Nomination

"LENA PILLARS NATURE PARK"

(RUSSIAN FEDERATION)

Proposal for inscription on
THE UNESCO WORLD CULTURAL
AND NATURAL HERITAGE LIST

Prepared by:

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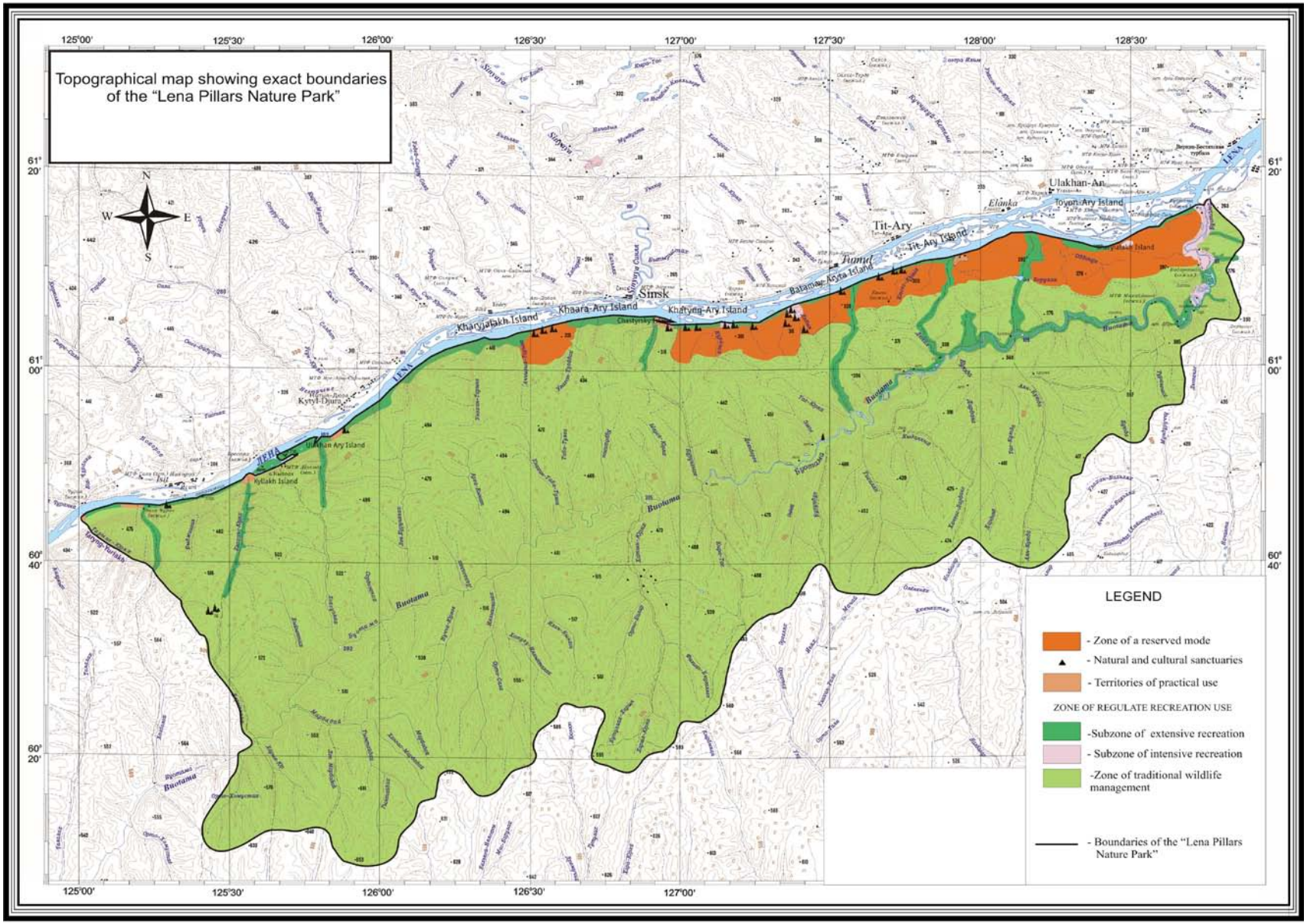
2010

Contents:

Executive summary

State Party	The Russian Federation.
State, Province or Region	Nominated property is located in Khangalassky and Olekminsky Uluses (districts) of the Republic of Sakha (Yakutia).
Name of Property	"Lena Pillars Nature Park".
Geographical coordinates to the nearest second	Nominated property occupies the right bank of the middle Lena River and is bordered by the following geographical coordinates: - extreme northern point: 61°16'30" N, 128°46'20" E; - extreme southern point: 60°06'30" N, 125°58'35" E; - extreme western point: 60°44'30" N, 125°02'00" E; - extreme eastern point: 61°13'20" N, 128°53'00" E.
Textual description of the boundary (ies) of the nominated property	**Northern boundary** of the nominated property starts from the Taryng-Yuryaha River mouth (right tributary of the Lena River), then it goes along the Lena River bank downstream to the Buotama River mouth and then to the Kachikatskaya branch (the south-westernmost tip of the Ary-Basa island). From here boundary goes downstream the Kachikatskaya branch to its crossing point with nameless branch. **Eastern boundary** starts from crossing point of Kachikatskaya branch and nameless branch, goes in south-easterly direction, passes westward of 263 m point. Then boundary comes southwards, passes 276 m point, and appears on watershed of the Lena and the Amga Rivers in upper reaches of the Lyutenge River, left tributary of the Amga River. **Southern boundary** goes in west-south-west direction along watershed of the Lena and the Amga Rivers till the source of the Bes-Yuryah River, right tributary of the Buotama River. **Western boundary** starts from the source of the Bes-Yurah River, goes down to the Buotama River along left the Bes-Yuryah valley side, crosses the Buotama in the mouth of the Bes-Yuryah and goes along the Khanyryaloh River, left tribytary of the Buotama River, till its sources. Then boundary crosses the Lena and the Buotama Rivers watershed, appears on the Taryng-Yuryah River source and goes down to the mouth along its stream way, i.e. to the prime point of description.
A4 (or "letter") size map of the nominated property, showing boundaries and buffer zone (if present)	Topographical map showing exact boundaries of the "Lena Pillars Nature Park".



A3. Topographical map showing exact boundaries of the "Lena Pillars Nature Park".

Justification: Statement of Outstanding Universal Value

The nominated property «Lena Pillars Nature Park» tells us three key-stories about our planet and the early evolution of life, namely: 1) the record of the "Cambrian Explosion", 2) the newcoming story of frozen ground karst phenomenon, and 3) the history of human deifying of a great natural monument.

1a) The site possesses a remarkable world-wide value being the most significant natural monument of the Cambrian Explosion, which was one of the pivotal points in the Earth's life evolution. Due to platformal type of carbonate sedimentation within tropical belt without subsequent metamorphic and tectonic reworking and magnificent impressive outcrops, the nominated property preserve the most continuous, fully documented, and richest record of the diversification of skeletal animals and calcified algae from their first appearances until the first mass extinction event which is excellent documented in parallel in three types of sedimentary basins during the first 35 m.y. of the Cambrian evolution.

1b) The «Lena Pillars» comprises the earliest and the largest, in both temporal and spatial senses, fossil metazoan reef of the Cambrian world. This reef being a site of Cambrian diversification is comparable to the Great Barrier Reef in modern world. The high preservation quality of both skeletal and soft-bodied fossils being coupled with high resolution isotope and palaeomagnetic records as well as with various well-preserved sedimentary fabrics allows researches to solve diverse ecological and evolutionary problems with a precision comparable with the study of modern biotas and communities.

2) Situated within the nominated territory Cambrian carbonates remained to be a place of unique ongoing geological processes now – the only model of recent frozen ground karst of karst plateaus. All the rock massif is touched by karst processes of perennially cryotic rocks under extremely continental semihumid climate conditions. The Lena and Buotama pillars are the only area on the globe where the processes of the fine disintegration of the rocks – cryohydration weathering – dominate in the shaping of carbonate pillar relief. These karst phenomena are enriched by thermokarst processes developed in the area of a great permafrost thickness (up to 600 m) which led to appearances of alases – thermokarst features of almost exclusively Yakutian affinities. The frozen ground karst in combination with thermokarst is an worldwide unique phenomenon of Eastern Siberia and in outstanding kind documented in the proposed property. It is quite different from all karst sites in the World Heritage List, which are located in humid areas. In turn, the semihumid continental climate conditions are expressed in a formation of tukulans which are eolian sand dunes being developed at almost polar latitudes.

3) Cambrian and present-day natural processes finally created Lena and Buotama Pillars known for inimitable beauty. Aesthetics effect of these large-scale rock river banks have no analogue all over the world. Improbable stone sculptures in form of uncountable fantastic pillars, steeples, towers with niches, passages, caves stretch for dozens of kilometers along the

banks of the Lena River and its tributaries. The Lena River itself, which is one of the biggest rivers in the world, is served as a magnificent animated and all times different pedestal for this tremendous scenery framed by the seasonal changing features of the taiga and mountain steppe vegetation.

The nominated area is the outstanding natural property providing an unmatched synthesis of Cambrian geological and palaeontological data which are the basis for our understanding of the far past, evolution of the Earth and of the life on our planet during one of pivotal and dramatic points of its development.

The "Lena Pillars Nature Park" could make a claim for its inscription on World Heritage List according to two criteria: vii and viii. Valuable geological (lower to middle Cambrian strata), paleontological (rich and exceptional fossils and biocenoses including the earliest metazoan reef belt) and unique geomorphological sites (frozen ground karst, thermokarst, and sand dune-tukulan) is combined here with outstanding natural scenic attractions.

Criteria under which property is nominated (itemize criteria)	VII, VIII
Name and contact information of official local institution/agency	Lena Pillars Nature Park. Address: Russian Federation, Republic of Sakha (Yakutia) 678010, Pokrovsk, Ordzhonikidze street, 56 Tel: (411244) 43-896 Fax: (411244) 45-289 e-mail: nppls@mail.ru

1 IDENTIFICATION OF THE PROPERTY

1a. Country (and State Party if different)

The Russian Federation.

1b. State, Province or Region

Nominated property is located in Khangalassky and Olekminsky Uluses (districts) of the Republic of Sakha (Yakutia).

1c. Name of Property

"Lena Pillars Nature Park".

1d. Geographical coordinates to the nearest second

The nominated property is bordered by the following geographical coordinates:

- extreme northern point: 61°16'30" N, 128°46'20" E;
- extreme southern point: 60°06'30" N, 125°58'35" E;
- extreme western point: 60°44'30" N, 125°02'00" E;
- extreme eastern point: 61°13'20" N, 128°53'00" E.

1e. Maps and plans, showing the boundaries of the nominated property and buffer zone

A1. Location of the "Lena Pillars Nature Park" on the map of Russia (page 9 of the Identification of the property section).
A2. Location of the "Lena Pillars Nature Park" on the map of Yakutia (page 10 of the Identification of the property section).
A3. Topographical map showing exact boundaries of the "Lena Pillars Nature Park". Scale - 1:500 000 (rolled and to be found separately from the text).
A4. Geological scheme of the Lena-Aldan region (page 13 of the Description section).
A5. Karst phenomena of the "Lena Pillars Nature Park" (page 17 of the Description section).
A6. Map of forests (page 40 of the Description section).
A7. Landscape map (page 48 of the Description section).
A8. Scheme of zoning and ecotourism development (page 101 of the Protection and management section).
A9. Scheme of the Specially Protected Areas of the South of the Republic of Sakha (Yakutia) (page 91 of the State of conservation and factors affecting the property section).
A10. Geological map of the "Lena Pillars Nature Park". (Annex A10).
A11. Scheme of subcryogenic water bearing complexes of difficult water exchange zone (Annex A11).
A12. Scheme of locally water bearing cryogenic and talik complexes of free water exchange zone (Annex A12).

A1. Location of the "Lena Pillars Nature Park" on the map of Russia.

Atlas Physical Geography of Russia

A2. Location of the "Lena Pillars Nature Park" on the map of Yakutia.

©Atlas of agricultural economy of the Yakut ASSR, 1989

1f. Area of nominated property (ha.) and proposed buffer zone (ha.)

Total square of the property equals to 1 272 150 ha.

As far as there is no economic activity around the nominated territory, a buffer zone is not required for the territory. Besides, the nominated territory borders on local SPAs in the south – Verkhneamginsky, Kyrbykan, Munduruchchu Resource Preserves, and republic SPAs – Verkhneamginsky and Amma Resource Preserves which function as buffer zone (see Fig. 63 on page 91, "SPAs of the Central Yakutia".)

2 DESCRIPTION

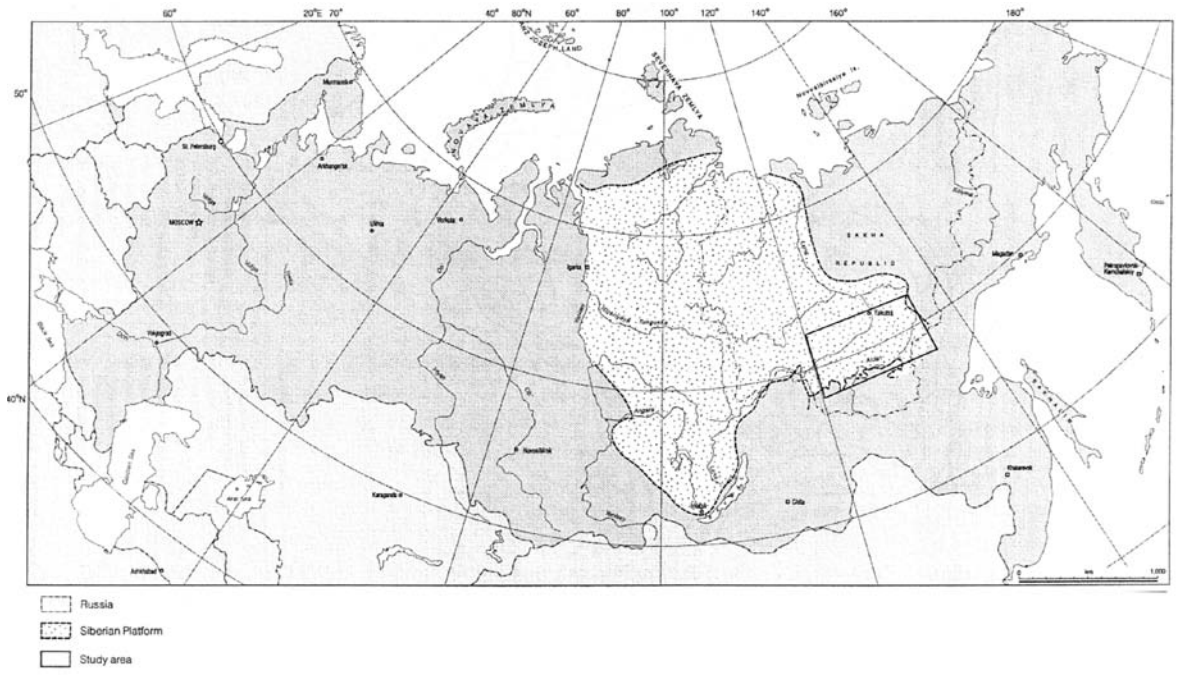
2a. Description of Property

The territory of the "Lena Pillars Nature Park" is located between the middle reaches of the Lena River in the North and the Buotama River basin in the South, in the Khangalassky and Olekminsky Uluses of the Republic of Sakha (Yakutia).

Geology

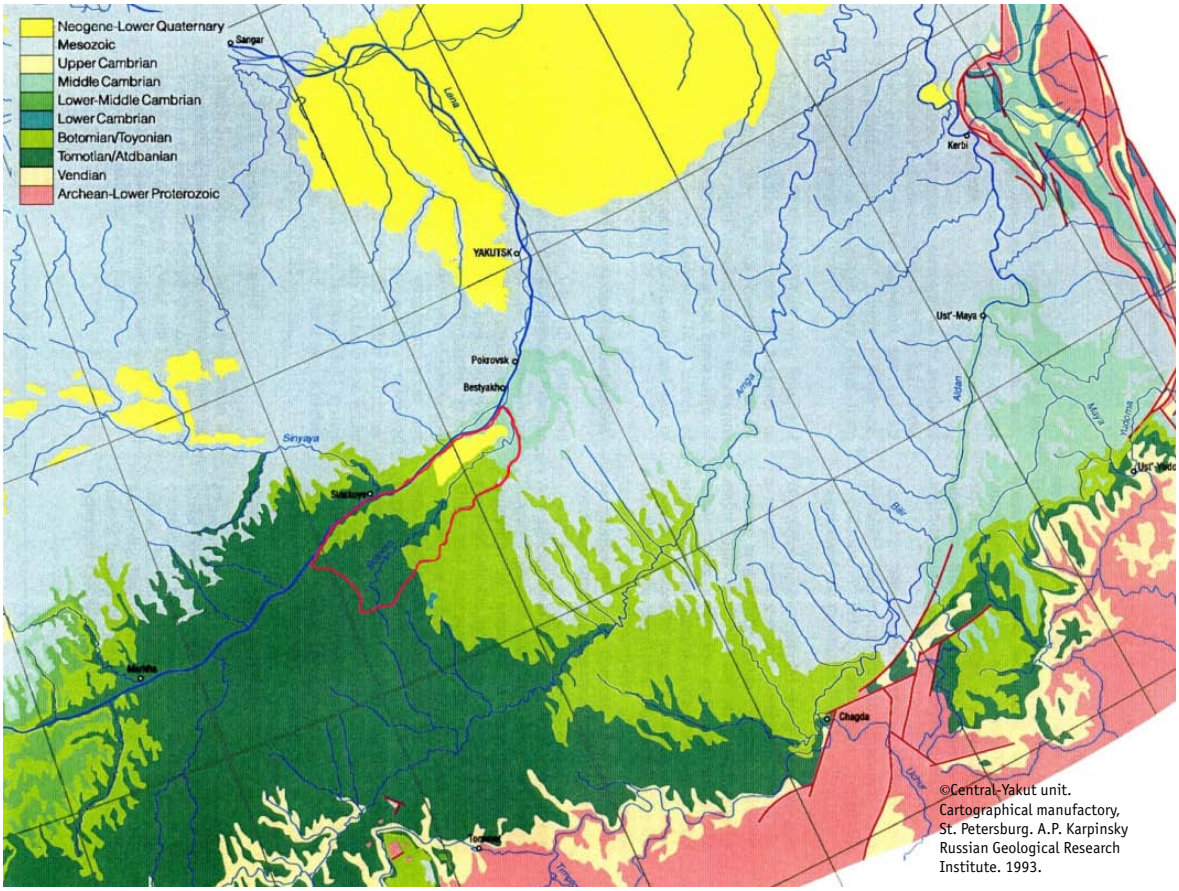
The "Lena Pillars Nature Park" is situated at the northern slope of the Aldan Anteclise at the south-eastern corner of the Siberian Platform. This region was involved in the entire sequence of processes undertaking by the platform as a whole. During its Phanerozoic geological development (since the distraction of Pannotia supercontinent in the Neoproterozoic and until the formation of Gondwana supercontinent in the Late Palaeozoic), the Siberian Platform was an isolated craton, known as Siberia, located largely at low latitudes and joint subsequently by a number of terranes which nowadays built its folded border (Altay-Sayan Foldbelt, etc.). Since the late Mesoproterozoic, the platformal stage sensu stricto of its development began and the submerged eastern part of the Siberian Platform has been little tectonically altered later on. As a result, the Neoproterozoic—Mesozoic succession outcropping here mostly have dips of less than two degrees. Of those, the latest Ediacaran and Cambrian marine fossiliferrous carbonates are most widely distributed here while the Ordovician and Silurian ones were denudated during the pre-Jurassic uplift and the Jurassic transgression. Here the Jurassic system is represented by both shallow marine and continental siliciclastics containing in places dinosaur bones. A weak tectonic activity of this region in the Jurassic, probably, related to collision of the Siberian Platform with terranes of the Verkhoyansk-Chukchi Foldbelt, brought out an appearance of some thin dolerite dykes which, however, do not disturbed the principal

Fig. 1. The territory of the Siberian Platform.



area of Lower Palaeozoic platformal strata. The Cenozoic sediments are represented mostly by Late Neopleistocene alluvial deposits related to the development of permafrost complex and containing a relatively rich assemblage of woolly mammoth fauna. Bony remains of these animals found practically in the same place present an important testimony of the mammoth fauna evolution. This assemblage includes bones which are well-preserved for a DNA analysis. The post-glacial Holocene complex includes alluvial, lacustrine, bog, and eolian deposits (for instance, "fossil" sandy dunes – tukulans). The Lena River valley started to form by the late Neogene and finally brought out the present rocky relief while the Pillars began to emerge during the Neopleistocene and their columnar appearance is mostly due to high diurnal temperature fluctuations and frozen ground karst processes.

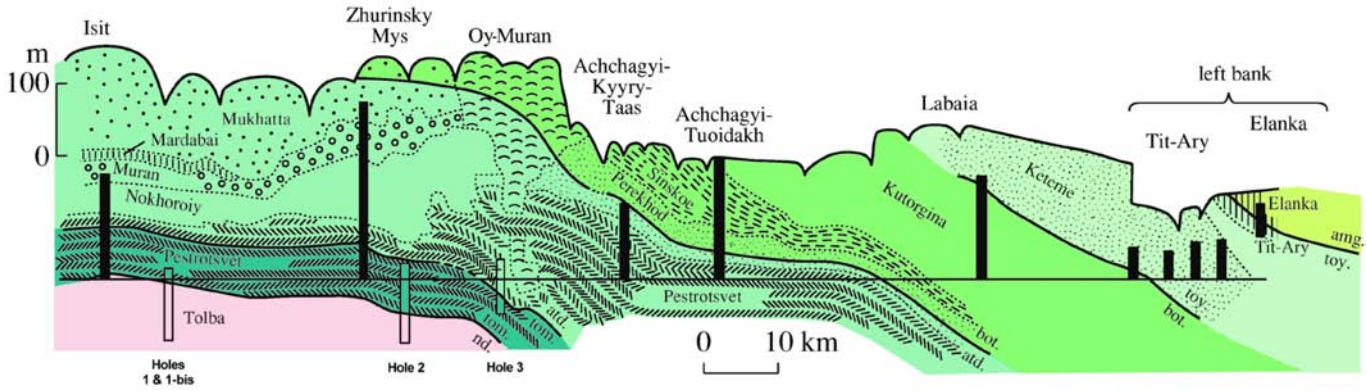
However, the principal sediments of this area are the lower to lower middle Cambrian richly fossiliferous continuous carbonates of various marine genesis. This strata characterise the Fortunian Stage, the Stage 2 (Terreneuvian Series), the stages 3 and 4 (Series 2), and the Stage 5 (Series 3) of the International Stratigraphic Chart issued by the International Commission on Stratigraphy (2008) and, thus, embraces an interval of c. 542-506 Ma. Those are the rocks that build the Lena Pillars as well as the Buotama Pillars themselves. The Cambrian sedimentary sequence commences with subtidal to intertidal mudstones of the Tolba Formation (Fortunian Stage) which is transgressively overlain by largely red argillaceous mudstones of the Pestrotsvet Formation (160-195m in thickness), which encompasses a large number of archaeocyathan-calcimicrobial reefs and



A4. Geological scheme of the Lena-Aldan region.

reefal complexes of the Cambrian stages 2 and 3. The 20-kilometres wide Oy-Muran Reef Massif forms a carbonate barrier on the border of inner (western) and outer (eastern) basins. The Oy-Muran Reef Massif itself composes of multiple isometric archaeocyathan-calcimicrobial bioherms of dome-like shape up to 5 metres in diameter. (Archaeocyaths are extinct calcareous rigid aspiculate sponges and calcimicrobes are calcified probable cyanobacterians.) The inner basin facies are represented mostly by various back-reef limestones such as cross-bedded ooid-shoal of the Churan Member and shelly grainstones and calcimicrobial boundstones of the Marbaday Member and the Mukhatta Unit (80-120 m in total thickness) as well as by intensely burrowed lagoonal dolostones of the Nokhoroy Member (40-80 m in thickness). The outer basin facies comprise deep subtidal Perekhod Formation (25-75 m in thickness) containing spongal clotted mud mounds and following dysoxic finely bedded calcareous mudstones of the Sinsk and Kutorgina formations (190-280 m in total thickness) bearing features of deep-water slope deposition. Later on (during the Cambrian stages 4 and 5) due to a ramp progradation, reefal belt displaced eastward at present coordinates and the uppermost Keteme, Tit-Ary, Elanka, and Kychik formations (up to 360 m in total thickness) are represented mostly by lagoonal dolostones and back-reef facies including abundant carbonate tempestites.

Fig. 2. Profile of the Cambrian formations along the Lena River (after Savitskiy & Astashkin, 1979). Black columns mark sections sampled for carbon isotopy and paleomagnetic properties, white columns mark drillholes, horizonal line shows a river water level.



