Emerging Pests and Pathogens

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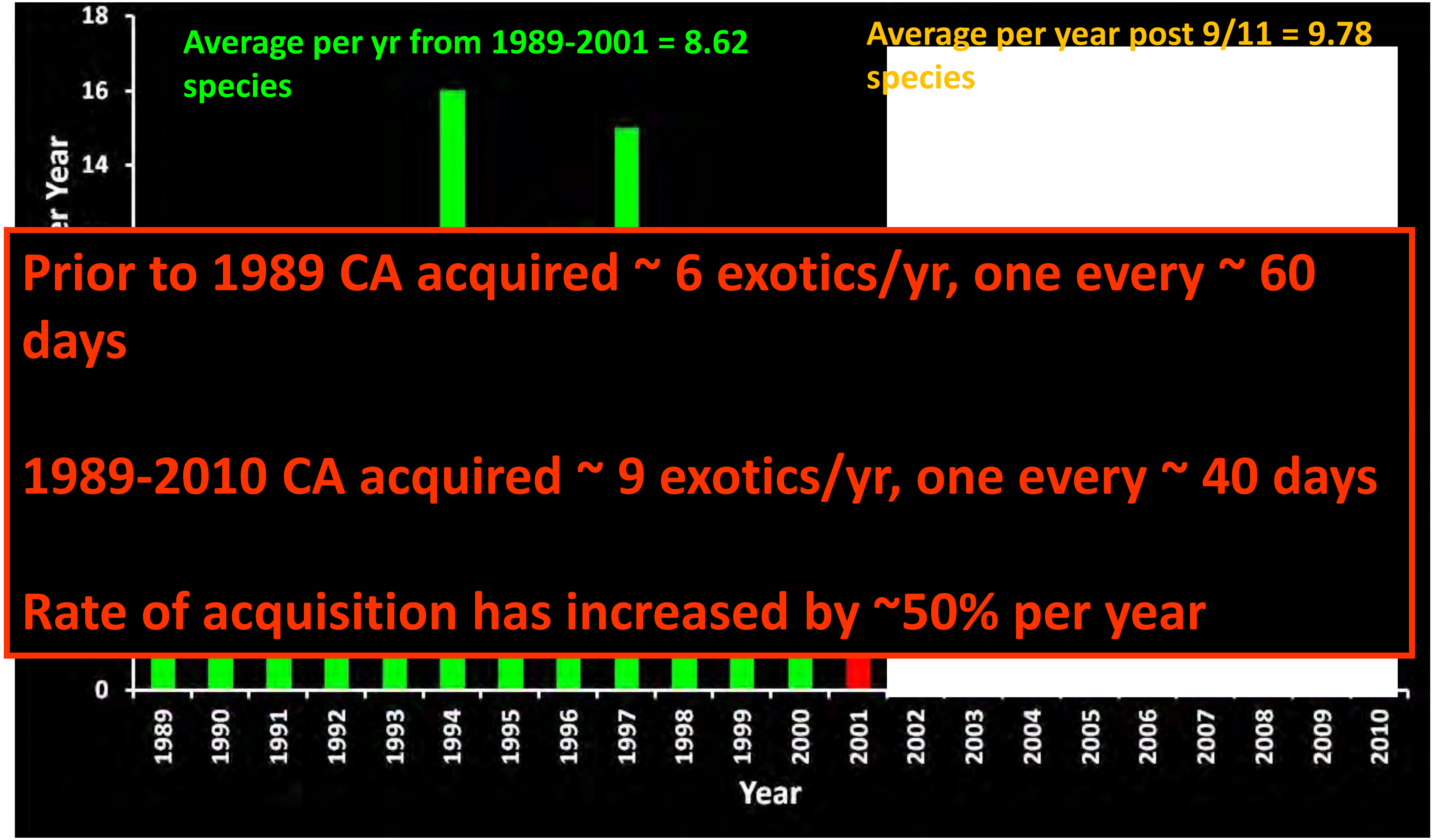
California’s Invasive Species Problem

- California has lot of exotic arthropods
  - 1,636 species as of 2010
- Where do they come from?
  - Origin suspected for 992 exotics
  - Originated elsewhere in North America = 43%
    - Existing invasion bridgeheads or translocation of natives
  - Europe = 25%
  - Mexico, Central, & South America = 9%
  - Asia (10%), Australia (5%), South Pacific (4%)

Average Species per Year



Prior to 1989 CA acquired ~ 6 exotics/yr, one every ~ 60 days

1989-2010 CA acquired ~ 9 exotics/yr, one every ~ 40 days

Rate of acquisition has increased by ~50% per year

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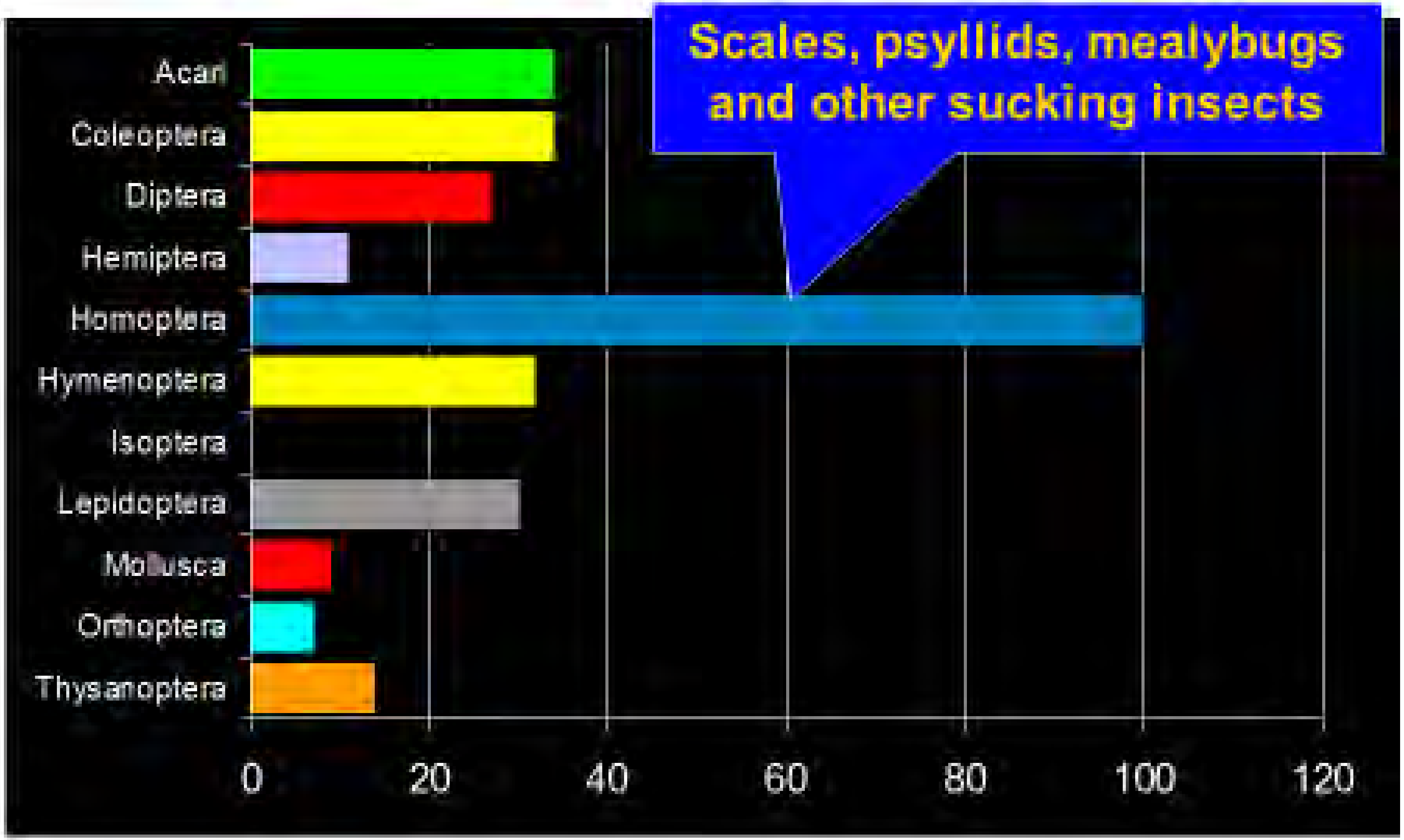
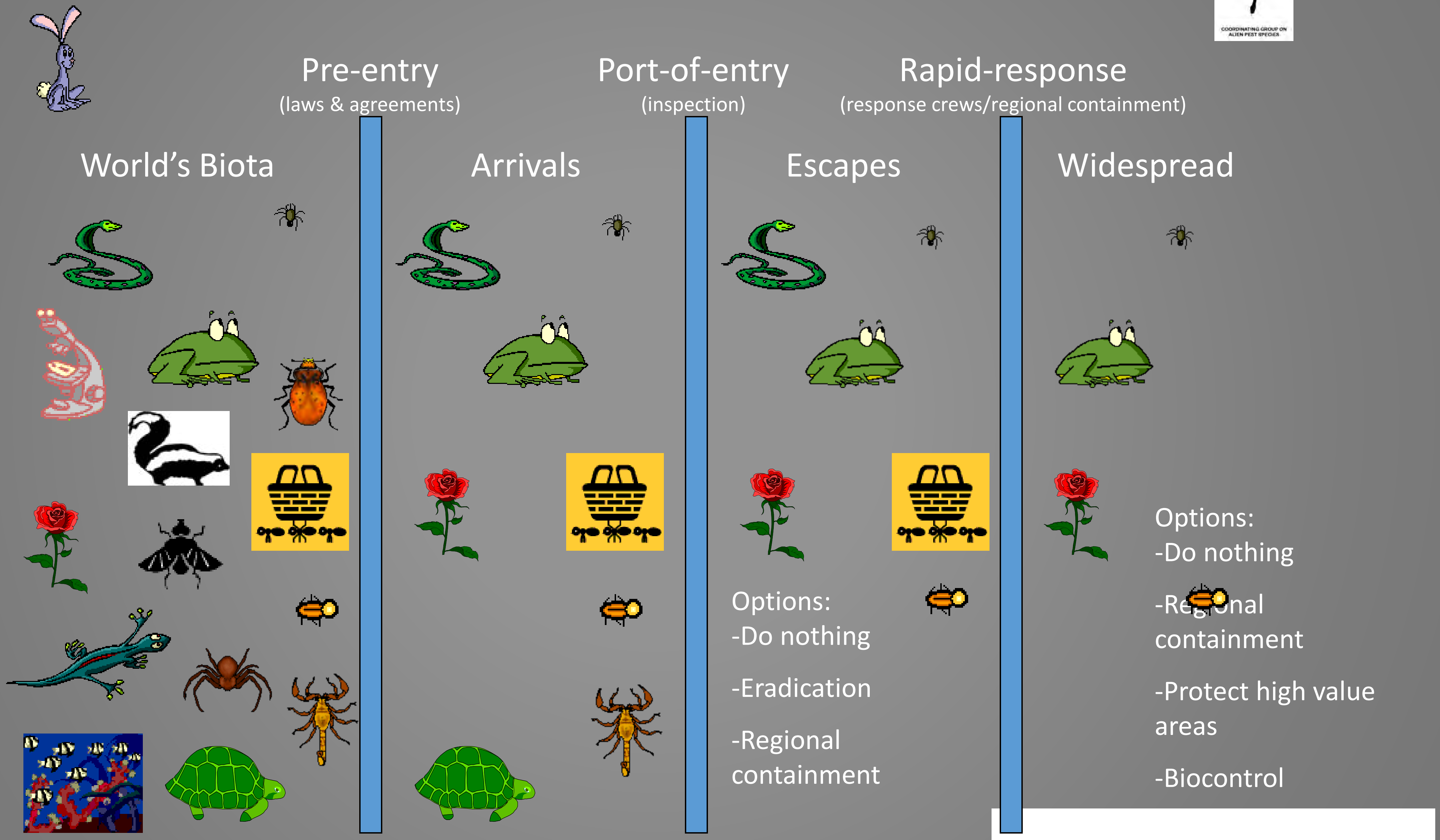
Number of Newly Established Invertebrates (1955-2000) by Order

