THE MAYFLIES OF ACADIA NATIONAL PARK, MAINE, U. S. A.

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ABSTRACT

The mayflies of Acadia National Park on Mount Desert Island were surveyed from April - October, 1987 with extensive field collections. The park occupies 12,145 ha on a coastal island. Collecting sites varied considerably in elevation, substrate composition, acidity and salinity.

Twenty-three genera and 47 species were recorded, 22 of which were new species records for Mount Desert Island and five were new for the State of Maine. *Leptophlebia* spp. were the most widely distributed species in lentic habitats and *Stenoma modestum* was the most ubiquitous lotic species. Mayfly species richness recorded in this study compared favorably with that recorded on Mount Desert Island in the 1930's.

INTRODUCTION

A study of the distribution of mayfly species in Maine is currently underway. As part of this effort, a survey of Acadia National Park, Mount Desert Island was undertaken in 1987. Prior to this, recent information on mayflies was limited to surveys of the aquatic insect fauna of two watersheds (Mingo and Gibbs 1980, Mingo et al. 1978), research on particular species (Gibbs and Mingo 1986) and data from water quality studies (Gibbs et al. 1984, Rabeni et al. 1985). Of particular value, for the sake of long term comparison, was a survey of the insect fauna of Mount Desert Island that was done in the 1930's. Mayflies from this earliest survey were identified by H. T. Speith and recorded by Procter (1946).

This paper gives results of our 1987 project in Acadia National Park with a comprehensive list of species present, defines the habitat characteristics of the nymphs, and compares the species present with those found in the same region over 40 years ago.

STUDY AREA AND METHODS

Acadia National Park covers 12,145 ha on Mount Desert Island on the central coast of Maine (Fig. 1). A central range of mountains forms the

backbone of the island from east to west rising to an altitude of 305-457 m above sea level. There are steep cliffs at the eastern edge of the range and more moderate slopes on the western side. To the north and south are gentle slopes which leave a section of the island with an altitude of about 61 m above sea level. Lentic habitats range in size from Long Pond (360 ha) to transient seasonal pools. Lotic habitats are dominated by first and second order streams which occur at all elevations and have a variety of substrates and flow rates.

In the spring of 1987, 12 primary sampling sites were established within park boundaries (Fig. 1). These sites were chosen to represent a wide spectrum of diversity in aquatic habitats that are available to aquatic insects. In addition, randomly chosen secondary sites were sampled as time permitted. Both nymphs and adults were collected by a variety of methods. The location of secondary sites, collecting and rearing methods, and observations on swarming and oviposition are detailed by Mack (1988). Physical and chemical characteristics of the sampling sites were recorded when monthly samples were taken (Tables 1 and 2).

RESULTS

Mayfly Species Collected

Forty-seven species of mayflies representing 22 genera and 7 families were collected during this study. After taking into account name changes which resulted since Procter's (1946) survey, 25 of the species which were originally found in the area were recollected, 10 species were not found, 22 species were new records for Mount Desert Island, and 5 were new to the State of Maine (Table 3).

Species Richness at the Primary Collecting Sites

The greatest diversity of mayfly species occurred in a lake outlet stream (Duck Brook, 21 species) and the lower reach of a second order stream (Stanley Brook, 15 species) (Table 4). The majority of taxa were found in riffle sections of these streams in association with gravel and cobble substrates, leafpacks and woody detritus. Cobble substrates in Duck Brook supported a rich covering of moss from which many species were collected. No mayflies were found in Northeast Creek probably because this stream falls under regular tidal influence. Salinity in Northeast Creek often exceeds 8 ppt.

In contrast to the lotic habitats, lentic habitats were relatively depauperate. Mesotrophic Aunt Betty Pond yielded the highest number of species (5) among lake sites (Table 5). Eagle Lake (0 species) and Great Long Pond (2 species) were the most oligotrophic of the primary sites. Collections of adults near these lakes indicate that *Leptophlebia*, *Siphlonurus*, *Stenacron* and *Hexagenia* were present but not collected in this survey. The Beaver Pond (1 species) was characterized by high temperatures and a high concentration of emergent vegetation and algae. Sargent Mountain Pond (0 species) was an

acidic site with a pH of 4.7 during the sampling period.

Leptophlebia, the most widely distributed taxon in the park, was abundant in temporary pools, ponds and along stream margins. *Stenonema modestum* was also ubiquitous, especially in lotic habitats. Other species such as *Acerpenna pygmaeus*, *Callibaetis ferrugineus*, *Centroptilum album*, *C. bellum*, *Ephemerella aurivillii* and *E. rotunda* were only found at single locations.

