Heredity
https://doi.org/10.1038/s41437-018-0084-z

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# Occurrence of subdioecy and scarcity of gender-specific markers reveal an ongoing transition to dioecy in Himalayan seabuckthorn (*Hippophae rhamnoides* ssp. *turkestanica*)

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Received: 29 December 2017 / Revised: 7 April 2018 / Accepted: 8 April 2018


## Abstract

Dioecy and the dynamics of its evolution are intensely investigated aspects of plant reproduction. Seabuckthorn (*Hippophae rhamnoides* ssp. *turkestanica*) is an alpine shrub growing wild in certain parts of western Himalaya. The previous studies have reported heteromorphic sex chromosomes in the species and yet marker-based studies indicate high similarity between the male and female genomes. Lack of information on sexual system in the species has further complicated the situation. A systematic study was thus undertaken to understand the sexual system in seabuckthorn and to discern the extent of similarity/dissimilarity between the male and female genomes by generating a large number of markers using amplified fragment length polymorphism and representational difference analysis. Floral biology and regular monitoring of species revealed the presence of polygamomonoecious (PGM) plants in most populations at a low percentage (~2–4%). PGM plants showed low pollen production and overall low fertility, suggesting a monoecy–paradioecy pathway at function. The results of the marker study demonstrated that there are limited differences between male and female genomes and these differences were not uniform across the populations in the Leh-Ladakh region, especially when the geographical distance increases. Results also suggest that a dynamic partitioning of genomes is operational between the two genders of seabuckthorn and differences are not homogenized across the populations. Both reproductive biology-based and DNA marker-based studies indicate that genders have separated recently. The present study proposes seabuckthorn as a promising model system to study evolution of dioecy and sex determination.

## Introduction

Dioecy is widespread among the flowering plants. It is believed to have evolved independently from cosexuality on several occasions (Renner 2014). The evolutionary routes toward dioecy may include transitory stages, represented by some plants which bear bisexual flowers either along with staminate (andromonoecious), pistillate (gynomonoecious), or both the types (polygamomonoecious (PGM)), and exist along with fully evolved unisexual plants. Plant populations with such a gender configuration are termed subdioecious (Geber et al. 1999). Subdioecy is often maintained in a population until complete dioecy is established (Ross 1982; Barrett 2002), with a possibility of reversion to cosexuality (Charlesworth and Charlesworth 1979). Breakdown of established dioecy may also result in subdioecious condition (Ehlers and Bataillon 2007). Species harboring subdioecious condition can help in understanding the prevailing mechanism of gender determination and provide

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**Electronic supplementary material** The online version of this article (https://doi.org/10.1038/s41437-018-0084-z) contains supplementary material, which is available to authorized users.

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Published online: 04 May 2018