Automated Pest Monitoring – From Field to Computer to Recommendation

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Greg Krawczyk (Penn State University)

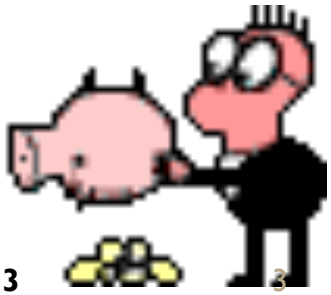
Outline for today's presentation

1. Introduction – L. Hull
2. Development of the Z-Trap - J. Park
3. Field Trials – L. Hull
4. Commercialization and MyTraps - J. Park
5. Future of Automated Pest Monitoring – L. Hull

Insect pest monitoring

Why do it?

- Detect the presence/absence of pests
- Determine if pests exceed action thresholds
- Assess possible consequences of our action/inaction
- Prevent unnecessary expenditure of control measures



Current Methodology to Monitor Lepidopteran Pests

- Plastic sex pheromone traps are used to monitor insect populations

- 1 trap per 1-2 ha is recommended for apple orchards

- At least 1-2 times a week, the number of insects in each trap must be counted manually, which involves much labor and travel

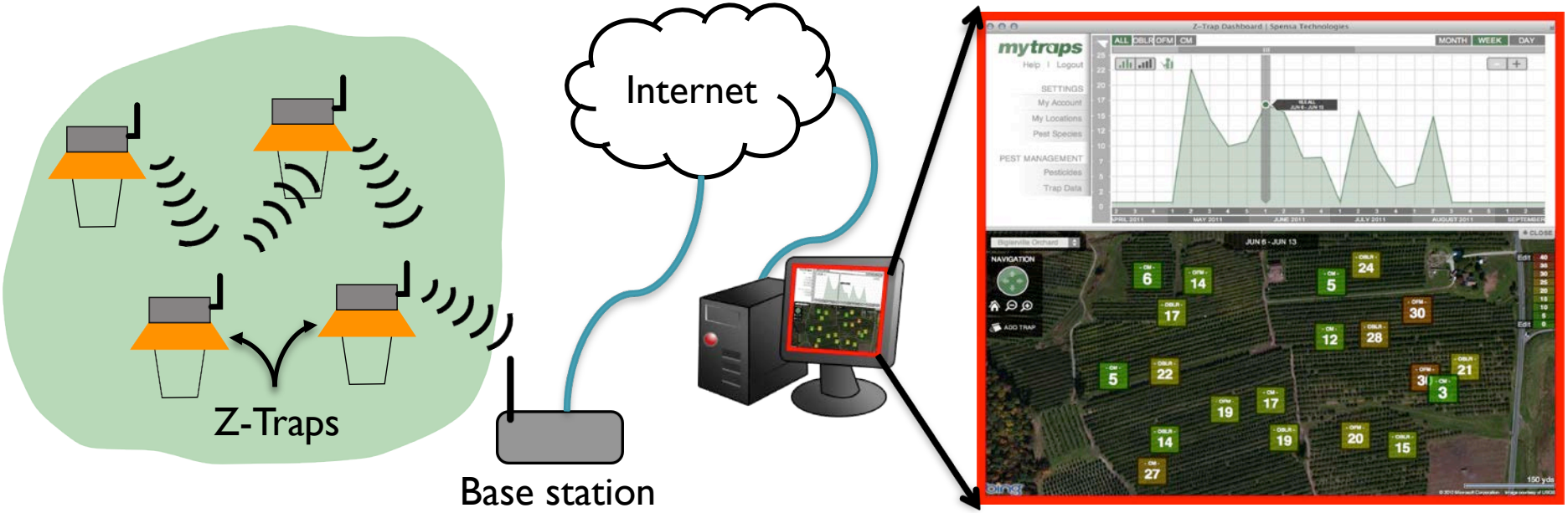
Monitoring Insect Populations and Pest Infestations

Two Research Topics Under the Comprehensive Automation for Specialty Crop (CASC) Project

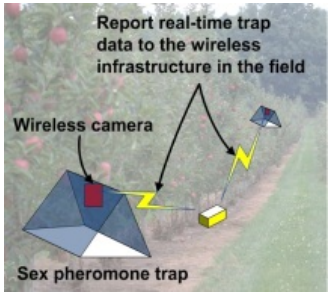
1. **Develop wireless sensors that can be integrated with a pheromone baited trap for automatic monitoring of insect populations**

2. **Develop computer vision algorithms for automatically detecting internal feeding worm (IFM) damaged apples**

Our Solution:
Automated Insect Monitoring Using Z-Traps



Evolution of Z-Trap



Aug-08

Jan-09

Feb-09

Jun-09

Feb-10

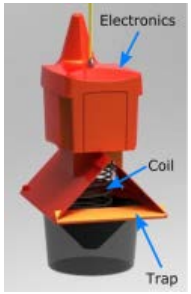
Apr-10

May-10

Jun-10

Jul-10

Aug-10



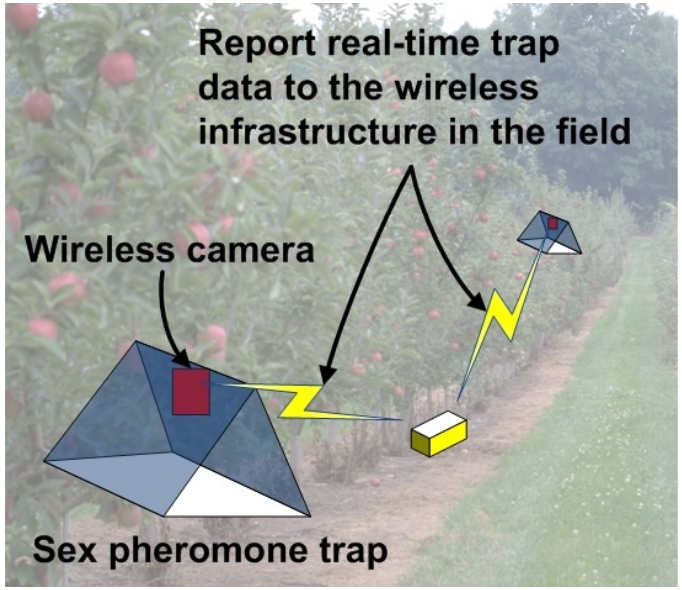
Feb-11

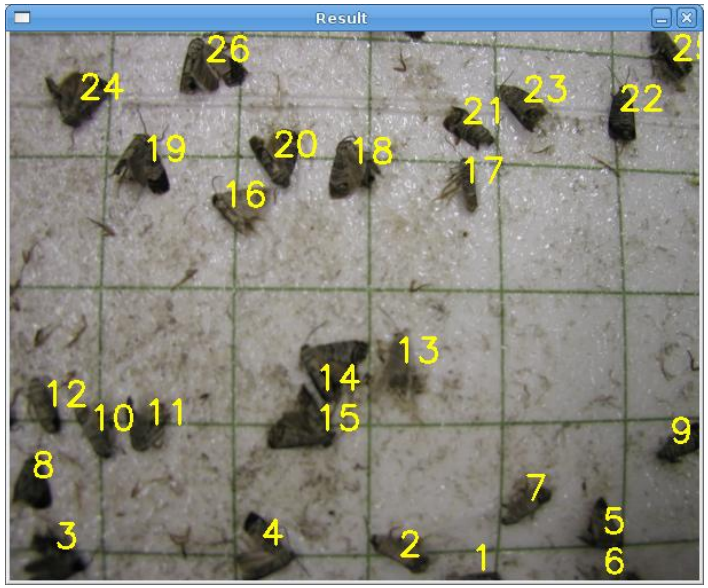
Apr-11

May-11

Apr-12

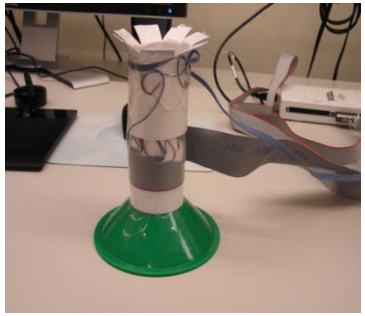
Aug 2008

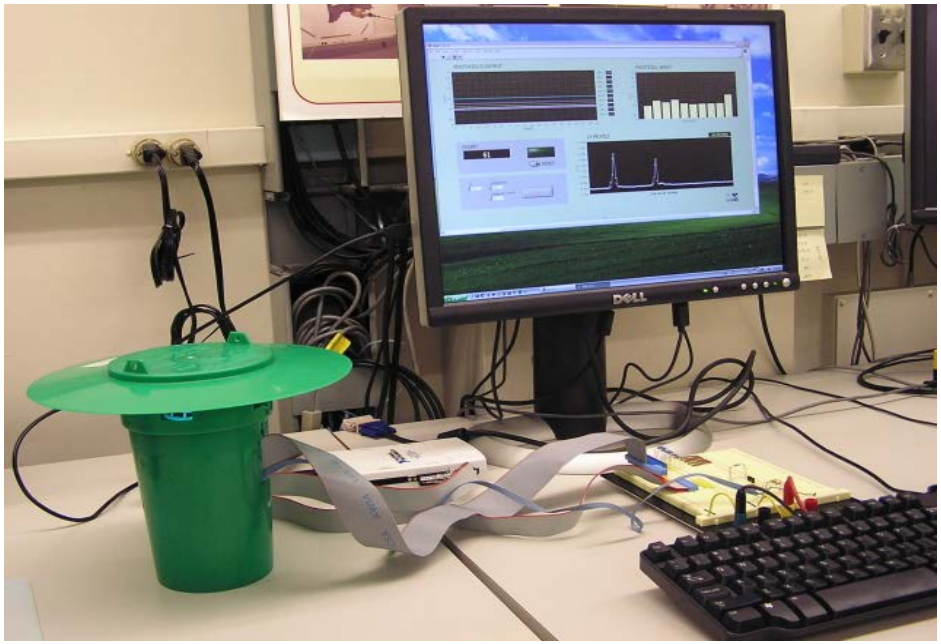




Initial concept in the SCRI proposal

Jan 2009





LED (Light Emitting Diode)

LDR (Light Dependent Resistor)

Feb 2009

Funnel with sensors

Moths

Wind tunnel experiment setup at WSU

June 2009

IR bucket traps at PSU-FREC

Feb 2010

First zapper-based trap prototype

July 2010

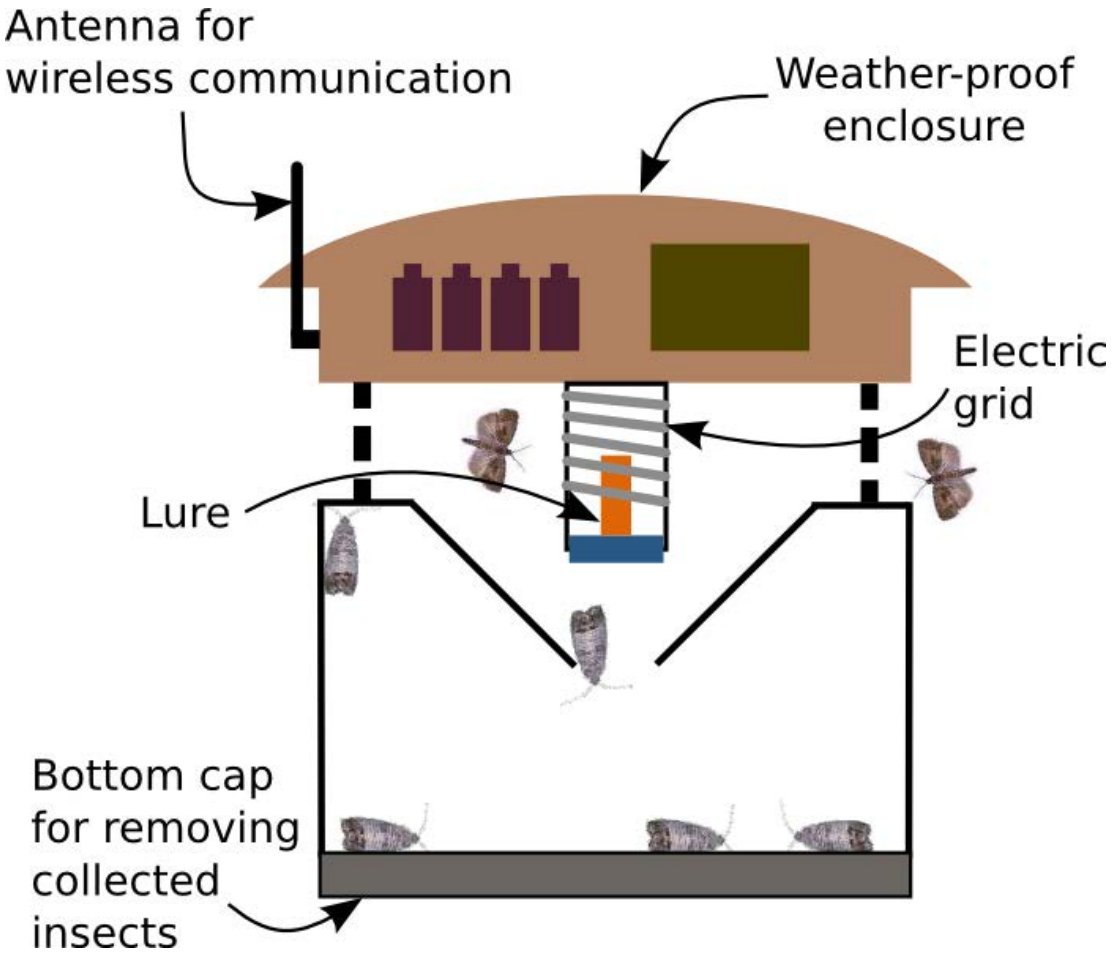



Different versions of zapper traps

June 2011

June 2012

Z-Trap Components



2011 and 2012 Field Experiments

Various versions of the Z-Traps and LPD traps were deployed at the WSU Sunrise orchard in Washington



Various versions of the Z-Traps, IR and LPD traps were deployed at the Penn State FREC



