

Update on Forage Pests

for

Emerging Forage Pests Task Force

December 1, 2022

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BC Ministry of Agriculture and Food*

Acknowledgments:

Funding for this project (2017-2022) was provided by:

- Canadian Agricultural Partnership (CAP), a federal-provincial-territorial initiative
- Dairy Industry Research and Education Committee (DIREC)
- Lower Mainland Horticulture Improvement Association (LMHIA)
- Pacific Field Corn Association
- University of the Fraser Valley, Dr. Renee Prasad

Thank you for collaboration on research trials:

- Dr. Wim Van Herk, Agriculture and Agri-Food Canada, Agassiz, BC
- Dr. Jeremy McNeil, Western University, London Ontario

A BIG thank you to all collaborators who provided fields, trapped, collected, shared info, and participated in calls, meetings and events

Priority Pests surveyed in the Fraser Valley and Vancouver Island

- True Armyworm (*Mythimna unipuncta*)
- Western Corn Rootworm (*Diabrotica virgifera*)



Both can cause significant damage to corn and grass crops in BC

Objectives for the Emerging Pests of Forage project

- Survey and pest distribution, and record pest impacts ✓
- Outreach to industry on the pests ✓
- Research into biology ✓
- Incorporating new pest management tools into BC production ✓

Recent Presentations and Sharing of Forage Pest Information from this Project

1. Islands Agriculture Show, July 2022
2. Pacific Field Corn Association, spring 2022
3. Article in BC Holstein News, fall 2022
4. Email updates to Task Force, summers 2021 and 2022
5. Corn field days, Aug-Sept 2021



Recent Presentations and Sharing of Forage Pest Information from this Project

6. Poster to Entomological Society of America/Canada/BC, Nov 2022
7. Research papers
 - One in press, thanks to Dr. van Herk, hopefully one more on Armyworm
8. Meetings with colleagues in other provinces –
 - To keep others aware of BC's pest issues and look for more solutions
 - Western Forum on Pest Management,
 - Canadian Corn Pest Coalition



Emerging pests in forage corn and grass in British Columbia: Learning to deal with True armyworm (*Mythimna unipuncta*) and Western corn rootworm (*Diabrotica virgifera*)



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 Willem G. van Herk, Agassiz Research and Development Centre, Agriculture and Agri-Food Canada, Agassiz, BC
 Jeremy N. McNeil, Department of Biology, University of Western Ontario, London, ON

Introduction: The first known outbreak of **True Armyworm (Family: Noctuidae, *Mythimna unipuncta* (Haworth))** in British Columbia occurred in 2017, when Vancouver Island and Fraser Valley forage producers of grass, cereals, and corn experienced unprecedented losses from larval defoliation. This is a North American migratory insect that is introduced annually in spring to southern Canada on wind currents or storms.

Western Corn Rootworm (Family: Chrysomelidae, *Diabrotica virgifera virgifera* (LeConte)) was detected in 2016 in Fraser Valley for the first time in BC. Since 2017 it has caused crop damage in unmanaged forage and sweet corn fields from both root feeding by larvae and adult feeding on silks. Rootworm is native to the Americas and has been a significant pest for many years in major corn growing regions in eastern USA and Canada.

Methods and Results: True Armyworm, *M. unipuncta*

- True Armyworm was not known to outbreak in BC prior to 2017. However, specimens have been recorded in BC museums for over 100 years at irregular intervals.
- Annual surveys (2018-2022) with uni-traps and pheromone lures (Trece, OK, USA) were carried out in BC, as well as WA, OR, and northern CA, where outbreaks also occurred in 2017 (Fig.1).
- Moth wings from BC, WA, OR, and CA were sent for isotope analysis to Western University, lead by Dr. Jeremy McNeil. Early results suggest that moths caught in spring in BC came from northern California (CA), and summer moths caught in BC are residents.
- Results from field observations and lab trials show that *M. unipuncta* does not overwinter in BC.
- Moth catch numbers vary each year (Fig.2), but there have been no more outbreaks. Action threshold of 30 moths per night have not been reached.
- Annual trapping results demonstrate that *M. unipuncta* moths are caught every year in the Fraser Valley and Vancouver Island in BC. There are two peak moth flights per year (Fig.3).
- What causes large immigration of moths? Most likely: Spring storms, high spring moisture/rainfall, high populations in CA.

Figure 1. Western areas affected by True armyworm in 2017



Figure 2. Annual total catches of *M. unipuncta* moths on Vancouver Island and Fraser Valley in pheromone baited traps, May-Sept, 2018-2022

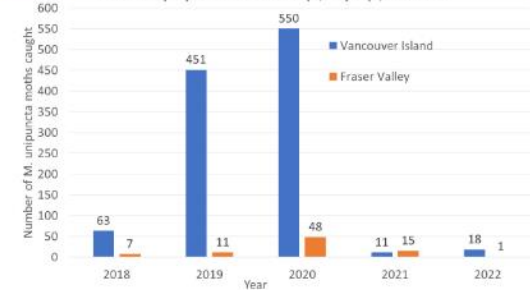
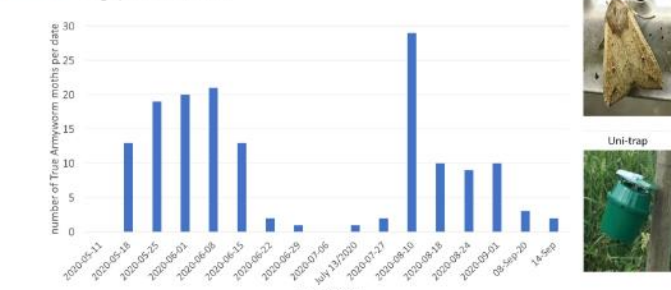


