

N°572

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**INTRODUCTION OF A PREDACIOUS RED WOOD ANT,
FORMICA LUGUBRIS (HYMENOPTERA: FORMICIDAE),
 FROM ITALY TO EASTERN CANADA**

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Abstract

Can. Ent. 107: 1271-1274 (1975)

A brief history of the importance attributed to red wood ants in Europe and the outstanding qualities of three species, *Formica lugubris* Zett., *F. polyctena* (Foerst.), and *F. aquilonia* Yarr., are presented. The reasons for choosing *F. lugubris* as a suitable species for introduction to Canada are given. The collecting in Italy, shipping by air to Canada, and eventual release in Quebec is discussed. In conclusion it is stated that the establishment and acclimatization of this species in Quebec was successful, and that increased reproduction and spread is anticipated.

Résumé

On présente un bref rappel historique de l'importance des fourmis des bois d'Europe et les qualités remarquables de trois espèces particulières, *Formica lugubris* Zett., *F. polyctena* (Foerst.) et *F. aquilonia* Yarr. On explique le choix de *F. lugubris* pour son introduction au Canada. Sa récolte en Italie, son transport aérien jusqu'au Canada et son relâchement au Québec sont décrits. En conclusion, on affirme le succès de l'établissement et de l'acclimatation de cette espèce au Québec, de même qu'on anticipe une reproduction et une dispersion accrue.

The role predacious red wood ants play in regulating populations of defoliating insects in European forests has been under observation for many years. Gosswald (1951) reported that as many as 175 years ago recommendations were made in Germany to encourage the use and multiplication of ant nests as desirable measures against forest pests. Throughout the 19th century considerable attention was given to red wood ants, as witnessed by publications of such prominent entomologists as Sponeck, Ratzeburg, Forel, Altum, and Hess (Gosswald 1951). However, it is during the past 50 years that the greatest interest has been shown and most of the research work done both in central Europe and Russia (Cotti 1963).

Some of the investigations carried out during the first half of the present century were severely criticized by both entomologists and foresters, due largely to the lack of a proper classification of the species involved. With the present improved understanding of the *Formica rufa* L. group, it is becoming more and more evident that some species are effective predators, and should be considered as desirable components of the forest, while other species are less important. The confusion that existed between field and wood ants, between foraging and aphid-tending ants, and between aggressive and timid ants has been greatly clarified.

Red Wood Ants in Europe

Out of the eight species reported by Betrem (1960) and Yarrow (1955), three (*F. polyctena* (Foerst.), *F. lugubris* Zett., and *F. aquilonia* Yarr.) are considered as outstanding predators capable of destroying large quantities of insects at times of infestation, and thereby, aid in maintaining forest insect populations in equilibrium (Gosswald 1951; Pavan 1959). A fourth species, *F. rufa* L., is also an outstanding predator, but it is monogynous, does not develop colonial nests, and usually will not tolerate other species of the *F. rufa* group.

F. polyctena has received much attention (Cotti 1963), due mostly to its outstanding aggressivity, its ability to develop large colonial populations and to forage over extensive areas. Its wide and uniform distribution from the Alps to the North and Baltic Sea has stimulated considerable interest among German entomologists.

F. lugubris is also aggressive (Fig. 1a), forms colonies of large nests (Fig. 1b), and maintains extensive foraging areas. This species has been studied in Italy by Pavan,

Ronchetti, and Pepe (Cotti 1963), and has been successfully transplanted in large numbers by Pavan (1950, 1960), and Pavan and Ronchetti (1972), from northern Italy to the Apennines as far south as Calabria, and to the island of Sardinia. In the Alps this species, preferring a more humid climate, is found at higher elevations, and in a wider range of forest sites than *F. polycтена*. In other parts of Europe, distribution of *F. lugubris* is discontinuous, with apparently isolated populations occurring in the British Isles, the Pyrenees, and the Scandinavian peninsula.

F. aquilonia is closely related to *F. lugubris* both in form and habits, and in some areas the two species are not easily distinguishable. This species has not been studied as extensively as *F. polycтена* and *F. lugubris*, but its distribution and bionomics are well known.

