Ecology, Genetics, and Biological Control of Invasive Annual Grasses in the Great Basin

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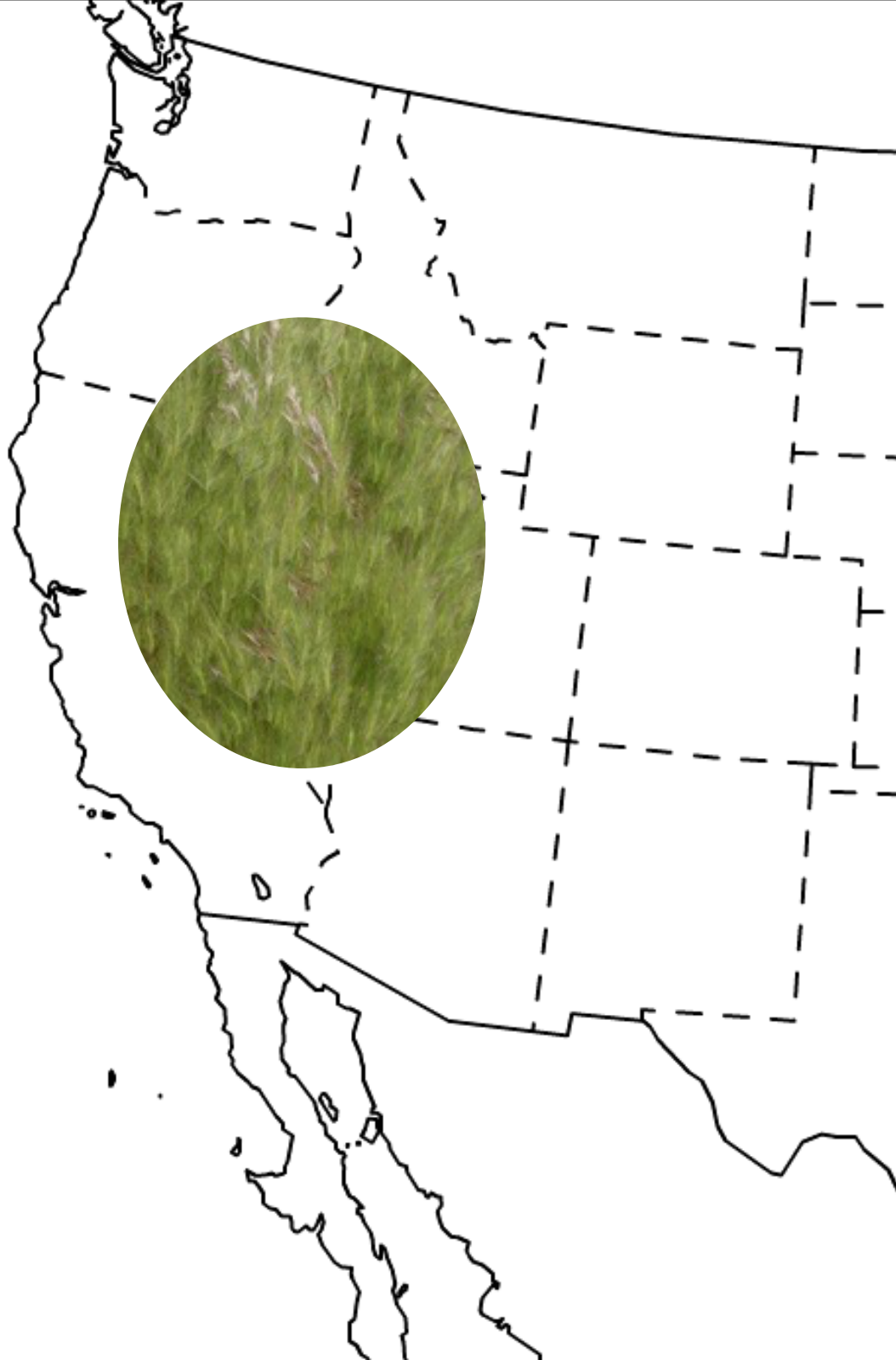
Invasive annual grasses in the Great Basin

- Medusahead (*Taeniatherum caput-medusae*)
- Cheatgrass (*Bromus tectorum)*
- Red brome (*Bromus rubens*)



