

Evolutionary drivers of the invasion of stinkwort (*Dittrichia graveolens*) in California

Nicky Lustenhouwer, Miranda K. Melen & Ingrid M. Parker University of California, Santa Cruz

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## Spreading populations can **evolve** rapidly



#### **Climate conditions**



Species interactions



Dispersal



Accelerating invasion

Colautti & Barrett 2013 Science; Alexander & Levine 2019 PNAS; Williams et al. 2016 Science; Phillips et al. 2006 Nature

## Range expansion of both native and exotic species





Invasive species

### Native species range shifts with climate change

Universität Potsdam; Parmesan et al. 1999 Nature

### Stinkwort



# Dittrichia graveolens







Map adapted from Brullo & De Marco 2000 Port Acta Biol

### Stinkwort



# Dittrichia graveolens





## Evolution of flowering time during northward range expansion in Europe





## Evolution of flowering time during northward range expansion in Europe







Northern plants flower earlier...





Wageningen, the Netherlands

Flowering day (z)

#### Stinkwort invasion in California







A.

#### Stinkwort invasion in California







#### Stinkwort invasion in California







### **Risk assessment**

#### **Reported risks**

- Contact dermatitis
- Toxicity to livestock
- Vineyards
- Restoration

#### USDA Weed Risk Assessment



**Establishment Spread Potential** 

### Risk assessment

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How can we incorporate evolution into risk assessment?

### Comparing evolution during exotic and native range expansion



Evolution in response to:

- 1. The spread process
- 2. Abiotic environment
- 3. Biotic environment

Native range



Brownsey et al. 2013 Calif Agr; Botanical Museum, Helsinki, 2018

#### Comparing evolution during exotic and native range expansion



Exotic range in California

#### Native range in Europe















## The spread process itself: seed dispersal













1



. 2



Habitat suitability models: can including the native range expansion improve risk assessment in California?

### Roadways as invasion corridors





## Moving away from roads: restoration and rangelands



2



- How does stinkwort respond to the soil microbial community?
- Has this response evolved during range expansion?
- Parallel greenhouse experiments with Wim van der Putten in the Netherlands





- How does stinkwort respond to the soil microbial community?
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- Will stinkwort be able to invade native plant communities?
- Will evolution exacerbate this impact over time?

# Working with practitioners



#### Key topics

Competitive ability Seed bank dynamics Management along roadsides Mechanical vs. chemical control Mitigating impacts to agricultural systems







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We're excited to hear about your questions!





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# Thank you

#### California

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