DISCUSSION

The 47 species collected in Acadia National Park in 1987 represent only 28% of the 167 species recorded for Maine in a recent survey of the State's mayfly fauna (Burian 1990). It seems likely that the comparative paucity of the mayfly fauna in the park is related to a regional lack of major rivers and streams that are common elsewhere in the State. Chemical constraints appear to have excluded mayflies from at least two of the habitats surveyed. Even though some species of Baetidae, Caenidae and Leptophlebiidae have been reported from brackish water habitats (Brittain 1982, Berner and Pescador 1988), none of these or any other species were found in the saline waters of Northeast Creek. The absence of mayflies in Sargent Mountain Pond appears to be related to the acidity of the environment. *Leptophlebia* spp. have been recorded from such habitats (Harper & Harper 1982, Hunter et al. 1985) but this genus was not represented in Sargent Mountain Pond.

Overall, more species were collected in this study than were found previously by Procter (1946). Because we collected both nymphs and adults and Procter used only adult material, this discrepancy in species richness can be attributed to methodological differences rather than changes in species diversity. In addition, samples were taken from early spring to late fall in this study, but only during the summer and fall during Procter's survey. Thus, many of the spring emerging species may have been missed in the earlier study. The absence of several previously recorded species during this survey is probably due to three main factors. First, the extent to which systems are naturally variable from year to year or over several decades is largely unknown. Second, some species which were initially recorded may not have been endemic but rather were carried to the island by winds. *Choroterpes basalis*, for instance, was found previously and is known to occur in nearby large mainland rivers, yet was absent during this survey. And third, Procter's survey included all of Mount Desert Island, whereas this study was limited to a smaller area contained within the boundaries of Acadia National Park. The persistence of sensitive mayfly species seems to indicate that environmental conditions have not changed drastically over the past 40 years.

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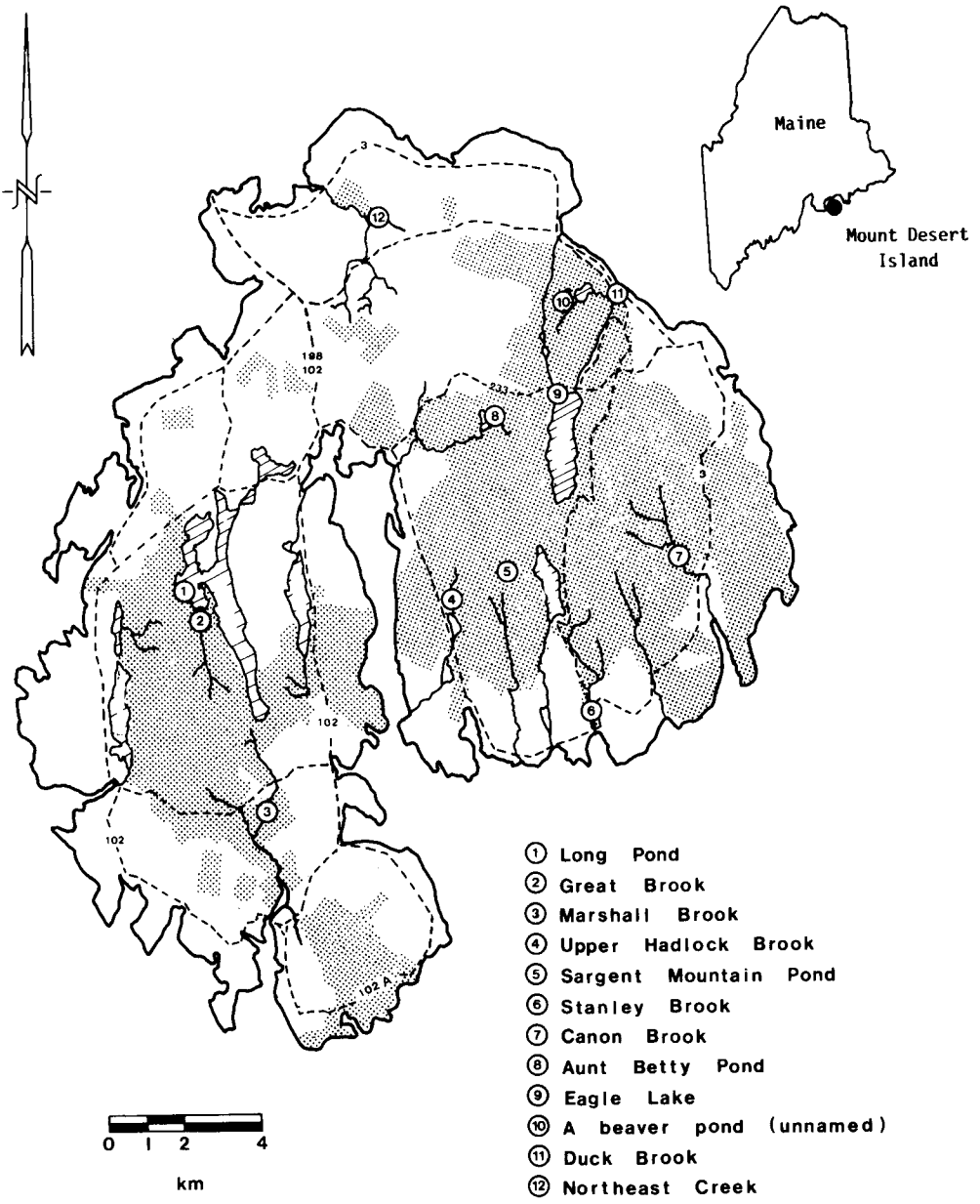