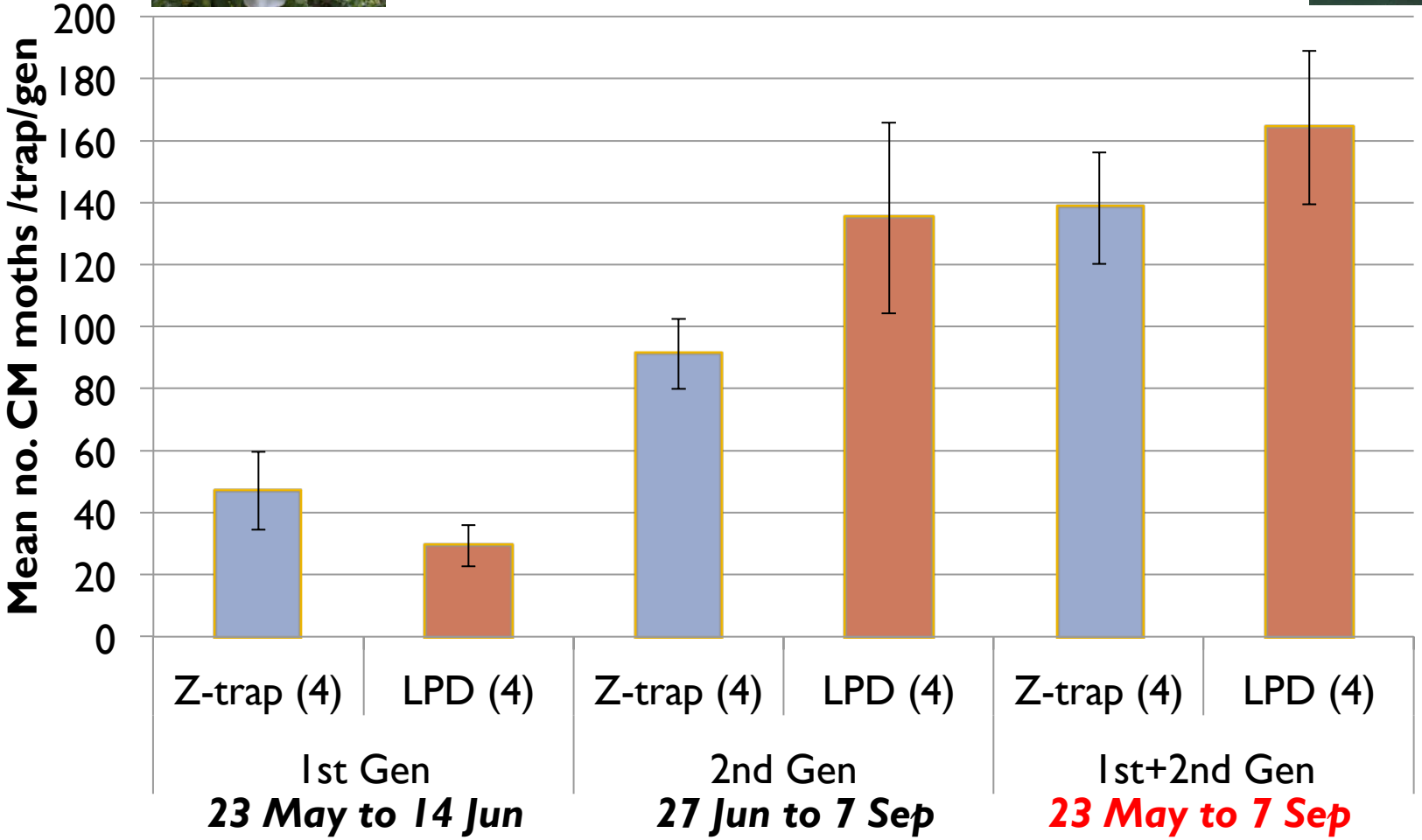
Field Tests Setup at Sunrise, WA – 2011/12

2011

Traps Rotated weekly

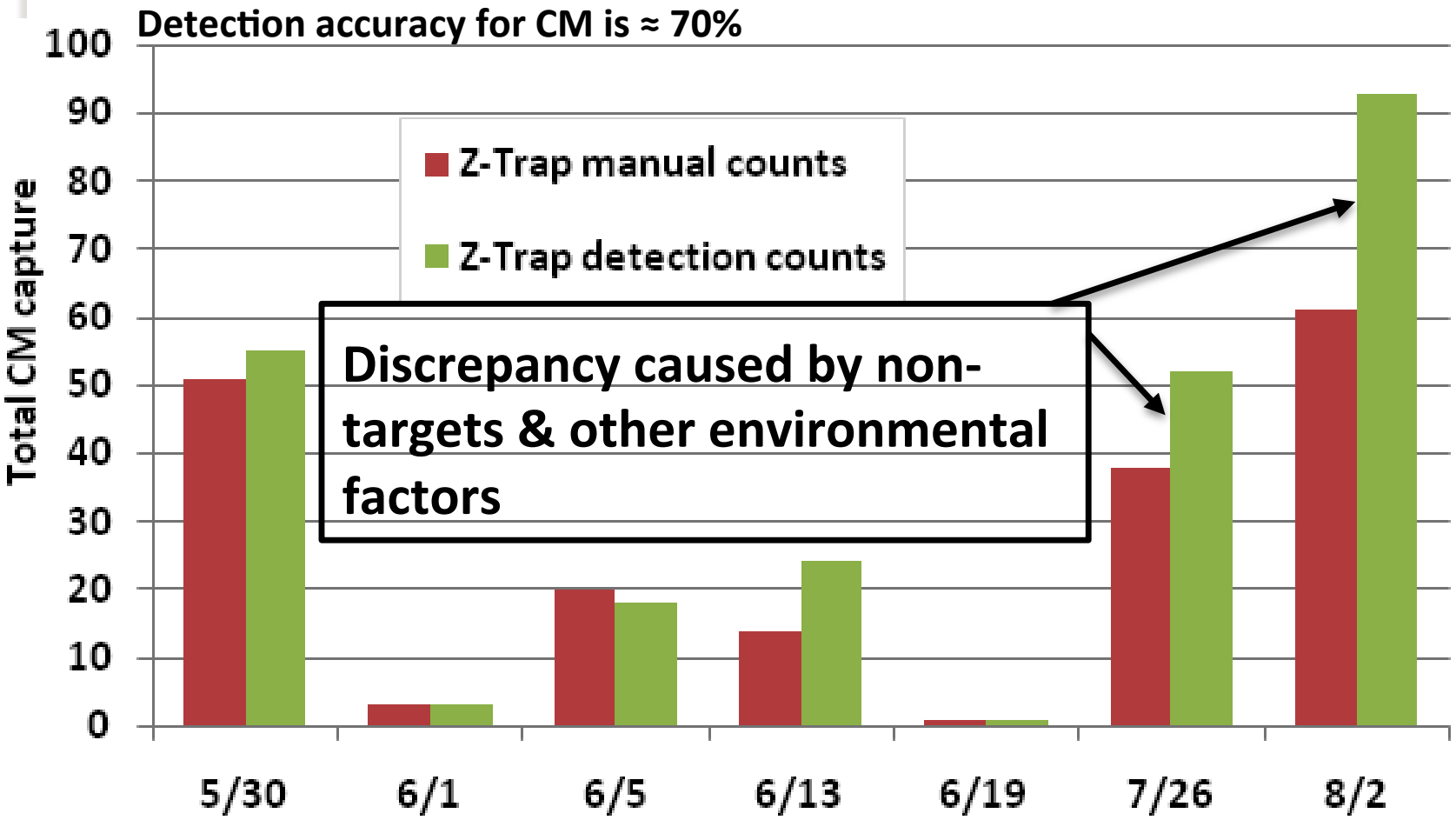
2012

Weekly capture of CM adults by Z-Traps at WSU - 2011



V. Jones (WSU) – Unpubl. data

Manual and Detection Counts of CM adults by Z-Traps at WSU - 2011



V. Jones (WSU) – Unpubl. data

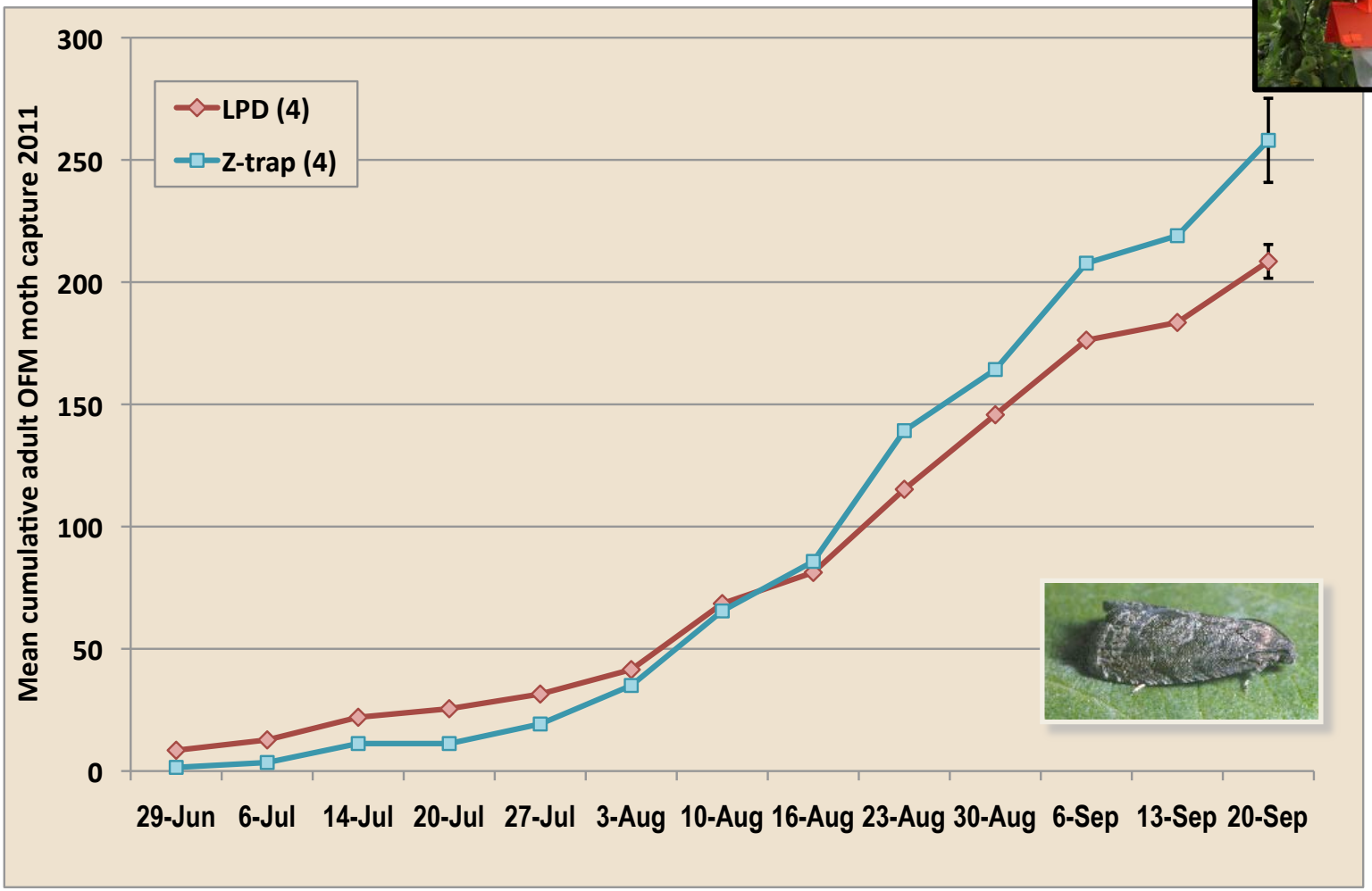
Field Tests Setup at PSU-FREC – 2011/2012

= LPD

= Z-Traps

Traps rotated weekly

Cumulative Oriental fruit moth capture in Z-Traps and LPDs at PSU-FREC -- 2011

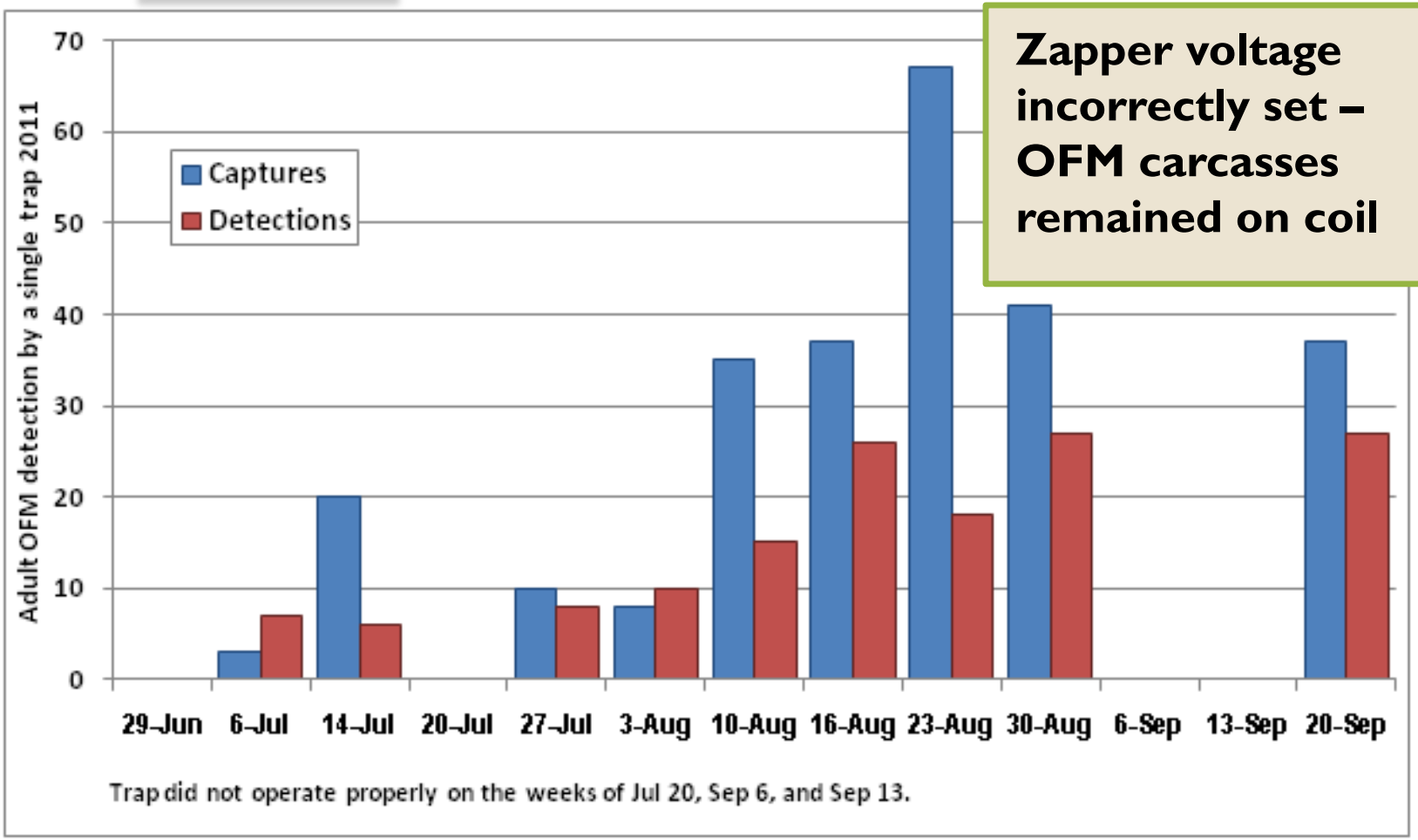


notes:
23-Aug: 2 Z-traps not working properly; data excluded
30-Aug: 1 Z-traps not working due to storm damage
1-Sep: OFM Z-traps not outside 1-Sep to 2-Sep, corresponding LPD traps were left outside.

