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INTRODUCTION

Black flies have been long-time residents of Maine and cause extensive nuisance problems for people, domestic animals, and wildlife. The black fly problem has no simple solution because of the multitude of species present, the diverse and ecologically sensitive habitats in which they are found, and the problems inherent in measuring the extent of the damage they cause. As a beginning to the understanding of the nature of the black fly problem, an inventory of black fly species and habitats was made throughout the state. Previous black fly surveys in Maine, Waters (1969) and Bauer (1977), have been geographically limited.

In the present survey, black flies were collected extensively throughout the state from 1976 through 1978. Presented here is an annotated list of species found, records of black fly species swarming around humans or biting humans, and the succession of species in selected streams and rivers.

MATERIALS AND METHODS

Extensive sampling of immature and adult black flies was done throughout Maine for 3 years. In excess of 300 sites were sampled one or more times each year in every part of the state. Numerous streams were sampled for immature forms at weekly or biweekly intervals. Streams in the Penobscot River watershed and Piscataquis River watershed were most intensively sampled.

Streams and rivers were sampled by scraping immature black flies off rocks or by gathering vegetation infested by the larvae or pupae. The black flies and vegetation were placed immediately into 70% ethanol and later separated from substrate materials in the laboratory. At each collection site, stream temperature and flow were measured and stream width was estimated.

Adults were collected in conjunction with sampling for immature black flies. Insects swarming around humans were collected with an aerial insect net and placed into 70% ethanol. Additional specimens were returned to the laboratory live and then frozen for electrophoretic analysis. Black flies which were in the process of biting humans were collected separately by placing a vial over the fly in the act of biting. An insect was detected either when the collector felt the pain of the bite, or when blood was observed. Black flies simply crawling or resting on the skin were not taken as biters.

Keys and papers used in the identification of larvae, pupae, and adults were by Davies et al. (1961), Snoddy and Bauer (1978), Stone (1964), Stone and Snoddy (1969), and Wood et al. (1963). Adults of the *Simulium jenningsi* group, *S. penobscotensis*, *S. jenningsi*, and *S. nyssa* are isomorphic. A sample of 225 biting black flies and 150 swarming black flies of this group were identified by electrophoretic techniques (May et al. 1977).

RESULTS AND DISCUSSION

Table 1 is an annotated list of larval and pupal black flies found in Maine. The data on county distribution, dates, stream width, and water temperature were obtained from collections over the 3 years of the survey. Forty-three species were recorded although several were represented only in single collections. Both *Prosimulium fuscum* and *P. mixtum* were found but were separated in only a few of the identifications and are therefore presented together. *S. venustum* and *S. verecundum* were separated in most of the identifications and hence are presented separately.

The black flies which were swarming around humans are listed in Table 2. Species of the *S. jenningsi* group were the most significant swarming pests in July, August, and September in the Penobscot River and Piscataquis River areas. The electrophoretic identifications indicated that less than 6% were *S. nyssa* and *S. jenningsi*; the rest were *S. penobscotensis*. *S. fibrinflatum* was a serious swarming pest in the Penobscot River area, but not in the Piscataquis River area. *S. venustum* and *Prosimulium* spp. were present as swarmers only in the spring and summer.

Species of the *S. jenningsi* group were the only biting black flies recorded for July and August in the areas and years sampled. The electrophoretic identifications indicated that these were all *S. penobscotensis*. The possible *S. nyssa* component of the biters indicated by May et al. (1977) was not observed. During the time of this study *S. venustum* and *Prosimulium* biters were present in May and June, but were not serious pests in areas sampled.

Species succession in rivers and streams is shown in Fig. 1-3. Two years of data were combined for each stream in the Penobscot River area (Fig. 1). In the Piscataquis River area summer data were collected in 1976 and spring data were collected in 1977 (Fig. 2).

Fig. 3 shows the results from 1 stream in Gorham and consists of summer samples in 1977, and primarily spring samples in 1978.

Of particular interest in these studies were species communities and how they differed from stream to stream. It is hoped that these data may serve as a basis for future population dynamics research.

