

Biocontrol of Sahara mustard: An update on exploration in the native range



René FH Sforza, Augé M, Marini F, Bon MC, Winkler DE, Cristofaro M and Smith L



Cal-IPC, Yosemite, CA 03 Nov. 2016

Collaborations



Daniel Winkler & Travis Huxman

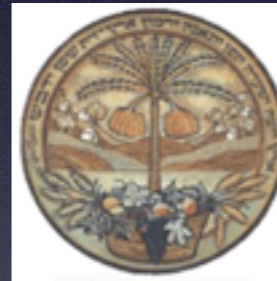


David Garmon & Carl Bell

Partners



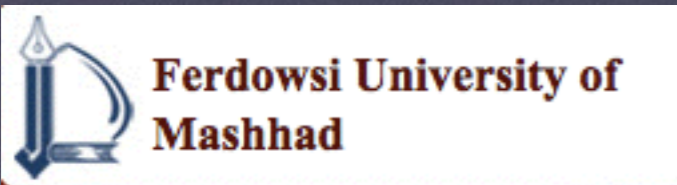
Italy - Enrico deLillo



Israel - Alon Singer



Iran



Irkaya Farms-Qatar-Nazar Nawrani



- European Biological Control Laboratory



- Foreign exploration
- Ecology & Genetics of pests
- Host specificity of BCAs
- Quarantines

www.ars-ebcl.org

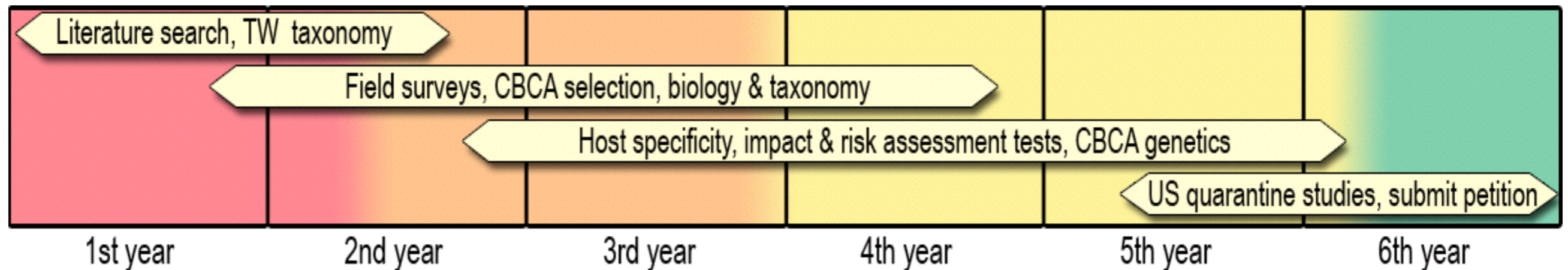
- So many weeds, so little time...



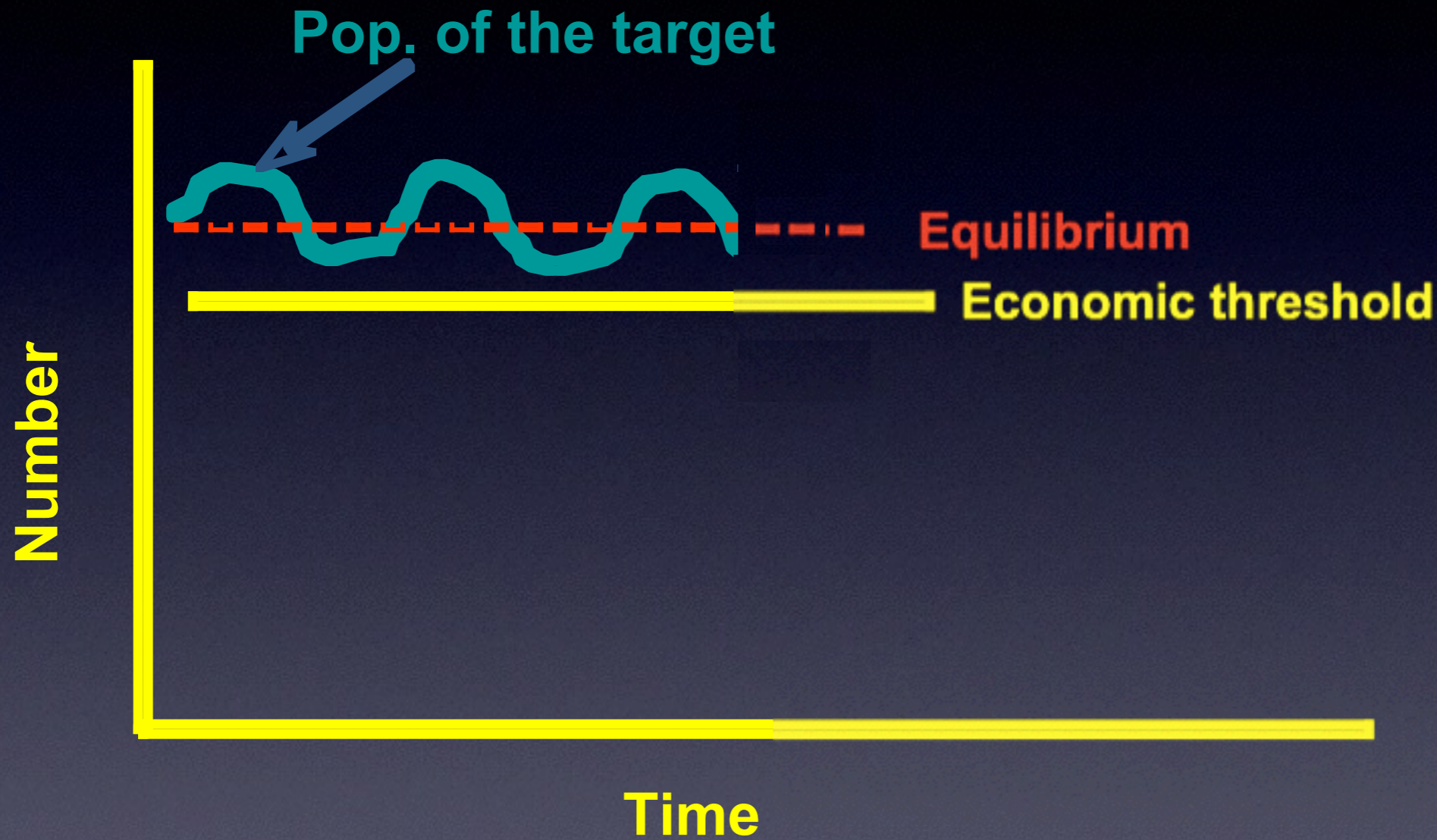
Classical biocontrol

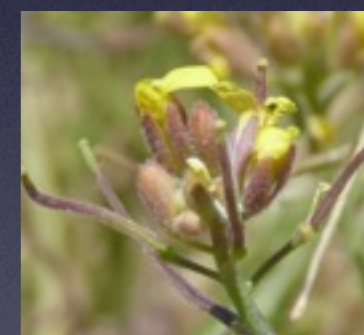
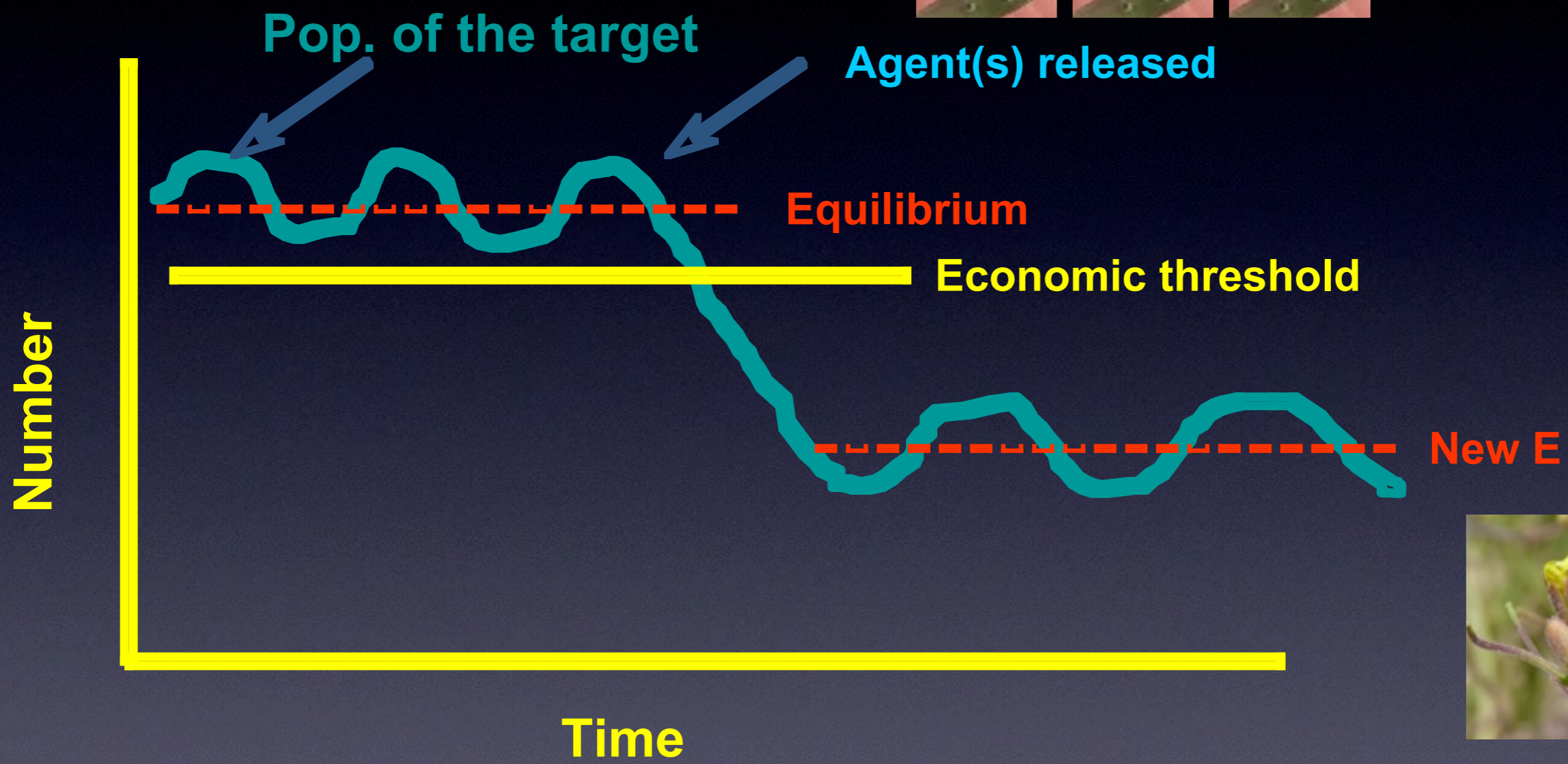
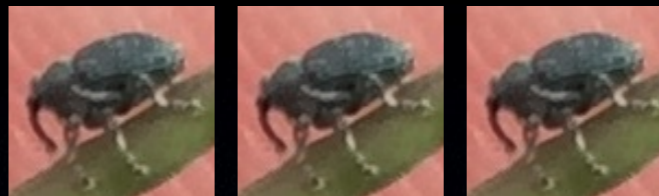


