentage of Pond Area)
Acer rubrum (0.8%)
Carex striata (63.7%)
Chamaecyparis thyoides (0.3%)
Chamaedaphne calyculata (35.0%)
Vaccinium corymbosum (0.1%)
1 refer to the Appendix for vegetation cover details of individual patches

Skit pond is a natural depression located south of Tabernacle-Chatsworth Road, north of a railroad, and east of Skit Branch, in Tabernacle Township, Burlington County (Latitude 39˚47'51.53" Longitude 74˚36'51.42"). Skit pond is surrounded primarily by pine-scrub oak upland. A highbush blueberry zone forms the perimeter of the pond. Patches of Walter's sedge and warty panic-grass occur in the non-woody portion of the pond. Skit pond has the lowest plant-species richness of the 13 ponds. Skit pond supports large numbers of Pine Barrens treefrogs and spring peepers.

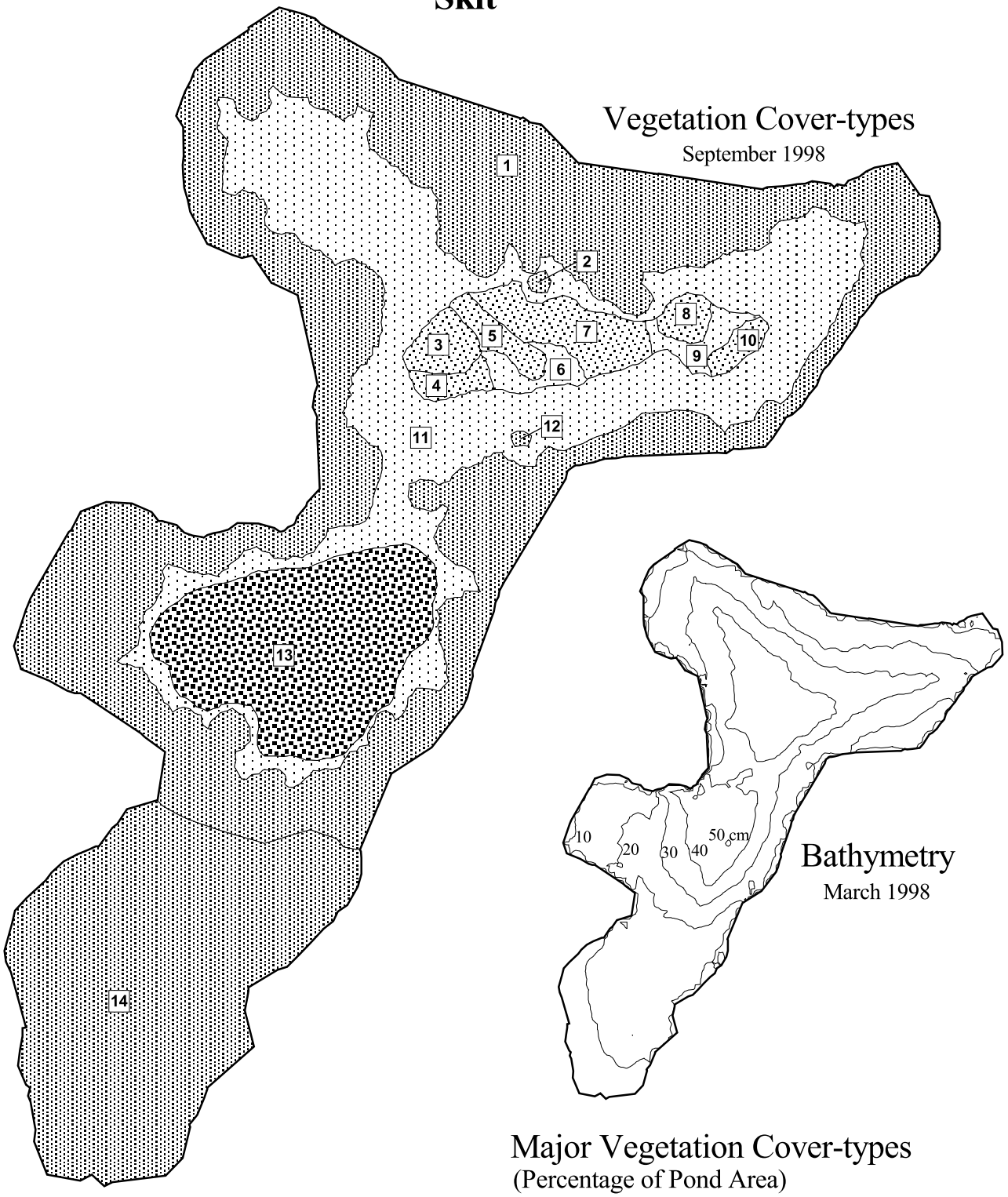
Plant species present in 1998
Herbaceous plants:
Carex striata
Drosera intermedia
Dulichium arundinaceum
Panicum verrucosum
Rhynchospora alba
Woody plants:
Acer rubrum
Aronia arbutifolia
Eubotrys racemosa
Gaylussacia frondosa
Kalmia angustifolia
Pinus rigida
Vaccinium corymbosum