Figure 3. Port Alberni True Armyworm catch, 11 traps, May-Sept 2020, grass field edges, total moths = 155



True Armyworm moth, *Mythimna unipuncta*



Methods and Results: Western Corn Rootworm, *D. virgifera*

- Prior to 2016, *D. virgifera* was not known to be present in BC. This pest was also detected in WA at the same time as BC.
- Annual surveys (2018-2021) with un-baited yellow sticky cards along edges of corn fields was carried out in BC (Fig.4). On average 150 traps were set per year, in mid July, checked every 7-14 days, and beetles were counted. Traps were removed in early September before corn harvest. This is the standard method used in eastern North America. Beetles are caught from mid July through harvest in September. Peak flight is in late August.
- Surveys confirmed that the pest is only present in the Fraser Valley and not in other parts of BC.
- Corn growers in the Fraser Valley of BC implemented preventive practices such as rotating out of corn every 5 years, and use of in-furrow insecticides at planting. While these tools are also used for other pests, the use of *Bacillus thuringiensis* (*Bt*)-traited corn varieties resistant to corn rootworm larvae was new to BC growers.
- Sweet corn growers also have applied foliar insecticide if beetles are abundant at silking (pollination).

Figure 4.

Yellow sticky trap in corn field



- With the goal to better forecast the pest risk, in 2021 we compared a commercial semiochemical lure (Fig.5) (Csalomon®, Budapest, Hungary) baited yellow sticky traps (Pherocon AM, Great Lakes IPM, MI, USA) to unbaited traps in corn fields. Baited traps caught about 10x more beetles than unbaited traps. (Van Herk et al, in press).
- In 2022, we paired baited and unbaited traps in forage corn fields. Baited traps caught more beetles overall and caught earlier than unbaited (passive) traps (Fig.6). Baited traps caught 7x more beetles during the first week of August, and then gradually declined to 1.66x in later weeks of August.
- While the advantage of the lure decreases over time, its use may be worthwhile particularly in fields or regions with low populations of rootworm or to monitor spread of the pest to new areas.

Figure 6. Mean Number of *D. virgifera* beetles caught per trap in forage corn fields, Fraser Valley, July-August 2022, comparing lure-baited and unbaited (no lure) yellow sticky traps

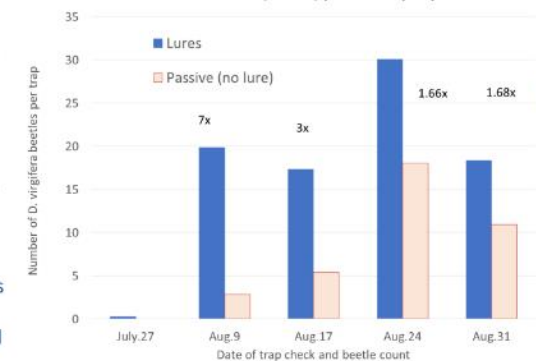


Figure 5. Yellow sticky trap with Lure circled. Many beetles caught!



Conclusions: While it is clear from our surveys that *M. unipuncta* migrates to BC every year, introduction of enough moths to cause an outbreak in grass and corn fields seems uncommon. Field scouting with pheromone traps and visual scouting for larvae when moth catches increase remain important tools for growers so pest management steps can be taken. Pest notices, articles, and presentations within the grower community helped raise awareness of this 'new' pest and how to deal with it.

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- Pacific Field Corn Association

- University of the Fraser Valley
- Agriculture and Agri-Food Canada

Thank you to all collaborators, staff, and summer students who provided fields, trapped, collected, shared info, and participated in calls, meetings and events

Conclusions: In BC, *D. virgifera* appears limited to the Fraser Valley. Through surveys with traps and visual searches in fields and communication with the agricultural industry and researchers in BC and eastern North America, we have been able to learn about the biology of this new pest in BC, try new tools, and enable growers to implement prevention and management approaches to minimize damage to both forage and sweet corn.

Western Corn Rootworm survey methods, 2017-2022

- Many corn fields throughout the lower mainland:
 - Richmond, Pitt Meadows, Langley, Agassiz, Glen Valley, Deroche/Dewdney, Surrey, Delta, Matsqui, Sumas, and Chilliwack.
- Yellow sticky traps were set in late July, checked every 7-14 days, and removed by Sept 10.
 - Use of un-baited yellow sticky traps are the North American industry standard
- Visual corn health checks were performed at most field visits.
 - Check for unstable plants, poor roots, drought-stricken plants
 - Check for leaf feeding or presence of beetles (“window-paning”)



- No western corn rootworm have been recorded on Vancouver Island or in BC's interior regions.
- The pest is only present in the lower mainland, and across the border in Washington



Unexplained Damage from Rootworm?

- In Eastern Canada and USA, Western Corn Rootworm is becoming resistant to most of the transgenic corn hybrids, and the frequency of 'unexplained damage (UXD)' from failing hybrids is increasing.
- So far, we haven't seen occurrence of this in the Fraser Valley

How to prevent this?

- Encourage BMPs-- pest prevention practices and appropriate use of *Bt* hybrids
- Crop rotation out of corn every few years is the primary means of prevention
- Monitor for UXD with
 - sticky traps,
 - plant health checks,
 - grower reports
 - Stay in touch with colleagues



Slightly Different Approach to survey in 2021 and 2022

- 30-34 fields with traps in 2021 and 2022, rather than the 110+ fields in previous years
- Wanted to test out the use of baited (lures) traps and unbaited traps (no lures).
- Wim van Herk (AAFC) lead a comparative trial on this in 2021.
- Showed baited traps caught about 10x as many beetles as unbaited traps.
- In 2022, we set a baited trap and an unbaited trap in each field.
 - Would we get a 10x difference in trap catch in routine field monitoring?
 - Would there be other advantages?

