Foreign Exploration - Determining Appropriate Places to Collect Agents

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Presentation content

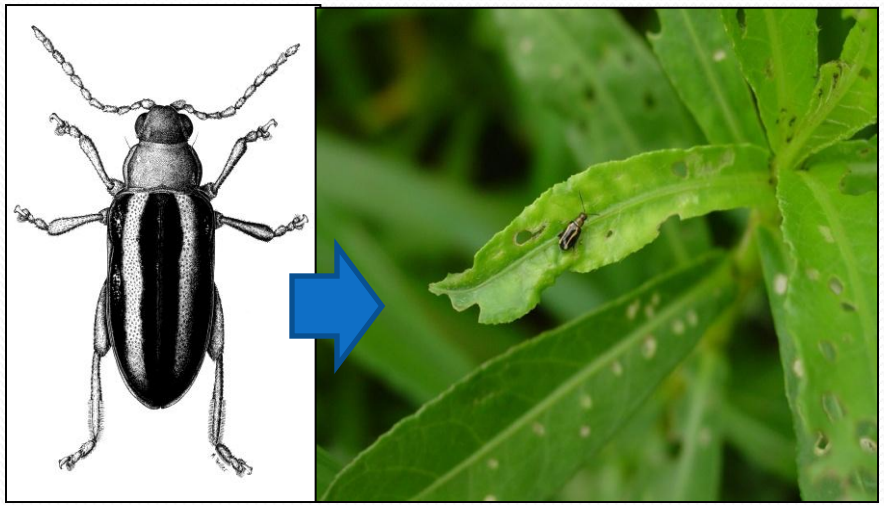
- Introduction
- Mission of SABCL
  - Field exploration
  - Examples of selection of places
    - Water primrose
    - Alligator weed
    - Brazilian peppertree
    - Imported fire ants
    - Little fire ants
    - Cactus mealybug
- Concluding remarks

ARS OVERSEAS LABS

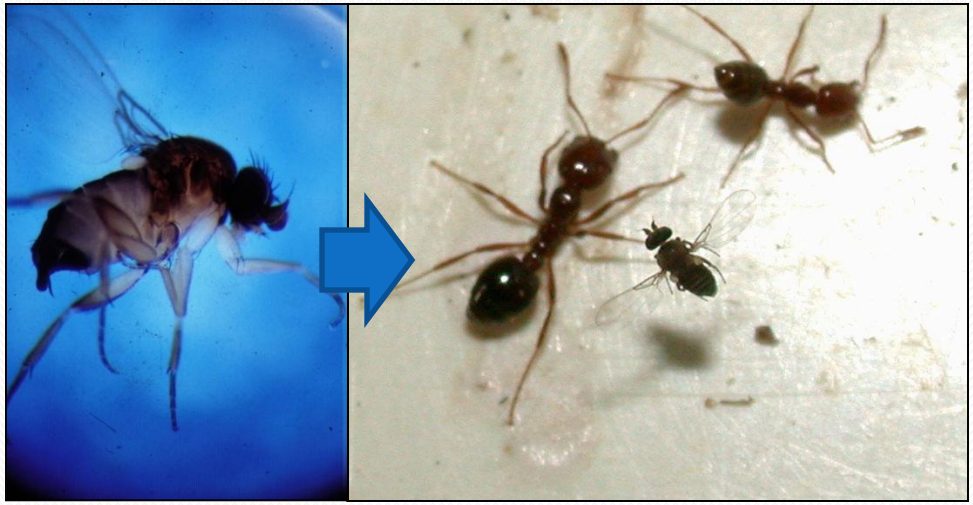
MAIN MISSION of SABCL

- **TO DEVELOP NATURAL ENEMIES FOR THE BIOCONTROL OF ARGENTINE INVASIVE SPECIES**

WEEDS



INSECTS



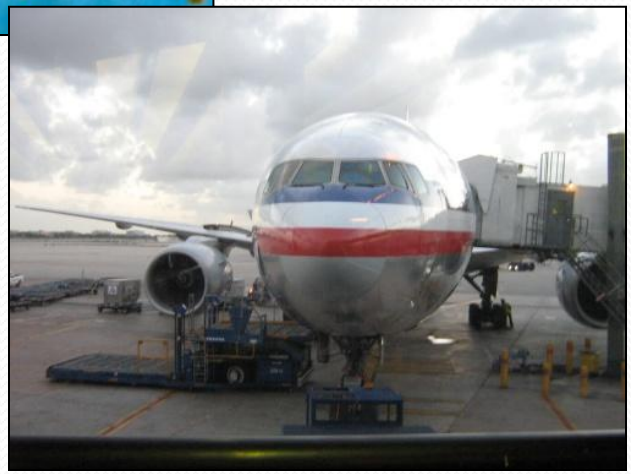
MISSION STEPS in ARGENTINA

USDA - ARS
SABCL
South American Biological Control Laboratory

1. **Exploration**

2. **Evaluation**
   a. Specificity
   b. Damage on target

3. **Exportation**



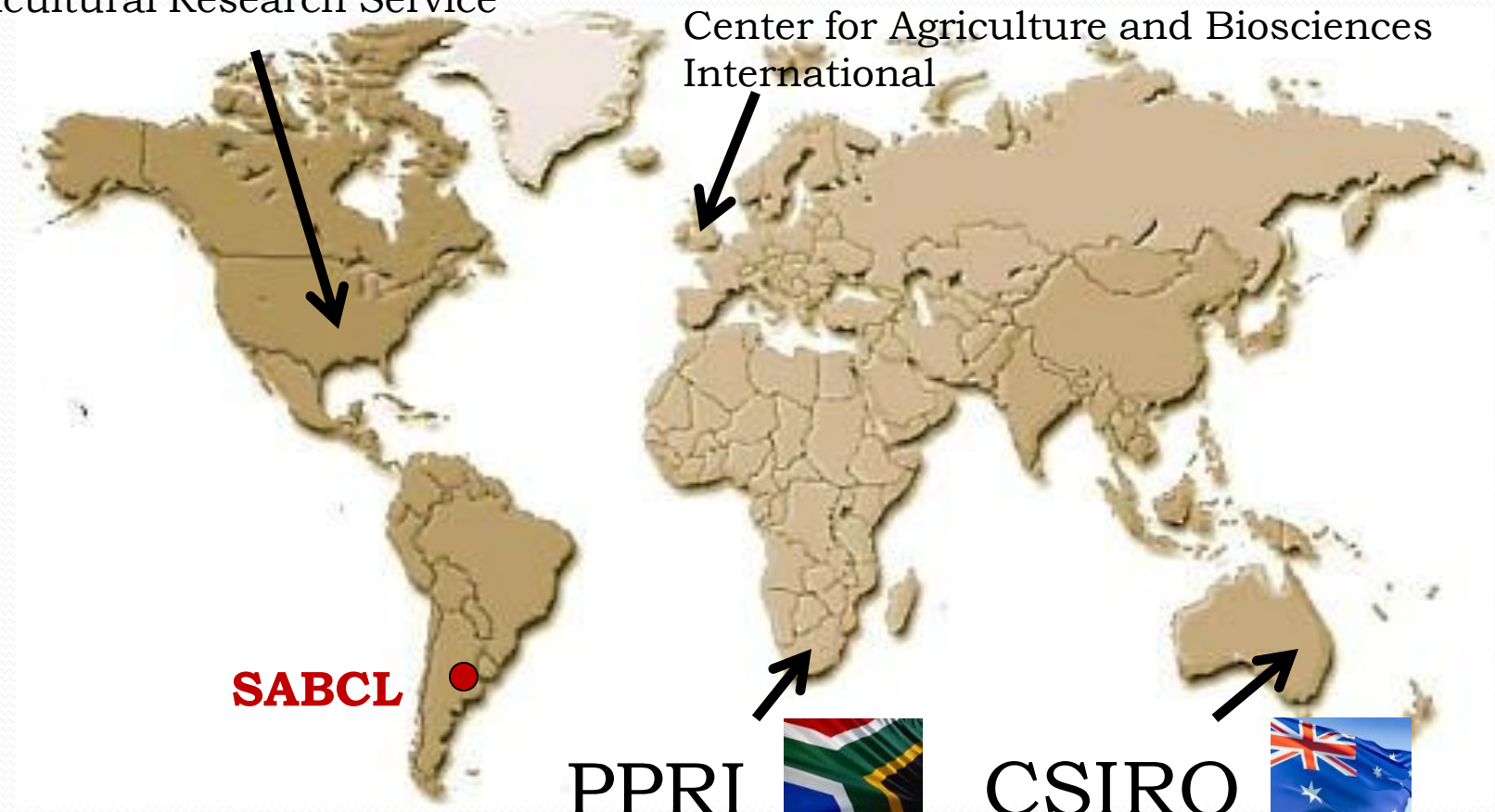
RECIPIENTS of NATURAL ENEMIES from SABCL

ARS

Agricultural Research Service

CABI

Center for Agriculture and Biosciences International



PPRI

Plant Protection Research Institute

CSIRO

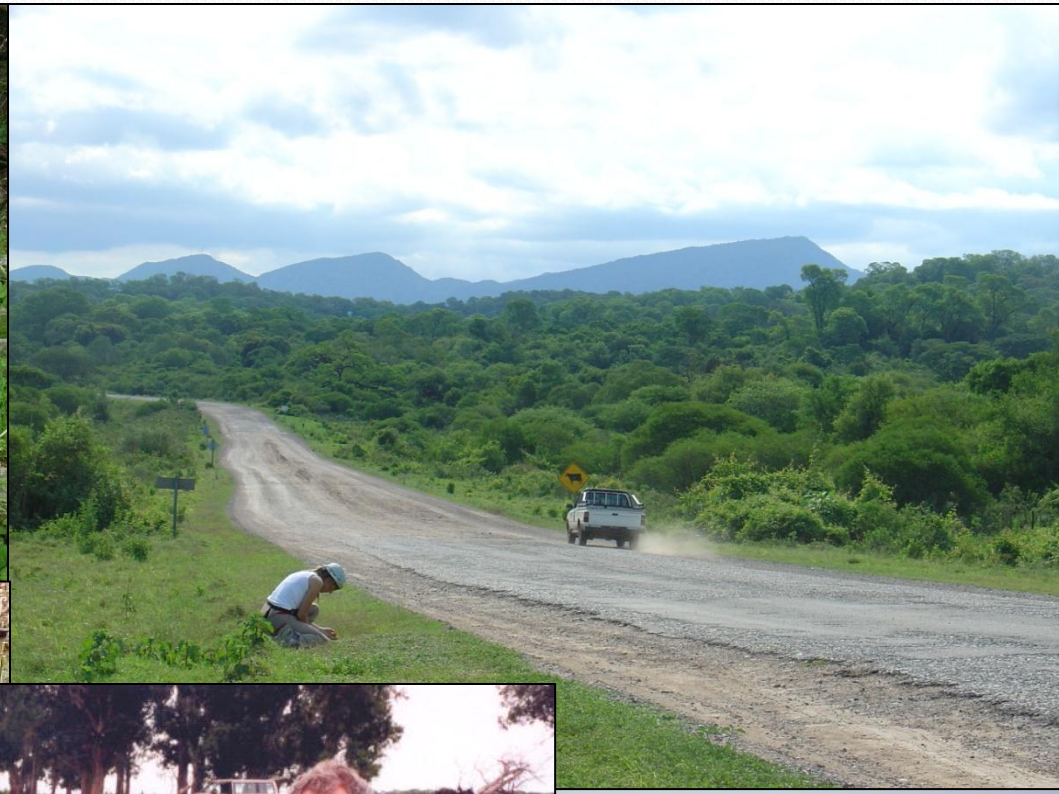
Commonwealth Scientific and Industrial Research Organization

