

The unique nature monuments of the Chai River basin (Tomsk oblast, Western Siberia)

N M Semenova

Tomsk State University, 36, Lenin Avenue, Tomsk, 634050, Russia

E-mail: nmsemnv@mail.tomsknet.ru

Abstract. Brief information is given on the nature and the monuments of nature in the basin of the Chaya river in the Chainskiy district of the Tomsk oblast. The current state of the main natural attractions of the area, described in the scientific works of the beginning of the XX century, is considered: the 'Kulayka mountain' – a natural and ancient monument of the peoples of Siberia and a wild habitat of linden (*Tilia cordata* Mill.) trees – a relic of the Tertiary Era. The general analysis of the expansion of linden in the Western Siberian region is provided. The data is provided on the isolated locations of the linden habitats in the Western Siberia beyond its modern habitat. The chief attention is given to the description of the natural habitat of linden on the right bank of the Chaya river in the Tomsk oblast. A history of discovery, research and protection of the 'Linden Island' in the Tomsk region is summarized. The main reasons for the study of the 'Linden Island' on the Chaya river are presented. The specifics of the ecological status of *T. cordata* in the harsh conditions of the Western Siberia are considered. The data on the current state of the 'Linden Island' in the Tomsk oblast are presented in comparison with the data from the previous researchers. It proposes measures to ensure protection of the unique natural monuments in the Chaya river basin.

1. Introduction

The identification of nature monuments in the Western Siberia was carried out along the study of its nature for the purpose of economic development and settlement, assessment of quality of the natural resources available here that present considerable interest for the economic development of Russia. Today, the rational use of the natural resources of Siberia, the preservation of the natural and cultural heritage of this vast region, which has been subject to some significant anthropogenic transformations due to the prolonged and large-scale exploitation of its natural resources, is becoming topical.

The first nature monuments in the Western Siberia became known in the XIX century. In different geographic regions of Siberia, unusually diverse by natural conditions, their own unique monuments of nature were described. For instance, the basin of the Chaya river in the Tomsk oblast.

2. Study Area

The basin of the Chaya river is a part of the catchment basin of the Ob' River – the main waterway of the West Siberian Plain. The Chaya river is the upper left-bank side stream of the Ob' River in the Tomsk oblast. The length of the river is 194 km, the catchment area is 27,200 km². The lower part of the drainage basin of the Chaya river is located within the boundaries of the Chainskiy administrative district of the Tomsk oblast (figure 1), the area of which is 72,43 km².

The terrain is flat. The absolute elevations do not exceed 120 m. About 90% of the territory of the Chainskiy district is occupied by forests and peatlands