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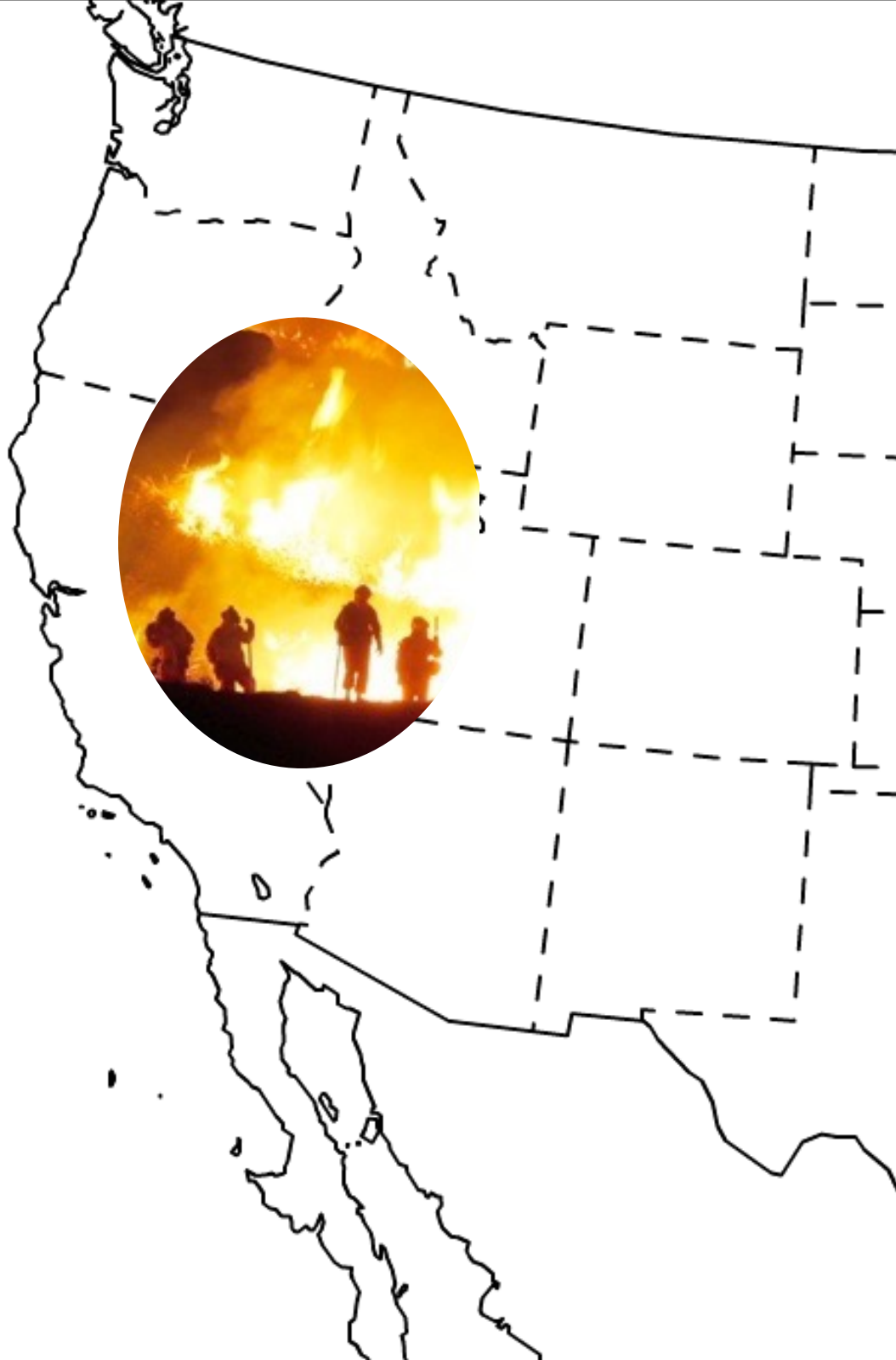

Objectives

- Genetics of invasive grass populations
- Invasive grass ecology
  - Impact
  - Proliferation / constraints
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Invasive annual grass genetics

- Self-pollinators but not self-incompatible
- Adaptation to new environments
  - Genetic diversity?
  - New introduction for each environment?
- Identify source populations
- Need for sequence-based genetic markers (SSRs)

