

Current Status of *Ips amitinus* Eichh. (Coleoptera, Scolytidae) in North-West Russia

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Through continuous range expansion the eight-toothed bark beetle *Ips amitinus* Eichh. has colonized the whole St.Petersburg region and now is nearly as common as *Ips typographus* L. though less numerous. Valamo archipelago is the only spruce-forest territory not yet colonized by *I. amitinus*. Data strongly suggest that the most probable route for invasion of *I. amitinus* to Finland was the route from Estonia bypassing the Gulf of Finland, through the St.Petersburg area and the Isthmus Karelicus. Also new captures of the species more than 300 kilometres to the south-east of previously known occurrences are recorded.

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1. Introduction

At the beginning of the century the eight-toothed bark beetle *Ips amitinus* Eichh. was only known in Central Europe and in States of the west of the former Russian Empire, namely Poland (Jat-zentkovsky 1912) and the Baltic countries. The northern border of this species distribution passed through southern Estonia (Zolk 1932). In 1933 *I. amitinus* was found in central and northern Estonia (Zolk 1935) and became a common species everywhere in Estonia. In modern insect collections of Estonia *I. amitinus* is even more abundant than *I. typographus* (Voolma *et al.* 1977). In the 1950s *I. amitinus* was registered for the first time in southernmost Finland. First captures of the species were done in Tvärminne and in Ruotsinkylä, Tuusula. Later *I. amitinus* was found in a number of locations in Finland. The border of the species geographic range was reported to move northward (Koponen 1975, 1980). Great attention was paid

to this process in Finland. Up to the 1990s *I. amitinus* is still absent in Norway (Silfverberg 1992). *I. amitinus* was introduced independently into several provinces of Sweden (Lundberg, 1995), but still does not breed there as resident species of Scolytidae do. The data about this bark beetle in North-West Russia are scarce and the route of its invasion to Finland has not yet been elucidated. The aim of this paper is to present information about the current occurrence of *I. amitinus* in northwestern Russia and to consider the most probable route of the species invasion to Finland.

2. Methods

To update the records on *I. amitinus* a number of quite different landscapes in the North-West of Russia and especially around St. Petersburg were selected. More attention was paid to spruce forests and mixed coniferous forests. Only the locations in these forests are shown and numerated in the figures. The numbering of locations, arranged according

to the Fennoscandian provinces or other regions is as follows: *Lim*: Lapland Nature Reserve (1); *Kk*: Kandalaksha Nature Reserve (2); *Kpoc*: Voloma (3); *Kon*: "Kivach" Nature Reserve (4); *Kol*: Loimola (5), Olonets (6); *LK*: Khuukhkanmyaki (7), Valamo (8), Vladimirovka (9); *IK*: Leipuasuo (10), Lembolovo (11), Mesterjärvi (12), Lindula grove, Roshchino (13); *The St. Petersburg Region outside Fennoscandian provinces*: Vaskelovo (14), Proba (15), Morskaya (16), Gatchina (17), Vasilkovo (18), Shapki (19), Divenskaya (20), Yashchera (21), Rudnaya Gorka (22); *The Novgorod Region*: Yablonovka (23); *The Tver Region*: Central Woodland State Nature Reserve (24); *The Moscow region*: Zvenigorod (25), Kalistovo (26), Sofrino (27), Prioksko-Terrasny Biosphere Reserve (28). Data about findings of *I. amitinus* in the following locations were taken from literature: 1, 2 — Mozolevskaya and Sharapa (1996); 3, 5, 6 — Yakovlev et al. (1986); 4 — Mosolevskaja et al. (1991); 24 — Lurie (1967); 28 — Nikitsky et al. (1996). In other locations the collections were made by the author. The absence of *I. amitinus* in the location was postulated when complete lists of spruce bark beetles containing at least some of rare species were available.

