Combining Forces to Detect Invasive Forest Pests

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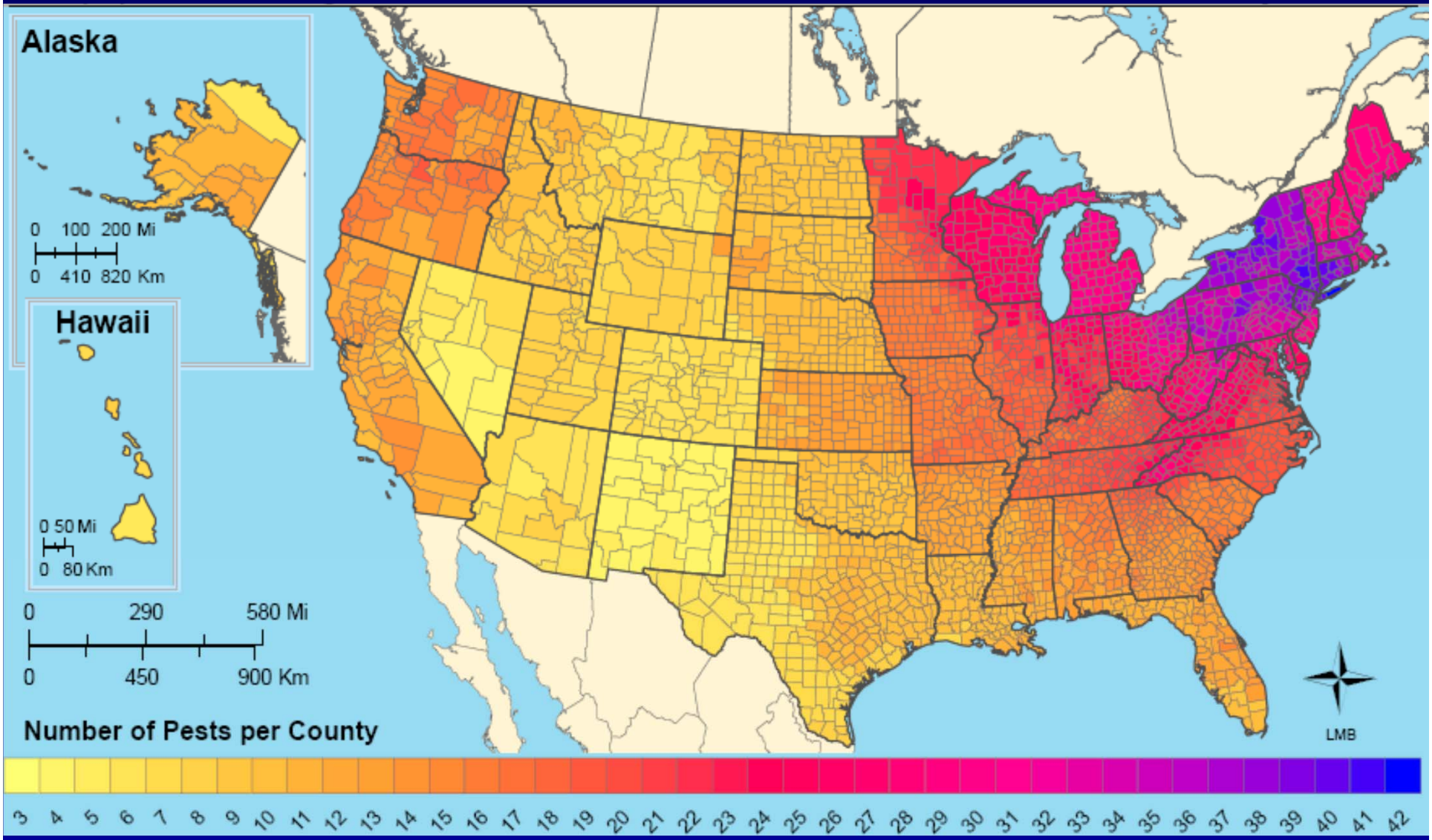
Invasive forest pests – why we care….

1. Many of us have first-hand experience with invasive forest pests.

Distribution of High Impact Invasive Forest Pests



Liebhold, McCullough, et al. 2013. Div. and Dist.

Invasive forest pests – why we care….