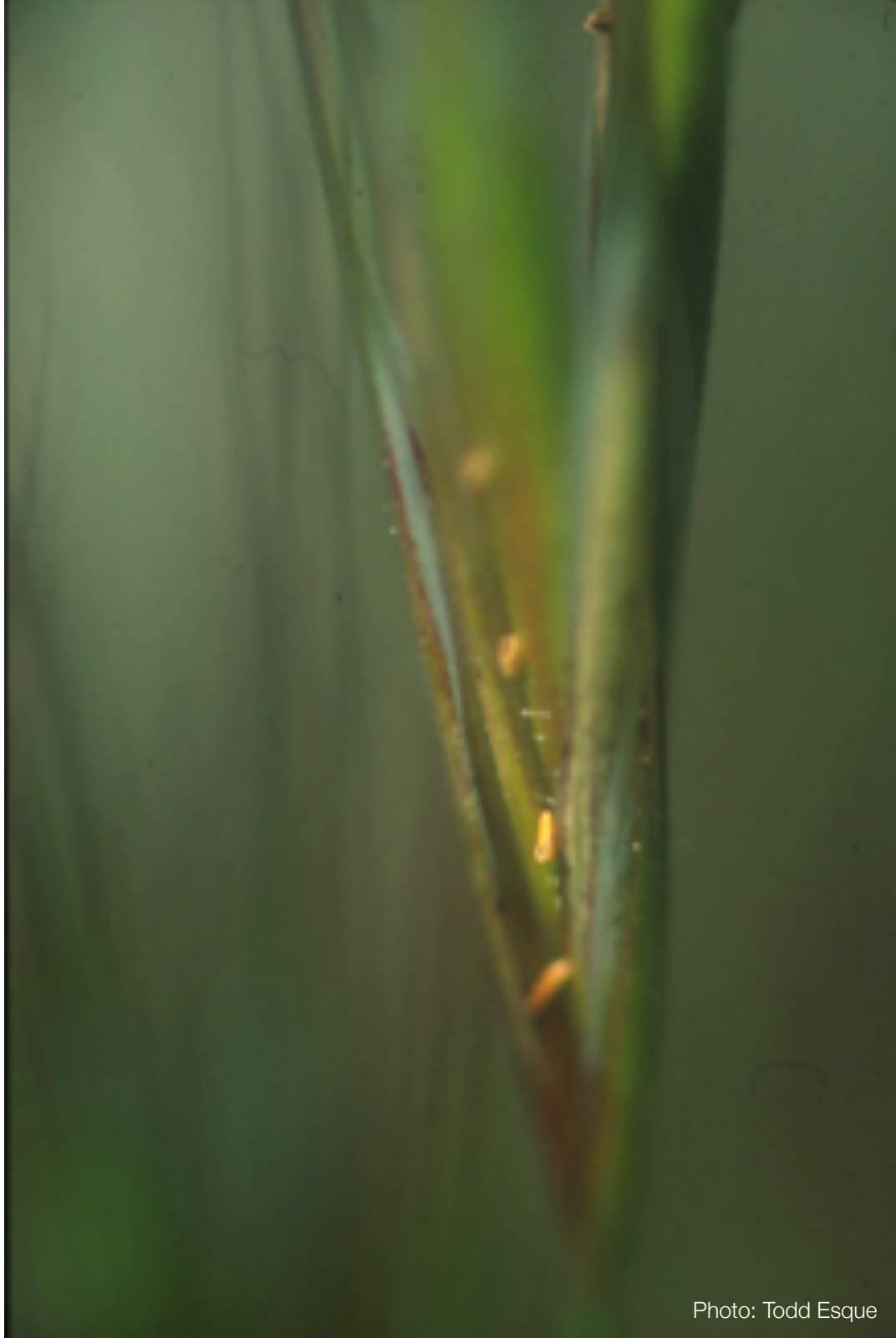

Photo: Todd Esque

Invasive annual grass genetics

- SSRs (simple sequence repeats)
  - Abundant
  - Sequence- & PCR-based
- Cheatgrass SSRs likely to also work in red brome
- SNPs (single-nucleotide polymorphisms)
- Study invasiveness traits

Rector et al. (2013) *Invas. Pl. Sci. Mgmt.*,
Gaskin et al. (2013) *Invas. Pl. Sci. Mgmt.*

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Medusahead entomofaunal surveys

- Survey beetle and ant diversity within vs. adjacent to medusahead invasions
  - Pitfall traps at six locations
  - Effect of invasion?
- Several ant genera less abundant in medusahead (one more abundant)
- Two beetle genera less abundant in medusahead

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Medusahead endophytes

- Invasive weed associations with native fungal endophytes
  - Cheatgrass, spotted knapweed
  - Increased invasiveness
- Describe endophyte mycoflora of medusahead in native and invaded ranges
  - *Beauvaria* found in NV medusahead
- Collaboration with ARS-Peoria

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Year-round natural enemy surveys

- Compare mortality factors between native and invaded ranges
  - Seed bank (early Autumn)
  - Post-germination (Autumn)
  - Vegetative growth (Spring)
  - Seed fill (late Spring)

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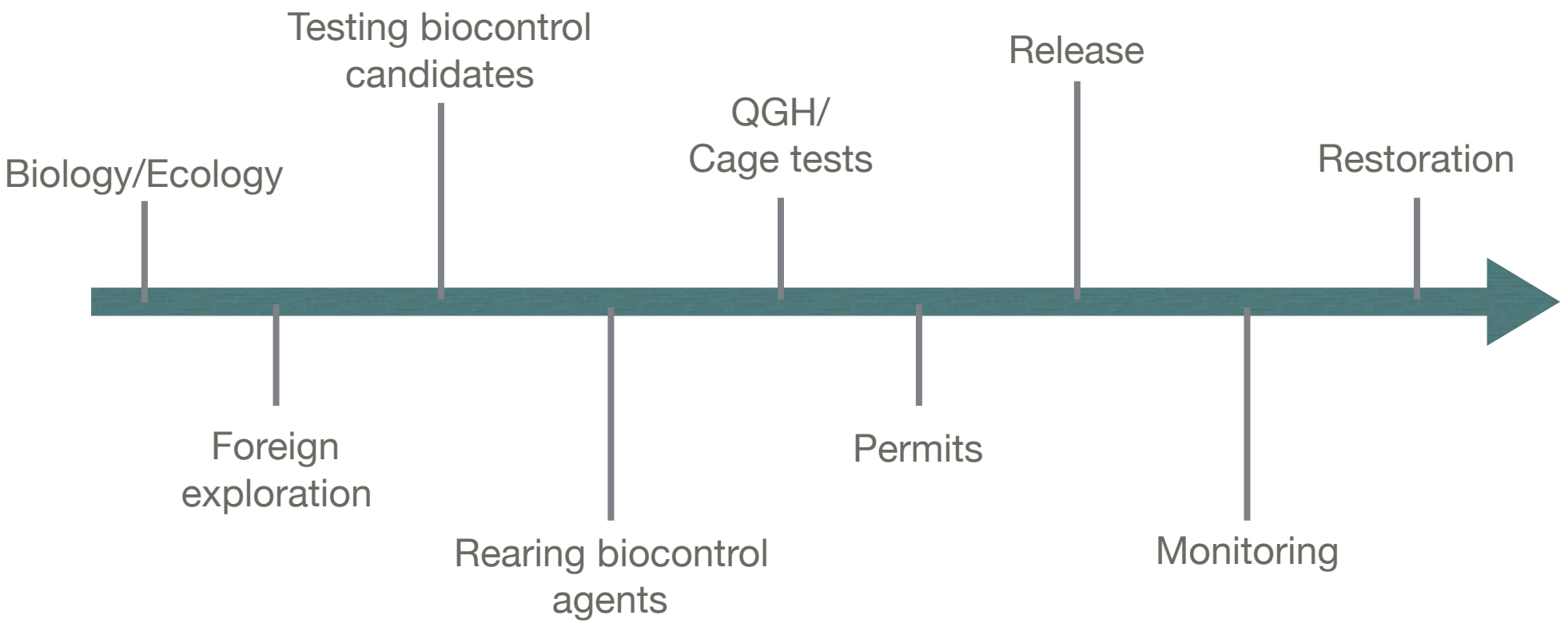
Biological Control Timeline



Annual grass biological control

- Focus on eriophyid mites
  - High host-specificity
  - Rapid life cycle
  - High potential for impact
- Collaboration with ARS-EBCL, BBCA (Rome), Serbian, Italian and Bulgarian universities

