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DISTRIBUTION OF *LAETIPORUS SULPHUREUS* (BULL.) MURRILL IN FOREST COMMUNITIES OF THE URAL RIVER VALLEY WITHIN THE WEST KAZAKHSTAN REGION

This study examines the distribution and ecological characteristics of *Laetiporus sulphureus* (Bull.) Murrill in the forest communities of the Ural River valley in the West Kazakhstan region. This fungus, possessing both parasitic and saprotrophic properties, plays a crucial role in the nutrient cycle by decomposing lignin in the wood of deciduous trees.

Based on a comprehensive geobotanical and mycological analysis conducted during field studies from 2019 to 2024, it has been determined that *L.sulphureus* is present across a wide range of forest communities, including elm, willow, poplar, aspen, alder, and oak forests. A strong association between the fungus and tree species such as *Quercus robur, Salix alba*, and *Populus alba* has been observed.

The results of the study highlight the high ecological plasticity of *L. sulphureus*, enabling it to effectively adapt to various types of forest communities. The fungus shows a marked preference for moist forests rich in deciduous species, which provide stable, moisture-retaining substrates essential for its growth. Its association with floodplain and ravine forests underscores its significant role in the ecosystems of the Ural River valley.The obtained data confirm the key role of *L. sulphureus* in shaping and maintaining the biodiversity of the region's mycobiota.

Key words: *Laetiporus sulphureus*, forest communities, Ural river valley, West Kazakhstan Region, biodiversity.

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Батыс Қазақстан облысы шегіндегі Жайық өзені аңғары орманды қауымдастықтарында *Laetiporus sulphureus* (Bull.) Murrill таралуы

Бұл зерттеуде Батыс Қазақстан облысы шегіндегі Жайық өзені аңғары орман қауымдастықтарында кездесетін *Laetiporus sulphureus* (Bull.) Murrill-дің таралу ерекшеліктері мен экологиясы қарастырылады. Паразиттік және сапротрофтық қасиеттерге ие бұл саңырауқұлақ ағаш субстраттарындағы лигнинді ыдырату арқылы қоректік заттардың айналымында негізгі рөл атқарады. 2019–2024 жылдар аралығында жүргізілген далалық зерттеулер барысындағы кешенді геоботаникалық және микологиялық талдау негізінде *L.sulphureus* -тің шегіршін, тал, терек, көктерек, қайың және емен ормандарын қамтитын әртүрлі орман қауымдастықтарында кездесетіні айқындалды. Бұл саңырауқұлақтың *Quercus robur*, *Salix alba* және *Populus alba* сияқты ағаш түрлерімен айқын байланысы анықталды.

Зерттеу нәтижелері *Laetiporus sulphureus*-тің жоғары экологиялық икемділікке ие екенін көрсетеді, бұл оның белгілі бір орман қауымдастықтарына сәтті бейімделуіне мүмкіндік береді. Саңырауқұлақ көбінесе ылғалды және жапырақты ағаш жыныстарына бай ормандарға басымдық береді, өйткені олар оның өсуіне қажетті тұрақты және ылғал сақтайтын субстраттармен қамтамасыз етеді. Жайылмалы және байрақты ормандармен байланысы *L.sulphureus*-тің Жайық

аңғары экожүйелеріндегі маңызын айқындайды. Алынған деректер L. sulphureus түрінің аймақ микобиотасының биоәртүрлілігін қалыптастыру мен сақтаудағы елеулі рөлін дәлелдейді.

Түйін сөздер: *Laetiporus sulphureus*, орман қауымдастықтары, Жайық өзені аңғары, Батыс Қазақстан облысы, биоалуантүрлілік.

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Распространение *Laetiporus sulphureus* (Bull.) Murrill в лесных сообществах долины реки Урал в пределах Западно-Казахстанской области

В данном исследовании рассматриваются распространение и экологические особенности *Laetiporus sulphureus* (Bull.) Murrill в лесных сообществах долины реки Урал на территории Западно-Казахстанской области. Этот гриб, обладающий как паразитическими, так и сапротрофными свойствами, играет важную роль в круговороте веществ, разлагая лигнин в древесине лиственных пород. На основе комплексного геоботанического и микологического анализа, проведённого в ходе полевых исследований в период с 2019 по 2024 годы, установлено, что *L. sulphureus* встречается в широком спектре лесных сообществ, включая вязовые, ивовые, тополевые, осиновые, ольховые и дубовые леса. Отмечена выраженная ассоциация гриба с такими древесными видами, как *Quercus robur*, *Salix alba* и *Populus alba*.

Результаты исследования свидетельствуют о высокой экологической пластичности *L. sulphureus*, что позволяет ему эффективно адаптироваться к различным типам лесных сообществ. Установлено, что наибольшее предпочтение гриб отдаёт увлажнённым лесам, богатым лиственными породами, которые обеспечивают стабильные и влагосохраняющие субстраты, необходимые для его роста. Связь с пойменными и байрачными лесами подчёркивает его важное значение для экосистем долины реки Урал. Полученные данные подтверждают значимую роль *L. sulphureus* в формировании и поддержании биоразнообразия микобиоты региона.

