ENVIRONMENTAL IMPACT STUDIES IN THE ICEWATER CREEK WATERSHED: A PROGRESS REPORT FOR 1982.

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INTRODUCTION

In 1980, the Environmental Impact Section of the Forest Pest Management Institute, through the co-operation of the Sault Ste. Marie District of the Ontario Ministry of Natural Resources, initiated a long-term environmental impact research program in the Icewater Creek watershed about 50 km north of Sault Ste. Marie, Ontario.

The overall objective of the Icewater Creek research program is to examine in depth a number of aquatic and terrestrial habitats and microhabitats and their resident animal populations to determine: (1) the nature and degree of inherent risk (2) the level of actual exposure and (3) actual response to forest pest management strategies involving aerial applications of pest control agents.

The program will have three distinct phases designed to generate information on three aspects of the effects of forest pest control activities on the environment: (1) the potential risk (2) actual exposure and (3) actual response. In general, the actual impact on each part of the environment is primarily a factor of the susceptibility of that portion of the ecosystem to the particular pest control procedure and its level of exposure to the pest control agent used i.e., Risk + Exposure = Response. To this extent, part of the objective of the first two portions of the program will be to help predict potential hazards of any suggested pest control action. The third portion of the program will test actual responses and elucidate the nature of and ecosystem responses to actual impacts. This will involve relating impacts at lower trophic levels or among specific groups of organisms to secondary impacts on higher trophic levels and changes within the ecosystem e.g., altered food supply, changes in basic processes such as predation or pollination, etc.

Each phase of the program will involve looking at the specific aspect under consideration with respect to variable parameters in pest management strategies, specifically: (1) timing of pest control actions, (2) application procedures involved and (3) nature of the pest control agent(s) used. The result will be that assessments on the relative safety or hazard of a given pest management strategy can be partially predicted. This will apply to pest control actions contemplated for any time of the year and against different pest species or different life stages of a given pest species. In order to try and make the findings of this program applicable to broad geographical areas with dissimilar climatic conditions, sampling activities and results reported will be tied to other "time scales" besides real time, including phenological development of tree species, pollen sources, potential target insect species and other biological groups, as well as some measurement of accumulated heat units. This will allow the results of the findings of this research program to be applied in both a predictive and dynamic sense to operational pest control programs, and will allow for testing and verification of the research results by environmental impact experimentation and monitoring activities under operational conditions.

Phase 1 activities - 1980-1982

The potential hazard of a pest control action to a specific group of organisms will depend on the presence or absence of the organism in the environment at the time the action is carried out, and on other factors determined by the biology of the organism. Some of these factors (to be considered in deciding on potential risk) are: seasonal migrations in and out of areas; localized movements from habitat to habitat; life cycles and resultant changes in susceptibility to pest control agents; population cycles and seasonal changes in the age class structure within populations; reproductive cycles and accompanying behaviour; feeding activities and seasonal changes in food source utilization; and daily and seasonal activity patterns and the influence of environmental parameters on them. Sampling activities in the research area initiated in 1980 and continued through 1982 were designed to gather information on these factors for different groups of organisms and to evaluate various methods for collecting this type of data.

The terrestrial studies carried out have been concentrated in the lower watershed of Icewater Creek (Fig. 1), where the creek valley widens out at the confluence with the Goulais River. Aquatic studies have been spread over accessible portions of the Icewater Creek system with most of the intensive sampling concentrated near points of access on the upper and lower watershed (Fig. 1). The work carried out in 1980 and 1981 was summarized in earlier progress reports (Kingsbury et al. 1980, 1982). This report outlines briefly the studies carried out in 1982, and presents some illustrative data indicative of some of the outputs from the program to date. A brief outline of plans for 1983 in each study area is presented at the end of the report.

Phase 2 activities - 1982

An organism present in a forest ecosystem treated with a pest control agent will only be directly affected if it is exposed to toxicologically significant quantities of the control agent. Significant route or routes of exposure (e.g., dermal contact, inhalation, ingestion, etc.) will vary for different organisms and control agents, but are all related to how much of the material ends up in the organism's "living space" and in what physical form it arrives there.

In 1982 laboratory studies were initiated by Dr. Alam Sundaram of FPMI's Spray Kinetics and Physics project to develop and test methodologies by which spray deposits on the floral surfaces of wildflowers, shrubs and trees might be measured. The purpose of this work is to develop the capability to measure pesticide exposure to pollinating insects foraging on various pollen and nectar sources contaminated by aerial sprays. The work done in 1982, results achieved and problems encountered are briefly outlined in this report.

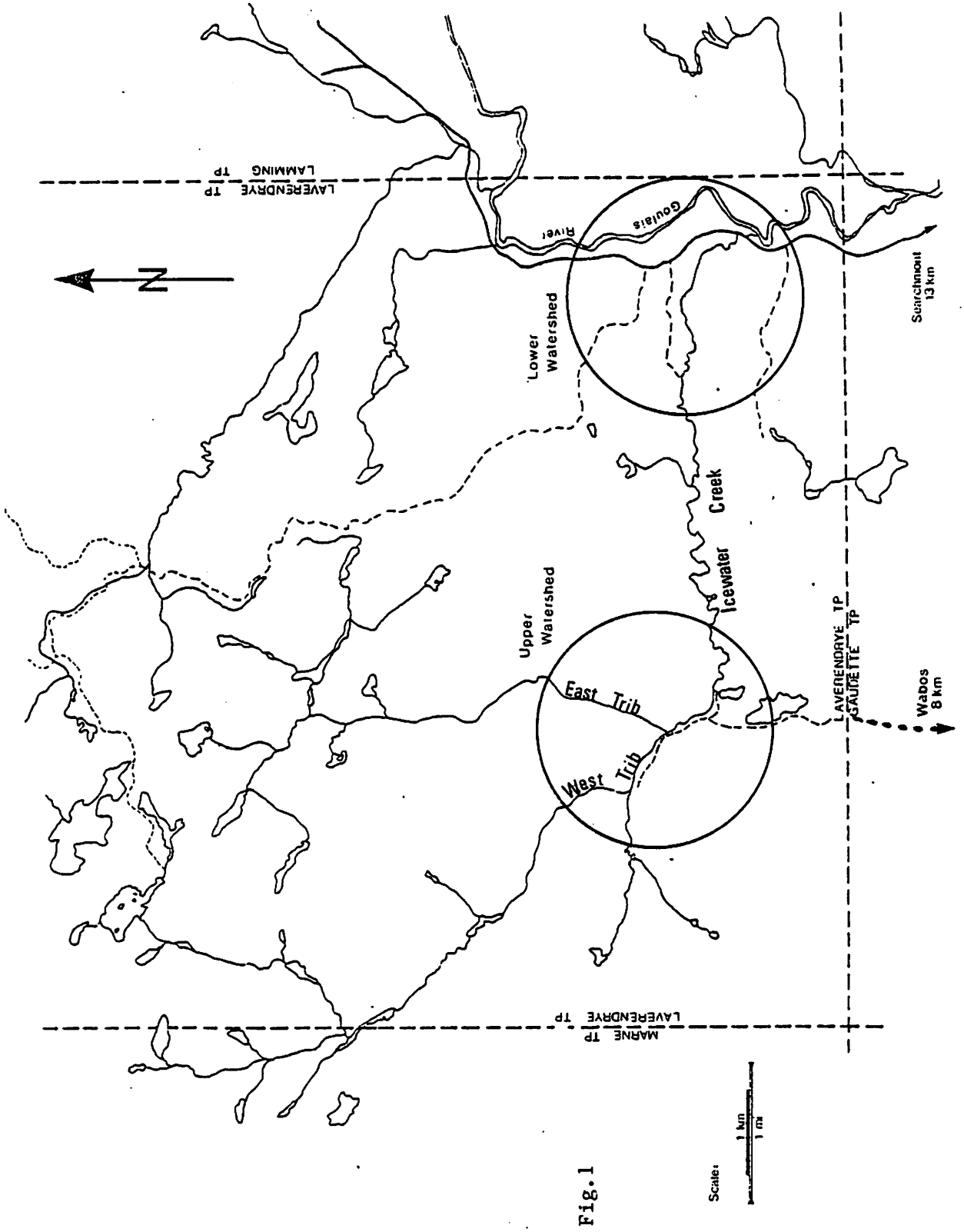

LAVERENDRYE TP
LAMMING TP
MARNE TP
LAVERENDRYE TP
LAVERENDRYE TP
SAUDETTE TP
Goulais River
Lower Watershed
Upper Watershed
Icewater Creek
East Trib
West Trib
Searchmont 13 km
Wabos 8 km
N
Scale: 1 km
1 mi

Fig.1

METEOROLOGICAL STUDIES

With the FPMI meteorology van committed to other sites in 1981, there was no full-time on-site weather recording capability in the Icewater Creek research area in 1982. Weather measurements were recorded manually using a modified Heath kit weather station during periods of intense biological sampling such as pollinator surveys. In September of 1982, a Meteorology Research Inc. Weather Wizard purchased expressly for the Icewater Creek research program was installed at the lower watershed trailer site (Fig. 2). This will provide continuous recordings at 5 to 60 minute intervals of seven meteorological parameters (wind speed, wind direction, temperature, relative humidity, barometric pressure, solar radiation, precipitation) and up to six unspecified inputs. This system will be particularly valuable in providing accurate data on accumulated heat units in the research area, which will fulfil the objective of tying the biological events studied to a phenological time scale.

FLOWERING PLANT SURVEY

Weekly surveys initiated in 1980 to record flowering plants (pollen and nectar producers) in the lower Icewater Creek watershed were continued throughout the 1982 season. In total, 127 flowering species representing 34 families have been recorded over a three year period (Table 1). The survey to date has concentrated on the more common and conspicuous flowering plants which appear to contribute the most to the "pollinator ecology" of the area in terms of being most extensively utilized by insect pollinators. Some very small flowering species of lesser importance to pollinators and the larger tree species such as the aspens, pines, birches, spruces, etc. have not been included, nor have plants such as the horsetails, club mosses etc. which produce pollen spores without a true "flower" to attract pollinators.

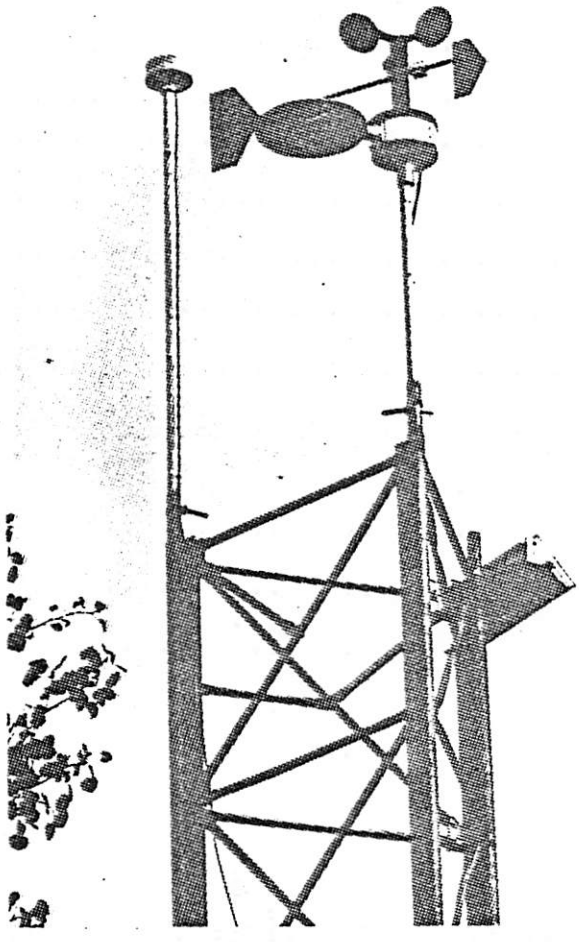
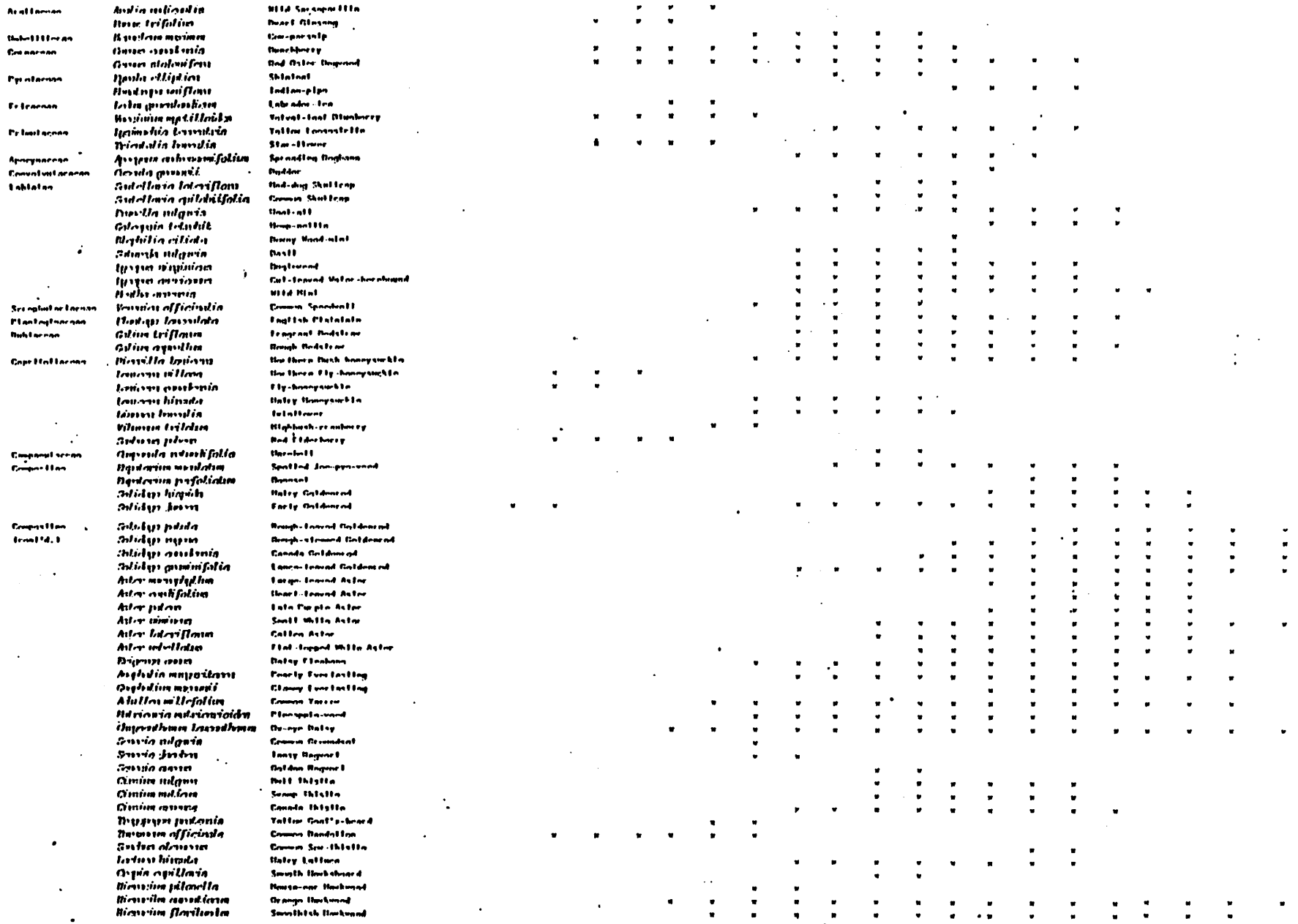


Figure 2. Instruments from the Weather Wizard system used for collecting meteorlogical data in the lower Icewater Creek watershed

Table 1.
Flowering plant survey of the lower Icewater Creek watershed for the years 1980 - 1982

