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Minute Man National Historical Park
March - October, 1992

A Survey of Selected Fauna
with Recommendations for Wildlife Conservation
and Habitat Management

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Minute Man National Historic Park
Faunal Surveys
1992

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I.

Summary

During the March through October period of 1992, Richard Walton and Bryan Windmiller, along with three assistants, conducted faunal surveys and a habitat use study at Minute Man National Historic Park. Survey findings include observations of 61 species of breeding birds, 12 species of breeding amphibians, 8 species of reptiles, 12 species of fish, 42 species of butterflies, 30 species of odonates, and a variety of aquatic macro-invertebrates.

Two state-listed invertebrates, Mystic Valley Amphipod and Elderberry Borer Beetle, were found. Spotted Salamander, a watch-listed species, was also found at MMNHP, while Common Shiner occurs nearby. Finally, Frosted Elfin —a rare butterfly species in Massachusetts, was also located in the Park.

While a number of factors, including location and physical shape, tend to preclude and/or prevent a high degree of bio-diversity, a moderate representation of the typical fauna of eastern Massachusetts occurs at MMNHP.

We believe that the Park's role as a conservator of natural resources can be measurably enhanced while at the same time accomplishing its cultural mission. To this end we have presented prioritized recommendations focusing on future research as well as habitat preservation and management.

II.

Introduction

This work addresses a portion of the fauna and ecology of Minute Man National Historic Park (MMNHP). As such it provides several components of an overall effort to determine present natural resources at MMNHP. Base-line data will be critical to measuring changes in the studied fauna as well as providing input for future conservation and management decisions. In brief, a series of faunal surveys and vernal pool studies was conducted at MMNHP. Primary goals included:

- 1) Identification and locations of any State-listed rare species.
- 2) Basic faunal inventories with special regard to birds, amphibians, reptiles, butterflies, and specific invertebrate groups.
- 3) Clarification of terrestrial habitat usage by Spotted Salamanders.

Our surveys were done during the March - October, 1992 period. The results of the surveys are presented below. A separate report on Amphibian Habitat Use and Movement Patterns is forthcoming.

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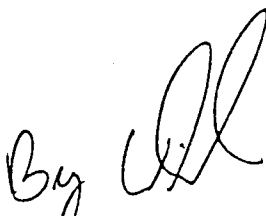
Further assistance was provided by Joe Martinez, Leslie Thomas, and Jennifer Busch who completed independent amphibian and vernal pool surveys. A copy of Joe Martinez's report is attached. Thomas and Busch are sending in their report separately.

We thank you for the opportunity to take part in this valuable work and trust that our findings and recommendations will be of assistance.

Sincerely,



Richard K. Walton


Bryan Windmiller

III.

Survey of Breeding Birds

Methodology

Two methodologies were used to determine the breeding birds at MMNHP during the 1992 nesting season.

1) U. S. Fish & Wildlife Bird Survey Miniroute

The route followed for this survey begins at Fiske Hill and goes west to the North Bridge Visitor Center along Massachusetts Avenue, Virginia Road, and Lexington Road; seventeen census stops were made at approximately 1/4 mile intervals. See Reference Map #1 (RM#1) and MMNHP Strip Map (SM); census stops are labeled 1-17. At each census stop all birds seen and heard were recorded for a period of three minutes. The initial census was done on June 2, 1992 and repeated on 3 June, 9 June, 12 June, and 16 June. In order to take advantage of increased birdsong and less traffic the census was begun between 6:00 A.M and 7:00 A.M. each morning. Results are attached and indicate species and abundance for each stop and census (see MMNHP BB-6/2, 6/3, 6/9, 6/12, & 6/16).

2) Massachusetts Breeding Bird Census

During the period April through June (with the majority of effort in June) breeding birds were censused throughout the park using the methodologies and criteria employed during the Massachusetts Breeding Bird Census. See Massachusetts Audubon Society, Criteria Sheet (MAS-CS). Breeding birds were identified in over eighty different polygons (see RM#1) representing twelve different habitats. Results are attached and indicate species, polygon location (referenced to RM#1), and criteria for breeding confirmation (see MMNHP - Breeding Bird Area Census - June 1992).

Summary

A total of sixty-two species of birds were observed on the various censuses (see attached summary - "MMNHP Birds Observed"). Because the inventory was largely done during the height of the nesting season it is safe to assume that virtually all species recorded nest in MMNHP. The single exception is Great Blue Heron. No Federally Endangered or Massachusetts' species of Special Concern (Threatened or Endangered) were observed. In general, the breeding birds recorded were typical of the mixed deciduous/coniferous transitional forest, second growth fields, agricultural edges, and wetlands of this region of Massachusetts. Several species are of local interest. As available second growth scrub has been reduced breeding species associated with this habitat type, including Brown Thrasher, Rufous-sided Towhee, and Indigo Bunting, have declined locally. Nesting Bobolinks have also been drastically reduced as available hayfields and meadowlands have declined. Each of these species was recorded on the census. See "Recommendations" for further discussion.

MMNHP Bird Observed

Common Name	Latin Name
Great Blue Heron	<i>Ardea herodias</i>
Canada Goose	<i>Branta canadensis</i>
Broad-winged Hawk	<i>Buteo platypterus</i>
Red-tailed Hawk	<i>Buteo jamaicensis</i>
American Kestrel	<i>Falco sparverius</i>
Ring-necked Pheasant	<i>Phasianus colchicus</i>
Killdeer	<i>Charadrius vociferus</i>
American Woodcock	<i>Scolopax minor</i>
Rock Dove	<i>Columba livia</i>
Mourning Dove	<i>Zenaida macroura</i>
Chimney Swift	<i>Chaetura pelagica</i>
Downy Woodpecker	<i>Picoides pubescens</i>
Northern Flicker	<i>Colaptes auratus</i>
Eastern Wood Pewee	<i>Contopus virens</i>
Eastern Phoebe	<i>Sayornis phoebe</i>
Great Crested Flycatcher	<i>Myiarchus crinitus</i>
Eastern Kingbird	<i>Tyrannus tyrannus</i>
Tree Swallow	<i>Tachycineta bicolor</i>
Northern Rough-winged Swallow	<i>Stelgidopteryx serripennis</i>
Barn Swallow	<i>Hirundo rustica</i>
Blue Jay	<i>Cyanocitta cristata</i>
American Crow	<i>Corvus brachyrhynchos</i>
Black-capped Chickadee	<i>Parus atricapillus</i>
Tufted Titmouse	<i>Parus bicolor</i>
White-breasted Nuthatch	<i>Sitta carolinensis</i>
Carolina Wren	<i>Thryothorus ludovicianus</i>
House Wren	<i>Thryothorus aedon</i>
Wood Thrush	<i>Hylocichla mustelina</i>
American Robin	<i>Turdus migratorius</i>
Gray Catbird	<i>Dumetella carolinensis</i>
Northern Mockingbird	<i>Mimus polyglottos</i>
Brown Thrasher	<i>Toxostoma rufum</i>
Cedar Waxwing	<i>Bombycilla cedrorum</i>
European Starling	<i>Sturnus vulgaris</i>
Warbling Vireo	<i>Vireo gilvus</i>
Red-eyed Vireo	<i>Vireo olivaceus</i>
Blue-winged Warbler	<i>Vermivora pinus</i>

MMNHP Bird Observed

Yellow Warbler	<i>Dendroica petechia</i>
Pine Warbler	<i>Dendroica pinus</i>
Prairie Warbler	<i>Dendroica discolor</i>
Black-and-White Warbler	<i>Mniotilta varia</i>
American Redstart	<i>Setophaga ruticilla</i>
Common Yellowthroat	<i>Geothlypis trichas</i>
Scarlet Tanager	<i>Piranga olivacea</i>
Northern Cardinal	<i>Cardinalis cardinalis</i>
Rose-breasted Grosbeak	<i>Pheucticus ludovicianus</i>
Indigo Bunting	<i>Passerina cyanea</i>
Rufous-sided Towhee	<i>Pipilo erythrophthalmus</i>
Chipping Sparrow	<i>Spizella passerina</i>
Field Sparrow	<i>Spizella pusilla</i>
Song Sparrow	<i>Melospiza melodia</i>
Bobolink	<i>Dolichonyx oryzivorus</i>
Red-winged Blackbird	<i>Agelaius phoeniceus</i>
Common Grackle	<i>Quiscalus quiscula</i>
Brown-headed Cowbird	<i>Molothrus ater</i>
Northern Oriole	<i>Icterus galbula</i>
Purple Finch	<i>Carpodacus purpureus</i>
House Finch	<i>Carpodacus mexicanus</i>
American Goldfinch	<i>Carduelis tristis</i>
House Sparrow	<i>Passer domesticus</i>

