Some Drivers of Sahara Mustard Invasion: Surficial Geology and Primary, Secondary, and Tertiary Roads

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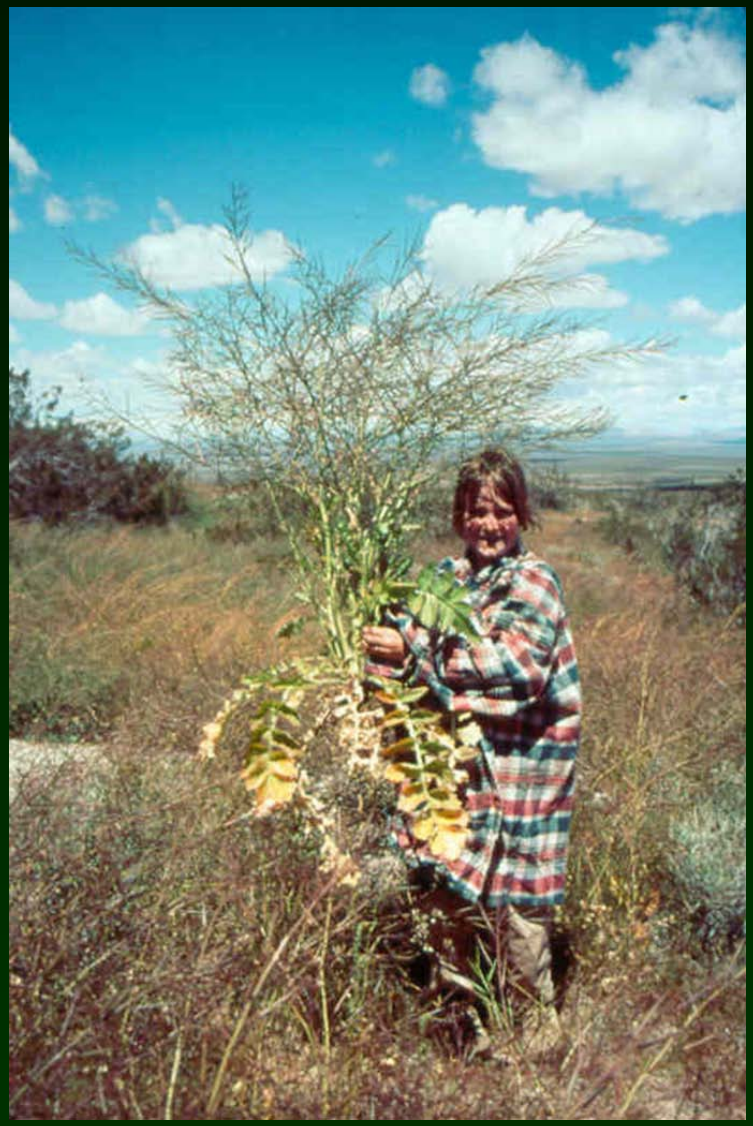
USGS
science for a changing world

Objectives

- Develop models of *Brassica tournefortii* (BRTO) invasion & establishment in the Colorado & Mojave deserts
- Identify contributing factors



Locations of 2 Study Areas

- Daggett
- Chemehuevi Valley

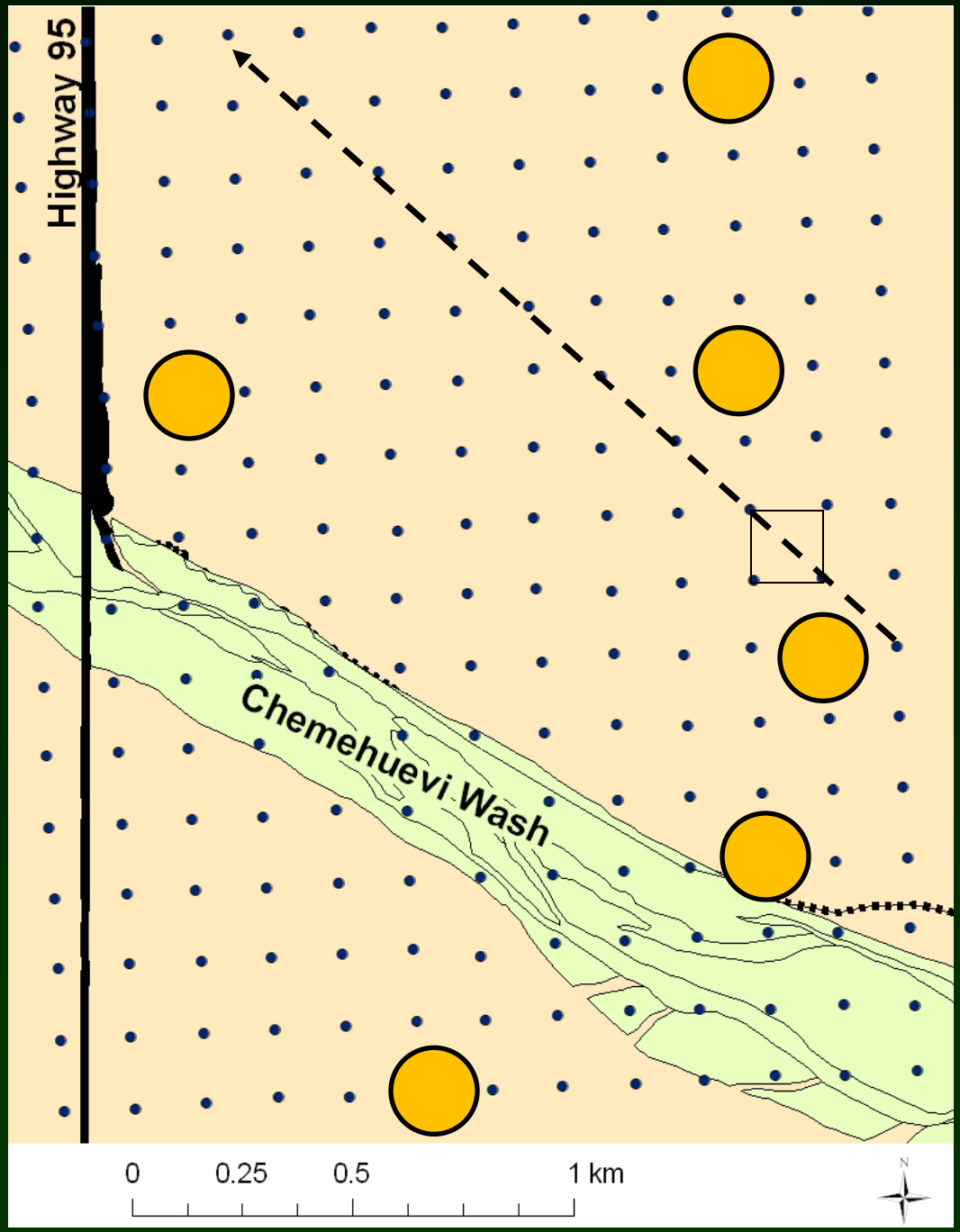
Objectives: Colorado Desert site

- Retrospective analysis of BRTO arrival
- Changes in BRTO distribution & density in 1999 & 2009
- Sources & contributors to BRTO invasion, density, distribution