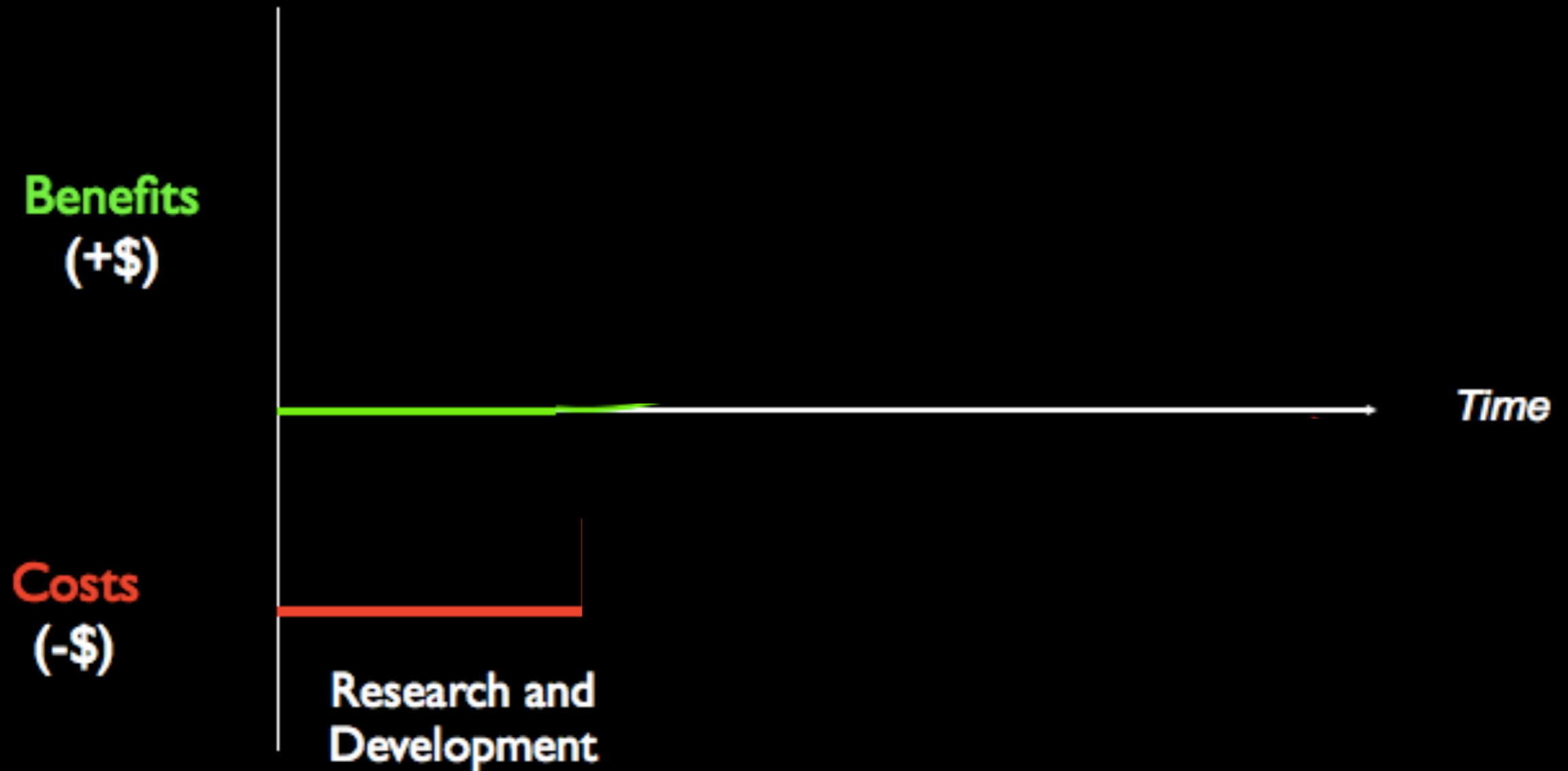
- Target selection
- **Foreign exploration**
- **Selection of candidate agents (BCAs)**
- **Host specificity testing**
- **Efficacy evaluation**
- Regulatory approval
- Multiplication
- Release, establishment, distribution
- Impact assessment



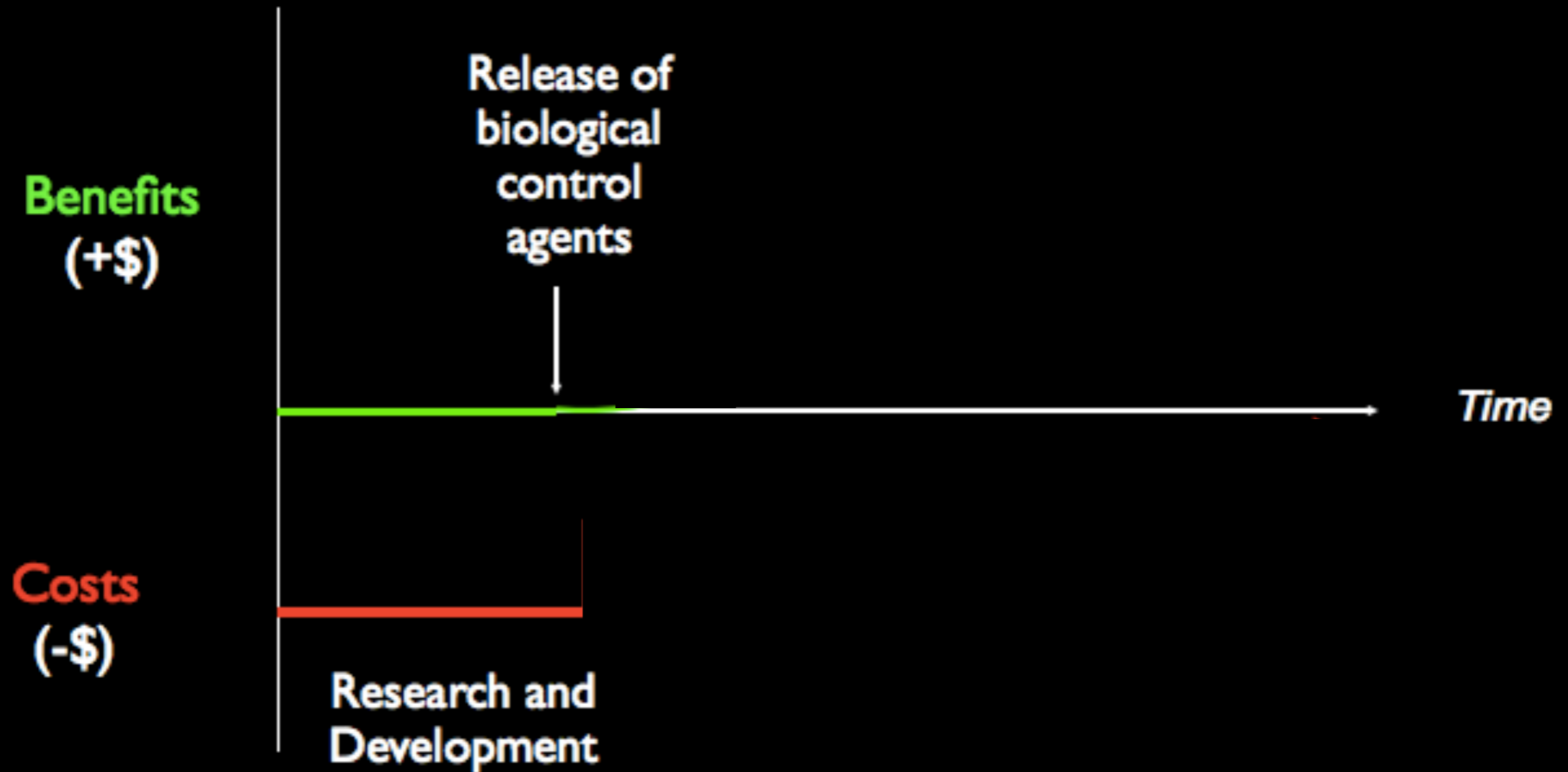
Overall perspective of a classical biocontrol program of weeds



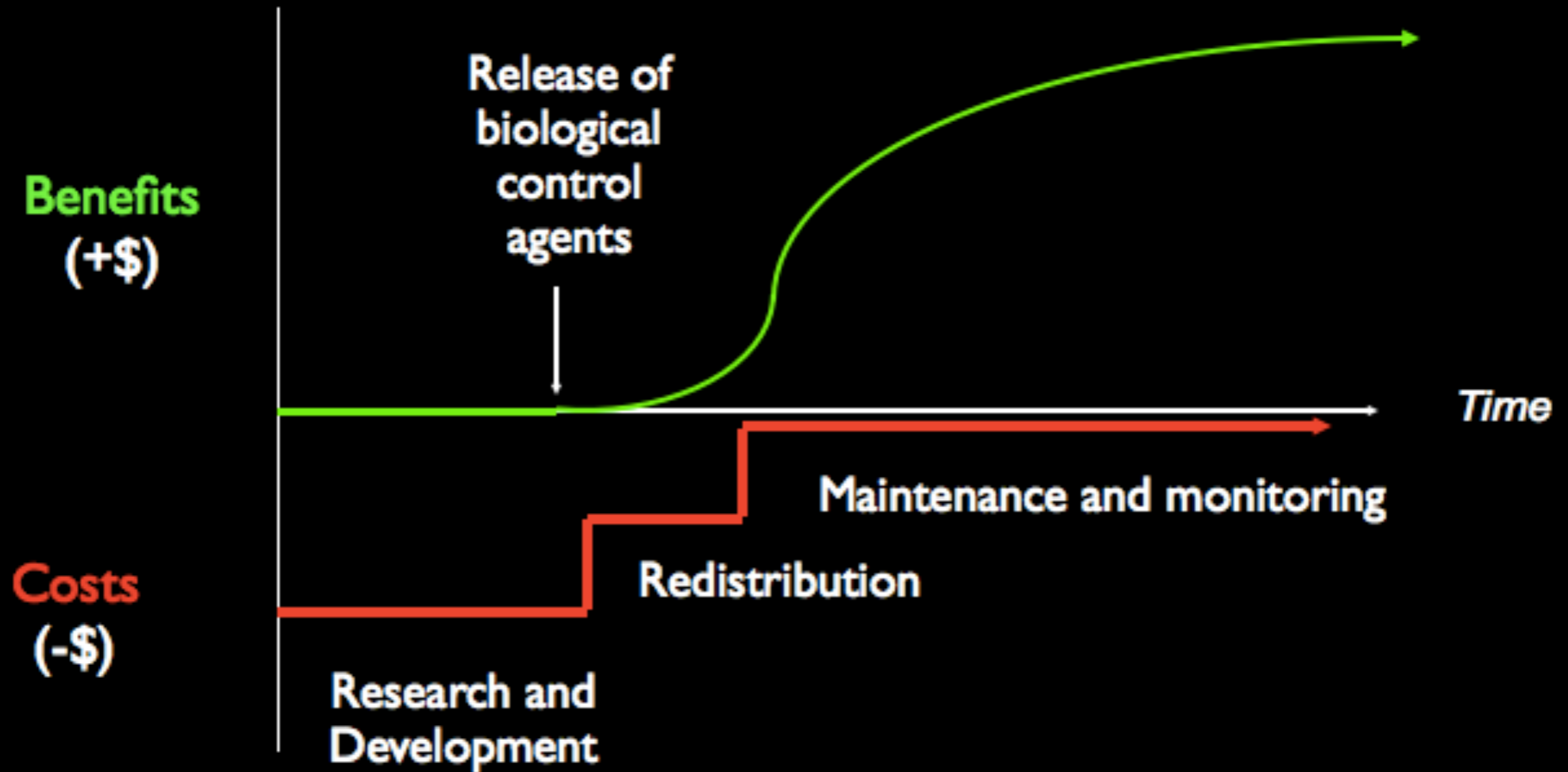




Schematic view of the costs and benefits associated with a successful biological control program (Briese 2000)



