

## World Heritage Sites

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## LENA PILLARS NATURE PARK RUSSIAN FEDERATION

*Lena Pillars Nature Park in eastern Siberia contains in the form of steep pillared cliffs and spires of rock, a series of many monumental belts of limestone and dolerite karst which stand intermittently along some 250 kilometres of the right bank of the middle course of the Lena River and the left bank of the Buotama, a parallel tributary. These are the fossilised remains of a very large Cambrian reef, comparable to the present-day Great Barrier Reef, which preserves the evolutionary record during the Cambrian explosion of life of a wide range of skeletal and soft-bodied fossils of very high quality, with extensive examples of karstic weathering in permafrost.*

### COUNTRY

Russian Federation

### NAME

Lena Pillars Nature Park

### NATURAL WORLD HERITAGE SITE

2012: Inscribed on the World Heritage List under natural criterion (viii).

### STATEMENT OF OUTSTANDING UNIVERSAL VALUE

The UNESCO World Heritage Committee adopted only a provisional Statement of Outstanding Universal Value (SoOUV) at its meeting in 2012. The Committee is expected to approve the final SoOUV at its meeting in June 2013.

### IUCN MANAGEMENT CATEGORY

Unassigned

### BIOGEOGRAPHICAL PROVINCE

East Siberian Taiga (2.4.3)

### GEOGRAPHICAL LOCATION

In the south centre of the Republic of Sakha (Yakutia) in eastern Siberia, in the Khangalassky region about 200 km southwest of Yakutsk. The Park stretches some 250 km along the right bank of the middle reaches of the Lena River and an area to its south including the Buotama river basin, averaging some 65 km wide. It is located between 61°16'30"N x 128°46'20"E to 60°06'30"N x 125°58'35"E and 60°44'30"N x 125°02'00"E to 61°13'20"N x 128°53'0"E.

### DATES AND HISTORY OF ESTABLISHMENT

- 1995: The Lena Pillars Nature Park established by the government of the Republic of Sakha by the resolution of 10.2.1995;
- 2003: The status of the Park confirmed by the government of the Republic of Sakha by State Assembly Ordinance No.3N 214 III, supplemented in 2007;
- 2011: The Park Management Plan for 2012-2016 drawn up.

## LAND TENURE

The property is owned by the Republic of Sakha which regulates the Park under the jurisdiction of the Republic's Ministry of Nature Conservation. The customary right of the Evenki people to traditional subsistence use of 60% of the area is respected.

## AREA

The total area of the property is 1,272,150 ha. The property is bound by the 5-10 km wide river Lena on its northern edge and four local or state resource reserves along its southern boundary. No buffer zone has been proposed.

## ALTITUDE

From 683m on the southwestern boundary to about 220m at the eastern end of the site at the mouth of the Buotama River on the Lena.

## PHYSICAL CHARACTERISTICS

The Park is distinguished by a spectacular series of monumental columnar cliffs up to 100m high of limestone and dolerite karst which stand intermittently along some 200 kilometres of the right bank of the Lena River in a 40 kilometre wall, and along the left bank of the Buotama, a nearly parallel tributary. These are the richly fossiliferous remains of a large early Cambrian metazoan reef belt, comparable to the present-day Great Barrier Reef, formed at a time of rapid bio-diversification of marine biota in a warm shallow sea in three basins, inner, lagoonal and outer on a basement of Precambrian mudstones. From the uppermost Precambrian era through the first 35 million years of Lower to Middle Cambrian time (542-501mya) the belt lay off the eastern lobe of an immense island platform located in the southern tropics which over the next 300 million years of crustal movement migrated northward to its present site in northeast Siberia.

The carbonate sediments then laid down, now a denuded plateau between 980m to 1370m thick, were undisturbed for over 500 million years by strong tectonic or metamorphic activity and were not affected by the last major glaciation. This resulted in a well ordered, well preserved and nearly level 35-million year record of thin strata containing marine deposits which today extend many kilometres along the riverbanks of the site. Their now dissected deeply weathered surfaces expose a wide array of the skeletal and soft-bodied fossils of marine animals and phytoplankton which diversified during the period, revealing the earliest development of multicelled life into forms related to those existing today. Especially important is the Sinsk Biota from the very earliest metazoan reef where precisely defined fossils were preserved by phosphatisation. The strata enable extensive study of the fossils' distribution, development, stratigraphy and dynamics. From them two of the earliest major events, the Sinsk and Toyonian extinctions, were deduced and even the first signs that such forms originated in the final Precambrian period, the Ediacaran.

