Vegetation types at risk from Sahara mustard invasion: Using Maxent to inform early detection and conservation targets with climate change

Cal-IPC Symposium, October 2019

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Or…
Where are those weeds going?

Cal-IPC Symposium, October 2019

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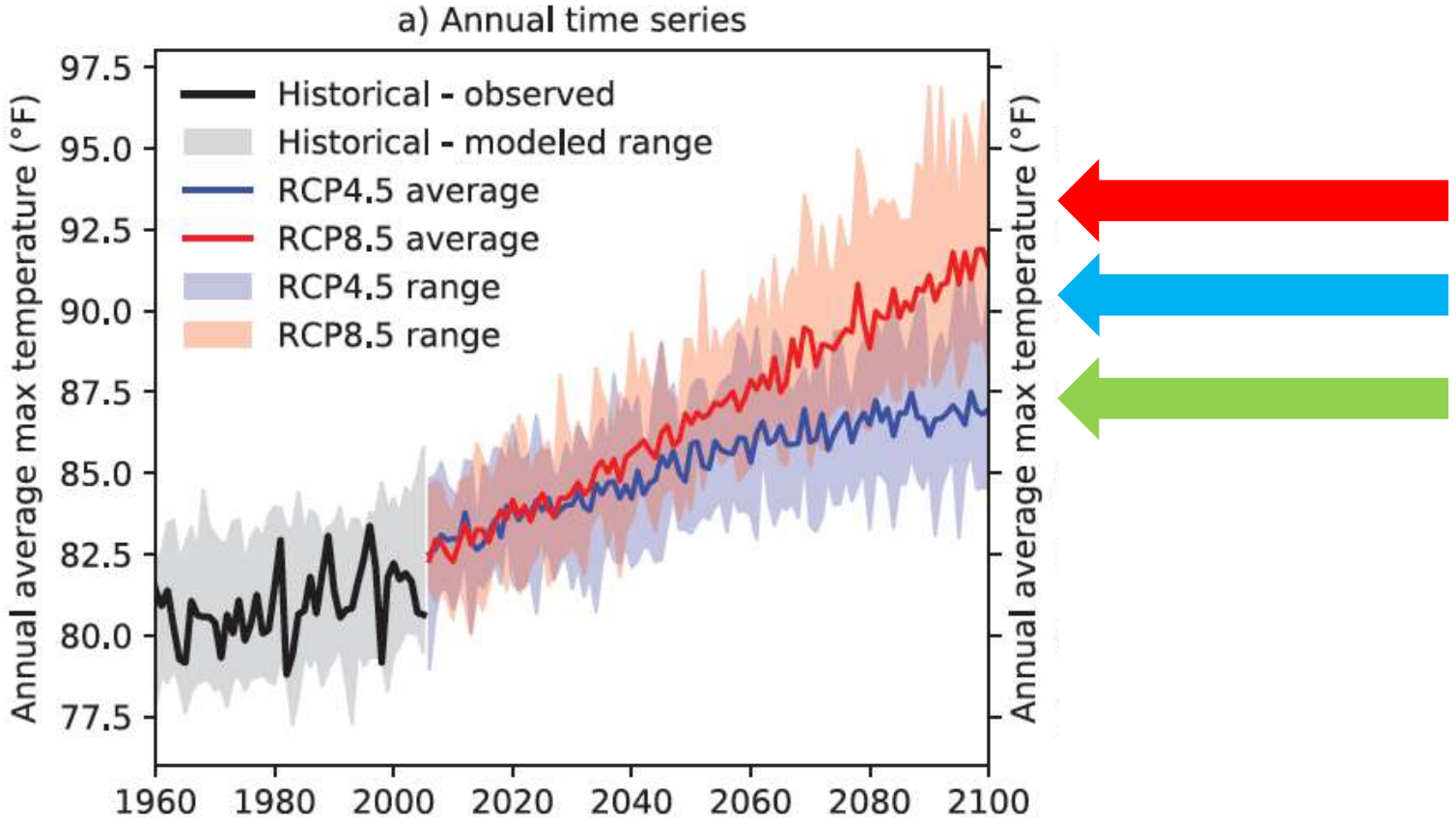
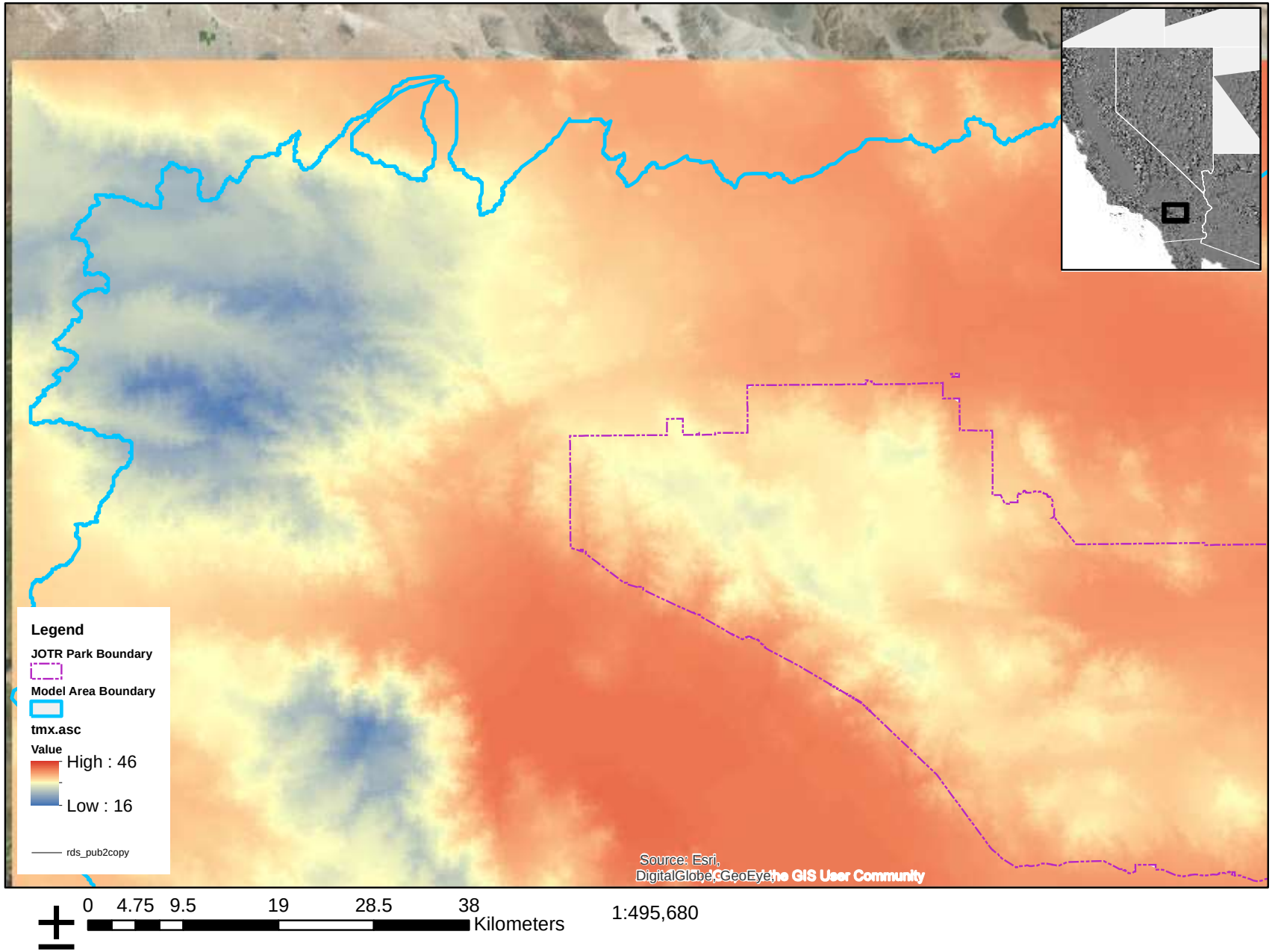
Climate change predictions vary based on emissions scenarios

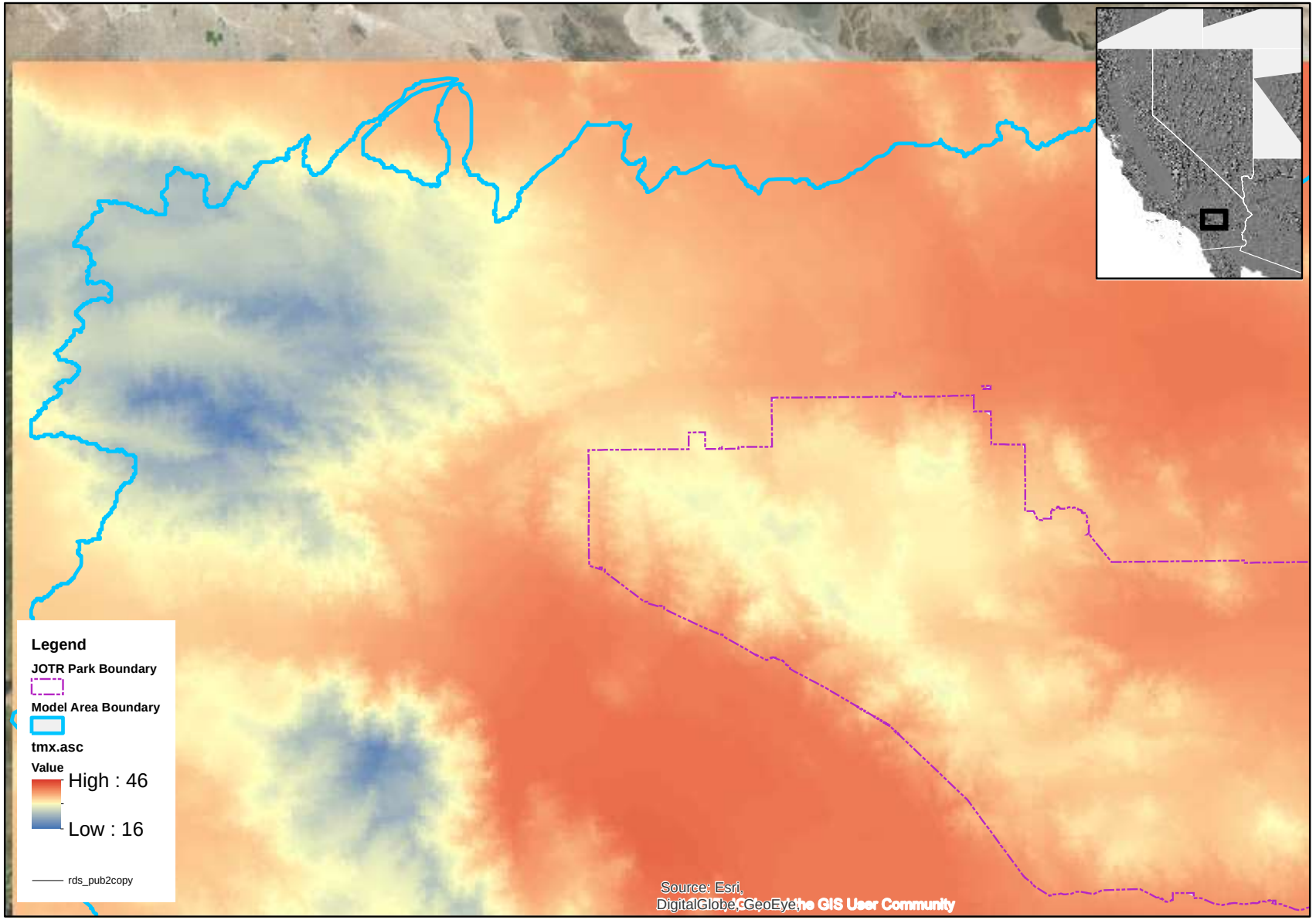


Source: Hopkins, Francesca. (University of California, Riverside). 2018. Inland Deserts Summary Report. California's Fourth Climate Change Assessment. Publication number: SUM-CCCA4-2018-008.
Free and available online. www.climateassessment.ca.gov/regions/