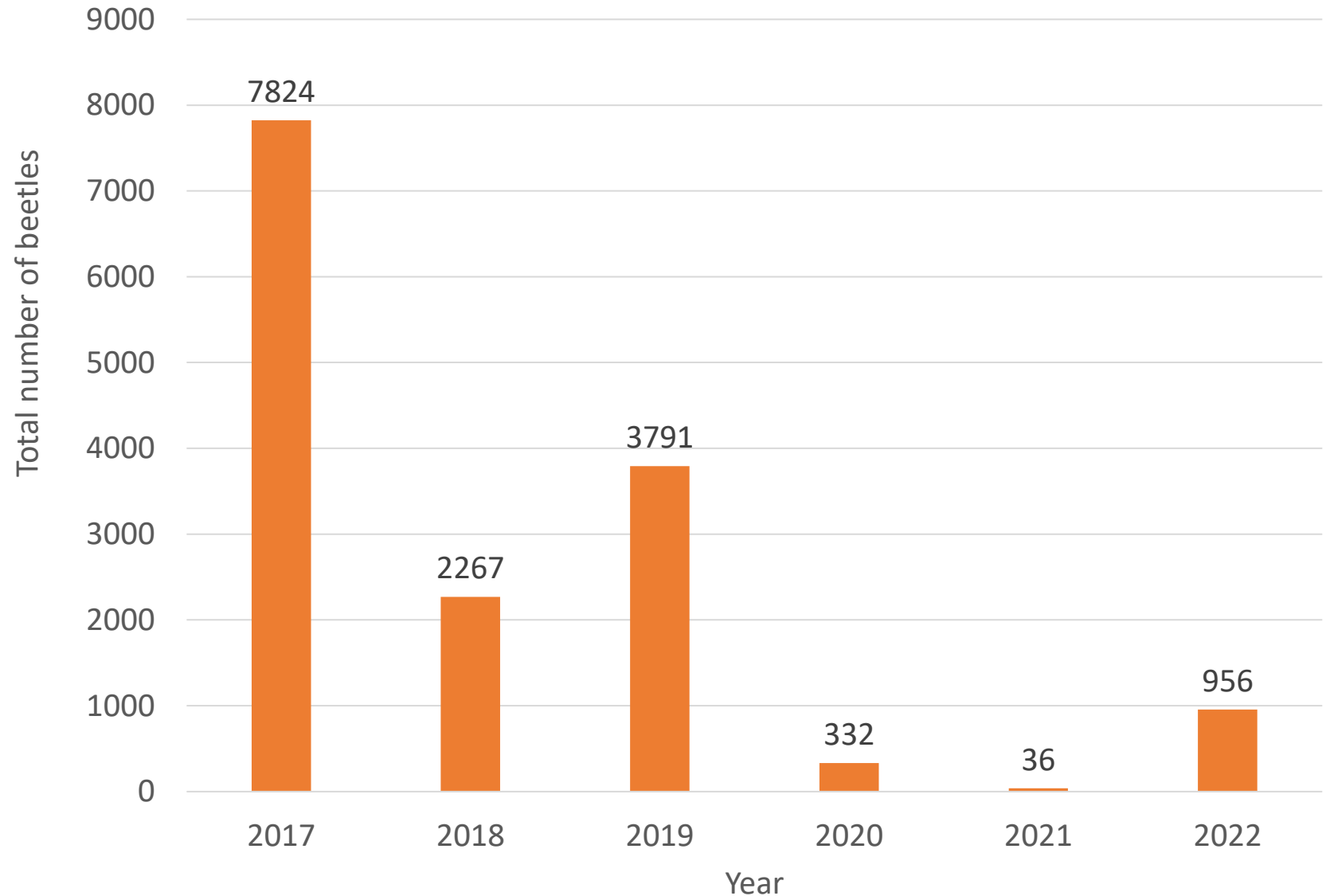
.

Between 110 and 140 traps set per year in 2017-2020.

In 2021 and 2022, decreased to 30-34 traps set each year.

Traps set throughout the region from Delta to Agassiz in all years.

Total number of Western Corn Rootworm beetles caught each year in the Fraser Valley, 2017-2022

