Putting Sterile Insect Technique into the Modern IPM Toolbox:

Over 20 years of successful area-wide integrated pest management in Canadian pome fruit

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Okanagan-Kootenay Sterile Insect Release Program

Success for Growers, the Environment, and Communities.

[94%]
reduction in Codling Moth population

[96%]
reduction in related pesticide use

[250%]
return on investment for local community

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Okanagan, BC, Canada

OKSIR is the **ONLY** community-based, area-wide IPM Program in the world that uses the sterile insect technique to control codling moth.

Okanagan, BC, Canada

- Hot Dry Summer / Mild Winter
- High Tourism Area and Urban-Rural Interface
- Program area: 21 000 square km
- Pome fruit production area:

  1992 – 8900 ha

  2017 – 3500 ha (-60%)

An Apple a day keeps the Dr. away!

Apples and Pears are Important of Healthy Diet

- No. 2 in World Fruit Production

(2008 - Apple/Pears 86.4 million tons; Watermelon 94.5 million tonnes)

- Top consumed fruit in Europe

(ahead of the citrus category)

- Second most consumed fruit in the USA

(second only to bananas)

Source: 2017 World Apple and Pear Association website http://www.wapa-association.org/

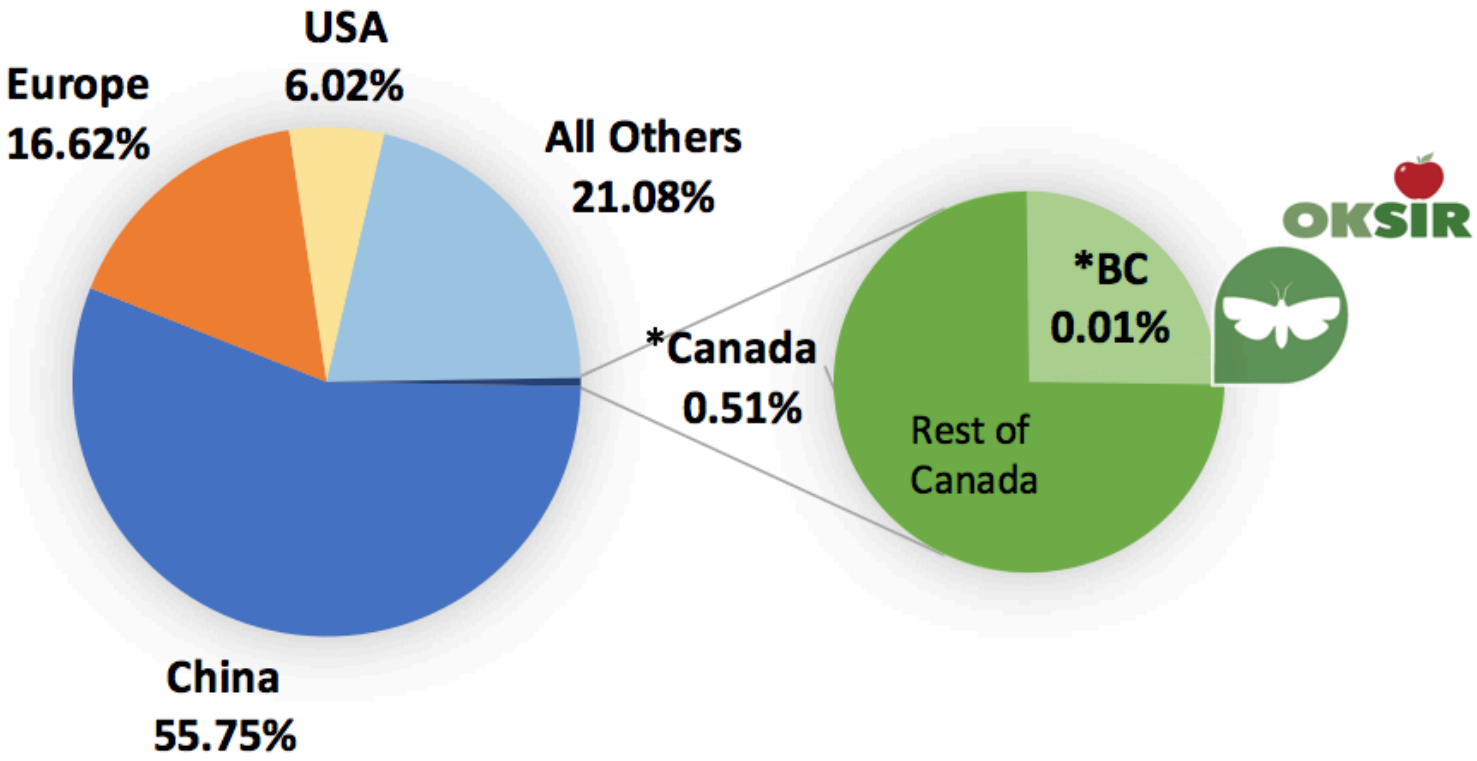
The Pest: Codling Moth

- The larva of the codling moth is the proverbial “worm in the apple”.
- Codling moth was introduced to Canada from Europe in early part of last century.
- A key economic pest in most temperate regions, directly attacking the fruit.
- Left uncontrolled, damages 50-90% crop.