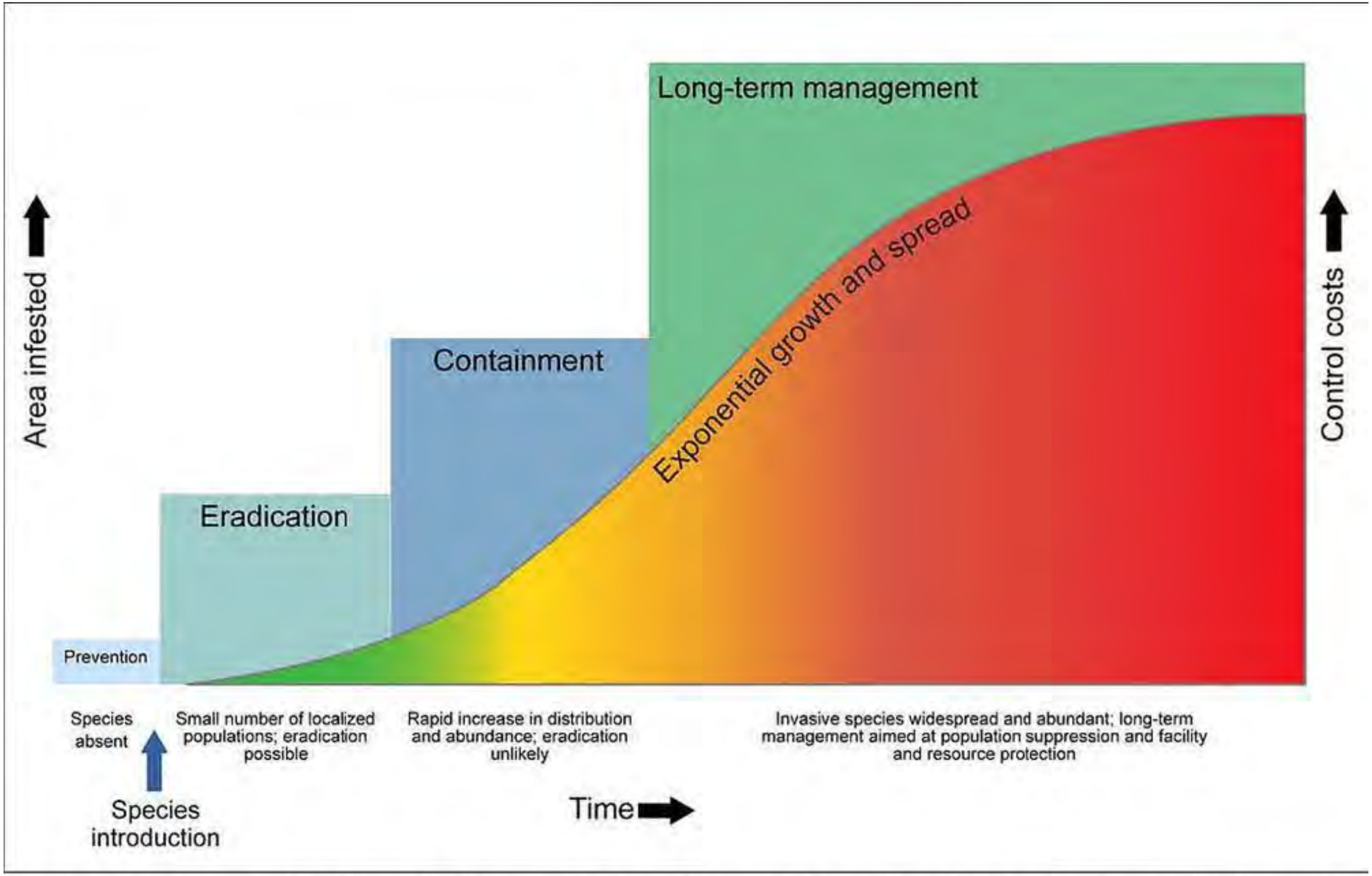


How do invasive species establish

- The “Tens Rule”
  - Of non-native species that enter a new ecosystem about **10% of these will survive**, and of those survivors **a further 10% (1% of the original number) will become invasive pests**.
- Factors that can affect the successful invasion, establishment, and spread of invasive species.
  - Propagule pressure – the # and frequency of introductions.
  - Minimum viable population size – to sustain population & grow. (ISHB sib mating)
  - Lag period – localized low populations may persist for a long time (years) before exponential growth occurs.
  - Genetic adaptation to it’s new environment.
  - Dispersing widely at low densities that are undetectable/not detected until exponential growth occurs.
  - Large areas, ample supply of a wide variety of hosts.
  - Climate and environment
  - Absence of natural enemies that regulate their population in their home range.
  - Can breed really quickly (life cycle is just a few days as opposed to months or years) and/or there are not effective native species that can compete with the invader.
  - Have wide tolerances for a variety of different climates or can utilize many different types of resources in the environment.