These three species are considered desirable predators because they possess the following qualities: they are facultative predators capable of attacking the active and quiescent stages of a wide variety of prey; colonies may consist of many nests; when prey are scarce the ants can revert to aphid honey-dew as a food source; predation may occur during the day and night in all areas of the flora strata throughout the growing season.

Selection of Formica lugubris Zett.

Owing to the absence in Canada of suitable, aggressive, predacious species of red wood ants (Finnegan 1971, 1974), and the conviction that an efficient, facultative predator of this type would be beneficial to the forest ecosystem, it was decided to introduce *F. lugubris* from northern Italy to eastern Canada.

There are several reasons for choosing this species for importation the most important being: the similarity in climatic conditions between its natural habitat in Europe and the southern Boreal Forest Region of eastern Canada; the adaptability of the species to the establishment on new sites (Pavan and Ronchetti 1972); and the ability of the species to inhabit a wide range of forest sites.

The population of *F. lugubris* destined for exportation was collected about 50 km northeast of Bergamo, Italy, on a site with a northeastern exposure, and at an altitude of from 1500 to 1600 m. The forest composition was *Picea excelsa* Lk. (95%), *Larix europaea* L., and *Fagus silvatica* L. (5%), and a ground cover of *Cytisus* sp. Approximately 1,300,000 worker ants and 2,000 mated queens were collected and

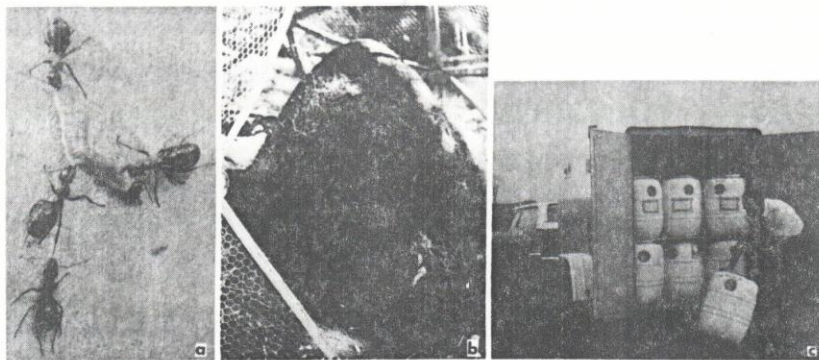


FIG. 1. *Formica lugubris* Zett. (a) adults attacking a larch sawfly larva, *Pristiphora erichsonii* (Htg.); (b) a 2-year-old nest (measuring 120 cm), introduced from northern Italy to Quebec; (c) arrival of a colony in Quebec from northern Italy.

shipped to Canada by air in well-ventilated plastic barrels (Fig. 1c). Although a minimum of nesting material was included with the ants, the consignment was received in quarantine in Quebec, where the nesting material was carefully separated from the ants, and autoclaved. At this stage the total number of workers was estimated (based on a 10% count), and the number of queens determined (actual count). It was estimated that approximately 5% of the population had perished during the shipment. The remainder were liberated about 30 km north of Quebec City during the first week in June, in a mixed 35-year-old plantation of *Pinus resinosa* Ait. (50%), *P. strobus* L. (40%), *Picea glauca* (Moench) Voss and *Abies balsamea* (L.) Mill. (5%), and *Betula papyrifera* Marsh. (5%). This site was chosen for its southern exposure, its mixed coniferous composition, its deep, well drained soil, and its accessibility by roads.

The ant population was originally released around six 1-year-old stumps covered with dead branches and pine needles. A distance of approximately 50 m separated each stump. However, after 3 or 4 days these sites were completely abandoned, and about 35 small, natural nests were formed over an area of approximately 3 ha in the immediate vicinity. An intense search for suitable nesting sites continued throughout July and August, and by the end of September most had re-grouped into five large nests, about 50 cm in height, and 10 smaller nests less than 30 cm in height. All of these nests overwintered successfully without apparent population loss. However, re-grouping continued during the following summer, so that by October 1972 there were three large nests measuring over 80 cm in height, and two measuring about 60 cm in height. No further changes in nest number occurred during the 1973 growing season, and the existing nests continued to increase in size, with the two largest attaining a height in excess of 125 cm. The total population at the end of the 1973 growing season was estimated at over 3,000,000 ants, based on nest size.