Cydia pomonella (L.)
(Lepidoptera: Tortricidae)

2016 Global Apple Production

In 2016, 76.4 million metric tonnes of apples were produced



Source: World Production, United States Department of Agriculture , Foreign Agricultural Service, December 2016

*Source: Canada Production, Stats Canada Fruit and Vegetable Production 2012

Is CM still a problem in 2017 ?

Information from a recent Industry IPM Conference:

2017 Orchard Pest and Disease Management Conference, Portland, OREGON USA

- 10 of 22 talks were on codling moth control
- Changing climate, increase in generations of CM per season
- Concerns of resistance to chemical – no new development online
- *Cydia pomonella* Granulosis Virus – threat of resistance
- Pacific Biocontrol rep: "*With mating disruption, supplementary sprays are a reality.*"
- Recognition there is no stand-alone technology

Is there another way?

YES!

- ✓ Area wide IPM using SIT to control codling moth
- ✓ Supplement with Sterile codling moth

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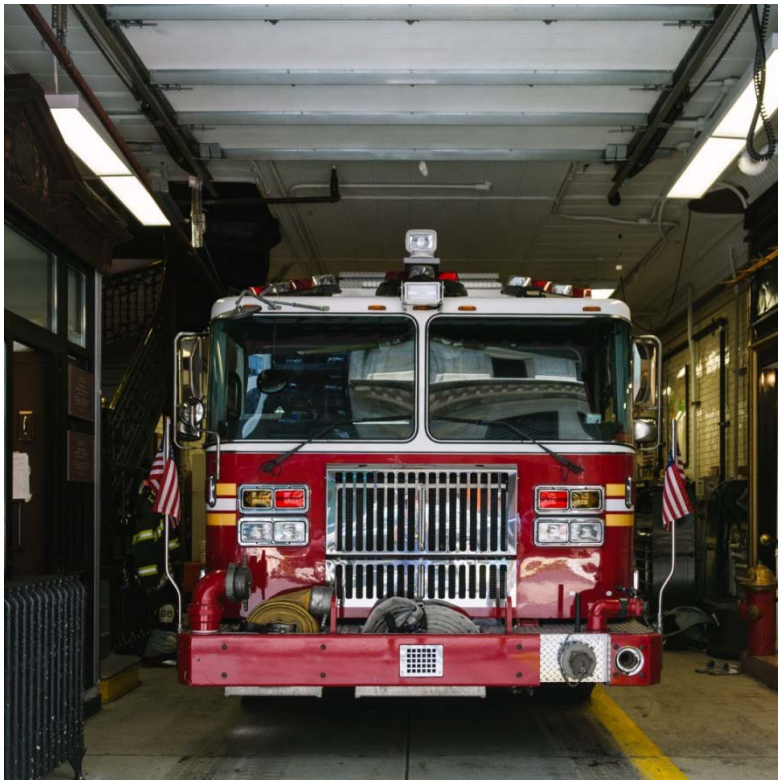
Area-wide approaches work



- **Reduced costs and increased efficiency.**
- **The same approach can be applied successfully to pest control.**

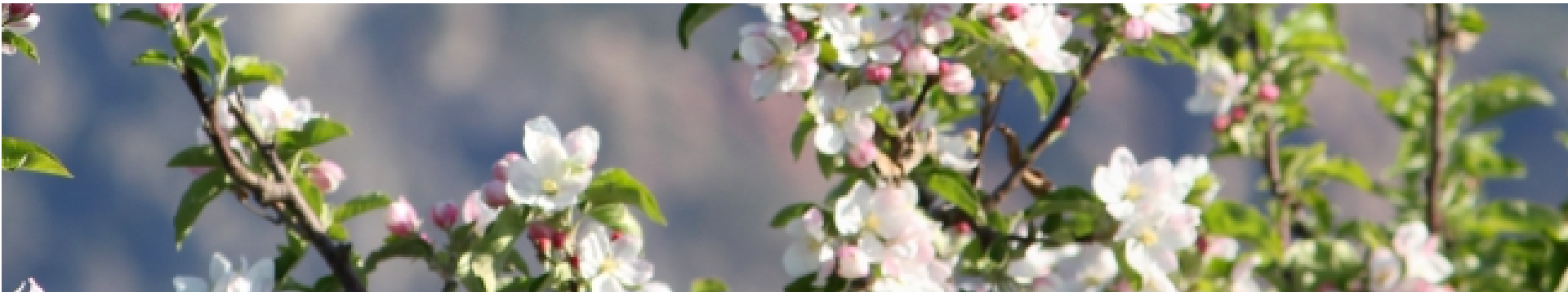
Sterile Insect Technique is one of the most effective tools to include into Area Wide Integrated Pest Management

OKSIR – The beginning…

- **Initial CM SIT Research done in early 70's by Dr. Jinx Proverbs**
  Proved dramatic reduction of wild codling moth populations using SIT (Proverbs et al. 1978, 1982)
- **Late 80's SIT research revisited - Led by Ag Canada, Dr. Arnold Dyck**
  local regional governments and industry revisited and reconsidered using SIT
  An area wide Program was developed to deliver mandatory control through a unique area wide partnership
- **Concerns with increasing use of organophosphates/ CM resistance**
  Commitment to an area wide approach was seen as the solution to address negative environmental, health, economic impacts
  to protect lakes, rural/urban interface, increase in agri-tourism.
- **Construction of Mass Rearing Facility completed in 1993**
- **Phase-in Strategy beginning with orchard sanitation**
  to reduce wild populations before sterile insect release began in 1994.