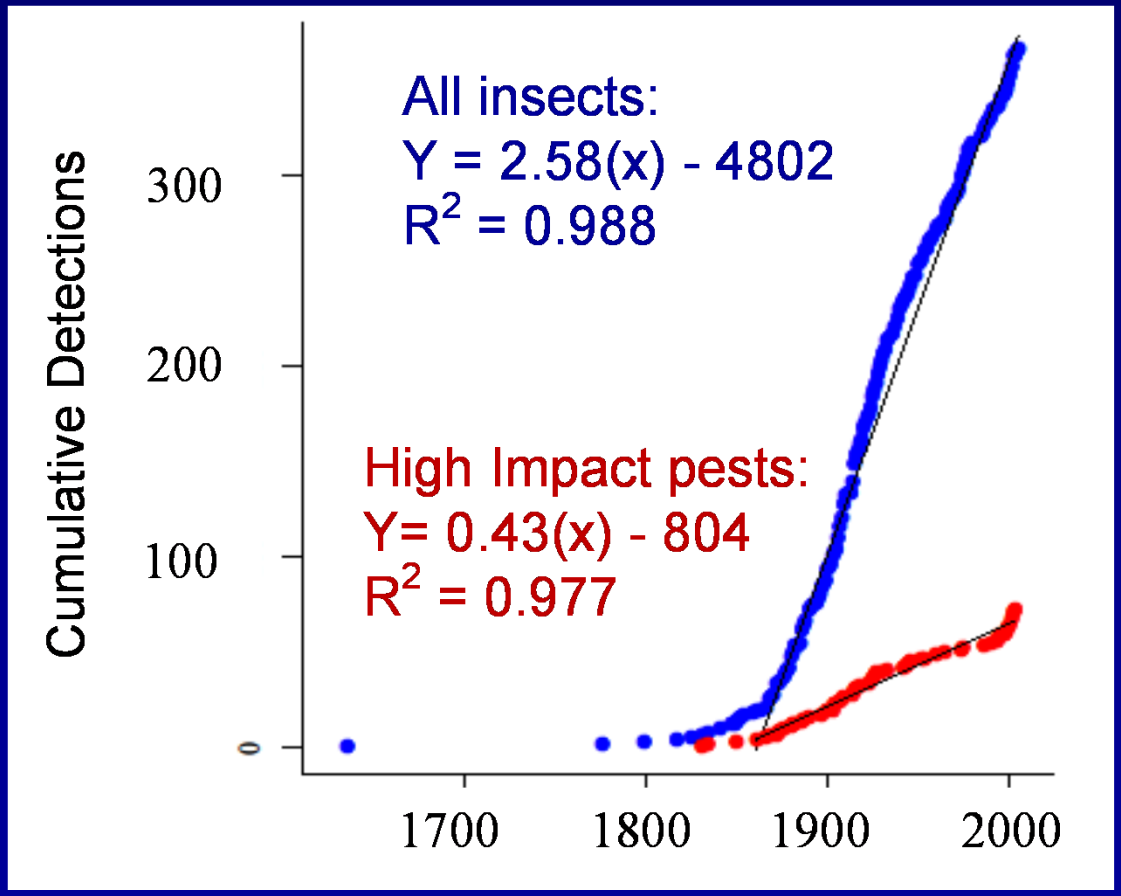
1. Many of us have first-hand experience with invasive forest pests.
2. They keep coming…

Invasion pathways for non-native insects are known

- Hitchhikers: commercial cargo or travelers baggage
- Infested commodities (produce, grain, spices, etc.)
- Live plant material, cut flowers
- Smuggling
- Solid wood packing material (SWPM)

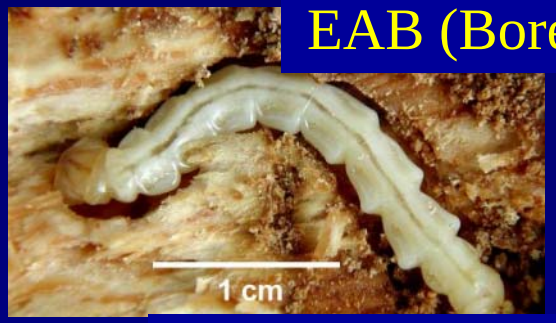
Regulatory efforts to prevent introductions of non-native insects are likely offset by increasing global trade & travel.

Non-native forest insects: > 455 species in the U.S.
Roughly 2.5 new species detected per year since 1860.
"High impact" invaders: 62 species. A new high impact pest is detected every 2 years.



Aukema et al. 2010. BioScience

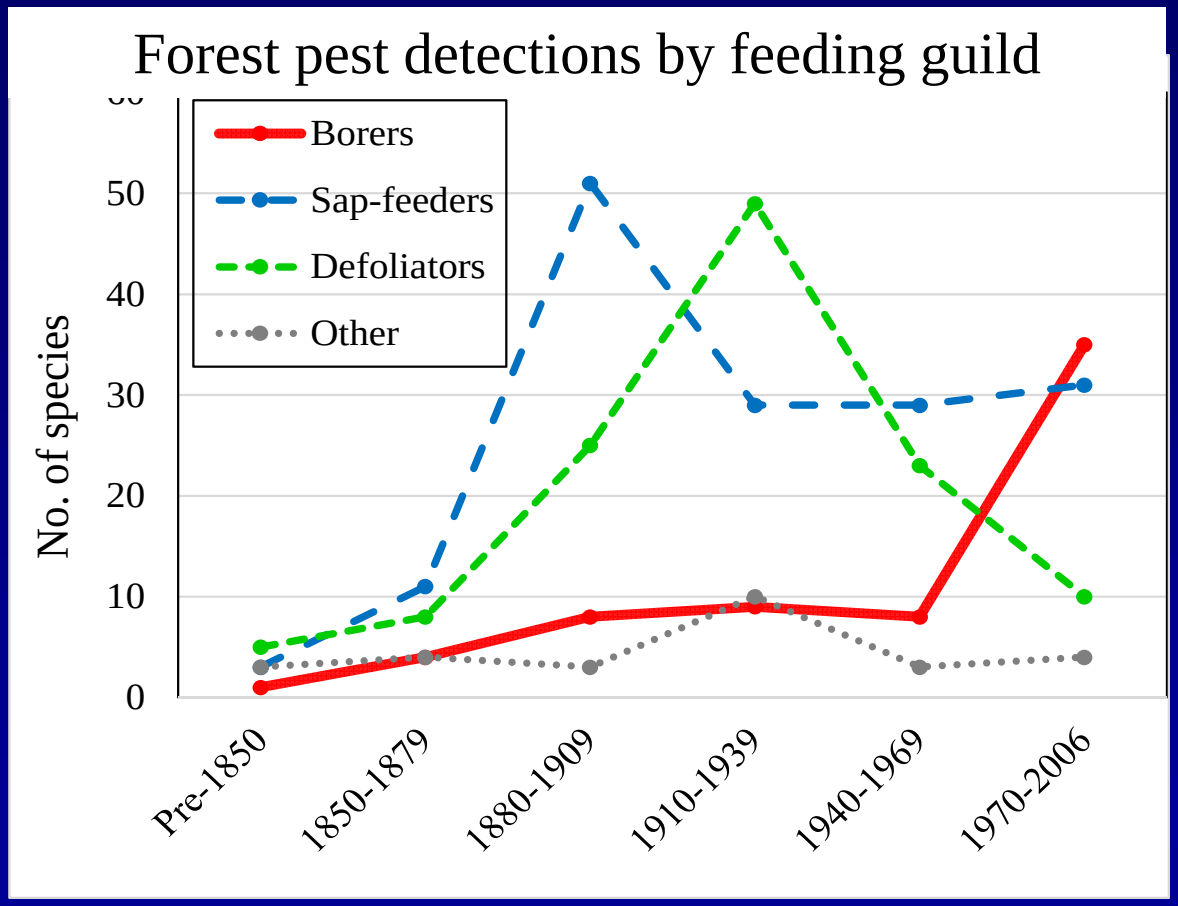
EAB (Borer)