Manual and Detection Counts for an OFM Z-Trap PSU - 2011

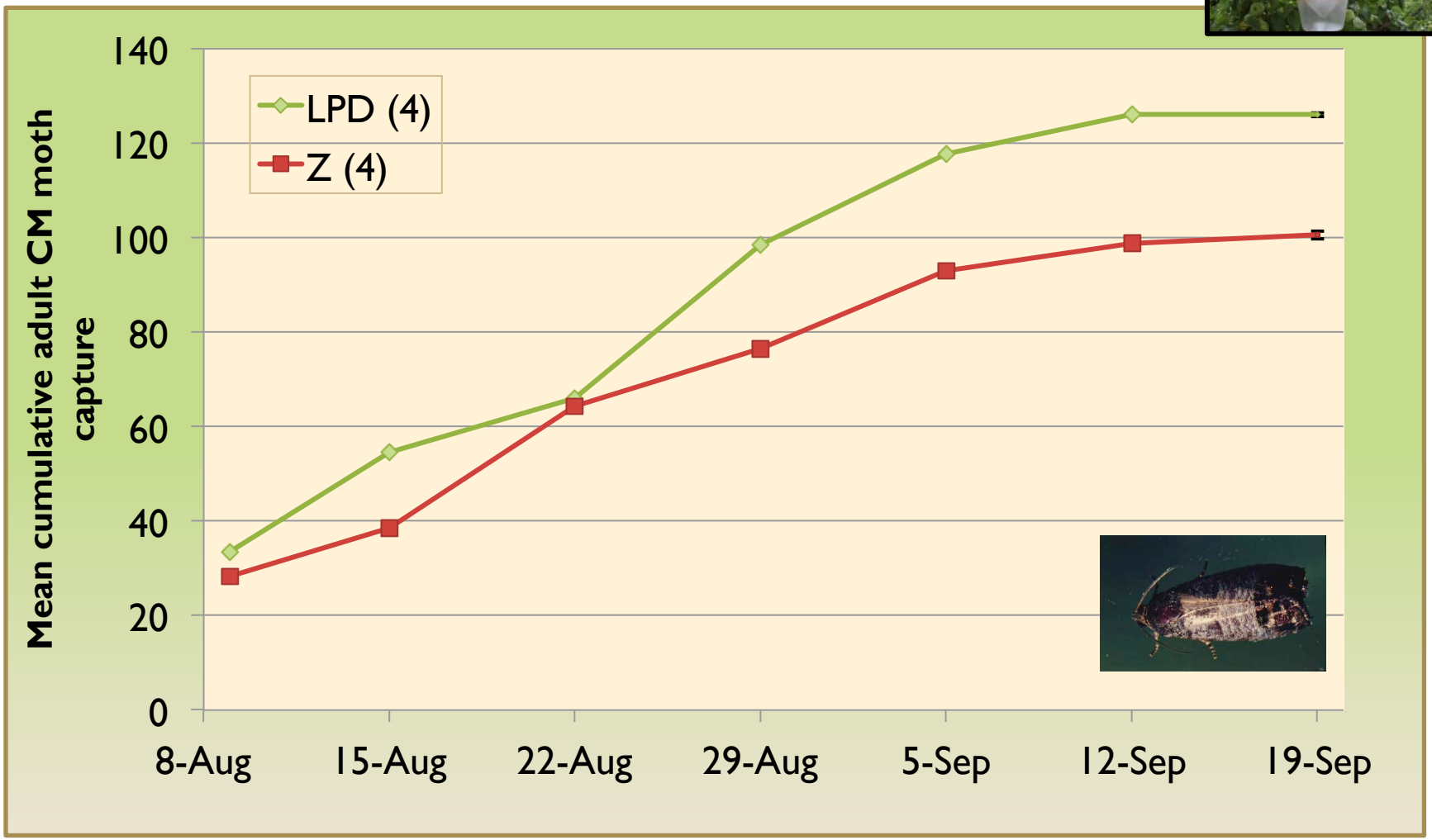
OFM

Detection error = 41%



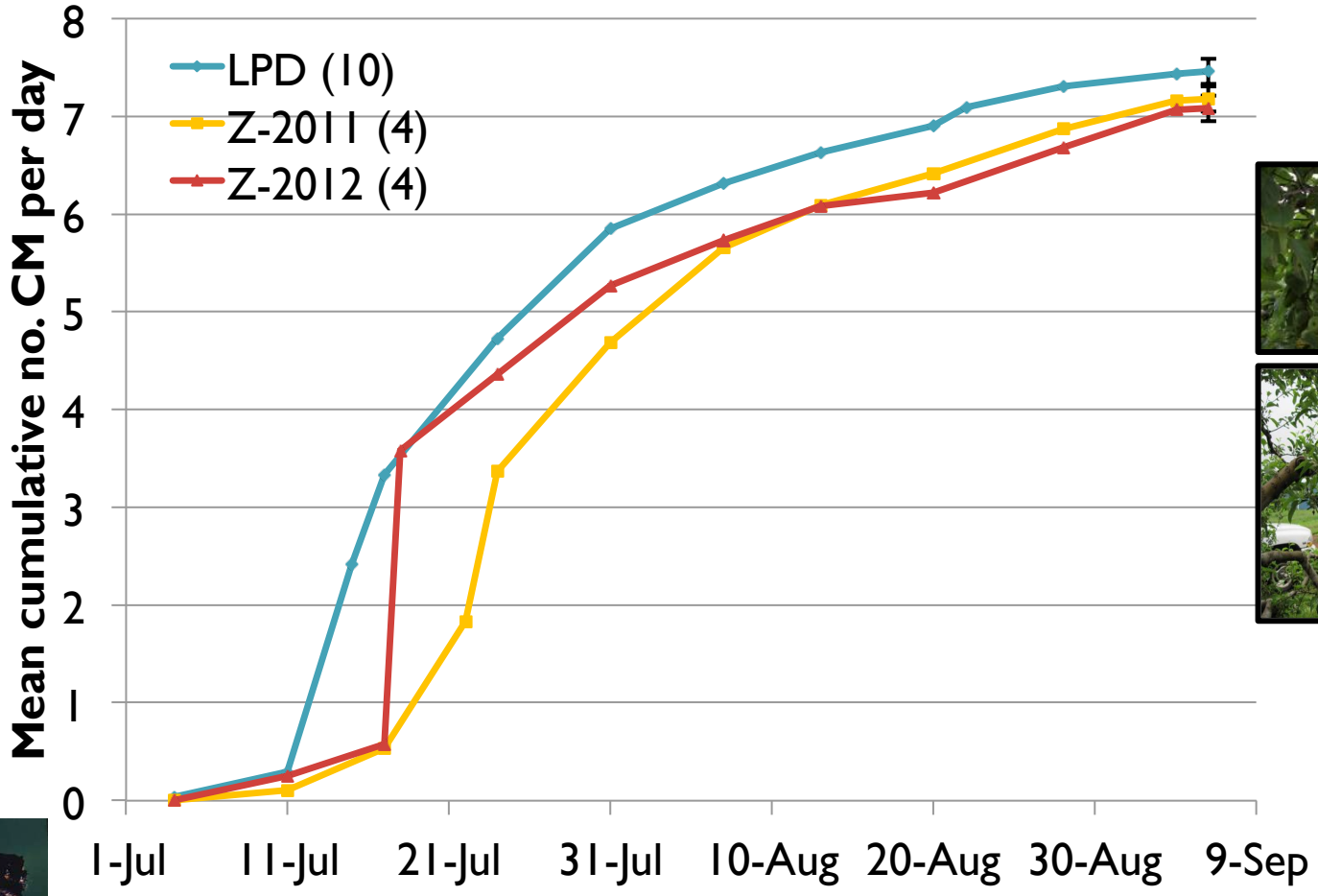
Zapper voltage incorrectly set – OFM carcasses remained on coil

Cumulative codling moth adult capture in LPD and Z-Traps at PSU-FREC -- 2011.



30-Aug: only 3 Z-traps due to storm damage
No data 6-Sep (9am) to 9-Sep (9am) due to stormy weather

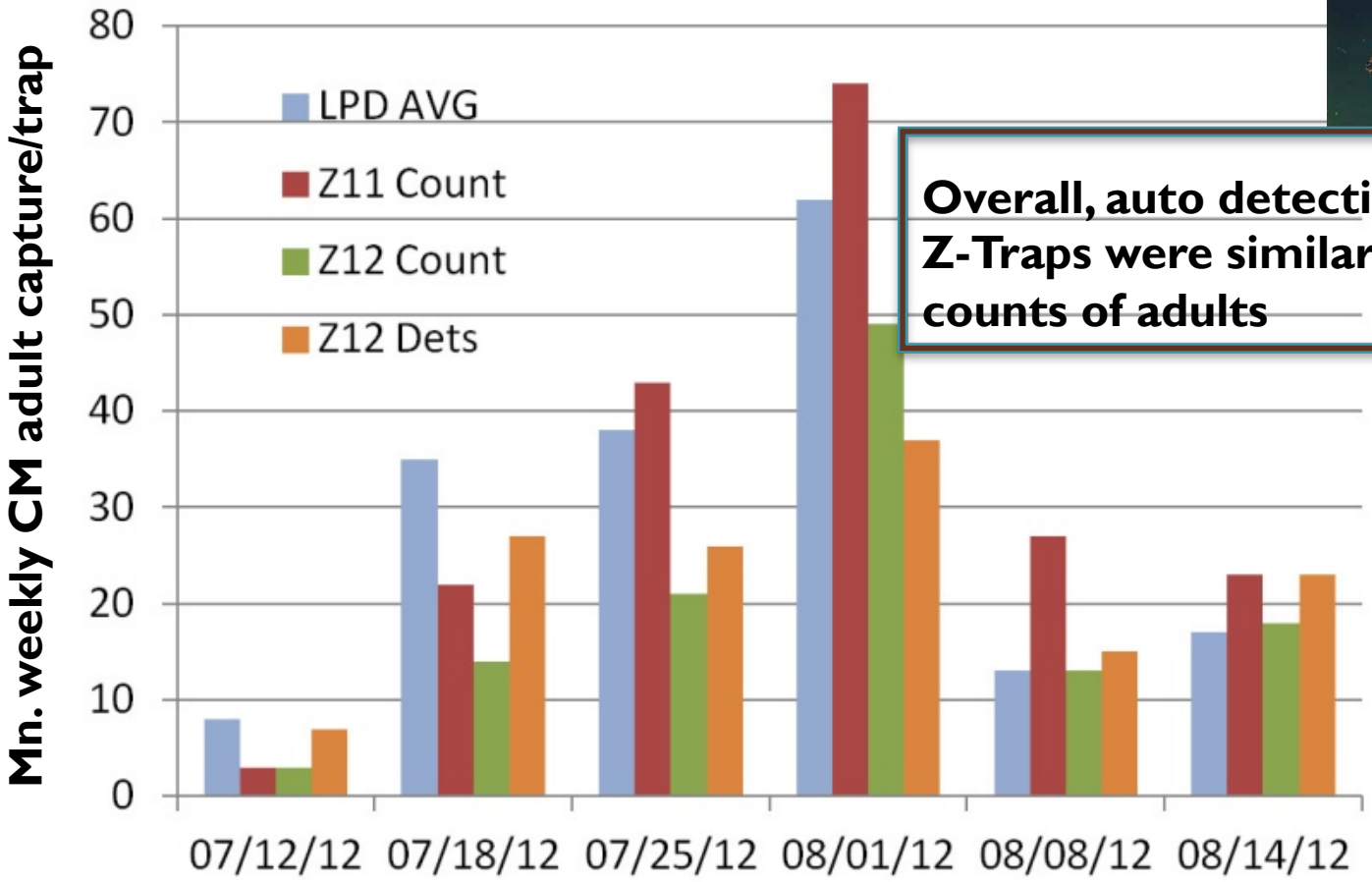
Cumulative capture of CM in LPD, 2011 Z-Traps (Z11), and 2012 Z-Traps (Z12) at WSU in 2012.



