



# Genetic Variation in *Goniolimon speciosum* (Plumbaginaceae) reveals a complex history of steppe vegetation



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# Steppe

- ▢ Ecoregion characterized by grassland plains without trees
- ▢ Semi arid and continental climate with temperature extremes
- ▢ May be semi-desert or covered with grass and shrubs (season & latitude)
- ▢ Also called veld (S.Africa) or prairie (N. America)



# Eurasian Steppe

- ▣ Largest temperate grassland in the world
- ▣ Extends 8,000 km from Hungary through Ukraine and Central Asia
- ▣ Interrupted by mountain ranges, affected species distribution
- ▣ Herbaceous vegetation that tolerate little rain
- ▣ Began to form in early Miocene



# Why *Goniolimon speciosum*?

- ▮ *Goniolimon speciosum*  
(Plumbaginaceae)
  - ▮ Typical steppe plant
  - ▮ Distributed throughout entire Eurasian steppe
  - ▮ Mountain steppe species:
    - ▮ NE Eurasia in Miocene ☾ Pliocene



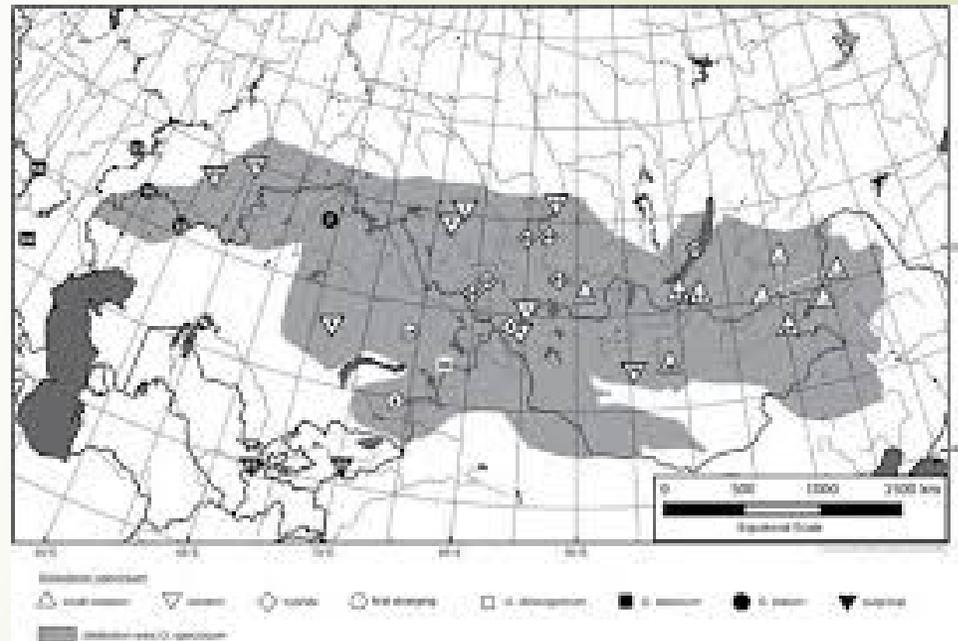


# Overview

- “...the spatial pattern of genetic variation in other ecological groups of steppe plant species differs from previously investigated mountain-steppe plants, as the former could be characterized by a different history”
- Origin of steppe species usually attributed to Central Asia... but may not be the whole story
- Used nuclear (ITS) and plastid (trnH-psbA and trnQ-rps16) to study genetic variation
  - Usually done by florogenetic methods
  - Relying on geographical events for molecular clocks leads to errors

# Methods

- Genomic DNA from 37 herbarium species of *G. speciosum*
  - Also included 2 close relatives from Central Asian mtn. ranges as outgroup
- ITS data used for divergence time estimates
  - 11 taxa used
- Distribution map created using current and previous observations





# Results

- ▮ Phylogenetic tree using ITS and plastid sequences showed incongruence
- ▮ ITS Data:
  - ▮ s.l. clade: *G. dshungaricum* diverged first
  - ▮ s.s. clade: 2 samples from eastern Kazakhstan region diverged first
  - ▮ Remaining samples represent 2 genetic groups (SE species area)
- ▮ Plastid Data:
  - ▮ 2 genetic groups formed after branching from *G. tataricum*
  - ▮ 3 subclades in one group (E *G. elatum*, *G. dshungaricum*, SE *G. speciosum*)
    - ▮ SE spread farther than in ITS analysis
  - ▮ Other group contains rest of *G. speciosum* samples and most western *G. elatum* samples
- ▮ Main lineage of *G. speciosum* evolved in mid-Pliocene
  - ▮ Further branching in late Pliocene-Pleistocene



# Discussion

- ▢ Incongruence due to hybridization of lineages
  - ▢ Incomplete lineage sorting possible... lineages coalesce into ancestral species
  - ▢ Sympatry of *speciosum* and *elatum* explains hybridization
- ▢ ITS phylogeny
  - ▢ Monophyly of *Goniolimon* spp.
  - ▢ *G. dshungaricum* could be subspecies or separate ancestral species
  - ▢ Central Asian origin of *G. speciosum* supported (Pliocene)
  - ▢ 2 genetic groups clear: SE group, broadly distributed Western group
  - ▢ Split in groups occurred mid-Pliocene
  - ▢ Some samples formed intermediate group
    - ▢ Western ITS ribotype & SE plastid haplotype
  - ▢ Northward colonization of *G. speciosum* in early Pleistocene
- ▢ Steppe species with different ecological preferences have different history
- ▢ Need more analysis of Central Asian *G. speciosum* to solidify hypothesis