Ключевые слова: *Laetiporus sulphureus*, лесные сообщества, долина реки Урал, Западно-Казахстанская область, биоразнообразие

Introduction

Laetiporus sulphureus, commonly known as the "chicken of the woods", is a parasitic fungus characterized by its vibrant yellow color and typically inhabits older trees. This basidiomycete is found on all continents, though it is only utilized for culinary purposes in select regions [1]. The fruiting bodies are distinctive, featuring semicircular shapes that can reach diameters of up to 40 cm and often exhibit a short stem. They grow on tree trunks in a console shape, frequently overlapping in cascades. The bright sulfur yellow to vivid yellow coloration is typical of young fruiting bodies, while older ones may become light orange or white-orange with brown spots, transitioning to a dry, hard, and compact form as they age. The underside of the fruiting body features a layer of tubular hymenophores, from which white spores are released [1-4].

Primarily found in temperate hardwood forests, *L. sulphureus* thrives particularly on weakened or dead deciduous trees, notably oaks (*Quercus robur* and *Quercus alba*), but can also colonize other species such as cherry (*Prunus avium* and *Prunus serrulata*) and chestnut (*Castanea dentata*). The fruiting bodies typically emerge above ground on standing or fallen trees, with sporulation occurring from late summer to fall [4].

Ecologically, *L. sulphureus* plays a crucial role as both a saprophyte and a parasite, significantly contributing to nutrient cycling in forest ecosystems through the decomposition of lignocellulosic material [5, 6]. As a "white rot" fungus, it selectively breaks down lignin while leaving cellulose intact, enriching forest soils and promoting microbial diversity. This lignin degradation is facilitated by enzymes such as laccase, peroxidase, and manganese peroxidase. In addition to its ecological significance, *L.sulphureus* possesses distinct visual characteristics that may deter herbivores, while its soft, fleshy texture when young makes it an appealing option for culinary and medicinal applications [6, 7].

Distribution and Host Plant Associations in Kazakhstan, host plants: this species is found on both

live and dead trunks of various deciduous trees, including *Quercus robur* L. (oak), Salix spp. (willow), *Prunus* spp. (cherry), *Juglans* spp. (walnut), *Pyrus* spp. (pear), *Castanea* spp. (sweet chestnut), *Fagus* spp. (beech), *Betula* spp. (birch), *Fraxinus* spp. (ash), *Gleditsia* spp., and *Eucalyptus* spp. Occurrences on coniferous hosts are less frequent and include *Taxus* spp. (yew), *Pinus* spp. (pine), *Picea* spp. (spruce), and *Larix* spp. (larch) [8].

Documented Locations in Kazakhstan [8]: *Larix sibirica* Ledeb. (*Pinaceae*): East Kazakhstan Region, Kazakhstan Altai, Sarymsakty Ridge, at an elevation of 2800–3000 m above sea level, recorded on 7–8 August 1958 by M.P. Vasyagina. Same region, Katon-Karagay, Narym Ridge, approximately 15 km east of Uryl village, at ~2000 m above sea level, recorded on 30 July 1961 by G.I. Petko. *Salix alba* L. (Salicaceae): Uralsk Region, Burlin District, collected on 18 July 1952 by M.A. Tartenova. *Salix australior* Anderss.: Shymkent Region, Malyi Boroldaу River gorge, north of Ulken-Tura Ridge, within gallery forests, documented on 22 August 1960 by M.P. Vasyagina. *Salix songarica* Anderss.: Almaty Region, Charyn River, Charyn Ash Forest Reserve, recorded on 5–10 March 1943 by B.I. Kravtsev. *Salix* sp.: Aktobe Region, Temir Station, Temir Forest Nursery, recorded on 27 August 1952 by T.I. Guryeva. *Populus alba* L.: Shymkent Region, near Vannovka village, documented on 14 August 1949 by S.R. Schwarzman [8, 9]. Aktobe Region, Temir Nursery, recorded on 28 August 1952 by T.I. Guryeva. *Quercus robur* L. (*Fagaceae*): Almaty Region, Almaty city, Kirova Street, recorded on 17 September 1962 by N. Kazhieva. *Ulmus laevis* Pall. (Ulmaceae): Uralsk Region, Burlin District, Utva Forest, documented on 5 August 1952 by M.A. Tartenova. *Fraxinus sogdiana* Bge. (*Oleaceae*): Almaty Region, Charyn River, Charyn Ash Forest Reserve, recorded on 15 October 1941 and 18 May 1943 by B.I. Kravtsev. Kindiktas, Kurday Lane, recorded on 22 May 2009 by G.A. Nam [10], including an observation on an old stump within the territory of Sairam-Ugam National Nature Park [11].

Additional observations: Further specimens have been recorded on willows in the floodplain forests of Zhambyl district, Zhetyzhol ridge, in Uygur District at the Charyn ash grove, and on ash in the floodplain of the Charyn River near Sarytogay [12].

Materials and methods

2.1. Study area

The research area in northwestern Kazakhstan follows the Ural River, which traverses two major zones: the Eurasian steppe and the Sahara-Gobi desert. In this region, the steppe is divided into dry fescue and feather grass steppes, extending to the Caspian lowland near Yanaikino-Bogatsk in West Kazakhstan. Moving southward, the area transitions into sagebrush-fescue-feather grass steppes, reaching as far as Atameken village. The southernmost section is characterized by sagebrush and biyurgun Caspian desert steppes [13].

