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Trophic specialization features of bark beetle *Ips hauseri* Reitter, 1895 (Coleoptera, Curculionidae: Scolytinae) in coniferous forests of Kazakhstan

Особенности пищевой специализации короеда *Ips hauseri* Reitter, 1895 (Coleoptera, Curculionidae: Scolytinae) в хвойных лесах Казахстана

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Ключевые слова: хвойные, ель Шренка, *Pícea schrenkiana,* сосна*, Pinus sylvestris,* пищевая специализация, короед, Казахстан.

Abstract. The biological characteristics of *Ips hauseri* Reitter, 1895 in the coniferous mountain forests of Kazakhstan were studied during the period of depression of the bark beetle population in the windfall zone of 2011 in the high-mountain Medeu tract. According to our observations, during the stages of development and regress of the mass reproduction cluster in the period from 2012 to 2024, the bark beetle attacked and developed only on Schrenk's spruce *Pícea schrenkiana* Fisch. & C.A.Mey., 1842. Scots pine in the Medeu tract and in the parks of Almaty was not populated during this period.

Резюме. Изучены биологические особенности *Ips hauseri* Reitter, 1895 в хвойных горных лесах Казахстана в период депрессивного состояния популяции короеда в зоне ветровалов 2011 года в высокогорном урочище Медеу. По нашим наблюдениям на этапах развития и затухания очага массового размножения в период с 2012 по 2024 гг. короед атаковал и развивался только на ели Шренка: *Pícea schrenkiana* Fisch. & C.A.Mey., 1842. Сосна обыкновенная в урочище Медеу и в парках Алматы в этот период не заселялась.

Introduction

Insects are a natural and very significant part of zoocenoses in the forests of Russia. The diversity of insects, food links with plants and the ability to spread determine their important role in forest ecosystems. Xylophilic insects represent a significant part of the entomofauna of forest ecosystems and, as a rule, act as participants in the process of reducing sick and dying plants. Some species of xylophages are able to attack living plants that are under stress when the protective reactions of trees are weakened due to the negative impact of climate change. At the same time, drying out of forest-forming tree species is observed over large areas, accompanied by the emergence of outbreak of mass reproduction of xylophilic insects [Storozhenko et al., 2018].

Bark beetles of the genus *Ips* De Geer, 1775 are very importance among xylophilic insects [EPPO, 2024]. Many species of this genus are distinguished by their potential ability for mass proliferation in coniferous stands that have lost their resistance. The main environmental factors preceding the increase in the number of beetles of the genus *Ips* are the lack of precipitation and high air temperatures during the growing season. Often, outbreak of mass reproduction of species of this genus occurs in forest areas damaged by windfalls and snow breaks, forest wild fires, exposed to phytophagous insects eating the needles, or affected by diseases caused by phytopathogenic microorganisms [Kulinich et al., 2013].

Most of the Palearctic bark beetles of the genus *Ips* are widespread European-Siberian species. In most areas beetles of this genus with preference to certain coniferous species, easily change for others within the family Pinacea, especially during periods of mass reproduction of bark beetles.

In the coniferous forests of Central Asia, the bark beetle *Ips hauseri* Reitter, 1895 (Figs 1, 2) is of great forestry importance. The main food plant of this species is Schrenk's spruce (*Picea schrenkiana*), but in forest ecosystems and parklands of Kazakhstan, researchers observed a change in the food specialization of *Ips hauseri*. During the increase in population, the bark beetle inhabited Scots pine (*Pinus sylvestris*), despite the presence of weakened or damaged *Picea schrenkiana* trees [Kostin, 1964]. In parklands of Tajikistan in the city of Dushanbe, *Ips hauseri* bread on Calabrian pine (*Pinus brutia*) and Crimean pine (*P. nigra* ssp. *palassiana*) [Kadyrov, 2007]. Based on the change in the

Fig. 1. Spruce forest with *Picea schrenkiana* in vicinity of Chimbulak ravine damaged by hurricane in May 2011.

Рис. 1. Ельник с *Picea schrenkiana* в окрестностях урочища Чимбулак, повреждённый ураганом в мае 2011 года.

food specialization of the bark beetle and the similarity of climate, assumptions were made about the possible penetration of *Ips hauseri* into countries adjacent to Central Asia and into Europe [Vanhanen et al., 2008; Ismukhambetov et al., 2013]. Nowadays, there remains a need to clarify the features of the trophic specialization and ecological indicators of this endemic bark beetle in the conditions of its primary range.

Our research was aimed at studying the biology and food specialization of the bark beetle in areas of mass reproduction in the conditions of the Zailiysky Alatau in areas of windfalls in 2011.