2nd Generation flight

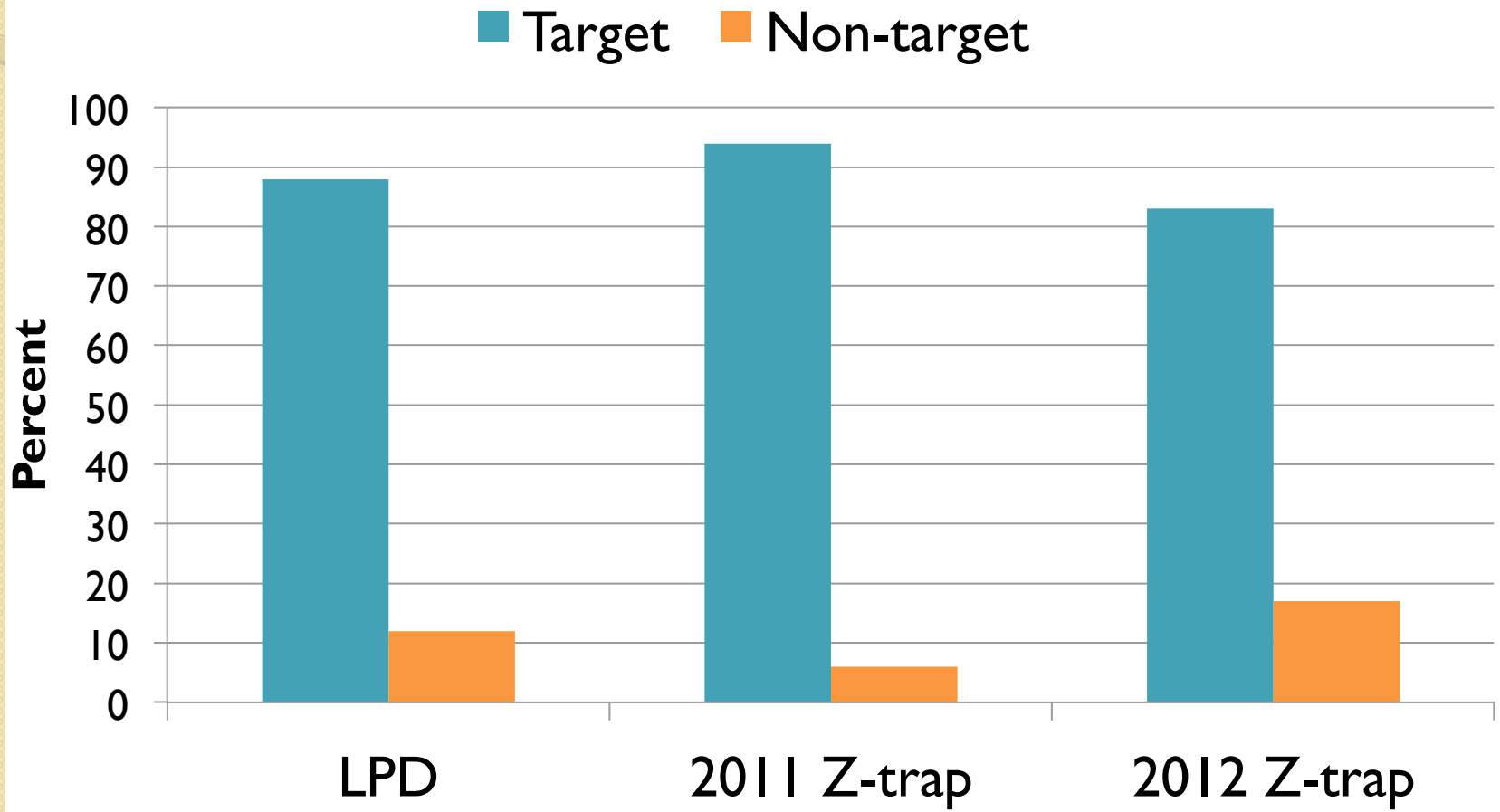
5 Jul to 7 Sep

Weekly manual capture of CM adults by LPD and Z-Traps vs auto-detections at WSU in 2012.

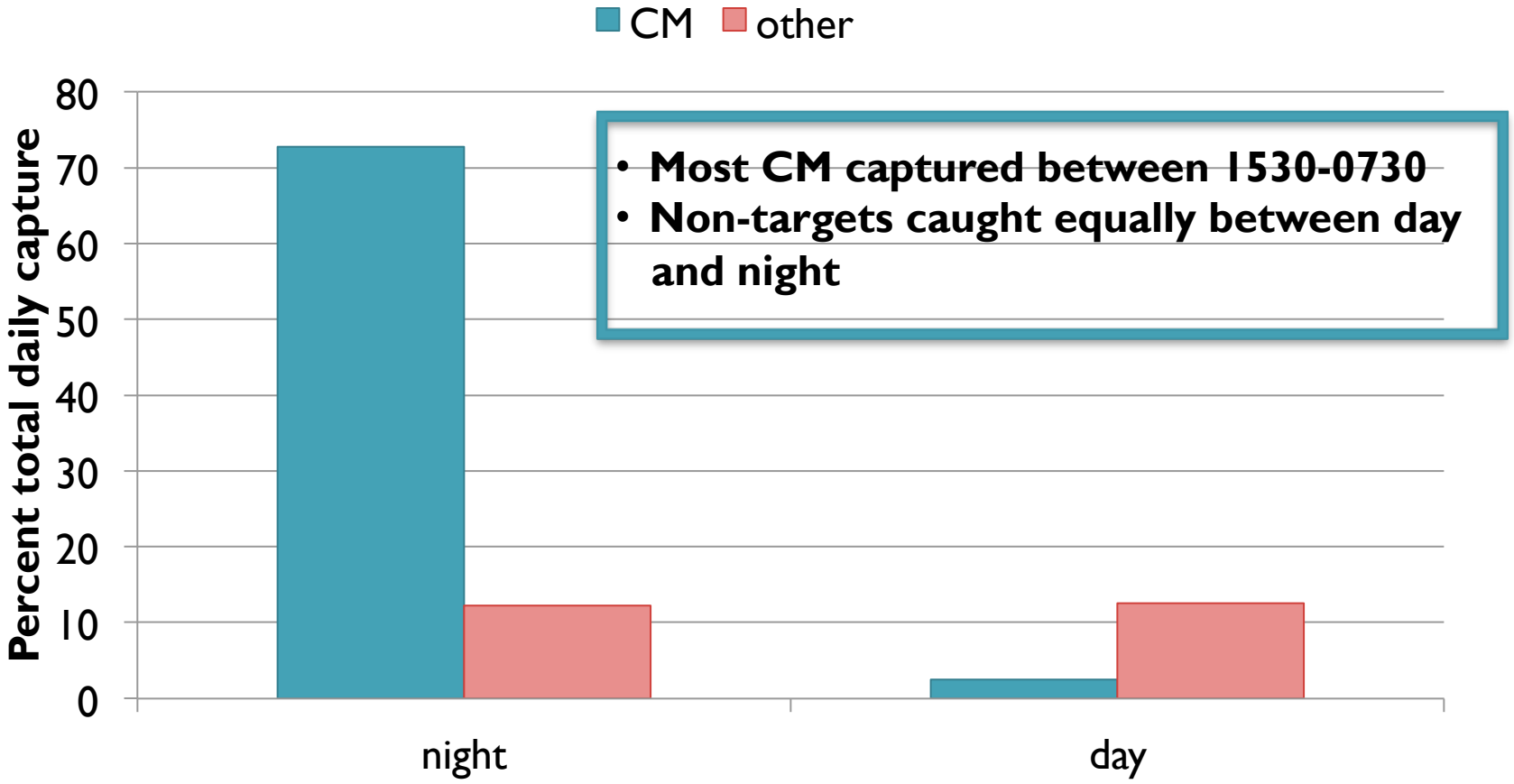


Overall, auto detections by Z-Traps were similar to manual counts of adults

Percent of CM vs. non-target capture, WSU 2012



Proportion of CM and non-target captures during the day vs. night – PSU 2012



Note: Approximate sampling periods for NIGHT were from 1530 to 0730 and DAY were from 0730 to 1530.