Berry et al. 2014. Modeling mustard invasion. IPSM 7:599-7616

Chemehuevi Valley – 4.7 km^2

- 180 belt transects
- 6 annual plant transects



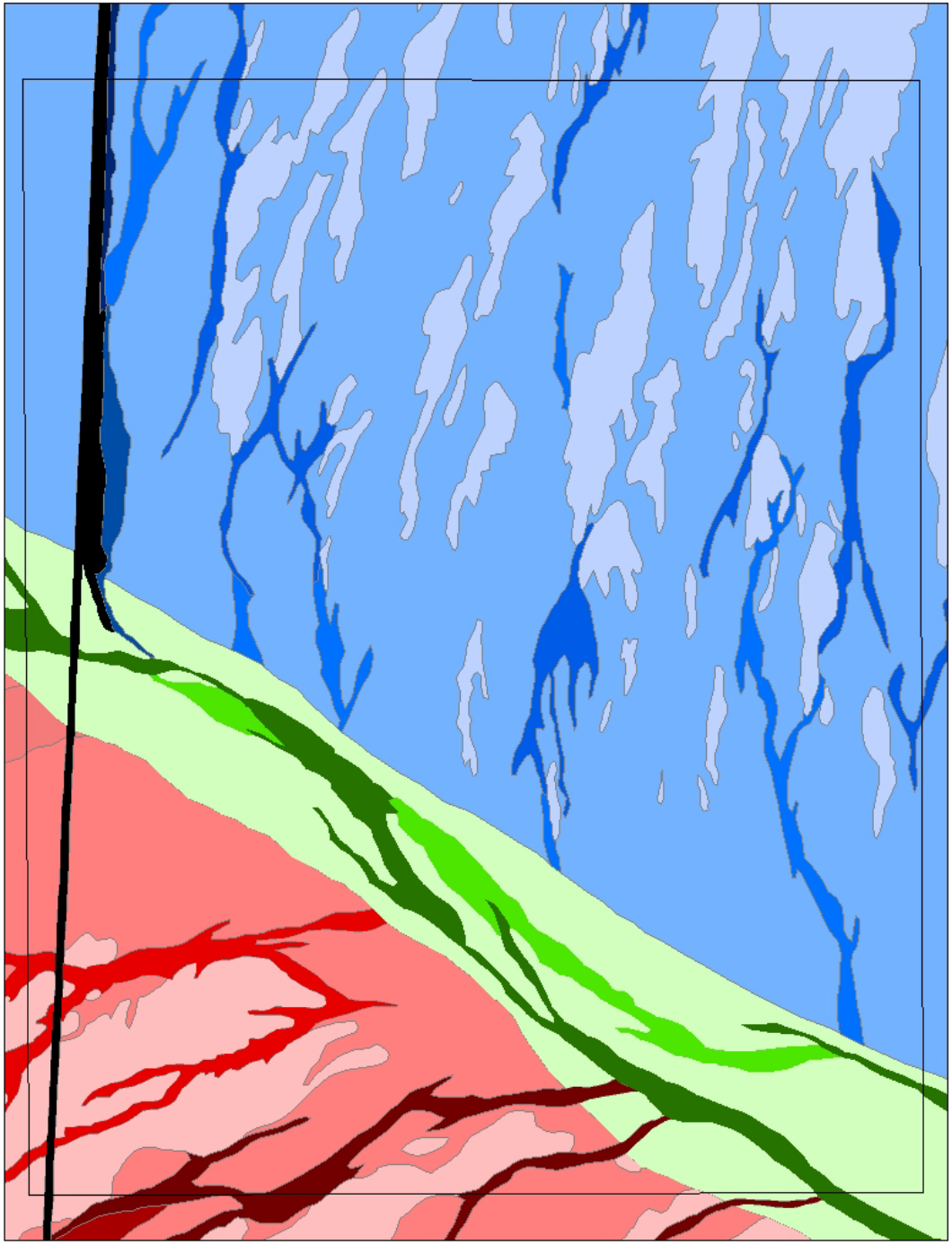
OPEN DESERT NORTH: small stream channels cutting through granitic soils