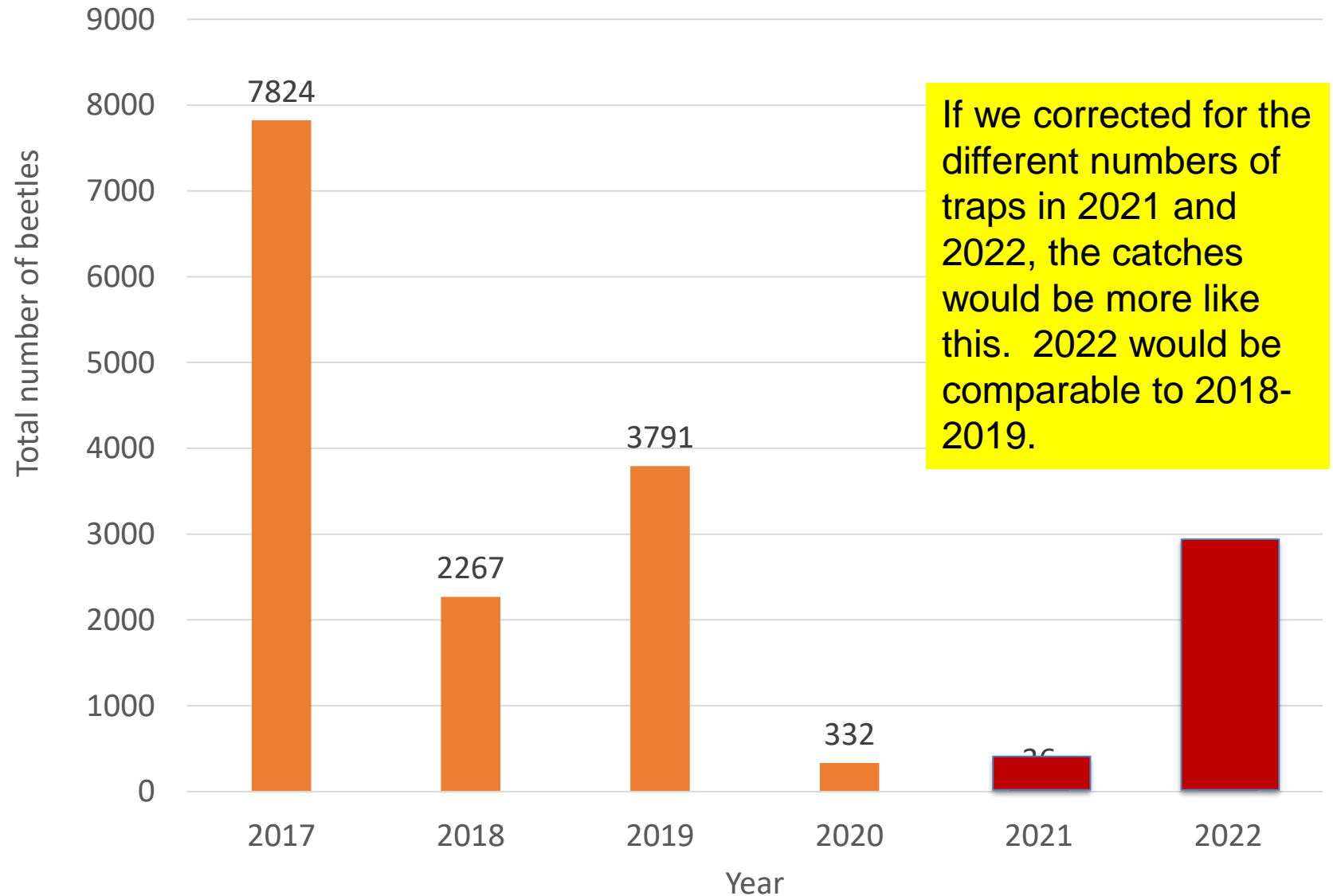


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Results from baited traps:

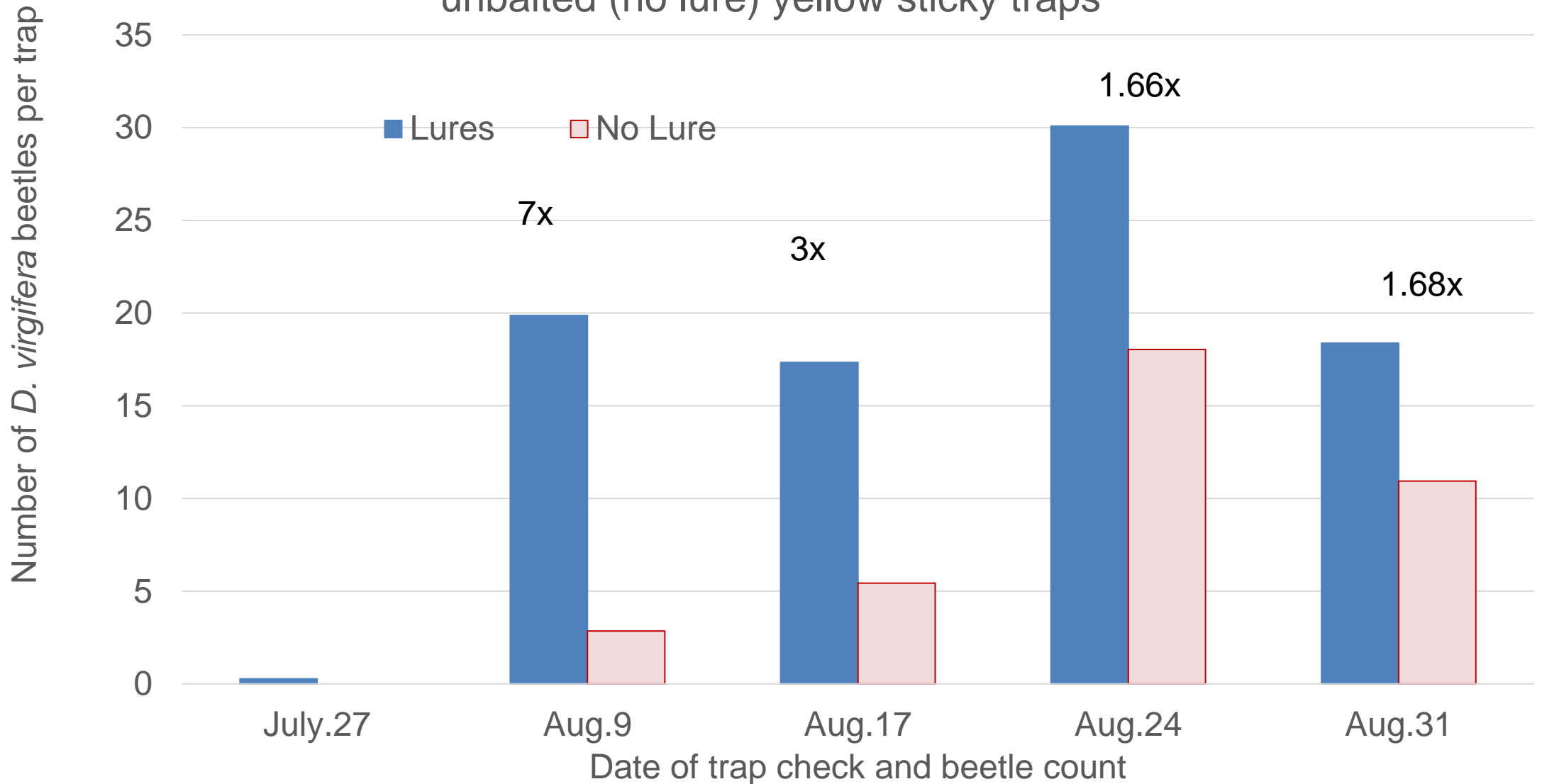
- Baited traps caught beetles a week earlier, but peak catch times were the same as unbaited traps (peak catch from Aug 23-early Sept).
- In 2022, in total, baited traps caught twice as many beetles as unbaited traps (1833 vs 956).
 - (All traps and all dates)



