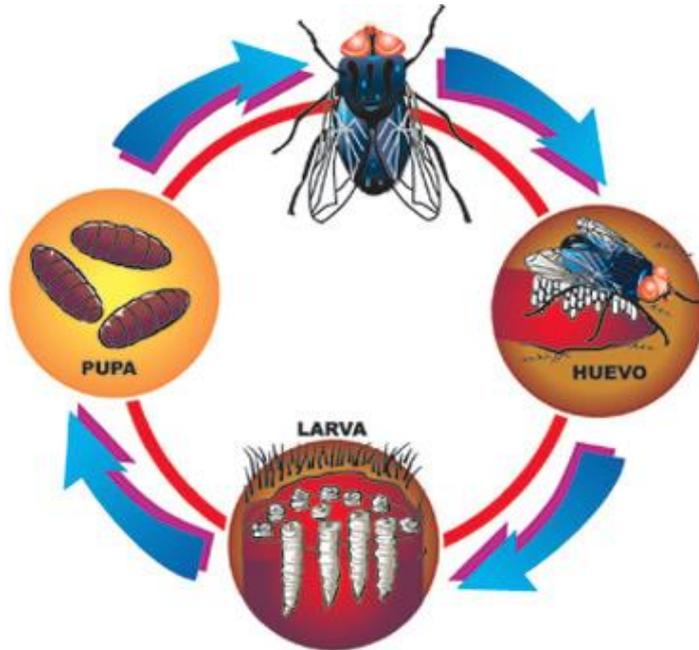


Transgenic strains for genetic control of the New World screwworm in Panama

Max Scott



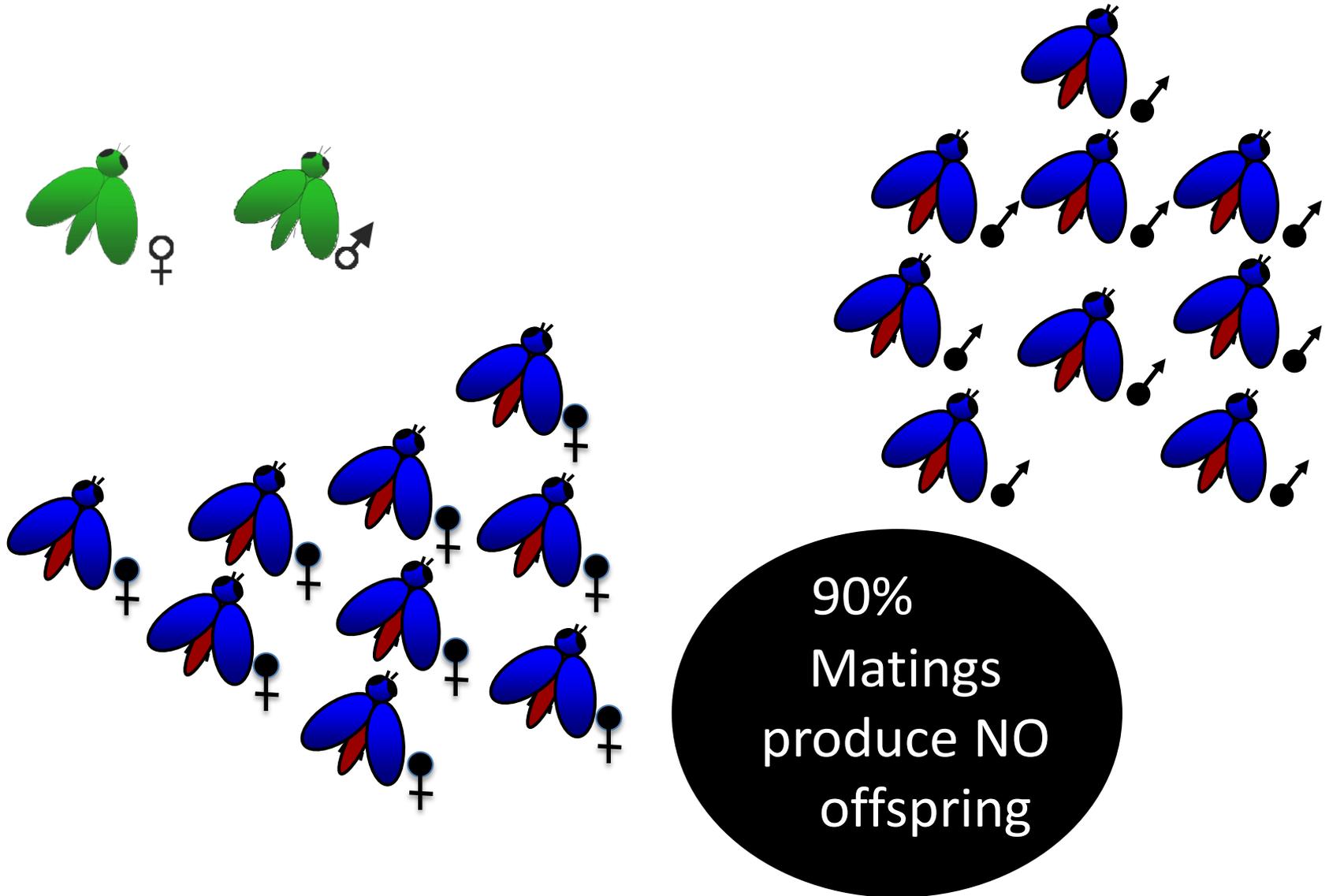
New world screwworm *Cochliomyia hominivorax*



