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Early 20th century Russian peat scientists as possible vectors for the establishment of *Calluna vulgaris* in Georgian *Sphagnum* bogs

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In the summer of 2000, a stand of *Calluna vulgaris* (L.) Hull was found in the Ispani 2 bog near Kobuleti, being the first known occurrence of this species in Georgia (Transcaucasia). Pollen analysis of a peat core from the *Calluna vulgaris* stand shows that the species established itself there around 1920/1930. Dispersal by migrating birds, deliberate introduction as a garden plant, and unintentional introduction with cultural products are shown to have been improbable vectors for introduction far from the species' main distribution area. It is concluded that *Calluna vulgaris* may have been accidentally introduced by Russian peat scientists and prospectors that were active in the area around the time of establishment.

Keywords: *Calluna vulgaris*, Colchis (Transcaucasia), bog, plant introduction, pollen analysis

Introduction

Heather, *Calluna vulgaris* (L.) Hull, is a widespread species in Europe and West-Siberia (Fig. 1). In the summer of 2000, the species was found for the first time in the Republic of Georgia (Transcaucasia), in somewhat disturbed sites of the Ispani bogs near Kobuleti (N 41° 51' E 41° 48') in the autonomous republic of Ajara (Matchutadze & Kaffke in prep). These sites are 1100 km southeast of the species' main distribution area and 150 km northeast of its nearest isolated location in East-Turkey (Davis et al. 1978). This paper discusses the time and the possible causes of its establishment in the Ispani bogs.

Methods

To date the establishment of *Calluna vulgaris*, pollen analysis was performed on a peat core from the centre of the *Calluna vulgaris* area in the Ispani 2 bog.

Processing of the 0,5 cm³ peat samples included boiling in 10% KOH, addition of *Lycopodium* spores to determine pollen concentrations (Stockmarr 1971) and peat accumulation rates (Middeldorp 1986), sieving (120 mm), acetolysis for 7 minutes, and mounting in silicone oil (2000 centistokes) (cf. Faegri & Iversen 1989, Moore et al. 1991). Pollen and spores were named after Moore et al. (1991). Names of pollen types

Fig. 1: Distribution map of *Calluna vulgaris* (L.) Hull. Asterisk indicates the new location in Georgia (changed after Hoffmann et al. 1998).

are written in SMALL CAPITALS to distinguish them from taxa (Joosten & De Klerk 2002).

Complete slides were counted until a pollen sum of at least 200 grains was reached. The pollen sum includes all pollen ascribed to upland (non-wetland) plant species. Pollen and spores that might originate from wetland taxa were excluded from the sum.

Results and discussion

The results of the palynological analysis are shown in Fig. 2.

CALLUNA VULGARIS is a very characteristic pollen type that is only produced by *Calluna vulgaris*, and that hardly can be confused with other pollen types (Moore et al. 1991). The first single CALLUNA VULGARIS grains were found in the samples 69 cm and 59 cm (Fig. 2). In sample 49 cm 2 pollen grains and from sample 39 cm on many CALLUNA VULGARIS pollen grains were encountered.

No CALLUNA VULGARIS pollen record is known from any other Holocene pollen diagram from Georgia. Furthermore, the population of *Calluna vulgaris* in Georgia is extremely small. Only some specimen grow in the Ispani 1 bog at one kilometre distance from the coring site, and the 2000 m^2 large area in Ispani 2 from which the core was taken constitutes the only other known occurrence. As regional CALLUNA VULGARIS pollen values (sensu Janssen 1973) are generally low, also in regions with abundant *Calluna vulgaris* (Mulder & Janssen 1999), CALLUNA VULGARIS pollen will be absent from the regional pollen deposition in Ispani and all CALLUNA VULGARIS pollen will originate from the cored site itself or its immediate surroundings (cf. Janssen 1973).