MMNHP BB-6/2

Species	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	Totals
Canada Goose							4											4
Ring-necked Pheasant												1						1
Mourning Dove							1									1		2
Chimney Swift												2	2		2		1	7
Downy Woodpecker															1			1
Eastern Phoebe													2				1	3
Eastern Kingbird															1			1
Tree Swallow															1			1
Barn Swallow																1		1
Blue Jay										2	1	1			1		1	6
American Crow		1							1	4			1		1	1	4	13
Black-capped Chickadee				4	1							1			1		1	8
Tufted Titmouse		2			2	1												5
White-breasted Nuthatch		1																1
Wood Thrush										1								1
American Robin			1				3	2							1	2	1	10
Gray Catbird			1		2	1				3					1			8
Northern Mockingbird		2										1				1		4
Cedar Waxwing			2													2		4
European Starling			2	1	2											1		6
Red-eyed Vireo								1										1
Blue-winged Warbler								1		1								2
Yellow Warbler				1							1				2	2		6
American Redstart								1	1									2
Common Yellowthroat		2				1						1	1		1			6
Scarlet Tanager									1									1
Northern Cardinal						1		1	1	1		1				2		7
Rose-breasted Grosbeak											1						1	2
Song Sparrow						1		1				1				1		4
Red-winged Blackbird		1	2	1	2				2		2				2		2	14
Common Grackle		1							1						1			3
Brown-headed Cowbird									1					1			1	3
Northern Oriole															1	1		2
Purple Finch															1			1
House Finch			3				1								1			5
American Goldfinch				1		1			1						2			5
House Sparrow											1					2		3

MMNHP BB-6/3

Species	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	Totals
Canada Goose	1																	1
Ring-necked Pheasant										1								1
Rock Dove																1		1
Mourning Dove							1	1		16					1			19
Chimney Swift					1	1			1			2	1		1		1	8
Common Flicker	1																	1
Eastern Kingbird										1					1	1	1	4
Great-crested Flycatcher										1								1
Tree Swallow															6			6
Barn Swallow											3							3
Blue Jay		1		3	1					1			1					7
American Crow			2		1	1	2			1		1	1	1			1	12
Black-capped Chickadee	1				1		1		1									4
Tufted Titmouse			1															1
White-breasted Nuthatch		1								1						1		3
House Wren					1													1
Wood Thrush									1									1
American Robin	1	1	1	2	2		1		1	1	1	1	1				2	15
Gray Catbird		1				1		1	1									4
Northern Mockingbird	2											1					1	4
Cedar Waxwing			2															2
European Starling	2		3	3		6					3	2				6		25
Warbling Vireo															1			1
Blue-winged Warbler										1								1
Yellow Warbler											1				1	2	1	5
American Redstart						1		1	1									3
Common Yellowthroat		1				2					1	2					1	7
Scarlet Tanager									1									1
Northern Cardinal							1		1	1	1				1			5
Rose-breasted Grosbeak								1			1						1	3
Song Sparrow						1					1	2			1	1	1	7
Red-winged Blackbird	1	1		2	1						3				2	1	1	12
Common Grackle			1	2		1			1				2		1	1		9
Brown-headed Cowbird								4	1					1	1		1	8
Northern Oriole				1								1			1		1	4
House Finch		1						4				2			2	2		11
American Goldfinch									1							1	1	3
House Sparrow											3					2		5

MMNHP BB-6/9

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	Totals
Species																		
Mourning Dove	1			1				1	1	1					1	2		8
Chimney Swift						2						3			2		2	9
Downy Woodpecker																1		1
Eastern Kingbird											2							2
Barn Swallow											1	1			1	1		4
Blue Jay							1			1					1	1	1	5
American Crow					1				2	1			1		1			6
Black-capped Chickadee		1			1	1		2		2				1				8
Tufted Titmouse			1												2			3
White-breasted Nuthatch		1																1
House Wren					1					1								2
American Robin	1	1		1	1		1	2	1			1		1			2	12
Gray Catbird	2	1						1	1				1					6
Northern Mockingbird	2						1									2	1	6
European Starling				2					1			4			2		1	10
Red-eyed Vireo								1	1									2
Yellow Warbler											1			1	2		1	5
American Redstart								1										1
Common Yellowthroat		1	1									1	1	1				5
Scarlet Tanager									1									1
Northern Cardinal															1			1
Blue-breasted Grosbeak								1			1							2
Chipping Sparrow		1		2														3
Song Sparrow	1					2		1				1	1				1	7
Red-winged Blackbird		1	2	1		1					2	1		1	1		1	11
Common Grackle		1						4	3		1					2		11
Brown-headed Cowbird											1						1	2
Northern Oriole															1			1
House Finch								2							2	1		5
American Goldfinch											2	2			2	1		7

Species	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	Totals
Long-necked Pheasant											1							1
Mourning Dove							4		1	1	9	1			1			17
Chimney Swift					1							3			2		2	8
Common Flicker								1	1									2
Eastern Phoebe											1						1	2
Eastern Kingbird											1				1			2
Great-crested Flycatcher																	1	1
Blue Jay		1		1		1											1	4
American Crow		1	2		1	1				1	2		2	1	1	2		14
Black-capped Chickadee				2					1	1					2	1		7
Tufted Titmouse	1												1					2
White-breasted Nuthatch															2			2
House Wren			1		1			1	1									4
American Robin	1	1		1	2	1	1	2				4		4	2	2	2	23
Gray Catbird		1	2		2	1				1		1	1				1	10
Northern Mockingbird	3															2	2	7
European Starling			2	2					2			2			3			11
Red-eyed Vireo								1										1
Warbling Vireo															1			1
Black-and-white Warbler								1										1
Blue-winged Warbler								1										1
Pied Warbler				1														1
Junco Warbler								1					1	1	1		1	5
American Redstart																1		1
Common Yellowthroat		1			1							1	1			1	1	6
Scarlet Tanager									1									1
Northern Cardinal							2		1	1								4
Chipping Sparrow		1					2	1										4
Song Sparrow					1	1					1	1			1		1	6
Red-winged Blackbird			2	1	1	1			2		2		1		2		1	13
Common Grackle		1						3			1		1		2		1	9
Brown-headed Cowbird						1		1	1	1							1	5
Northern Oriole								1							1	1	1	4
House Finch	2		1					4		1	2	1			1	1		13
American Goldfinch			1	1												1		3
House Sparrow											4	1				2		7

MMNHP BB-6/16

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	Totals
Long-necked Pheasant											1							1
Killdeer											1							1
Mourning Dove														1				1
Chimney Swift									1			1			2		1	5
American Kestrel				1														1
Common Flicker							1											1
Eastern Phoebe																1		1
Great-crowned Flycatcher						1												1
Tree Swallow				1														1
Blue Jay					1		1		2	2				2			1	9
American Crow		2			2	1	1								1		1	8
Black-capped Chickadee		1			1			1	1				1					5
Tufted Titmouse		3			1	2										1	1	8
White-breasted Nuthatch				1	1			1	1									4
American Robin	1	2							1	1	1	1			1		2	10
Gray Catbird		1			2	1				1			1		1		1	8
Northern Mockingbird	3									1	1				1	2	2	10
Cedar Waxwing							1	2	1									4
European Starling	1		7	1							1					13	4	27
Red-eyed Vireo					1				1									2
Parula Vireo															1		1	2
Indigo-banded Warbler				1														1
Yellow Warbler		1						1				1			1	1	1	6
American Redstart						1		1										2
Common Yellowthroat		1						1					1		1			4
Northern Cardinal			2			1					1							4
Chipping Sparrow							1		1							1		3
Song Sparrow					1	1		1			1	1				1	1	7
Red-winged Blackbird			1	1	2	1	1	3			2		2		2			15
Common Grackle							1		1			1						3
Brown-headed Cowbird									1			1			1			3
Northern Oriole				1												1		2
House Finch				1				2	1					2	1		1	8
American Goldfinch							1									2		3
House Sparrow											3	1				1		5

Breeding Bird Area Census

	LOC	SYM	LOC	SYM	LOC	SYM	LOC	SYM	LOC	SYM
Great Blue Heron	611-3	x	330-13	x						
Killdeer	220-1	x								
American Woodcock	621-2	t	330-14	d						
Rock Dove										
Mourning Dove	220-1	s'	310-7	s	310-6	s				
Red-tailed Hawk	611-2	t	210-6	t						
Broad-winged Hawk	420-1	t	210-4	t						
Black-billed Cuckoo	410-5	fy								
Downy Woodpecker	170-4	x	410-4	fl	611-3	t	330-3	fl		
Common Flicker	410-7	t	170-4	x	410-13	x	410-14	d	310-13	fl
Common Flicker	410-17	s	611-3	s	330-3	fl	330-13	x	310-10	t
Eastern Wood-Pewee	320-5	x								
Eastern Phoebe	410-7	t	330-3	x						
Eastern Kingbird	210-1	t	410-5	ts	330-13	s				
Great-crested Flycatcher	420-2	s	330-7	t						
Tree Swallow	310-6	x	611-1	on						
Barn Swallow	210-5	ny	170-4	x						
Rough-winged Swallow	510-1	t								
Blue Jay	410-14	fy	210-3	nb	330-9	nb	330-10	nb	330-11	fl
Blue Jay	410-17	s	611-3	s	330-3	fl	330-13	s	430-5	s
American Crow	170-4	x	410-8	fl	611-3	s	330-13	s		
Black-capped Chickadee	420-2	s	170-4	s	410-4	nb	430-4	fl	310-13	x
Black-capped Chickadee	410-17	x	611-3	s	430-5	s				
Tufted Titmouse	330-6	s	170-4	s	410-8	fl	410-10	fl	611-3	x
Tufted Titmouse	310-10	fl								
White-breasted Nuthatch	410-13	s	410-8	s						
House Wren	420-3	fl	310-13	fl						
Carolina Wren	611-3	s								
Wood Thrush	410-7	s	611-2	s	410-14	x	410-15	s	410-16	s
Wood Thrush	410-18	s								
American Robin	410-10	fy	330-3	fy	330-3	fl	430-4	fl	310-7	d
American Robin	310-6	d	170-3	fl	310-11	on	310-13	x	611-3	s
American Robin	330-13	fl								
Gray Catbird	410-6	fy	170-4	ny	410-7	s	310-3	fy	614-1	nb
Gray Catbird	330-11	fl	320-6	s/t	611-3	s/t	330-13	fl	410-18	t