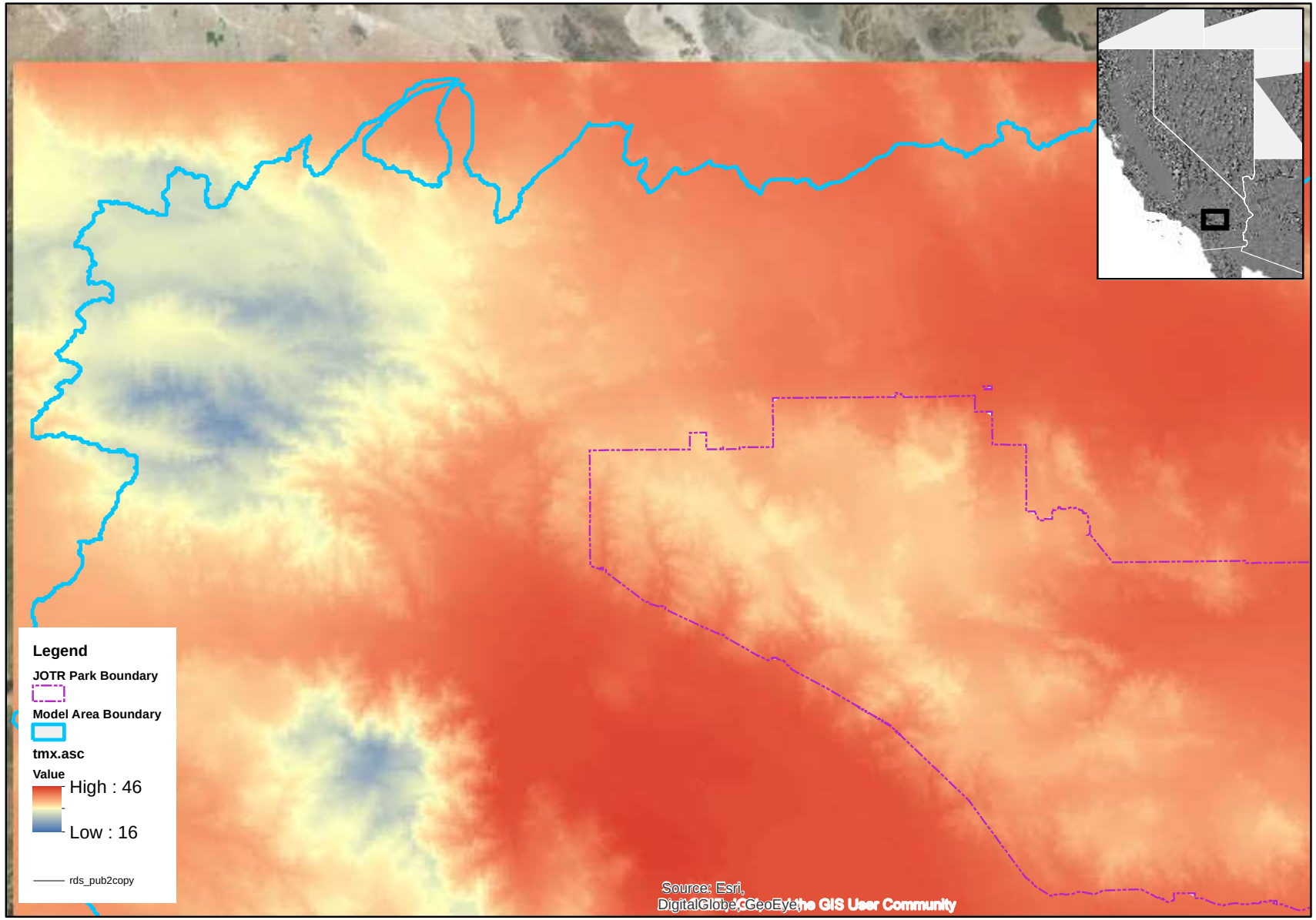
1951-1980 Maximum summer temperature °C



1981-2010 Maximum summer temperature °C



2070-2099 MIROC45 Modeled maximum summer temperature °C



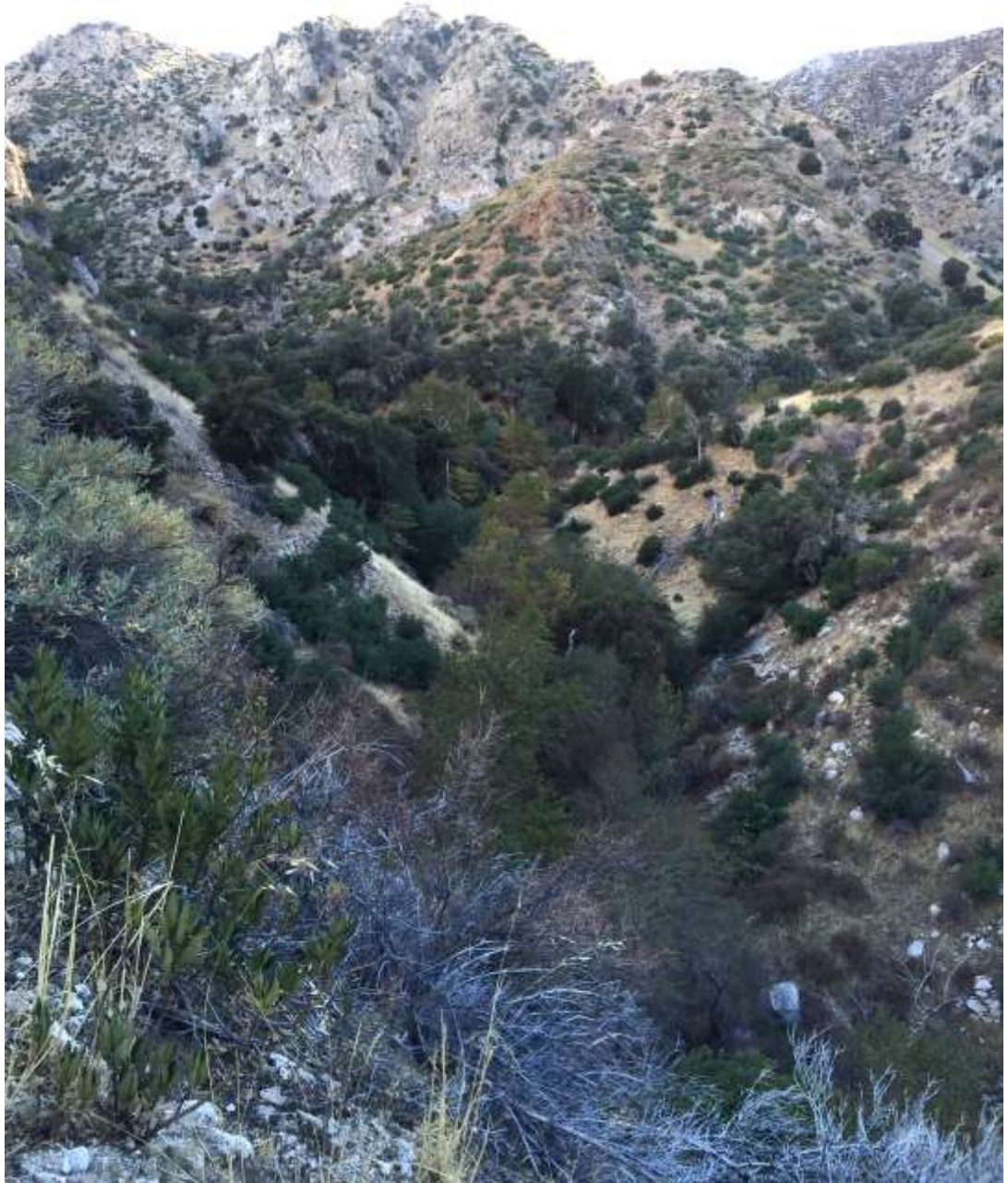
Sonoran/Colorado Desert Vegetation

Hotter, drier

Elevations -100’ – 3,000’