Family	Species	Common Name	April 22-30	May 1-7	May 8-14	May 15-21	May 22-31	June 1-7	June 8-14	June 15-21	June 22-30	July 1-7	July 8-14	July 15-21	July 22-31	August 1-7	August 8-14	August 15-21	August 22-31	September 1-7	September 8-14	September 15-21	September 22-30	October 1-7
Alismataceae	*Sagittaria latifolia*	Broad-leaved Arrowhead												x	x									
Pontederiaceae	*Heteranthera dubia*	Water-stargrass												x	x	x	x	x						
Liliaceae	*Erythronium americanum*	Trout Lily	x	x	x	x	x	x																
	Clintonia borealis	Clintonia					x	x	x	x	x	x												
	Smilacina racemosa	False Solomon's Seal							x	x	x													
	Maianthemum canadense	Wild Lily-of-the-valley					x	x	x	x	x	x	x											
	Streptopus roseus	Rose Twisted-stalk					x	x	x	x	x													
	Polygonatum biflorum	Solomon's Seal					x	x	x	x	x													
	Trillium cernuum	Nodding Trillium			x	x	x	x	x	x	x													
Iridaceae	*Iris versicolor*	Larger Blue Flag											x	x										
Salicaceae	*Salix sp.*	Willow		x	x																			
Myricaceae	*Myrica gale*	Sweet Gale		x	x																			
Polygonaceae	*Rumex acetosella*	Sheep Sorrel											x	x	x									
	Fagopyrum sagittatum	Buckwheat										x	x	x	x	x	x	x	x					
Portulacaceae	*Claytonia caroliniana*	Spring-beauty			x	x	x	x																
Caryophyllaceae	*Cerastium vulgatum*	Mouse-ear Chickweed								x	x	x	x											
Ranunculaceae	*Ranunculus ambigens*	Spearwort												x	x									
	Ranunculus recurvatus	Hooked Buttercup							x	x	x	x	x	x										
	Ranunculus acris	Common Buttercup										x	x	x										
	Thalictrum dioicum	Early Meadow-rue								x	x	x	x	x										
	Thalictrum dasycarpum	Purple Meadow-rue										x	x	x										
	Thalictrum polygamum	Tall Meadow-rue								x	x	x	x	x	x									
	Anemone quinquefolia	Wood Anemone			x	x	x	x	x															
	Clematis virginiana	Virgin's Bower										x	x	x	x	x	x	x	x	x				
	Caltha palustris	Marsh Marigold			x	x	x	x																
	Coptis groenlandica	Goldthread				x	x	x	x															
	Aquilegia canadensis	Columbine							x	x	x	x	x	x	x									
Saxifragaceae	*Ribes cynosbati*	Canada Gooseberry					x	x																
	Ribes glandulosum	Skunk Currant		x	x	x	x	x																
Rosaceae	*Physocarpus opulifolius*	Ninebark										x	x	x	x									
	Spiraea latifolia	Meadow-sweet										x	x	x	x	x	x	x	x					
	Pyrus americana	American Mountain Ash									x	x	x											
	Amelanchier sanguinea	Roundleaf Juneberry			x	x	x	x																
	Fragaria virginiana	Common Strawberry			x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	
	Potentilla recta	Rough-fruited Cinquefoil											x	x	x									
	Potentilla norvegica	Rough Cinquefoil								x	x	x	x	x	x	x	x	x	x	x	x	x	x	
	Rubus idaeus	Wild Raspberry						x	x	x	x	x	x	x	x	x								
	Rubus occidentalis	Black Raspberry										x	x	x										
	Rubus flagellaris	Dewberry				x	x	x	x	x	x	x	x	x										
	Rubus allegheniensis	Blackberry											x	x	x	x								
	Prunus pensylvanica	Pin Cherry			x	x	x	x	x															
	Prunus virginiana	Choke Cherry					x	x	x	x														
Leguminosae	*Trifolium pratense*	Red Clover													x	x	x	x	x	x				
	Trifolium repens	White Clover								x	x	x	x	x	x	x	x	x	x	x				
	Trifolium hybridum	Alsike Clover									x	x	x	x	x									
	Melilotus alba	White Sweet Clover										x	x	x	x	x								
Oxalidaceae	*Oxalis montana*	Common Wood-sorrel									x	x	x	x	x									
Aceraceae	*Acer rubrum*	Red Maple			x	x																		
Balsaminaceae	*Impatiens capensis*	Spotted Touch-me-not														x	x	x	x					
Guttiferae	*Hypericum perforatum*	Common St. John's-wort										x	x	x	x	x	x	x	x	x				
	Hypericum ellipticum	Pale St. John's-wort									x	x	x	x	x	x	x	x	x	x				
	Hypericum canadense	Canadian St. John's-wort													x	x	x	x	x	x				
	Hypericum virginicum	Marsh St. John's-wort												x	x									
Violaceae	*Viola palmata*	Common Blue Violet		x	x	x	x	x	x	x	x	x												
	Viola pallens	Northern White Violet				x	x	x	x	x	x													
	Viola pensylvanica	Smooth Yellow Violet					x																	
Onagraceae	*Epilobium angustifolium*	Fireweed										x	x	x	x	x	x	x	x	x	x			
	Oenothera biennis	Evening-primrose										x	x	x	x	x	x	x	x	x	x			
	Oenothera fruticosa	Sundrops								x	x	x	x	x	x	x	x	x						

Table 1 (concluded)



TERRESTRIAL INVERTEBRATE STUDIES

Honeybees

Honeybee colonies were moved from the main apiary near the Sault Ste. Marie airport to the lower Icewater Creek research area early in May, as soon as road conditions permitted. Two colonies were placed on a high platform (see 1982 annual progress report, page 9) and equipped with activity monitoring devices described in the Icewater Creek progress reports of 1980 and 1981.

Black bear damage to the hives occurred on 10 June and replacement hives were relocated on the work trailer roof where monitoring continued for the remainder of the season.

Pollen collection and identification

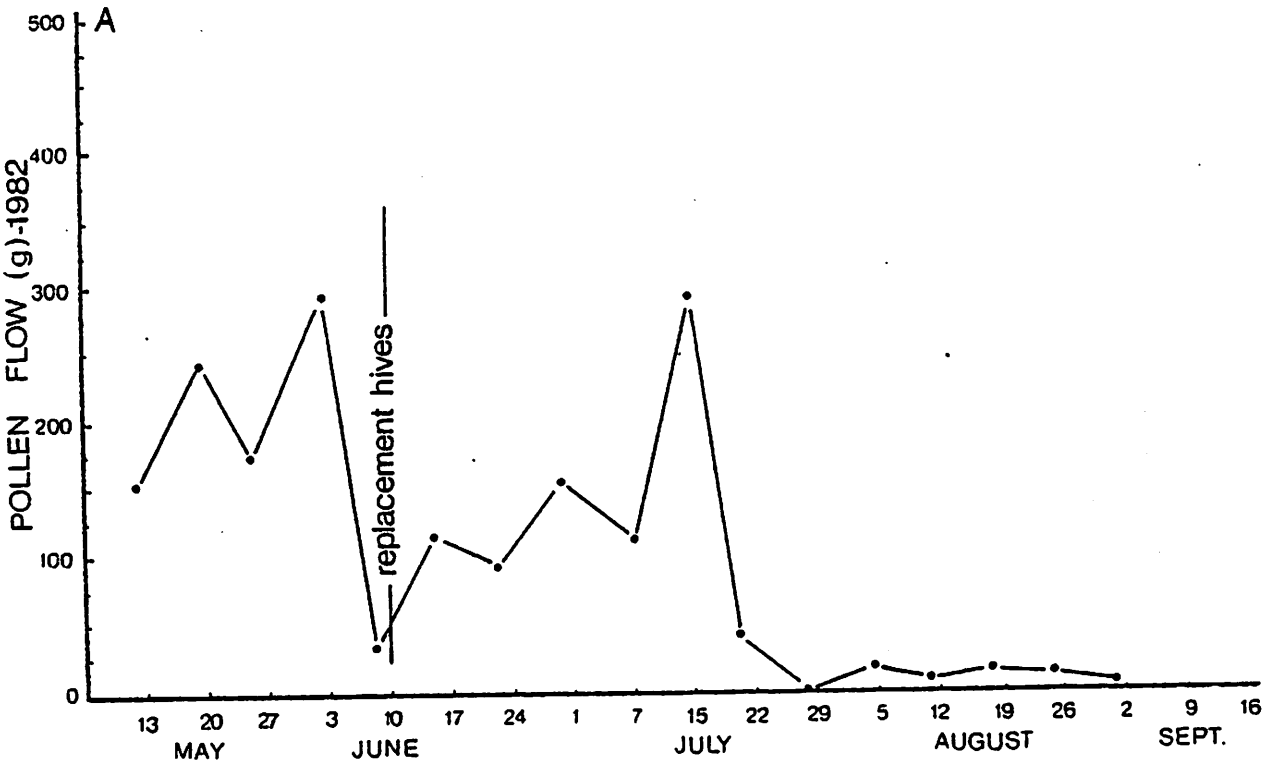
The "pollen flow" in the research area as measured by honeybees was monitored again in 1982. Weekly pollen collections were taken from two hives and returned to the laboratory for cleaning, drying and color coding as in 1981. Pollen flow in 1982 is presented in Figure 3A. Pollen collecting patterns in 1982 are very similar to those recorded previously in 1980 and 1981 (Figure 3B) in spite of differing weather conditions experienced over the three seasons, except that late summer pollen collections were very small, probably due to very dry conditions.

Pollen collections were color-coded in the laboratory and the per cent of each color in the weekly sample is presented in Table 2. Honeybees again collected a smut fungus during the latter part of July and early August, but the host plant has not as yet been found. The 1982 pollen identification has not been completed for inclusion in this progress report.

Honeybee brood production

Brood production of two honeybee colonies was monitored every two weeks from 3 June to 25 August. Each colony was equipped with two bee boxes (supers) each containing 10 frames of wax comb suitable for brood rearing. Total number of cells available for brood production numbered approximately 293,728 (Dadant 1975). Each side of each colony was photographed every two weeks (Figure 4). Each photograph was examined carefully and all capped brood cells counted. Honeybee brood production of two bee colonies located in the lower Icewater Creek watershed in 1982 is presented in Figure 5 on the basis of percentage utilization of available cells.

Two brood rearing peaks were recorded, late May-early June and again in mid-July. These peaks coincide with peaks in pollen-collecting recorded in Figures 3A and B. In 1982 honeybees in the Icewater habitat only utilized a maximum (late July) of 6% of the available cells for brood rearings. This is attributable to the adverse weather conditions of



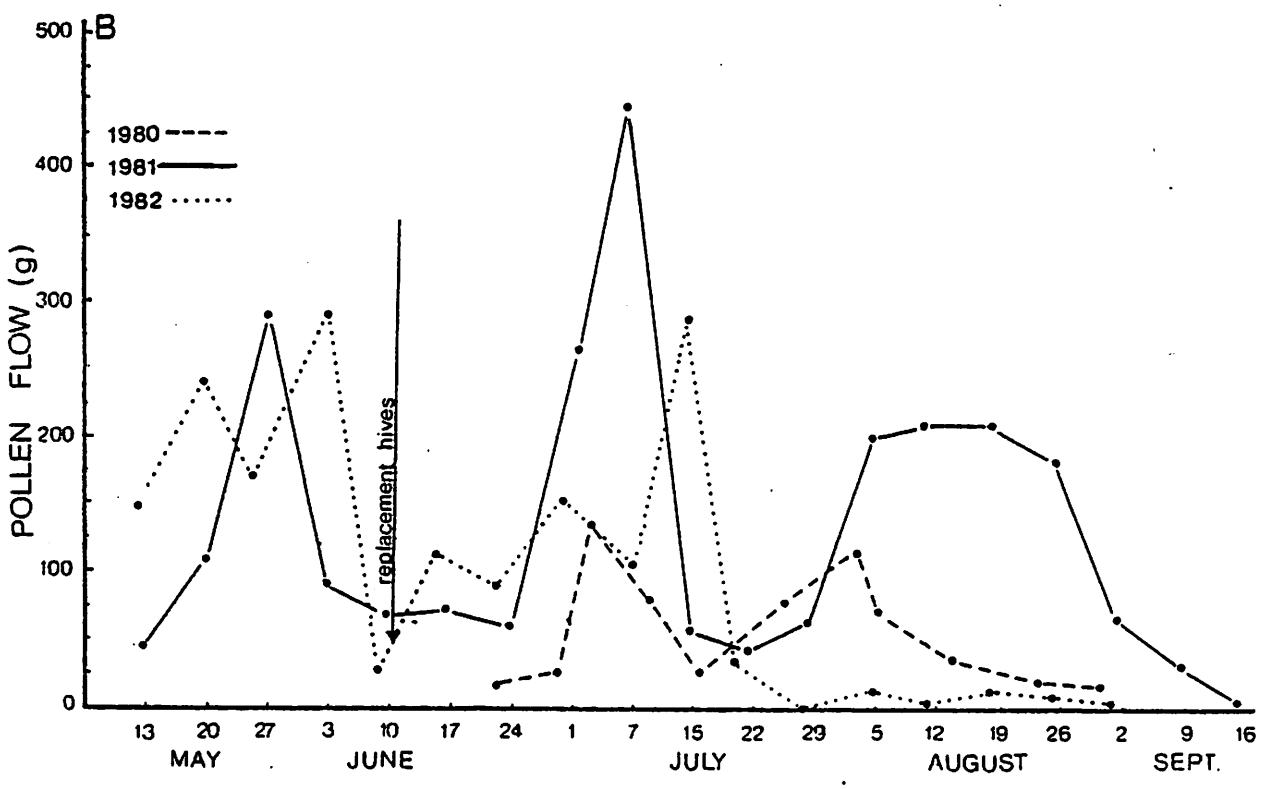


Figure 3A. Pollen flow from the lower Icewater Creek Watershed in 1982.

Figure 3B. Three year pollen flow trends in the lower Icewater Creek Watershed, 1980-82.

Table 2
Percent numbered colour-coded pollen pellets in weekly pollen samples from honeybee colonies Ice Water Creek Research Area, 1982

Pollen No.	May				June				July				August			
	5-12	13-19	20-26	26-2	3-9	10-16	17-23	24-30	1-7	8-14	15-21	22-28	29-4	5-11	12-18	19-25
4	56.9	25.5	53.6	78.9	30.6	30.5	23.8	36.9	-	-	-	-	-	-	-	-
10	9.2	13.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-
18	33.9	33.1	37.8	-	-	-	-	-	-	-	-	-	-	20.5	-	-
102	-	5.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-
19	-	22.2	7.6	6.7	3.6	1.9	-	-	-	-	-	-	-	1.4	5.2	12.9
82	-	-	1.0	8.5	16.3	3.4	-	-	-	-	-	-	-	-	-	-
12	-	-	-	4.7	49.2	-	-	-	-	-	-	-	-	-	-	-
36	-	-	-	1.2	0.3	-	7.8	29.4	72.8	24.9	19.8	4.0	-	-	3.5	11.8
79	-	-	-	-	-	34.2	16.0	-	-	-	-	-	-	-	1.6	-
50	-	-	-	-	-	30.0	-	33.7	23.8	72.8	68.4	75.8	11.2	-	-	-
56	-	-	-	-	-	-	52.4	-	-	-	-	-	-	-	-	-
71	-	-	-	-	-	-	-	-	3.4	2.3	-	-	-	-	-	-
78	-	-	-	-	-	-	-	-	-	-	4.3	4.0	0.7	14.8	-	-
76	-	-	-	-	-	-	-	-	-	-	7.5	1.6	13.8	31.4	11.8	6.4
7	-	-	-	-	-	-	-	-	-	-	-	-	0.7	-	-	-
81	-	-	-	-	-	-	-	-	-	-	-	-	9.7	22.6	-	-
99	-	-	-	-	-	-	-	-	-	-	-	-	17.7	-	-	-
75	-	-	-	-	-	-	-	-	-	-	-	-	-	-	77.8	67.1
38	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.8
Jet Black	-	-	-	-	-	-	-	-	-	-	-	14.5	46.2	9.3	0.1	-

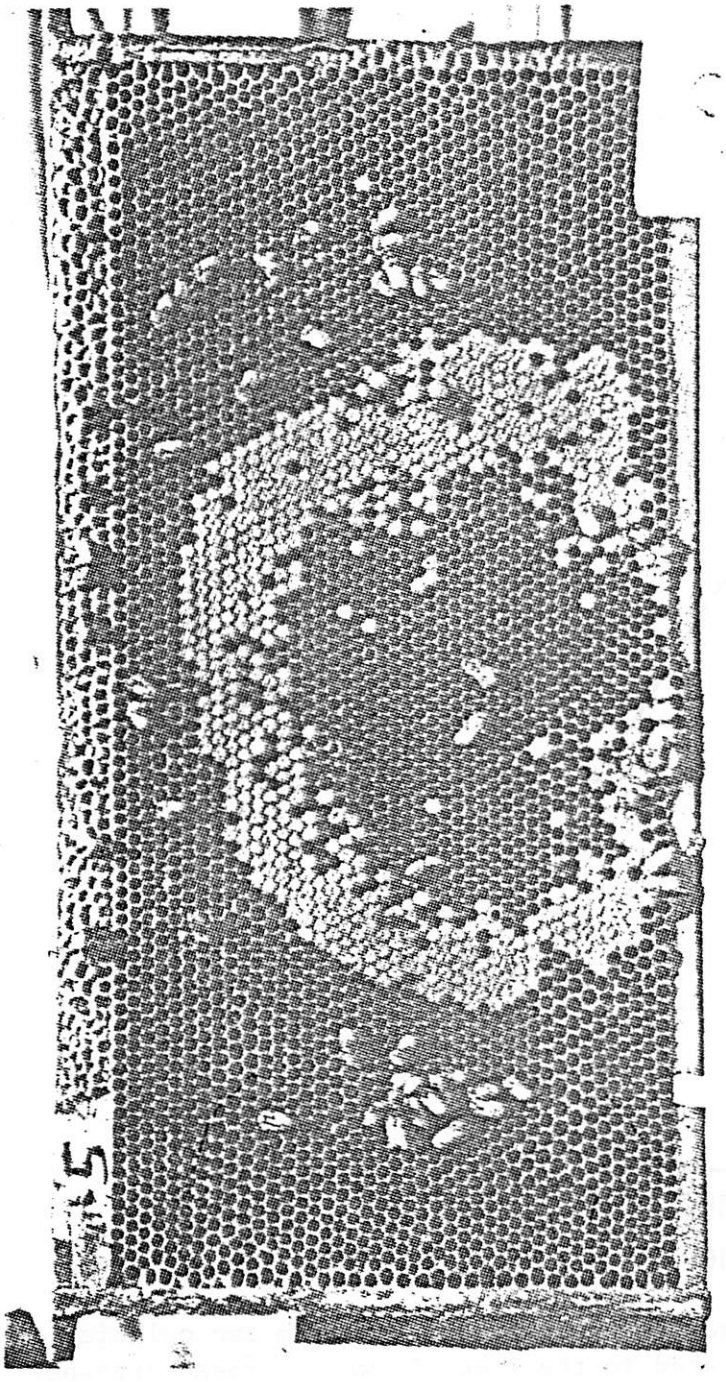


Figure 4. Frame of wax comb containing capped brood, Icewater Creek Research area, 1982.