Breeding Bird Area Census

Northern Mockingbird	170-6	ny	330-9	ny	430-3	fl	320-6	s	611-4	fl
Brown Thrasher	330-10	nb								
Cedar Waxwing	170-4	nb	310-9	t						
European Starling	420-1	t	210-1	t	310-5	fl	310-7	t	621-2	t
European Starling	170-1	fl	330-9	fl	320-6	t	330-3	fl		
Red-eyed Vireo	330-10	fy	410-18	s	410-17	s	611-4	s		
Warbling Vireo	621-2	s								
Pine Warbler	420-1	s								
Blue-winged Warbler	330-6	s	310-4	s	320-6	fy				
Yellow Warbler	330-6	s	410-7	s	621-2	fy	310-9	s	310-13	fl
American Redstart	410-7	s								
Common Yellowthroat	330-6	s	170-4	s	410-7	s	320-2	s	410-14	n
Common Yellowthroat	320-6	fy	611-3	s	330-13	s	611-3	s		
Scarlet Tanager	611-1	s	420-4	t	410-15	s				
Northern Cardinal	410-9	fy	330-11	fl	320-6	n	611-3	s	330-13	t/s
Northern Cardinal	430-5	s								
Rose-breasted Grosbeak	410-7	s	611-2	s	410-14	t	310-13	s	611-3	x
Indigo Bunting	622-1	s								
Rufous-sided Towhee	330-3	s	330-12	s						
Field Sparrow	330-3	s	330-3	s						
Chipping Sparrow	170-4	ts	410-10	fl	330-13	fl				
Song Sparrow	330-6	s	330-8	fy	210-5	fy	310-9	fl	320-5	s
Song Sparrow	310-13	fl	611-3	s	330-13	x/s				
Bobolink	210-3	n								
Red-winged Blackbird	310-9	fl	430-4	fl	410-5	fl	621-1	fl	320-6	fl
Red-winged Blackbird	330-3	fl								
Common Grackle	621-2	fy	410-5	fy	410-11	ts	430-4	fl	410-14	fl
Brown-headed Cowbird	170-7	fl	310-6	t	410-7	fl	330-8	fl	310-13	fl
Northern Oriole	621-2	t	320-4	x	410-14	t	320-5	x	310-13	fl
Northern Oriole	330-13	fl								
House Finch	330-6	s	410-7	s	310-10	s				
American Goldfinch	410-7	t	310-13	s/t	611-3	s	611-3	s	611-4	s
American Goldfinch	310-10	x								

IV.

Survey of Cold-Blooded Vertebrates

Methodology

1) Amphibians

Aquatic-breeding amphibians were sought primarily by identifying likely breeding sites and then systematically searching these sites for breeding adults, egg masses, and larvae. Several techniques were used to locate occurrences of aquatic breeding amphibians, they are listed below along with the locations at which each technique was employed:

Survey Technique*	Localities Employed
Visual Search for Egg Masses	All sites of presumed probable amphibian breeding
Auditory Survey for Calling Frogs/Toads	Throughout MMNHP
Dip-Netting for Adults, Larvae	All sites of presumed probable amphibian breeding
Road Surveys for Migrating Adults/Juveniles	All major roads on 4 occasions during nocturnal rains, 1 in late March, 1 in late May, 2 in early June.
Seining	Cook's Pond, Whittemore Pond, Folly Pond, Vernal Pool south of Virginia Rd., 2 un-named ponds on either side of Rt. 2A, near Sunnyside La. Larger ponds seined at least twice.
Minnow Trapping for Larvae	Folly Pond, small pond at Eagle's Beak
Drift Fence/Pitfall Trapping	Whittemore Pond: 87 days x 20 traps, also 31 days x 8 traps at small pond on Cranberry Hill, just S. of MMNHP

* Additionally, hoop-trapping for turtles resulted in the capture of 1 adult bullfrog.

Our amphibian survey commenced on March 15 and continued until October 10, 1992. Survey efforts were not uniformly distributed around MMNHP but were generally concentrated on the most productive sites. The primary efforts of Windmiller and Walton were focused on the areas adjacent to Route 2A. These efforts were considerably enhanced by independent amphibian surveys conducted by Joe Martinez and the team of Leslie Thomas and Jennifer Busch.

The terrestrial-breeding redback salamander and terrestrial life-history stages of other amphibians were sought by turning over likely cover items (logs, stones, trash, *Sphagnum* mounds).

2) Reptiles

Turtles were sought by visual searching for basking individuals, and by hoop-trapping. Hoop traps were set in the Cranberry Bog Pond (near Route 2A and Airport Road), Cook's Pond, Folly Pond, the vernal pool south of Virginia Road, Mill Brook just upstream of its confluence with the Concord River and a backwater of the Concord River. A total of approximately 120 trap-days was logged. The most extensive effort was centered on the vernal pool south of Virginia Road, which was regarded as potential spotted turtle habitat.

Snakes were not a central focus of this survey effort. However, three half-day snake surveys were conducted (3 people per survey) during the summer. These efforts were focused on the eastern half of MMNHP and involved searching promising basking sites, fields, and overturning potential cover objects on sunny mornings following relatively cool nights. Snakes were always incidentally sought by our party while walking through the site. No specific snake trapping efforts were conducted. Additionally, we attempted to survey the roads that traverse MMNHP for road-killed snakes during our very frequent travels through the Park.

3) Fish

Fish were sought incidentally by seining and dip-netting as part of the broader amphibian surveys and as part of hoop-trapping efforts for turtles. Hoop traps were also employed in Mill Brook and Elm Brook with fish captures as a primary objective. Minnow-trapping for fish was conducted in Elm Brook, Folly Pond, a tributary of Mill Brook behind the Willow Pond Kitchen, and at a small pond in the Eagle's Beak. Additionally, we have included captures of fish during a 1991 electroshock survey of a reach of Mill Brook just upstream of MMNHP boundaries.

Results

The results of the survey of cold-blooded vertebrates are presented in the attached Table. The following narrative, below, summarizes the major findings.

1) Amphibians

Eleven species of amphibians were found to breed in MMNHP; these included four species of salamanders and seven species of anurans (frogs and toads). All the relatively common amphibian species native to eastern Massachusetts were found with the exception of the leopard frog (a possibly declining species) and the northern dusky salamander (a species not particularly common in northeastern Massachusetts). No rare (state-listed) species of amphibians were encountered; one watch-listed species, the spotted salamander breeds in the Park.

Overall, the abundance of pond-breeding species appeared skewed in favor of species that are broadly tolerant of habitat fragmentation and human intrusion, particularly the green frog, bullfrog and spring peeper. The two vernal pool-dependent species, the spotted salamander and wood frog, were not abundant in the Park. No large populations of spotted salamanders exist in MMNHP and only one fairly large population of wood frogs was observed despite the presence of several breeding sites apparently capable of supporting large populations of both species. The primary reason for the restricted distribution of these species in MMNHP is probably the extreme fragmentation of woodlands, and the proximity of major roads to all breeding sites.

The rarest amphibian species in the park was the two-lined salamander, the only stream-breeding species encountered. The distribution of this species is limited by the lack of well-oxygenated stream habitat in MMNHP, it was only found in a small stretch of riffles in Elm Brook, just north of the Route 2A culvert.

Additional detailed information on the distribution and conservation status of MMNHP amphibians is presented in the attached report on amphibian habitat preferences and movement patterns.

2) Reptiles

The three common species of turtles in eastern Massachusetts were observed in MMNHP. However, due to the lack of large ponded areas, all populations except those of the Concord River wetlands were very small. Despite repeated efforts, no spotted turtles were observed in MMNHP. Their absence is probably due to the paucity of suitable shrub swamp habitat and the extreme barriers to dispersal that Route 2A and Old Lexington Road present.

Five species of snakes were observed in MMNHP. Two additional species, the ring-necked and red-bellied snakes may occur in small numbers in the Park but were not found in this survey. Overall, snakes were remarkably rare in MMNHP. We recorded only one individual of three of the five species observed; only the garter snake was observed in moderate numbers. As fairly wide-ranging carnivores, the larger species of snakes (northern water snake, milk snake, black racer) are certainly subject to very high mortality when they are forced to cross the major roads of the park. The small, forest-dwelling red-bellied and ring-necked snakes may be limited by the paucity of moderately-large patches of woodland.