HWA (Sap feeder)

Gypsy moth (Defoliator)

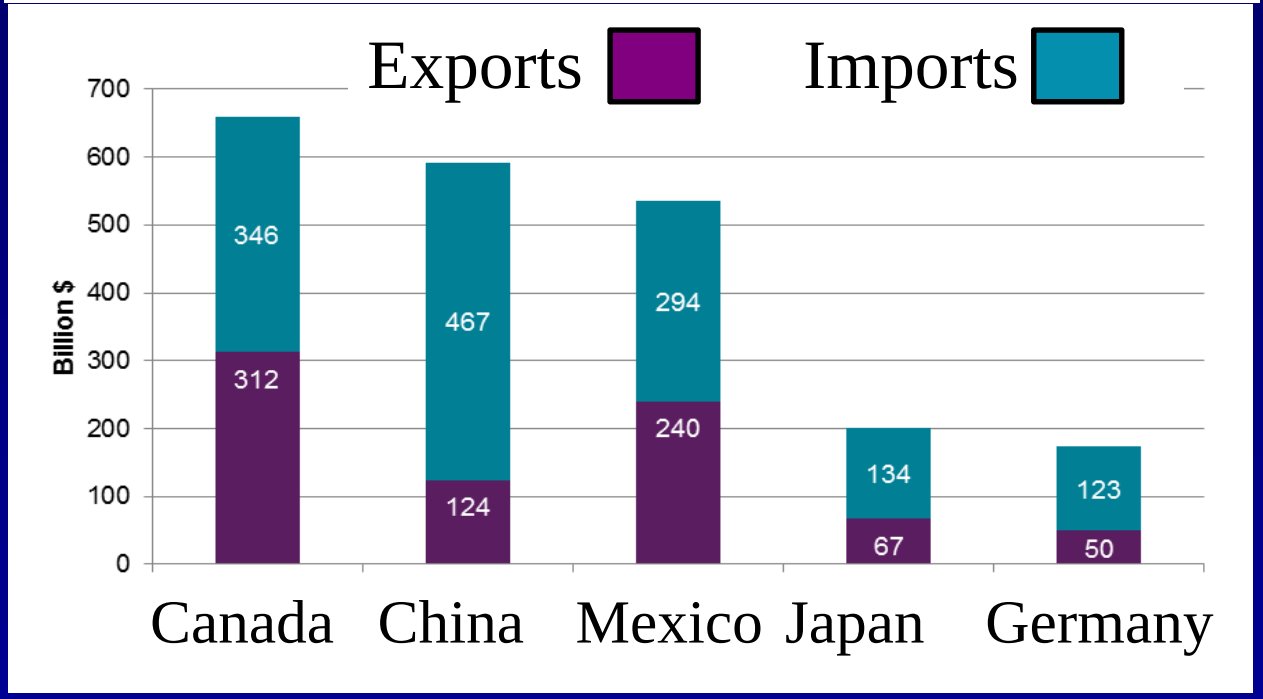
Dramatic jump in new phloem- and woodborer detections since 1980 reflects global trade & containerized shipping.



1980-2010: 56% of new forest pest detections were woodborers.

Most of the non-native forest pests in the US are European but many recent pests are native to Asia.

U.S. Trading Partners - 2014



"…the known unknowns and the unknown unknowns…"

Invasive forest pests – why we care….

1. Many of us have first-hand experience with invasive forest pests.
2. They keep coming…
3. Economic costs (and other impacts) of major invaders are staggering.

