

MONOGRAPH

Variability of European Black Poplar (*Populus nigra* L.) in the Danube Basin

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Due to habitat loss in last few decades the Black Poplar (*Populus nigra*) become an endangered tree species. It serves as indicator species for sustainable floodplain forest management.

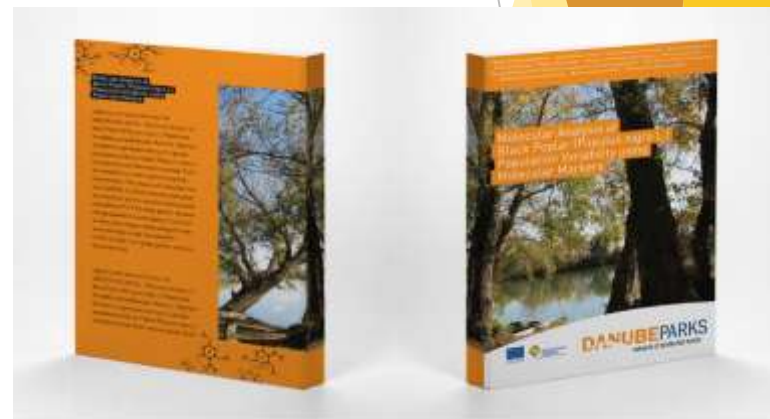
DANUBE PARKS STEP 2.0 project ("Anchoring the Danube River Network of Protected Areas as Platform for Preservation of Danube Natural Heritage"), aims to promote Black Poplar as flagship species. Implementation of conservation activities, within the project, for this species will contribute to improve forest habitat management practice but at the same time stressing the role of Danube Protected Areas for its preservation.

Public Enterprise "Vojvodinašume" within the mentioned project took very ambitious tasks to lead the activity entitled as "Black Poplar conservation". Having the most experience in this tree species PE "Vojvodinašume" additionally played an important role in bringing together protected areas with forestry agencies along the Danube. PE "Vojvodinašume" become an important bridge builder between various sectors and a key for the implementation of the "DANUBE PARKS Guidelines for Ecological Forestry in Danube Riparian Woodland" adopted as draft version in first DANUBE PARKS project.

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DANUBE PARKS

network of protected areas



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1. General considerations of the European black poplar biology, significance and conservation prospects

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2. Variability of leaf morphometric characters in *Populus nigra* populations in the Danube Basin

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3. Genetic variability of *Populus nigra* L. in the Danube Basin

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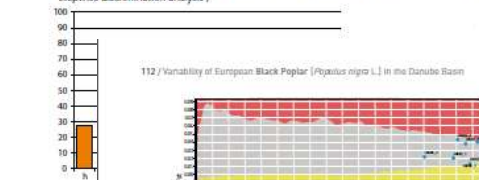
2000; Papadimitriou and Saroglou, 2006; Warden-Brock et al., 2006; Savits et al., 2006; Balmacher et al. (2011) reported that both reproductively effective pollen and seed were predominantly dispersed over short distances. Fertilization occurs within 20 km after a viable pollen grain has landed on a receptive stigma (Savits et al., 1996). Mature

river, due to a chain of hydropower plants in Germany and Austria along the river and its tributaries (Figure 1.13). These dams stop the transport of sediments, induce river bed incision and thus unaturally lower the water level, resulting in serious problems, not only in nature conservation, but also in water management, flood protection, infrastructure

The Danube floodplain forests belong to the endangered habitats on the European level and are therefore listed in the Flora Fauna Habitat Directive (FFH Directive, 1992). Two habitat types are particularly relevant:

derived characters should be used in the future because they might be important in discrimination of other distant populations that evolved in different conditions.

Graph 2.2. Percentage of allocation according to the model calculated by the forward stepwise discrimination analysis)



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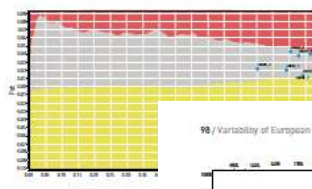


Figure 3.6. Graphical view of the test for sets 3: PMS16, locus 4: WPM516, locus 5: WPM52

3.3.6. Genetic distances between

Based on the genetic distances between presentation (dendrogram) of their relationship between populations were computed (2012), UPGMA (Unweighted Pair Group Joining) plots were made in NTSYSp5.0

Mean genetic distances between pop Danube Basin observed in the plots of were substantially low (Figure 3.7, and 3

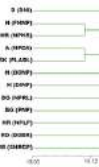


Figure 3.7. UPGMA dendrogram presenting

2.4. Relationship between the populations of *Populus nigra*

According to the results of the principal component analysis, the first four principal components described more than 90% of the total variance (Table 2.12). The first three principal components explained 81.5% of the total variance) were used to present relations among the examined populations (Graph 2.4). It seems that populations Dunajské lúky, Fertő-Hanság, Duna Ipoly and Neuburg-Ingolstadt are considerably apart from the others.