3) Fish

Eight species of fish were recorded in MMNHP, four additional species were found in Mill Brook just outside the Park boundaries and doubtless range into MMNHP proper. Several species of fish are known to occur in the Concord River system but were not observed in this survey; they include the white sucker, carp, and northern pike. The banded sunfish and blacknose dace are also relatively common in the area and may occur in MMNHP, they were not, however, observed in this survey. Three of the twelve species recorded in or near MMNHP are introduced (non-native) species: the bluegill sunfish, largemouth bass, and yellow bullhead. One observed species (common shiner) is watch-listed.

The rarest species of fish observed in MMNHP is the brook trout, an apparently native population of which persists in Elm Brook. This population appears small, and restricted to a relatively small area of the brook.

Observations of Cold-Blooded Vertebrates (MNHP- 1992)

Common Name	Location Name	Code	Breed?	Notes
Amphibians				
Spotted Salamander	1) Whittemore Pond	521-2	Y	17 breeding adults, ~ 70 juveniles
	2) Cook's Pond	520-1	Y	Relatively small population (< 15 egg masses)
	3) Vern. Pool S. of Va. Rd	521-8	Y	Largest population, but only about 20 egg masses
	4) Small Pond N. of 2A	521-7	Y	One egg mass (Martinez), eaten prior to hatching.
	5) Pool in wetland N. of visitor's center	521-4	Y	One Egg Mass (Thomas/Bush)
Redback Salamander	Throughout Park in Wooded areas		Y	Not especially abundant
Red-Spotted Newt	1) Cook's Pond	520-1	Y	Sizeable Population
	2) Whittemore Pond	521-2	Y	1 larva, 1 juvenile
	3) Folly Pond	520-3	Y	Sizeable Population
Two-lined Salamander	1) Elm Brook, just N. of 2A	614-1	Y	Only found in 1 small area
	1) Cook's Pond	520-1	Y	Some larvae found
	2) N. Bank, Concord River	614-2	Y	Several males calling
	3) Palumbo Farm ditches	621-1	Y	A few males calling
	4) Whittemore Pond	521-2	N	Adults trapped moving to and from pond, no calling
	5) Lex. Rd., SE of Willow Pond Kitchen		Y	Breeding adults moving across rd. in both directions
American Toad	6) Lex. Rd., S. of Wayside		Y	Males heard calling to South

Comm	Site	Location Name	ID	Breed?	Notes
Bullfrog		1) Cook's Pond	520-1	Y	2-3 calling males, a few larvae
		2) Pond S. of 2A, E. of Sunnyside	521-9	Y	Best breeding site, many larvae, adults
		3) Vern. Pool S. of VA Rd.	521-8	N	1 adult trapped
		4) Folly Pond	520-3	Y?	1-2 calling males
		1) Cook's Pond	520-1	Y	Very productive site, many killed x-ing Old Mass Ave.
Gray Treefrog		2) Folly Pond	520-3	Y	Moderate breeding chorus, many larvae
		3) Lex. Rd. by Wayside		Y	Crossing rd., breeding along Mill Brook
		4) Cranberry bog, S. of 2A	521-1	Y	Small chorus, adults killed crossing 2A
		5) Whittemore Pond	521-2	Y	Small number of larvae found
		1) Cook's Pond	520-1	Y	Large population
Green Frog		2) Cranberry bog, S. of 2A	521-1	Y	Numerous larvae
		3) Whittemore Pond	521-2	Y	Important non-breeding site, several larvae
		4) Folly Pond	520-3	Y	Large population
		5) Small pond S. of Folly Pond	521-6	Y	Only amphibians observed
		6) Small pond N. of 2A	521-7	Y	Moderate population, co-exist with bullheads
		7) Vern. Pool S. of VA. Rd.	521-8	Y	Moderate population, larvae perished when pond dried
		8) Pond S. of 2A, E. of Sunnyside	521-9	Y	Small population, outcompeted by bullfrogs
		9) Pond, ditches - Palumbo Farm	621-1	Y	Adults, small # larvae
		10) Wetland S. of Battle Rd. Visitor Center	521-5	N	Juvenile habitat
		11) Mill Brook, N. of Lex. Rd.		N	Non-breeding habitat

Common Name	Location Name	Code	Breed?	Notes
Pickereel Frog	1) Cook's Pond	520-1	Y	Best breeding site, many juveniles, larvae
	2) Whittemore Pond	521-2	N	Important non-breeding site for juveniles
	3) Folly Pond	520-3	Y	Small number larvae, juveniles
	4) N. Bank, Concord River		Y	1 adult heard calling
Spring Peeper	Wetlands throughout MNIHP			Use many ephemeral pools, ditches in addition to ponds
Wood Frog	1) Cook's Pond	520-1	Y	Small chorus (about 10-20 males)
	2) Whittemore Pond	521-2		37 breeding adults trapped
	3) Vern. Pool N. of Battle Rd. Visitor Center	521-3		~ 30 egg masses, same pool as Mystic Valley Amphipod
	4) Vern. Pool S. of VA. Rd.	521-8		Largest population, about 350 egg masses
	5) Small Pond N. of 2A	521-7		Larvae seined, co-existing with brown bullheads
	6) Pond/ditch system, Palumbo Farm	621-1	Y	Martinez recorded 3 and 11 egg masses in 2 pools
	7) Wooded wetland N. of Whittemore Pond	611-4	N	Tracked 3 frogs from Whittemore to this area
	8) Cranberry Bog S. of 2A	521-1	N	Used by 1 radio-tracked frog from Whittemore Population
	9) Wooded wetland S. of Virginia Road	611-5	N	Used by 1 radio-tracked frog from Whittemore Population
	10) Wooded Wetland S. of 2A	521-5	N	Adults and juveniles observed in swamps east of pool

Observations of Cold-Blooded Reptiles (MNIIP - 1992)

Common Name	Location Name	Code	Breed?	Notes
Reptiles				
Painted Turtle	1) Pond by Battle Rd. Vis. Ctr.	520-2	N	1 adult observed
	2) Concord River		N	Adults trapped and observed, only large population
	3) Whittemore Pond	521-2	N	Scutes of dead adult found
	4) Farm pond, Palumbo Farm	621-1	N	1 adult
Snapping Turtle	1) Cranberry bog, S. of 2A	521-1	N	1 adult trapped
	2) Whittemore Pond	521-2	N	1 adult, 1 sub-adult trapped
	3) Vern. Pool S. of VA. Rd.	521-8	N	2 sub-adults trapped
	4) Concord River		N	1 adult trapped
	5) Farm Pond, Palumbo Farm	621-1	N	1 adult observed
Stinkpot	1) Mill Brook (near mouth)		N	1 adult trapped
Garter Snake	1) Fiske Hill	330-1	N	Individuals observed on several occasions
	2) Powerline N. of 2A	330-3	N	Several observations in same area
	3) Whittemore Pond	521-2	N	One adult observed
	4) S. of VA Rd.	611-4 521-8	N	Adults observed on 2 occasions
Milk Snake	1) 2A, S. of Visitor Center		N	1 adult found dead on 2A
Northern Water Snake	1) Whittemore Pond	521-2	N	1 adult observed
Ribbon Snake	1) Wetland S. of Vis. Ctr.	521-5	N	1 adult observed eating radio-tagged wood frog
	2) Powerline S. of 2A	330-3	N	1 juvenile observed
Black Racer	1) Mowed field, Fiske Hill	330-1	N	Reliable sighting by MNIIP Ranger

Common Name	Location Name	Code	Breed?	Notes
Fish				
American Eel	1) Mill Brook (outside MNHP)		N	1 observed electroshocking (1991) just north of MNHP
	1) Mill Brook		N	Adults trapped in hoop trap
Bluegill Sunfish	2) Pond by Battle Rd. Vis. Ctr.	520-2	N	Adults observed
	1) Elm Brook	614-1	Y	1 Adult and 5 juveniles trapped/netted
Brook Trout	1) Small pond, N. of 2A	521-7	Y	Numerous adults, juveniles
	2) Small pond, Eagle's Beak	521-10	Y	Numerous adults, juveniles
Brown Bullhead	1) Mill Brook		N	1 adult trapped in hoop trap
	2) Concord River floodplain		Y	Numerous juveniles seen in flooded wet meadow
Common Shiner	1) Mill Brook (outside MNHP)		N	1 caught electroshocking just north of MNHP (1991)
Golden Shiner	1) Pond at Battle Rd. Vis. Ctr.	520-2	N	2 large adults found dead
	2) Mill Brook (outside MNHP)		Y	Adults observed
Largemouth Bass	1) Pond at Battle Rd. Vis. Ctr.	520-2	N	Juveniles observed electroshocking N. of MNHP (1991)
	2) Mill Brook (outside MNHP)		Y	Adults observed
Pumpkinseed Sunfish	1) Mill Brook		N	Several adults trapped
	2) Small Pond, Eagle's Beak	521-10	Y	3 juveniles trapped
Redfin Pickerel	1) Mill Brook (outside MNHP)		Y	Adults/juvs. captured by electroshocking N. of MNHP
Yellow Bullhead	1) Mill Brook (outside MNHP)		Y	Adults/juvs. captured by electroshocking N. of MNHP
	1) Mill Brook		N	Adults trapped
Yellow Perch	2) Pond at Battle Rd. Vis. Ctr.	520-2	N	Adults observed

Methodology

During the period May through July, 1992 MMNHP was censused for butterflies. The census focused primarily on the observation and recording of adult butterflies. Egg, larval, and pupal stages were not included. An effort was made to schedule the census so that it coincided with the several major flight periods during the season.