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Table 1.
Larval and pupal black flies collected in Maine, 1976-1978.

-
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1. *Twinnia tibblesi* Stone and Jamnback
 Counties of collection: Androscoggin, Penobscot, Piscataquis
 Dates collected: May 2-17
 Stream width range: 0.3 m
 Substrates: vegetation, rocks
 Water temperature: 8-10°C
 Number of collection sites: 4
 2. *Prosimulium decemarticulatum* (Twinn)
 County of collection: Penobscot
 Dates of collection: April 25 - June 3
 Stream width range: 0.5-12 m
 Substrates: vegetation, rocks
 Water temperature: 8-11°C
 Number of collection sites: 5
 3. *Prosimulium fontanum* Syme and Davies
 Counties of collection: Androscoggin, Aroostook, Cumberland, Franklin, Hancock, Kennebec, Lincoln, Oxford, Penobscot, Piscataquis, Somerset, Waldo, Washington, York
 Dates collected: April 13-June 12
 Stream width range: 0.3-20 m
 Substrates: vegetation, rocks
 Water temperature: 4-23°C
 Number of collection sites: 102
 - 4.&5. *Prosimulium fuscum* Syme and Davies/*Prosimulium mixtum* Syme and Davies
 Counties of collection: Aroostook, Cumberland, Franklin, Hancock, Kennebec, Oxford, Penobscot, Piscataquis, Sagadahoc, Somerset, Washington, York
 Dates of collection: March 30-June 10
 Stream width range: 0.3-30 m
 Substrates: vegetation, rocks
 Water temperature: 5-25°C
 Number of collection sites: 91
 6. *Prosimulium gibsoni* (Twinn)
 Counties of collection: Penobscot, Piscataquis
 Dates of collection: April 29-May 17
 Stream width range: 0.5-6 m
 Substrates: vegetation, rocks
 Water temperature: 8-11°C
 Number of collection sites: 6
 7. *Prosimulium magnum* Dyar and Shannon
 Counties of collection: Androscoggin, Cumberland, Hancock, Lincoln, Oxford, Penobscot, Piscataquis, York
 Dates of collection: March 30-June 10
 Stream width range: 0.3-15 m

- Substrates: vegetation, rocks
Water temperature: 4-17.5°C
Number of collection sites: 42
8. *Prosimulium multidentatum* (Twinn)
Counties of collection: Cumberland, Hancock, Kennebec, Lincoln, Penobscot, Piscataquis, Somerset, Washington
Dates of collection: March 30-July 21
Stream width range: 0.6-30 m
Substrates: vegetation, rocks
Water temperature: 5-24°C
Number of collection sites: 24
9. *Prosimulium pleurale* Malloch
County of collection: Piscataquis
Date collected: May 11
Stream width: 70 m
Substrate: rocks
Water temperature: 8°C
Number of collection sites: 1
10. *Prosimulium rhizophorum* Stone and Jamnback
Counties of collection: Androscoggin, Cumberland, Kennebec, Lincoln, Oxford, Penobscot, Waldo
Dates of collection: April 29-May 22
Stream width range: 0.3-12 m
Substrates: vegetation, rocks
Water temperature: 7-15°C
Number of collection sites: 8
11. *Prosimulium saltus* Stone and Jamnback
See Waters 1969
12. *Cnephia abditoides* Wood
County of collection: Penobscot
Date collected: May 17
Stream width: 1 m
Substrate: vegetation
Water temperature: 10°C
Number of collection sites: 1
13. *Cnephia dacotensis* (Dyar and Shannon)
Counties of collection: Cumberland, Franklin, Kennebec, Penobscot, Piscataquis, York
Dates collected: April 30-June 10
Stream width range: 0.3-6 m
Substrate: vegetation
Water temperature: 8-17.5°C
Number of collection sites: 7
14. *Cnephia denaria* Davies, Peterson, and Wood
Counties of collection: Androscoggin, Penobscot, Washington
Dates collected: May 1-May 17