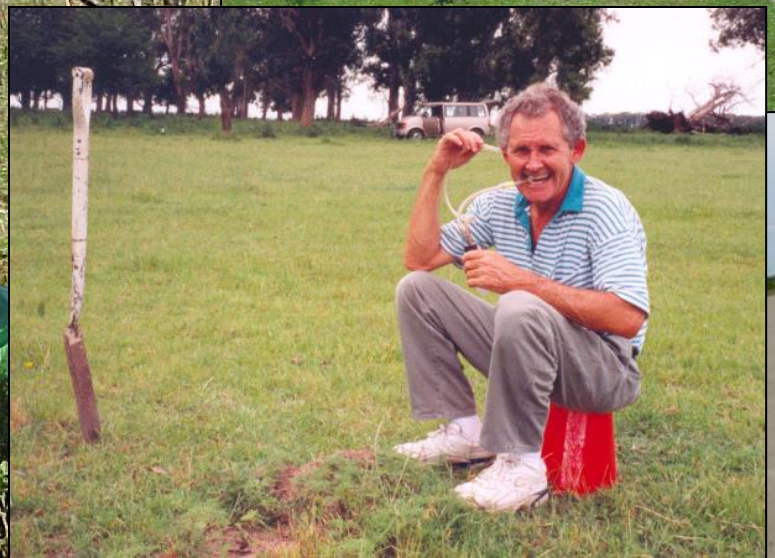
MISSION AT THE RECEIVING COUNTRY

1. Evaluation in quarantine
2. Field release
3. Post-release studies

FIELD EXPLORATION

FIELD EXPLORATION

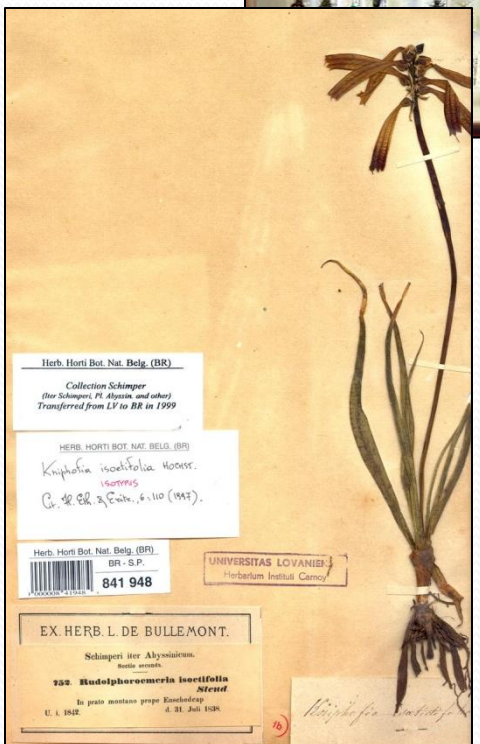




FIELD EXPLORATION

Basic tools to start the explorations

- **Museum information**
- **Herbarium information**
- **Bibliographic search**
- **SABCL records**
- **Local scientists**



Examples of selection of places to collect agents

I - Water primrose

Ludwigia hexapetala & L. grandiflora

Invasive in USA and Europe

Carruthers & Grewell, ARS Albany-Davis

In the USA, there are other species considered native

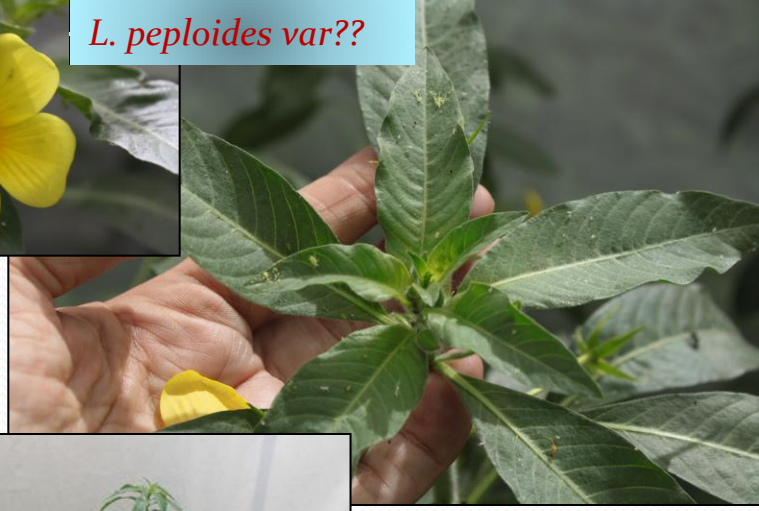
In California, invasive populations are genetically homogeneous

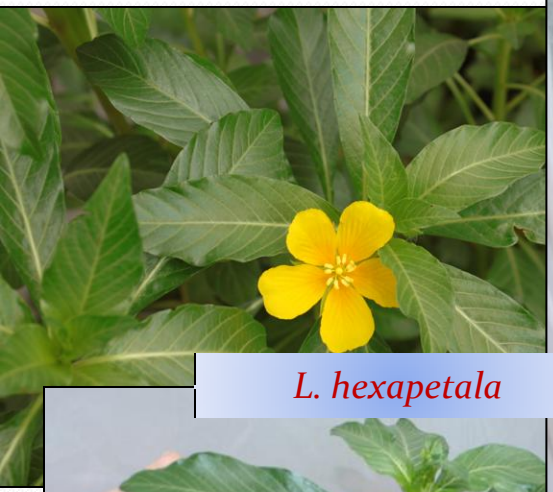
L. hexapetala **(2n=80)**

L. grandiflora **(2n=48)**

L. peploides var glabrescens

L. peploides var??



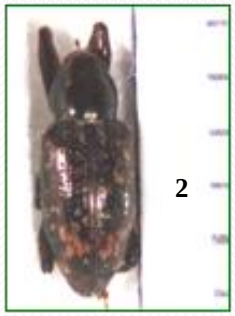


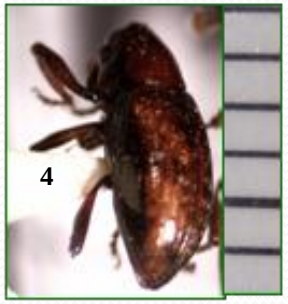
L. hexapetala

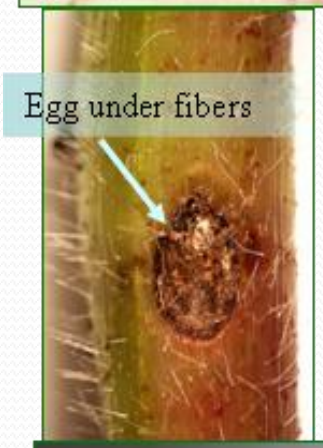
L. grandiflora

In Argentina, there are several spp. and subspp. with high morphological variability and overlapping geographic ranges

Potential candidates for BC







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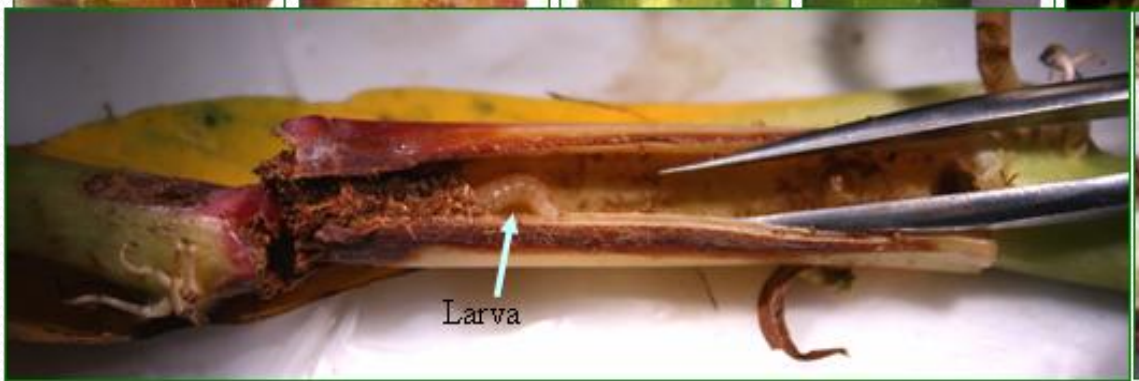
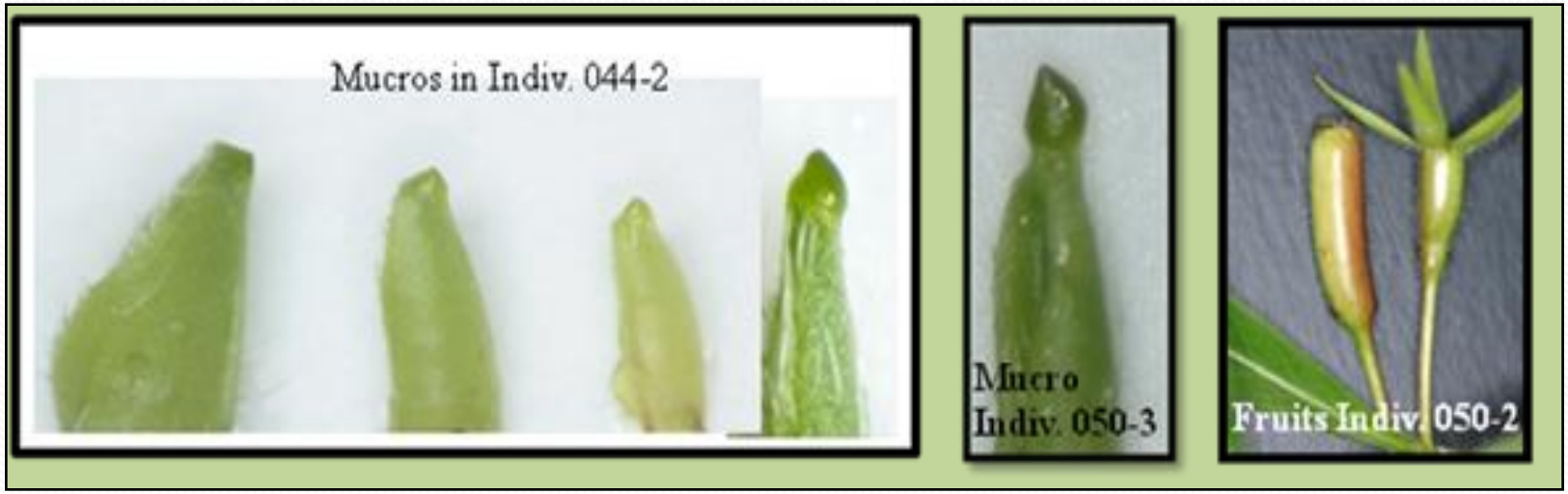
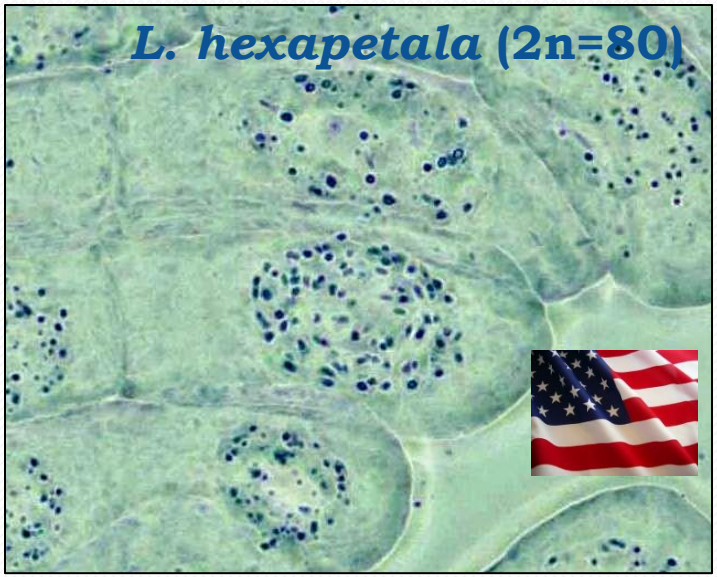
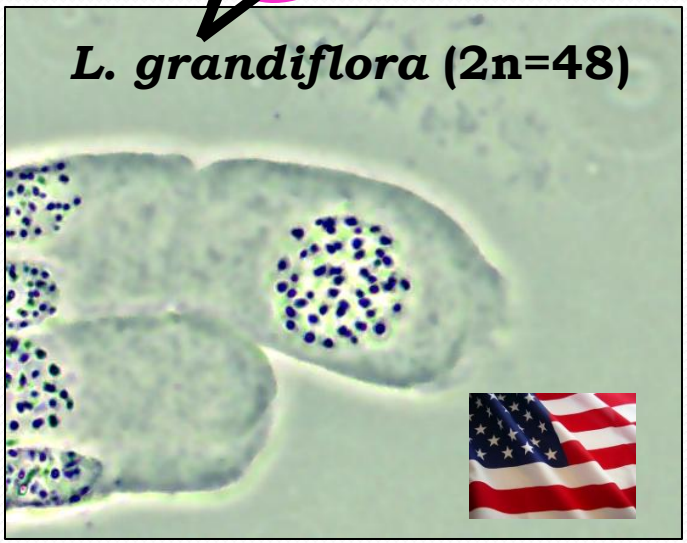