Economic Cost Estimates by Insect Feeding Guild

Annualized marginal damages in millions of $USD

	Government		**Households**		**Markets**
TOTALS	Federal	Local	Spent	Property values	Timber
Borers (71)	92	1770	760	830	130
Defoliators (155)	110	170	160	410	18
Sap feeders (192)	14	170	130	260	4

Aukema et al. 2011. PLoS One Vol. 6: 1-7

Invasive Forest Insect Impacts

- Productivity, species composition, ecosystem functions
- Ecosystem services
- Biodiversity; endangered species; wildlife habitat
- Pesticide use
- Cultural issues

Social & Political Aspects

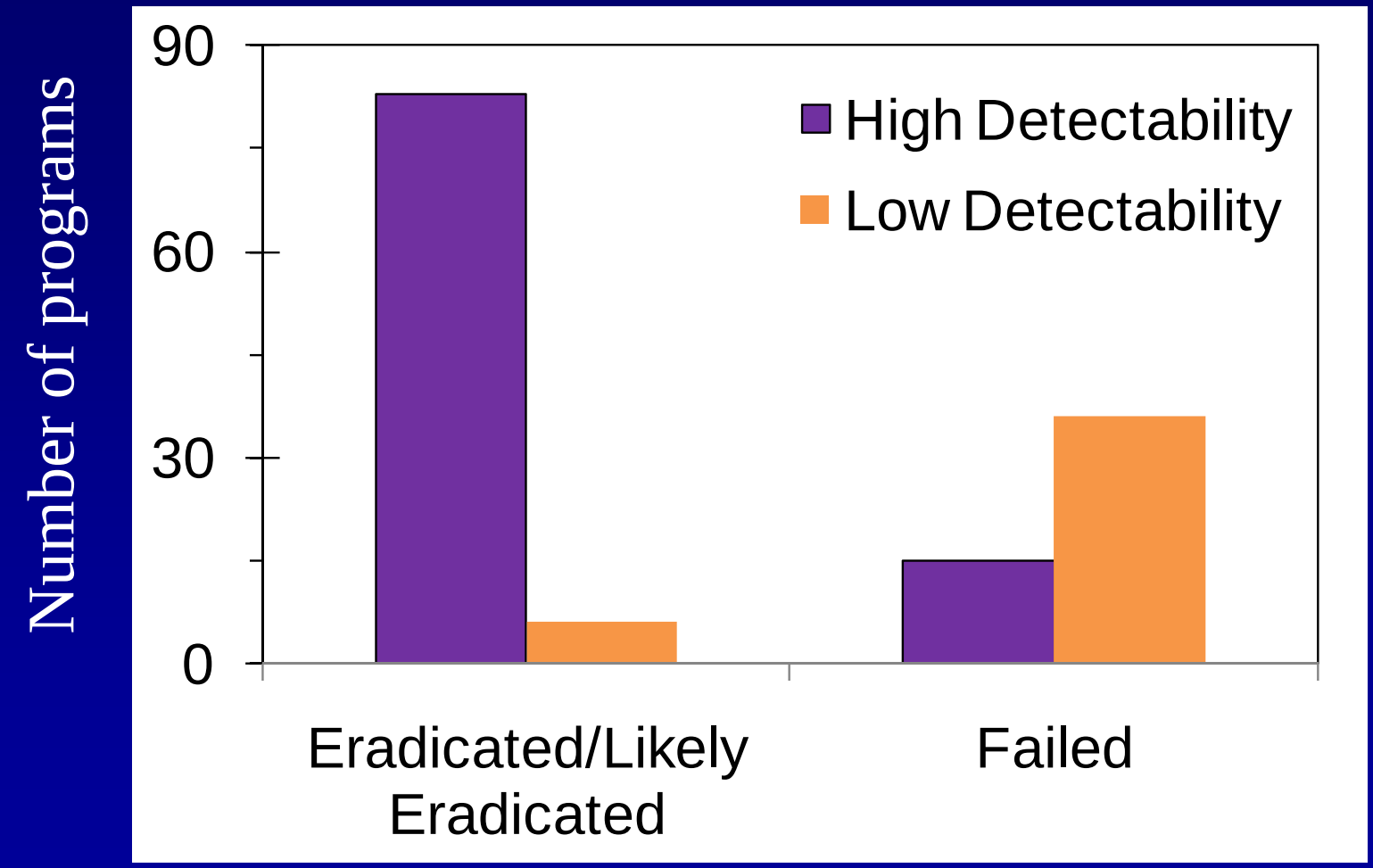
- Municipal officials may face unhappy residents.
- Local resources often overwhelmed.
- “Rats” & scam artists appear.

Invasive forest pests – why we care….

1. Many of us have first-hand experience with invasive forest pests.
2. They keep coming…
3. Economic costs (and other impacts) of major invaders are staggering.
4. Early detection is of new non-native forest insects is critical but often difficult.

Forest Insect Detectability & Eradication Success

Highly detectable pests (e.g., long range pheromones) are 8-9 times more likely to be eradicated (N = 144 programs).



Tobin et al. 2014. Biol. Invasions

Early detection of a new invader facilitates an effective response but is often challenging.

- Many recently established invasive forest pests, including borers & sap-feeding insects, lack long range pheromones.
- Most invasive forest pests first establish in urban or residential areas that are usually not well-surveyed.
- Innovative research on detection options needed; (Visual or acoustic attractants? Hyperspectral imagery to detect infested trees?)
- **Citizen science:** More “eyes” looking at trees increases the likelihood that new pests will be detected early.