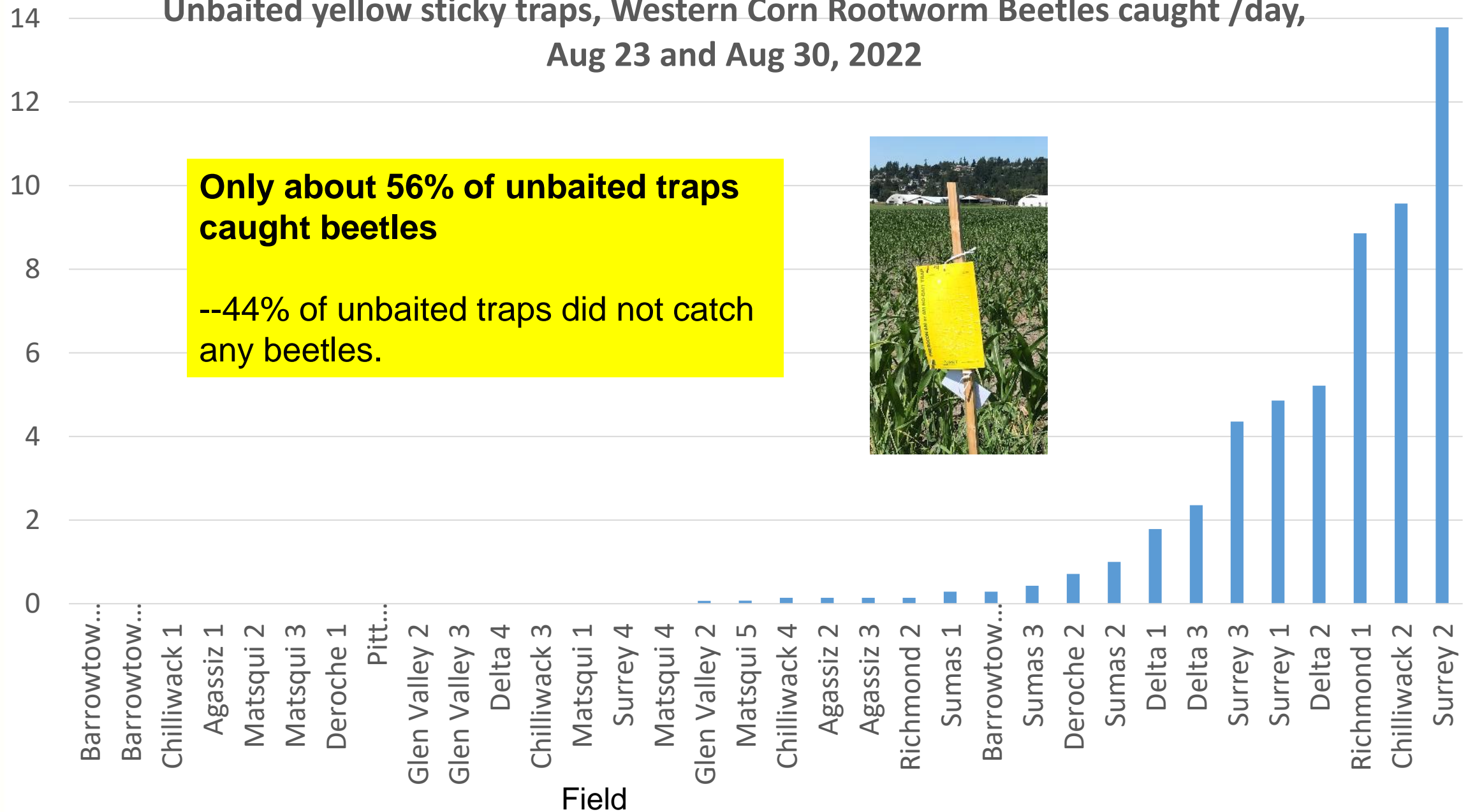
Explanation of graph in next slide

- In 2022, we paired baited and unbaited traps in forage corn fields. Baited traps caught more beetles overall and caught 1 week earlier than unbaited traps.
- Baited traps caught 7x times more beetles during the first week of August, and then gradually declined to 1.66x in later weeks of August.
- While the advantage of the lure decreases over time, its use may be worthwhile particularly in fields or regions with low populations of rootworm or to monitor spread of the pest to new areas.

