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INTRODUCTION OF THE PARASITES CAMPOPLEX SPP. INTO NEWFOUNDLAND FOR THE BIOLOGICAL CONTROL OF THE BIRCH CASEBEARER

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ST. JOHN'S, NEWFOUNDLAND
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A.G. RASKE

INTRODUCTION

The birch casebearer (*Coleophora fuscedinella* Zeller[1]) is native to Europe where it attacks primarily birch (*Betula*), alder (*Alnus*), and elm (*Ulmus*). It was accidentally introduced into eastern United States about 1925 (Gillespie, 1932) and has since spread throughout much of northeastern North America. In 1953, it was discovered in southwestern Newfoundland and by 1971 it had spread throughout the Island and has become an important pest of white birch (*Betula papyrifera* Marsh). The most common form of damage is the browning of trees and loss of foliage (Fig. 1) caused by the feeding of late-instar larvae in early summer. This damage tends to become masked, except on severely defoliated trees, by the continuous production of new leaves. In the spring large numbers of early-instar larvae may destroy flushing buds (Fig. 2) causing twig, branch, and sometimes tree mortality.

This insect has not been in Newfoundland long enough to forecast its probable damage to birch stands but because some damage has already occurred and because of the increased interest in birch as a commercial species, studies have been initiated to determine a practical and effective means of controlling this pest. These studies have shown that a number of

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[1](Lepidoptera: Coleophoridae)

insecticides provide excellent control. Three of these, Sevin, Malathion and Cygon, are registered for use against this casebearer in Canada and formulation and timing of application have been published by Clark and Raske (1972). However, chemical treatment is suitable only for protecting ornamental trees. It is not economically feasible or environmentally acceptable to apply insecticides to control this pest in forest areas because birch occurs mainly as a component of softwood stands; pure stands are relatively small and widely distributed.

Studies have also shown that native insect parasites do not reduce casebearer population levels appreciably. Although 19 native species of parasites have been reared from the casebearer in Newfoundland (Appendix I) the total percent parasitism has averaged only about 3 percent. In Europe, on the other hand, there are 25 species of parasites and these destroy about 50% of the casebearer populations in some areas.[2 & 3] Therefore it appeared practical to introduce parasites from Europe in an attempt to achieve control in Newfoundland. In 1968, the Canadian Forestry Service initiated such a program in co-operation with the Commonwealth Institute of Biological Control (C.I.B.C.). The C.I.B.C. has its headquarters in Trinidad and maintains stations throughout the world.

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[2]Pschorn-Walcher, H. 1969. Birch casebearer (Colephora fuscedinella): Work done in Europe in 1969. Ann. Proj. Statement, Comm. Inst. Biol. Contr., Delémont, Switzerland. Unpublished report.

[3]Pschorn-Walcher, H. 1970. Birch casebearer (Coleophora fuscedinella): Work done in Europe in 1970. Ann. Proj. Statement, Comm. Inst. Biol. Contr., Delémont, Switzerland. Unpublished report.

This report summarizes the life history of the birch casebearer in Newfoundland; describes the criteria for choosing parasites for introduction, the life history of candidate parasites, the introduction and release of the parasite Campoplex, the behavior of the parasite, and discusses the results of the release. A glossary of specialized biological control terms is provided in Appendix III.

LIFE HISTORY AND HABITS OF THE BIRCH CASEBEARER IN NEWFOUNDLAND

An understanding of the life history and habits of a pest species is prerequisite to the introduction of a parasite so that any introduced species can be released to coincide with the occurrence of susceptible stages of the pest.

In Newfoundland the birch casebearer has a one-year life cycle. The adults (Fig. 3) emerge in early July and eggs are laid along the midribs on the underside of the leaves. The eggs hatch in August and the young larvae feed by mining the leaves. In September they molt, cut a case from the epidermis of the mined leaf and continue feeding, carrying their case with them (Fig. 4). Prior to leaf fall the larvae crawl to branch crotches, or to the base of leaf buds, to overwinter. About mid-May of the following year the overwintered larvae move to the flushing buds and begin feeding. After a few days they molt and expand their case. They molt again in early June to the fourth and final larval instar and form a larger, cigar-shaped, case (Fig. 5). Feeding continues until mid-June when the larvae pupate. Pupation occurs within the larval case which is attached by silken threads to either birch leaves or twigs, or to ground vegetation.

