

# ГЕТЕРОГЕННОСТЬ СРЕДИ ВИДОВ ОЛЬХИ (*ALNUS* MILL., BETULACEAE) СЕВЕРА РОССИИ: КОМБИНИРОВАННЫЙ ПОДХОД

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## РЕЗЮМЕ

Филогенетический анализ и морфологические данные свидетельствуют в пользу выделения *A. kolaensis* Orlova в качестве самостоятельного вида. Морфологические данные листьев полностью совпадают с распределением генотипов.

# HETEROGENEITY IN NORTHERN RUSSIAN ALDERS (*ALNUS MILL.*, *BETULACEAE*): COMBINED APPROACH

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## SUMMARY

The phylogenies established from DNA sequences together with morphological analyses support the separation of *A. kolaensis* Orlova as a distinct species. Morphological data from leaves coinciding well with the distribution of genotypes.

## MOTIVATION

This paper is mostly about so-called "Kola alder" (*Alnus kolaensis* Orlova). Since its discovery in 1954, there have been many discussions about its taxonomical status. In the current work, we accepted the species rank for Kola alder, pioneering the use of both the morphological and molecular methods for solving this aim.

## RESULTS AND DISCUSSION

All sequences for *A. incana* and *A. glutinosa* coincided with sequences from NCBI GenBank. The sequences of five *A. kolaensis* samples were identical and differed both from *A. incana* and *A. glutinosa* by one nucleotide for each species. One herbarium sample identified as *A. kolaensis* represented a heterozygote on the investigated site; one allele corresponded to the *A. kolaensis* sequence, and another to *A. incana*. This sample is apparently an occasional hybrid *A. incana* × *A. kolaensis* which have ovate leaves with an obtuse top are 60 mm in length and 40 mm in width, seven veins of the first order, hairy only on veins (see Fig. 1).

Principal component analysis of both classical and geometric morphometry data shows high polymorphism among the alder groups in this study. Nevertheless, on the plot of first two components (Fig. 2) three sectors corresponding to *A. glutinosa*, *A. incana* and *A. kolaensis* sequences are well enough allocated. Prospective hybrid *A. incana* × *A. kolaensis* appears to take a marginal position within *A. kolaensis* sector. The *A. xpubescens* sample is located separately from other three sectors.

Both morphological and sequence analysis yielded similar results, and it confirms previously-obtained findings from studies of *Betulaceae* (Bousquet et al., 1992) and other families (Navarro et al., 2005). Thus, we can use amount of morphological characteristics of a leaf blade and nuclear gene sequence in the systematics of *Betulaceae*.

To our knowledge, the hybrid origin hypothesis (Orlova, 1954) of *Alnus kolaensis* has not been confirmed. Additionally, due to DNA differences within Kola alder, we cannot

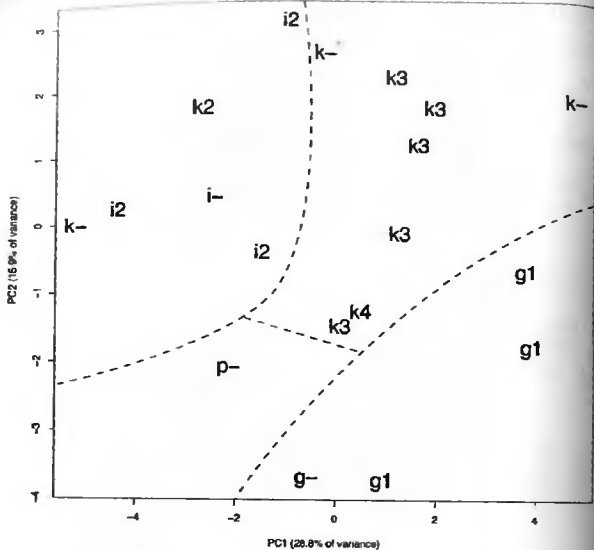


Fig. 1. The heterozygous (*Alnus incana* × *A. kolaensis*) herbarium sample: whole view and a catkin.

consider it as an ecological form (Ilinsky, Shipunov, 2005). Other hypotheses (Tzvelev, 2002) remain unclear. Based on morphometric and genetic data, *A. kolaensis* must be considered an independent species, because the differences among other species show similar levels of difference. This conclusion will influence not only *Alnus* taxonomy but also the conservation policy in Murmansk region where many habitats of Kola alder are now under the effect of high air pollution (Zvereva, Kozlov, 2007).

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**Fig. 2.** The plot the first and the second components received from combination of classical and geometric morphometry methods. Letters indicate the following species: g — *Alnus glutinosa*, i — *A. incana*, k — *A. kolaensis*, p — *A. × pubescens*. Numbers indicate genotypes (ITS sequences): “-” — unknown, 1 — *A. glutinosa*, 2 — *A. incana*, 3 — *A. kolaensis*, 4 — *A. incana* × *A. kolaensis*.

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