Fig. 1. Location of primary sampling sites on Mount Desert Island, Maine. Shaded areas represent Acadia National Park.

Table 1. Characteristics of lotic habitats sampled.

	Months Sampled	Elevation (m)	Temp. (^{o}C)	pH	Specific Conductance $umhos.cm^{-1}$	Velocity cm.s	Substrate
Canon B.	Apr. - Sept.	49	10 - 20	5.8 - 6.3	27 - 42	-	silt gravel detritus
Duck B.	May - Oct.	60	8.5 - 23	5.9 - 6.8	39 - 61	-	gravel cobble
Great B.	May - Oct.	3	13 - 17	6.5 - 6.8	35 - 41	3 - 60	sand, silt gravel woody detritus
Hadlock B.	Apr. - Sept.	85	7 - 17.5	5.7 - 6.3	24 - 61	0 - 30	gravel cobble boulders
Marshall B.	May - Sept.	-	13.5 - 26	5.8 - 6.2	30 - 81	0 - 50	silt fine gravel
Northeast C.	May - Oct.	-	12 - 24	5.9 - 7.8	585 - 10,000	-	silt detritus
Stanley B.	May - Oct.	6	7.5 - 21	6.4 - 7.2	46 - 80	0 - 80	gravel cobble boulders

Table 2. Characteristics of lentic habitats sampled.

	Months Sampled	Elevation (m)	Temp. (^{o}C)	pH	Specific Conductance $umhos.cm^{-1}$
Sargent Mt. Pond	Apr. - Oct.	325	10 - 22	4-6 - 4.9	30 - 70
Aunt Betty Pond	Apr. - Oct.	64	12.5- 24	6.7 - 7.0	63 - 84
Eagle Lake	May - Oct.	85	11 - 23	6.4 - 6.8	40 - 61
Beaver Pond	May - Sept.	55	20 - 30	4.7 - 5.8	30 - 69
Long Pond	May - Sept.	18	15 - 22	6.5 - 6.9	39 - 59

Table 3. Comparison of mayfly species collected in the 1930's (Proctor 1946) (A) and in 1987 (B).

A	B
Siphlonuridae	
Ameletus	*Ameletus*
X *ludens* Needham	XXX *lineatus* Traver
Siphlonurus	sp.
quebecensis (Provancher)	*Siphlonurus*
mirus Eaton	XX *alternatus* (Say)
typicus Eaton	*quebecensis* (Provancher)
sp.	*mirus* Eaton
	typicus Eaton
	sp.
Baetidae	
Baetis	*Acerpenna*
X *pluto* McDunnough	XXX *macdunnough* (Ide)
pygmaeus (Hagen)	*pygmaeus* (Hagen)
sp.	*Baetis*
Callibaetis	XX *amplus* (Traver)
X *americana* Banks	XX *brunneicolor* McDunnough
ferrugineus (Walsh)	XX *flavistriga* McDunnough
X *fluctuans* (Walsh)	XX *tricaudatus* Doods
hageni Eaton	sp.
Cloeon	*Callibaetis*
rubropictum McDunnough	*ferrugineus* (Walsh)
sp.	*Centroptilum*
	XX *album* McDunnough
	XXX *bellum* McDunnough
	XXX *rufostrigatum* McDunnough
	Cloeon
	rubropictum McDunnough
	sp.
Heptageniidae	
Heptagenia	*Arthroplea*
hebe McDunnough	XX *bipunctata* McDunnough
Iron	*Cinygmula*
fragilis Morgan	XX *subaequalis* (Banks)
pleuralis Banks	*Epeorus*
vitrea Walker	*fragilis* (Morgan)
Stenonema	*pleuralis* (Banks)
X *canadense* Walker	*vitreus* (Walker)
X *fuscum* Clemens	sp.
interpunctata Say	*Leucrocuta*
mediopunctatum McDunnough	XXX *aphrodite* (McDunnough)
rubromaculatum Clemens	*hebe* (McDunnough)
X *rubrum* McDunnough	*Stenacron*
X *tripunctatum* Banks	*interpunctatum* (Say)
sp.	sp.
	Stenonema
	modestum (Banks)