Material and methods

The study of the biological characteristics of *Ips hauseri* in the forest ecosystems of Kazakhstan was carried out from 2019 to 2024 in the Zailiysky Alatau in natural stands of Schrenk spruce. Coniferous forests on the ridge grow on the altitudinal belt from 1600 to 2800 m. The population dynamics of bark beetles on Schrenk spruce was studied on model trees in mountain coniferous plantations near Almaty (the high-mountain tract of Medeu and the southern slopes of Mount Chimbulak) and in the area of Talgar. In addition, *Pinus sylvestris* cultures were surveyed in Medeu and Almaty to identify the change in the host species by the bark beetle. Temporary model areas were located in forest areas adjacent to snowbreaks in 2020–2021. In the Medeu tract at 43°09'30" N, 77°02'59.4" E at an altitude of 1498 m a.s.l., on the slopes of Mount Chimbulak at 43°07'12" N, 77°04'46" E at an altitude of 2248 m a.s.l. (Fig. 1).

The phenological characteristics of *Ips hauseri* were studied during reconnaissance surveys of plantations: trees inhabited by the bark beetle were identified in the plantations, and imago, eggs, larvae and pupae were counted. Petrov's barrier (window) traps were used to determine the flight periods of the beetles; they were hung on the branches of fallen spruce trees. Ethanol was used to attract insects to the traps. The population indices were studied according to the method of Mozolevskaya et al. [1984]. The population density (p), mortality of the young generation in the egg, larval, pupa and young beetle phases (m), and the bark beetle stock of *Ips hauseri* in the plantation (thousands of pieces/ha) were analyzed.

The entomological material was identified by A.V. Petrov using identification keys [Stark, 1952; Kostin, 1973; Douglas et al., 2019]. Bark beetles collected during the research are stored in the A.V. Petrov collection.

The photographs of the beetles were taken with a Canon 50D camera and an MP-e65 lens. Digital processing of the photographs was performed using the Picolay program.

The present work is registered in ZooBank (www.zoobank.org) under LSID urn:lsid:zoobank.org:pub:1C8F8AE8-5C5C-4EA4-A74A-504A83208FDA

Results

Ips hauseri is a Palaearctic species of bark beetle with a range limited to the distribution of Tien Shan spruce *P. schrenkiana*. This species is common in mountain coniferous forests of Kazakhstan, the northwestern provinces of China, Kyrgyzstan, and in coniferous cultures in Tajikistan [Stark, 1952; Kostin, 1971; Toktoraliev, 1993; Kadyrov, 2008, Knizek, 2010; EPPO, 2024]. The Natural History Museum in Budapest (Hungary) houses a specimen collected in Usinsk in the Western Sayan Mountains in southern Siberia [Mandelshtam, 2002]. There is no other information of finding this species in Russia. I.A. Kostin [1971] pointed out that *Ips hauseri* is not found east of the Dzungarian Alatau and does not penetrate into the territory of the Russian Federation. Probably, in the monograph on bark beetles by V.N. Stark [1952], the information about the presence of *I. hauseri* in the Southern Altai refers only to the territory of Kazakhstan. A.A. Legalov [2002] in "A checklist of bark and ambrosia beetles from Siberia and the Russian Far East", recorded this species for the Krasnoyarskii Krai and South Altai based on these works. The mention in the review on bark beetles by Knizek [2010] about the distribution of this species of bark beetle in the territory of the Russian Federation, we believe to be erroneous.

The development of the bark beetle was recorded on trees of the Pinaceae family: *Picea schrenkiana*, *Pinus sylvestris*, *P. brutia*, *P. nigra* ssp. *palassiana*, *Cedrus* sp. [Stark, 1952; Kostin, 1955, 1964, 1973; Marikovsky, 1956; Ismukhambetov, 1964, 1969, 1976; Pfeffer, 1995; Toktoraliev, 1995; Kadyrov, 2007].

The spring flight of beetles in the conditions of the high-mountain tract Medeu begins at daytime temperatures of 10–12 °C from the third ten-day period of April and continues until the second ten-day period of June. The bark beetle often populates the trunks of fallen trees, less often develops on the trunks of spruce trees suffering from a lack of moisture. It eats out passages in areas of the trunk with thick bark.