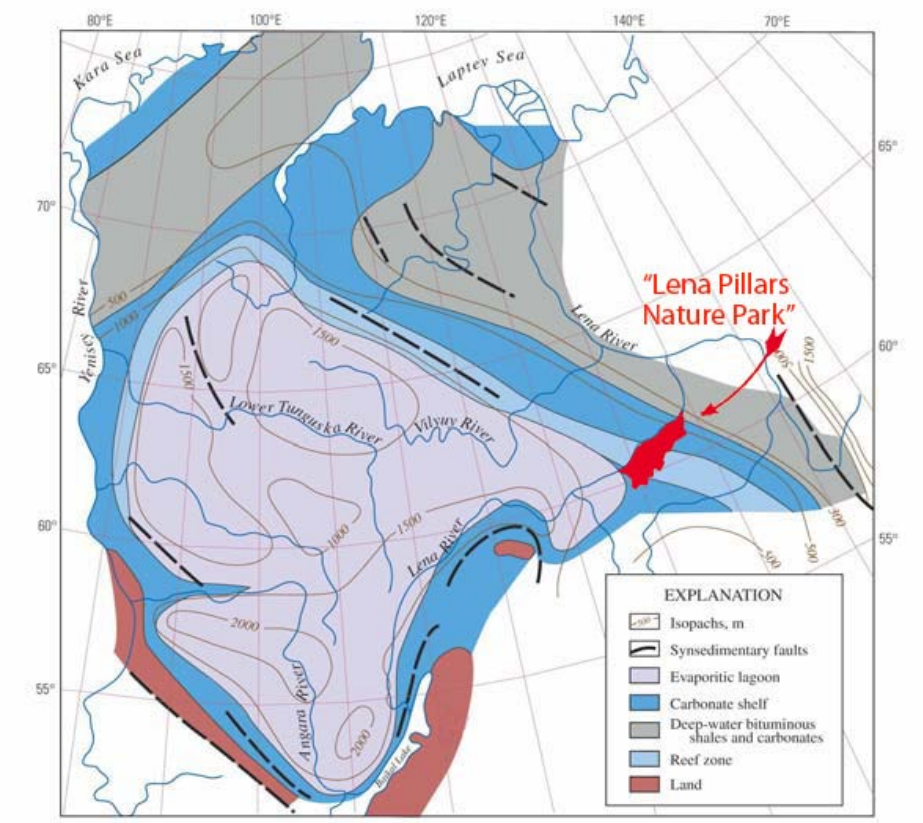


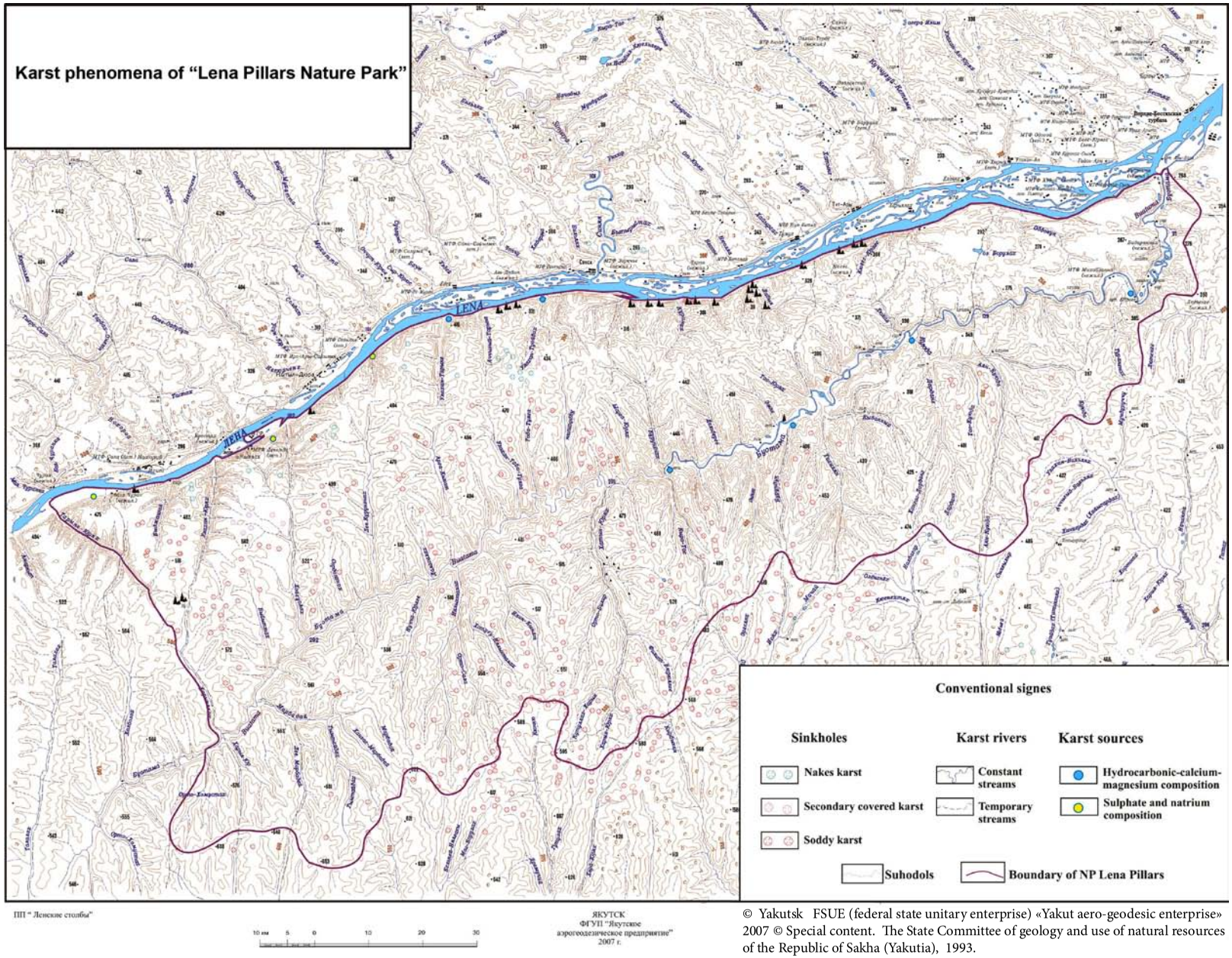
Fig. 3. Palaeogeography of the Siberian Platform in the early Cambrian (based on Savitskiy & Astashkin, 1979).

Karst phenomena and Relief

Karst phenomena of the "Lena Pillars Nature Park"

Frozen ground karst of the nominated property is the emblem of the plain plateau: karst develops in the limestones and dolomites dated by Lower Cambrian (thickness 400-500 m outcrop) in the area of the spread of continuous permafrost in the Sub-Arctic extreme continental and dry climate. In spite of the insignificant quantity of the precipitations falling on the territory of the "Lena Pillars Nature Park", karst processes are widespread here. The main reason is the role of the permafrost in relation to the water which is the principal factor of the karstification. On the one hand, in spring and summer periods the evaporative capacity practically equals zero as a consequence of the low temperatures of the soil. Moreover, in the warmer parts of the year the chilled surface condenses actively the water from the air because of the considerable difference of temperatures between the air and the soil. On the other hand, the permafrost blocks the quick filtration of the precipitations into karst massifs. That is the reason of the accumulation of the water, causing the karst processes on the surface. Therefore the development of karst relief in the regions with permafrost needs some times less of precipitations than the ones where the permafrost is absent (Trofimova, 2007). Additionally, the infiltration of the summer precipitations along the deep fissures of carbonate rocks, as well as the considerable snow accumulation, causing the warming impact on the cryolithozone, have done much to support the activity of karst process on the territory of the "Lena Pillars Nature Park". Moreover, the factor of carbonate reaction plays a significant role in the development of the processes considered: the displacement of the temperature maximum lowers the base of the seasonal thawing layer, favoring the formation of intra-permafrost taliks, are the features of the regions with the carbonate karstifying rocks.

Fig. 4. Prilenskoe plateau. *Photo by N. Kalitin*



A5. Karst phenomena of “Lena Pillars Nature Park”.

So, three main morpho-genetic types of the karst are developed here: naked, secondary covered and soddy ones. Naked karst is observed mainly in the valley band of the right bank's parts of Prilenskoe plateau and in the bedrock slope of the valley of Lena adjacent to the one, where the karst rocks are bared immediately on the surface in consequence of the rainwash of the loose deposits. Secondary covered karst is noted both on the erosion terrace of Lena, and on the valley band of Prilenskoe plateau, as well as on the watershed of the Lena, the Buotama and the Amga Rivers, covered by the cryogen-eolian sediments. The soddy type is one is marked on the slopes of the valleys, where the surface loose cover usually is unconsiderable.

The following surface and underground karst forms are fixed on the territory of the "Lena Pillars Nature Park".

1) Numerous oval karst *sinkholes*, mainly cone-shaped, more rarely, asymmetric, and saucer-shaped ones are present in the area. The formation of the sinkholes is due to the karst process, as well as to the processes of the frost and cryohydratational weathering, favouring the increase of karst rock surface's solution and the growth of the activity of the erosion processes. The diameter of sinkholes varies from 5-10 to 20-40 m and the depth of 0,5 to 10 m. Some sinkholes, placed on the bottom of dry channels, have in diameter 100-150 m and a depth of 20-30 m. Saucer-shaped ones are characterized by the sizes up to 50-100 m in diameter and 0,5 m in the depth. In the conditions of naked karst the cleft ponors are fixed very often at the bottom of sinkholes. Ponors, found at the bottom of sinkholes in secondary covered karst, indicate the presence of the cleft karst limestones under the sand deposits, providing the drainage of the surface waters. The last is the confirmation of the recent activity of karst processes.

The following peculiarities are revealed in the disposition of the sinkholes. The majority of them are concentrated according to certain lines which are coinciding with small erosion depressions. The orientation of these depressions corresponds to the main systems of the tectonic fissuring of karst rocks – diagonal and orthogonal, developed on the nominated territory. The sinkholes emerge on the surface of the plateau.

Fig. 5. Collapse sinkhole of Ulakhan-Taryn.
Photo by V. Samsonova

Fig. 6.

Fig. 7.

Fig. 6, 7. Karst sinkholes in the mouth of Buotama. *Photo by L. Kipriyanova*

Fig. 8. Ponor at the bottom of sinkhole. *Photo by L. Kipriyanova*

In dry season the sinkholes are without water. A humid diluvium cover is observed at the bottom of the deepest ones. These sinkholes are bushy, but sedges are growing at their bottoms. The sinkholes are filled by rain. As time goes on the water from these lakes penetrates into the clefts and the lakes disappear.

Fig. 9. Dry channel of Labiya. *Photo by V. Samsonova*

2) The formation of the karst-erosion valleys with the temporary flow – dry valleys, having the local name – *suhodol* was caused by the coalescence of karst sinkholes, situated along main tectonic systems. The length of suhodol achieve more than 10 km: for the river Kuuda there is 21 km, for the stream Arga-Kinat – 15 km, for the stream Tigilyan – 10,5 km, etc. M. Pulina and J.-N. Salomon (2005) consider the suhodol as the classic form of the cold karst.

3) *Karst lakes* are formed in consequence of the coalescence of the several neighbouring karst sinkholes in conditions of the filling of karst cavities in the cleft limestones by the sandy-clay deposits. The largest lakes are placed on the watershed area of the Lena, the Buotama and the Amga Rivers occupying the depressions by the sizes till a few kilometres in diameter. (Obviously, these depressions are the relic of paleokarst). Usually the shores and bottoms of the lakes are frozen, their depths don't exceed 2 m (Korzhuev, 1961; Spector, Spector, 2009). But small drainage lakes (till 10-30 m in diameter), related by the short parts of the stream channels, are the most spread.

Fig. 10. Lake on the watershed of the Lena and the Buotama Rivers (satellite image).

Small sizes, oval forms and steep high shores (up to 5 m) are the confirmation of karst origin of the lakes. Frequently the limestones are exposed on the shores of the water bodies, separate debris of the limestone are observed at the bottom of the lakes. Processes of landsliding and solifluction are exposed on the steep slopes of the water bodies.

Mineralisation of the lake waters is less 100 mg/l. The last indicates the damping of solution processes and the recharge of lake waters only by the atmospheric precipitations.

4) *Dissappearances of rivers and streams* is the feature of the regional hydrographical network. With the exception of the Buotoma River, all karst rivers and streams of the nature park have the interrupted water cources either in the head reach or in the middle

course and lower reach, by example river Marbaday, streams Nucha-Uryage, Arga-Kinat, etc., during which the karstholes in the form of sinkholes and clefts, frequently with the ponors, are fixed in the river beds.

5) *Karst sources* are represented by two types: edge low-pressure ground waters of the hydrocarbonic-calcium-magnesium composition (their mineralisation is 200-400 mg/l), supplying by the aquifers, situated supra and intra of the permafrost, and related with the taliks in the slope foots; and waters under the pressure of the sulphate and natrium composition (their mineralisation reaches up to 2000 mg/l), belonging to the deep aquifers, situated intra and beneath of the permafrost, which are unloaded to the bottom of the rivers and streams.

The edge low-pressure sources are observed more often. As a rule, the ones are characterized by the small debits and by the rough change of the regime and chemical composition in course of the year. Under the pressure sources are distinguished by the considerable debits (till several tens of litres per minute) and by the constance of regime and chemical composition.

6) Specific forms of karst relief – *karren*, are noted on the watershed of Lena and Buotama. The karren were formed in the conditions of the naked karst on account of the uneven solution of the karst rocks. Rock-rills karren (Rillekarren after A. Bugli) are fixed on the steep limestone slopes in the form of the small and narrow (till 2-3 cm) parallel scallops, orientated according to the dip of the slopes. The scallops are separated by the rough crests. Cleft karren – named "limestone pavements" – (Klaftkarren) were revealed on the smooth surface, where the water flow down slowly, along the clefts dissecting the rocks (predominantly by the orthogonal and diagonal directions). Sometimes the shallow, named kamenitza, with the flat bottoms and hanging over walls – basins of solution, are observed. The sizes of kamenitza in diameter reach 10-15 cm at the depth of 5 cm. Karren are destroyed very quickly because of activity of the cryogen weathering processes of the outcropping limestones.

Lena pillars are the peculiar form of the underground (deep) karst, dissected by the Lena River under episodic incisions into Lena plateau. The pillars stretching along the shores of the Lena River both in the form of the separate pillars, and in the form of the cogged walls. The height of the pillars achieve 200-350 m. Development of deep karst is associated with the work of intra and beneath permafrost waters.

Fig. 11. Lena Pillars. *Photo by P. Kolosov*

Lena Pillars were formed predominantly 400 thousands years ago (Spector, Tolstihin, 2004). By now the Siberian platform is lifted for 200 m owing to the tectonic movements, causing the deep incision of the Lena River valley and the increase of karst process activity. Every small fissure in carbonate massif was exposed to the karst process including the solution and export of the rocks. As a result of this, on the one hand, the widening of the fissures and the separating the next blocks from the main massif of the rocks was effected, and on the other hand, the formation of numerous niches, clefts, sheds, karst arches, as well as the small caves (channels) was carried out.

Fig. 12. Fissures widened in Lena Pillars. *Photo by V. Ryabkov*

Fig. 13. Karst arch. *Photo by L. Kipriyanova*

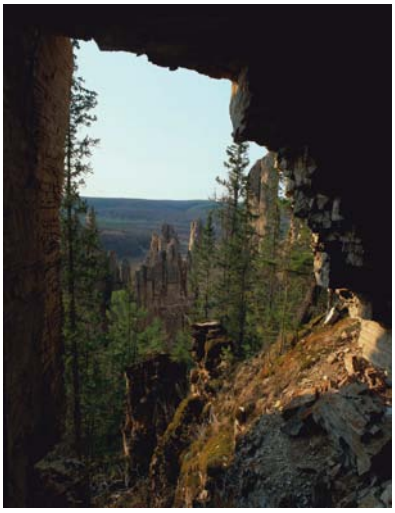


Fig. 14. Karst niche. *Photo by V. Ryabkov*

The sizes of niches, clefts and sheds are small; up to 2 m in the width and to 3-4 m in the depth.

The disposition of the groundwater flow channel fragments on the different levels indicate the periods of the decrease of the Lena River incisions which are characterized by the most favourable conditions for the horizontal circulation of underground waters. Underground galleries are marked in the valley of the Buotama River too. Karst caves have lengths up to 30 m.

Fig. 15. Enrances of cave Tit-Ary.
Photo by L. Kipriyanova

Fig. 16. Scallops in cave Tit-Ary.
Photo by L. Kipriyanova

Fig. 17. Dead end in cave Tit-Ary.
Photo by L. Kipriyanova

Fig. 18. Undeground gallery in valley of the Buotama River. *Photo by V. Samsonova*

Fig. 19. Fragments of the ground water flow channels.
Photo by V. Spector

Numerous split cavities, situated along the clefts of unloading of the cliff face parallelly to the river, are widespread on the upper parts of valley of the Lena River. Its sizes reach to 50-100 m length and 0,5-2,0 m width. Solution pipes and natural pits are the doubtless evidence of the activity of karst processes on the nominated territory.

Fig. 20.

Fig. 21.

Fig. 20, 21. Clefts of unloading of the cliff face valley of Lena. *Photo by V. Spector*

Fig. 22. Karsthole. *Photo by V. Spector*

Fig. 23. Solution pipe. *Photo by V. Spector*

Fig. 24. Natural pit. *Photo by V. Spector*

At present the cryogenic weathering of the limestones, as well as the gravitational-slope, karst, fluvial and abrasion processes play the important role in the recent modeling of Lena Pillar relief.

Relief

The Park's area is located mainly within the low bedded denudation plateau with absolute watershed points between 200 and 400 m. Smooth relief is interrupted at areas of original rocks exposures at river valley sides. The Park's area is located at the south-western edge of the vast Central Yakutian plain, which gradually turns into split Lena plateau to the west of Erge-Echite creek. The boundary between these geomorphologic structures lies along watersheds with absolute heights about 300 m.

The relief of the "Lena Pillars Nature Park" is a bedded denudation plateau formed as the result of transformation of ancient Paleozoic structures under influence of several erosion and denudation cycles after Paleozoic era. Features of this prolonged continental development of the area are shown in the modern relief.

Along the Lena River valley, the low plateau level is generally observed, with absolute heights below 400 m (average 200-300 m). Sharply expressed high plateau level is located in the west outside the nominated property. Within the area of the Nature Park, the plateau is vastly denuded. Here its surface is cut by valleys of rivers and creeks into separate round-loaf-like flat-topped massifs. In the area of the Buotama River mouth, the water divides are narrowed and look like slender ridges.

In the valley part of the plateau, for instance, in the Lena Pillars area, Cambrian limestone is cut into blocks series by a complex system of cracks. Along these cracks, blocks break off into abrupt rocks. Depending on the decay degree, the blocks fall apart into pillars, steeples, towers and separate skerries quite often corroded by small caverns and niches.

Ubiquitous spreading of cavernous limestone is the reason of karst meso- and micro-relief forms development. Karst is often displayed at separated parts of the plateau, where it is actively developed at slopes and small creeks' beds. Besides this, karst is concentrated in areas of circulation of ground and subsoil waters.

Thermokarst relief forms are confined to super flood plain terraces and to areas of talus accumulation, with polygonal vein ice taking part in cryogenic construction of sediments. They are typical mostly for the left bank of the Lena River.

Where the Lena River cuts through limestone, riversides are typically rocky. In many places such banks are split by deep perched valleys – creek valleys and less deep erosive ravines. Their outfalls often do not reach the Lena River line and bear on either towpath, or surface of low terraces, creating debris cones there.

As a whole, the examined area is a transitional zone from the high western parts of the plateau to the multiple terraced surface of alluvial valley of Central Yakutia.

The latest and modern uplift of the area has led to deep cutting in of valleys of small rivers, and to active denudation development at original slopes, which finally has caused significant partition of relief in valley parts of the plateau.

Fig. 25. The valley of the Buotama River - right tributary of the Lena River. *Photo by V. Ryabkov.*

Relief forms related with the perennial permafrost

Most well developed cryogenic processes are cryogenic weathering of rocks, permafrost karst, thermokarst, and frost shattering.

Cryogenic weathering is most intensive at slopes. The recent lifting of Lena plateau contributed to activation of cryogenic weathering, evidenced by denudated rocky slopes of the Lena River and large volumes of debris under them.

Permafrost karst is widespread. There is both deep underground and ground karst. Deep karst was most active before the appearance of permafrost. Deep caverns are usually filled with fine materials, however, at present they are frozen. Ground karst results in karst dolines and depressions. Their diameter can reach 20-40 m, and they are as deep as 5-10 m (Korzhuev, 1961). Usually they are fixed by plant cover and are filled with fine materials. Karst lakes are widespread in the region, especially at the Lena-Buotama interfluves.

Thermokarst is developed on high terraces of the River Lena that consist of sandy-loam lake-alluvial deposits. Thermokarst relief forms are found at points of repeat-vein ice thawing. Such landscapes are represented by polygonal-subsidence forms of microrelief (bylar in Sakha language), primary thermokarst depressions (dyuedya), full-flowing thermokarst lakes (tympy), and upland thermokarst depressions (alas).

Frost shattering is common for flood plain areas and dealluvial trails with the finest clay deposits. Processes of frost shattering going on in seasonally thawing and seasonally freezing layers are observed everywhere. Evidence of such processes on the ground can be seen in the formation of a slightly uneven relief.

Hydrography

The nominated property is located on the right bank of the great Siberian river Lena. The drainage area of the Lena equals 2490 km^2 and occupies the 8-th place in the world (Mostakhov, 1972). Starting from the Baikal Ridge branches, it is running to the Arctic Ocean, with a total length of 4,400 km. The Lena river is filled up with the waters of over 545 tributaries more than 10 km long, with annual average water discharge of about 1700 m^3/sec (Glushkov, 1996). Tremendous masses of water transfer great amount of heat from the south to the north, where insufficient thermo-supply is the main limiting factor. In such a way the Lena not only forms unique mezzo-climatic conditions for plants and animals inhabiting its shores, but also provides a unique «ecological channel» for southern species of flora and fauna, entering far to the North (Solomonov, 1998).

Fig. 26. Panorama of the Lena river from a viewing point. *Photo by V. Ryabkov*

In the region of the Lena Pillars the river is 5-10 km wide. Just from the concerned point the Lena river bed changes its character. Sandbanks give place to numerous big and small towheads, and the left bank is isolated from a fairway by nearly continuous chain of islands. Due to plenty of islands, sandy rifts and shoals Lena has a very instable fairway in this section. It is notable that many big islands are in fact chains of smaller ones (Korzhuev, 1959).

In the region of the Lena Pillars there is a very peculiar drainage network, associated with the main tectonic fractures what determines rectangular structure of the modern river drainage to a large extent.

In contrast to other, more northern parts of Central Yakutia, lakes are not numerous and rather small here.

The main rivers are Lena and its right tributary Buotama. Other streams are mainly temporary ones and form visible run-off only in spring period or in rainy seasons.

Large water masses of the Lena river form peculiar conditions that leave their traces not only in form of deeply developed right bank, being in fact the Lena Pillars, but also play essential role in forming of unique climate of this region.

Climate

The climate of the "Lena Pillars Nature Park" is unique too: annual temperature difference reaches 100°C, precipitation is low (like in steppes or semi deserts), and the solar energy in summertime is as high as in the regions of Central Asia. All these factors result in a unique sharply continental climate, but at the same time this territory is covered by middle-taiga forests. Large water masses of the great Siberian river Lena also contribute their share in formation of unique meso-climatic conditions for Central Yakutia.

The strong continental climate is a prerequisite for the unique phenomenon of frozen ground karst (low precipitation, but additional water from air wetness condensation at frozen ground, Criteria VIII). It is also the reason for the outstanding seasonal changes of landscape features (related to Criteria VII).

Considering its geographical location, the Lena Pillars Nature Park is situated in Central Yakutia with a severe and peculiar climate. It is stipulated by geographical position of the region and the character of prevailing relief. Due to considerable remoteness from the Atlantic Ocean and natural barriers from the Pacific Ocean (high mountains of the Southern and Eastern Siberia), the named two oceans produce practically no influence on the climate of Central Yakutia. But at the same time this region is easy accessible to invasions of Arctic air masses from the Arctic Ocean, that greatly influence the climate.

All these factors result in a rather distinctive, pronounced continentality of this region's climate, with considerable annual ranges (Korzhuev, 1959).

Fig. 27. The Lena river is covered with ice till June. *Photo by V. Ryabkov.*

Winter in Central Yakutia is rather long (over 6 months) and cold (-40, -60°C). In this season a severe winter Siberian anticyclone prevails here. Under the conditions of anticyclone a clear, frosty, dry and calm weather occurs. Stagnation of air stipulated by light breeze and clear sky produces great cooling and sharp temperature inversion. Under the conditions of clear and calm weather air temperature falls down to -50, -60°C (Gavrilova, 1973).

Spring is very short and late here. It is characterized with unstable weather, wind gain and relatively more often precipitation. In spring the temperature grows quickly owing to supply of warm air from the south and intensive income of solar energy.

Summer in Central Yakutia lasts for 3 months (from June until August). The continentality of the climate plays a great role. In this period mean daily temperature of the air exceed +10°C. At daytime in summer the temperature can reach +30, +35°C. Due to significant warming up a diffuse depression forms here. As a result of strengthening of cyclonic activity and enhancement of absolute air humidity summer is the time of maximum precipitation, though it is rather modest – about 120 mm a year (Gavrilova, 1973).

Autumn is also very short like spring lasting from late August till September. It is characterized by strengthening of anticyclone activity that produces establishing of clear and frosty weather. Cyclones are accompanied with arctic air masses causing immediate lowering of temperature.

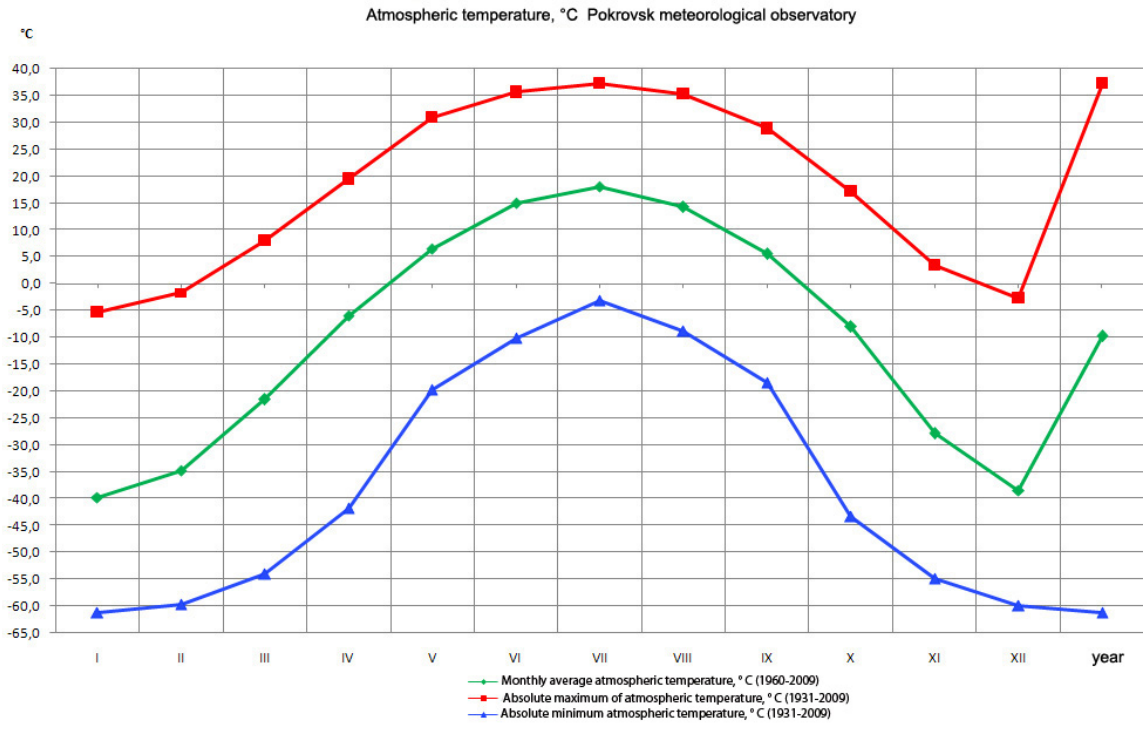


Fig. 28. Atmospheric temperature, °C Pokrovsk meteorological observatory

Average annual precipitation equals to 251 mm in Pokrovsk close to the Lena Pillars Nature Park. Maximum depth of snow cover in the forests is 39 cm, and in the fields - 33 cm. Average date of snow cover formation - 13.X, the earliest – 28.IX, and the latest one – 26.X. Melting of seasonal snow cover occurs in the 1-st decade of May. Total number of days with snow cover is about 203 (Kononov, 1982).

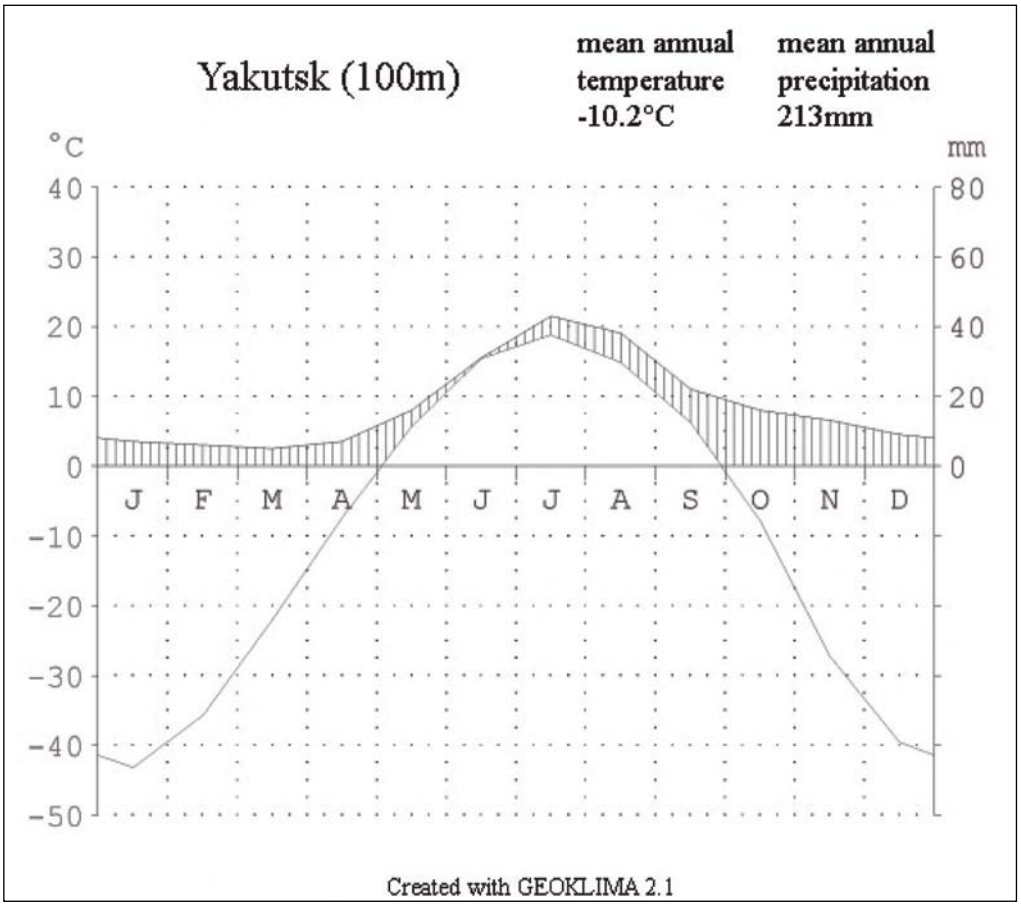


Fig. 29. Climate diagram in the format by Walter and Lieth.