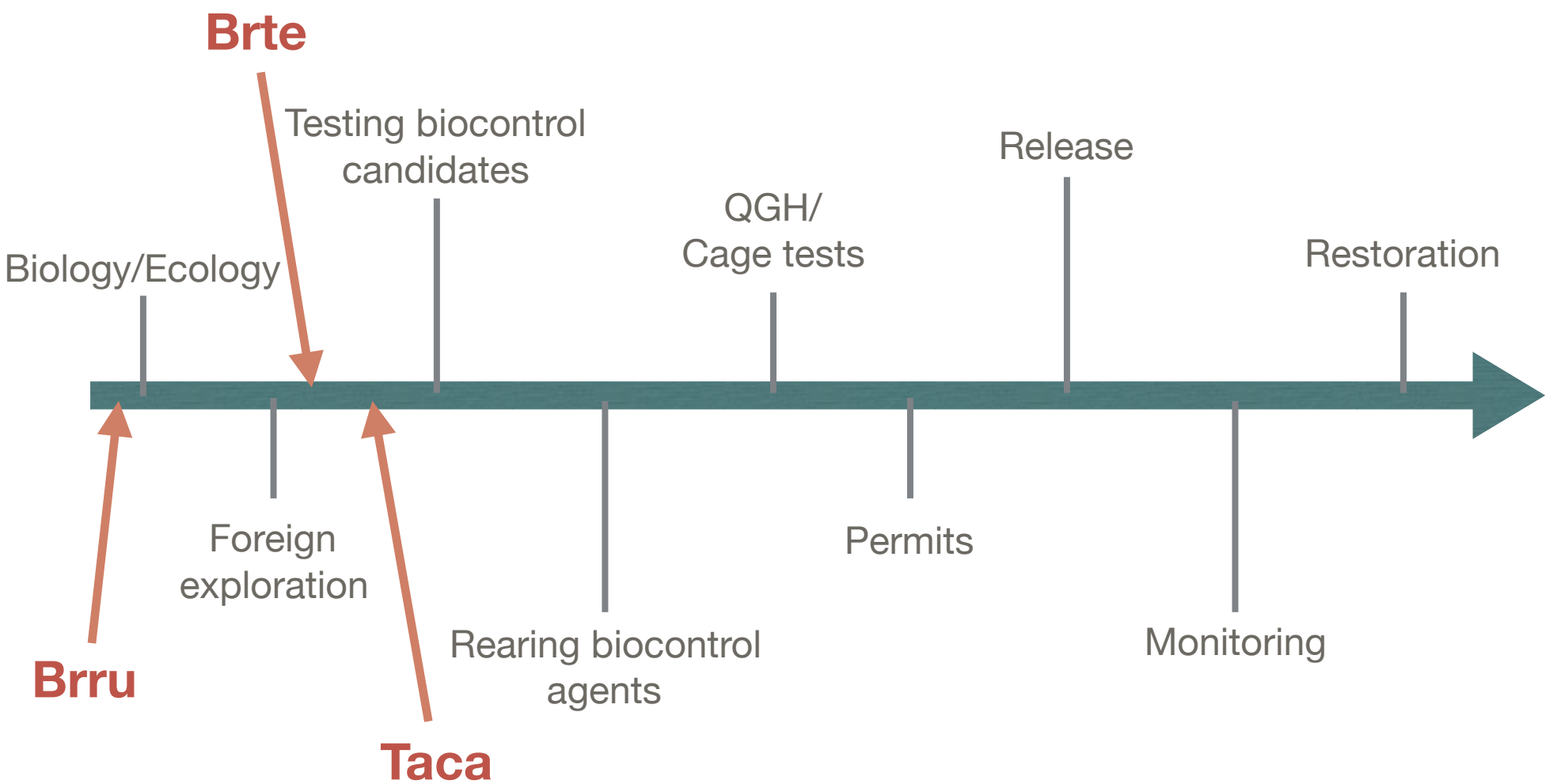
Rector & Petanovic (2012) *Zootaxa,*
Stoeva et al. (2011) *Exp. Appl. Acarol.,*
Pecinar et al. (2011) *Arth.-Pl. Interact.*