Endemic distribution of the New World screwworm before SIT

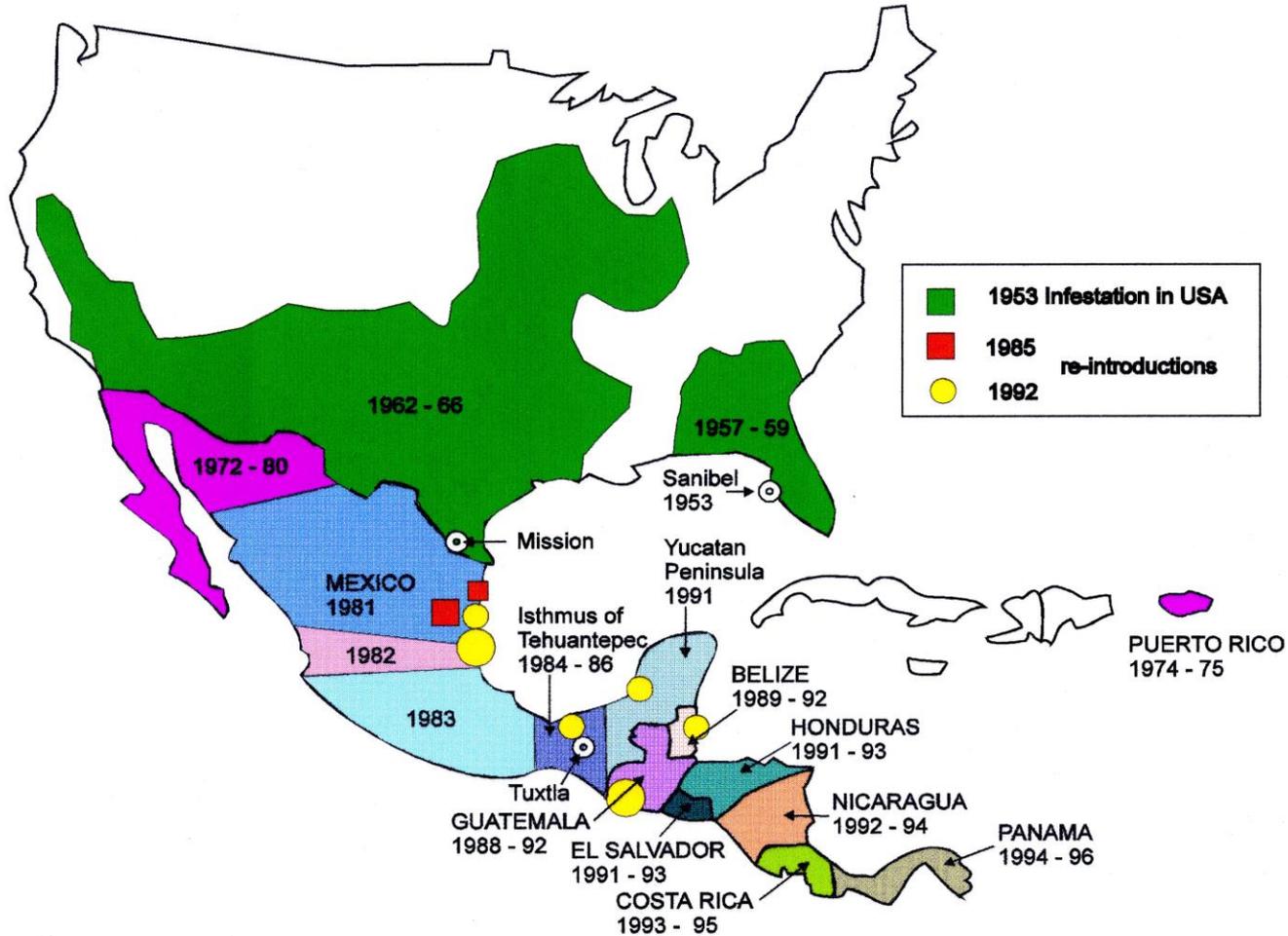


NWS SIT Program: Repeated releases of sterile males and females



NWS Eradication Program

Screw-worm fly, *Cochliomyia hominivorax*, distribution and eradication



Current distribution of the NWS



USDA-APHIS. 2009

**SIT: Raise millions of NWS in a factory,
sterilize by radiation and release regularly**



COPEG facility, Pacora, Panama



Mass Rearing



60,000 flies per cage



16 million pupae per week



Dispersal of sterile insects

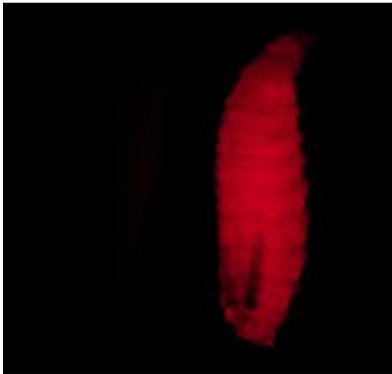
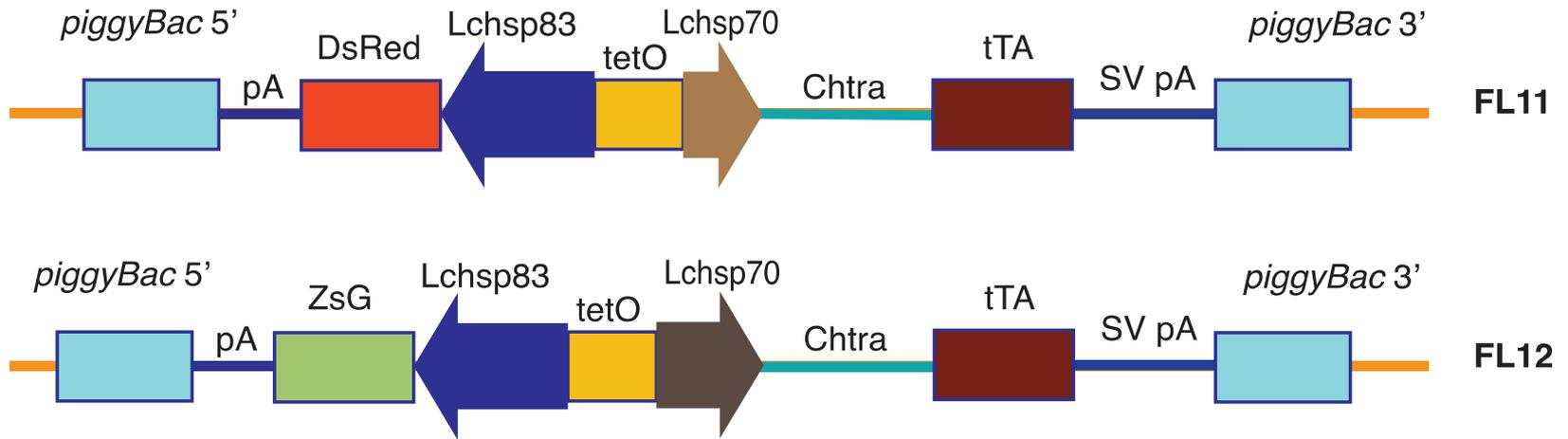