However, forests formed exclusively by Scotch pine were also studied in 13 locations. These locations were selected in northern, central, southern and eastern parts of St. Petersburg area and in the Novgorod Region. Namely they were: *LK*: Khuukhkanmyaki, Valamo, Kuznechnoye; *IK*: Petyajärvi, Zaporozhskoye, Pesochnoye, Zelenogorsk; *The St. Petersburg region outside Fennoscandian provinces*: Vaskelovo, Kavgolovo, railway station Ladozhskoye ozero, Chaika, Yashchera; *The Novgorod Region*: Borovno. The inundated forests on river banks were studied in 6 locations including the Volchaya River near Petyajärvi, the Roshchinka River near Roshchino, the Lava River near Vasilkovo, the Yashchera River near railway station Nizovskaya, the Yashchera River and the Luga River near Yashchera village, the Ragousha River near Rudnaya Gorka village. Four parks in the environs of St. Petersburg (Sergievka in Old Peterhof, parks of Orzhitsy, Gatchina, Pavlovsk) and one in Vyborg ("Mon Repos") were also examined. All the places were visited either several times a year (since 1978, but mostly in 1994-1996) or studied during a local work. In each location the author did an itinerary at least 5 km long in the relatively uniform forest. During these excursions attention was paid to examination of the lower parts of standing thick and thin dying and dead trees, fallen, lying and undersized trees. Because of the vicinity of human settlements in practically all locations recently cut dead trees were available for examination. All the parts of the fallen trees were examined, including the trunk parts with thick, middle and thin bark, as recommended, e.g., by Stark (1952). Knife was used to remove the bark when appropriate. The presence of species-specific galleries on debarked trees was also recorded. The galleries of *I. amitinus* differ strikingly from all other spruce *Ips* bark-beetles galleries by multiplicity of branches, always exceeding 3, usually 4. *I. typographus* accompanying the species makes usually a gallery consisting of 1-2, rarely 3, branches. The branches of *I. amitinus* galleries are longer than those of *I. typographus*, the mating chamber is better seen because the galleries and the chamber are more impressed into xylem than those of *I. typographus*. The galleries of *I. amitinus* were

described by Chewyrev (1905) and nicely depicted in the recent monograph by Pfeffer (1994). The collections of the Zoological Institute (St. Petersburg) and the Forest Technical Academy (St. Petersburg) were examined for presence of labeled specimens of *I. amitinus* from the territory of the former USSR including Russia.

3. Results

The occurrence of *I. amitinus* in North-West Russia and in more thoroughly studied territories around St. Petersburg is given in Fig. 1a and Fig. 1b, respectively. The data permit us to conclude that *I. amitinus* can now be found in many locations in the vicinity of St. Petersburg. The species is even present in the most south-eastern parts of the St. Petersburg Region (officially named Leningrad oblast) and in the eastern parts of the Novgorod Region. *I. amitinus* was not previously recorded in both these regions. *I. amitinus* was found in absolutely all locations with Norwegian spruce forests. The only exceptions were the islands of Valamo archipelago and some parks. In the parks only a limited amount of dead wood is left and can be examined. So, the only real exception is Valamo where spruce forests cover significant territories. Only once *I. amitinus* was found in the park, in Gatchina. Of 13 studied pure Scotch-pine forests only in one location (Zelenogorsk) *I. amitinus* was found.

In North-West Russia *I. amitinus* was found on different materials: stumps (collected by the author together with *Hylastes cunicularius* Er. in Southern Karelia), fallen trees and standing trees either together with *I. typographus* or alone. *I. amitinus* is common on thin trees with sticking bark that can be inhabited up to the very top. Twice all three spruce-tree bark-beetle species (*I. amitinus*, *I. typographus*, *Ips duplicatus* Sahlb.) were found on the single fallen tree, where the former occupied the very top and the latter - the region more close to the roots. On the lying trees *I. amitinus* was significantly less abundant than *I. typographus*. It seems that *I. amitinus* does not inhabit sawed wood. To conclude, *I. amitinus* is a species with rather wide hygothermal optimum, because on the one hand trees on rides and forest glades and on the other hand the young trees in the deep shade and even stumps with the wet bark

can be inhabited. Only in one location (in Zeleznogorsk) the species was found on pines (once with *Tomicus minor* Hart. August, 1978 and once with *I. typographus*, June, 1979). The species absence in other pine woods is more or less well documented because of absence of typical galleries in a number of fallen pine-trees. Therefore, the Norwegian spruce is the preferred and almost only host-plant of *I. amitinus* in North-West Russia.

