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DIRECTION OF LOCAL MORPHO-SHAPING WINDS AT NORTH-WESTERN SHORE OF OLKHON ISLAND ON BAIKAL

Chak W. A., Kozyriewa E. A., Szczypek T., Wika S. **Kierunki lokalnych wiatrów morfotwórczych na północno-zachodnim wybrzeżu Olchonu na Bajkale.** Na podstawie pomiarów azymutów pochylenia drzew zniekształconych przez dominujące wiatry oraz azymutów osi morfologicznych współczesnych wypukłych i wklęsłych form deflacyjnych, dokonano próby rekonstrukcji lokalnych kierunków wiatrów rzeźbotwórczych na północno-zachodnim wybrzeżu wyspy Olchon. Analizy przeprowadzono w czterech stanowiskach: Bolszoj Chużir, Charancy, Ułan-Chuszin i Piesczanoje. Stwierdzono dwudzielność kierunków wspomnianych wiatrów. Uzyskane wyniki są bardziej szczegółowe, niż rezultaty klasycznych pomiarów na stacjach meteorologicznych.

Хак В.А., Козырева Е.А., Щипек Т., Вика С. **Направления местных рельефоформирующих ветров на северо-западном побережье о. Ольхон на Байкале.** На основе измерений азимутов наклона деревьев, деформированных преобладающими ветрами, а также азимутов морфологических осей современных положительных и отрицательных дефляционных форм, выполнена попытка реконструкции локальных направлений рельефоформирующих ветров на северо-западном побережье острова Ольхон. Исследования проведены в четырех пунктах: Большой Хужир, Харанцы, Улан-Хушин и Песчаное. Установлено два основных направления упомянутых ветров. Полученные результаты являются более детальными, чем результаты классических измерений на метеорологических станциях.

Key words: morpho-shaping winds, Olkhon Island, lake Baikal

Abstract

On the basis of measurements of azimuths of inclination of trees deformed by prevailing winds and azimuths of morphological axes of contemporary convex and concave accumulation and deflation landforms, the attempt to reconstruct local directions of relief-shaping winds at the north-western shore of Olkhon Island was made. Analyses were carried out in four sites: Bolshoy Khuzhir, Kharantsy, Ulan-Khyshin and Peschanoye. Direction duality of the above-mentioned winds was stated. Results obtained are more detailed than results of classic measurements made at meteorological stations.

INTRODUCTION

Characteristic elements of low landscape of the north-western shore of Olkhon are aeolian sands, shaped in a form of old, fixed, and – most of all – contemporarily wind-blown dune landforms (AGAFONOV, 1975, 1990; TAISAEV, 1982, 1994; ABALAKOV, KUZMIN, SNYTKO, 1989; AGAFONOV et al., 2001; LISAKOVA, 2008). Among main fields of wind-blown sands one should number (from the south-west towards the north-east) the following ones: Sem Sosen, Yalga, Maly Khuzhir, Bolshoy Khuzhyr, and often passing over

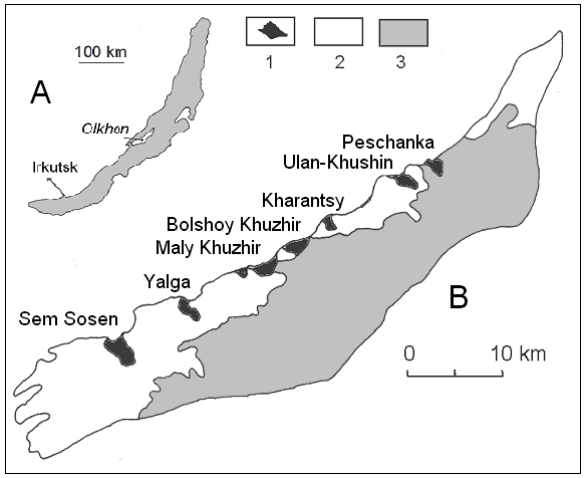

Fig. 1. A – Location of Olkhon Island and B – location of fields of wind-blown sands (1) on Olkhon against a background of steppe (2) and taiga (3) distribution
Rys. 1. A – Lokalizacja wyspy Olkhon oraz B – lokalizacja pól rozwiewanych piasków (1) na Olchonie na tle rozmieszczenia stepów (2) i tajgi (3)

Kharantsy, Ulan-Khushin and Peschanoye (WIKA, SNYTKO, SZCZYPEK, 1997; fig. 1).