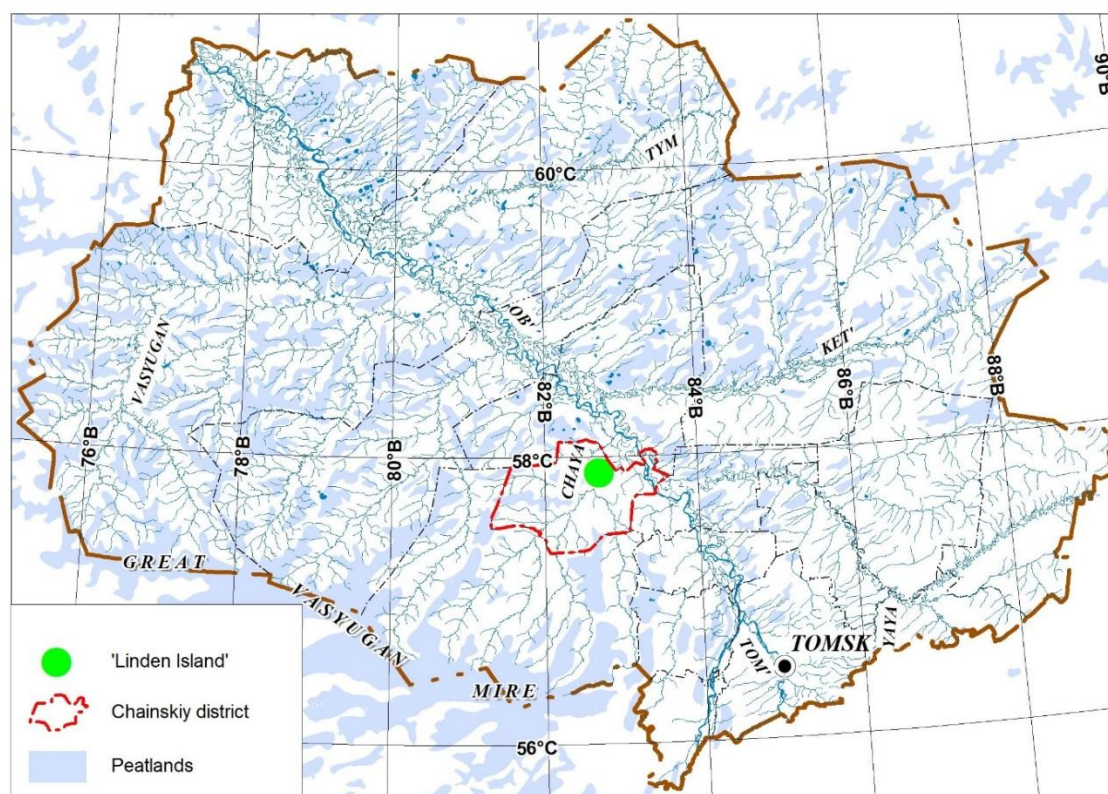


Figure 1. The study area. Tomsk oblast.

3. Materials and methods

The objective of this study is: (1) a brief analysis of the history of the discovery and description of the nature monuments in the basin of the Chaya river within the Chainskiy district of the Tomsk oblast in connection with the ideas on the development of this territory; (2) a description of the current state of the most valuable natural objects of the area that keep the memory of its geological history and the evolution of natural landscapes in the Western Siberia in the Post-Tertiary time.

The initial materials used to reach the objective were: (1) the published scientific heritage of the researchers and experts who participated in the first soil and geobotanical studies of the Narymskiy Kray [1-3]; (2) the verbal reports of the indigenous residents of the Chainskiy district of the Tomsk oblast; (3) the original data we collected during the expeditions to study the monuments of nature in the Tomsk oblast [4].

The site surveys of the nature monuments were carried out in 2012-2016. Apart from the author of this article, plant and soil scientists of the Tomsk State University participated in the field studies in the basin of the Chaya river.

4. Results and discussion

4.1. The Chaya river basin can be characterized by its unique natural environment and nature monuments

Geomorphologically the basin of the Chaya river is confined to the vast, flat and heavily waterlogged Vasyugan Plain, a large part of which is occupied by the Great Vasyugan Mire that stretches across the area of 70,000 km². It is assumed that it is because of the vast areas of forested and open peatlands that the territory of the left bank of the Ob River was given the name 'Narymskiy Kray'.

Ilyin R S [1], who studied the nature of the Narymskiy Kray in the 30s of the XX century, considered the catchment basin of the Chaya river an integral part of this territory that shared one common history. At the same time, he had to notice some particular features of the Chainskiy

watershed. Firstly, the Chaya river is the upper left-bank tributary of the Ob' River in the Narymskiy Kray. Therefore its catchment basin occupies the most southerly position. In addition, the Chaya river, unlike other left-bank tributaries of the Ob' River is characterized by the greatest slope of the river bed.

Ilyin R S [1] gives the evidence to support the ancient history of the basin of the Chaya river, the gradual changes in the landscapes and degradation of the soils formed in the dry and warm time of the Mindel-Riss interglacial period. He notes that in the catchment area of the Chaya river the suffusional forms of relief are there, which is characteristic of the modern steppe zone. The climate fluctuations in Asia in the Post-Tertiary period were much stronger than in Europe. Therefore the displacement of landscape-climatic zones was more prominent. The boundary of the prehistoric steppes passed considerably to the north of the catchment basin of the Chaya river. Subsequently with the climate cooling, the steppe vegetation retreated under the pressure of the deciduous forests which were subsequently replaced by the dark coniferous forest. A great number of suffusion depressions of different size and shape in the interfluvial areas, given the weak drainage of soil, presented favorable conditions for development of peatlands.