Morphological plasticity

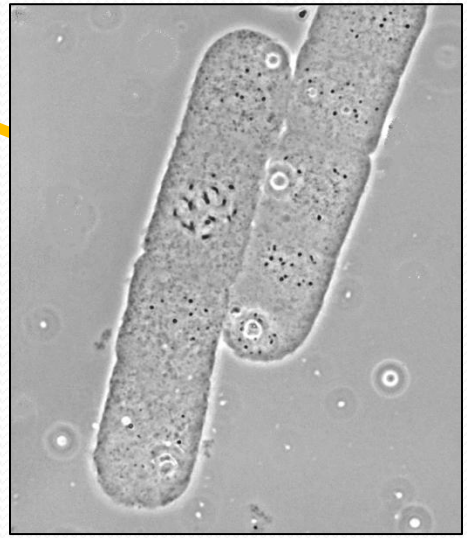


Chromosome counts





***Ludwigia* sp. (2n=64)**



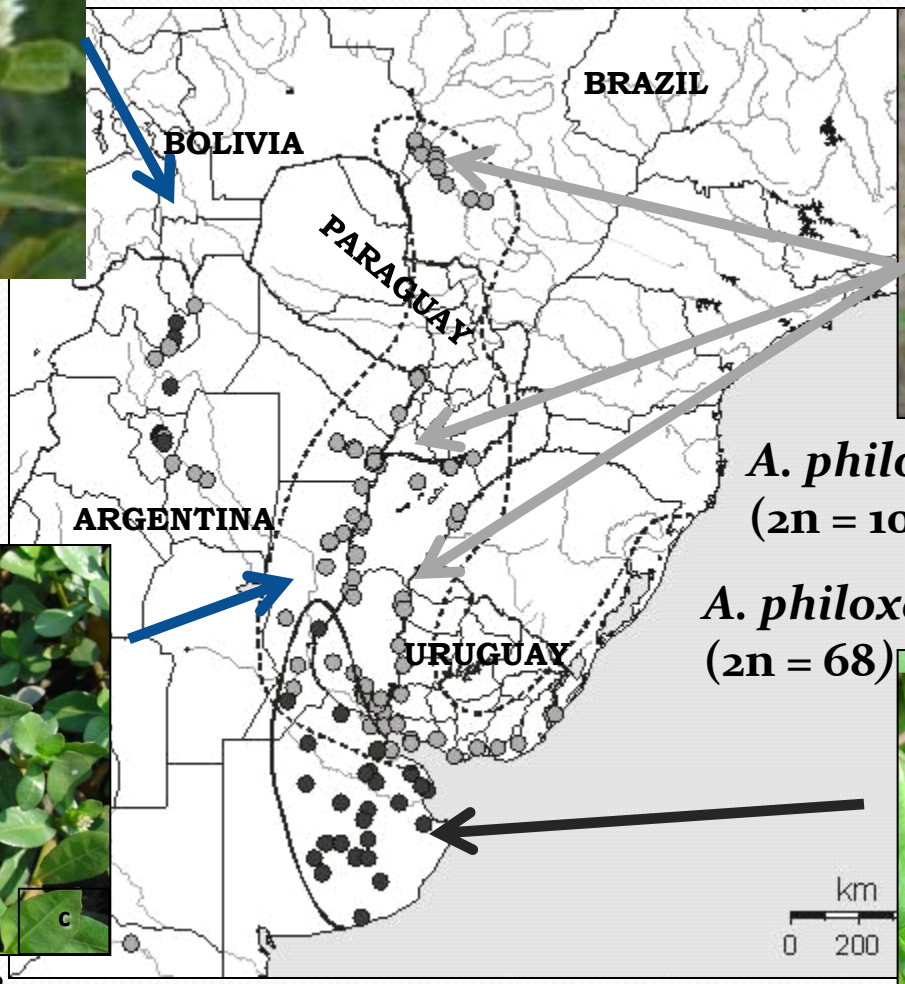
***L. peploides* (2n=16)**

II - Alligator weed

Alternanthera philoxeroides

Invasive in USA, Australia, and China

A. philoxeroides ?
(2n= ?)



A. philoxeroides angustifolia
(2n = 100 & 102)

A. philoxeroides philoxeroides
(2n = 68)

A. philoxeroides ?
(2n = 100 & 102)

Cytogenetical and morphological differences

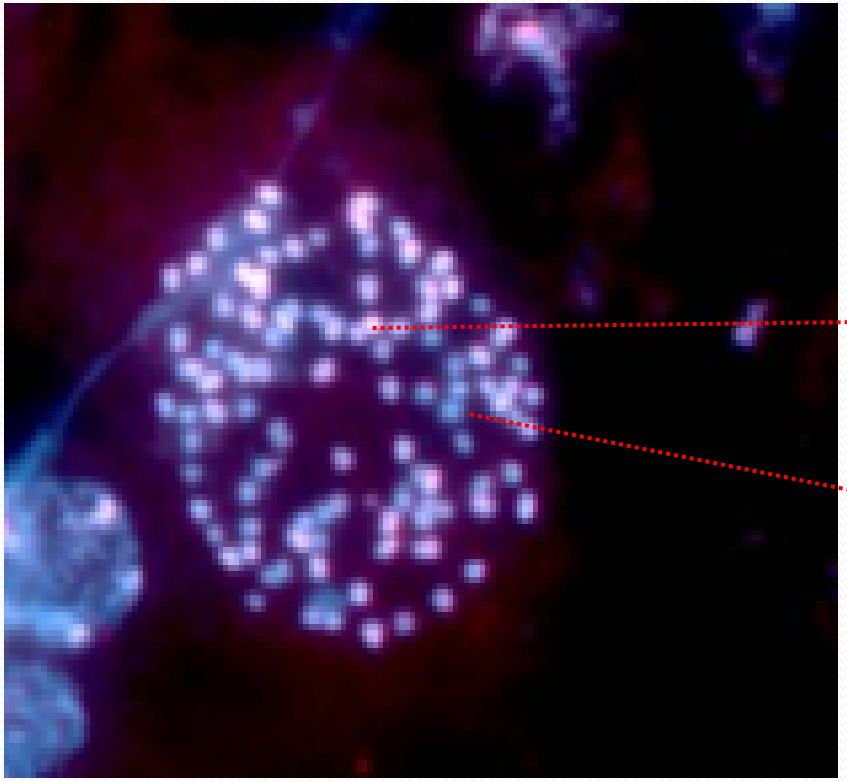
A. aquatica

Alligator weed (hybrid)

Genomic in situ hybridization technique

(In collaboration with the University of Buenos Aires)

To determine the origin of the chromosomes



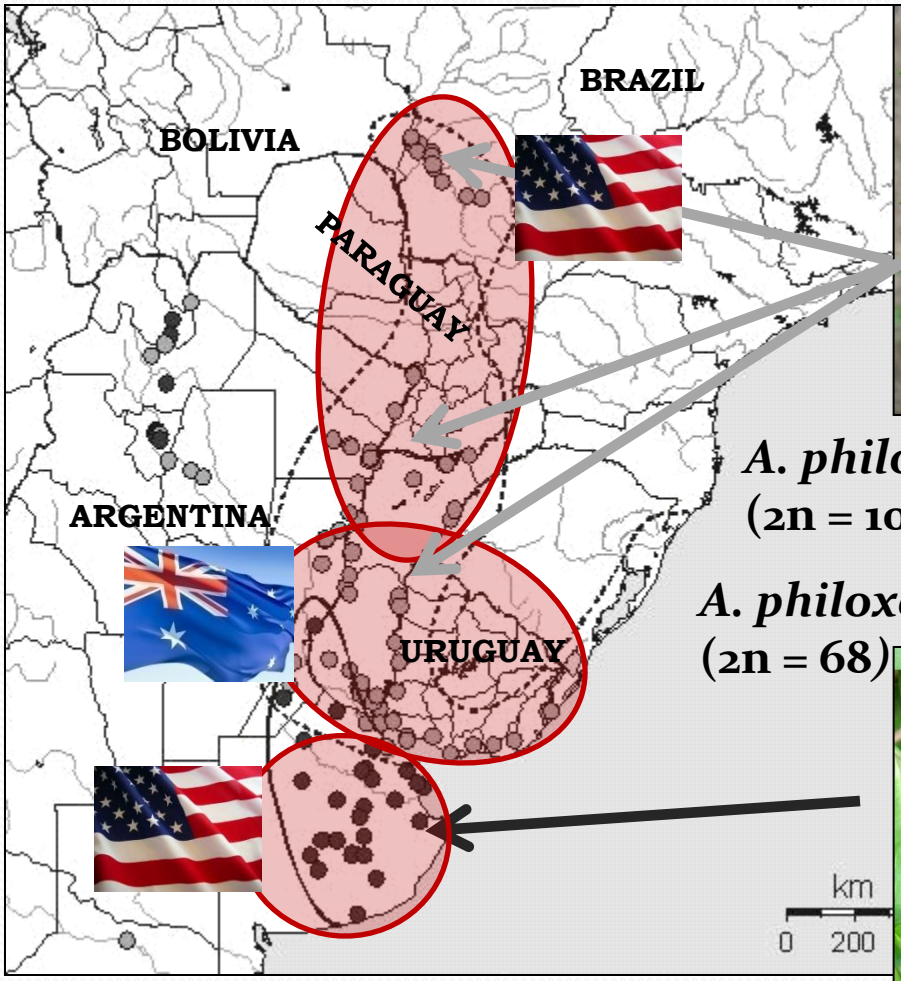
Hybridized chromosome

Non-Hybridized chromosome

The higher the number of chromosomes the better is the performance of the flea beetle in aquatic habitats

A. philoxeoides angustifolia

Agasicles hygrophila



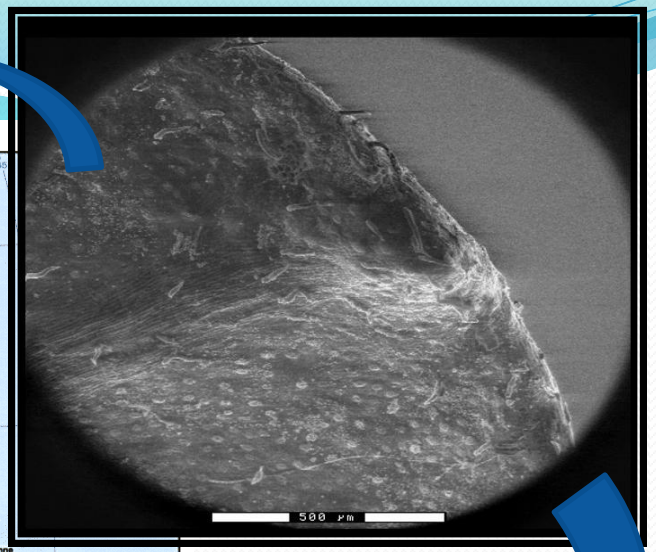
A. philoxeroides angustifolia
(2n = 100 & 102)

