Integrating ecological, social, and economic perspectives on the spread of weeds in CA

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(Integrative Graduate Education, Research, & Training)

Outline

- Rationale
- Overview of project components
- Four components
- Thoughts on collaborating

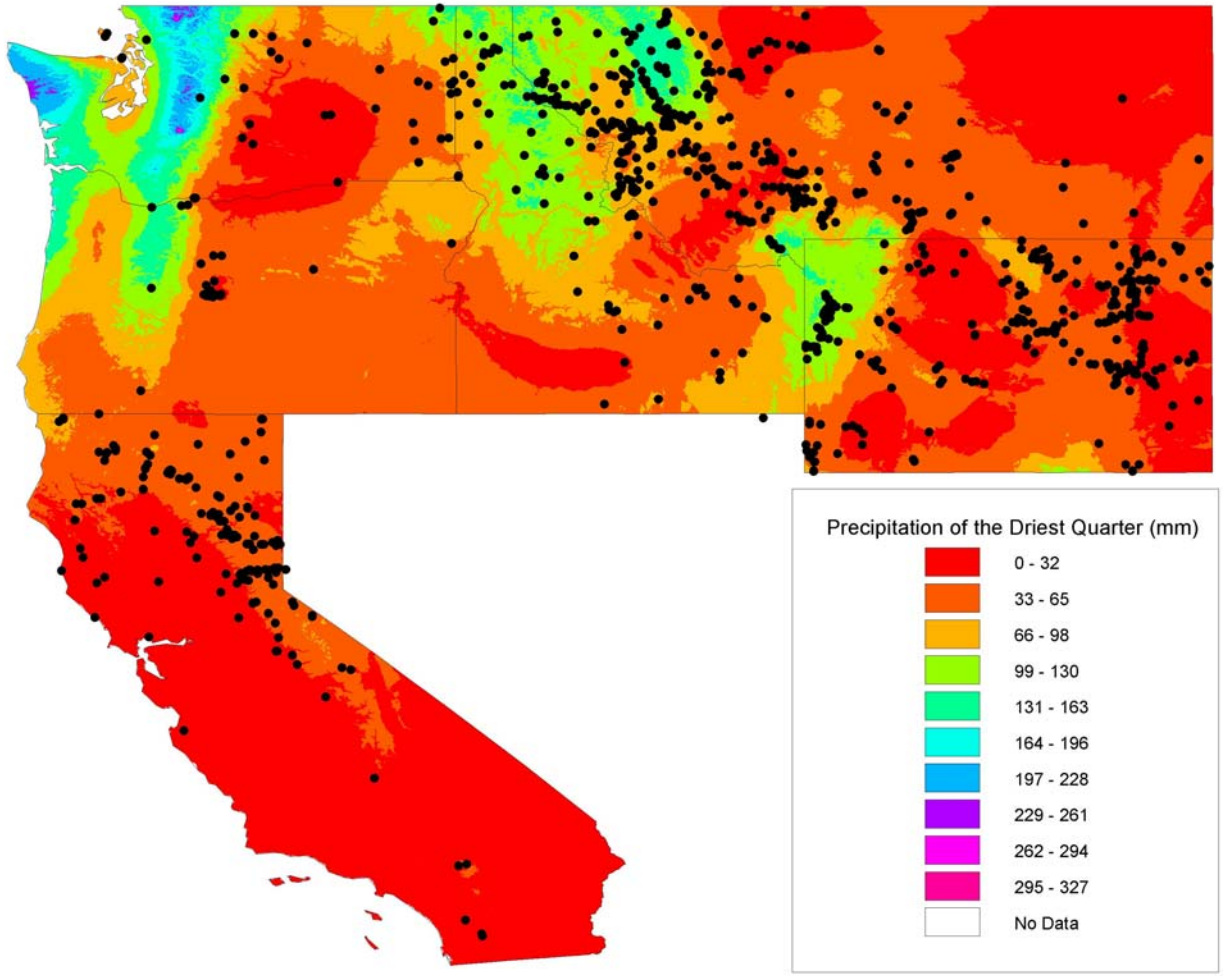
Rationale

- Need tools to predict risks and costs of spread on relevant space-time scales
- Connect and integrate biological models with social and economic factors
  - human mediation of dispersal, land use patterns, economic costs & benefits
- Spotted knapweed
  - early spreader in CA (<5%)