Environmental attributes	
Water Quality (March-June 1998)	
median pH	3.8
med. specific conductance (µS/cm)	76
med. total organic carbon (mg/L)	53
Morphometry (March 1998)	
total pond area (m^2)	2973
open water area (m^2)	1166
mean water depth (cm)	33
maximum water depth (cm)	62
mean shore slope (rise/run)	0.06

Anuran species present in 1996-1999.	
Bufo woodhousii fowleri	Fowler's toad
Hyla andersonii	Pine Barrens treefrog
Pseudacris c. crucifer	northern spring peeper
Rana clamitans melanota	green frog
Rana utricularia	southern leopard frog
Rana virgatipes	carpenter frog



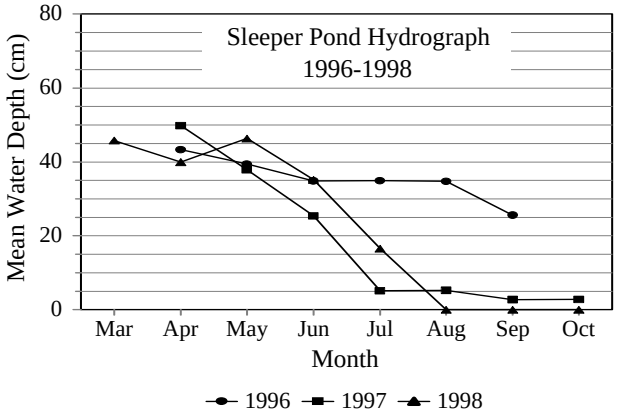
Skit


Vegetation Cover-types
September 1998
1
2
3
4
5
6
7
8
9
10
11
12
13
14
Bathymetry
March 1998
10
20
30
40
50 cm
N
0
10
20 Meters
Major Vegetation Cover-types
(Percentage of Pond Area)
Carex striata (4.8%)
Panicum verrucosum (9.6%)
Sphagnum species (24.6%)
Vaccinium corymbosum (60.9%)
1 refer to the Appendix for vegetation cover details of individual patches

Sleeper pond is a natural depression located north of Fleming Pike, east of Burnt House Road, and south of Sleeper Branch, in Waterford Township, Camden County (Latitude 39˚43'16.89" Longitude 74˚46'09.29"). The surrounding vegetation consists of dry pine lowland. Distinct vegetation zones of leatherleaf and Walter's sedge are present. Sleeper pond exhibits high anuran-species richness, supporting large numbers of Pine Barrens treefrogs, spring peepers, and leopard frogs.

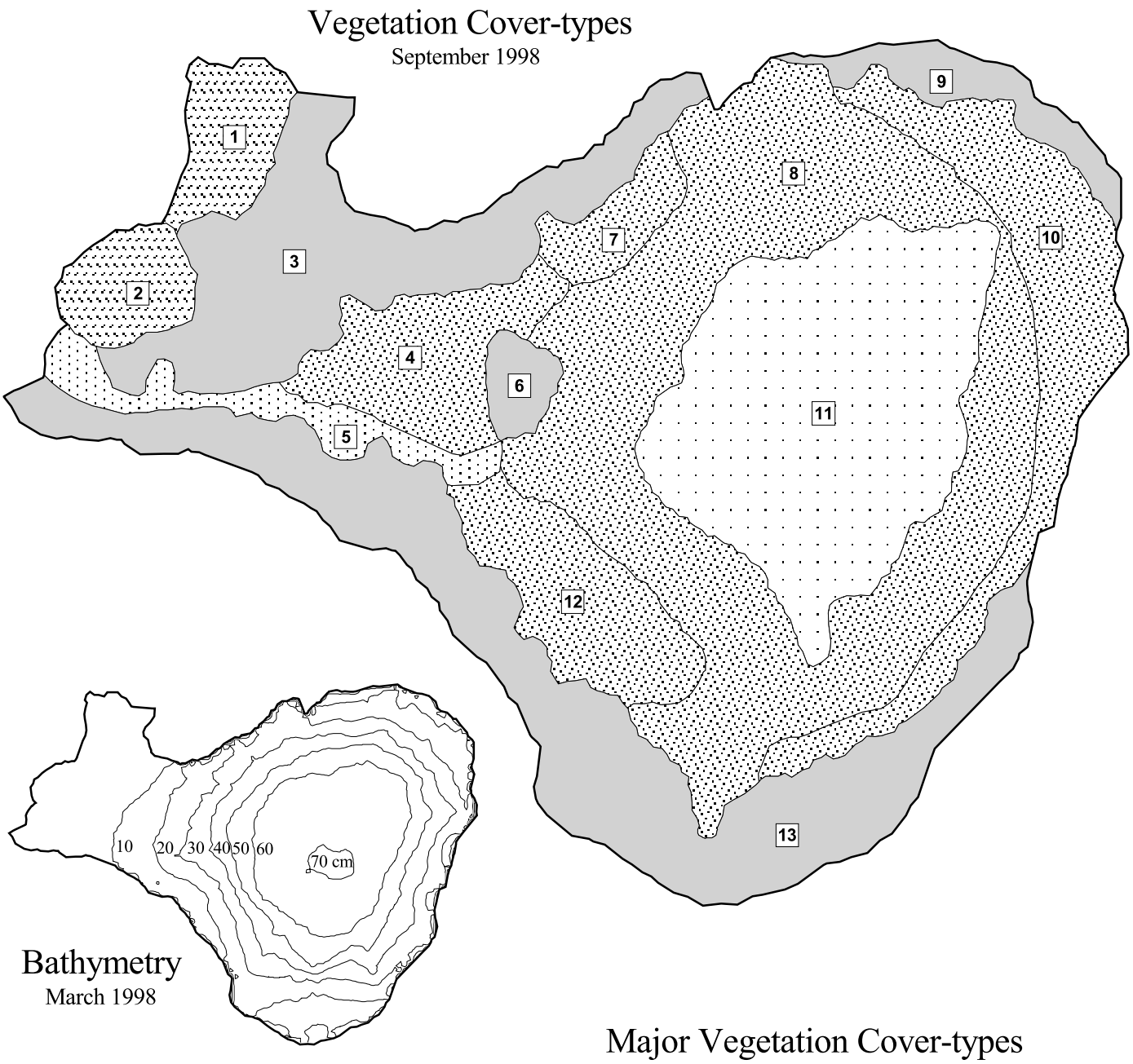
Plant species present in 1998
Herbaceous plants:
Carex striata
Dulichium arundinaceum
Eleocharis flavescens var. olivacea
Juncus pelocarpus
Nymphaea odorata
Panicum verrucosum
Utricularia geminiscapa
Woodwardia virginica
Xyris difformis
Woody plants:
Acer rubrum
Chamaedaphne calyculata
Clethra alnifolia
Eubotrys racemosa
Gaylussacia frondosa
Ilex glabra
Kalmia angustifolia
Lyonia mariana
Nyssa sylvatica
Pinus rigida
Smilax glauca
Smilax rotundifolia
Vaccinium corymbosum