Summary

A total of 42 species of butterflies were observed during the census period (see attached summary "MMNHP - Butterflies - 1992"). Over 430 individual butterflies were observed in nine different habitats. This represents approximately one-third of the regularly occurring butterflies in Massachusetts and as such indicates fairly good diversity. Approximately four hundred and thirty individual butterflies were observed in nine different habitats types. Species, dates, numbers of individuals, habitat type, and polygon reference numbers are given in the attached "MMNHP-Leps Data". One species, the Frosted Elfin (*Incisalia irus*), is of particular concern. Apparently confined to the eastern portion of the state, its rarity is indicated by the fact that only 12 individuals were found during the 5-year period of the Massachusetts Butterfly Atlas Project (1985-1989). The Massachusetts Natural Heritage Program is planning to sponsor research on Frosted Elfin in 1993. For further discussion see "Recommendations", Section IX, below.VII.

SWALLOWTAILS

Black Swallowtail
Eastern Tiger Swallowtail
Canadian Tiger Swallowtail

WHITES & SULPHURS

Cabbage White
Clouded Sulphur
Orange Sulphur

GOSSAMER WINGS

American Copper
Coral Hairstreak
Banded Hairstreak
Juniper Hairstreak
Frosted Elfin
Henry's Elfin
Eastern Pine Elfin
Gray Hairstreak
Spring Azure

BRUSHFOOTS

Pearl Crescent
Eastern Comma
Mourning Cloak
Red Admiral
American Lady
Painted Lady
Viceroy
Little Wood Satyr
Common Ringlet
Common Wood Nymph

SKIPPERS

Silver-spotted Skipper
Northern Cloudywing
Sleepy Duskywing
Juvenal's Duskywing
Common Sootywing
Least Skipper
European Skipper
Cobweb Skipper
Indian Skipper
Peck's Skipper
Tawny-edged Skipper
Long Dash
Northern Broken Dash
Little Glassywing
Hobomok Skipper
Dun Skipper
Dusted Skipper

PAPILIONIDAE

Papilio polyxenes
Papilio glaucus
Papilio canadensis

PIERIDAE

Pieris rapae
Colias philodice
Colias eurytheme

LYCAENIDAE

Lycaena phlaeas
Satyrrium titus
Satyrrium calanus
Mitoura grynea
Incisalia irus
Incisalia henrici
Incisalia nippon
Strymon melinus
Celastrina argiolus

NYMPHALIDAE

Phyciodes tharos
Polygonia comma
Nymphalis antiopa
Vanessa atalanta
Vanessa virginiensis
Vanessa cardui
Limenitis archippus
Megisto cymela
Coenonympha tullia
Cercyonis pegala

HESPERIIDAE

Epargyreus clarus
Thorybes pylades
Erynnis brizo
Erynnis juvenalis
Pholisora catullus
Ancyloxpha numitor
Thymelicus lineola
Hesperia metea
Hesperia sassacus
Polites peckius
Polites themistocles
Polites mystic
Wallengrenia egeremet
Pompeius verna
Poanes hobomok
Euphyes vestris
Atrytonopsis hianna

Butterfly Data

Species	Date#	individuals	LCT	Poly
<i>Papilio polyxenes</i>	3-Jun	1	210	3
<i>P. glaucus</i>	14-May	1	330	4
	22-May	1	310	3
	27-Jul	1	310	12
	27-Jul	1	621	2
<i>P. canadensis ?</i>	15-Jun	1	310	3
<i>Pieris rapae</i>	1-May	1	210	1
	3-May	2	210	1
	3-May	1	330	2
	14-May	2	330	3
	14-May	1	170	1
	14-May	1	330	3
	18-May	1	330	1
	20-May	3	170	5
	22-May	3	310	3
	22-May	1	310	2
	28-May	4	210	2
	3-Jun	1	210	3
	3-Jun	6	210	2
	12-Jun	12	210	2
	27-Jul	1	310	12
<i>Colias philodice</i>	18-May	1	210	1
	28-May	10	210	2
	3-Jun	2	210	3
	3-Jun	6	210	2
	4-Jun	3	310	3
	12-Jun	5	210	2
	27-Jul	5	310	12
	27-Jul	2	621	2
<i>C. eurytheme</i>	27-Jul	2	310	12
<i>Lycaena phlaeas</i>	14-May	2	330	3
	18-May	1	210	1
	18-May	1	310	1
	22-May	3	310	2
	3-Jun	3	210	2
	12-Jun	1	330	3
	4-Jun	3	310	3
	4-Jun	10	310	2
	4-Jun	1	320	2
	15-Jun	2	310	3
	15-Jun	3	310	2
<i>Satyrrium titus</i>	27-Jul	1	310	12
<i>S. calanus</i>	27-Jul	3	210	1
<i>Mitoura grineus</i>	26-Jun	1	170	4
<i>Incisalia irus</i>	12-Jun	1	330	3
<i>I. henrici</i>	3-May	1	330	1
<i>I. nippon</i>	3-May	1	330	2

Butterfly Data

<i>Megisto cymela</i>	4-Jun	1	320	2
	4-Jun	1	330	3
	12-Jun	1	310	5
	12-Jun	1	310	4
	12-Jun	1	330	3
<i>Coenonympha tullia</i>	28-May	1	210	2
	3-Jun	9	210	2
	4-Jun	5	310	3
	4-Jun	12	310	2
	4-Jun	1	320	
	12-Jun	2	2	4
	12-Jun	1	330	3
	12-Jun	1	310	5
	16-Jun	4	310	6
	16-Jun	3	310	3
	16-Jun	10	310	2
	27-Jul	1	210	1
	27-Jul	1	621	2
<i>Cercyonis pegala</i>	27-Jul	20	210	1
	27-Jul	6	310	12
	27-Jul	3	621	2
<i>Epargyreus clarus</i>	12-Jun	1	310	5
	27-Jul	2	310	12
	27-Jul	1	621	2
<i>Thorybes pylades</i>	12-Jun	1	310	4
	15-Jun	1	310	6
<i>Erynnis brizo</i>	12-Jun	1	310	4
<i>E. juvenalis</i>	14-May	1	430	1
	14-May	1	410	1
	15-May	2	410	2
	15-May	3	330	5
	18-May	1	330	1
	18-May	5	420	1
	18-May	1	330	3
	20-May	3	430	1
	4-Jun	1	320	2
	12-Jun	1	330	3
<i>Pholisoa catullus</i>	28-May	1	210	2
	3-Jun	2	210	3
	3-Jun	3	210	2
	12-Jun	2	330	3
<i>Ancyloxpha numitor</i>	25-Jun	5	210	5
	3-Aug	17	1st Pond	
<i>Thymelicus lineola</i>	12-Jun	1	330	3
<i>Hesperia metea</i>	4-Jun	1	330	3
<i>H. sassacus</i>	16-Jun	1	330	3

Butterfly Data

<i>Polites peckius</i>	4-Jun	5	310	3
	4-Jun	6	310	2
	4-Jun	1	330	3
	12-Jun	15	310	4
	12-Jun	1	330	3
	15-Jun	2	310	3
	15-Jun	5	310	2
<i>P. themistocles</i>	4-Jun	5	310	2
	15-Jun	2	310	3
<i>P. mystic</i>	12-Jun	1	330	3
	12-Jun	6	310	4
	12-Jun	1	210	4
<i>Wallengrenia egereme</i>	27-Jul	2	210	1
<i>Pompeius verna</i>	27-Jul	2	210	1
<i>Poanes hobomok</i>	12-Jun	1	410	4
	15-Jun	2	310	3
<i>Euphyes vestris</i>	27-Jul	10	210	1
	27-Jul	2	310	12
	27-Jul	1	621	2
<i>Atrytonopsis hianna</i>	6-Apr	2	330	3

VI.

Survey of Odonates

Methodology

Dragonflies and damselflies were inventoried in and around wetlands, ponds, and streams of MMNHP. This was done as opportunities presented themselves and often as a supplement to primary census goals. Therefore, the data presented does not represent a comprehensive list but rather an initial survey of this fauna at MMNHP.

Summary

Thirty one species of odonates were identified comprising 8 damselfly (Zygoptera) species and 23 dragonfly (Anisoptera) species. The attached summary, "MMNHP Odonates," indicates observation dates and locales. Of the species observed, two skimmers, *Libellula auripennis* and *L. semifasciatus* are regarded as locally uncommon.