CHEMEHUEVI WASH: axial valley wash

OPEN DESERT SOUTH: volcanic origins, desert pavements

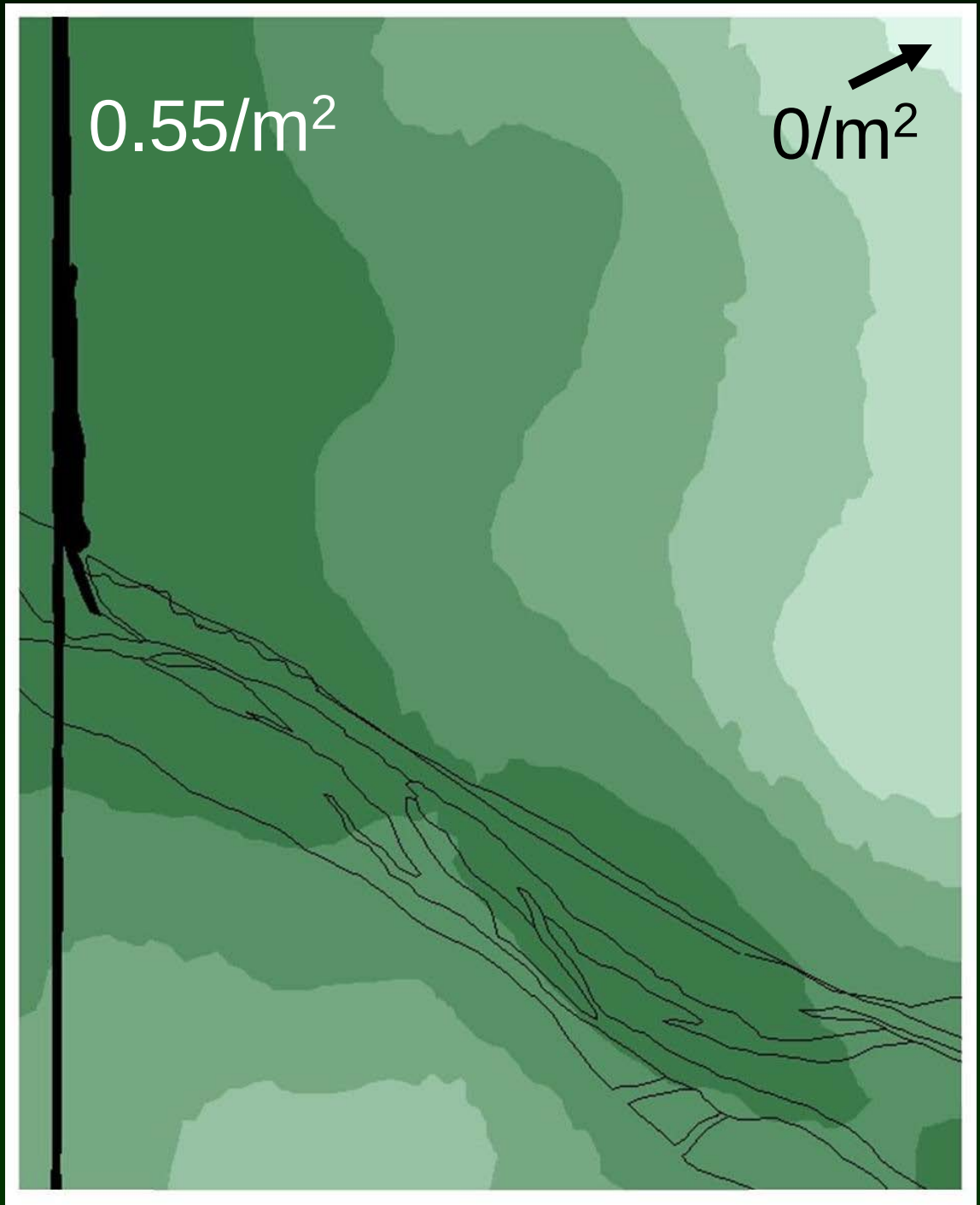
Surficial geology

- Open Desert N.: (granitic), ≥ 6000 yrs
- Wash, <200 yrs
- Open Desert S.: (volcanic), 20,000-300,000 yrs



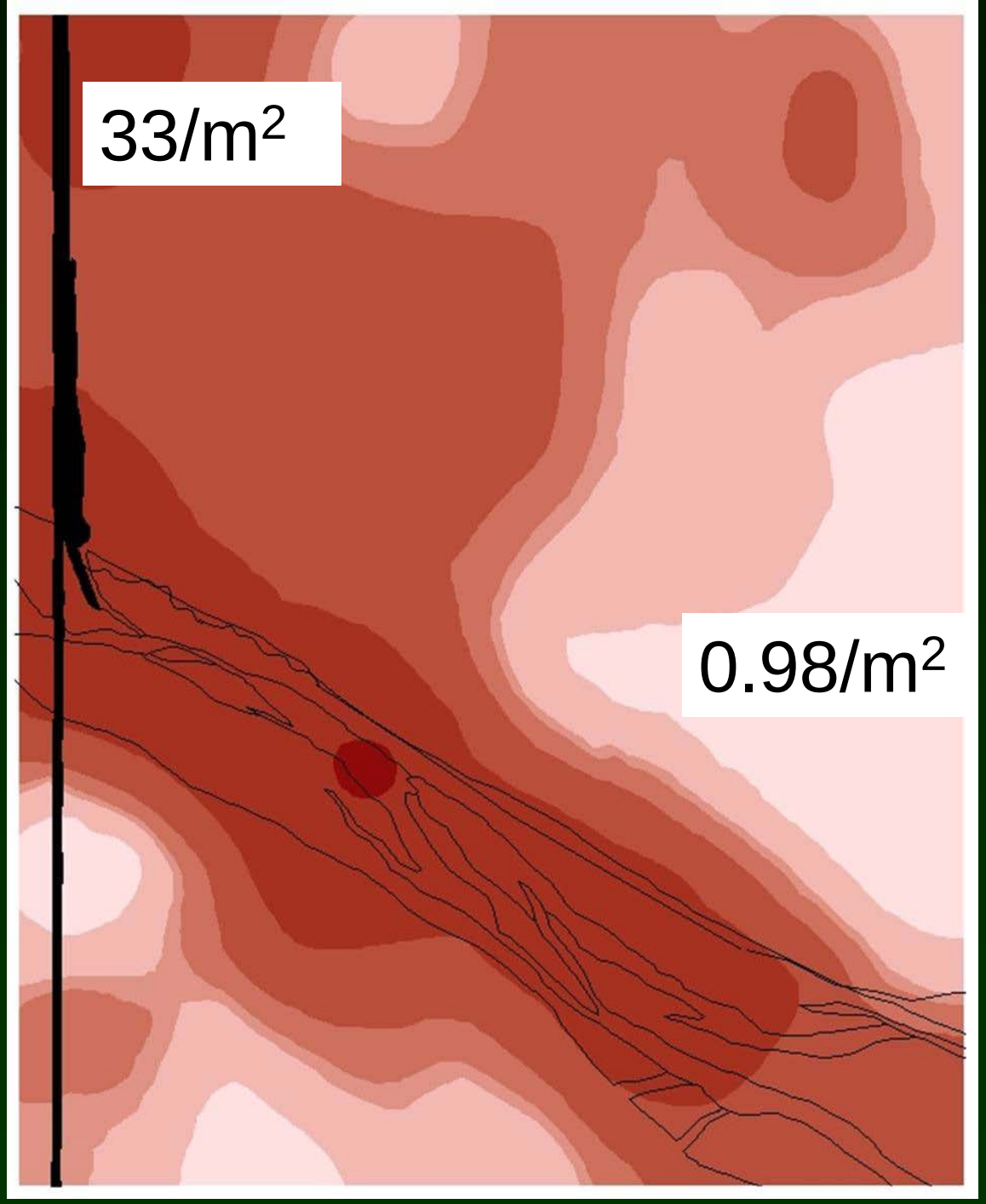
1999 BRTO densities

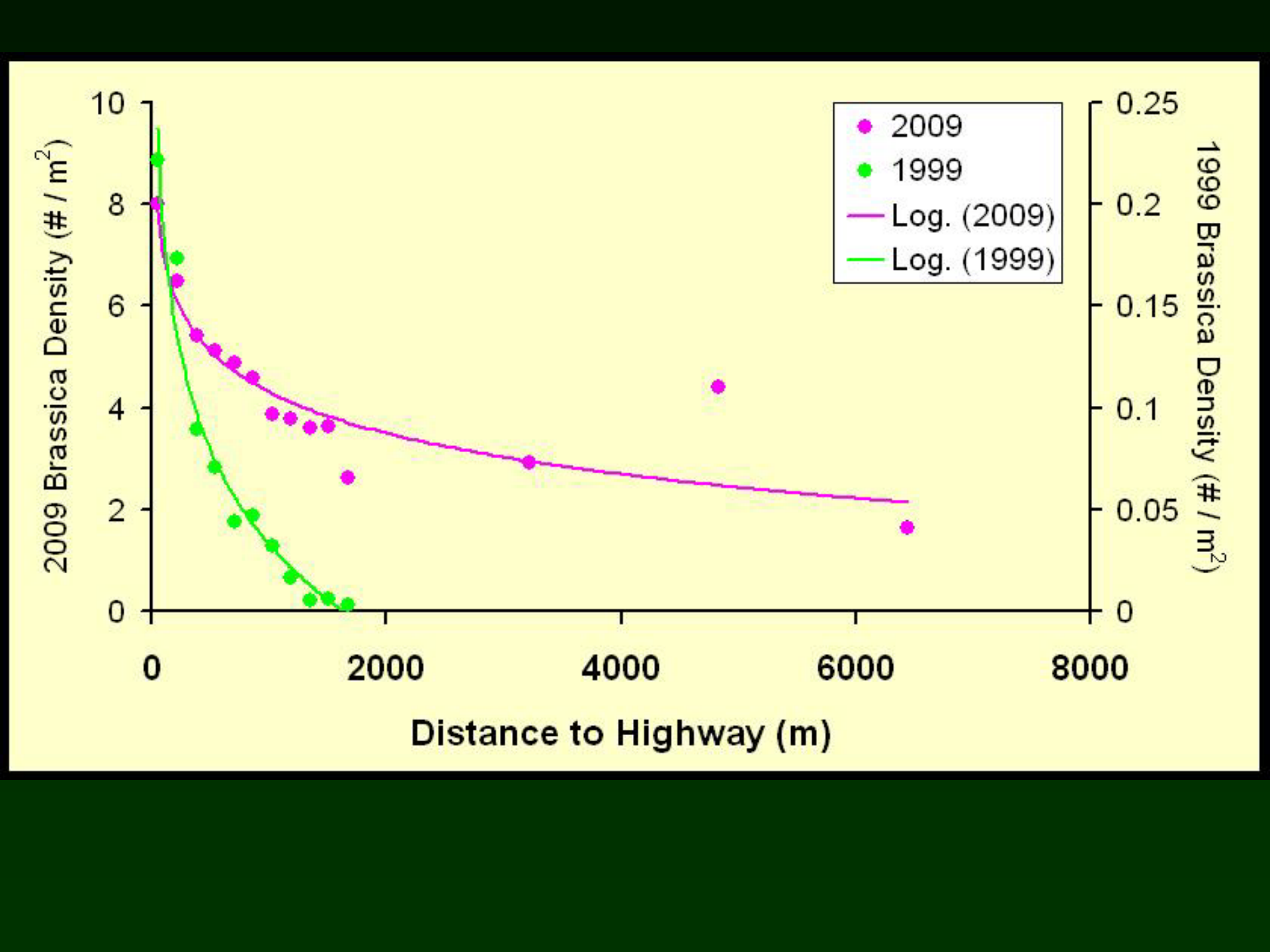
- Counts from 180 transects
- ordinary kriging
- contour maps of BRTO densities