A. philoxeroides philoxeroides
(2n = 68)

III - Brazilian peppertree

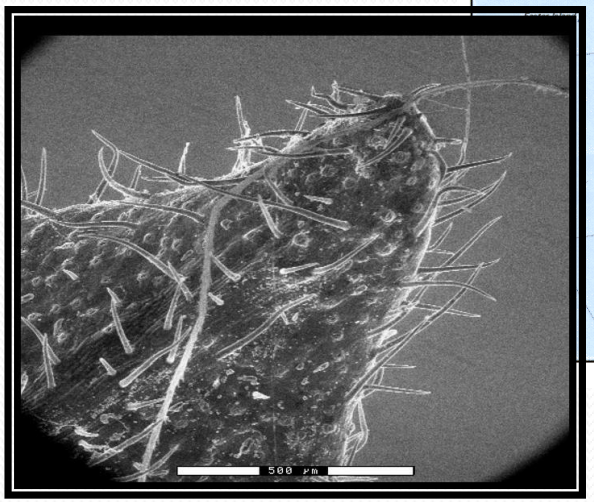
Schinus terebinthifolius

Invasive in USA

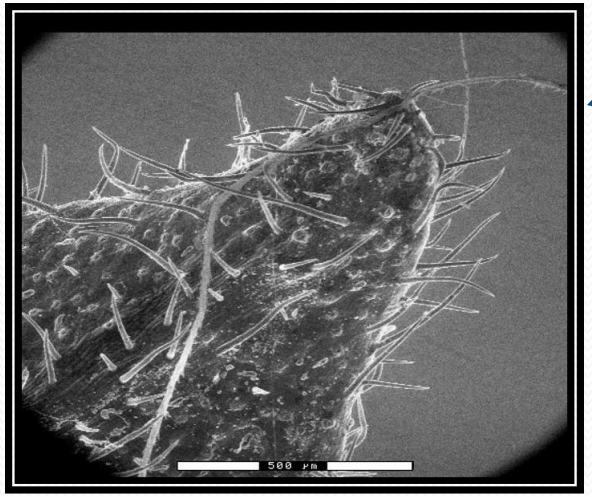


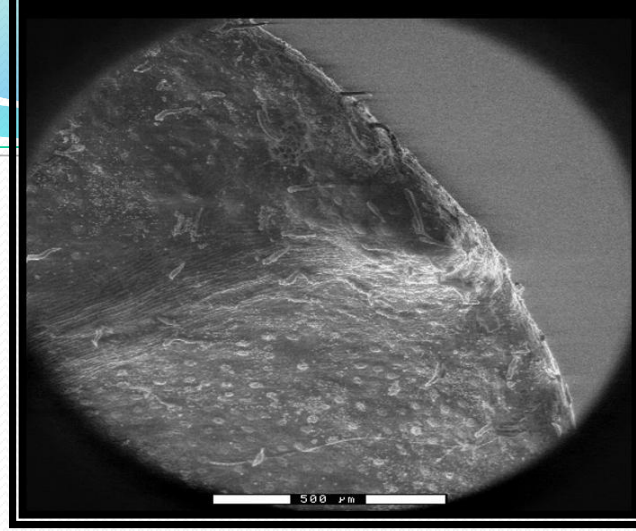
GLABROUS FORM

PUBESCENT FORM



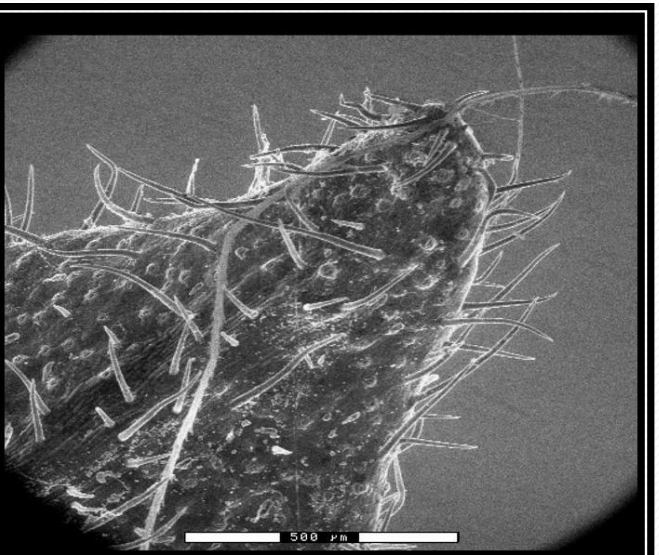
PUBESCENT FORM

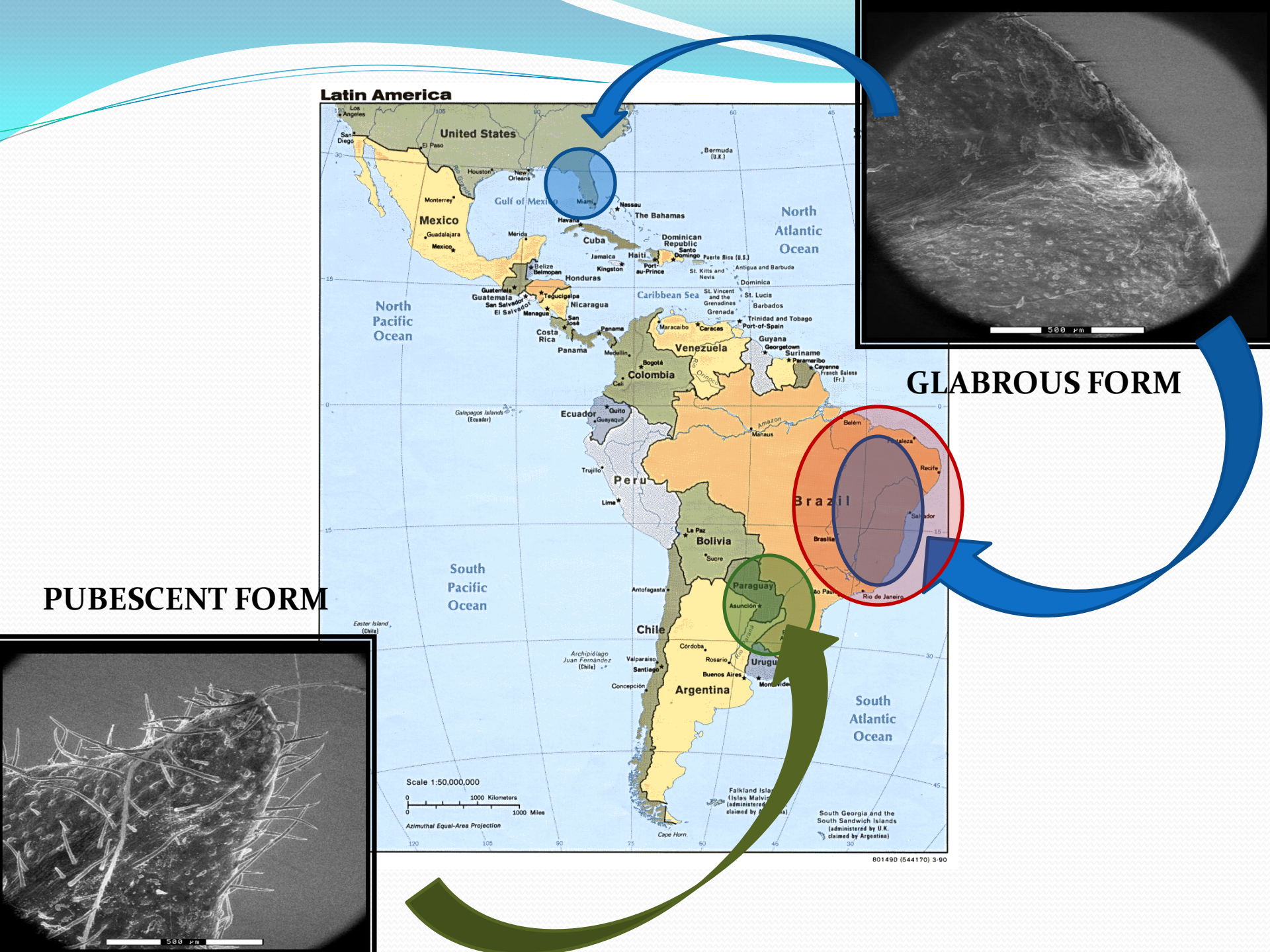




GLABROUS FORM

PUBESCENT FORM




Latin America
United States
Los Angeles
San Diego
El Paso
Houston
New Orleans
Miami
Bermuda (U.K.)
Gulf of Mexico
Nassau
The Bahamas
Havana
Cuba
Mexico
Monterrey
Guadalajara
Mérida
Jamaica
Kingston
Haiti
Port-au-Prince
Dominican Republic
Santo Domingo
Puerto Rico (U.S.)
St. Kitts and Nevis
Antigua and Barbuda
Dominica
North Atlantic Ocean
Belize
Belmopan
Honduras
Guatemala
San Salvador
El Salvador
Tegucigalpa
Managua
Nicaragua
San José
Costa Rica
Panama
Caribbean Sea
St. Vincent and the Grenadines
St. Lucia
Barbados
Grenada
Trinidad and Tobago
Port-of-Spain
Maracaibo
Caracas
Venezuela
Guyana
Georgetown
Suriname
Paramaribo
Cayenne
French Guiana (Fr.)
North Pacific Ocean
Medellín
Bogotá
Colombia
Cali
Galapagos Islands (Ecuador)
Ecuador
Quito
Guayaquil
Amazon
Manaus
Belém
Fortaleza
Recife
Trujillo
Peru
Lima
Brazil
Salvador
Brasília
Rio de Janeiro
La Paz
Bolivia
Sucre
South Pacific Ocean
Antofagasta
Paraguay
Asunción
Easter Island (Chile)
Chile
Archipiélago Juan Fernández (Chile)
Valparaíso
Santiago
Concepción
Córdoba
Rosario
Buenos Aires
Argentina
South Atlantic Ocean
Scale 1:50,000,000
1000 Kilometers
1000 Miles
Azimuthal Equal-Area Projection
Cape Horn
South Georgia and the South Sandwich Islands (administered by U.K. claimed by Argentina)
801490 (544170) 3-90
500 µm
GLABROUS FORM
PUBESCENT FORM
500 µm

IV - Imported fire ants

Solenopsis invicta (& *S. richteri*)

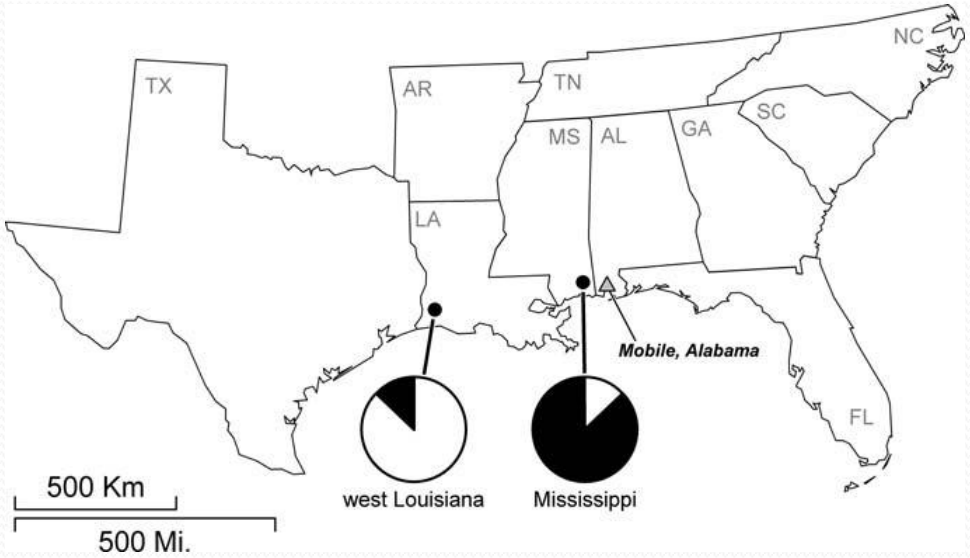
Invasive in USA, Australia, China, Taiwan