Mojave Desert Vegetation

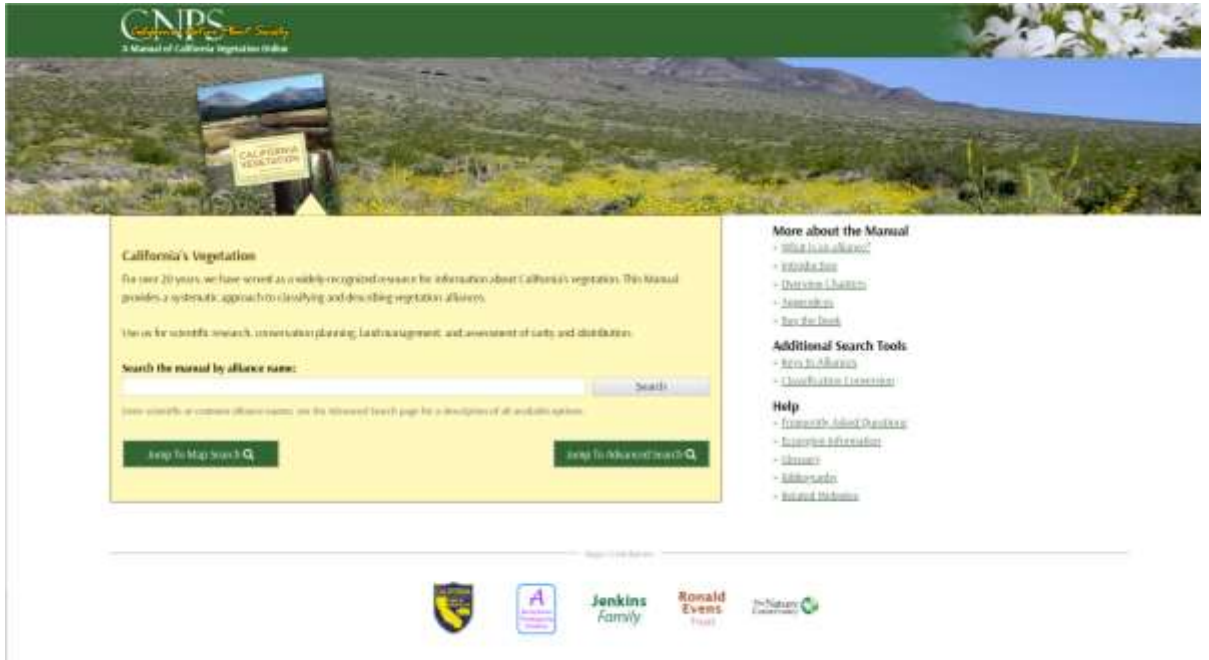
Transverse Range / “Coastal” Vegetation



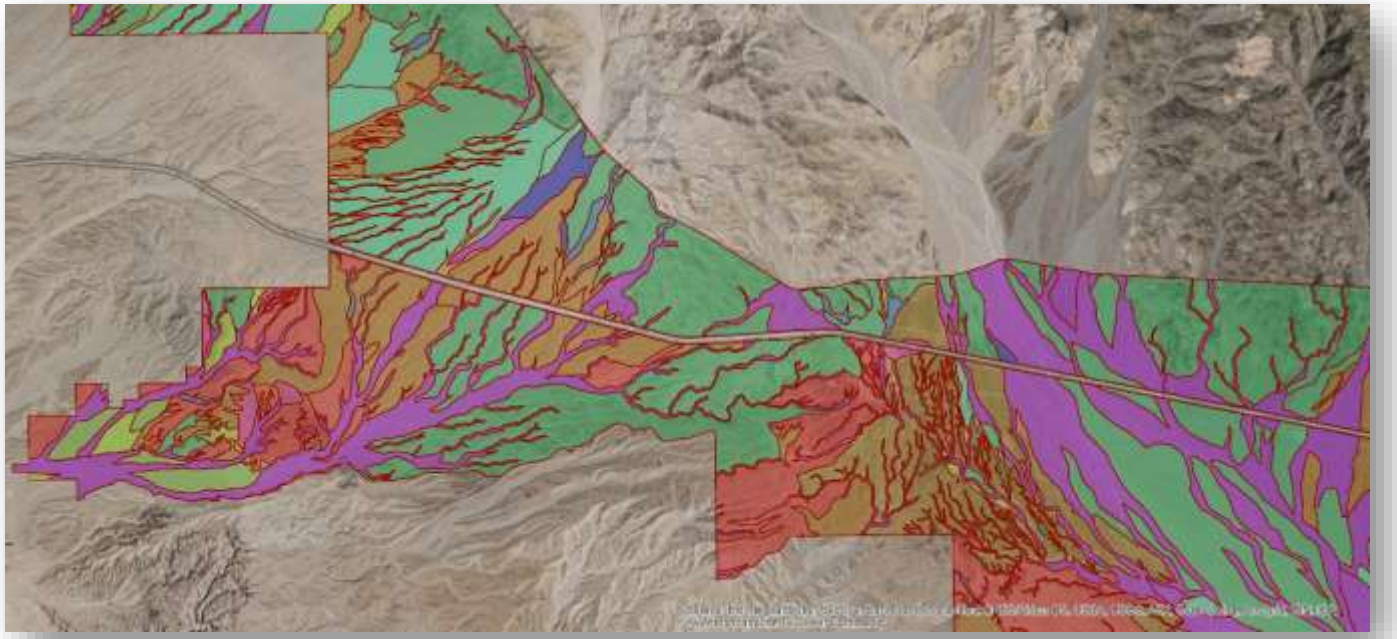
Vegetation Type Mapping/NVCS

- National Vegetation Classification Hierarchy (NVCS; Federal Geographic Data Committee 2008)
- DFG and CNPS Vegetation Classification and Mapping Program
- Manual of California Vegetation (MCV) Second Edition (Sawyer, *Keeler-Wolf and Evens,* 2009)
- Alliance: Dominant perennial cover:

"defined by plant species composition, and reflects the effects of local climate, soil, water, disturbance, and other environmental factors" (MCV Online)



Species Distribution Modeling:
Which vegetation types will be impacted?



Sand Field Communities in the Coachella Valley

Invasibility Patterns

- Mesic environments more invasible than extremes

BUT….

- Right invader may conquer “invasion resistant” communities.
- E.g. Sahara mustard in the desert

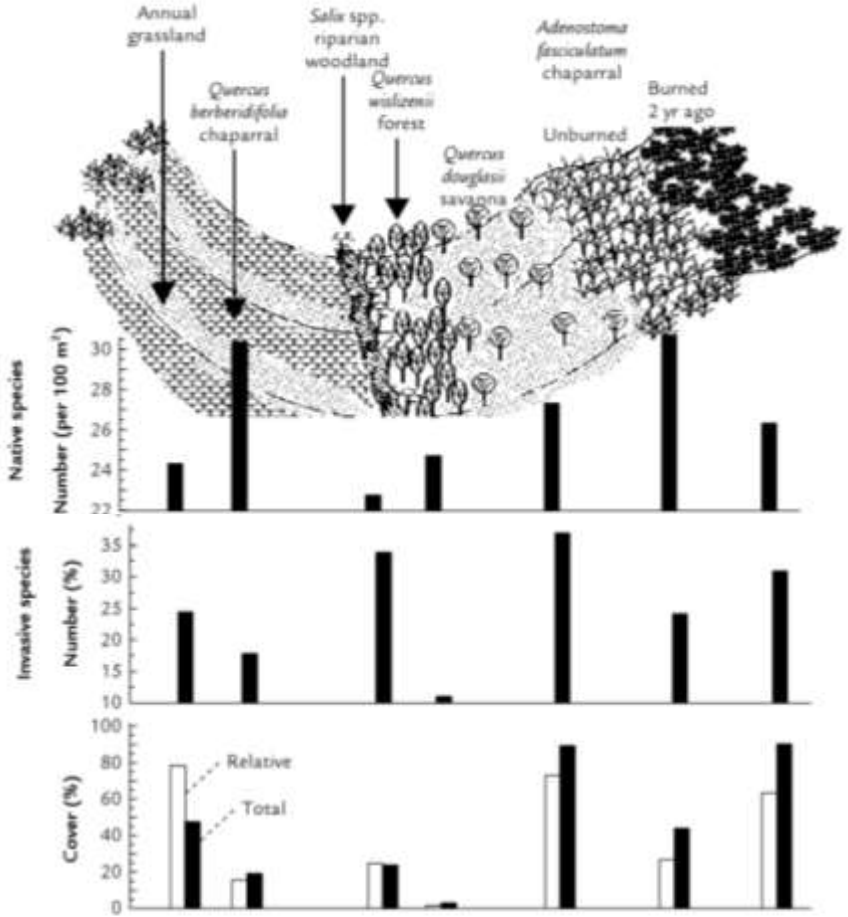


Fig. 13.2 Native and invasive species in seven plant communities of the Stebbins Cold Canyon Reserve, North Coast Ranges, California (150–500 m above sea level). Each column represents a mean from three 100-m² plots. 'Relative cover' of invaders is their cover with respect to the cumulative vegetation cover in all strata (herbs, shrubs and trees). Comparing means for individual vegetation types, the only significant correlation is between percentage of invasive species and total cover of invasive species ($r = 0.75$; $n = 7$; $p = 0.05$). Rejmánek (unpublished data).

Rejmánek, M., Richardson, D.M. and Pyšek, P., 2005. Plant invasions and invasibility of plant communities. Vegetation Ecology