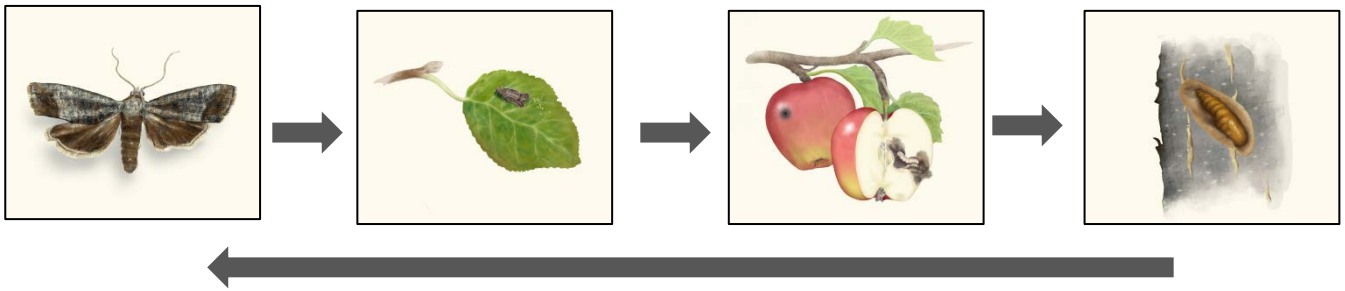
Governance and Funding

- **Board of Directors**
  - ✓ 5 local elected officials and 3 growers (including 1 organic)
- **Advisory Committees**
  - ✓ technical and regulatory matters
- **Funded through Municipal Taxation**
  - ✓ property tax assessment – all properties (60%)
  - ✓ grower parcel tax on planted acreage (40%)
- **Annual Program Budget**
  - ✓ $3,1 million **CAD (2.16 million EURO)**

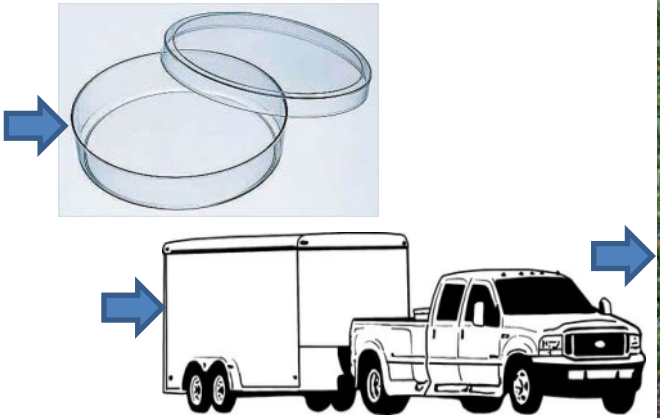


Program Services

- Mandatory Area-wide Control Application
  - ✓ weekly sterile insect release on all orchard properties
- Surveillance
  - ✓ Pheromone traps,, banding, visual inspection, fruit damage
- Enforcement
  - ✓ Inspection, fruit stripping, tree removal
- Education
  - ✓ One-to-one consultations, GIS Maps, website, newsletters, meetings



Mandatory Area-wide Control



- Production capacity 780 million sterile codling moth
- Weekly sterile released into all orchards at a rate of 2000 sterile moths per hectare/per week
- 1:1 ratio of males and females