Six flights per week in Panama-Colombia border
3000 insects per nautical mile
14 million flies per week

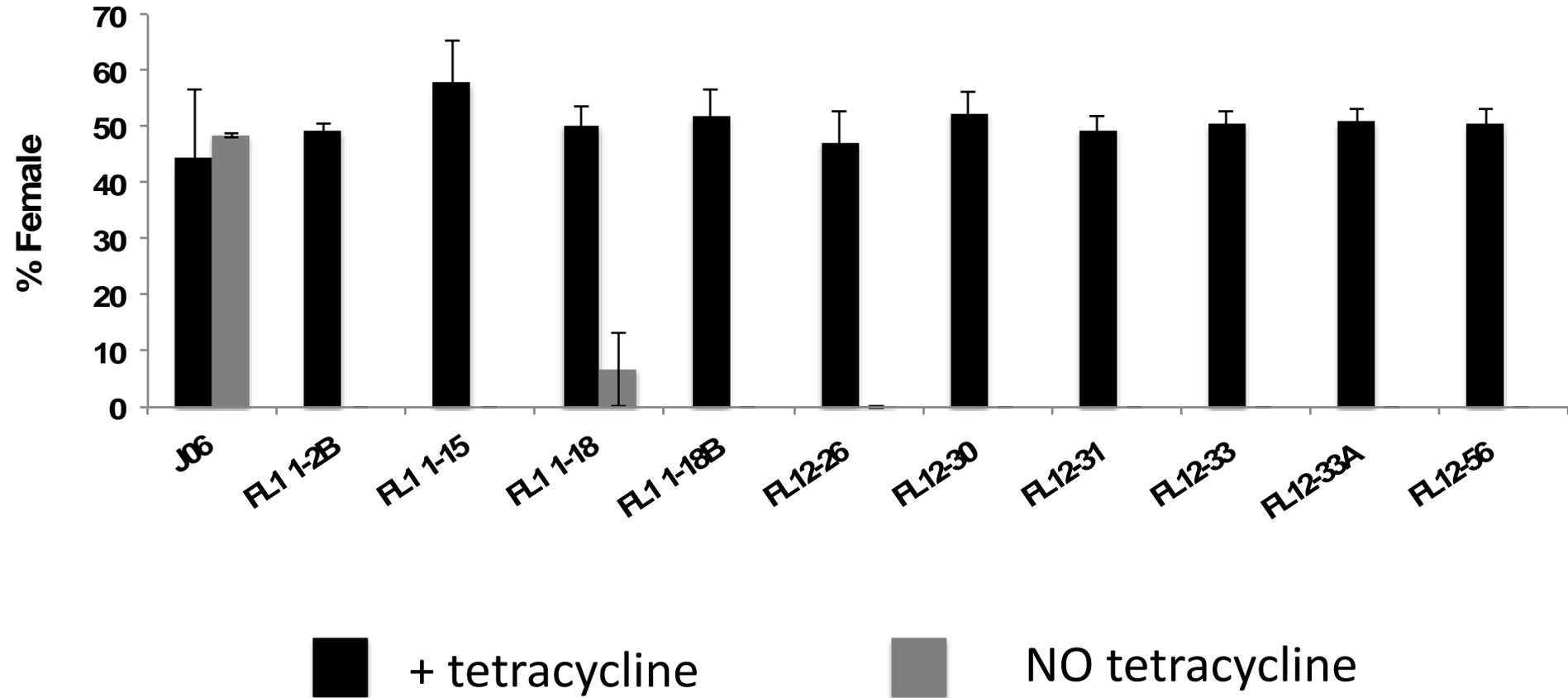
Benefits of NWS eradication by SIT

- No need to use pesticides.
- Selective and efficient population suppression.
- Direct benefits of NWS eradication to the North and Central American livestock industries are estimated to be over \$ 1.5 billion/ year, compared with a total investment over half a century of close to \$ 1 billion.
- A male only strain of NWS could save at least half of the costs of production for the COPEG plant.

