Aeolian landscape of Yarki Island on northern Baikal

A Bajkál-tó északi részén található Yarki sziget eolikus felszíne

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Abstract – The paper describes the basic forms of the aeolian relief of the narrow bar of Yarki island in the northern part of lake Bajkal distinguishing high and low aeolian landforms. The genesis of these features is also discussed together with the prevailing plant associations of the vegetation cover. Yarki island presents a barrier against the lake waves of the Baikal and thus preserves a special ecosystem in the background lagoon.

Összefoglalás – A tanulmány bemutatja a Bajkál-tó északi részén található Yarki sziget eolikus felszínének formáit, megkülönböztetve magas és alacsony eolikus felszínformákat. E képződmények kialakulása is bemutatásra kerül a növénytakaró uralkodó társulásaival együtt. Yarki szigete akadályt képez Bajkál-tó hullámaival szemben megőrizve ezzel a mögöttes lagúna különleges élővilágát.

Key words – aeolian relief, dune, Yarki island, Baikal
Tárgyszavak – eolikus felszín, dűne, Yarki szigete, Bajkál-tó

Introduction

Yarki Island occurs in fringe northern part of Baikal. It separates the so-called Angara sor (shore-lake) from the open reservoir (*Fig. 1*). This lagoon, presently strongly swamped and occupied by peat, is located at the mouth of two rivers flowing into the Baikal from the north: the Verkhnaya Angara and the Kichera. This island protects a specific lagoon ecosystem, considered to be a bird sanctuary, against disturbing influence of lake waves. The aim of this work is to present – among others on the base of the authors' own observations – the features of aeolian landscape occurring here, changing intensively under the influence of the wind and storm waves from the Baikal.

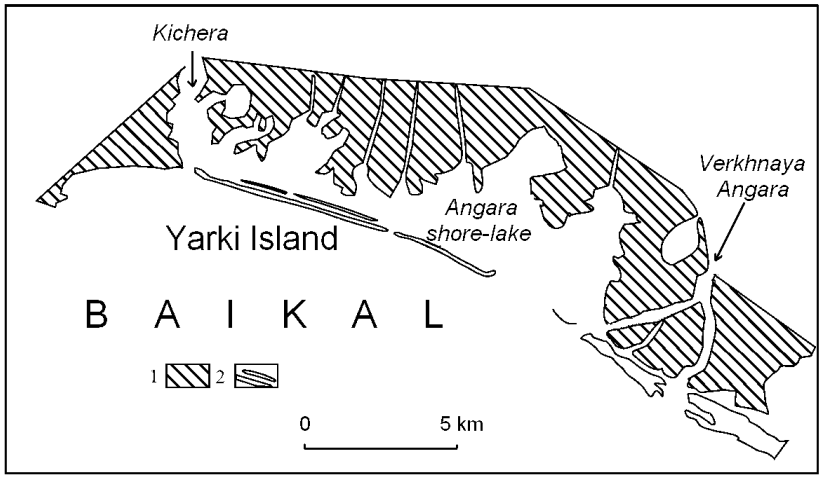

Figure 1 Location of Yarki Island. 1 – Kichera-Angara Plain, 2 – area of bar
1. ábra Yarki sziget helyszínrajza. 1 – Kichera-Angara Síkság, 2 – a turzás trülete

Genesis and contemporary state of the island

Yarki Island actually makes a very narrow 50–100m cuspate bar or bay and it is an effect of accumulation of deposits brought by the above-mentioned rivers, and also by the influence of the waves of the Baikal lake. It is a Holocene landform built of sandy fluvial and lacustrine deposits, which after rising over the water level were formed by wind. Numerous dune landforms of former heights of up to 10–12m developed here the base of which was made by previous spill banks (ROGOZIN 1993). This bay started to be disturbed by abrasion rather strongly as a result of the natural fluctuation of the water level in the lake about 2000 years ago (AFANASJEW 1967; SIZIKOW 1987). As early as in the mid 20th century this island was clearly elevated over the water level, which is proved by the typical Siberian term *yar* – яр (high steep shore at river or lake),. Since this time – owing to human impact – it has been distinctly degraded (ROGOZIN & TRZCINSKIJ 1993). It was caused by: 1) aeolian processes, intensified as a result of intensive disturbance of the vegetation cover (dune blowing out and sand removing into the lake, formation of deflation depressions, the bottoms of which reached the lake level), 2) abrasion of lake waves, catastrophically intensified by the building of a dam on the Angara in Irkutsk (water level in Baikal rose 1m).Presently in many

places lake waves flow through the island into the lagoon (sor) during storms. These waves also contribute to that the eastern part of Yarki Island practically does not already exist, whereas the western part is divided into two fragments (*Fig. 1*).

