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Potential forest pest beetles conveyed to Finland on timber imported from the Soviet Union

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TIIVISTELMÄ: MAHDOLLISIA UUSIA METSÄTUHOLAISIA NEUVOSTOLIITOSTA SUOMEEN TUOTAVASSA PUUTAVARASSA

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Coniferous timber imported by rail from the Soviet Union to Finland was studied for the presence of potential forest and timber pest beetles. Systematic samples of fourteen lots of pine pulpwood were examined. Seven of the lots originated from the European parts of the Soviet Union and seven from Siberia. 23 species of Scolytidae and about 18 other phloeophagous species were found including three species new for Finland: *Phaenops guttulata* (Buprestidae), *Ips subelongatus* and *Orthotomicus erosus* (Scolytidae).

Neuvostoliitosta rautateitse tuodusta havupuutavarasta tutkittiin maalle uusien metsätuholaiskovakuoriaisten esiintymistä. Neljästätoista mäntykuitupuuerästä tutkittiin systemaattisesti valitut näytteet. Seitsemän eristä oli peräisin Neuvostoliiton Euroopan puoleisista osista, seitsemän Siperiasta. Kaarnakuoriaislajeja tavattiin 23 ja muita nilaa syöviä lajeja noin 18. Suomelle uusia lajeja tavattiin kolme: *Phaenops guttulata* (Buprestidae), *Ips subelongatus* ja *Orthotomicus erosus* (Scolytidae).

Keywords: forest pests, Scolytidae, pest introduction, timber trade, import, Finland, Soviet Union.
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1. Introduction

Finland imported 3.74–6.62 million cubic meters of raw timber per year during the 1980's. The most important source was the Soviet Union, accounting for 70.4–95.6 % of the yearly volume (Ulkomaankauppa ... 1981, 1982, ..., 1990, Uusitalo 1989).

The import of raw timber involves a risk of introducing new, exotic forest pests (e.g. Wichmann 1955, Schmidt 1958, 1963, Schneider 1963, 1965, Francke-Grosmann 1964, Marchant and Borden 1976). Gillefors (1988) and Lundberg (1988) have recently published lists of beetles conveyed to Sweden on timber. There are no published data from Finland about the occurrence of pest insects in imported timber.

The aim of the present study is to obtain data about the number of species and individuals of tree-living beetles in coniferous timber imported from the Soviet Union, and to discuss the risks involved. Only families with a potential as forest or timber pests (Coleoptera: Buprestidae, Bostrychidae, Cerambycidae, Curculionidae and Scolytidae) are dealt with in this paper.

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2. Material and methods

The material was gathered in summer 1985 at two places in Southeast Finland: the Kaukas factories at Lappeenranta (61°5'N,28°5'E) and the Sunila pulp mill at Karhula (60°30'N,27°E). The former imported about 110 000 m^3 of coniferous pulpwood by rail from the Soviet Union in 1985, the latter about 240 000 m^3.

The study was concentrated on pine pulpwood. Other tree species that occurred occasionally among pine in some assortments were also studied. Samples were taken from the railway wagons that arrived at the factories in June, July or August. The timber in each wagon is always of the same origin, i.e. loaded at the same dispatch station. Every wagon has a corresponding consignment note including information about the assortment, volume, transport distance by rail and station of dispatch. There are no statistics available about the origin of the timber lots, but according to observations made by the importers the transport distance has often been thousands of kilometers, sometimes even over 6000 km. The timber lots were selected to cover the different transport distances as well as possible. Otherwise the wagons were chosen at random.