The Ural River floodplain has three main components: the riverbed, central floodplain, and terraced sections. The riverbed, lined with gravel-sand banks up to 700 meters wide, supports native willow (*Salix alba*) along with other shrub willows such as *Salix triandra*, *Salix viminalis*, and *Salix acutifolia*. The central floodplain features forests dominated by poplar (*Populus alba*, *P. nigra*), elm (*Ulmus laevis*), and aspen (*Populus tremula*), forming dense wooded areas between 2 and 5 kilometers wide, especially in the middle reaches near the Caspian lowland. Downstream, these forests thin out, giving way to isolated groves and habitats of oak (*Quercus robur*) and alder (*Alnus glutinosa*). Post-fire areas previously occupied by poplar are often succeeded by aspen (*Populus tremula*), maple (*Acer negundo*), and ash (*Fraxinus excelsior*). Additionally, unique ravine forests of oak and birch near Kabyltobe contribute to the rich biodiversity of the Ural River floodplain ecosystem.

2.2. Sample Collection

This study investigates *Laetiporus sulphureus* (Bull.) Murrill and related macromycetes within the Ural River Valley of West Kazakhstan, with field observations and specimen collections conducted from 2019 to 2024. Research focused on macroscopic fungi across varied forest communities, identifying patterns in species distribution and ecological association.

Fieldwork was timed to coincide with optimal growth periods for macromycetes to ensure representative sampling and quality data collection [14]. Specimens were documented fresh in the field, with select samples photographed to capture essential morphological features. Photographic documentation utilized a Canon EOS 4000D and an iPhone 12, with in situ photos taken whenever feasible. In cases where field conditions were unsuitable, specimens were photographed on neutral backgrounds in a controlled lab setting. For each specimen, comprehensive field notes were recorded, detailing the collection date, habitat type, fruit body characteristics, and substrate attachment [14, 15].

To maintain sample integrity, each fruiting body was carefully wrapped and stored in dedicated, con-

tamination-free boxes. Specimens were then dried in herbarium cabinets at 50-55°C for 30-40 minutes, eliminating pests and preparing samples for long-term storage. Each prepared specimen was placed in individually numbered packages, which included the species name, collection location, collector's details, and registration number [14]. Morphological data, including macro- and micro-measurements of fruit bodies, basidia, and spores, were recorded using binocular magnifiers and fluorescence microscopy [15].

Geobotanical assessments focused on forest communities, where the composition and spatial distribution of macromycetes were analyzed. Vegetation assessments utilized Shennikov's (1964) methodology [16], which included evaluations of floral composition, canopy structure, and species abundance based on the Drude scale. These assessments allowed for the classification of dominant and subdominant species, contributing to a more nuanced understanding of mycocenoses in these ecosystems.

Species names were referenced in Latin, with any taxonomic updates cited from S.K. Cherepanov (1995) [17] and S.A. Abdullina's List of Vascular Plants of Kazakhstan (1999) [18]. Mycobiota classification aligned with the 10th edition of Ainsworth & Bisby's Dictionary of Fungi (Kirk et al., 2008) [19], complemented by updates from the Index Fungorum and MycoBank databases [20, 21].

Research results and discussion

Laetiporus sulphureus, recognized for its striking color and distinctive structure, exhibits unique morphological and microscopic traits that make it easily identifiable in its natural habitat.

Fruiting body structure: the fruiting bodies of *L. sulphureus* are typically fan-shaped and sessile, often growing in a shingle-like pattern along a common base, and sometimes forming rosettes on fallen logs. They can reach a total width of up to 90 cm, with individual caps ranging from 5-25 cm across and up to 3 cm thick. Fresh caps are vivid yellow to orange with a velvety, suede-like texture, gradually fading to a dull yellow or pale ocher as they age. With maturity, the caps harden and become brittle (figure 1).

Figure 1 – Fruit bodies of L. sulphureus on a host tree in their natural habitat

Surface and pore features: the cap surface varies from smooth to finely wrinkled, and it can appear wavy or radially folded. Initially, the cap edges are blunt and even, becoming wavy and thin over time. The pore surface ranges from bright to dull yellow, and does not bruise. Pores number 2-4 per mm² and shift from round to angular as they mature, with edges becoming slightly toothed. Tubes, which are sulfur-yellow and short (up to 5 mm deep), feature thin partitions. When young, the flesh of *L. sulphureus* is thick, soft, and watery, with a juicy, cheese-like texture that becomes tough and chalky as it dries. Initially yellowish, the flesh turns white with age, exuding a pleasant mushroom aroma and slightly sour taste. In herbarium storage, dried specimens retain their yellow hue for years. Microscopically, *L. sulphureus* spores are ovoid to broadly ellipsoid, measuring 5–7 × 3.5–5 µm, often containing a central oil droplet. Spores are initially pale yellow but fade quickly. The hyphal system is primarily thin-walled, with a dimitic structure. In the tube trama, hyphae are densely packed and measure 3–6 µm, while those in the cap tissue are loosely arranged, 4–15 µm in width, with frequent right-angled branching. Generative hyphae are tubular, septate, and smooth-walled, ranging from 4–7 µm wide. Hymenial cystidia and clamp connections are generally absent, which further aids in distinguishing *L. sulphureus*. Notably, *L. sulphureus* specimens exhibit remarkable durability, retaining their characteristic yellow hues for years in herbarium conditions. This resilience enhances their identification over time and assists in distinguishing them from other similar species.

Ecology: *Laetiporus sulphureus* functions as both a parasitic and saprobic fungus, primarily colonizing living and dead oak trees, though it can occasionally be found on other hardwood species. This fungus induces a reddish-brown cubical heart rot in its hosts, characterized by thin layers of white mycelium within the wood's cracks. *L. sulphureus* is an annual fungus, commonly growing in shelving clusters elevated above the ground, though it may also appear as solitary specimens. Fruiting bodies emerge predominantly in summer and fall, with occasional occurrences in winter and spring.