Example: Asian longhorned beetle

ALB detection is difficult. Adult ALB do not produce long distance pheromones & are not highly attracted to host volatiles or colors.

Citizen Science: All ALB populations in the USA were first reported by residents.

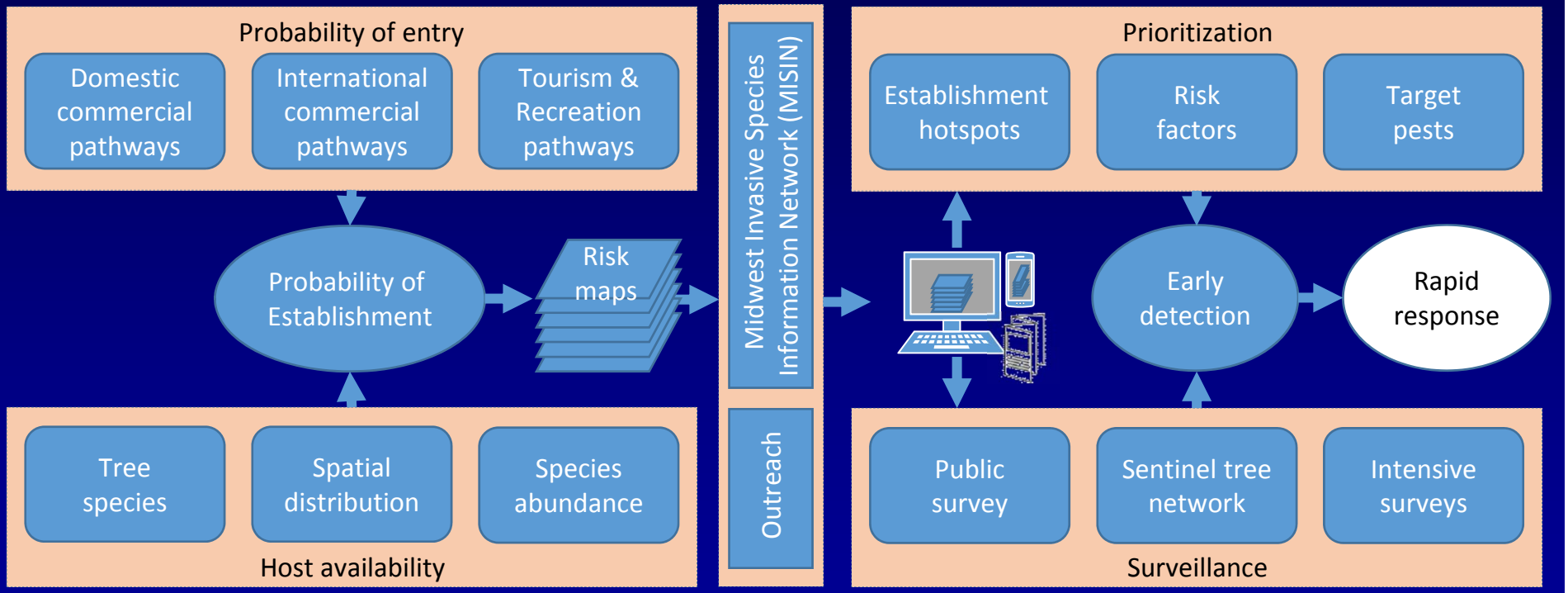
Cell phone camera photos taken by resident of Worcester, MA in 2008 led to discovery of the largest ALB infestation to date.

MSU's Eyes on the Forest: Linking Research, Outreach & Communication

Communication

Risk models: 3 target pests

Outreach



Eyes on the Forest: Linking Research, Outreach & Communication

Identified 3 target pests: ALB, HWA and TCD

Research: Assess & map relative risks of entry & establishment in Michigan for each pest

Outreach: Build awareness of the 3 target pests & other invasive forest pests across the state.

Communication: Facilitate reporting of suspect pests or symptomatic trees.

Goals: Increase chance of early detection & successful response if new invasive forest pest becomes established.