SELECTION OF PARASITE SPECIES

Criteria for judging parasite species

In Europe, the birch casebearer is attacked by a least 25 species of primary parasitic insects,[2,3 & 4] none of which occur in Newfoundland. Not all of the species were considered suitable for introduction and candidates were evaluated by criteria described as follows: (1) No species was considered as a candidate unless it had parasitized at least 20% of a random sample of casebearers in one locality. (2) The parasite should be abundant under climatic conditions, similar to those of the country proposed for introduction. (3) The life cycle of the parasite should be synchronized with that of its host and the habits of the parasite should be well adapted to those of its host. (4) The parasite should be host specific; absolute host specificity is rare but the parasite with the least number of hosts tends to be most effective. (5) The species that is intrinsically inferior in multi-parasitism should be imported first. Such a parasite will be most effective in the absence of competition from intrinsically superior parasites. (6) The species should be a primary parasite and should not act as a hyperparasite. (7) The parasite should be readily identifiable to species.

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[2] Ibid.

[3] Ibid.

[4] Pschorn-Walcher, H. 1971. Birch casebearer (Coleophora fuscedinella): Work done in Europe in 1971. Ann. Proj. Statement, Comm. Inst. Biol. Cont., Delémont, Switzerland. Unpublished report.

Life history, habits and description of candidates

The C.I.B.C., European Station at Delémont, Switzerland, studied the life histories and habits of eight candidate species belonging to five genera that occur in continental Europe. The detailed distribution of the species is described by Pschorn-Walcher[5] and results of these studies are summarized below.

Apanteles spp. -- These are the most abundant parasites in many European localities. Three species are involved: A. coleophorae, A. corvinus and A. mesoxanthus. The first two are difficult to distinguish from each other in the adult stage, while the third, A. mesoxanthus, can be recognized by its reddish legs. Separation of living adults is difficult; therefore any introduction would probably mean the liberation of all three species.

The females oviposit into the first-instar casebearer larvae and overwinter as young larvae in the host insect. The larvae mature in spring and adults emerge in July. Consequently, their life cycle is reasonably well synchronized with that of the host. They appear to attack only a few host species and they are not hyperparasites. Superparasitism is rare, but multiparasitism between Apanteles and Campoplex species is common, and Campoplex appears to survive more often, i.e. Campoplex is intrinsically superior to Apanteles.

Campoplex spp. -- These are abundant in many climates of central Europe and especially in northern Germany where the climate is similar to that of Newfoundland. Two species are involved; Campoplex borealis, and Campoplex n.sp. (= new species), but it is difficult to distinguish between

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[5]Pschorn-Walcher, 1969, 1970, 1971. Unpublished report.

them. Males cannot be differentiated but in females the ovipositor is slightly longer in Campoplex n.sp. than in C. borealis. Distinguishing characters were found in the egg and larval stages, but these characters can only be compared after dissection of the host insect and therefore are not useful for field identification. Any introduction would doubtless mean the liberation of both species.

The females oviposit only into the first instar casebearer larvae, and overwinter as young larvae in the host insect. The larvae mature in spring and adults emerge in May, June and July. The life cycle of those that emerge in July is well synchronized with that of the host and they are reasonably host specific. In multiparasitism Campoplex is inferior to the chalcid parasites, slightly superior to Apanteles and distinctly superior to Orgilus.

Orgilus punctulator -- This species is the most abundant parasite of the birch casebearer in the dry and warm climate of the Rhine Valley, but is rare or absent in other locations. It occurs in low numbers in the mountains of Austria[2,3] indicating that it can withstand cold winters. Its life cycle is similar to that of Campoplex spp. and Apanteles spp. It emerges in late July and its life cycle is well synchronized with that of its host. It is probably the most host specific of all the parasites considered. Superparasitism is common and in multiparasitism O. punctulator is usually intrinsically inferior to both Campoplex spp. and Apanteles spp.