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Table 3.3. Number of alleles per population and locus

locus	WPM5	WPM6	WPM7	WPM8	WPM9	WPM10	PMS16	WPM15	WPM16	Mean	S.D.
D (DN)	15	14	9	11	10	6	6	6	6	9.88	3.76
A (NPDA)	14	14	7	10	6	6	6	5	5	8.50	3.70
SK (PLADU)	14	11	11	11	9	6	6	6	10	9.75	2.71
H (FNHP)	12	13	11	11	7	7	7	9	9	9.63	2.45
H (DNIP)	14	12	12	11	9	7	6	9	10	10.00	2.73
H (DNIP)	12	10	11	9	7	8	6	7	8	8.75	2.12
SRB (DNKR)	11	9	8	11	7	8	8	15	15	9.00	1.51
HR (NPVR)	11	11	8	10	6	8	8	10	10	9.00	1.77
HR (NPFL)	10	8	8	9	5	6	5	7	7	7.25	1.83
BG (PNP)	12	10	12	10	8	7	6	6	6	8.88	2.48
BG (NPFL)	12	10	14	15	8	9	7	10	10	10.63	2.83
RD (DDBR)	11	13	11	13	6	9	6	8	8	9.63	2.83
Mean	12.33	11.28	10.17	11.08	9.20	7.25	6.42	8.38	9.24	2.55	
Total	24	19	22	23	12	11	9	14	14	1.68	5.95

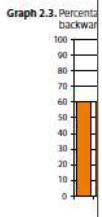
Table 3.4. Number of alleles (allelic richness) per population and locus based on minimal sample size

locus	WPM5	WPM6	WPM7	WPM8	WPM9	WPM10	PMS16	WPM15	WPM16	Mean	S.D.
D (DN)	13.74	13.11	8.40	12.24	6.52	5.96	5.96	5.96	5.96	9.36	3.32
A (NPDA)	13.37	13.11	6.71	9.82	5.95	5.83	5.83	5.00	5.00	8.30	3.43
SK (PLADU)	12.77	10.36	10.71	10.28	8.32	5.80	6.00	9.55	9.22	2.40	
H (FNHP)	11.20	11.32	10.13	9.88	6.38	6.76	6.40	8.38	8.82	2.09	
H (DNIP)	13.46	11.40	13.27	10.53	8.32	6.65	5.90	8.60	9.54	2.56	
H (DNIP)	11.76	9.91	10.68	8.94	6.77	6.00	6.00	7.00	8.62	2.04	
SRB (DNKR)	10.75	8.99	7.77	10.76	6.52	6.00	7.57	9.84	8.61	1.51	
HR (NPVR)	10.45	10.33	7.75	9.39	5.80	7.80	7.60	8.55	8.58	1.61	
HR (NPFL)	9.86	7.78	7.86	8.84	4.97	5.92	4.90	6.71	7.13	1.80	
BG (PNP)	11.32	9.55	11.75	9.77	7.20	6.96	5.76	6.76	8.51	2.40	
BG (NPFL)	10.80	9.36	12.52	13.35	7.54	8.75	6.78	9.84	9.84	2.29	
RD (DDBR)	10.68	12.25	10.45	12.13	5.76	6.48	5.96	7.56	9.15	2.60	
Mean	11.96	11.45	11.85	11.31	7.46	7.21	6.40	8.62	9.21	2.44	
Total	13.74	13.11	8.40	12.24	6.52	5.96	5.96	5.96	9.36	3.32	

Figure 1.4. Populus nigra and allocation of river main woodlands (1991). Beach have changed woodlands (1991) river populus changing (2000) (L. J. Papadimitriou et al., 2006)



Figure 1.13. Wetlands The Danube floodplain conservation interests and the range of sustainable and ecot for the preservation



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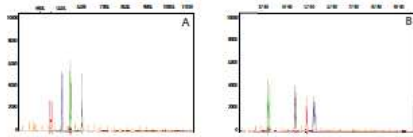


Figure 3.2. Amplified fluorescent dye-labeled products of 8 microsatellite loci analyzed by 3130 Genetic Analyzer (Applied Biosystems®). Pairs of peaks labeled with the same fluorescent dye represent heterozygous loci, while homozygous loci are visible as single peaks. A) amplified loci: WPM512 (red), PMS16 (blue), WPM509 (green) and WPM503 (black) representing yellow fluorescence; B) amplified loci: WPM516 (green), WPM518 (black) representing yellow fluorescence, WPM500 (red) and WPM505 (blue).

3.3.1. Pattern and amount of genetic variation

To assess the level of genetic diversity of the European black poplar in the Danube Basin, following parameters were determined per locus and population: the number of alleles, allelic richness based on a minimal sample size, allelic size range, observed (H_o) and expected (H_e) heterozygosity (Nei, 1973).

Our results show a very low level of clonality, since only in two populations two individuals shared the same genotype which support findings of Smulders et al. (2008), who found a low level of duplicated genotypes along dynamic rivers.

The number of alleles per locus and population, and the corresponding values for allelic richness based on a minimal sample size are presented in Table 3.3, and Table 3.4. The allelic size range per locus and population is presented in Table 3.5. The number of alleles ranged from 9 - 24 depending on loci with the mean value of 9.24 ± 2.55. All populations had a similar mean number of alleles detected (Table 3.3, and 3.4). The results presenting the number of alleles based on a minimal sample size (allelic richness) were consistent with the general number of alleles, and the mean value was 9.71 ± 2.44. The highest mean allelic richness was observed in population BG (NPFL), which indicates that this population shows the highest genetic diversity, while the lowest was recorded in population A (NPDA).

Thank you for attention!