- Stream width range: 0.3-6 m
Substrates: vegetation, rocks
Water temperature: 5-17°C
Number of collection sites: 4
15. *Cnephia invenusta* (Walker)
County of collection: Piscataquis
Dates collected: April 29 (pupae), October 19 (larvae)
Stream widths: 9 m, 140 m
Substrate: rocks
Water temperature: 5-20°C
Number of collection sites: 2
16. *Cnephia mutata* (Malloch)
Counties of collection: Androscoggin, Aroostook, Franklin, Hancock, Kennebec, Lincoln, Oxford, Penobscot, Piscataquis, Sagadahoc, Somerset, Waldo, Washington, York
Dates collected: March 30-May 27
Stream width range: 0.3-15 m
Substrates: vegetation, rocks
Water temperature: 4-17°C
Number of collection sites: 91
17. *Simulium anatinum* Wood
County of collection: Washington
Date collected: May 22
Stream width: 1 m
Substrate: vegetation
Water temperature: 15°C
Number of collection sites: 1
18. *Simulium aureum* Fries
Counties of collection: Aroostook, Penobscot, Piscataquis, York
Dates collected: May 17-October 28
Stream width range: 1-5 m
Substrates: vegetation, rocks
Water temperature: 10-23°C
Number of collection sites: 14
19. *Simulium corbis* Twinn
Counties of collection: Aroostook, Cumberland, Franklin, Penobscot, Piscataquis, Somerset, Washington
Dates collected: May 11-June 19
Stream width range: 2-60 m
Substrates: vegetation, rocks, dam face
Water temperature: 8.5-19°C
Number of collection sites: 16
20. *Simulium croxtoni* Nicholson and Mickel
Counties of collection: Franklin, Penobscot, Piscataquis, Somerset, Waldo
Dates collected: May 11-June 19
Stream width range: 1-4 m
Substrates: vegetation, rocks

- Water temperature: 9-14°C
Number of collection sites: 8
21. *Simulium decorum* Walker
Counties of collection: Aroostook, Penobscot, Piscataquis, Somerset, Washington
Dates collected: May 5-November 9
Stream width range: 1-30 m
Substrates: vegetation, rocks, dam face
Water temperature: 12.5-25°C
Number of collection sites: 28
22. *Simulium emarginatum* Davies, Peterson, and Wood
Counties of collection: Cumberland, Penobscot, Piscataquis, York
Dates collected: April 12-May 12
Stream width range: 10-20 m
Substrates: vegetation, rocks
Water temperature: 7-12°C
Number of collection sites: 11
23. *Simulium euryadminiculum* Davies
Counties of collection: Aroostook, Penobscot, Piscataquis
Dates collected: April 14-May 11
Stream width: 18 m
Substrate: vegetation
Water temperature: 5°C
Number of collection sites: 3
24. *Simulium excism* Davies, Peterson, and Wood
County of collection: Kennebec
Date collected: May 16
Stream width: 1 m
Substrates: vegetation, rocks
Water temperature: 10°C
Number of collection sites: 1
25. *Simulium fibrinflatum* Twinn
Counties of collection: Androscoggin, Aroostook, Cumberland, Kennebec, Penobscot, Piscataquis, Somerset, Waldo, Washington
Dates collected: May 24-November 2
Stream width range: 1-300 m
Substrates: vegetation, rocks
Water temperature: 11-27°C
Number of collection sites: 59
26. *Simulium furculatum* (Shewell)
County of collection: Penobscot
Date collected: May 17
Stream width: 2 m
Substrate: sticks in beaver dam
Water temperature: 8°C
Number of collection sites: 1