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[2]Ibid.

[3]Ibid.

Chalcids -- The two species, Chrysocharis nitetis and Cirrospilus pictus, are considered together because of their similar life histories and habits. They are reasonably abundant in many localities, and species recognition is not difficult. They oviposit into the host larvae in fall, and emerge in the following April and May. Both of these species produce several generations for each generation of the host insect. Their life cycle is not well synchronized with that of the host. Multiparasitism is common, and they are intrinsically superior to the other candidate parasites. They are also known to be hyperparasites.

Choice of parasite

Although no one parasite satisfied all the criteria, Campoplex spp. and Apanteles spp. met almost all criteria equally well. Apanteles spp. was slightly preferred by criterion 5 in that it is somewhat inferior to Campoplex spp. However, Campoplex was chosen for introduction because by criterion 3 they were considered to be more host specific. Even though Orgilus punctulator satisfies several criteria better than the other candidates, it was not considered for introduction because it was only common in a warm, dry climate whereas the climate of Newfoundland is cool and moist. The chalcids were not considered because they only satisfy the criterion of being readily identified.

INTRODUCTION AND RELEASE OF CAMPOPLEX

Introduction and Release in 1971

About 30,000 birch casebearer cases were collected from several localities in Europe (Appendix II) in late June of 1971. The cases were shipped by air to the Entomology Research Institute of the Canada Department of Agriculture, Belleville, Ontario, for quarantine and rearing. They were stored at 45°F and incubated at 72°F. Dates of arrival, incubation period and emergence are shown in Appendix II.

Additional cases were collected earlier in the season from the same localities and reared in Europe. The percent parasitism by Campoplex in these samples indicated that from 2,000 to 4,000 parasites should emerge from the 30,000 host cases shipped to Canada, but only 526 adults eventually emerged (Appendix II). A total of 429 Campoplex adults[6] were received at weekly intervals by air from Belleville during the month of August. They arrived in good condition and mortality was negligible (Table 1).

An area near Cormack (49°21'18" North, 57°19'41" West and about 400 feet elevation), in western Newfoundland, was selected as a release site. The area burned over in 1948 and has since regenerated to birch, white spruce (Picea glauca (Moench) Voss) and black spruce (Picea mariana (Mill) B.S.P.). The stand is open-grown and the birch trees ranged from 7 feet to 20 feet in height (Fig. 6).

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[6]The remaining 97 parasites either died in Belleville or emerged too late to be included in the last shipment to Newfoundland.

Table 1.- Number of Campoplex adults received and released in Newfoundland.

Date shipped from Belleville	Date arr. in Nfld.	Date released	Time of release	Temp. (% R.H.) at time of release	No. received				Number released		Cage No.	No. of dead parasites recovered from cage
					Living			Dead				
					♂	♀	Total		♂	♀		
1971 - Released near Cormack												
Aug. 4	Aug. 5	Aug. 6	10:30a.m.	62(65)	128	71	199	20	48	71	4	5
									80	39	5	24
Aug. 10	Aug. 12	Aug. 12	10:30a.m.	72(75)	26	23	49	4	26	23	6	20
Aug. 17	Aug. 19	Aug. 20	11:30a.m.	52(93)	25	43	68	7	25	43	3	7
Aug. 26	Aug. 27	Aug. 28	11:00a.m.	62(70)	36	42	78	4	18	21	2	0
									18	21	1	0
Total					215	179	394	35	215	179		56
1972 - Released near Badger												
Aug. 14	Aug. 15	Aug. 16	10:00a.m.	45(-)	31	26	57	0	31	26	-	2

On arrival in August the parasites were released into cages that had been placed over six, 7-foot high white birch trees. Casebearer eggs averaged about three per leaf on these trees and it was considered that enough larvae would survive to support the parasites. The cages (Fig. 6) were 4 x 4 x 8 feet in size, with a 3/8 inch plywood top, and the sides were screened with 26-strands-per-inch nylon. Clear plastic sheeting, 6-mil in thickness, was stapled to the inside bottom frame of the cage to prevent the parasites from escaping.

