Unraveling the Taxonomic Classification of the Tolowa wallflower (Brassicaceae: *Erysimum*), a dune endemic of the California North Coast

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Introduction:
Proper identification of narrowly distributed species is pivotal for their management and conservation. Found in the Tolowa Dunes State Park, Del Norte County, California, there is an Erysimum population that does not fit the species boundaries of E.concinnum Eastw., its currently assigned name. A closely related species, E.menziesii Wettst, arguably better fits the morphology of the Tolowa wallflower, with the caveat that it still does not adequately depict the population. E.menziesii is known as dune species and is federally recognized as endangered. Through a genetic assessment as well as measuring morphological features, we set out to determine the proper taxonomic ranking of the Tolowa Wallflower.

Importance of the study:
Determining the proper taxonomic classification is crucial to understand the species' relationship to other members of its family as well as helping with conservation efforts. The Tolowa wallflower's current name, E.concinnum, does not have special protection due to the lack of a rare species rank. At the same time, E.menziesii is considered to be endangered and receives funding and adequate conservation effects to help keep the species population protected.

Species Description (Al-Shehbaz 2012)**:**

***E*. menziesii**
Stem: 0.2 –2.5 dm **Leaf:** 0.5 – 1.5 cm wide, spoon-shaped entire to lobed, flat; hairs 3 – 5 rayed **Flowers:** sepals 7 – 14 mm; petals 15 – 30 mm, 6 – 14 mm wide, yellow, claw 10 – 15 mm. **Fruit** 3 –14 cm, 2 – 4 mm wide, cylindric and green while juvenile, flat parallel to septum when dry, not constricted between seeds; valves outside with 3 or 4 rayed hairs, glabrous, midvein obscure; style 0.3 – 2 mm **Seed:** 32 – 74, 1.8 – 2.8 mm, oblong, wing widest at tip. **Habitat:** Coastal Dunes, Headlands and cliffs.

E. concinnum
Stem: 0.4–5 dm**, Leafy:** 0.4-2 cm wide, spoon-shaped to oblanceolate, flat and coarsely dentate. Hairs 2–3 rayed. **Flowers:** sepals 8–19 mm, petals 15 – 32 mm and 16 wide, cream to yellow in color. **Fruit:** 5 – 13 mm, 2.2 – 5 mm wide, cylindric while juvenile. Parallel to septum, not constricted between seeds, valves outside with 2–5 ray hairs, inside glabourus, midvein obscure; style 0.5 – 2.5 mm. **Seed:** 42 – 68, widely ovate to round, wing continuous. **Habitat:** Cliffs, Coastal bluffs, dunes, prairies.

Maps:
Basemap from esri

GBIF.org (11 March 2023) GBIF Occurrence Download https://doi.org/10.15468/dl.gmydcs

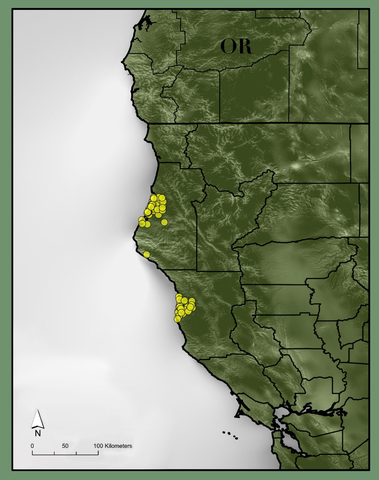
Photos:
California Academy of Sciences and the National Geographic Society, Nicolas Arms March 2021, E.concinnum, Inaturalist.

California Academy of Sciences 2018 Jonathan Lee, E. menziesii, CalFlora

Methods:
https://github.com/edgardomortiz/Captus

Description:
Ihsan A. Al-Shehbaz 2012, Erysimum concinnum, in Jepson Flora Project (eds.) Jepson eFlora, https://ucjeps.berkeley.edu/eflora/eflora_display.php?tid=25128, accessed on March 29, 2023.

Erysimum menziesii



Erysimum concinnum

Tolowa Wallflower

Methods:

Field work:
- Sample populations from the distribution of both *E.concinnum* and *E.menziesii*
- Measure morphological traits such as:
  - basal and cauline leaf length, width and thickness
  - petal length and width
  - sepal length and width
  - fruit length, width and thickness
  - angle of fruit pedicel and fruit tip perpendicular to stem
  - petal colors (white, creamy, yellow)
- Collect leaf samples from several members of each population and preserve them in silica gel for DNA extraction
- Collect voucher specimens if needed, these would be deposited at the Herbarium of Cal Poly Humboldt.

Lab work:
- Extract DNA from leaf samples, using extraction with Macherey-Nagel NucleoSpin Plant II Kit.
- Send extracted DNA off to be sequenced using target sequencing and Angiosperm 353.
- Process the DNA sequences with the CAPTUS pipeline, and perform a phylogenetic analysis

Expected results:

This study intends to elucidate the taxonomic classification of the Tolowa wallflower population, we are testing three hypotheses:

- The Tolowa wallflower population belongs to *E. concinnum*
- The Tolowa wallflower population belongs to *E. menziesii*.
- The Tolowa wallflower population is and independent species.

The latter two outcomes would results in a rare species rank and the subsequent protection associated with said rank.

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