The reason of contemporary mobility of aeolian sands on Olkhon is the anthropogenic interference into

the natural environment: excessive taiga cutting and intensive cattle and sheep breeding. Sand mobility is here favoured by very low annual precipitation sum – about 200 mm (*Baikal...*, 1993).

Location and shape of the above-mentioned sand fields betoken that they were and are in general shaped by winds blowing from north-western sector. But observations of different aeolian landforms within these fields as well as trees deformed by wind distinctly indicate that directions of blowing morpho-shaping winds are quite diversified here.

This study focuses on paying attention to local wind directions having morphogenetic importance at the north-western shore of Olkhon (a case study of sites: Bolshoy Khuzhir, Kharantsy, Ulan-Khushin and Peschanoye; fig. 1).

METHODS OF INVESTIGATIONS

To realize the task set in every site at least 100 measurements of azimuths of inclination direction of randomly selected tress (there are exclusively Scots Pine *Pinus sylvestris* and Siberian Larch *Larix sibirica*) and directions of morphological axes of randomly selected convex and concave deflation and accumulation landforms were made. On this basis – applying method described by MYCIELSKA-DOWGIAŁŁO (1980) – directions of local winds of morpho-shaping significance were determined. These directions were compared with data taken from meteorological year-books (*Spravochnik po klimatu...,* 1967, 1971).

Determination of predominating directions of local winds on the basis of bended trees is applied since a long time (e.g. DÄNIKER, 1923; SOKOŁOWSKI, 1927; KRYGOWSKI, 1935; KOT, 1985; PEŁKA, 1994; PULWERT, 2005). Measurements of azimuths of axes of different aeolian deflation and accumulation landforms are of similar significance. They were also applied on Baikal (SZCZYPEK S., 2004; KHAK, SZCZYPEK S., SZCZYPEK T., 2006; SNYTKO, SZCZYPEK S., 2006).

RESULTS OF INVESTIGATIONS

Official meteorological information, referring to wind directions on Olkhon, and graphically presented on maps in *Atlas volneniya...* (1977) and in Atlas of Baikal (*Baikal...*, 1993) show, that north-western and western winds predominate here. Applied in the given study table data, presented in meteorological year-books, refer to Khuzhir site, located in the middle part of the shore analysed. Considering its location and topographic conditions, it seems to be representative for the area discussed. On the basis of data mentioned, wind direction roses were constructed, referring to the periods 1947–1960 (*Spravochnik po klimatu...*, 1967) and 1956–1965 (*Spravochnik po klimatu...*, 1971). Both roses (fig. 2A, B) have slightly different shapes. But they betoken, that winds blowing from widely understood western sector (about 47% and 40% respectively) prevail over winds from the eastern one (about 32% and 38%). So they are predominant. This information does not answer the question in relation to morpho-shaping significance of winds from this or other direction. Therefore, we will present below results of analyses of trees and aeolian landforms in this area, which was above mentioned.