Schematic view of the costs and benefits associated with a successful biological control program (Briese 2000)



Schematic view of the costs and benefits associated with a successful biological control program (Briese 2000)



M. Augé

Sahara mustard - Brassica tournefortii

- Brassicaceae
- Winter annual mustard
- Originating and widely distributed in Eurasia/North Africa/Middle East
- First collected in California (Coachella valley) in 1927 (with date palms?)
- Favors sandy soil, desert ecosystems
- Completing its life cycle during winter months
- Displacing wildflowers
- No classical Biocontrol management

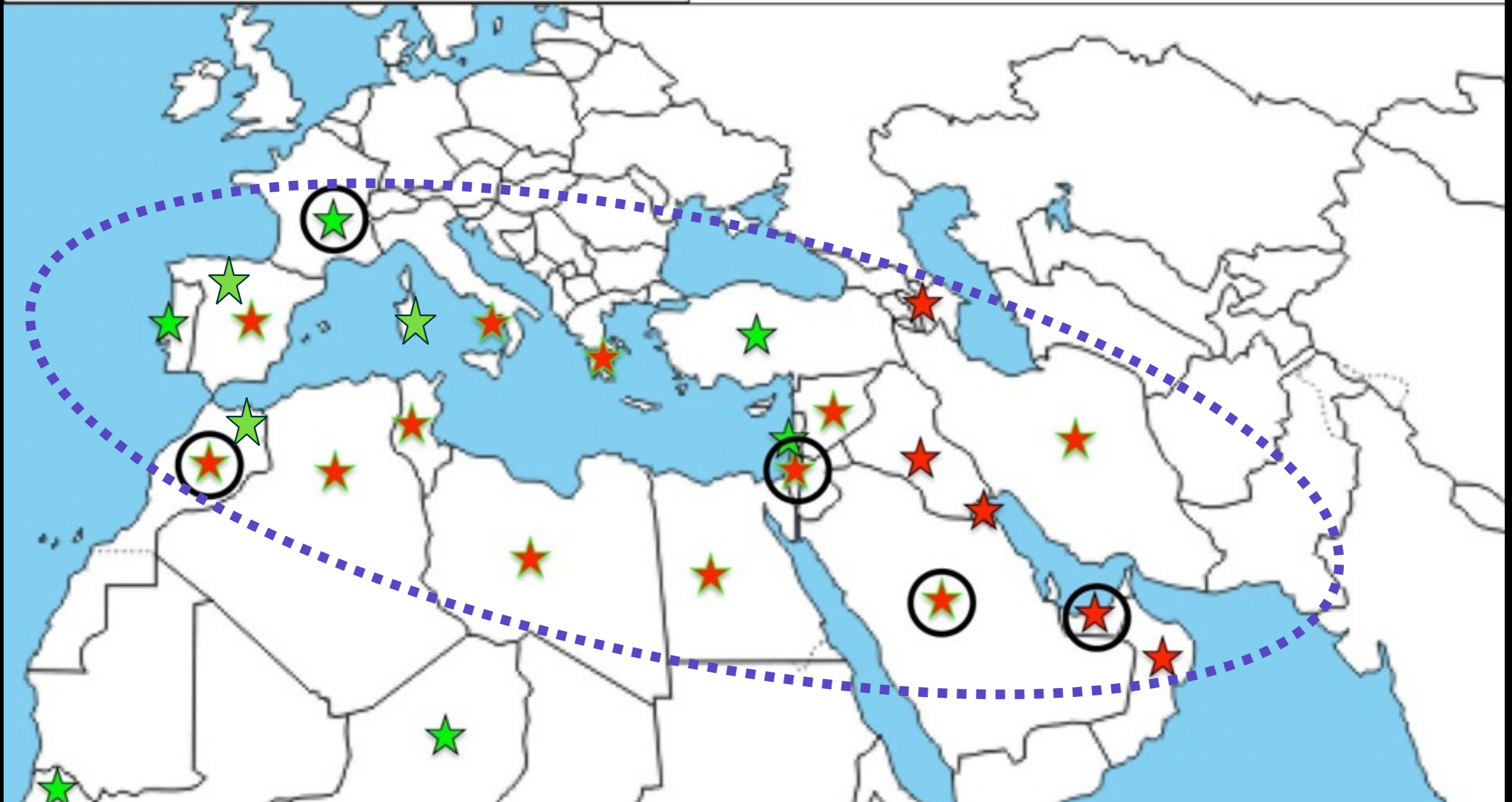
Sahara Mustard Distribution

Based on herbarium records

★ specimen in Br. Museum of NH

★ specimen in Fr. Museum of NH

○ specimens for DNA analysis



Sahara mustard in Qatar



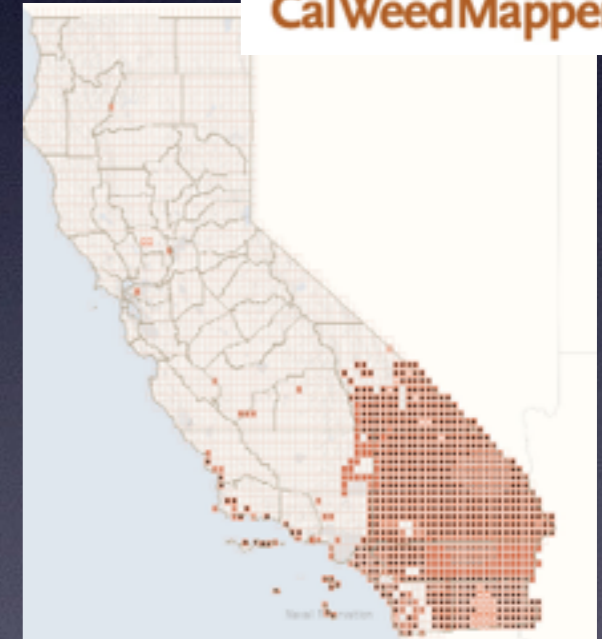
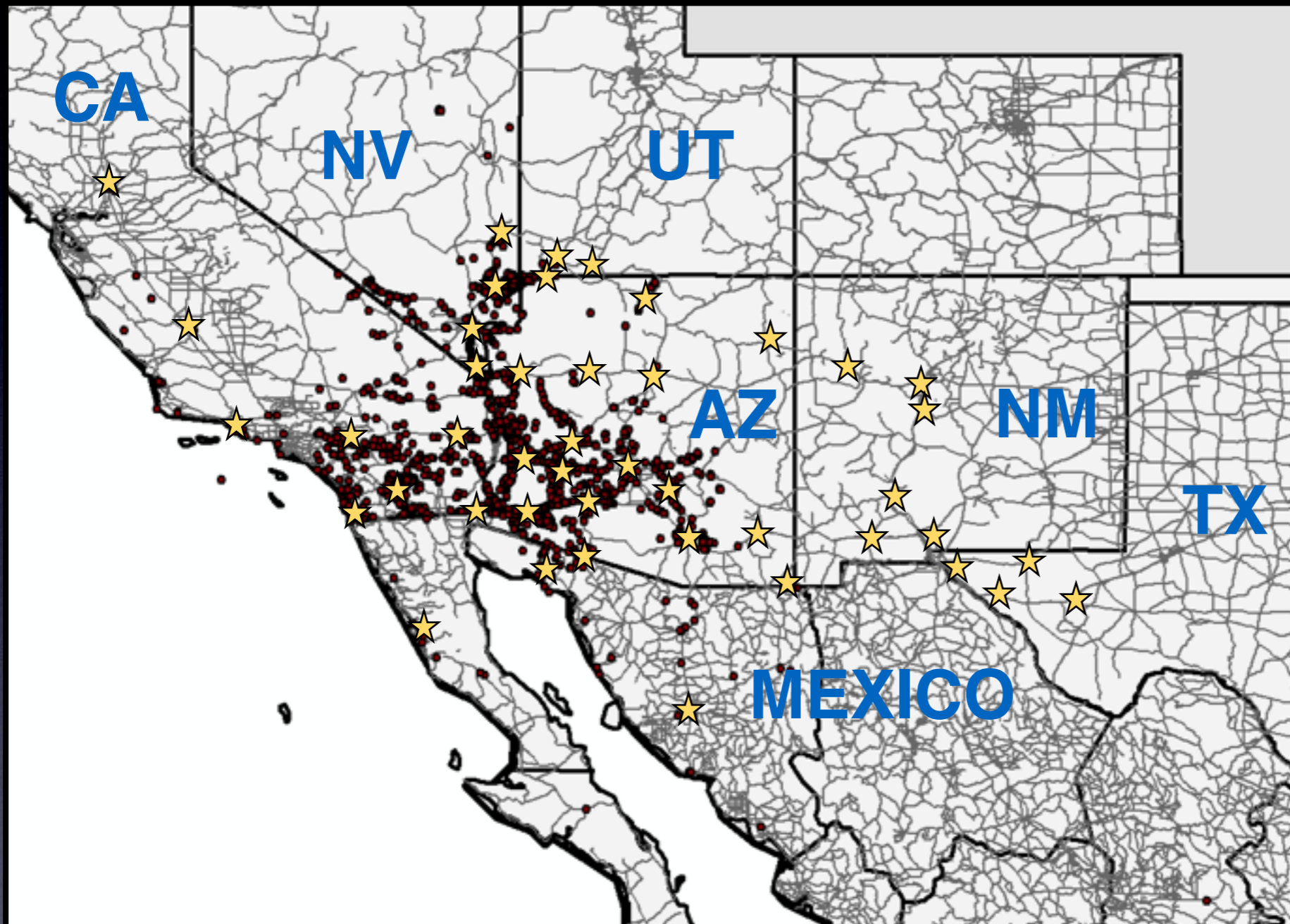
M. Augé