MMNHP Odonates

ZYGOPTERA							
Agrionidae							
<i>A. maculata</i>	x	8/20					
Libellulidae							
<i>L. eurinus</i>	7/1FP	x	7/6				
<i>L. rectangularis</i>	x	8/20	9/1 FP				
<i>L. vigilax</i>	8/30 CP	9/1 FP	x	8/20			
Coenagrionidae							
<i>Argia fumipennis violacea</i>	7/1VC	6/16 BV	x	8/20	x	8/25	8/30 CP
<i>Enallagma aspersum</i>	6/16 BV	8/30 CP	x	8/20	9/1 FP		
<i>E. signatum</i>	7/1FP	7/6 PF					
<i>Ischnura verticalis</i>	7/1FP	x	8/20	8/25 BV			
ANISOPTERA							
Gomphidae (Clubtails)							
<i>Gomphus exilis</i>	7/1VC						
<i>Dromogomphus spinosus</i>	VC						
Aeschnidae (Darners)							
<i>Anax junius</i>	7/1FP	EB	6/16 BV	x	8/20	7/30 CB	8/26 PL
<i>A. constricta</i>	x	8/20					
Libellulidae (Skimmers)							
<i>Perithemis tenera</i>	x	8/20	8/25 VC				
<i>Celithemis elisa</i>	6/25PFF	7/6 EB	EB				
<i>C. eponina</i>	7/30 CB						
<i>Libellula auripennis</i>	6/16 BV						
<i>L. cyanea</i>	7/1VC	8/26 PL	8/25 BV				
<i>L. incesta</i>	x	8/20					
<i>L. luctuosa</i>	7/1FP	EB	x	8/20	8/26 PL		
<i>L. lydia</i>	6/16 BV	EB	7/1FP	x	8/20	8/30 CP	
<i>L. pulchella</i>	6/16 BV	EB	7/1FP	x	8/20	7/30 CB	8/30 CP
<i>L. quadrimaculata</i>	7/1FP						
<i>Erythemis simplicicollis</i>	6/25: BV	EB	9/1 FP				
<i>Pachydiplax longipennis</i>	7/1FP	EB	x	8/20	9/1 FP		
<i>Sympetrum sp.</i>	7/1FP	EB					
<i>S. rubicundulum</i>	6/16 BV	7/30 CB	7/6 EB	x	8/20	8/25 BV	8/26 PL
<i>S. rubicundulum</i>	8/30 CP	9/1 FP					
<i>S. semicinctum</i>	8/25 BV						
<i>S. vicinum</i>	x	8/20	8/26 PL	8/25 BV			
<i>Leucorrhinia frigida</i>	7/1FP	EB					
<i>L. intacta</i>	7/1FP	EB					
Codes							
BV= Battle Rd. Vis Center							
CB =Cranberry Bog							
EB=Elm Brook							
FP= Folly Pond							
PFF= Palumbo Farm Fields							
VC= Vis Center Con Riv							

VII. Survey of Aquatic Macro-Invertebrates

Methodology

Aquatic macro-invertebrates were sought by dip-netting and seining in various wetlands throughout MMNHP. Observations were recorded from seven wetlands along the Route 2A section of the Park and two wetlands along the Old Lexington Road section (see attached Table for localities). No observations are recorded from the North Bridge/Concord River section. Field notes of aquatic invertebrate observations are recorded from March 31 to October 2, 1992.

The taxonomic level of identification varied with the experience of the observers; most identifications were made to the genus level. Identifications were made both in the field (if the observers were sufficiently experienced with the taxa at hand) and in the laboratory with the aid of a 40x dissecting microscope. Amphipod samples were sent to Dr. Douglas Smith of the University of Massachusetts for verification of species-level identifications.

Results

The results of this survey are presented in the attached Table. Odonates (dragon- and damselflies) are not recorded here as observations of adult odonates are presented in Section VI, above.

Overall, 41 taxa of aquatic macro-invertebrates were identified in the nine wetlands included in this survey. Of the observed taxa, 28 were insects, 6 were crustaceans, 3 were molluscs, and 4 were worms of three phyla. This list represents only some fraction of the overall number of taxa that occur in MMNHP. The results of this survey reflect biases in sampling techniques, the choice of sampling localities, and our experience in identifying the various invertebrate groups. Our efforts were concentrated in the larger ponded areas of MMNHP; comparatively little sampling was done in streams, and no observations are recorded from the Concord River and the mouth of Mill Brook.

One state-listed rare invertebrate species, the Mystic Valley Amphipod, was recorded; observations of this species are described in Section VIII, below. Chironomids, one species of water boatmen, and two species of backswimmers were particularly abundant in the ponds of MMNHP. Overall, Cook's Pond and Folly Pond were observed to have, by far, the most diverse invertebrate faunas of the areas surveyed in MMNHP. The relatively high invertebrate diversity of these two ponds is a consequence of their relatively large size and high habitat diversity.

**List of Aquatic Macro-Invertebrate Taxa Observed and Identified
Minuteman NHP, 1992
(does not include odonates)**

Lower Phyla	
Turbellaria (Flatworms)	Throughout
Nematoda (Roundworms)	Throughout
Hirudinea (Leeches)	CP, FP
Tubificidae (Tubifex Worms)	Flooded Farm Fields, Off
Molluscs	
Pelecypoda (Bivalves)	
<i>Anodonta c. cataracta</i> (Freshwater Mussel)	VCPO
Sphaeriidae (Fingernail Clams)	Pools, ponds throughout MNHP
Gastropoda (Snails)	
<i>Planorbella</i> sp.	FP, VCST
Crustaceans	
Anostraca (Fairy Shrimp)	
<i>Eubranchipus</i> sp.	CP
Amphipoda (Amphipods)	
<i>Crangonyx aberrans</i> (Mystic Valley Amphipod)	VCST, VCV, VAVP
<i>Crangonyx</i> sp.	MB
<i>Gammarus fasciatus</i>	MB
Isopoda (Isopods)	
<i>Caecidotea communis</i>	Throughout MNHP
Cambaridae (Crayfish)	
<i>Orconectes rusticus</i>	CH
Aquatic Insects (Except Odonates)	
Ephemeroptera (Mayflies)	
<i>Heptagenia</i> sp.	EB
<i>Siphonurus</i> sp.	CP, FP
Trichoptera (Caddisflies)	
<i>Limnephilus</i> spp.	CP, FP, VCV, VAVP, MB
<i>Ptilostomus (ocellifera)</i>	CP
<i>Phryganea</i> sp.	CP
<i>Glossosoma</i> sp.	EB
<i>Hydropsyche</i> sp.	VAVP

Taxon (Common Name)	Localities
Insects (Continued)	
Hemiptera (True Bugs)	
<i>Hesperocorixa</i> sp.	Throughout MNHP
<i>Notonecta irrorata</i> (backsimmer)	WP, FP, CP, VAVP
<i>Notonecta undulata</i> (backswimmer)	All ponds, vernal pools
<i>Belostoma (lutarium)</i> (giant water bug)	CP, FP
<i>Ranatra fusca</i> (Water Scorpion)	CP, FP
<i>Hydrometra</i> sp. (Water Measurer)	CP
<i>Pelocoris</i> sp. (Water Bug)	CP, FP
<i>Gerris</i> sp. (spp.) (Water Striders)	Throughout
Coleoptera (Beetles)	
<i>Rhantus</i> sp. (Predaceous Diving Beetle)	CP, CH
(<i>Graphoderus</i> ?) sp. (Predaceous Diving Beetle)	CP, FP, WP
<i>Agabus</i> sp. (Predaceous Diving Beetle)	FP
<i>Dytiscus</i> sp. (spp.) (Predaceous Diving Beetle)	All ponds, vernal pools.
<i>Hydrochora</i> sp. (Scavenging Water Beetle)	CP
<i>Tropisternus</i> sp. (Scavenging Water Beetle)	CP
<i>Halplus</i> spp. (Crawling Water Beetles)	CP, FP, WP, VCVF
<i>Gyrinus</i> sp. (Whirligig Beetles)	CP, FP, WP
<i>Cybister</i> sp.	CP, FP
Diptera (True Flies)	
<i>Chironomus</i> spp. (midges)	Throughout
<i>Chaoborus</i> sp. (Phantom Midge)	VCVP, WP
<i>Culicidae</i> (Mosquito Larvae)	WP, VAVP, Others
Megaloptera (Fishflies etc.)	
<i>Chauliodes</i> sp.	VCST, FP

Key To Localities

CH	Small Pond by Cranberry Hill Office Park (just outside MNHP)
CP	Cook's Pond
EB	Elm Brook
FP	Folly Pond
MB	Mill Brook
VAVP	Vernal pool south of Virginia Road
VCPO	Permanent pond west of Battle Road Visitor Center
VCST	Shallow stream flowing from North of Visitor Center South, across Rt. 2A
WP	Small vernal pool north of Battle Road Visitor Center
	Whittemore Pond

VIII.

Observations of Rare Species

Two species of state-listed rare invertebrates were found in MMNHP, the Mystic Valley Amphipod (*Crangonyx aberrans*) and the Elderberry Borer Beetle (*Desmocerus palliatus*). Both species are listed as "Species of Special Concern" in the most recent (1993) List of Rare Wetlands Wildlife compiled by the Massachusetts Natural Heritage and Endangered Species Program. Our observations on the status and distribution of these two species in MMNHP are detailed, below.

1) Mystic Valley Amphipod

Mystic Valley Amphipods are small (~5mm) aquatic shrimp-like organisms that are globally restricted to eastern Massachusetts and areas of neighboring Rhode Island and New Hampshire. Within this area, the species is found typically in small streams and marshes of coastal plain red maple and Atlantic white cedar swamps. According to the describer of this species (Dr. Douglas Smith, University of Massachusetts), Mystic Valley Amphipods rarely occur in temporary (vernal) pools that are entirely isolated from more permanent wetlands.