2009: BRTO densities

- ~84 fold increase in BRTO




2009
1999
Log. (2009)
Log. (1999)
2009 Brassica Density (# / m2)
1999 Brassica Density (# / m2)
Distance to Highway (m)
0
2000
4000
6000
8000
0
2
4
6
8
10
0
0.05
0.1
0.15
0.2
0.25

General Linear Models

- Variables likely to influence BRTO density:
  - surficial geology/soils
    - Open Desert North
    - Chemehuevi Wash, axial valley wash
    - Open Desert South
  - distance to Hwy 95
  - Stream channels, and interactions

Predictor variables for 1999 *BRTO* density: GLM (non-spatial model)

Significant effects for:

- Surficial geo/soils
- Proximity to highway
- Proximity to axial Chemehuevi Wash
- Increasing # of ephem. stream channels

Predictor variables for 2009 BRTO Density (power covariance model, GLMs)

Significant effects for:

- Surficial geo/soils
- Proximity to Hwy 95
- Increasing # stream channels

Vulnerablities:

- Axial Valley wash
- Small, ephemeral stream channels

Young surfaces and soils are vulnerable

Old surfaces are least vulnerable

Summary- Chemehuevi

- BRTO can invade from roads,

large and small stream channels

- Old geological surfaces & pavements less vulnerable than young surfaces
- High potential for negative effects on
  - Vegetation, tortoises, ecosystems

Objectives: Mojave Desert site

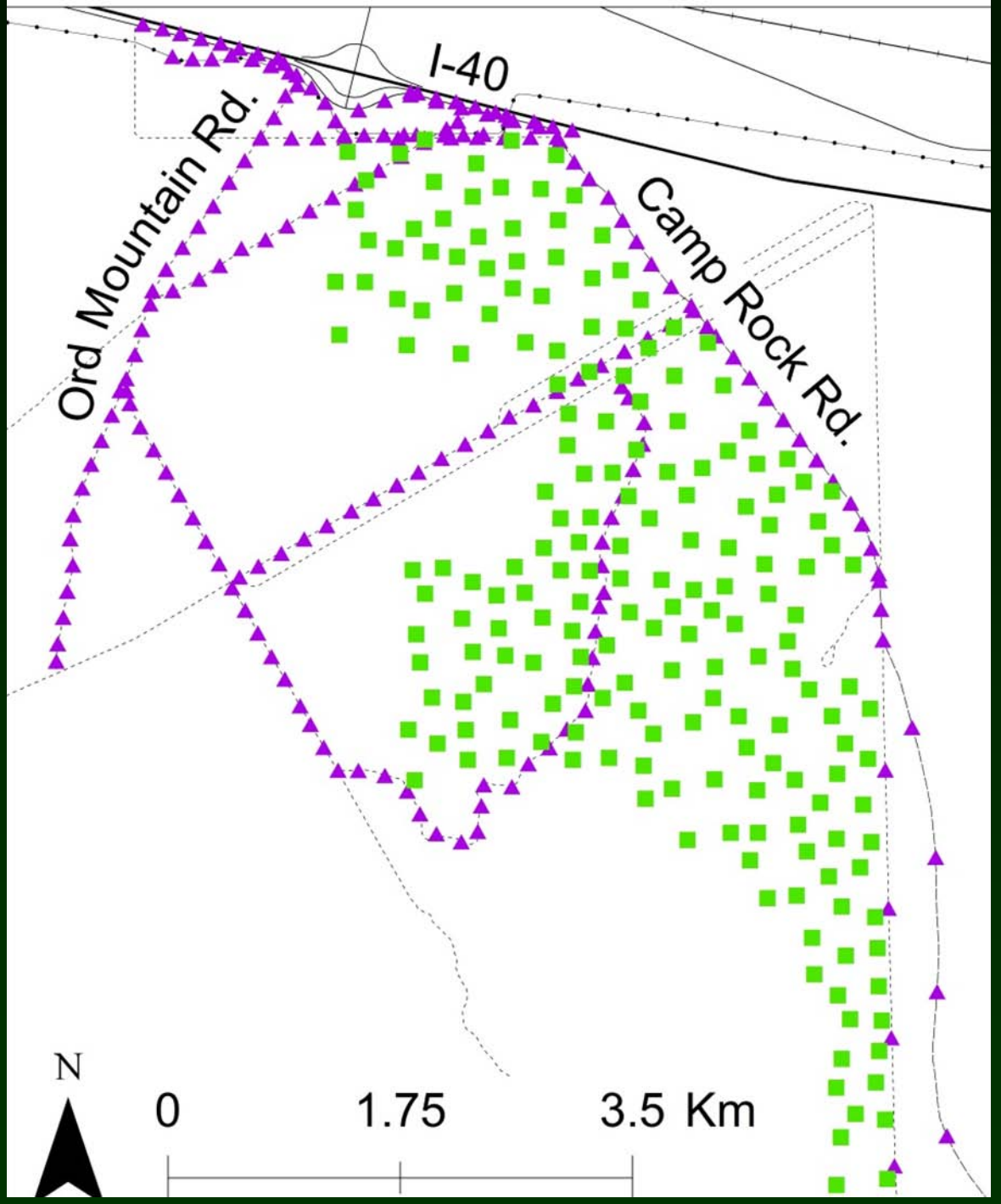
Background: 2005, observed BRTO in early stage of invasion. 2010, collected data