Table 1 – Ecological distribution of *Laetiporus sulphureus* in the research area

	Location	Forest type / Plant community	Host	Substrate	Coordinates	Collection Date	Sample No.
1.	Terekty district, floodplain forest near Akzhaiyk sanatorium, left bank of the Ural River	Elm forest (*Ulmus laevis*), elm-grassland (*Bromus inermis, Silaum silaus*, *Aristolochia clematites* community)	*Ulmus laevis* Elm	On the trunk of elm	N50°9680' E51°3136'	11.07.2020	19
2.	Terekty district, left bank of the Ural River near Kabyltobe village	Birch forest (*Quercus robur*, *Populus tremula*, *Populus canescens*, *Betula pendula*, *B. pubescens*), oak-lily of the valley (*Q. robur*, *Convallaria majalis*), oak-euonymus-horsetail (*Q. robur*, *Euonymus verrucosus*, *Equisetum arvense* community)	*Quercus robur* (Oak)	On the trunk of oak	N51°19.567' E51° 54.300'	01.08.2020	27
3.	Baiterek district, right bank of the Ural River near Yanvartsevo village	Oak forest (*Quercus robur*), oak-brome grassland (*Quercus robur*, *Carex supina*)	*Quercus robur* (Oak)	On the trunk of oak	N51°27.843' E52°15.560', h-40 m	08.08.2020	38
					N51° 27.885' E52°15.632', h-44 m		39
					N51° 27.970' E52°15.955', h-43 m		40
					N51°27.891' E52°16.081', h-45 m		42
		Oak-horsetail (*Q. robur*, *Equisetum arvense*) community		At the base of oak	N51°27.829' E52°16.044', h-44 m		44

Continuation of the table

	Location	Forest type / Plant community	Host	Substrate	Coordinates	Collection Date	Sample No.
4.	Baiterek district, floodplain forest near Petrov village, right bank of the Ural River	Aspen forest (*Populus tremula*), aspen-lettuce (*Populus tremula*, *Lactuca serriola*) community	*Populus tremula* (Aspen)	On fallen aspen remnants	N51°26.111' E52°00.114', h-76 m	16.08.2020	82
		Mixed poplar forest (*Populus alba*, *Populus nigr*a), alder-stinging nettle (*Alnus glutinosa*, *Urtica dioica*) community	*Alnus glutinosa* (alder)	On alder shrubs and stems	N51°30.463' E52°15.271',	16.08.2020	84
5.	Borli district, near Priuralny village,floodplain forest, left bank of the Ural River	Oak forest (*Quercus robur*), Oak-blackberry (*Quercus robur*, *Rubus caesius*) community	*Quercus robur* (Oak)	Inside a large cavity on the trunk of oak	N51°28.835' E53°07.076', h – 58 m	04.09.2020	107
6.	Borli district, near Utvinka village, small-leaved floodplain forest, left bank of the Ural River	Black poplar (*Populus nigra*) and elm (*Ulmus laevis*) mixed with white poplar, white poplar-brome (*Populus alba*, *Carex vulpina*) community	*Populus alba* (white poplar)	At the base of white poplar, old and decayed specimen	N51°28.174' E52°48.815', h – 56 m	04.09.2020	111
7.	Terekty district, near Kabyltobe village, Akhmadi beam, left bank of the Ural River	Broadleaf and small-leaved forest (*Quercus robur*, *Betula pendula*, *B. pubescens*, *Populus tremula*), birch forest (*Betula pendula*, *B. pubescens*), birch-brome (*Betula pendula*, *B. pubescens*, *Carex supina*) community	*Populus tremula* (Aspen)	On the trunk of aspen	N51°19.233' E51°54.541', h – 68 m, N51°19.233' E51°54.542', h – 68 m	13.09.2020	148; 150
		Oak-brome (*Quercus robur*, *Carex supina*) community	*Quercus robur* (Oak)	On the oak trunk, old decayed specimen	N51°19.369' E51°54.782', h – 55 m		164
8.	Terekty district, floodplain forest near Sholpan settlement	Small-leaved forest (*Populus alba*, *P. nigra*, *Ulmus laevis*, *Salix alba*), black poplar-blackberry-lily of the valley (*Populus nigra*, *Rubus caesius*, *Convallaria majalis*)	*Populus nigra* (Black poplar)	On a cut black poplar stump, fresh	N51°21.194' E51°56.151',	17.09.2020	170
9.	Baiterek district, right bank of the Ural River near Yanvartsevo village	Oak forest (*Quercus robur*), Oak-brome grassland (*Quercus robur*, *Carex supina*) community	*Quercus robur* (Oak)	At the base of the oak, young specimen	N51°27.801' E52°15.524', h – 42 m; N51°27.800' E52°15.526', h – 41 m	17.09.2020	174; 175;
10.	Akzhaik district, floodplain forest near Kolovertnoye village, right bank of the Ural River	Mixed black poplar (*Populus nigra*) and white willow (*Salix alba*) forest, white poplar-brome (*Populus alba*, *Carex riparia*) community	*Salix alba* (white willow)	At the base of the white willow	N50°33.808' E51°05.891', h – 16 m	10.10.2020	228