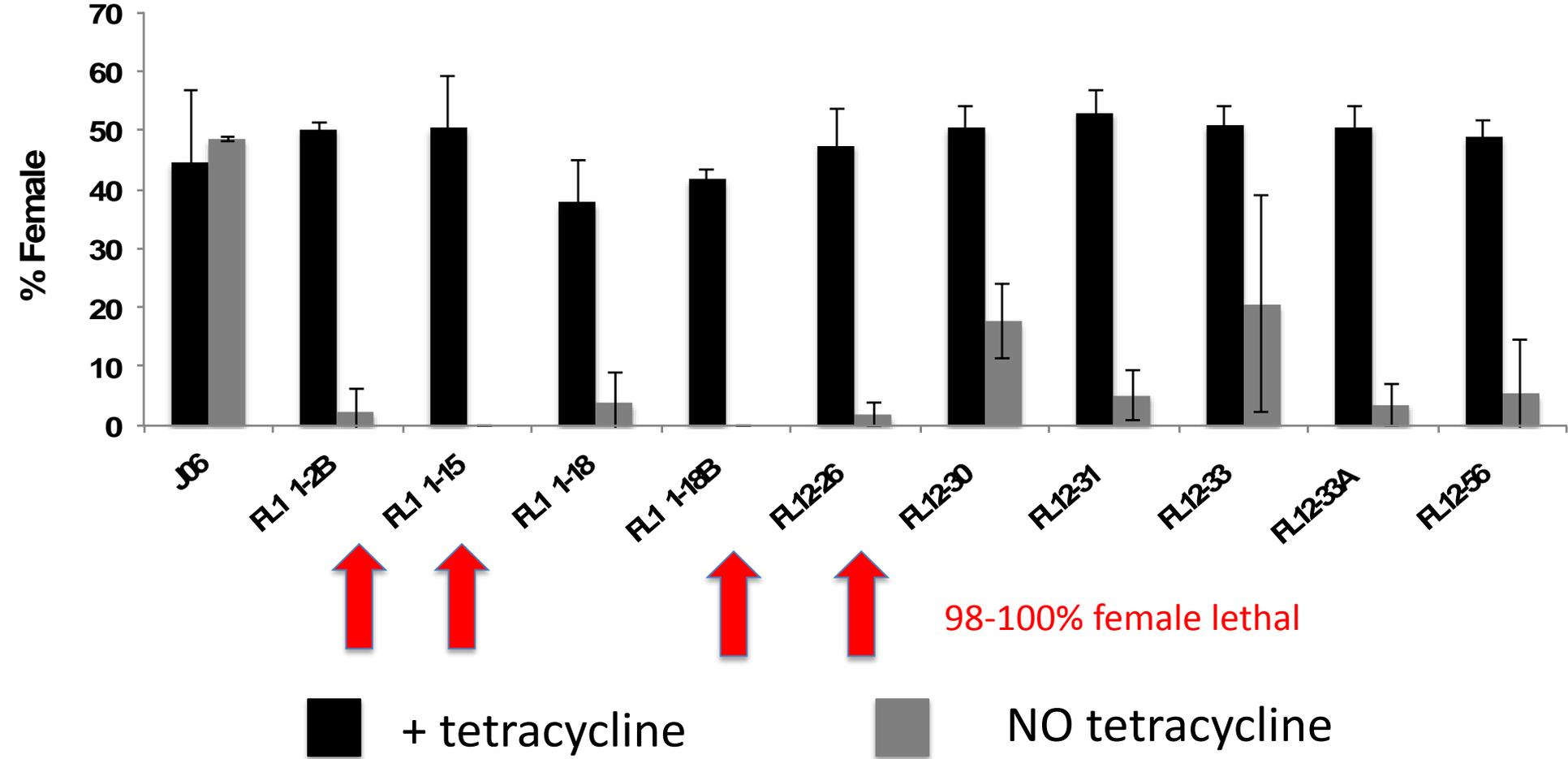
25 transgenic female lethal (FL) lines



Female lethality in homozygous transgenic lines



Female lethality in heterozygous transgenic lines



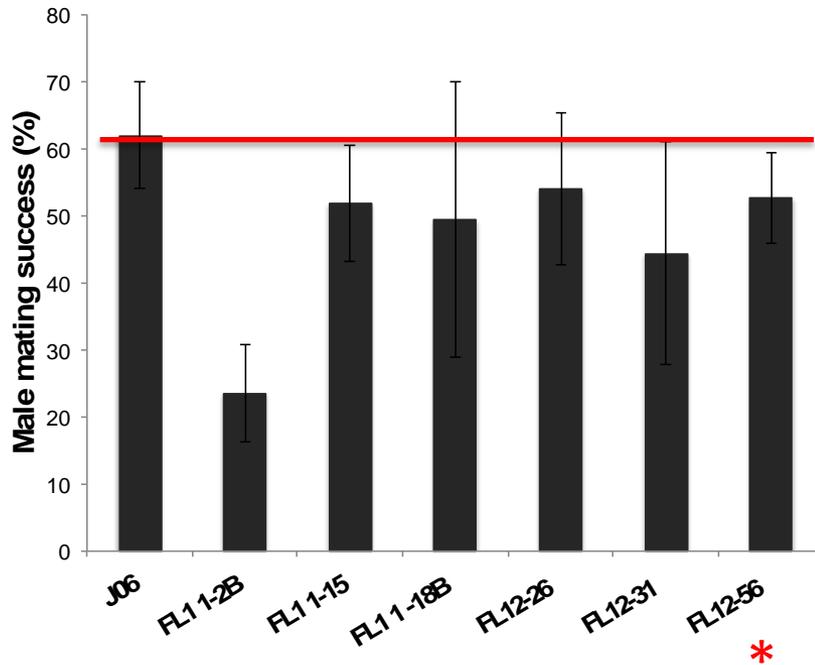
Fitness Tests of transgenic NWS

- Biological parameters important for production (Pupal weight, larval production, adult emergence, egg weight, embryo hatch, sex ratio)
- Longevity
- Male competition
- Potential for outcrossing
- Influence of genetic background on female lethality