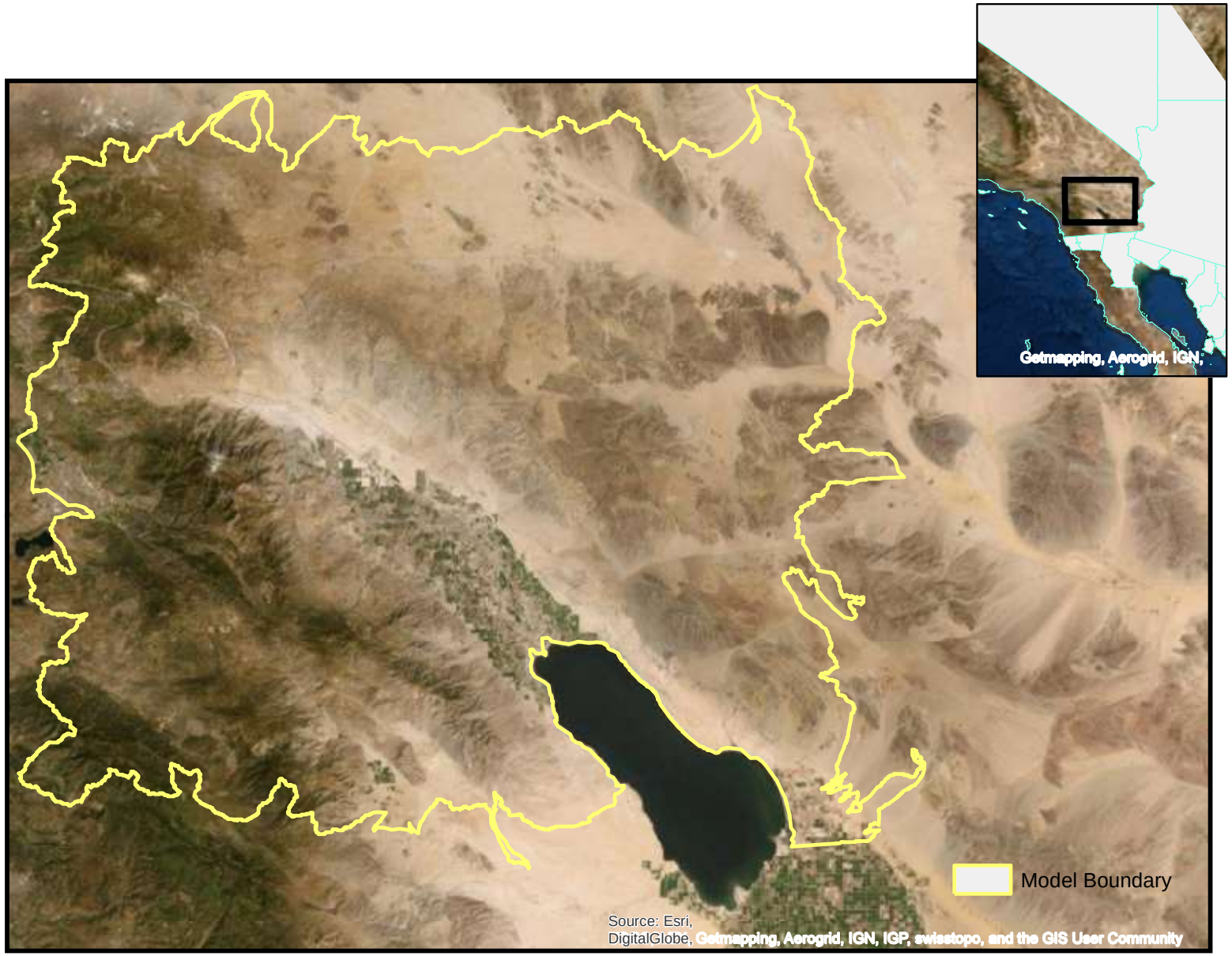
Invasibility Patterns

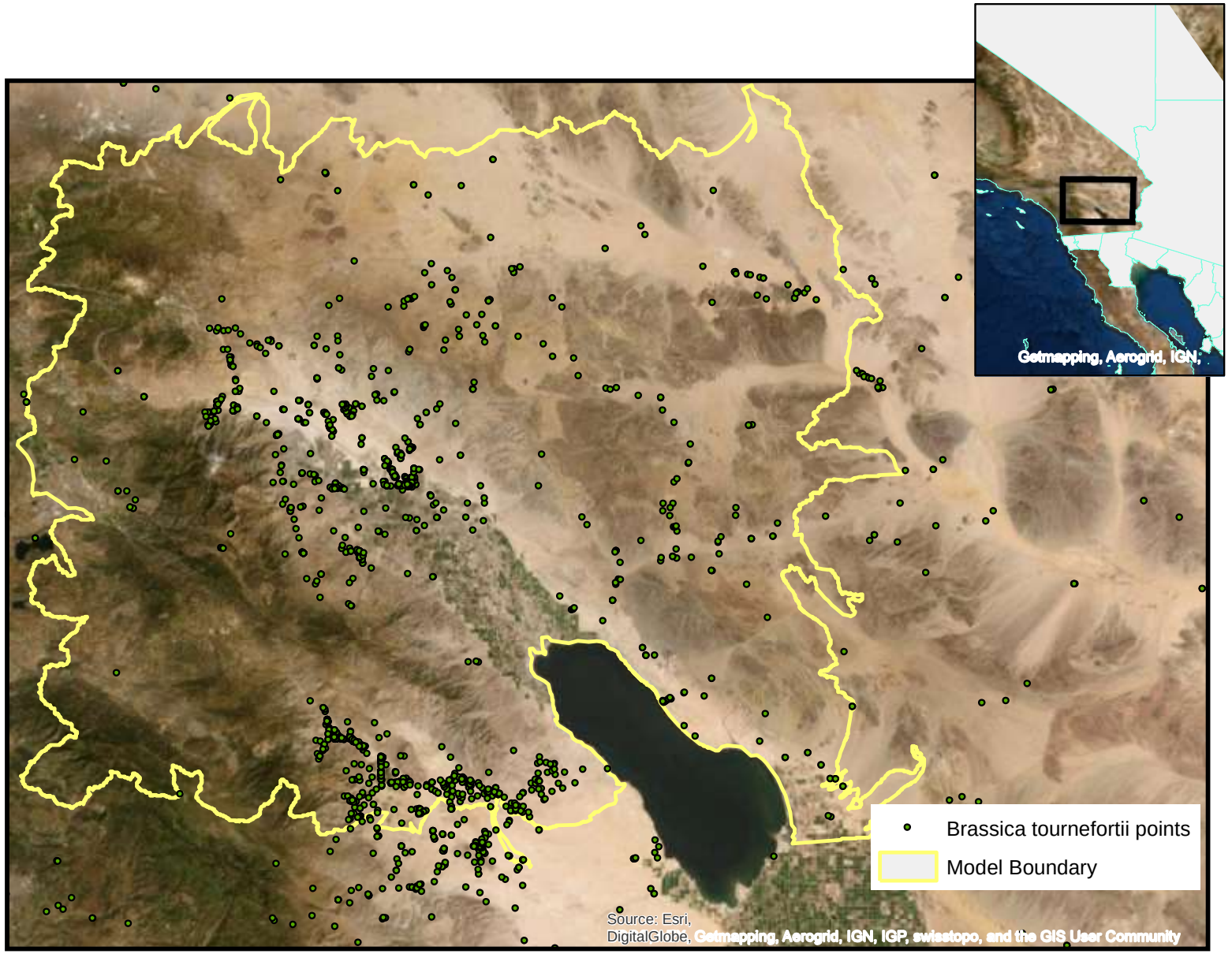
- Mesic environments maybe more invasible than extremes

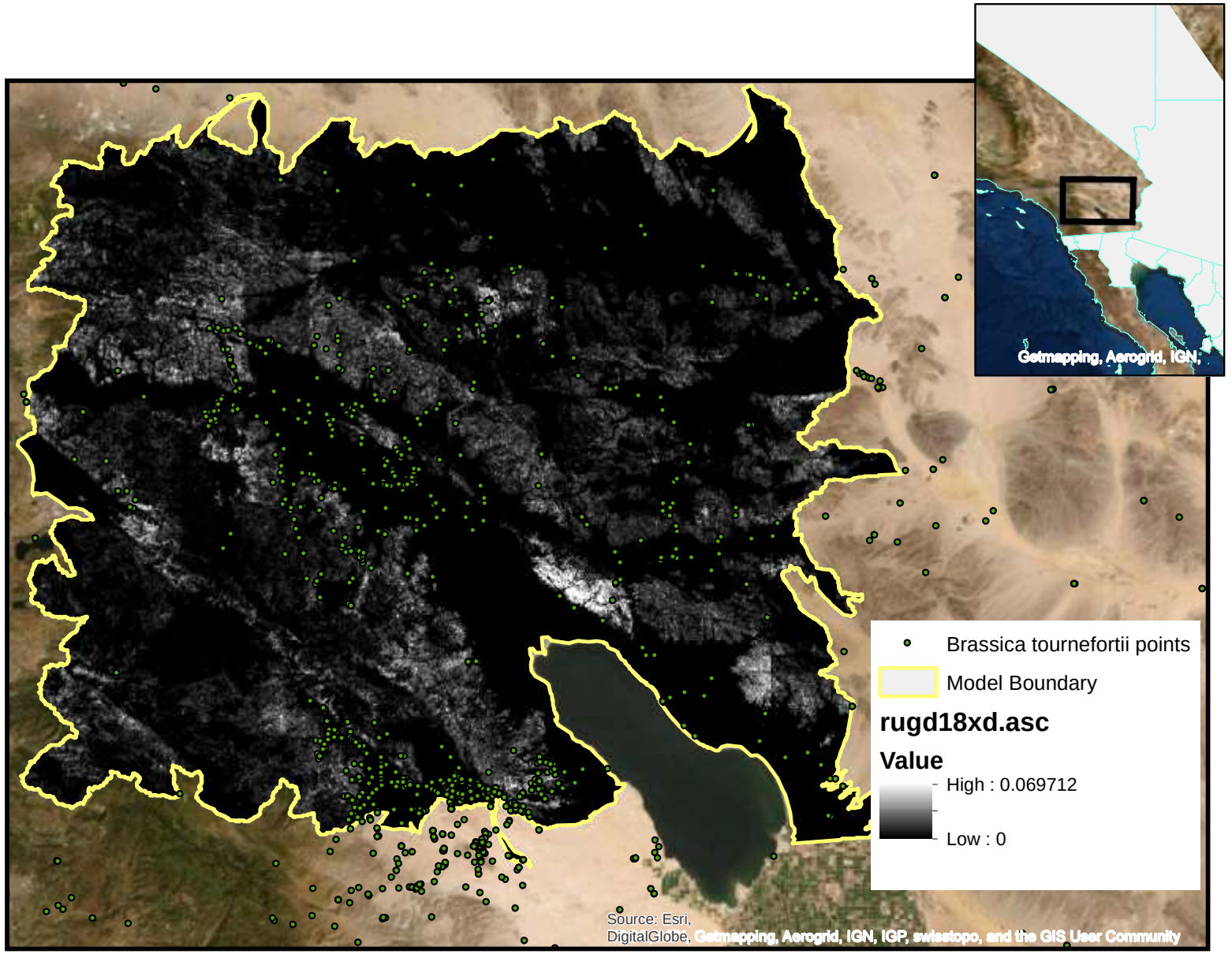
BUT….

- Right invader may conquer “invasion resistant” communities.
- E.g. Sahara mustard in the desert

- Community structure matters, including shade, water availability and competition
- Disturbance, resource inputs, etc. facilitate invasion on the whole