Sahara mustard in France

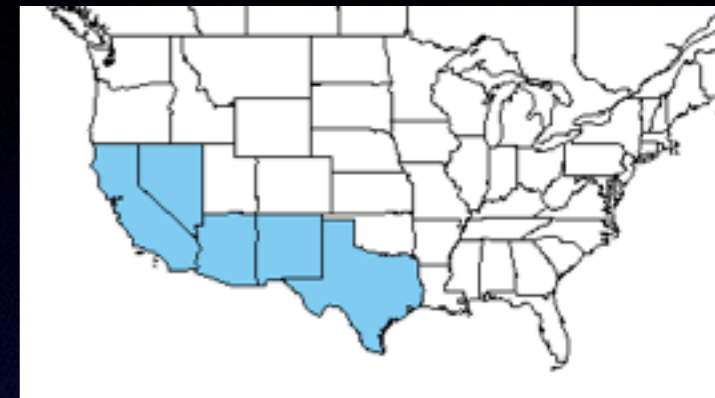
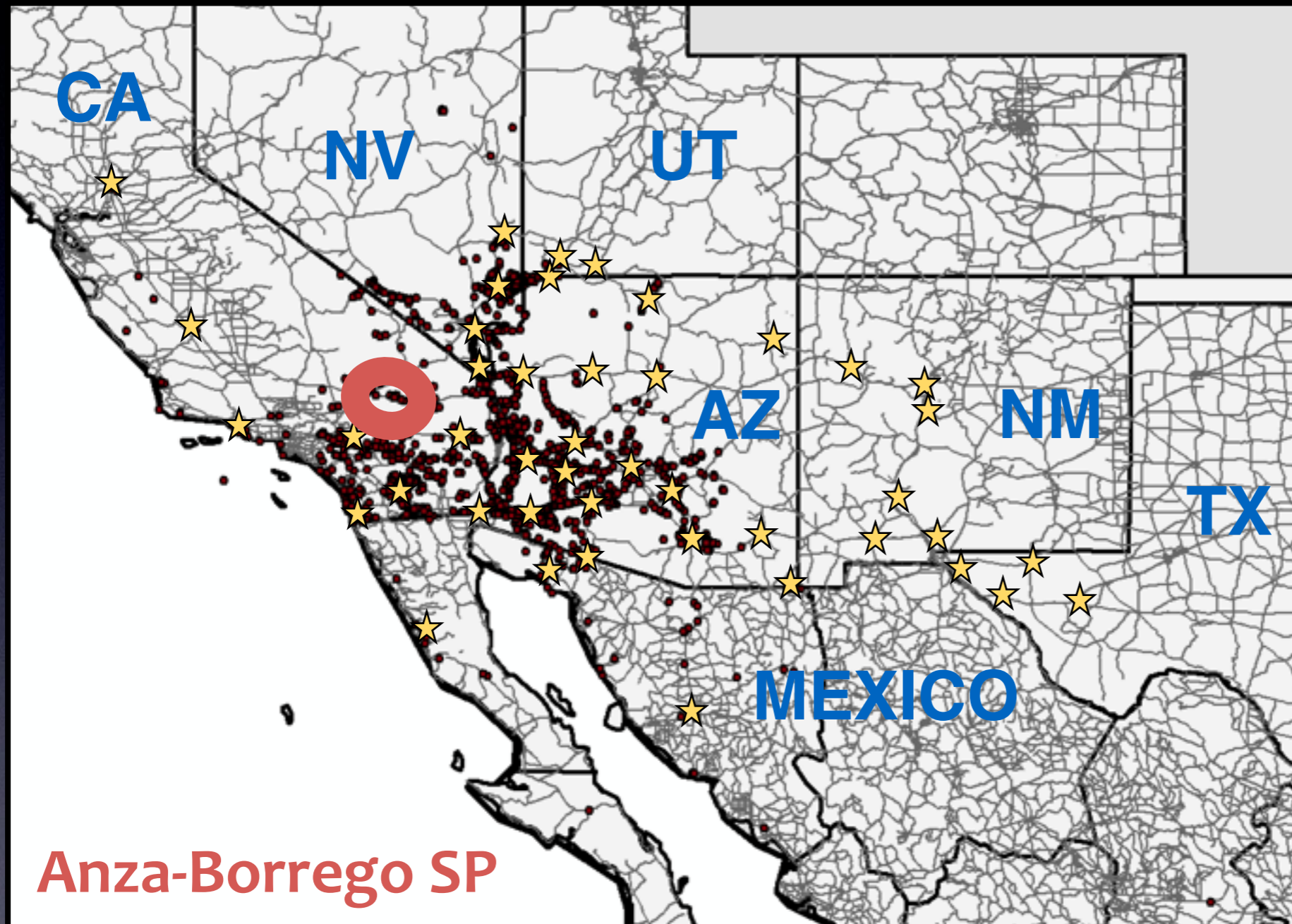


B. Bock

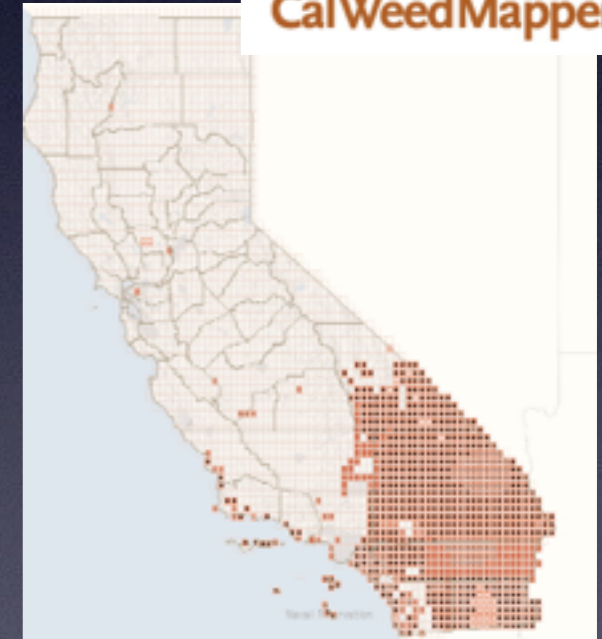
Current ★ and historical records ○ for SM