- Evaluate roles of paved & dirt roads, e.g., roads associated with utility rights-of-way
- Model & identify factors contributing to invasion & establishment

~41 km^2 study area

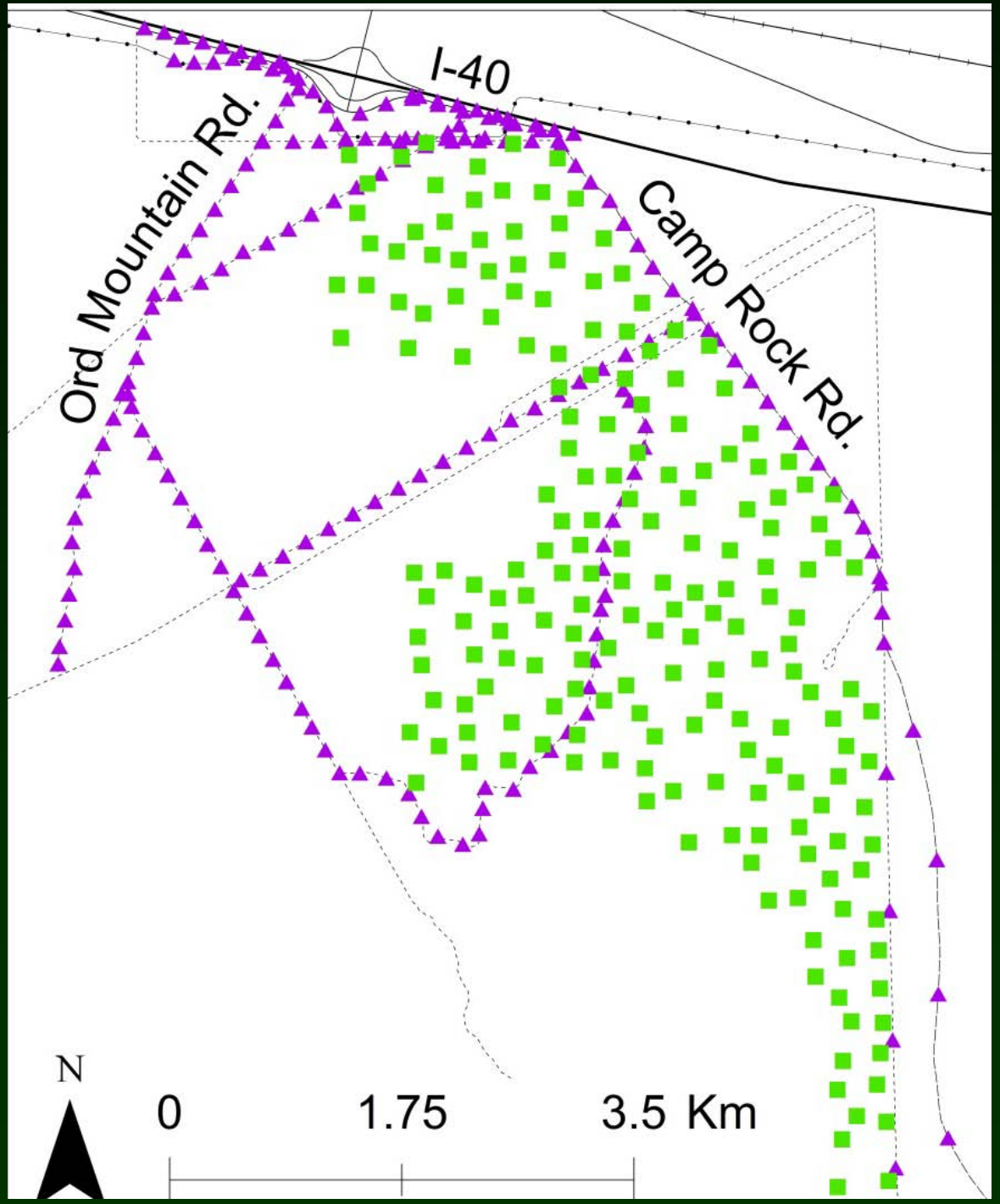
Study area & road types

- 1°: I-40
- 2°: County road
- 3 °: 7 utility-line roads, 1 mining & rec. road, & Kern pipeline



Transects: each 2 x 100 m

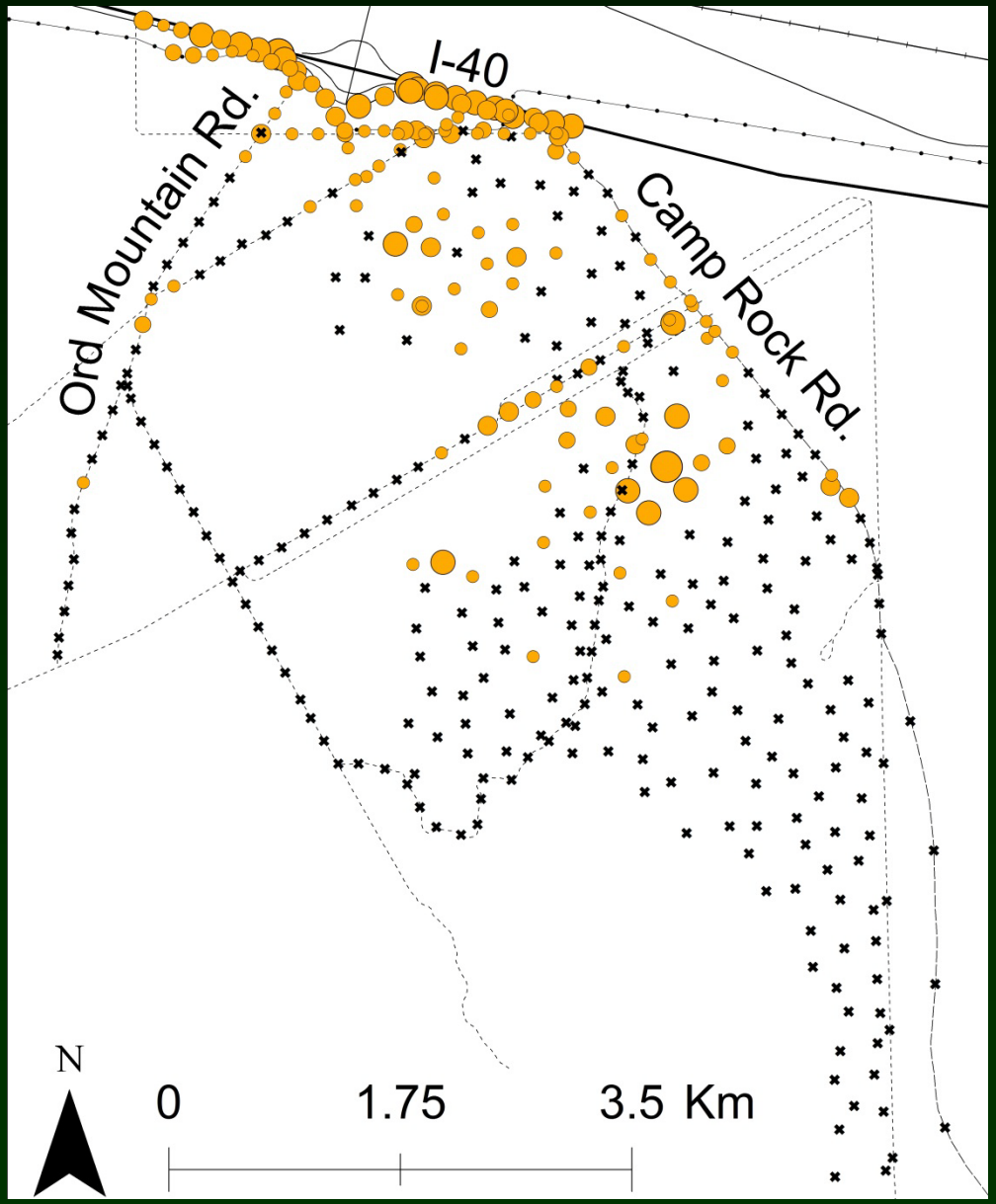
- 199 on road berms
- 199 on hectare plots