A total of 394 living Campoplex spp. (215 males and 179 females) were released into the cages (Fig. 7) in August at weekly intervals (Table I). When the first release was made, most casebearers were in the egg stage; only about 1% of the casebearers were in the parasite-susceptible first-instar larval stage. When the last release was made hatching was completed, about 90% of the casebearers were in the first instar and the remaining 10% were in the second instar, and not susceptible to parasitism (Fig. 10). A total of 22 Campoplex females were found dead in the cages. Of these 15 were identified by the Entomological Research Institute in Ottawa as Campoplex n.sp. and seven as Campoplex borealis. Of the 7 Campoplex borealis, 2 were dead on arrival and 5 were recovered from the cage floor within the first week after release.

Introduction and Release in 1972

The C.I.B.C. collected about 25,000 host cases in north and northwest Germany in late June of 1972[7]. These were shipped to Belleville and reared as in 1971. A few Campoplex emerged in July but not enough

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[7]Pschorn-Walcher, H. 1972. In Quarterly Progress Rep., No. 2, Comm. Inst. Biol. Contr., Delémont, Switzerland. Unpublished report.

for release. They were later identified as Campoplex borealis (J.S. Kelleher, personal communication). In early August, 57 additional Campoplex emerged, and these were shipped to Newfoundland and released at a site located 8 miles southwest of Badger (48°53'32" North, 56°11'31" West) in central Newfoundland. The area had been cut over and contained young, open-grown, balsam fir (Abies balsamea (L.) Mill.) and white birch. Casebearer population levels were not determined but defoliation was estimated as moderate.

The parasites were released onto a caged tree on August 16. About 5% of the casebearers had hatched and were in the first instar (Fig. 10). After 1 week the cage was opened and the parasites liberated.

BEHAVIOR OF CAGED CAMPOPLEX

When released, most of the female parasites flew directly to the sides of the cages but a few searched leaves of white birch immediately for host insects (Fig. 8). During warm sunny weather, most females were active on the foliage, but during cool, cloudy weather, they were inactive and perched on the sides of the cage or on the tree. Males were commonly observed on the screen, regardless of the weather. Mating was observed in all cages and usually occurred within 30 minutes following release. Only one mating, out of a total of about 25 observed, occurred after the first day of release. Egg laying occurred on warm, sunny days throughout the month of August. Females were observed inserting their ovipositors into leaf areas containing first-instar casebearer larvae, but they also probed other irregularities within the leaf surface. Living males and females were observed in every cage until September 8. When the cages were next examined on September 22, no living adults were found.

SURVIVAL OF PROGENY

A total of 737 late instar larvae and pupae of the casebearer were collected in late June 1972 from the six caged trees on which the parasites were released in 1971. These were reared in the laboratory at approximately 70°F and 70% R.H. A total of 107 Campoplex parasites (50 females and 57 males) emerged from the rearings. Percent parasitism, based on the number of female parasites released per cage, was much higher (0.66 to 1.31) in those parasites released in early August than for those (0.03 to 0.21) released in late August (Table II). All female parasites were identified as Campoplex n.sp. at the Entomological Research Institute, Ottawa.

In July 1972 the six cages containing the overwintered birch casebearer larvae were examined at 3-day intervals to check for the emergence of Campoplex parasites; progeny of those released in 1971. The first Campoplex parasite was seen on July 27 and two were seen on August 7. The numbers seen in the cages increased until August 16 when the total for the six cages was 150 parasites. The peak emergence period for the parasites was between August 10 and August 16. On August 23 the cages were opened and the parasites liberated. Birch casebearer egg numbers averaged 16 per leaf in the infested birch stand where the parasites were liberated.