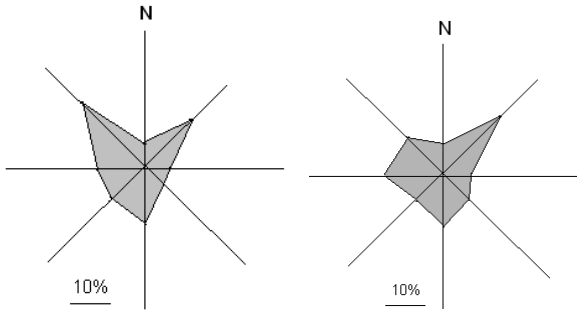

Fig. 2. Wind roses for Bolshoy Khuzhir site:
A – for the period 1947–1960 (after *Spravochnik...*, 1967),
B – for the period 1956–1965 (after *Spravochnik...*, 1971)
Rys. 2. Róże wiatrów dla stacji Bolszoj Chużir:
A – dla okresu 1947–1960 (wg *Spravochnik...*, 1967), B – dla okresu 1956–1965 (wg *Spravochnik...*, 1971)

Bolszoy Khuzhir site

Measured trees are deviated from the perpendicular here from 3° up to 35° (inclination up to 20° predominates – 87,5% of cases – photo 1), whereas azimuths

Photo 1. Pines bended by wind in Bolshoy Khuzhir site (phot. by T. Szczypek)
Fot. 1. Sosny pochylone przez wiatr w stanowisku Bolszoj Chużir (fot. T. Szczypek)

of their bending – together with azimuths of landform axes – are included in the wide interval 83–227° (fig. 3). It betokens the contribution of morphologically active winds blowing from directions 263–47°. The outline of rose of directions of tree inclinations and azimuths of landforms axes can be divided into two unequal parts: smaller (26% of cases) with predominant winds from directions 263–316° and larger (74% of cases)

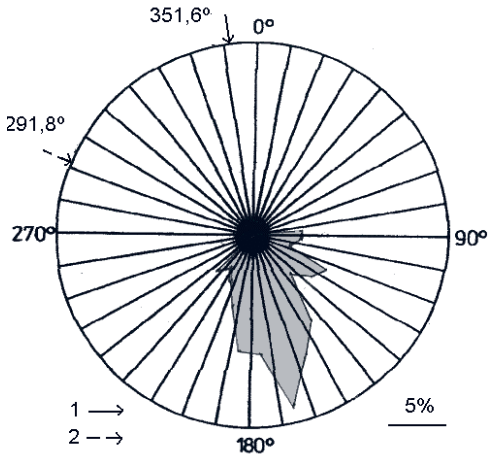

Fig. 3. Bolshoy Khuzhir site: azimuths of tree inclination and directions of morphological axes and reconstructed directions of predominant relief-shaping winds (1 – major, 2 – secondary)
Rys. 3. Stanowisko Bolszoj Chużir: azymuty pochylenia drzew i kierunków osi morfologicznych oraz zrekonstruowane kierunki dominujących wiatrów rzeźbotwórczych (1 – głównych, 2 – drugorzędnych)

with predominating winds 316–47°. Mathematical-statistical analyses indicate that in Bolshoy Khuzhir site the main morpho-shaping role is played by winds from direction 351,6°, whereas secondary – from the direction 291,8° (these directions differ from each other of 59,8° – fig. 3).

Kharantsy site

In this site trees disturbed by wind were measured exclusively. Actually there are not any distinct aeolian landforms here, which can fulfill criteria for the mentioned measurements. Therefore, the trees analysed are deviated from the perpendicular from 3° up to 17° (photo 2), at the same time it is worth stressing that

Photo 2. Larches bended by wind in Kharantsy site (phot. by T. Szczypek)
Fot. 1. Modrzewie pochylone przez wiatr w stanowisku Charancy (fot. T. Szczypek)

inclination up to 10° predominates (86%). Azimuths of inclination directions of these trees are included in the interval of 122–253° (fig. 4). In connection with it morphologically active winds blow here from directions 302–73°. The outline of rose of azimuths of tree inclination is moderately uniform. Therefore it is possible to state, that average direction of morpho-shaping winds amounts here to 348,5° (fig. 4).