Mean Number of *D. virgifera* beetles caught per trap in forage corn fields, Fraser Valley, July-August 2022, comparing lure-baited and unbaited (no lure) yellow sticky traps



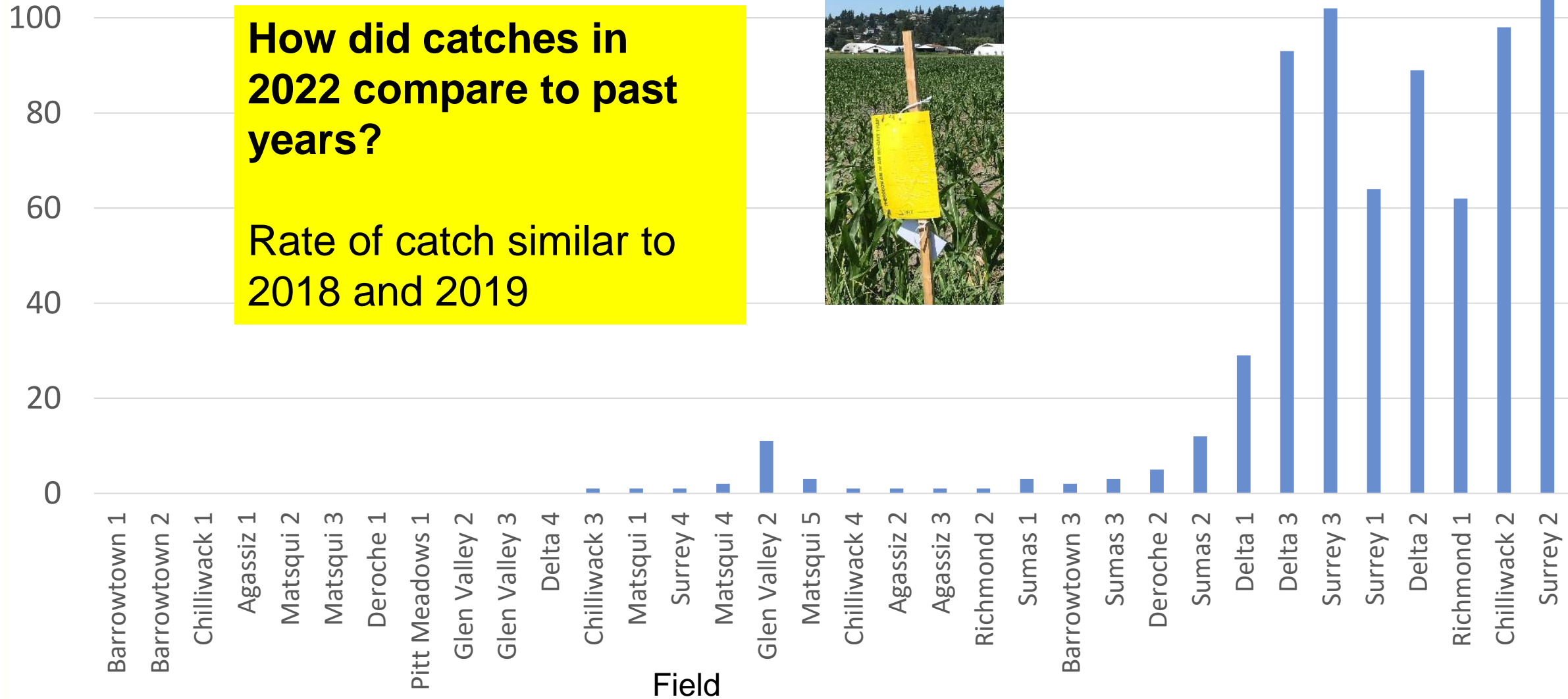
Unbaited yellow sticky traps, Western Corn Rootworm Beetles caught /day, Aug 23 and Aug 30, 2022



Beetles/trap/day Aug 23. **with lures**, 24 forage corn fields,
Fraser Valley, 2022