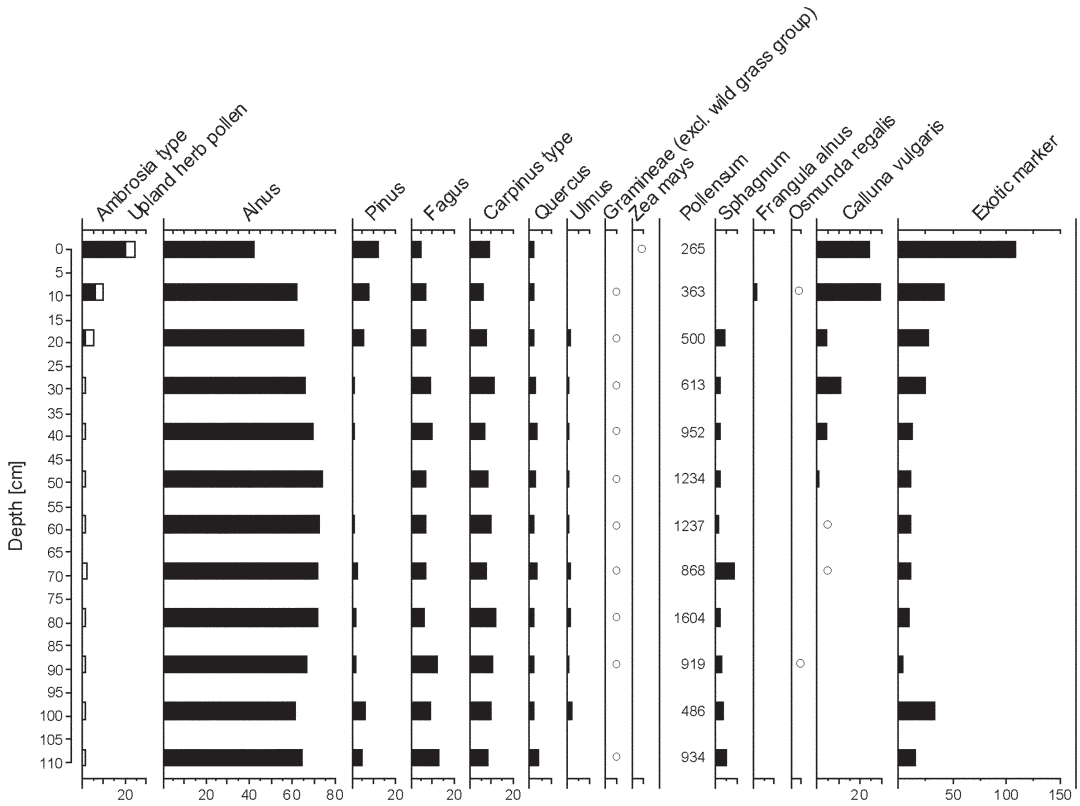

Fig. 2: Pollen diagram of the *Calluna vulgaris* location in Ispani II (Georgia) (selected curves only). Circles denote single grain occurrences.

The age of the peat samples can be estimated using the exotic marker percentage values. Under the assumption that the influx (N cm^{-2} a^{-1}) of pollen grains that constitute the pollen sum has remained constant, the exotic marker values (expressed as percentage of the pollensum) change proportionally to the change in peat accumulation rate (expressed in cm a^{-1}). The higher exotic marker values in the upper 39 cm of the core are then caused by lesser compaction of the peat. Between 89 and 39 cm the exotic marker values are constant at approximately 10%. ^{14}C AMS-dating of a core taken from the centre of the Ispani 2 bog showed a mean peat accumulation rate of 0.4 cm a^{-1} in the past 1000 years (Kaffke et al. 2000, cf. Neishtadt et al. 1965). Assuming that the exotic marker value of 10% corresponds to this rate of 0.4 cm a^{-1}, the cumulative marker values (pollen density dating, Middeldorp 1986) point at a first appearance of CALLUNA VULGARIS pollen (69 cm) around 1900 AD. The increase in CALLUNA VULGARIS pollen values at a depth of 39 cm would have occurred around 1973.