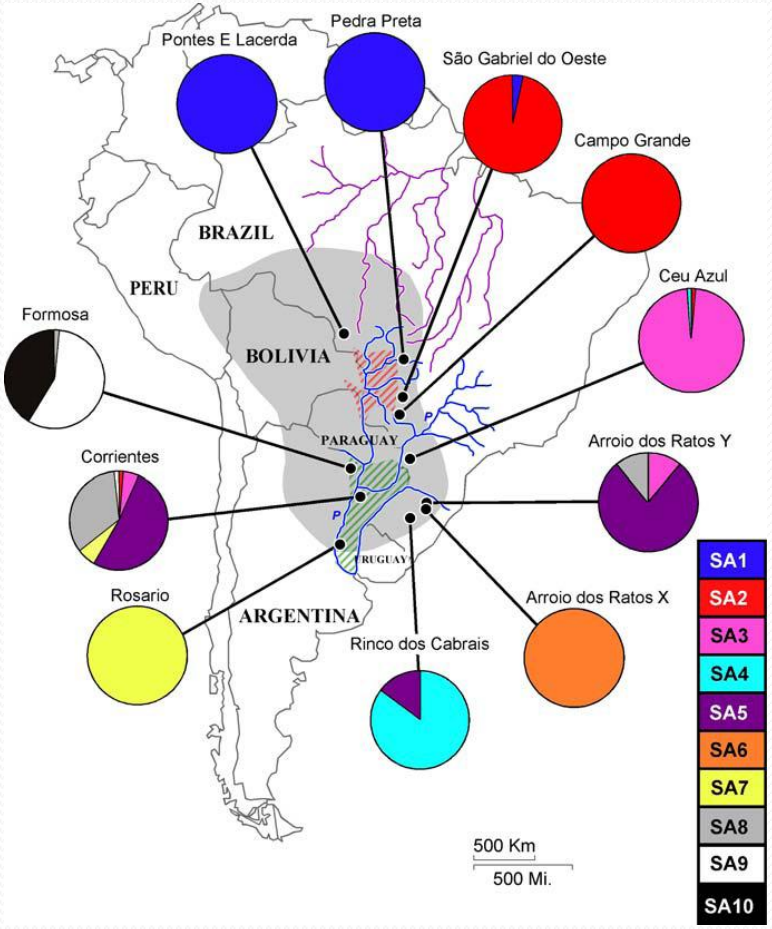
Native source

Caldera et al. 2008

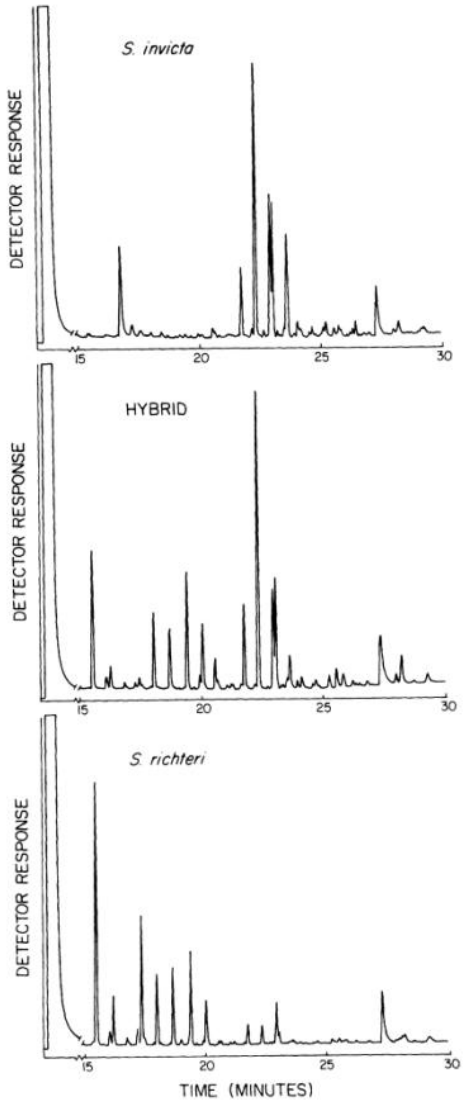
Native source

Vander Meer & Lofgren 1990





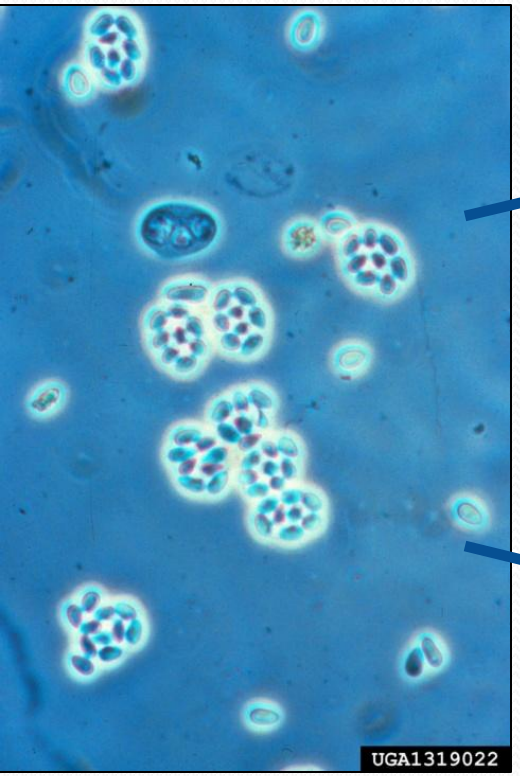
Caldera et al. 2008



Vander Meer & Lofgren, 1990

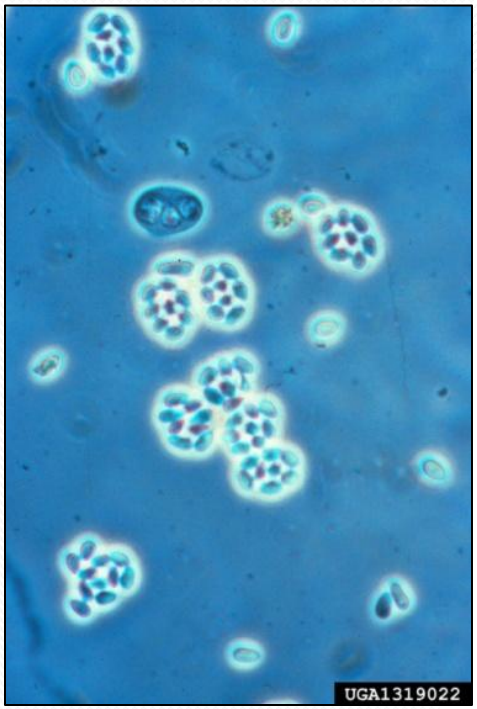
HONDURAS
Caribbean Sea
NICARAGUA
COSTA RICA
Cartagena
Maracaibo
Caracas
Merida
Maturin
TRINIDAD & TOBAGO
Cucuta
VENEZUELA
Georgetown
Paramaribo
GUYANA
FRENCH GUIANA (FR.)
Cayenne
PANAMA
Medellin
Manizales
Ibague
Bogota
Cali
COLOMBIA
SURINAME
Quito
ECUADOR
Guayaquil
Cuenca
Manaus
Belem
Sao Luis
Fortaleza
Teresina
BRAZIL
Recife
PERU
Lima
Salvador
BOLIVIA
Cuiaba
Brasilia
Goiania
La Paz
Cochabamba
Santa Cruz
Sucre
Belo Horizonte
PARAGUAY
Londrina
Rio De Janeiro
Sao Paulo
Salta
Asuncion
CHILE
San Miguel de Tucuman
RED IMPORTED FIRE ANT
Pacific Ocean
Atlantic Ocean
ARGENTINA
Porto Alegre
Cordoba
Santa Fe
Rosario
BLACK IMPORTED FIRE ANT
Valparaiso
Santiago
Buenos Aires
Montevideo
Concepcion
Mar del Plata
South America
International Boundary
Road
River
National Capital
City or Town
0 400 1000 KM
0 400 1000 Miles
© 2007 Geology.com
Falkland Islands (U.K.)
South Georgia (U.K.)

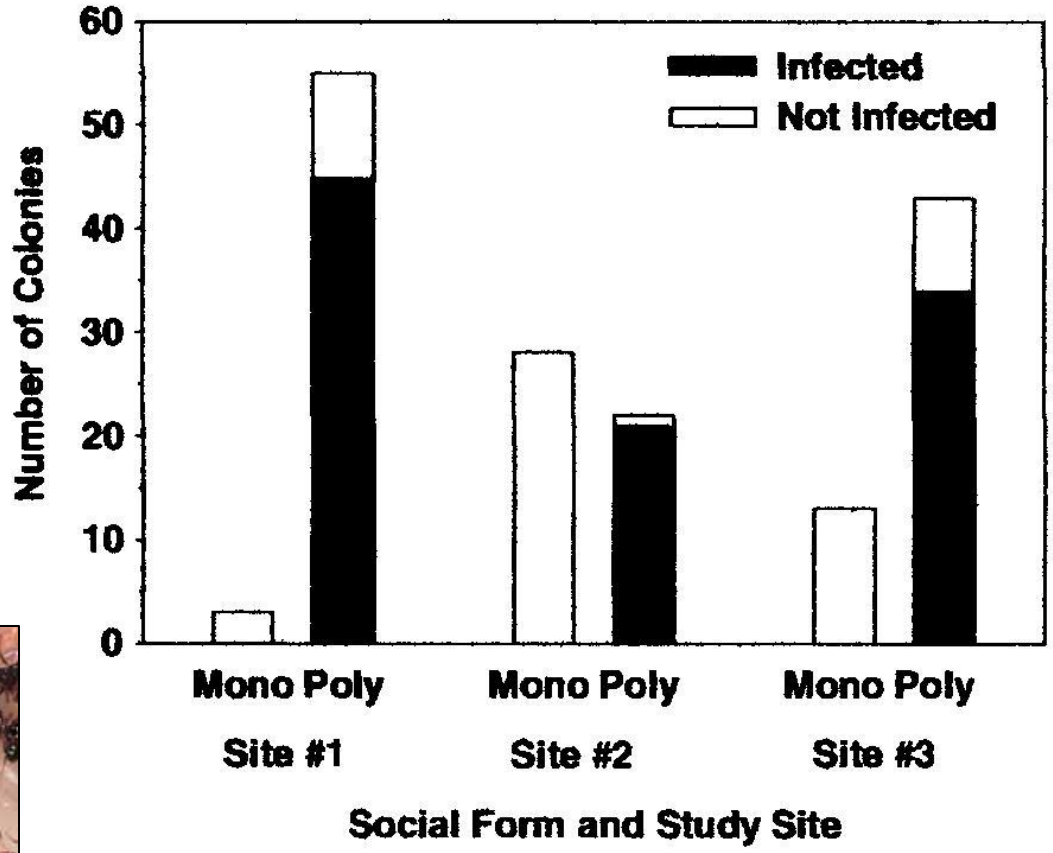
Red imported fire ant infection with *Kneallhazia* (=*Thelohania*) *solenopsae*



