



***Pyrus caucasica* Fed. Ancestor of Georgian Pear Landraces**

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Abstract: Georgia (South Caucasus) has wild Caucasian pear (*Pyrus caucasica*) representing as relict and endemic species of the Caucasus. It is determined by molecular analysis as the ancestor of 15 pear landraces of Georgia. We used *in situ* and *ex situ* methods for conservation of *P. caucasica*, as crop wild progenitor and relative for pear varieties breeder. Wild Caucasian pear was determined as a crop wild relative species according to the results of the field works carried out in Georgia and this species received high conservation value. According to scoring system to establish scores of crop wild relative pear species revealed the following data: The threats of *P. caucasica* have been determined only as near threatened with score 2; The rarity of this species was calculated as frequency of 10×10 km and the number of individuals reaches till 20 with score 4; Endemism of this species is not only in Georgia but on the Caucasus ecoregion and score is 5; Gene pool and taxon group identification was related with score 10 according to molecular study of pear species. The analyses have revealed the tendency of *P. caucasica* to be have high score (21) and in the last criteria of this species has showing closely relatedness to famous 15 traditionally Georgian pear landraces.

Key words: CWRs, domestication, georgia, pear, *Pyrus caucasica*

INTRODUCTION

Georgia is located in the South Caucasus and officially covers a territory of 69,700 square kilometers and its population is almost 4.6 million. The name of the country is “Sakartvelo” in the Georgian language but it’s common name “Georgia” is semantically linked to Greek (γεωργία, transliterated geōrgía) and Latin (georgicus) roots meaning “Agriculture” (Javakhishvili, 1930). The primary domestication in the fourth centre of crop origin and diversity named as the Near East included the South Caucasus, Asia Minor, Iran and the Fertile Crescent (Vavilov, 1992). Many local varieties and endemic species of Georgia are known in this domesticated centre.

Otherwise, Colchis forest is refugium in the Western Georgia of Tertiary geologic period from 66-2.588 million years ago (Nakhutsrishvili, 2013). Locations of the relict tree species are modelling in forest vegetation by GIS program, which potentially existed in six regions of western Asia: Colchis forest of Georgia, western Anatolia, western Taurus, the upper reaches of the Tigris River, Levant and the southern Caspian basin (Tarkhnishvili *et al.*, 2012). Now a days, the real existence of relict species is in the Colchis forest and in the southern Caspian basin.

Wild Caucasian pear *Pyrus caucasica* Fed. (Rosaceae) is determined as relict tree and ancestor of fruit pear landraces of Georgia (Akhalkatsi *et al.*, 2012). Domestication of *P. caucasica* was confirmed by morphometric and systematic molecular methods by

genetic relationships between wild populations and local cultivars of pear containing only few mutations (Asanidze *et al.*, 2014).

Therefore, in total, eleven species of wild pear occur in Georgia, but *P. caucasica* is endemic species of the Caucasus and most widespread among the wild pears of Georgia and it is considered as main progenitor species of local pear cultivars (Khomizurashvili, 1973). Further, *P. caucasica* and *P. pyraster* (L.) Burgsd. are regarded as the main wild progenitors, from which the cultivated European pear (*P. communis* L.) has probably evolved (Volk *et al.*, 2006). The local Georgian names of the cultivated pear Mskhali and wild Caucasian pear *Panta* exists in all Georgian dialects; they do not have analogues in any other languages (Javakhishvili, 1930).

In this work, it was necessary to determine *P. caucasica* species threats and conservation levels in local populations of Georgia for determination of responsibility to the nature protection of this Crop Wild Relative (CWR). Thus, scoring system indexes was determined threats of wild pear species and it will be necessary to evaluate CWR priority for conservation.