During the spring of 1992, we searched for amphipods in wetlands throughout MMNHP. Samples of all crangonyctid amphipods (the family comprising the Mystic Valley Amphipod) were preserved and brought to the laboratory for identification. Samples were then sent to Dr. Douglas Smith for verification of these identifications.

We found two separate populations of the Mystic Valley Amphipod in MMNHP. One population occupies a narrow wetland that drains from north of Marrett Street/Airport Road, south across the roads and then south and west passing north of the Battle Road Visitor Center and west of the small permanent pond near the visitor center before draining south across Route 2A (just west of the entrance road to Minuteman Vocational Tech.) and then south, across the MMNHP boundary. Amphipods were found throughout the shallow stream channels of this wetland. Additionally, several Mystic Valley Amphipods were found in a small vernal pool, isolated from the stream system, located just northwest of the Battle Road Visitor Center. This "Visitor Center Population" was not densely distributed in the stream, but individuals could be taken with minimal effort from many locations.

A second population of Mystic Valley Amphipods (the "Virginia Road Population") was found in and around the large vernal pool located south of Virginia Road, west of Bedford Lane, east of Old Bedford Road, and North of Route 2A. The amphipods were found in the vernal pool itself, as well as in the seasonal, short, inlet and outlet channels of the pool. The Virginia Road Population appeared abundant, with the greatest densities found in the inlet stream channel of the vernal pool. The Virginia Road Population has been reported to the Massachusetts Natural Heritage Program and the vernal pool that they occupy has been submitted for certification.

In addition to the Visitor Center and Virginia Road Populations, amphipods of the genus *Crangonyx* were found in the tributary of Mill Brook located just behind (north and west of) the Willow Pond Kitchen. We were not, however, able to capture adults (adults are generally present only in the spring) and no certain identification was made. (A close relative of the Mystic Valley Amphipod, *Crangonyx pseudogracile*, occurs in the Concord area; it is not considered a rare species.) The Mill Brook site should therefore be surveyed

this coming spring and regarded in the interim as being a possible Mystic Valley Amphipod habitat. Finally, we did not search the small stream just north and east of the Fiske Hill Parking Lot. It is close to the Visitor Center Population and provides similar habitat.

2) Elderberry Borer Beetle

The Elderberry Borer Beetle is a relatively large, brightly colored beetle of the bark beetle family, *Cerambycidae*. The adult beetles are apparently active for only a relatively short flight season in early-mid summer. They deposit their eggs in the soft pith of common elderberry (*Sambucus canadensis*) and the larvae develop within the pith. The present status of the Elderberry Borer Beetle in Massachusetts is uncertain, museum records indicate that it may have been more abundant in the past.

One population of Elderberry Borer Beetles was found in MMNHP. A total of three adult beetles were found in a stand of elderberries located on the banks of the northeastern corner of the ditch system that drains the main Palumbo Farm field, southeast of Merriam's Corner. All observations of the beetles were made in the first week of July. We had hoped to mark and recapture adult beetles to estimate the population size but repeated visits after July 10 failed to turn up any adult beetles.

Although we did not find Elderberry Borer Beetles elsewhere in MMNHP, the beetle's flight season is apparently short and easily missed. We did, however, notice insect oviposition scars in the new growth of elderberries located along a wet ditch on the northern boundary of MMNHP lands, almost due north of Manuel Drive. These oviposition scars were similar in appearance to those observed in the elderberries upon which we had observed the three adults on Palumbo Farm. (The oviposition scars in question appeared different than those of the black-horned tree cricket - another insect that oviposits in elderberry - as pictured in The Natural History of Wild Shrubs and Vines (Donald Stokes, 1989: The Globe Pequot Press)). Clearly, more effort will be required to assess the distribution and abundance of Elderberry Borer Beetles in MMNHP.

3) Watch-Listed Species

The Massachusetts Natural Heritage and Endangered Species Program maintains an informal "Watch-List" of species that do not presently merit rare species status but are candidates for possible future listing. One watch-listed species was found in MMNHP, the spotted salamander (*Ambystoma maculatum*). Its presence in MMNHP is marginal (see Section IV, above) and it would benefit from well-focused conservation measures.

One individual of a second watch-listed species, the common shiner (*Notropis cornutus*, a small minnow) was found in Mill Brook near Concord Lumber in August, 1991. The species is, therefore, likely to occur in the reach of Mill Brook within MMNHP boundaries.

Additionally, the Frosted Elfin butterfly (*Incisalia irus*) was located on and near the powerline cut just west of the Fiske Hill area. Although only two individuals were observed, further censusing should be able to determine the size and exact location of the colony. This species is confined to the eastern portion of the state and during the Massachusetts Butterfly Atlas Project (1985-1989) only 12 individuals were found. The Massachusetts Natural Heritage Program is planning to sponsor research on Frosted Elfin in 1993 and this may well provide an opportunity for MMNHP to accomplish this work. An account of Frosted Elfin is attached.

Conclusions

The results of our survey of birds, cold-blooded vertebrates, and selected invertebrate groups indicate that Minute Man National Historical Park possesses a moderately depauperate representation of the fauna of eastern Massachusetts. Most of the fairly common species typical of the habitat types present in MMNHP were observed, but rare species, species with large home ranges, and those with specialized habitat requirements were either absent or present in fairly low numbers.

The absence of most rare and/or regionally declining species in the taxa that we surveyed is broadly attributable to several obvious ecological characteristics of MMNHP at the landscape scale. These characteristics are ranked, below, in generally descending order of importance.

- 1) MMNHP is located in an area of moderately dense human development thus restricting the available species pool.
- 2) MMNHP is bisected by large roadways throughout its length. All areas of the park are within the dispersal distance of small terrestrial vertebrates (e.g. frogs, snakes) from a well-trafficked road. The consequences of road-kill mortality are significant throughout the Park.
- 3) The Park is generally long and linear in shape. This shape not only mandates that all areas are fairly close to the roadways, along which the Park is generally aligned, but also exposes most area of the Park to edge-related influences from disturbed area within or beyond the Park boundaries. Such negative edge-related phenomena as nest parasitism, predation by domestic animals, and invasion by exotic plant species are manifest throughout the Park. Furthermore, linear natural landscape features, particularly streams and linear wetlands, tend to traverse narrow areas of the Park, MMNHP thus owns and manages only small segments of these systems. Likewise, dispersal corridors around breeding sites, such as vernal pools, inevitably extend well beyond the Park's boundaries.
- 4) Areas of relatively undisturbed vegetation (woodlands, marshes, successional communities) are highly fragmented by roads, houses, and areas of other anthropogenic disturbance. As a result, few large patches of undisturbed vegetation remain and interior-dependent/edge-sensitive species are generally absent from MMNHP.
- 5) Aquatic systems are subject to considerable pollution via non-point discharges, primarily road runoff and agricultural/lawn runoff.

To date, the planning of land acquisition and management in MMNHP has been guided primarily by the historical focus of the Park. Land purchases have generally not been made with wildlife/biodiversity - related concerns paramount. Likewise, land management techniques have traditionally focused on historical preservation/interpretation and visitor access resulting in a disturbance regime not conducive to the maintenance of many rarer species. Beyond the control of MMNHP, the hoped for relocation of Route 2A has not materialized, leaving the Park with an extreme barrier to dispersal by terrestrial animals and a source/cause of various edge-related effects.

Despite all the limitations described above, MMNHP does, however, continue to support healthy populations of a large number of vertebrate and invertebrate wildlife species. In total, we found 62 species of breeding birds, 12 species of breeding amphibians, 8 species of reptiles, at least 12 species of fish, and moderately diverse communities of butterflies, odonates, and aquatic insects. Among the species found were 2 watch-listed species of vertebrates, 2 state-listed species of invertebrates, and one further invertebrate species whose status is worthy of concern.

We believe that MMNHP currently serves an important, if somewhat secondary, purpose as a refuge for wildlife in a suburban region that is facing severe development pressures. The role of MMNHP as a regional resource for wildlife conservation and public education regarding wildlife and natural resources conservation can be significantly enhanced by enactment of the following recommendations. These recommendations are based upon the results of our surveys and are generally targeted at specific rare species or species whose status in MMNHP is threatened. Note, however, that habitats preserved or enhanced for the immediate benefit of, for example, a population of Mystic Valley Amphipods or Frosted Elfins will benefit the more common species that also utilize that habitat as well as the Park visitors who seek natural and scenic diversity.

Recommendations

We have grouped our recommendations into three general categories:

- A. Further resource inventory and research.
- B. Habitat Preservation
- C. Habitat Management, Enhancement, and Acquisition

We suggest that the recommendations be generally prioritized in that manner, with resource inventories and preservation schemes enacted with precedence over management, enhancement, and acquisition schemes.

Moreover, we have individually prioritized all our recommendations. We regard those recommendations given a "Priority 1" rating as generally more important than "Priority 2" recommendations.