Overview: project components

- Predicting potential range
- Vector analysis
- Forecasting risk - dynamic spatial models
- Economic and futures scenarios

Predicting potential range



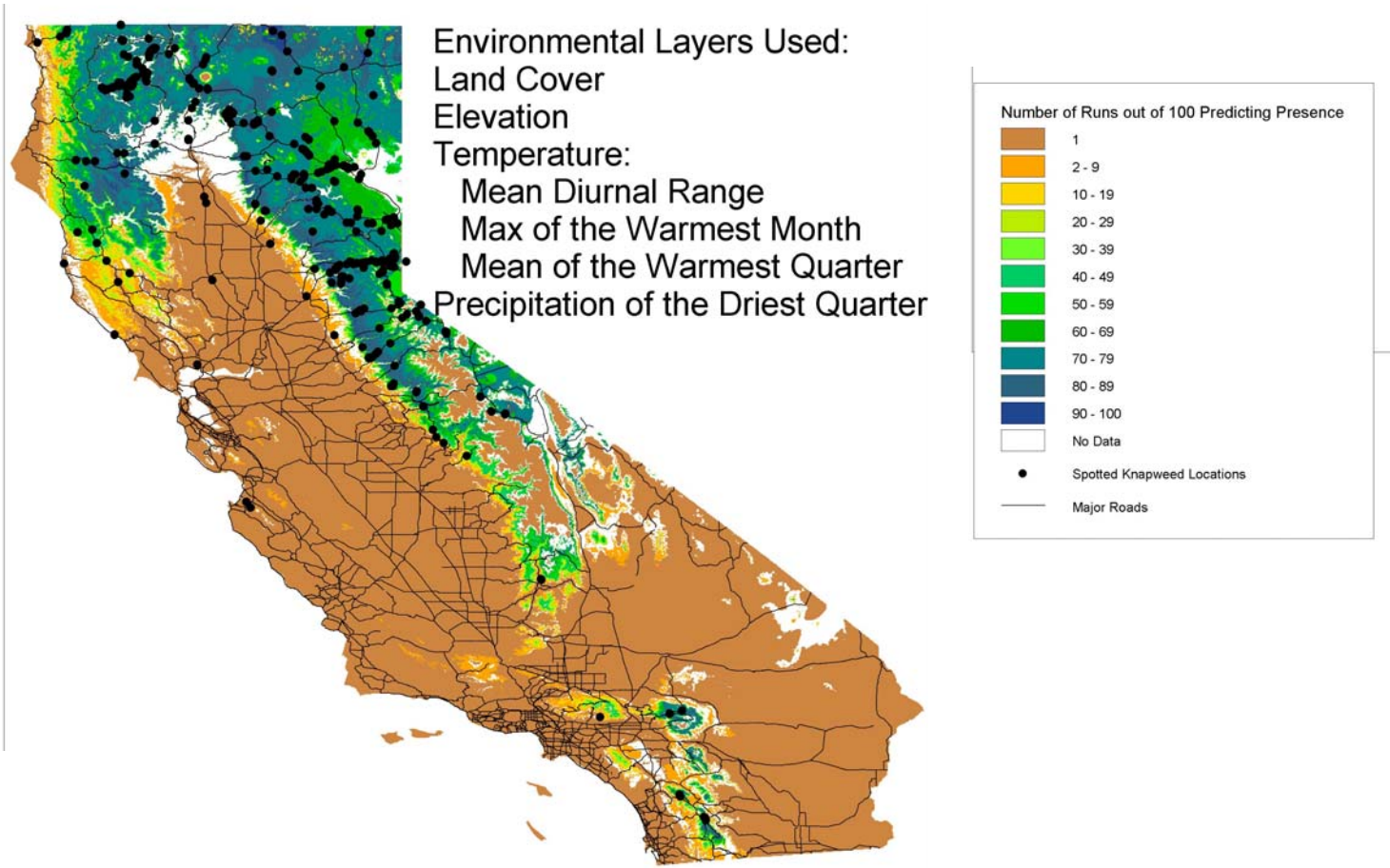
Sam Veloz

Landscape variables

WA, OR, ID, MT, WY

Genetic algorithm

Predicting potential range



Vector analysis

- Possible spread vectors: “Expert opinion”, land managers
- How important are spread vectors such as construction crews, hikers, fire equipment?
- Are there significant vectors that we might not have considered?
- How many sites originate from in versus out-of-state?