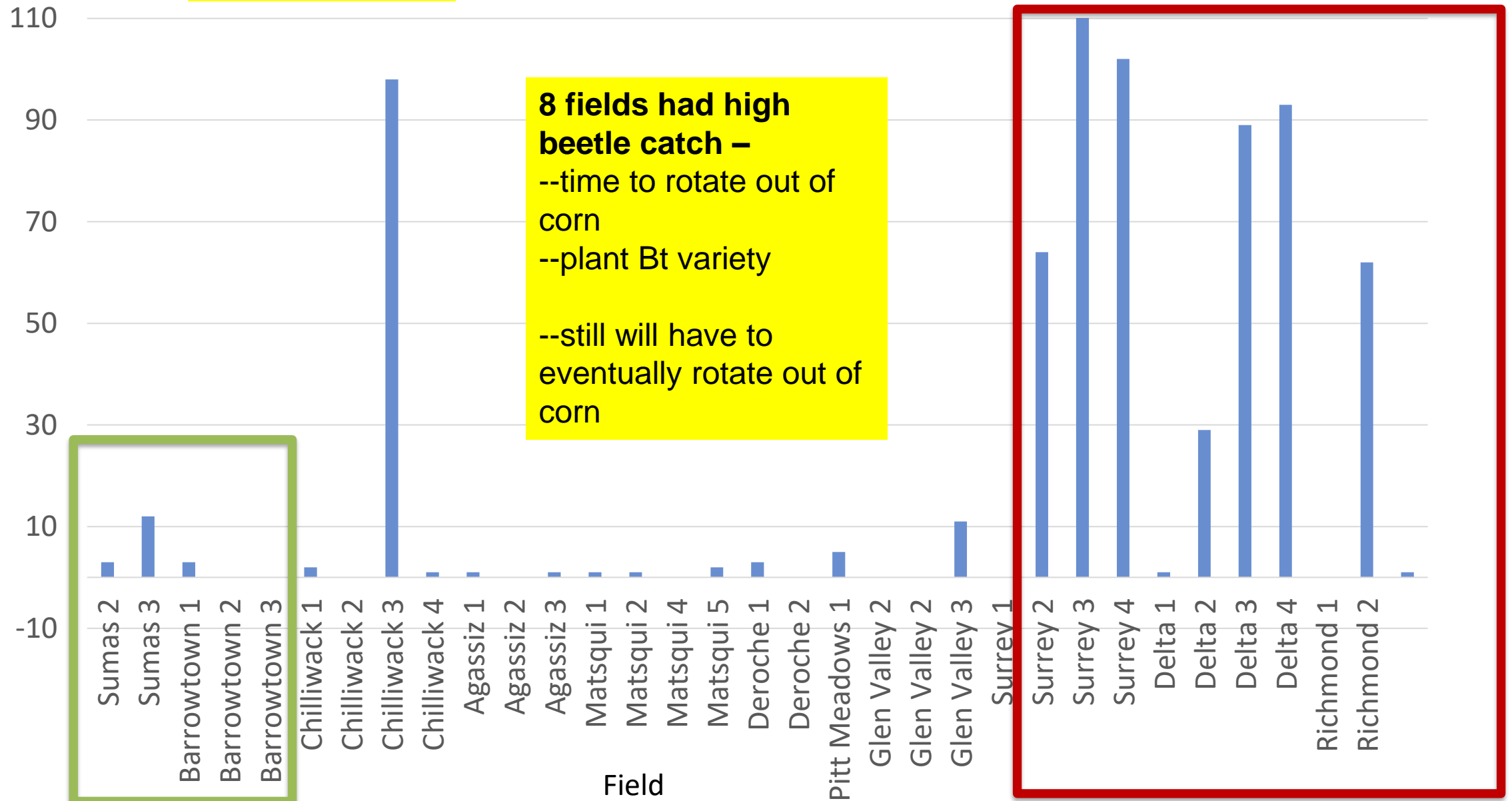
Total beetles per unbaited trap, 2022



Explanation of graph in next slide

- Our trap catches in Sumas and Barrowtown areas confirm that the Nov '21 flood did not eradicate corn rootworm from the area
 - (see bars in **green** box).
- Beetle incidence and rootworm damage is increasing in Surrey and Delta, and remains high in Richmond.
 - (see bars in **red** box).

Total beetles per unbaited trap, 1 trap per field, 2022



Review of prevention tools:

- includes crop rotation out of corn every few years (~5 years)*,
- early planting when possible, and
- use of *Bt*-traited corn, for example in years 3 to 5 (after 2 years of conventional corn)*
- Use of Force in furrow at planting (for Wireworm and Corn Rootworm)*

*Contingent on info specific to each field, such as monitoring info, field history, other pests being managed, etc.


Additional factors affecting Rootworm populations

- Wet spring
- Cool spring,
- Late planting = more risk of damage from rootworm larvae



Western Corn Rootworm in BC:

- <https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/agriculture-and-seafood/animal-and-crops/plant-health/western-corn-rootworm.pdf>



BRITISH COLUMBIA | Ministry of Agriculture

Western Corn Rootworm

September 2018

Western Corn Rootworm (WCRW) *Diabrotica virgifera* is a major corn pest native to the Americas. It was first detected in the Fraser Valley in August 2016. Populations reached record levels in local forage and sweet corn fields during the 2017 season. Surveying efforts have found WCRW throughout the



True Armyworm, *Mythimna unipuncta*



True Armyworm methods

- Pheromone traps were set along edges of grass fields in the Fraser Valley and on Vancouver Island.
- Traps were set by early May, and checked every 7-14 days until September.
- Mostly we used bucket traps, but in some years, we also used wing traps.
- Both traps types are suitable.



Fraser Valley 2020: 48 uni-traps set from May-early September

Vancouver Island 2020: 24 uni-traps set May-mid September

From studies done at Western University with our BC moths, it was determined that:

- Spring Armyworm moths are immigrants from Northern California,
- Summer moths are BC residents
- True Armyworm does not overwinter in BC.