Environmental attributes	
Water Quality (March-June 1998)	
median pH	4.0
med. specific conductance (µS/cm)	48
med. total organic carbon (mg/L)	30
Morphometry (March 1998)	
total pond area (m^2)	3266
open water area (m^2)	2159
mean water depth (cm)	46
maximum water depth (cm)	75



Anuran species present in 1996-1999.	
Hyla andersonii	Pine Barrens treefrog
Hyla versicolor	northern gray treefrog
Pseudacris c. crucifer	northern spring peeper
Pseudacris triseriata kalmi	New Jersey chorus frog
Rana clamitans melanota	green frog
Rana sylvatica	wood frog
Rana utricularia	southern leopard frog
Rana virgatipes	carpenter frog

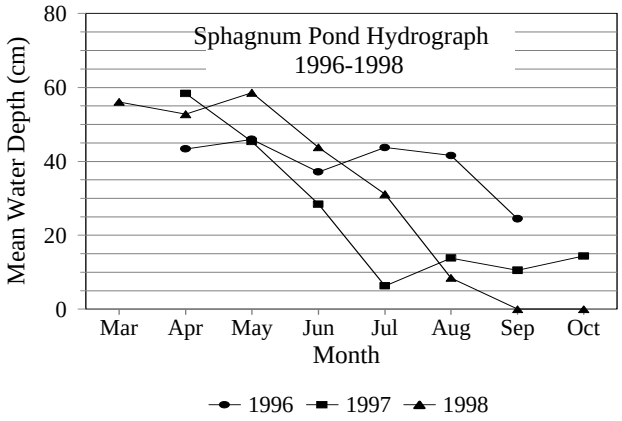
Sleeper


Vegetation Cover-types
September 1998
1
2
3
4
5
6
7
8
9
10
11
12
13
10
20
30
40
50
60
70 cm
Bathymetry
March 1998
N
0
10
20
Meters
Major Vegetation Cover-types
(Percentage of Pond Area)
Acer rubrum (4.8%)
Carex striata (45.4%)
Chamaedaphne calyculata (30.2%)
Sphagnum species (2.6%)
Emergent herb (17.0%)
1 refer to the Appendix for vegetation cover details of individual patches

Sphagnum pond is an excavated basin located upstream from Hampton Road, adjacent to a dike, and on the eastern side of Skit Branch, in Shamong Township, Burlington County (Latitude 39˚46'22.15" Longitude 74˚40'20.70"). Pine-scrub oak upland borders the pond to the southeast and southwest. A narrow band of Atlantic white cedar separates the pond from Skit Branch to the northwest and the dike to the northeast. The pond supports a high percentage cover of submerged, floating *Sphagnum* species and several aquatic and emergent plant species. No shrub zone is present at this excavated pond. Sphagnum pond supports large numbers of Pine Barrens treefrogs and spring peepers, and lesser numbers of carpenter frogs, green frogs, and leopard frogs.