Table 3 continued.

Leptophlebiidae

Choroterpes	Habrophlebia
X basalis (Banks)	vibrans Needham
Habrophlebia	Habrophlebiodes
vibrans Needham	americana (Banks)
Habrophlebiodes	Leptophlebia
americana (Banks)	cupida (Say)
Leptophlebia	XX intermedia (s.l.) (Traver)
cupidus (Say)	johnsoni McDunnough
johnsoni (McDunnough)	nebulosa (Walker)
nebulosus	sp.
sp.	Paraleptophlebia
Paraleptophlebia	debilis (Walker)
debilis (Walker)	XX guttata (McDunnough)
mollis (Eaton)	mollis (Eaton)
volitans McDunnough	volitans McDunnough
	sp.

Ephemerellidae

Ephemerella	Ephemerella
deficiens Morgan	XX aurivillii Bengtsson
dorothea Needham	dorothea Needham
funeralis McDunnough	XX invaria (Walker)
X temporalis McDunnough	XX rotunda Morgan
sp.	Eurylophella
	funeralis McDunnough
	XX prudentalis McDunnough
	XX verisimilis (McDunnough)
	sp.

Caenidae

Caenis	Caenis
amica Hagen	amica Hagen
sp.	XX diminuta (Walker)
	sp.

Ephemeridae

Ephemera	Ephemera
simulans Walker	simulans Walker
	Hexagenia
	XX limbata Serville

X reported by Procter (1940) but not in 1987.
XX new records for Mount Desert Island.
XXX new records for the State of Maine.

Table 4. Species of mayfly nymphs collected from lotic sampling sites.

	Duck Brook	Stanley Brook	Great Brook	Canon Brook	Hadlock Brook	Marshall Brook	North-east Creek
Siphlonuridae							
Ameletus							
lineatus		X					
sp.					X		
Siphlonurus							
mirus			X		X		
sp.				X			
Baetidae							
Acerpenna							
macdunnoughi	X	X	X				
Baetis							
amplus	X	X					
brunneicolor	X			X			
flavistriga	X	X					
tricaudatus	X	X					
Centroptilum							
album		X					
Heptageniidae							
Cinygmula							
subaequalis		X					
Epeorus							
fragilis	X	X					
pleuralis	X	X		X	X		
vitreus	X	X					
Leucrocuta							
hebe	X	X					
Stenacron							
interpunctatum	X	X		X			
Stenonema							
modestum	X						
Leptophlebiidae							
Habrophlebia							
vibrans	X		X	X			
Habrophlebiodes							
americana	X	X	X				
Leptophlebia							
intermedia	X		X				
johnsoni			X				
nebulosa			X				
sp.				X	X		
Paraleptophlebia							
debilis			X				
guttata	X						
mollis	X						

Table 4 continued.

	Duck Brook	Stanley Brook	Great Brook	Canon Brook	Hadlock Brook	Marshall Brook	North-east Creek
Ephemerellidae							
Ephemerella							
aurivillii		X					
dorothea	X	X					
invaria	X						
Eurylophella							
funeralis	X	X	X	X	X		
prudentalis	X						
verisimilis	X						

Table 5. Species of mayfly nymphs collected from lentic sampling sites.

	Aunt Betty Pond	Long Pond	Beaver Pond	Sargent Mt. Pond	Eagle Lake
Siphlonuridae					
Siphlonurus alternatus	X				
Heptageniidae					
Arthroplea bipunctata	X				
Stenonema modestum	X				
Leptophlebiidae					
Leptophlebia sp.	X	X			
Paraleptophlebia sp.		X			
Ephemerellidae					
Eurylophella verisimilis	X				
Caenidae					
Caenis diminuta			X		