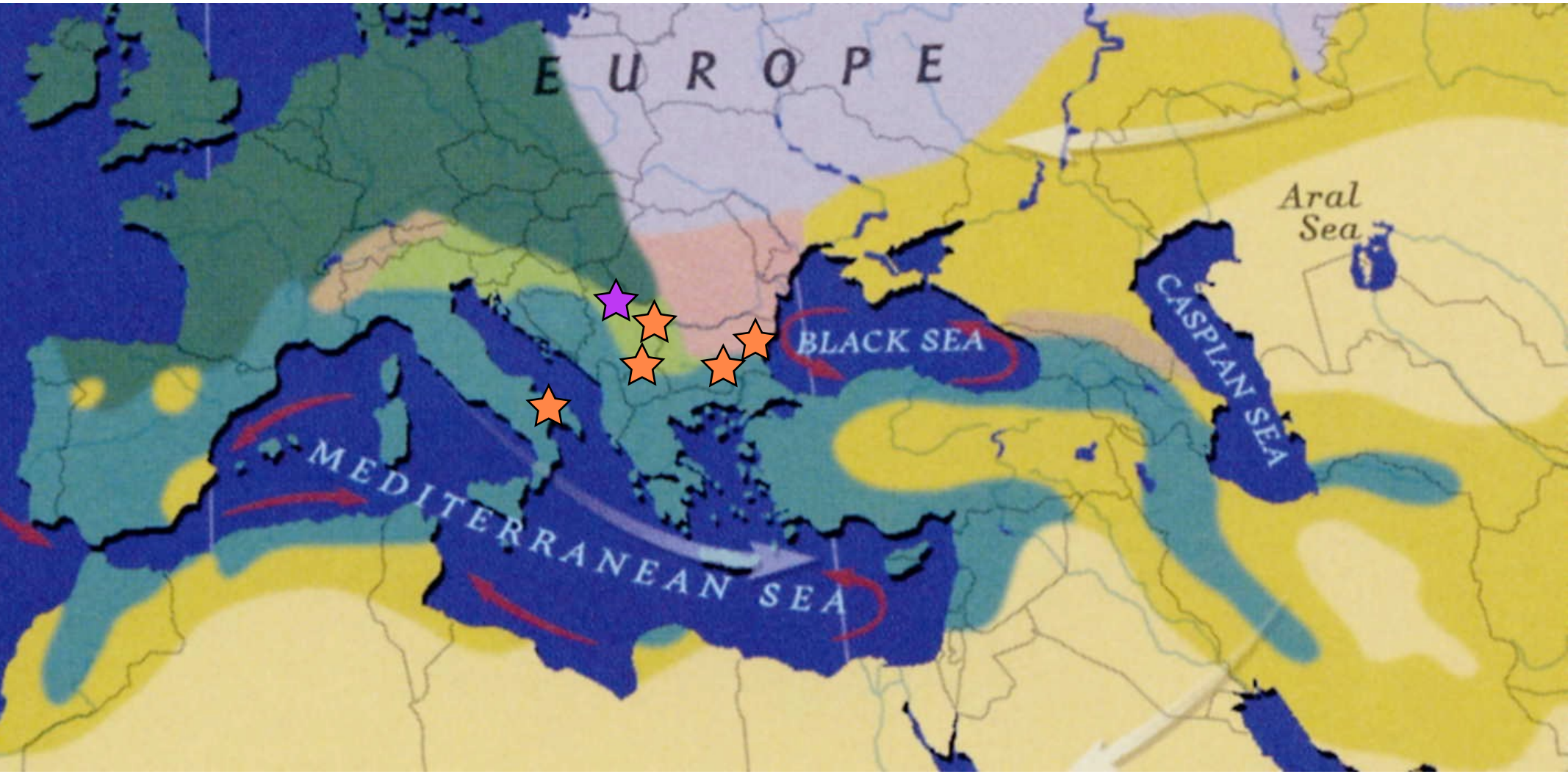
Annual grass biological control

- Foreign exploration - 2014, 2015
  - Medusahead mites found in Bulgaria, Italy, Serbia
  - Cheatgrass mites found in Serbia
- * Travel funds from BLM & ARS-EBCL

Photo: Dragica Smiljanic

Biological Control Timeline





Cheatgrass & medusahead native range surveys, 2014-15

Cheatgrass mites =

Medusahead mites =


CKY MOUNTAINS
N O R T H
A M E R I C A
UNITED
STATES
Great
Basin
Mississippi
Gulf Stream
North Atla
GULF OF
MEXICO

Invasive annual grass native range surveys, 2016-20

Cheatgrass mites =
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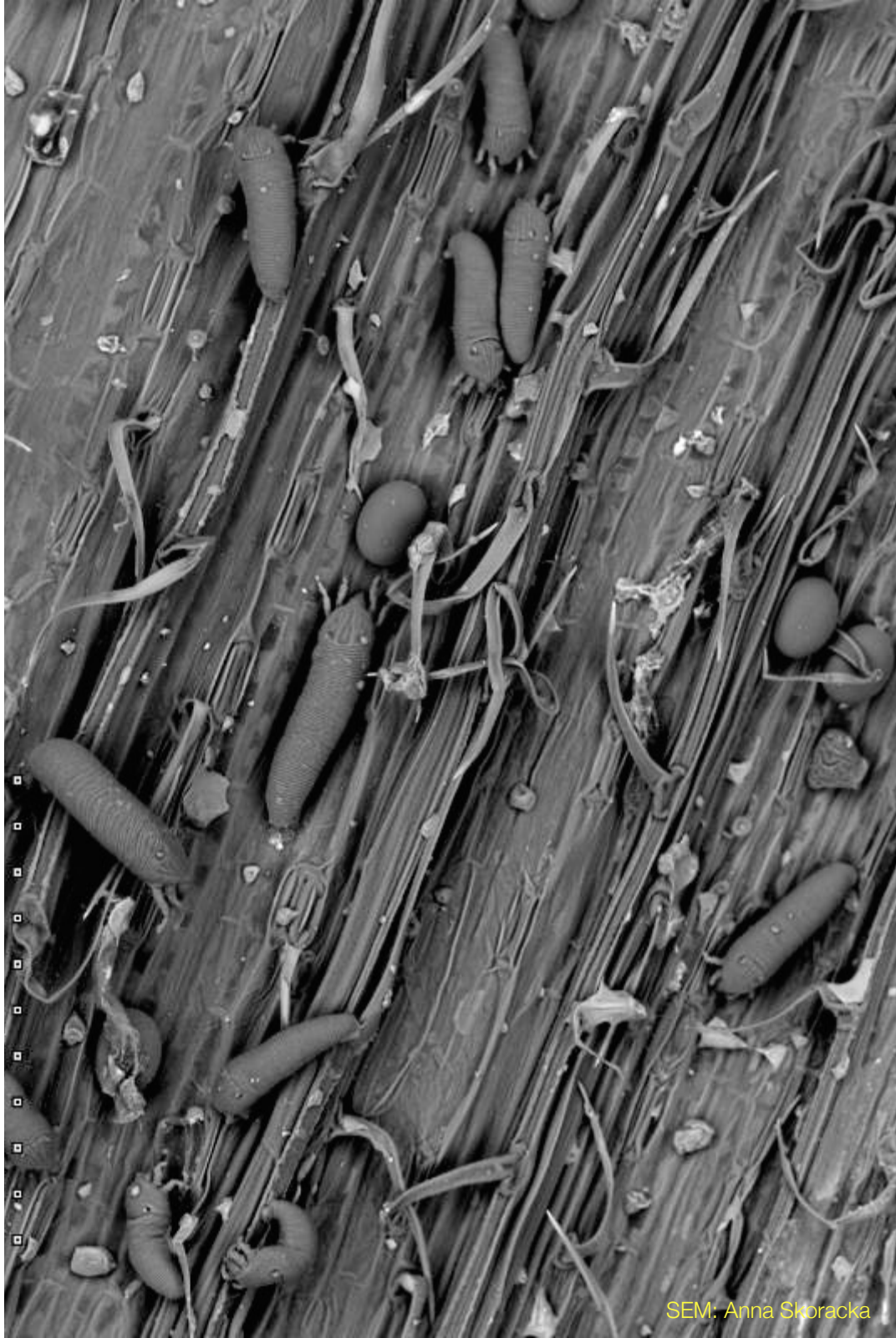
Annual grass/mite interactions