The flat plateau surface was subject to millennia of freeze-thaw cycles in an extreme continental sub-humid climate. Wedges of ice penetrated deeply into the rock, shattering it into wide gullies along joints and eroding the softer marlstones and slate. Ice-weathering (cryohydration) of condensation on the surface split and disintegrated the rock into finer pinnacles, with carbonate dissolution contributing to the erosion of grottoes and caves. The upland water draining down steep gullies carved through the rows of rock buttresses. Subsequent uplifting of the plateau caused the Lena and Buotama to cut into these on both the Lena and the Buotama river banks where currents removed the debris, exposing the pillared walls of stone along the banks. The dominance of pillar weathering by cryohydration is known only from this site and the combination of cryogenic erosion with fluvial incision and scour is unusual on such a scale.

The land is covered by two types of landscape, mid-taiga and intrazonal mid-taiga both on perennially frozen rock. This underlies uplands, slopes, old terraces, mid-level sand-ridge terraces, low terraces and shallow valleys. South of the Lena the uplands are underlain by permafrost 400-500 metres deep, though it is not monolithic, and the valleys by permafrost 100-200m deep. Several karstic features preserve a unique record of ice-weathering in permafrost and melting permafrost landscapes (thermokarst), plus unusual high-latitude aeolian sand dunes (*tukulans*) 20-30m high in Quaternary sandy river terraces along the Lena river. The karst development of the surface is not deep because the great depth of permafrost blocks the infiltration of water. The summer surface thaw therefore extends from less than one to four metres depending on aspect and type of soil cover, creating the conditions for a widespread though unexceptional thermokarst of dolines, caves, solution pipes, sink holes, often in lines above fissures, sculpted karren surfaces, ice hummocks, shallow depressions

formed by collapsed ice hummocks, small shallow lakes and dry valleys. The soils are complex with some 16 types of cryotic soil, with river terrace soils dominant in the east and a pattern of valley and interfluvial soils in the upland centre and west. Under the forests there is thick pale yellow solodised soil and podsol, and under the steppes, chernozem. In the lowlands there are soddy calcareous soils derived from scree, carbonate loam, sandy loam, sand on river terraces, lacustrine and boggy deposits and floodplain alluvium.

## CLIMATE

The tropical paleoclimate of the Cambrian period when the Siberian platform was located in the southern hemisphere encouraged the development of multicellular life in its warm seas. The present-day climate is of the extreme continental type, with a 100°C maximum temperature range between -60°C and +40°C and average temperatures of -42°C in January and +66°C in July. It has an annual low semi-arid annual precipitation of 253mm with 203 days of snow cover. Both snow cover and rainfall increase to the southwest of the site. The extreme cold is intensified by the pooling in central Yakutia of Arctic air masses during the winter of over seven months long.

## VEGETATION

Cambrian flora:

No land vegetation existed in Cambrian time since the terrain was dry, rocky and barren except for a thin crust of microbial soil.

Present flora:

The site is covered by continuous perennially frozen rocks and cryotic soils except under the river beds. The dominant vegetation is mountain boreal forest of the east Siberian middle taiga with some mountain steppe, karstic rock outcrops with calcareous scree, plus the *tuluk* sand dunes. It is on an ecological border: the immense northward movement of water by the Lena slightly ameliorates the mesoclimate along its shores and forms a channel for the advance of plant species from the south, with several here reaching their northernmost limit. 464 species of vascular plants in 276 genera and 81 families were recorded in the World Heritage Tentative List submission for the site (Russian Federation, 2006). The dominant taiga forest is of Kajander's larch *Larix cajanderi*, the most cold-hardy tree in the world, with low scrub covering 87% of the site. It grows with alder *Alnus viridis*, cowberry *Vaccinium vitis-idaea*, blueberry *V. uliginosum* and Labrador tea *Ledum palustre*. On well-drained colluvium, pine forests *Pinus silvestris* with bearberry *Arctostaphylos uva-ursi* and cowberry cover 7.6% and elsewhere spruce forests of *Picea obovata* cover 5.4%, along with blue willow *Salix caesia* and aspen *Populus tremula* in the valleys and birch *Betula divericata* and dwarf birch scrub *B. exilis* on bogs. There are also steppes, sedge grass meadows and sparse psammophytes on the aeolian sand dunes of the riverside. There are very high numbers of algae, fungi, lichens, leaf mosses and liverworts. 21 nationally rare and endangered species of vascular plants are recorded including, on carbonate eluvium, a brassica endemic to the site, *Redowskia sophiifolia*.