Table 1. Pokrovsk meteorological observatory data for 1960-2009

Parameter	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Year
Monthly average atmospheric temperature, °C (1960-2009)	-40,2	-34,9	-21,9	-6,4	6,2	14,9	18,2	14,4	5,7	-7,8	-27,8	-38,4	-9,8
Absolute maximum of atmospheric temperature, ° C (1931-2009)	-5	-2	8	20	31	36	37	35	29	17	3	3	37
Absolute minimum atmospheric temperature, ° C (1931-2009)	-61	-60	-54	-42	-20	-10	-3	-9	-18	-43	-55	-60	-61
Monthly amount of precipitations, mm (1960-2009)	9	7	6	8	20	36	46	42	32	18	15	10	249

Permafrost soils

One of the specific features of natural environment of Yakutia is continuous spreading of permafrost. That is frost penetration at considerable depth inside the earth's crust, with the frozen condition of permanently frozen ground lasting for years, centuries, millenniums. Layers of permafrost grounds with zero or below zero temperature form a permafrost zone. Under the conditions of Central Yakutia depth of permafrost depends on many factors, among them: relief character, drainage, soil supply with moisture, type of vegetation, etc. In well-drained areas permafrost lies deeper than in over wetted lowlands; and in forests depth of seasonal soil thawing is considerably smaller than in open spaces.

The permafrost soil is the prerequisite for the unique phenomena of frozen ground karst and thermokarst because of the air wetness as additional water to low precipitation. Moreover, the permafrost blocks the infiltration of the superficial water into karst massif.

Depth of permafrost soils. Existing cartographic surveys (e.g., Melnikov, 1970; Fotiev et al, 1974; Baranov, 1977; Engineering... 1977; Kondratieva, 1989; Soloviev, 1991) show that the data on the depth of permafrost soils is quite diverse, ranging from 100 to 400 m at watersheds and 100-200 m in river valleys. However, there is no factual data obtained by drilling within the bounds of the described region.

In neighbouring regions, south of the Lena Pillars Nature park territory, according to S.M. Fotiev et al. (1974) in the upper reaches of the River Khayisardakh, and according to B.V. Volodko (Bosikov, Vasiliev, Fedorov, 1985) in the valleys of rivers Sylgylyr and Ulu, Jurassic and Cambrian rocks are frozen to the depth of 600 m and below. To the west, in the region of the Tuolba River lowlands the depth of permafrost soils is 200 m (Sevonko, 1952). Based on this data it is possible to estimate the maximum depth of permafrost soils at watersheds exceeding 400 m.

Widespread development of karst and many ground exits of inter- and under permafrost waters show that the permafrost is not monolithic. Under the riverbeds of the Lena River tributaries above the permafrost taliks may be developed indicated by nearby poplar forests.

Cryogenic composition was studied in detail during the 1:200 000 geological survey (Gravis, Konchenko, 1986; Drozdov, Ponamoreva, 1986; Gravis et al., 1987). Cracking of limestone causes the development of fracture cryogenic textures to the depth of 20 m. In cavernous karst rocks icing can reach even greater depths. For example, in Buotama-Amga interfluves icy content was discovered in hydrogeological wells at the depths of 300-400 m. The total humidity is 15%.

Eluvial deposits of watersheds contain little ice. In coarse eluvium crusty and massive cryogenic textures with a humidity of 5% are prevalent, and in loam eluvium massive and lens shaped cryogenic textures with a humidity of up to 20% are common.

Eolian sands are characterised by massive cryogenic texture with a humidity of up to 5%. Lake thermokarst deposits have a broken-lens, irregular-latticed and massive cryogenic textures with a humidity of 25 to 40% depending on the peat content of deposits.

Alluvial deposits of low terraces sometimes contain ground and ice veins with a strength of 3-5 m, and top down view width of 0.5 m. Sand deposits with massive cryogenic texture are characterised with a humidity of up to 20%, sandy-loamy up to 30-40%.

Lake-alluvial deposits of high terraces containing repeat-vein ice are found in inter-alas spaces. Their humidity reaches 40-50% and cryogenic structures are lens shaped and lens-latticed.

The depth of seasonally thawing layer and the temperature of rocks on the territory of the Lena Pillars Nature Park was not researched specifically, that is why we used the results of such research conducted in neighbouring regions (e.g., Bosikov, Vasiliev, Fedorov, 1985; Stashenko, 1985; Varlamov, Skachkov, Skryabin, 2002). Spatial distribution of these important features of permafrost depends on landscapes. On karst subtype of upland locality type ledum-blueberry-cowberry and cowberry-green larch forests are prevalent. The depth of seasonally thawing layer (STL) under ledum-blueberry-cowberry cover in loamy soil with detritus content is 1.2-1.4 m, and under cowberry-green cover is 0.9-1.1 m. In such landscapes the temperature of rocks varies from -1.5 to -2.5° C.

Upland sandstone subtype of locality is present sporadically on the far north-east of the Nature Park. On drained watershed areas under bearberry-lichen pine forests on sands the depth of STL is 2.0-2.2 m, and the rock temperature is -1.0 to -1.5°. Under bearberry-cowberry pine forests the depth of STL changes from 1.8 to 2.0 m with the rock temperature of -1.5 to -2.0°. On relatively weakly drained areas with ledum-cowberry larch forests in sandy-loam deposits the depth of STL drops to 1.2-1.4 m. The rock temperature is -2 to -2.5°.

The slope type of locality is characterised by contrasting conditions of active layer and soil temperature regime formation. Within the frames of the described region there is a clear distinction between shadowed forested and highly illuminated steppe slopes depending on exposure. On the slopes of northern exposure under alder-cowberry-green larch forests in fragmental rocks with loamy filler the depth of STL varies from 0.6 to 1.3 m. The rock temperature is between -2 and -4°. On steppe slopes of southern exposure the depth of STL is 2.5-4 m on average. Rock temperatures on such locations can be above 0°, and below zero values may reach -1.5°.

Ancient terrace type of locality is composed of sandy-loamy deposits and covered in cowberry and cowberry-green larch forests. The depth of STL here varies from 0.8 to 1.4 m, and the rock temperature changes from -2 to -3.5°. At burned out locations the depth of STL rises to 1.6-2.2 m.

Sand-ridge type of locality consists of the following prevalent stows: lichen-bearberry pine forests (STL 2.0-2.5 m, rock temperature -0.5 to -1°), bearberry-cowberry larch-pine forests (STL 1.8-2.0 m, rock temperature -1.0 to -1.5°), cowberry larch and cowberry-green birch-larch forests (STL 1.3-1.5 m, rock temperature -2.0 to -2.5° C).

Low terrace type of locality is distinguished by the contrast of STL depth and rock temperatures. Spruce-larch and cowberry-green larch forests on clay sands of above the flood plain terraces are characterised with an STL depth of 0.8-1.0 m, and rock temperatures of -1.0 to -3.0°; steppe forbs-grains meadows on clay sands of above the flood plain terraces have an STL depth of 1.8-2.2 m and rock temperature of -0.5 to -2°; flood plain forbs-grains meadows STL depth is 1.2-1.4 m, rock temperature is -0.5 to -2°; on low flood plains with osiers and forbs-grains meadows in sandy-loam deposits STL depth is 1.2-1.4 m and rock temperature is -0.5 to -1°; and on sand deposits STL depth is 2.5-3 m and rocks have above zero temperatures.

Small valley type of locality is also distinguished by contrasting landscapes. STL depths of 2.5-3 m and above zero rock temperatures are characteristic for sand-shingle spits with osiers and alders, and some poplars in places. The depth of STL in green spruce forests in sandy-loam-shingle-sand deposits is 1.0-1.2 m, rock temperature is -1 to -2°; in cowberry-green larch forests in sandy-loam deposits STL depth is 1.0-1.2 m, rock temperature is -2 to -3°. Peculiar slope-valley complexes on the verge of slope trails and stream valleys with spruce-larch cowberry-green forests have an STL depth of 0.6-0.8 m and rock temperatures of -3 to -4°. Similar temperatures are characteristic of yerniks with moss-peat cover where the depth of STL is only 0.4-0.6 m.

Soil cover

Soil cover of the Lena Pillars Nature Park is complex and diverse, including 16 sub-types of cryogenic soils. Here, at a relatively small area, are found major soil types of Central and Southern Yakutia, from cryogenic taiga soils, pale, podzolic and sod-calcareous soils to cryogenic chernozem. One can clearly observe the dependence of spatial soils spreading from relief conditions and soil-forming rocks.

The middle and high Lena River terraces, flood plain parts along the Lena and Buotama Rivers, and river valleys' and plateau slopes of different steepness take part in the Buotama River outlet relief structure (Korzhuev, 1959). Vegetation cover of the area is presented by different types of larch and pine forests at watersheds, brakes over the narrows, meadows and bushes at flood plains and watersheds, and also by dry steppe areas along the slopes of the Buotama valley. The soil-forming rock at high Lena terraces is carbonate loam, at Bestyakh terrace, ancient alluvium sediments of loamy sand and sand. Along river valleys, the soil-forming rocks are modern loamy and sandy-loamy sediments.

Starting from big differences between the soil-forming rocks of zonal and intrazonal soils, taking into consideration their spatial location and complex structure of river valleys soil cover (multicomponent structure, sharp syngenetic differentiation, contrast range, etc.), the soil cover of the area is considered as a complicated mixture of flood land soils developed against a background of zonal soils combinations. 11 cryogenic soil types take part in forming soil cover structure.

Soil cover of the Saamys Kumaga tukulan also has complex structure (multicomponent structure, contrast range, etc.) and is considered as a complex combination of zonal soils in conjunction with flood land soils developing in the Lena valley. Distinguishing feature of this area is the presence of significant mass of blown sands at the watershed. 10 cryogenic soil sub-types take part in the soil cover structure. The prevailing soil type is typical pale cryogenic soils in combination with solodized soils at high terraces, and cryogenic taiga podzolic soils at middle terraces. The brightest feature of tukulan is the presence of cryogenic podzolic and cryogenic pale grey soils.

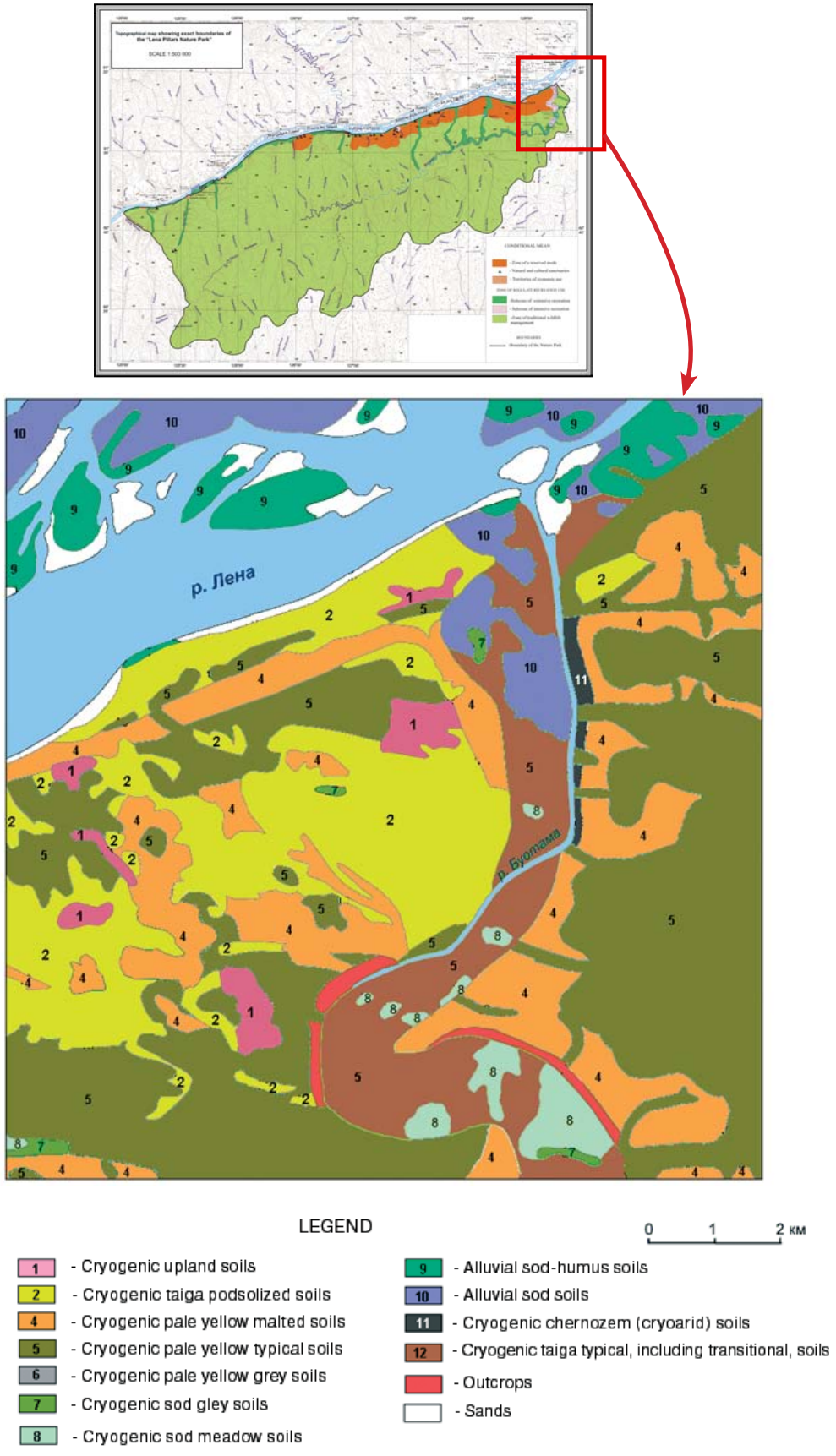
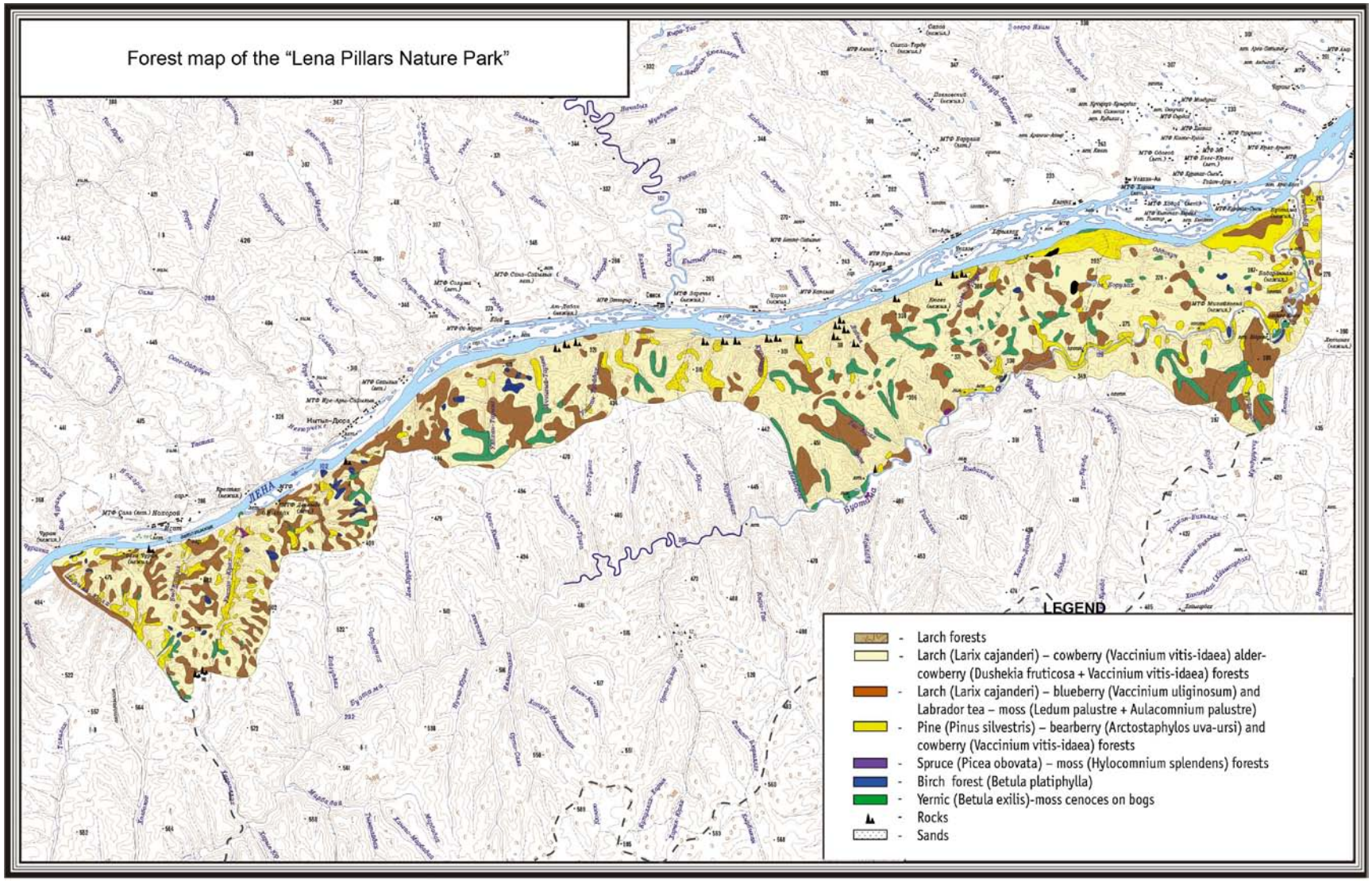


Fig. 30. Scheme map of the Buotama river outlet soil cover



A6. Forest map of the "Lena Pillars Nature Park".

Peculiarities of soil cover determine features of the vegetation. The Park's territory is covered mainly by low larch taiga with participation of pine forests, relatively wide distribution of alassy in the eastern part, and meadow and steppe vegetation in river valleys. Among the forests larch forests prevail covering 87,0 %, pine forests cover 7,6 %, and 5,4 % is covered by fir-woods, birch-woods and yerniks (dwarf birch bushwood). Valleys of the Buotama River, small taiga rivers and creeks are covered with yerniks of dwarf birch, *Betula divaricata*, sometimes – *Betula exilis*, sedge-grass meadows, rarer - forb meadows. Fragments of steppe vegetation are spread on well warmed bedrock slopes of the Lena and specially Buotama riverbanks.

Fig. 31. Autumn colours of the Lena Pillars. *Photo by V. Ryabkov.*

This vegetation complex is in primeval state and natural dynamic, nearly untouched by human influence. The deciduous larch taiga is typical for the strong continental climate with semihumid conditions and permafrost in the Eastern parts of the Boreal zone in Eurasia.

It contains the very specific and diverse flora of vascular plants, mosses, lichens, and fungi, which is adapted to the specific climatic conditions of Eastern Siberia.

Fig. 32. Pine and larch forests of the Park. *Photo by V. Grigoryev*

Fig. 33. *Redowskia sophiifolia* – a local endemic of the Lena Pillars. *Photo by V. Ryabkov*

The vegetation cover is responsible for the exceptional/exciting landscape character of the proposed property. In combination with the rock formations it forms unique landscape features with totally different seasonal aspects. In spring, the spectacular pillars are framed by the light green larch trees, in summer by colorful flowers of herbs, but in autumn by an impression of a "golden coat" (Crit. VII).

In the areas of rare psammophyte vegetation there occur so called "tukulans" (masses of windblown semistabilized and stabilized sands).

The occurrence of the local endemic plant species *Redowskia sophiifolia* (*Brassicaceae*) indicates the special biogeographical position of the Lena Pillars region from a biodiversity point of view.

Fauna

For the North-East of Russia, the zoogeographical complex of the Lena Pillars also has a number of unique features, based on the special peculiarities of this region: original climate which forms the distinct character of landscape, vegetation and fauna.

The region of the Lena Pillars situated in the border area of Prilenskoe Plateaue and Central Yakutian plain is characterized by a singular combination of faunistic complexes. Here, along with dominating forest elements, there also occur representatives of mountain-taiga (musk deer, maral) and mountain steppe (northern pika) complexes. There is also a northern boundary of areals of many vertebrate species: reptiles and chiropterans.

Invertebrates

Among the animals inhabiting the territory of the Lena Pillars insects stand out for their great diversity, wide spreading in all the forest, open meadow and steppe biocenosis, in stagnant-water and running water reservoirs.

Systematic studying of faunistic diversity of insects of the Lena Pillars NP was conducted in course of complex expedition for bio-ecological justification of the necessity of establishing the Park (1991-1992). In result of these and further investigations there was published a comprehensive list of insects, comprizing 645 species from 96 families and 8 отрядов (Averensky, 2001; Bagachanova et al., 2001, Potapova, Zhirkov, 2001).

Ichthyofauna

Due to enhanced protection regime in the territory of the Lena Pillars NP, and particularly at the Buotama river, this area plays significant role in conservation of the central Yakutian Ichthyofauna which contains lake and mainly river types. There are non-migratory as well as semianadromous species of fish.

Amphibia and reptilia

Amphibia and reptilia are presented with two species: Siberian salamander *Salamandrella keyseplingii*, Dybowski, 1870 and Siberian frog *Rana amurensis* Boul, 1888, common lizard *Lacerta vivipara* Jacquin, 1787 and common northern viper *Vipera berus* Linnaeus, 1758.

The territory of the Lena Pillars is the northern boundary of areals of few reptiles of these cold region.

Avifauna

The territory of the Lena Pillars plays a significant role in the recovery of species diversity and resources of considerably transformed avifauna of Central Yakutia.

Fauna of nesting birds is presented with 105 species (that is about 80% of fauna of all the nesting birds of Central Yakutia). Ornitho-complexes of meadow, skirt and forest birds are presented here completely or almost completely. Wetlands' complex is rather modest, however, after the introduction of a protection regime a considerable

increase of their numbers and diversity has been registered. The basis of winter avifauna of the studied region is formed with nonmigratory birds (26 species). Baikal teal, osprey, golden eagle and peregrine are listed into the Annex to CITES Convention being protected species of international importance.

Mammals

Species diversity of mammals of the Lena Pillars NP is rather abundant considering the regional scale and represents over 56% of total composition of Yakutian mammals. According to preliminary data, this region of the Middle Lena valley can be considered a center of biodiversity of the studied group of animals in Yakutia.

The territory of Park is inhabited by 38 species of mammals. On the whole, complex of mammals' species presents a typical fauna of middle-taiga subzone of Palaearctic.

Wood Bison

Wood bison is inscribed in Appendix II of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). It is included in the IUCN (International Union for Conservation of Nature) Red Book, which was recognized as world catalogue for endangered species of animals.

On April 6, 2006, 30 wood bison (mainly underyearlings – 15 females and 15 males) were transported from Elk Island National Park, Canada, to Lena Pillars Nature Park, Yakutia, which has a specially constructed farm named Ust'-Buotama that includes a network of pens and a number of special and residential buildings.

The main aim of the mission is elaboration of theoretical, methodical and applied approaches to the project on restoration of historic habitats of wood bison on the territory of Yakutia, thus enriching the bio-diversity of northern ecosystems and increasing their productivity and stability.

Since the brood stock on the territory of Lena Pillars Nature Park has been created, it now can be said that the first stage of wood bison re-acclimatization in Yakutia has been accomplished and the next stage has begun – re-settlement of the species across the territory of Yakutia.

Fig. 34. Wood bison at the Ust`-Buotama farm. *Photo by A. Butorin*

Landscapes

The territory of the park is located at interface of three landscape provinces: Leno-Amginskaya alas province, Leno-Amginskaya sandstone province, and Leno-Aldanskaya karst province (Permafrost & Landscape Map …, 1991). This factor provides for fairly wide range of conditions influencing functioning and evolution of genetically and structurally diverse typological geographical landscapes.