Protecting Hawaiʻi





Sources: National Invasive Species Council; U.S. Department of Agriculture; National Park Service; U.S. Fish and Wildlife Service; Rodgers, L. South Florida Water Management District; Department of Primary Industries, State of Victoria, Australia; and GAO. | GAO-16-49

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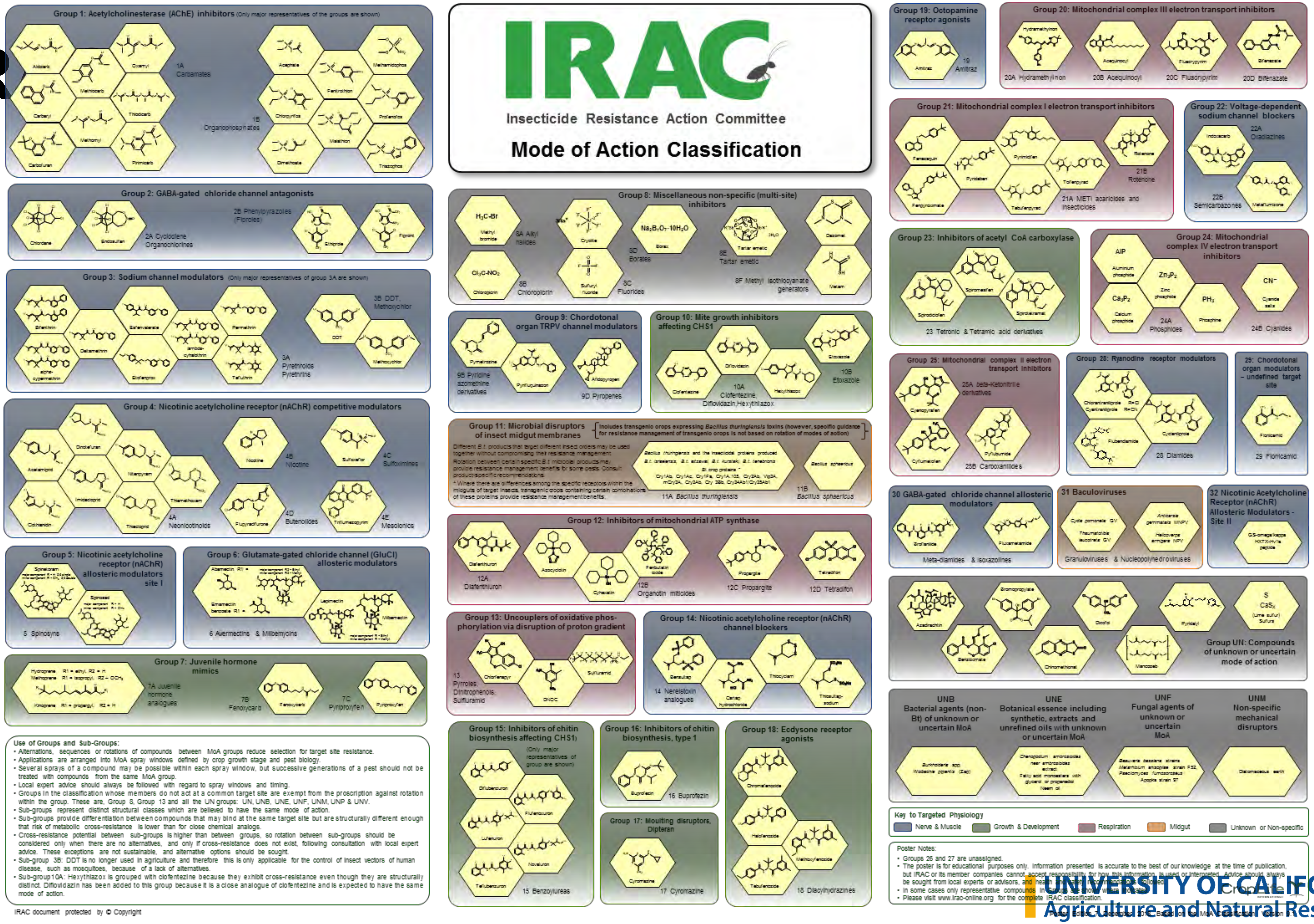

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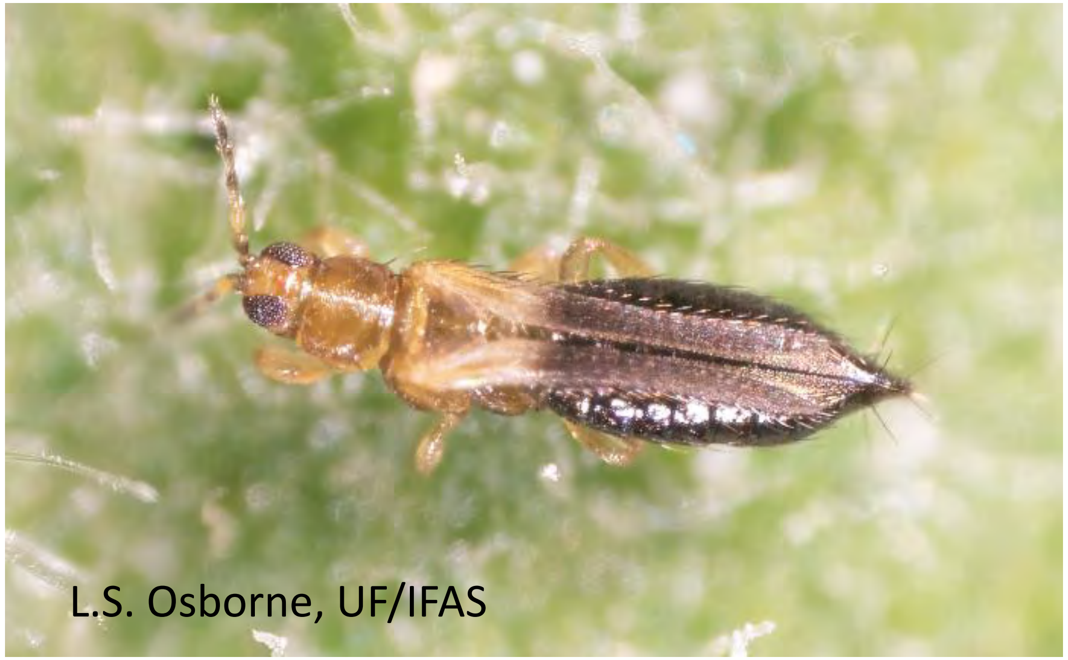
Mode of Action

- The Mode of action defines the process of how an insecticide works on an insect or mite at a molecular level

- Why is it good to know the Mode of Action of an Insecticide?
  - Knowing the Mode of action of an insecticide is key to managing resistance

- Insecticide Mode of Action Major classes
  - Nerve and Muscle (ex. Group 3 Pyrethroids, Group 4 Neonics)
  - Growth (ex. Group 7 Juvenile hormone mimics)
  - Respiration (ex. Group 13 Pyrroles (chlorfenapyr))
  - Midgut (ex. Group 11 *Bacillus*)
  - Unknown or Non-specific (ex. Group 8 Borates, Group UN Azadirachtin)

Thrips parvispinus (Pepper Thrips)



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Thrips parvispinus (Pepper Thrips)

