



Spatiotemporal evolution of *Reaumuria* (Tamaricaceae) in Central Asia: insights from molecular biogeography

MINGLI ZHANG^{1,2,*}, XIAOLI HAO^{3,1,§}, STEWART C. SANDERSON⁴, BYALT V. VYACHESLAV⁵, ALEXANDER P. SUKHORUKOV⁶ & XIA ZHANG³

¹Key Laboratory of Biogeography and Bioresource in Arid Land, Xinjiang Institute of Ecology and Geography, Chinese Academy of Sciences, Urumqi 830011, China;

²Institute of Botany, Chinese Academy of Sciences, Beijing 100093, China;

³School of Life Science, Shihezi University, Shihezi 832003, China;

⁴Shrub Sciences Laboratory, Intermountain Research Station, Forest Service, U.S. Department of Agriculture, Utah 84601, USA;

⁵Komarov Botanical Institute, Russian Academy of Sciences, St. Petersburg, RU-197376, Russia;

⁶Department of Higher Plants, Biological Faculty, Moscow Lomonosov State University, 119234, Moscow, Russia.

*author for correspondence. E-mail: zhangml@ibcas.ac.cn

§contribution equal to first author.

Abstract

Reaumuria is an arid adapted genus with a distribution center in Central Asia; its evolution and dispersal is investigated in this paper. Eighteen species of *Reaumuria* and nine species of two other genera in the Tamaricaceae, *Tamarix* and *Myricaria*, were sampled, and four markers ITS, *rps16*, *psbB-psbH*, and *trnL-trnF* were sequenced. The reconstructed phylogenetic tree is fundamentally consistent with previous morphological classification, except that *R. soongorica*, sometimes considered to be a separate genus or subgenus, is completely nested within *Reaumuria*. The ancestral area of the genus is suggested to be western Central Asia, and distributions in the Iran-Mediterranean area and the Tianshan and Pamir-Alai mountains are inferred as dispersals. Westward dispersals to the Iran-Mediterranean were ancient Oligocene to Miocene, whereas dispersals eastward were recent. The spatiotemporal evolution of *Reaumuria* is used as a link to abiotic paleoclimatic and geological events, in particular, increased aridity beginning at the Eocene-Oligocene Transition (EOT), and as a result of uplift of the Himalayas and Qinghai-Tibet Plateau (QTP). The diversification of the two sections (22.51–19.78 Ma) suggests a response to increasing aridification in response to QTP uplift and expansion.

Key words: *Reaumuria*, Central Asia, molecular clock, evolution, EOT, QTP

Introduction

Central Asia occupies a vast area of the Eurasian continent, from across the Caspian Sea to the Daxinan Mountains in northeastern China, and northward to Siberia and the Altai mountains and southward to the Kunlun and Hindukush mountains and the Iranian Plateau. In brief it includes in the western part, five countries of Middle Asia, and in the east, an arid area consisting of northwestern China and southern Mongolia, see Fig. 1. According to the floristic divisions of Grubov (1999), the Central Asian flora can be divided into three parts, Mongolian, Junggar–Turanian, and Tibetan, although most of the area of Tibet is considered to belong to East Asia (Wu and Wu, 1996). The vegetation of Central Asia is fundamentally grassland and desert; however, it also includes montane forests of the Tianshan and Pamir-Alai ranges. Central Asia is characterized by an arid climate with low annual precipitation, and is arid-hot in summer and cold in winter (Grubov, 1999). The ancestor of the sister arid-adapted families Tamaricaceae and Frankeniaceae may have been an inhabitant of the northern latitudinal arid zone that existed in southern Asia before QTP uplift (Guo et al., 2008), and adapted to saline environments associated with borders of the Paratethys Sea. The subsequent spatiotemporal evolution of organisms in this region is related in large part to the process of increasing aridification and continentality, controlled by factors such as westward