Continuation of the table

	Location	Forest type / Plant community	Host	Substrate	Coordinates	Collection Date	Sample No.
11.	Terekty district, near Akzhaik sanatorium, left bank of the Ural River	Willow forest (*Salix alba*), willow-couch grass (*Salix alba*, *Elytrigia repens*) community	*Salix alba* (white willow)	On the trunk of white willow	N50°58.305' E51°19.039', h – 25 m	16.10.2020	233
		Willow-herb-grass (*Leonurus cardiaca*, *Thalictrum flavum*, *Galium boreale*) with reed (*Calamagrostis phragmitoides*) community	*Salix alba* (white willow)	On the trunk of white willow	N50°58.333' E51°18.995', h – 26 m,	16.10.2020	234
12.	Terekty district, near Pogromnoe, left bank of the Ural River	White poplar forest (*Populus alba*), white poplar-blackberry (*Populus alba*, *Rubus caesius*) community	*Populus alba* (white poplar)	On the trunk of white poplar	N50°58.333' E51° 18.985' h – 26 m	16.10.2020	235
13.	Akzhaik district, floodplain forest near Kolovertnoye village	Mixed small-leaved forest (*Populus alba*, *Populus nigra*, *Salix alba*), black poplar-reed (*Populus nigra*, *Calamagrostis epigejos*) community	*Populus nigra* (black poplar)	Along the riverbank, on black poplar	N50°33.773' E51° 05.873'	30.10.2020	251
14.	Akzhaik district, floodplain forest near Moiyldy village, right bank of the Ural River	Mixed black and white poplar and white willow (*Salix alba*) forest, willow-blackberry (*Salix alba*, *Rubus caesius*) community	*Salix alba* (white willow)	On the trunk of white willow	N50°03.438' E51°17.538', h – 7 m	30.10.2020	257
		White willow wheatgrass (*Salix alba*, *Elytrigia repens*) community	*Salix alba* (white willow)	Very large specimen on a cut stump of white willow	N50°03.435' E51°17.539', h -7 m	30.10.2020	258
		black poplar-ruderal-sedge (*Populus nigra*, *Carex vulpina*) community	*Populus nigra* (black poplar)	On the trunk of black poplar	N50°03.592' E51°17.515', h – 9 m	30.10.2020	261
				On the trunk of fallen black poplar	N50°03.433' E51°17.531', h – 7 m	30.10.2020,	262
		white poplar-blackberry community (*Populus alba*, *Rubus caesius)* community	*Populus alba* (white poplar)	At the base of white poplar	N50° 3.592' E51°17.535', h – 9 m	30.10.2020	263

Continuation of the table

	Location	Forest type / Plant community	Host	Substrate	Coordinates	Collection Date	Sample No.
15.	Terekty district, floodplain forest near Kogalatubek village, central floodplain of the Ural River's left bank, near the relict Bobrovoe Lake	Mixed small-leaved forest (*Populus alba*, *Populus nigra*, *Salix alba*), white poplar-blackberry community (*Populus alba*, *Rubus caesius*); white willow-blackberry community (*Salix alba*, *Rubus caesius*)	*Populus alba* (white poplar)	On the trunk of white poplar	N50°25.997' E51°08.384',	07.11.2020	266
			Salix alba (white willow)	On the trunk of white willow	N50°25.971' E51°08.459', h – 7 m		268
		White poplar forest (*Populus alba*), white poplar-blackberry (*Populus alba*, *Rubus caesius*) community	*Populus alba* (white poplar)	On the trunk of white poplar	N50°26.066' E51°08.208', h -10 m		286
16.	Terekty district, floodplain forest near Akzhaik sanatorium, left bank of the Ural River	White poplar forest (*Populus alba*), white poplar-blackberry (*Populus alba*, *Rubus caesius*) community	*Populus alba* (white poplar)	At the base of a white poplar, old specimen	N50°58.098' E51°18.778', h – 26 m	05.06.2021	351
17.	Terekty district, near Kabyltope village, left bank of the Ural River, Akhmadi beam	Mixed oak-birch forest (*Quercus robur*, *Betula pendula*, *B. pubescens*, *Populus tremula*, *Populus canescens*), oak-lily of the valley (*Quercus robur*, *Convallaria majalis*) community	*Quercus robur* (Oak)	On the trunk of oak, old specimen	N51°19.582' E51°54.226', h – 46 m,	20.06.2021	358
18.	Krugloozernoye village,floodplain forest, near terrace, right bank of the Ural River	Black poplar forest (Populus nigra), black poplar-blackberry (Populus nigra, Rubus caesius) community	*Populus nigra* (black poplar)	At the base of black poplar	N51°04.065' E51°18.523', h – 26 m	03.07.2021	404
19.	Baiterek district, floodplain forest near Yanaikino village, right bank of the Ural River	White willow forest (*Salix alba*), willow-sedge (*Salix alba*, *Carex melanostachya*) community	*Salix alba* (white willow)	In a hole at the lower part of a white willow	N50°41.689' E51°06.858', h – 13 m	06.07.2021	435
		Mixed white poplar and white willow forest (*Populus alba*, *Salix alba*), willow-blackberry (*Salix alba*, *Rubus caesius*), willow-marshmallow (*Thalictrum minus*) community	*Salix alba* (white willow)	On the trunk of willow, old specimen	N50°41.346' E51°07.150', h – 15 m	06.07.2021	436
20.	Terekty district, floodplain forest near Shagatay village, left bank of the Ural River	White poplar forest (*Populus alba*), white poplar-sedge (*Populus alba*, *Carex acuta*) community	*Populus alba* (white poplar)	On the trunk of white poplar	N50°26.276' E51°08.409', h -13 m	25.07.2021	447
21.		White poplar-sedge-licorice (*Populus alba*, *Glycyrrhiza glabra*, *Carex acuta*) community		On the trunk of white poplar, young specime	N50°27.080' E51°09.415', h – 14 m	01.08.2021	476