Monogyne form

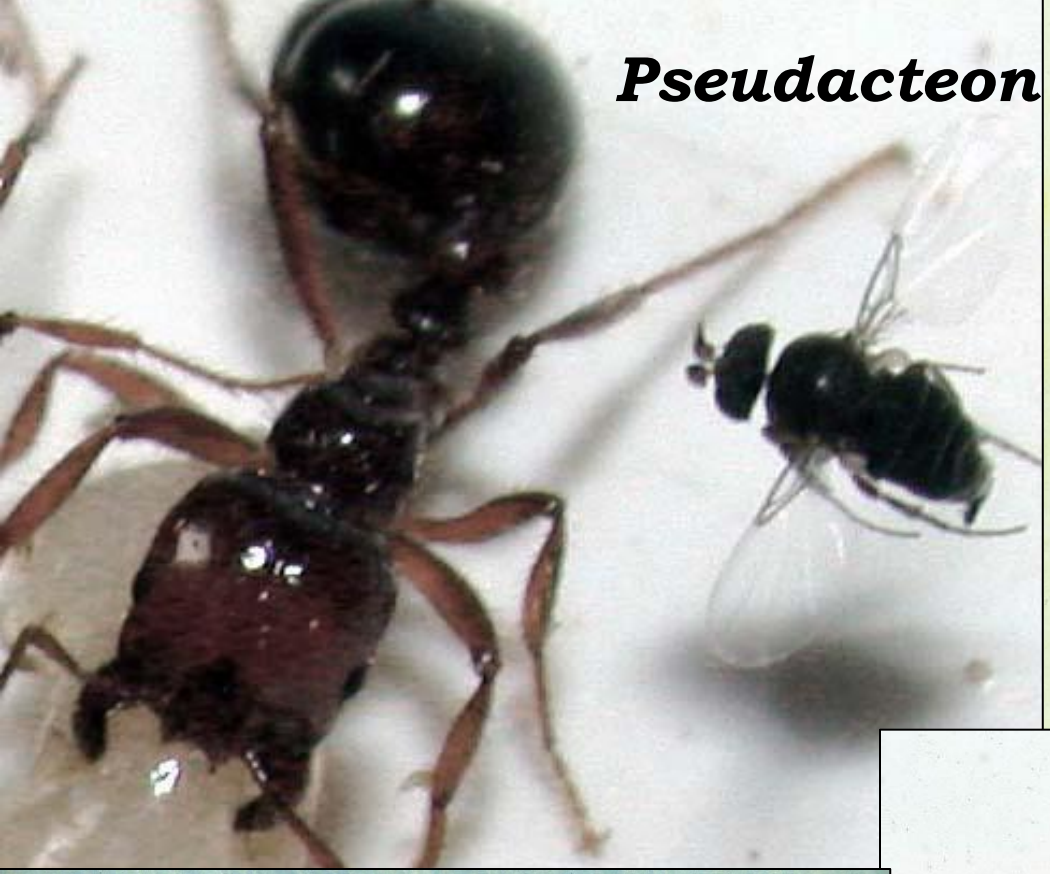
Polygyne form

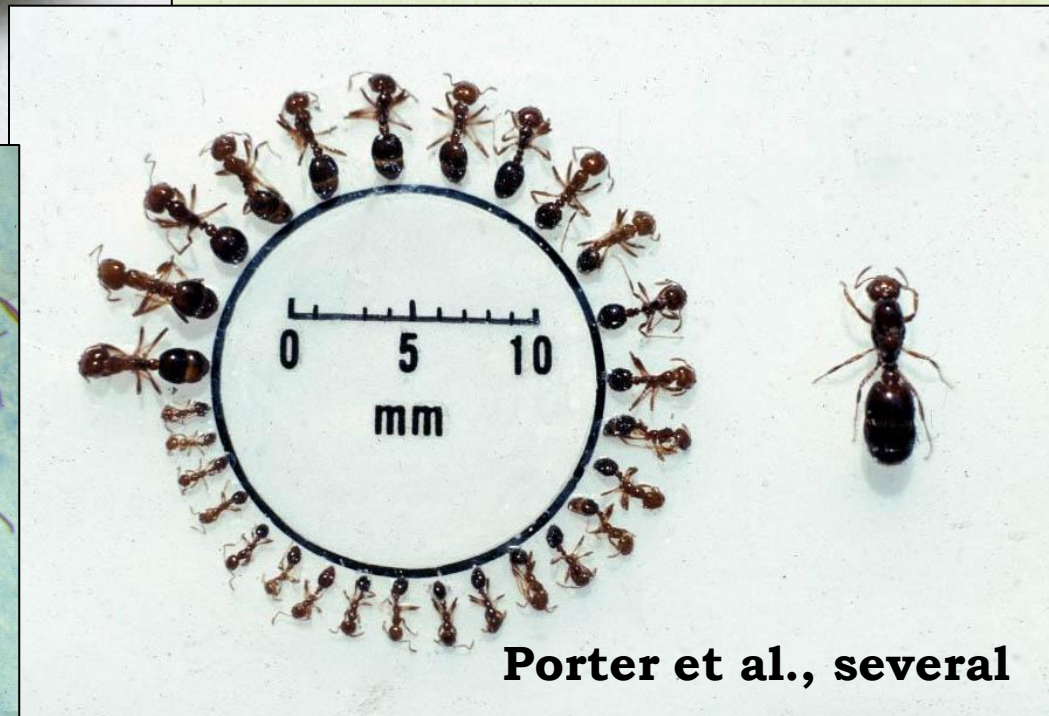




David Oi, 2006

Pseudacteon decapitating flies

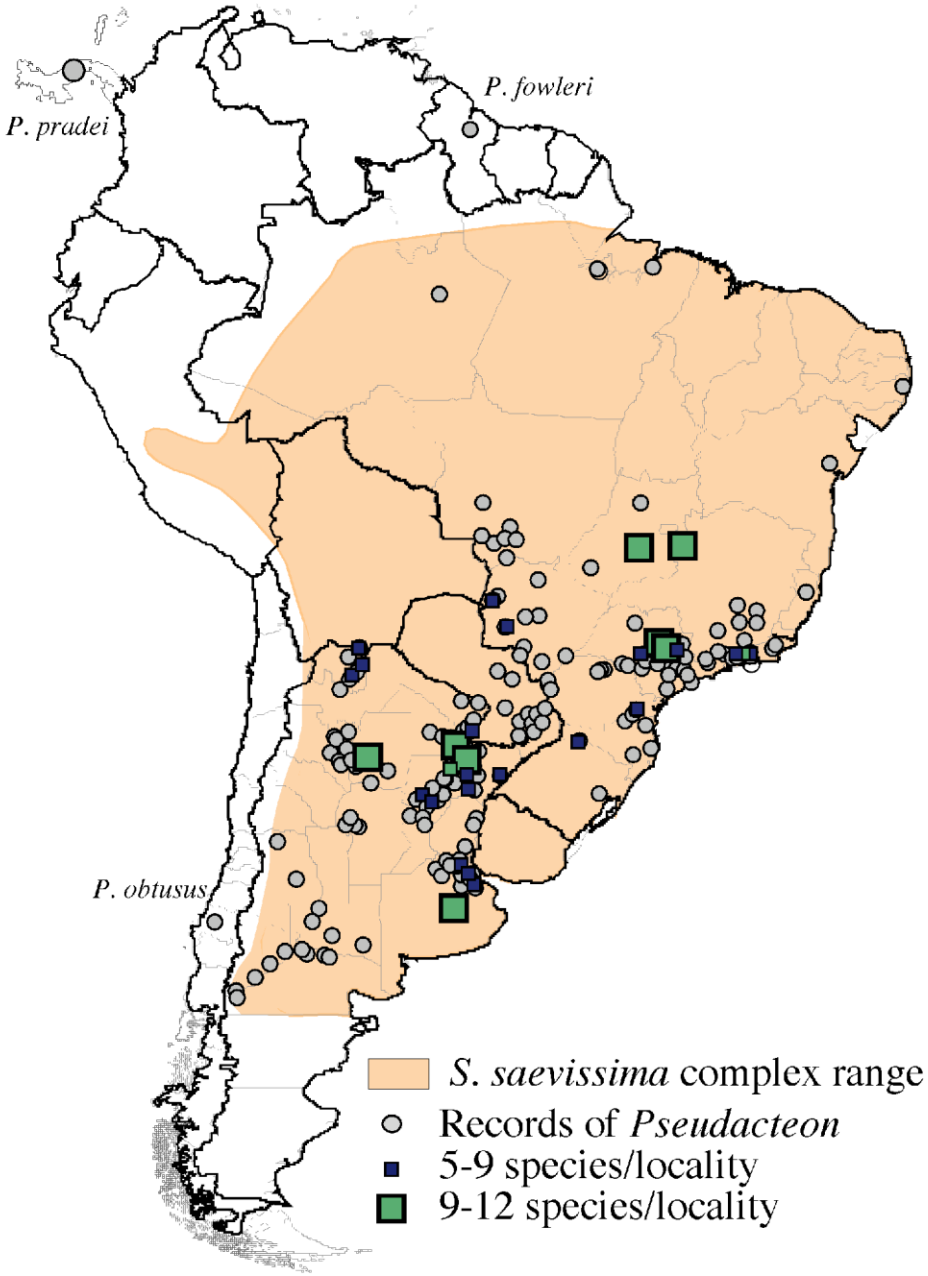




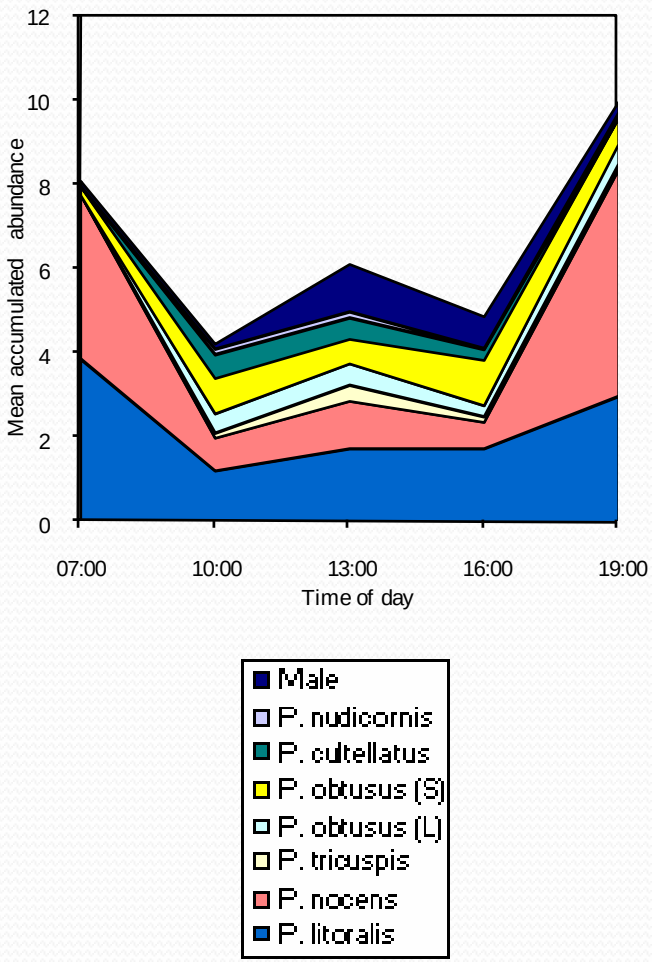
Porter et al., several

Calcaterra et al., 2005

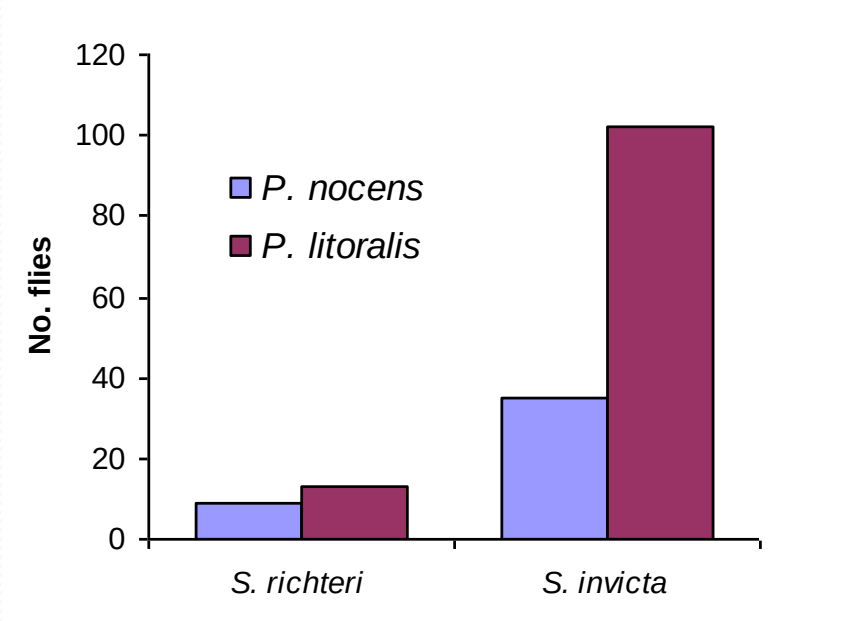
Patrock et al., 2009



Daily activity pattern



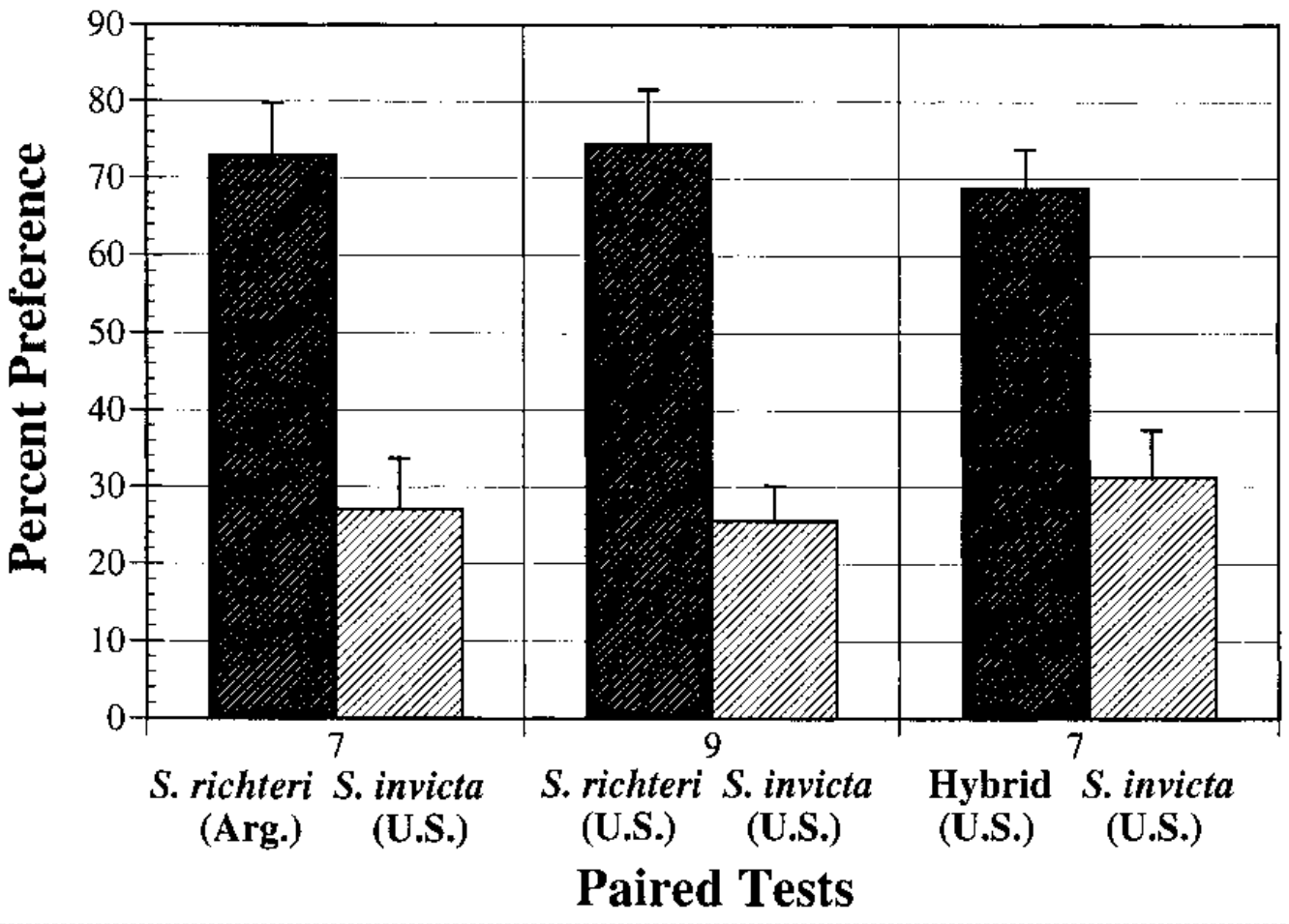
Host preference



Calcaterra et al. 2005

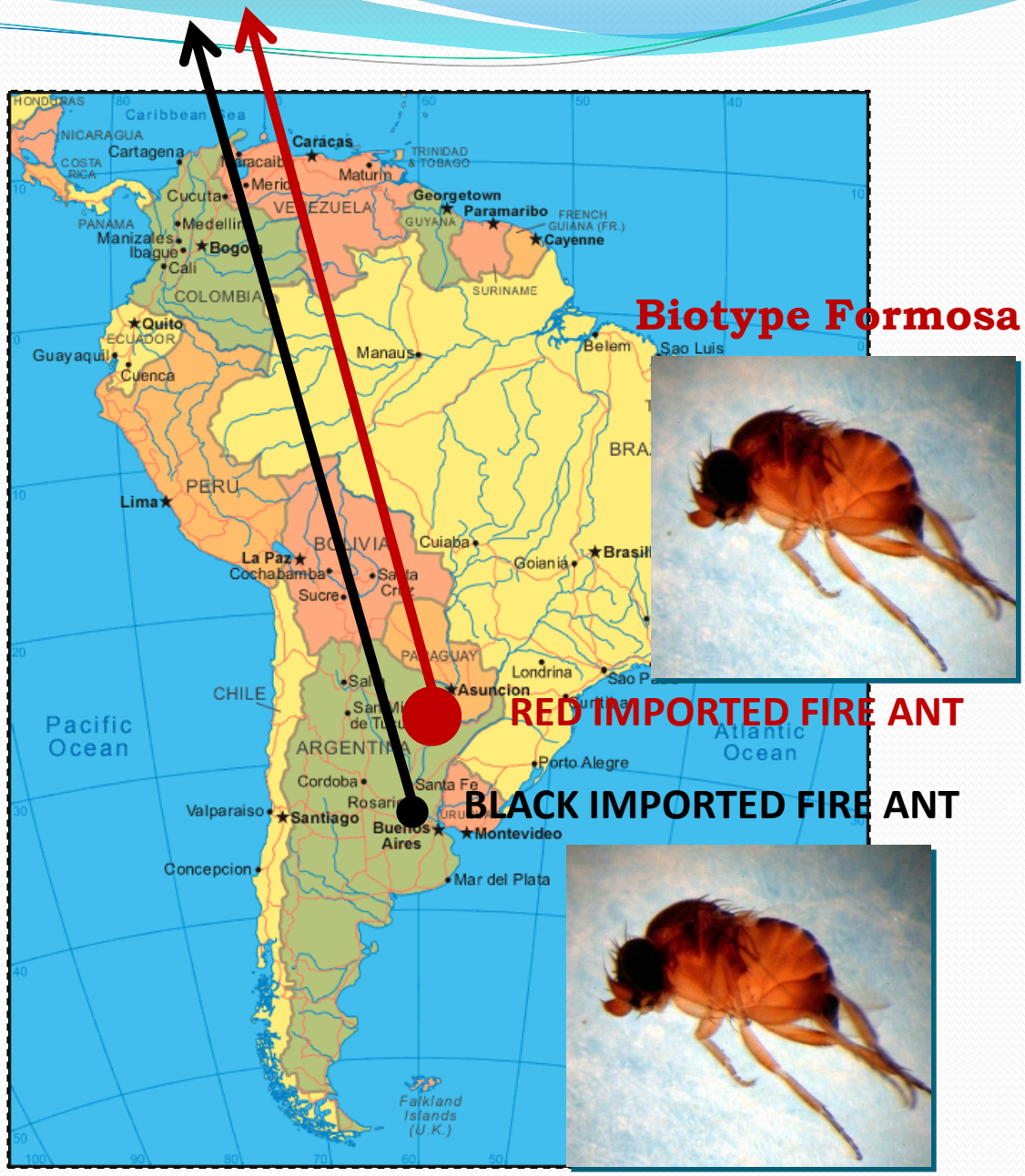
Parasitoid host matching

Pseudacteon curvatus from Buenos Aires



Porter and Briano 2000

Pseudacteon curvatus **released in the US in 2000**



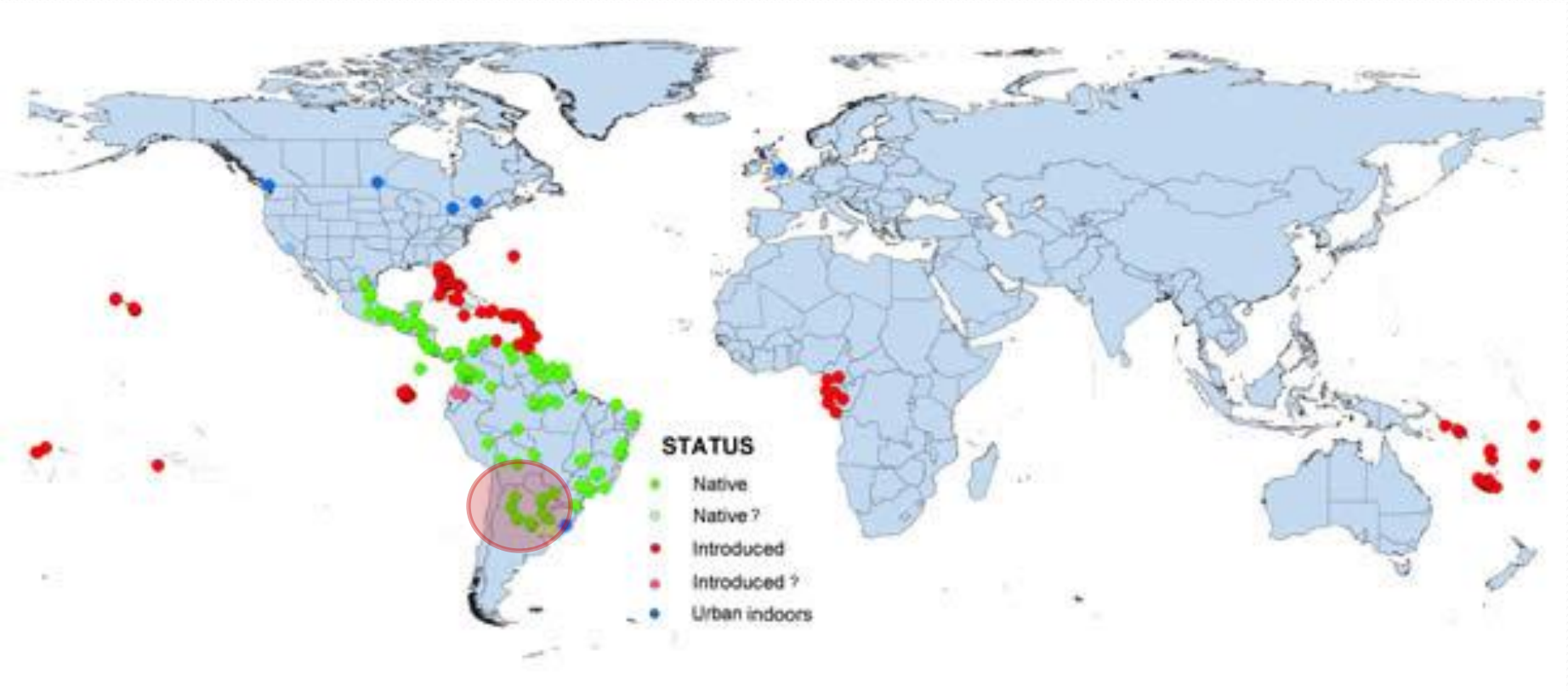
Biotype Buenos Aires

V - Little fire ants

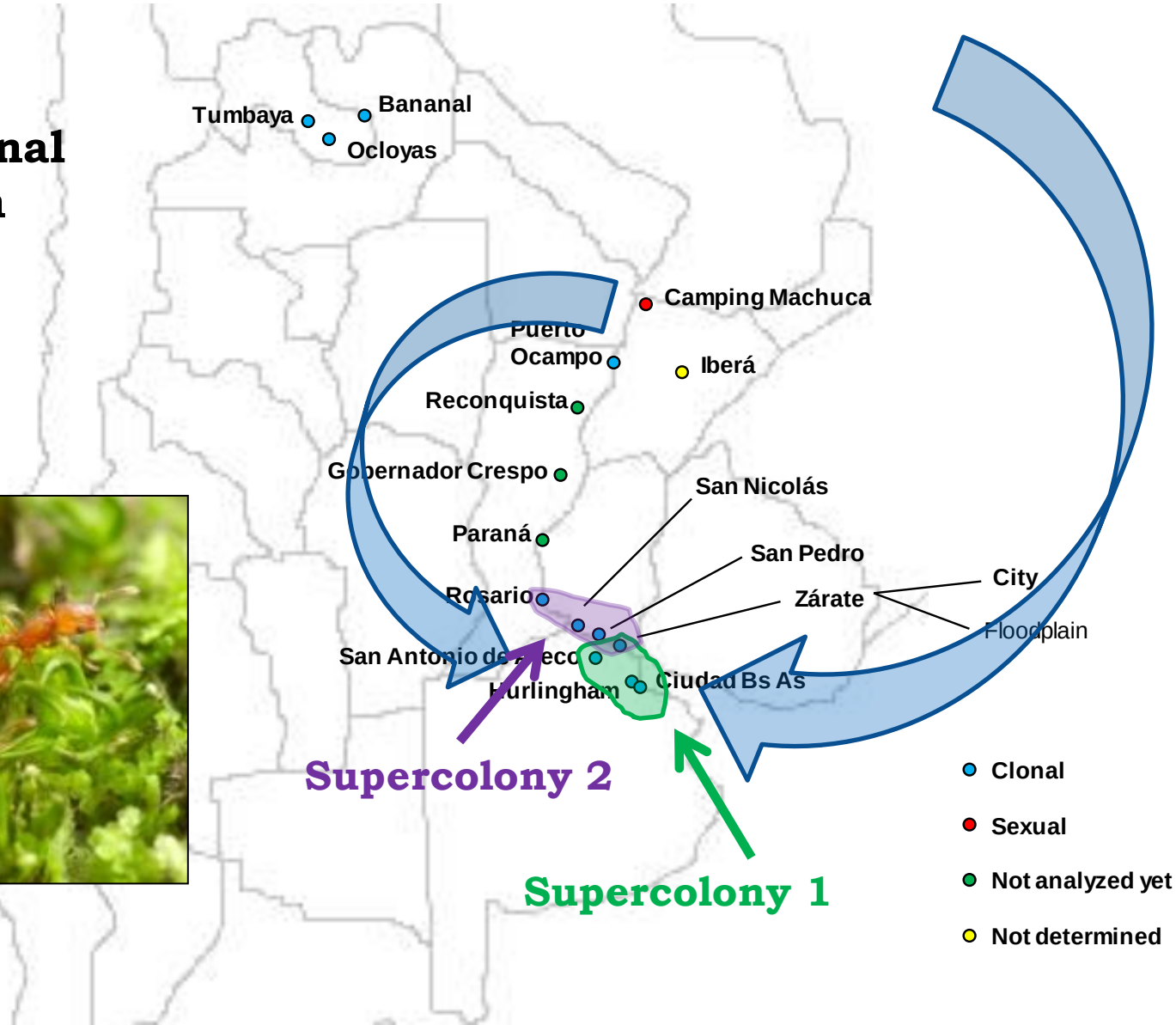
Wasmannia auropunctata