Collected more detailed information for about 40 sites

- Email posting on Cal-Weed-Talk Listserv
- Follow up contacts, contacts through Steve and CDFA, through Kari's work in N. California
- Historical records
- Information gathered from Forest Service, BLM, CDFA, State Parks, local community groups

Possible Vectors

Road Unspecified (I.e. blowing hay, private vehicle or via road crews)	15
Road Equipment	3
Straw/Hay/Alfalfa Seed Off Truck	3
Straw/Hay/Alfalfa Seed Planted	3
Straw/Hay/Alfalfa Seed from Livestock Use	1
Logging Equipment or Activities	3
Fire Equipment or Activities	5
Construction Equipment or Activities	8
Log Home Kit	2
Contaminated Christmas Trees	1
Campers	1
Hiker Transplanted (intentional)	1
Unknown	1

Forecasting risk: dynamic spatial models

- What is the probability that a location will become infected in X years
- Data defined models (avail. data)
- Consider alternative spread mechanisms – compare using data
- Need a statistical framework

Statistical model

- Estimate risk (p) from data
- Data: location + date occupied (observed)
- Presence only data
- Conditional likelihood

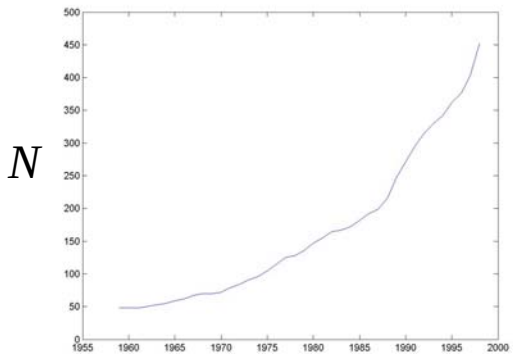
Alternative spread models

risk p_i —link→ "mechanistic" model η_i

$\eta_i = \beta_0$ Random dispersal from out of state

$\eta_i = \beta_0 + \beta_2 N_{i-1}$ Random out-of-state + within-state FOI

Force of invasion (FOI)



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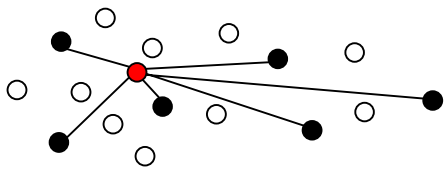
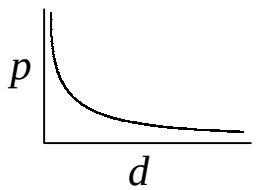
$\eta_i = \beta_0 + \beta_2 \sum_{z=1}^{\Omega} w_z e^{-\alpha d(x,z)}$ Within-state FOI: distant dependent