In his travel notes on the Chaya river Ilyin R S [1] mentions two natural places of interest in the basin of the Chaya river, mentioned in the earlier studies of this area by Dranitsyn D A [2] and Kuznetsov N I [3]. They literally correspond to the etymology of the phrase 'monuments of nature' in its modern sense. It is the 'Kulayka mountain' located in the immediate vicinity of the administrative center of the Chayanskiy district, and the 'Linden Island' near the former village of Rozhdestvenka.

The 'Kulayka mountain' is an archaeological, historical and cultural and natural monument well-known outside the district. Its modern value is the result of a successful collaboration between man and nature. It is a classic example of a geological, geomorphological and paleontological monument created directly by nature, interest to which was shown yet by the ancient man.

There is a special attitude to the linden tree in the Chayinskiy district. Despite the fact that the area belongs to the northern territories of the Tomsk oblast with rather severe climatic conditions, linden is widely used in landscape gardening in the village Podgornoye and neighbouring settlements. The location of the 'Linden Island' in the vicinity of the former Rozhdestvenka settlement is treated by the local population in favor of its anthropogenic origin. Nevertheless, even the first explorers of the nature of this region noted the relict character of the 'Linden Island' they discovered. In particular, Ilyin R S [1] considered it the remains of once powerful broad-leaved forests gradually ousted by the dark coniferous forest. This assumption, expressed almost a hundred years ago, fully corresponds to one of the current hypotheses on the origin of linden in the Western Siberia.

4.2. The natural and cultural heritage of the Chaya river basin is in need of an adequate protection

The 'Kulayka mountain' is a sacred mountain of the indigenous people of Siberia located on the right bank of the Chaya river downstream of the mouth of the Ikksa river. It is by nature a riverside cliff that exposes loose sedimentary rocks whose height is over 40 m. The stratigraphy of the exposure corresponds to the features of the structure of all other geological exposures along the Chaya river. The bottom part of the geological section is mainly represented by sands. The top of the section is represented by clays and loams that effervesce when exposed to hydro-chloric acid.

The 'Kulayka mountain' provided its explorers with many unique finds, however, even more were lost. From a sacred place it turned into a place of rest and scientific and ecological tours. At the same time, the mountain together with the adjacent forested or grassy areas performs other practical functions, which are an integral part of the traditional types of economic activities in rural areas among which are cattle grazing, gathering, and so forth.

The name of the mountain is contextually connected with the ancient Kulayskaya culture, the bearers of which have written their page in the history of the ancient peoples of Vasyugan Area. 'The Kulayka mountain' by nature is also a geological exhibit which had a pivotal value in the knowledge of the geological history of the Chaya River basin.

Despite the multi-faceted scientific, historical, cultural and aesthetic value of the 'Kulayka mountain', its protection is not appropriately organized. Located on the outskirts of the capital of the Chainskiy district, it is influenced by a negative impact of both natural and anthropogenic factors. The landslides and landfalls gradually destroy the riverside cliff. The bank of the Chaya river at the foot of the 'Kulayka mountain' is littered with fossils that quickly deteriorate under the influence of wind, water currents and various mechanical loads.

The 'Linden Island' in the Chainskiy district was officially recognized in 1962 as a particularly valuable natural site of the Tomsk oblast, which is subject to special protection. It is now located in a deserted and relatively inaccessible area, however is influenced by the presence of man. Today there are no settlements in the immediate vicinity of the 'Linden Island', but the presence of people here is regularly observed, which affects the state of this unique monument of nature.