27. *Simulium gouldingi* Stone
Counties of collection: Aroostook, Franklin, Penobscot, Piscataquis, Waldo, Washington
Dates collected: May 22-August 24
Stream width range: 1-30 m
Substrates: vegetation, rocks
Water temperature: 13-20°C
Number of collection sites: 11
28. *Simulium impar* Davies, Peterson, and Wood
Counties of collection: Aroostook, Washington
Dates collected: May 15-23
Stream width range: 0.3-1 m
Substrates: vegetation, rocks
Water temperature: 8-17°C
Number of collection sites: 3
29. *Simulium innocens* (Shewell)
County of collection: Penobscot
Date collected: May 17
Stream width: 1 m
Substrate: vegetation
Water temperature: 10°C
Number of collection sites: 1
30. *Simulium jenningsi* Malloch
Counties of collection: Aroostook, Franklin, Lincoln, Penobscot, Piscataquis, Somerset, Waldo
Dates collected: May 24-September 23
Stream width range: 1-75 m
Substrates: vegetation, rocks (rarely)
Water temperature: 12-25°C
Number of collection sites: 29
31. *Simulium latipes* (Meigen)
Counties of collection: Aroostook, Cumberland, Franklin, Lincoln, Penobscot, Piscataquis, Somerset, Waldo, York
Dates collected: May 15-July 29
Stream width range: 0.3-20 m
Substrates: vegetation, rocks
Water temperature: 10-21°C
Number of collection sites: 37
32. *Simulium nyssa* Stone and Snoddy
Counties of collection: Androscoggin, Aroostook, Cumberland, Kennebec, Lincoln, Penobscot, Piscataquis, Somerset, Waldo, Washington, York
Dates collected: May 24-October 19
Stream width range: 1-300 m
Substrate: vegetation
Water temperature: 11-27°C
Number of collection sites: 64

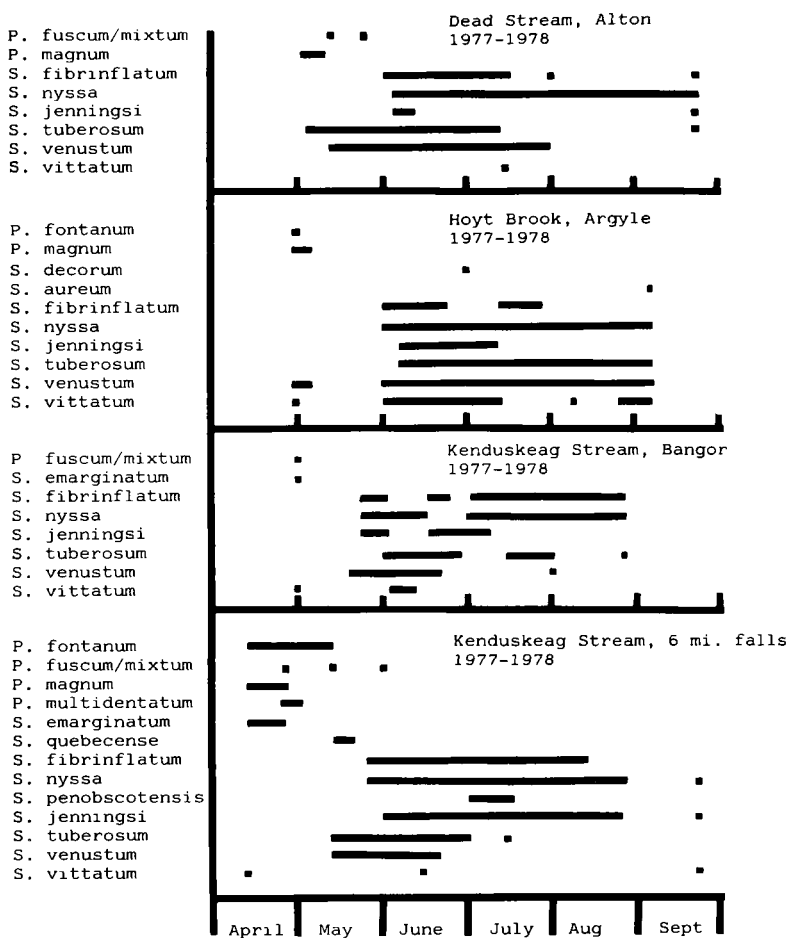
33. *Simulium parnassum* Malloch
Counties of collection: Hancock, Piscataquis
Dates collected: June 11-August 2
Stream width range: 1-4 m
Substrate: rocks
Water temperature 10-16°C
Number of collection sites: 4
34. *Simulium penobscotensis* Snoddy and Bauer
Counties of collection: Aroostook, Cumberland, Penobscot, Piscataquis
Dates collected: June 3-October 28
Stream width range: 3-300 m
Substrate: vegetation
Water temperature: 13-25°C
Number of collection sites: 21
35. *Simulium pictipes* Hagen
County of collection: Piscataquis
Dates collected: July 29, August 26
Stream widths: 10 m, 80 m
Substrate: rocks
Water temperature: 18°C, 21°C
Number of collection sites: 2
36. *Simulium pugetense* (Dyar and Shannon)
Counties of collection: Androscoggin, Cumberland, Penobscot, Washington, York
Dates collected: April 18-May 22
Stream width range: 0.3-30 m
Substrates: vegetation, rocks
Water temperature: 7-13 °C
Number of collection sites: 5
37. *Simulium quebecense* Twinn
Counties of collection: Franklin, Penobscot, Washington
Dates collected: May 11-June 19
Stream width range: 3-30 m
Substrates: vegetation, rocks (rarely)
Water temperature: 8-15°C
Number of collection sites: 7
38. *Simulium rivuli* Twinn
Counties of collection: Androscoggin, Franklin, Kennebec, Penobscot, Piscataquis, Washington
Dates collected: May 8-July 19
Stream width range: 0.3-30 m
Substrates: vegetation, rocks
Water temperature: 10-13°C
Number of collection sites: 7
39. *Simulium rugglesi* Nicholson and Mickel
Counties of collection: Penobscot, Piscataquis
Dates collected: May 30-September 7
Stream width: 300 m