Occupancy (i-1) Dispersal kernel





Alternative spread models

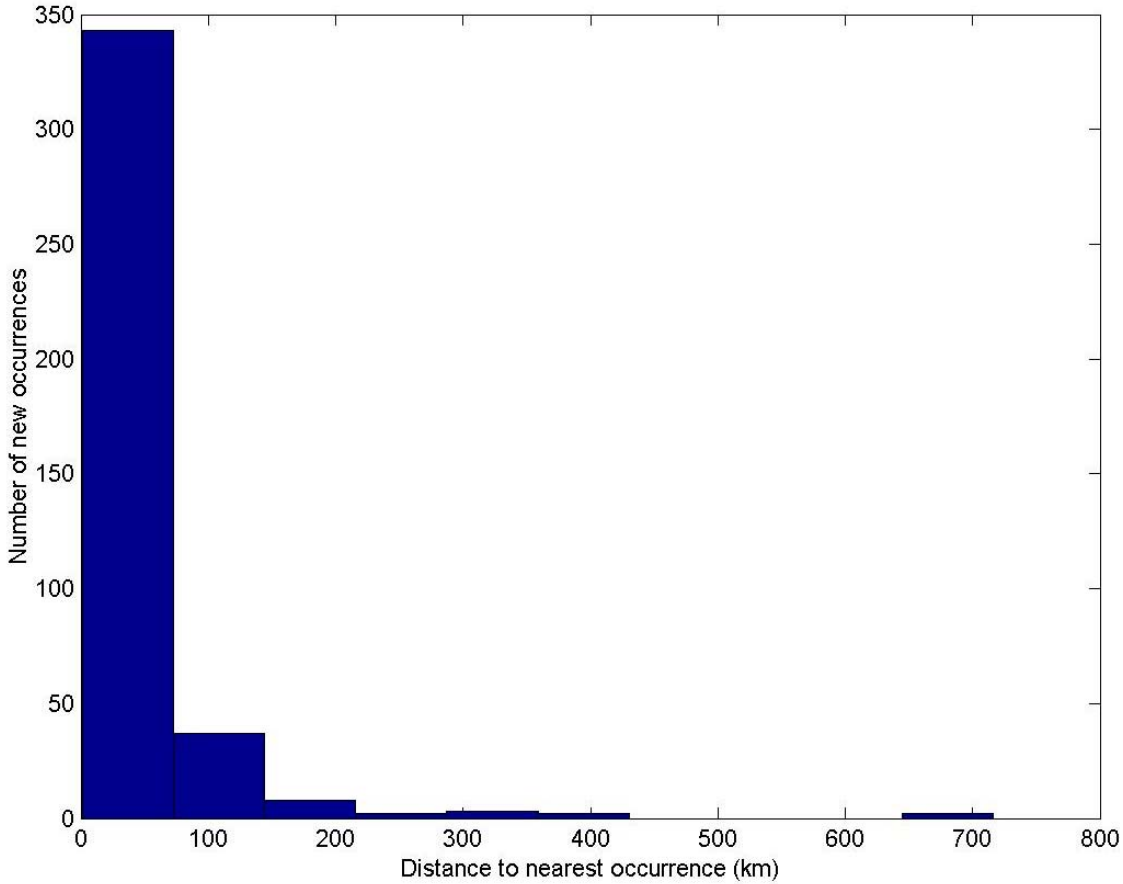
Testing models (hypotheses)

$$\eta_i = \beta_0$$ poor model

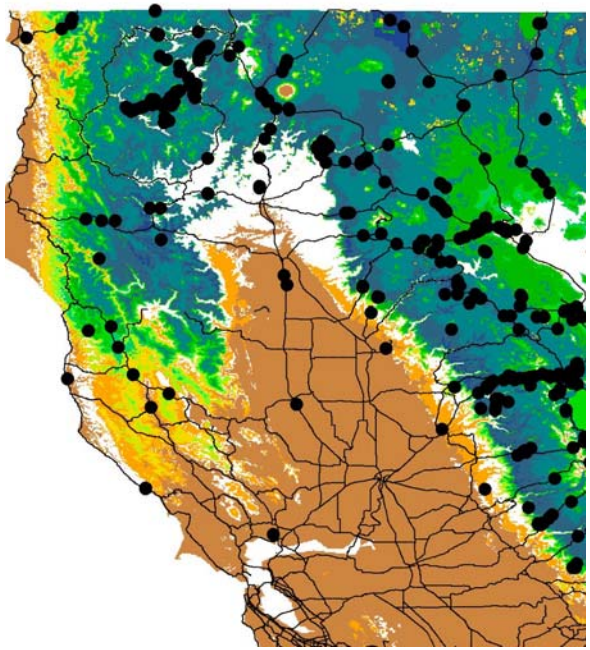
$$\eta_i = \beta_0 + \beta_2 N_{i-1}$$ better model $p < 0.001$

$$\eta_i = \beta_0 + \beta_2 \sum_{z=1}^{\Omega} w_z e^{-\alpha d(x,z)}$$ best model $p < 0.001$

Distance by road



Alternative spread models



Habitat quality (Q)
Different dispersal scales
Roads (connectedness)
- distance
- hay transport

$$\eta_i = \beta_0 + \beta_1 A_{i-1} + \beta_2 Q_x \sum_{z=1}^{\Omega} w_z Q_z e^{-\alpha_1 d(x,z)} + \beta_3 Q_x \sum_{z=1}^{\Omega} w_z Q_z e^{-\alpha_2 d(x,z)}$$

Out of state

Within-state long distance

Within-state short distance

Economic and futures scenarios

- Forecasts (5 yr, 10 yr, 50 yr)
- Bioeconomics of controlling spread
  - wildlands & production systems
  - manager behavior in response to policy options
- Futures scenarios
  - transportation forecasts
  - increasing human population
  - climate change

Collaboration

- Distance, different institutions, different priorities, different motivation
- Team meetings very difficult
- Web-based collaboration

cpb-eve.ucdavis.edu/cgi-bin/twiki/view/Weedspread