

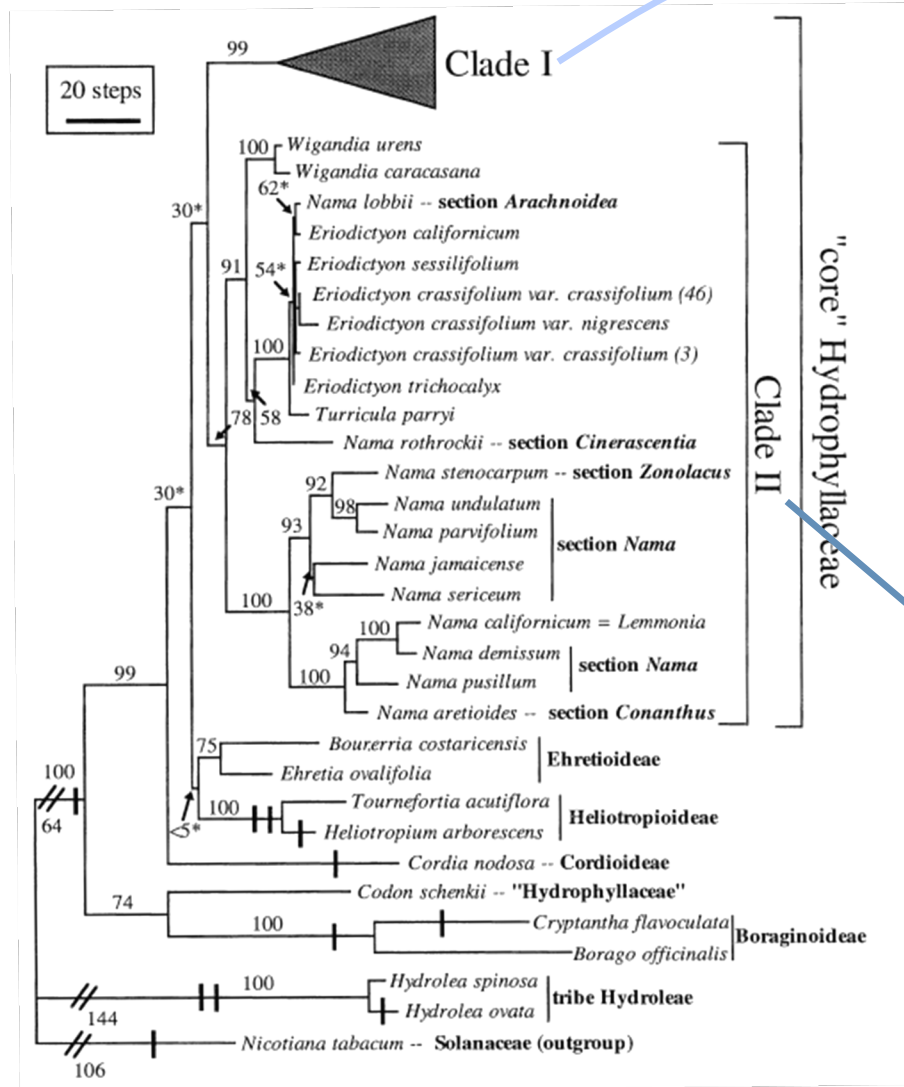
Looking for one thing and finding another: phylogenomic study of *Eriodictyon capitatum* (Namaceae) resolves the placement of the enigmatic *Nama rothrockii*.



Santa Barbara
Botanic Garden

C. Matt Guilliams & Kristen Hasenstab-Lehman
Department of Conservation and Research

Namaceae and Hydrophyllaceae s.s.