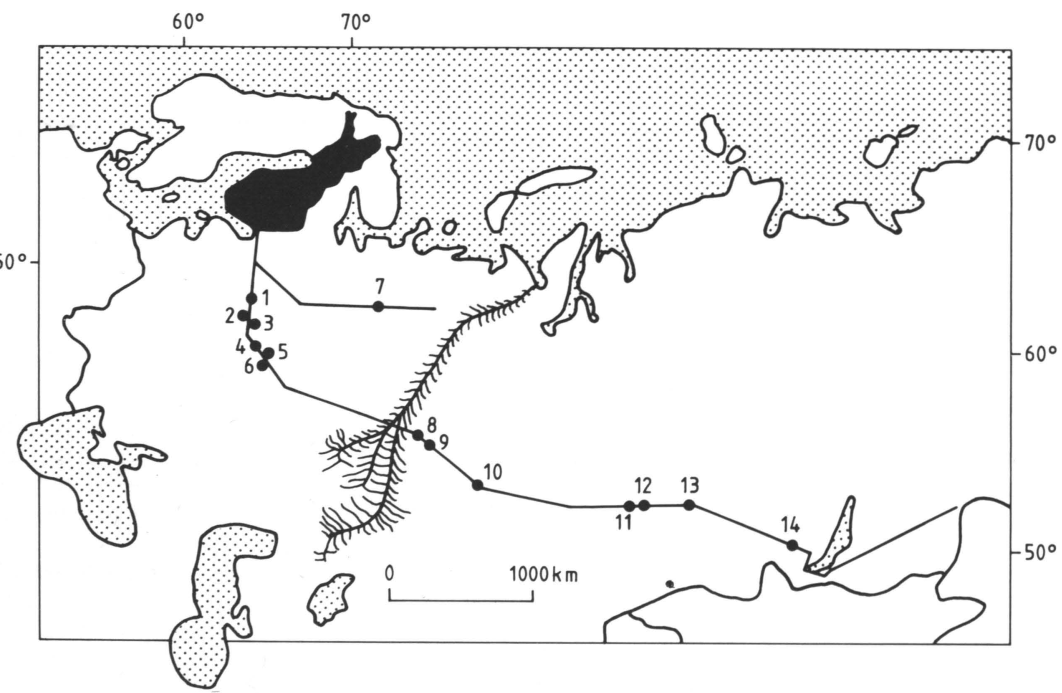

Fig. 1. The approximate origins of the 14 studied timber lots. Exact transport distances by rail in Table 1.

Table 1. The studied lots according to the transport distance by rail and the samples examined. Tree species: a = aspen, b = birch, f = fir, l = larch, p = pine, s = spruce.

Lot no.	Transport distance, km	Number of bolts and tree species	Examined volume, m^3	Date of arrival
1	533	18p	0.30	5.6.
2	631	15p	0.32	5.7.
3	685	18p	0.30	1.8.
4	891	20p	0.36	1.8.
5	938	20p	0.41	28.6.
6	960	20p	0.30	2.7.
7	1732	20p	0.28	22.7.
8	2604	13p	0.81	13.8.
9	2675	12p, 2b	0.15	20.8.
10	3143	9p, 10a, 1s	0.15	3.7.
11	4179	23p, 10s, 4l, 3f	0.63	18.6.
12	4243	7p, 6l, 6f, 1s	0.27	4.7.
13	4612	10p, 6l, 4s	0.48	17.6.
14	5365	5p, 4l	0.66	18.8.
		210p, 20l, 16s, 10a, 9f, 2b	5.42	

Fourteen lots were studied in all. The transport distance ranged from 533 to 5365 km. In most cases the station of dispatch could be located on a map (Atlas SSSR 1986), and in the remaining cases the origin of the timber could be assessed on the basis of the transport distance. Seven of the lots were from the European side of the Ural Mountains and seven from Siberia (Fig. 1).

A systematic sample of 10–40 bolts was taken from each wagon by picking every n:th bolt on the top of the stacks. If the assortment consisted of short stumps not stacked in order, the sample was taken from the surface bolts starting from either end of the wagon. Barkless bolts with no insects were also included in the sample. Information about the samples is given in Table 1.

An area of 50 cm was debarked around both ends of each bolt. Bolts under 150 cm in length were debarked entirely. The length of the debarked area and the bolt diameter with bark from the middle were measured. The volume of the examined bolts was calculated using the Huber's formula: $V = g_{0.5h} \times h$, where $g_{0.5h}$ is the cross-sectional area in the middle and h the length of the bolt.

The galleries of bark beetles (Scolytidae), as well as the larvae plus pupae of other phloeophagous species, were counted on the debarked area. Only living specimens were taken into account. The figures were then converted into average numbers per m^3 in each lot. This was done by dividing the total number of galleries or individuals found by the total volume of the examined bolts.