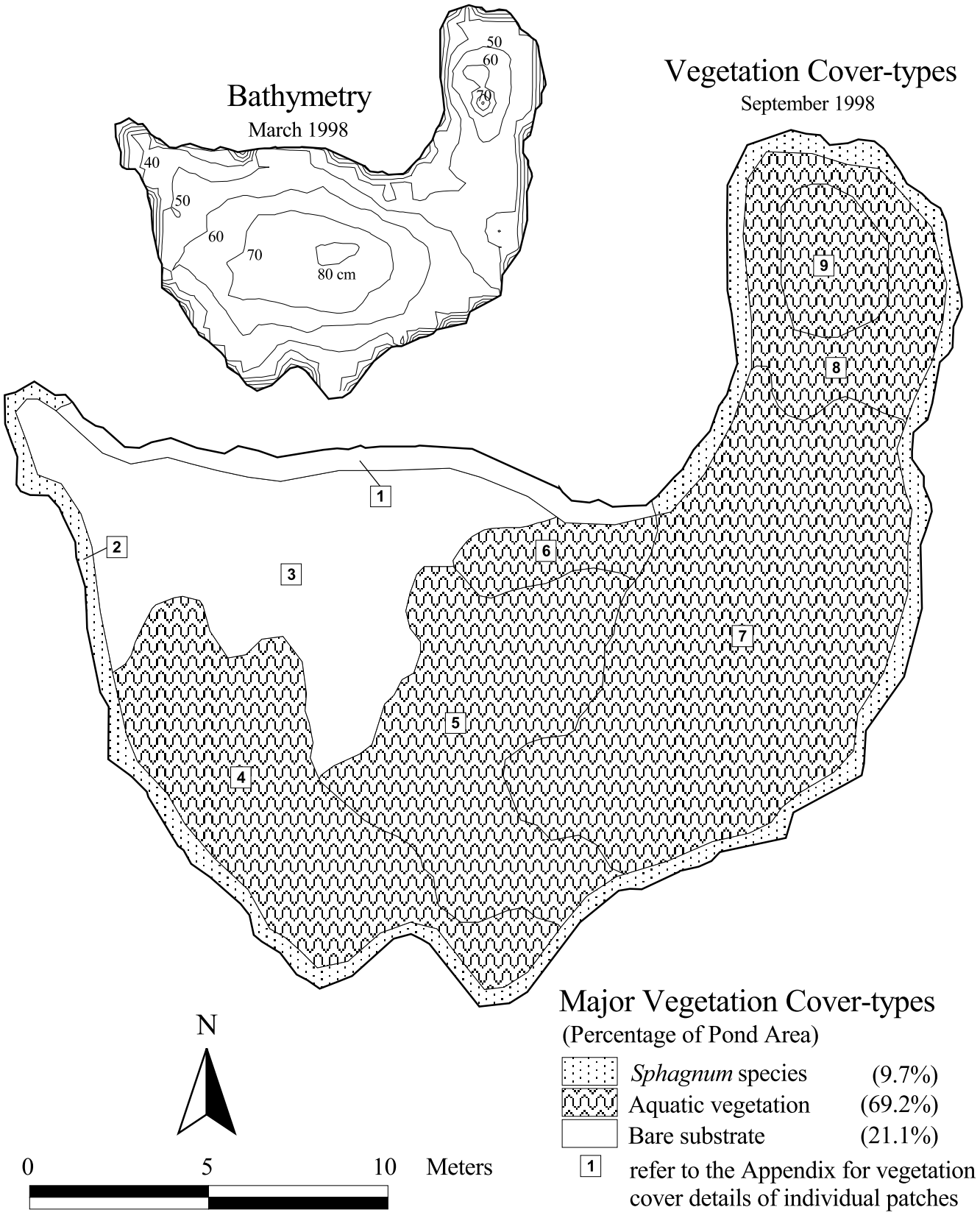
Plant species present in 1998
Herbaceous plants:
Cladium mariscoides
Cyperus dentatus
Drosera intermedia
Dulichium arundinaceum
Eleocharis robbinsii
Eleocharis tuberculosa
Juncus pelocarpus
Lachnanthes caroliniana
Nuphar variegata
Nymphaea odorata
Orontium aquaticum
Panicum verrucosum
Peltandra virginica
Rhexia virginica
Scirpus subterminalis
Triadenum virginicum
Utricularia purpurea
Xyris difformis
Woody plants:
Chamaecyparis thyoides
Chamaedaphne calyculata
Eubotrys racemosa
Gaylussacia dumosa
Gaylussacia frondosa
Kalmia angustifolia
Smilax rotundifolia
Vaccinium corymbosum
Vaccinium macrocarpon

Environmental attributes	
Water Quality (March-June 1998)	
median pH	4.3
med. specific conductance (µS/cm)	33
med. total organic carbon (mg/L)	4
Morphometry (March 1998)	
total pond area (m^2)	336
open water area (m^2)	336
mean water depth (cm)	56
maximum water depth (cm)	88
mean shore slope (rise/run)	0.21