## FAUNA

Cambrian fauna:

Since the Cambrian period the thick sedimentary layers in which multicellular life first diversified lay almost undisturbed for over 540 million years. Their now dissected deeply weathered surfaces therefore reveal an intact and orderly record of the range of the skeletal and soft-bodied fossils of marine animals and phytoplankton which evolved during the period, especially in the precisely defined fossils of the Sinsk Biota. The barren land surfaces of this period were surrounded by warm shallow seas where the conditions gave rise to the creation of reefs. Worldwide, 350 of the 2,000 early Cambrian genera have been found in the strata of the Lena Pillars, largely calcified algae and cyanobacteria, the origins of which are traced back to the Precambrian. They include the first stromatolites, calcified sponges, primitive cnidarians, brachiopods, burrowing worms and calcimicrobes.

Quaternary sediments have yielded the skeletal remains of hunted woolly mammoths *Mammuthus primigenius* and woolly rhinoceros *Coelodonta antiquitatis* and other animals now extinct.

Existing fauna:

The mammalian fauna is typical of the middle taiga zone though there are southern taiga species here at their northern limit. Its chief characteristics are the high number of rodents and the vast number of invertebrate species. The nomination notes that 38 mammals occur on the site, 56% of Yakutian

mammals. The World Heritage Tentative List submission (Russian Federation, 2006) records the main predator mammals: brown bear *Ursus arctos*, wolf *Canis lupus*, east Siberian lynx *Lynx lynx wrangeli*, wolverine *Gulo gulo*, sable *Martes zibellina* and east Siberian ermine *Mustela erminea kaneii*. The main herbivores are moose *Alces alces*, reindeer *Rangifer tarandus*, Siberian red deer (*maral*) *Cervus elephas*, Siberian musk deer *Moschus moschiferus*, roe deer *Capreolus pygargus* and Siberian hare *Lepidus timidus*. Thirty wood bison *Bison bison* were introduced from Canada in 2006 to the Ust'-Buotama breeding farm. At least 15 species of rodents were named, including northern pika *Ochotona hyperborea*, musk rat *Ondatra zibethicus*, red squirrel *Sciurus vulgaris*, Siberian chipmunk *Tamias sibiricus*, wood lemming *Lemmus sibiricus*, six species of vole and four species of shrew.

The Tentative List submission cites 105 nesting birds - 80% of the breeding birds of central Yakutia - of which 26 do not migrate. The list includes grey heron *Ardea cinerea*, tundra swan *Cygnus columbianus*, Baikal teal *Anas formosa*, osprey *Pandion haliaetus*, white-tailed eagle *Aquila albicilla*, golden eagle *Aquila chrysaetos*, peregrine *Falco peregrinus*, gyrfalcon *F. rusticolus*, Siberian white crane *Leucogeranus leucogeranus* (CR), great grey owl *Strix nebulosa* and woodcock *Scolopax rusticula*. There are two notable amphibians, Siberian salamander *Salamandra keyserlingii*, and Siberian wood frog *Rana amurensis*, two reptiles, northern viper *Vipera berus* and viviparous lizard *Zootoca vivipara*. There are 21 species of lake and river fish, some semi-anadromous. The invertebrate fauna of 645 species in 96 families is very diverse and flourishes in every habitat.

## CONSERVATION VALUE

The sediment layers of the site's many belts of limestone and dolerite pillars contain a well-preserved array of the skeletal and soft-bodied fossils of the marine animals and phytoplankton developed in lower to middle Cambrian reefs between 542 and 501 mya. They reveal a record of their evolution during the earliest explosion of multicelled life into forms ancestral to those existing today. The quality of the fossils and their unusual nature complement and compare well with the Canadian Burgess Shale and Chinese Chengjiang deposits laid down in the same period. In addition there are extensive examples of karstic weathering in permafrost, and the monumental appearance of the colonnades of riverbank spires are scenically exceptional.