Table 2. Scolytidae and other phloeophagous species found in the European (1–7) and Siberian (8–14) lots. Numbers of the lots as in Table 1 and Figure 2.

Buprestidae	
Buprestis sp.	14
Phaenops guttulata Gebler	11
Melanophila sp. ?	8, 11
Bostrychidae	
Stephanopachys substriatus (Payk.)	6
Cerambycidae	
Asemum striatum (L.)	8
Aseminae sp.	14
Tetropium castaneum (F.)	11
Tetropium sp.	12
Rhagium inquisitor (L.)	2, 3, 8, 13
Lepturinae sp.	8, 10, 11
Xylotrechus rusticus (L.)	9, 10
Monochamus sutor (L.)	10
Monochamus sp.	2, 8, 9, 10, 11, 13
Acanthocinus aedilis (L.)	2, 3, 5, 8, 9
Cerambycidae sp.	14
Scolytidae	
Scolytus ratzeburgi (Janson)	9
Tomicus minor (Hartig)	1, 5, 7
T. piniperda (L.)	1, 3, 5, 7
Hylurgops glabratus (Zett.)	7
H. palliatus (Gyll.)	1, 2, 3, 5, 7, 9, 11, 12
Hylastes brunneus (Erichs.)	1, 3, 5, 7
Crypturgus cinereus (Herbst)	1, 2
C. pusillus (Gyll.)	1, 2
Dryocoetes hectographus Reitt.	2, 7
Trypodendron lineatum (Oliv.)	1, 2, 3, 5, 11, 12, 13
Pityogenes irkutensis (Eggers)	13
P. chalcographus (L.)	1, 5
P. quadridens (Hartig)	5, 11
P. bidentatus (Herbst)	2
Ips acuminatus (Gyll.)	9, 11, 12, 14
I. sexdentatus (Börner)	4, 8, 14
I. typographus (L.)	13
I. duplicatus (Sahlb.)	8
I. subelongatus (Motsch.)	14
Orthotomicus proximus (Eichh.)	1, 2, 9, 12, 14
O. erosus (Woll.)	14
O. suturalis (Gyll.)	1, 2, 5, 8, 9, 11
O. laricis (F.)	1, 2, 12, 13, 14
Curculionidae	
Pissodes pini (L.)	1, 2, 3, 4, 5, 7
Pissodes sp.	8, 9, 11, 12, 13, 14
Hylobius sp.	8, 9, 14

3. Results

Seventeen species of Scolytidae and four species of other phloeophagous beetles were found from the European lots. Fourteen species of Scolytidae and about sixteen species of other phloeophagous beetles were found from the Siberian lots. The species are listed in Table 2. *Phaenops guttulata* (Buprestidae), *Ips subelongatus* and *Orthotomicus erosus* (Scolytidae) were new for Finland.

The average number of species found from one lot was 8.4 ±1.1, ranging from one to fourteen, with an average effort of 0.38 ±0.05 m^3 of timber examined. This is only part of the species that were actually present, since one wagon contains approximately 50 m^3 of timber.

The average numbers of galleries or individuals per m^3 of different taxa, including the most numerous and some important species, are given separately for the European and Siberian lots in Table 3.

Table 3. The average numbers of different taxa in the European and Siberian lots. Mean number of galleries (Scolytidae) or individuals (others) per m^3 ± S.E.M. are given.

European lots		Siberian lots	
Hylurgops palliatus	178 ± 105	*Ips acuminatus*	130 ± 122
Tomicus spp.	97 ± 41	*Orthotomicus* spp.	48 ± 26
Trypodendron lineatum	65 ± 39	SCOLYTIDAE tot.	203 ± 148
Orthotomicus spp.	42 ± 31		
SCOLYTIDAE tot.	446 ± 187		
Pissodes pini	241 ± 186	*Pissodes+Hylobius* spp.	27 ± 16
Monochamus spp.	1 ± 1	*Monochamus* spp.	18 ± 7
CERAMBYCIDAE tot.	43 ± 24	CERAMBYCIDAE tot.	67 ± 22
BUPRESTIDAE tot.	0 ± 0	BUPRESTIDAE tot.	4 ± 3

4. Discusssion

There are dozens of examples of bark beetles that have been introduced and established to new areas, with varying economic consequences (Marchant and Borden 1976). The worst case so far may be *Scolytus multistriatus* (Marsham) acting as a vector for the Dutch elm disease (*Ceratocystis ulmi*). The species was introduced from Europe to North America in the early 1900's and has since then spread throughout the continent and, together with the fungus, practically wiped out the white elm (*Ulmus americana* L.) as a forest tree species (Marchant and Borden 1976, Knight and Heikkenen 1980, p. 338).