- Substrate: vegetation
Water temperature: 17-20°C
Number of collection sites: 3
40. *Simulium tuberosum* (Lundström)
Counties of collection: Androscoggin, Aroostook, Cumberland, Franklin, Hancock, Kennebec, Lincoln, Oxford, Penobscot, Piscataquis, Sagadahoc, Somerset, Waldo, Washington, York
Dates collected: May 3-November 18
Stream width range: 0.3-160 m
Substrates: vegetation, rocks
Water temperature: 7-27°C
Number of collection sites: 169
41. *Simulium venustum* Say
Counties of collection: Androscoggin, Aroostook, Cumberland, Franklin, Hancock, Kennebec, Lincoln, Oxford, Penobscot, Piscataquis, Somerset, Waldo, Washington, York
Dates collected: April 25-November 23
Stream width range: 0.3-300 m
Substrates: vegetation, rocks
Water temperature: 8-27°C
Number of collection sites: 97
42. *Simulium verecundum* Stone and Jamnback
Counties of collection: Androscoggin, Aroostook, Cumberland, Hancock, Kennebec, Oxford, Penobscot, Piscataquis, Waldo, York
Dates collected: April 25-November 23
Stream width range: 1-20 m
Substrates: vegetation, rocks
Water temperature: 8-25°C
Number of collection sites: 29
43. *Simulium vittatum* Zetterstedt
Counties of collection: Aroostook, Cumberland, Franklin, Oxford, Penobscot, Piscataquis, Somerset, Washington
Dates collected: March 30-December 28
Stream width range: 1-300 m
Substrates: vegetation, rocks
Water temperature: 5-25°C
Number of collection sites: 117

Table 2.
Number of adult black flies swarming around humans, Maine.

	<i>S. jenningsi</i> group	<i>S. fibrin-</i> <i>flatum</i>	<i>S. vittatum</i>	<i>S. venustum</i> complex	<i>P. fuscum/</i> <i>mixtum</i>
PENOBSCOT RIVER WATERSHED (1977-1978)					
May	2	14	0	8	11
June	382	1517	11	7	2
July	1395	280	8	1	0
August	1649	268	209	3	0
September	76	6	0	0	0
Totals	3504	2085	228	19	13
PISCATAQUIS RIVER WATERSHED (1976-1977)					
May	0	0	0	43	25
June	57	0	0	57	0
July	929	35	0	43	0
August	537	27	0	5	0
September	175	18	0	1	0
October	35	10	0	1	0
Totals	1733	90	0	150	25

Figure 1. Seasonal succession of black fly species in the Penobscot River watershed, Maine, 1977-1978. The lines indicate presence of immature black flies in the streams.