Anuran species present in 1996-1999.	
Hyla andersonii	Pine Barrens treefrog
Pseudacris c. crucifer	northern spring peeper
Rana clamitans melanota	green frog
Rana utricularia	southern leopard frog
Rana virgatipes	carpenter frog

Sphagnum


Bathymetry
March 1998
50
60
70
40
50
60
70
80 cm
Vegetation Cover-types
September 1998
1
2
3
4
5
6
7
8
9
N
0
5
10
Meters
Major Vegetation Cover-types
(Percentage of Pond Area)
Sphagnum species (9.7%)
Aquatic vegetation (69.2%)
Bare substrate (21.1%)
1 refer to the Appendix for vegetation cover details of individual patches

APPENDIX

Appendix. Vegetation cover-type designations, initial detailed-cover estimates, and patch size for vegetation patches in selected Pine Barrens Treefrog ponds in the New Jersey Pinelands. Patch numbers correspond with those on vegetation cover-type maps. Numerical values included in the initial detailed-cover estimates are from the Braun-Blanquet cover scale, where 2 = 5-25%, 3 = 25-50%, 4 = 50-75%, and 5 = > 75%. The four-letter cover codes are as follows: ACER=Acer rubrum, BARE=bare substrate, CAST=Carex striata, CHCA=Chamaedaphne calyculata, CHTH=Chamaecyparis thyoides, CLMA=Cladium mariscoides, DALG=dry algal mat, DEVE=Decodon verticillatus, DUAR=Dulichium arundinaceum, ELMI=Eleocharis microcarpa, ELRO=Eleocharis robbinsii, ERGI=Erianthus gigantea, HERB=emergent herb, JUPE=Juncus pelocarpus, KAAN=Kalmia angustifolia, NYOD=Nymphaea odorata, PALO=Panicum longifolium, PAVE=Panicum verrucosum, PAVI=Panicum virgatum, PIRI=Pinus rigida, PRPE=Proserpinica pectinata, REVI=Rhexia virginica, SCCY=Scirpus cyperinus, SCSU=Scirpus subterminalis, SMRO=Smilax rotundifolia, SPHG=Sphagnum spp., STWA=standing water, TRVI=Triadenum virginicum, VACO=Vaccinium corymbosum, VAMA=Vaccinium macrocarpon, WOVI=Woodwardia virginica, XYRI=Xyris difformis or X. smalliana.

Patch #	Cover Type	Initial Detailed-Cover Estimate	Area (m^2)
Albertson			
1	*Chamaedaphne calyculata*	CHCA5/SPHG5	34.1
2	*Chamaedaphne calyculata*	CHCA5/SMRO2/SPHG5	3.6
3	*Chamaedaphne calyculata*	CHCA5/SPHG5	2.6
4	*Acer rubrum*	ACER5/CHCA5/SMRO2/SPHG5	1.8
5	*Acer rubrum*	ACER5/SPHG5	37.3
6	*Sphagnum*	SPHG5/REVI2	16.2
7	*Sphagnum*	SPHG5	3.3
8	*Dulichium arundinaceum*	DUAR4/SPHG5	9.4
9	*Chamaedaphne calyculata*	CHCA5/SPHG5	55.7
10	*Acer rubrum*	ACER5/CAST2/ SPHG5	3.6
11	*Dulichium arundinaceum*	DUAR4/SPHG5	10.3
12	*Acer rubrum*	ACER5/CHCA5/SPHG5	143.5
13	*Acer rubrum*	ACER5/SPHG5	12.8
14	*Chamaedaphne calyculata*	CHCA2/WOVI2/SPHG5	1.1
15	*Chamaedaphne calyculata*	CHCA5/WOVI2/SPHG5	4.0
16	*Sphagnum*	SPHG5	291.4
17	*Acer rubrum*	ACER5/CHCA5/SPHG5	86.3
18	*Acer rubrum*	ACER5/CHCA5/SPHG5	25.1
19	*Acer rubrum*	ACER5/SPHG5	1.2
20	*Acer rubrum*	ACER5/CHCA5/WOVI2/SPHG5	2.4
21	*Chamaedaphne calyculata*	CHCA5/SPHG5	74.9
Chew			
1	*Panicum longifolium and P. virgatum*	PAVI4/DALG5	41.2
2	Emergent herb	HERB2/DALG5	2080.4
3	*Panicum longifolium and P. virgatum*	PAVI4/DALG5	8.0
4	*Panicum longifolium and P. virgatum*	PAVI4/VAMA2/DALG5	18.6
Gravel			
1	*Dulichium arundinaceum*	DUAR4/SPHG5	16.8
2	*Carex striata*	CAST2/SPHG5	47.9
3	*Sphagnum*	SPHG5	508.4
4	*Chamaedaphne calyculata*	CHCA5/CAST2/SPHG5	12.6
5	*Dulichium arundinaceum*	DUAR3/SPHG5	35.6
6	*Decodon verticillatus*	DEVE2/SPHG5	1.8
7	Bare substrate	BARE5	87.7

Appendix. Continued.