Program Services

- Mandatory Area-wide Control Application
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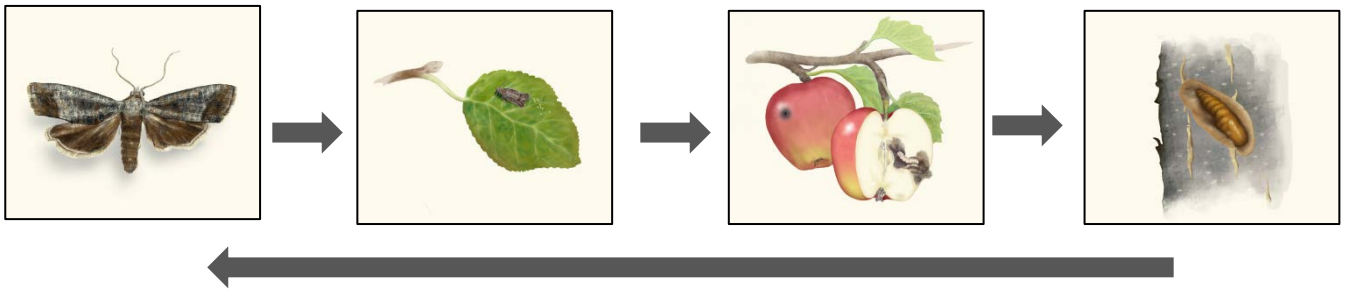
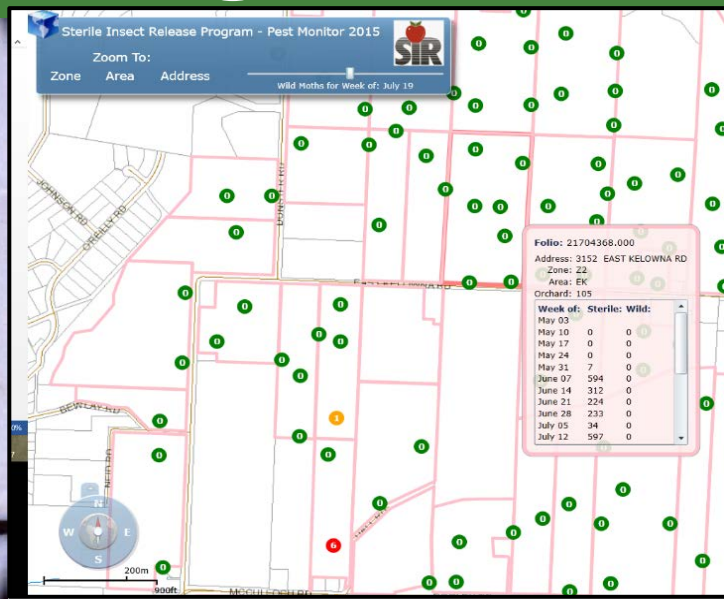


Orchard Monitoring



- 1 Delta trap per hectare baited with 1 mg codlemone lure
- Staff checks traps weekly for sterile/wild captures
- Data uploaded in field w/smart phone app and noted on traps
- Available for growers to monitor website, by email or in field.
- Staff carry out visual fruit inspection – ongoing/harvest

Urban Monitoring

- SIR staff band host trees primarily in 200 m buffer zone areas near commercial orchards.
- Banding is a useful tool that can aid in assessing the level of wild codling moth presence in particular trees.

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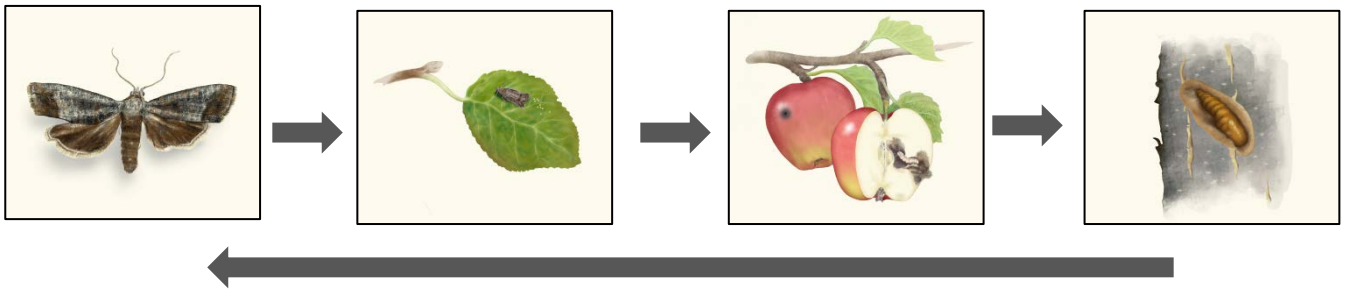

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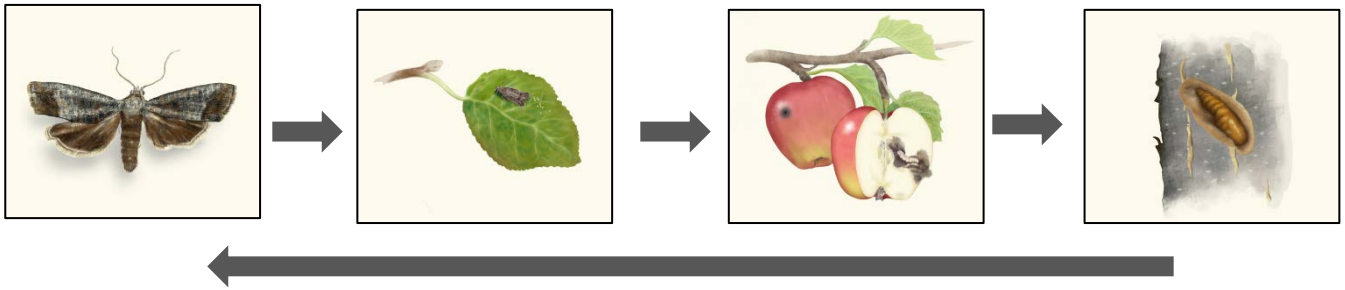