Current ★ and historical records ○ for SM



CalWeedMapper

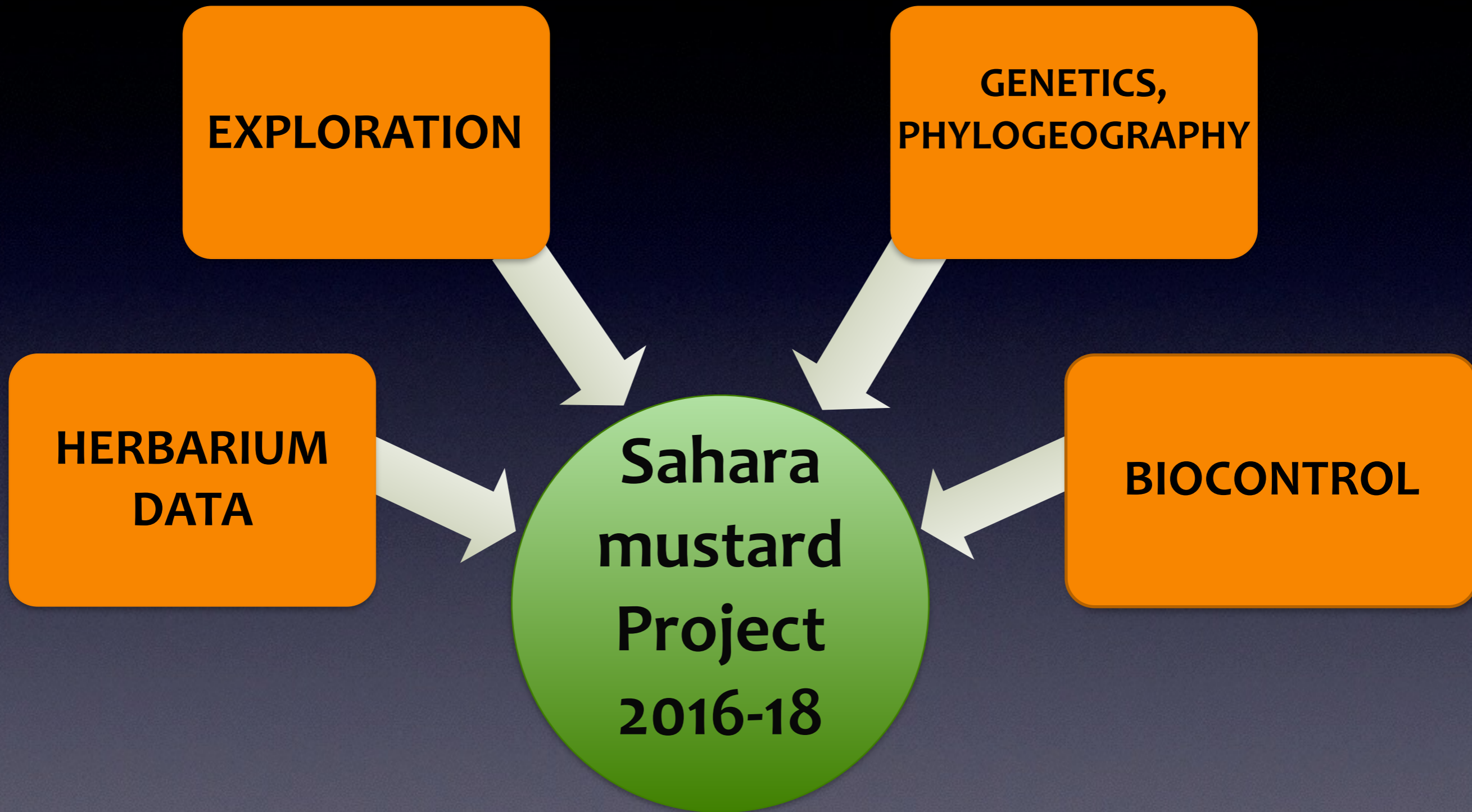


Invasion of SM in Anza-Borrego SP

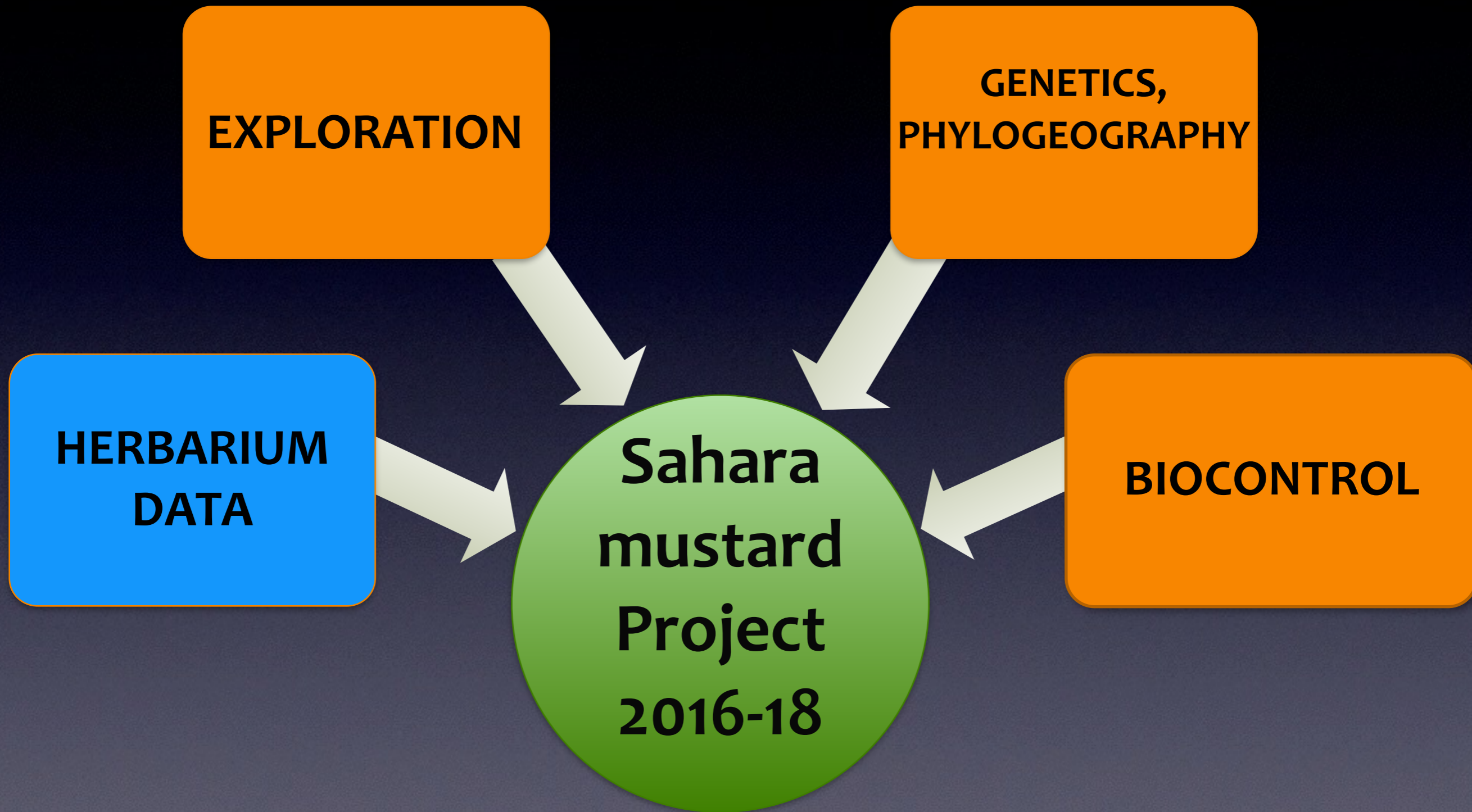


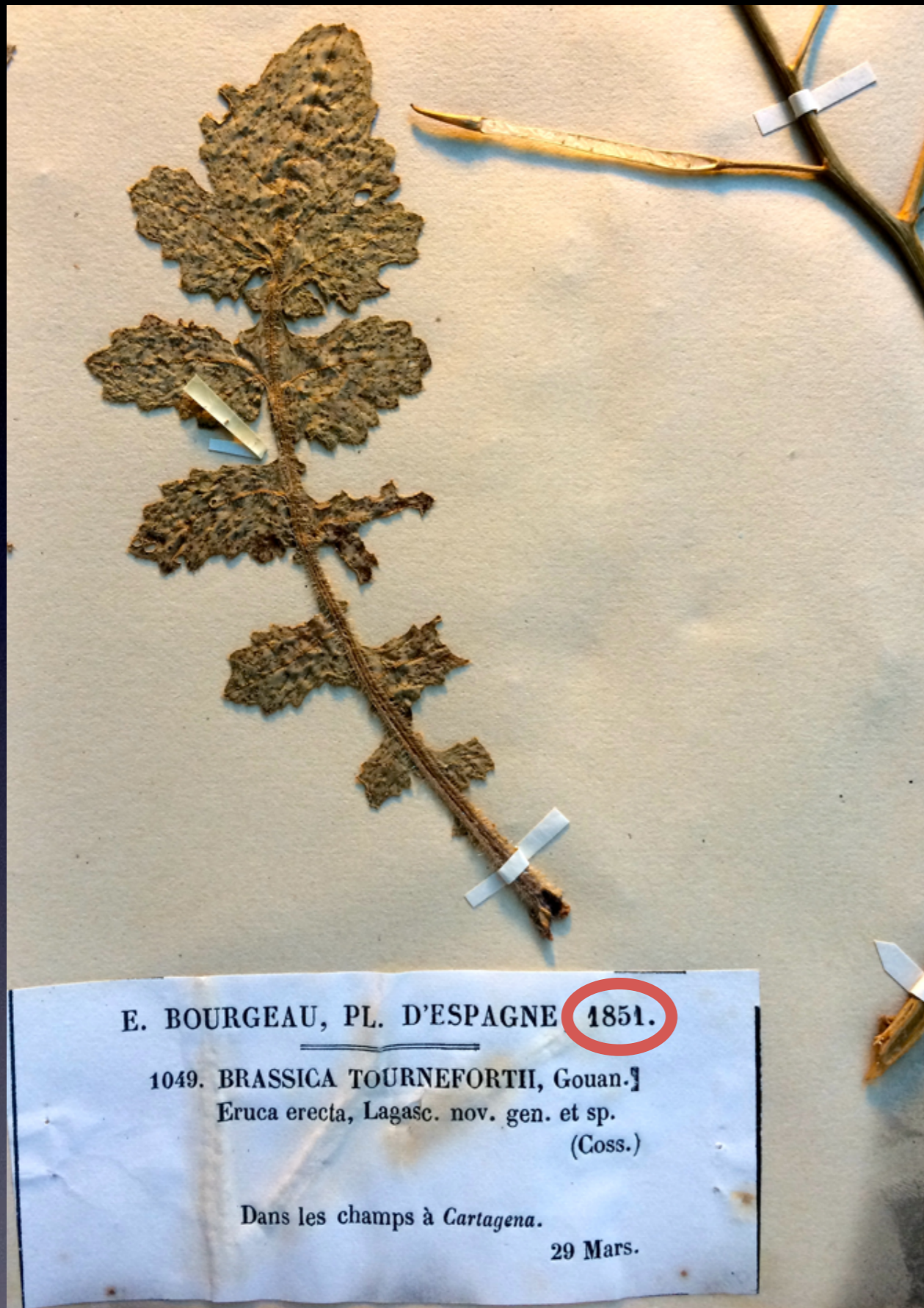
D. Winkler

Specific Goals of the Project



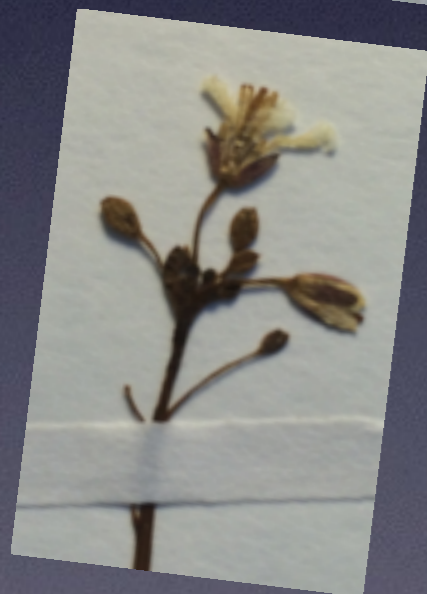
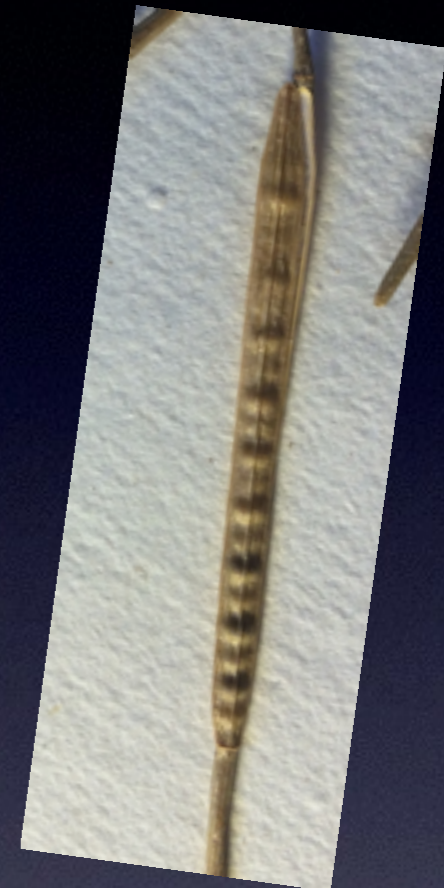
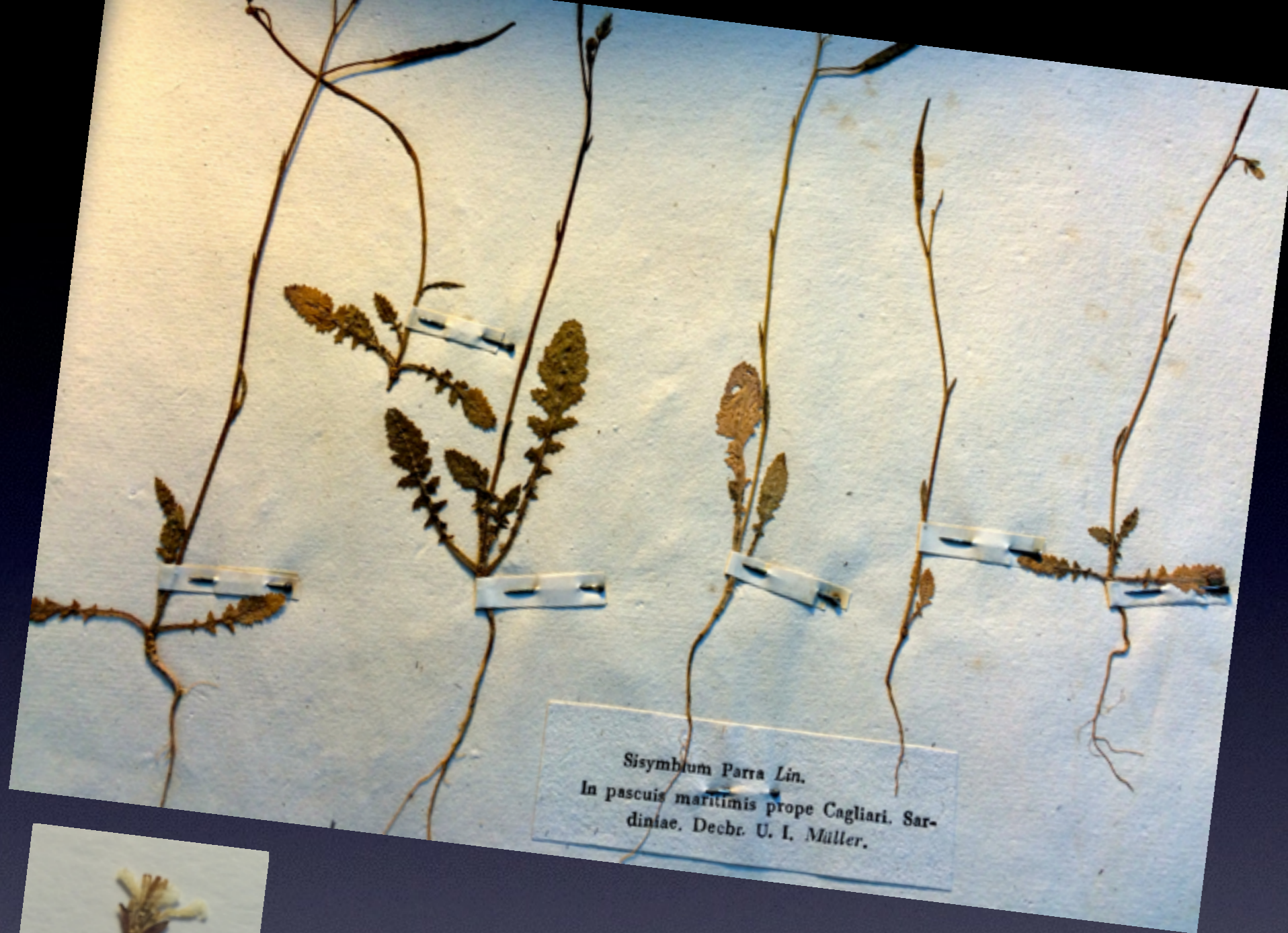
Specific Goals of the Project





The purpose of visiting herbaria is to get locations and dates for preparing exploration