Patch #	Cover Type	Initial Detailed-Cover Estimate	Area (m^2)
8	*Chamaedaphne calyculata*	CHCA5/CAST2/SPHG5	4.0
9	*Chamaedaphne calyculata*	CHCA5/VACO3/CAST2/SPHG5	8.1
10	*Chamaedaphne calyculata*	CHCA5/SPHG5	104.0
11	*Chamaedaphne calyculata*	CHCA5/SPHG5	1057.4
12	*Carex striata*	CAST3/SPHG5	240.9
13	*Chamaedaphne calyculata*	CHCA5/CAST2/SPHG5	7.5
14	*Carex striata*	CAST2/SPHG5	309.9
15	*Carex striata*	CAST3/SPHG5	14.6
16	*Chamaedaphne calyculata*	CHCA5/VACO2/CAST2/ SPHG5	5.6
17	*Sphagnum*	SPHG5	42.8
18	*Pinus rigida*	PIRI5/CHCA5/KAAN2/CAST2/ SPHG5	6.1
19	*Carex striata*	CAST2/SPHG5	125.9
Furnace			
1	*Panicum longifolium and P. virgatum*	PALO3/SPHG2/BARE4	6.5
2	Emergent herb	JUPE3/PALO2/PRPE2/TRVI2/SPHG2	28.5
3	Emergent herb	JUPE3/ BARE4	30.4
4	Emergent herb	JUPE3/PRPE2/TRVI2/SPHG2/BARE4	36.5
5	*Sphagnum*	SPHG5	50.5
Hays			
1	*Vaccinium corymbosum*	VACO5	850.6
2	*Sphagnum*	SPHG5	426.6
3	*Decodon verticillatus*	DEVE3/PAVE2/SPHG5	8.6
4	*Panicum verrucosum*	PAVE3/SPHG2/BARE4	83.0
5	*Chamaedaphne calyculata*	CHCA4/SPHG5	1.9
6	*Decodon verticillatus*	DEVE3/PAVE2/SPHG5	50.5
7	*Panicum verrucosum*	PAVE3/SPHG2/BARE4	46.9
8	*Chamaedaphne calyculata*	CHCA3/SPHG5	31.1
9	*Chamaedaphne calyculata*	CHCA3/SPHG5	3.0
10	*Chamaedaphne calyculata*	CHCA5/SPHG5	12.2
11	*Chamaedaphne calyculata*	CHCA5/SPHG5	22.1
Hampton			
1	*Sphagnum*	SPHG5	27.9
2	*Panicum longifolium and P. virgatum*	PAVI5/VAMA3	0.7
3	Emergent herb	JUPE3/XYRI3/BARE4	31.0
4	Emergent herb	ELMI5/PRPE3/JUPE2	3.5
5	Emergent herb	ELMI5/JUPE2/PRPE2/XYRI2	54.4
6	Emergent herb	ELMI3/XYRI3/JUPE2/BARE3	69.9
7	Emergent herb	ERGI3/JUPE2/PRPE2/XYRI2/BARE4	196.4
8	*Panicum longifolium and P. virgatum*	PAVI4/VAMA3/SPHG5	36.6
Mullica			
1	*Pinus rigida*	PIRI4/VACO4/CHCA5/SPHG2	36.8
2	*Acer rubrum*	ACER4/PIRI4/VACO2/CHCA5/SPHG4	28.6
3	*Acer rubrum*	ACER2/VACO5/CHCA3/SPHG5	31.4
4	*Vaccinium corymbosum*	VACO5/CHCA5/SPHG2	4.2
5	*Vaccinium corymbosum*	VACO5/CHCA5/SPHG2	16.7
6	*Pinus rigida*	PIRI5/CHCA5/SPHG5	24.6
7	*Pinus rigida*	PIRI5/CHCA5/SPHG5	12.7
8	*Pinus rigida*	PIRI5/VACO5/CHCA5/SPHG3	13.6

Appendix. Continued.