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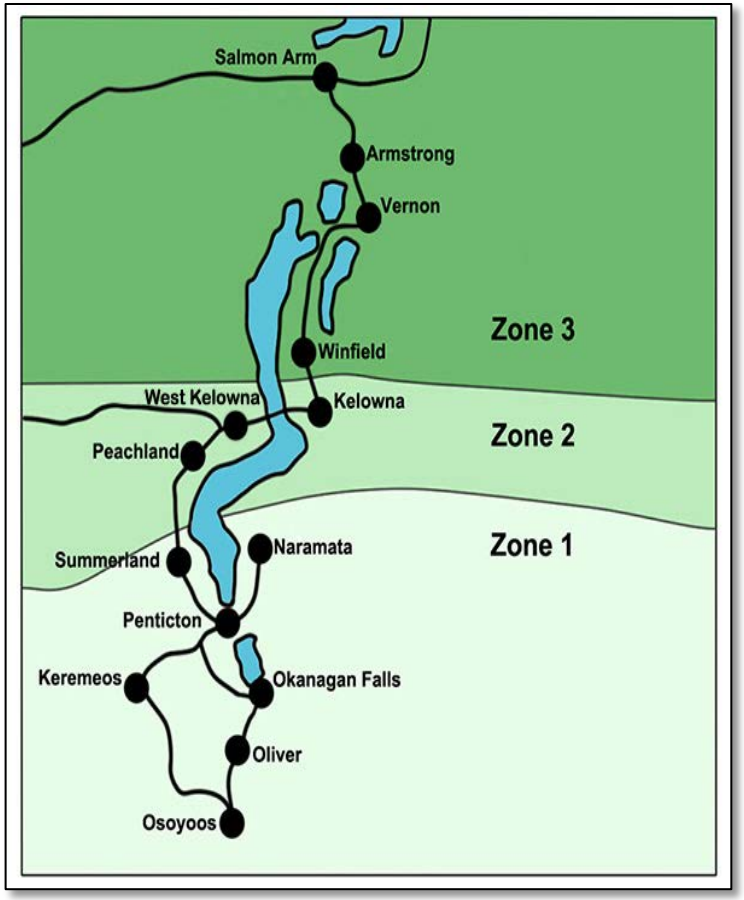
Program Area