The Paris Museum of Natural History



Observing all phenological stages

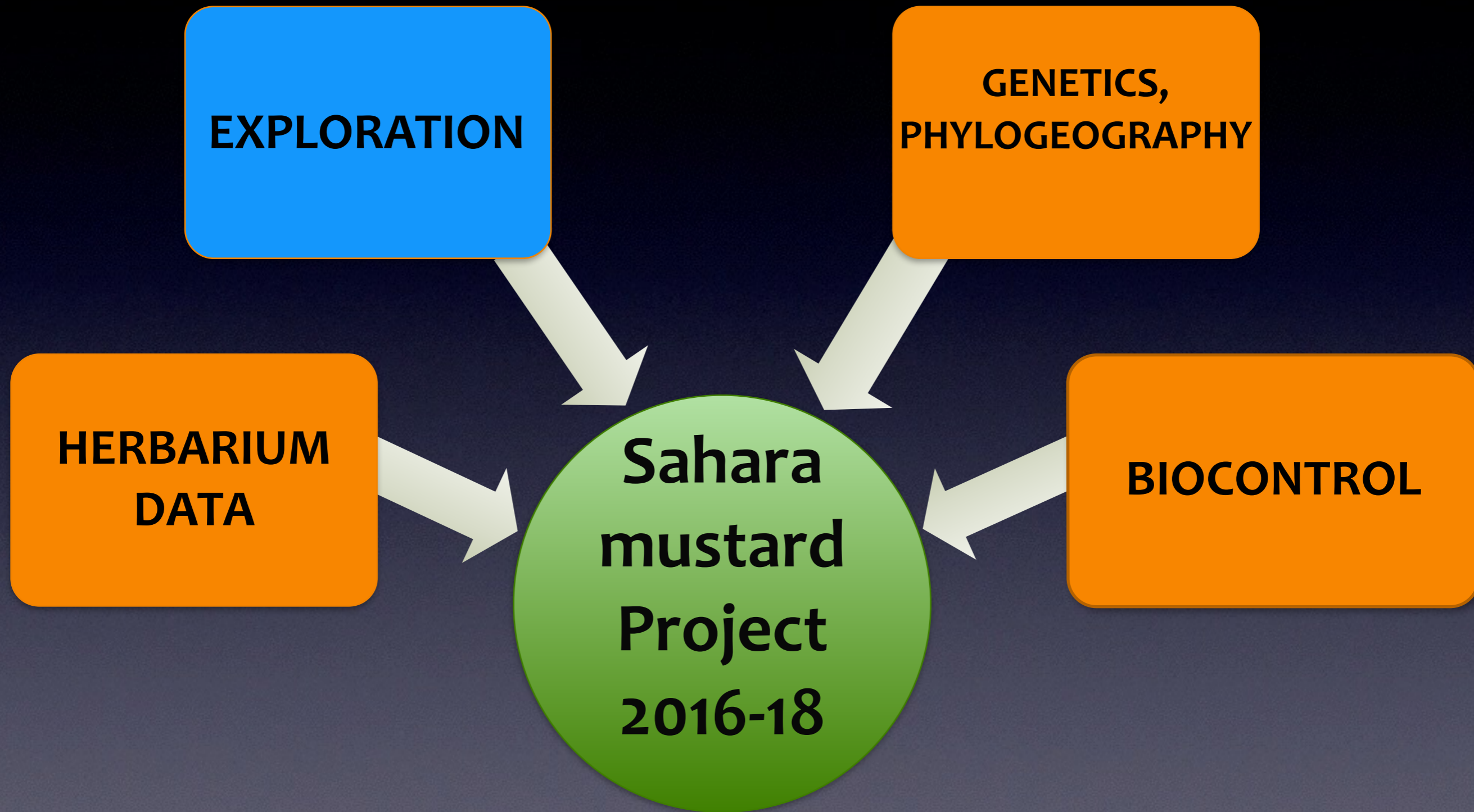
CALIFORNIA
United States of America
RIVERSIDE COUNTY
62006 Brassica *Tournefortii Gouan.
naturalized, from north Africa
La Quinta alt. ca. 10 ft
sandy desert March 9, 1962
Collected by Lewis S. Rose

Duplicate from
STATE HERBARIUM OF SOUTH AUSTRALIA
ADELAIDE
Brassica tournefortii Gouan.
South Australia. Lower Murray Mallee.
Ca. 8km west of Murray Bridge, ca. road to
Kinchana.
Leg. K. Czornij Collector's No. 542
Date 22.VIII.1973
Communication of new determinations will be greatly appreciated
by the Adelaide Herbarium.

Data from the native
range but...also from
the introduced range



Specific Goals of the Project



Why collecting?

1. Obtain voucher specimens for future morphological studies
2. Conduct genetic analyses of native and invasive populations
3. Find potential biocontrol agents



Where collecting?

- ☀ All native range (permits)
- ☀ Natural & agricultural ecosystems
- ☀ Roadsides
- ☀ National parks
- ☀ All year round
- ☀ Cooperation in hosted countries
- ☀ All kinds of BCAs (insects, mites, pathogens)



Collecting in Uzbekistan (Tamarix project)

Where have we been in 2016?



Foreign exploration in Europe & the middle East

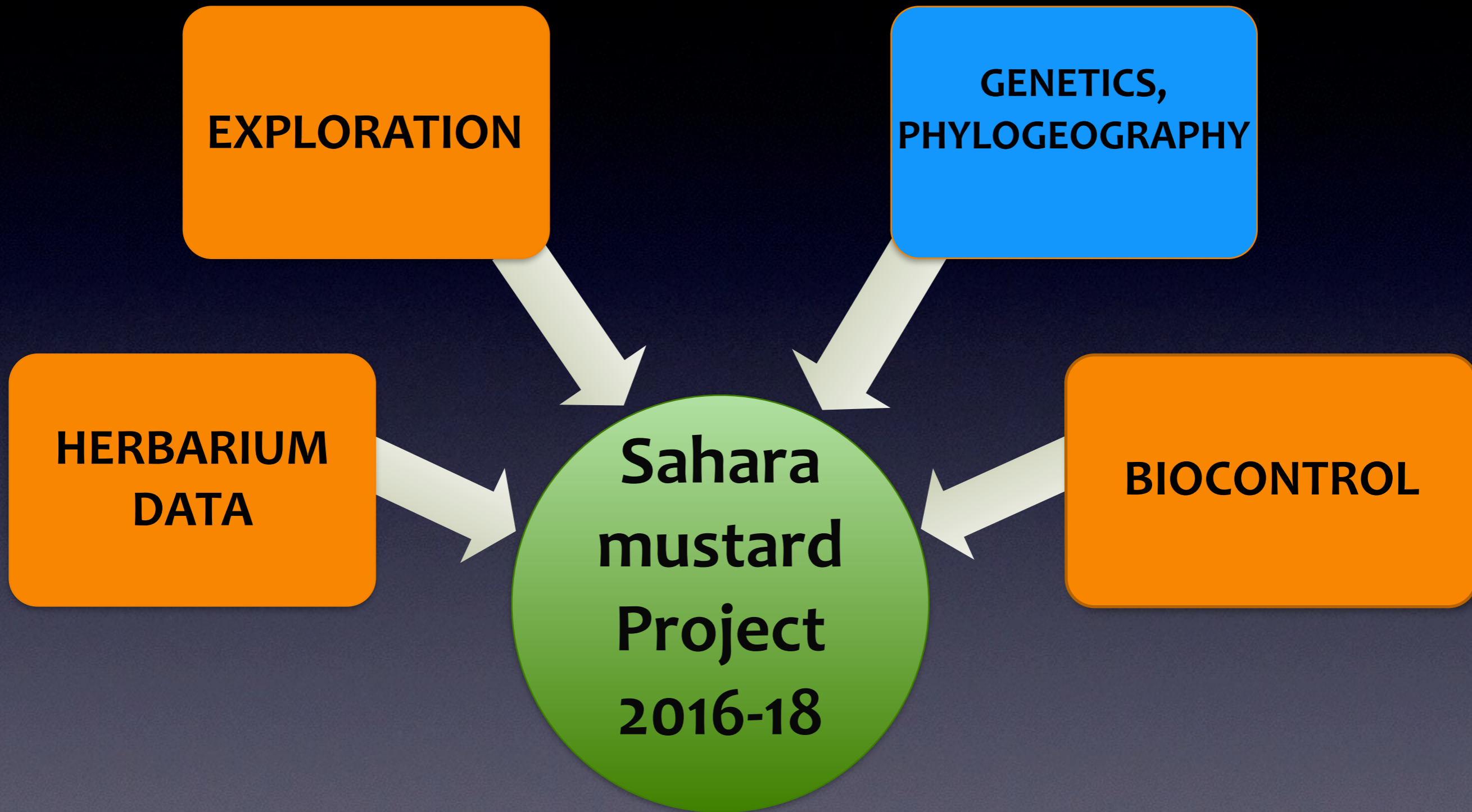
- **USDA-ARS France quarantine greenhouse**



- **Limited access to EBCL staff**

- **SOLID**
- **LIQUID**
- **AIR**

Specific Goals of the Project

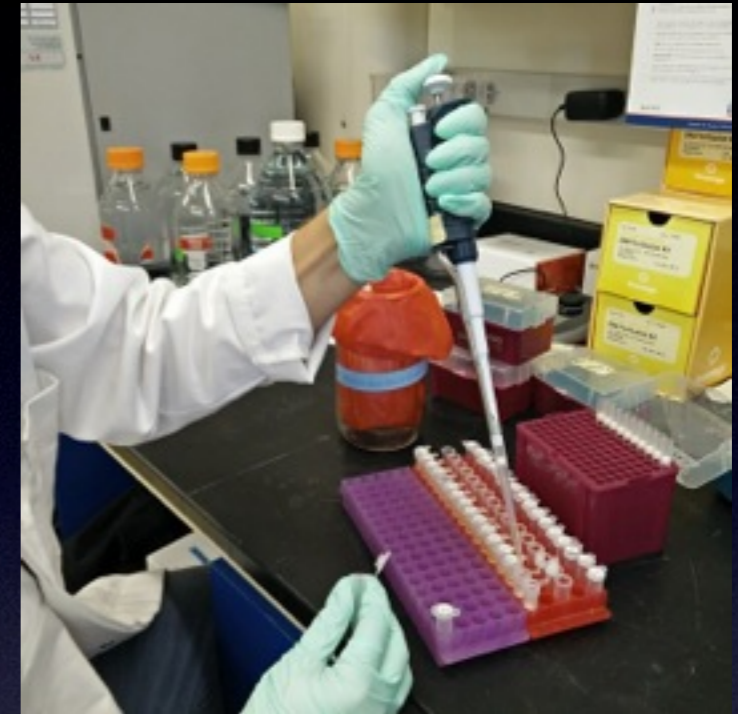


Phylogeography of Sahara mustard

- The goal is to determine which old world population(s) of Sahara mustard invaded North America
- In the U.S., the phylogeography study is conducted by Daniel Winkler (University of California, Irvine) (ddRAD-seq)

ddRAD libraries for the weed in the old world need to be built as those in the U.S.