Patch #	Cover Type	Initial Detailed-Cover Estimate	Area (m^2)
9	*Pinus rigida*	PIRI5/CHCA5/SPHG4	23.2
10	*Pinus rigida*	PIRI5/VACO3/CHCA5/SPHG3	30.2
11	*Vaccinium corymbosum*	VACO5/CHCA4/SPHG2	7.9
12	*Chamaedaphne calyculata*	CHCA5/SPHG5	2014.6
13	*Chamaedaphne calyculata*	CHCA5/WOVI2/SPHG5	10.2
14	*Chamaedaphne calyculata*	CHCA5/WOVI2/SPHG5	34.5
15	*Vaccinium corymbosum*	VACO5/CHCA2/SPHG3	6.8
16	*Chamaedaphne calyculata*	CHCA5/DEVE2/SPHG5	54.0
17	*Chamaedaphne calyculata*	CHCA5/DEVE3/SPHG5	8.1
18	*Chamaedaphne calyculata*	CHCA4/DEVE4/SPHG5	10.4
19	*Chamaedaphne calyculata*	CHCA5/DEVE2/SPHG5	10.1
20	*Carex striata*	CAST5/DEVE2/SPHG5	34.4
21	*Decodon verticillatus*	DEVE2/SPHG5	70.2
22	*Carex striata*	CAST5/SPHG5	16.3
23	*Chamaedaphne calyculata*	CHCA5/DEVE2/SPHG5	38.9
24	*Chamaedaphne calyculata*	CHCA5/CAST2/DEVE2/SPHG5	8.1
25	*Carex striata*	CAST3/DEVE2/SPHG5	15.1
26	*Chamaedaphne calyculata*	CHCA5/CAST2/DEVE2/SPHG5	34.3
27	*Carex striata*	CAST3/SPHG5	4.6
28	*Chamaedaphne calyculata*	CHCA5/DEVE2/SPHG5	3.1
29	*Acer rubrum*	ACER3/CHCA2/DEVE4/SPHG5	7.4
30	*Sphagnum*	SPHG5	2109.4
31	*Chamaedaphne calyculata*	CHCA3/DEVE3/SPHG5	7.6
32	*Decodon verticillatus*	DEVE3/SPHG5	3.1
33	*Vaccinium corymbosum*	VACO5/CHCA3/SPHG5	4.3
34	*Pinus rigida*	PIRI4/VACO5/CHCA3/SPHG5	17.7
35	*Chamaedaphne calyculata*	CHCA5/SPHG5/DEVE2	243.6
36	*Chamaedaphne calyculata*	CHCA3/DEVE3/CAST3/SPHG5	3.4
37	*Decodon verticillatus*	DEVE2/SPHG5	97.1
38	*Chamaedaphne calyculata*	CHCA5/DEVE5/SPHG5	6.1
39	*Sphagnum*	SPHG5	16.1
Price			
1	*Chamaedaphne calyculata*	CHCA4/CAST2/SPHG5	117.9
2	*Sphagnum*	SPHG5	14.3
3	*Chamaedaphne calyculata*	CHCA5/SPHG5	3.9
4	*Vaccinium corymbosum*	VACO5/SPHG5	5.4
5	*Panicum longifolium and P. virgatum*	PALO5/CAST3/DUAR3	37.7
6	*Sphagnum*	SPHG5	28.0
7	*Acer rubrum*	ACER4/CHCA4/CAST2/SPHG5	14.0
8	*Dulichium arundinaceum*	DUAR3/CAST2/SPHG3/BARE3	12.0
9	*Dulichium arundinaceum*	DUAR4/SPHG5	20.1
10	*Carex striata*	CAST5/SPHG5	37.3
11	*Acer rubrum*	ACER2/DUAR3/CAST2/SPHG3/BARE3	4.9
12	*Acer rubrum*	ACER2/SPHG5	17.8
13	*Chamaedaphne calyculata*	CHCA5/CAST3/SPHG5	4.9
14	*Chamaedaphne calyculata*	CHCA4/CAST2/SPHG5	5.3
15	*Panicum longifolium and P. virgatum*	PALO5/SPHG5	22.5
16	*Dulichium arundinaceum*	DUAR5	2.2

Appendix. Continued.

Patch #	Cover Type	Initial Detailed-Cover Estimate	Area (m^2)
17	*Acer rubrum*	ACER4/CHCA5/CAST3/SPHG5	15.4
18	*Chamaedaphne calyculata*	CHCA5/SPHG5	11.4
19	*Decodon verticillatus*	DEVE2/SCCY2/SPHG5	2.2
20	*Sphagnum*	SPHG5/SCCY3	9.4
21	*Decodon verticillatus*	DEVE4/SPHG5	4.4
22	*Panicum verrucosum*	PAVE2/BARE5	180.9
23	*Chamaedaphne calyculata*	CHCA4/CAST2/SPHG5	10.8
24	*Panicum verrucosum*	PAVE3/SPHG5	12.7
25	*Acer rubrum*	ACER5	2.2
26	*Acer rubrum*	ACER5/CHCA5/SPHG5	13.7
27	*Chamaedaphne calyculata*	CHCA5/DEVE2/SPHG5	11.7
28	*Sphagnum*	SPHG5	15.8
29	*Decodon verticillatus*	DEVE3/SPHG5	31.7
30	*Chamaedaphne calyculata*	CHCA5/SPHG5	39.0
31	*Sphagnum*	SPHG5	21.6
32	*Chamaedaphne calyculata*	CHCA5/SPHG5	4.7
33	*Carex striata*	CAST4/SPHG5	114.5
34	*Chamaedaphne calyculata*	CHCA4/CAST2/SPHG5	526.4
35	*Chamaedaphne calyculata*	CHCA5/SPHG5	9.3
36	*Carex striata*	CAST4/SPHG5	25.7
37	*Acer rubrum*	ACER4/CHCA5/SPHG5	2.3
38	*Decodon verticillatus*	DEVE2/SPHG5	28.1
39	*Acer rubrum*	ACER5/DEVE2/SPHG5	4.5
40	*Acer rubrum*	ACER5/CHCA5/SPHG5	49.7
41	*Chamaedaphne calyculata*	CHCA5/SPHG5	48.8
42	*Chamaedaphne calyculata*	CHCA5/CAST2/SPHG5	2.0
43	*Chamaedaphne calyculata*	CHCA5/SPHG5	2.0
44	*Sphagnum*	SPHG5	31.0
45	*Chamaedaphne calyculata*	CHCA5/SPHG5	1.2
46	*Acer rubrum*	ACER5/CHCA5/SPHG5	154.8
47	*Chamaedaphne calyculata*	CHCA5/SPHG5	18.1
48	*Acer rubrum*	ACER5/STWA5	11.2
49	Bare substrate	BARE5	604.7
50	*Chamaedaphne calyculata*	CHCA5/SPHG3	1.9
51	*Sphagnum*	SPHG5	13.1
52	*Dulichium arundinaceum*	DUAR2/SPHG5	40.8
Sandy			
1	*Chamaedaphne calyculata*	CHCA5/SPHG5	2398.3
2	*Vaccinium corymbosum*	VACO5/CAST4/SPHG5	10.8
3	*Chamaedaphne calyculata*	CHCA5/SPHG5	14.9
4	*Chamaedaphne calyculata*	CHCA4/WOVI5/SPHG5	48.2
5	*Chamaedaphne calyculata*	CHCA5/SPHG5	64.4
6	*Chamaedaphne calyculata*	CHCA5/SPHG5	57.3
7	*Acer rubrum*	ACER3/CHCA5/VACO3/WOVI5/SPHG5	65.1
8	*Chamaedaphne calyculata*	CHCA4/WOVI5/SPHG5	145.5
9	*Carex striata*	CAST4/SPHG5	4000.5
10	*Carex striata*	CAST3/SPHG5	94.1
11	*Carex striata*	CAST3/SPHG5	877.9
12	*Chamaedaphne calyculata*	CHCA5/SPHG5	4.7