## CULTURAL HERITAGE

The earliest Palaeolithic evidence world wide of stone chipping was found in 1982 at a nearby downstream settlement on the banks of the Lena in the Diring-Yuryakh district, at a site dated between 1.8 to 2.5 mya. There are also signs of late Palaeolithic and Neolithic settlements. These people hunted large mammals, burying the remains of woolly mammoth, woolly rhinoceros and bison, and left petroglyphs picturing moose. Reindeer breeding and fishing were the basic occupations. Agriculture followed Russian expansion.

## LOCAL HUMAN POPULATION

Eight local communities of the Evenki people with six ancestral farms occupy 884,000 hectares and use the Park for hay-making on 300 hectares, reindeer farming, cattle and horse breeding at the mouth of the Buotama, subsistence hunting, sable hunting and fishing. Six people lived at a government monitoring station in 2006.

## VISITORS AND VISITOR FACILITIES

The site is potentially one of the main tourist magnets of eastern Siberia. The government and the Sakha Republic with local communities, have advertised the site widely. In 2010 annual visitor numbers at the recreation sites between Pokrovsk and the Park were 9,917, up from 4,838 in 2006, 8,064 of whom visited the Park itself by road or boat. Local schools also visit on educational summer camps (500 children in 11 camps in 2010). The season is between mid June to mid September. An upper limit has been established of 23,000 visits a year, based on the site's carrying capacity. There are three tourist/recreation centres: the Labiya River centre on the site with 2 winter cabins, the Buotama Mouth centre opposite the river mouth with an inspector's house, diesel cabin and 10 summer cabins, and Bestyakh centre 43 km downriver with inspector's house, garage, bathhouse and 3 summer cabins. A new Environmental Education Centre in Pokrovsk, 80 km downstream, is being built. There is no tourism management plan but a brief program for the development of environmental tourism 2012-2016 has been drawn up which contains principles though no operational details. However, ecotourism trails through landscapes near the Buotama river mouth, the Labiya River and the Diring-Yuryakh site have been developed, and local people provide transport, guides and local produce for sale.

## SCIENTIFIC RESEARCH AND FACILITIES

The site is an outstanding natural laboratory for sedimentologists and paleoecologists. The well-preserved sediments in which multicellular life first diversified reveal a well ordered and well preserved record of a wide array of the marine animals and phytoplankton which evolved during the early and mid Cambrian periods. The high quality of the fossils and their matrices also yield high resolution isotopic and palaeomagnetic evidence of their age and composition. This compares with the Great Barrier Reef in complexity and clarity but over a far longer period of time and probably formed by different processes. The thin fossiliferous strata, traceable for many kilometres permit extensive study of great paleontological value of their distribution, development, stratigraphy and dynamics, enabling a precise examination of many ecological and evolutionary problems which complements the evidence from other sites. In 2006 geological researches were carried out by the Siberian Research Studies Institute for Geology, Geophysics and Mineral Resources of Novosibirsk with the Moscow Paleological Institute. Studies made of every aspect of these sediments, are cited in the nomination bibliography. More recently the variety of ecotypes has also been examined to provide a basis for management and educational tourism.

## MANAGEMENT

The Park is managed by the state of Sakha as a non-profit legal entity on the basis of the laws and decrees of the Ministry of Natural Resources of the Russian Federation and the Sakha Republic on Specially Protected Natural Areas, and on the Park itself. The Management Plan for 2012-2016 was drawn up in 2011 in conformity with Federal Government Order 491 of the Federal Service for Supervision of Natural Resource Use. It provides for conservation with monitoring patrols, scientific research, environmental education and recreational uses. Five zones are defined: Reserved (a c.115 x 7.5 km strip along the Lena river), Sacred Places (23 locations, mostly on the Lena), Restricted and Active Recreation (intensive recreation in nine sites along the Lena and the lowest 25 km of the Buotama river; extensive recreation along most of the Lena banks and along 12 tributaries). Annual monitoring is done of the conditions of the landscape and geology, of the endemic *Redowskia sopherifolia*, of sable and red deer populations, waterfowl migration, and meteorological conditions. No tree cutting, hunting or fishing are permitted except to the residents of the six small local intermittently residential communities whose traditional subsistence management practices over 60% of the site are respected and will continue to ensure the preservation of the Park's biodiversity. Horse breeding and hunting of sable are licensed, also a breeding area for reintroduced bison at the mouth of the Buotama river. As a result of this successful protection there has been a recovery of the diversity of the mammal, bird and fish species of south-central Yakutia.