Priority I Recommendations

Further Resource Inventory and Research

- 1) Seek out new populations of Elderberry Borer Beetle, particularly along farm ditches on lands north of Old Lexington Road, Concord.
- 2) Determine whether the *Crangonyx* amphipods found in the Mill Brook tributary behind the Willow Pond Kitchen are Mystic Valley Amphipods. Also seek out Mystic Valley Amphipods in the stream near the Battle Road Visitor Center.
- 3) Determine the approximate population size of the Elderberry Borer Beetles on Palumbo Farm with mark/recapture methods.
- 4) Determine the distribution and approximate population sizes of Mystic Valley Amphipods in the "Virginia Road" and "Visitor Center" populations.

Habitat Preservation

The following are areas in which we recommend no significant disturbance of existing soils and vegetation with the exception of enhancement, and management recommendations cited below.

- 1) All woodlands and wetlands in the trapezoidal area south of Virginia Rd., w. of Bedford La., E. of Old Bedford Rd., and North of Route 2A (Mystic Valley Amphipod habitat, most productive vernal pool in MMNHP, largest patch of fairly intact woodlands, most unique wetland area).
- 2) All vegetation on the berms of the Palumbo Farm ditch system (Elderberry Borer Beetle habitat).
- 3) All wetlands and all woodlands within 100 feet of the wetland edge of the stream/wetland system that serves as habitat for the "Visitor Center" population of Mystic Valley Amphipods (Mystic Valley Amphipod habitat, locations described in Section VIII, above).
- 4) All areas of Elm Brook, its associated wetlands, and upland woodlands within 100 feet of the edge of the associated wetlands (the only well-oxygenated stream habitat in MMNHP, only brook trout and two-lined salamander populations, only healthy stream-invertebrate fauna, unique bordering wetlands with significant patches of common elderberry.)
- 5) All woodlands within 500 feet of the edge of Cook's Pond (the most diverse aquatic habitat, vernal pool in MMNHP, the resident populations of gray tree frogs and spotted salamanders appear to move towards the woodlands southeast of Old Mass. Ave.).

- 6) All wetlands in the Concord River Floodplain and along the reach of Mill Brook in the North Bridge section of the Park (unique vegetation in MMNHP, habitat for the only large populations of turtles, and the majority of fish species, possibly including the watch-listed common shiner).

Habitat Management, Enhancement, and Acquisition

- 1) If, after further research, the status of the Elderberry Borer Beetle in MMNHP proves as grave as it now appears, we recommend that MMNHP plant elderberries in wet soils along the edges of as many open fields as possible, particularly in that portion of MMNHP on either side of Old Lexington Road, in Concord.

Priority 2 Recommendations

Further Resource Inventory and Research

- 1) Monitor, on a yearly basis, the number of egg masses laid by wood frogs and spotted salamanders in the vernal pool south of Virginia Road, this is the most important breeding site in MMNHP for both species.
- 2) Use minnow traps/seines to determine the status of the common shiner in Mill Brook, near its confluence with the Concord River.
- 3) Determine the approximate size and extent of the brook trout and two-lined salamander populations associated with Elm Brook.
- 4) Assess the population size of the Frosted Elfin in the powerline area west of Fiske Hill and determine the distribution of nectaring and larval host plants.

Habitat Preservation

- 1) All woodlands within 300 feet of any vernal pool used as a breeding site by spotted salamanders and wood frogs (terrestrial habitat for the spotted salamander and other species, movement corridors and habitat for wood frogs and other ranid frogs).
- 2) All woodlands in a roughly triangular area between the western shore of Cook's Pond and the eastern half of Whittemore Pond (a major migratory corridor for several amphibian species).
- 3) All fields and second-growth scrub areas on Fiske hill (the only known habitat in MMNHP for the black racer, possible habitat for the equally uncommon milk snake).

Priority 2 Recommendations (continued)

Habitat Management, Enhancement, and Acquisition

- 1) Use volunteer labor and inexpensive materials to enhance the capacity of Elm Brook to serve as brook trout habitat (a description of appropriate methods is available from Trout Unlimited). Simultaneously, place additional natural cover objects (logs, stones) long the brook to enhance two-lined salamander habitat.
- 2) Close Old Massachusetts Avenue southeast of Cook's Pond to through traffic during the breeding migrations of wood frogs and spotted salamanders in early spring (rainy nights, typically around March 20) and those of the gray tree frog (rainy nights at the end of May, first 10 days of June). Other than Route 2A, Old Mass. Ave is the source of the greatest amphibian and reptile road-kill mortality.
- 3) Acquire additional wetlands and woodlands south of the present MMNHP boundary in the vicinity of Folly Pond. These extensive wetlands doubtless provide vernal pool habitat and appear to be possible spotted turtle habitat.
- 4) Acquire additional land North of Cook's Pond. The present small buffer around Cook's Pond certainly limits the potential habitat value of this otherwise productive and diverse wetland.
- 5) It is assumed that MMNHP's plans for future habitat management will create more "open space" and less shrub and forest cover in the park. In general this should encourage butterfly diversity throughout. Several factors will be important in complementing these efforts. Native plant species acting as larval hosts and/or nectaring sources for adult butterflies should be given priority if landscaping plans include introducing floral material. Careful consideration should be given to mowing schedules and the application of pesticides should be absolutely minimized. Presently, meadows such as those surrounding the visitors centers at the North Bridge and the Battle Road are cut several times during the growing season. Mowing patterns and schedules might well take into consideration flight periods and nectaring resources for butterflies and at the same time provide the necessary public access.

While agricultural lands have been declining in Concord for well over a century, the loss of farmlands in Concord has been particularly severe during the last four decades. A commensurate decline in the wildlife associated with agricultural edges, fallow fields, and grazing land has also occurred. Bobolink and Eastern Meadowlark are two field nesting species whose breeding populations have declined dramatically over the last decades. In both cases we can attribute this decline to loss of nesting habitat and short mowing schedules.

Remnant populations of both species are still found in Concord and it seems reasonable to assume that an increase in suitable nesting habitat, a potential result of habitat changes at MMNHP, in combination with less frequent mowing, would result in increased numbers of these species. Bobolinks were seen prospecting in the hay fields on the north side of the Kaveski and McHue farms and might be expected to successfully nest in the area if mowing was not commenced until early July.

Another class of habitat, second growth scrub, is becoming less and less common in the Concord area. Historically, as farmers cleared and then left fallow certain fields for several years, second growth provided important habitat for nesting birds. Species including Brown Thrasher, Indigo Bunting, Prairie Warbler, and Field Sparrow are now relatively rare in Concord because many of these scrub areas have either been replaced by development and manicured lawns, or have grown up to shrub and forest communities. Small areas of this habitat already exist in MMNHP (Powerline cut west of Fiske Hill and north of the William Smith House and west of Hanscom Drive). Management practices could encourage and maintain existing habitat as well as create additional areas.

	March	April	May	June	July/August
Vernal Pools		evening searches for calling anurans, esp. <i>Rana pipiens</i>	search for calling anurans, check <i>Ambystoma</i> hatching success	dip-net surveys of invertebrates	check on pools to note hydroperiod
Rare Crustaceans	(included above): dip-net vernal pools for Eubranchipus intricatus	dip net small pools and streams for <i>Cragonyx aberrans</i>		(included above): dip-net search for <i>Limnadia lenticularis</i> in additional trapping	
Rare Turtles		assess habitat, search for turtles in pools, initiate hoop trapping	scan for basking turtles, set and check hoop traps		
Other Herpetozoans		search for stream salamanders, four-toed salamanders	search for salamanders, snakes under appropriate substrates	as for May	as for May
Elderberry Borer Beetle			locate significant patches of elderberry, seek beetles	search for adult beetles	
Butterflies		collect and identify butterflies throughout; flight period #1	as for April; flight period #2	as before; flight period # 3	as before; end of each month
Birds	census for owls and woodcock		locate and identify breeding birds in 4-day period at end of month	as for May; periods at beginning and end of month	



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PUBLIC SERVICE INFORMATION

WATER RESOURCES •

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NATURAL HISTORY

Massachusetts Breeding Bird Atlas 1974-1978

A cooperative project of the Massachusetts Division of Fisheries

Massachusetts Audubon Society

Criteria for possible, probable and confirmed breeding

Possible Breeding - this code will be entered in the first column or

✓ Bird recorded in the breeding season in possible nesting habit
other indication of breeding noted.

Probable Breeding - codes entered in second column

S Singing male present (or breeding calls heard) on more than c
the same place.

T Bird (or pair) apparently holding territory.

D Courtship and display; or agitated behavior or anxiety calls
suggesting probable presence of nest or young nearby; broodp
female or cloacal protuberance on trapped male.

N Visiting probable nest-site.

B Nest building by wrens and woodpeckers.

Confirmed Breeding - codes entered in third column

DD Distraction display or injury feigning, coition

NB Nest building by any species except wrens and woodpeckers

*UN Used nest found

FE Female with egg in the oviduct

FL Recently fledged young

FS Adult carrying fecal-sac

FY Adult(s) with food for young

ON Adult(s) entering or leaving nest-site in circumstances :
nest

NE Nest and eggs or bird setting and not disturbed or egg shells found away from nest

NY Nest with young or downy young of waterfowl, quail, waders, etc.

*use with caution