Appendix. Continued.

Patch #	Cover Type	Initial Detailed-Cover Estimate	Area (m^2)
13	*Chamaecyparis thyoides*	CHTH3/CHCA5/VACO2/CAST2/SPHG5	3.8
14	*Chamaecyparis thyoides*	CHTH4/CHCA5/CAST2/SPHG5	22.1
Skit			
1	*Vaccinium corymbosum*	VACO5	1222.8
2	*Vaccinium corymbosum*	VACO5/SPHG5	2.7
3	*Carex striata*	CAST3/SPHG5	24.5
4	*Carex striata*	CAST2/SPHG5	14.3
5	*Carex striata*	CAST2/SPHG5	20.2
6	*Sphagnum*	SPHG5	19.7
7	*Carex striata*	CAST4/SPHG5	57.7
8	*Carex striata*	CAST3/SPHG5	14.4
9	*Sphagnum*	SPHG5	18.9
10	*Carex striata*	CAST3/SPHG5	12.3
11	*Sphagnum*	SPHG5	694.0
12	*Vaccinium corymbosum*	VACO5/SPHG5	1.8
13	*Panicum verrucosum*	PAVE2/SPHG5	285.2
14	*Vaccinium corymbosum*	VACO4/KAAN2/SPHG4	584.4
Sleeper			
1	*Acer rubrum*	ACER2/CHCA5/VACO3/SPHG5	82.6
2	*Acer rubrum*	ACER4/PIRI3/CHCA5/SPHG2	74.0
3	*Chamaedaphne calyculata*	CHCA5/SPHG5	352.3
4	*Carex striata*	CAST4/SPHG5	153.2
5	*Sphagnum*	SPHG5	85.1
6	*Chamaedaphne calyculata*	CHCA5/SPHG5	35.1
7	*Carex striata*	CAST2/SPHG5	58.9
8	*Carex striata*	CAST3/SPHG5	834.6
9	*Chamaedaphne calyculata*	CHCA5/SMRO2/SPHG5	75.8
10	*Carex striata*	CAST2/SPHG5	275.8
11	Emergent herb	HERB2/JUPE2/SPHG5	555.0
12	*Carex striata*	CAST4/SPHG5	161.5
13	*Chamaedaphne calyculata*	CHCA5/SPHG5	522.2
Sphagnum			
1	Bare substrate	BARE5	10.3
2	*Sphagnum*	SPHG5	32.5
3	Bare substrate	BARE5/SPHG2	60.7
4	Aquatic vegetation	NYOD2/SPHG5	50.0
5	Aquatic vegetation	SCSU5/ELRO2/NYOD2	49.0
6	Aquatic vegetation	SCSU5/ELRO2/CLMA2	8.5
7	Aquatic vegetation	SCSU5/ELRO4	90.5
8	Aquatic vegetation	NYOD2/SCSU2/BARE4	23.8
9	Aquatic vegetation	NYOD2/SCSU2/STWA5	10.7
Roberts			
1	*Vaccinium corymbosum*	VACO5/CHCA5/WOVI5/SPHG5	244.2
2	*Chamaedaphne calyculata*	CHCA5/SPHG5	2.9
3	Bare substrate	BARE4/REVI2	20.6
4	*Chamaedaphne calyculata*	CHCA5/SPHG5	1.7
5	*Sphagnum*	SPHG5	143.0