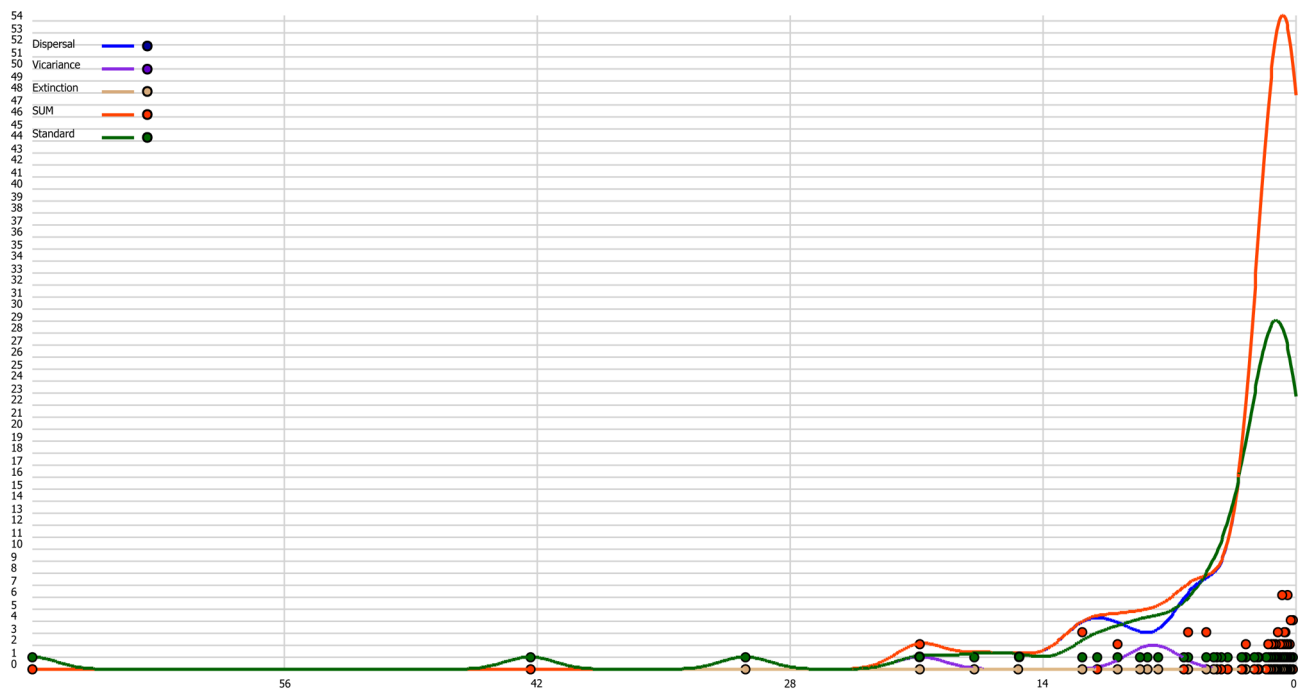


FIGURE 4. For S-DIVA results, the calculations of its biogeographical events including dispersal, vicariance and extinction, produced in RASP, are shown.

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Appendix An outlook of the classification system for *Reaumuria*.

Section 1. *Odontoglossa* Niedenzu

Leaves flat, obsolete petiolate; bracts sparse.

Series 1. *Reflexae* Gorschk.

- (1) *R. babataghi* Botsch.
- (2) *R. turkestanica* Gorschk.
- (3) *R. reflexa* Lipsky
- (4) *R. botschantzevii* Zuckerw. & Kurbanov
- (5) *R. korovinii* Botsch. & Lincz.
- (6) *R. sogdiana* Kom.

Series 2. *Cistoideae* Gorschk.

- (7) *R. alternifolia* (Labill.) Britt.
- (8) *R. cistoides* Adam.
- (9) *R. hypericoides* Willd.

Series 3. *Vermiculatae* Gorschk.

- (10) *R. vermiculata* Linn.
- (11) *R. mucronata* Jaub. & Spach
- (12) *R. hirtella* Jaub. & Spach

Section 2. *Blepharoglossa* Niedenzu

Leaves terete or subterete, fleshy, sessile in axils; bracts mostly dense, appressed to calyx.

Series 4. *Kaschgaricae* (Gorschk.) M.L. Zhang

Leaves short, subterete, thick, bracts sparse, short.

- (13) *R. kaschgarica* Rupr.
- (14) *R. soongarica* (Pall.) Maxim.
- (15) *R. fruticosa* Bge.

Series 5. *Persicae* (Gorschk.) M.L. Zhang

Bracts numerous, imbricate, or forming involucre.

- (16) *R. persica* Boiss.
- (17) *R. oxiana* (Ldb.) Boiss.
- (18) *R. badhysi* E. Kor.