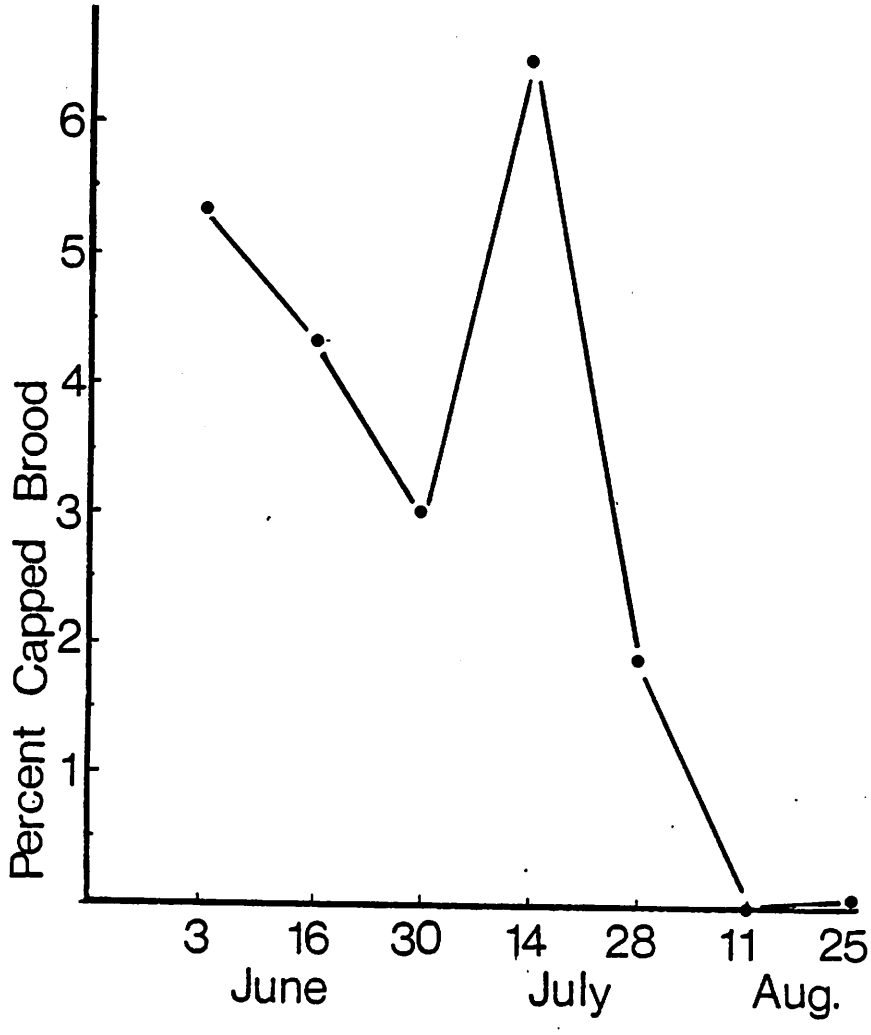


Figure 5. Honeybee brood production from two colonies located in the lower Icewater Creek Watershed in 1982.

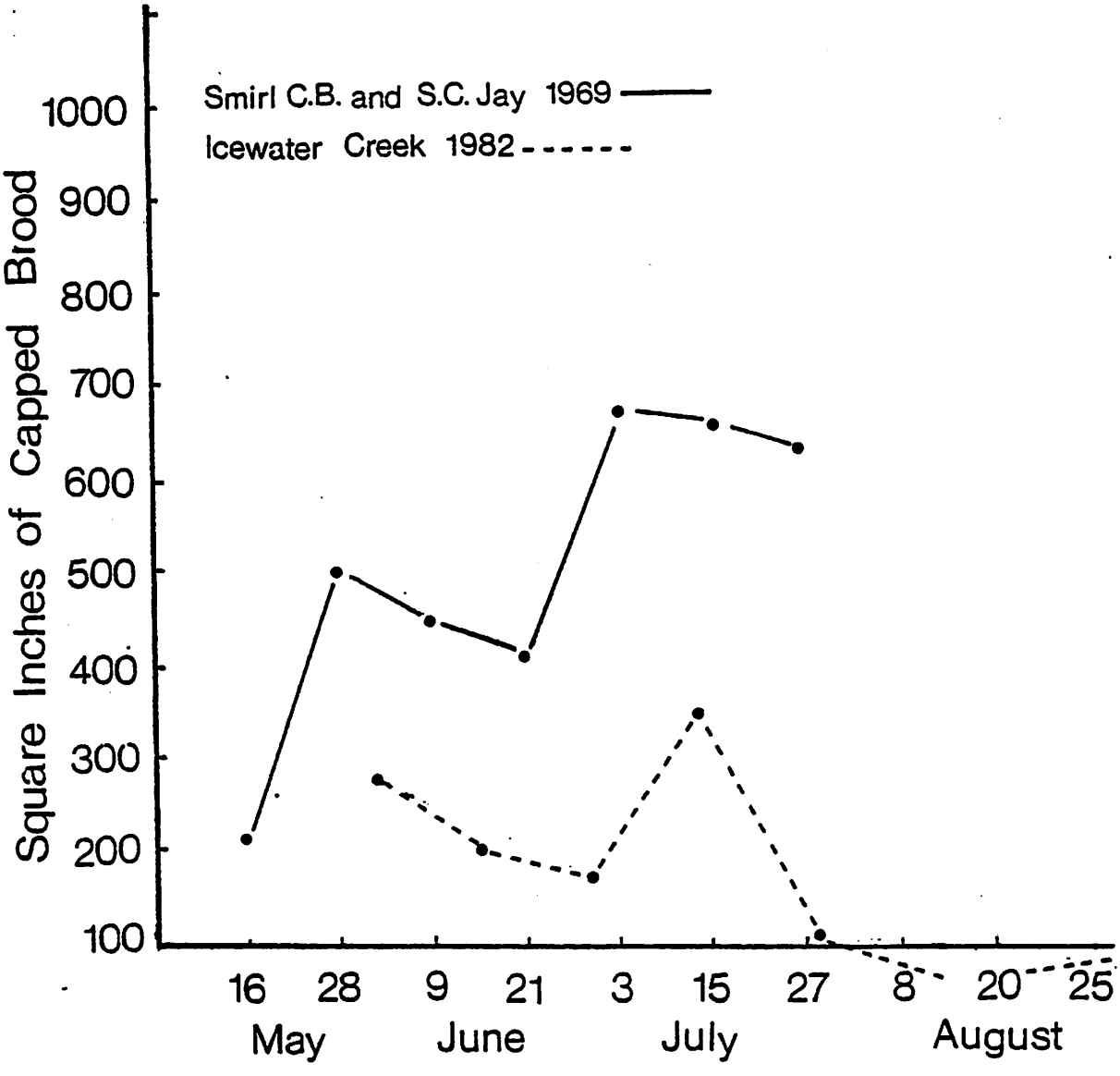


Figure 6. Honeybee brood production recorded from two different foraging habitats.

1982, combined with a relatively meager foraging habitat found in a forest habitat as opposed to the more bountiful conditions present in agricultural situations. Smirl and Jay (1972) measured brood production of relatively newly hived bees throughout a season in a semi-agricultural setting and described the results as "depressed due to poor foraging conditions". Brood production of the Icewater Creek colonies show the same production trends as the Manitoba experimental hives but the results reflect the much poorer foraging conditions of a completely forested setting (Figure 6).

Native Pollinators

Native insect pollinator visits to flowering plants were recorded at seven time intervals during June, July and August 1982. Two metre square plots of mixed wild flower bloom were randomly selected along road sides or forest openings. Insect pollinator visits (landings on flower parts) were counted during a five minute period each hour of the monitoring period. Several weather parameters were recorded during each census period. Total pollinator visits to these mixed flower plots and prevailing weather conditions over the census periods are presented in Figure 7.

Pollinator surveys were also carried out on single species flower plots, where only one type of pollen or nectar source was present, either as a natural situation or because of deliberate removal of other flowers present. These single species surveys were used to gain information on the range of insects visiting specific flowers over the period of a day. In some instances data was collected over several days in order to evaluate the influences of weather and plant and insect development on the pollinator complex utilizing specific pollen and nectar sources. Table 3 presents data on the major groups of insects visiting flowers of various plants on different dates.

Identification of actual insect species visiting various plants is generally not possible in the field because taxonomic evaluation requires microscopic examination of specimens. It requires collecting insects as they are visiting flowers and taking them back to the laboratory for identification. Although tedious and time consuming, these types of studies define flower-pollinator associations much more precisely than field censuses alone. Table 4 shows floral associations found for twelve species of andrenid bees collected to date from the Icewater Creek research area. Although these data must be regarded as incomplete in that they are based on just over 100 individuals identified to species, they do demonstrate the specific preferences of wild pollinator species for individual or a limited number of pollen and nectar sources. Once these floral relationships are well established, the implications of pesticide impacts on individual species or groups of wild pollinators can be much more readily predicted.

Considerable progress was made in defining the pollinator complex present in the Icewater Creek area through a contract let to identify Hymenoptera collected from flowers in the area between 1980 to 1982. A similar taxonomic study on dipterans collected in the area is also in progress. Some 128 different taxa of Hymenoptera were identified, most to the

species level, and a key for field identification of the most important pollinators found on flowers in the area was prepared for us in future pollinator census work.

Soil Fauna

The soil fauna pit-fall trapping program initiated in 1980 and 1981 was continued throughout the 1982 season. Pit-fall traps were put in place on 28 April when roads first became passable. Weekly collections were taken at both the deciduous (S-1) and coniferous (S-2) site until 21 October when the program was terminated for the season. The 1982 soil fauna pit-fall collection data with accompanying soil temperatures are presented in Table 5. The numbers of invertebrates collected were lower in 1982 than 1981, no doubt a reflection of the very dry weather experienced during the summer months.

Activity patterns for adult Carabid beetles inhabiting the deciduous and coniferous sites were similar in nature with a higher population occupying the coniferous site with its deeper, damper duff and litter layer (Figure 8). Adult beetle activity appears to peak around mid-June, then declines during the remainder of the year with the exception of a small peak near the end of July. These activity trends are quite similar to those recorded in 1981 in spite of different weather patterns (Figure 9A and B). Captures of adult staphylinid beetles were greatly reduced during the 1982 season on both sites, but generally suggested similar seasonal activity patterns to those recorded in 1981 (Figure 10).

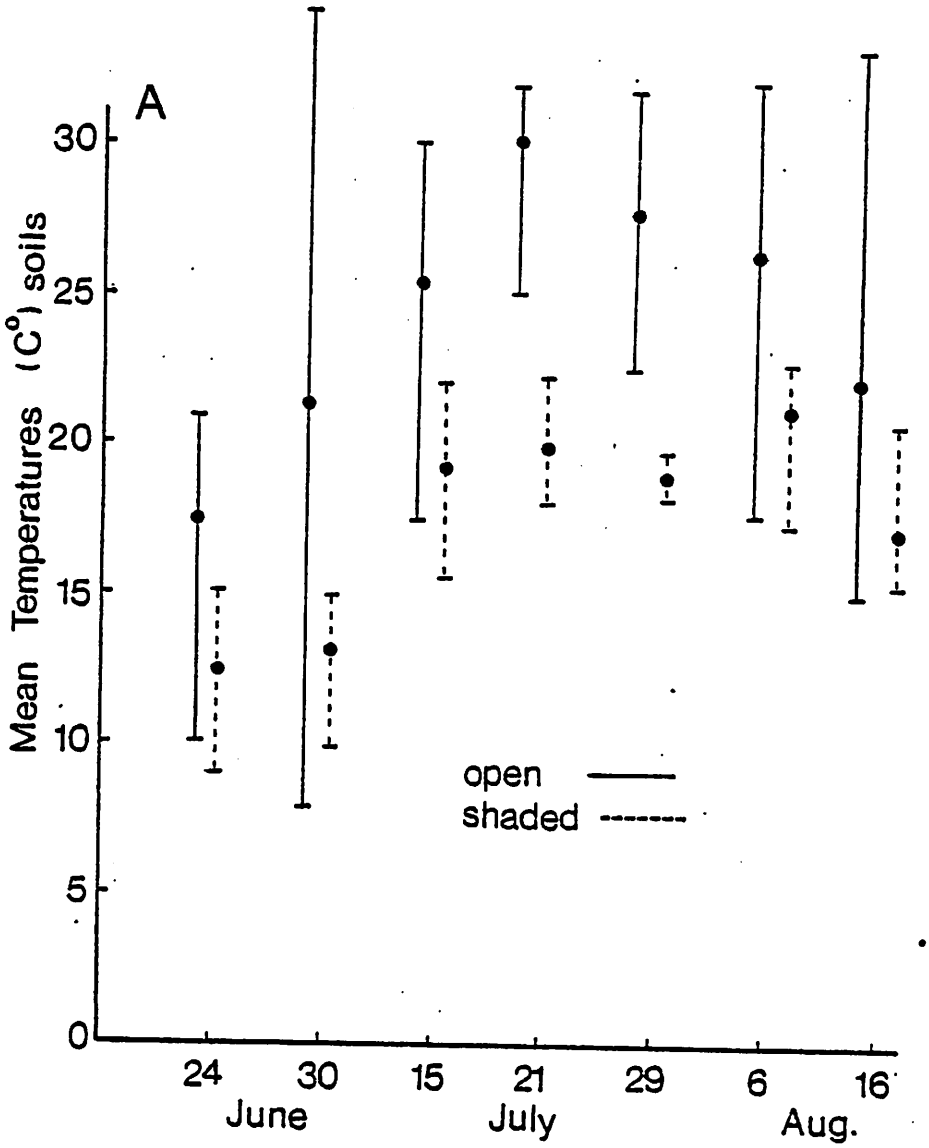
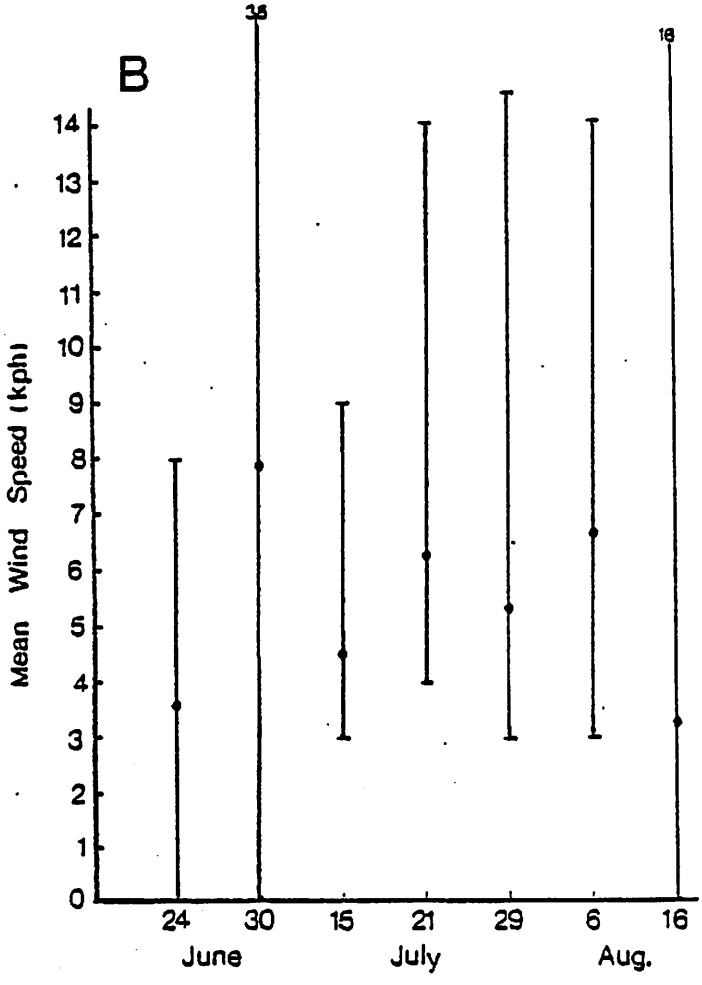
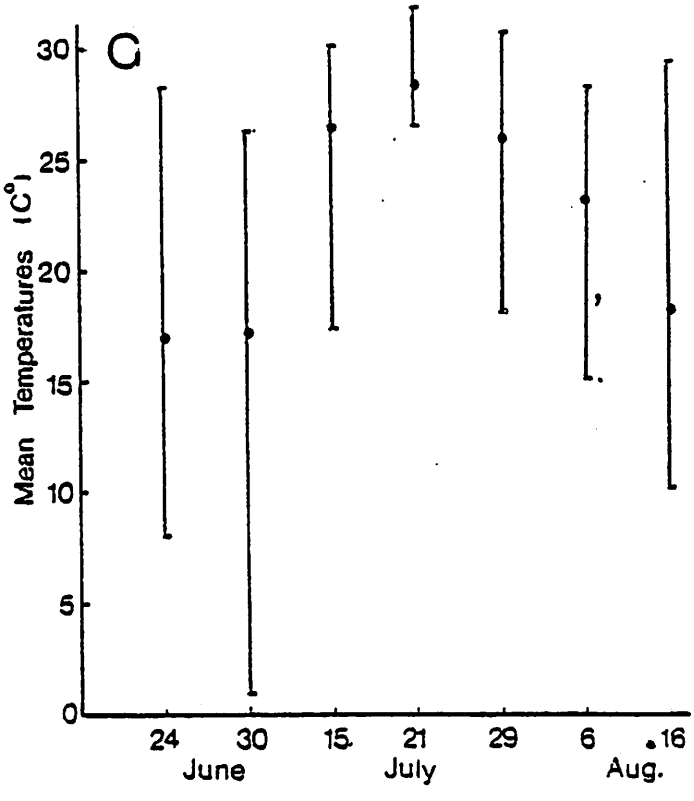