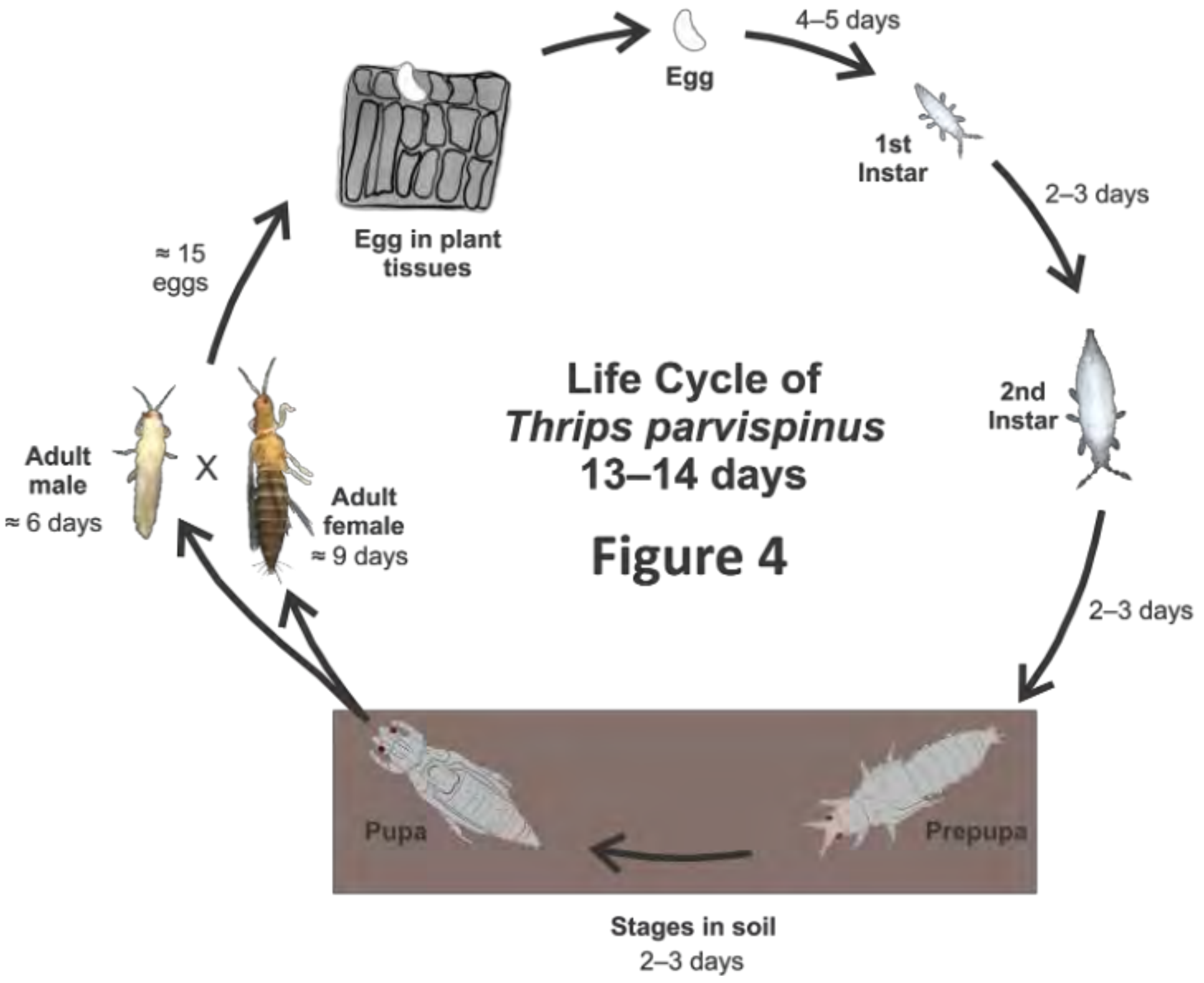
- First detected in Puna Hawai’i in 2006 on Papaya
- In May 2020 found on Anthurium in Florida
- 2021 found on Mandevia in a greenhouse in Ontario, Canada
- 2022 found in Georgia
- 2023 collected on Dipladenia, Mandevilla, and Gardenia flowers at a garden center in Colorado
- 2023 Reported from North Carolina and South Carolina on Gardenia
- Intercepted in Ohio and Pennsylvania

Thrips parvispinus (Pepper Thrips)

- Very Small ~1mm long
- Females brown-black with light-colored head and legs
- Males entirely yellow and smaller ~0.6 mm

Thrips parvispinus (Pepper Thrips)

- Quick life cycle under greenhouse conditions
- Research is ongoing to understand their biology
- Unknown what % pupate in soil
- Reported to sexual and asexual reproduction



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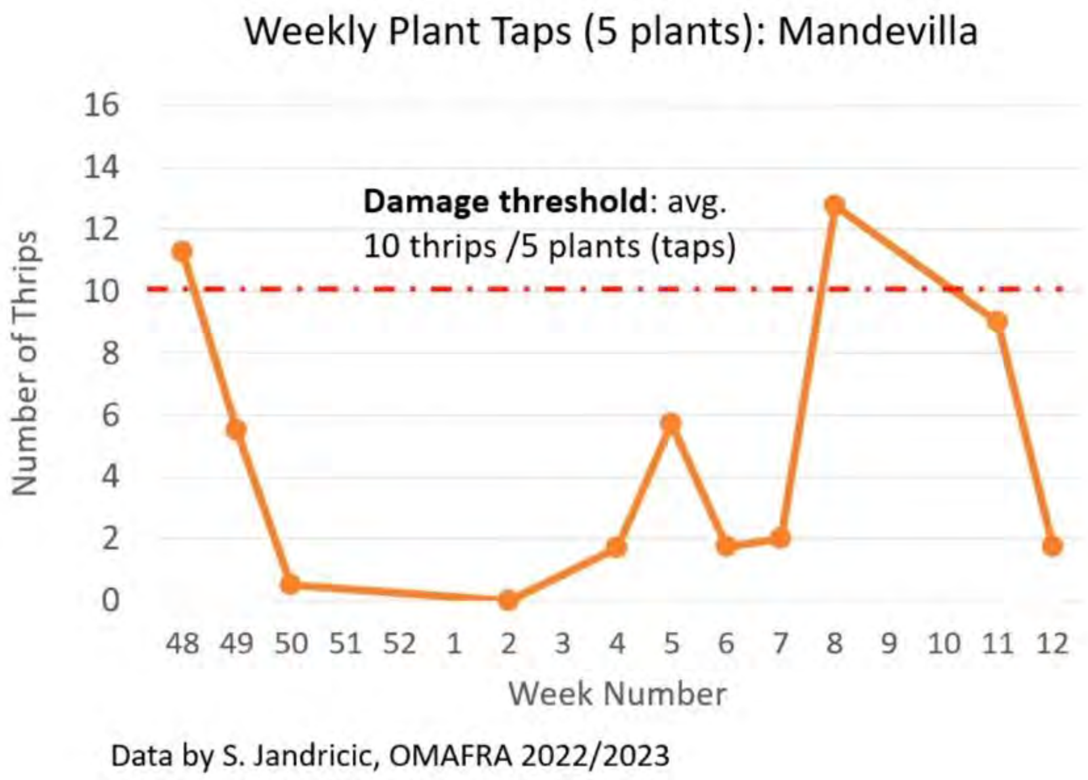
Thrips parvispinus (Pepper Thrips)

- Attacks at least 43 species including:
  - Gardenia, Mandevilla, Dipladenia, Peppers, Anthurium
  - Hoya, Ficus, Hibiscus, Jasmine, Chrysanthemum, Schefflera, Strawberry, Etc
- Reported to be attracted to pollen/nectar
- Feed on leaves and flowers causing extensive damage

Monitoring *Thrips parvispinus*

- A quick life cycle makes weekly monitoring necessary
- Tap sampling good for estimating current populations
- Damage threshold (mandevilla)
  - 2+ thrips/ plant in vegetative stage
  - 10+ thrips when starting to flower
- Sticky Cards
  - Used for monitoring and mass trapping
  - Color may have impact



Managing *Thrips parvispinus*

- Regular monitoring and establishing thresholds very important
- Rotate insecticide groups
- Some success at reducing populations using Orius and Chrysoperla
- Ensure good sanitation

Group	Product	Active Ingredient
1B	Acephate 97 UP	Acephate
1B	DuraGuard ME	Chlorpyrifos
5	Conserve SC	Spinosad
5 + 4C	Xxpire	Sulfoxaflor + Spinetoram
6	Avid, Timectin	Abamectin
13	Pylon	Chlorfenapyr
21A	Hachi-Hachi	Tolfenpyrad
28	Mainspring GNL	Cyantraniliprole

UF Recommended pesticides. Compiled by Dr. Revynthi

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(Photos by Erin Powell, Ph.D., Lance Osborne, Ph.D., and Muhammad Z. Ahmed, Ph.D.)

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Nipaecoccus viridis (Lebbeck Mealybug)

(Photos by Erin Powell, Ph.D., Lance Osborne, Ph.D., and Muhammad Z. Ahmed, Ph.D.)

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Nipaecoccus viridis (Lebbeck Mealybug)

- Also called hibiscus mealybug

- Host range of 140+ species
  - Citrus, gardenia, jasmine, oleander, hibiscus

- Causes distorted fruit and leaves, branch dieback, wilting, and (in the case of young trees) tree death

- Becomes an issue in absence of natural enemies, overuse of insecticides, enclosed spaces

Ovisac attached ventrally to a gravid female Hibiscus mealybug. Photograph by David Olabiyi.