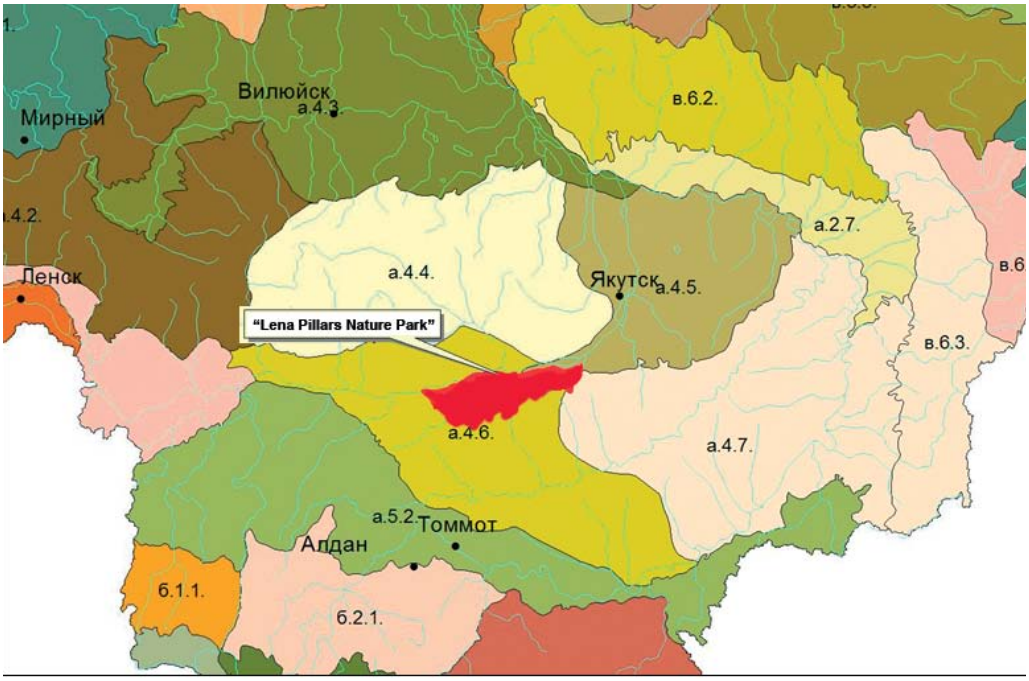
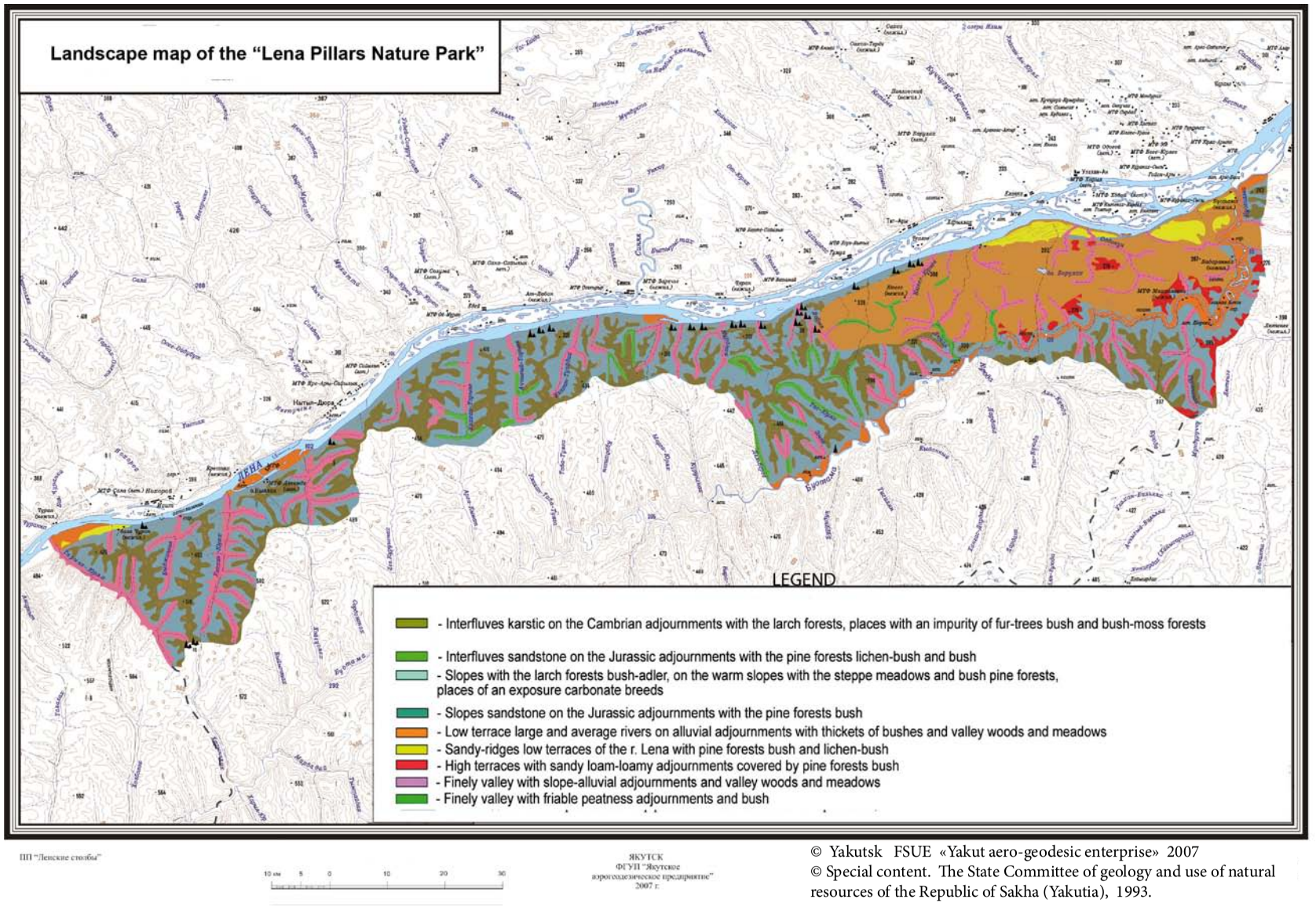


Fig. 35. Location of the "Lena Pillars Nature Park" on the Cryogenic landscape map of Central Yakutia:
a.4.5. - Lena-Amga alassy,
a.4.7. - Lena-Amga sandstone,
a.4.6. - Lena-Aldan karst

Within limits of these provinces in the territory of the Park two types of landscapes are distributed – mid-taiga continuous perennially frozen rocks (PFR) and intrazonal mid-taiga continuous PFR with understream taliks, presented by following types of localities: upland, slope, old-terraced, sandy-ridge type of mid-altitudinal terraces, inter-alas, and low-terraced, and shallow valley (Permafrost Landscapes …, 1989).

Upland type of locality is distinguished by non-homogeneous lithogenic base and can be divided into two sub-types. Karst upland sub-type with low-bush and low-bush-moss larch forests with sporadic spruce is distributed in Cambrian rock eluvium. Jurassic eluvium shows sandy upland sub-type with lichen-low-bush and low-bush pine forests.

Shallow valley localities with alluvial sediments are covered with valley forests, yerniks, and willow-shrubs.



A7. Landscape map of the "Lena Pillars Nature Park".

Slope type underlain by carbonaceous Cambrian rocks is mainly represented by low-bush-alder larch forests. On warm aspect slopes these forests are replaced by steppificated meadows and low-bush pinewoods, and by rock vegetation at plots with active denudation processes and Cambrian rocks outcropping.

Inter-alas type localities with sabulous-argillaceous sediments are occupied by low-bush and low-bush-moss larch forests; such types can be found in the eastern part of the Park.

The Park also contains sandy-ridgy type of locality, displayed on mid-altitudinal sandy terraces of Lena River with low-bush, lichen-low-bush, and low-bush-lichen pinewoods.

Alluvial sediments within boundaries of low-terraced type of locality typically display valley forests, willow-shrubs, and meadows.

Landscape structure of Lena Pillars Nature Park was investigated within three most tourist-prospective plots of the Park – Labiya Creek influx, Saamys Kumaga tukulan (drift sands), and Buotama River influx. Field study results and remote sensing data interpretation provided information on current state of landscapes, revealed regular patterns of natural complexes distribution, and provided materials for 1:500 000 scale landscape maps.

The quantitative composition and peculiarities of landscape complexes differentiation, as well as differences in their genesis and components show that the territory of the Lena Pillars Nature Park has quite a complex landscape structure. Areas of the park that are presently used for recreational purposes are distinguished by composition of the main elements of their landscape structures (table 2).

Study of landscape differentiation features allowed for the identification of landscape complexes on the territory of these recreational zones that are of high educational or aesthetical value and are rarely found in other regions of Russia. Such unique landscapes are a valuable part of recreational potential.

Remarkable landscapes that attract tourists with their beauty are usually structural elements (facies, stows) of typological natural and territorial complexes of higher rank (group types of stows and location types). Analysis of landscape structures on the territory of recreational zones led to identification of a number of remarkable and noteworthy sites (table 3). Such landscapes on the territory of the Lena Pillars Nature Park include:
- Cliff, eolian, cryogenic, karst, and erosive formations;
- Steppe slopes and dry riverbeds characteristic of karst regions;

Table 2. Landscape pattern of the Lena Pillars Nature Park

Landscape types	Recreational lands		
	Mouth of the Labyja Brook	Mouth of the Buotama River	Saamys-Kumaga tukulan
Lena River floodplane	+	+	+
Medium-height terraces of the Lena River	-	+	+
High terraces of the Lena River	-	+	+
Near-watershed portions of the Plateau	+	+	-
Hard-rock outcrops	+	+	-
Steep slopes of river valleys	+	+	-
Medium-gradient slopes	+	+	+
Low-gradient slopes	+	+	+
Drainage rills and creek valleys	+	+	+
Bottoms of small river valleys	+	+	-
Drift sands	-	+	+

Table 3. Notable natural landscapes within the territory of the Lena Pillars Nature Park

Notable landscape	Recreational lands		
	Mouth of the Labyja Brook	Mouth of the Buotama River	Saamys-Kumaga tukulan
Steppificated meadows on slopes	+	+	-
Steppificated meadows in valleys	-	+	-
Spruce forests in valleys	+	+	-
Poplar forests in valleys	+	-	-
Suffosion lows	-	+	+
Lena Pillars geological nature monument	+	-	-
Drift sands	-	+	+
Hard-rock outcrops	+	+	-
Karst funnels	+	-	-
Cryogenic landscapes	-	+	-
Pine forests	-	+	+

- "Warm" valley complexes of talik zones with their associated plant communities (poplar forests);
- "Cold" valley complexes with spruce forests;
- "Kyrdal" steppe communities typical for the regions with sharp continental climate;
- Park pine forests promising from the recreational point of view.

On the basis of landscape research results justification was prepared for the establishment of tourist routes in locations "Labyia", "Saamys-Kumaga", and "Labyia Stream mouth". 6 routes have been developed with description of 25 remarkable landscapes from the point of view of ecotourism, which reflect the natural and landscape structure features of the park territory. Maps for the tourist routes have been made with a scale of 1:100 000 and 1:25 000. All of this was used for the publication of "The Lena Pillars" pamphlet in 2000.

The remarkable nature of karst landscapes is revealed by the content of excursions at "Labyia" area, where they are represented by rock formations, "mountain" elements that break the monotony of plains taiga landscape of Central Yakutia, as well as steppe regions, dry riverbeds in small valleys etc. Excursion to "Saamys-Kumaga" Tukulan, "desert" element of the middle taiga landscape, underlines the uniqueness of the park's nature, introduces tourists to eolian landscapes of Yakutia and conditions of their formation. Excursions to remarkable landscapes at the Buotama River mouth enrich the knowledge and ideas about the nature of the park gained in the previous locations.

The landscape approach allows for an even representation and complex reflection of specific features of geological, geomorphological, botanical, and other monuments of

Fig. 36. A Christmas tree on the Lena Pillars. *Photo by A. Kamenev*.

nature using information about the history of their development, place and role in present day natural environment, evolution of natural objects. Using this method when developing the content for excursions leads to tourists forming a coherent picture about the nature of the park, raises the informational content and attractiveness of the trip, develops ecological way of thinking.

One of the most prospective directions for landscape research is the study of peculiarities of formation, morphology, and dynamics of eolian landscapes of the park. On the basis of analysis of data from climate reference books, maps and aerial surveys of different years geomorphologic and climatic conditions for the formation of eolian landscapes were researched (Vasiliev, Samsonova, 2000).

During the field research of 1998-2000 the surrounding areas and the top of Saamys-Kumaga ridge was explored, as well as the ridge bank, eolian formations of the brow side, and base of the Lena River Lena 4th terrace fragment ledge near the Buotama River mouth. Information was gained on meso- and microforms of eolian relief, their spatial distribution. Dynamics of eolian processes, activated in north-eastern part of Saamys-Kumaga massif after a fire that destroyed a forest in that location, are being monitored.

It has been confirmed that the 4th terrace of the Lena River has often been a site for forest fires in the past. Digs at the lithogenic base of the sand-ridge type of locality at the mouth of the Buotama River down to the depth of 3.5-4.0 metres have yielded horizons with traces of fires at the depths of 1.0, 2.0, and 2.5 metres. This fact allows considering fires as one of the main factors for the eolian relief formation at this location on the Lena River. Results of research into eolian landscapes significantly add to and expand the contents of the existing excursion materials for locations Saamys-Kymaga and the Buotama River mouth.

Study of the canyon (specific fragment of a river valley typical for karst regions) at the Oldokun River mouth showed that this location has valuable recreational resources for the development of tourism and can be used to expand the existing excursion programme. In order to provide the necessary information for organising excursions in this part of the park and Labyia stream mouth it is necessary to organise and conduct research to study karst formations.

An important direction is the study of landscape behaviour in modern climatic conditions. Ideas that will be given to tourists by guides on the basis of such research will help to create ecologically justified behaviour in everyday professional and recreational activities. With an aim of studying the present day landscape dynamics on the territory of Yakutia the area of the Lena Pillars Nature Park is used as one of the research grounds. Dendroclimatologic materials enrich excursions with information on climate change on the territory of the park and Central Yakutia as a whole, which is of particular importance considering the climate warming and landscape changes.

The next task for implementing the programme of creating a complex landscape basis for planning and organising nature conservation and recreational activities on the

territory of the park is a physical-geographical zoning with an aim of regulating the recreational nature management. As a result of the work principal patterns of distribution and dynamics of landscapes will be revealed in each physical-geographical zone, for every one of which the number of recreational objects will be defined, recreational potential and capacity will be evaluated, and types of recreational nature management will be identified.

Research into the nature of the Lena Pillars Nature Park continues and use of all possibilities offered by the landscape method to study its specifics will expand the list of remarkable landscapes on the territory of the park in the future and the geographic spread of sites for educational tourism taking into account the recreational capacity of natural complexes.

Major cryogenic ecosystems

At the nominated area are spread the most important modern cryogenic ecosystem types with peculiar soil cover, vegetation and fauna with high number of rare and disappearing species.

Steppe ecosystems are developed over the unique soils for the extra-continental climate – cryogenic chernozem. Specific features of cryogenic chernozem soils are: presence of icy permafrost and slight gleization indications (rusty spots) in the profile; traces of former flood plain soil-formation stage; intense dehydration of the upper horizon (0-30 cm) during almost whole vegetation period; and, at the same time, increased humidification of the super-cryogenic horizon; close deposition of the carbonate horizon; foliate structure; tongue-like humus and carbonate horizons; significant humus content in the upper horizon (0-20 cm). Vegetation is presented by petrophyte communities notable for their systematic and ecological flora composition with constant ecological vegetation structure. Vertebrate species composition is not very diverse and is presented by birds of open landscapes (kestrel, skylark, etc.); of mammals, typical inhabitants are narrow-skulled vole and Siberian roe.

Fig. 37. A thermokarst lake in the Park's territory. *Photo by V. Ryabkov*

Forest ecosystems are presented mainly by ecosystems of spruce, pine and larch taiga. Larch forest ecosystems prevail. These are characterized by relatively thick, for the region concerned, cover (20-30 cm) of cryogenic pale solodized soils. The main forest-forming species is Kajander's larch, in the underbrush dominate red whortleberry, bearberry, great bilberry and wild rosemary. Vertebrate population is presented by typical taiga complex species.

Tukulan ecosystem. Soil cover of tukulan has complex multi-component and contrast structure and is considered as an aggregate combination of zonal soils in conjunction with flood plain soils of the Lena valley. A distinguishing feature of this area is presence of significant mass of weaving sands over the watershed. Vegetation here is very poor and is presented by psammophytes. Here grows the endemic of Central Yakutian tukulan – *Koeleria skrjabinii*. Here and there, one can meet single specimen or small groups of xerophyte species: *Equisetum arvense, Artemisia commutate, Aconogonon ocreatum, Thymus mongolicus, Corispermum sibiricum* etc. No terrestrial vertebrate animals typical for the given landscape element, are present. As open stations among dense forest, they attract a number of insectivore birds.

Rocky outcrop ecosystem. Cryogenic sod-carbonate immature soils are developed at steep slopes of the Lena Pillars. These are characterized by rubbleness, thin silt profile (up to several centimeters) and close dislocation of dense rocks. Total vegetation coverage does not exceed 10%. Floristic composition is mainly presented by steppe species. At rock benches and ledges are noted single plants with participation of xerophilous and petrophilous species. Here grows *Redowskia sophiifolia* – local endemic of the Lena pillars. Besides, at rocks and crevices are met firns *Cystopteris fragalis* and *Woodsia glabella.* Here dwell prey birds (peregrine, kestrel, etc.), swift, house martin; of mammals typical inhabitant is a musk deer.

2b. History and Development

Nominated territory is situated within Khangalassky and Olekminsky uluses where Lena River and its numerous big and small tributaries flows – one of the biggest water artery of the North of Eurasia. That's why Lena River remains to be the main line of people's insights from south to north for long years. According to some sources of information, the populating in particular began in Paleolith along Lena River, and then, step by step, people subdued the whole Asian North-East, and then populated America straight across the Bering neck.

In 1982 the Diring-Yuryah site was allocated – a unique antique monument enclosed archeological monuments vary in time and tools of Early Paleolith similar to Oldoway tools of Africa. This allowed Yakut archeologists to put forward a hypothesis on extra-tropical descent of man and more ancient history of area development. However, monuments of follow-up periods of Early and Middle Paleolith have not found yet. Thus, we can suggest only culture of Late Paleolith which evidence (monuments) was found within the whole territory of Republic, and also on Sink IV-V and Diring-Yuryah sites. Pioneer settlers which started to develop huge and vast areas were Pleistocene animals' hunters. This is evidenced by the burials of mammoth, bison, woolly rhinoceros, Lena horse and reindeer near Lena Pillars and along Kuranah, Labyya and Buotama rivers.

As a result of new human entry from south and mammoths extinction the inhabitants became moose (Alces alces), reindeers' and other taiga animals' hunters in ensuing millennia. Neolith people started to make bulk of faceted tools which assisted to improve hunting and fishing tools. The main hunt aim appeared to be big taiga animals, especially moose (Alces alces). The image of moose holds a central position in numerous petroglyphs situated within the nominated territory on Lena and Buotama rocks.

With the advent of new Ust-milsky culture carriers (from the end of IV millennium B.C.E. till middle of II millennium B.C.E.) fishing evolved in national economy. Technology of tools handling and ceramics are greatly improved. The Bronze Age began in the middle of II millennium B.C.E. and alternated by the Early Iron Age in V century B.C.E. In such a way, Middle Lena inhabitants, conserving their aged system of survival, got into iron, and iron techniques and ironmongery were wide spread and developed during follow-up centuries. This was assisted by iron deposits along Buotama and Lyutenga rivers. Ferriferous concretions found at that time within the nominated territory were related to sedimentary deposits and could not be mention as characteristic of large iron-ore deposits.

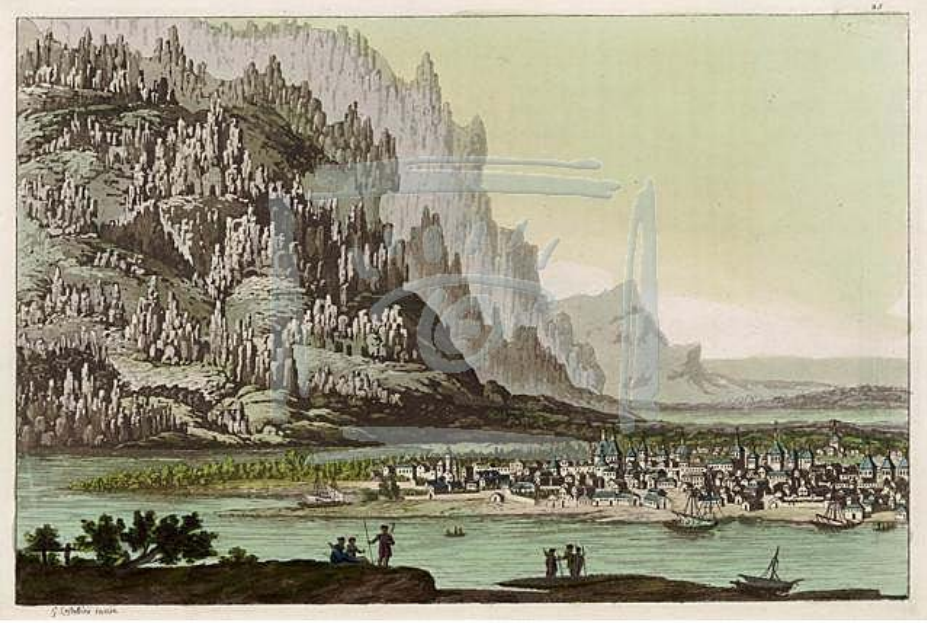
According to scientists, bearers of Ust-milsky culture were the forefathers of Yukaghirs – primordial North-Asian nation. Insight of small groups of Tungus-language tribes began in the Iron Age, and more strong migration of Evenk forefathers began in second part of A.D. who opened up riding and packing in reindeer breeding – a new type of economic activity in region. Part of the territory of Park became a pasture area for deer breeding from this moment. Besides, rich wild animals and plants remained to be an important extra source of Evenks and other people survival.

A ranking place in history of development belong to Yakuts, whose forefathers, few in number Turcoman-language people, appeared in VI-VII centuries. Yakuts were populated the far bank of Lena River and its tributaries and were able to keep and to adapt horse-breeding and stock-raising economic structure in extremely natural and climatic conditions, to ensure trades, especially farriery. They widely used ironstone from Lyutenga and Buotama rivers watershed for trade tools and other economic needs.

A new step in economic development of territory began with insight of Russian people. Spread of agriculture became the most important result in economic development. Hunting trade tools were greatly improved, shotgun appeared, household things and clothes, dwelling, feeding were changed. Russian old identity of Prilenie not only introduced innovation in economic structure, but also opened up much elements of material and spiritual culture of indigenous people.

During the II expedition on Kamchatka under command of V. Bering on Tamma River in 1735-1744 (Megino-Kangalassky ulus) the Tamginsky iron foundry was on-stream and was supplied by means of ironstone from the current territory of Park as that ironstone was enclosed 45,5% of iron. Small co-operative farms of reindeer-breeders "Buotama" and "Combine" were organized in XX century within the territory of Park in the mouth of Buotama River and in Dikimde locality in the end of 1920 and had survived till sixties of XX century. Except of traditional crafts and trades (reindeer breeding, hunting, fishing) those co-operative farms were occupied with goods traffic for gold mining on Aldan.

In such a way, in millennium past and currently the nominated territory appears as a place for traditional survival of Evenks who keeps traditional types of economic activity based on smart limit of consumption and environmentally friendly use of natural resources.



View of Yakutsk town and the Lena Pillars. Charle de Lespinass (after Julio Ferrario "Il costume antico e modern, o, storia di tutti I popoli antichi e moderni" (Asia. Volume 4. Milan. 1818).

Fig. 38. Ice ridges on the Lena River. *Photo by V. Ryabkov.*

3 JUSTIFICATION FOR INSCRIPTION

3a. Criteria under which inscription is proposed (and justification for inscription under these criteria)

The "Lena Pillars Nature Park" is nominated under the following criteria:

vii Contains unique natural objects of outstanding beauty and aesthetic significance

"Lena Pillars Nature Park" – is a unique natural monument and a monument of the coldest and severe region inhabited by people all around the year. It occupies more than 1 272 thousand ha which include a range of unique and outstanding aesthetical value sites, first of all the famous cliffs which are lined up as solid walls along the right bank of great Siberian River Lena and its tributary Buotama River. Fabulous rocky statues up to 100 m high stretch almost 40 km along the Lena River. Lonely cliffs, standing against rockslides and green forested slopes, can be seen along around 200 km. During more than half a billion years the light-brown, brown-grey laminated limestones eroded. Within the previous 2 million years, fluvial masses of red sands deposited here after karst and erosion processes formed various fanciful rocks.

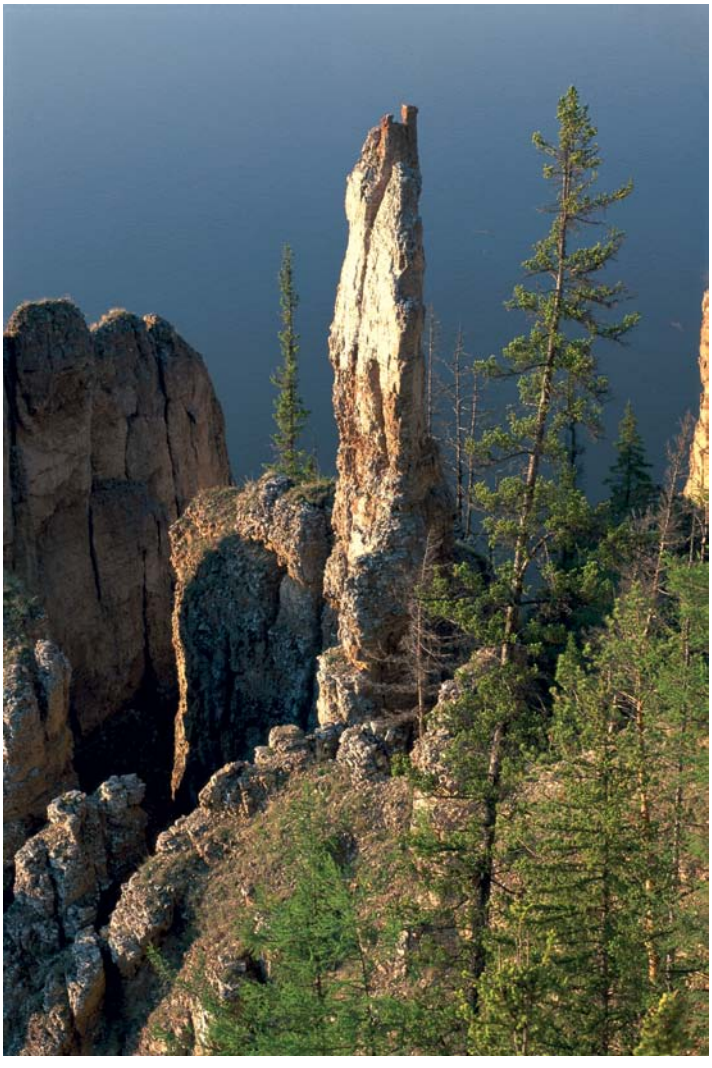


Fig. 39. A thin pillar. *Photo by V. Ryabkov.*

There are many outstanding karst landscapes around the World, with unique outcrop formations, different geologic structure and age, criteria and space structure. The most valuable landscapes are already inscribed into World Heritage List (see Comparative analysis chapter), most of them are, for example, much higher than the Lena Pillars. But if we take into account the exceptional variety of the outcrop formations, and the fact that they continously stretch along such a significant distance (such phenomena, according to our knowledge, have never been noted around the already inscribed World Heritage Sites), then the global value of the Lena Pillars becomes obvious.

Thus we can claim that the Lena Pillars have a relief with completely unique features and with exclusively high aesthetic potential. With wind and water, heat and cold, the «nature-artist» has created the genuine masterpiece made of colonnades, towers, cathedrals, caves and holes. These agents created human and animal like figures in the fantastic statues of rocky boulders.

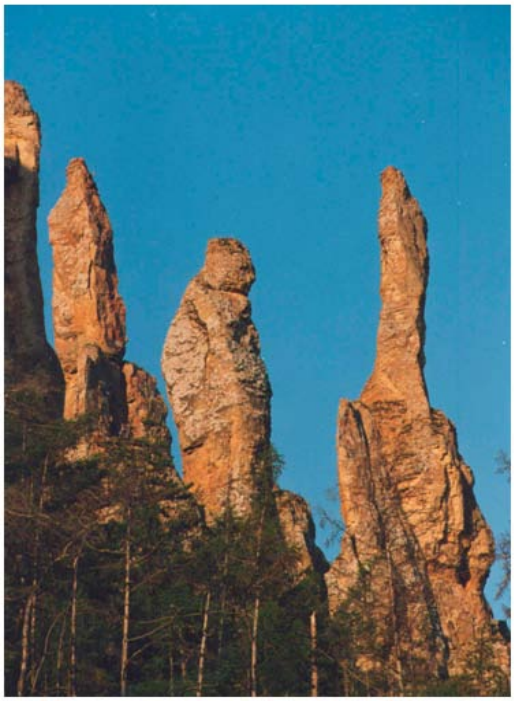


Fig. 40. Stone monuments of mysterious creatures. *Photo by P. Kolosov.*

Fig. 41. Kihi-Taas – the stone man. *Photo by P. Kolosov.*

The nominated territory boasts very rich an diverse vegetation, which contributes to the landscape diversity and enhances the aesthetic evaluation of the "Lena Pillars Nature Park": larch taiga with pine forest inclusions and alas on the watersheds turns to meadows and steppe in the Lena and Buotama Rivers valleys, then numerous islands with amazing sceneries full of flowers, shrubby and grassy plants (more than 300 species). Here can be observed the exotic phenomena of the Yakutian nature: tukulans - real sand dunes in the sea of endless taiga.

The variety and surprising combination of Lena Pillars rocky forms had been attracted the attention of humans since the old days and keep attracting people till today. Since 2000 BC these voiceless rocky giants became bystanders and treasurers of vanished and existent civilizations, expressed in the ancient art - petroglyphs. The virgin soil gave birth to new centers of civilization, which contributed to the further development of human culture in the north lands and exploration of its immense space. Thousands of years of living in extreme natural and climatic conditions formed the special strategy of sustenance of native people, based on optimal functioning of system «nature – human – production – ecologic traditions». That's why all native people treated every natural site and phenomena as divinity and having a «soul-master». The special meaning in the traditional outlook was given to the Lena Pillars, which has been treated as Sacred and which were places for worship, ceremonies and rituals. People used rock painting on Lena cliffs to deliver to descendants their vision of world order, spiritual and cultural experience, humanistic ecologic traditions, which now perform the outstanding scientific and aesthetic value.