Includes all Z-Trap and LPD trap data

Commercialization

Spensa Technologies Inc was founded in 2009

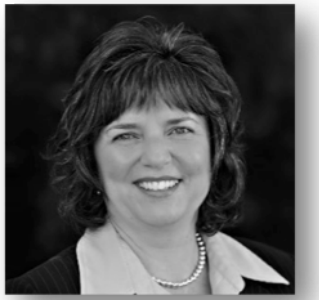
The Team

Johnny Park

Henry Medeiros

Tom Puterbaugh

Ben Brame



Kim Nicholson

Ed Lee

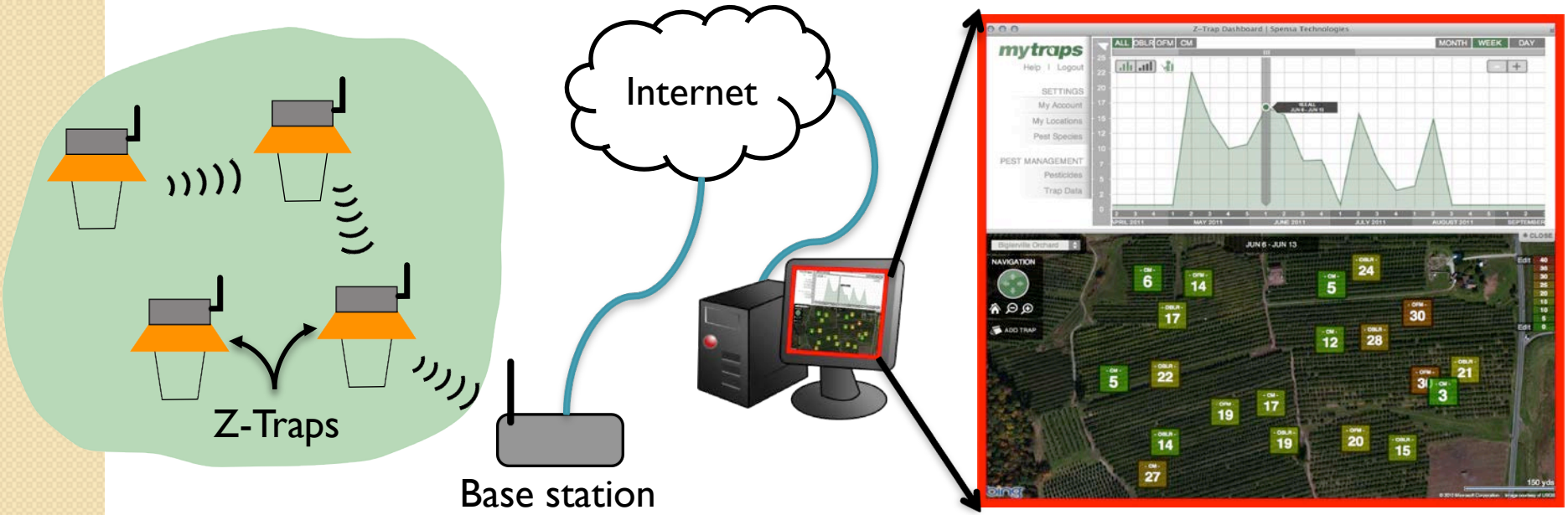
Lisa Park

Anderson Nascimento

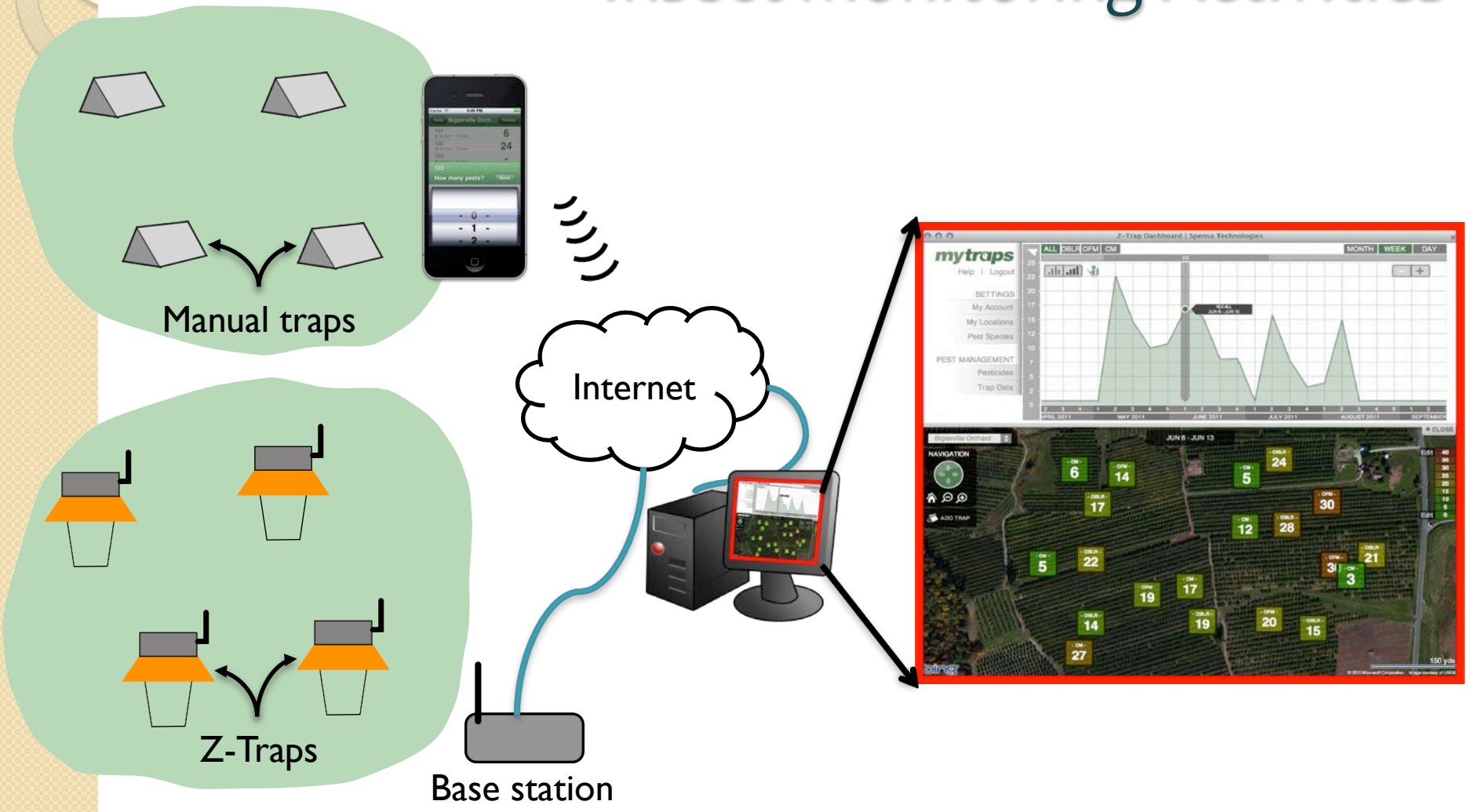
German Holguin

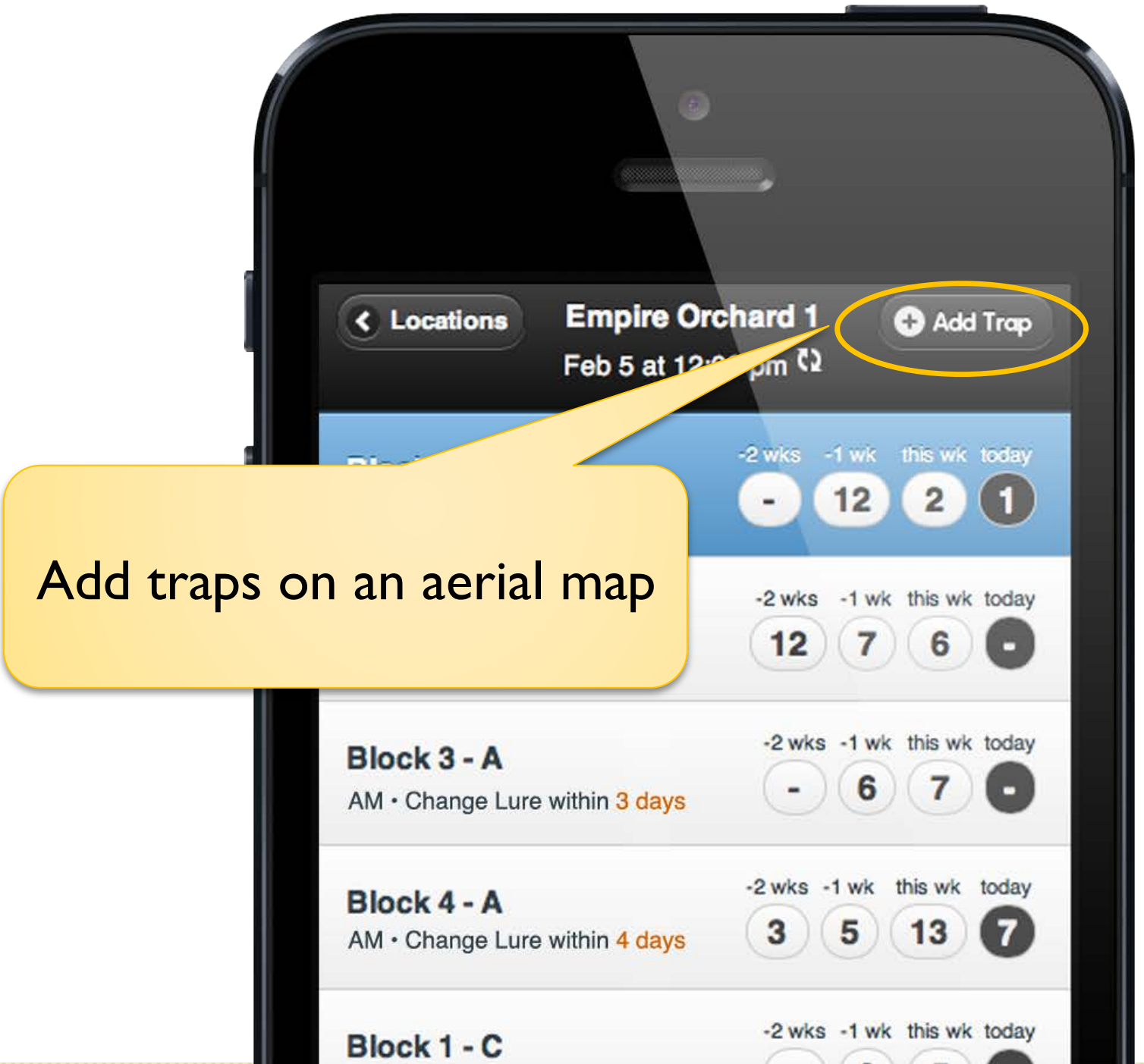
Z-Trap Prototype Starter Kit for 2013 Pilot Tests

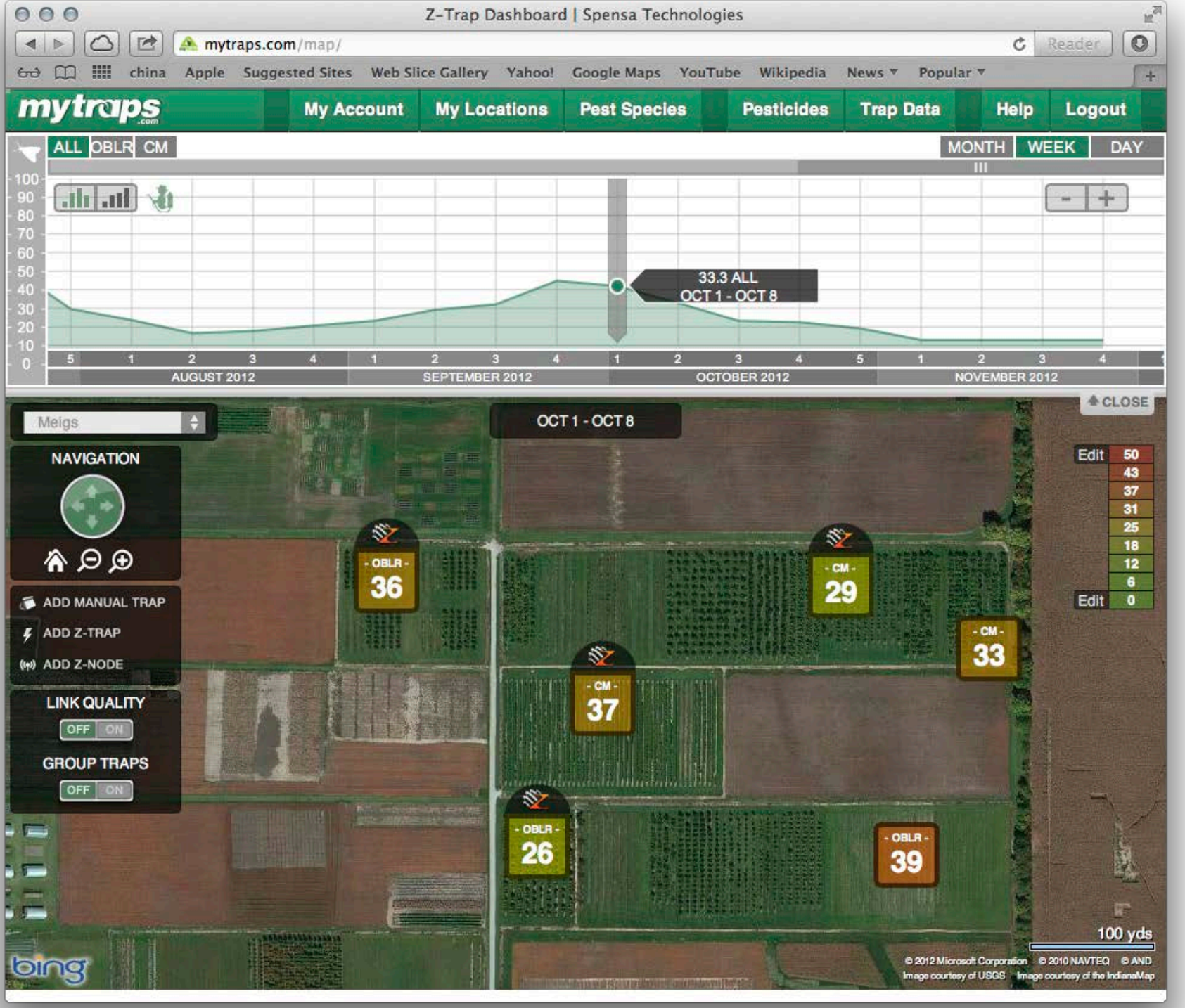
Visualization Tool for Insect Population Data Collected by Z-Traps



Visualization and Management Tool for Insect Monitoring Activities




Add traps on an aerial map
Locations
Empire Orchard 1
Feb 5 at 12:
pm
Add Trap
-2 wks -1 wk this wk today
- 12 2 1
-2 wks -1 wk this wk today
12 7 6 -
Block 3 - A
AM • Change Lure within 3 days
-2 wks -1 wk this wk today
- 6 7 -
Block 4 - A
AM • Change Lure within 4 days
-2 wks -1 wk this wk today
3 5 13 7
Block 1 - C
-2 wks -1 wk this wk today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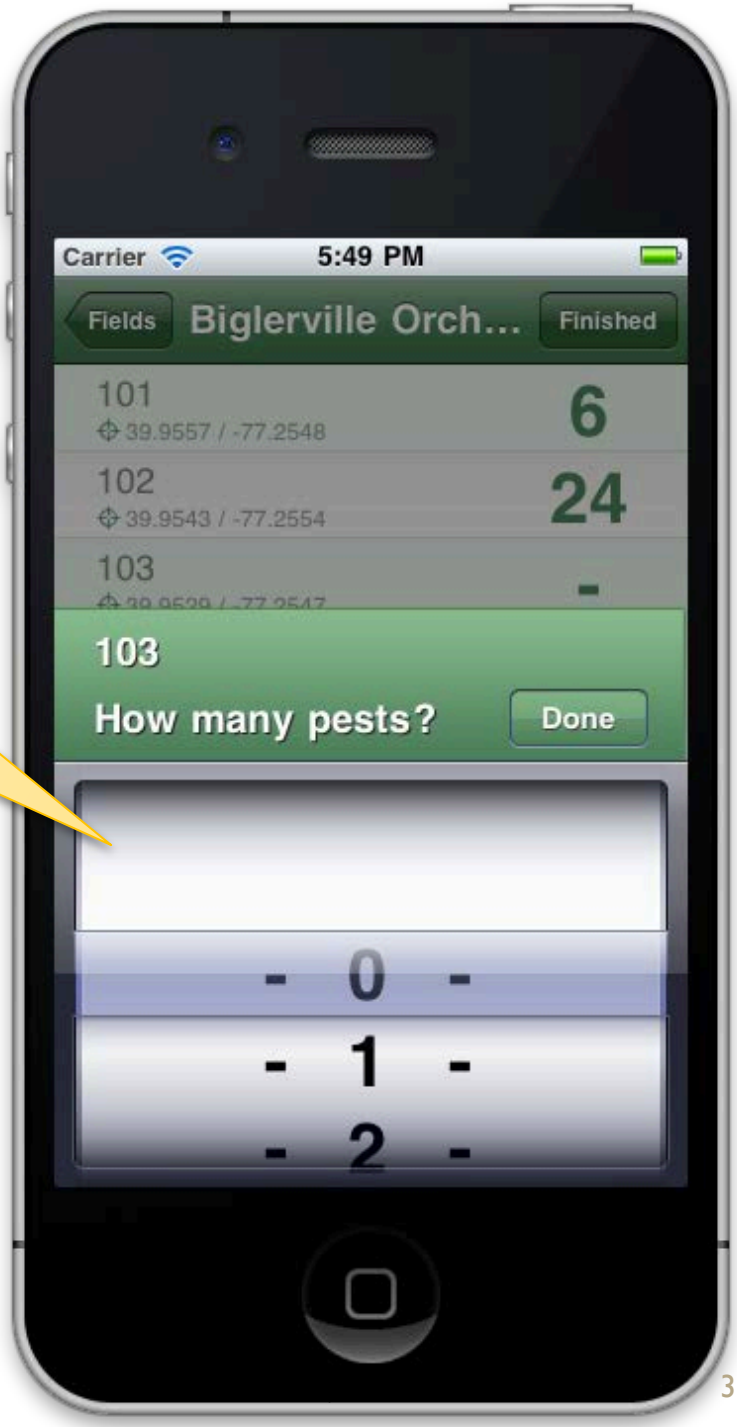
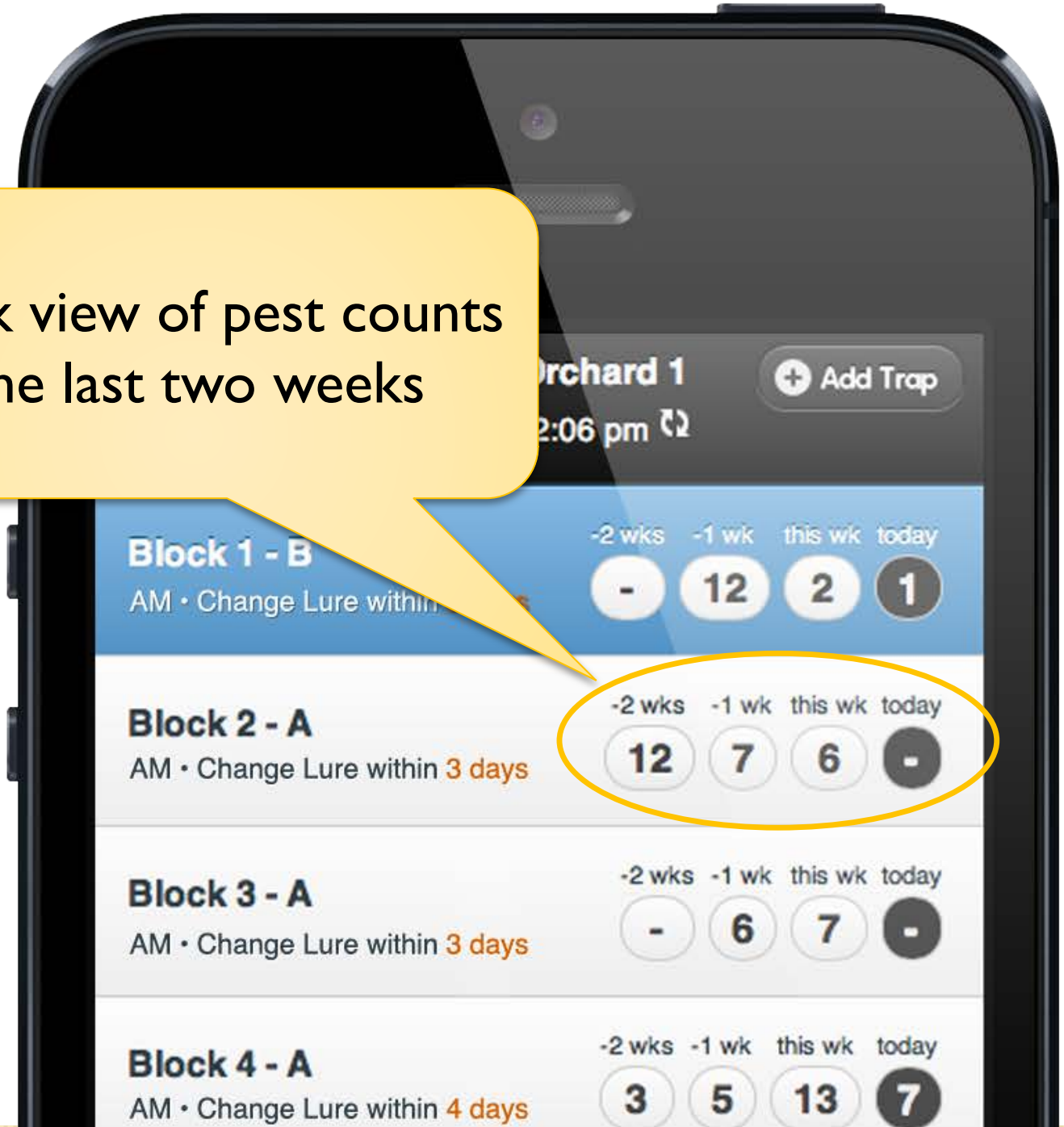
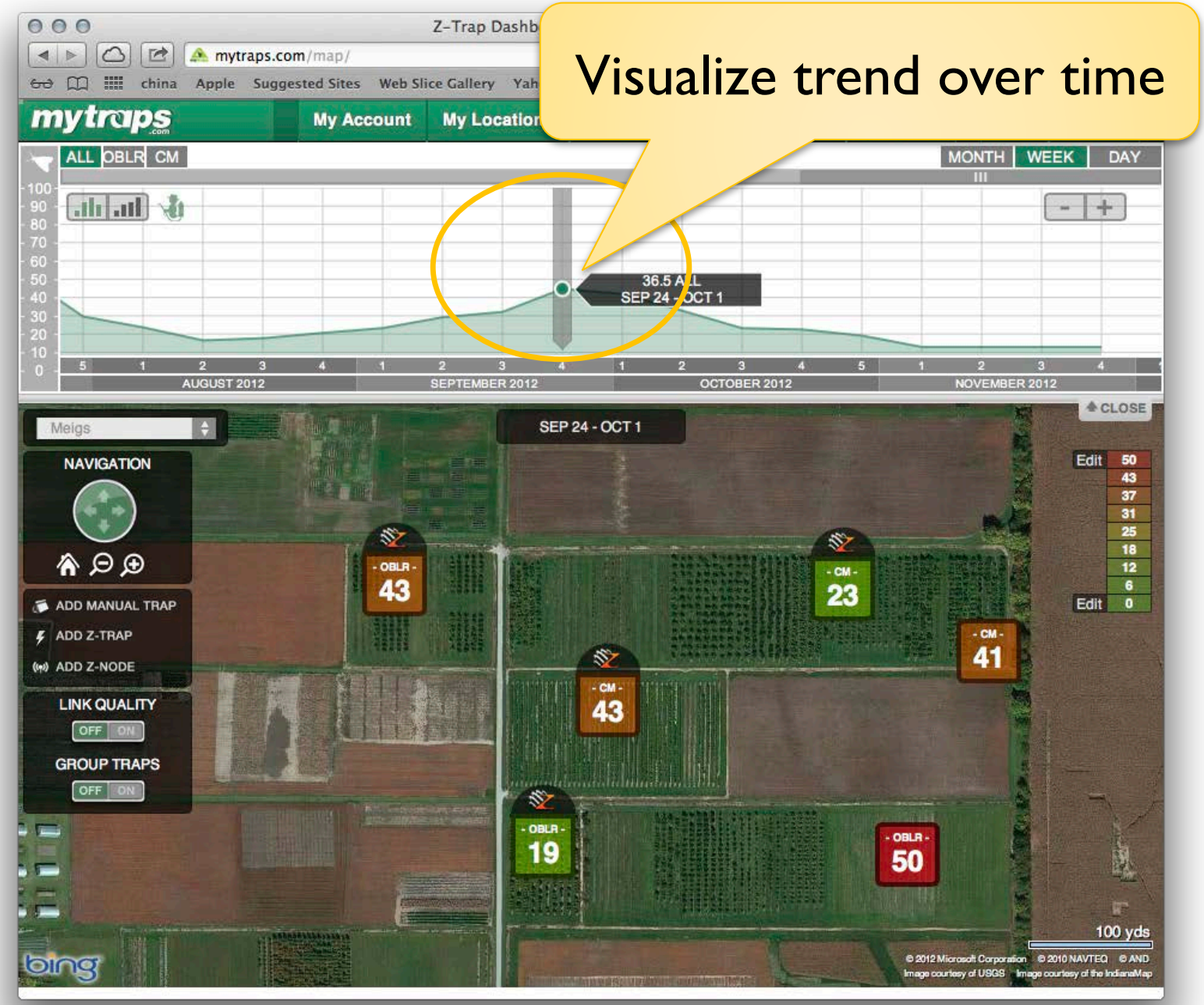
Easily enter trap data in the field