Invasive in Hawaii, Caribbean islands, and western Africa

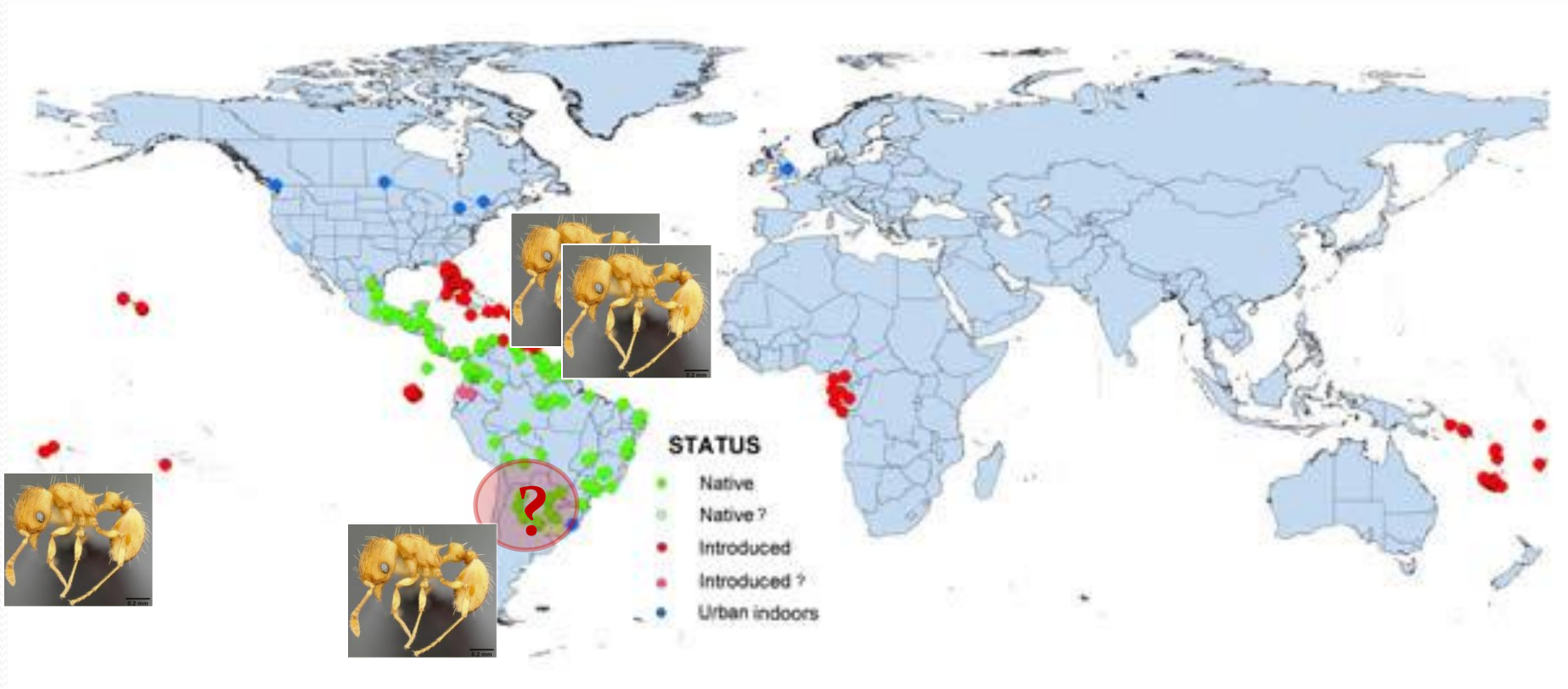
Native and introduced range of *Wasmannia auropunctata*



Sexual & clonal reproduction



Genetic matching analysis is being conducted with materials from Argentina, northern South America, the Caribbean, and Hawaii



VI - Cactus mealybug

Hypogeococcus pungens

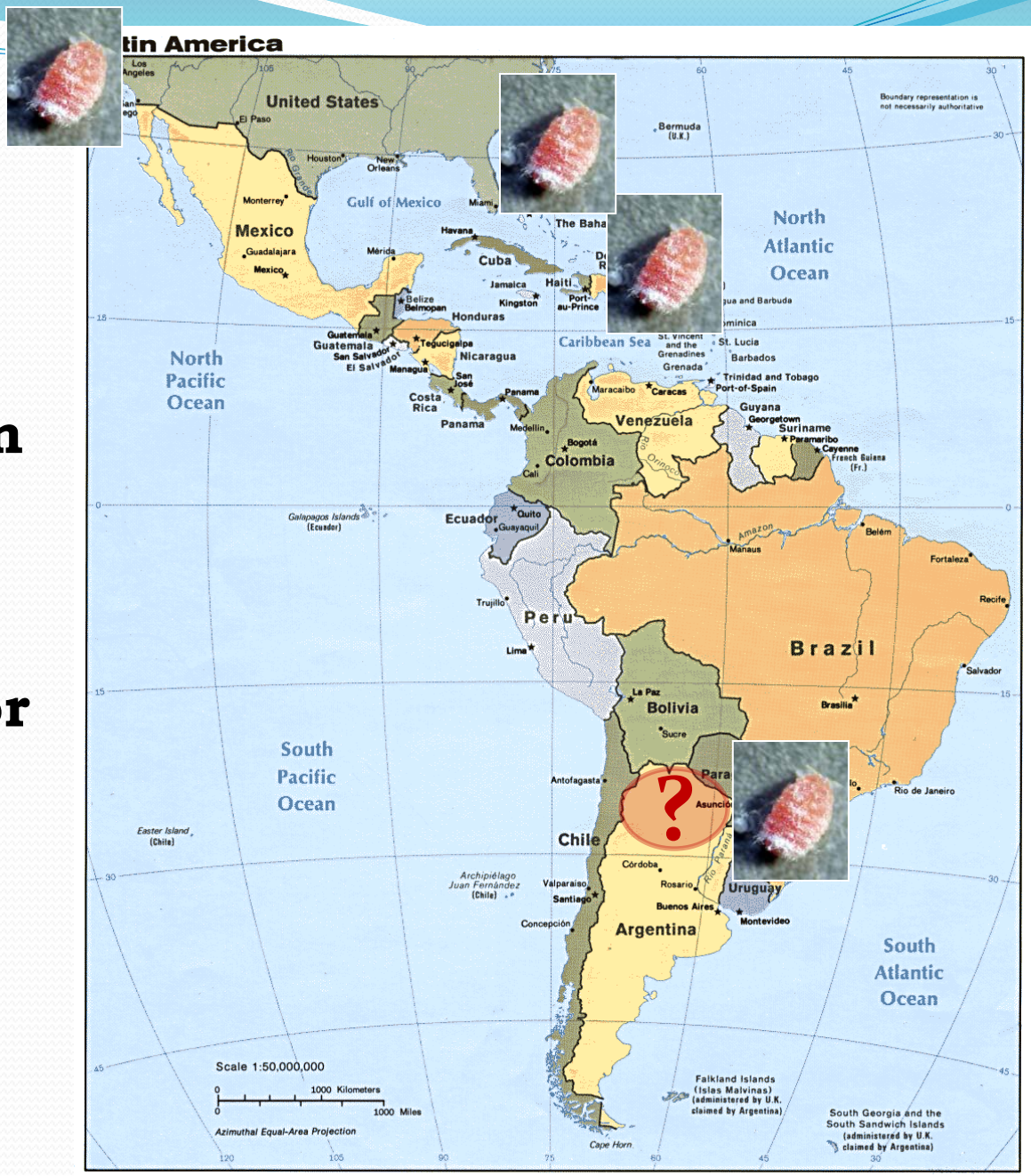
Invasive in Puerto Rico

Host cacti:
***Harrisia* spp. (3)**
***Monvillea* sp.**
***Cleistocactus* sp.**

Non-cacti hosts:
***Alternanthera* spp.**
***Gomphrena* sp.**
***Portulaca* sp.**

MEALYBUGS COLLECTED ON *ALTERNANTHERA* OR *PORTULACA* DO NOT DEVELOP ON CACTI

Genetic analysis is being conducted with materials from Argentina, Puerto Rico, Florida, and California, for the presence of races or cryptic species