Fig. 42. Neolithic rock painting with a moose family. *Photo by A. Kamenev.*

With its glamorous beauty the Lena Pillars dazzled many travelers, explorers, artists and writers. I. Standling, a Swedish journalist, who visited the Lena Pillars in the late 19th century, noted exceptional natural beauty of the Lena Pillars: «Colossal rocks of red sandstone alternating with forested hills are reflected in the waters of the giant river. Here rise Cyclopean sandstone walls brought one against another by some supernatural forces… Here under the low-browed cliff is the eternal giant whirlpool, while away there are dominating kind of countless spires of temples and minarets or ruins of colossal

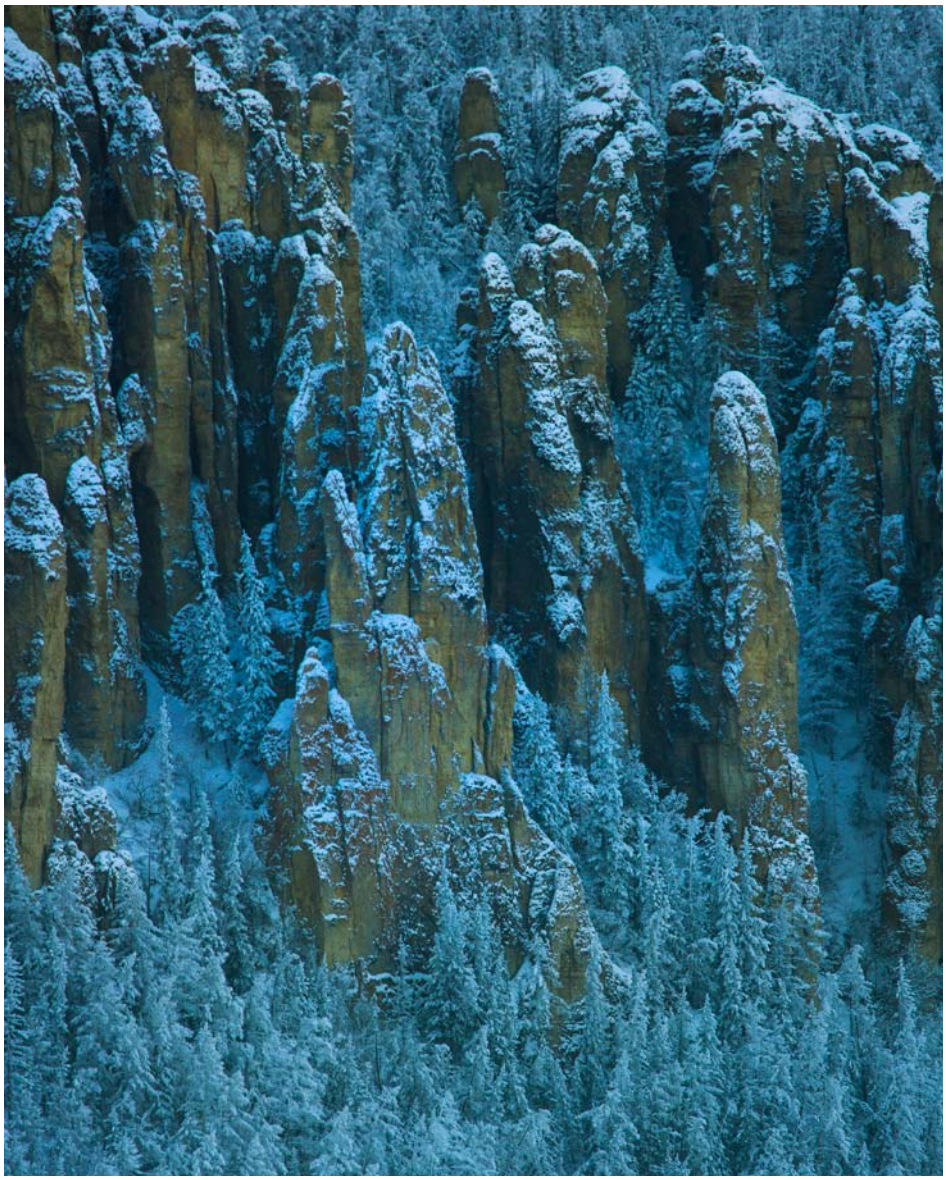


Fig. 43. The Pillars. *Photo by A. Kamenev*

castles made of pale-gray limestone. Columns of slender larches and Siberian firs stand in the ravines as it were armies ready to assault the fortresses, formidably dominating over them, while far away, at its highest, there are lonely firs, like soldiers, climbing uphill to the fortress. Then slaty layers flash and give the river shores the fantastic view. Here and there one can see the dark hole of underground grotto, in other places there are warm sulfurous springs spouting from mountain».

Fig. 44. The Buotama river. *Photo by A. Ogloblin*

Bewitched from the amazing beauty and greatness of the Lena Pillars, the Siberian poet Anatoly Olkhon wrote (Anatoly Olkhon, 1903 - 1950):

«Rocks? No, there are no rocks,
There are ancient creatures in a line,
Raising their bared teeth,
Burning with the rainbow colors.
Mountains? No, they are not like mountains,
They are towers, castles, chambers,
Colonnades, terraces, cathedrals,
Minarets, tombs, houses…
Will you say to me – cliffs? Indeed,
This is a herd of flying horses,
Rhinoceros, elephants, hippopotamus…"
(Olkhon, 1951)

The essential part of the "Lena Pillars Nature Park" is virtually untouched, a virgin region, which by itself is the significant factor of high aesthetic value. Prof. O.N. Tolstikhin, writes: «Maybe the main feature of nature is to give people rest, return them to the world of beauty and happiness, lead off from misery and heavy worries which fell to our society. By conserving nature we conserve ourselves, our souls and not only resources necessary for expanded reproduction». This masterpiece made by nature is wonderful at any season and any day or night. Especially it is impressive at evenings, when cliffs, covered by sunset light, are getting ignited, getting pink as if they rise from their reflections in the calm water, and coming to life from churning waters after light wind or passing ships and boats. The aesthetical value is intensified by the rich colors of the four seasons which are exceptionally well pronounced by the strong continental climate. The impressive beauty

of the nominated territory is the permanent object for famous artists, photographers, writers, tourists. The fabulous statues of rocky boulders, numerous rifts and rapids of the Buotama river, sand dunes, endless taiga with seasonally changing coloration from light to dark green in spring and summer to yellow in autumn and black and white in winter and the integrity of multifaced virgin nature of this wonderful place have been echoed in many movies, pictures, paintings, books and folklore.

Being a Special Protected Area with unique natural landscapes, rich flora and fauna, conserved traditional aboriginal activities (reindeer breeding, fishery, subsistence hunting, cattle breeding), cultural and ethnographic sights, the "Lena Pillars Nature Park" has been Yakutia's "business card" for many years. To date, the "Lena Pillars Nature Park" is one of the main tourist destinations for Russians and foreigners in Siberia - like Lake Baikal and the Volcanoes of Kamtchatka.

«My admiration is endless, and I am standing still before this beauty. The Lena river banks, the unbounded Lena Pillars….and silence. The beauty of rough nature. I feel quite small standing before the Lena Pillars. I dare not to touch this nature for fear to disturb it. I look at all this in wonderment. I am fine here. I breathe in air which is so clean! I've absorbed this nature so deep in myself that it will always be kept in my soul» (Bruno Alend, France).

And this is another exceptional aesthetic value of the nominated territory with inimitable and mythic beauty - when a human of modern post industrial civilization begins (as our ancient ancestors) to feel himself as integral part of nature, a grain of sand in the Universe and directly joins the circle of nature.

Such values can be regarded as "transformative values" sensu Bryan G. Norton which stand in contrast to plain demand values. Nature in its diversity and beauty - as represented by the "Lena Pillars Nature Park" - can function as a central transformative value: "Through experiences of nature, a new sense of value emerges" (Norton 1987, p. 192).

The "Lena Pillars Nature Park" has not only demand value for humans for satisfying needs and preferences. The awe-inspiring Lena Pillars Nature Park also possesses transformative value by providing occasions for us to examine, deliberate over, and revise our own values - and that is, to grow as human beings.

Fig. 45. Gigantic karren of the valley of Lena. *Photo by P. Kolosov*

viii Be outstanding example representing major stages of Earth's history, including the record of life, significant on-going geological processes in the development of landforms, or significant geomorphic or physiographic features.

viii (a) Be outstanding example representing major stages of Earth's history, including the record of life.

The Lena River and its tributaries provide within the boundaries of the nominated territory natural cuts of the uppermost Ediacaran (Precambrian) to middle Cambrian strata of a total thickness from 980 to 1370 m on the distance of over 150 km. The strata themselves were accumulated in platformal environments and were not subsequently objects of either metamorphic hit or strong tectonic dislocations. As a result, each stratum of a few centimetres thickness only is easily traceable for dozens of kilometres mostly having dips of less than two degrees (Savitskiy & Astashkin, 1979; Spizharski et al., 1986; Astashkin et al., 1991; Sukhov, 1997; Pegel, 2000; Varlamov & Rozanov, 2008). Also, the pillar relief itself provides an excellent outcropping of Cambrian rocks. Various palaeogeographic reconstructions based on comprehensive palaeomagnetic, tectonic, sedimentological, and biogeographic criteria place the Siberian Platform at low, tropical, latitudes during the Cambrian (Kirschvink et al., 1997; Debrenne et al., 1999; Smith, 2001; Cocks & Torsvik, 2007; Meert & Lieberman, 2008).

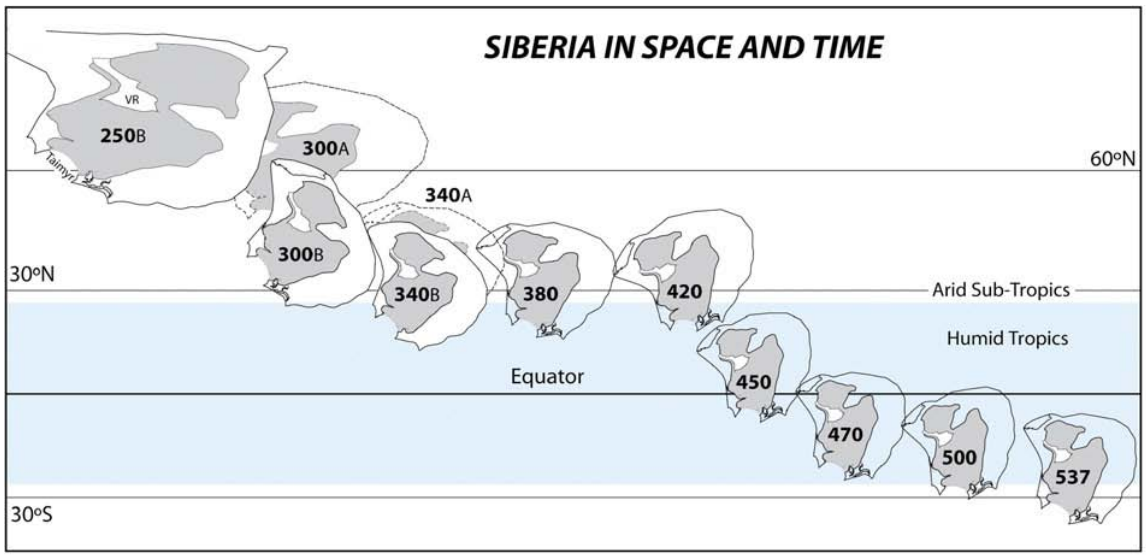


Fig. 46. Siberia in space and time (after Cocks & Torsvik, 2007). The Cambrian position is marked by number 500 Ma.

These strata were formed during the latest Ediacaran – early to middle Cambrian interval, the interval which is called the "Cambrian Explosion" and which was one of the major diversification events on the Earth where all the body plans still existing now have appeared (as well as many completely extinct ones). Finally, this is Siberia only where this interval is represented by marine carbonates of a high facies diversity while carbonates are the best sediments for the skeletal fossil preservation. Due to the presence of three different contemporary epeiric basins here, which are an inner platformal basin, a transitional reefal belt, and outer deep-water platformal basin, an analysis of a parallel evolution of faunas and floras is possible in this area including an origin of deep water fauna. An observed progradation of the carbonate ramp is expressed in eastward displacement of transitional reefal belt during the early-middle Cambrian. All these extraordinary circumstances allow scientists to ground unique researches here.

Fig. 47. Thin plan-parallel lamination of Cambrian strata. *Photo by A. Zhuravlev*

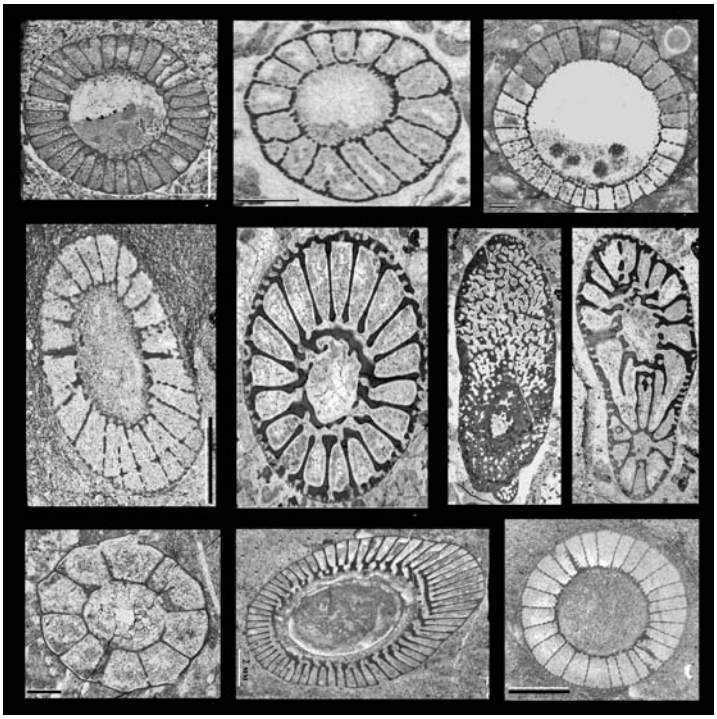


Fig. 48. Thin sections of archaeocyaths (calcified aspiculate sponges) from lower Cambrian reefs of the"Lena Pillars Nature Park".

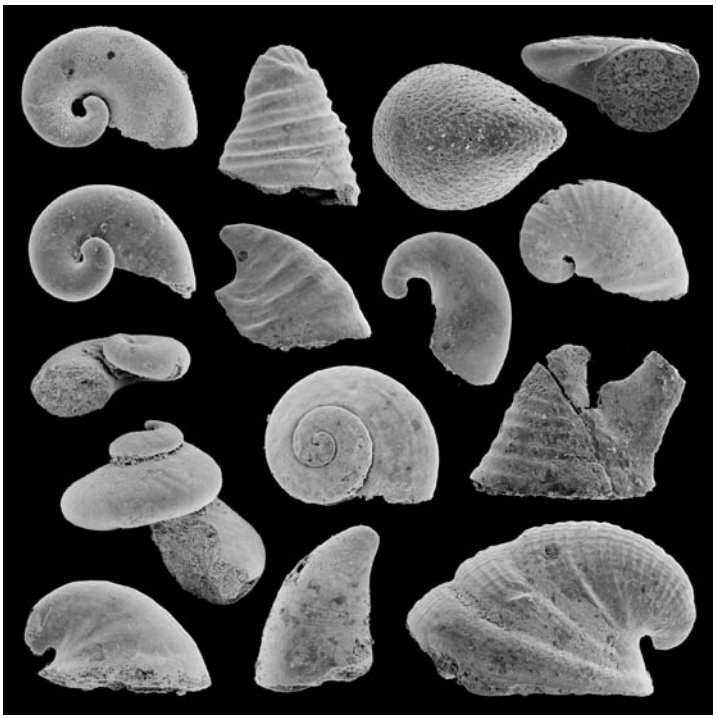


Fig. 49. Mollusc shells from lower Cambrian reefs of the "Lena Pillars Nature Park".

Due to a continuous succession, carbonate composition, and excellent outcropping of the Lena Pillars, leading geochemists and geophysicists developed the most detailed records of the palaeomagnetic and stable isotope alternations for the early to middle Cambrian interval (Kirschvink & Rozanov, 1984; Magaritz et al., 1986, 1991; Magaritz, 1989;

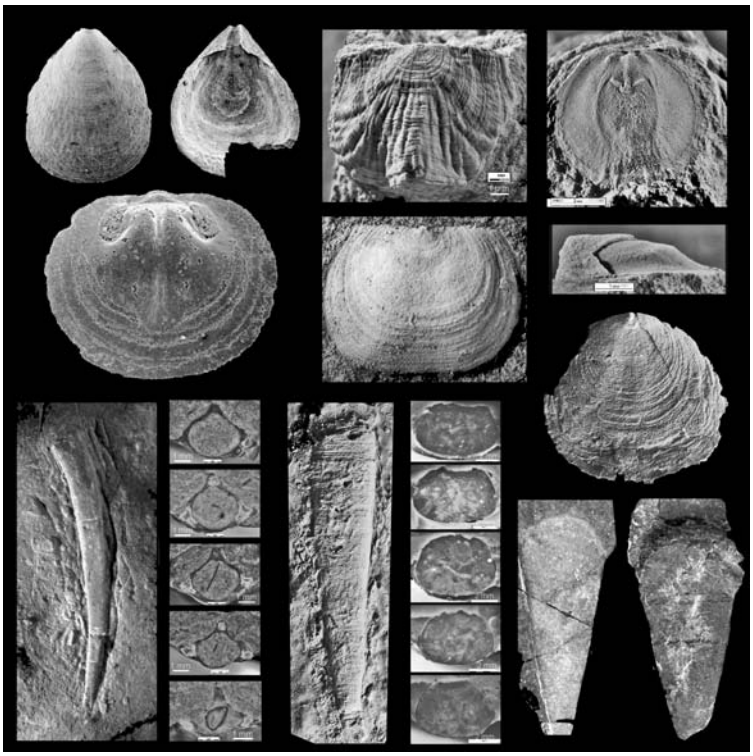


Fig. 50. Hyolith and brachiopod shells from lower Cambrian reefs of the "Lena Pillars Nature Park".

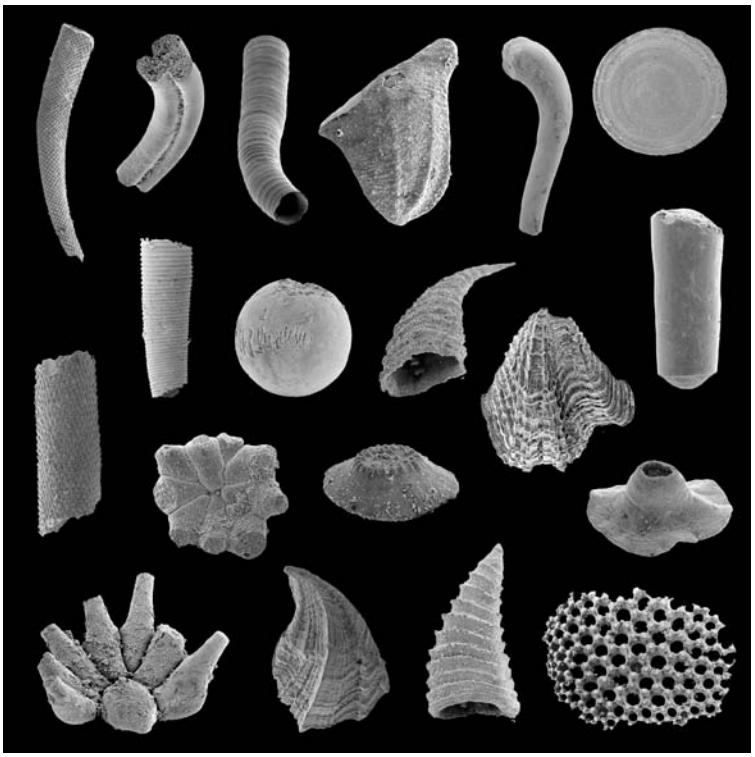


Fig. 51. Small shelly fossils from the lower Cambrian of the "Lena Pillars Nature Park".

Kirschvink et al., 1991; Brasier et al., 1994a, b; Derry et al., 1994; Ripperdan, 1994; Nicholas, 1996; Schields, 1999). Carbon and strontium isotope curves as well as palaeomagnetic scale established here serve the reference scales for the whole world. Data of such a precision are necessary for understanding of the evolution of the Earth lithosphere, hydrosphere, and atmosphere and are very important for the global Cambrian stratigraphy as well as for palaeogeographic and other general geological and palaeoecological implications.

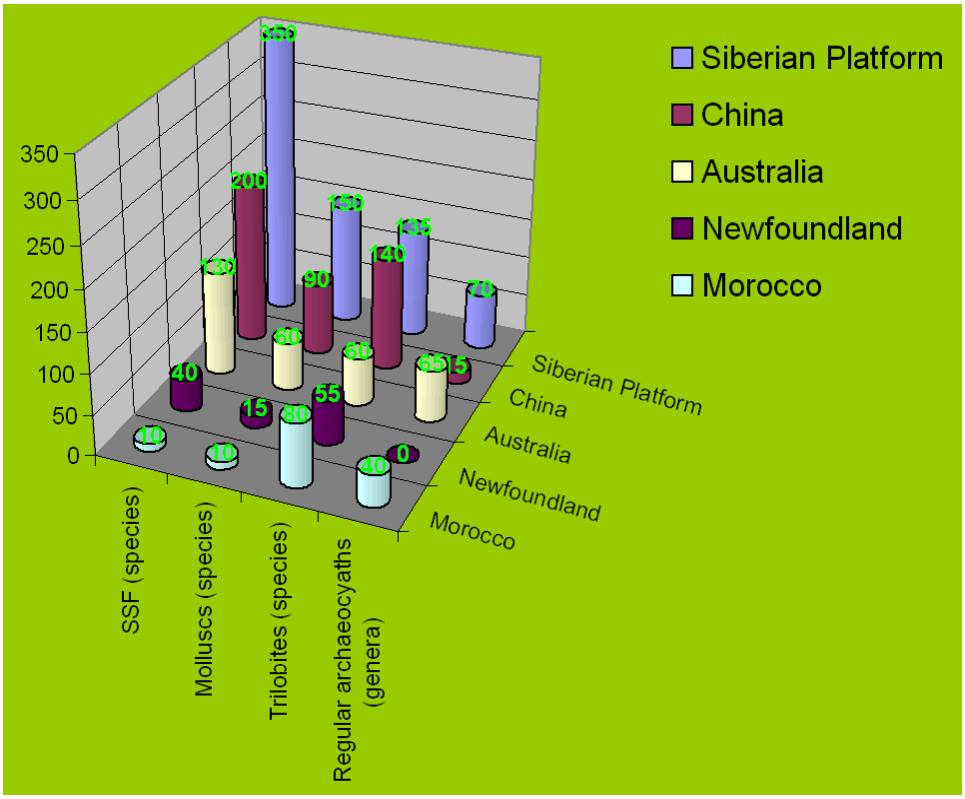


Fig. 52. Species and generic diversity in early Cambrian key regions of the world.

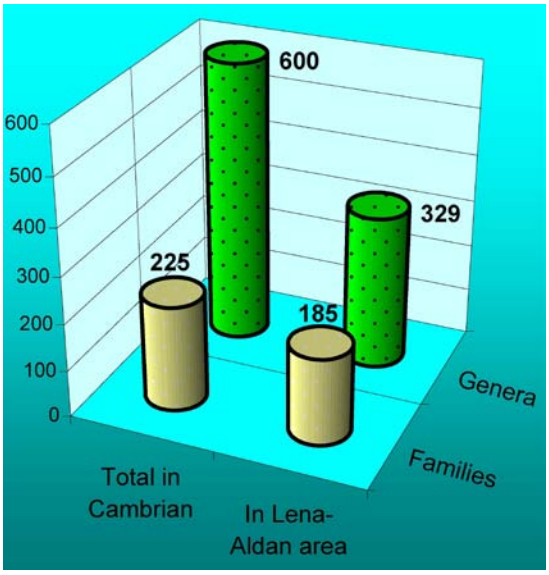


Fig. 53. The total number of fossil animal genera and families described from the Cambrian, and number of taxa known from the Lena-Aldan region of the Siberian Platform.

The Lena Pillars' sections allow scientists to estimate the early stages of multicellular animal evolution in its full diversity and dynamics. It should be emphasized that among approximately 2,000 early Cambrian genera, which are known today, about 350 are described from the area under discussion – and this is a really amazing number (Sepkoski, 1992; Zhuravlev & Wood, 1996; Zhuravlev & Riding, 2001; Dixon et al., 2001; Varlamov & Rozanov, 2008; Rozanov et al., 2008). This list is enlarged almost every year. These genera include the first archaeocyaths (rigid aspiculate calcified sponges), radiocyaths, coralomorphs (skeletal primitive cnidarians), brachiopods, and some other groups of animals with mineralized skeletons while the contemporary general diversity of this region was the highest in the early Cambrian of the world. This is the area where the very systematics of archaeocyaths, hyoliths, and many other problematic groups, which comprise the core of the animals involved in the Cambrian skeletal revolution, is developed since 19th century (Schmidt, 1886; Toll, 1899; Zhuravleva, 1960, 1969; Korde, 1961; Khomentovskiy & Repina, 1965; Rozanov et al., 1969; Sysoev, 1972; Luchinina, 1975; Lipps & Signor, 1992; Palmer & Repina, 1993; Dzik, 1994; Scrutton, 1997; Hooper & van Soest, 2002; Debrenne et al., 2011). For some of the aforementioned groups, this area was also the center of their origin (Rozanov, 1984). Additionally, a number of complete and intact specimens of extraordinary preservation – the so-called Sinsk Biota, which contains a number of unique species including those with phosphatized soft tissues and cells as well as their embryos, is described here (Ivantsov, 1999; Ivantsov & Wrona, 2004; Ivantsov et al., 2005a, b).