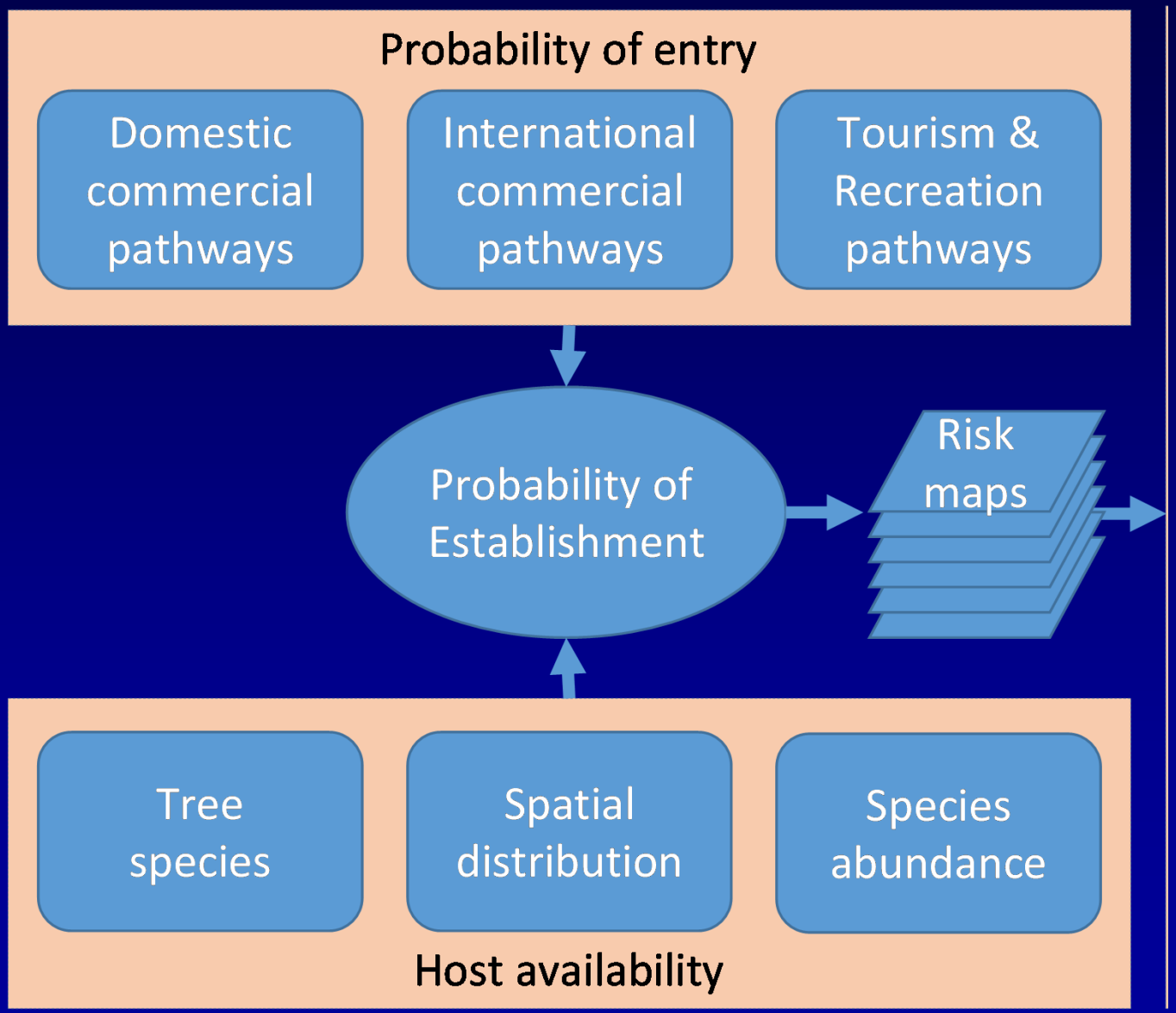
Three Target Pests

ALB kills maples & other trees

TCD can kill walnut

HWA kills E. hemlock

Risk Modeling – Likelihood of Entry & Establishment



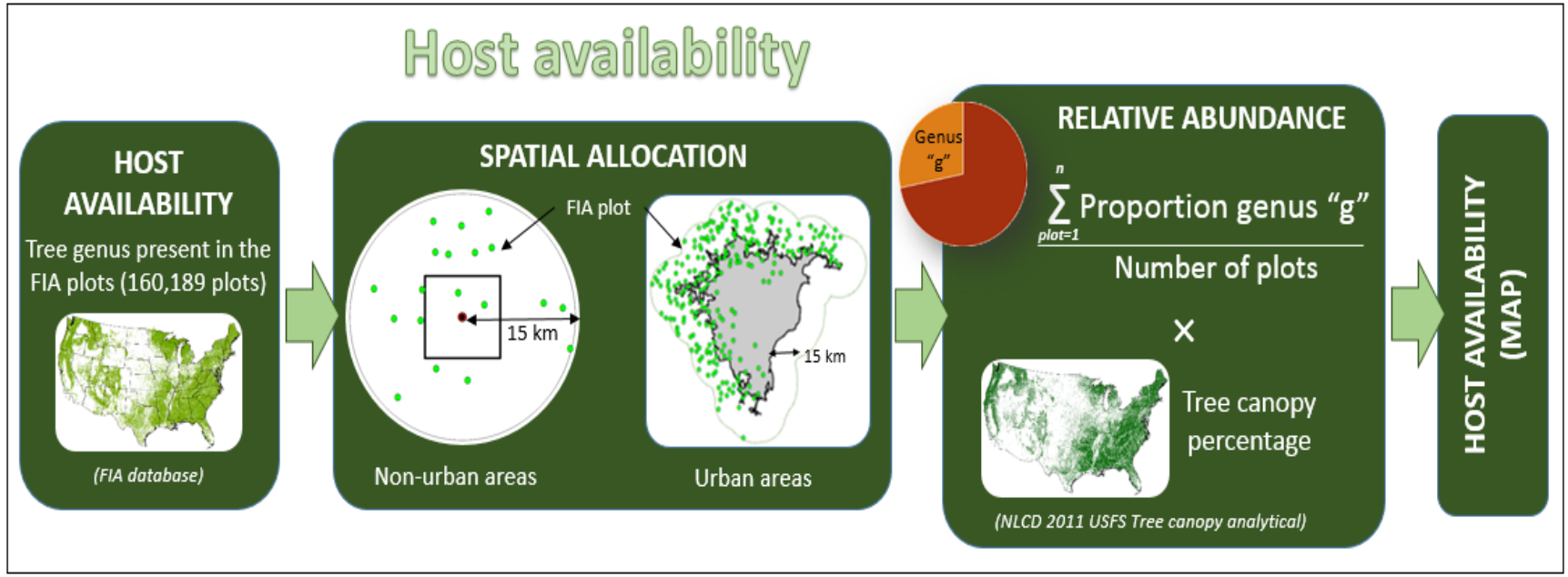
Risk Modeling – Likelihood of Entry for each Pest