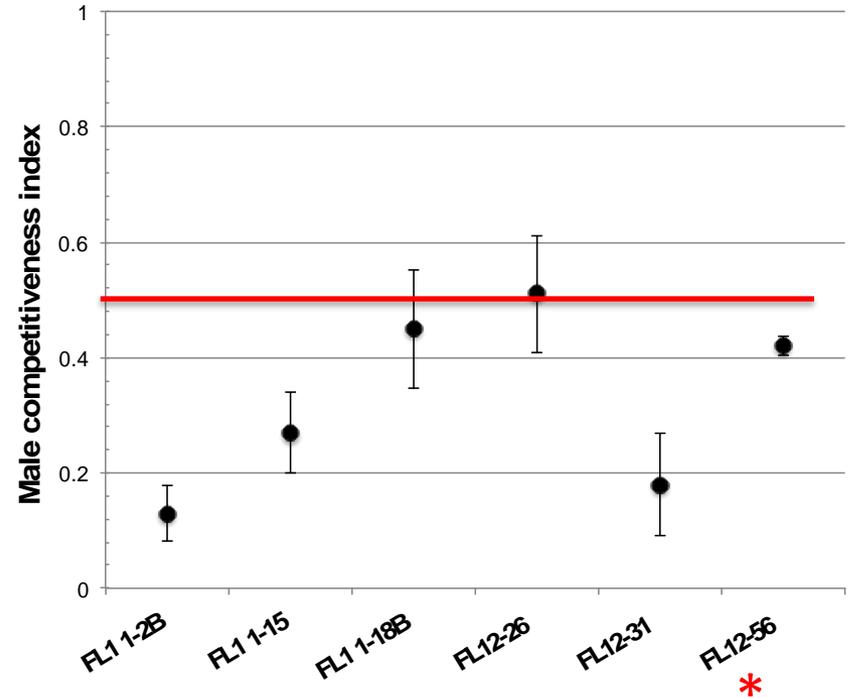
Male mating success and male competition assays

Red Line: As competitive as non-transgenic J06 males

A

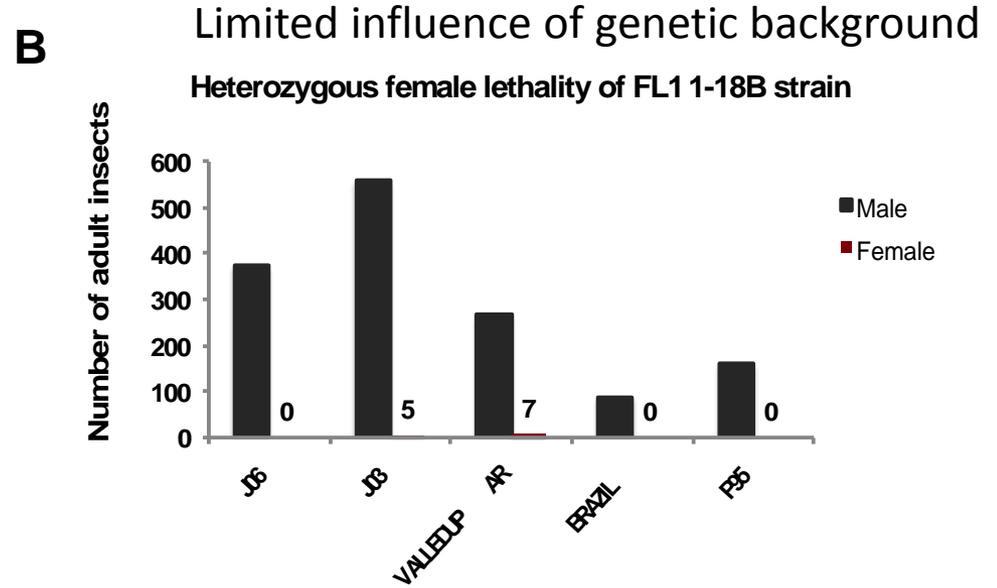
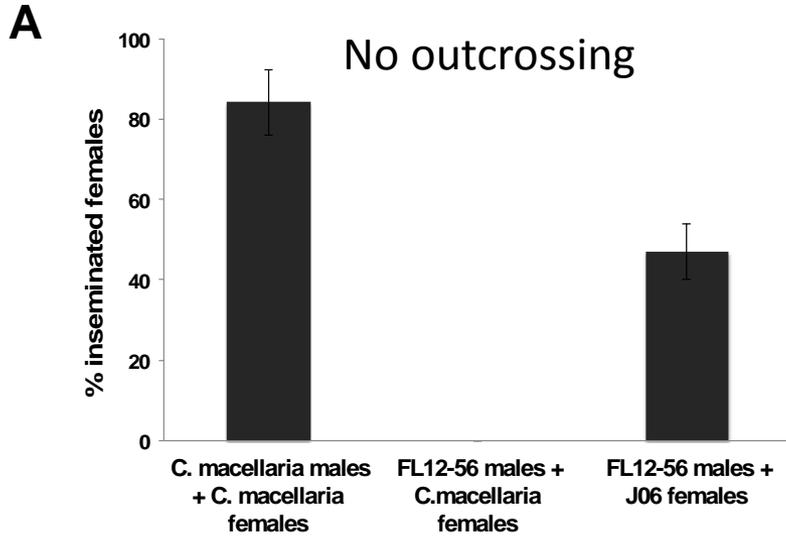