Fig. 54. A Cambrian bioherm of the Oy-Muran Reef Massif. *Photo by A. Zhuravlev*

The most outstanding object in the nominated territory are reefal facies. Excellent preservation, high diversity, and multiple localities of reefal fauna in the Lena Pillars (Byd'yangaya, Negyurchene, Oy-Muran and other reefal areas) provide a firm basis for detailed palaeoecological and population dynamics' studies of the earliest metazoan reefal biota which are comparable in precision with studies of modern reefs only. However, if modern reefs represent a single time slice only, the Lena Pillars provide over 20 such time slices which let research understand a real evolutionary process from its very beginning (because metazoan reefs appeared here and during this first 5 million years existed on the Siberian Platform only) which shaped the communities of organisms if they were a co-evolved entities or simply occasional sets of co-existing species. Additionally, such features of communities can be studied in relation to the significance the significance of alpha-, beta, and gamma-diversities; hub-species and their influence on the community structure; interspecific and intraspecific interactions; ecological successions; trophic webs; tiering, and many others. The Oy-Muran Reef Massif occupying the central part of

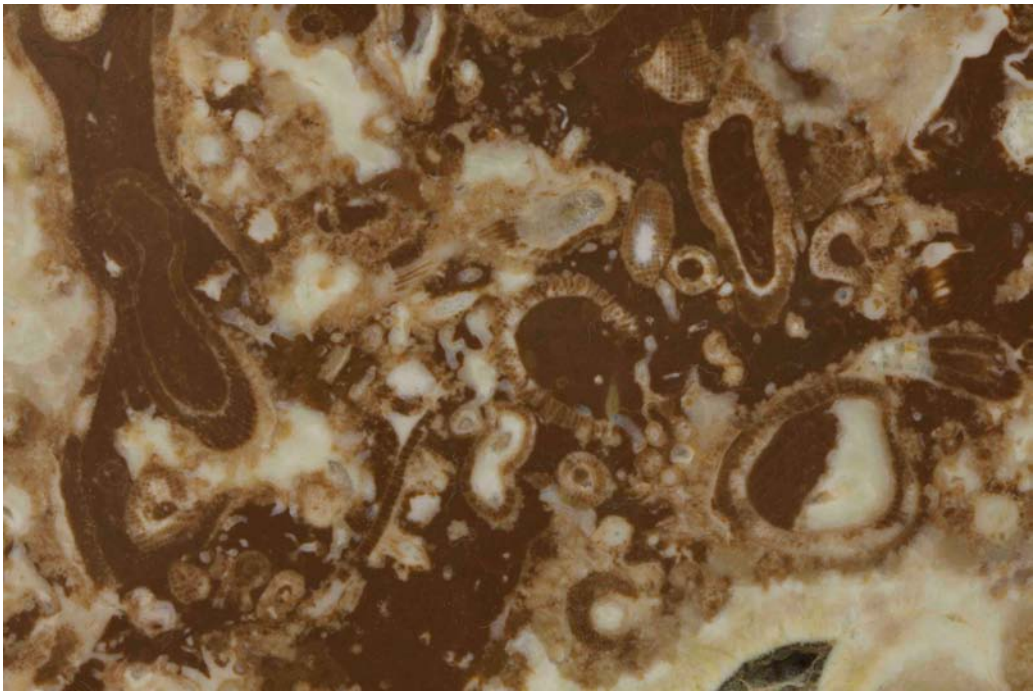


Fig. 55. A longitudinal polished section of an Oy-Muran reefal sample with *in situ* archaeocyaths and other reefal organisms. Cambrian Stage 2. *Photo by V. Il'ynsky.*

the Lena Pillars was of the same significance for the Cambrian world as the Great Barrier Reef is for the modern Earth. Certainly, there are other interesting reefs on the planet now but the Great Barrier Reef is still a unique phenomenon. Besides, the Lena Pillars' region is the very region where the first metazoan reefs appeared. As a result, the Lena Pillars became a field laboratory for leading sedimentologists and palaeoecologists. These

Fig. 56. Intact complete giant arthropods *Phitophylaspis* of the Sinsk Biota. Cambrian Stage 3. *Photo by V. Il'ynsky.*

studies drastically changed our understanding of the reef evolution and their results are now cited in text-books and treatises (James & Debrenne, 1980; Chuvashov & Riding, 1984; Riding & Voronova, 1984; Rowland & Gangloff, 1988; Riding, 1991; Wood et al., 1992; Wood, 1993, 1995, 1999; Copper, 1994; Kruse et al., 1995; Zhuravlev & Wood, 1995; Stanley, 2001; Rowland & Shapiro, 2002; Kiessling et al., 2003; Rowland & Hicks, 2004; Zhuravlev & Naimark, 2005; Debrenne, 2007; Gandin & Debrenne, 2010).

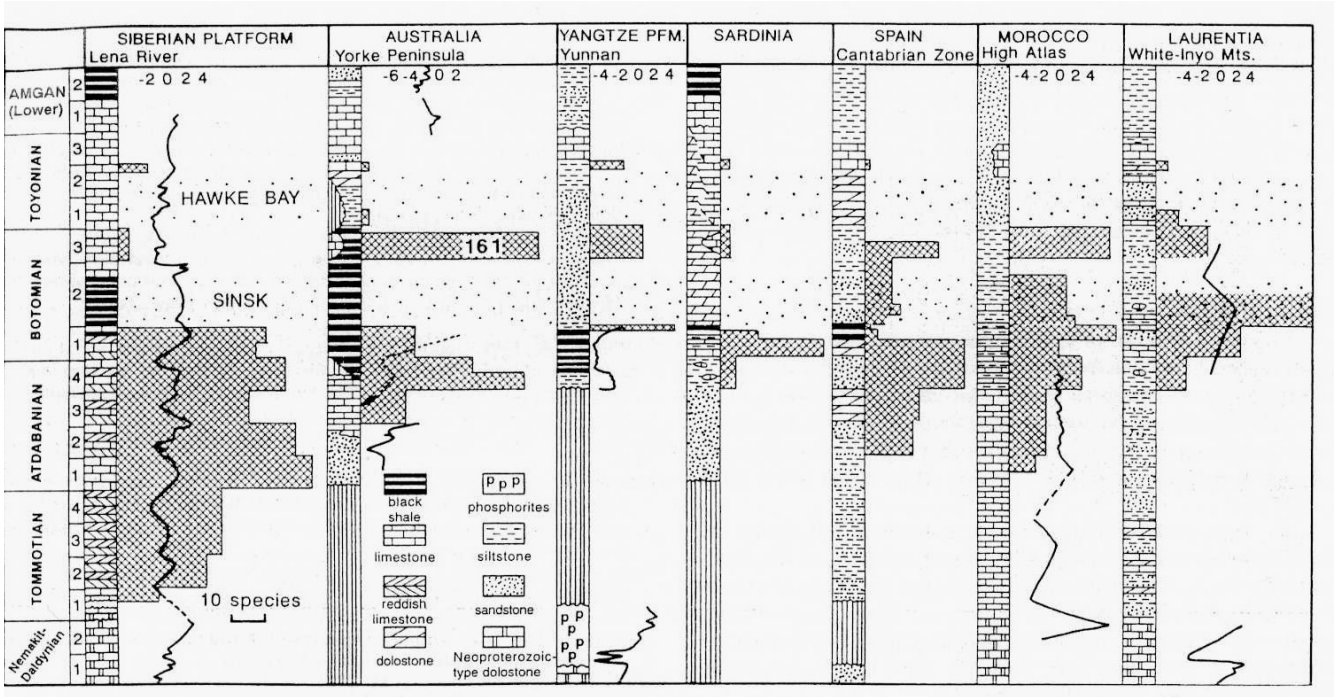
The Lena Pillars' carbonate, mostly reefal and perireefal facies, let researches to analyze palaeoclimate alternations on the eve of the first Greenhouse Epoch in the Phanerozoic because only here it is possible to use in concert a representative enough (for statistics) data on faunal diversification, reliable data on carbon and strontium isotopes, and correct data on diverse carbonate mineralogies. This data also allow us a better understanding of the fate of modern reefs due to a possible global warming because alike their early Cambrian analogies modern reefs are built by organisms possessing volatile aragonite and high-magnesium calcite skeletons and by sedimentary fabrics of the same composition (Zhuravlev & Wood, 2008, 2009).

Fig. 57. Ooid shoal of Cambrian back-reef facies. *Photo by A. Zhuravlev.*

Fig. 58. Tempestites of Cambrian back-reef facies. *Photo by A. Zhuravlev.*

The same facies are suitable for statistic analyses of a high precision of stratigraphic distribution of various skeletal groups. An accumulation of statistic data brought out a distinguishing of the fist mass-extinction events in the Earth history which are known as the Sinsk and Toyonian extinction events and even the very names of this events are borrowed from the toponymy of the Lena Pillar's area. It had been shown that these events were the pivotal points in animal evolution comparable with the well-known Permo-Triassic extinction event because the so-called Early Cambrian (Tommotian) Evolutionary Fauna which has gone during that time was comparable by its uniqueness with the following Palaeozoic Evolutionary Fauna which has gone during the Permo-Triassic extinction event (Brasier, 1992, 1995; Rozanov, 1992; Hart, 1996; Zhuravlev & Wood, 1996, 2008; Erwin, 1998; Hallam, 2005).

Fig. 59. Global diversification and mass extinction (Sinsk) of Cambrian reefal fauna (after Zhuravlev & Wood, 1996). Note the complete absence of reefal organisms elsewhere but the Siberian Platform during the earliest Cambrian (here named the Tommotian and the early Atdabanian).



viii (b) Be outstanding example representing significant on-going geological processes in the development of landforms, or significant geomorphic or physiographic features.

Frozen ground karst

Karst of the "Lena Pillars Nature Park" is the only and unique example in the world of the recent development of the frozen ground karst on the plain plateau at 200-500 m above sea level, constituted by the limestone and dolomites of Lower Cambrian. All rock mass is covered by the karst process in the conditions of the perennially cryotic rocks to 500 m thickness. Karst is developed in the Sub-Arctic extreme continental and dry climate. (See Chapter 2a "Karst phenomena of the "Lena Pillars Nature Park"" for detailed information.)

The Lena River is the only place on the globe where the processes of the fine disintegration of the rocks – cryohydratational weathering, are the dominant in the modeling of limestone pillar relief.

Frozen ground karst of the nominated territory is divided into a) the surface the surface karst (associated with the supra permafrost aquifers) and b) the underground one (related with the intra and beneath permafrost aquifers) one. Classic surface and underground karst forms are: karst sinkholes, ponors, suhodols, karst lakes, disappearances of the rivers, karst sources, karren, karst niches, karst pillars are the clear confirmation of the karstification. Activity of the recent karst processes on the territory of NP Lena Pillars is estimated by 21,4 mm per 1000 years.

The on-going development of Lena Pillars is controlled considerably by the gravitational-slope processes, conditioned, on the one hand, by the ancient tectonic joints, on the other hand, by the unloading of the cliff face parallel to the river. Generally, the development of the recent Lena Pillars karsts is related with the fissures of unloading of the cliff face.

Recent fluvial processes play the peculiar role in the formation of pillar's relief. The moving valley's talus, witnessing about on-going weathering processes of limestone pillars, are wide spread along the bedrock shores of Lena River. River waters of these rivers undermine the shores and carry off the weathering material. New products of the cover, creeping from above, are accumulated in exchange of the talus creeped and washed. Thus, the process of slope disintegration is accomplished constantly, which is due to, on the whole, the widening of the river valley.

3b. Proposed Statement of Outstanding Universal Value

The nominated property «Lena Pillars Nature Park» tells us three key-stories about our planet and the early evolution of life, namely: 1) the record of the "Cambrian Explosion", 2) the newcoming story of frozen ground karst phenomenon, and 3) the history of human deifying of a great natural monument.

1a) The site possesses a remarkable world-wide value being the most significant natural monument of the Cambrian Explosion, which was one of the pivotal points in the Earth's life evolution. Due to platformal type of carbonate sedimentation within tropical belt without subsequent metamorphic and tectonic reworking and magnificent impressive outcrops, the nominated property preserve the most continuous, fully documented, and richest record of the diversification of skeletal animals and calcified algae from their first appearances until the first mass extinction event which is excellent documented in parallel in three types of sedimentary basins during the first 35 m.y. of the Cambrian evolution.

1b) The «Lena Pillars» comprises the earliest and the largest, in both temporal and spatial senses, fossil metazoan reef of the Cambrian world. This reef being a site of Cambrian diversification is comparable to the Great Barrier Reef in modern world. The high preservation quality of both skeletal and soft-bodied fossils being coupled with high resolution isotope and palaeomagnetic records as well as with various well-preserved sedimentary fabrics allows researches to solve diverse ecological and evolutionary problems with a precision comparable with the study of modern biotas and communities.

2) Situated within the nominated territory Cambrian carbonates remained to be a place of unique ongoing geological processes now – the only model of recent frozen ground karst of karst plateaus. All the rock massif is touched by karst processes of perennially cryotic rocks under extremely continental semihumid climate conditions. The Lena and Buotama pillars are the only area on the globe where the processes of the fine disintegration of the rocks – cryohydration weathering – dominate in the shaping of carbonate pillar relief. These karst phenomena are enriched by thermokarst processes developed in the area of a great permafrost thickness (up to 600 m) which led to appearances of alases – thermokarst features of almost exclusively Yakutian affinities. The frozen ground karst in combination with thermokarst is an worldwide unique phenomenon of Eastern Siberia and in outstanding kind documented in the proposed property. It is quite different from all karst sites in the World Heritage List, which are located in humid areas. In turn, the semihumid continental climate conditions are expressed in a formation of tukulans which are eolian sand dunes being developed at almost polar latitudes.

3) Cambrian and present-day natural processes finally created Lena and Buotama Pillars known for inimitable beauty. Aesthetics effect of these large-scale rock river banks have no analogue all over the world. Improbable stone sculptures in form of uncountable fantastic pillars, steeples, towers with niches, passages, caves stretch for dozens of kilometers along the banks of the Lena River and its tributaries. The Lena River itself, which is one of the biggest rivers in the world, is served as a magnificent animated and all times different pedestal for this tremendous scenery framed by the seasonal changing features of the taiga and mountain steppe vegetation.

The nominated area is the outstanding natural property providing an unmatched synthesis of Cambrian geological and palaeontological data which are the basis for our understanding of the far past, evolution of the Earth and of the life on our planet during one of pivotal and dramatic points of its development.

The "Lena Pillars Nature Park" could make a claim for its inscription on World Heritage List according to two criteria: vii and viii. Valuable geological (lower to middle Cambrian strata), paleontological (rich and exceptional fossils and biocenoses including the earliest metazoan reef belt) and unique geomorphological sites (frozen ground karst, thermokarst, and sand dune-tukulan) is combined here with outstanding natural scenic attractions.

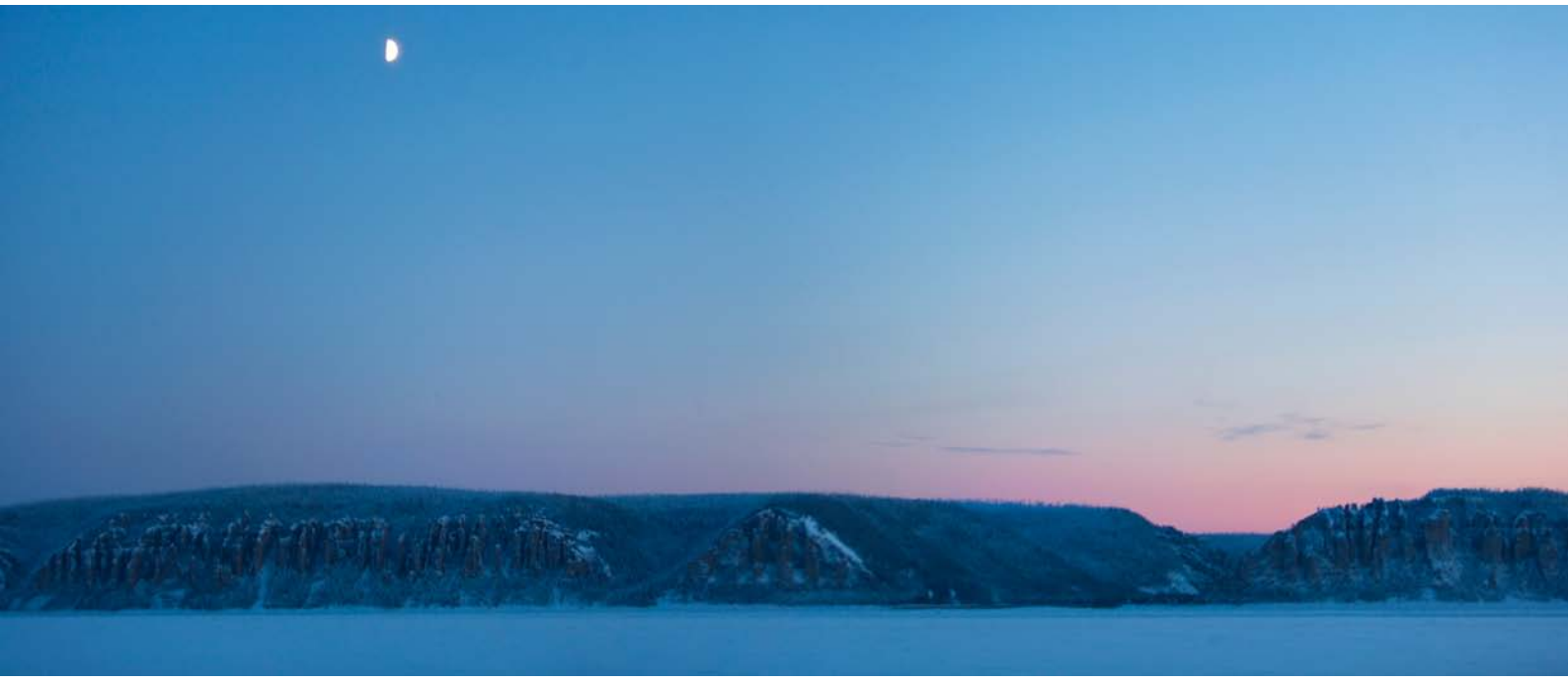


Fig. 60. View of the Lena Pillars across the Lena River in middle November. *Photo by A. Kamenev*

3c. Comparative analysis (including state of conservation of similar properties)

1. GEOGRAPHICAL ANALYSES

1.1. The Udvardy scheme analyses – biogeographical realms level

Eastern Palaearctic – is one of the greatest biogeographical realms allotted upon the prominent M. Udvardy natural demarcation scheme (1975). However, there is only a few World Natural Heritage Sites – about 15 - in comparison with the other regions of the Earth. Moreover, they are distributed very irregularly. So, most of the sites are accumulated in the southern and south-eastern parts of Eastern Palaearctic (in China, Northern India, and Nepal). Another three sites are located in its central part – in mountains and plateaus of southern Russia («Golden Mountains of Altai», «Uvs Nuur Basin», «Lake Baikal»). There are some more sites in the eastern part of the region, in its coastal: two in Japan and two in Russia («Central Sikhote-Alin», «Volcanoes of Kamchatka»). One more Russian site stands apart: it is the «Wrangel Island» in the Chukchi Sea, being the northernmost of World Natural Heritage Sites. At the same time, practically all the northern part of Eastern Palaearctic (tundras, open woodlands and taiga of Russian Siberia and the Far East) presents a vast region with not a single World Natural Heritage Site until now. This disproportion is just partly corrected by the Russian World Heritage site Putorana Plateau, inscribed in 2010.

The "Lena Pillars Nature Park" is situated in Central Yakutia, i.e. in the north-eastern sector of Eastern Palaearctic, and in such a way can partially cover that significant gap clearly seen on the global scheme of World Natural Heritage Sites location.

2. COMPARISON WITH OTHER WNH SITES

The nominated property comprises a segment of the Lena river about 200 km long that plays a role of main nature axis, «the frame» of the protected area. And from this point of view the concerned region is a rather interesting one. If we consider World Natural Heritage Sites which also comprise rather extensive sections of large rivers, it turns out that there are only few of such sites in the world (at that, small rivers are abundantly represented in WNH sites).

Some of the large rivers are plain ones, slowly running, sometimes meandering greatly (like Jau and Rio-Negru – site Central Amazonia, Niger – in park «W»). Other rivers are running in canyons (Grand-Canyon of Colorado river in the USA, Nakhanny in Canada) or deep gorges («Three parallel rivers» in China). There are also segments of rivers with giant waterfalls (Iguasu, Victoria at the Zambezy river).

CRITERION VII

The Pillars stretching along the Lena river channel are famous for their really fancy and fantastical contours and present the main aesthetic resource of the Park. They can be easily seen from a rather long distance. Just because this magnificent nature decoration the proposed region can really pretend for a high appreciation considering Criterion (vii).

Table 4 presents comparison of the Lena Pillars with a number of World Natural Heritage sites (both natural and cultural-natural) which also comprise a series of skerries and were included into the World Natural Heritage List in particular considering Criterion (vii), i.e. they were recognized extremely picturesque and exotic ones. Some of them are also situated along rivers' banks, while the others are geographically isolated and have no relation to rivers.

Table 4. Comparison of the Lena Pillars with rock pillar landscapes in other World regions (including WH properties).

Name of property / status	Short description	Genesis	Height of skerries
The Lena Pillars Nature Park (Russia) / Property, nominated to inscription into the World Natural Heritage List	A many kilometers «chain» of skerries, formed with ancient limestones, along the Lena river right bank, graceful and wondrous diverse forms of rock pillars.	Frozen ground karst, erosion and cryohydratational weathering	Up to 50-100 m
Meteora (Greece) / World cultural-natural Heritage property	Massive and high rocks of sandstone with flat apexes and steep slopes, located in a compact group.	Ancient tectonics, erosion and weathering	Up to 200-300 m
Uishan Mountains (China) / World cultural-natural Heritage property	A series of massif sandstone mountains-skerries with steep slopes and rounded domelike apexes along the channel of "Nine Turns River"	Ancient tectonics, erosion and weathering	Up to 50 m
Ulin-Yuan' (China) / World Natural Heritage property	Hundreds of high peaks with steep slopes made of sandstone and located in a rather compact group	Erosion and weathering	Up to 200 m
Shilin (China) / Cluster of the World Natural Heritage property South China Karst	The unique «stone forest» with exceptional diversity of forms and colours of spire-shaped limestone pillar rocks and outcrops around lake	Early tectonics, karst, erosion and weathering	Up to 30-50 m
Ha-Long Bay (Vietnam) / World Natural Heritage property	Hundreds of small limestone islands-mountains in a shallow coastal zone of the Gulf of Tongking	A classic example of tropic «tower» karst	Up to 150-200 m
Cindjy-du-Bemarakha (Madagaskar) / World Natural Heritage property	Limestone «stone wood», located on a high bank of the Manombolo river and forming a rather compact massif	Swallow holes – one of the widespread forms of karst relief	Up to 20-30 m

Nahanni (Canada) / World Natural Heritage property	High mountaine landscape (up to 2,972m a.s.l.), massiv forms of rocks, Waterfalls, canyons and outcrops (limestone, sandstone) along the Nahanni river channel	Karst, erosion and cryogenic weathering	Up to 100-200 m
Bryce Canyon (USA) / National park	Picturesque compact massif of red sandstone outcrops (towers, pillars, spires, «stone forest»)	Erosion and weathering	Up to 100-150 m
Arches (USA)/ National park	Unique stone statues of red sandstone on the waste mountainous plateau	Erosion and weathering	Up to 50 m
Cévennes (France) / at the Tentative List (Cultural landscape)	High mountainous cultural landscape with separate outcrop relief forms, allocated on the vast territory (limestone steeps, towers, pillars, spires, «stone forests»)	Karst, erosion and weathering	Up to 100-200 m

Considering the immense length of the almost continuous rock pillars chain (about 40 km) spreading along the channel of a giant river of some kilometers width, one of the largest on the continent, we can surely acknowledge, that the present site does not have any analogues in the World. Indeed, the last majority of sites considered in the Tab.3 are geographically separated and do not have such close connection with rivers (heavilly dissected high mountainous areas, dry canyons with erosion relief, compact groups of outcrops – massif and small, «stone forests» and others). And only few of these similar sites include the river parts with picturesque rock pillars along the banks, as the described Russian site does; however these rivers are relatively small compared to the Lena river, and the amount of rock pillars along their channels, is far less (Wuyi Shan, Cévennes), or there are canyons instead of rock outcrops (Nahanni).

Morover, the aesthetic perception of the Lena Pillars is considerably increases due to two more facts, which gainfully outline this Yakutian phenomenon against other similar territories, namely:

- **Excellent observational** possibility in two major perspectives: firstly, when watching from «inside», downwards, i.e. from the outcrops side, with Lena river, its islands and opposite bank in the middle distance; secondly, from the side of river (from bank or shipboard) – upwards. By the way, there are some intermediate (lateral) observational perspectives. As one Russian proverb has it, «visible as it was in your hands» (plainy visible). Meanwhlie, not every similar site from those listed above, has the same observational possibilities. Thus, in mountainous heavy-going areas the observation is generally possible from definite routes and sightseeing points (Wulingyuan). The site «Tsingy de Bemaraha», the natural «karst badland» is totally impassable. The most «visually accessible» are the American national parks – Arches and Bryce Canyon, open shallow bay Halong, and massif outcrops of Meteora, dominating above the vast plain.

- **Pronounced seasonality**, which enriches the landscape perception and notably increases its aesthetic potential. In the Lena Pillars case we can talk about some periods: violent spring vegetation and summer nature blossom; short but very colourful «golden autumn» (mainly thanks to deciduous larch, which is abundant along the Lena river banks); and the longest running period with thick snow cover which is an essential part of the northern taiga scenery during 7-8 months. This natural «scene change» is the result of northern location of the site and the extremely continental climate. Meanwhile, many other sites listed above are located much more southward – in subtropic or tropic latitudes, sometimes in the mild coastal climate (Halong, Meteora, Wuyi Shan, Shilin, Tsingy de Bemaraha). That is why we can not observe the permanent and thick snow cover there as the natural surrounding of unique outcrops – this important aesthetic landscape component is absent here. The change of seasons in tropic and subtropic latitudes goes another way compared to high latitudes: there is no «golden autumn» in Russian meaning. The most similar site in this meaning is only one – the Canadian park Nahanni, which is located in the same northern latitudes (61-62 degrees), in the taiga zone and in the continental climate, and the compositional basis of this park consists of the relatively large river – Nahanni. Bryce Canyon and Arches are also covered with snow for the certain period, but there is no «golden autumn» in this mountainous rocky territories.

Considering aesthetics, the important aspect is the conservation of wild, untamed territory. Some of the analogues considered above, are much more developed as the Lena Pillars region which resembles a wilderness area in most parts. The Cévennes site is virtually cultural landscape, which has been intensively developed by humans for long.

CRITERION VIII

A) CAMBRIAN SYSTEM

Only two sites related to the Cambrian Period of the Earth's history are listed in the World Cultural and Natural Heritage List nowadays, namely, the Canadian Rocky Mountain Parks and the Grand Canyon National Park (U.S.A.). The third one, which is the lower Cambrian Chengjiang site in the Yunnan Province of the P.R. China, has been included recently in the Tentative List.

The Canadian Rocky Mountain Parks houses the Burgess Shale which is one of the most significant fossil areas of the world. Despite exquisitely preserved softbodied marine fossils, this site is c. 10 m.y. younger than the comparable Sinsk Biota of the Lena Pillars is and, actually, represents only the second wave of the Cambrian Explosion following the first mass extinction event which already took out a large number of creatures representing in the Lena Pillars (e.g., entire reefal fauna). The sites are differed also by the type of fossil preservation and by the matrix composition. The Burgess Shale fossils are preserved being replicated in clay minerals and silica while those of the Sinsk Biota are replaced by phosphates which replicate tiny soft tissue structures and even individual cells and emryos. The Sinsk Biota is the only Cambrian Lagerstatte occurring in carbonates while all others Cambrian Lagerstätten including the Burgess Shale itself are restricted to siliciclastics. Finally, the Sinsk Biota represents a small part of the Cambrian fauna and other phenomena of the Lena Pillars while the Burgess Shale is the best Cambrian

site of the Canadian Rocky Mountain Parks. **The Canadian Rocky Mountain Parks do not contain any fossiliferous Cambrian reefal rock, their skeletal fossil record is very poor, and the entire interval of Cambrian strata is much shorter here.**

The Grand Canyon National Park in the U.S.A. is the most spectacular gorge in the world cutting strata which retrace the geological history of the past 2 billion years. However, the Cambrian System itself is represented here by poorly fossiliferous Tonto Group consisting of mostly barren shallow-marine to fluvial siliciclastics and intertidal carbonates. These strata bearing low diverse trilobites, brachiopods, and a few isolated sclerites comprise approximately one seventh or even less of the interval represented in the Lena Pillars (c. 5 m.y.) and is correlated with the uppermost formations of the Lena Pillars. **The Grand Canyon National Park embraces almost barren Cambrian strata only.**

The Chengjiang site of the P.R. China represents c. 2 m.y. Cambrian interval which again is comparable with a minor portion of the Lena Pillars' Cambrian which is the Sinsk Biota. Again, the Sinsk Biota is comparable by its significance with Chengjiang site which is slightly older than the Sinsk biota but much younger than the basal Cambrian strata of the Lena Pillars. Again, the Sinsk Biota is the only Cambrian Lagerstätte in carbonate facies and here soft tissues are preserved mainly due to phosphatization while Chengjiang Lagerstätte is represented by siliciclastics and soft-tissue preservation is relied mostly upon pyritization of organic matter here. As a result, cell structures and embryos are visible in the Sinsk fossils only due to a unique state of phosphatization. The Sinsk biota only represent an absolutely unique combination of both types of extraordinary fossil preservation, namely, a Burgess Shale-type Lagerstätte and an orstentype. In addition, the Sinsk Biota includes the most diverse assemblages of fleshy algae, distinct hexactenellids and demosponges, palaeoscolecid worms, and one of the biggest Cambrian animals, the trilobitomorph *Phytophylaspis* which is a half-meter in length. The Chengjiang site does not contain any fossiliferous Cambrian reefal rock, its skeletal fossil record is very poor, and the entire interval of Cambrian strata is much shorter here.