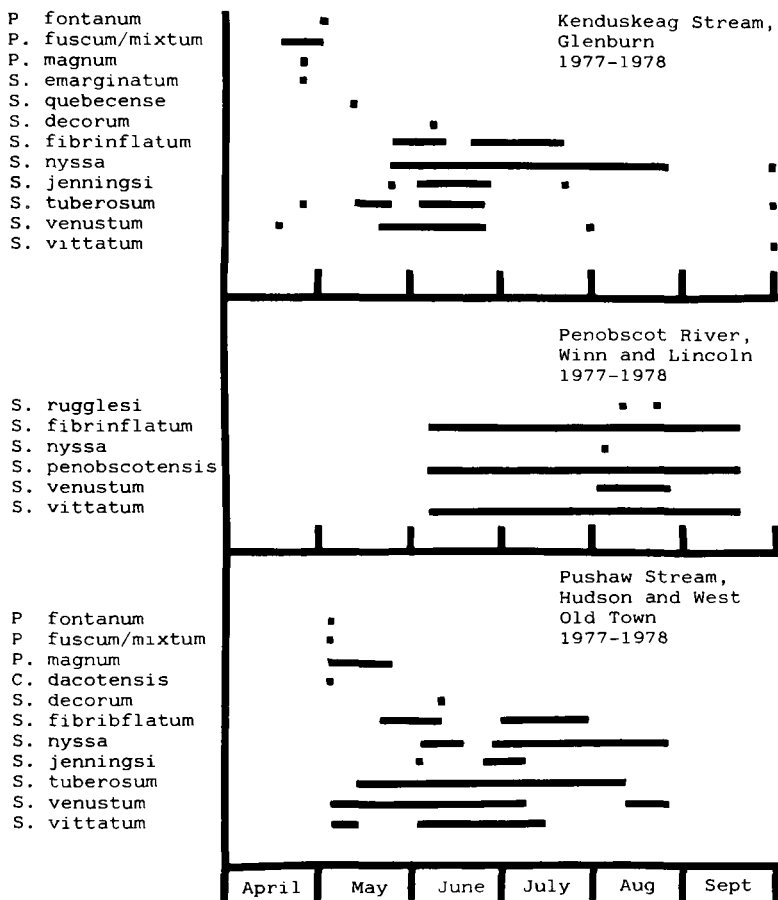
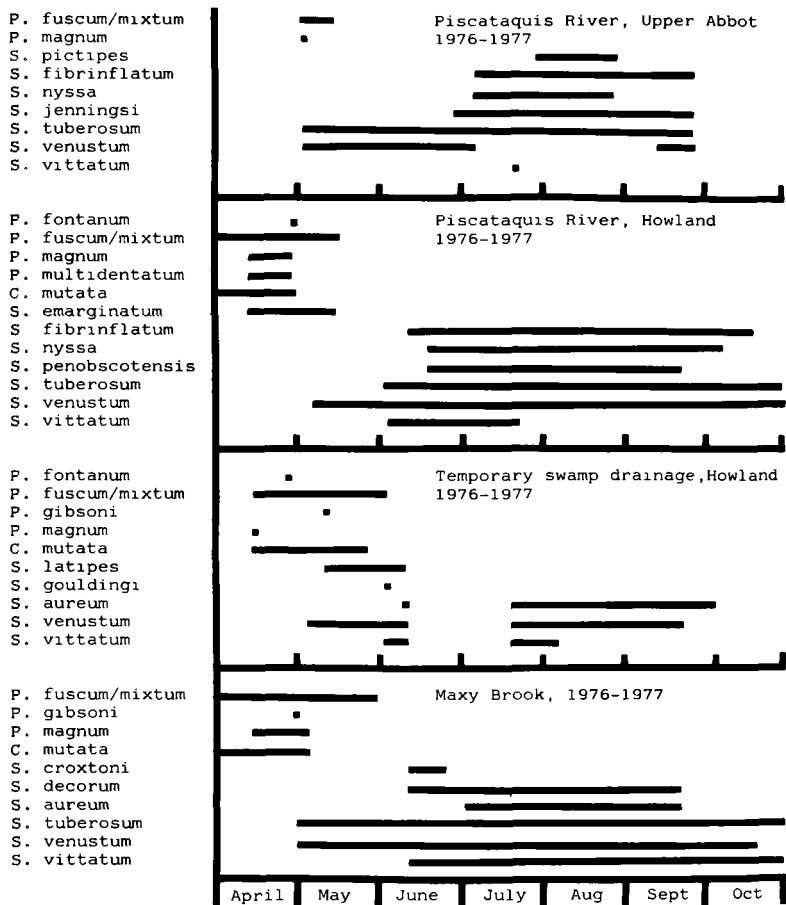