Pholistoma auritum var. *a.*



Phacelia nashiana

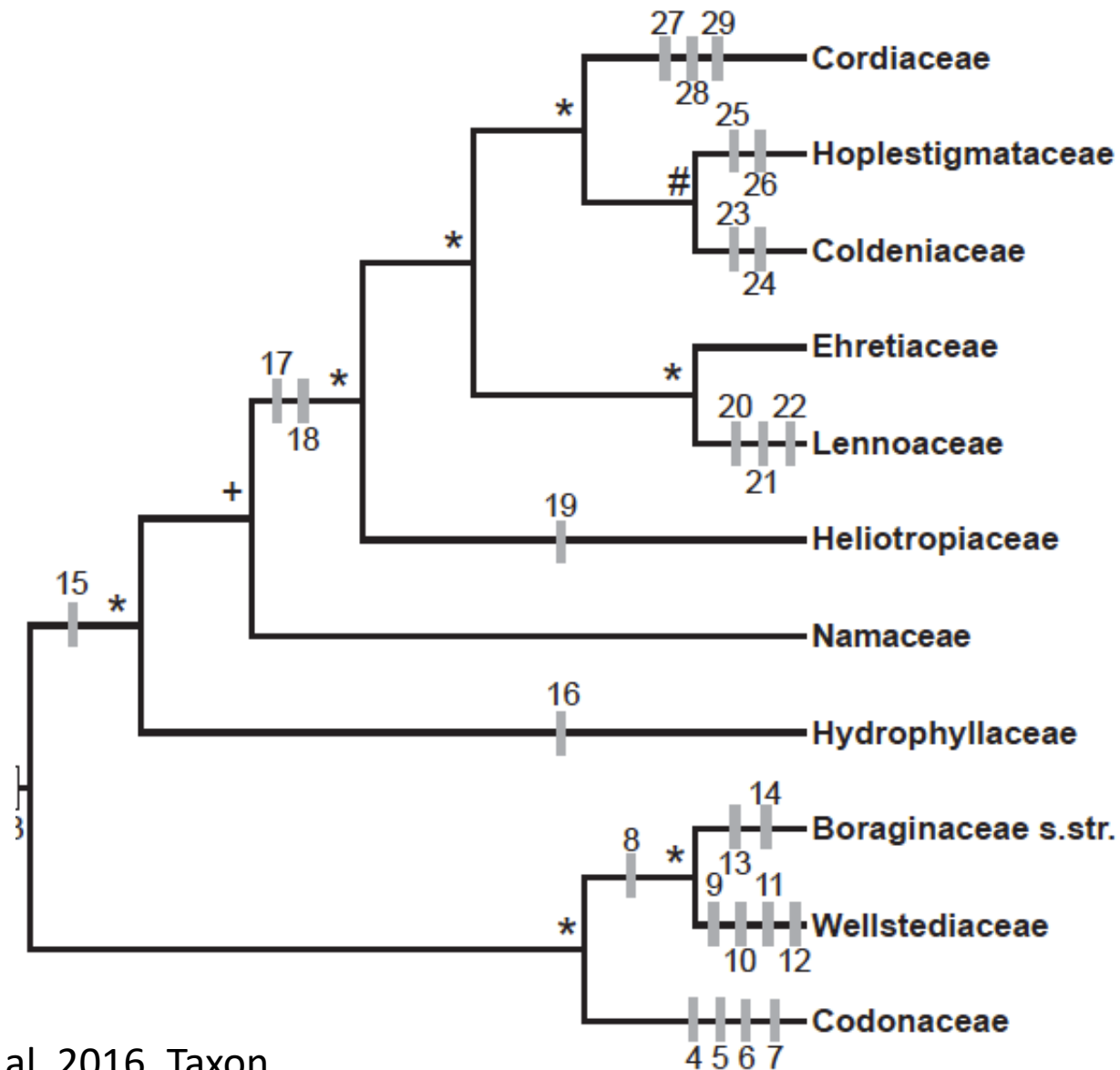


Nama demissum var. *d.*



Eriodictyon traskiae subsp. *smithii*

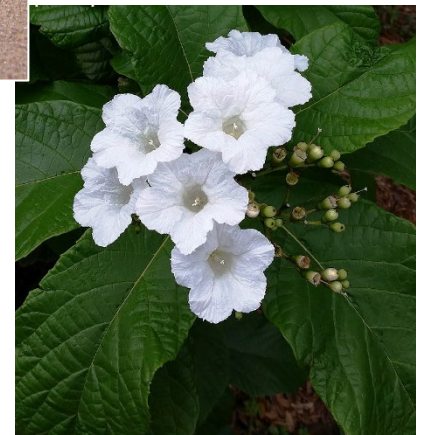
Current family level treatment of Boraginales



Amsinckia
Boraginaceae s.s.



Pholisma
Lennoaceae



Cordia
Cordiaceae

Namaceae vs. Hydrophyllaceae



Eriodictyon californicum
Photo by Cal. Academy Sci.



Nama demissa var. *d.*
Photo by Steve Matson

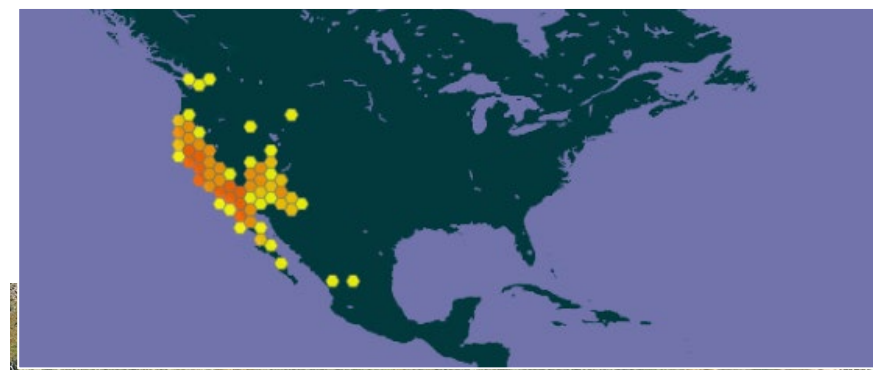


Phacelia linearis
Photo by Aaron Schusteff

Namaceae Molinari, *fam. nov.*

Similar to *Hydrophyllaceae*, but differing from it by having plants with styles branched to the base, instead of branched from the middle.

TYPE: *Nama* L., *nom. cons.* (1759).



Eriodictyon (11 species)



Wigandia (7 species)

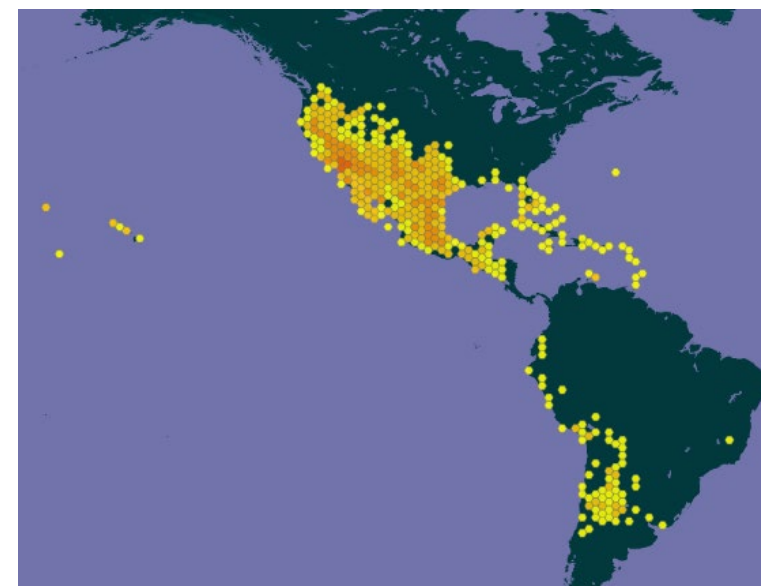


Photo by Steve Matson

Nama (55 species)



Jepson eFlora: Key page

Vascular Plants of California

[Key to families](#) | [Table of families and genera](#)

Key to Namaceae

[View taxon page for Namaceae](#)

Jepson Manual glossary definitions can be seen by moving your cursor over words underlined with dots.