Cambrian reefal rocks are known from Morocco (northern Africa), South Australia, western (MacKenzie Mountains) and eastern (eastern Labrador and western Newfoundlan) Canada, western United States (Nevada and California), some European countries (Spain, France, Sardinia), and some others. However, **in all these sites, the earliest Cambrian strata do not contain reefs and mostly are barren**, in a better case containing a few fossils. None of them comprise the earliest Cambrian reefs which are the most important for the understanding for the beginning of the evolution of the earliest reefal biota. None of them contains fossil assemblages which are richer than those of the Lena Pillars. Of all these sites, only the Lena Pillars have a continuous carbonate Cambrian record and the richest assemblages of skeletal fossils.

Table 5. World Cultural and Natural Heritage properties representing the Cambrian System, and further important Cambrian sites.

Site	Principal sediments	Fossiliferrous Cambrian interval	Reefs	Generic diversity	Lagerstätte
Lena Pillars (Russia)	carbonates	c.35 m.y. (542-506 Ma)	present Including the earliest ones	c.350	soft-tissue, cells, embryos
Rocky Mountains (Canada)/ World Heritage Property	siliciclastics	c.10 m.y. (516-506 Ma)	-	c.100	soft-tissue
Grand Canyon (USA) / World Heritage Property	siliciclastics	c.5 m.y. (511-506 Ma)	-	c.30	-
Chengjiang P.R. (China) / at the Tentative List	siliciclastics	c.2 m.y. (522-520 Ma)	-	c.150	soft-tissue
MacKenzie Mountains (Canada)	siliciclastics carbonates	c.10 m.y. (520-510 Ma)	present	c.40	-
Eastern Canada	siliciclastics carbonates	c.5 m.y. (510-505 Ma)	present	c.20	-
Western U.S.A.	siliciclastics carbonates	c.30 m.y. (542-510 Ma)	present	c.40	-
South Australia	carbonates siliciclastics	c.25 m.y. (535-510 Ma)	present	c.100	-
Anti-Atlas (Morocco)	carbonates siliciclastics	c.15 m.y. (525-510 Ma)	present	c.50	-
South Europe (Spain, France, Sardinia)	carbonates siliciclastics	c.15 m.y. (525-510 Ma)	present	c.40	-
Other areas of the Siberian Platform	carbonates	c.35 m.y. (542-506 Ma)	present	c.100	embryos

Some other areas of the Siberian Platform, namely, sections of the Sukharikha, Kotuykan, Yudoma, Gonam, and Aldan rivers also provide a rich record of skeletal fossils across entire lower Cambrian interval. However, **these sections do not contain reefal complexes or includes a few small reefs only and, as a result, their fossil assemblages are much poorer than those of the Lena Pillars Nature Park.**

B) FROZEN GROUND KARST

Karst plateaus are the classic forms of the relief in the karst regions composing more than 30 % of the land's area. The term "karst" came from the name of plateau Karst or Kras (at 380-430 m above sea level) in Slovenia, formed in the limestones dated by the Cretaceous. Karst plateaus are widely represented in different regions of the globe: plateau Grands Casses, rising to 700-1000 m in the limestones and dolomites of the Jurassic, and the one Vaucluse (338-950 m) in the limestones of Lower Cretaceous in France; plateau "Rock sea", reaching 2500-3000 m in the limestones and marles of Trias with the participation of the carbonate rocks referring to Jurassic and Cretaceous (Austria); the series of the plateaus on the Slovac-Hungary boundary in the limestones dated by Trias: Coniar, Pleshivets, Silotskoe and Yasovskoe (at 650-950 m); limestone plateau Yarangobilly (Silurian-Devonian) at the altitudes approximately 1100 m in Australia; the famous Mammoth Cave Plateau in the limestones of Carboniferous in Northern America, etc.

Four karst plateaus - Hallstatt-Dachstein Salzkammergut Cultural Landcape (Austria), Wulong (Chongqing) (South China), Henderson Island (UK: Pitcairn Islands), Phong Nha-Ke Bang National Park (Vietnam) – are situated now in the List of the World Natural Heritage (World…, 2008). The development of the karst is realized in the conditions of the humid climate for the all four karst plateaux: there is the humid temperate one, rising to subalpine and alpine in Hallstatt-Dachstein Salzkammergut Cultural Landcape, continental humid subtropical climate in Wulong, tropical humid maritime climate on the Henderson Island and humid tropical monsoonal one in Phong Nha-Ke Bang NP. The permafrost is absent in the all plateaus.

Only in NP Nahanni (Canada) the karst process is developed in the similar, as the "Lena Pillars Nature Park", climatic conditions: here is the same cold continental climate, although there is not extreme continental, one. But, if on the territory of NP Nahanni fall 400-600 mm of the precipitations per year, so will in the "Lena Pillars Nature Park" only 200-250 mm per year. What is more in distinction to the "Lena Pillars Nature Park" (altitude is to 500 m), NP Nahanni is placed in the high mountain area till 2972 m above sea level – in Mackenzie Mountain, where the mountain glaciation, instead permafrost, has the decision role in karst formation.

At present in the WH List there are already outstanding pillar landscapes, including Wulingyuan, Shilin and Danxia (China), Tsingy de Bemaraha (Madagascar). Some spectacular areas that are not in the WH List at present, such as Arches NP and Bryce Canyon (both in USA) and Numbung (Australia). These pillar landscapes were formed by different ways and some are in sandstones rather than limestones. Only in limestone pillars of NP Nahanni (Canada) the development of relief is effected at the dominance of the same, as for NP Lena Pillars, geomorphologic processes: processes of cryogenic weathering. But NP Nahanni is characterized by the cold climate with humid winter (climate 8Df by Koeppen) during the course of which the moistening of the rocks is realized by the atmospheric precipitations, conditioning the processes of the rough disintegration of the rocks by the frosty weathering. Climate of the "Lena Pillars Nature Park" is cold with dry winter (climate 9Dw by Koeppen), that is the reason why the moistening of the rocks is accomplished by the condensed waters, causing the processes of the fine disintegration of the rocks – cryohydratational weathering. That is why the pillars of NP Nahanni are distinguished by the massive forms of limestone pillars whereas Lena Pillars are characterized by graceful and whimsical forms.

C) UNIQUE FORMS OF EOLIC RELIEF – TUKULANS

Tukulans, as they call hummocky sands in Yakutia, are spread only in the region of the Middle Lena course and in the basin of its big tributary Vilyui river. It is a real natural phenomenon: nowhere else in the world are such prominent eolic land forms (massifs of moving sands) developed under the conditions of permafrost, in such high latitudes and in such continental climate (as is well known, dunes are most typical for estuaries and coastal regions, and, of course, for desert arid areas).

Results of comparison analyses of tukulans of the "Lena Pillars Nature Park" with other dune complexes of Eurasia situated within the World Natural Heritage Sites, are presented in Table 5. The main conclusion is that the exceptional specificity of Yakutian tukulans as a natural phenomenon has no analogues in other regions of Eurasia and the world. Notably, that they are interesting not regarding their size, but due to their genesis and conditions of origin.

Table 6. Comparative analyses of tukulans of the "Lena Pillars Nature Park" with other dune complexes of Eurasia , which are located in World Heritage properties.

Name of property	Dunes' height	Geogr. latitude	Conditions of origin
Yakutian tukulans («Lena Pillars Nature Park», Russia)	Up to 20-30 m	About 62° N	Boreal zone, permafrost, harsh continental climate
Kuronian spit (Russia/Lithuania)	Up to 70 m	About 55° N	Temperate zone, Baltic coast
Ubsunur Hollow (Russia/Mongolia)	Up to 15-20 m	About 51° N	Temperate zone, harsh continental arid climate, closed desert hollow in Central Asia
Danube Delta (Romania)	Up to 10 m	About. 45° N	Boreal zone, river delta, the Black Sea coast
Dunes in the Gvadalkvivir river delta (park Koto-Donyana, Spain)	Up to 40 m	About 37° N	Meridional zone, river delta, Atlantic coast

Fig. 61. Shifting sands of a tukulan. *Photo by A. Ogloblin*

Fig. 62. Saamys Kumaga tukulan. Space image

3d. Integrity and/or Authenticity

Integrity substantiation has been in accordance with the «Operational Guidelines».

Paragraph 88:

(a) The "Lena Pillars Nature Park" presents a single nature complex, its main components are inseparably tired with each other by common origin, history and the dynamics of natural development, and include all the elements necessary to express its outstanding universal value.

(b) By its size (1 272 150 ha) the nominated property is great enough to support the functioning of nature complexes and to ensure the complete representation of the features and processes which convey its significance. Besides, local and republican Resource Preserves adjacent to the Park's boundaries give additional integrity guarantees for the nominated property.

(c) The territory proposed for inscription on the World Natural Heritage List presents an integral system. Natural ecosystems, numerous nature monuments, and also evidences of human activity from ancient times are being sustainable preserved in its limits over a long period of time. Practically the whole territory proposed for inscription on the WNH List lies in the limits of the "Lena Pillars Nature Park" and so is provided with professional guarding by the Park administration and the staff on the basis of laws and decrees of the Governments of the Russian Federation and the Republic of Sakha.

Traditional nature management and license use of biological resources by local residents from eight communities of small nationalities of the North inhabiting the Park territory (and absolute absence of permanent settlements) present the main condition for conservation of nature monuments and biological diversity of ecosystems of the concerned territory.

Paragraph 90:

The biophysical processes and landform features of the nominated area are intact (see Section 4 for detailed information).

Paragraph 92:

The nominated property includes all the elements essential for maintaining its aesthetic features, first of all - great variety of skerries relief forms: fancy pillars, spires, towers, columns, complicated with grottos, passages, and caves, stretching along the riverbanks of the Lena and Buotama for dozens of kilometers. All the components of landscape bringing the "Lena Pillars Nature Park" an outstanding aesthetic significance are in natural interrelationship stipulated by the common genesis of the nominated property.

Paragraph 93:

The area of the "Lena Pillars Nature Park" has passed a long and complex period of geological development since Early Cambrian. The nominated property reflects both significant geological processes of surface development and outstanding geomorphological relief features. All significant relief forms of the property are interrelated and interdependent elements in their natural relationships.

4 STATE OF CONSERVATION AND FACTORS AFFECTING THE PROPERTY

4a. Present state of conservation

The area of the property

Natural complexes of the nominated property have not experienced significant economic influence of man and at present are in the state of conservation which is close to natural. After the establishment of the Nature Park, human pressure over the environment has been minimized. Forest cutting, mining and hunting (excluding licensed sable hunting) have been prohibited (see Chapters 5b and 5c).

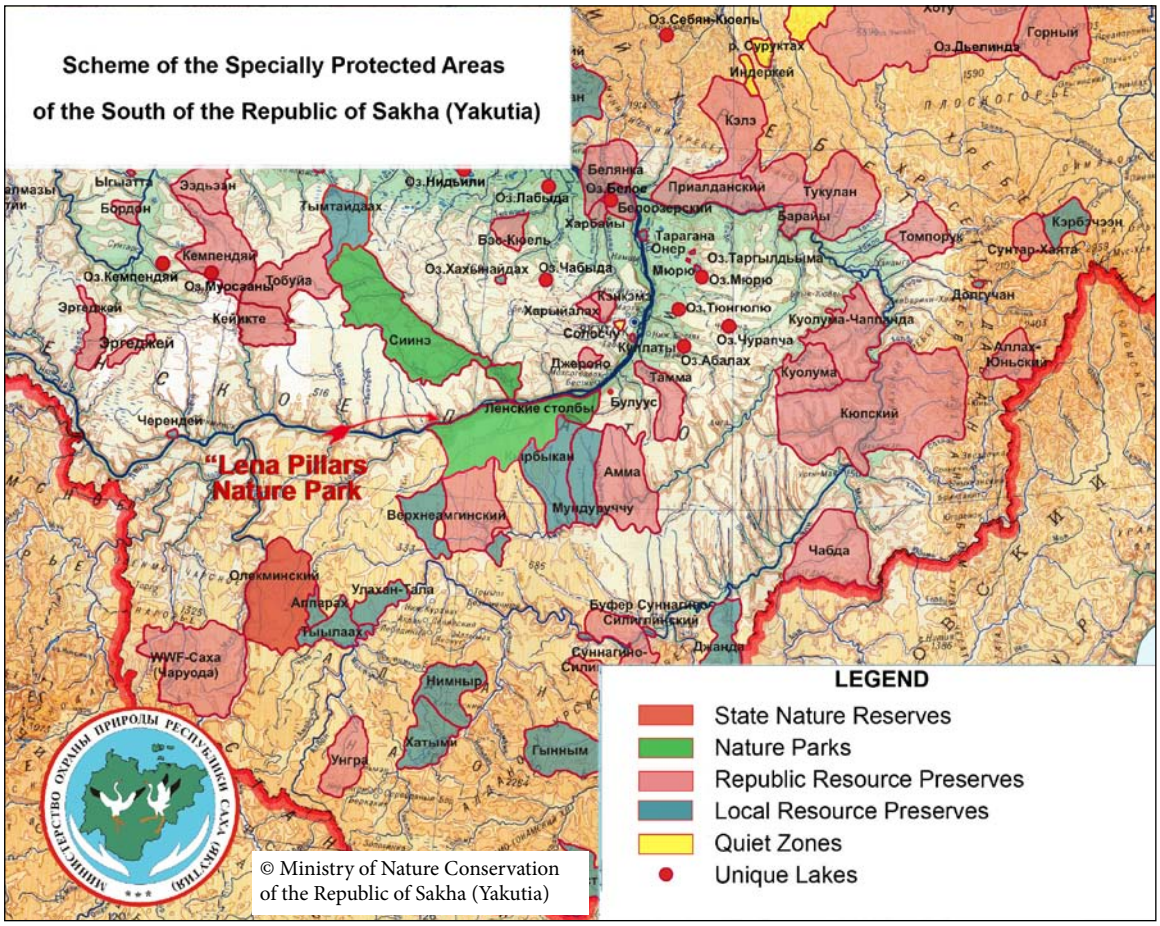


Fig. 63. Scheme of the Specially Protected Areas of the South of the Republic of Sakha (Yakutia)

4b. Factors affecting the property

Development Pressures (e.g., encroachment, adaptation, agriculture, mining)

There are no industrial enterprises within the nominated property and in the surrounding area.

Traditional economic activity is led within the Park's area: licensed sable hunting, horse breeding in the Boutama River mouth, deer farming and haymaking. 884 thousand ha of land or about 60% of area of the Park are assigned to 6 Evenk ancestral farms. One of them does deer farming, the other two, horse breeding, the rest live on fishing and hunting of hoofed animals. Upon the understanding with the Park's administration, the Khachykaat collective farm breeds 150 horses at the Park's area. Agricultural lands occupy about 300 ha of land.

Over last 30-40 years the area is limitedly used as a hunting. Hunters drop in occasionally, mainly during the sable hunting season. Members of ancestral farms annually bag 600-800 sable skins.

After the establishment of the Nature Park, tourist infrastructure is being developed.

Industry:
Emergency water discharge by oil-tankers and other large ships is possible.

Solution:
Water surface monitoring and taking part in breakdown elimination together with Ministry of Emergency Situations.

Agriculture:
Unauthorized spring grassland fires at grasslands of land-users. Unauthorized cattle grazing.

Solution:
Strengthening control over the agricultural lands in spring and summer periods.

Adaptation:
Introduction of the Canadian bison within bounded enclosures with the aim of the specie conservation, upon the International Agreement between the Russian Federation and Canada.

Solution:
Solicitation Ministry of Nature Conservation of Yakutia for transferring bisons away from the Park's area.

At the present time there is no economic activity negatively affecting to the natural complexes of the nominated property.

(ii) Environmental pressures (e.g., pollution, climate change, desertification)

To ecological factors influencing the natural complexes of the Park, one can relate global climate warming.

Noted from the end of XX century, the global warming has already influenced greatly the biota of the Earth (Gruza et al., 2001; Climate Change, 2001). Upon data by M.K.Gavrilova (1998), by mid XXI century the significant warming would take place over the whole north. Both annual average temperatures and monthly maximal and minimal temperatures would rise. The following data is given by V.T.Balobaev et al. (2003): for the last 100 years, winter temperatures in Central Yakutia (including the area of the "Lena Pillars Nature Park") has increased on average 10 °C, summer temperatures have remained almost the same +10 °C, annual average temperature has increased by 2.5 °C. Prediction value of annual average temperature in the global 2 °C increase scenario will make -5 °C, in the global 4 °C increase scenario, -2 °C. The permafrost boundary would be correspondingly moved further to the north to 5° N under the first scenario, and to 10° N under the second one.

Upon data by the Cryopedology Institute of the Siberian Branch of the Russian Academy of Sciences, from 1951 to 1991, due to global climate warming, annual average temperature at the Lena Pillars area has increased by 1.0 °C (Dobrolet weather station).

Mentioned climatic changes has no influence to the state of conservation of the Cambrian and other paleontological objects; possible influence to the Karst phenomena on the territory of the «Lena Pillars Nature Park» is not investigated.

(iii) Natural disasters and risk preparedness (earthquakes, floods, fires, etc.)

A threat to integrity of landscapes is fires. In summer 2001 the thunderstorm caused 11 forest fires over the area of 18 224 ha. In 2006 one forest fire near the Labydia River has been recorded. The area covered by the fire made 130 ha.

Administration of the Lena Pillars Nature Park and Khangalassky forestry have signed a cooperation agreement in the field of forest management within the area of the Lena Pillars Nature Park. The mutual activity plan worked out annually includes the following items:
- joint work for fires detection and explanation work through mass media;
- revelation of persons guilty of forest fires, giving an opinion, calculation of damaged caused, in 5 days;
- establishment of fire-hazardous periods till special order of the ulus administration.

Annual association agreement on mutual fires extinguishing is signed with the Aircraft Fire Extinguishing Brigade of Pokrovsk (branch of Aircraft Fire Extinguishing Service of Yakutia).

Occurring more rapid last years, the Lena River floods cannot significantly influence the main integrity factors of the natural complexes of the Park.

(iv) Visitor/tourism pressures

Today the Lena Pillars are the only widely advertised tourist brand of the Republic of Sakha (Yakutia). Upon the design value, the maximal size of visitors that does not bring damage to the Park is 23 thousand people. Presently the Park receives up to 10 thousand of tourists, which do not render negative effect over natural complexes of the Park (see Chapter 5h).

(v) Number of inhabitants within the property and the buffer zone

Estimated population constantly inhabiting the nominated area: 5-6 persons – the staff of the Brolog hydropost.
The buffer zone: no permanent inhabitants.
Total: 6 persons.
Year: 2006

5 PROTECTION AND MANAGEMENT OF THE PROPERTY

5a. Ownership

The area of the Lena Pillars Nature Park is the Republican property.

5b. Protective designation

Nature Park of the Republic of Sakha (Yakutia).

Juridical status is determined by the State and the Republican legal acts:

1. Extract from the federal Law of the Russian Federation «On specially protected natural areas» of 14.05.1995 (read with the Federal Law of 29.12.2004 N 199-FL) (Annex B1);
2. Law of the Republic of Sakha (Yakutia) "On Specially Protected Natural Areas in the Republic of Sakha (Yakutia)". Enacted by Ordinance of State Assembly (Il Tumen) of the Republic of Sakha (Yakutia) No.3N 214-III of December 25, 2003 (read with the Law of the Republic of Sakha (Yakutia) of 14.02.2007 429-3 N 873-III) (Annex B2);
3. Resolution of Government of the Republic of Sakha (Yakutia) «On establishment of the National Lena Pillars Nature Park in the territories of Khangalassky and Olekminsky Uluses» of 10.02.1995 N 39 (Annex B3);
4. STATUTE of the State Enterprise Nature Park (Aan Aiylgyly) "Lena Pillars" of the Republic of Sakha (Yakutia) (Annex B5).

5c. Means of implementing protective measures

Legal instruments for protection of the property are determined by the Regulations of the Nature Park confirmed by the Government of the Republic of Sakha (Yakutia). The Regulations include:

- protection regime;
- rights of persons in charge of protection of the territory;
- responsibility for violation of the protection regime.

The Park has the Protection Department with staff consisting of 9 persons equipped with necessary transport and communication devices. Besides, there is a Public Inspector Network of the Specially Protected Areas. Yakut Territorial Committee for Environmental Protection, Special Poaching Inspection of Ministry of Environmental Protection take part in the Park's protection. Upon the agreement with the Nature Park, in the summer period the Yakutia Aircraft Fire Extinguishing Brigade fulfills fire prevention measures.

5d. Existing plans related to municipality and region in which the proposed property is located (e.g., regional or local plan,conservation plan, tourism development plan)

The work of the Nature Park is based upon the basic program documents confirmed by the Government of the Republic of Sakha (Yakutia):

1. Decree of the President of the Republic of Sakha (Yakutia) "On measures for development of the Specially Protected Areas" № 837 of 16 August 1994.
2. State ecological policy of the President of the Republic of Sakha (Yakutia) for the transition period (7 March 1996).
3. International and National Tourism Development Program of the Republic of Sakha (Yakutia) confirmed by the Decree of the Government of the Republic of Sakha (Yakutia) of 6 September 1996 № 362.

5e. Property management plan or other management system

According to the Law "On Specially Protected Areas", the Lena Pillars Nature Park falls into the category of the national nature reserve under the jurisdiction of the Republic of Sakha (Yakutia). According to the Russian legislation, it is the Nature Park. It takes intermediate position between 2 and 3 IUCN Categories of protected area.

Regulations of the Nature Park confirmed by the Government of the Republic of Sakha (Yakutia) is a basic document regulating the activity of the Nature Park (Annex 5). The Regulations fully describe:

- juridical status;
- ownership form and privity;
- mission of the Park;
- management;
- protection regime;
- rights of persons in charge for protection of the territory;
- responsibility for violation of the protection regime;
- economic and financial activity;
- boundary description.

General aims of the Nature Park are:

1.1. Maintenance of the protected natural complexes in primary state and biodiversity conservation;
1.2. Revival and development of the traditional forms of management of local population;
1.3. Conservation of model and unique natural complexes and objects, monuments of nature, history and culture, and other sites of cultural heritage;
1.4. Creating conditions for regulated tourism and recreation;
1.5. Carrying out ecological monitoring;
1.6. Carrying out scientific research;
1.7. Restoration of damaged natural, cultural and historical complexes;
1.8. Organization of ecological education for local population.

In accordance with this, the Nature Park is divided into the following functional zones with different protection and management regime:

- Preservation regime zone
- Recreational zone
- Traditional management activity zone (lands of nomadic ancestry farms)
- Regulated management zone (for agricultural enterprises).

Administrative and criminal responsibility is determined for violation of the protection regime.

In 2008 the professional management-plan for 2008-2012 has been elaborated in conformity with Order of the Federal Service for Supervision of Natural Resource Usage of the Russian Federation №491 of 03.12.2007. (Annex B11).

5f. Sources and levels of finance

The Park is financed mostly from the Republican budget. Besides, the Park independently commands finance received from:

- tourism;
- scientific, conservancy, publication and advertisement activity;
- compensation paid by juridical and physical persons for bringing damage to complexes and objects within the Parks' area;
- selling forfeit of hunting, fishing and illegal nature management expropriated in the stated order;
- non-budget funds;
- grants and charitable contributions.

Table 6. Sources and levels of finance of the Lena Pillars Nature Park.

	2006	2007	2008	2009	2010	Total
Budget funds	11261,6	8861,9	9577,4	9972	9440,4	49113,3
Extra budgetary funds	850,0	1974,5	1000,0	2820,7	3390,2	10035,4
Investment funds	2700,0	1500,0	1500,0	6938,0	5500,0	18138
Directed funds	0	0	3452,9	650,0	39,4	4142,3
Thous. Rubles	14811,6	12336,4	15530,3	20380,7	18370	81429
$ UDS	439,9 тыс.	415,4	522,9	686,2	618,5	2741,7
€ EURO	359,2 тыс.	299,1	376,6	494,2	445,4	1974,5

5g. Sources of expertise and training in conservation and management techniques

Issues of management, training and raising the skill level of the staff are solved through Ministry of Nature Protection of the Republic of Sakha (Yakutia) and Ministry of small-scale business, tourism and employment development of the Republic of Sakha (Yakutia).

During last years the staff of the Nature Park have gone through the following training and educational programs:

- Meeting of the SPAs assistance Union, the Altay-Sayansky Eco region, 2010.
- RF National parks managers meeting, Smolensky Lakeland, 2010.
- Navy officers advanced training, Yakutsk, Sakha Republic (Yakutiia), 2010.
- Advanced training «Procurements management for federal and municipal purposes», Yakutsk, 2009.
- Ecological education workshop, Eco center «Zapovedniki», Moscow, 2008.
- Inter regional research and practice conference «Priorities of tourism development», Yakutsk, Sakha Republic (Yakutiia), 2008.
- The President Management Institute Courses of the Republic of Sakha (Yakutia), 2005-2007;
- Record keeping and personnel management courses, Krasnodar Study Center, June 2006;
- Courses of the Bookkeeping Institute in Yakutsk, June 2006 and in Moscow, December 2006;
- "Licensing the person in charge of navigation safety" courses, April 2006;
- Practical seminar "Organization and fulfillment of swoops against illegal use of bio-resources (poaching) at Specially Protected Areas", September-October 2005;
- Advanced training «Travel services sales management», Yakutsk, 2004.
- Courses of Yakutsk Commander Naval School, 1999;
- Seminar for inspectors of the Protected Areas upon the special program of the Ministry of Nature Protection of the Republic of Sakha (Yakutia), with the financial support of WWF, 1998;
- Expert Ecologist courses of Moscow State University, 1994.