The mating chamber, gnawed out by the male, is deepened into the sapwood, from which usually originate from 1 to 8 (usually 2–4) egg galleries (Fig. 2). The galleries are gnawed out by females in the bark, very slightly touching the sapwood (Fig. 2). The length

of the passages is from 10 to 15 mm (average length is 12 mm). The galleries are borrowed by the parents from the drilling flour, rarely can be filled with drilling flour. The egg chambers are located from 1 to 3 mm from each other. The actual fertility of females is 24–30 eggs (maximum 52). The larval mines are short (from 40 to 55 mm), directed perpendicular to the egg galleries. The pupal cradle is located in the bast tissues. The development cycle of the spring generation lasts from 40 to 55 days (egg development 9–12 days, larvae — 21–24 days, pupa 8–11 days). Young beetles of the spring generation remained in the old passages from 4 to 7 days, after which they left the passages. The flight of young beetles of the summer generation took place in spruce forests at an altitude of 2200 m from the end of May to the first ten days of July, in model areas in the Chimbulak region from the first ten days of May to the first ten days of August. After completion of development, some of the young beetles remained in the old parental galleries for the winter in 2020–2021, where the beetles gnawed out miner galleries around the larval passages. A small part of the young beetles left the old parental galleries. Their place of hibernation has not been determined. In 2020–2021, on model trees at an altitude of 2500 m above sea level, we recorded the complete development of one generation of beetles and the completion of development in September of 65% of young beetles of the second generation. 35% of the total number of older larvae hibernated in the larval phase. In some model areas in the Medeo tract, 89% of the beetles managed to complete their development at the end of September 2020. Our data coincide with the results of previous studies [Marikovsky, 1956; Ismukhambetov, 1976]. The latest outbreaks of mass reproduction of *Ips hauseri* in the mountainous regions of the Zailiysky Alatau were observed after hurricanes in May-June 2011 [Temreshev et al., 2012; Temreshev, 2013].

Massive windfalls were caused by hurricane winds, reaching 22–26 m/sec. in the Medeo region. In the Zailiysky Alatau, about 70 thousand trees were felled.

The period from 2014 to 2017 saw the maximum increase in the number of *Ips hauseri*, but no determination of the bark beetle population indicators in the outbreak in Zailiysky Alatau was carried out during this period. The period of our studies coincided with a sharp decrease in weakened and damaged spruce trees suitable for the reproduction of *Ips hauseri*. In 2019–2024, the bark beetle population increased only in areas of spruce forests damaged by snow avalanches.

The maximum settlement density on snowbreakers in Chimbulak in 2019 was 2.0 m.h./dm^2, the feeding surface area of the bark beetle family varied from 0.75 dm^2 to 3.1 dm^2, the mortality of the offspring varied from 35.5 to 89 %. The maximum mortality was recorded among older larvae and pupae affected by fungi. The bark beetle stock in areas damaged by snowbreakers varied from 1.92 thousand pcs/ha in 2019 to 0.09 thousand pcs/ha in 2024.

In the Medeu tract, *Ips hauseri* only inhabited Schrenk's spruce (Figs 3, 4). Previously published data on

Fig. 2. Galleries of *Ips hauseri* on Schrenk spruce.
Рис. 2. Ходы *Ips hauseri* на ели Шренка.

Figs 3–4. External appearance of *Ips hauseri.* 3 — dorsal view; 4 — lateral view.
Рис. 3–4. Внешний вид *Ips hauseri. 3* — вид сверху; 4 — вид сбоку.

changes in the trophic specialization of *I. hauseri* during the period of population growth in the outbreak of mass reproduction [Kostin, 1964, 1973] were not confirmed. The death of pines from the attack of the Hauser bark beetle in the Medeu area and in the parks of Almaty in the period 2019–2024 was not recorded. We observed cases of *Pinus sylvestris* drying out in these years in the immediate vicinity of the outbreak of mass reproduction of the bark beetle, but there were no settlements of *Ips hauseri* on the dying pines.

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References

Douglas H.B., Cognato A.I., Grebennikov V.V, Savard K. 2019. Dichotomous and matrix-based keys to the *Ips* bark beetles of the world (Coleoptera: Curculionidae: Scolytinae) // Canadian Journal of Arthropod Identification. No.38. P.1–234. https://doi.org/10.3752/cjai.2019.38

EPPO. 2024. *Ips hauseri*. EPPO datasheets on pests recommended for regulation. https://gd.eppo.int. Accessed 2024–07-20

Ismukhambetov Zh.D. 1964. Nasekomye-vrediteli tyian'-shan'skoy eli urochstcha Sumba (chrebet Ketmen') v rayone vetrovala // Trudy Kazakhskogo nauchno-issledovatel'skogo Instituta zastchity rasteniy. Vol.8. Alma-Ata: Kazakhskoe Gosudarstvennoe izdatel'stvo sel'khohozyaistvennoy literatury. P.251–254. [In Russian].

Ismukhambetov Zh.D. 1969. Nasekomye-vrediteli tyian'-shan'skoy eli i ikh lesokhoziyaistvennoe znatcheniye // Trudy Kazakhskogo nauchno-issledovatel'skogo Instituta zastchity rasteniy. Vol.9. Alma-Ata: Kazahskoe. Gosudarstvennoe izdatel'stvo sel´khohozyaistvennoy literatury. P.86–91. [In Russian].