Data & Databases Used

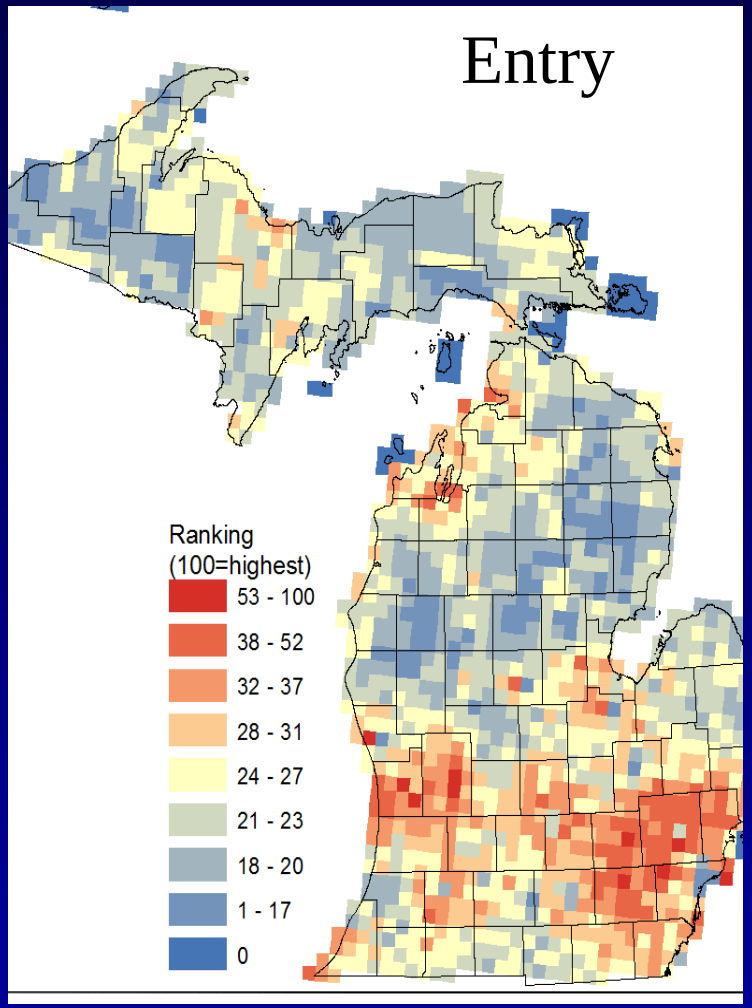
- Maritime and air imports 2012-2014 (SWPM)
- Truck and rail imports 2012-2014 (SWPM)
- MI - destination of commerce with SWPM 2012, 2015
- Truck volume: average in 2007 & projected
- Human population density
- High-intensity developed land; land use class 2011
- Warehouse and storage establishments 2014
- MI campground visitor data 2009-2012
- MI Park state boundaries
- Quarantine/Regulated area maps: ALB and HWA
- Plant nursery establishments 2014