B

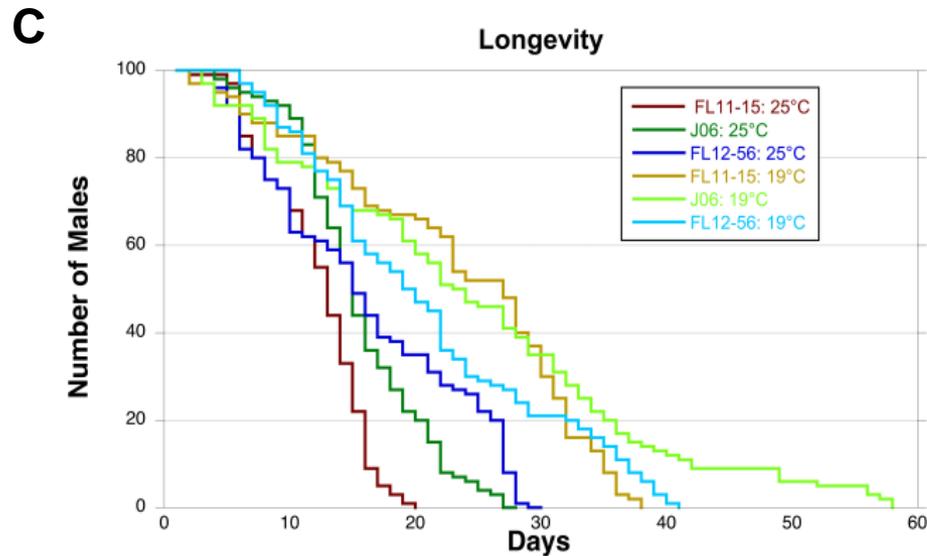


* FL12#56 selected for mass rearing and proposed field test

Preliminary risk assays



No difference
In lifespan



Field testing of NWS transgenic strains

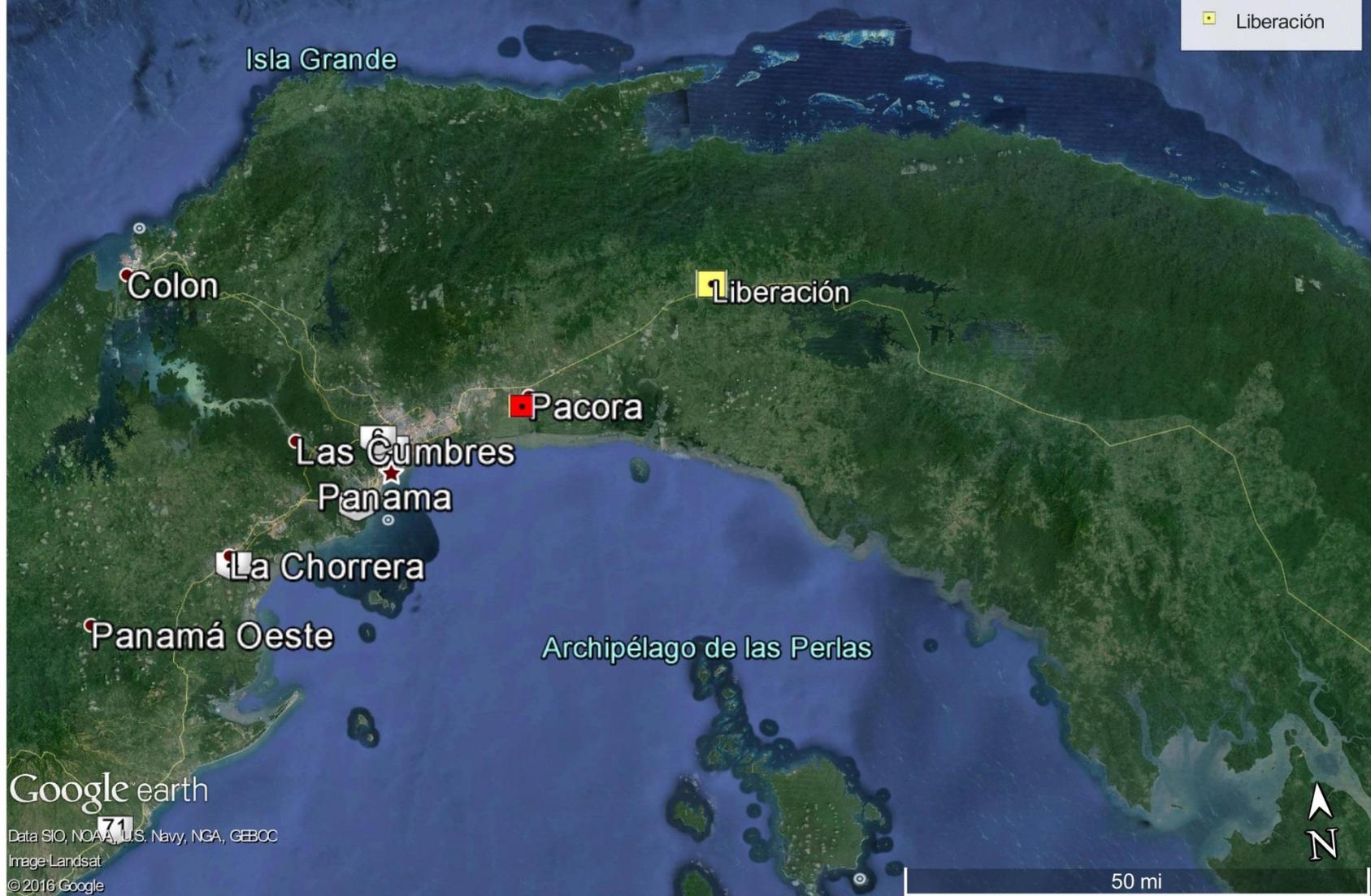
- **Proposed field release is radiation-sterilized, FL12#56 males** obtained by rearing the strain on diet with NO tetracycline
- **Aim:** studying dispersal and longevity in the field.
- Ground release of transgenic males
- COPEG has a site that has long been used to study the release of sterile insects in the field:
 - Ranch Shere Punjab near Pacora, Panama.
- There is data from 5 years of studies performed in this Ranch using the sterilized wild type J06 strain (mixed sex).
- The Ranch contains cows, goats, buffalo, horses, dogs. There is abundant wildlife (ocelotes, deer, howler monkeys, other tropical monkeys).