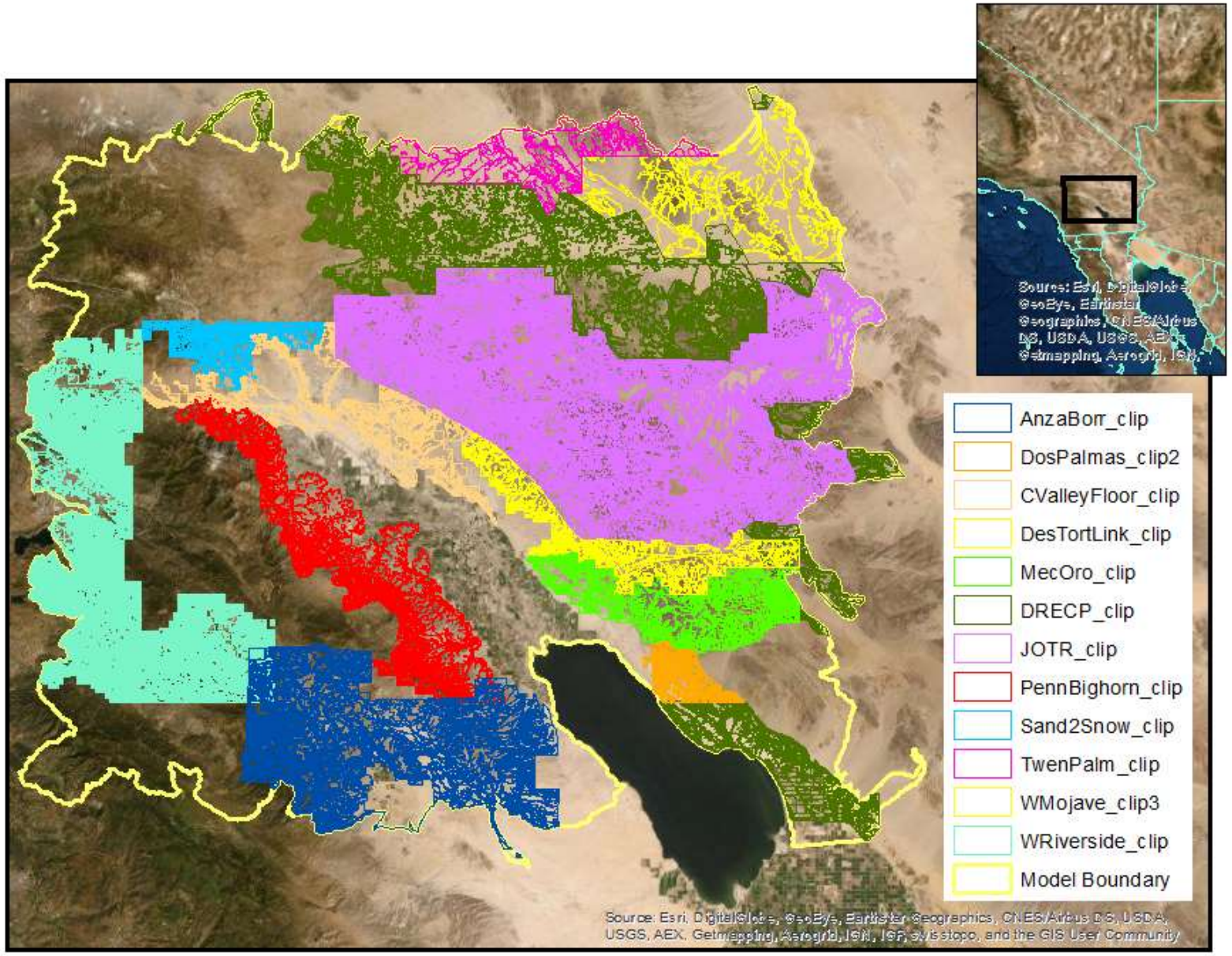

Getmapping, Aerogrid, IGN,
Model Boundary
Source: Esri,
DigitalGlobe, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community


Getmapping, Aerogrid, IGN,
Brassica tournefortii points
Model Boundary
Source: Esri,
DigitalGlobe, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community