Summary: BRTO abundance & location

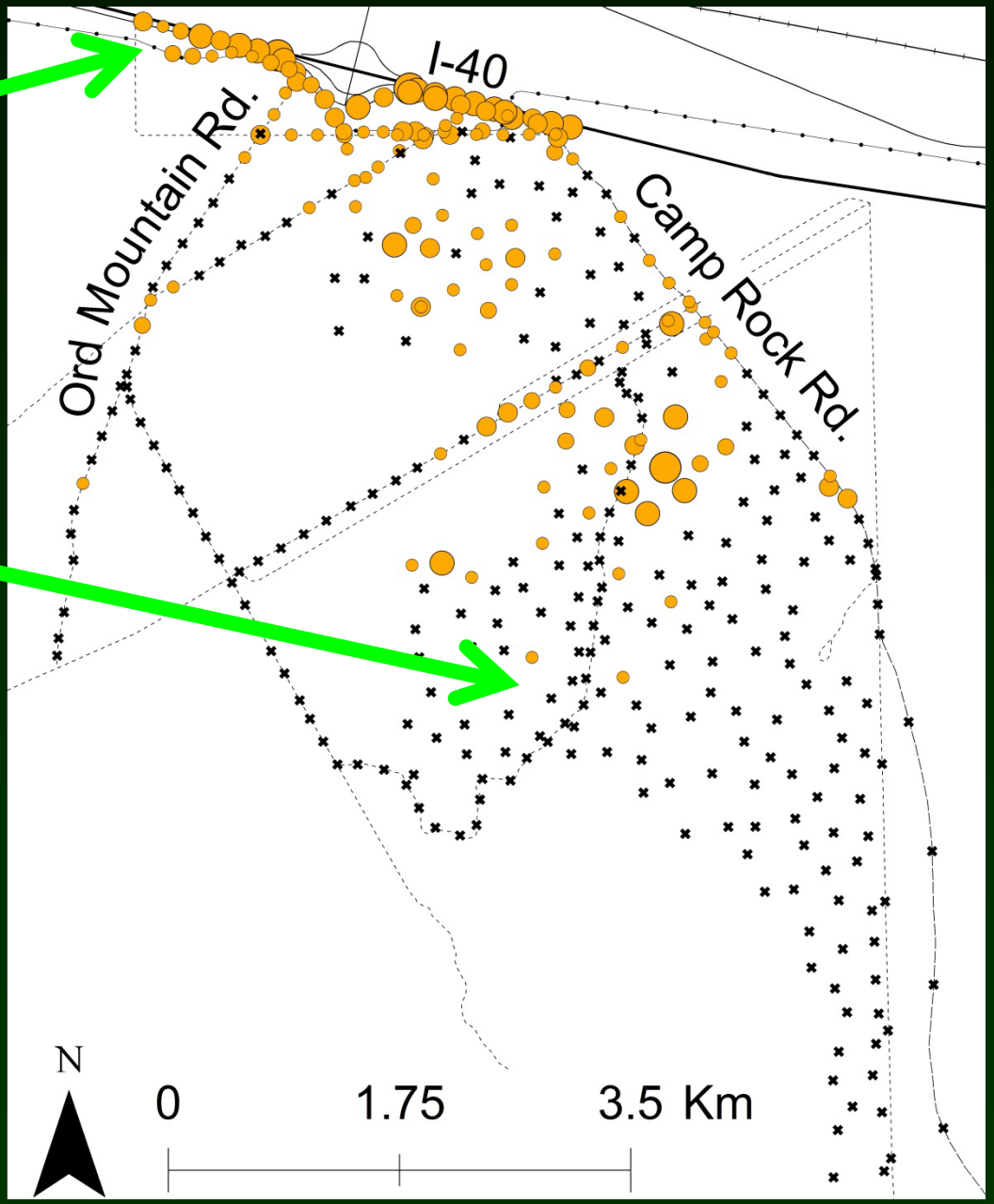
Brassica
(number per transect)