During the winter of 1971-72 a low temperature of -29°F was recorded on one occasion and as low as -27°F on three other occasions at Deer Lake near the release area. Furthermore, a below freezing temperature of 30°F was recorded on July 19 (Anon. 1972). Such low temperatures occur periodically in parts of Newfoundland but are not common in many areas of the Island. The survival of the parasites at these temperatures indicates that Campoplex will survive the Newfoundland climatic conditions.

Table II.- Percent parasitism, by Campoplex spp., of reared birch casebearer larvae.

Parasite release date (1971)	No. females released in cage (1971)	No. host larvae in 1972 sample	Percent of host parasitized in sample	Percent parasitism per female parasite in sample
Aug. 6	32	69	42.0	1.31
Aug. 6	39	204	25.5	0.66
Aug. 12	23	48	22.9	0.99
Aug. 20	43	130	9.2	0.21
Aug. 28	21	133	0.7	0.03
Aug. 28	21	153	3.3	0.16
Total	179	737		

SUMMARY AND CONCLUSIONS

Biological control with exotic parasites appeared to be a practical method for the control of the accidentally introduced birch casebearer. The life history and habits of eight European species of parasites of this casebearer were studied in their native environment. Of these, Campoplex spp. were chosen to be introduced into Newfoundland. A total of 394 adults were released onto six caged trees near Cormack in 1971 and progeny recovered. All progeny recovered have been identified as Campoplex n.sp. indicating that it has become established on the Island but that C. borealis has not survived. Campoplex n.sp. emerges in August in Newfoundland at the same time that the susceptible stage of the host occurs.

It emerges in July in Europe but development in Newfoundland is about 1 month longer and well synchronized to attack the susceptible stage of the host. July is also the emergence time in Europe for other possible parasite candidates such as Apanteles species. Presumably these would also emerge a month later in Newfoundland and consequently be just as well synchronized for parasitizing the casebearer as is Campoplex.

There has been no attempt made to evaluate the effectiveness of Campoplex in the control of the birch casebearer in Newfoundland. It is expected that reliable estimates of its value cannot be obtained for several years as most introduced parasites require considerable time to disperse and increase in numbers.

ACKNOWLEDGEMENTS

I wish to thank J.S. Kelleher, Belleville, Ontario, for furnishing the data for Appendix II, J.R. Barron, Entomology Research Institute, Ottawa, Ontario, for identifying Campoplex spp.

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Gillespie, A.M., 1932. The Birch Casebearer in Maine. Maine Forest Service, Bull. 7, 23 pp.

APPENDIX I

Parasites of the birch casebearer, Coleophora fuscedinella, reared in Newfoundland.

Parasites	Number of adults reared
Amblymerus sp.	5
Cirrospilus cinctithorax!	1
Copidosoma sp.	1
Diadegma sp.	1
Earinus zeirapherae	1
Gelis tenellus	11
Habrocytus phycidis	3
Habrocytus semotus	8
Habrocytus sp.	4
Itoplectus quadricingulata	9
Mesopolobus sp.	2
Oncophanes americanus	1
Orgilus coleophorae	53
Pnigalio flavipes	1
Pnigalio proximus	1
Pnigalio sp. tischeriae group	1
Pnigalio sp.	2
Scambus decorus	3
Torymus sp.	1

APPENDIX II

Shipments of host insects received at Belleville and Campoplex reared in 1971.[1]

Source of host cases	No. of host cases[2]	Date received[3]	Date incubated[4]	No. of host emerged	No. of Campoplex emerged	No. of other parasites emerged	Campoplex spp. emergence dates
Styria, Austria	685	June 25	July 9	238	67	29	July 21 to Aug. 20
Meppen, Germany	10,000	June 25	July 9	2,287	45	264	July 15 to Aug. 6
Knorburg, Germany	11,500	June 30	July 20	4,583	386	214	July 16 to Sept. 8
Bredstedt, Germany	8,500	July 5	July 9	5,807	28	97	July 15 to Aug. 26
Total	30,685			12,915	526	604	

[1]Information supplied by J.S. Kelleher, Canada Dept. of Agriculture, Belleville, Ontario.

[2]Samples of 300 cases from Meppen, and 1000 cases each from Knorburg and Bredstedt removed previous for test incubation.