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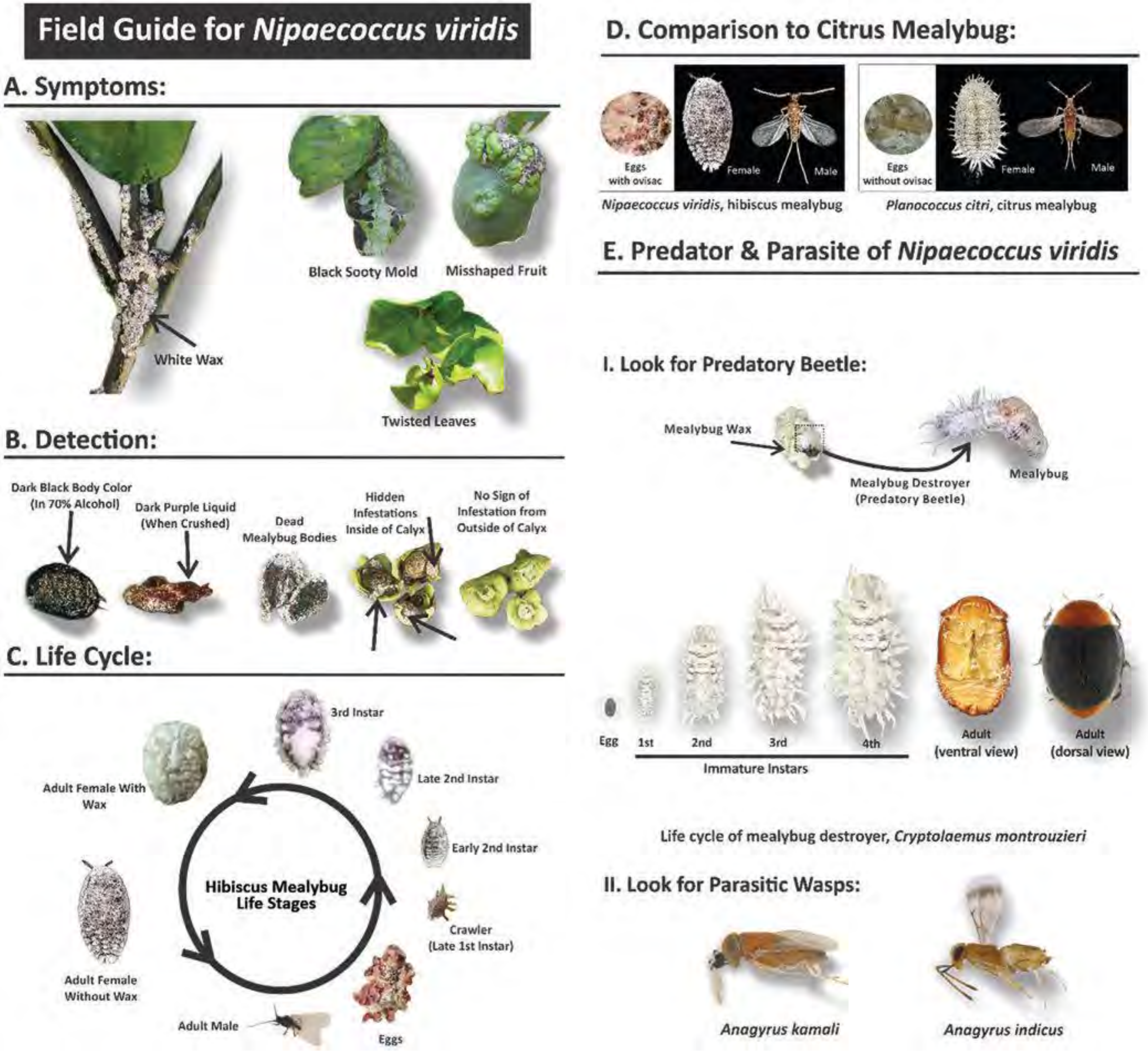

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Managing Lebbeck Mealybug

- Difficult to control with insecticides, use adjuvants to penetrate wax

- In laboratory assays acetamiprid, dimethoate, and zeta-cypermethrin were 80%+ effective (Diepenbrock, 2021)

- Biological control
  - *Anagyrus aegypticus, A. dactylopii, A. indicus, Leptomastix phenacocci*
  - *Cryptolaemus montrouzieri*

Legend

- Green: High Predation
- Yellow: Low Predation
- Red: No Predation

	Commercially Available Predators					Naturally Occurring Predators				
	Cryptolaemus montrouzieri	*Chrysoperla carnea*	*Adalia bipunctata*	*Hippodamia convergens*	*Orius insidiosus*	*Euborellia annulipes*	*Ceraeochrysa sp.*	(Lab Reared) *Diomus austrinus*	*Coccinella septempunctata*	*Olla v-nigrum*
Average # Larvae Consumed Per Day	18.8 ± 0.27	16.6 ± 0.71	4.7 ± 0.51	1.4 ± 0.36	0.3 ± 0.15	14.3 ± 1.07	13.4 ± 1.2	3.94 ± 0.82	3.27 ± 0.54	3.0 ± 2.0
% Predators Consumed Ovisacs	100%	25%	0%	0%	0%	80%	66.7%	10%	12.5%	0%

Cydalima perspectalis (Box Tree Moth)

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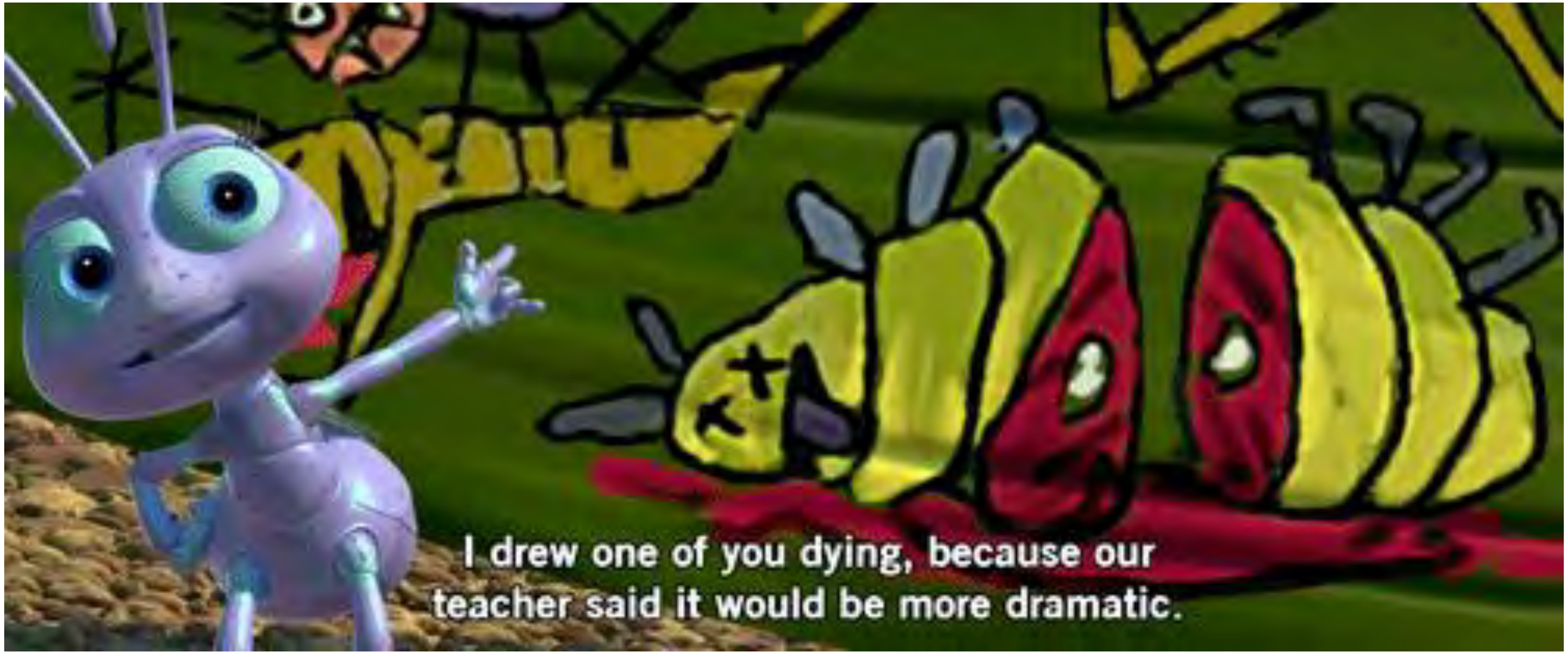
Cydalima perspectalis (Box Tree Moth)

- November 2018 Toronto, Canada
- July 2021 confirmed in Niagra County, New York
- November 2022 confirmed in Lenawee County, Michigan
- June 2023 confirmed in Hamilton County, Ohio
- 2023 detected in Massachusetts

Cydalima perspectalis (Box Tree Moth)

- Larvae about 1.5 in long
- Adult wingspan 1.5-1.75 in
- Can cause extensive feeding damage
- Once the leaves are gone, larvae consume the bark, leading to girdling and plant death.