- 0
- 1 - 25
- 26 - 50
- 51 - 200
- 201 - 600
- 601 - 1800



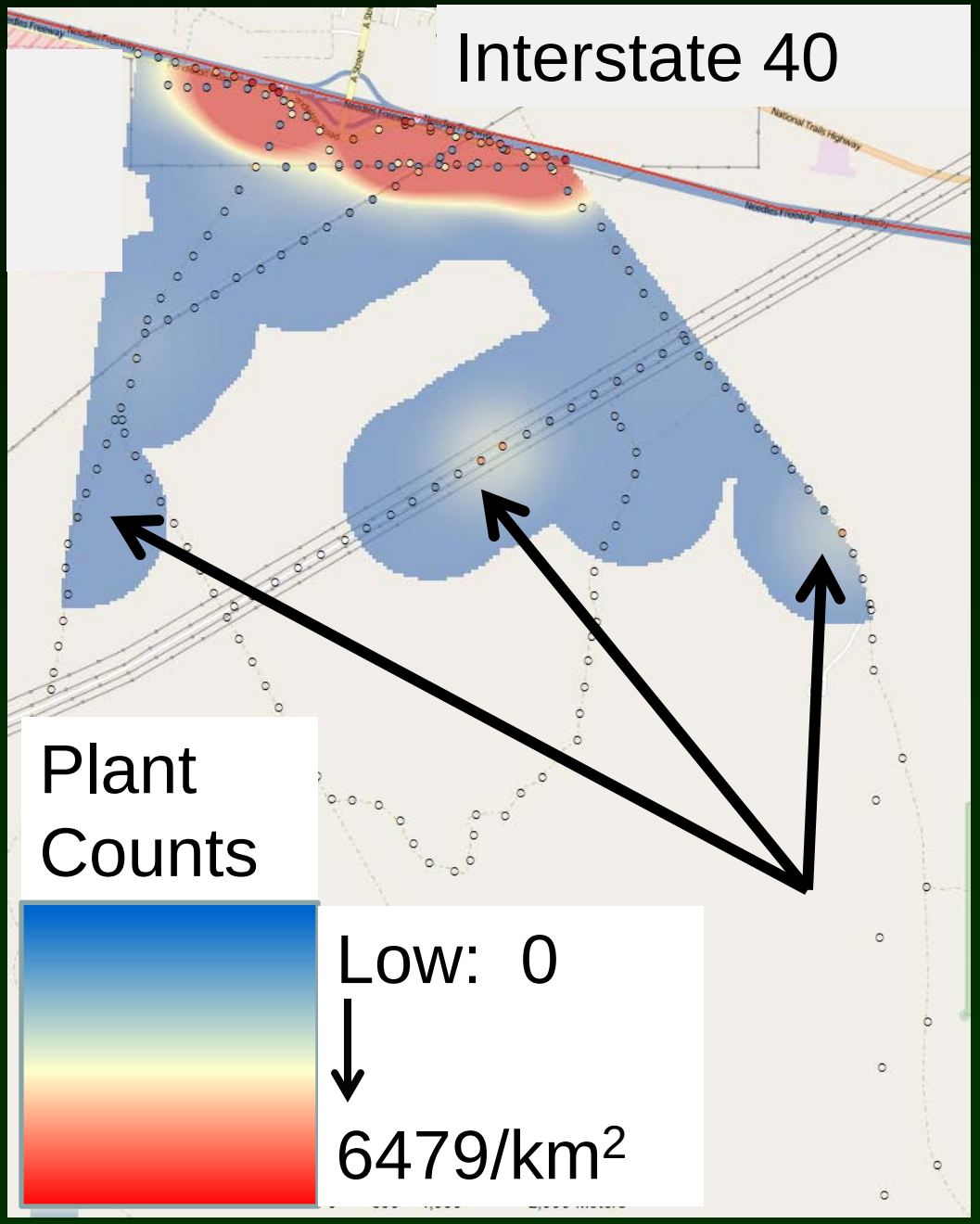
Summary: abundance & location

- BRTO on all I-40 transects
- More BRTO on east than west roads
- Most distant BRTO from I-40: 3.5 km



Road berm BRTO counts:

Used optimized hot spot analysis

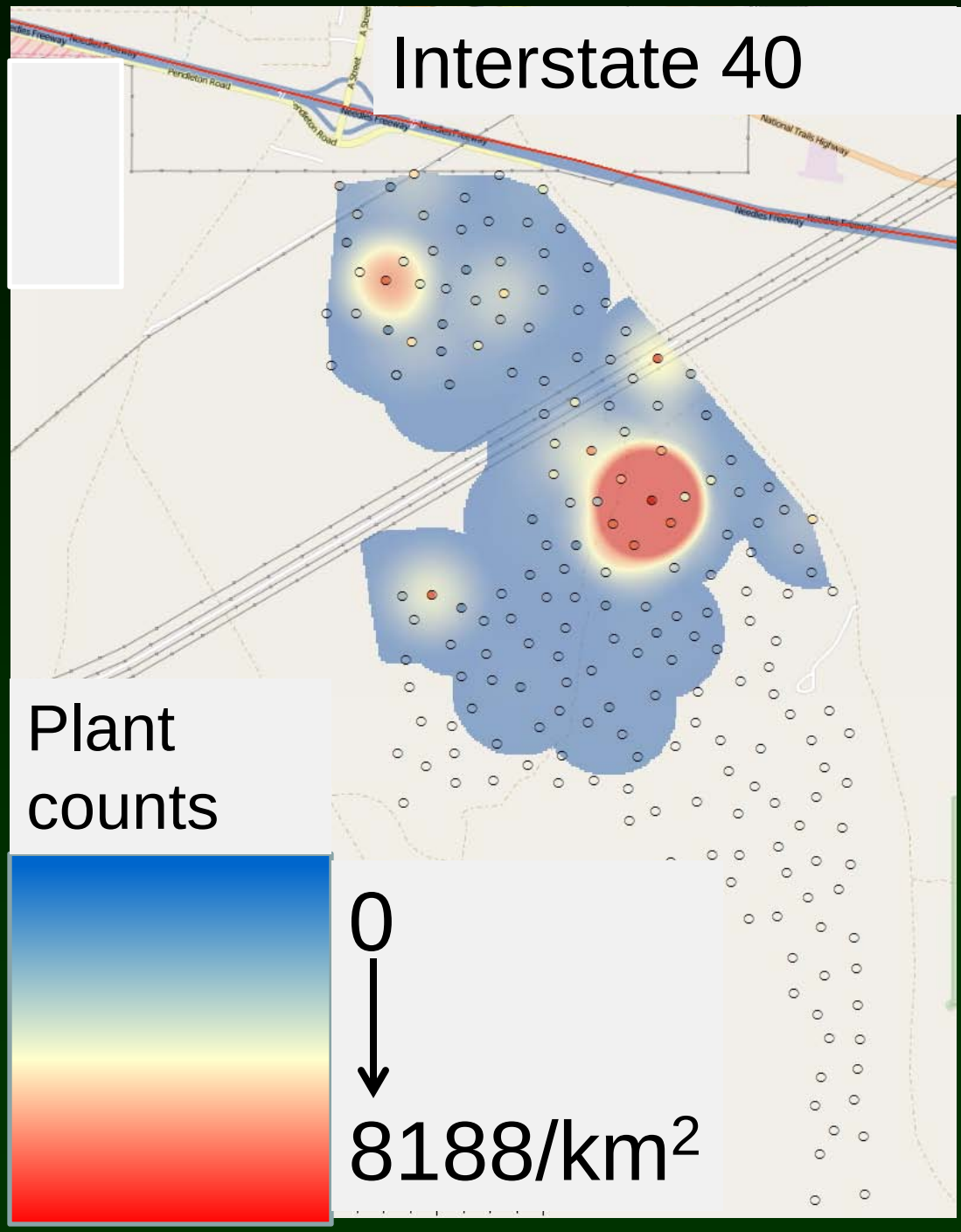


Findings from GLMs: Road berms

- High BRTO counts positively associated with proximity to 1˚ (I-40) and 3˚ roads
- Interactions between 1˚ & 2˚ roads also significant

Hectare plot transects

- 25% of plots had BRTO
- Highest BRTO count in a transect: 1765 **&**
- Closest road: 3°