[3]Stored at 45°F.

[4]Incubated at 72°F.

APPENDIX III

Glossary

Hyperparasite - an organism parasitic upon another parasite.

Intrinsically inferior parasite - parasite that cannot survive in competition with a parasite of a different species when both are in the same host at the same time.

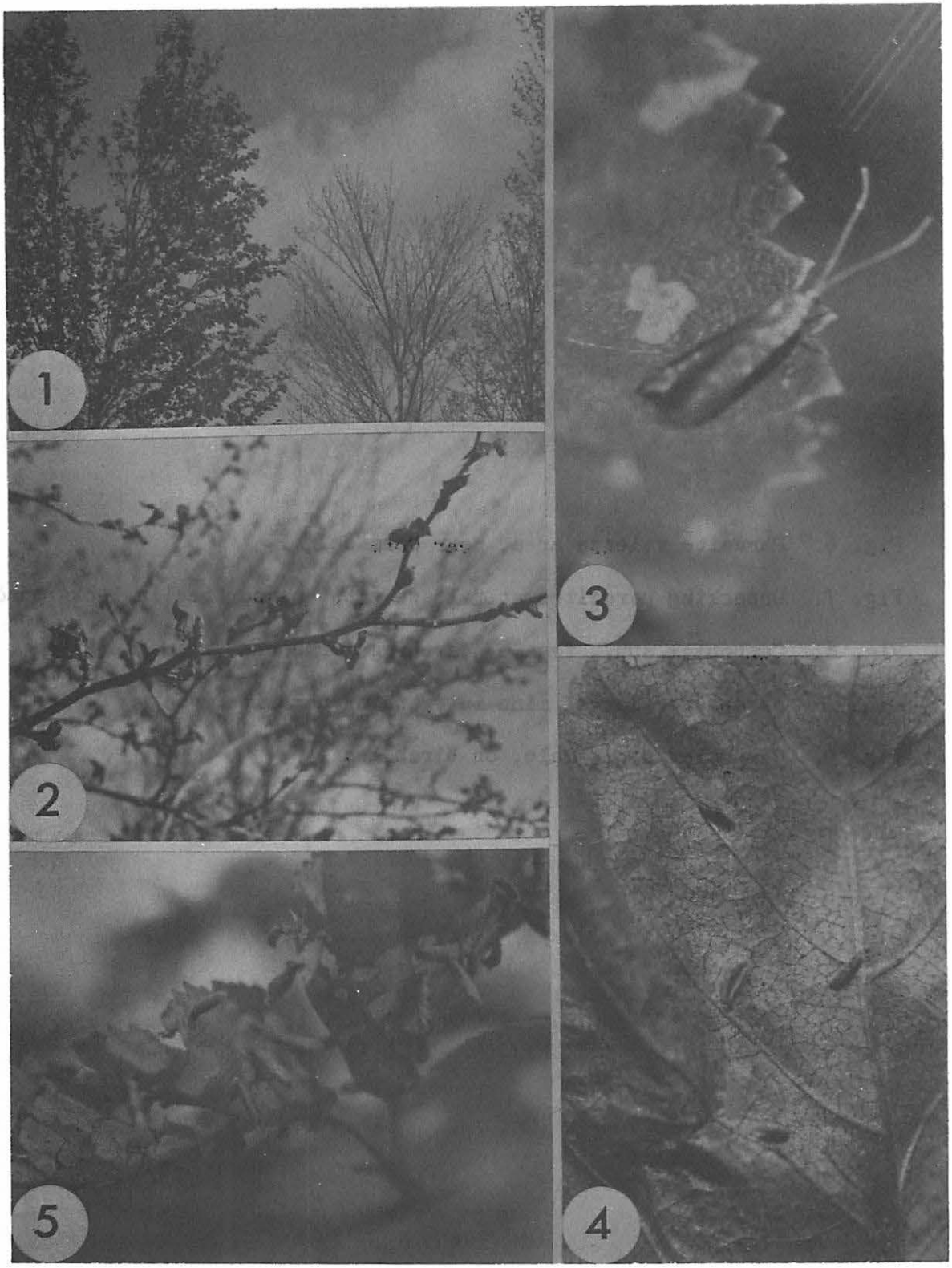
Intrinsically superior parasite - parasite that survives in competition with a parasite of a different species when both are in the same host at the same time.