Figure 7. Soil temperatures (A), wind speed (B), air temperature at 1 metre level (C) and mean number of pollinator visits per census per 100 stems of native bee pasture (D) 24 June-16 August, Icewater Creek 1982.





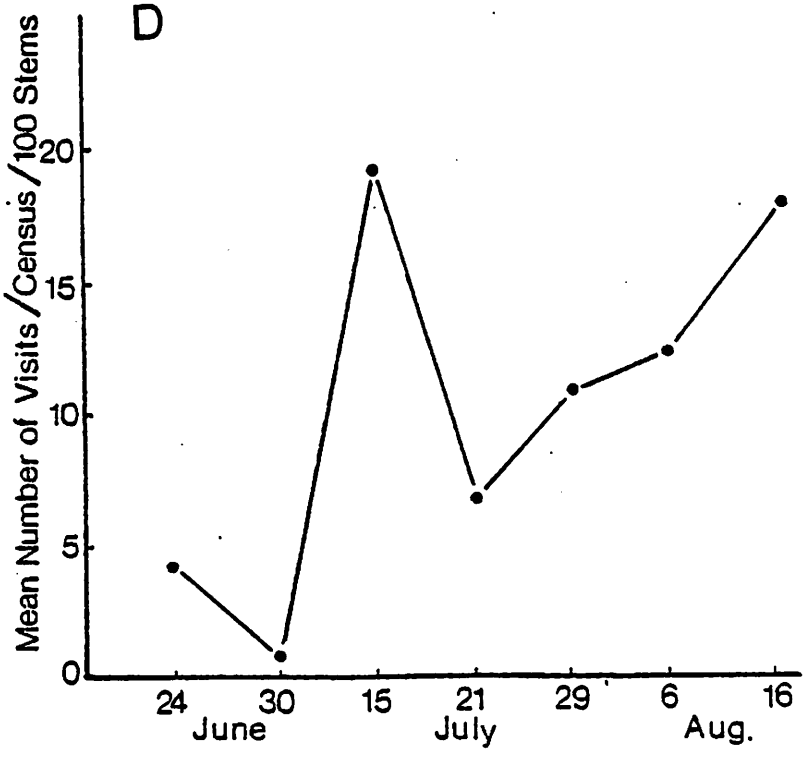


Figure 7 (concluded)

Table 3.
Proportions of pollinator visits by insects to various flower species of the lower Icewater Creek watershed, 13 May to 16 Aug. 1982.

Host species	Date	Total number of pollinator visits	% of pollinator visits by various insect groups*
Willow	13 May	20	70% Honeybees, 15% Ants, 15% Misc. Diptera
Trout lily	19 May	94	58% Andrenids, 20% Honeybees, 15% Misc. Diptera
Skunk currant	27 May	55	86% Ants, 11% Misc. Diptera
Serviceberry	27 May	61	36% Ants, 23% Honeybees, 18% Coleoptera, 11% Misc. Diptera
Pin Cherry	27 May	119	56% Ants, 18% Misc. Diptera
Common strawberry	27 May	118	92% Misc. Hymenoptera
	3 June	74	46% Andrenids, 34% Misc. Hymenoptera
	5 June	138	46% Misc. Diptera, 39% Misc. Hymenoptera
Choke cherry	3 June	160	59% Honeybees, 19% Misc. Hymenoptera, 14% Coleoptera, 11% Ants
	5 June	113	41% Ants, 18% Coleoptera, 11% Syrphids
Orange hawkweed	5 July	275	45% Honeybees, 25% Misc. Diptera, 16% Misc. Hymenoptera
	6 July	603	63% Honeybees, 14% Misc. Hymenoptera, 12% Misc. Diptera
	8 July	534	29% Honeybees, 21% Bumblebees, 13% Misc. Hymenoptera, 13% Lepidoptera, 12% Andrenids
Smoothish hawkweed	5 July	33	84% Misc. Hymenoptera
	6 July	89	47% Misc. Hymenoptera, 35% Lepidoptera
	8 July	63	32% Lepidoptera, 17% Syrphids, 14% Misc. Hymenoptera, 11% Misc. Diptera
Ox-eye daisy	5 July	407	45% Misc. Diptera, 20% Honeybees, 19% Misc. Hymenoptera
	6 July	403	65% Misc. Diptera
	7 July	82	67% Misc. Diptera, 17% Coleoptera
	8 July	193	44% Misc. Diptera, 22% Honeybees, 14% Misc. Hymenoptera
Black raspberry	21 July	385	32% Misc. Hymenoptera, 27% Lepidoptera, 24% Bumblebees
Heal-all	21 July	549	69% Lepidoptera, 14% Bumblebees
St. John's-wort	29 July	360	67% Bumblebees, 21% Misc. Diptera
Daisy fleabane	29 July	41	61% Misc. Diptera, 17% Misc. Hymenoptera
Goldenrod	29 July	96	78% Misc. Hymenoptera, 11% Misc. Diptera
	6 Aug	776	56% Misc. Hymenoptera, 20% Misc. Diptera
	16 Aug	752	43% Misc. Hymenoptera, 14% Misc. Diptera, 13% Coleoptera, 11% Ants
Yarrow	6 Aug	106	53% Misc. Diptera, 38% Misc. Hymenoptera
Fireweed	6 Aug	3661	71% Bumblebees, 16% Misc. Hymenoptera
Pearly everlasting	6 Aug	214	48% Misc. Diptera, 39% Misc. Hymenoptera
	16 Aug	144	42% Misc. Hymenoptera, 27% Coleoptera, 19% Misc. Diptera
Joe-pye-weed	16 Aug	571	48% Bumblebees, 14% Lepidoptera, 13% Coleoptera
Small white aster	16 Aug	265	71% Misc. Hymenoptera, 17% Misc. Diptera
Flat-topped white aster	16 Aug	174	62% Misc. Hymenoptera, 10% Syrphids
Late-purple aster	16 Aug	166	61% Misc. Hymenoptera, 17% Misc. Diptera, 11% Bumblebees

* only groups contributing 10% of visits or more are listed
Honeybees - *Apis mellifera* (Hymenoptera: Apidae)
Bumblebees - *Bombus* spp. (Hymenoptera: Apidae)
Andrenids - Hymenoptera: Andrenidae
Misc. Hymenoptera - Exclusive of Apidae and Andrenidae
Syrphids - Diptera: Syrphidae
Misc. Diptera - Exclusive of Syrphidae

Table 4.
Floral associations of pollinating
Andrenid bees (*Andrena* spp.) in the lower
Icewater Creek watershed, 1982.

Species	Trout Lily	Willow	Strawberry	Choke Cherry	Blueberry	Dogwood	Raspberry	Ox-eye Daisy	Orange Hawkweed	Mountain Ash	Goldenrod
A. erythronii	x	x		x	x				x		
A. regularis	x										
A. robertsonii		x									
A. miserabilis		x									
A. melanochroa			x								
A. carlini carlini				x		x	x		x	x	
A. carolina							x			x	
A. nuda							x				
A. nigrihirta								x			
A. distans								x			
A. nubecula											x
A. imiatrix	no floral association found yet										

Table 5.
Soil fauna collected in pitfall traps
Icewater Creek Research Area
28 April - 21 Oct. 1982

Phylum	Class	Order	Family	28 April to 5 May		5 May to 12 May		12 May to 19 May		19 May to 26 May		26 May to 2 June		2 June to 9 June		9 June to 16 June		16 June to 23 June		23 June to 30 June		30 June to 7 July		7 July to 14 July		14 July to 22 July		22 July to 28 July	
				S-1	S-2	S-1	S-2	S-1	S-2	S-1	S-2	S-1	S-2	S-1	S-2	S-1	S-2	S-1	S-2	S-1	S-2	S-1	S-2	S-1	S-2	S-1	S-2	S-1	S-2
Site				-	-	6.6	7.7	13.3	10.0	12.2	8.8			12.7	11.6	12.2	11.1	12.2	10.0	14.4	12.2	15.5	16.1	15.5	16.1	17.7	22.7	17.2	20.0
Ground temperature (°C)				-	-	-	-	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nemathelminthes	Nematode			-	-	-	-	1	1	-	1			-	-	-	2	-	-	1	1	-	1	-	-	1	2	-	-
Mollusca	Gastropoda			-	1	-	-	1	-	-	1			-	-	1	-	-	1	2	-	-	1	2	-	-	-	-	-
Annelida				-	-	-	1	1	-	-	1			-	-	1	-	-	1	2	-	-	1	2	-	-	-	-	-
Arthropoda	Arachnida	Pseudoscorpionida		-	-	-	-	-	-	-	-			-	1	-	-	-	1	-	-	-	-	-	-	-	-	-	-
		Phalangida		14	10	3	1	2	-	6	6			6	2	6	3	1	4	-	1	3	3	2	-	1	-	5	2
		Acari		22	2	44	1	54	2	62	15			29	5	9	11	5	-	22	12	14	1	5	5	7	12	11	2
		Araneida		2	19	6	7	1	-	14	44			11	15	5	10	2	9	14	5	1	6	2	1	-	6	3	-
	Diplopoda			20	-	9	-	28	-	15	2			9	-	5	1	2	-	4	1	4	2	20	1	27	-	24	1
	Chilopoda			-	-	-	-	-	-	-	1			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Insecta	Collembola		10	1	13	5	5	824	21	644			32	2	45	13	5	21	268	122	14	7	5	6	4	8	5	5
		Orthoptera	Acrididae	-	-	-	-	-	-	-	-			6	-	2	-	-	-	5	-	-	-	7	-	4	-	-	-
			Gryllacrididae	-	-	-	-	-	-	-	-			2	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		Psocoptera		-	-	-	-	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
		Thysanoptera	Thripidae	-	-	-	-	-	-	-	-			-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-
		Hemiptera (A)		-	-	2	2	-	-	1	-			-	1	-	3	1	1	5	-	-	1	-	-	-	1	1	1
		(J)		-	-	-	-	-	-	-	-			1	-	2	-	3	-	2	-	-	1	-	1	-	-	1	-
		Homoptera (A)		-	-	-	-	-	-	-	-			3	-	6	-	7	-	11	2	2	1	2	2	2	3	12	2
		(J)		4	-	3	-	-	-	7	1			16	-	20	1	14	1	36	1	29	-	7	1	3	-	1	-
		Neuroptera		-	-	-	-	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-
		Coleoptera	Carabidae	1	27	2	25	5	29	7	28			5	30	3	27	5	23	9	31	6	24	6	20	5	4	-	4
			Histeridae	-	-	-	-	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
			Staphylinidae	2	3	-	1	-	-	1	-			1	-	2	4	2	2	2	1	-	2	-	3	1	1	1	1
			Pselaphidae	-	-	-	-	-	-	-	-			-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-
			Silphidae	-	-	-	-	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
			Byrrhidae	-	-	-	-	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
			Elateridae	-	1	-	-	-	-	-	-			7	-	2	1	-	-	2	1	5	-	-	-	2	1	6	1
			Lampyridae	-	-	-	-	1	-	2	-			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
			Cantharidae	-	-	-	-	-	-	-	-			1	-	-	-	-	-	-	1	-	1	-	-	-	-	-	-
			Cryptophagidae	-	-	-	-	1	-	-	-			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
			Meloidae	-	-	-	-	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
			Carabycidae	-	-	-	-	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-
			Chrysomelidae	4	1	-	-	-	-	3	1			6	-	3	1	-	-	2	-	-	-	-	-	-	-	-	-
			Curculionidae	-	-	-	-	1	-	1	2			1	1	2	2	-	-	1	1	10	1	2	1	3	-	-	-
			Others	1	-	-	-	-	-	-	-			-	-	-	-	-	-	1	-	4	-	-	-	-	-	-	-
		Trichoptera		-	-	-	-	-	-	-	-			2	-	-	-	1	-	1	-	-	1	-	-	-	-	-	-
		Lepidoptera		-	1	1	-	-	-	-	-			3	-	-	-	-	-	-	-	2	-	-	-	1	-	2	1
		Diptera		21	8	1	-	2	-	96	12			34	7	10	1	10	7	45	3	18	18	7	3	8	17	34	19
		Siphonaptera		-	-	-	-	-	-	-	-			-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-
		Hymenoptera	Formicidae	3	3	-	-	-	-	2	1			4	3	6	3	2	2	8	3	1	3	2	4	2	2	6	-
			Others	5	2	-	-	-	-	3	1			7	-	4	1	4	5	11	-	3	2	1	1	1	3	9	-
		Misc. larvae		3	7	5	2	7	2	2	3			12	-	5	2	4	4	11	3	5	-	2	4	3	1	16	-
		Misc. pupae		1	-	-	-	-	-	-	1			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Chordata	Amphibia			2	1	-	1	-	1	-	-			-	-	1	-	-	-	-	-	1	-	1	1	1	1	-	-
	Mammalia			-	-	-	-	-	-	-	-			-	-	-	-	-	-	-	-	-	-	2	1	-	-	-	1
Unidentified				5	-	-	-	-	-	4	1			14	-	13	1	-	-	2	1	-	-	1	-	-	-	-	-
Total				120	87	89	46	109	859	247	765			212	68	154	87	66	81	466	196	122	78	77	55	75	62	138	41

Table 5 (concluded)
Soil fauna collected in pitfall traps
Icewater Creek Research Area
28 April - 21 Oct. 1982