There were few records of *I. amitinus* in other regions of Russia. At least in 1961–1963 *I. amitinus* was still absent in Central Woodland State Nature Reserve in Kalininsky Region (now Tver Region). It is quite unlikely that the species was missed because all the identifications were made by a high-class specialist — B.V. Soka-novsky (Lurie 1967) and many rare species were found providing evidence that significant collections were made. In 1989 *I. amitinus* was still absent in forests of the nature reserve “Kivach” (Mosolevs-kaja et al. 1991). At that time it was already present at least in some locations in Karelia to the north and to the west of “Kivach” but was reported there as “a not common” species (Yakovlev et al. 1986). At the latitude of Central Karelia in Finland, *Ips*, *I. amitinus* was also reported as “a not common species” at the same time (Muona & Viramo 1986). Of special interest is the fact that the species is absent in the lists of bark beetles made by Titova (1959) for Karelia. Titova has collected large material in forest clearings in northern and southern parts of Karelia in 1954–1956. Even in the 1990s *I. amitinus* is still absent in Northern Karelia (Kandalakshskiy State Nature Reserve) and Kola Peninsula (Mosolevs-kaya & Sharapa 1996). It seems very likely that the species does not yet occur in the Moscow region. Neither literature sources (Nikitsky et al. 1996), nor the special search by the author in different Norwegian spruce forests in the Moscow Region (in 1989, Zveni-gorod; in 1997, Sofrino, Kalistovo) gave evidence for the presence of *I. amitinus* near Moscow. Nikitsky et al. (1996) performed special search for xylophagous beetles in the Prioksko-Terrasny Nature Reserve, collected large material using window-flight traps and revised large collections of xylophagous beetles from the whole Moscow Region but failed to record the species.

The author has found one specimen of *I. amitinus* in the Zoological Institute (St. Petersburg) collections with the label: “Briansk, 17. VIII.1920, (leg.) V. Stark.” This finding was not mentioned by Stark (1952) in his “Fauna of the USSR”. In the Institute collection there are also several specimens of *I. amitinus* from Estonia all labeled “12.VI.32 *Picea excelsa*, (leg.) Zolk, K-Prvld, Estonia, *Ips amitinus* Eichh. det. K. Zolk”. These specimens were collected in Kastre-Peravald, an Experimental Forest of Tartu University and a training place for forestry students. Now this forest district is called Järvselja and belongs to the Faculty of Forestry, Estonian Agricultural University but serves for the same purpose. Outside Russia, but within the borders of the former USSR, *I. amitinus* has been collected by V. Gusarov in the Carpatian mountains.

4. Discussion

At the beginning of the century *I. amitinus* was not found in the environs of St. Petersburg (Gornostaev 1916). The species was not recorded in Finland, including Isthmus Karelicus, before World War II. It was not found in the 1930s by Jatzentkovsky during his local field work in eastern parts of the St. Petersburg (Leningrad) region (Jatzentkovsky 1931). Jatzentkovsky had known this species quite well during his work in Poland (Jatzentkovsky 1912) and would not miss it in St. Petersburg region if the species were present. So far, Jatzentkovsky (1930) has mentioned that the species is distributed up to the western borders of the USSR (in borders of the 1930s). However, at that time the species might be expected in western parts of St. Petersburg region. First of all, only in 1933, *I. amitinus* became quite common in most parts of Estonia (Zolk 1935). Second, already in 1934 *I. amitinus* was found in Tundo (Estonia) close to the eastern borders of St. Petersburg area.

In the 1950s *I. amitinus* was found in Finland (Nuorteva 1955a) and by now the species has been known in multiple locations in southern Finland, but up-to date has not yet been recorded from Norway and does not breed in Sweden (Lekander et al. 1977, Silfverberg 1992, Lundberg, 1995), where Norwegian spruce is still a common tree.