Multiparasitism - simultaneous parasitism of an organism by two or more parasites of different species.

Polyphagus parasite - one parasite species which attacks more than one species of host.

Primary parasite - a parasite that establishes itself on or in a host that is not a parasite.

Superparasitism - simultaneous parasitism of an organism by two or more individuals of the same species.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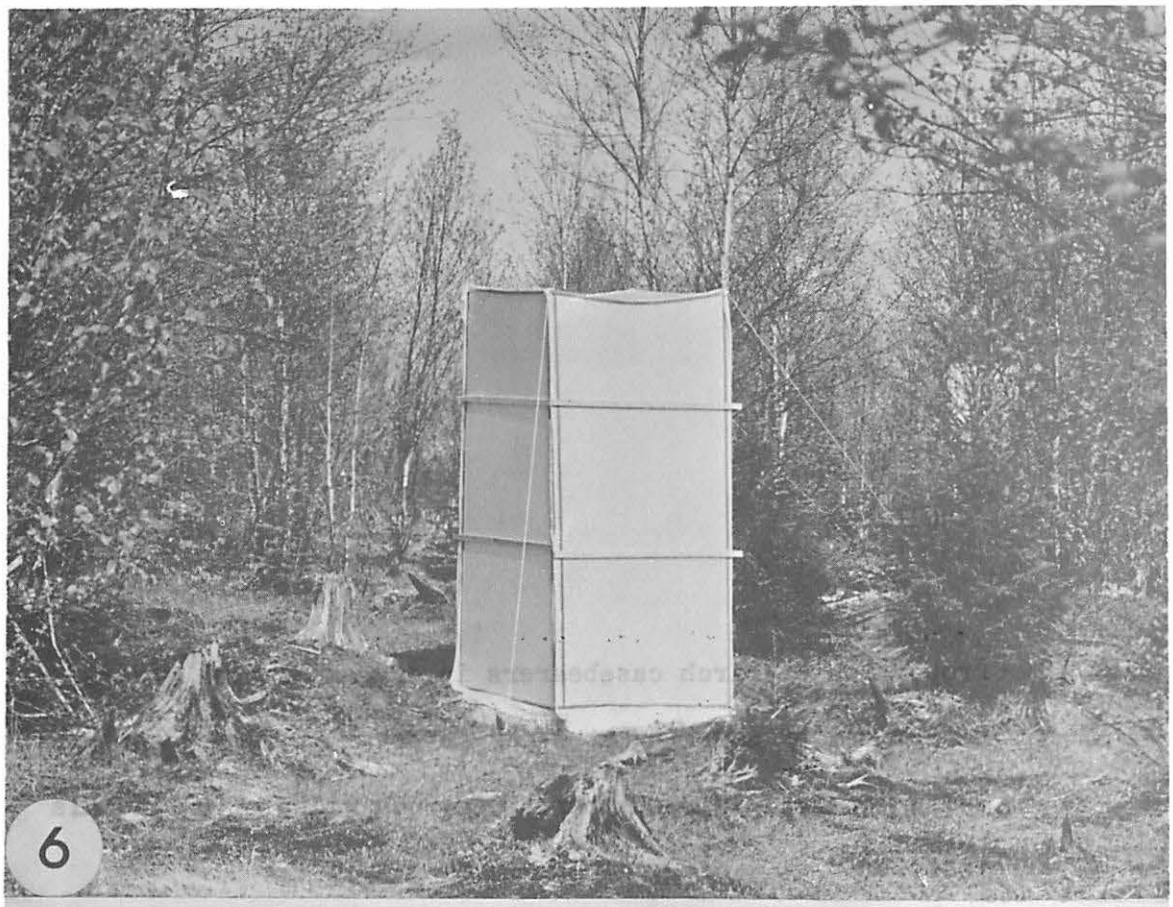