Discussion

The rapid establishment and steady increase in the numbers of the original population introduced in late May and early June 1971, indicates the species *F. lugubris* will probably acclimatize satisfactorily to Quebec conditions. The reproduction of individuals within each nest has been satisfactory, as evidenced by the large number of brood observed each year on the surface of the nests. During the 1972 and 1973 growing seasons, several thousand females (virgin queens) emerged in flight from each of the larger nests, but males were not produced abundantly. Although the production of many females and few males is indicative of strong nests, it is desirable during the first stage of establishment and propagation to have nests that will produce a large number of males to ensure the fertilization of females in flight. Fortunately, individual nests can be manipulated to favour the production of either sex, and this is currently being done.

Further to the initial introduction of *F. lugubris* in 1971, a second, larger colony was again imported from northern Italy, in May 1973, and released in a pure stand of *Pinus banksiana* Lamb., about 125 km north of Three Rivers, Que., in the St. Maurice river watershed. Approximately 40 nests were formed by this population during the first growing season. A minimum of re-grouping took place and 32 nests measuring more than 25 cm in height, and spread over 10 ha, entered hibernation in October in good condition.

The most serious hazards encountered by the newly introduced ant population were competition from indigenous ant species and birds. While the *F. lugubris* population seemed to be in complete command of the area occupied during the first 2 weeks after introduction, the pressure exerted by native ant species already present was largely responsible for the massive re-grouping observed during late summer. It was estimated that about one-fifth of the original area occupied by *F. lugubris* was eventually abandoned due to the interference and attacks by three large nests of *F. sanguinea* + *F. fusca* and one of *Camponotus pennsylvanicus* (DeGeer). Although it was felt that the

F. lugubris population would have eventually dominated the native ant species, it was decided to destroy the *F. sanguinea* + *F. fusca* and *C. pennsylvanicus* nests with an insecticide (chlordane sprayed on surface of nest in mid-September) in order to enhance the establishment of *F. lugubris*. Early next spring other nests of native ants, found in the area immediately surrounding the *F. lugubris* site, were also sprayed and destroyed with this insecticide.

Within a few days of the release of the *F. lugubris* ants in early June, a noticeable increase in the number of small songbirds was observed in the area, which lasted about 6 weeks, and also woodpeckers, ruffed grouse, and some migratory birds such as the evening grosbeak and the blue jay. However, only the yellow-shafted flicker, *Colaptes auratus luteus* Bangs, and the ruffed grouse, *Bonasa umbellus togata* (Linnaeus), were found to be serious habitual predators of ants. Two ruffed grouse hens and their coveys (a total of 13 birds) remained constantly in the ant area throughout the summer until early October. The yellow-shafted flicker was frequently seen feeding around nests during the summer. In the fall when the ant population on the trails diminished owing to cooler weather, it entered some of the nests repeatedly by making holes (from 10 to 20 cm deep and 10 cm in diameter) in the nest domes in search of ants. To protect the ant nests from these two species of birds and other less important predators, each nest was eventually covered with a cage consisting of a wooden frame and 3-cm mesh wire netting (Fig. 1b).

Acknowledgments

I wish to thank Prof. Dott. M. Pavan, Director, Institute of Agricultural Entomology, University of Pavia, Pavia, Italy, and his staff for the hospitality received while studying the bionomics of red wood ants in northern Italy during 1969 and 1970, and for his encouragement, assistance, and co-operation in developing the program of introduction of *F. lugubris* to Quebec. It was his personal interest in the work, his broad knowledge on the propagation of ants in Europe, and his influence with the Italian authorities, that made the project possible. My sincere thanks are also extended to the Italian Department of Agriculture and Forests, for authorizing, sanctioning, and encouraging the enterprise.

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(Received 5 March 1975)