- -> 15 populations sampled across the Mediterranean Basin
- Sampling can be seeds : germination then extraction of the first pair of leaves



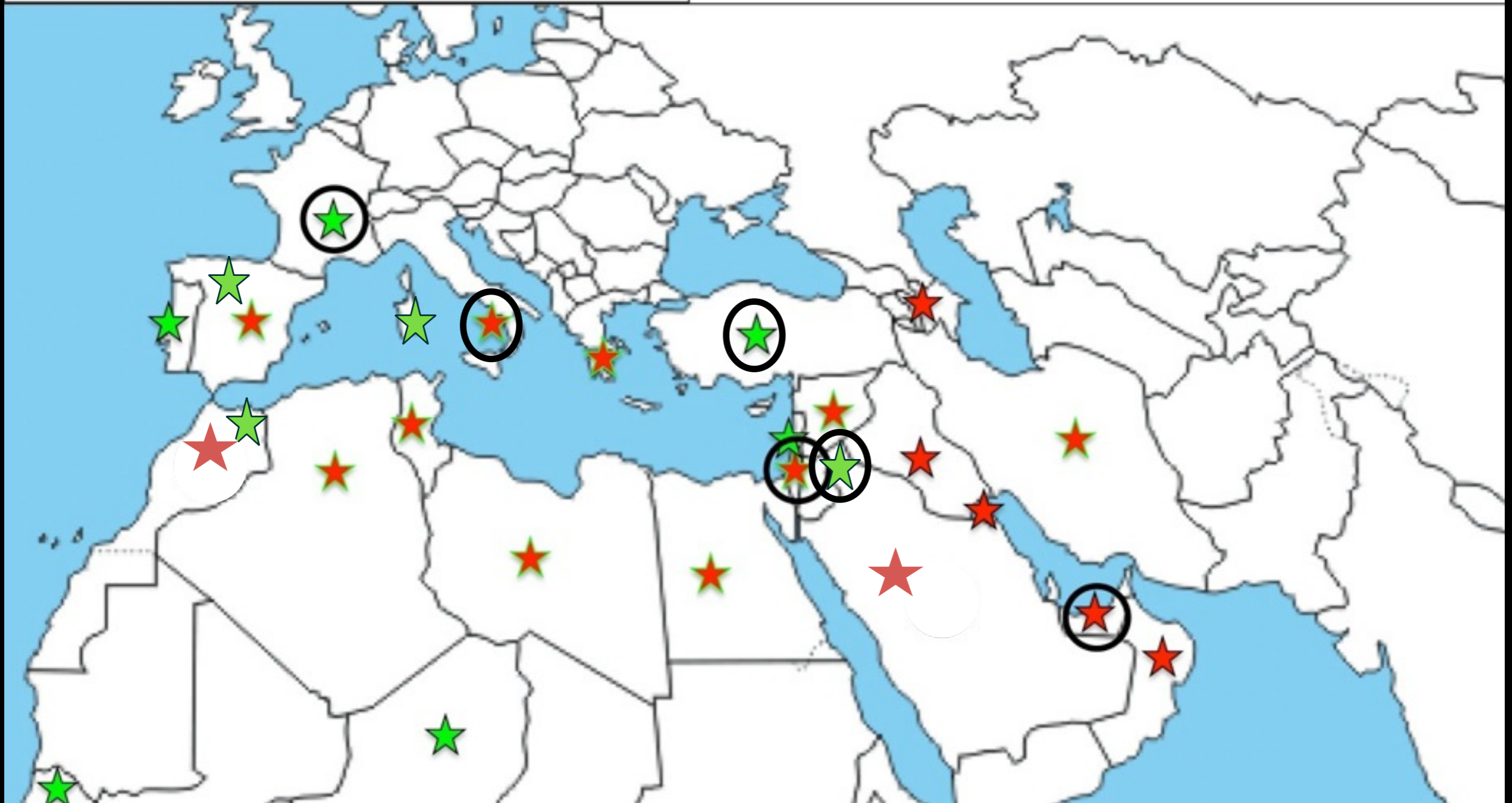
Sahara Mustard Distribution

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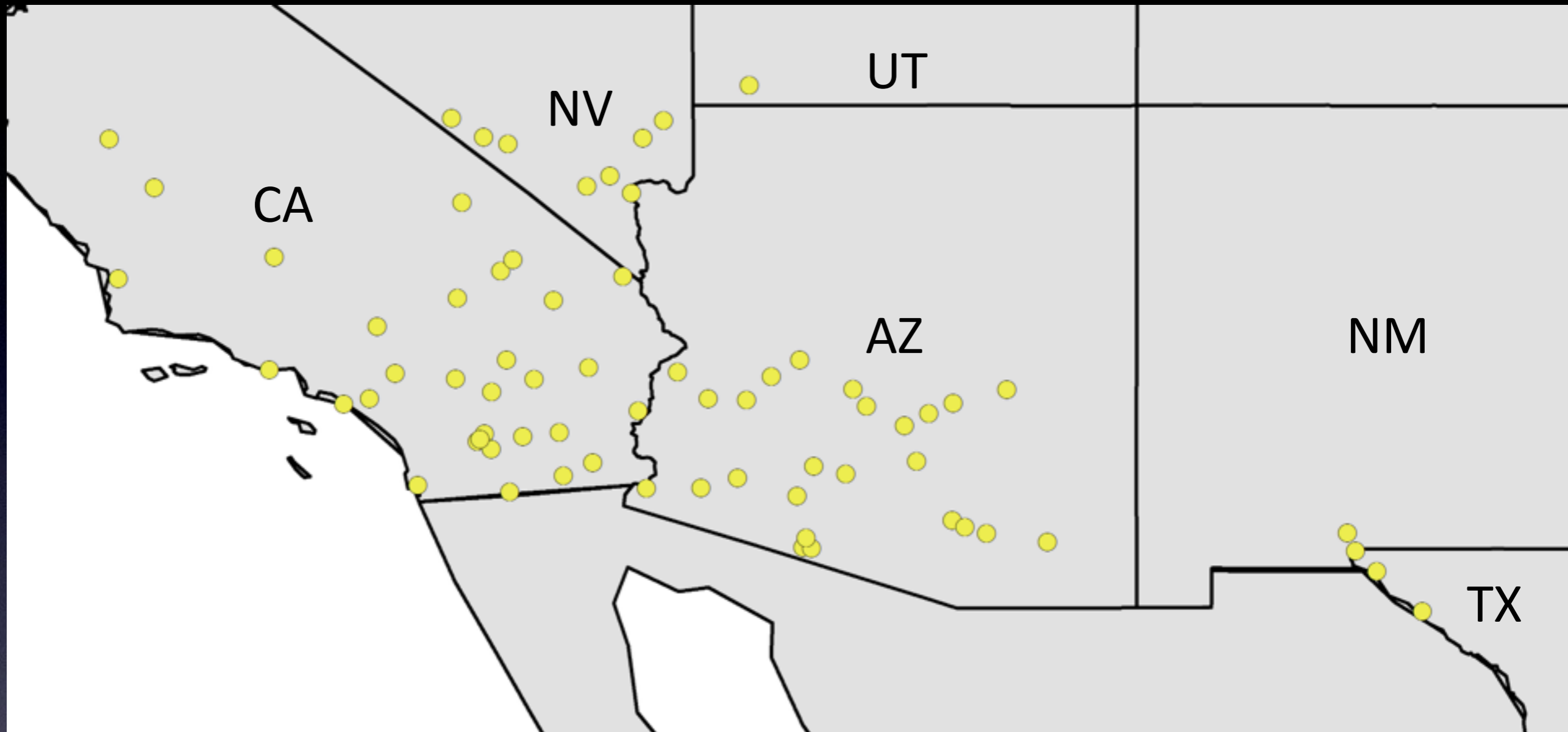
★ specimen in Br. Museum of NH

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○ specimens for DNA analysis



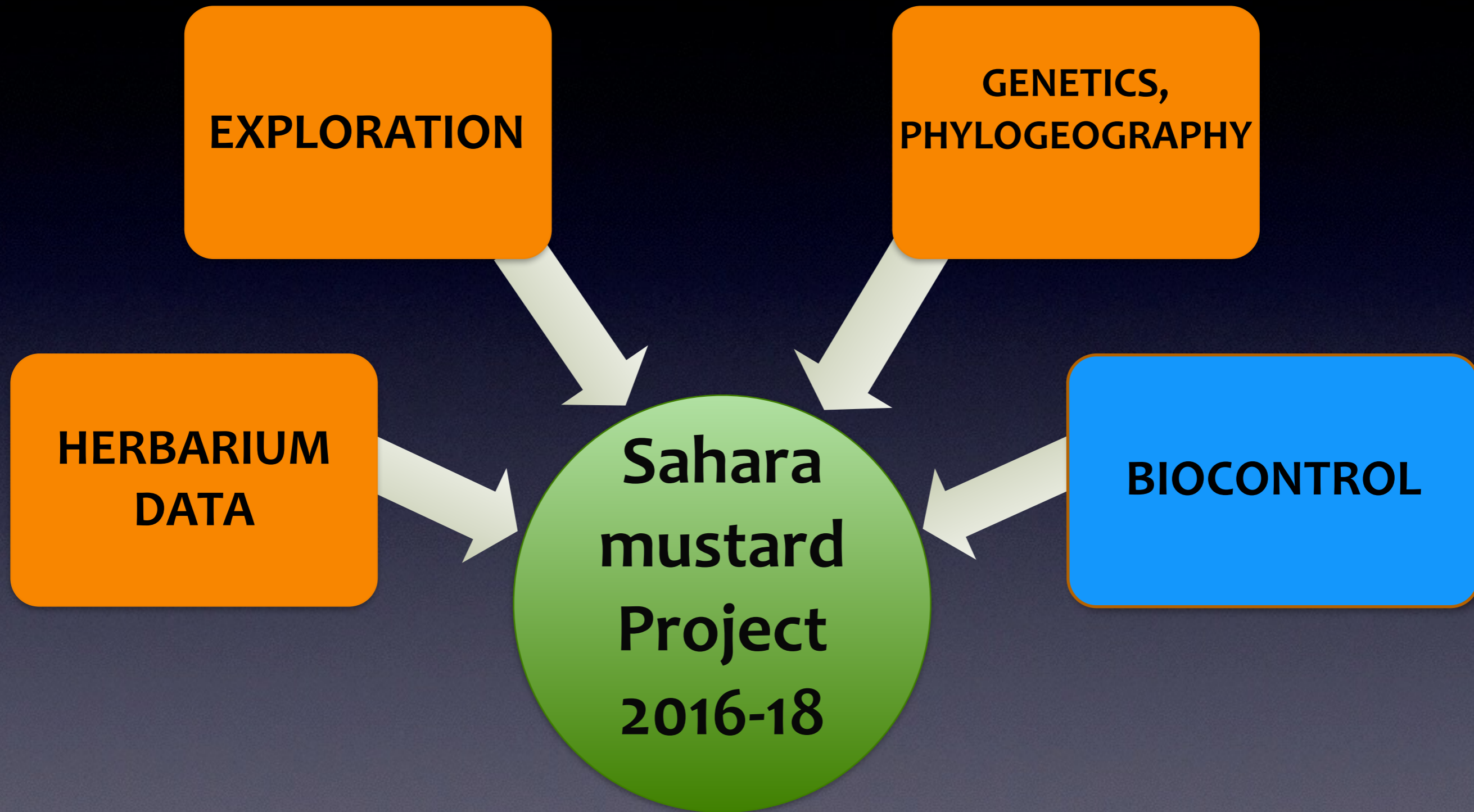
Phylogeography of Sahara mustard



- Collected tissue samples from 2,061 plants from 70 unique locations in United States

- Collected seeds from 1,074 plants from 63 localities

Specific Goals of the Project



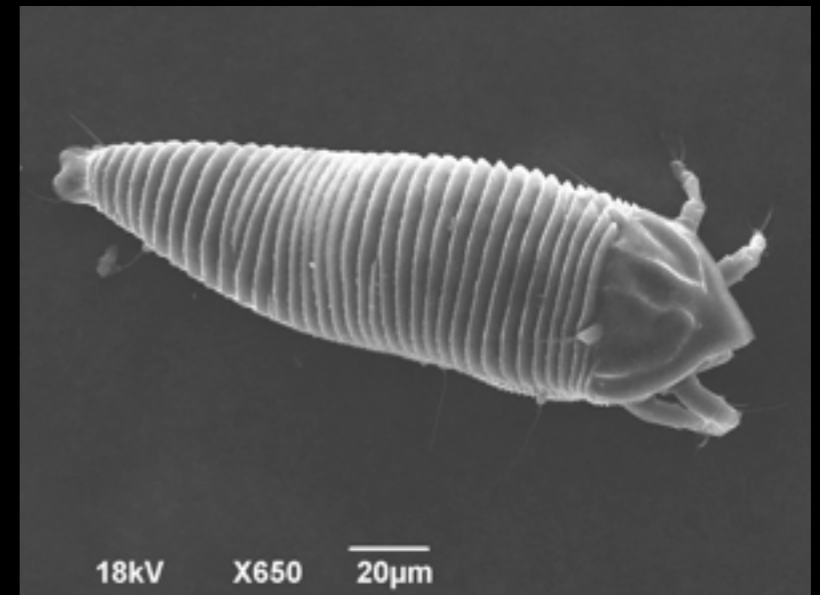
Biocontrol agents?