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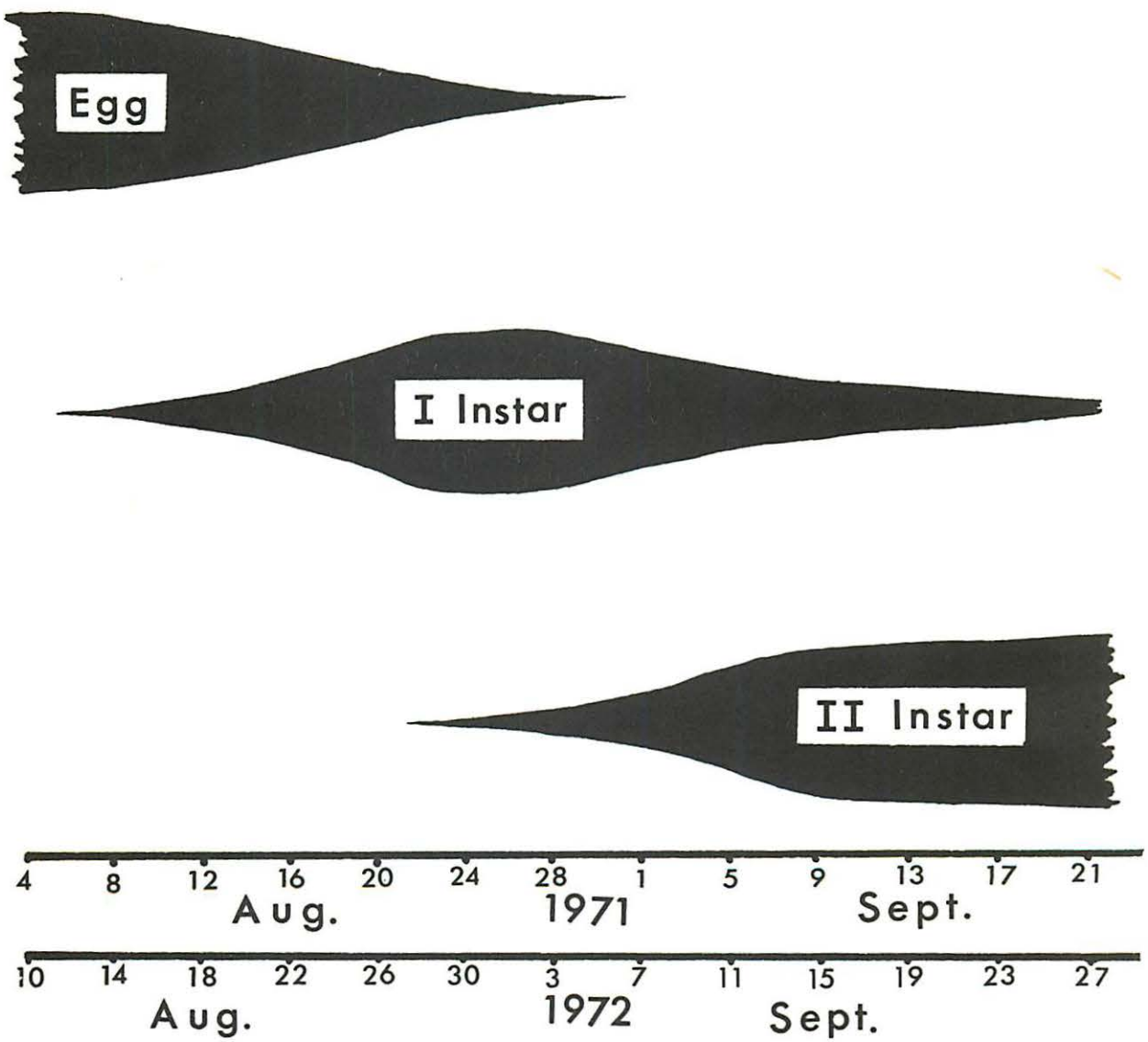
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