A quick view of pest counts in the last two weeks




Visualize trend over time
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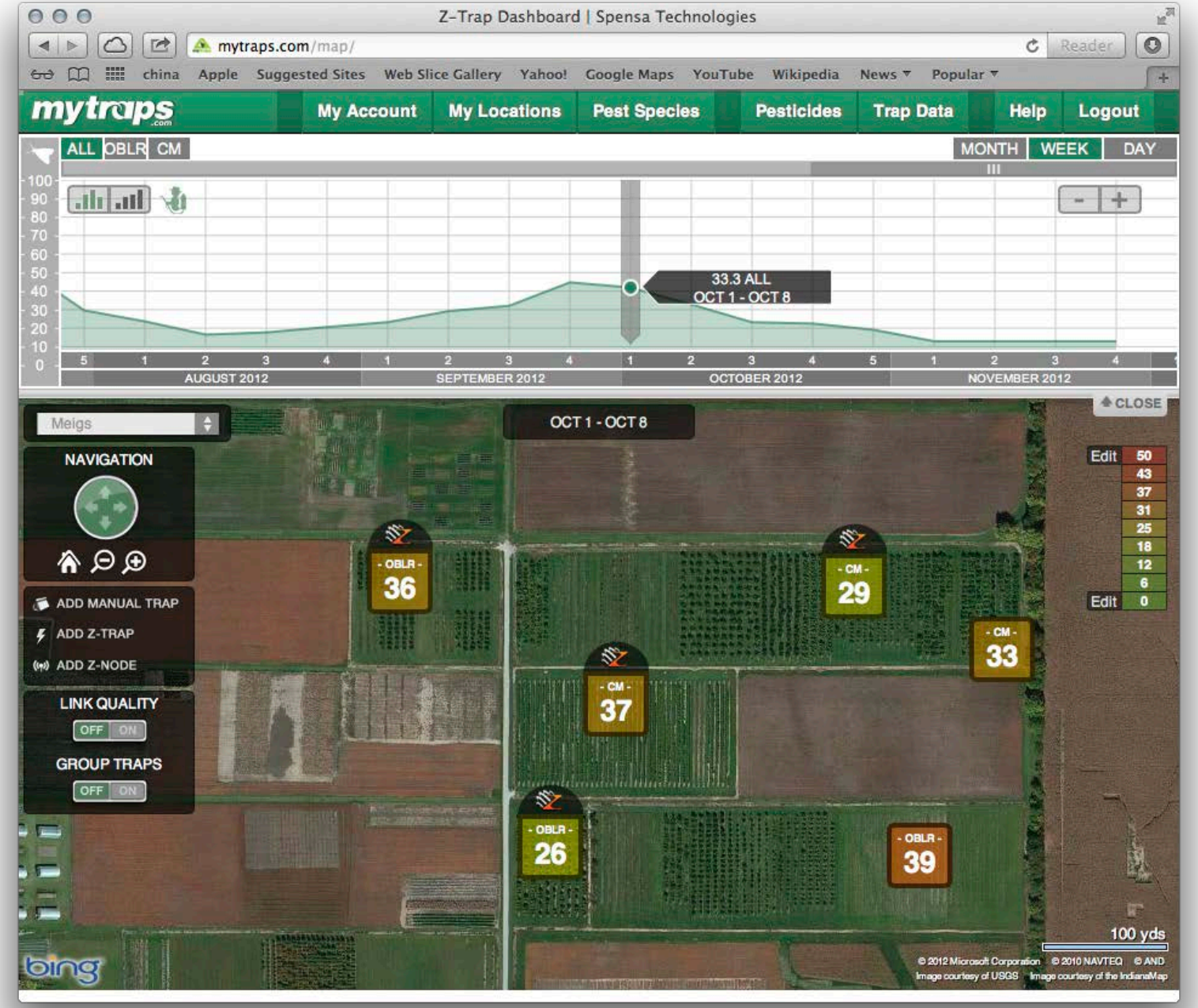
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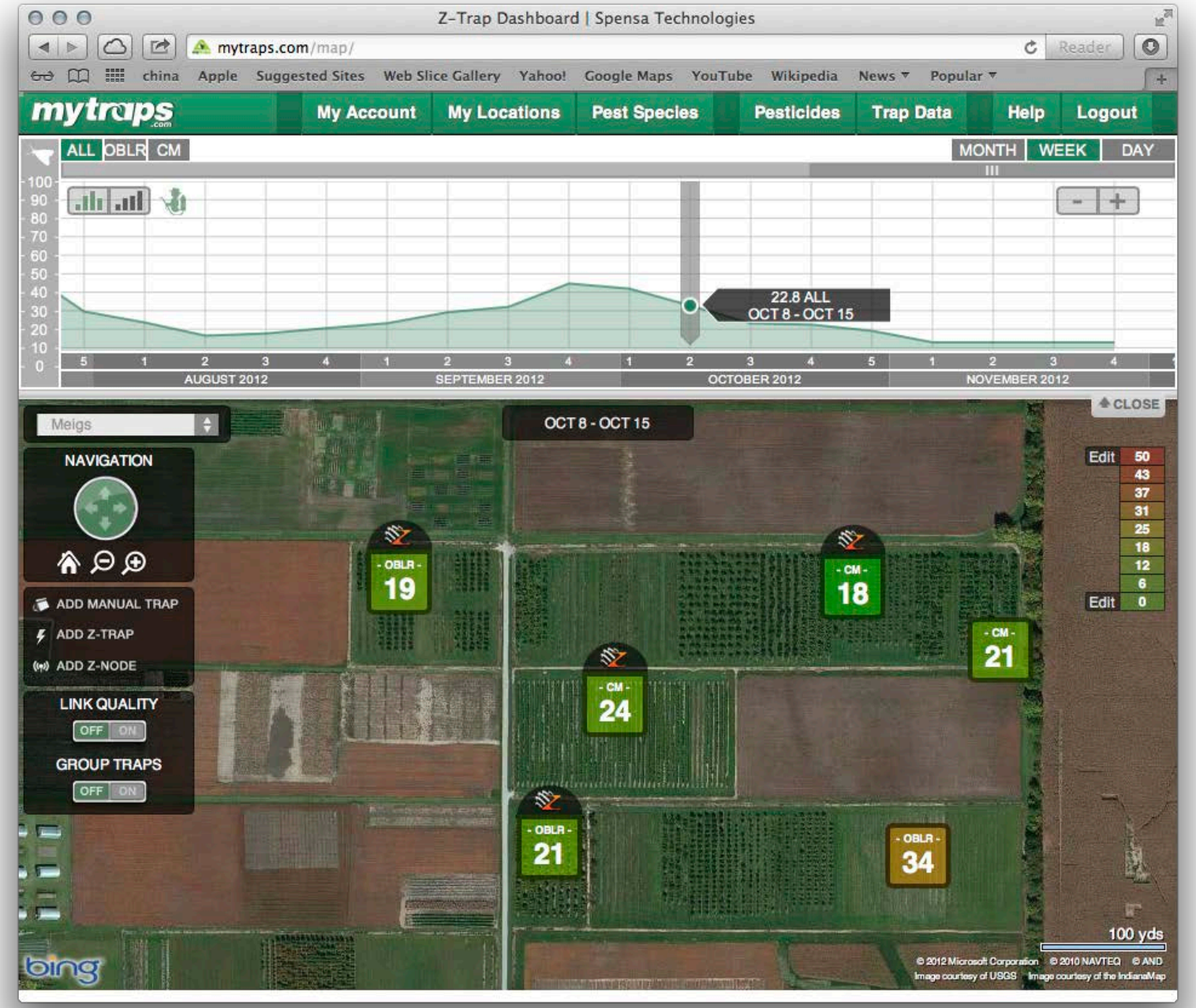
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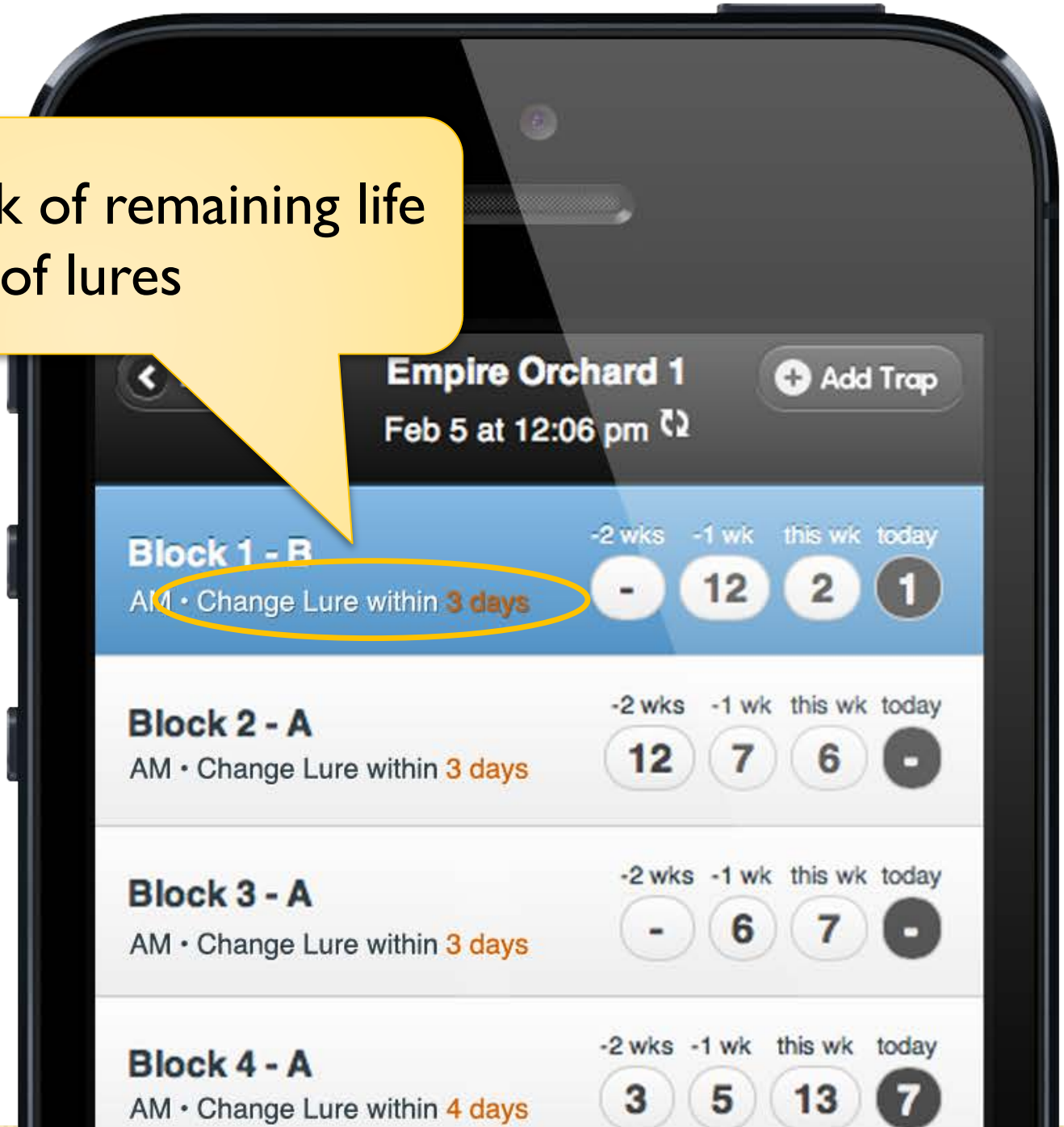
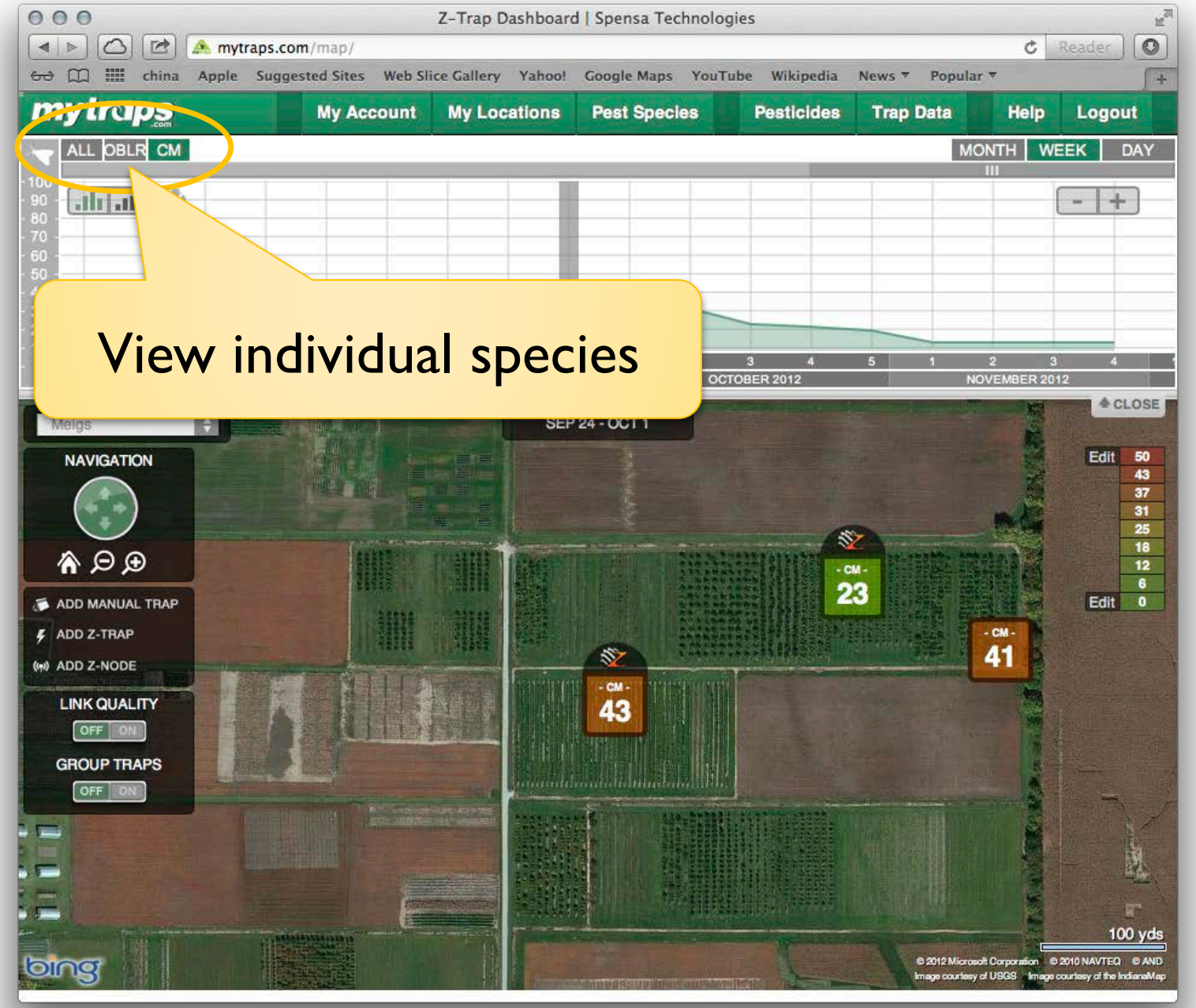
Keep track of remaining life of lures