Phylum	Class	Order	Family	28 July to 5 Aug		5 Aug to 11 Aug		11 Aug to 19 Aug		19 Aug to 25 Aug		25 Aug to 2 Sept		2 Sept to 8 Sept		8 Sept to 15 Sept		15 Sept to 23 Sept		23 Sept to 30 Sept		30 Sept to 6 Oct		6 Oct to 14 Oct		14 Oct to 21 Oct	
Site				S-1	S-2	S-1	S-2	S-1	S-2	S-1	S-2	S-1	S-2	S-1	S-2	S-1	S-2	S-1	S-2	S-1	S-2	S-1	S-2	S-1	S-2	S-1	S-2
Ground temperature (°C)				15.5	15.5	12.7	13.8	20.0	18.5	14.4	11.6	15.0	13.8	7.7	10.0	12.2	12.2	15.5	13.5	14.4	15.5	11.1	12.2	10.0	10.0	5.0	5.5
Nemathelminthes	Nematoda			-	-	1	-	-	-	-	6	15	25	7	-	-	4	-	2	-	2	-	3	-	1	1	1
Mollusca	Gastropoda			-	1	-	-	-	-	-	1	-	1	-	2	-	3	-	2	-	2	-	3	-	1	-	2
Annelida				-	-	-	2	-	1	-	1	3	2	-	4	1	-	-	4	-	2	1	1	-	-	-	-
Arthropoda	Arachnida	Pseudoscorpionida		-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	1	-	1	-	-
		Phalangida		1	1	2	2	-	3	-	2	1	1	-	2	-	2	3	-	-	1	-	-	1	2	-	1
		Acari		11	3	67	5	19	2	58	4	31	3	6	1	4	4	19	7	12	9	23	16	15	11	3	-
		Araneida		4	12	5	2	2	1	4	5	7	6	-	1	-	1	2	1	-	1	5	3	3	2	-	-
	Diplopoda			67	3	20	3	40	1	23	1	53	-	20	6	81	6	60	-	142	8	59	5	97	3	3	-
	Chilopoda			-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	1	-
	Insecta	Collembola		6	11	89	15	26	18	31	38	26	39	2	12	6	37	52	23	56	56	64	47	89	80	14	14
		Orthoptera	Acrididae	2	-	3	-	-	-	3	-	5	1	3	-	3	-	-	-	-	-	3	-	-	-	-	-
			Gryllacrididae	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		Psocoptera		1	-	3	1	-	2	2	4	1	6	-	-	-	2	3	4	-	-	1	1	1	2	-	-
		Thysanoptera	Thripidae	-	-	1	-	1	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	1	1
		Hemiptera (A)		8	1	-	1	2	2	-	-	-	-	-	-	-	1	-	1	-	-	-	-	1	-	-	-
		(J)		-	-	-	-	2	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		Homoptera (A)		15	12	19	2	10	2	12	3	29	1	2	3	3	-	3	1	1	1	1	2	1	-	2	-
		(J)		1	-	7	1	3	-	3	2	4	3	1	2	1	1	8	1	-	-	2	2	1	-	2	2
		Neuroptera		-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		Coleoptera	Carabidae	14	24	1	4	4	1	2	1	2	2	-	-	-	1	1	-	1	2	-	1	-	1	-	-
			Histeridae	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
			Staphylinidae	7	5	10	2	3	2	6	9	8	9	-	1	-	4	4	-	3	1	1	1	1	1	2	-
			Pentaphidae	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-
			Silphidae	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
			Byrrhidae	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-
			Elateridae	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-
			Lampyridae	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
			Cantharidae	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
			Cryptophagidae	-	-	-	-	-	-	3	-	-	-	3	-	-	-	3	-	-	-	-	-	-	-	-	-
			Nitidulidae	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
			Cerambycidae	-	-	2	-	-	-	-	-	-	-	1	-	-	-	1	-	1	-	2	-	1	-	-	-
			Chrysomelidae	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
			Curculionidae	1	-	12	-	4	-	4	1	-	-	-	-	1	-	3	3	1	2	1	1	1	-	-	-
			Others	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		Trichoptera		1	1	-	-	-	-	-	-	-	2	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-
		Lepidoptera		43	33	29	1	11	20	58	40	81	73	1	3	38	20	335	27	244	51	226	40	119	20	9	1
		Diptera		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-
		Siphonaptera		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		Hymenoptera	Formicidae	31	6	9	2	7	6	6	3	18	4	1	-	2	5	2	-	6	-	6	-	3	-	-	-
			Others	16	5	12	2	6	1	21	8	45	20	2	1	2	13	30	2	22	5	27	8	25	4	6	-
		Misc. larvae		11	4	30	14	13	4	25	15	39	37	16	29	12	26	17	8	11	17	7	9	25	17	13	7
		Misc. pupae		-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	-	-	-	-	-	-	-	-	-
Chordata	Amphibia			1	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Mammalia			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-
Unidentified				-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	1	1	-	1	-	-	-
Total				249	127	332	66	161	66	366	145	368	246	65	66	154	131	610	94	503	161	432	141	399	145	60	29

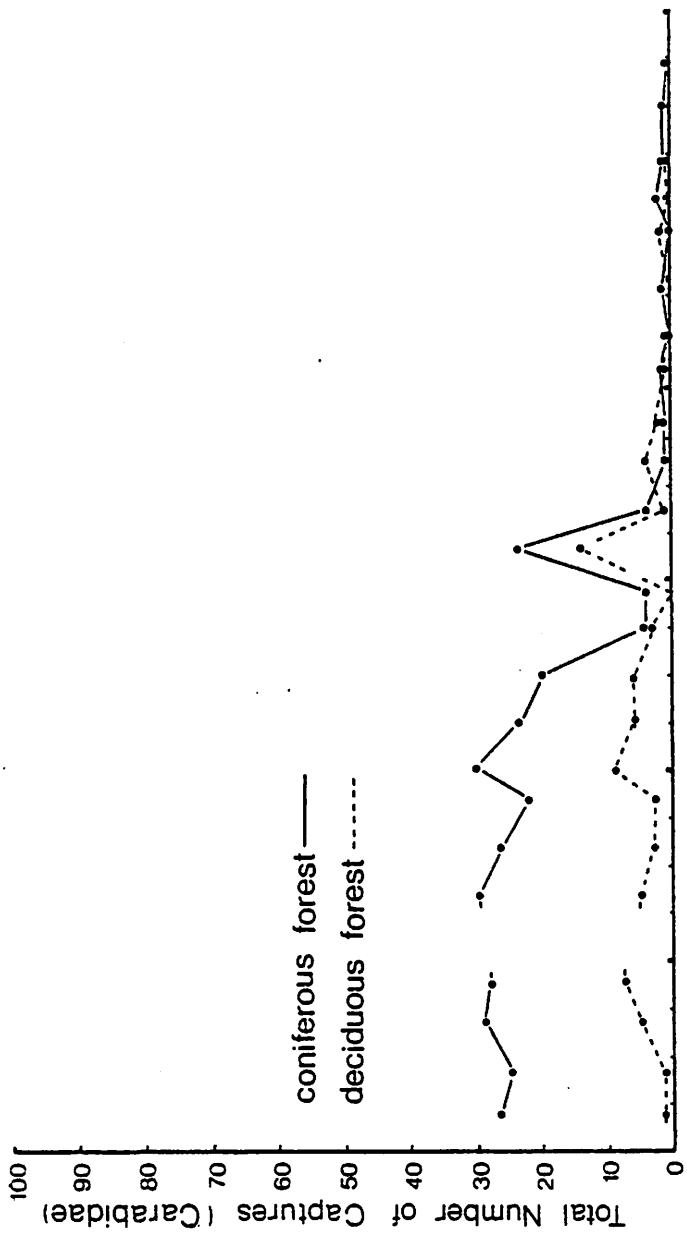


Figure 8. Adult Carabid beetle captures in coniferous and deciduous forest sites. Icewater Creek Research Area 1982.

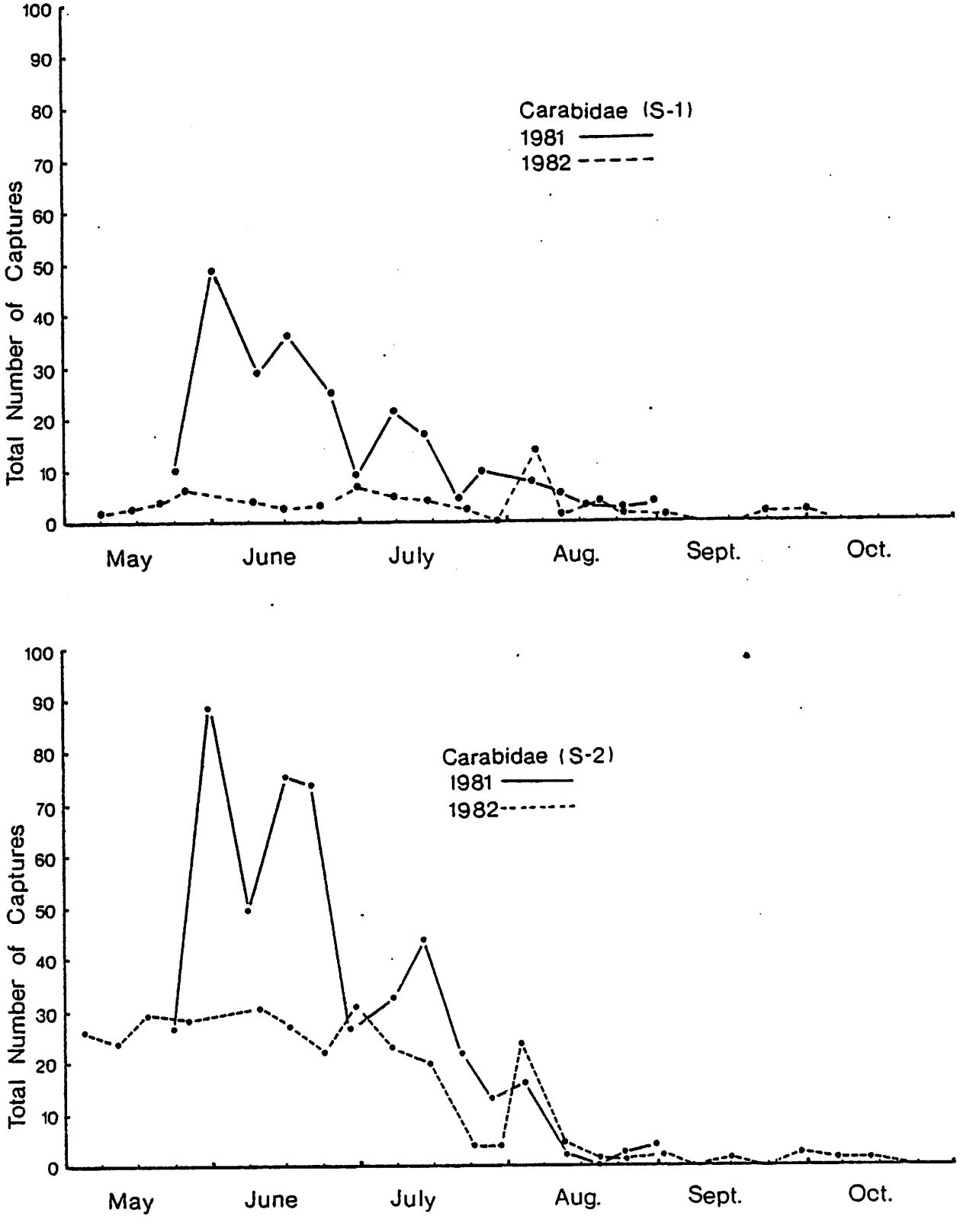


Figure 9. Adult Carabid beetle activity on a deciduous (S-1) and coniferous (S-2) site in the Icewater Creek Research Area, 1981 and 1982.

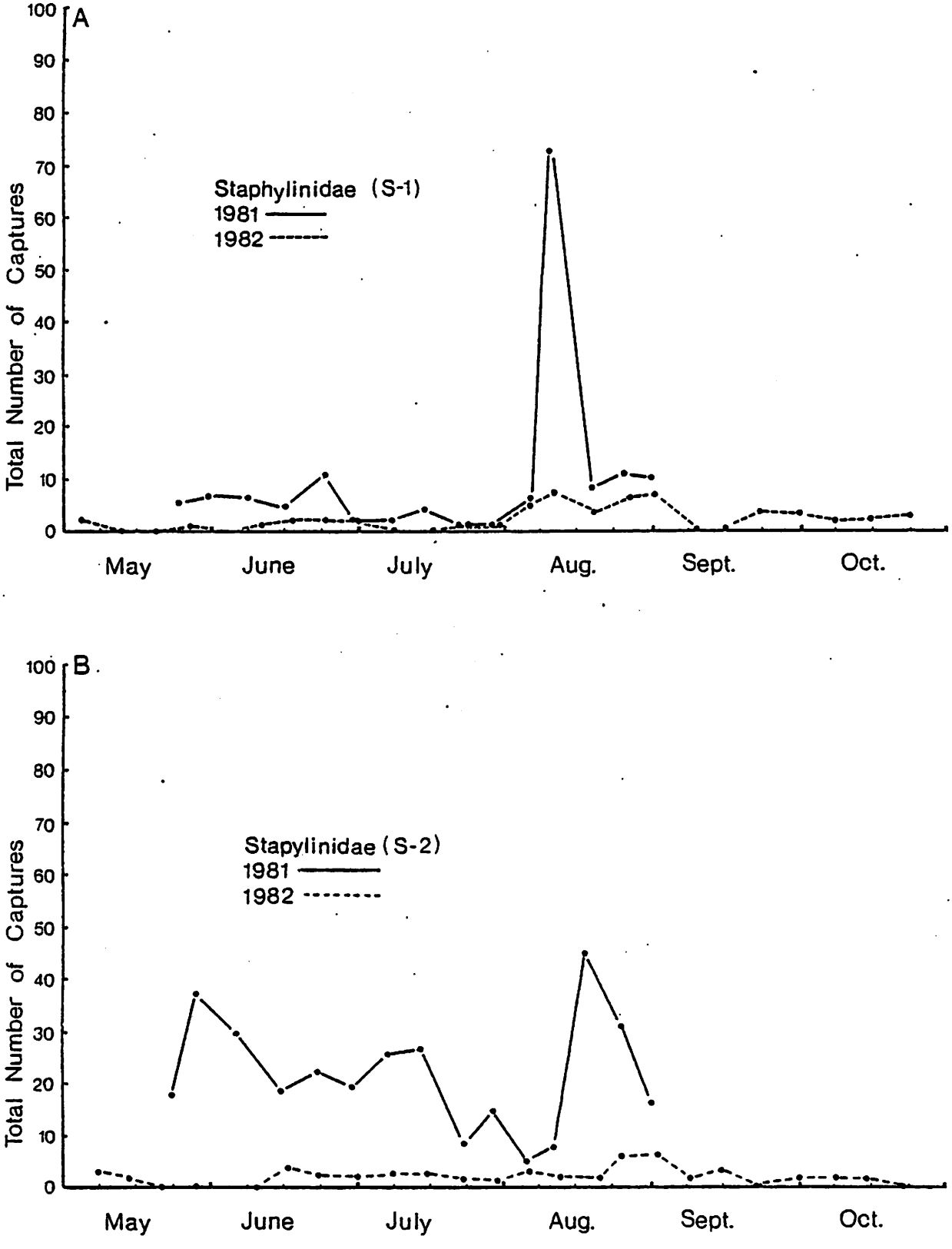


Figure 10. Adult staphylinid beetle activity on a deciduous (S-1) and coniferous (S-2) site in the Icewater Creek Research Area, 1981 and 1982.

TERRESTRIAL VERTEBRATE STUDIES

Forest Birds

Surveys documenting the avian complex inhabiting the lower Icewater Creek watershed over a three year period were completed in 1982. During 1980 and 1981, surveys were carried out in three separate distinct ecological sites, an uplands immature hardwoods site (S-1), a semi-mature softwoods site (S-2) and along the Icewater Creek valley bottom (S-3). In 1982, a fourth site was added, a mature hardwoods site (S-4). Table 6 summarizes combined records of birds sighted over a three year period on all four ecological sites in the lower Icewater Creek watershed. A total of 98 species representing 30 families have been recorded in the area. Additional species will no doubt be added from time to time as species occasionally stray from normal migration routes or are forced into the area by storms or other unseasonable weather conditions.

Bird population census methodology studies continued in 1982 with additional data being collected utilizing a singing male point census method of recording bird populations over a variety of time frames. The data are presented in Table 7 but have not as yet been integrated with data from other studies and analyzed. This report will be presented at a later date.

Table 6. Avifauna survey of the lower Icewater Creek watershed for the years 1980 - 1982.