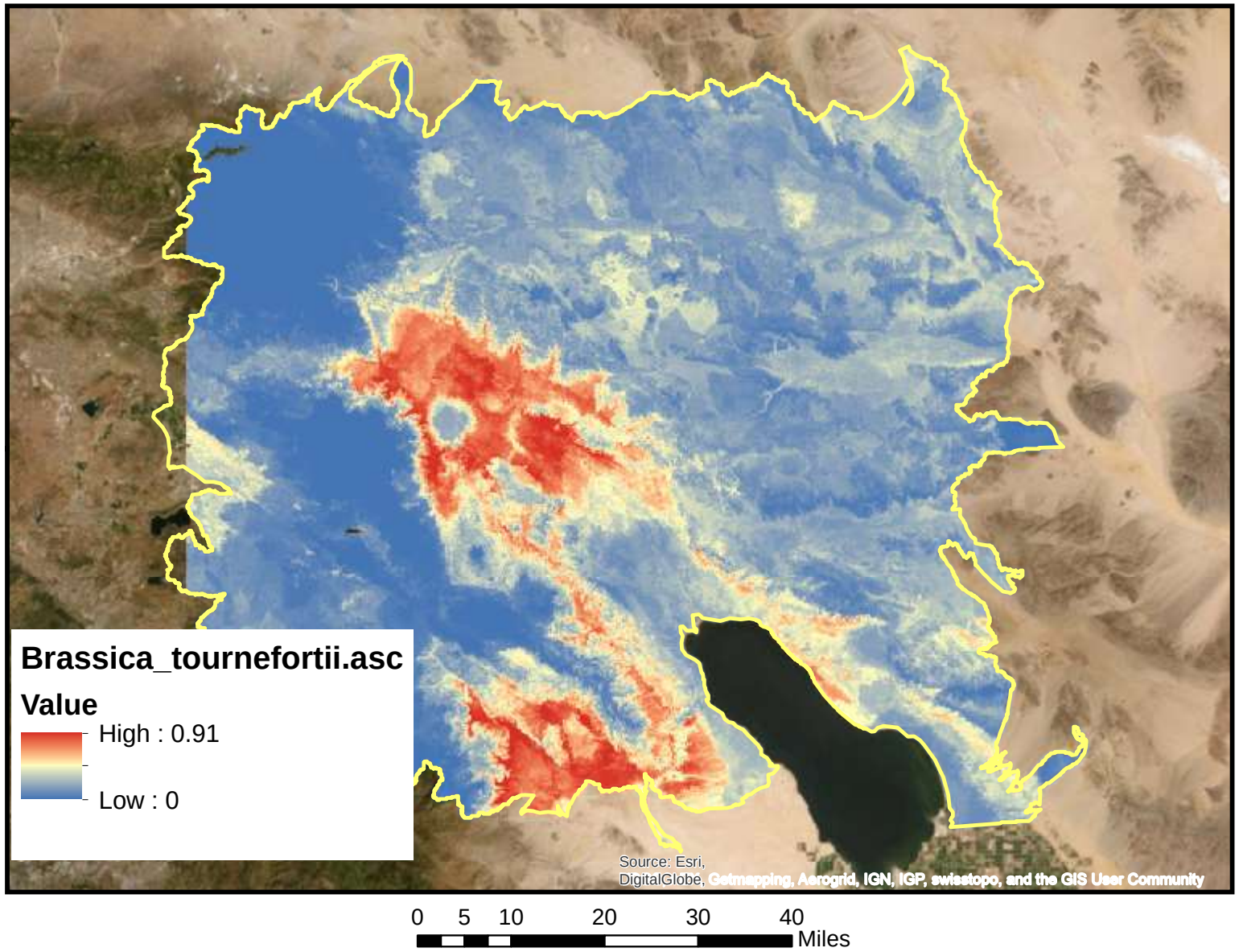
Lynn Sweet, Unpublished data

12 Regional Vegetation Maps



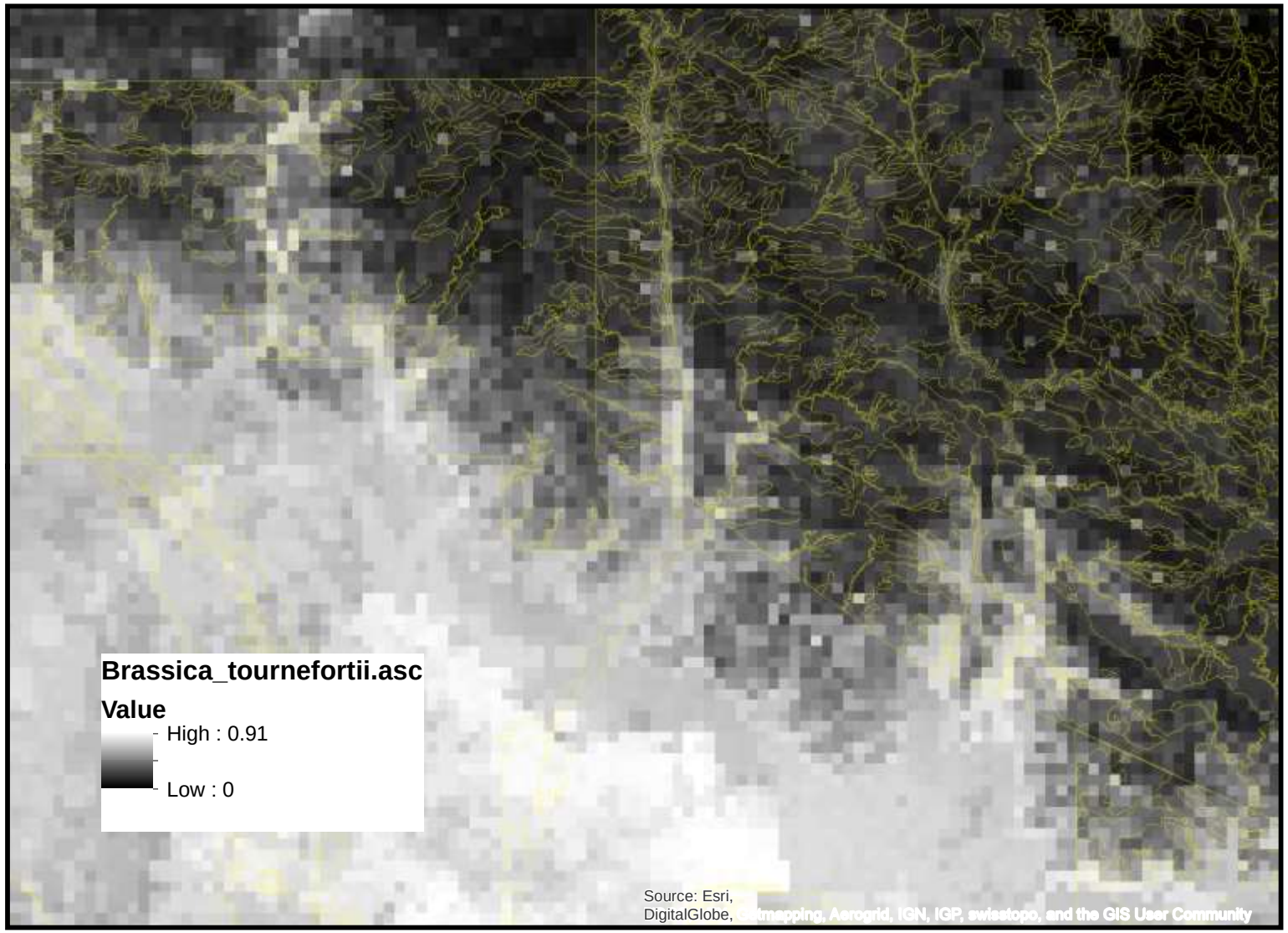
Lynn Sweet, Unpublished data

Current



Lynn Sweet, Unpublished data

Current



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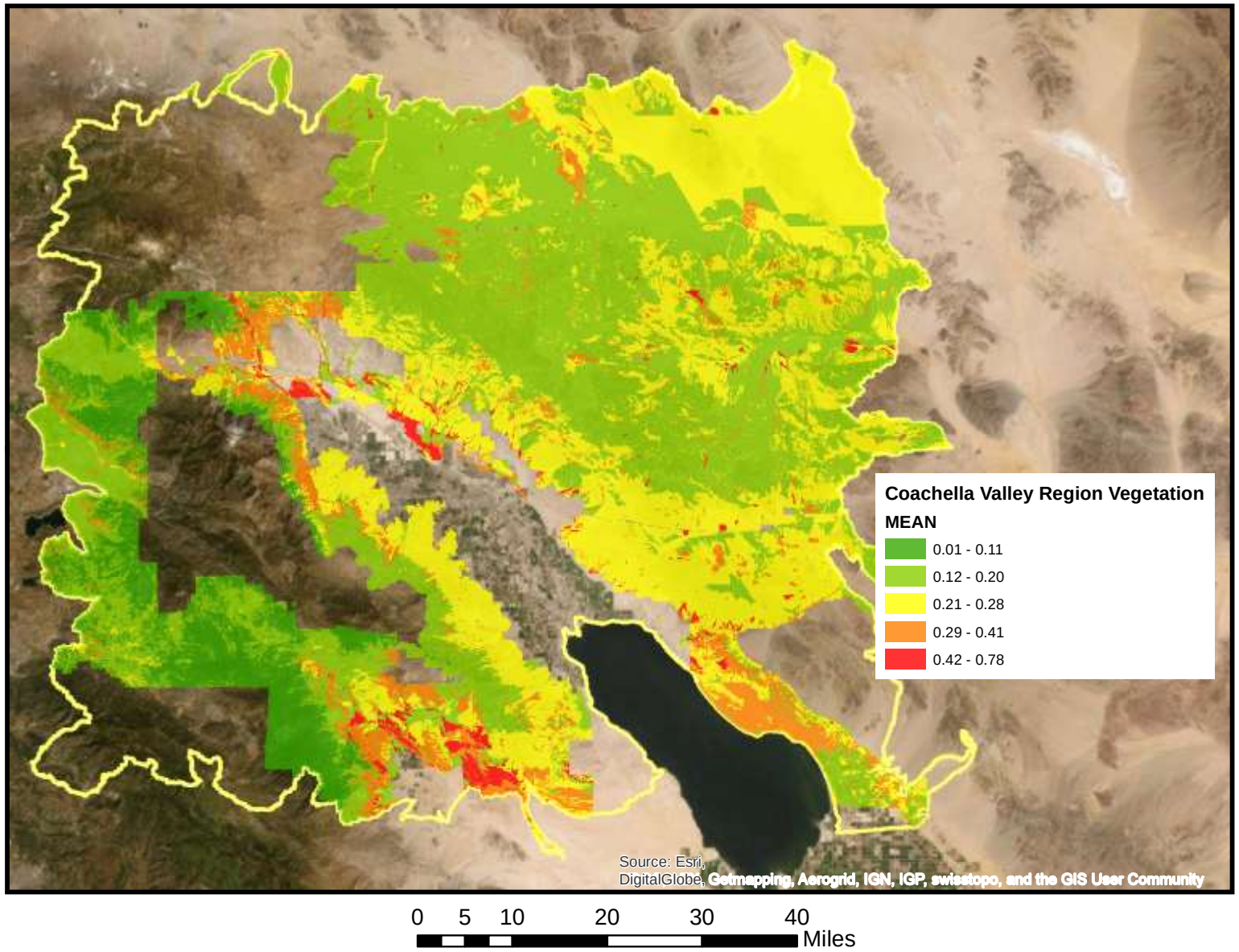
Current



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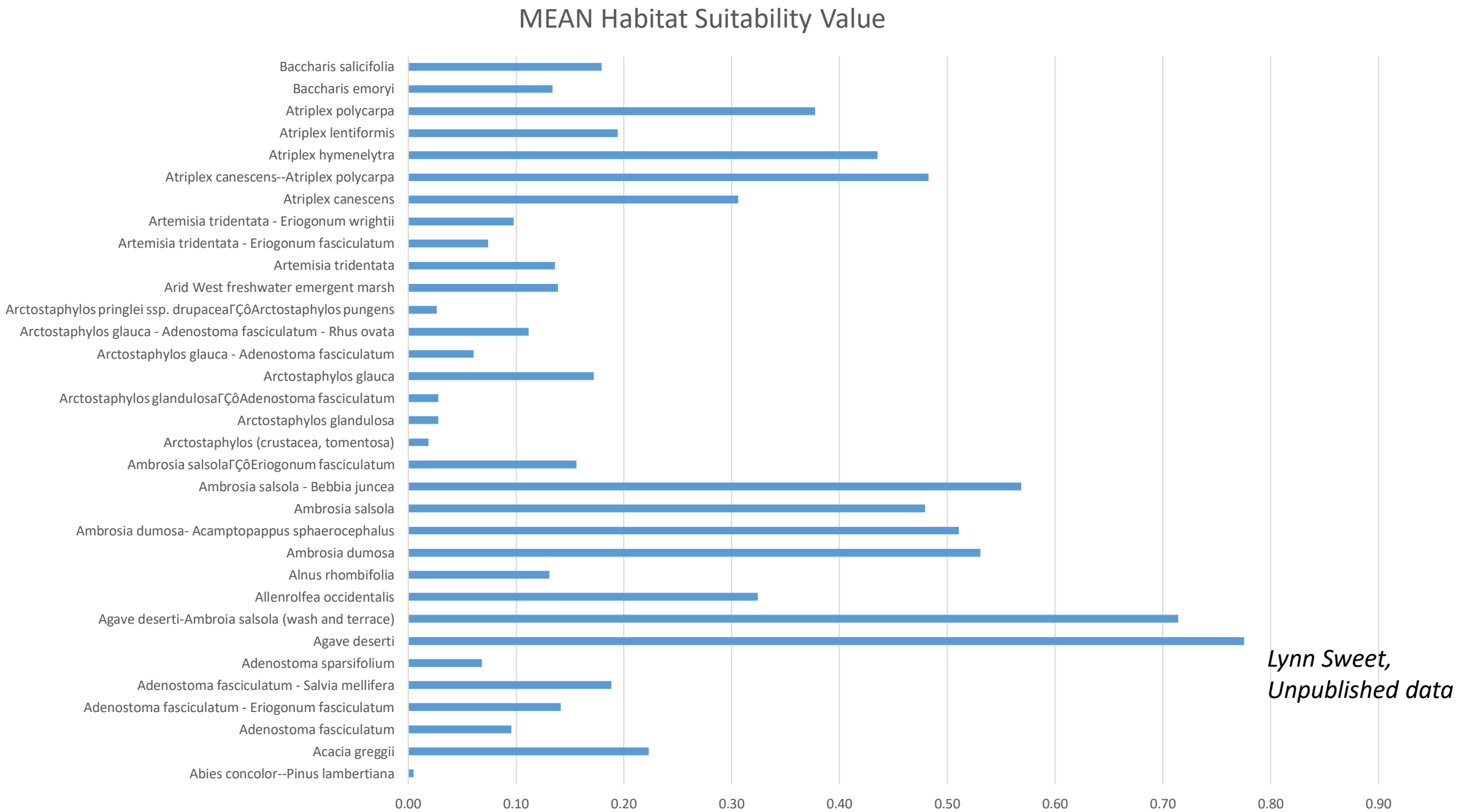
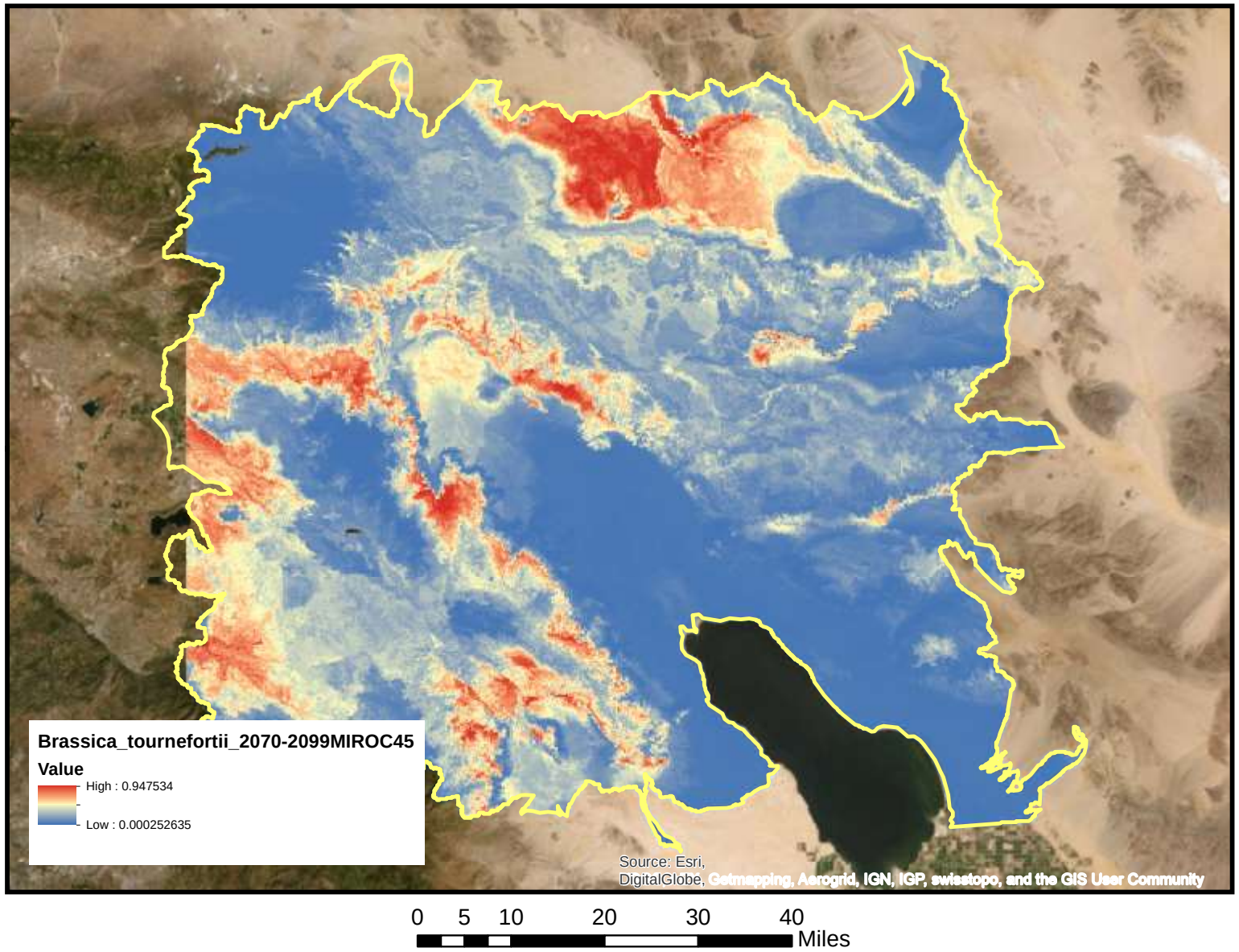
Current