## MANAGEMENT CONSTRAINTS

Natural fires recur - in 2001 eleven fires caused by thunderstorms burnt 18,200 hectares - and there are arrangements for aerial fire detection and suppression. Pressures from human uses barely exist except for spring grassland fires and unauthorised cattle grazing. However, waste water from passing tankers and the crossing of the Lena by an oil pipe line 800 km upstream could become sources of pollution. Climate change has had no effect to date.

## COMPARISON WITH SIMILAR SITES

The outstanding feature of this site are the numerous cryogenically formed, karstic pillared cliffs along the vast Lena and smaller Buotama rivers, and their fossils which contain the oldest and most detailed record of the evolution of metazoic life in the earliest Cambrian epochs. The sites are plentiful, accessible, well-preserved, paleologically valuable, scenic and are accompanied by a karstic permafrost landscape of considerable surficial variety. Worldwide, the remains of Cambrian reefs are fairly widespread but most are barren and do not contain fossil corals; such remains are also little found in periglacial environments. Those found in the Lena pillars are quite rich in species not found in the two most comparable World Heritage sites and complement them. The unique Sinsk biota is some 10 million years older than the famous Burgess Shale series of deposits in Yoho National Park in the Canadian Rocky Mountains World Heritage site, which are richer in soft-bodied fossils, and is comparable in time and quality with that discovered in 1984 on Maotianshan near Chengjiang in south-central Yunnan, China, though this has no fossil reef and lasted far less long.

Other comparable designated sites are, for serrated rows of pillars, Wulingyan in Hunan, the South China Karst sites in Sichuan, both in China, and Tsingy de Bemaraha in Madagascar; for more massive rock columns, Mount Wuyi, the sandstone Danxia sites in southeast China, and the sea islands of Ha Long Bay; for massive karst, Nahanni in northwestern Canada and for stratigraphic

record, the Grand Canyon of the Colorado, Arizona. Most of these sites, especially those in the mountains, are as scenic or more scenic and varied, and those in the tropics, far richer in flora and fauna. Mount Wuyi, Nahanni and the Colorado have more spectacular riverscapes. The lowland karst of the site is of interest but of less unusual character and does not compare with the spectacular array of dissolution and cryogenic features found in and around Nahanni National Park. Overall the Pillars contain many of these features to a greater or lesser extent but are uniquely significant for the great age and excellence of their fossils.

## STAFF

Under the Director there is a staff of 36: Administration, 5, Specialists in tourism and Education, 3, Environmental Inspectors, 9, Technical and Maintenance, 11 and Security, 6. 15 of the staff are highly qualified and a geomorphologist and geologist may be added. There are at present three new visitors' centres and seven inspector's lodges. There are three tourist centres and recreation bases, seven inspector's houses and two motor ships. Fire management and prevention are covered by the Yakutia Aircraft Fire Extinguishing Brigade and the local environmental protection and forestry units.

## BUDGET

There was a budget from the regional government plus a little self-generated revenue of US\$274,170 in 2010 (US\$524,000 is cited by UNESCO in 2012). This does not cover the provision and management of tourism. The Regional Investment Fund financed new visitors' centres and the WWF has supported construction of an Education Centre in Pokrovsk.

## LOCAL ADDRESSES

The Minister, Ministry of Nature Conservation of the Republic of Sakha, Dzerzhinskogo Sreet. 3/1, Yakutsk 677000, Republic of Sakha, Russian Federation

The Director, Lena Pillars Nature Park, Ordzhonikidse Street 56, Pokrovsk 678010, Republic of Sakha, Russian Federation. Web site: <http://www.lenskiestolby.ru>

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The principal sources for the above information were the original World Heritage nomination, the IUCN evaluation report and Decision 36 COM 8B.11 of the UNESCO World Heritage Committee.

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**DATE**

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