Family	Species	Common Name	February				March				April				May			
			1-7	8-14	15-21	22-28	1-7	8-14	15-21	22-31	1-7	8-14	15-21	22-30	1-7	8-14	15-21	22-31
Gaviidae	*Gavia immer*	Common Loon																
Ardeidae	*Ardea herodias*	Great Blue Heron														x	x	
	Botaurus lentiginosus	American Bittern																
Anatidae	*Anas platyrhynchos*	Mallard															x	
	Mergus merganser	Common Merganser																x
	Mergus serrator	Red-breasted Merganser																
Accipitridae	*Buteo jamaicensis*	Red-tailed Hawk													x	x		
	Buteo lineatus	Red-shouldered Hawk														x	x	x
	Buteo platypterus	Broad-winged Hawk																
Tetraonidae	*Bonasa umbellus*	Ruffed Grouse		x										x	x	x	x	x
Gruidae	*Grus canadensis*	Sandhill Crane																
Scolopacidae	*Gallinago minor*	American Woodcock												x		x	x	x
	Actitis macularia	Spotted Sandpiper														x		
Columbidae	*Zenaidura macroura*	Mourning Dove														x		
Cuculidae	*Coccyzus erythropthalmus*	Black-billed Cuckoo																x
Apodidae	*Chaetura pelagica*	Chimney Swift																x
Trochilidae	*Archilochus colubris*	Ruby-throated Hummingbird															x	x
Alcedinidae	*Megaceryle alcyon*	Belted Kingfisher														x		x
Picidae	*Colaptes auratus*	Common Flicker											x	x	x	x	x	x
	Dryocopus pileatus	Pileated Woodpecker		x				x						x	x	x	x	x
	Melanerpes erythrocephalus	Red-headed Woodpecker																x
	Sphyrapicus varius	Yellow-bellied Sapsucker														x		x
	Dendrocopos villosus	Hairy Woodpecker												x	x	x	x	x
	Dendrocopos pubescens	Downy Woodpecker													x	x	x	x
Tyrannidae	*Tyrannus tyrannus*	Eastern Kingbird														x	x	x
	Myiarchus crinitus	Great Crested Flycatcher													x	x	x	x
	Sayornis phoebe	Eastern Phoebe																
	Empidonax flaviventris	Yellow-bellied Flycatcher																
	Empidonax alnorum	Alder Flycatcher														x	x	x
	Empidonax minimus	Least Flycatcher														x	x	x
Tyrannidae	*Contopus virens*	Eastern Wood Pewee																x
(cont'd.)	*Nuttallornis borealis*	Olive-sided Flycatcher															x	x
Hirundinidae	*Tridoprocne bicolor*	Tree Swallow													x	x	x	x
	Progne subis	Purple Martin															x	
Corvidae	*Perisoreus canadensis*	Gray Jay		x										x				x
	Cyanocitta cristata	Blue Jay													x	x	x	x
	Corvus corax	Common Raven													x	x	x	x
	Corvus brachyrhynchos	Common Crow													x	x	x	x
Paridae	*Parus atricapillus*	Black-capped Chickadee		x	x			x			x			x	x	x	x	x
	Parus hudsonicus	Boreal Chickadee													x	x		x
Sittidae	*Sitta carolinensis*	White-breasted Nuthatch		x	x									x		x	x	x
	Sitta canadensis	Red-breasted Nuthatch		x	x			x						x	x	x	x	x
Certhiidae	*Certhia familiaris*	Brown Creeper														x	x	x
Troglodytidae	*Troglodytes troglodytes*	Winter Wren									x			x	x	x	x	x
Mimidae	*Mimus polyglottos*	Mockingbird																
	Dumetella carolinensis	Catbird															x	x
Turdidae	*Turdus migratorius*	American Robin									x		x	x	x	x	x	x
	Hylocichla mustelina	Wood Thrush														x	x	x
	Hylocichla guttata	Hermit Thrush													x	x	x	x
	Hylocichla ustulata	Swainson's Thrush													x	x	x	x
	Hylocichla fuscescens	Veery															x	x
Sylviidae	*Regulus satrapa*	Golden-crowned Kinglet												x	x	x	x	x
	Regulus calendula	Ruby-crowned Kinglet												x	x	x	x	x
Bombycillidae	*Bombycilla cedrorum*	Cedar Waxwing																x
Sturnidae	*Sturnus vulgaris*	Starling														x		
Vireonidae	*Vireo solitarius*	Solitary Vireo													x	x	x	x
	Vireo olivaceus	Red-eyed Vireo												x			x	x
	Vireo philadelphicus	Philadelphia Vireo													x	x	x	x
Parulidae	*Mniotilta varia*	Black-and-white Warbler													x	x	x	x
Parulidae	*Vermivora peregrina*	Tennessee Warbler															x	x
(cont'd.)	*Vermivora ruficapilla*	Nashville Warbler													x	x	x	x
	Parula americana	Parula Warbler														x	x	x
	Dendroica petechia	Yellow Warbler																
	Dendroica magnolia	Magnolia Warbler														x	x	x
	Dendroica tigrina	Cape May Warbler														x	x	x
	Dendroica caerulescens	Black-throated Blue Warbler													x	x	x	x
	Dendroica coronata	Yellow-rumped Warbler												x	x	x	x	x
	Dendroica virens	Black-throated Green Warbler													x	x	x	x
	Dendroica fusca	Blackburnian Warbler													x	x	x	x
	Dendroica pensylvanica	Chestnut-sided Warbler													x	x	x	x
	Dendroica castanea	Bay-breasted Warbler														x	x	x
	Dendroica striata	Blackpoll Warbler															x	
	Seiurus aurocapillus	Ovenbird															x	x
	Seiurus noveboracensis	Northern Waterthrush														x	x	x
	Oporornis philadelphia	Mourning Warbler															x	x
	Geothlypis trichas	Common Yellowthroat															x	x
	Wilsonia pusilla	Wilson's Warbler																
	Wilsonia canadensis	Canada Warbler														x	x	x
	Setophaga ruticilla	American Redstart															x	x
Icteridae	*Agelaius phoeniceus*	Redwinged Blackbird															x	
	Icterus galbula	Northern Oriole																
	Quiscalus quiscula	Common Grackle														x		
	Molothrus ater	Brown-headed Cowbird												x	x			x
Thraupidae	*Piranga olivacea*	Scarlet Tanager																
Fringillidae	*Pheucticus ludovicianus*	Rose-breasted Grosbeak														x	x	x
	Hesperiphona vespertina	Evening Grosbeak												x	x	x	x	x
	Carpodacus purpureus	Purple Finch												x	x	x	x	x
	Spinus pinus	Pine Siskin		x									x					x
															x		x	x
Fringillidae	*Spinus tristis*	American Goldfinch																
(cont'd.)	*Pipilo erythrophthalmus*	Rufous-sided Towhee									x		x	x	x	x	x	x
	Junco hyemalis	Dark-eyed Junco													x	x		
	Spizella arborea	Tree Sparrow									x					x	x	x
	Spizella passerina	Chipping Sparrow													x	x	x	x
	Zonotrichia leucophrys	White-crowned Sparrow											x	x	x	x	x	x
	Zonotrichia albicollis	White-throated Sparrow																
	Melospiza georgiana	Swamp Sparrow												x		x	x	x
	Melospiza melodia	Song Sparrow																
	Plectrophenax nivalis	Snow Bunting																

Table 6. (Concld.)

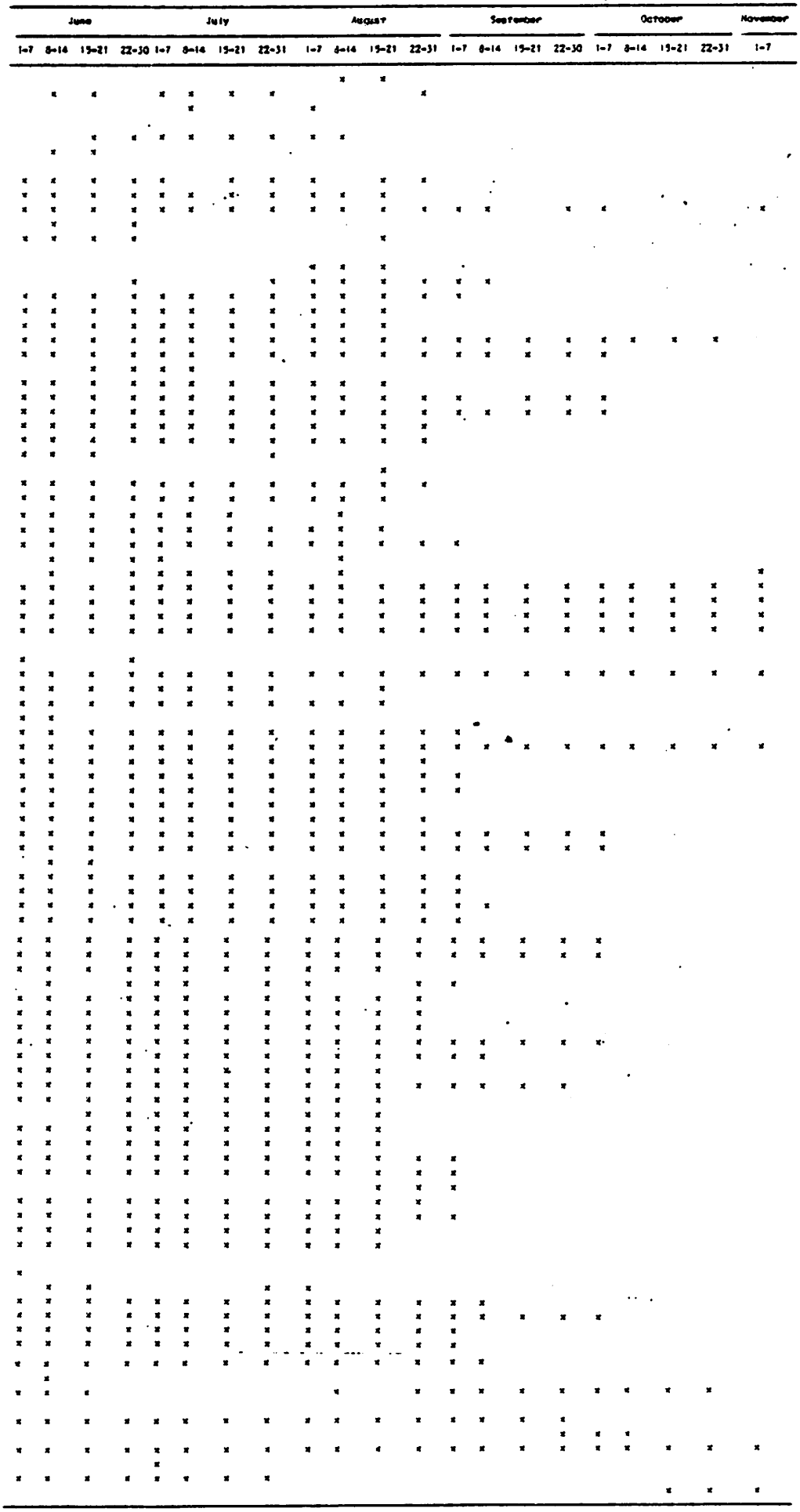


Table 7.
Seasonal Forest Bird Population Census
(Singing male - time frame Methodology)
Icewater Creek Research Area 19 May - 25 August 1982.

		19 May							26 May							2 June						
		Total Birds			Average Birds				Total Birds			Average Birds				Total Birds			Average Birds			
Family	Species	5 min	10 min	15 min	5 min	10 min	15 min	No. of plots	5 min	10 min	15 min	5 min	10 min	15 min	No. of plots	5 min	10 min	15 min	5 min	10 min	15 min	No. of plots
Tyrannidae	Great Crested Flycatcher	2	2	2	1.0	1.0	1.0	2	2	4	0	1.0	2.0	0.0	2	2	0	0	2.0	0.0	0.0	1
	Alder Flycatcher	2	0	0	2.0	0.0	0.0	1	2	4	0	1.0	2.0	0.0	2	4	2	2	4.0	2.0	2.0	1
	Least Flycatcher	2	0	0	2.0	0.0	0.0	1	4	2	2	4.0	2.0	2.0	1	8	4	0	4.0	2.0	0.0	2
Troglodytidae	Winter Wren	4	2	0	2.0	1.0	0.0	2	6	2	2	3.0	1.0	1.0	2	2	6	4	0.7	2.0	1.3	3
Turdidae	Hermit Thrush	2	3	2	0.7	1.0	0.7	3	4	4	2	2.0	2.0	1.0	2	5	2	0	1.7	0.7	0.0	3
	Swainson's Thrush	4	0	0	2.0	0.0	0.0	2	4	0	0	4.0	0.0	0.0	1	1	1	2	0.3	0.3	0.7	3
	Veery	0	0	0	0.0	0.0	0.0	0	2	4	0	2.0	4.0	0.0	1	2	0	2	1.0	0.0	1.0	2
Sylviidae	Golden-crowned Kinglet	0	0	0	0.0	0.0	0.0	0	11	0	2	11.0	0.0	2.0	1	8	0	4	8.0	0.0	4.0	1
	Ruby-crowned Kinglet	2	0	0	2.0	0.0	0.0	1	6	0	0	6.0	0.0	0.0	1	6	0	0	6.0	0.0	0.0	1
Vireonidae	Solitary Vireo	0	2	2	0.0	2.0	2.0	1	0	0	0	0.0	0.0	0.0	0	4	0	0	4.0	0.0	0.0	1
	Red-eyed Vireo	0	0	0	0.0	0.0	0.0	0	0	0	0	0.0	0.0	0.0	0	8	8	2	2.7	2.7	0.7	3
	Philadelphia Vireo	0	0	0	0.0	0.0	0.0	0	0	0	0	0.0	0.0	0.0	0	0	0	0	0.0	0.0	0.0	0
Parulidae	Black-and-white Warbler	16	2	4	8.0	1.0	2.0	2	4	2	2	1.3	0.7	0.7	3	6	4	4	2.0	1.3	1.3	3
	Tennessee Warbler	0	0	0	0.0	0.0	0.0	0	4	0	0	4.0	0.0	0.0	1	4	2	0	4.0	2.0	0.0	1
	Nashville Warbler	6	2	2	3.0	1.0	1.0	2	18	2	2	9.0	1.0	1.0	2	16	2	4	5.3	0.7	1.3	3
	Parula Warbler	2	0	4	1.0	0.0	2.0	2	4	4	2	2.0	2.0	1.0	2	12	0	0	12.0	0.0	0.0	1
	Yellow-rumped Warbler	6	2	2	6.0	2.0	2.0	1	0	0	0	0.0	0.0	0.0	0	0	4	0	0.0	4.0	0.0	1
	Black-throated Green Warbler	22	2	6	5.5	0.5	1.5	4	10	4	2	5.0	2.0	1.0	2	2	2	0	2.0	2.0	0.0	1
	Blackburnian Warbler	0	0	0	0.0	0.0	0.0	0	4	6	2	2.0	3.0	1.0	2	10	0	2	10.0	0.0	2.0	1
	Chestnut-sided Warbler	20	18	8	5.0	4.5	2.0	4	8	10	2	2.0	2.5	0.5	4	37	8	2	9.3	2.0	0.5	4
	Ovenbird	28	0	6	9.3	0.0	2.0	3	24	12	0	8.0	4.0	0.0	3	22	2	2	11.0	1.0	1.0	2
	Canada Warbler	0	0	0	0.0	0.0	0.0	0	0	2	2	0.0	2.0	2.0	1	12	4	2	4.0	1.3	0.7	3
	American Redstart	0	0	0	0.0	0.0	0.0	0	0	2	0	0.0	2.0	0.0	1	6	0	0	3.0	0.0	0.0	2
Fringillidae	Rose-breasted Grosbeak	21	12	8	5.3	3.0	2.0	4	12	4	0	6.0	2.0	0.0	2	10	2	2	3.3	0.7	0.7	3
	Purple Finch	1	0	0	1.0	0.0	0.0	1	8	0	4	8.0	0.0	4.0	1	6	4	0	3.0	2.0	0.0	2
	Chipping Sparrow	0	0	0	0.0	0.0	0.0	0	8	0	2	2.7	0.0	0.7	3	0	2	0	0.0	2.0	0.0	1
	White-throated Sparrow	40	16	11	10.0	4.0	2.8	4	24	6	13	8.0	2.0	4.3	3	14	8	4	4.7	2.7	1.3	3
Totals		180	63	57	65.8	21.0	21.0		169	74	41	92.0	36.2	22.2		207	67	38	108.0	31.4	18.5	

Table 7. (Continued)