So far, the invasion of the species to Finland might have passed through St. Petersburg region. No labeled specimens of *I. amitinus* collected in St. Petersburg area before 1978 had been seen by the author, but this can be due to the absence of bark-beetle collections made in the 1950s-1960s. Now the species is distributed in the whole St. Petersburg area and is quite common here.

The most striking fact is the absence of *I. amitinus* in Valamo archipelago, lying inside the present range of the species (Fig. 1a, b). It is very unlikely that *I. amitinus* was omitted during three-year long local work on Valamo because of following facts:

a) The internal parts of the Valamo central island are covered by spruce forests and in all continental spruce forests studied by the author, the species was easily found.

b) The archipelago was visited for three times (August, 1989 and June, 1990 and 1992) totaling the time of work to more than three weeks. The visits coincided with the periods when either the progeny of *I. amitinus* is abundant or the beetles start to form their galleries under the bark and so far the beetles may be easily collected (Annala & Nuorteva 1977).

c) Large number of different *Ips* DeGeer spe-

cies specimens from different materials (including logs, stumps, standing and fallen trees) were collected. In 1989 great number of *Ips* - inhabited logs were left on Valamo. These logs originated from winter-cut wood and were inhabited afterwards by different bark beetles in the spring of 1989. To collect bark beetles the logs were debarked by the author. The logs are considered to be the best substrate for *I. amitinus* (Koponen 1975).

d) Much less frequent (or more difficult to record) spruce inhabiting species like *Phthorophloeus spinulosus* Rey were collected during the stay on Valamo.

e) No typical galleries of *I. amitinus* were found on the trees examined.

The monastery of Valamo was self-sufficient as regards to the wood supply during its latest period of history (after the Second World War), the timber was never imported to the archipelago, it was even exported. Therefore *I. amitinus* could not have been imported to the archipelago via logs. Flying abilities of *Scolytidae* are thought to be too poor for beetles to actively overcome the distance from the shore of the Ladoga Lake - (somewhere 30 km or more from the places, where *I. amitinus* is now registered (Fig. 1,a,b) as abun-

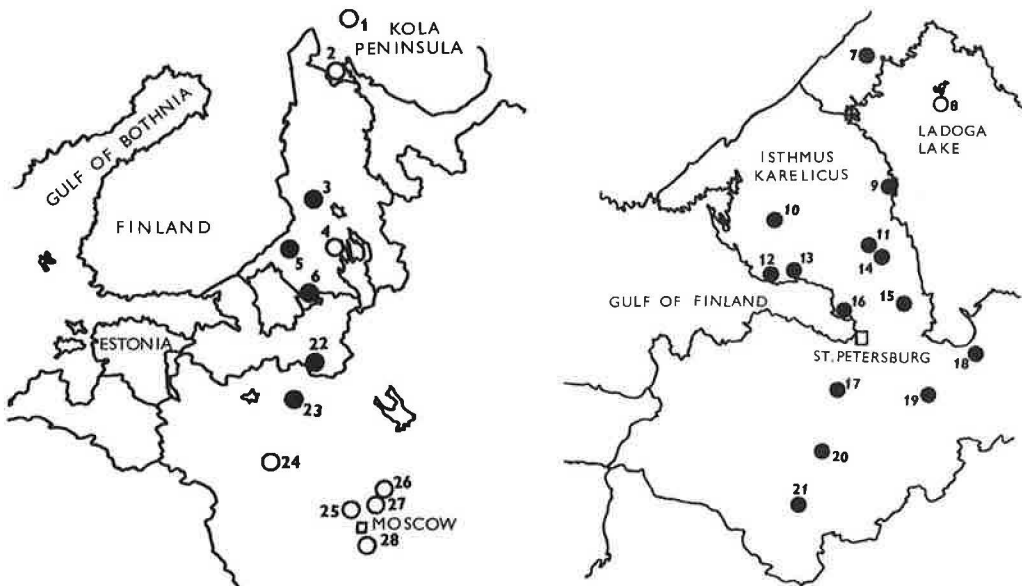


Fig. 1. Geographical distribution of *I. amitinus*: a) in the North-West of Russia; b) in vicinity of St. Petersburg. Closed circle: *I. amitinus* present, open circle: species absent despite of intensive study of bark beetle fauna of the place.

dant species). The absence of this species in Valamo forms further evidence of the recent character of the invasion of *I. amitinus* to North-West Russia and Finland.