1. Shrub, small tree
2. Leaf blade < 6 cm wide; stamens included ; stigmas not lobed; seeds 2–15 **ERIODICTYON**
- 2' Leaf blade (3)10–35 cm wide; stamens exerted ; stigmas 2-lobed; seeds >= 200 **WIGANDIA**
- 1' Annual, perennial herb, or subshrub
3. Annual **NAMA**
- 3' Perennial herb or subshrub
4. Plant 1–3 m **Eriodictyon parryi** [*Turricula parryi*]
- 4' Plant generally < 0.5 m
5. Leaves entire ; inflorescence not spheric, interrupted by leaf-like bracts **Eriodictyon lobbii** [*Nama lobbii*]
- 5' Leaves crenate-dentate; inflorescence spheric, not interrupted by leaf-like bracts **Nama rothrockii**

Woody plants

Annual herbs

Exceptions

The exceptional cases

harrowing
poodledog
bush rashes



Eriodictyon [Turricula] parryi
Subshrub



Eriodictyon [Nama] lobbii
Perennial herb



Nama rothrockii
Perennial herb

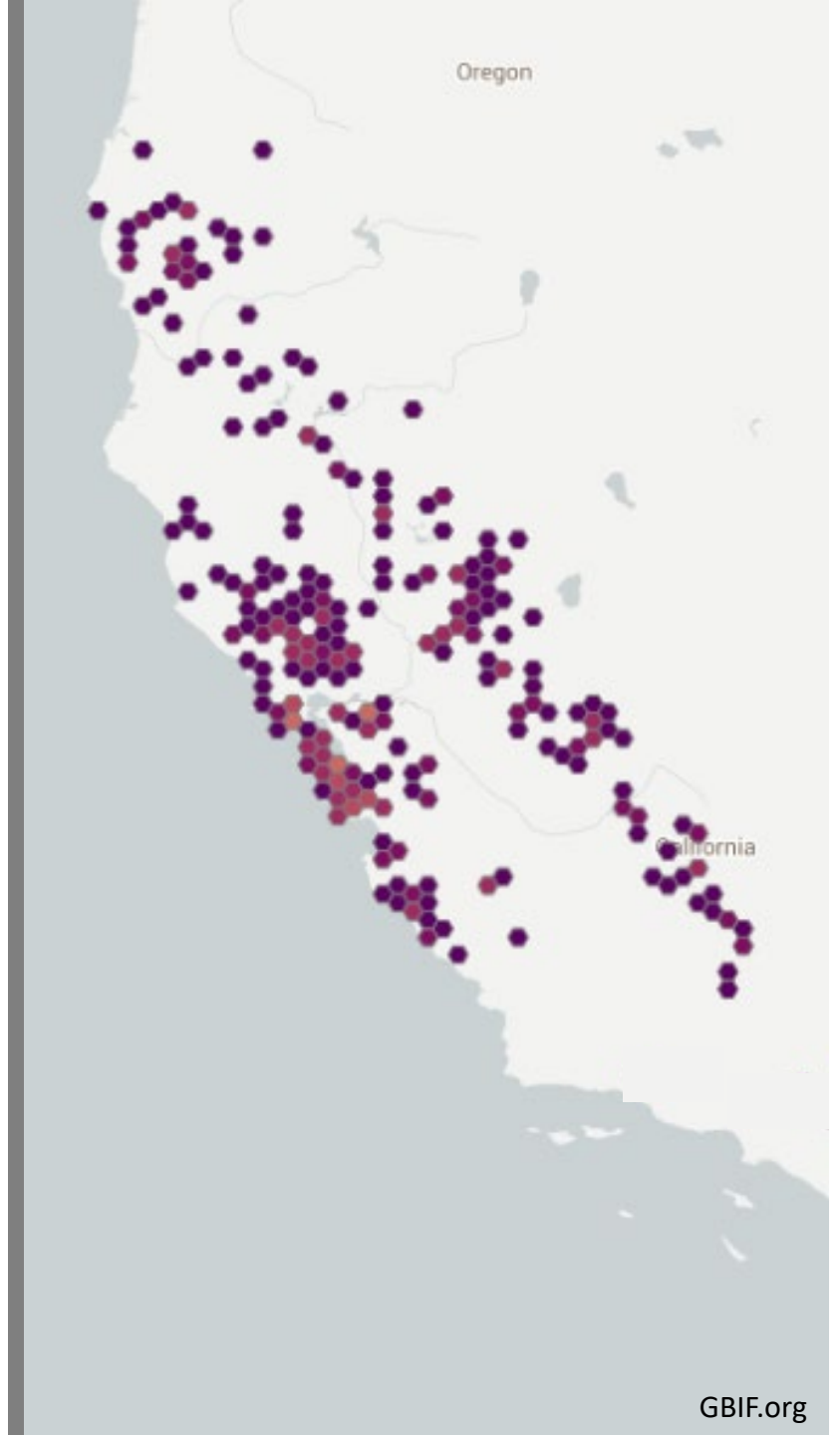
Eriodictyon californicum



Photo Steve Matson



Photo Aaron Schusteff



Eriodictyon crassifolium



Photo Neal Kramer

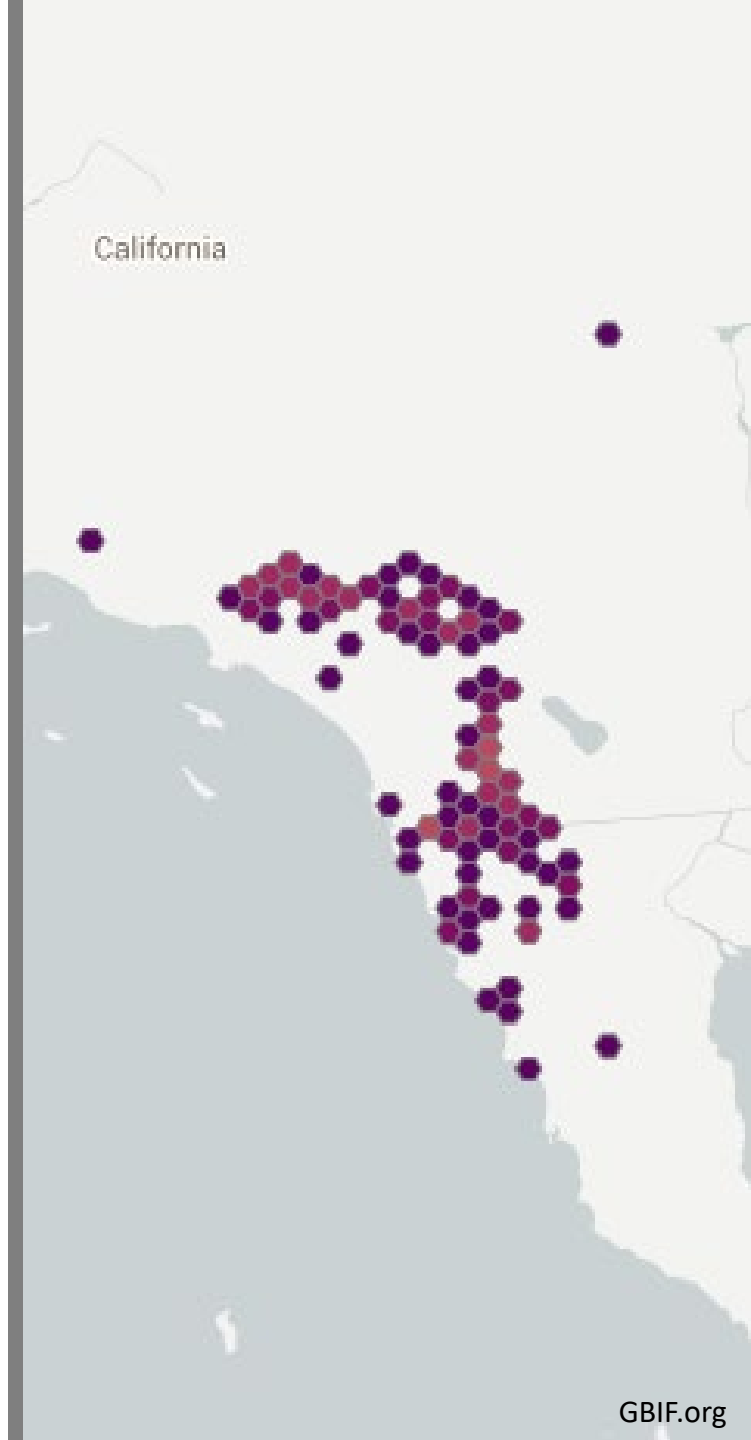
Photo Zoya Akulova



Eriodictyon trichocalyx



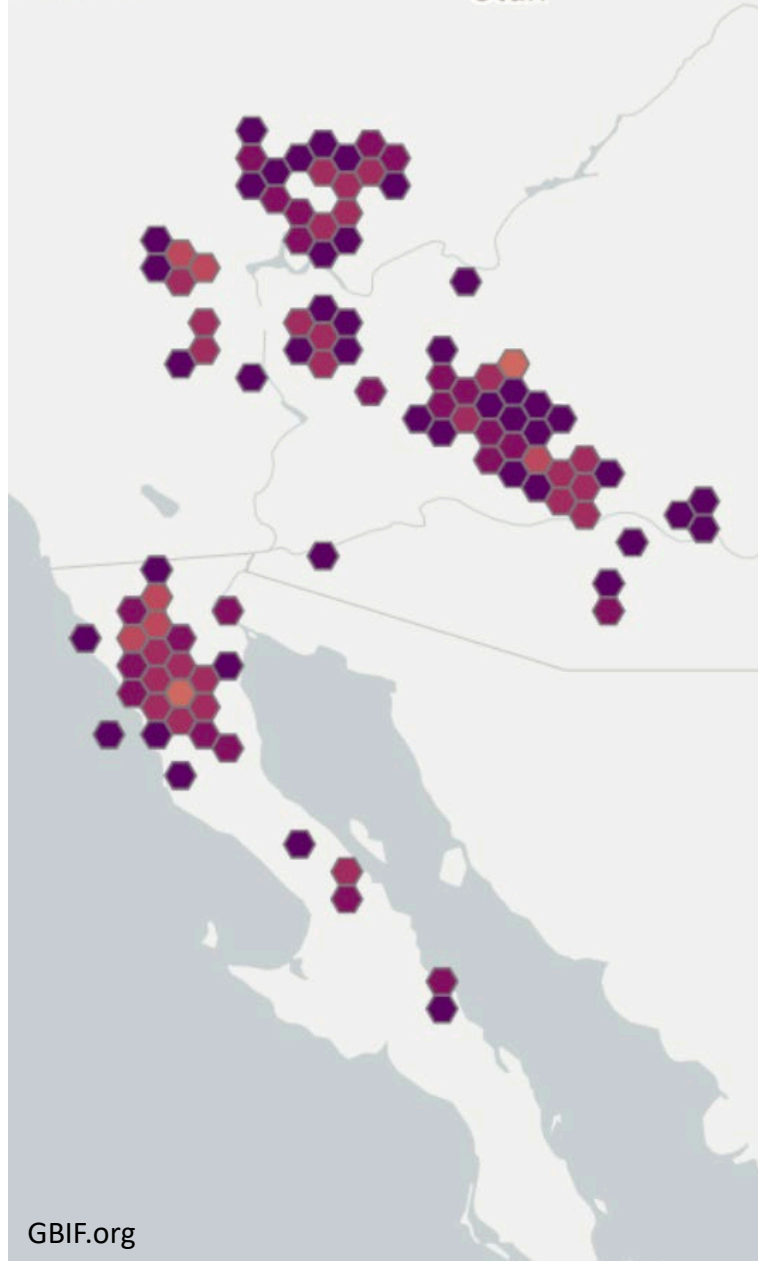
Photos Keir Morse



Eriodictyon angustifolium

Nevada

Utah



GBIF.org



Photo Dra. Anny Peralta



Photo Luis Vega

Eriodictyon capitatum
CNPS 1B.1 – FE – CR



Eriodictyon altissimum
CNPS 1B.1 – FE – CE



Photo by Heather Schneider



E. capitatum's narrow leaves

+

E. californicum's open inflorescences



=

Wells' 1962 *E. altissimum* hybrid origin hypothesis



E. altissimum: narrow leaves, open inflorescences

- Problems:** 1. neither taxa occur near present-day *E. altissimum*
2. need source of data other than morphology