Family	Species	9 June							18 June							23 June						
		Total Birds			Average Birds				Total Birds			Average Birds				Total Birds			Average Birds			
		5 min	10 min	15 min	5 min	10 min	15 min	No. of plots	5 min	10 min	15 min	5 min	10 min	15 min	No. of plots	5 min	10 min	15 min	5 min	10 min	15 min	No. of plots
Tyrannidae	Great Crested Flycatcher	8	4	0	2.7	1.3	0.0	3	2	2	0	2.0	2.0	0.0	1	6	2	1	2.0	0.7	0.3	3
	Alder Flycatcher	6	2	0	6.0	2.0	0.0	1	8	0	0	8.0	0.0	0.0	1	10	0	0	10.0	0.0	0.0	1
	Least Flycatcher	2	2	0	2.0	2.0	0.0	1	6	0	0	6.0	0.0	0.0	1	2	2	0	2.0	2.0	0.0	1
Troglodytidae	Winter Wren	4	2	0	4.0	2.0	0.0	1	12	4	0	4.0	1.3	0.0	3	10	0	0	3.3	0.0	0.0	3
Turdidae	Hermit Thrush	20	4	6	5.0	1.0	1.5	4	0	0	0	0.0	0.0	0.0	0	8	0	5	2.0	0.0	1.3	4
	Swainson's Thrush	5	6	3	1.7	2.0	1.0	3	7	0	0	3.5	0.0	0.0	2	24	2	5	6.0	0.5	1.3	4
	Veery	0	4	2	0.0	2.0	1.0	2	2	2	0	1.0	1.0	0.0	2	6	4	6	1.5	1.0	1.5	4
Sylvidae	Golden-crowned Kinglet	11	0	0	5.5	0.0	0.0	2	0	0	0	0.0	0.0	0.0	0	6	0	2	6.0	0.0	2.0	1
	Ruby-crowned Kinglet	2	0	0	2.0	0.0	0.0	1	6	0	0	6.0	0.0	0.0	1	2	2	0	2.0	2.0	0.0	1
Vireonidae	Solitary Vireo	4	0	2	2.0	0.0	1.0	2	0	0	0	0.0	0.0	0.0	0	0	2	0	0.0	2.0	0.0	1
	Red-eyed Vireo	10	0	2	3.3	0.0	0.7	3	16	0	6	5.3	0.0	2.0	3	18	2	6	6.0	0.7	2.0	3
	Philadelphia Vireo	0	0	0	0.0	0.0	0.0	0	0	0	2	0.0	0.0	2.0	1	4	2	4	2.0	1.0	2.0	2
Parulidae	Black-and-white Warbler	14	2	4	4.7	0.7	1.3	3	4	2	0	4.0	2.0	0.0	1	2	4	0	1.0	2.0	0.0	2
	Tennessee Warbler	5	2	0	2.5	1.0	0.0	2	4	0	0	4.0	0.0	0.0	1	4	0	0	4.0	0.0	0.0	1
	Nashville Warbler	22	2	0	5.5	0.5	0.0	4	10	0	0	5.0	0.0	0.0	2	10	6	2	3.3	2.0	0.7	3
	Parula Warbler	12	4	0	12.0	4.0	0.0	1	8	2	0	8.0	2.0	0.0	1	8	4	0	8.0	4.0	0.0	1
	Yellow-rumped Warbler	4	0	0	2.0	0.0	0.0	2	0	0	2	0.0	0.0	2.0	1	6	4	4	2.0	1.3	1.3	3
	Black-throated Green Warbler	18	2	0	9.0	1.0	0.0	2	0	0	0	0.0	0.0	0.0	0	8	2	0	8.0	2.0	0.0	1
	Blackburnian Warbler	6	4	4	6.0	4.0	4.0	1	10	0	2	10.0	0.0	2.0	1	12	0	2	12.0	0.0	2.0	1
	Chestnut-sided Warbler	20	12	6	5.0	3.0	1.5	4	16	4	2	5.3	1.3	0.7	3	30	4	0	10.0	1.3	0.0	3
	Ovenbird	24	0	2	8.0	0.0	0.7	3	14	0	0	14.0	0.0	0.0	1	16	6	2	5.3	2.0	0.7	3
	Canada Warbler	10	6	2	3.3	2.0	0.7	3	6	2	0	3.0	1.0	0.0	2	2	2	0	1.0	1.0	0.0	2
	American Redstart	9	7	0	4.5	3.5	0.0	2	4	0	2	2.0	0.0	1.0	2	13	0	2	4.3	0.0	0.7	3
Fringillidae	Rose-breasted Grosbeak	16	9	0	4.0	2.3	0.0	4	18	2	2	6.0	0.7	0.7	3	18	2	0	6.0	0.7	0.0	3
	Purple Finch	0	2	0	0.0	2.0	0.0	1	2	2	0	1.0	1.0	0.0	2	0	4	0	0.0	4.0	0.0	1
	Chipping Sparrow	0	0	0	0.0	0.0	0.0	0	0	0	2	0.0	0.0	1.0	2	0	2	0	0.0	2.0	0.0	1
	White-throated Sparrow	15	11	11	5.0	3.7	3.7	3	14	6	3	4.7	2.0	1.0	3	22	2	0	7.3	0.7	0.0	3
Totals		247	87	44	105.7	40.0	17.1		169	28	23	102.8	14.3	12.4		247	60	41	115.0	32.9	15.8	

Table 7. (Continued)

Family	Species	29 June							7 July							14 July						
		Total Birds			Average Birds				Total Birds			Average Birds				Total Birds			Average Birds			
		5 min	10 min	15 min	5 min	10 min	15 min	No. of plots	5 min	10 min	15 min	5 min	10 min	15 min	No. of plots	5 min	10 min	15 min	5 min	10 min	15 min	No. of plots
Tyrannidae	Great Crested Flycatcher	4	4	2	4.0	4.0	2.0	1	0	0	0	0.0	0.0	0.0	0	0	0	0	0.0	0.0	0.0	0
	Alder Flycatcher	6	0	2	6.0	0.0	2.0	1	0	0	0	0.0	0.0	0.0	0	0	0	0	0.0	0.0	0.0	0
	Least Flycatcher	0	0	0	0.0	0.0	0.0	0	0	0	0	0.0	0.0	0.0	0	0	0	0	0.0	0.0	0.0	0
Troglodytidae	Winter Wren	6	2	2	3.0	1.0	1.0	2	6	4	0	3.0	2.0	0.0	2	0	2	0	0.0	2.0	0.0	1
Turdidae	Hermit Thrush	32	8	8	8.0	2.0	2.0	4	10	2	7	3.3	0.7	2.3	3	6	2	0	2.0	0.7	0.0	3
	Swainson's Thrush	3	6	1	1.5	3.0	0.5	2	5	1	3	1.7	0.3	1.0	3	2	0	0	1.0	0.0	0.0	2
	Veery	6	0	0	3.0	0.0	0.0	2	4	2	0	4.0	2.0	0.0	1	0	0	0	0.0	0.0	0.0	0
Sylviidae	Golden-crowned Kinglet	2	2	2	2.0	2.0	2.0	1	0	0	0	0.0	0.0	0.0	0	0	0	0	0.0	0.0	0.0	0
	Ruby-crowned Kinglet	0	0	2	0.0	0.0	2.0	1	0	0	0	0.0	0.0	0.0	0	0	0	0	0.0	0.0	0.0	0
Vireonidae	Solitary Vireo	0	4	0	0.0	4.0	0.0	1	0	2	2	0.0	1.0	1.0	2	0	0	0	0.0	0.0	0.0	0
	Red-eyed Vireo	14	4	6	7.0	2.0	3.0	2	10	4	4	3.3	1.3	1.3	3	4	4	0	1.3	1.3	0.0	3
	Philadelphia Vireo	4	6	4	1.3	2.0	1.3	3	4	0	0	4.0	0.0	0.0	1	0	2	0	0.0	2.0	0.0	1
Parulidae	Black-and-white Warbler	10	0	4	5.0	0.0	2.0	2	4	0	0	4.0	0.0	0.0	1	2	0	0	2.0	0.0	0.0	1
	Tennessee Warbler	0	0	0	0.0	0.0	0.0	0	0	0	0	0.0	0.0	0.0	0	0	0	0	0.0	0.0	0.0	0
	Nashville Warbler	12	6	5	4.0	2.0	1.7	3	10	6	2	5.0	3.0	1.0	2	4	0	2	2.0	0.0	1.0	2
	Parula Warbler	0	0	0	0.0	0.0	0.0	0	0	0	0	0.0	0.0	0.0	0	0	0	0	0.0	0.0	0.0	0
	Yellow-rumped Warbler	4	2	0	2.0	1.0	0.0	2	0	0	0	0.0	0.0	0.0	0	2	0	0	2.0	0.0	0.0	1
	Black-throated Green Warbler	6	6	0	3.0	3.0	0.0	2	4	2	4	2.0	1.0	2.0	2	0	0	0	0.0	0.0	0.0	0
	Blackburnian Warbler	5	0	4	2.5	0.0	2.0	2	2	2	4	2.0	2.0	4.0	1	0	0	0	0.0	0.0	0.0	0
	Chestnut-sided Warbler	32	8	6	10.7	2.7	2.0	3	8	4	0	4.0	2.0	0.0	2	0	6	0	0.0	3.0	0.0	2
	Ovenbird	22	2	6	7.3	0.7	2.0	3	12	0	6	4.0	0.0	2.0	3	0	6	0	0.0	3.0	0.0	2
	Canada Warbler	12	4	0	6.0	2.0	0.0	2	0	0	0	0.0	0.0	0.0	0	0	0	0	0.0	0.0	0.0	0
	American Redstart	4	4	5	2.0	2.0	2.5	2	0	2	0	0.0	2.0	0.0	1	0	0	0	0.0	0.0	0.0	0
Fringillidae	Rose-breasted Grosbeak	6	2	6	2.0	0.7	2.0	3	6	0	0	3.0	0.0	0.0	2	0	0	0	0.0	0.0	0.0	0
	Purple Finch	2	0	0	2.0	0.0	0.0	1	0	0	0	0.0	0.0	0.0	0	0	0	0	0.0	0.0	0.0	0
	Chipping Sparrow	0	0	0	0.0	0.0	0.0	0	0	0	0	0.0	0.0	0.0	0	0	0	0	0.0	0.0	0.0	0
	White-throated Sparrow	34	16	10	8.5	4.0	2.5	4	21	16	4	5.3	4.0	1.0	4	14	2	6	7.0	1.0	3.0	2
Totals		226	86	75	90.8	38.1	32.5		106	47	36	48.6	21.3	15.6		34	24	8	17.3	13.0	4.0	

Table 7. (Continued)

Family	Species	22 July							28 July							5 August						
		Total Birds			Average Birds				Total Birds			Average Birds				Total Birds			Average Birds			
		5 min	10 min	15 min	5 min	10 min	15 min	No. of plots	5 min	10 min	15 min	5 min	10 min	15 min	No. of plots	5 min	10 min	15 min	5 min	10 min	15 min	No. of plots
Tyrannidae	Great Crested Flycatcher	0	0	2	0.0	0.0	2.0	1	0	0	0	0.0	0.0	0.0	0	0	0	0	0.0	0.0	0.0	0
	Alder Flycatcher	0	0	2	0.0	0.0	2.0	1	0	0	0	0.0	0.0	0.0	0	0	0	0	0.0	0.0	0.0	0
	Least Flycatcher	0	0	0	0.0	0.0	0.0	0	0	0	0	0.0	0.0	0.0	0	0	0	0	0.0	0.0	0.0	0
Troglodytidae	Winter Wren	4	0	2	4.0	0.0	2.0	1	0	0	0	0.0	0.0	0.0	0	0	1	0	0.0	1.0	0.0	1
Turdidae	Hermit Thrush	20	2	4	10.0	1.0	2.0	2	8	0	0	8.0	0.0	0.0	1	0	1	0	0.0	1.0	0.0	1
	Swainson's Thrush	5	3	3	1.7	1.0	1.0	3	0	0	0	0.0	0.0	0.0	0	1	0	0	1.0	0.0	0.0	1
	Veery	0	0	0	0.0	0.0	0.0	0	0	2	1	0.0	1.0	0.5	2	0	0	0	0.0	0.0	0.0	0
Sylviidae	Golden-crowned Kinglet	0	0	0	0.0	0.0	0.0	0	0	0	0	0.0	0.0	0.0	0	0	0	0	0.0	0.0	0.0	0
	Ruby-crowned Kinglet	2	0	0	2.0	0.0	0.0	1	0	0	0	0.0	0.0	0.0	0	0	0	0	0.0	0.0	0.0	0
Vireonidae	Solitary Vireo	0	0	0	0.0	0.0	0.0	0	0	0	0	0.0	0.0	0.0	0	2	0	2	2.0	0.0	2.0	1
	Red-eyed Vireo	21	6	6	5.3	1.5	1.5	4	18	2	0	4.5	0.5	0.0	4	0	4	2	0.0	2.0	1.0	2
	Philadelphia Vireo	2	0	0	2.0	0.0	0.0	1	0	0	0	0.0	0.0	0.0	0	0	2	0	0.0	2.0	0.0	1
Parulidae	Black-and-white Warbler	0	0	2	0.0	0.0	2.0	1	0	0	0	0.0	0.0	0.0	0	1	0	0	1.0	0.0	0.0	1
	Tennessee Warbler	0	0	0	0.0	0.0	0.0	0	0	0	0	0.0	0.0	0.0	0	0	0	0	0.0	0.0	0.0	0
	Nashville Warbler	6	0	4	2.0	0.0	1.3	3	0	0	0	0.0	0.0	0.0	0	0	0	0	0.0	0.0	0.0	0
	Parula Warbler	0	0	0	0.0	0.0	0.0	0	0	0	0	0.0	0.0	0.0	0	0	0	0	0.0	0.0	0.0	0
	Yellow-rumped Warbler	0	0	0	0.0	0.0	0.0	0	0	0	0	0.0	0.0	0.0	0	0	0	0	0.0	0.0	0.0	0
	Black-throated Green Warbler	4	2	2	4.0	2.0	2.0	1	0	0	2	0.0	0.0	2.0	1	0	0	0	0.0	0.0	0.0	0
	Blackburnian Warbler	0	0	0	0.0	0.0	0.0	0	0	0	0	0.0	0.0	0.0	0	0	0	0	0.0	0.0	0.0	0
	Chestnut-sided Warbler	4	2	2	2.0	1.0	1.0	2	0	2	0	0.0	2.0	0.0	1	2	0	1	1.0	0.0	0.5	2
	Ovenbird	6	6	6	2.0	2.0	2.0	3	0	0	1	0.0	0.0	1.0	1	0	0	1	0.0	0.0	1.0	1
	Canada Warbler	0	0	0	0.0	0.0	0.0	0	0	0	0	0.0	0.0	0.0	0	0	0	0	0.0	0.0	0.0	0
	American Redstart	0	0	0	0.0	0.0	0.0	0	1	0	0	1.0	0.0	0.0	1	0	0	0	0.0	0.0	0.0	0
Fringillidae	Rose-breasted Grosbeak	2	1	3	0.7	0.3	1.0	3	2	2	0	1.0	1.0	0.0	2	0	2	2	0.0	2.0	2.0	1
	Purple Finch	0	0	0	0.0	0.0	0.0	0	0	0	0	0.0	0.0	0.0	0	0	0	0	0.0	0.0	0.0	0
	Chipping Sparrow	2	2	0	2.0	2.0	0.0	1	0	0	0	0.0	0.0	0.0	0	0	0	0	0.0	0.0	0.0	0
	White-throated Sparrow	22	8	7	5.5	2.0	1.8	4	2	4	0	2.0	4.0	0.0	1	4	2	2	1.3	0.7	0.7	3
Totals		100	32	45	43.2	12.8	21.6		31	12	4	16.5	8.5	3.5		10	11	10	6.3	7.7	7.2	

Table 7. (Concluded)