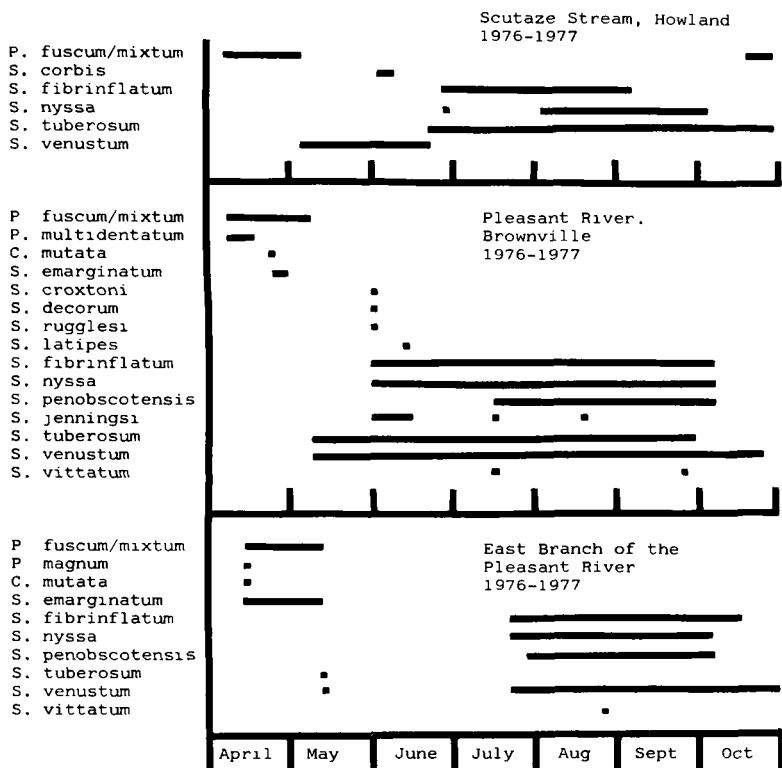
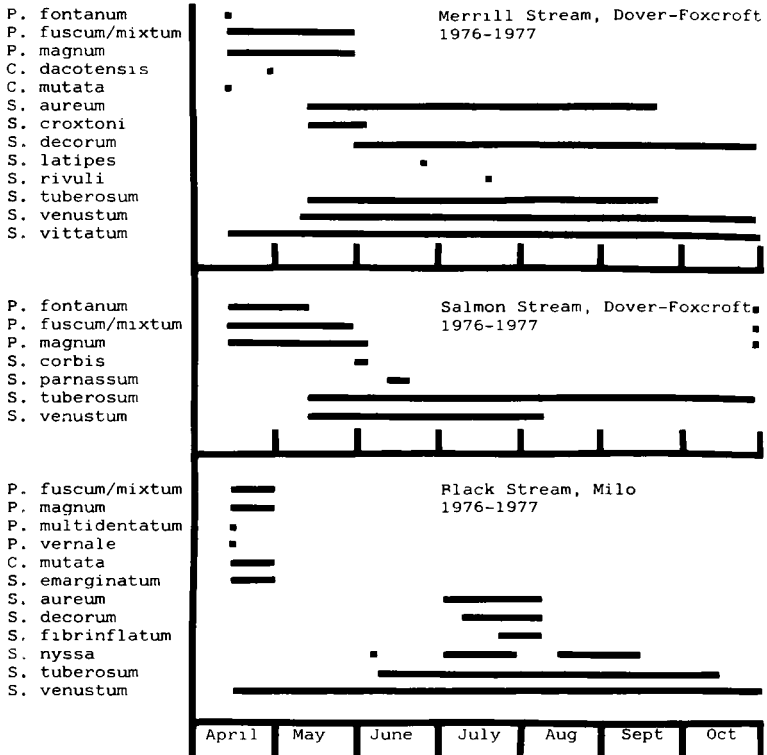