Study of *Eriodictyon* using genetic techniques

Project goals:

- Population genetics of rare *Eriodictyon* taxa
 - *E. altissimum* (Indian Knob mountainbalm)
 - *E. capitatum* (Lompoc yerba santa)
 - Levels and distribution of genetic diversity of these rare taxa
 - Degree of genetic connectivity among stands
- Phylogenetics of genus
 - Are the circumscriptions of the rare taxa supported by phylogenetic data?
 - Is Wells' hybrid origin idea for *E. altissimum* supported?
 - Confirm placement of exceptional taxa



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Methods

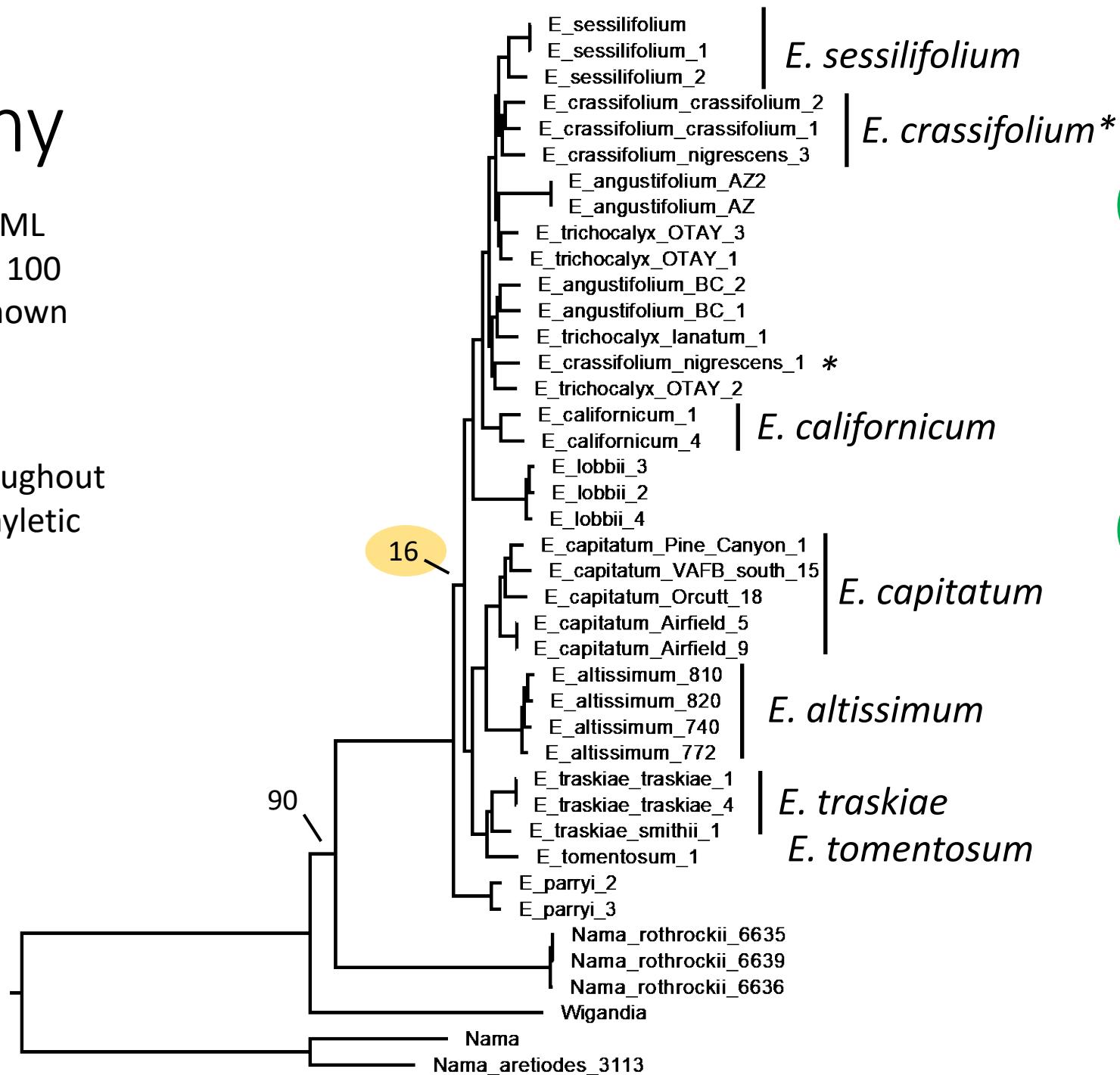
- Tissue sampling onto silica between 2015 and present
- gDNA extracted using CTAB
- Qubit fluorometer quantification
- ddRADseq enzymes EcoRI and MseI
- Sequencing at UC Riverside Illumina HiSeq (1 x 100bp)
- Quality filtering: Trimmomatic and iPyrad
- Maximum likelihood phylogenetic analysis in RAxML

Phylogeny

Most nodes with ML
bootstrap values = 100
Key < 100 values shown

Take-aways:

1. Good support throughout
2. Most taxa monophyletic



E. capitatum



E. altissimum



Wells' hybrid origin hypothesis for *E. altissimum* not supported

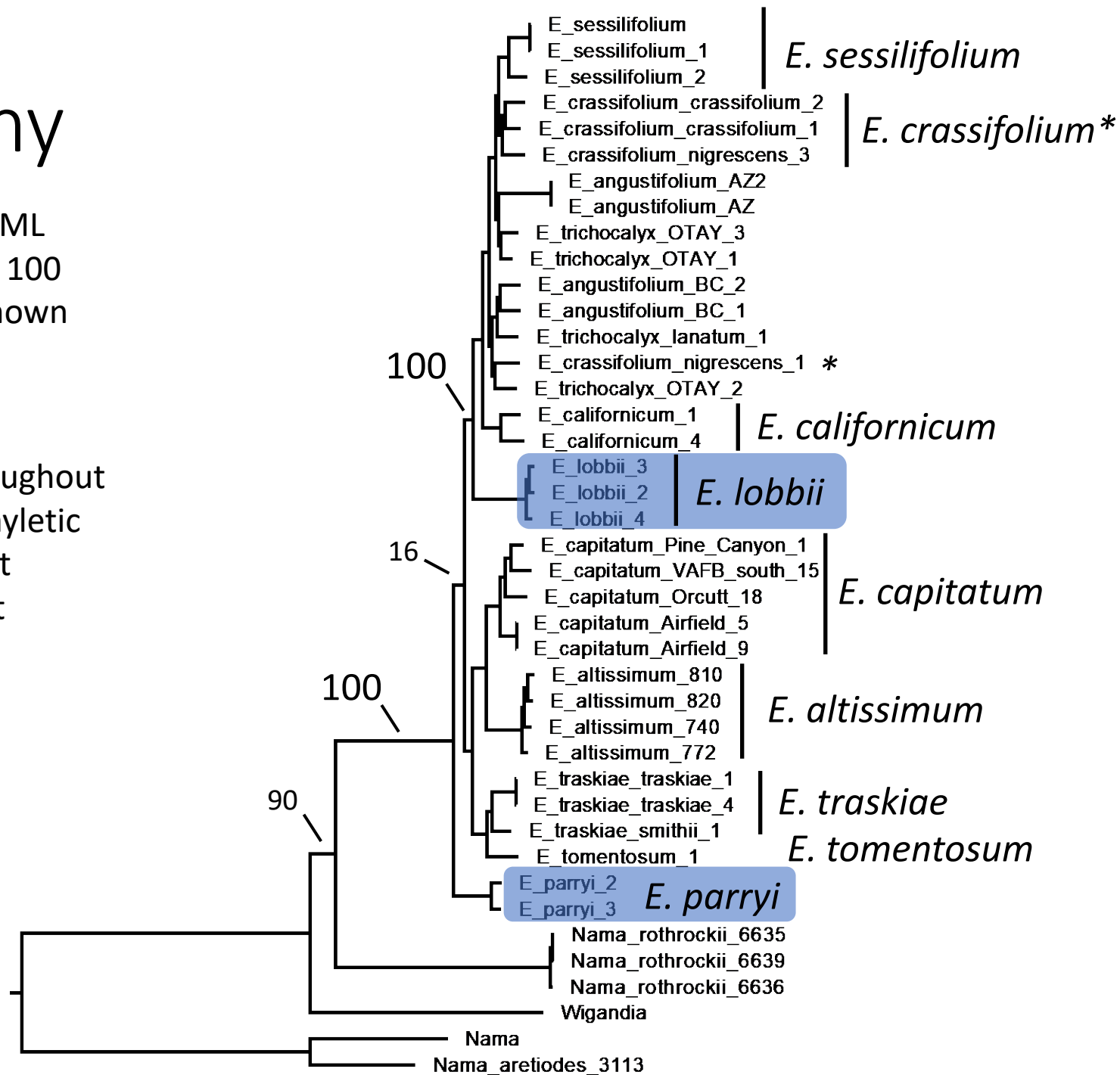
41 samples
2,248,102 bp

Phylogeny

Most nodes with ML
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Take-aways:

1. Good support throughout
2. Most taxa monophyletic
3. *E. parryi* placement
4. *E. lobbii* placement



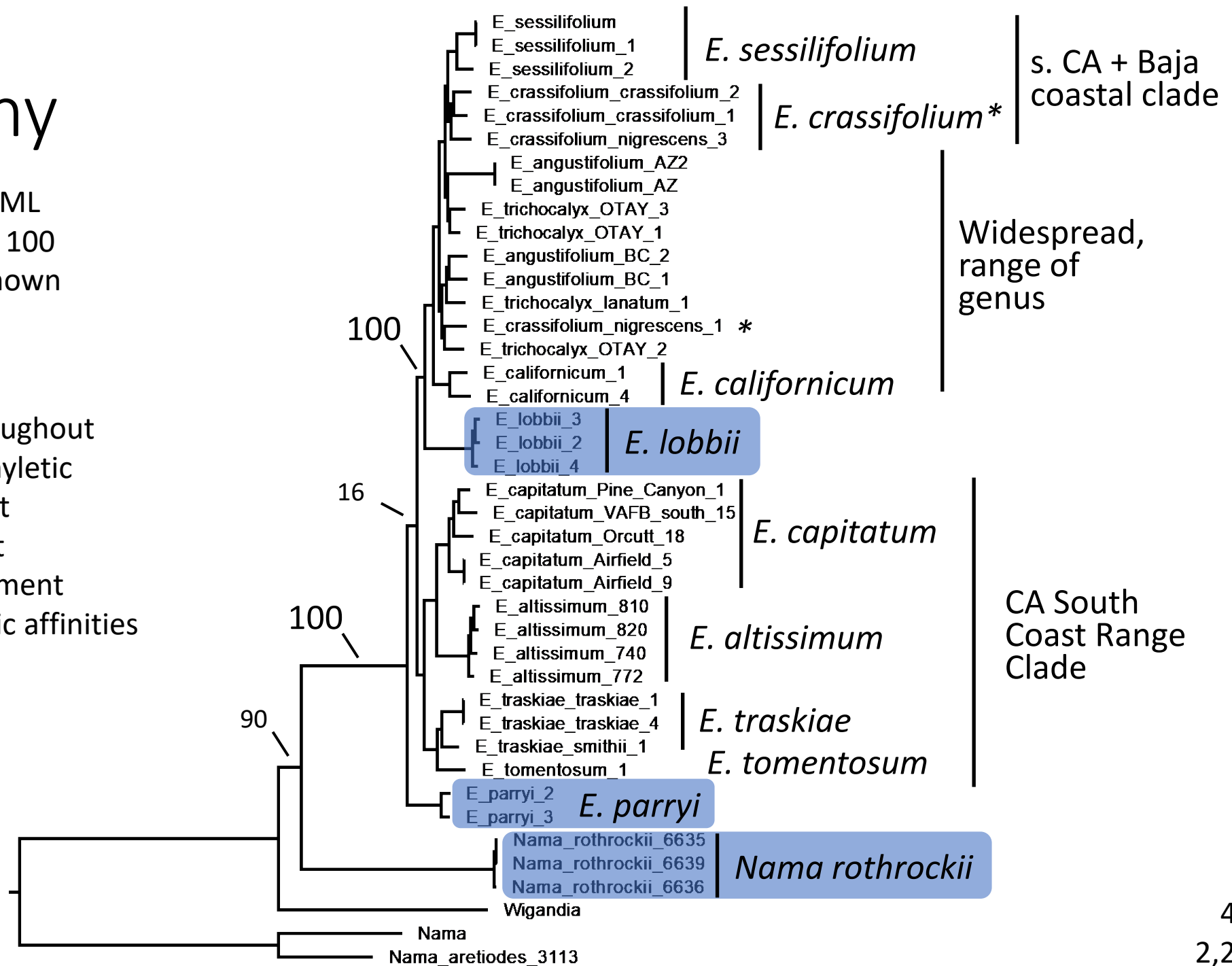
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Phylogeny

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Take-aways:

1. Good support throughout
2. Most taxa monophyletic
3. *E. parryi* placement
4. *E. lobbii* placement
5. *N. rothrockii* placement
6. Clear biogeographic affinities in some clades