Family	Species	11 August							18 August							25 August						
		Total Birds			Average Birds				Total Birds			Average Birds				Total Birds			Average Birds			
		5 min	10 min	15 min	5 min	10 min	15 min	No. of plots	5 min	10 min	15 min	5 min	10 min	15 min	No. of plots	5 min	10 min	15 min	5 min	10 min	15 min	No. of plots
Tyrannidae	Great Crested Flycatcher	0	0	0	0.0	0.0	0.0	0	0	0	0	0.0	0.0	0.0	0	0	0	0	0.0	0.0	0.0	0
	Alder Flycatcher	0	0	0	0.0	0.0	0.0	0	0	0	0	0.0	0.0	0.0	0	0	1	0	0.0	1.0	0.0	1
	Least Flycatcher	0	2	0	0.0	2.0	0.0	1	0	0	0	0.0	0.0	0.0	0	0	0	0	0.0	0.0	0.0	0
Troglodytidae	Winter Wren	0	0	0	0.0	0.0	0.0	0	0	0	0	0.0	0.0	0.0	0	0	2	0	0.0	2.0	0.0	1
Turdidae	Hermit Thrush	0	0	0	0.0	0.0	0.0	0	0	0	0	0.0	0.0	0.0	0	0	0	1	0.0	0.0	1.0	1
	Swainson's Thrush	0	0	0	0.0	0.0	0.0	0	0	0	0	0.0	0.0	0.0	0	0	0	0	0.0	0.0	0.0	0
	Veery	0	0	0	0.0	0.0	0.0	0	0	0	0	0.0	0.0	0.0	0	0	0	0	0.0	0.0	0.0	0
Sylvilidae	Golden-crowned Kinglet	4	0	0	2.0	0.0	0.0	2	0	0	0	0.0	0.0	0.0	0	0	0	1	0.0	0.0	1.0	1
	Ruby-crowned Kinglet	0	0	0	0.0	0.0	0.0	0	0	0	0	0.0	0.0	0.0	0	0	0	0	0.0	0.0	0.0	0
Vireonidae	Solitary Vireo	0	0	0	0.0	0.0	0.0	0	0	0	0	0.0	0.0	0.0	0	0	0	0	0.0	0.0	0.0	0
	Red-eyed Vireo	12	2	2	4.0	0.7	0.7	3	28	10	6	7.0	2.5	1.5	4	16	2	2	4.0	0.5	0.5	4
	Philadelphia Vireo	4	0	0	4.0	0.0	0.0	1	2	0	4	1.0	0.0	2.0	2	4	0	0	4.0	0.0	0.0	1
Parulidae	Black-and-white Warbler	0	0	0	0.0	0.0	0.0	0	0	0	0	0.0	0.0	0.0	0	2	0	1	2.0	0.0	1.0	1
	Tennessee Warbler	2	0	0	2.0	0.0	0.0	1	0	0	0	0.0	0.0	0.0	0	0	3	2	0.0	1.5	1.0	2
	Nashville Warbler	0	0	0	0.0	0.0	0.0	0	0	0	0	0.0	0.0	0.0	0	1	1	2	0.5	0.5	1.0	2
	Parula Warbler	0	0	0	0.0	0.0	0.0	0	0	0	0	0.0	0.0	0.0	0	0	0	0	0.0	0.0	0.0	0
	Yellow-rumped Warbler	0	0	0	0.0	0.0	0.0	0	0	0	0	0.0	0.0	0.0	0	0	0	0	0.0	0.0	0.0	0
	Black-throated Green Warbler	6	0	2	3.0	0.0	1.0	2	2	0	0	2.0	0.0	0.0	1	0	2	0	0.0	2.0	0.0	1
	Blackburnian Warbler	0	0	0	0.0	0.0	0.0	0	0	0	0	0.0	0.0	0.0	0	0	0	0	0.0	0.0	0.0	0
	Chestnut-sided Warbler	2	0	0	2.0	0.0	0.0	1	0	2	0	0.0	2.0	0.0	1	4	2	1	2.0	1.0	0.5	2
	Ovenbird	1	0	0	1.0	0.0	0.0	1	0	0	0	0.0	0.0	0.0	0	0	3	0	0.0	3.0	0.0	1
	Canada Warbler	2	4	0	2.0	4.0	0.0	1	8	4	0	8.0	4.0	0.0	1	6	2	0	3.0	1.0	0.0	2
	American Redstart	3	0	0	1.0	0.0	0.0	3	0	0	0	0.0	0.0	0.0	0	2	1	3	1.0	0.5	1.5	2
Fringillidae	Rose-breasted Grosbeak	0	0	0	0.0	0.0	0.0	0	2	0	0	2.0	0.0	0.0	1	6	0	0	6.0	0.0	0.0	1
	Purple Finch	0	0	0	0.0	0.0	0.0	0	0	0	0	0.0	0.0	0.0	0	0	0	0	0.0	0.0	0.0	0
	Chipping Sparrow	0	0	0	0.0	0.0	0.0	0	0	0	0	0.0	0.0	0.0	0	0	0	1	0.0	0.0	1.0	1
	White-throated Sparrow	4	0	3	2.0	0.0	1.5	2	3	2	4	1.5	1.0	2.0	2	13	10	4	4.3	3.3	1.3	3
Totals		40	8	7	23.0	6.7	3.2		45	18	14	21.5	9.5	5.5		54	29	18	26.8	16.3	9.8	

AQUATIC STUDIES

Collections of stream benthos from Icewater Creek and its two major headwater tributaries were continued throughout 1982. Sampling was initiated in early May and subsequent collections were made at monthly intervals to the end of the year. Two types of artificial substrates were used for collecting benthic invertebrates; a multiple-plate sampler consisting of 8 cm x 8 cm hardboard plates mounted on a threaded rod and attached to a brick, and a sampler consisting of 0.5 kg of gravel (12-24 mm screen size) wrapped in 4 mm x 4 mm aperture seine netting. All collected invertebrates were hand sorted from the substrates and preserved in 70% methanol for subsequent identification.

Taxanomic keys developed for Icewater Creek have been completed, and the identification of most aquatic invertebrates to genus, and in some cases to species, is currently underway beginning with the 1980 benthos samples. The benthic invertebrate identification will assist in determining spatial and temporal changes in bottom fauna composition and density within the watershed. Although none of these data have been analyzed and the identification of benthos has to date been limited to the 1980 samples, preliminary observations have indicated that the more recently employed artificial substrates produced greater numbers and less variance of benthic invertebrates than did Surber samples. An example of the taxonomic composition of Surber samples obtained from a station on Icewater Creek in 1980 is presented in Table 8.

Adult aquatic insects were collected during the summer and fall of 1982 from a 1.5 x 4.6 x 1.8 m emergence tent erected over a portion of stream near the lower end of the watershed, and at random from the stream bank and adjacent foliage. Adult mayflies, stoneflies, dragonflies, caddisflies and craneflies were dried, pinned, and stored for subsequent identification.

To augment the assessment of resident brook trout initiated in 1981, a fish collection weir was reconstructed on the main stream, at the site used in the previous summer, to capture fish migrating up or down stream. Although design and material modifications increased the efficiency of the weir, the trapping success was frustrated by repeated floods damaging or removing the weir. Because of the fluctuating water levels, the trap was operational for only 13 days from 24 August to 25 October, when it was dismantled and removed from the stream. During the 13 days, two sexually mature brook trout were captured moving upstream, measured, and released.

Fish population densities were estimated at three sites on the mainstream and at one site on both of the two major headwater tributaries using a removal method with successive electroshocker sweeps within an enclosed area. All brook trout captured were weighed, measured, adipose fin clipped, and released. Sculpins were also weighed, measured, and released while all other species were identified, counted, and released. Brook trout density estimates were calculated as the number of trout per m^2 of stream obtained in five successive passes (or until no further trout were

captured) with the electroshocker through the sampling site. Table 9 summarizes the results of brook trout population sampling in Icewater Creek in mid-summer and early fall. These data demonstrate an apparent dispersal of brook trout in September within the mainstream portion, into the headwater tributaries, or out of the system entirely. Further assessment is necessary to determine the structure and seasonal migration patterns of the brook trout population.

Table 8.
Benthic invertebrates (mean number and one standard deviation of four samples) collected in Surber samples from Icewater Creek, 1980

	16 July/80	23 July/80	6 Aug/80	20 Aug/80	17 Sept/80	22 Oct/80	28 Nov/80
	Mean ± S.D.	Mean ± S.D.	Mean ± S.D.	Mean ± S.D.	Mean ± S.D.	Mean ± S.D.	Mean ± S.D.
Ephemeroptera (Total)				2.0 ± 2.45	21.33 ± 9.02	0.67 ± 0.58	1.25 ± 2.5
Ephemerella subvaria					1.0 ± 1.73		
Ephemerellidae							0.25 ± 0.50
Heptagonia sp.				1.25 ± 2.5	0.33 ± 0.58		
Heptageniidae				0.75 ± 1.5	0.33 ± 0.58		
Epeorus (Iron) sp.						0.33 ± 0.58	
Rithrogena undulata					19.33 + 12.22	0.33 ± 0.58	1.0 ± 2.0
Stenonema vicarium					0.33 ± 0.58		
Odonata (Total)						0.33 ± 0.58	
Cordulegaster sp.						0.33 ± 0.58	
Plecoptera (Total)	0.25 ± 0.50	0.25 ± 0.50		0.50 ± 0.58	1.0 ± 0.0		2.0 ± 2.0
Chloroperla sp.				0.50 ± 0.58	0.33 ± 0.58		
Isogenus hansoni					0.33 ± 0.58		0.25 ± 0.50
Isoperla sp.							0.75 ± 0.96
Leuctra tenuis	0.25 ± 0.50	0.25 ± 0.50					
Leuctra sp.							0.25 ± 0.50
Paracapnia opis							0.25 ± 0.50
Taeniopteryx sp.					0.33 ± 0.58		0.5 ± 1.0
Trichoptera (Total)			1.00 ± 1.15	8.25 ± 10.21	5.0 ± 7.81	1.33 ± 1.15	0.50 ± 0.58
Glossosoma sp.				1.50 ± 3.0	1.67 ± 2.08	0.33 ± 0.58	0.25 ± 0.50
Hydropsyche betteni			0.50 ± 0.58	5.75 ± 8.50	2.67 ± 4.62	0.33 ± 0.58	
Hydropsyche bifida			0.25 ± 0.50				
Hydroptilidae						0.33 ± 0.58	
Onocosmoecus sp.					0.33 ± 0.58		
Lepidostoma sp.						0.33 ± 0.58	
Polycentropus sp.							0.25 ± 0.50
Rhyacophila manistee			0.25 ± 0.50	1.0 ± 1.41	0.33 ± 0.58		
Diptera (Total)	11.00 ± 8.04	9.50 ± 7.94	11.75 ± 7.63	19.25 ± 21.98	3.0 ± 4.34	24.0 ± 29.44	10.75 ± 11.44
Chironomidae (Larvae)	10.75 ± 8.34	8.25 ± 8.5	11.25 ± 7.93	17.0 ± 20.54	2.33 ± 3.21	23.67 ± 29.74	9.0 ± 10.52
Chironomidae (Pupae)		0.25 ± 0.5					
Heleidae (Larvae)	0.25 ± 0.50			0.75 ± 0.96			0.5 ± 1.0
Simuliidae (Larvae)		1.00 ± 1.15	0.50 ± 0.58	1.0 ± 1.41			0.75 ± 0.5
Tipulidae				0.5 ± 1.0	0.67 ± 1.15	0.33 ± 0.58	0.50 ± 0.58
Oligochaeta	0.25 ± 0.50					2.33 ± 2.08	
Total	11.50 ± 7.51	9.75 ± 7.63	12.75 ± 6.85	30.0 ± 32.32	30.33 ± 5.69	28.67 ± 30.75	14.5 ± 9.71

Table 9. Estimates of density, size of fish caught and frequency of recapture in brook trout population sample areas, Icewater Creek, 1982.

Station	13 to 20 July				8 to 15 September			
	Size of Sample area (m^2)	Actual Catch	Number of trout per 100 m^2	Number of trout marked	Actual catch	Number of trout per 100 M^2	Number of Recaptures	Per cent Recaptures
Mainstream								
0239-0284 m	238.5	17	7.1	15	2	0.8	1	7%
Total Length Mean (Range)		71 mm (49→134)			73 mm (71→75)			
Weight Mean (Range)		5.0 g (1.1→22.4)			4.5 g (4.3→4.7)			
Mainstream								
2418-2463 m	274.5	29	10.6	27	3	1.1	1	4%
Total Length Mean (Range)		64 mm (50→144)			89 mm (83→91)			
Weight Mean (Range)		3.8 g (12→27.8)			5.8 g (4.3→7.1)			
Mainstream								
8375-8425 m	302.7	18	5.9	10	0 (one sweep only because of high water)			
Total Length Mean (Range)		56 mm (40→69)						
Weight Mean (Range)		2.0 g (0.9→3.3)						
East Trib.								
0140-0180 m	205.3	4	1.9	4	13	6.3	1	25%
Total Length Mean (Range)		113 mm (63→199)			93 mm (68→137)			
Weight Mean (Range)		23.9 g (2.7→75.2)			9.3 g (3.0→25.4)			
West Trib.								
0400-0440 m	212.4	15	7.1	15	11	5.2	4	27%
Total Length Mean (Range)		90 mm (50→159)			99 mm (67→135)			
Weight Mean (Range)		11.1 g (1.4→37.5)			10.0 g (3.0→22.0)			

EXPOSURE MEASUREMENT STUDIES

Spray deposits on blossoms

In 1982 FPMI's Spray Kinetics and Physics project initiated a project at the request of the Environmental Impact project to attempt to develop and test methods for measuring deposits of aerial sprays on the floral surfaces of flowers, shrubs and trees. The objective was to develop the capability of evaluating the pesticide exposure potentially encountered by pollinating insects foraging on pollen and nectar sources within treated areas. The important pollinator forage species present in the Icewater Creek research area could then be exposed to simulated aerial pesticide applications and the quantity of spray collected by each could be evaluated and compared.

Studies with both water and oil based sprays containing a variety of colored and fluorescent dyes showed that spray droplets landing on flower tissues were rapidly absorbed without leaving any sort of identifiable stain. Further work using spray formulations containing enough acrylic polymer to cause in-flight encapsulation of spray droplets showed that these spray drops persisted on flower petals for some time and could be counted with a certain degree of accuracy. Droplet counting on the reproductive portions (anthers and stigmas) was extremely difficult and of doubtful accuracy. It was concluded that it may be possible to find simulated spray formulations which will allow quantification of deposits on flowers, but they may not bear much resemblance to field formulations generally used in forest pest control operations and thus not reflect actual field conditions.

Studies contemplated for 1982 studying the movement of tracer dyes within Icewater Creek were not carried out due to last minute commitments to other programs. They will again be planned for 1983.

PLANS FOR 1983

TERRESTRIAL INVERTEBRATE STUDIES

Honeybees

- The honeybee program will be discontinued so that wild pollinator studies can proceed without the competitive influence of introduced domestic pollinators.

Wild Pollinators

- Complete "pollinator-host" baseline studies at the Lower Icewater site.

- Carry out extensive wild pollinator collections to identify the seasonal abundance and host preferences of the more common pollinator species, as well as the pollinator complexes occurring on selected blossom.

- Collect pollens carried by wild pollinators in the field to identify their preferred forage species.

Ground Insects

- Repeat the season long pit-fall trapping program on two ecological sites.

- Contract taxonomic evaluation of ground insect material collected in 1981-83 beyond the current identification to family.

Scavenger insects

- Initiate studies to collect data on the "scavenger insect" complex of the area and to document their seasonal activity patterns.

TERRESTRIAL VERTEBRATE STUDIES

Forest birds

- Conduct a season long bird netting and banding program to document songbird movements into and out of the area, breeding and fledgling phenologies and fledgling growth.

- Initiate studies to follow color banded songbirds in their breeding territories and study their changes in activity over the breeding season.

AQUATIC STUDIES

Aquatic invertebrates

- Complete year 'round assessment of aquatic invertebrate populations at three sites in the Icewater Creek system using two types of artificial substrate sampler.

- Intensify collection of emerging adult aquatic insects and carry out spot sampling required to fill gaps in current distribution and life history data on major aquatic invertebrates present in Icewater Creek.

Fish

- Conduct fish population censuses at selected sites within the Icewater Creek system throughout the open-water season to document trout populations and their movements within and in and out of the system.

Leaf processing in stream

- Initiate year 'round studies on the rate of leaf processing by stream invertebrates at headwater and downstream sites within Icewater Creek.

EXPOSURE MEASUREMENT STUDIES

Spray deposits on blossoms

- Due to the technical difficulties encountered with assessment using simulated sprays, this aspect of the work will be postponed until actual insecticide residues on blossoms can be analyzed during future Phase-3 activities.

Streamwater exposure studies

- Initiate tracer dye movement studies within Icewater Creek designed to simulate movement of pesticides in the system, beginning with point source applications.

TOXICOLOGY STUDIES

Pollinator toxicology

- Initiate laboratory studies to evaluate the toxicology of current forestry pesticides to pollinators. Topical application tests with fenitrothion will be attempted on honeybees, bumble bees and andrenid bees.

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