- Model species *Aceria tosichella* (wheat curl mite)
  - Cryptic species complex
  - Genetic lineages with divergent host-ranges
- Collaboration with Polish university



SEM: Anna Skoracka

Annual grass/mite interactions

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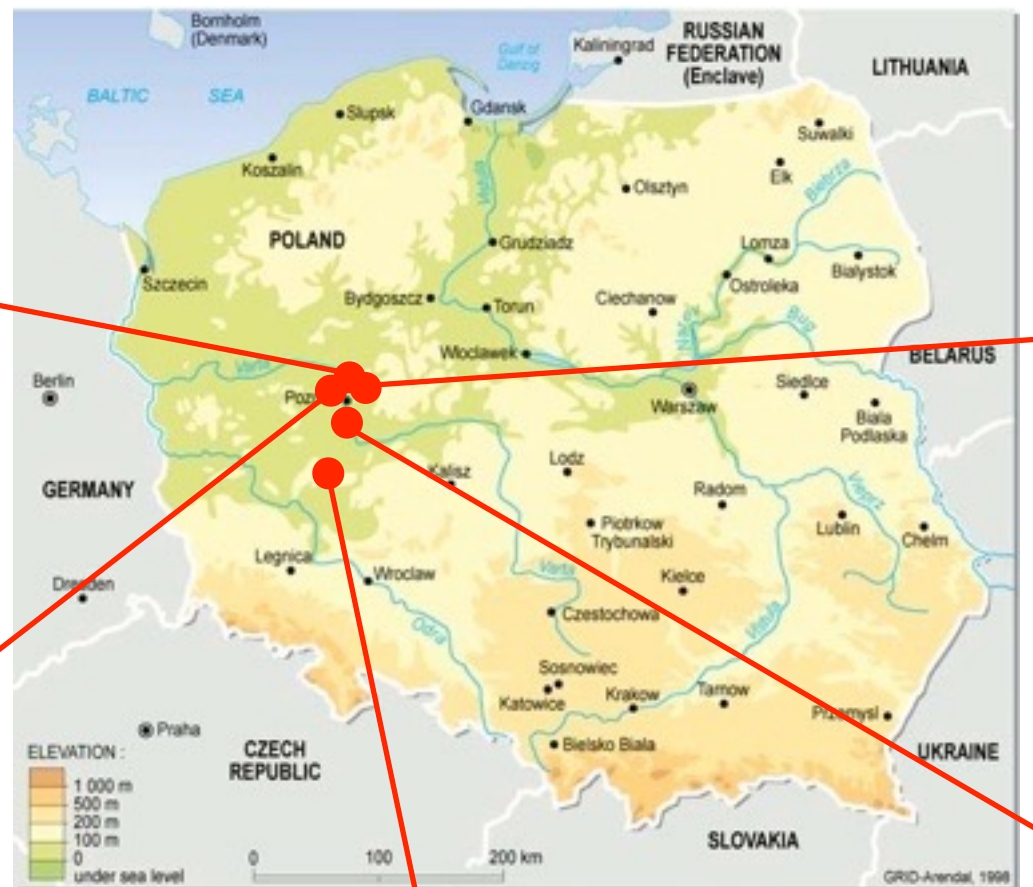
Annual grass/mite interactions