Ubicación de Rancho Shere Punjab

El Llano de Chepo, Panama

Legend

- Cuidades
- GBG Planta
- Liberación



Google earth

Data SIO, NOAA, U.S. Navy, NGA, GEBCO

Image Landsat

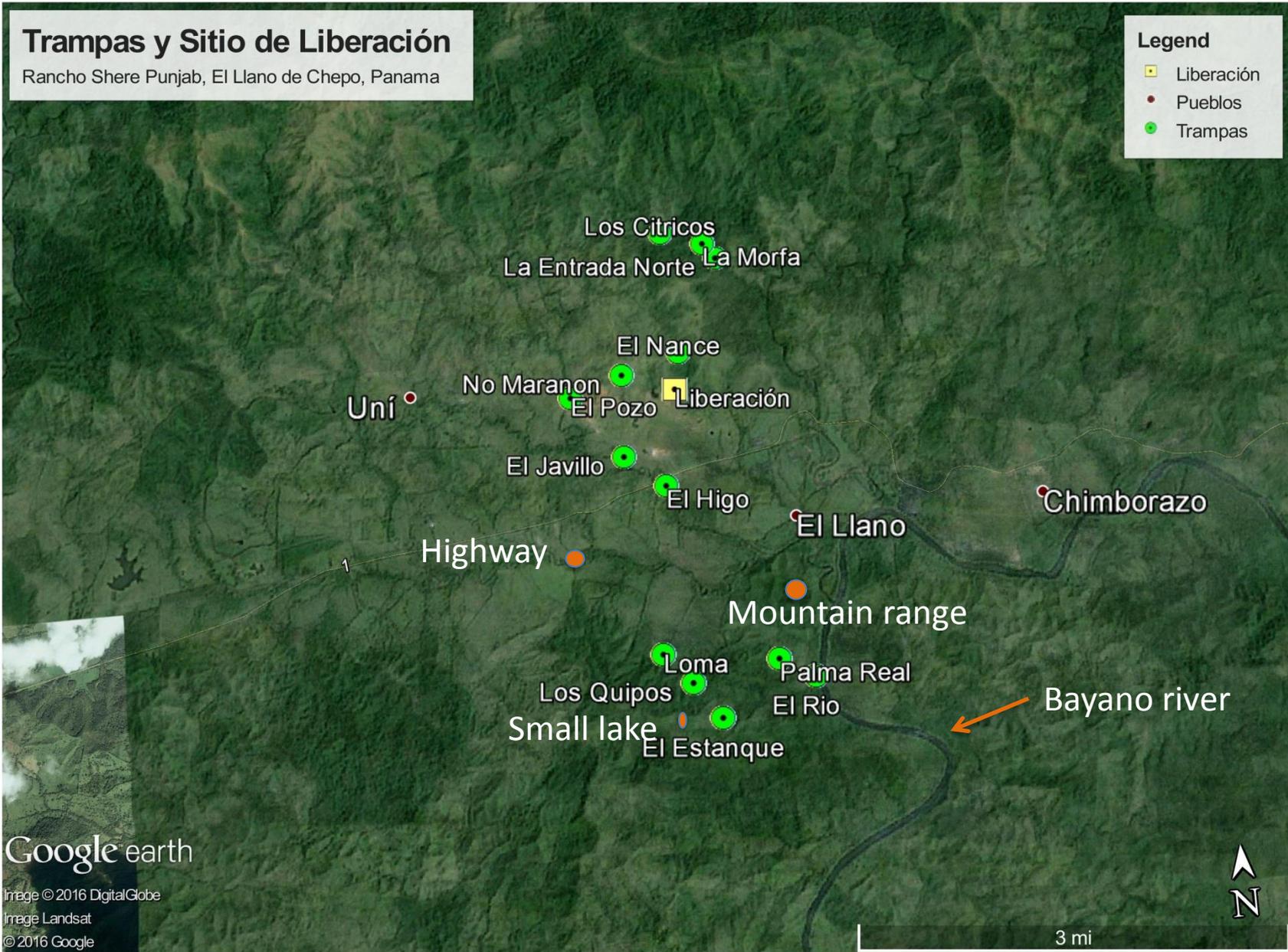
© 2016 Google

Trampas y Sitio de Liberación

Rancho Shere Punjab, El Llano de Chepo, Panama

Legend

- Liberación
- Pueblos
- Trampas



Google earth

Image © 2016 DigitalGlobe
Image Landsat
© 2016 Google



Pupae are marked with Dayglo powder, so they are recognized and their age is known when they are re-captured in field traps.

- Emergence and sex ratio
- Longevity
- Dispersion
- Number of recaptured insects.

- 5 L pupae 50 g dayglo are added.
No harmful effects of dye.





Vertical sticky traps using attractant Swormlure-4.
They are checked every day for the presence of insects.

Check color (ptilino), fertility of females, number of insects.

Process of government approval for field release of transgenic NWS in Panama

- **National Biosecurity Commission**

Ministry of Agriculture (MIDA)

Ministry of Environment (ANAM)

Ministry of Health (MINSA)

Ministry of Foreign Relations (MIRE)

Ministry of Commerce and Industry (MICI)

Secretary of Science and Technology (SENACYT)

Authority of Food Security (AUPSA)

