



The tricky lichen genus *Vulpicida*: phylogeny and species delimitation

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INTRODUCTION:

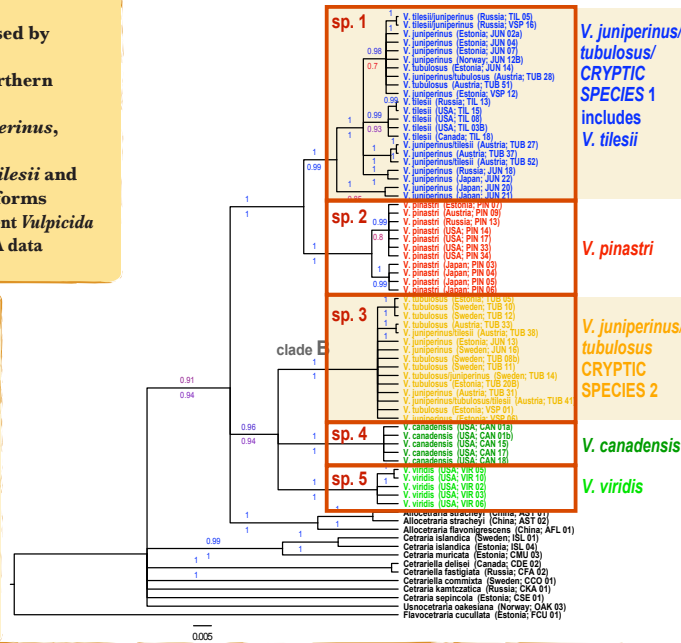
- The genus *Vulpicida* (Parmeliaceae, Ascomycota) belongs to the morphological group of “cetrarioid lichens”
- Characteristic bright yellow colour of medulla is caused by unique set of secondary metabolites
- Distributed in the temperate and arctic regions of northern hemisphere
- Consists of six species: *Vulpicida canadensis*, *V. juniperinus*, *V. pinastri*, *V. tubulosus*, *V. tilesii* and *V. viridis*
- Morphological distinction between *V. juniperinus*, *V. tilesii* and *V. tubulosus* is difficult due to frequent intermediate forms
- AIM OF THE STUDY — to assess the distinctiveness of current *Vulpicida* species & investigate the monophyly of the genus using DNA data

MATERIAL & METHODS:

- 71 specimens for molecular study; additional 35 *V. juniperinus* & *V. tubulosus* specimens for morphological study
- 5 loci: ITS, IGS, Mcm7, RPB1, mtSSU
- 353 new sequences
- Cloning of 12 specimens for checking paralogous copies in ITS
- Recombination detection in RDP v.3. and v.4. & GARD
- Species delimitation in Brownie & BPP
- Gene trees (one locus and concatenated) in BEAST & MrBayes
- Species trees in *BEAST, STEM & BEST

ITS gene tree

Branch support posterior probabilities (PP) from BEAST & MrBayes

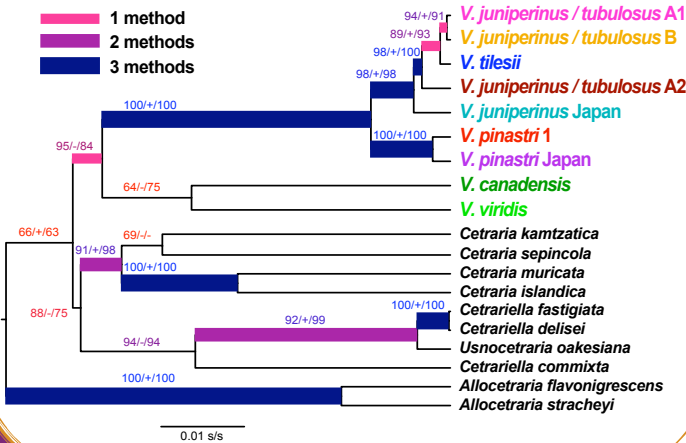


*BEAST species tree

Branch annotations: *BEAST, STEM, BEST

Supported by

- 1 method
- 2 methods
- 3 methods



RESULTS:

- Strong conflicts between individual gene trees
- On the ITS gene tree, two cryptic species can be detected, but these are not supported by morphology, other gene trees or species tree methods
- No paralogous copies of ITS or significant recombination events were found
- Sensitive BPP detected several evolutionarily independent lineages while Brownie was more conservative
- According to species tree and delimitation methods:
 - V. canadensis* and *V. viridis* are clearly distinct species
 - V. juniperinus*, *V. tilesii*, *V. tubulosus* and *V. pinastri* form a closely related group of taxa

DensiTree

Posterior density of species trees from *BEAST

- V. juniperinus / tubulosus A1*
- V. juniperinus / tubulosus B*
- V. tilesii*
- V. juniperinus A2*
- V. juniperinus Japan*
- V. pinastri 1*
- V. pinastri Japan*
- V. canadensis*
- V. viridis*

CONCLUSIONS:

- Tricky *Vulpicida* exemplifies how analysis methods can affect the conclusions
- Strong phylogenetic signal from ITS tends to dominate over other loci in the concatenated phylogenies
- Coalescent based species tree inference needs less markers to produce more consistent outcome
- Although the monophyly of the genus is not supported by all species tree methods, there is also no conclusive evidence against it
- We propose four instead of current six species in *Vulpicida*, reducing *V. tubulosus* and *V. tilesii* to synonymy under *V. juniperinus*



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Photos by Andres Saag