Qualitative and quantitative changes in pollen assemblages can be correlated to known historical changes in vegetation and thus be used to derive dates independently (cf. Joosten 1985, 1986). *Ambrosia* was introduced to Ajara after 1900 (Davitadze 1974). A relevant amount of AMBROSIA pollen was found from 19 cm upward. The occurrence of a single pollen grain in sample 89 cm is interpreted as long distance transport or pollution. The high AMBROSIA pollen values above a depth of 20 cm probably reflect the changes in land use and the increase of ruderal habitats around Ispani since the collapse of the Soviet Union. The decreasing values of ALNUS pollen in the uppermost part of the diagram prob-

Fig. 3: Participants of the 2nd International Congress of Soil Scientists investigate a coring from the Ispani I bog. Third from the right V.S. Dokturovsky. Explanation by Prof. A. Flerov (fourth from the left). (from Flerov 1936).

ably reflect the increased use of trees for fuel since the 1980s, when the *Alnus* forest between Ispani 1 and 2 changed into a regularly cut low brushwood of *Alnus barbata* and *Frangula alnus* (Krebs & Resagk 2002). Both phenomena indicate that the uppermost 19 cm are very young.

Considering these changes in land use, it is plausible that the assumption of a constant influx of upland pollen (pollen sum) does not hold. Also the increased values of the "upland herb pollen" curve point at an opening up of the landscape. A reduction in the regional tree cover generally leads to a reduction of total upland pollen influx (cf. Grosse-Brauckmann 1978, Frenzel 1997). Consequently, the estimated age of the sample at 69 cm, where the first CALLUNA VULGARIS pollen was found, should be corrected to approximately 1920–1930.

The question remains how *Calluna vulgaris* first arrived in Ispani. *Calluna* indeed produces many small seeds (Gimingham 1972), but seed dispersal by wind is restricted. Beijerinck (1940) reported a dispersal distance of 100 m with a wind velocity of 10 m s^{-1}. The seeds clearly need a vector to be transported over much larger distances. Transport by water can be excluded, because of the ombrogenous character of the bogs involved.

Potential vectors in seed dispersal are birds that are resident to *Calluna vulgaris* rich areas and that migrate through the Ispani area. Such species include *Gallinago gallinago*, *Asio flammeus*, *Motacilla flava*, *Coturnix coturnix*, *Caprimulgus europaeus*, *Merops apiaster*, *Falco* sp., *Circus pygargus*, and *Circus aeruginosus* (Elphick 1995 and own observations). Endozoochory is improbable because most of the birds in question do not eat seeds, whereas the small seeds of *Calluna vulgaris* (0,6 x 0,35 mm, Gimingham 1972) are unattractive for herbivorous birds. Furthermore, considering the large distance to the nearest major *Calluna* stands, the birds will have excreted any *Calluna* seeds before arrival at Ispani (*cf.* Bonn & Poschlod 1998). Transport of seeds stuck to feet or in plumage (epizoochory) cannot be excluded, but leaves the question why establishment of *Calluna* in Ispani did not happen until the first decennia of the 20th century.

Another possibility is introduction by man. Living plants or seeds may have been introduced deliberately in gardens and may have spread to natural areas. This applies, for example, to *Spiranthes sinensis*, an exotic species that grows in the Botanical Garden of Batumi (Dmitrieva 1989, 1990), and is also found in the Ispani bogs. There are no indications that *Calluna vulgaris* was introduced in this way. Heath gardens have apparently never been laid out in Georgia, and no records exist of the introduction of *Calluna* in Georgian botanical gardens.

Many other plants species, like *Ambrosia artemisiifolia*, were unintentionally introduced to Georgia via cultural products (Davitadze 1974, 1980). A possible vector for *Calluna vulgaris* diaspores could have been sheep wool imported from Europe, but also this is improbable. Apart

from limited trade movements in Soviet times, a spread of *Calluna* from that source would have required a previous establishment of the species near transport and manufacture centres. On these more accessible places, its early discovery would have been much more probable.

A last possibility is that *Calluna vulgaris* seeds were introduced by mire scientists and prospectors. We know that a.o. the famous mire scientist Vladimir Semenovich Dokturovsky visited the bogs Ispani 1 and 2 (Dokturowsky 1931, Fig. 3). Before he and his collaborators visited Georgia, they visited many other places where *Calluna vulgaris* occurred (Krishtofovich 1936). *Calluna vulgaris* seeds may have been introduced via their boots, clothes, or coring devices. Probably many such visits to Ispani were made during the time of peat extraction in Ispani 1 in the 1930s. The estimated date of establishment of *Calluna vulgaris* of around 1920 fits well with this hypothesis.

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