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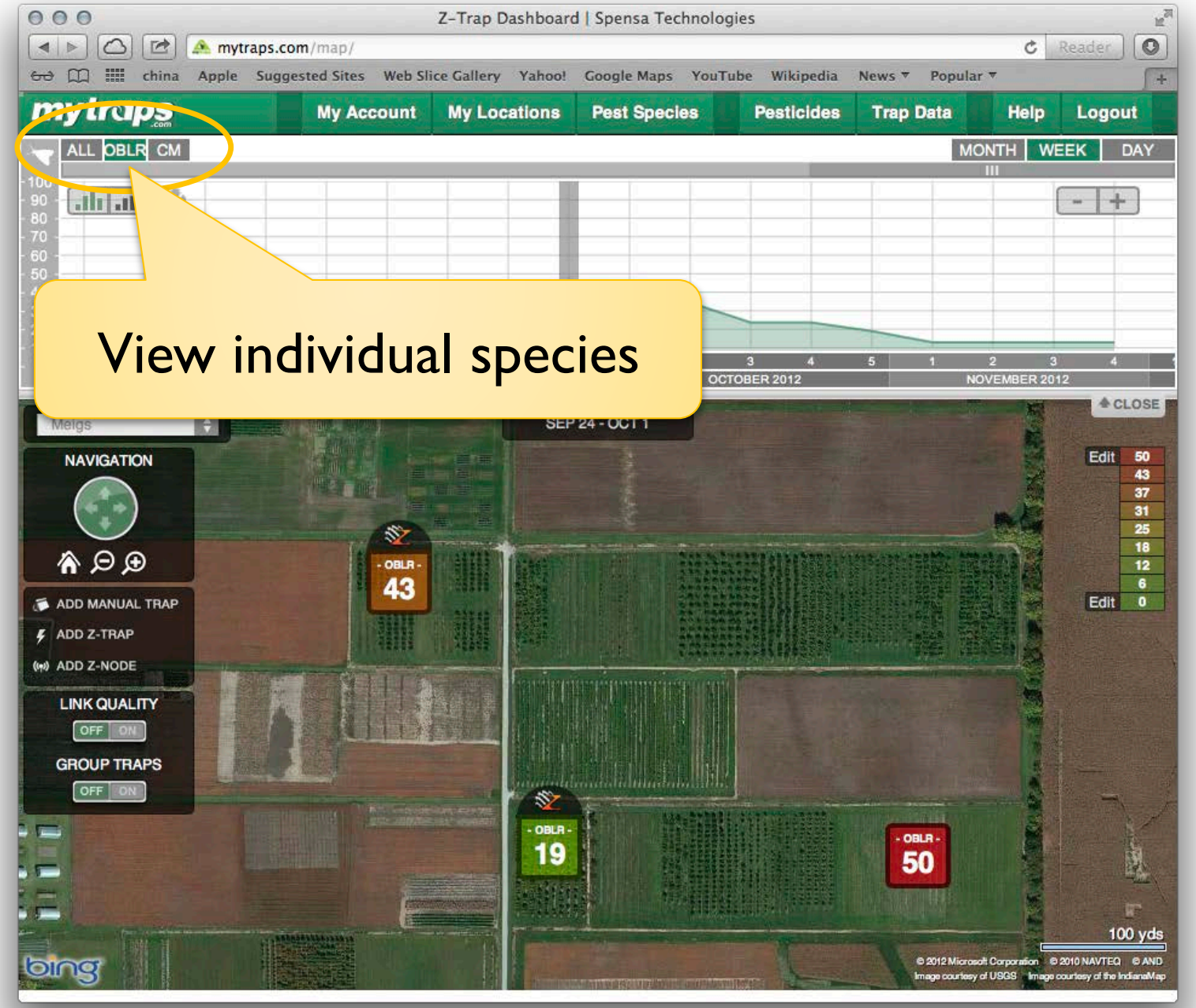
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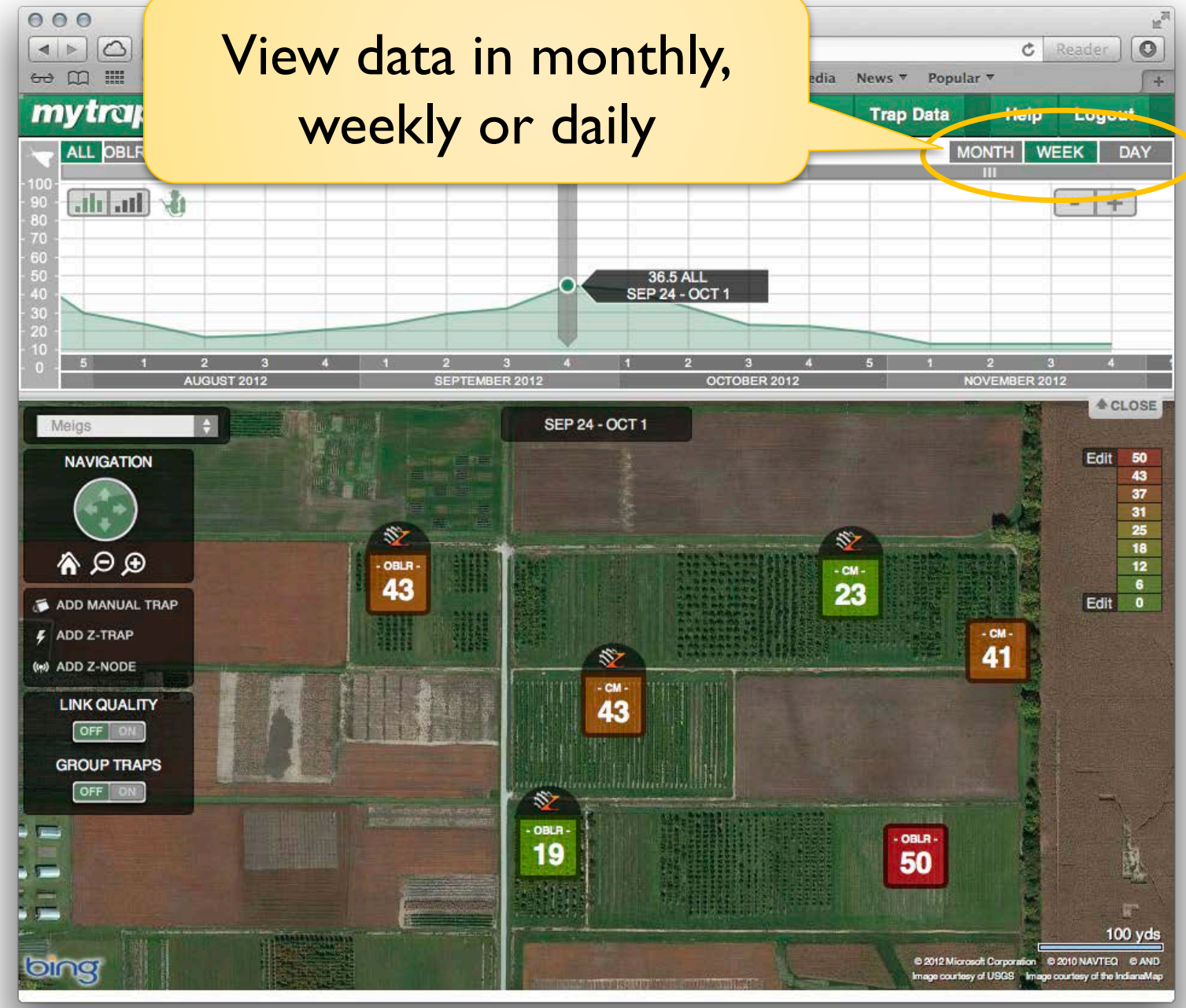
View data in monthly, weekly or daily
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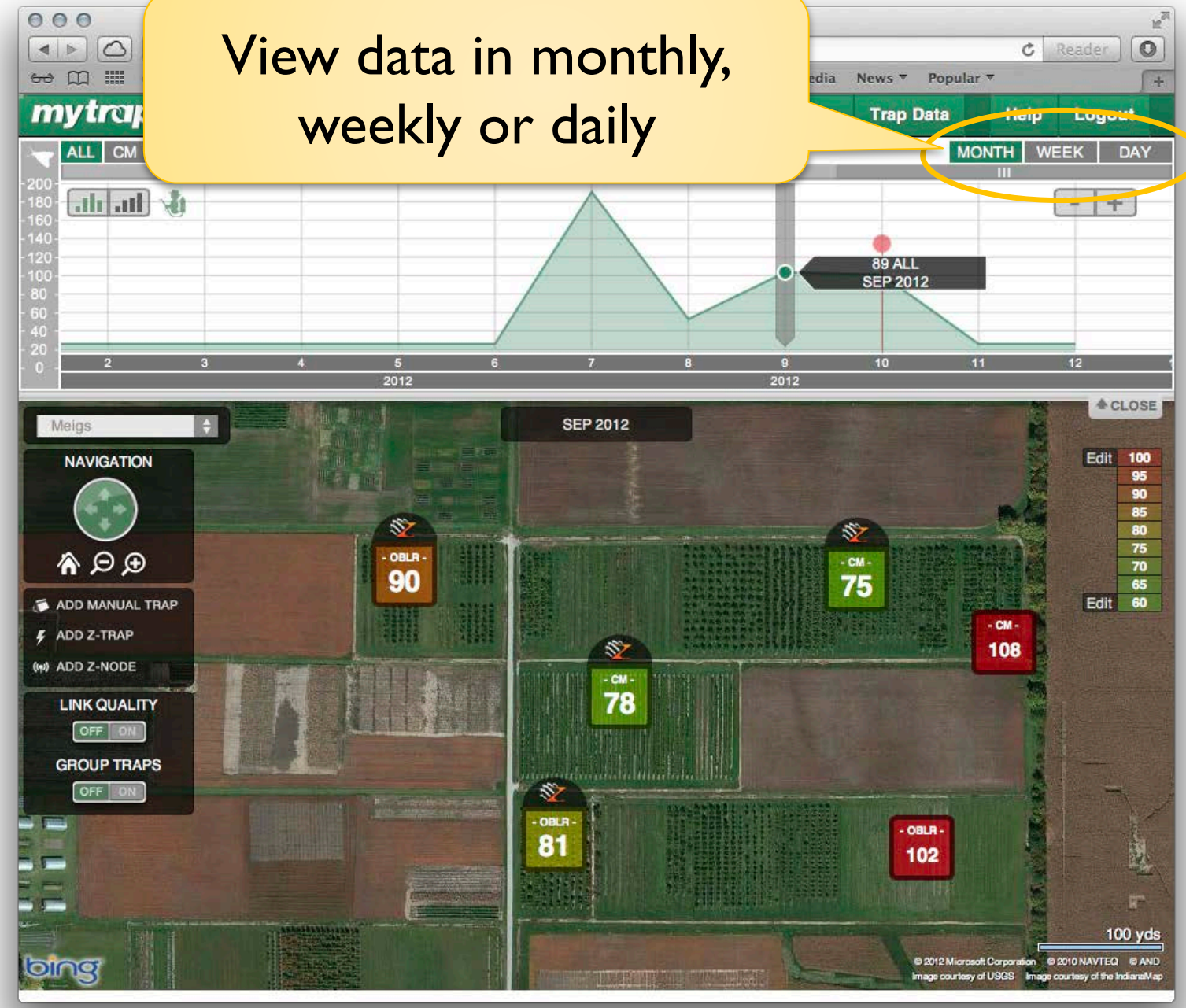
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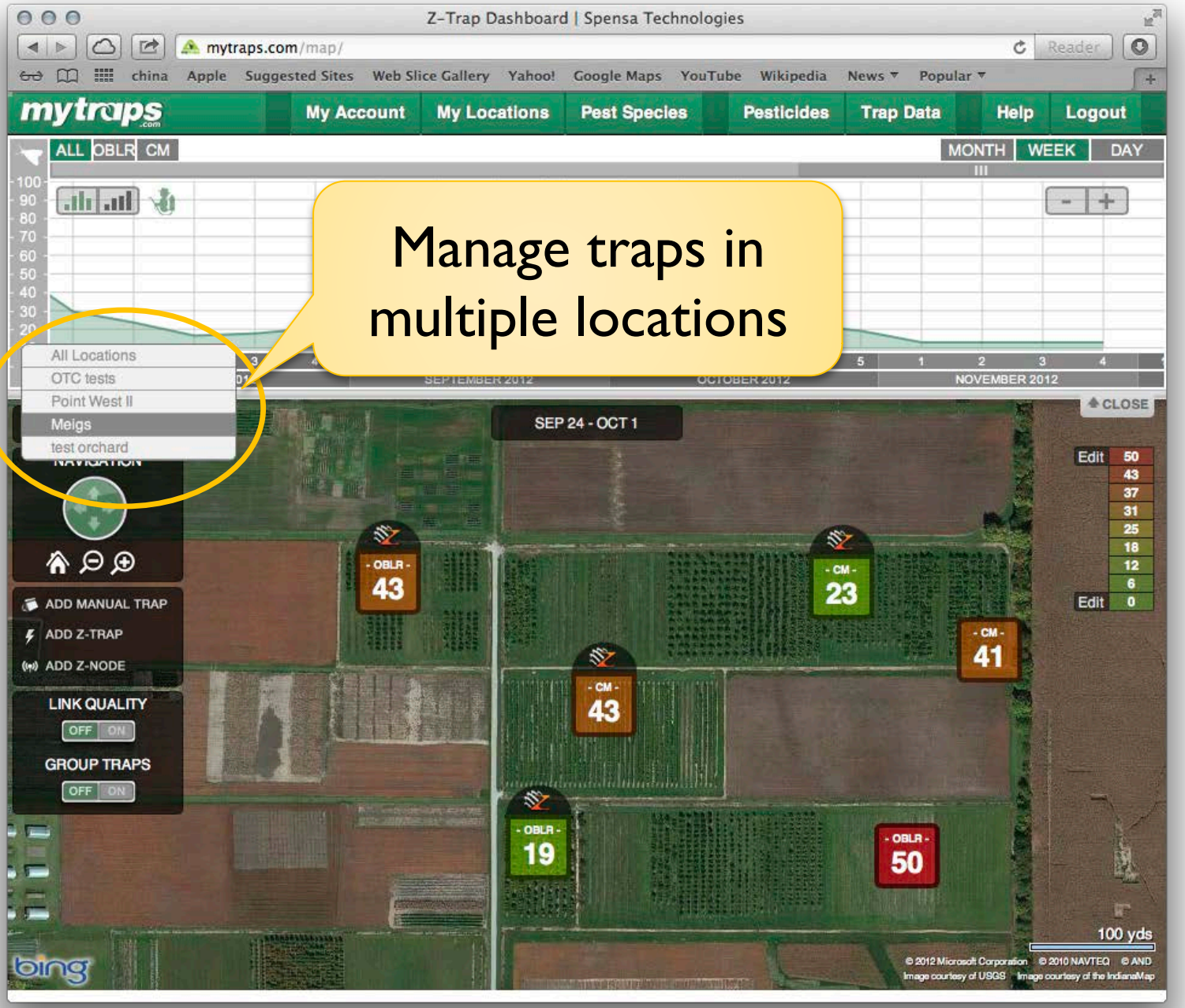
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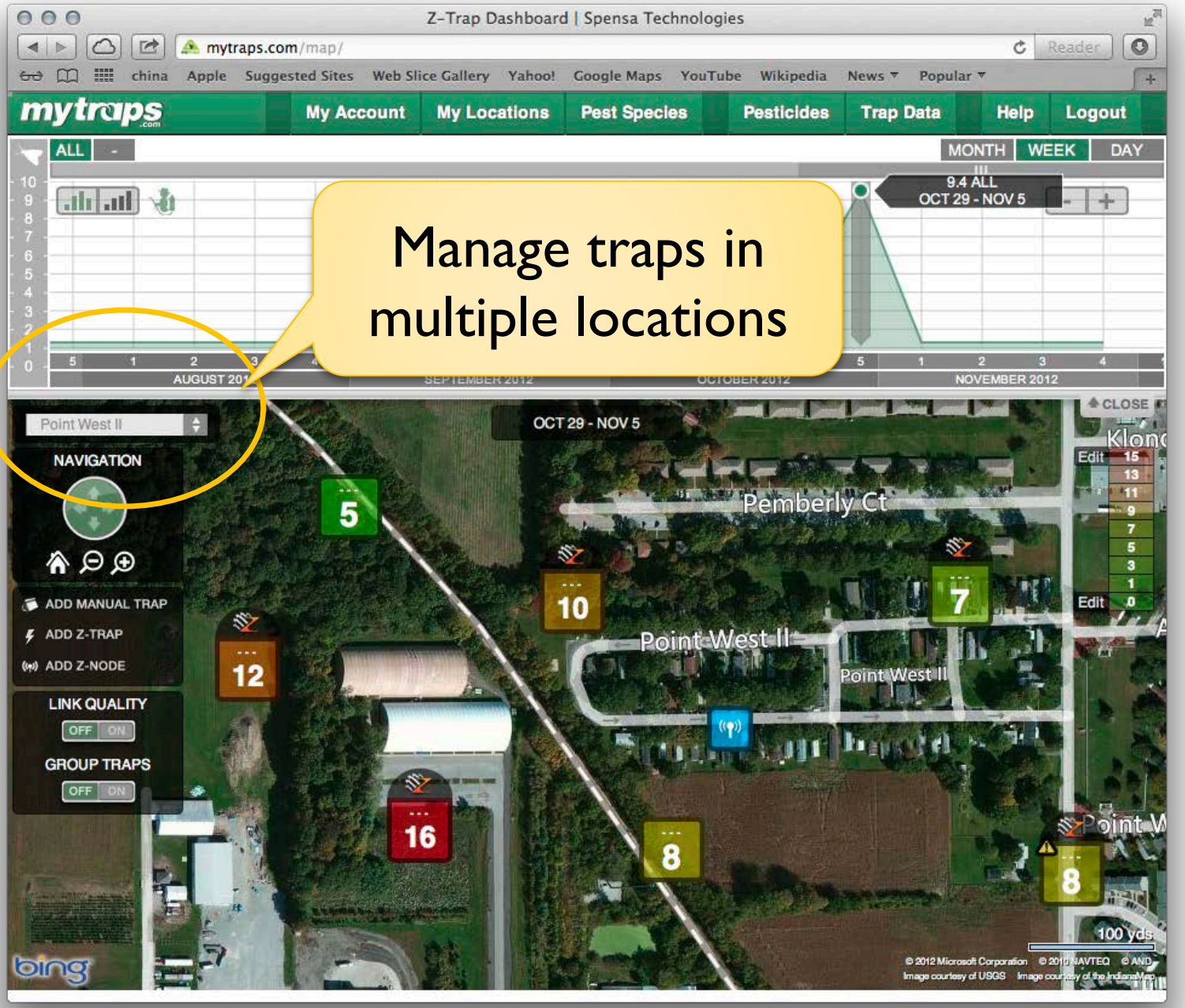
Trap Data
Help
Logout
ALL
OBLR
CM
MONTH
WEEK
DAY
All Locations
OTC tests
Point West II
Meigs
test orchard
Manage traps in multiple locations
SEP 24 - OCT 1
CLOSE
ADD MANUAL TRAP
ADD Z-TRAP
ADD Z-NODE
LINK QUALITY
OFF ON
GROUP TRAPS
OFF ON
- OBLR - 43
- CM - 23
- CM - 41
- CM - 43
- OBLR - 19
- OBLR - 50
Edit
50
43
37
31
25
18
12
6
Edit
0
100 yds
bing