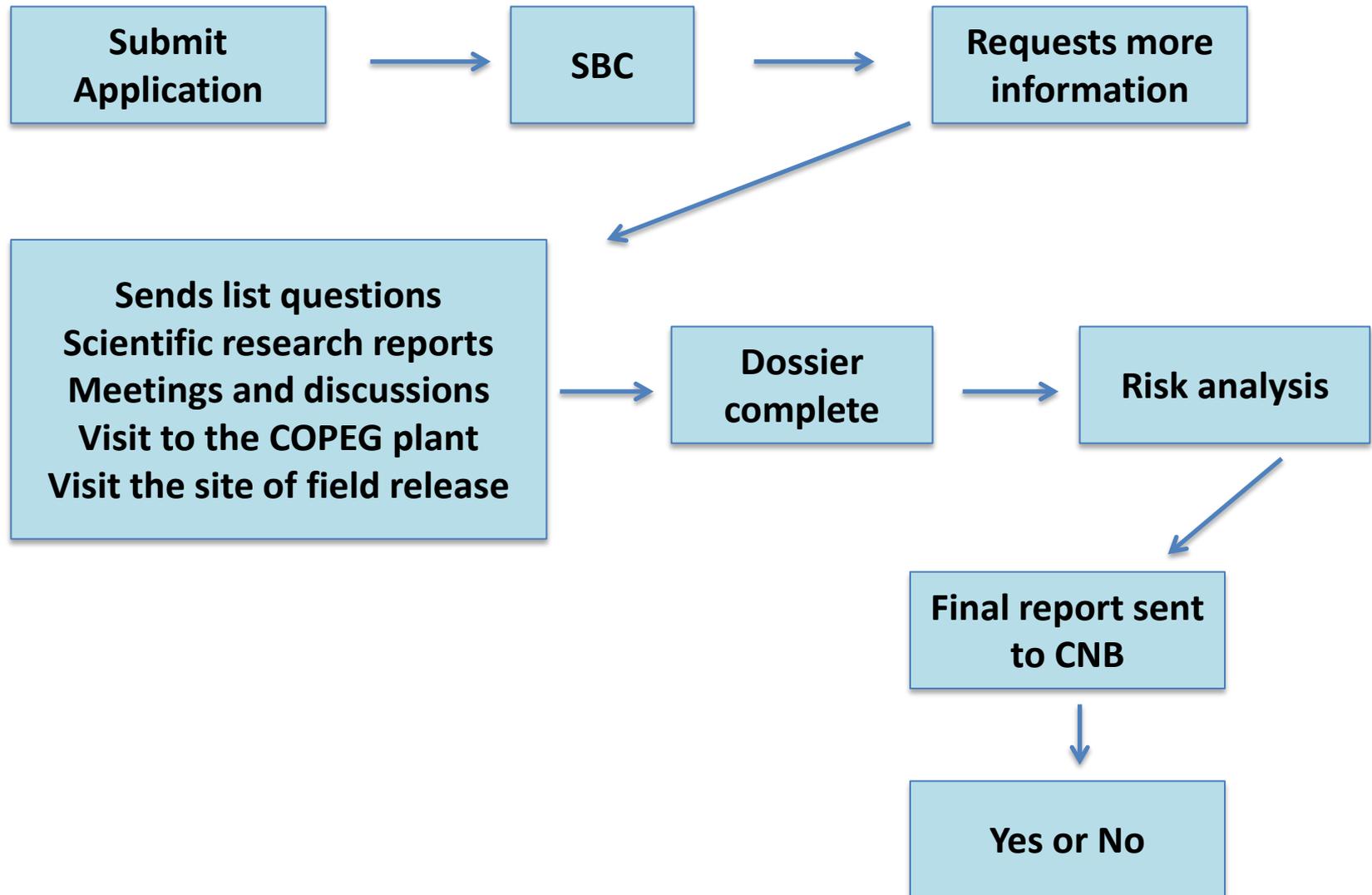
Authority of Aquatic Resources (ARAP)

Civil society (assoc. of professionals, consumers)

Sectorial Biosecurity Committee

- Composed by members of
 - Ministry of Agriculture (MIDA)
 - Ministry of Environment (ANAM)
 - Ministry of Health (MINSA)
- Most of our interactions were with:
 - Ivette Vargas, Veterinary doctor, MIDA
Head of the Biosecurity Commission of Panama
 - Humberto Hernandez, Head of Sanitary Education,
Animal Health Department, MIDA
 - Cilini Arosemena, Veterinary Doctor, Direction of Research and
Development
Authority of Aquatic Resources of Panama (ARAP)

Application process for field release of GMO



Application document

- Presentation of project-like a grant application.
- Description of the field site.
- Description of infrastructure of study.
- Detailed description of transgenic strain.
- Description of all foreign genetic material.
- Detailed description of field experiments.

Questionnaires

- What was the criteria for choosing location of study?
- Details of release/recapture study. Traps.
- Procedures to handle effects on the environment.
- Treatment of waste and metabolic residues of GMO.
- Does NWS possess piggyBac transposase?
- Had the NWS genome been sequenced?
- Biosecurity of production/irradiation.
- Transport of GMO inside/outside plant.

SBC evaluation criteria

- Details of genetic makeup of GMO. Can it be passed on to other species? Can it persist in the environment?
- Environmental impact (Food chain, waste management)
- Impact on human health.
- Impact on animal health.

Acknowledgements



COPEG, Pacora, Panama: Dr. Carolina Concha



Team ARS-Panama: Dr. Steve Skoda Pamela Phillips

- **Agustin Sagel**
- Mario Vasquez
- Trinidad Pardo
- Gladys Quintero
- Domitildo
- Nicolas
- Hermogenes
- Rosa



APHIS-USDA/COPEG: - Dr. John Welch
- Guillermo Fadul
- Dr. Gwen Keller



North Carolina State University. Raleigh, USA.

-**Dr.Fang Li** and Dr. Ying Yan
-Rebecca Edman, Holly Wantuch, **Esther Belikoff.**

STRI-Panama.

-Dr. Owen McMillan and Dr. Carolina Concha



Smithsonian

ARS-USDA/COPEG Team



APHIS-USDA/COPEG - Technical Direction