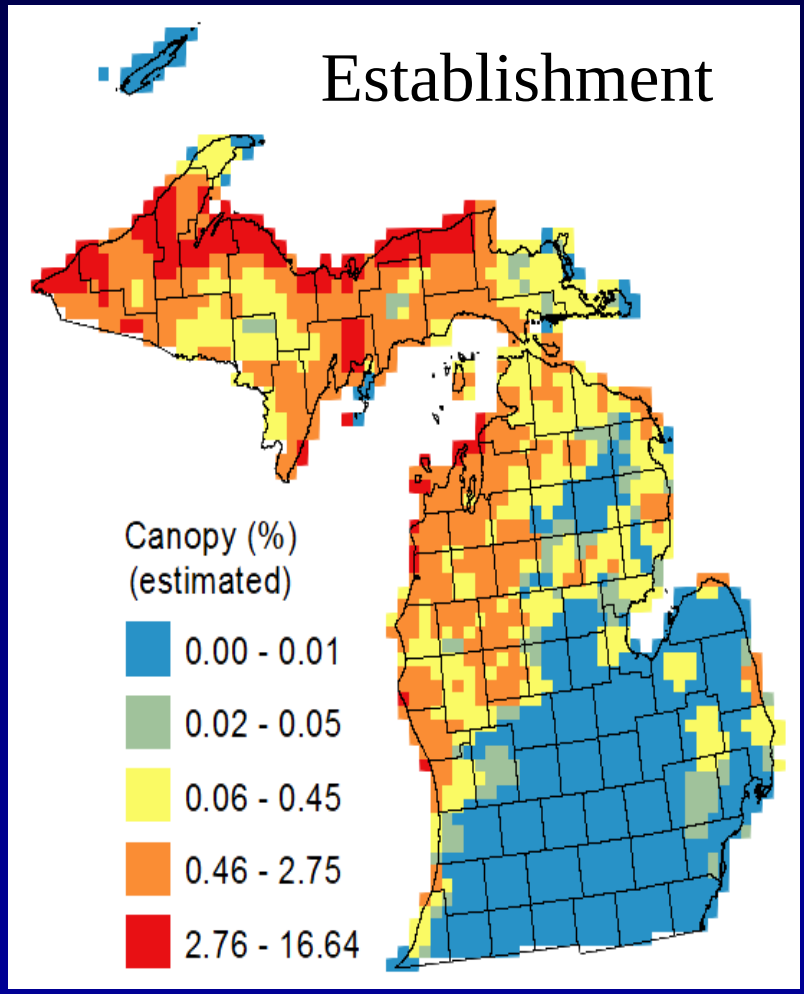
Risk Modeling for ALB, HWA & TCD

Likelihood of establishment largely based on host tree distribution in Michigan forests & urban forests



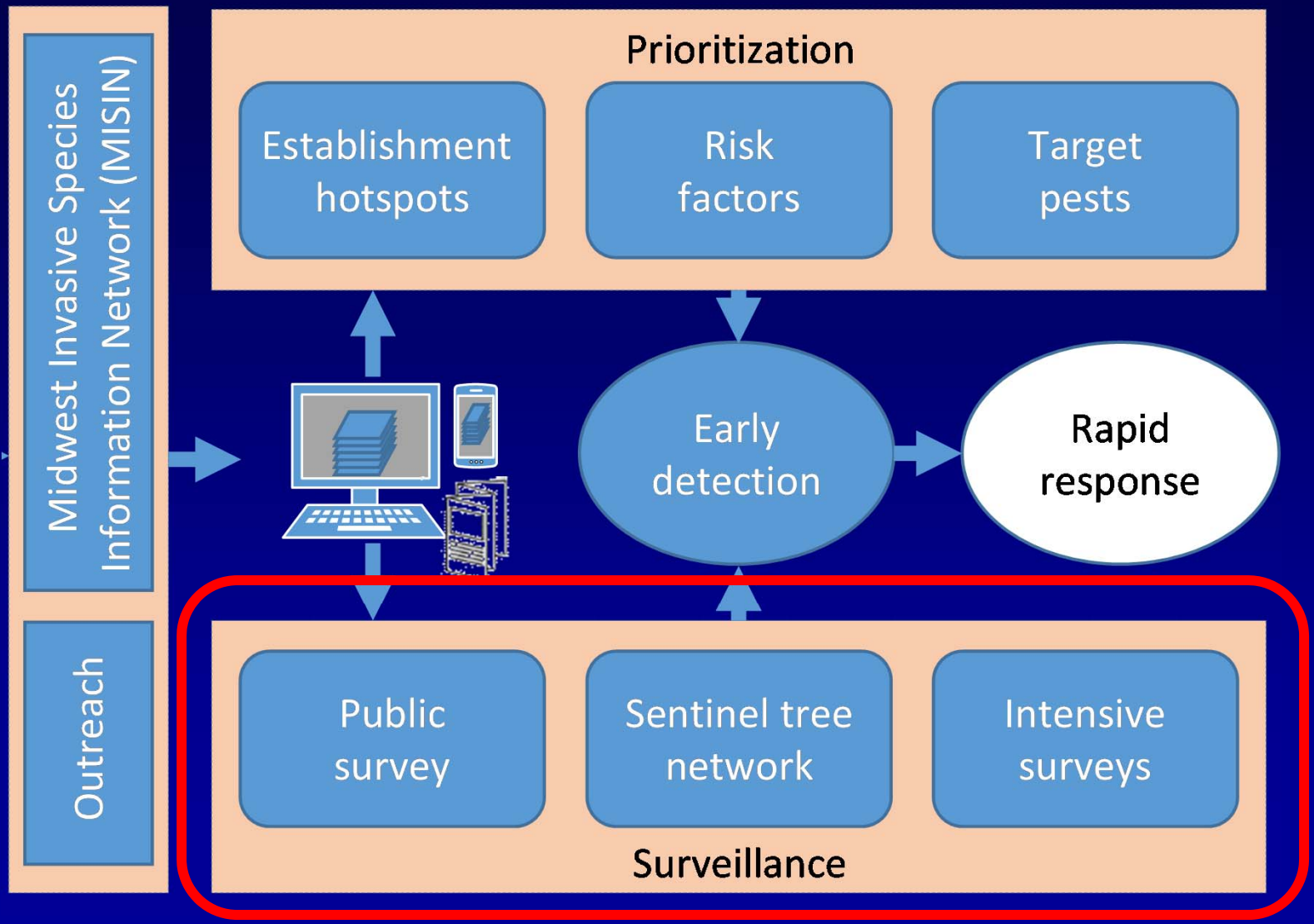
Hemlock Wooolly Adelgid Risk Model (preliminary)





Colunga-Garcia & McCullough

Eyes on the Forest – Communication & Outreach



Plant Pest Diagnostic Clinics – the First Responders

Expertise provides essential support for outreach, communication, detection, research & regulatory activities

Research

Extension

Diagnostics

Regulatory

EAB was unknown before 2002 - what else is out there?

Asian woolly hackberry aphid

Asian longhorned beetle

Citrus longhorned beetle