Pome Fruit Production

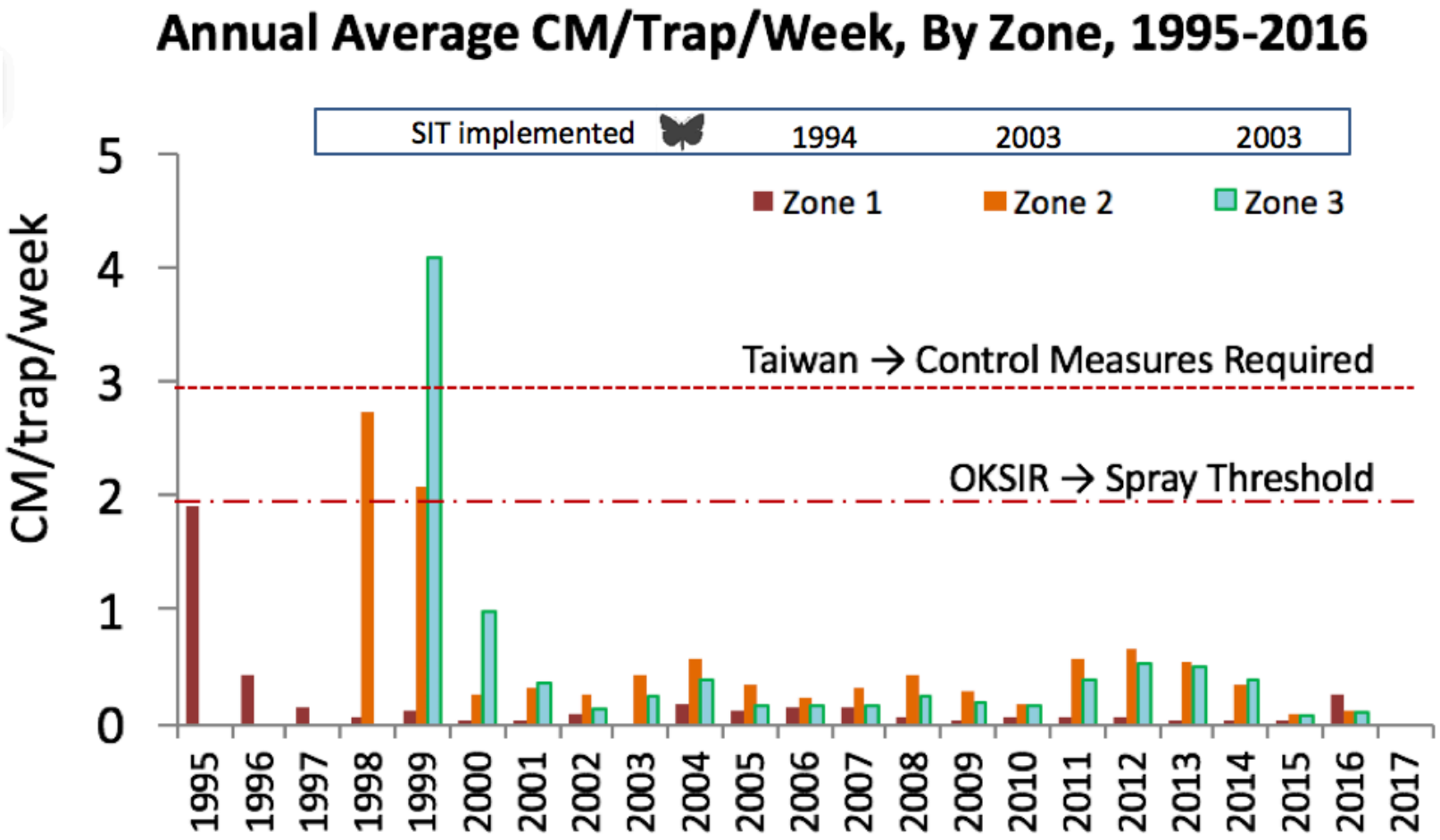
1992 – 8900 ha

2016 – 3395 ha

Zone 1 – Sterile insect technique (SIT) 1994 - present

Zones 2/3 – SIT 2003 – 2010
MD 2011 – 2014
(Mating disruption trial)