Concluding remarks

A RESPONSIBLE FIELD EXPLORATION IS ESSENTIAL FOR THE SUCCESS OF THE PROJECT

Concluding remarks

(cont.)

WHERE TO COLLECT ?

WHAT TO COLLECT ?

ON WHAT TO COLLECT?

Concluding remarks
(cont.)

AT PRESENT, MORE SOPHISTICATED TOOLS ARE AVAILABLE TO BETTER SELECT THE APPROPRIATE PLACES TO COLLECT AGENTS

Concluding remarks (cont.)

IMPORTANT CONSIDERATIONS ARE:

- Identity of the target
- Biological variations
- Geographical variations
- Climate matching
- Genetic matching
- Source populations
- Host preferences

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BIOLOGICAL CONTROL

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Genetics

Cladistics

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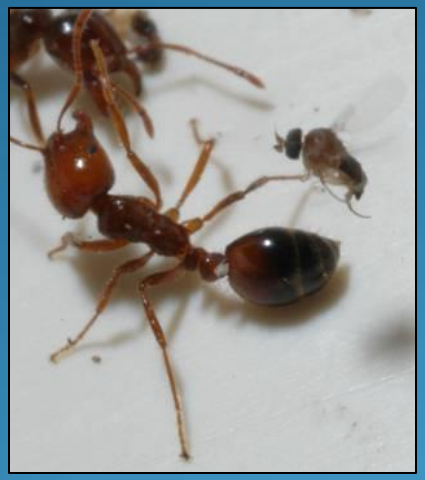
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