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# Biodiversity of Sea Buckthorn (*Hippophae rhamnoides* L.) in the Karakorum Mountains of Northern Pakistan

Muhammad Arslan Nawaz[1], Martin Wiehle[2], Konstantin V. Krutovsky[3], Asif Ali Khan[4], Andreas Buerkert[1]

[1] *University of Kassel, Organic Plant Production and Agroecosystems Research in the Tropics and Subtropics, Germany*

[2] *University of Kassel, Tropenzentrum / ICDD, Germany*

[3] *Georg-August-Universität Göttingen, Forest Genetics and Forest Tree Breeding, Germany*

[4] *Muhammad Nawaz Shareef University of Agriculture, Plant Breeding and Genetics, Pakistan*

## Abstract

Sea buckthorn (*Hippophae rhamnoides* L.) is a dioecious, wind-pollinated deciduous shrub species in Eurasia, including the Karakorum Mountains region of Pakistan (Gilgit-Baltistan). Contrary to other countries such as China and Germany, where it is considered as medicinal (especially fruits) and traded on national and international scales, in Pakistan this species is heavily underutilised. Moreover, a striking diversity of coloured berries in Pakistan from red to yellow raises the question: which varieties might be more suitable for different national and international markets. Therefore, both morphological and genetic diversity of sea buckthorn were studied to characterise and evaluate the present variability, including hypothetically ongoing process of domestication. Three hundred sea buckthorn individuals were sampled from eight different sites and distinguished each into wild and supposedly domesticated (within villages) stands. Dendrometric (height, stem diameter, canopy area), fruit (20-berry weight, volume, length: width ratio and moisture %) and leaf (area and length: width ratio) morphometric traits and leaf samples were taken for each individual. Twelve EST-SSR markers were used for genotyping. Significant differences in morphological variables were found across sites and between wild and village stands. A significant correlation ($r = 0.493$, $p < 0.001$) was found between leaf area and altitude. Twenty-two colour shades of berries and, 20 and 15 dorsal ventral colour shades of leaves, respectively, were observed using a Royal Horticultural Society (RHS) colour charts. Mean number of private alleles was 0.6 and mean genetic diversity of sea buckthorn within populations measured as an expected heterozygosity was high ($He = 0.699$). Overall, the populations were in a Hardy-Weinberg equilibrium suggesting random mating within populations with a moderate level of differentiation ($FST = 0.016$). However, three distinct genetic clusters were observed that apparently corresponded to the geographic locations of the populations. Interestingly, the two sites that had the lowest values of fruit and leaf morphometric parameters formed a genetically distinct cluster. Physical barrier appeared to be the cause of reduced gene flow. Considering high allelic richness and genetic diversity, the Gilgit-Baltistan region seems to be a promising source for improved germplasm of sea buckthorn.

**Keywords:** Domestication, EST-SSR markers, gene flow, Gilgit-Baltistan, morphological and genetic diversity

**Contact Address:** Martin Wiehle, University of Kassel, Tropenzentrum / ICDD, Steinstraße 19, Witzenhausen, Germany, e-mail: wiehle@uni-kassel.de