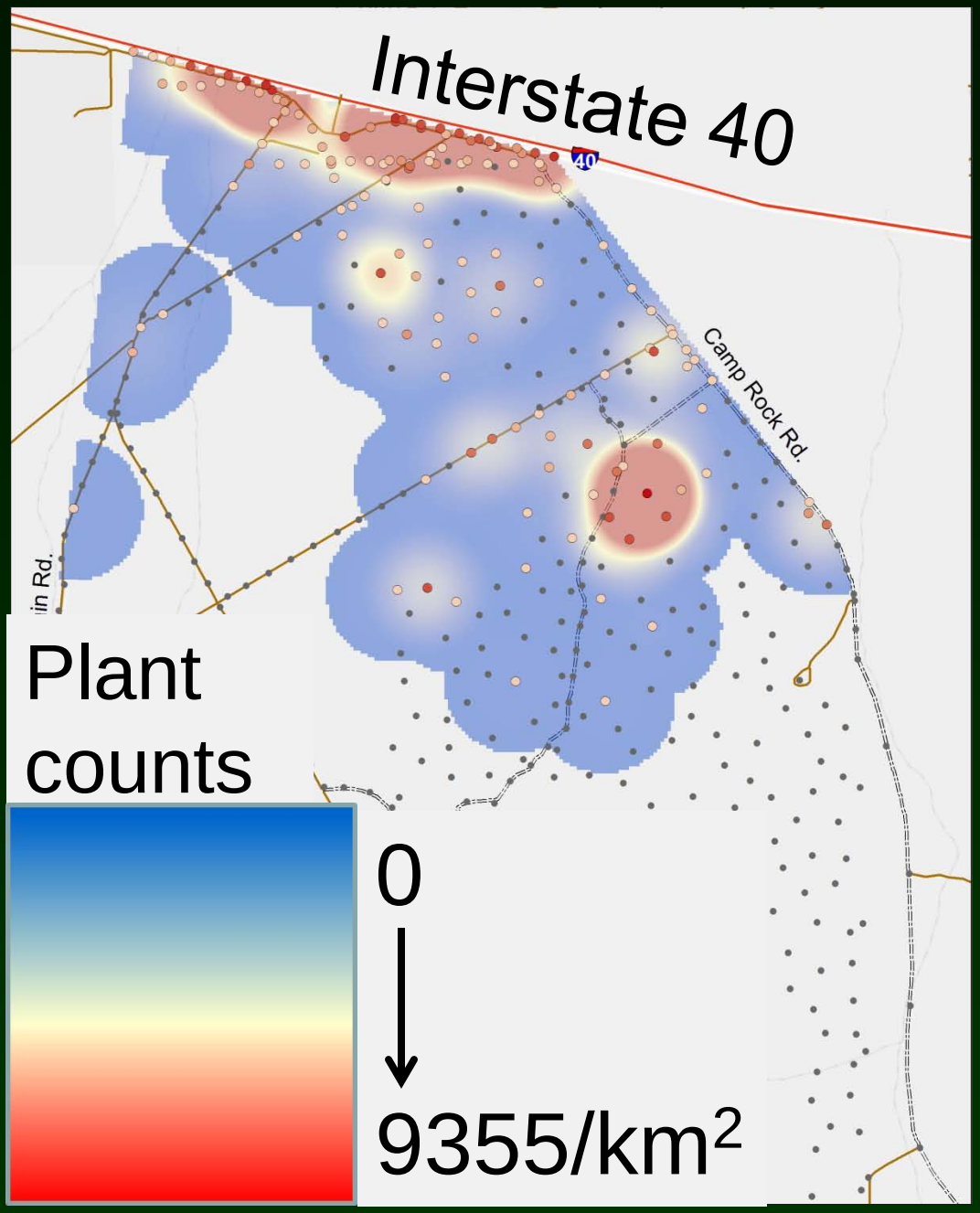


Findings: BRTO on hectare transects

- Distance to the 2˚ road had significant positive effect
- Probability of BRTO increased by proximity to 2˚ road
- Interactions of distances to all 3 road types were significant

Combined 2 data sets for visual eval.

- All 3 road types important, synergistic effects
- Once BRTO arrives to interior desert, can establish & spread without roads

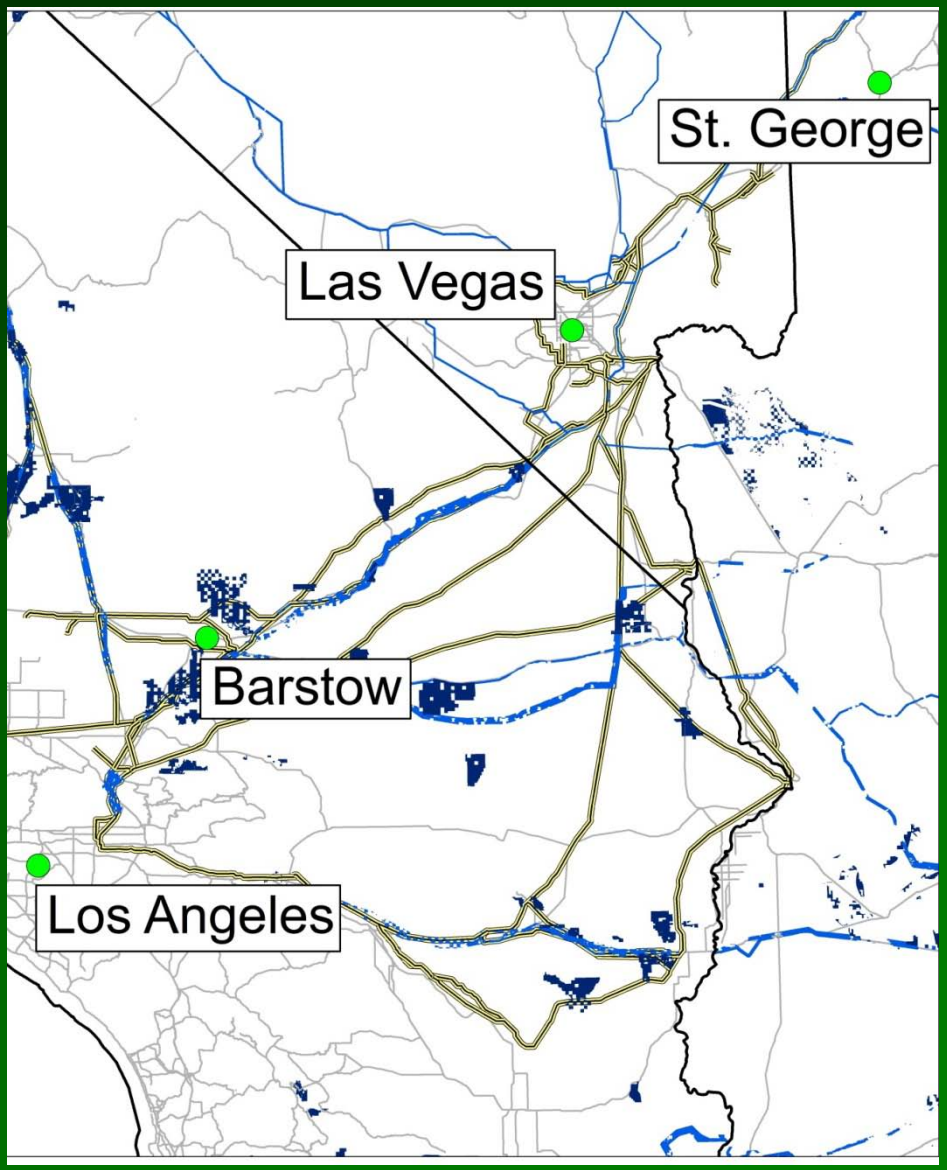


Applications:

- Early warning, *Weed Sentry Program* similar to NV, highly desirable
- Use geological maps, identify surficial geology
- Use topo maps to identify stream channels

Abella et al. 2009. Environ. Monit. Assess. 151:221-230

- Use road, utility & transmission line maps
- Ensure active weed control for roads, rights-of-way, utilities



Major Cities
Roads
Transmission Lines:
Existing
PEIS
Renewable Energy
Transmission Corridors

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