The linden (*Tilia cordata* Mill.) in the all Ob River basin is a very rare, vulnerable species, a relic of the tertiary broad-leaved forests. Due to its exclusive location in the Tomsk oblast, linden has been included on the regional Red Book [5]. The linden habitat in the Tomsk oblast is far beyond its main habitat in the Western Siberia. The eastern expansion boundary of linden in this region passes on the right bank of the Irtysh River. In the Omsk oblast, the territory of which adjoins the Tomsk oblast from the west, linden accounts for about 5% of the forested lands. The more eastern Tomsk and Novosibirsk oblasts both have only one linden habitat which are considered the local monuments of nature [6]. They were discovered by the first Russian settlers and later became the research subject for numerous scientific expeditions conducted at different periods to study the nature of the Western Siberia.

The natural habitat of linden in the territory of the Tomsk oblast is located on the right side of the Chaya river basin, which is a large left-bank tributary of the Ob' River (figure 1), the sources of which are formed at the maximum elevations of the Ob-Irtysh watershed. The second more southern location of linden in the territory of the Novosibirsk oblast is confined to the southern macro-slope of the main Ob-Irtysh watershed. Thus it refers to two isolated linden habitats at the eastern limit of the linden expansion in the Western Siberia. It is symbolic that they are separated from one another by the vast expanses of the Vasyugan Mire system occupying wide areas of the main Ob-Irtysh watershed and representing the southern expansion limit of sphagnum peatlands that cover the interfluvial spaces of the northern half of the West Siberian Plain with a continuous cover. Therefore, one linden habitat is confined to the northern periphery of the Vasyugan wetlands system, the second is confined to the southern periphery.

It is quite natural that the state of linden in the natural conditions of its habitat among the forests and moors of the Tomsk oblast aroused the interest of the researchers of Siberian nature. At the beginning of the XX century this was due to the soil-geobotanical zoning and assessment of prospects for the development of agriculture and forestry [1-3]. In the second half of the XX century, the natural habitats of linden were of interest to scientists and experts as a source of local planting material for landscape gardening in towns and villages of the Tomsk oblast. In this regard, the linden habitat in the Chainskiy district of the Tomsk oblast was studied by the specialists of the Siberian Botanical Garden of the Tomsk State University under the guidance of Moryakina V.A., its director [5]. Today's interest in 'The Linden Island' is chiefly associated with the need for its study and protection as a unique monument of nature [4, 5, 7].

The natural linden plantation in the Tomsk oblast, from the first mention to the present day, are only a few adult trees and some young growth [7]. Some interesting data on the state of 'The Linden Island' on the Chaya river is available in the herbarium of Krylov P N in the Tomsk State University, which were provided by Yurkov P M and Dobyshin V E, who visited the so-called 'Island' in the middle of the 20th century. They show that relatively recently the linden plantation in the Tomsk oblast comprised a group of adult lindens 7.5-9 m in height and a trunk diameter of 10-16 cm. Besides, the two trees from this group had the trunk diameter about 29 cm [8].

Moryakina V A [9], who conducted a study of 'The Linden Island' in 1977, counted 22 adult trees 10-12 m high with a trunk diameter of 12-24 cm. The maximum height of mature trees was 17 m. By

the time of our visit of ‘The Linden Island’ [10], the number of adult trees was reduced by half (table 1). Today there are only 11 trees with a diameter of their trunks up to 18 cm. It will be noted that in the 30s of the past century Ilyin R S [1] wrote about 15 linden trees that survived in this refugium.

The conditions for survival of linden in Siberia in the modern natural and climatic state are very difficult. Moryakina V A [9], who studied ‘The Linden Island’ in the Tomsk oblast, noted that the linden regeneration here is only vegetative. Individual trees can blossom, but renewal happens by rooting shoots. Old or relatively old trees at the age of about 60, dying off as a result of diseases, freezing or windfalls, still support life of young sprouting trees. At the time of our study of the ‘Linden Island’ the number of such young lindens with a trunk diameter up to 5 cm, evolved on the nutrient substrate of the stumps and trunks of the dead and dying trees, counted about 50 pieces [10].

Table 1. The change in some characteristics of the ‘Linden Island’ in the Chaya river basin.