Figure 2. Seasonal succession of black fly species in the Piscataquis River watershed, Maine, 1976-1977. The lines indicate presence of immature black flies in the streams.







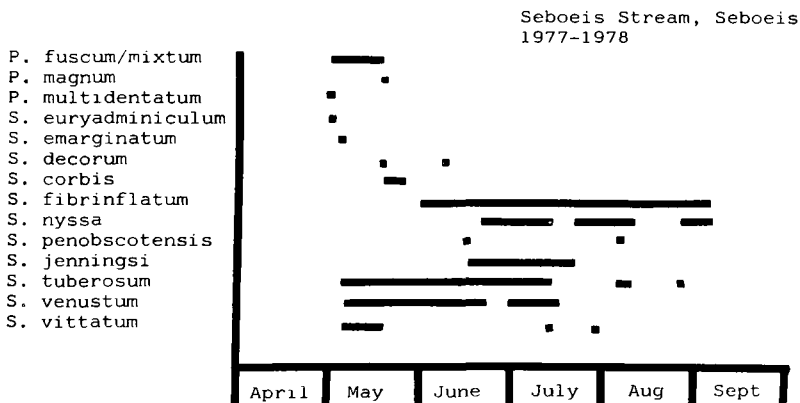
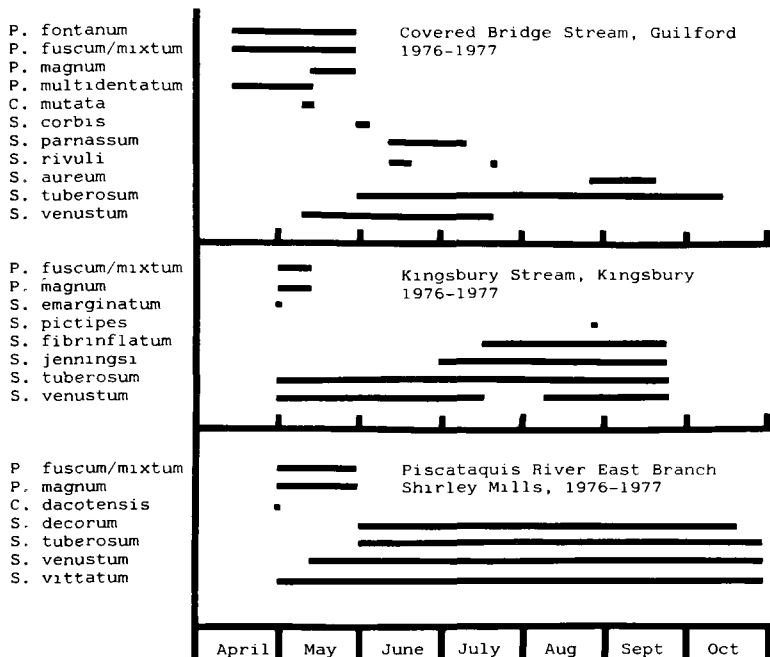


Figure 3. Seasonal succession of black fly species in the Little River, Gorham, Maine, 1977-1978. The lines indicate presence of immature black flies in the streams.