→ Insects ?



Courtesy M. Cristofaro

→ Mites ?



Courtesy M. Cristofaro



- **ITALY (April)**

in the southeast of Italy, we found a flea beetle (*Psylloides* sp.?), and a root-galling insect (*Ceutorhynchus* sp.?)



M. Cristofaro



- **TURKEY (March)**

Near Antalya, we found a stem mining larva (Lepidoptera or Chrysomelidae) and a seed feeder (potentially the adult from the chrysomelid larva).



M. Cristofaro



- **ISRAEL (March)**

Near Cesarea, we found phytophagous beetles, such as a a Curculionidae Ceutorhynchini, a Chrysomelidae, and a possible stem-galling midge (Cecidomyiidae)



M. Cristofaro



M. Cristofaro



- **JORDAN (April)**

We found typical symptoms of an Eryiophiid mite



M. Augé

Where will be going in 2017?



★ 2016 ★ 2017

Next steps?

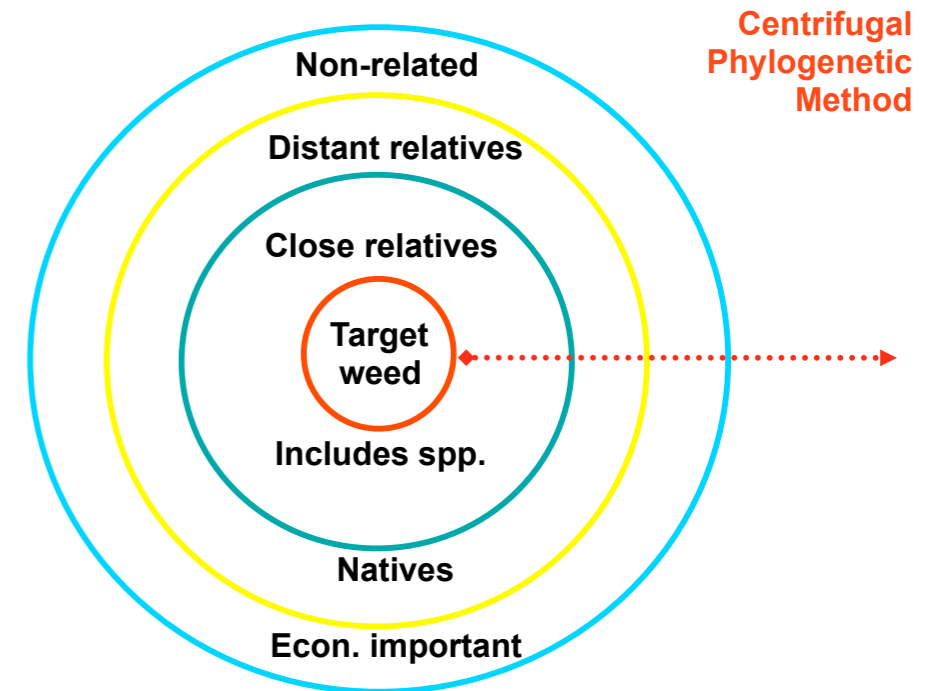
.1.



.2.

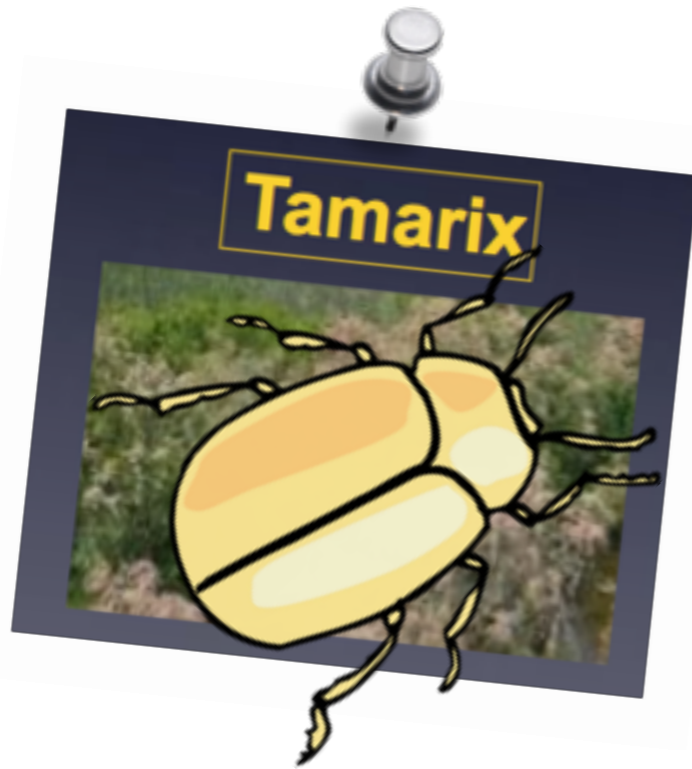


.3.



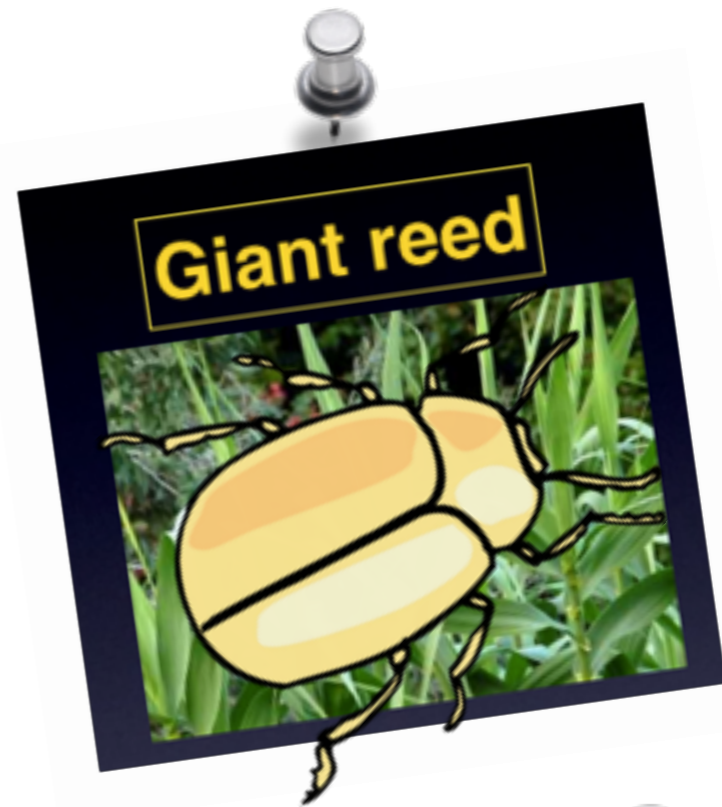
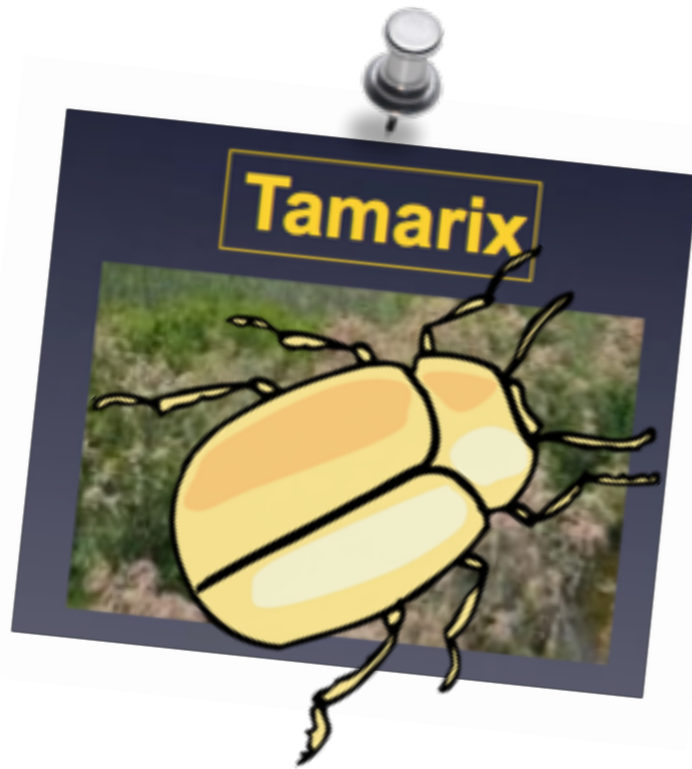
- When **Insects** go high, **Weeds** go low

The present

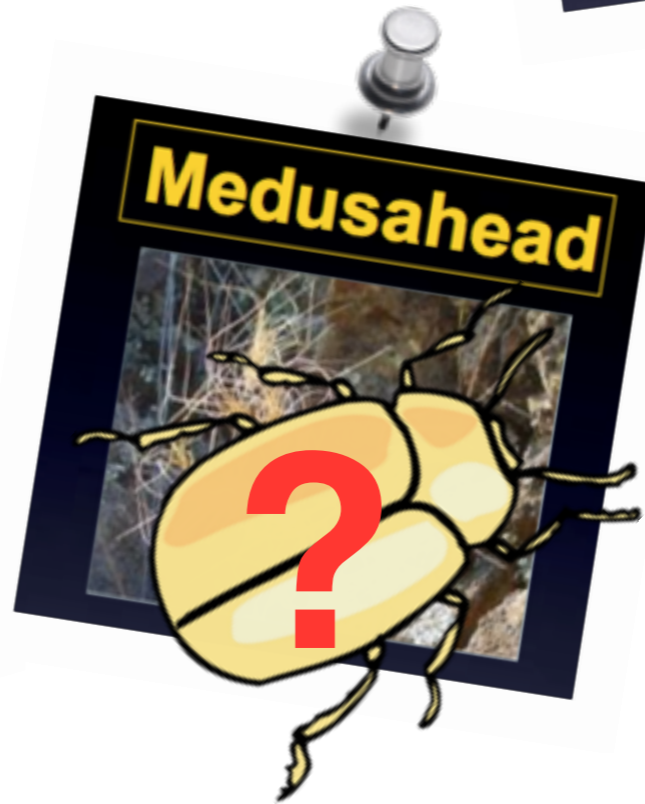


- When **Insects** go high, **Weeds** go low

The present



The future



Thanks - Gracias - Merci



From the top of Half Dome