Name	The middle of the XX c. [8]	The 70s of the XX c. [9]	The middle of the second decade of the XXI c. [10]
Number of adult trees, pcs.	-	22	11
Height of adult trees, m	7,5-9,0	10-12 (17)	7-12
Trunk dia. of adult trees, cm	10-16 (29)	12-24	10-16 (18)

Thus, the number of adult trees in the ‘Linden Island’ on the Chaya river and their morphological characteristics change with time under the influence of natural and man-caused factors. However, the area of the Island remains almost unchanged. According to the results of our studies, the total area of the site occupied by linden is about 0.2 hectares. Approximately the same area was recorded by Kuznetsov N.I. [3] in his research findings about 100 years ago.

The ‘Linden Island’ in the basin of the Chaya river appeared on a slope of the watershed plateau of the southwestern exposition. The slope is dissected by deep log. One of these logs became a refuge for a group of linden trees growing there. The ‘Linden Island’ is confined to the bottom of the log slope. In winter time fresh linden shoots and low adult trees are safely covered with a thick snow cover. In all seasons of the year there are no strong winds there. All this provides more or less livable conditions for survival and renewal of linden.

However, linden at the extreme limit of its expansion in the Western Siberia is in unequal conditions of the struggle with nature and man. Despite the adversities of natural conditions for growth of linden trees in this area, the main negative factor that caused the reduction in the number of trees in this unique island in the basin of the Chaya river in recent years is a direct encroachment of man. The linden here was cut down and drawn from the ground, it was used as planting material for the landscaping of the neighboring settlements. Therefore, today the linden island in the Tomsk region requires immediate protection, continuous monitoring and restriction of visits up to a complete lockdown.

5. Conclusion

The conducted research allows to draw the following conclusions:

(1) The first explorers of the Narymskiy Kray in the heart of Western Siberia discovered the unique monuments of its nature.

(2) Today’s generation of scientists and nature enthusiasts must protect them for future generations in the existing conditions of natural and anthropogenic dynamics of the environment.

Acknowledgments

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References

- [1] Ilin R S 1930 Nature of the Narym region *Notes on the Study of Siberia* vol 2 (Tomsk: Biological Institute Publishing) (in Russian)

- [2] Semenova N M 2014 Current inventory results for the nature monuments in Tomsk oblast *Bioecological Local Studies: Global, Russian and Regional Problems. Proceedings of the 3rd All-Russian scientific-practical conference* (Samara: Volga Region State Social and Humanitarian Academy) pp 175-81 (In Russian)
- [3] Dranitsun D A 1915 Notes on Soil Science and Geology of the Western Part of the Narymsky district *Proceedings of the Soil and Geo-botanical Expeditions to Study Colonization Regions of Asian Russia* **1** iss 1 (In Russian)
- [4] Kuznetsov N N 1916 Description of the vegetation of the Narymsky district in Tomsk region *Proceedings of the soil and geo-botanical expeditions to study colonization regions of Asian Russia* **2** (1) (in Russian)
- [5] *The Red Book of Tomsk Region* 2013 ed A M Adam (Tomsk: Print Manufactory) (In Russian)
- [6] Semenova N M 2000 Nature monuments in the system of protected areas in Western Siberia *Nature Conservation: Collection of Papers* ed A E Berezin (Tomsk: Izdatelstvo NTL) pp 99-113 (in Russian)
- [7] *Rare and Endangered Species of Animals and Plants of the Tomsk Region* 1984 ed I P Laptev (Tomsk: Tomsk University Publishing) (In Russian)
- [8] Polozhiy A V and Krapivkina E D 1985 *Relics Tertiary broad-leaved forests in the flora of Siberia* (Tomsk: Tomsk University Publishing) (in Russian)
- [9] Moryakina V A 1979 Islet of the linden in the Tomsk region – a rare botanical object *Especially valuable forest objects* ed I V Taran (Novosibirsk: Lesproekt) pp 155-62 (in Russian)
- [10] Semenova N M, Volkova I I, Amelchenko V P, Volkov I V and Kolesnichenko L G 2017 Rare and endangered plants of specially protected areas of West Siberian boreal coniferous forests (inside Tomsk oblast) *International Journal of Environmental Studies* **74** (5) 732-43