METHODOLOGY

Pyrus caucasica involves the comparison of ‘total’ natural CWR pear diversity as already actively conserved either *in situ* or *ex situ*. This is the basis for gap analysis, which can be divided into four consecutive steps (Maxted *et al.*, 2008):

- **Step 1: Circumscription of target taxon and target area:** First, the taxonomic (e.g. genus, section or species) and geographical (e.g. global, regional, country or province) breadth of the analysis must be established
- **Step 2: Assessment of natural diversity:** The level of diversity occurring within the target taxon must be defined at the taxonomic, genetic or ecogeographical levels, i.e. how many taxa occur in the circumscribed taxon, but also the inherent genetic diversity within those taxa
- **Step 3: Assessment of current conservation strategies:** The diversity occurring *in situ* can be compared to the diversity currently conserved in order to assess the efficiency of both *in situ* and *ex situ* conservation techniques
- **Step 4: Reformulation of conservation strategy:** Assessment of the effectiveness of current conservation coverage in relation to natural *in situ* diversity identifies the element of diversity that is under conserved, i.e. the 'gaps' in the existing conservation strategy and helps refocus the strategy to conserve the maximum diversity and fill these gaps. The revised priorities are likely to require complementary *in situ* and *ex situ* conservation actions to ensure the comprehensive conservation of the target taxon's gene pool

According to this concept three Gene Pools are distinguished as follows: Primary Gene Pool (GP-1) within which GP-1A are the cultivated forms and GP-1B are the wild or weedy forms of the crop; Secondary Gene Pool (GP-2), which includes less closely related species from which gene transfer to the crop is possible but difficult using conventional breeding techniques; Tertiary Gene Pool (GP-3), which includes the species from which gene transfer to the crop is impossible, or if possible requires sophisticated techniques, such as embryo rescue, somatic fusion or genetic engineering.

The taxon group concept is used to establish the degree of CWR relatedness of a taxon. Application of the taxon group concept assumes that taxonomic distance is positively related to genetic distance. The CWR rank of taxon groups is defined as follows: Taxon Group 1a- crop; Taxon Group 1b-same species as crop; Taxon Group 2-same series or section as crop; Taxon Group 3-same subgenus as crop; Taxon Group 4-same genus; Taxon Group 5-same tribe but different genus to crop.

Thus, combined use of the gene pool and taxon group concept proposed above provide the best pragmatic means available to determine whether a species is a CWR and how closely related a CWR is to its crop.

Table 1: Scoring system for CWRs priority

Legends and status	Score
Threat (IUCN)	
Critically endangered	10
Endangered	7
Vulnerable	4
Near threatened	2
Least concern	0
Rarity	
Present in one 10×10 km	10
Present in 2-5 10×10 km	7
Present in 6-20 10×10 km	4
Present in 21-50 10×10 km	2
Present in >50 10×10 km	0
Endemicity	
Only in georgia	10
Only in the caucasus	5
Only in South-east europe	2
Throughout europe	0
GP/TG	
Gene pool 1b/Taxon group 1b	10
Gene pool 2/Taxon group 2	6
Taxon group 3	4
Taxon group 4	2
Gene pool 3/Taxon group 5	0

This scoring system (Table 1) was studied in this work and this method was applied to wild Caucasian pear species distributed on the territory of Georgia and the evaluation was used for field survey. The criteria to be scored are threat level determined according to IUCN categories; Rarity of species calculated as frequency of 10×10 km grid squares where the species occurs; Endemicity was determined according to Key of Georgian Flora (Ketskhoveli, 1959), the herbarium data and preliminary investigation on fields. Gene pool and taxon group identification was related to molecular study of pear species (Asanidze *et al.*, 2014).

RESULTS AND DISCUSSION

Pyrus caucasica grows in the Caucasus. It is relict and endemic species to the Caucasus. This species is a tree, 20-25 (30) m tall, with a broadly pyramidal or oval crown having numerous prickles when young. The bark on the stem and older branches has deep longitudinal cracks; sometimes the bark peels in large strips or flakes. Young offshoots are greenish or dark brown with a few small, light lenticels. Leaves are 3-5 cm long and 2.5-4.5 cm wide, orbicularovate, ovate or oval, with a short sharp tip and a broadly cuneate, rounded or slightly cordate base. The leaves on young plants are sharply serrated on all edges and non-pubescent; those on adult plants are smooth-edged and pubescent only near the edges. Flowers are 2.5-3.5 cm in diameter, assembled in inflorescence of 5-8 flowers. Petals are white or pinkish. Fruits are 1.5-3 cm in diameter, for the most part round or