Contemporary Aeolian relief of Yarki island

Aeolian landforms are the dominating elements of the relief and they occur throughout the whole island. There are mostly old forms (originated under the influence of – generally speaking – northern winds), which underwent significant remodelling by contemporary wind activity. Of morphogenetic importance are the winds blowing from northeast and the secondary role is played by winds from southwest. The above-mentioned winds blow the older aeolian landforms and simultaneously create many contemporary microforms.

The actual landscape of Yarki Island within the range of aeolian relief is diversified. It is possible to divide so-called low relief and high relief here referring to the height and the morphological distinctness of the landforms. In both cases this relief has typical deflation characters. Below, based on concrete examples, main features of both kinds of aeolian relief of Yarki Island will be presented.

High aeolian relief on Yarki Island is rarely met, but more often it is identified with the landscape of this area. Presently it is represented by some distinct dune remnants of 4–5m high, 10–30m long and 20–30m wide (*Fig. 2; photo 1*).

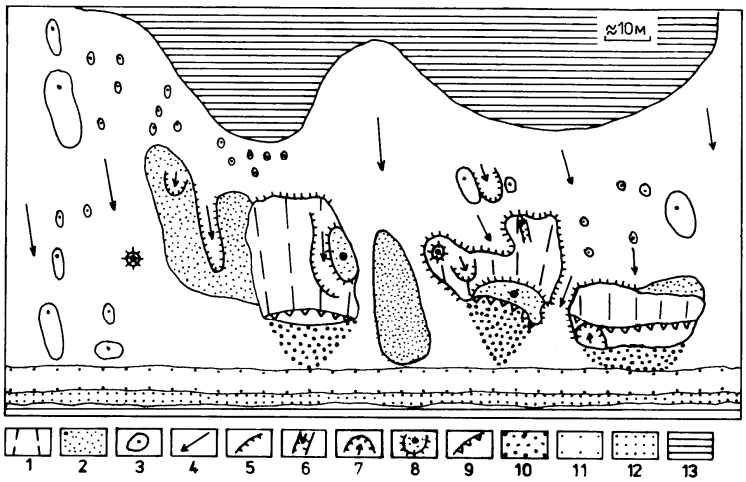

Figure 2 An example of high aeolian relief
1 – destroyed windward slopes of dunes, 2 – aeolian cover sands, 3 – sand shadows, 4 – deflation plains, 5 – deflation undercuts, 6 – deflation corridors, 7 – blowouts, 8 – deflation remnants, 9 – abrasion undercuts, 10 – sandy screes, 11 – zone of "osushka", 12 – beach, 13 – water
2. ábra A magas eolikus felszín egy példája
1 – a dűnék roncsolt szélfelőli lejtője, eolikus takaró homok, 3 – homok árnyék zónák, 4 – deflációs laposok, 5 – deflációs bevágások, 6 – deflációs folyosók, 7. kifúvások, 8 deflációs maradványok, 9 – abráziós bevágások, 10 – homokos törmeléklejtők, 11 – "osushka" zona, 12 – part, 13 – víz

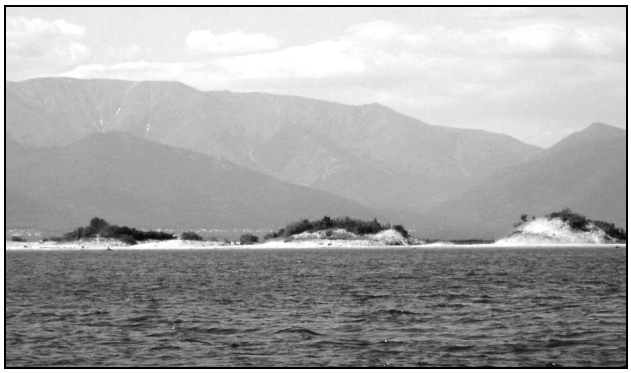

Photo 1 High aeolian relief – general view (photo by S. Wika)
1. fotó Magas eolikus felszín (fotó: S. Wika)

They are characterised by the presence of fragmented, blown windward slopes and the complete lack of leeward slopes, which were disturbed by abrasion. Undermined, earlier aeolian material presently lies at the foot of steep abrasion slopes in the form of sandy waste slope. According to ROGOZIN (1993) in the lower part of the present remnants deposits of high spill banks occur, in the top of which a humus horizon is observed. Above it aeolian sands barely lie. Therefore, in the opinion of the mentioned author, the landforms discussed here are characterised by swash-aeolian genesis. The remnants analysed rise clearly above the almost flat deflation areas, on which distinct signs of the wash of the waves are visible. Remnants are divided by more or less wide deflation corridors, on bottom of which sandy covers develop. At the deflation surfaces also numerous, sandy shadows of different sizes and sometimes flat deflation depressions are formed (WIKA et al. 2006).