Continuation of the table

	Location	Forest type / Plant community	Host	Substrate	Coordinates	Collection Date	Sample No.
22.	Akzhaik district, floodplain forest near Chapay village (right bank of the Ural River), left bank of the Ural River	White poplar forest (*Populus alba*), white poplar-blackberry (*P. alba*, *Rubus caesius*) community	*Populus alba* (white poplar)	At the base of white poplar, old specimen	N50°12.702' E51°11.797', h – 10 m	01.08.2021	478
23.	Baiterek district, right bank of the Ural River, along the Bykovka River flowing into the Ural River near Spartak village	White poplar forest (*Populus alba*), white poplar-sedge (*Populus alba*, *Carex acuta*) community	*Populus alba* (white poplar)	On the trunk of white poplar	N51°25.919' E52°04.988', h – 43 m	21.08.2021	492
		Willow (*Salix alba*) mixed with black poplar (*Populus nigra*) forest, black poplar-blackberry (*Populus nigra*, *Rubus caesius*) community	*Salix alba* (white willow)	On the trunk of white willow	N51°24.260' E52°05.231', h – 42 m	21.08.2021	496
24.	Baiterek district, right bank of the Ural River near Kirsanov village	Elm forest (*Ulmus laevis*), elm-Aristolochia (*Ulmus laevis*, *Aristolochia clematitis*) community	*Ulmus laevis (elm)*	On the trunk of	N51°25.625' E52°24.921', h – 45 m	21.08.2021	503
25.	Terekty district, floodplain forest near Kabyltobe village, Vorovskaya beam	Oak forest (*Quercus robur*), oak-lily of the valley (*Quercus robur*, *Convallaria majalis*) community	*Quercus robur* (Oak)	On the trunk of oak	N51°20.225' E51°55.313', h – 44 m	29.08.2021	510
26.		*Salix alba* (white willow) grove, *Salix alba* and *Bidens tripartite* community;	*Salix alba (white willow)*	On the trunk of willow	N50°36.988' E50°58.776', h – 17 m	05.09.2021	515
	Akzhayik district, right bank of the Ural River, near Budarin village, floodplain forest close to Budarin canal	Salix alba and ruderal (*Sonchus arvensis*, *Arctium lappa*, *Persicaria amphibia*) community Salix alba and motherwort (*Leonurus cardiaca*) community		On a fallen willow, On the trunk base and hollow of a tree	N50°36.242' E50°57.961', h – 18 m; N50°39.646' E51°06.462', h – 17 m		516, 517
27.	Baiterek district, floodplain forest in the right bank of the Ural River, near Bogatsk village	*Populus tremula* (aspen) forest, *Populus tremula* and *Rubus caesius* community	*Populus tremula (aspen)*	On the trunk of lower part of aspen	N50°39.288' E51°07.084', h – 18 m,	05.09.2021	518
		Populus tremula and Glycyrrhiza glabra community		On the trunk of aspen	N50°39.310' E51°07.110', h – 20 m		520
		Populus alba and *Carex acuta* community	*Populus alba* (white poplar)	On the trunk of white poplar	50° 39.316' E51°07.112', h – 22 m		521
28.	Baiterek district, floodplain forest near Yanaikino village, right bank of the Ural River	*Populus tremula* forest, *Populus alba* and *Carex acuta* community	*Populus tremula (aspen)*	On the cut stump of aspen	N50°41.319' E51°07.447', h – 15 m	25.09.2021	522

Continuation of the table

	Location	Forest type / Plant community	Host	Substrate	Coordinates	Collection Date	Sample No.
29.	Terekty district, left bank of the Ural River, near Kabyltobe village, ravine forest near Poluosov stream in Alpi beam	*Quercus robur* and *Betula pendula* mixed forest, *Fraxinus excelsior*, *Quercus robur*, and *Convallaria majalis* community	*Quercus robur* (Oak)	On the trunk of old broken oak	N51°19.248' E51°53.769', h – 38 m	26.09.2021	530
		Quercus robur, *Populus tremula*, and *Convallaria majalis* community	*Populus tremula (aspen)*	At the base of aspen	N51°19.248' E51°53.747', h – 40 m		534
		Ravine forest with northern-facing birch (*Betula pendula*, *B. pubescens*), Convallaria majalis and *Petasites hybridus* mixed birch and bramble (Rubus caesius) community	*Quercus robur* (Oak)	At the root of the oak	N51°19.356' E51°54.721', 58 m,		539
30.	Akzhayik district, right bank of the Ural River, near Chapay village, floodplain forest	*Populus nigra* (black poplar) mixed with *Populus alba* (white poplar) forest, *Populus alba* and *Rubus caesius* community	*Populus nigra (black poplar)*	On a cut stump of black poplar	N50°12.698' E51°11.716', h – 11 m	03.10.2021	553
31.	Terekty district, left bank of the Ural River, near Kogaltyubek village,floodplain forest	*Populus nigra* forest, *Populus nigra*, *Salix alba*, and *Rubus caesius* community	*Salix alba* (white willow)	On the trunk of white willow	N50°25.989' E51°08.409', h – 11 m	03.10.2021	559
32.	Krugloozernoye village,floodplain forest, near terrace, right bank of the Ural River	*Populus nigra* and *Salix alba* mixed with *Populus alba* forest	*Populus alba* (white poplar)	Near trunk of white poplar	N51°05.803' E51°19.069', h-22 m	17.10.2021	569
		Mixed *Ulmus laevis* orest with *Fraxinus excelsior* (ash) and *Salix alba* (*white willow*) forest	*Salix alba* (white willow)	On trunk of white willow	N51°06.019' E51°18.931', h – 25 m		573
33.	Baiterek district, floodplain forest in the right bank of the Ural River, near Bogatsk village	*Salix alba* (white willow) forest	*Salix alba* (white willow)	On trunk of white willow, previous year's fruiting body	N50°39.689' E51°06.836', h – 9 m	24.04.2022	588
		Populus alba (white poplar) forest, *Populus alba* and *Rubus caesius* community	*Populus alba* (white poplar)	Several specimens on the midsection of white poplar	N50°39.251' E51°06.963', h – 12 m; N50°39.251' E51°06.961', h – 12 m		590; 592
34.	Borli near Borli village, floodplain forest, left bank of the Ural River	Mixed forest (*Populus alba*, *P. nigra*, *Ulmus laevis*, *Salix alba*), *Salix alba* and *Carex acutiformis* community	*Salix alba* (white willow)	Near a burnt, dried white willow	N51°25.963' E52°41.310', h – 48 m	18.05.2022	613