Koponen (1975) being aware of the occurrence of *I. amitinus* in northern Estonia, but having no data from St. Petersburg region, has suggested that *I. amitinus* might overfly the Gulf of Finland with favorable winds. Koponen (1975, 1980) based his speculations on the fact, that the first records of *I. amitinus* in Finland were from southernmost parts of the country, from the vicinity of Helsinki (see below).

To discuss the routes of invasion of *I. amitinus* to Finland it is necessary to mention that mating of all European *Ips* species takes place in growing galleries. *I. amitinus* gives in St. Petersburg region only one generation each year. The fertilized females lose most of their muscle tissue during building of galleries and do not abandon them. Therefore, the occurrence of one fertilized female in a new region is unreal. Even if occurred it would unlikely result in formation of a new colony. The probability of the simultaneous arrival of several beetles over the Gulf of Finland to start a new colony is low. First, the width of Gulf of Finland in the narrowest place near Estonia exceeds 50 km. It is much more than the distance the borderline of the distribution area was estimated to cover during its progress in one season (18-24 km) (Koponen 1980). Second, *I. amitinus* is still absent on Aland Islands, Valamo and even Turku archipelago which are separated from the continent by water-covered distance that is much less than the width of Gulf of Finland. Third, *I. amitinus* has not yet overflowed the Gulf of Bothnia and it is not yet registered in Sweden. The width of Gulf of Bothnia in the narrowest place is only slightly greater than the width of Gulf of Finland between Estonia and Finland. *I. typographus* specimens twice were found in Finland in locations more than 40 km from the nearest spruce forests (Nuorteva, 1955b, Nilssen 1984) where they were, probably, brought with wind. Despite this observations, it is not necessary to discuss the transfer by wind as the route for invasion of *I. amitinus* to Finland as well as possible import of the species with timber from the USSR, because of high probability of another way, i.e. the inva-

sion of *I. amitinus* to Finland through St. Petersburg area and Isthmus Karelicus bypassing the Gulf of Finland. Current occurrence and abundance of the species in St. Petersburg area and data on *I. amitinus* range expansion in Estonia, Finland and Russia argue for this way of invasion.

Koponen (1975) indicated that the first captures of *I. amitinus* in south-western Finland were done in Tvärminne and in Ruotsinkylä (Tuusula). These first finding of the species in south-western Finland, as discussed by Koponen (1975), might be simply due to the vicinity of biological research stations or large cities, like Helsinki and to the most intensive collection process there. He wrote: "There were naturally few finds in areas where no special search was made for *Ips amitinus* or bark beetles in general". Koponen (1975) gave also an example of the absence of *I. amitinus* in Satakunta (*St*), lying inside the species range, till 1970 when this eight-toothed bark beetle was collected by him after special search. In this respect late finding (in 1961) of *I. amitinus* by Nuorteva (1963) in Virolahti, near the current border between Finland and Russia, might simply be due to the absence of previous systematic search of the species there. Indeed, many common bark-beetles collected by Nuorteva in 1961 were reported as new not only for Virolahti, but for the whole province *EK*. Because of the ability to inhabit standing trees (especially when lying trees are not available) the species could easily be missed without specialized search. Finally, in the coastal forests of Gulf of Finland Scotch pine is the dominant tree and I failed to find *I. amitinus* there (see Methods).

Koponen (1975) also states that in the beginning of the 1970s there were two centers where *I. amitinus* was relatively more common. The commonness of *I. amitinus* was evaluated in terms of percent of locations where *I. amitinus* was found in comparison to percent of locations where other species of *Ips* bark beetles were found. One of this centers was in south-west Finland and the other in eastern Finland. The last point is in agreement with the suggestion that the route for invasion of *I. amitinus* to Finland passed around Gulf of Finland, through St. Petersburg area and Isthmus Karelicus. Taking in account the estimated

time of appearance of the species in northern Estonia and the speed of distribution area borderline progress, there was enough time to accomplish this way.

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