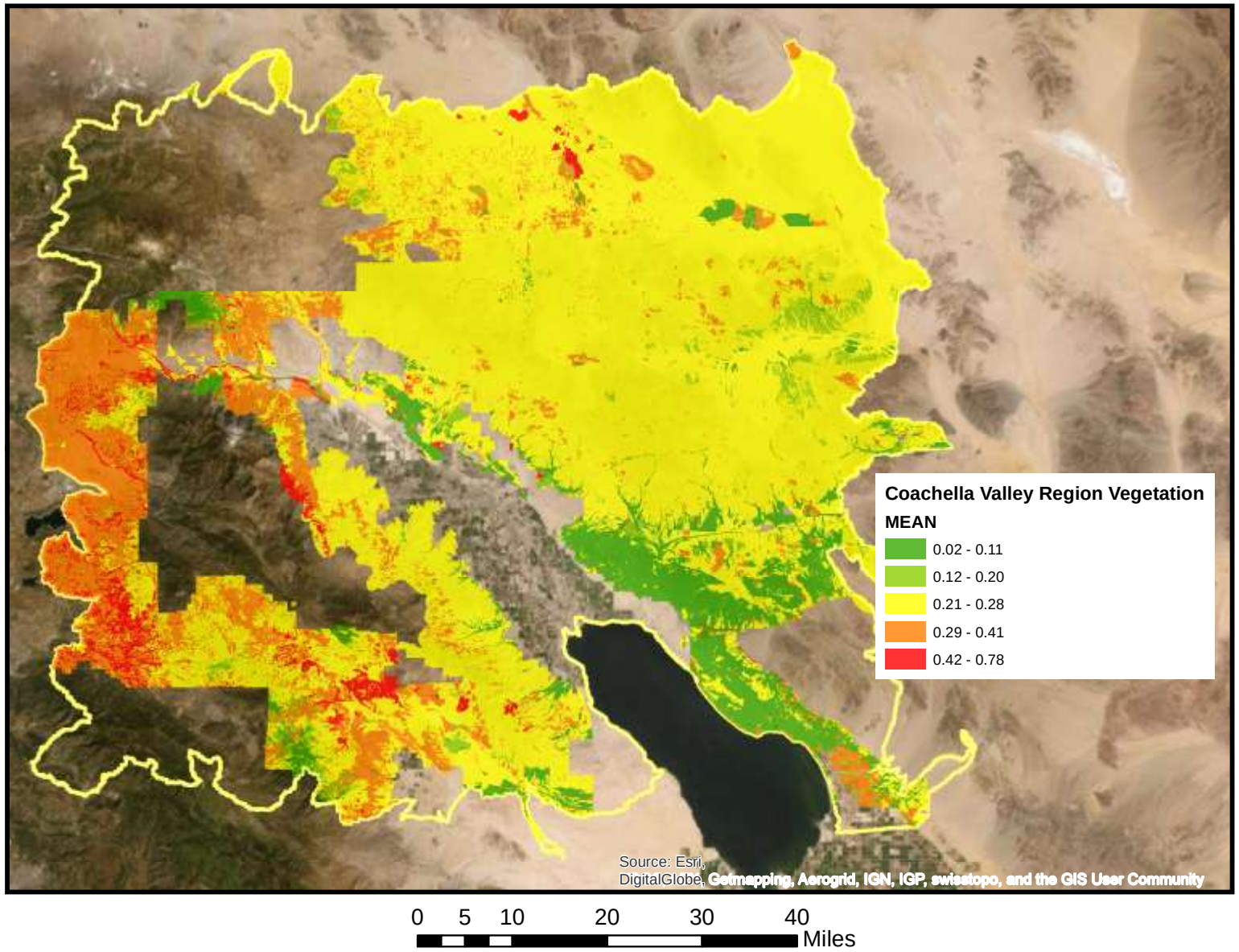
Lynn Sweet, Unpublished data

Future



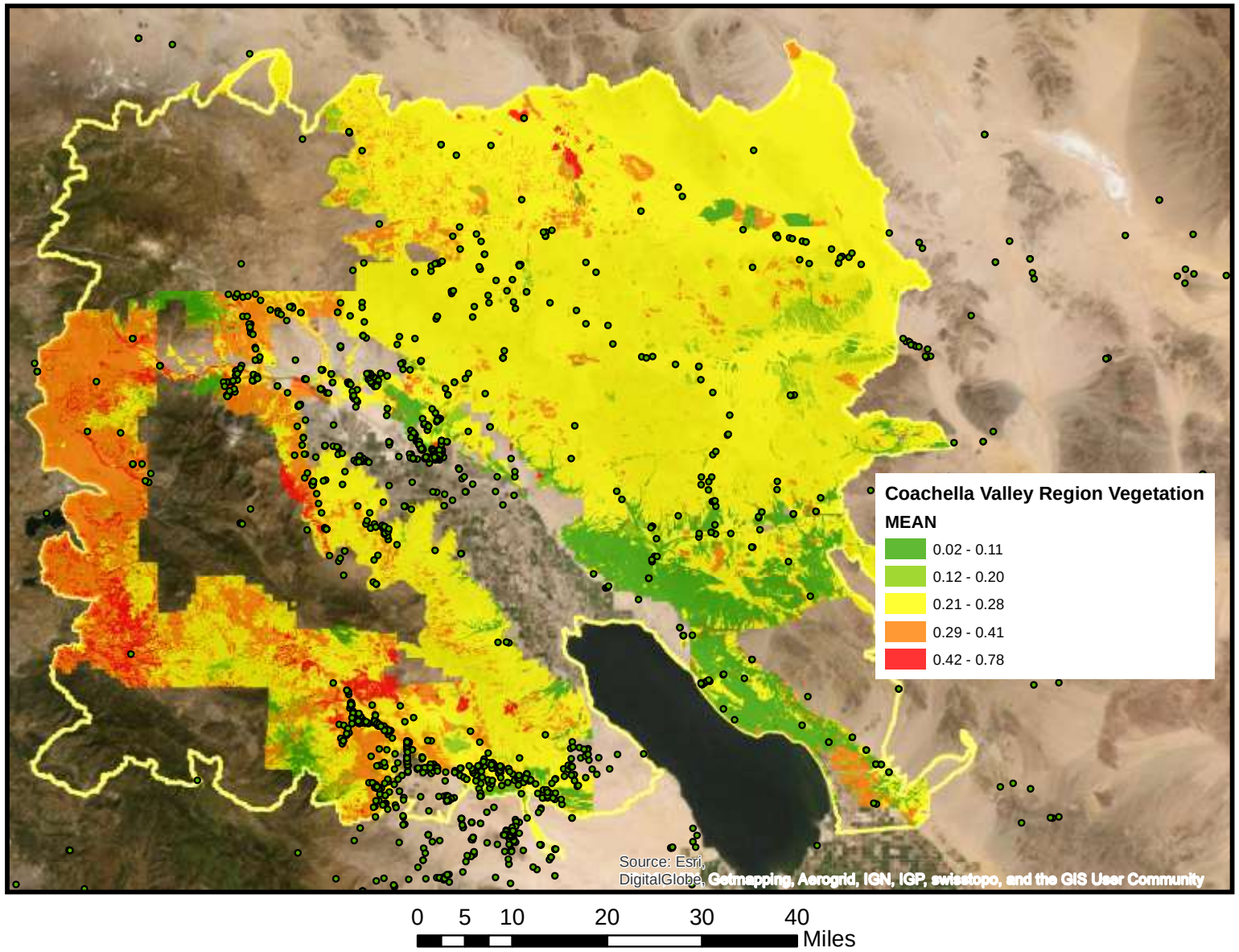
Lynn Sweet, Unpublished data

Future



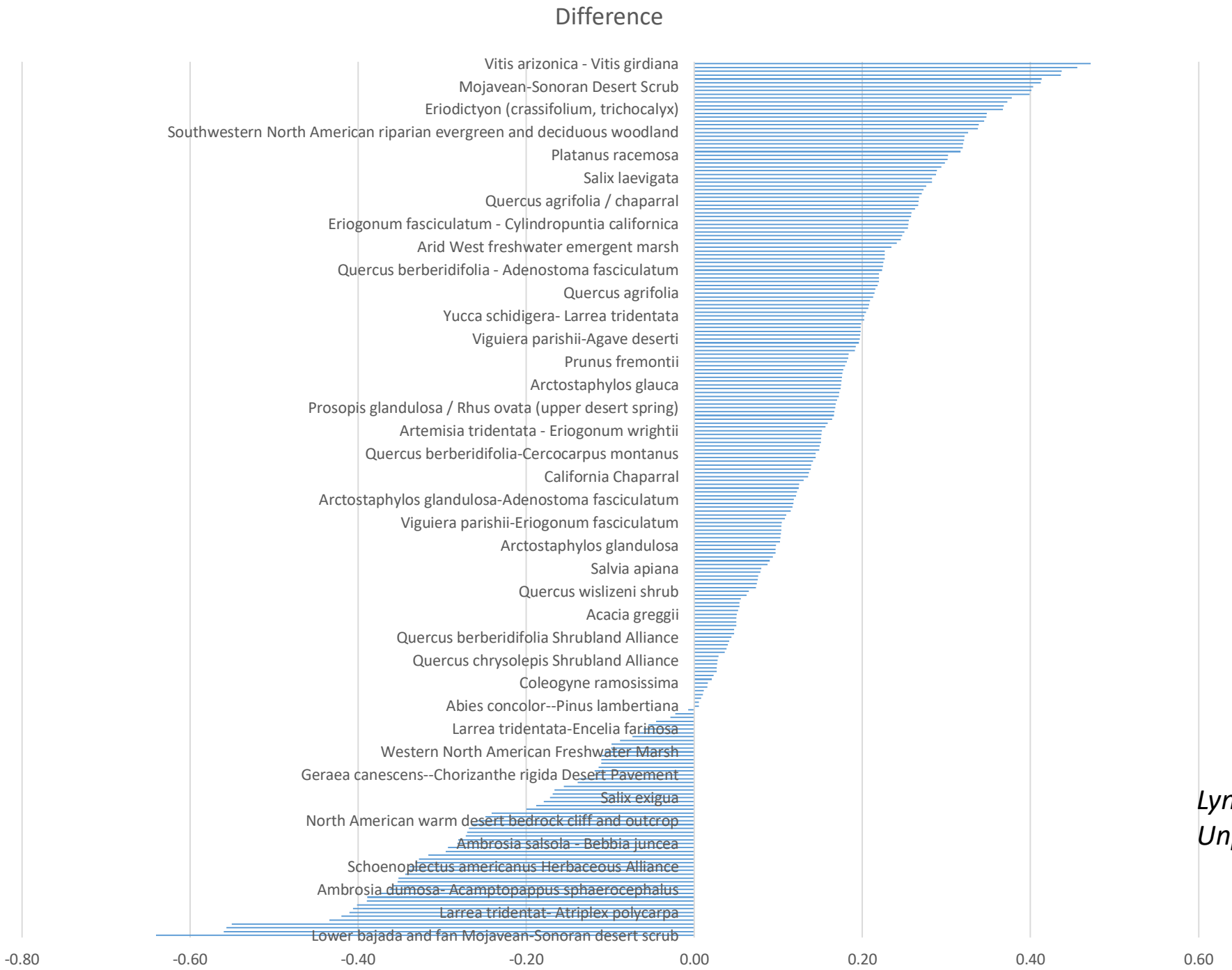
Lynn Sweet, Unpublished data

Future
Vs.
Current
Points



Lynn Sweet, Unpublished data

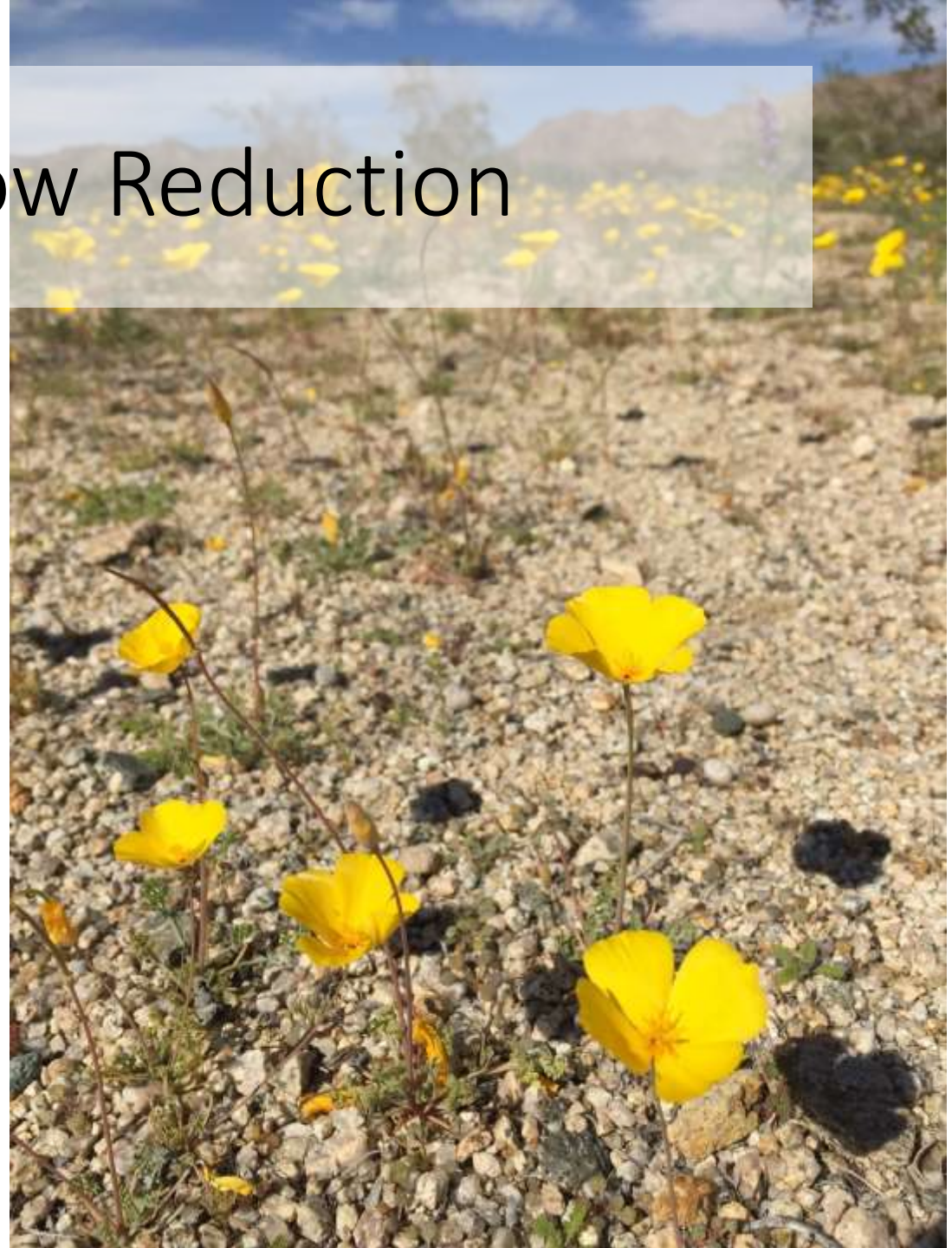
Future



Lynn Sweet,
Unpublished data

Top Types Predicted to Show Reduction

- Lower bajada and fan Mojavean-Sonoran desert scrub (-0.64)
- Agave deserti (-0.56) S
- Dicoria canescens--Oenothera deltoides Sparsely Vegetated Active Dune (-0.56) S
- Washingtonia filifera- Platanus racemosa / Salix spp (-0.55) S
- Larrea tridentata- Atriplex polycarpa (-0.41) S
- Atriplex hymenelytra (-0.41) S
- Psorothamnus schottii (-0.40) S
- Atriplex canescens--Atriplex polycarpa (-0.39) S



Top Types Predicted to Show Gain

- Vitis arizonica - Vitis girdiana (+0.47) *C*
- Baccharis emoryi (+0.46) *C*
- Salix gooddingii (+0.44) *C*
- Eriogonum fasciculatum - Simmondsia chinensis - Cylindropuntia californica (+0.44) *T*
- Adenostoma fasciculatum - Salvia mellifera (+0.41) *C*
- Ericameria palmeri (+0.41) *C*
- Mojavean-Sonoran Desert Scrub (+0.40) *M*
- Heteromeles arbutifolia - Quercus berberidifolia - Cercocarpus montanus - Fraxinus dipetala (+0.40) *C*
- Arctostaphylos glauca - Adenostoma fasciculatum - Rhus ovata (+0.37) *C*