Continuation of the table

	Location	Forest type / Plant community	Host	Substrate	Coordinates	Collection Date	Sample No.
35.	Borli near Priuralny village, floodplain forest, left bank of the Ural River	*Quercus robur* (oak) forest, *Quercus robur* and *Rubus caesius* community	*Quercus robur* (Oak)	On the trunk of oak	N51°28.858' E53°07.047', h – 61 m	02.06.2022	644
		Quercus robur and *Convallaria majalis* community		On cut stump of oak	N51°28.894' E53°07.069', h – 63 m		649
		Quercus robur and *Aristolochia clematites* community		On an old branch of oak, young specimen	N51°28.943' E53°07.034', h – 64 m		653
36.	Borli district, near Zharsuat village, floodplain forest, left bank of the Ural River	*Salix alba* (white willow) mixed with *Fraxinus excelsior* (ash) and *Acer negundo* (boxelder maple) forest	*Salix alba* (white willow)	Several young specimens on white willow	N51°29.224' E53°17.317', h – 57 m	02.06.2022	669
37.	Borli district, near Bymakol village, floodplain forest, Ural River valley, left bank of the Ural River	Mixed forest (*Populus alba*, *Ulmus laevis*, *Fraxinus excelsior*), *Rubus caesius* community	*Populus alba* (white poplar)	On the trunk of white poplar	N51°28.674' E52°45.337', h – 54 m	02.06.2022	678
38.	Borli district, near Borli village, floodplain forest, left bank of the Ural River	Mixed small-leaved forest (*Populus nigra*, *Populus tremula*, *Ulmus laevis*) with *Thalictrum minus* (small meadow-rue) and *Galium boreale* (northern bedstraw) community	*Populus alba* (white poplar)	On the trunk of white poplar	N51°26.102' E52°41.507', h – 38 m	11.06.2022	739
39.	Akzhayik district, right bank of the Ural River, near Mergen village, floodplain forest	*Ulmus laevis* (elm) and *Glechoma hederaceae* (ground ivy) community	*Ulmus laevis (elm)*	On the trunk of fallen elm	N50°33.903' E51°07.662', h – 8 m	23.09.2023	781
40.	Baiterek district, right bank of the Ural River, along the Bykovka River flowing into the Ural River near Spartak village	White poplar forest *(Populus alba),* white poplar-sedge *(Populus alba, Carex praecox)* community	*Populus alba* (white poplar)	On the trunk of fallen polar	N51°26.216' E52°06.545', h – 37 m	29.06.2024	821
41.	Baiterek district, right bank of the Ural River, along the Bykovka River flowing into the Ural River near Spartak village	White poplar forest *(Populus alba),* white poplar-sedge *(Populus alba, Rubus caesius)* community	*Populus alba* (white poplar)	On the trunk of white poplar	N51°26.221' E52°06.521', h – 39 m	29.06.2024	827

Based on the results, it can be seen that the distribution of *Laetiporus sulphureus* within the Ural River valley in the West Kazakhstan region reveals notable biogeographical patterns linked to riparian habitats and specific microclimatic conditions. Occurrences of *L. sulphureus* are recorded on both the left and right banks of the Ural River, with a pronounced affinity for floodplain forests dominated by hardwood species, specifically *Quercus robur*, *Salix alba*, and *Populus alba* (figure 2).