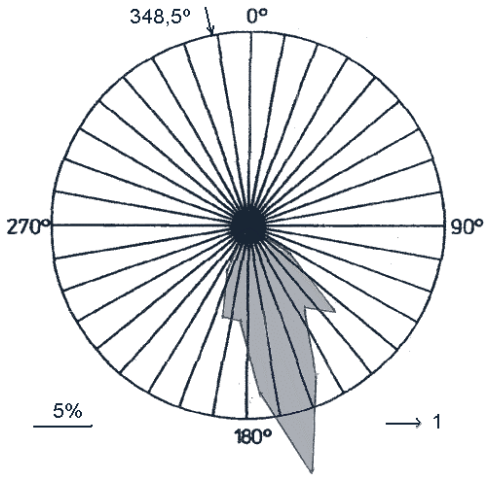

Fig. 4. Kharantsy site: azimuths of tree inclinations and reconstructed directions of predominant relief-shaping winds (1)
Rys. 4. Stanowisko Kharantsy: azymuty pochylenia drzew oraz zrekonstruowane kierunki dominujących wiatrów rzeźbotwórczych (1)

Ulan-Khushin site

Trees disturbed by wind are deviated from the perpendicular here from 3° up to 28° (photo 3), at the same it is worth stressing that inclinations up to 10° predominate – 71,8% (up to 20° – 93,7%). Azimuths of directions of tree inclinations and directions of axes of aeolian landforms are included in the interval: 80–199° (fig. 5) what means, that morphologically active winds blow here from directions 260–19°. Rose of directions of tree inclinations and azimuths of landform axes – similarly to Bolshoy Khuzhir – can be divided

Photo 3. Larches bended by wind in Ulan-Khushin site (phot. by T. Szczypek)
Fot. 3. Modrzewie pohylone przez wiatr w stanowisku Ułan-Chuszin (fot. T. Szczypek)

into two parts: smaller (38,3% of cases) with predominant winds from directions 260–315° and larger (61,8% of analysed cases) with winds from direction 315–19°. Because of it, the calculations indicate, that main morpho-shaping winds blow here from the average directions 330,8°, whereas secondary winds – from direction 298,7° (the difference in directions amounts to 32,1° – fig. 5).

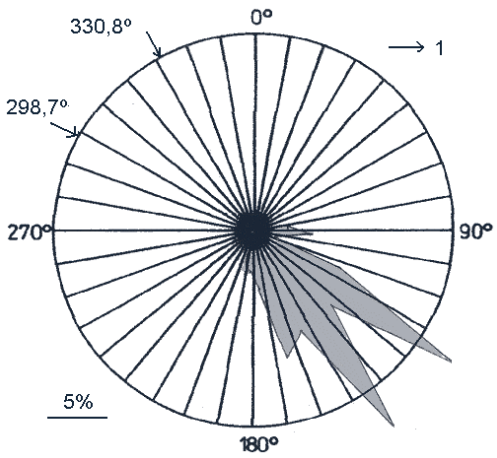

Fig 5. Ulan-Khushin site: azimuths of tree inclinations and directions of morphological axes and reconstructed directions of predominant relief-shaping winds (1 – main, 2 – secondary)
Rys. 5. Stanowisko Ułan-Chuszin: azymuty pochylenia drzew i kierunków osi morfologicznych oraz zrekonstruowane kierunki dominujących wiatrów rzeźbotwórczych (1 – głównych, 2 – drugorzędnych)