Mitigation


I drew one of you dying, because our
teacher said it would be more dramatic.

Managing Box Tree Moth

- Pheromone traps are being used for monitoring
- Possible mating distruption?
- Insecticides labeled for caterpillar control (*Bt*, Spinosad)

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Dotted Paropsine Leaf Beetle (*Paropsis atomaria*)

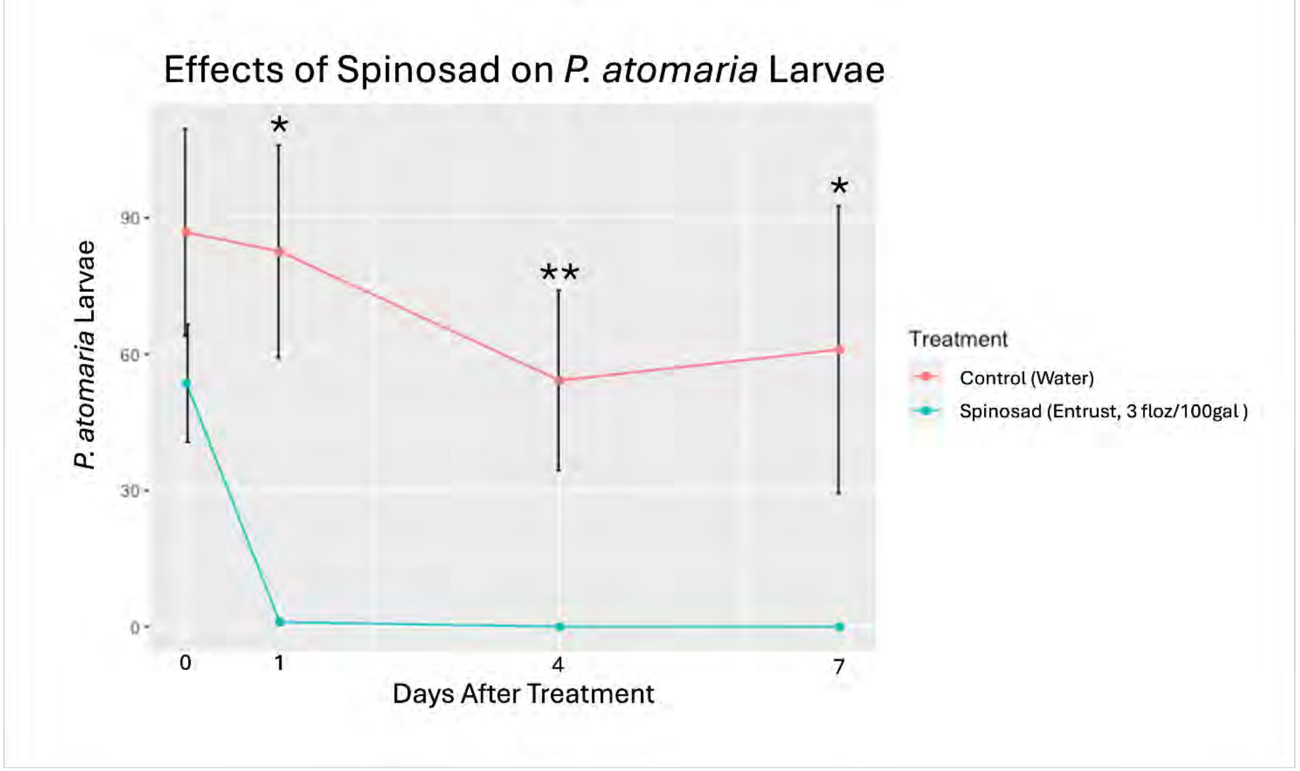
- Native to Australia
- First identified in Los Angeles in August 2022
  - L.A., Orange, Riverside, San Diego Counties
- Adults- Convex oval bodies (10-13 mm long) with yellow and orange markings and have 2 generations per year.
- Larvae- 4 instars with yellowish bodies with black heads and terminal segments. Have defensive glands on terminal segments that discharge droplets. Mature larvae drop to soil to pupate
- Eggs laid in a ringed cluster on young stems & leaves. Number of eggs per cluster from 20-100

Dotted Paropsine- Hosts

- *E. albopurpurea*
- *E. brunnea*
- *E. calycogona*
- *E. camaldulensis*
- *E. cinerea*
- *E. citriodora*
- *E. coolabah*
- *E. cosmophylla*
- *E. diversicolor*
- *E. eximia*
- *E. ficifolia*
- *E. globulus*
- *E. grandis*
- *E. grossa*
- *E. kitsoniana*
- *E. kruseana*
- *E. lansdowneana*
- *E. leucoxylon*
- *E. lunata*
- *E. maculata*
- *E. paniculata*
- *E. polyanthemos*
- *E. prava*
- *E. propinqua*
- *E. rudis*
- *E. robusta*
- *E. saligna*
- *E. salubrus "Gimlet"*
- *E. scoparia*
- *E. shirleyi*
- *E. sideroxylon*
- *E. tereticornis*
- *E. torelliana*
- *E. torquata*
- *E. "Torwood"*

Dotted Paropsine- Management

- Spinosad foliar application
- Soil drench of neonicotinoids
- Trunk Injections



UC IPM Pest Note Publication 74104


Jim Robbins, Bugwood.org

Crapemyrtle Bark Scale (*Acanthococcus lagerstromiae*)

- First discovered in Texas in 2004
- Hosts include- Crapemyrtle, beautyberry, apple, St. Johnswort, boxwood, pomegranate, persimmon, fig, privet and raspberries
- Infestation start under bark and at branch nodes

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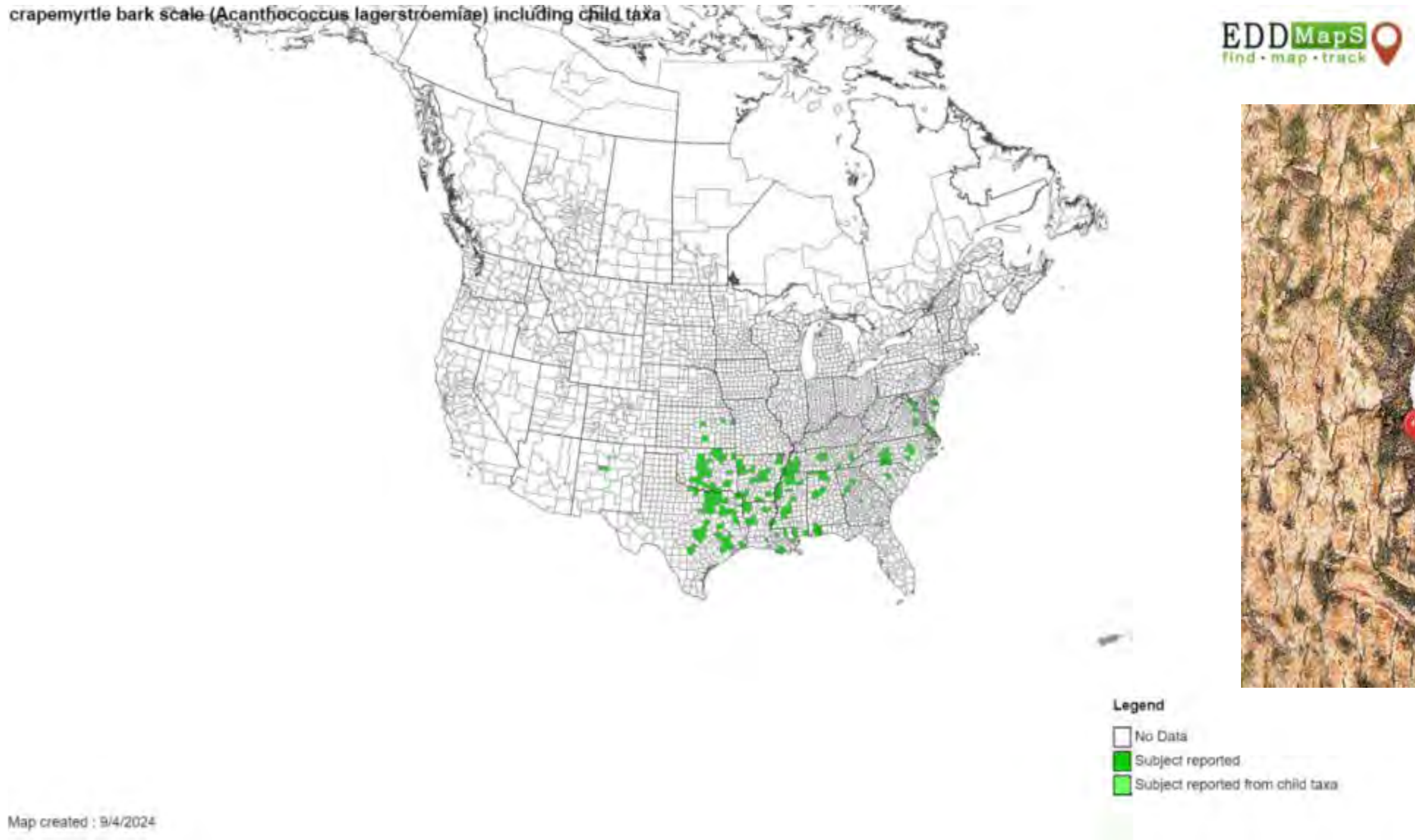
Crapemyrtle Bark Scale