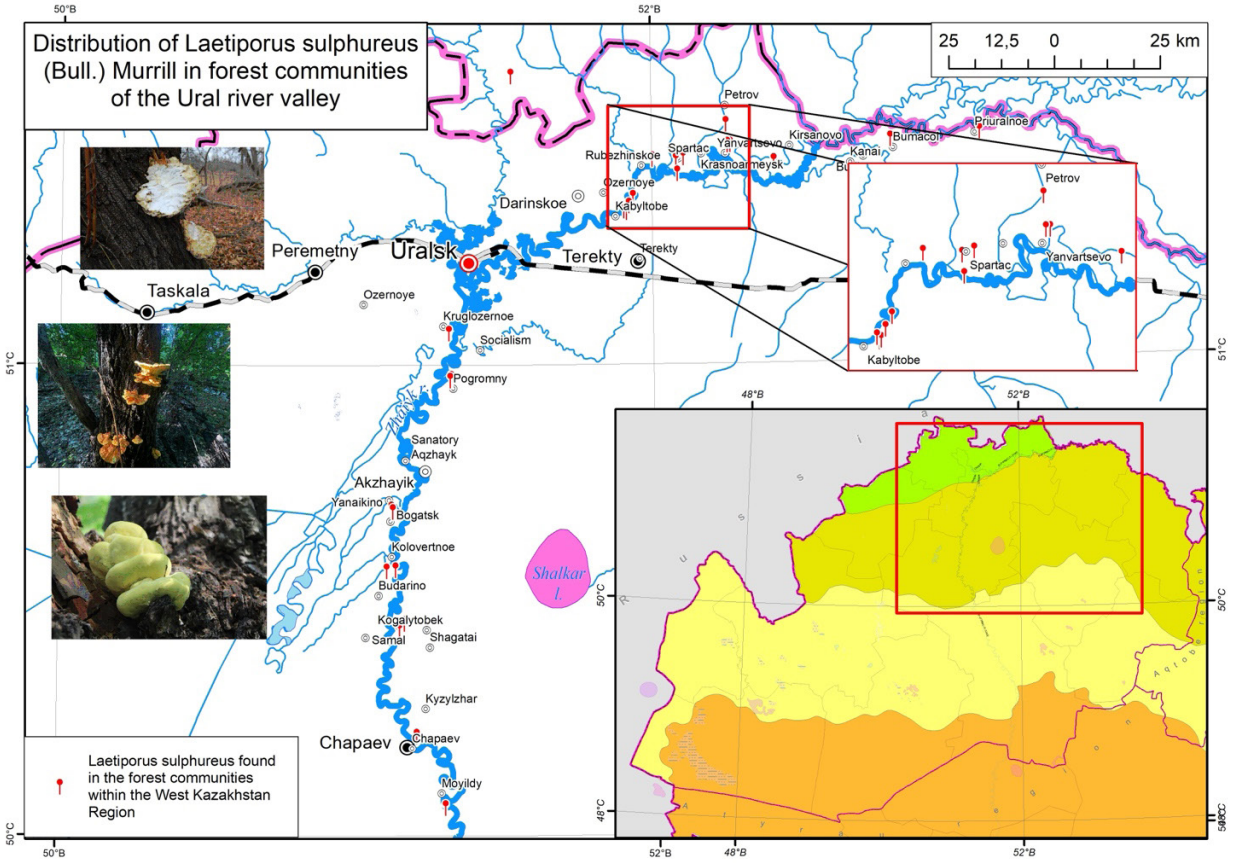

Figure 2 – Map-scheme of *Laetiporus sulphureus* (Bull.) Murrill distribution in in forest communities of the Ural river valley within the West Kazakhstan Region

Laetiporus sulphureus demonstrates a strong presence along the left bank of the Ural River, particularly within mature hardwood forests near Akzhaiyk, Priuralny, and Kabyltobe. These floodplain forests, characterized by dense populations of *Quercus robur* and *Populus alba*, likely provide the structural integrity and moisture retention necessary for optimal development of *L. sulphureus* fruiting bodies, supporting consistent sporulation across multiple sites.

The right bank, while showing slightly fewer occurrences, also hosts significant populations of *L. sulphureus*, especially near settlements such as Yanvartsevo, Petrov, and Kolovertnoye. Mixed hardwood communities, notably those with *Salix alba* and *Populus alba*, offer suitable substrates for fungal colonization. These sites likely mirror the favorable conditions on the left bank, creating similar microhabitats conducive to fungal development.

The consistent association of *L. sulphureus* with specific hardwood hosts like *Quercus robur*, *Salix alba*, and *Populus alba* underscores the importance of substrate composition and stability within its ecological niche. The humid, stable conditions along both banks of the Ural River valley appear to facilitate the species' development, supporting its role in nutrient cycling and wood decomposition in these riparian ecosystems. This distribution pattern establishes *L. sulphureus* as an ecologically significant, hardwood-associated species within the river valley's floodplain forests.

This study offers an in-depth assessment of the ecological distribution and substrate preferences of *L. sulphureus* within the Ural River valley floodplain forests of West Kazakhstan. The marked preference for hardwood substrates, particularly *Quercus robur*, *Salix alba*, and *Populus alba*, suggests that these species provide a favorable nutrient profile, structural support, and moisture retention for fungal colonization. The proximity of these hardwood communities to water sources likely promotes the presence of *L. sulphureus*, indicating its affinity for humid and stable microclimatic conditions.

The observed diversity of forest communities supporting *L.sulphureus* highlights its adaptability within specific ecological limits, especially in

habitats dominated by hardwood species. Although *L.sulphureus* shows flexibility in host species, its selective colonization of particular hardwoods suggests environmental requirements that shape its distribution and persistence in these riparian ecosystems. These insights into bank-specific occurrences and host preferences enhance our understanding of *L. sulphureus* habitat specificity, potentially guiding future research on the ecological functions and conservation needs of this and similar basidiomycetes in temperate riparian zones.

Conclusion

This study highlights essential aspects of *Laetiporus sulphureus* ecology in the forest communities of the Ural river valley within the West Kazakhstan region, especially its reliance on hardwood substrates and particular microhabitat conditions. The strong association of *L.sulphureus* with *Quercus robur*, *Salix alba*, and *Populus alba* emphasizes its ecological role as a hardwood-associated species within these humid forest ecosystems.

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