sometimes pyriform, yellow or green-yellow, non-rusty, with residual sepals. Pulp is white or greenish-white, sour-sweet, astringent and bitter, with a large number of seeds, darkening at maturity, edible after seasoning. This species is entomophilous. It is zoochore. Blossoms in April-May; fruits ripen in late July-September. Chromosome number: $2n = 34$.

This species is a mesophyte. It occurs everywhere in the woodlands of the Caucasus, in mountainous and flat areas with sufficient moisture, often along river valleys. Caucasian pear grows up to elevations of 1,500-1,600 (1,900) m above sea level. The plant prefers light (sandy), medium (loamy) and heavy (clay) soils, requires well-drained soil and can grow in heavy clay soil. It can grow in semi-shade (light woodland) or no shade. Dislikes very exposed positions. Established plants are drought tolerant. A very hardy plant tolerates to temperatures down to below -15°C . Plants often sucker and can form dense thickets. There are many varieties of cultivated pears and they are widely cultivated in the temperate zone for their edible fruits. By selection of varieties fresh fruits can be obtained from late July-April or May of the following year. Seed - best sown in a cold frame as soon as it is ripe in the autumn, it will then usually germinate in mid to late winter. Stored seed requires 8-10 weeks cold stratification at 1°C and should be sown as early in the year as possible. Temperatures over $15-20^{\circ}\text{C}$ induce a secondary dormancy in the seed. Prick out the seedlings into individual pots when they are large enough to handle and grow them on in light shade in a cold frame or greenhouse for their first year. Plant them out in late spring or early summer of the following year.

The applied scoring system to CWR of *P. caucasica* individuals was selected according to the criteria, such as threat level, rarity, endemism and GP/TG and concepts determined as high score (21) for this species (Table 2).

The highest score 10 on GP/TG legend confirms very closely relation of wild Caucasian pear with Georgian landraces by morphometric and molecular analysis using SSR markers. The domesticated group from *P. caucasica* is determined for 15 Georgian landraces: *Akiro*, *Bebani*, *Borbala*, *Kartuli mskhali*, *Khinos mskhali*, *Korda*, *Kvichicha*, *Majara*, *Nenes mskhali*, *Panta mskhali*, *Samariobo*, *Shakara*, *Shav mskhala*, *Tavrejuli*, *Tsvrili mskhali* (Akhalkatsi *et al.*, 2012; Asanidze *et al.*, 2014).

Wild Caucasian pear is used as a food (fruit) and for preparing of alcohol schnapps *Araki*. It is a progenitor of many Georgian pear landraces. Threat assessment of this species is related to wood cutting and habitat disturbances, which might threaten this species. *P. caucasica* should be declared as species of high economic value as wild relative of edible plants. *Ex situ* conservation of this species will be effective to collect

Table 2: Scoring system of *P. caucasica*

Legends and status	Score
Threat (IUCN)	
Near threatened	2
Rarity	
Present in 6-20 10×10 km	4
Endemism	
Only in the caucasus	5
GP1+2	
Gene pool 1b/Taxon group 1b	10
Sum	21

seeds and keep in seed banks. The local population and governmental bodies responsible for the nature protection should be informed about high conservation value of this species. Monitoring of the number of individuals in populations should be undertaken.

Thus, the results of this study have shown that some Georgian pear landraces are direct domesticated from the native wild pear species *P. caucasica*. The other local cultivars might be obtained due to selective works by breeding of local landraces with introduced cultivars from different countries in historically different periods. The molecular study of these taxa has clear in more details origin of these cultivars (Asanidze *et al.*, 2014). The results confirm the hypothesis that some local pear cultivars of Georgia are directly domesticated from the endemic and relict wild Caucasian pear species *P. caucasica*.

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