On Yarki island low aeolian relief is the predominating element. It is mostly represented by not high wavy areas of blown sand covers with accompanying deflation landforms and transverse dunes of up to 1–2m height (*Fig. 3; photo 2*). They have asymmetrically shaped opposite slopes but the slope angle is not large (8–12° 13–21°). Leeward slopes of generally SW exposure are partly blown by rarely appearing winds from this direction. The windward slopes of these landforms exposed generally towards NE, are therefore to the rule strongly degraded by deflation and at their place smaller or larger deflation depressions develop with

remnants of the same genesis appearing between them. The direct background of these slopes is similarly disturbed: there are also deflation areas of different size with preserved remnants (*Fig. 3; photo 2*). Sand removed from the northern part of the narrow island is mainly accumulated at the foot of leeward dune slopes in the form of actually developing aeolian belts of cover sands, however, its parts extend into the inshore parts of the Baikal, shallowing it.

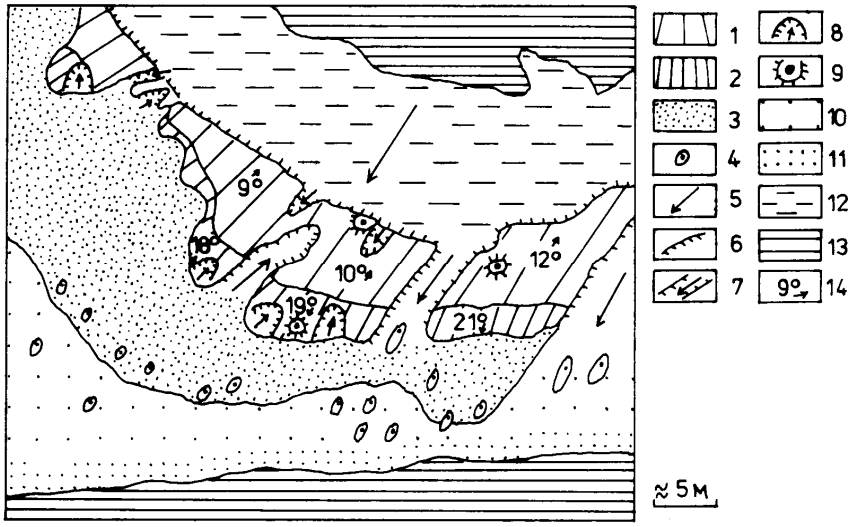

Figure 3 Example of low aeolian relief:
1 – windward slopes of dunes, 2 – leeward slopes of dunes, 3 – aeolian cover sands, 4 – sand shadows, 5 – deflation plains, 6 – deflation undercuts, 7 – deflation corridors, 8 – blowouts, 9 – deflation remnants, 10 – zone of "osushka", 11 – beach, 12 – swampy areas, 13 – water, 14 – inclination of slopes and direction
3. ábra Alacsony eolikus felszín egy példája:
1 – szélfelőli lejtők és dűnék, 2 – szélárnyékos lejtők és dűnék, 3 – eolikus takaró homok, 4 – homok árnyék zónák, 5 – deflációs laposok, 6 – deflációs bevágások, 7. – deflációs folyosók, 8 – kifúvások, 9 – deflációs maradványok, 10 – "osushka" zóna, 11 – part, 12 – mocsaras területek, 13 – víz, 14 . lejtők inklinációja és iránya

Photo 2 Low aeolian relief – general view (photo by T. Szczypek)
2. fotó Alacsony eolikus felszín (fotó: T. Szczypek)

Vegetation of Yarki Island

Vegetation cover on Yarki Island is weakly differentiated, poor in respect of flora and strongly transformed by human. In the area investigated, 100 vascular plant species, a dozen or so moss species, some lichens species and 19 plant communities were stated (including only in the dignity of associations). They were documented by 41 phytosociological surveys, made by means of BRAUN-BLANQUET (1964) method. The lack of flora and vegetation was probably caused by extreme climatic-habitat conditions, and also by human activity (tourism and recreation). As early as in the 1930s, in some parts of the island settlements existed, today proved by two abandoned houses. Among them ruder vegetation with contribution of among others *Artemisia mongolica, Chenopodium album* var.*, Descurainia sophia, Elytrigia repens, Lamium album* ssp. *orientale, Polygonum arenastrum* exists. Completely different ruder vegetation systems were shaped in distinct terrain depressions, which are surrounded by birch brushwood or other bush species. In these sheltered places camps are most often pitched. In their nearest neighbourhood patches dominated by *Calamagrostis epigejos*, *Tanacetum vulgare* or *Rumex acetosa* are visible. These species are sometimes accompanied by *Chamaerion angustifolium*, *Equisetum arvense, Lactuca sibirica, Silene repens*. To the rule, ruder communities were shaped in the central part of the island, where *Betula pendula, Padus avium, Pinus pumila, Larix gmelini, Picea obovata, Salix triandra* ssp. *Nipponica* were planted. It is most often also possible to meet patches of communities with *Rosa acicularis* in this fragment of the island.