Z-Trap Dashboard | Spensa Technologies
mytraps.com/map/
mytraps
My Account
My Locations
Pest Species
Pesticides
Trap Data
Help
Logout
MONTH
WEEK
DAY
9.4 ALL
OCT 29 - NOV 5
AUGUST 2012
SEPTEMBER 2012
OCTOBER 2012
NOVEMBER 2012
Manage traps in multiple locations
Point West II
NAVIGATION
ADD MANUAL TRAP
ADD Z-TRAP
ADD Z-NODE
LINK QUALITY
OFF ON
GROUP TRAPS
OFF ON
OCT 29 - NOV 5
Pemberly Ct
Point West II
Point West II
CLOSE
Edit
Edit
100 yds
bing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3 Easily spot trends
4 Integrate pesticide records
February 19 - February 25 2012
Location Field
PSU-FREC Block A
APPLICATION
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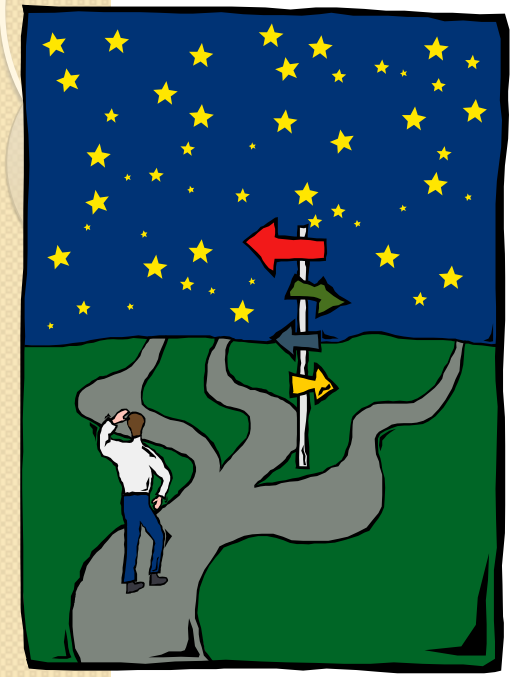
http://mytraps.com

Conclusions

Z-Traps will:

- Provide an accurate and reliable way to monitor pest populations in orchards on an hourly, daily and weekly basis
- Save growers/consultants hours of valuable time and expense driving to and manually checking traps
- Have the capability to monitor and instantaneously transmit moth capture data, may improve the timing and efficacy of insecticide applications
- Time stamp all data collections
- Growers and consultants can access data anywhere at anytime by mobile phone or web browser

Future work



- Continue to improve Z-Trap moth capture rates and reduce the number of false detections
- Continue working on technology that conserves power – desire to have batteries last the entire season (this has been already achieved though not fully tested in the field)
  - Test duty cycling
- Investigate classification of multiple insect species and improve detection algorithms
- Continue work on MyTraps to improve function and user friendliness.
- Test traps on other species of insects, including leafrollers, stink bugs, natural enemies, etc.

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- **Oregon State University**
- **Washington State University**
- **USDA**


Thank you
Questions ?