Ismukhambetov Zh.D. 1976. Vrediteli tyian'-shan'skoy eli i mery bor' by s nimi. Alma-Ata. 71 p. [In Russian].

Ismukhambetov Zh.D., Mukhamadiev N.S., Duysembekov B.A. 2013. Karantinnyie vrediteli v elovykh lesakh Tyan-Shanya // Bulleten' Postoyannoi Kommisii VPRS MOBB po biologicheskoy zaschite lesa. Vol.9. Zaschita lesa — innovatsii vo imyia razvitiya. Pushkino: VNIILM. P.49–53. [In Russian].

Kadyrov A.Kh. 2007. Kompleks drevogryzustchikh i vnutristeblevykh zhestkokrylikh (Scolytidae, Carambycidae, Buprestidae) Yugo-Vostochnoy chasti Sredney Azii. Dushanbe. 274 p. [In Russian].

Kostin I.A. 1955. Nasekomye-vrediteli eli Shrenka v Dzhungarskom, Zailiyskom y Kungey Alatau // Trudy Instituta zoologii AN KHazakhskoy SSR. Alma-Ata. Vol.4. P.206–217. [In Russian].

Kostin I.A. 1964. Stvolivye vrediteli khvoynykh lesov Kazakhsana. Alma-Ata. 183 p. [In Russian].

Kostin I.A. 1973. Zhuki-dendrophagi Kazakhstana (Koroedy, drovoseki, zlatki). Alma-Ata: Nauka Khazakhskoy SSR. 288 p. [In Russian].

Kulinich O.A., Chalkin A.A., Ryaskin D.I., Arbuzova E.N., Kozyreva N.I., Petrov A.V. 2022. [Distribution and quarantine status of the bark beetles from a genus of *Ips* on the territory of Russia and other countries] // Zaschita i karantin rasteniy. Vol.4. P.27–31. [In Russian]. https://doi.org/10.47528/1026-8634_2022_4_27

Legalov A.A. 2022. A checklist of bark and ambrosia beetles (Coleoptera: Scolytidae and Platypodidae) from Siberia and the Russian Far East // Acta Biologica Sibirica. Vol.8. P.623–646. https://doi.org/10.5281/zenodo.7726527

Marikovskii P.I. 1956. Mezhvidovie otnosheniya koroedov, obitautchich na tyanshanskoy eli // Trudy Instituta zoologii i parazitiligii Akademii Nauk Kirgizskoi SSR. Vol.5. P.73–77. [In Russian].

Mozolevskaya E.G., Kataev O.A., Sokolova E.S. 1984. Metody lesopatologicheskogo obsledovaniya ochagov stvolovykh vrediteley i bolezney lesa. Moscow: Lesnaya promyshlennost. 152 p. [In Russian].

Pfeffer A. 1995. Zentral- und Westpaläarktische Borken- und Kernkäfer (Coleoptera: Scolytidae, Platypodidae) // Entomologica Basiliensia. Vol.17. P.5–310.

Stark V.N. 1952. Koroedy. Zhestkokrylye // Fauna SSSR. Vol.31. Moscow–Leningrad: Izdatel´stvo Akademii Nauk SSSR. 462 p. [In Russian].

Storozhenko V.G., Bykov A.V., Bukhareva O.A., Petrov A.V. 2018. Ustoychivost' lesov. Teoriya I praktika biotsenoticheskikh issledovaniy. Moscow: KMK. 171 p. [In Russian].

Temreshev I.I., Kolov S.V. 2013. [Insects from windbreak sites in the State National Natural Park «Ile-Alatau», Almaty Oblast, Kazakhstan] // Euroasian Entomological Journal. Vol.12. No.2. P.125–131. [In Russian].

Temreshev I.I., Kolov S.V., Gritsenko N.I., Ismagulov E.Zh. 2012. Ob entomologicheskoy obstanovke v mestakh vetrovala v GNPP «Ile-Alatau»// Materialy mezhdunarodnoy konpherentsii «Zhivotnyi mir Kazakhstana i sopredel'nikh territoriy». Almaty: Nur-Print. P.163–165. [In Russian].

Toktoraliev B.A. 1995. Nasekomye-ksilophagi lesov Kyrgyzstana. Avtorepherat dissertatsii doktora biologicheskikch nauk. Moscow: MGUL. 45 p. [In Russian].

Vanhanen H., Veteli T., Niemelä P. 2008. Potential distribution ranges in Europe for *Ips hauseri*, *Ips subelongatus* and *Scolytus morawitzi*, a CLIMEX analysis // EPPO Bulletin. Vol.38. No.2. P.249–258. https://doi.org/10.1111/j.1365-2338.2008.01212.x

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