SIT 2015 – present

Codling Moth Weekly Captures



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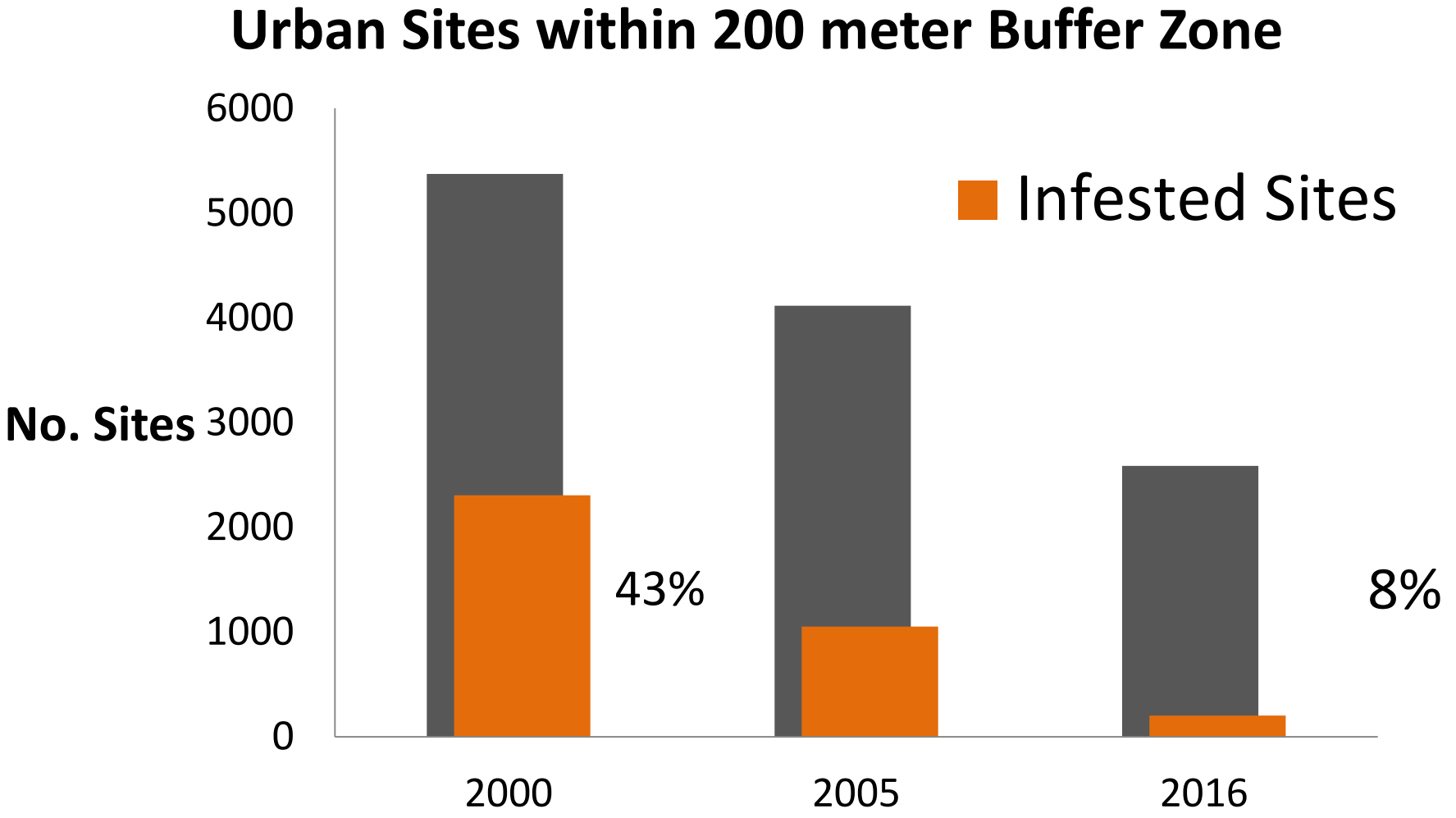
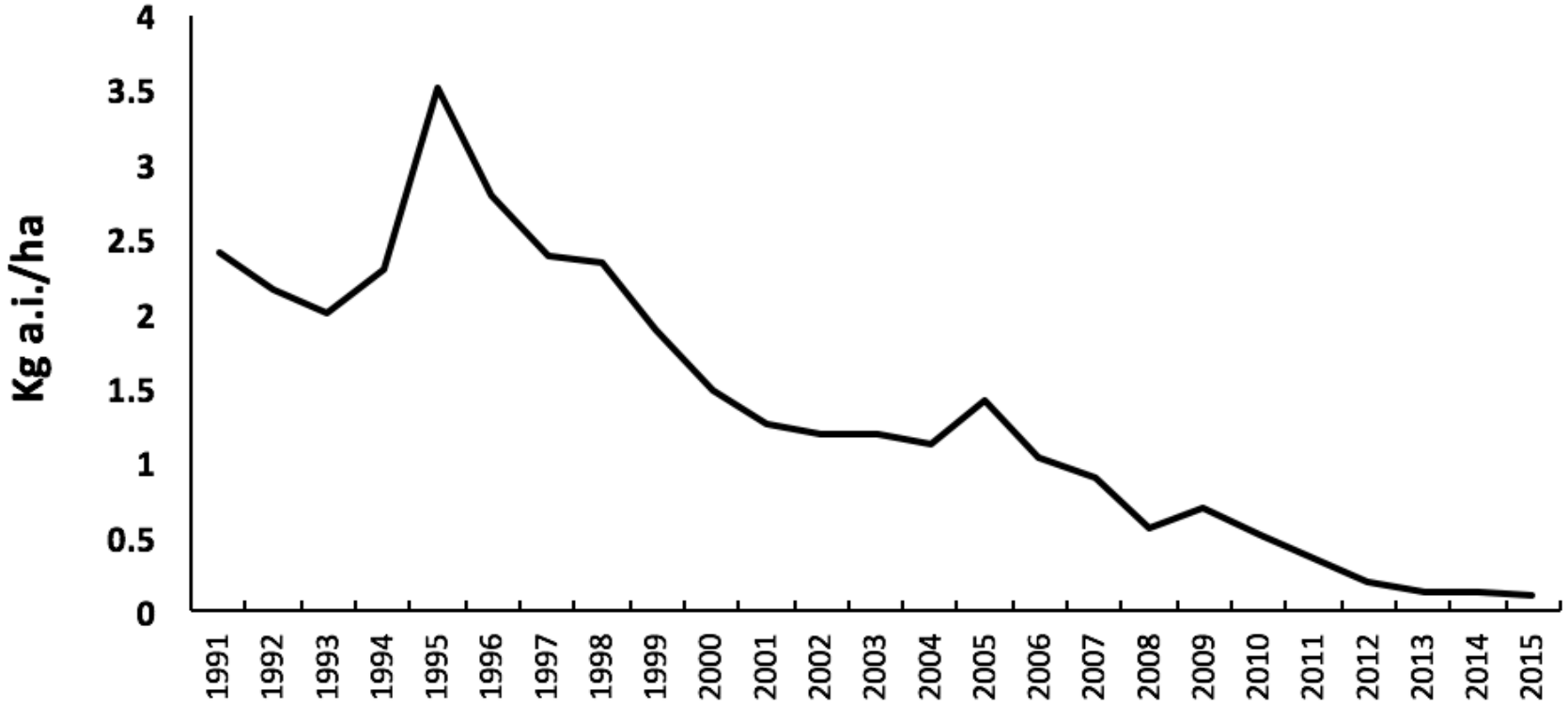
Reducing Urban Problems