Quackgrass
Elymus repens

Smooth brome
Bromus inermis



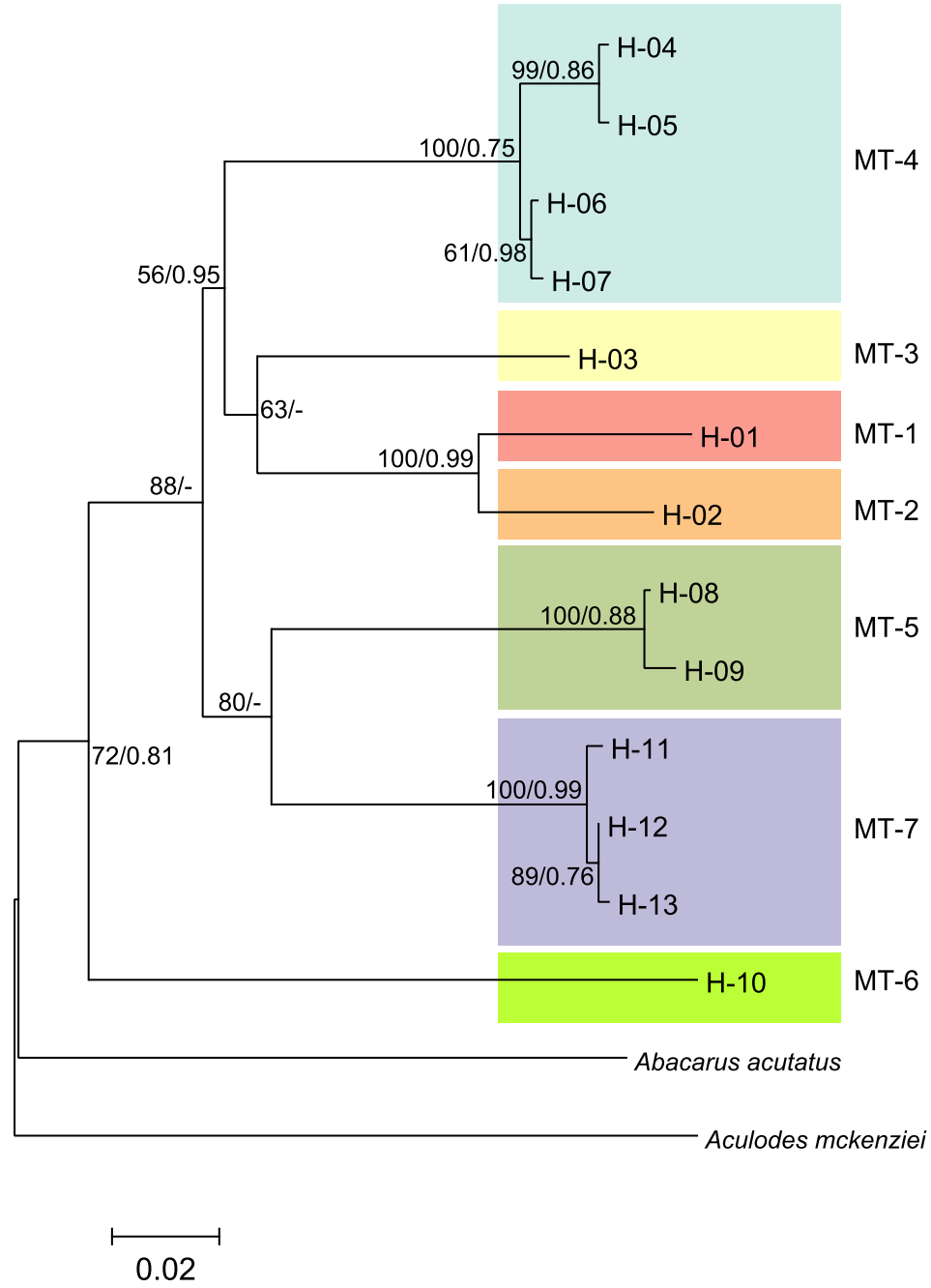
Bread wheat
Triticum aestivum

Tall oat-grass
Arrhenatherum elatius

Wall barley
Hordeum murinum

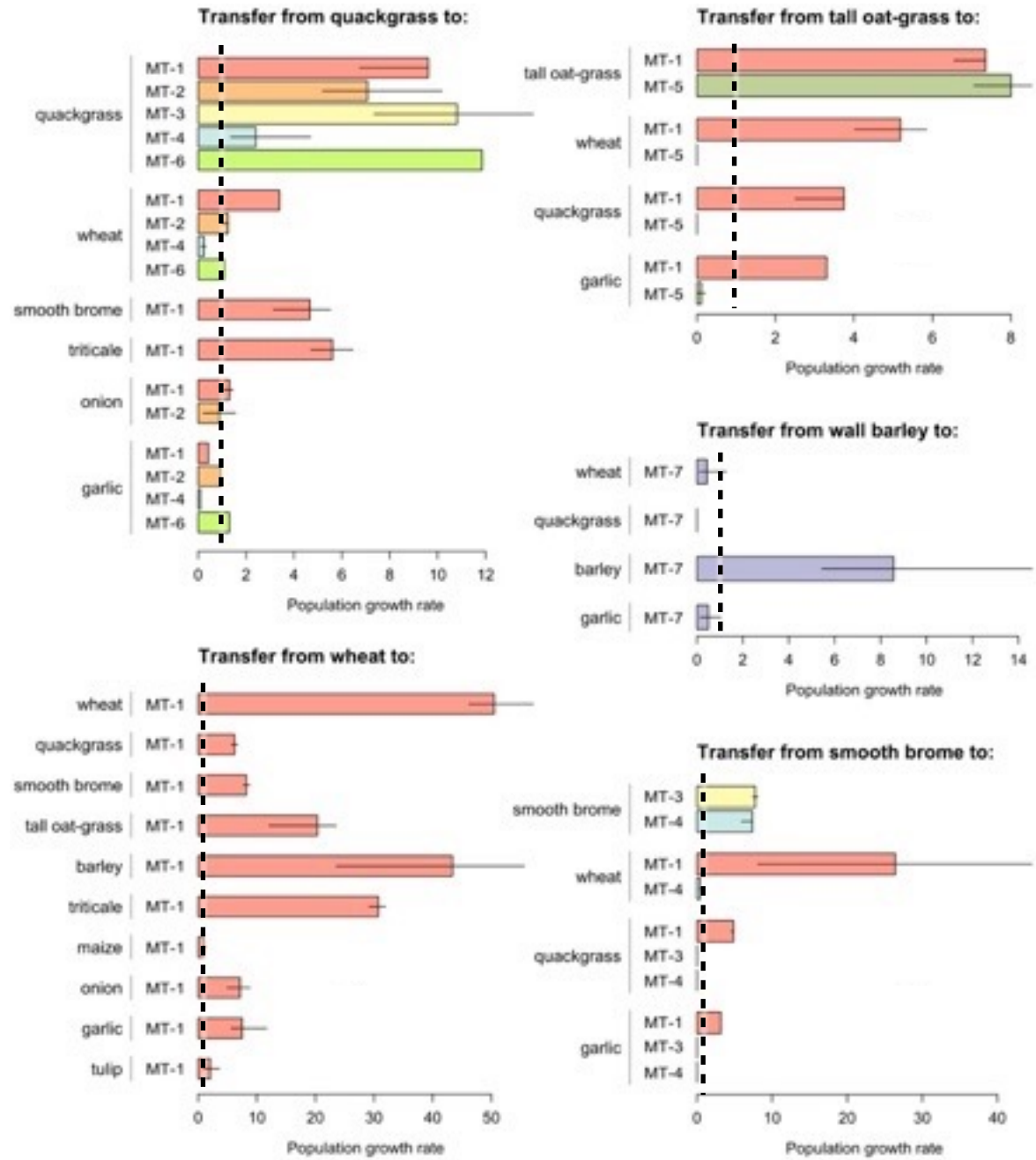
Annual grass/mite interactions

- MT-CO1 lineages
  - *Aceria tosichella* s.l. is a cryptic species complex
  - Different lineages from different host plants
  - Reproductive isolation on sympatric plants



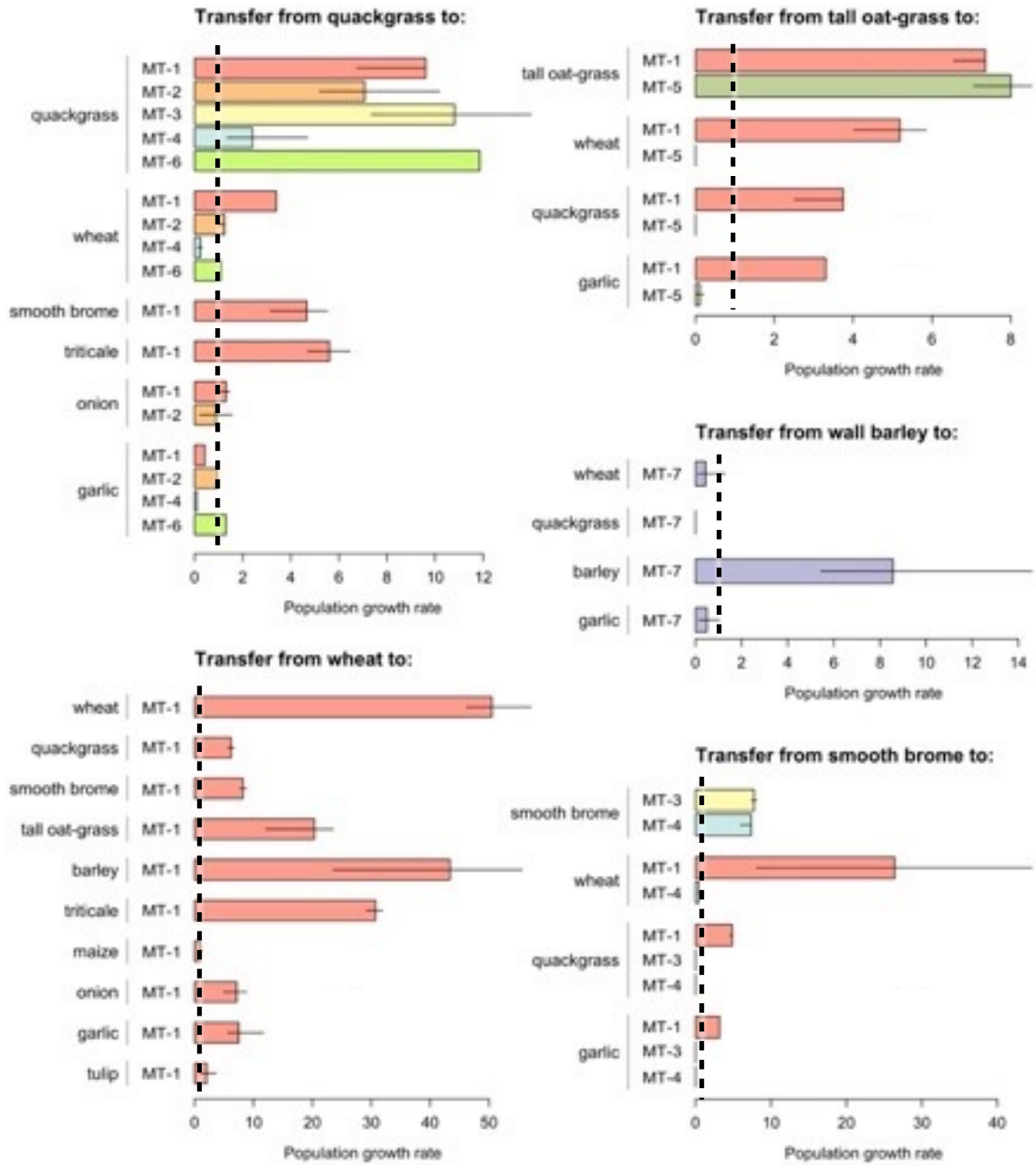
Annual grass/mite interactions

- Transfer experiments revealed variability in host-preference and specificity
  - MT-1 colonized almost every tested host
  - Only MT-1 colonized wheat
  - Little or no colonization of non-source hosts by other lineages



Annual grass/mite interactions

- Synthesis:
  - Very closely related eriophyids may have very different host ranges
  - 6 of 7 MT lineages in this study showed some degree of host-specificity
    - All tested on wheat



Skoracka et al. (2014) *Ann. Appl. Biol.*,
Skoracka et al. (2014) *Biol. J. Linn. Soc.*,
Skoracka et al. (2013) *Biol. J. Linn. Soc.*

Annual grass/mite interactions

- Host-range diversity within WCM - model system
  - Cereals, wild grass hosts
- Can we predict host-range based on genotype?
  - Holy grail of modern biological control
  - Genomics strategies

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