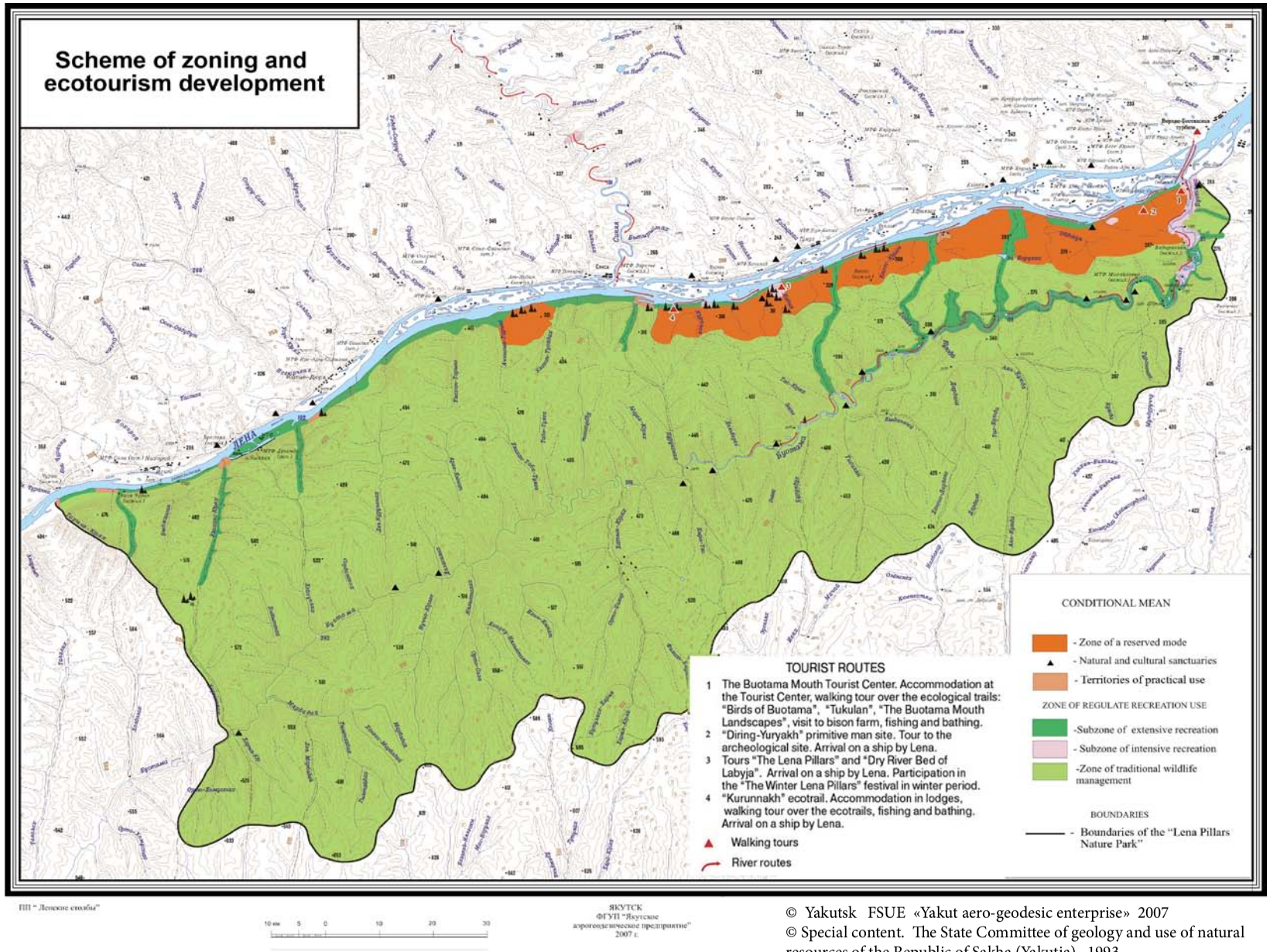
5h. Visitor facilities and statistics

The central office of the Nature Park is situated in Pokrovsk, which is located 80 km away from Yakutsk. Pokrovsk can be reached by the main road or by the Lena River. The main tourist routes go along the Lena River side. For conveyance of passengers the Park has 2 motor ships. The Center of Ecological Education – the modern building constructed with the support of WWF, is situated in Pokrovsk. The Park has 3 tourist centers, 7 inspector's lodges and 2 winter cabins. Bestyakh tourist center is situated 37 km away from Pokrovsk up the Lena River. It has the Inspector's house, garage, bath-house, 3 summer cabins and a visit-center. Ust'-Buotama tourist center is situated on the opposite side of the Lena River. It has the Inspector's house, diesel cabin, 10 summer cabins and a visit center. The Labyja river tourist center (located directly at the Lena Pillars) has 2 cabins.

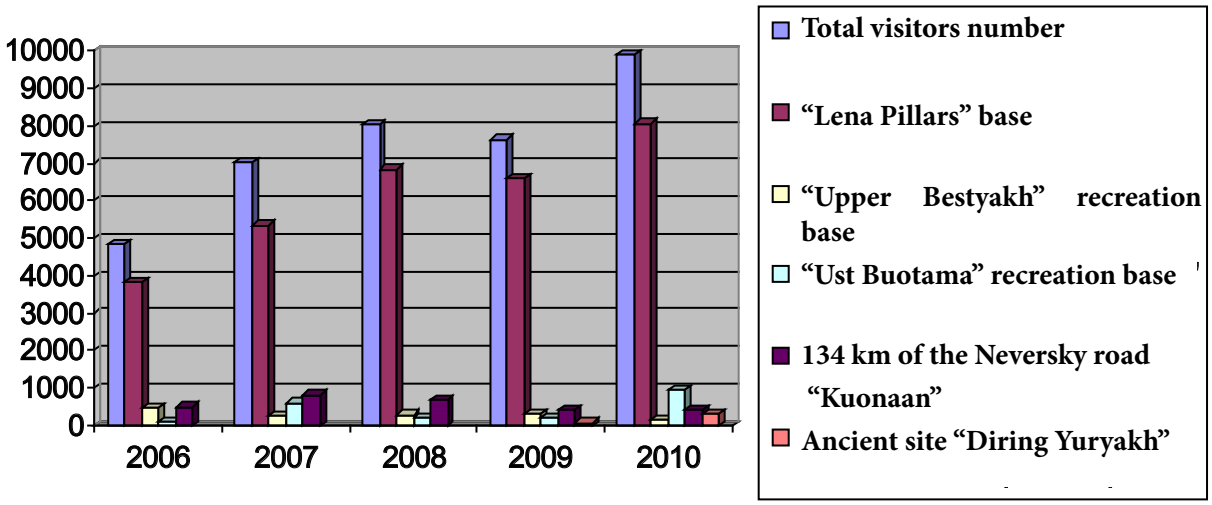
According to estimated data, the Park can be visited by 23 thousand of people every year without any damage for nature. At present time, the Park admits up to 10 thousand of guests during the best tourist seasons. The statistics shows the Park's visits for the recent 5 years:

Table 7. The statistics shows the Park's visits for the recent 5 years

	2006	2007	2008	2009	2010	Total for 5 years
Total visitors number	4838	7016	8025	7631	9917	37427
"Lena Pillars" base	3838	5349	6833	6603	8064	30687
"Upper Bestyakh" recreation base	395	246	290	327	151	1409
"Ust Buotama" recreation base	108	602	228	229	962	2129
134 km of the Neversky road "Kuonaan"	497	819	674	400	420	2810
Ancient site "Diring Yuryakh"	-	-	-	72	320	392



A11. Scheme of zoning and ecotourism development.



In particular, the statistics shows the Park's visits in 2006 is:

"Lena Pillars" base
The first motor ship came to the Lena Pillars Tourist Center on June 10, the last, on September 23. In 2006, the Center was visited by 3838 people, which came through tourist agencies upon contracts with the Park.

"Upper Bestyakh" recreation base
At the Upper Bestyakh Tourist Center the tourist season lasted 100 days, from June 8 till September 15. The Center was visited by 495 people.

"Ust'-Buotama" recreation base
From this center start the "Birds of Buotama" and "Tukulan" eco-trails. In 2006 the Center was visited by 108 people, many of which watched bisons.

134 km of the Neversky road "Kuonaan"
Between June 10 and September 5, the Buotama was visited by 497 people (over 100 of them have come by invitations). The most favorable period for tourism and rafting is the first part of summer, when the Buotama is full.

In all for 2006, the Park's area was visited by 4838 persons received by the excursion tour group tickets. Besides, over 100 persons visited the Park by invitations.

Fig. 64. Traditional travel mode. *Photo by V. Ryabkov*

Building and improvement of touristic sites was conducted until 2010.

Finished and put in commission:
- Observation site and ladder to the Labiya River;
- Ladder to the Diring-Yuryakh;
- inspector's house on the Labiya River;
- hardscape elements on the Labiya River;
- Visit center "Diring-Yuryakh";
- Visit center "Lena Pillars".

5i. Policies and programmes related to the presentation and promotion of the property

Activity of the Park is supported by the following Republican Aimed Programmes:
1. "Environmental protection of the Republic of Sakha (Yakutia) in 2003-2006" of 26 December 2002 № 644;
2. "Environmental protection of the Republic of Sakha (Yakutia) in 2007-2011" of 19 December 2006 № 402-3;
3. "Development of business undertakings and tourism of the Republic of Sakha (Yakutia) for 2007-2011" of 19 December 2006.

The Park is a member of many regional and international tourist exhibitions.

Regional tourist exhibition: "Sakha travel" – permanently;

Russian tourist exhibitions: Mitt, MTF – 2002-2005;

International tourist exhibitions:
1. London - 2003.
2. Berlin – 2004.
3. Kharbin – 2005.
4. Moscow – 2006.
5. Seoul – 2007.
6. Moscow – 2007.
7. Inchon (South Korea) – 2009.
8. IUCN park presentation – 2010.
9. Expo-Shanghai – 2010.

The Park is a permanent base for the Republican biological, conservancy and eco-tourism conferences. Every year the Park runs ecological camps for schoolchildren and invites students of Yakutsk State University (biological and geographical faculty) (BGF YGU) for summer fieldwork.

A number of video films about the Park's nature has been shot; monographic articles and diverse advertising printed matter have been published; souvenirs of local artists and signs have been produced.

Since 2006 the Park started publications of thematic pages in the ulus newsletter «Khangalas». Every year five pages are devoted to the Park's activities. Till 2009 the «Park's Bulletin» was published by the Park's stuff every quarter, which was distributed among school teachers and ulus organisations (the total coverage - 300 units). Besides these print editions, the articles about Park constantly appear in the Republican newsletters «Yakutiya», «Sakha sire», «Yakutsk vecherny», «Bayanay», «Kyym», «Zapovednoye bratstvo», «Nashe vremya» and others.

Moreover, the close work with the «Khangalas» TV and radio studio is conducted since 2004, the best reportings and translations were run through the National broadcasting

company «Sakha». Also the reporting series were run in the central Media. The Park's stuff constantly takes part in the talk shows, radio programs and news editions devoted to ecology and ecologic tourism. Besides TV programs, the movies «The time architecture» by MPR TV studio and «The Lena Pillars» by NVK «Sakha» in 2006. The English channel «Discovery» filmmakers worked in the Buotama river mouth in the July of 2006. Two TV Andrei I's programs «Seekers» were on the 1 central TV channel. In the beginning of the 2010 the Lena Pillars were visited by the French guest, who took dogsled from Yakutsk. It was shown on the central Media news.

The «Park's march» event is held every year. In the April 2006, within the event the Park in collaboration with BGF YGU arranged the eco tourism and eco education workshop in the Park's headoffice. Every year this event expands. Thus, in 2010 it covered 10 localities and 14 general education institutions. The total amount of partisipants was 700 persons.

The Park's work priorities is the ecologic education of the younger generation. Within this activity the ecologic educational summer camps work every year. In 2010 the Park admitted 11 camps, which covered 500 children. One of these camps is the regional scholar research-educational expedition «Shenken» under direction of the academician N.G. Solomonov. This expedition started to work in 2001 and conducts the field works in the Park every year. Also, every year the military-patriotic camp «Teenager» for intractable children takes place in the Buotama river mouth. Pupils of international child's fund «Children of Asia» raft down the Buotama river every year. Moreover, there are 5 ecological clubs in the Visit center of Pokrovsk town, which cover 74 pupils. The studies are held by the Park's stuff and young naturalists from the Oy village.

Every year students from the BGF YGU, the Pokrovsk business college, Yakutsk and central higher educational institutions came to the Park for the summer field works. The plain air «Gold of Pillars» takes place in the Park every year since 2001. The N.M. Zasimov's art gallery of the Pokrovsk cultural center «Sargy Tyusyulgete» arranges the likenamed exhibition, which attracts attention of art devotees every year. In 2009 the exhibition was held in the cultural center of the Yakutsk state university of M.K. Ammosov. During one month the exhibition was visited by more than 2000 of students, citizens and guests of Yakutsk.

5j. Staffing levels (professional, technical, maintenance)

By the early 2007, the staff of the Nature Park counted 36 persons, 15 of which have higher education, 17- specialized secondary education and 4 - secondary education:
Director, 1
Vice-Director, 2
Bookkeeper, 2
State inspector, 9
Eco-education specialist, 1
Methodologist, 1
Tourism specialist, 2
Secretary , 1
Motor ship captain, 2
Motor ship technical personnel, 5
Security guard, 6
Maintenance personnel, 2
Driver, 2

6 MONITORING

6a. Key indicators for measuring state of conservation

Indicator	Periodicity	Location of records
State of landscapes	Annual	The Park's Office; Institute of Biological Problems of Cryolitozone of the Siberian Branch of the Russian Academy of Sciences (IBPC SB RAS)
State of geological objects	Annual	The Park's Office; Institute of Geology of Diamonds and Noble Metals of the Siberian Branch of the Russian Academy of Sciences (IGDNM SB RAS)
Vegetation and florescence of *Redowskia sophiifolia* Cham. et Schlecht.	Annual	The Park's Office; IBPC SB RAS
Sable population density	Annual	The Park's Office; IBPC SB RAS; Biological Resources Department of the Ministry of Environmental Protection of the Republic of Sakha (Yakutia) (BRD MEP RS(Y))
Red deer population density	Annual	The Park's Office; IBPC SB RAS; BRD MEP RS(Y)
Waterfowl seasonal migrations	Annual	The Park's Office; IBPC SB RAS; BRD MEP RS(Y)
Meteorological data	Annual	The Park's Office; IBPC SB RAS; BRD MEP RS(Y)

6b. Administrative arrangements for monitoring property

Monitoring within the Lena Pillars Nature Park territory is provided by the staff of Institute for Biological Problems of Cryolithozone RAS SB, Institute for Cryopedology RAS SB, and Yakutsk State University. Members of Institute for Biological Problems of Cryolithozone RAS SB are annually conducting count of ungulate and sable numbers, organize field researches of flora, fauna, and ecological condition of the Park's nature complexes.

In 2006, geological expedition of Siberian Research Studies Institute for Geology, Geophysics and Mineral Resources (SNIIGGiMS, Novosibirsk) conducted field researches in the Park. Representatives of SNIIGGiMS and the Moscow Paleontological Institute RAS took part in these investigations too. It was a preliminary stage for International Field Researches in 2007.

6c. Results of previous reporting exercises

Landscape state monitoring

At the stage of establishment of the Lena Pillars Nature Park, we have studied the landscape structure of three sites most perspective for tourism: Labyja creek mouth, Samys Kumaga tukulan and Buotama mouth. Based on the full-scale study and the remote sensing data interpretation we have received information on the modern state of landscapes, revealed the nature complexes spreading pattern and made up 1:100 000 landscape maps. In total at these sites, we have picked out 25 typological landscape units of the landscape type – subtype – group of tract types level.

The following study of peculiarities of landscape differentiation in 1999-2005 allowed outlining landscape complexes of the Park of educational and aesthetic value, which are rarely found in other regions of Russia. Such are:
- rock, eolian, cryogenic, karst and suffosive formations;
- steppe slopes and dry river-beds typical for karst spreading regions;
- warm valley complexes of talik zones with typical vegetation (poplar woods);
- cold valley complexes with spruce forests;
- kyrdal steppe communities typical for regions with sharp continental climate;
- park-like pine forests perspective for recreation.

On the basis of the landscape research we have worked out eco-trail routes at the sites of Labyja, Saamys Kumaga and the Buotama River mouth. Six routes and descriptions of 25 notable landscapes from the point of view of eco tourism reflect peculiarities of nature and landscape structure of thet Park. 1 : 100 000 and 1 : 25 000 tourist route schemes have been worked up. During the field research, we have studied surroundings, bank and surface of Saamys Kumaga ridge, eolian formations of the near-edge area and bench basis of the Lena River IV terrace fragment near the Boutama River mouth. Data on eolian meso- and microrelief forms and their spatial distribution has been collected. We observe the dynamics of eolian process which has been activated in the northeastern part of the Saamys Kumaga massif after the fire has destroyed forest at this part of the Park. It was stated that the Lena River IV terrace has formerly been periodically subject to fires. In geological sections studied in lithogenic basis sediments of sandy-ridge locality type in the Boutama River mouth down to 3.5-4.0 m horizons with traces of fires at depths of 1.0, 2.0 and 2.5 m have been found. This fact gives reasons to consider fires abs one of the main eolian relief forming factor at this part of the Lena River valley. The results of studying eolian landscapes significantly expand the informal part of the trail interpretation material for Saamys Kumaga and the Boutama River mouth. Investigation of the canyon, the river valley fragment typical for karst spreading regions located in the Oddokun River mouth, has showed that this site has valuable recreational potential for the tourism development and can be used for broadening the existing excursion program. For the trail interpretation in this area and in the Labiya River mouth additional karst formations research is necessary.

7 DOCUMENTATION

7a. Photographs, slides, image inventory and authorization table and other audiovisual materials

IMAGE INVENTORY AND PHOTOGRAPH AND AUDIOVISUAL AUTHORIZATION FORM

№	Format (slide/ print/ video)	Caption	Date Of photo (mo/yr)	Photographer/Director of the video	Copyright owner (if different than photographer/ director of the video)	Contact details of copyright owner (Name, address, tel/fax, and e-mail)	Non exclusive cession of rights
	1	2	3	4	5	6	7
	Video	Lena Pillars NP	2006-2007	D. Ermolaeva, O. Zakharova	NVK "Sakha"	677000, Yakutsk, Ordzhonikidze st., 48, tel/fax: 35 3951, e-mail: nvk@sakha.ru	Yes
1	Photo	Freeze-up at the Lena river.	10.2005	A. Yermakov	PENTA Ltd. Publishing House	tel/fax: +7 (495) 508 7055, e-mail: info@penta-photo.ru	Yes
2	Photo	Panorama of the Lena river from a viewing point.	06.2005	V. Ryabkov	PENTA Ltd. Publishing House	tel/fax: +7 (495) 508 7055, e-mail: info@penta-photo.ru	Yes
3	Photo	Shifting sands of a tukulan.	08.2005	A. Ogloblin	PENTA Ltd. Publishing House	tel/fax: +7 (495) 508 7055, e-mail: info@penta-photo.ru	Yes
4	Photo	The Lena river is covered with ice till June.	05.2006	V. Ryabkov	PENTA Ltd. Publishing House	tel/fax: +7 (495) 508 7055, e-mail: info@penta-photo.ru	Yes
5	Photo	A thin pillar.	06.2005	V. Ryabkov	PENTA Ltd. Publishing House	tel/fax: +7 (495) 508 7055, e-mail: info@penta-photo.ru	Yes
6	Photo	The Park rents two cruise ships for tourists' service.	09.2005	A. Ogloblin	PENTA Ltd. Publishing House	tel/fax: +7 (495) 508 7055, e-mail: info@penta-photo.ru	Yes
7	Photo	The Lena River.	06.2005	V. Ryabkov	PENTA Ltd. Publishing House	tel/fax: +7 (495) 508 7055, e-mail: info@penta-photo.ru	Yes

№	1	2	3	4	5	6	7
8	Photo	*Redovskia sophiifolia* – a local endemic of the Lena Pillars.	05.2006	V. Ryabkov	PENTA Ltd. Publishing House	tel/fax: +7 (495) 508 7055, e-mail: info@penta-photo.ru	Yes
9	Photo	A thermokarst lake in the Park's territory.	06.2005	V. Ryabkov	PENTA Ltd. Publishing House	tel/fax: +7 (495) 508 7055, e-mail: info@penta-photo.ru	Yes
10	Photo	A thermokarst lake in the Park's territory.	06.2005	V. Ryabkov	PENTA Ltd. Publishing House	tel/fax: +7 (495) 508 7055, e-mail: info@penta-photo.ru	Yes
11	Photo	A winter scenery.	11.2005	A. Yermakov	PENTA Ltd. Publishing House	tel/fax: +7 (495) 508 7055, e-mail: info@penta-photo.ru	Yes
12	Photo	Fissures widened in Buotama Pillars.	09.2005	A. Ogloblin	PENTA Ltd. Publishing House	tel/fax: +7 (495) 508 7055, e-mail: info@penta-photo.ru	Yes
13	Photo	Pillars have varied and fantastical forms.	05.2006.	V. Ryabkov	PENTA Ltd. Publishing House	tel/fax: +7 (495) 508 7055, e-mail: info@penta-photo.ru	Yes
14	Photo	Pillars have varied and fantastical forms.	05.2006.	V. Ryabkov	PENTA Ltd. Publishing House	tel/fax: +7 (495) 508 7055, e-mail: info@penta-photo.ru	Yes
15	Photo	Saamys-Kumaga tukulan.	08.2005	A. Ogloblin	PENTA Ltd. Publishing House	tel/fax: +7 (495) 508 7055, e-mail: info@penta-photo.ru	Yes
16	Photo	The Buotama River.	09.2005.	A. Ogloblin	PENTA Ltd. Publishing House	tel/fax: +7 (495) 508 7055, e-mail: info@penta-photo.ru	Yes
17	Photo	Panorama of pillars.	06.2005	V. Ryabkov	PENTA Ltd. Publishing House	tel/fax: +7 (495) 508 7055, e-mail: info@penta-photo.ru	Yes
18	Photo	Traditional travel mode.	02.2000	V. Ryabkov	PENTA Ltd. Publishing House	tel/fax: +7 (495) 508 7055, e-mail: info@penta-photo.ru	Yes

№	1	2	3	4	5	6	7
19	Photo	Panorama of the Lena River from a viewing point.	06.2006	V. Grigoryev	V. Grigoryev		Yes
20	Photo	Pine and larch forests of the Park.	06.2006	V. Grigoryev	V. Grigoryev		Yes
21	Photo	Pillars at the right Lena riverbank.	06.2006.	V. Grigoryev	V. Grigoryev		Yes
22	Photo	Lena Pillars in September.	09.2005	A. Ogloblin	PENTA Ltd. Publishing House	tel/fax: +7 (495) 508 7055, e-mail: info@penta-photo.ru	Yes
23	Photo	The valley of the Buotama River - right tributary of the Lena River.	09.2005	A. Ogloblin	PENTA Ltd. Publishing House	tel/fax: +7 (495) 508 7055, e-mail: info@penta-photo.ru	Yes
24	Photo	Buotama Pillars.	09.2005	A. Ogloblin	PENTA Ltd. Publishing House	tel/fax: +7 (495) 508 7055, e-mail: info@penta-photo.ru	Yes
25	Photo	Buotama Pillars.	09.2005	A. Ogloblin	PENTA Ltd. Publishing House	tel/fax: +7 (495) 508 7055, e-mail: info@penta-photo.ru	Yes
26	Photo	Karst arch.	06.2009	L. Kipriyanova	L. Kipriyanova	nppls@mail.ru	Yes
27	Photo	Collapse sinkhole of Ulakhan-Taryn.	07.2010	V. Samsonova	V. Samsonova		Yes
28	Photo	Thin plan-parallel lamination of Cambrian strata.	07.2008.	A. Zhuravlev	A. Zhuravlev	Ayzhur@mail.ru	Yes
29	Photo	Ooid shoal of Cambrian back-reef facies.	07.2008.	A. Zhuravlev	A. Zhuravlev	Ayzhur@mail.ru	Yes
30	Photo	Intact complete giant arthropods Phitophylaspis of the Sinsk Biota. Cambrian Stage 3.	10.2010	V. Il'ynsky	V. Il'ynsky		Yes

7b. Texts relating to protective designation, copies of property management plans or documented management systems and extracts of other plans relevant to the property.

Regulation Documents presented in Annex B.

B1. Extract from the Federal Law of the Russian Federation «On specially protected natural areas» of 14.05.1995 (read with the Federal Law of 29.12.2004 N 199-FL);

B2. Law of the Republic of Sakha (Yakutia) On Specially Protected Natural Areas In The Republic of Sakha (Yakutia). Enacted by Ordinance of State Assembly (Il Tumen) of the Republic of Sakha (Yakutia) No.3N 214-II of December 25, 2003;

B3. Resolution of Government of the Republic of Sakha (Yakutia) «On establishment of the National Lena Pillars Nature Park on the territories of Khangalassky and Olekminsky Uluses» of 10.02.1995 N 39;

B4. Resolution of Government of the Republic of Sakha (Yakutia) «On rename of National Nature Parks into Nature Parks of the Republic of Sakha (Yakutia) and approval of the Standard Statute of a Nature Park of the Republic of Sakha (Yakutia)» of 6.11.2006 N 495;

B5. STATUTE of the State Enterprise Nature Park (Aan Aiylgy) «Lena Pillars» of Sakha Republic (Yakutia) of 6.11.2006 N 495;

B6. Draft Regulation of the Government of Republic of Sakha (Yakutia) "On "Lena Pillars" Nature Park boundaries statement";

B7. Description of boundaries of the Lena Pillars Nature Park;

B8. Letter of President of the Republic of Sakha (Yakutia) on representation of the "Lena Pillars Nature Park" for inscription on the UNESCO World Heritage List of 22.12.2010;

B9. Letter of Dr. Allison Palmer, President, Institute for Cambrian Studies, of April 2, 2007;

B9.1. Letter of Acad. Prof. Dr. Andrej Kranjc, Secretary-General of the Slovenian Academy of Sciences and Arts, of December 1, 2010;

B10. Answers to questions in the IUCN Fossil Site Evaluation Checklist;

B11. Management plan of the Lena Pillars Nature Park for the period 2008- 2012.

7c. Form and date of most recent records or inventory of property

- Monographic collected articles "National Nature Park. Geology, soils, vegetation, fauna. Conservation and management". Publication of Yakutsk State University, 264 p., 2001;
- Annual reports of the national Lena Pillars Nature Park for 2000-2006;
- "Gold of the Lena Pillars" album, 2006;
- "The Lena Pillars National Nature Park" booklet, 2006.

7d. Address where inventory, records and archives are held

Ministry of Nature Conservation of the Republic of Sakha (Yakutia)
Address:

677000, Russian Federation, the Republic of Sakha (Yakutia),
Yakutsk, Dzerzhinskogo st., 3/1.
Tel.: (4112) 34-12-90, 34-49-15
Fax: 42-13-72,
E-mail: sterh@sakha.ru

The Lena Pillars Nature Park
Address: 678010, Russian Federation, the Republic of Sakha (Yakutia),
Pokrovsk, Ordzhonikidze st., 56.
Tel: (411244) 43-896
Fax: (411244) 45-289
e-mail: nppls@mail.ru

7e. Bibliography

Annex D has over 100 titles of the most significant scientific publications dedicated to the Lena Pillars.

8 CONTACT INFORMATION OF RESPONSIBLE AUTHORITIES

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9. Ekaterina Petrovskaya
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8b. Official Local Institution/Agency

Nature Park is the nature conservation institution of the Republic of Sakha (Yakutia) and is under the jurisdiction of Ministry of Nature Conservation of the Republic of Sakha (Yakutia):

Russian Federation,
The Republic of Sakha (Yakutia)
677000, Yakutsk, Dzerzhinskogo st. 3/1.
Tel.: (4112) 34-12-90, 34-49-15
Fax: 42-13-72
e-mail: sterh@sakha.ru
Minister: Vladimir A. Grigoryev

At local level the site management is executed by the Lena Pillars Nature Park:

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The Republic of Sakha (Yakutia)
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Director: Lyubov D. Kipriyanova

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   Yakutsk, Dzerzhinskogo st., 2, ltf.lorp@mail.ru
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   677000 Yakutsk, Lenina av., 24,
   tel.: +7 (4112) 42-47-01, fax: +7 (4112) 36-69-21, +7 (4112) 34-12-21
3. Sakha Tour Company
   677000 Yakutsk, Kurashova st., 24, office 5,6,
   Tel.: +7 (4112) 34-43-65, e-mail: sakhatour@mail.ru
4. Tour Service Center Company
   Yakutsk, Poyarkova st., 12-53
5. Ministry of entrepreneurship and tourism
   http://www.minpred.ru/
6. Archaeology and Ethnography Museum of Yakutsk State University
   Yakutsk, Kulakovskogo st., 48,
   tel.: +7 (4112) 49-68-41
7. Biology Institute of the Yakutsk office of the Siberian branch of the Russian Academy of Sciences
   677891 Yakutsk, Lenina avenue, 41
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   www.sakha.ru/sakha/ync/biology.htm
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   tel.: +7 (4112) 44-46-96, fax: +7 (4112) 44-44-76,
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9. SIGNATURE ON BEHALF OF THE STATE PARTY

Deputy Minister of Natural Resources and Environment of the Russian Federation — **Igor I. Maydanov**

Nomination

"LENA PILLARS NATURE PARK"

(RUSSIAN FEDERATION)

ANNEX