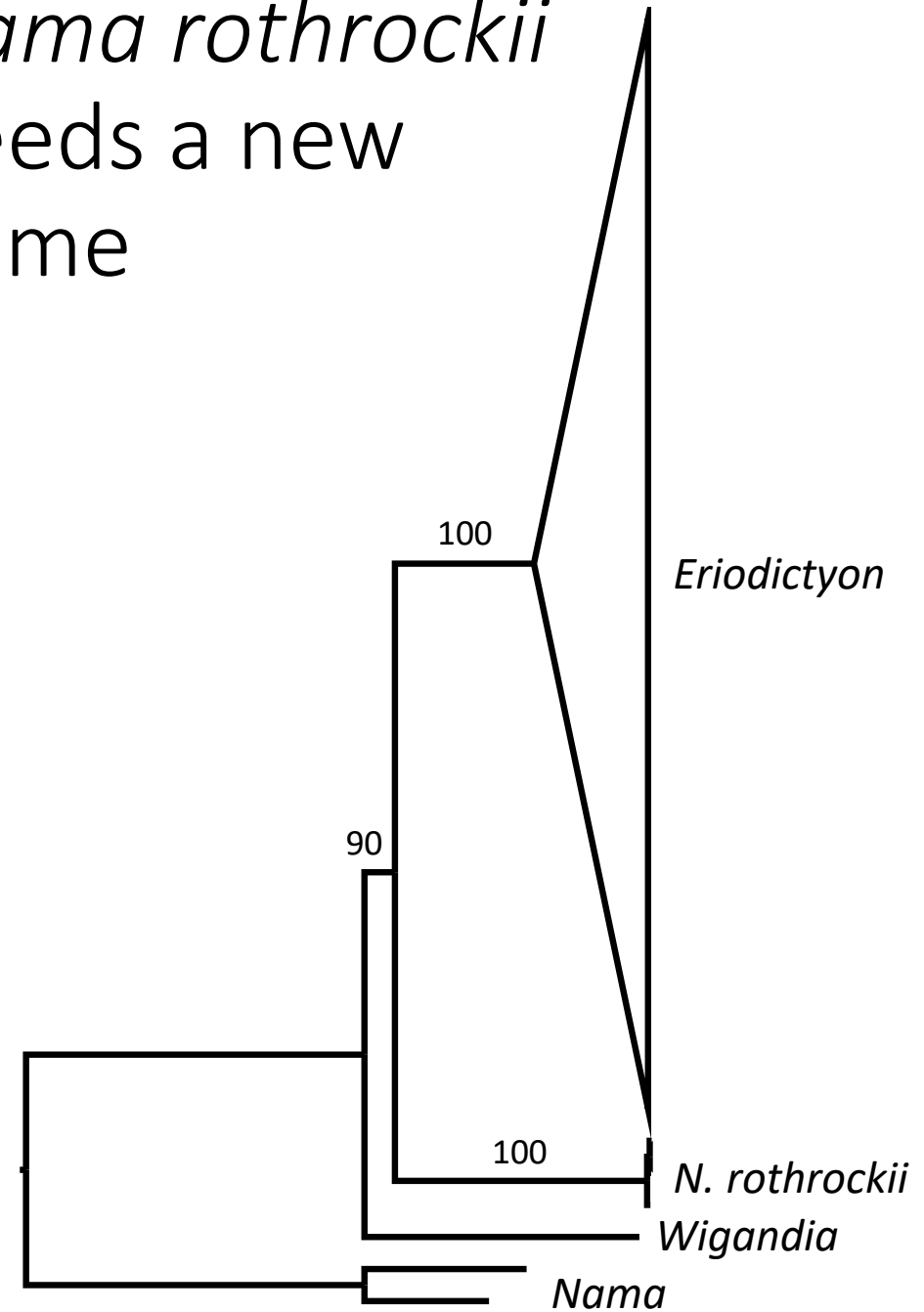
Take home ideas

- The molecular method (ddRADseq) worked for Namaceae
 - Useful at higher level, among genera and within *Eriodictyon*
 - Excellent for population genetics (data not shown)
- Well-supported phylogeny
 - Most lower taxa monophyletic, incl. *E. altissimum* and *E. capitatum*
 - No support for Wells' hybridization idea
 - Placement of exceptional taxa confirmed
 - *E. parryi* with *Eriodictyon*, but not confidently placed
 - *E. lobbii* included in *Eriodictyon*
 - *Nama rothrockii* sister to *Eriodictyon* (next slide)





Nama rothrochii
needs a new
name



Do you have ideas for
a new genus name?

Or should it become
an *Eriodictyon*?



Scan this QR code and fill out the
Google Poll or email me:
mguilliams@sbotanicgarden.org



Acknowledgments

For help with field work/samples:

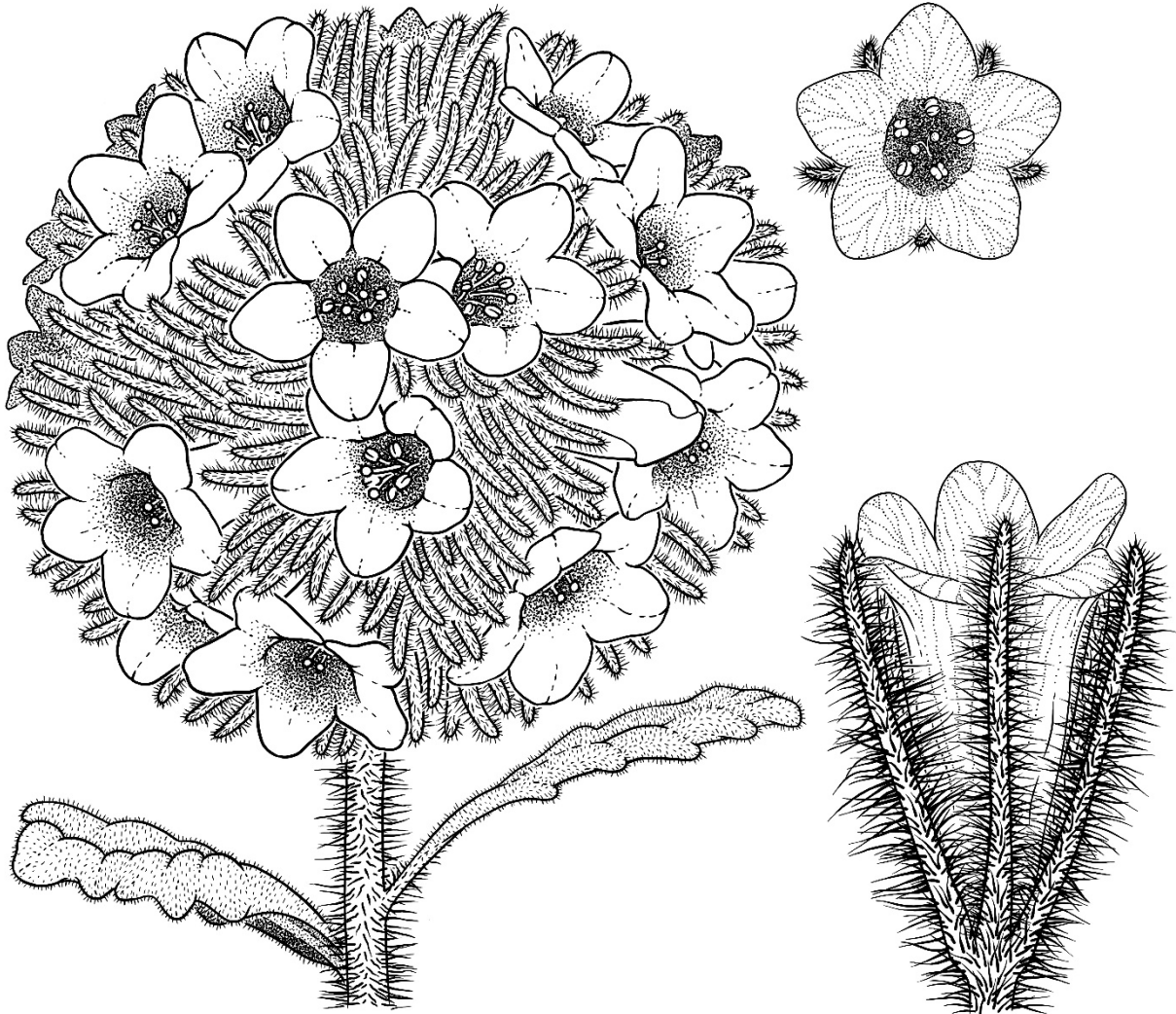
Lisa Andreano (State Parks), Wendy Boes, Kyle Gunther (SDSU), Lawrence Janeway (USFS), Chris Kofron (USFWS), Connie Rutherford (USFWS), Heather Schneider (SBBG), Mike Simpson (SDSU) Mike Walgren (State Parks)

For permits and access:

US Fish and Wildlife Service for 10(a)(1)(A) permit, Guidetti Family for access to Indian Knob, Orcutt Oil Field, Luanne Lum (VSFB), Hollister Ranch, Lloyd Simpson (LPNF), Scott Eliason (SBNF); Jose Delgadillo and Exequiel Ezcurra for permits to collect in Mexico.

Funding:

US Fish and Wildlife Service, Julie Vanderwier, Mark Elvin, and Kristie Scarazzo



Nama rothrockii illustration by Emma Oyle