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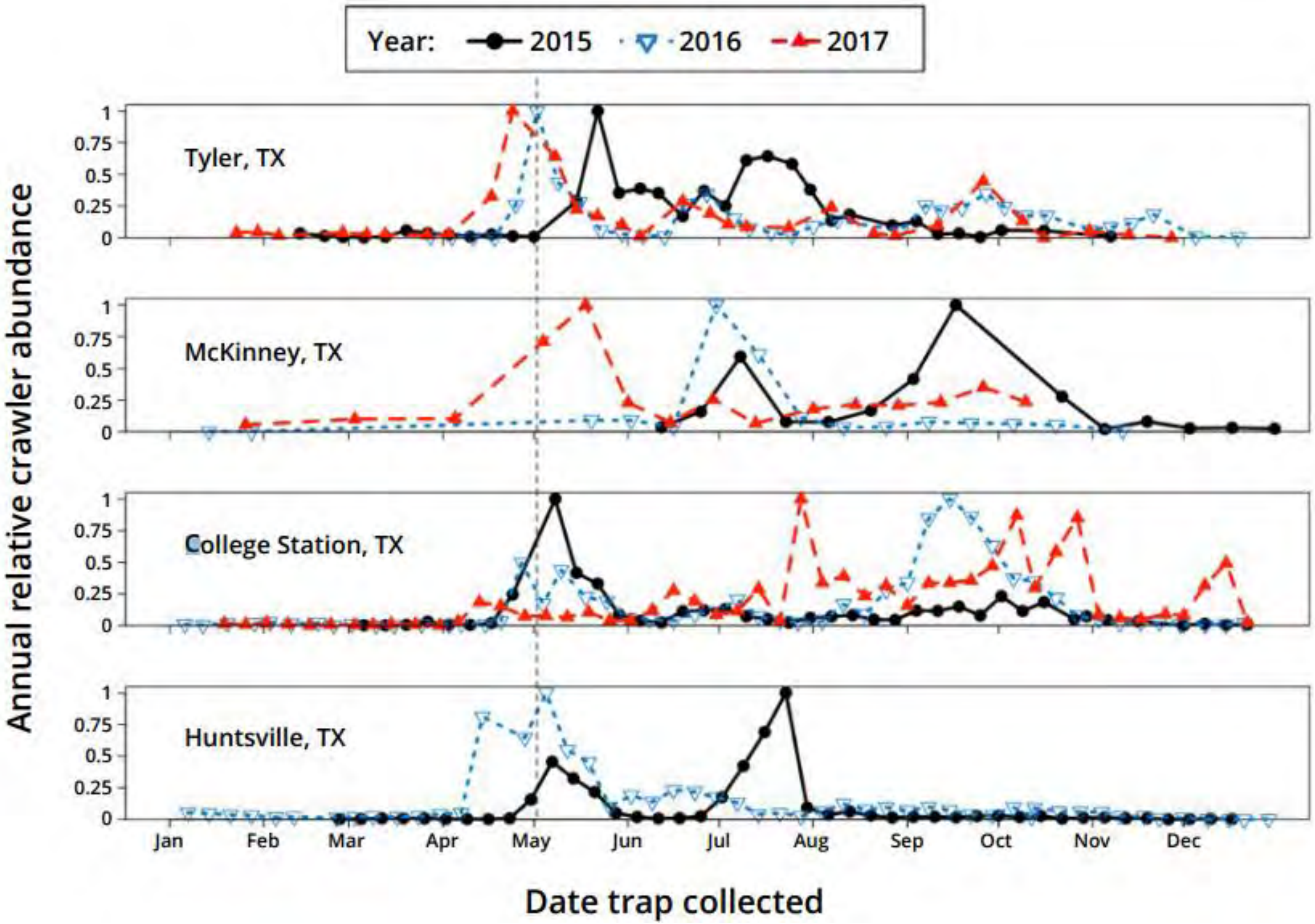
Crapemyrtle Bark Scale



Abundance of CMBS crawlers using double-sided sticky tape

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Crapemyrtle Bark Scale- Management

- Biological control- Lots of generalist lady beetles feed on CMBS but do not provide great control

- Systemic- Soil drench of imidacloprid or dinotefuran early spring

- Contact- bifenthrin, pyriproxyfen, or buprofezin at labelled rate applied twice on a 7 – 14 day interval.

- Limited to zero control- Horticultural oils, acephate, azadirachtin, afidopyropen, chlorantraniliprole, cyantraniliprole, Substugae strain PRAA4-1, Burkholderia spp. strain A396, and flupyradifurone

Crapemyrtle Bark Scale- Management

ACTIVE INGREDIENT	MOA*	APPLICATION METHOD	TIMING	COMMENTS
Dinotefuran	4A	Basal trunk spray	Early spring; timing of first leaf bud	Basal trunk spray: spray to cover/wet bark from media to 4–5 feet above soil media. Consider use with nonionic surfactant.
		Drench	Early spring; timing of first leaf bud	Systemic; apply to soil.
Imidacloprid	4A	Drench	Early spring; timing of first leaf bud	Systemic; apply to soil. Provides up to 2 years' control.
Buprofezin	16	14 oz. / 100 gal.	Mid-April to beginning of May	Apply to the bark. Good coverage required.
Pyriproxyfen	7C	12 fl. oz. / 100 gal.	Mid-April to beginning of May	Apply to the bark. Good coverage required.
Bifenthrin	3A	21.7 fl. oz. / 100 gal.	Mid-April to beginning of May	Apply to the bark. Good coverage required.

*Codes developed by the Insecticide Resistance Action Committee. Periodically switching insecticide use among different mode of action (MoA) groups reduces the risk that insects will develop resistance to any insecticide group.