Peschanoye site

The shape and location of field of wind-blown sands betoken, that it has originated under the influence of generally understood north-western winds. But measurements made in this site indicate, that local directions of morpho-shaping winds are slightly other here (KOZYRIEWA, SZCZYPEK, TRZCINSKIJ, 2008). Results of observations, after statistical processing show, that in Peschanoye site north-eastern and north-north-western winds are of morpho-shaping significance. Directions determined on the basis of measurements of trees are equal (contribution of 50%): winds deforming tree habit blow from directions 42,9° and 337,3°. In the case of reconstruction on the basis of landform axes it was stated, that winds from the direction of 32,3° decidedly predominate here (85,7% of cases), whereas winds blowing from the direction 352,6° are of secondary importance (only in 14,7% of cases). Tree deviation from the perpendicular is included in the interval 3–30° (photo 4). Inclinations up to 10° predominate (65%, up to 20°–90%). Taking into account the generalised rose (fig. 6) it is possible to state, that azimuths of directions of tree inclinations and directions of landform axes are included in the interval 128–250°, therefore active winds blow here from directions 308–70°. Duality of azimuth rose betokens that in Peschanoye site winds from the direction 31,5° (72,0%) are of main significance in the shaping of aeolian relief, while winds from the direction 340,4° are distinctly of secondary importance (28% of cases – fig. 6). Therefore, the difference between both angles amounts to 50,9°.

Photo 4. Pines bended by wind in Peschanoye site (phot. by T. Szczypek)
Fot. 4. Sosny pochylone przez wiatr w stanowisku Pieszczanoje (fot. T. Szczypek)

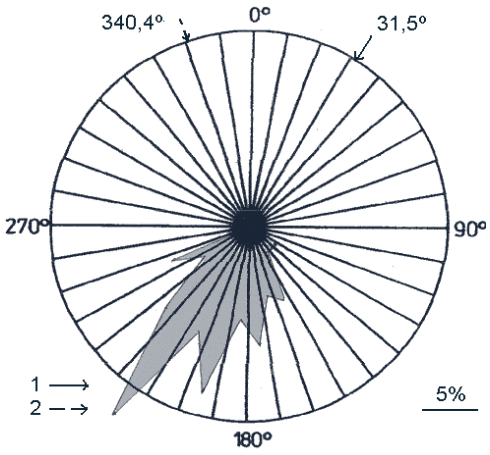

Fig. 6. Peschanoye site: azimuths of tree inclinations and directions of morphological axes and reconstructed directions of predominant relief-shaping winds (1 – main, 2 – secondary)
Rys. 6. Stanowisko Piesczanoje: azymuty pochylenia drzew i kierunków osi morfologicznych oraz zrekonstruowane kierunki dominujących wiatrów rzeźbotwórczych (1 – głównych, 2 – drugorzędnych)

FINAL REMARKS

Presented results of analyses made at the north-western shore of Olkhon indicate two directions of influence of morphologically active winds, blowing from the open surface of the Small Sea Strait: statistically reconstructed predominant directions are included within general interval 291,8°–31,5°, therefore they differ of 99,7°. Morpho-shaping role of reconstructed

wind directions is not identical, although there are no rules for that, if more northern or more western winds are of larger importance. It certainly results from local conditions of terrain relief and the shape of shoreline as well as from the presence or lack of more compact forest complexes.

Reconstructed morpho-shaping wind directions on Olkhon are clearly different from those at central-eastern shore of Baikal (SNYTKO, SZCZYPEK S., 2006). In the last case in every from three analysed sites dual character of direction of wind influence is more readable; statistically determined predominant winds are included in the interval 240,3°–308,6° (difference in directions is almost 1/3 smaller: 68,3°), in every case north-western winds are of more essential morpho-shaping significance, whereas south-western winds - of secondary. Therefore, it is possible that the size of water surface influences on larger constancy of relief-shaping wind directions, blowing from above it (in our case from Baikal): the larger it is (open Baikal in the east of Olkhon), the more stable wind directions are (the surface of the Small Sea *Maloye More* Strait between the stable land – the range of Maritime Mountains *Primorsky Khrebet* and Olkhon is miniature in relation to open Baikal).

Results of investigations on local directions of active morphologically winds on Olkhon in general correspondent with the sector of predominant winds, read from the wind rose, but they are decidedly more precise (provided on condition that measurements were made correctly).

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