Strong winds and initial sandy soils mostly enable island occupancy by psammophytes and xerophytes. From the southern part of the island, in the distance of 4–5m from the Baikal shore patches of association *Craniospermo-Leymetum secalini* develop. Considering syngenesis, it is a natural perdochorical community (FALIŃSKI 1969). Its phytocenoses stretch in the form of narrow belts practically along the whole island shore. The lack of them is only noticed in places that are systematically flooded by lake waves and in these sections, where brushwood grows near water sheet, therefore in places, where typical sandy banks

do not occur. Then the patches of *Craniospermo-Leymetum secalini* best developed are observed in this fragment of Yarki Island, where characteristic dune remnants (high aeolian relief) originated. Here they are less disturbed by people. Vertical and horizontal structure of this association and its physiognomy are here shaped in a classic way. The decided majority of its patches to the rule has the complete set of characteristic and distinguished species (CHYTRÝ et al. 1993, CHYTRÝ et al. 1995, WIKA et al. 2003). In them are present as follows: *Aconogonon angustifolium, Astragalus sericeocanus, Carex sabulosa, Corispermum sibiricum, Craniospermum subvillosum, Festuca rubra* ssp. *baicalensis, Isatis oblongata, Leymus secalinus*. Sometimes also individual clumps of *Vaccinium uliginosum* appear. At sandy banks, strongly penetrated by humans, *Astragalus sericeocanus, Craniospermum subvillosum* disappear first and slightly later *Isatis oblongata*. At more intensive treading of psammophylous vegetation, from the patches of this community *Leymus secalinus* is successively supplanted. Its place is occupied by *Calamagrostis epigejos*, rarely by *Elytrigia repens*. In typical patches of *Craniospermo-Leymetum secalini* there is the lack of mosses and lichens. They appear only in degeneration stages of this association.

At the northern side of the island peatbogs in he form of belts with a width of a few to a dozen metres or so and sometimes they stretch to even many tens of metres. In many cases they are dried up, thus they are also covered with different species of grass and more xerophylous mosses. In some fragments of dried peatbogs young individuals of trees *Betula alba, B. pendula, Pinus sylvestris* and bushes– *Salix caprea, Spirea dahurica* appear as well. But there, where waves flood the land (at least periodically), patches of associations of *Caricetum limosae* and *Caricetum diandrae* were shaped. At peaty soils sedges frequently occur. To the rule they are sporadically accompanied by flower plants, as e.g. *Comarum palustre, Iris laevigata, Lathyrus palustris, Menyantes trifoliata, Namburgia thyrsiflora*. In small flooded areas there are favourable conditions for aquatic vegetation. There among others: *Elodea canadensis, Hippuris vulgaris, Lemna trisulca, Rorippa palustris, Scirpus radicans, Spirodela polyrhiza, Utricularia neglecta* were noted.

At the border of peatbogs and brushwood patches of natural communities *Vaccinium uliginosum* (to the rule it reaches the height of 50cm) and *Empetrum nigrum* develop. These species often occur together. Both communities clearly differ in habitat conditions, number of species, and especially the presence or lack of moss layer. Community with *Vaccinium uliginosum* occupies humid soils indicated by among others such species as *Carex fusca, Lathyrus palustris, Moehringia lateriflora*. Coverage in moss layer to the rule amounts to 50% of patch area. This layer is mostly built of: *Climacium dendroides* and *Hypnum* sp. Then in the community of *Empetrum nigrum* in moss layer, significantly weaker shaded, xerophylous species prevail, which are typical for open places, e.g. *Ceratodon purpureus, Brachythecium albicans* and *Rhacomitrum canescens*.

In this part of the Yarki Island to scarcity belong to patches with contribution of *Carex rostrata, Cicuta virosa, Equisetum variegatum, Majanthemum bifolium, Rubus articus, Veronica longifolia*.

Final remarks

Contemporary aeolian landscape in Yarki Island most of all has anthropogenic genesis. The variety of aeolian landforms is the result of morpho-shaping intensified in the last decades, mostly by deflation wind activity. It is connected with vegetation cover degradation by men periodically abiding here. Peaty vegetation in this area is mostly connected with deep deflation depressions, reaching almost lake level. The second factor leading to the decay of the initial dunes is the intensive abrasion caused by storm waves of the open lake of Baikal. In some places, where aeolian landforms were practically damaged and washed, dammed lake waves – as was earlier mentioned – wash to the sor. Therefore it is possible to state, that dune stabilisation is a certain kind of guarantor of island existence, and then it ensures the following functioning of the valuable – from ecological point of view – sor. Its eventual liquidation will be connected with ecological catastrophe and complete rebuilding of ecosystems in the northern Baikal.

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