- Eriodictyon (crassifolium, trichocalyx) (+0.37) *C*

Top Less-Common Types Predicted to Show Gain

- Vitis arizonica - Vitis girdiana (+0.47) C
- Eriogonum fasciculatum - Simmondsia chinensis - Cylindropuntia californica (+0.44) C
- Ericameria palmeri (+0.41) C
- Heteromeles arbutifolia - Quercus berberidifolia - Cercocarpus montanus - Fraxinus dipetala (+0.40) C
- Arctostaphylos glauca - Adenostoma fasciculatum - Rhus ovata (+0.37) C
- Salvia mellifera (+0.35) C

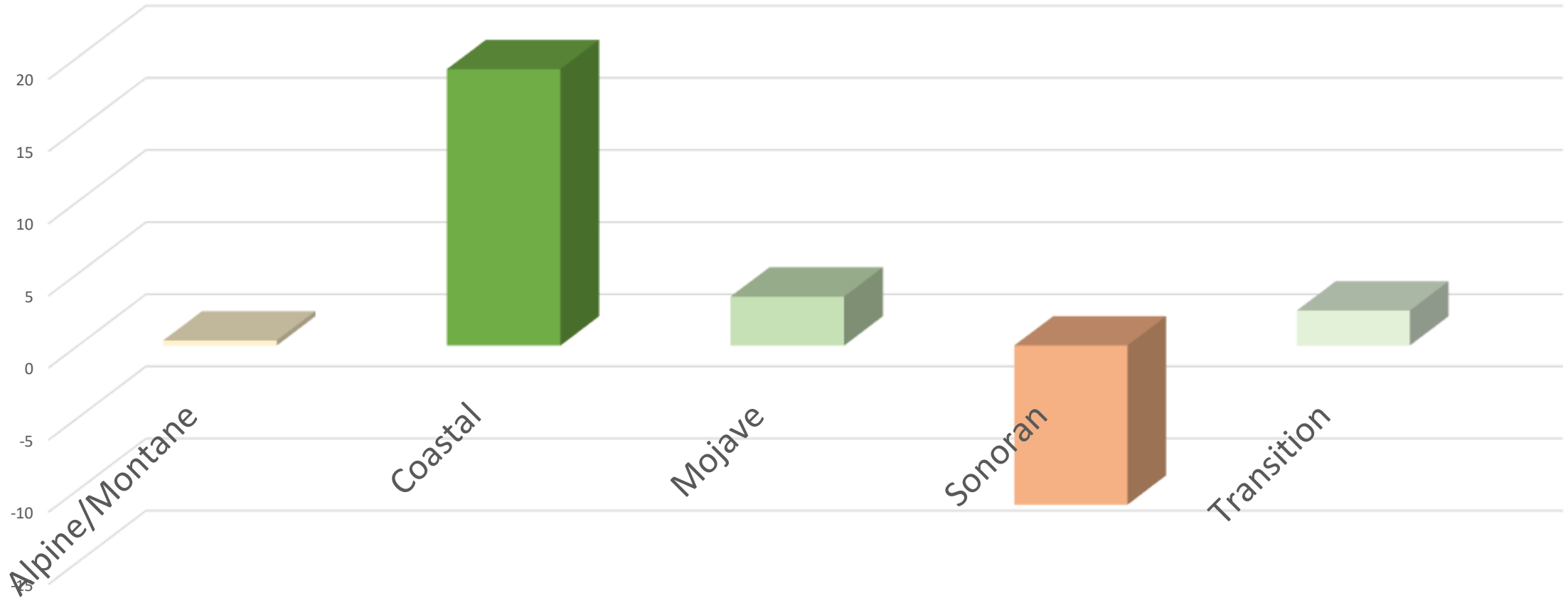
Top Common Types Predicted to Show Reduction

- Dicoria canescens--Oenothera deltoides Sparsely Vegetated Active Dune Provisional Alliance (-0.56) S

- Larrea tridentata- Atriplex polycarpa (-0.41) S

- Psorothamnus schottii Shrubland Provisional Alliance (-0.40) S

Expected General Trend Across Vegetation Types by Bioregion



Conclusions

- Higher temperatures and variation in rainfall → changes in species distributions
- Sahara mustard possible shift coast-ward
- Invasive annual species may disperse into new vegetation types
- Invasibility and new interactions may occur
- Conservation and restoration priorities should incorporate future species distributions of both existing invasive species and future invaders

Questions?

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