Reduction in Pesticide Sales

Estimated Kg of Pesticide Active Ingredient Applied/ha for Control of Codling Moth, 1991 - 2015



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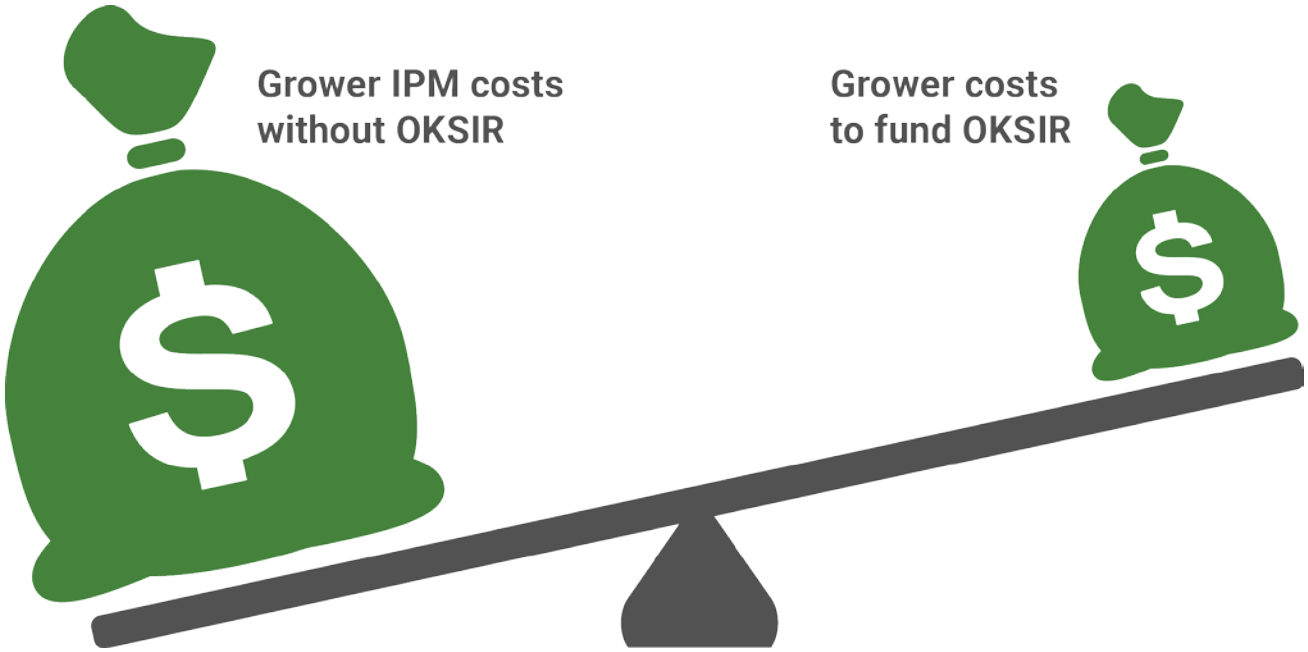
Additional Benefits of Area-wide

- Surpassed Program goal of fruit damage at harvest below 0.2% in well over 90% orchards.
- Reduction in Pesticide used against CM
  - ✓ Maintains social license and tax payer contributions
  - ✓ Increase in beneficial insects
- AW systems approach supports export programs (apples and/or cherries: Taiwan, China, Japan)
- Area-wide structure able to support contract work on other pests (BCFGA, CFIA)

OKSIR costs growers 65% less



Benefit-Cost Analysis (L. Cartier, Okanagan College, 2014)

- 250% ROI (employment and producer benefits)
- Non-agricultural willingness to pay = 90.4%(n=506, 178 RDOS)

20+ Years and Still Relevant

Residents and Tourists

↑ Population & Development
(desire for 'pastoral' lifestyle)

↑ Environmental Awareness
(local/provincial pesticide bans)

Changing Consumer Demands
(local and sustainable/low-input/organic)

People Want Healthy Communities with a Tradition of Agriculture

Orchardists

Changing Climate
(timing and monitoring more important)

Changing Pests
(early surveillance is key – Area Wide)

Changing Pesticide Rules
(can chemicals keep pace?)

Agricultural Pests are a Regional Problem that need Area-Wide Control

OKSIR Positioned for the Future

❑ Financially Strong:

No Tax Increase for the past 7 years
Capital Replacement with surplus reserve

❑ External Review:

International Experts recommend OKSIR as a role model for area-wide IPM using sterile insect technique

❑ Strategic Plan:

Direction to expand scale and scope by collaboration with other regions ;adding value by expanding to incorporate other pests.

Challenges/Opportunities Ahead

Local Program:

- Continued funding for CM that is no longer key pest
- New invasive pests (Brown Marmorated Stink Bug)
- Pressure for taxation to be redirected fund other services
- Fixed costs of facility running at 1/3 capacity

Expansion of Scope:

- Adjusting staff resources and structure to add value through including other area wide services; DAS, new invasive pests

Challenges/Opportunities Ahead

Expansion of Scale:

- Securing interest of other regions for sales of excess production capacity.
  - Pressure on world apple producers to address resistance and supplemental sprays (conventional and organic) Opportunity in 99.99% production to use area wide SIT
  - Permission to import and release sterile codling moth ie. requirement for veterinary certification, questions on authority to release beneficial control agent OKSIR CM SIT – ie. EPPO, Organic certifiers. [Precedent releases in Canada, NZ, SA and USA]
- Affordable and sustainable shipping logistics
- Adapting authority/governance of OKSIR Program from public sector to include “for profit”, taking on liabilities, restructuring staffing and administration to support commercial ventures

Next Phase: Diversification

1. Alternative Revenue Streams
   - Year round facility production? Commercialization?
   - Sterile moth Sales/ Egg Sheet Sales/ Active Ingredient Virus
2. Building Technical Network of Collaboration
   - Member of the FAO/IAEA Coordinated Research Program
   - Collaboration with WSU using Decision Aid System
   - Collaborating with NZ/USA on UAS for release
3. Inter-regional Global Co-operation
   - Work with global leaders in addressing invasive pests in a changing climate by:
     - Developing projects transferring area-wide knowledge
     - Building on opportunities to enhance value in IPM systems Starting with the addition of CM SIT to the IPM toolbox for Pome fruit production

SIT into the Modern IPM Toolbox:

Call For Collaborations

Good for our Environment. Good for our Growers.
Good for our Communities.

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