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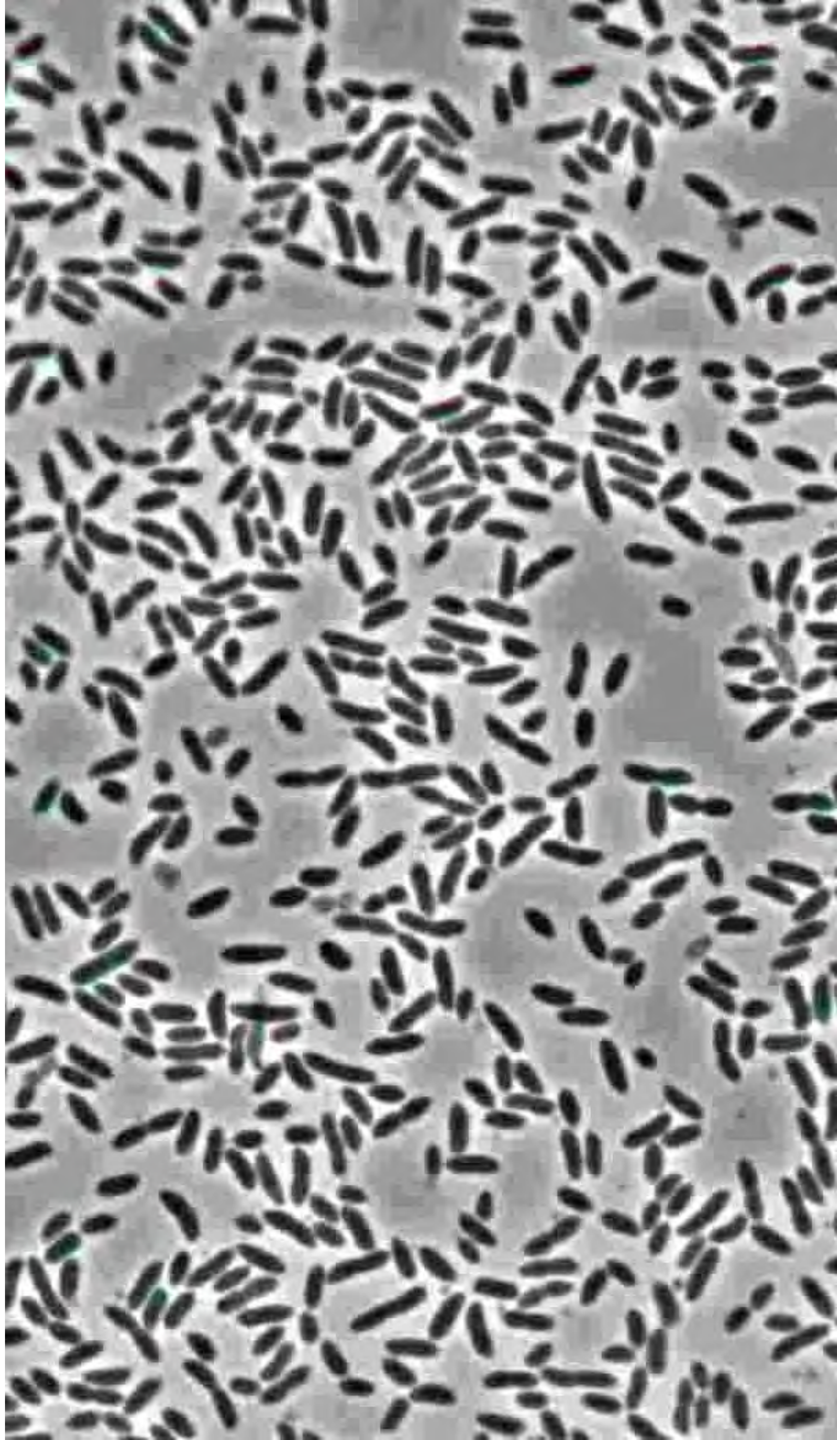
Acute Oak Decline

- Associated with three types of bacteria
- *Brenneria goodwinii*
- *Gibbsiella quercinecans*
  - Were consistently associated with necrotic tissue, suggesting a role in lesion formation
  - Degradation of oak phloem and sapwood
- *Rahnella victoriana*
  - Present in both healthy and diseased trees may play a role in symptoms



Acute Oak Decline

- Affects oaks in Great Britain and Iran
- Decline disease
  - Predisposing – related in general to site resilience and involves long term influences and/or biological factors that weaken the host before the onset of declining.
  - Inciting – short term, transient factors – biotic/abiotic origin
  - Contributing – secondary pests and pathogens that bring weakened trees to death.
- Occurrence with bark boring beetle
  - *Agrilus bigutattus*
    - Oak splendor beetle

Acute Oak Decline - California

- Hollister, CA
- Stem symptoms
  - Bark cracks with dark exudate
  - Cracks between bark plates
  - Inner bark necrosis
  - Sapwood degradation

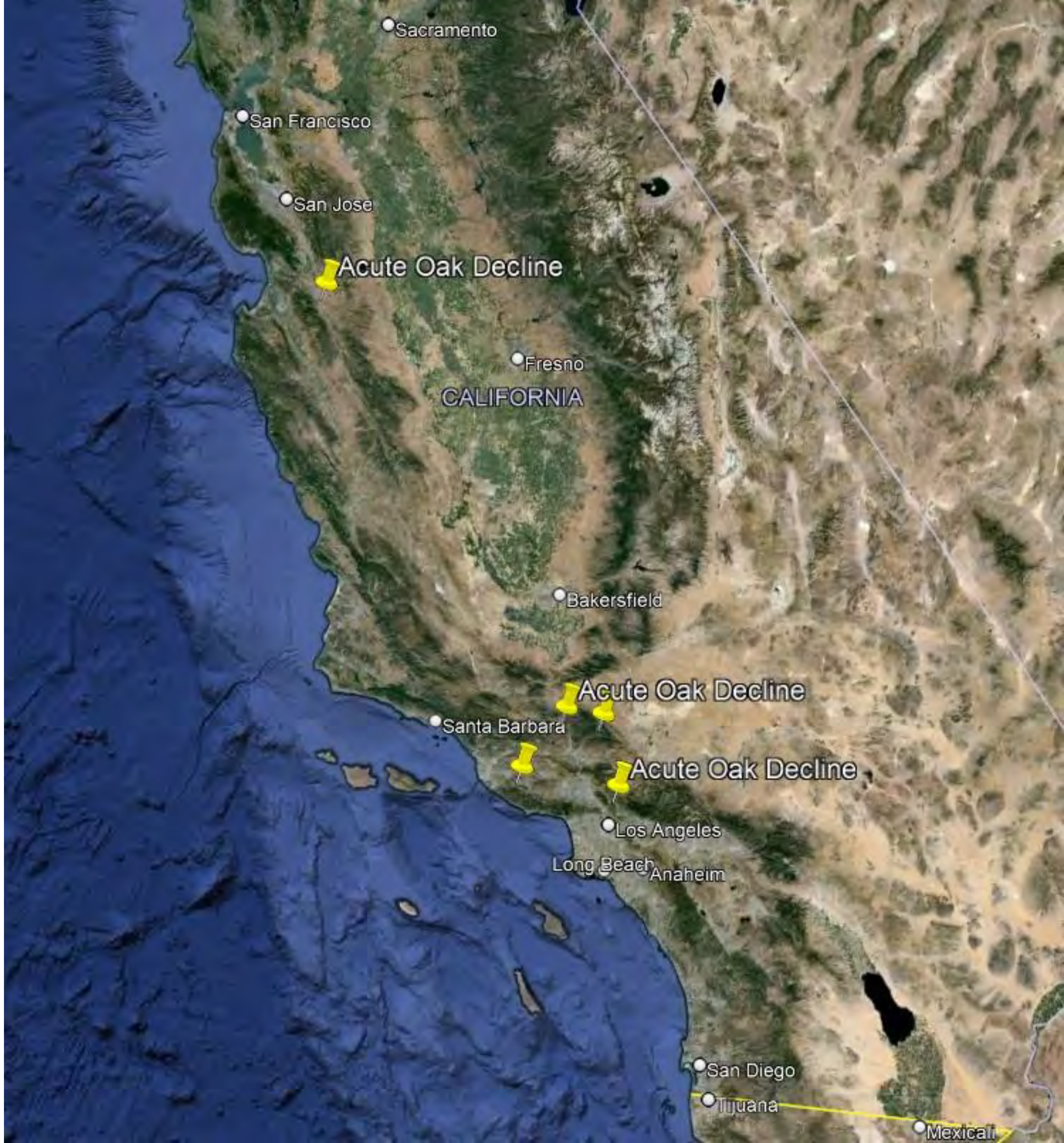
Acute Oak Decline – Hollister, CA

Acute Oak Decline – Castaic, CA

Distribution of Acute Oak Decline

Locations to date:

- Hollister, CA
- Castaic, CA
- Green Valley, CA
- Newbury Park, CA
- La Canada Flintridge, CA
- Malibu, CA



AOD Management

- Trees with severe infections have lower pH, different microbiome composition, high C and N content.
- Monitor trees for symptoms
- Felling infected trees and treat
  - Stripping outer bark and sapwood of heavily infected trees and burn on site.
  - Chip bark and left onsite to decompose naturally – do not use for mulch, compost or soil conditioner
  - Don’t move infested wood without first stripping them of bark and sapwood.
- Don’t move infested wood
- Report infested trees – County Agricultural Commissioner, Cal Fire or USFS Forest Service forest health professionals.

Tiny Tower Italian Cypress

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Acknowledgements *Thank you!*

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