It is quite difficult to assess the probability of the introduced species becoming established. For instance, *Ips cembrae* (Heer) has become established in Great Britain on European larch (*Larix decidua* Mill.), whereas *Ips typographus* (L.) and *I. amitinus* (Eichh.) have not, in spite of repeated introductions and the presence of suitable hosts (Laidlaw 1946, Crooke and Bevan 1957, Bevan 1987).

Marchant and Borden (1976) discuss the

factors that affect the success of the prospective invader. First, the species must arrive alive and in a stage of its life cycle synchronized with the new environment. Second, a suitable and susceptible host must be within reach. In principle, only one gravid female is needed for establishment, but many more individuals may be required to overcome the host resistance by mass attack and to set up a source of secondary attraction that would concentrate the beetles on selected suitable hosts. After establishment, the initial population will necessarily be very small and, therefore, rapid adaptation of the invading species to the new environment is usually essential.

A species has an opportunity to spread to the surroundings when new adults are leaving the timber. Individuals emerging in the autumn must pass the winter before swarming the next spring. However, many scolytids such as *Ips* spp. may hibernate and carry out the maturation feeding in their galleries (c.f. Schwenke 1974). Consequently, there may be individuals ready to swarm in timber in the spring, too. Callow and emerging adults of the following species, for instance, were encountered: *Ips subelongatus* and *Orthotomicus erosus* 19.8., *Ips sexdentatus* 20.8., *Ips acuminatus* 21.8. and, hibernated in the galleries, *Ips acuminatus* and *Pityogenes irkutensis* 17.6. It would appear that the whole growing season is critical from the point of view of possible spreading.

A switch of host tree species by the introduced species has frequently been observed (e.g. Marchant and Borden 1976). According to Stark (see Butovitsch 1937), four scolytid species living on Siberian larch (*Larix sibirica* Ledeb.), *Scolytus morawitzi*, *Dryocoetes baicalicus*, *Ips subelongatus* and *Ips fallax*, have spread widely outside the range of their host via timber transport. In the new areas they live on scots pine (*Pinus sylvestris* L.). Pests living on other exotic conifers may also be able to switch to *Pinus sylvestris* and *Picea abies* Karsten. There are a number of pests of Siberian larch that could become established on the stands of introduced larch species in Finland. Of the species found, *Ips subelongatus* and *Phaenops guttulata* are both major pests on Siberian larch (Rozhkov 1966).

Considerable numbers of *Monochamus* spp. were found in the Siberian lots. *Monochamus* pine sawyers are the most important vectors of the pine wood nematode, *Bursaphelenchus xylophilus* Steiner & Bührer (Linit et al. 1983, Kobayashi et al. 1984). The most probable way for the pine wood nematode to spread into a new area is to be carried by its emerging vectors from infested timber to the nearby crowns of living pines. Since *Monochamus* pine sawyers are good and perseverant flyers, they are likely to find suitable pines for their maturation feeding even at a distance. According to Enda and Enda and Mamiya (see Mamiya 1984), nematode-contaminated adults of *Monochamus alternatus* Hope caused nematode transmission in 100 % of tested healthy pines when caged on the branches. The pine wood nematode was evidently introduced to Japan in the beginning of the century and has since then spread throughout the main island of Honshu and become the most serious forest pest in Japan (Mamiya 1984). During the last decade the species has spread to the continent, and now seems to have an extensive distribution in China (Mamiya 1985). Tomminen and Nuorteva (1987) have discussed the possibilities of the species spreading to Finland.

The present material demonstrates that considerable numbers -- both species and individuals – of tree-living beetles are conveyed alive on timber imported by rail. Despite the small volume (5.2 m^3) examined, even potential pest species new for Finland were encountered. The origins of the timber and the species occurring in it should therefore be monitored efficiently. Storing of imported timber during the growing season should be avoided.

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