Photo: Heather Shobe

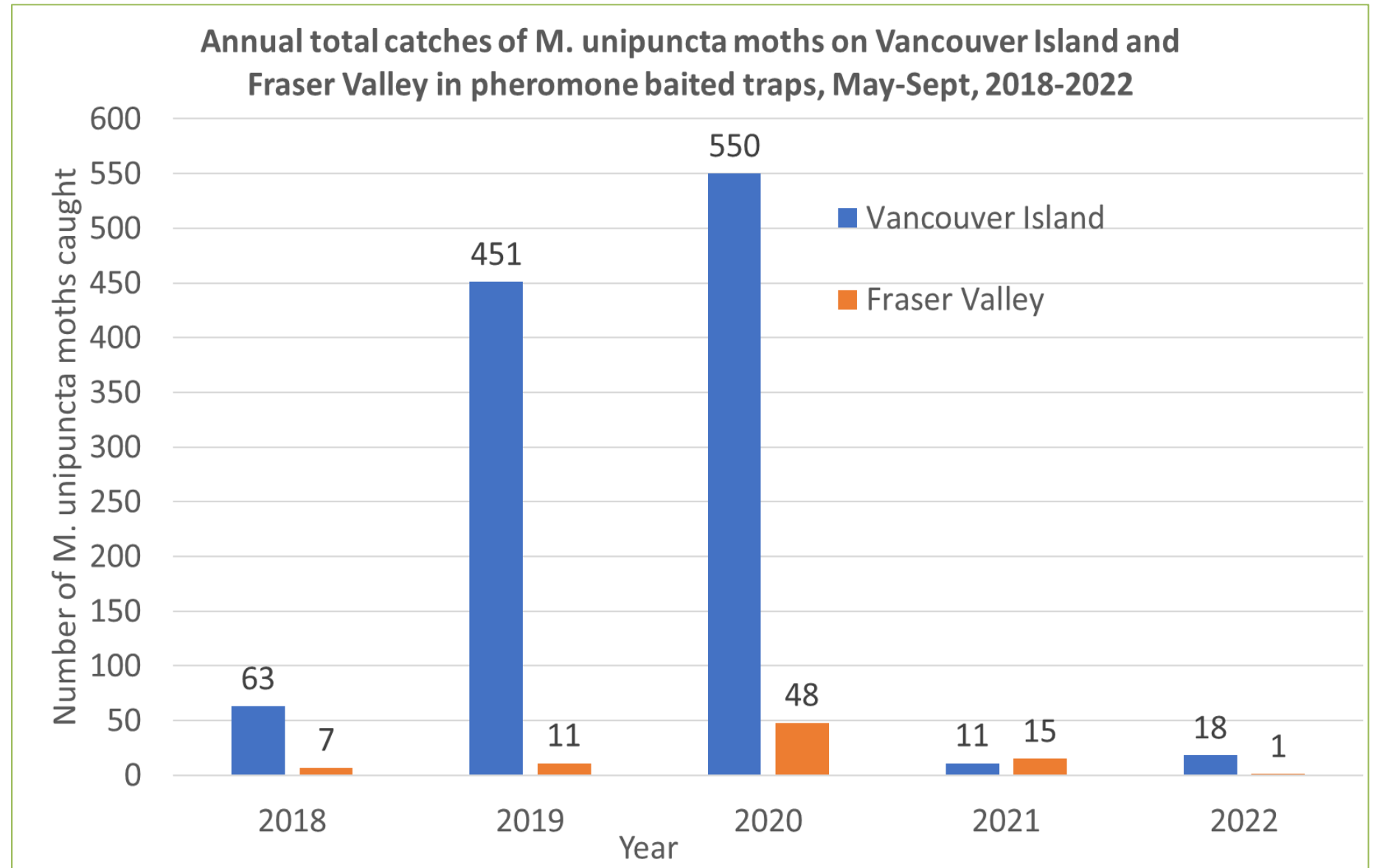


True Armyworm Over the years....

True armyworm moths arrive in BC every year.

Populations vary a lot from year to year.

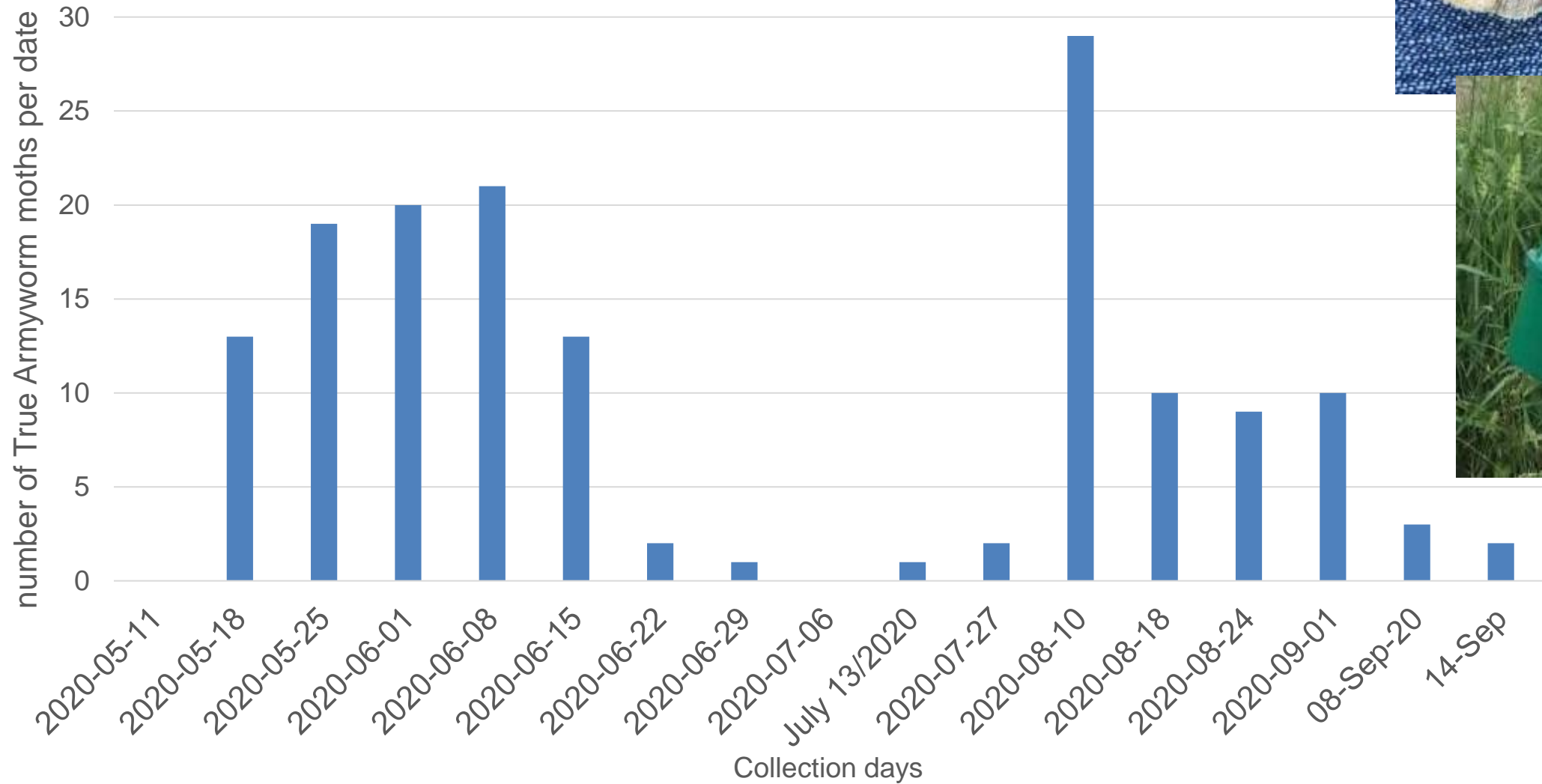
Based on the few years we have been surveying, it appears that outbreaks are rare.



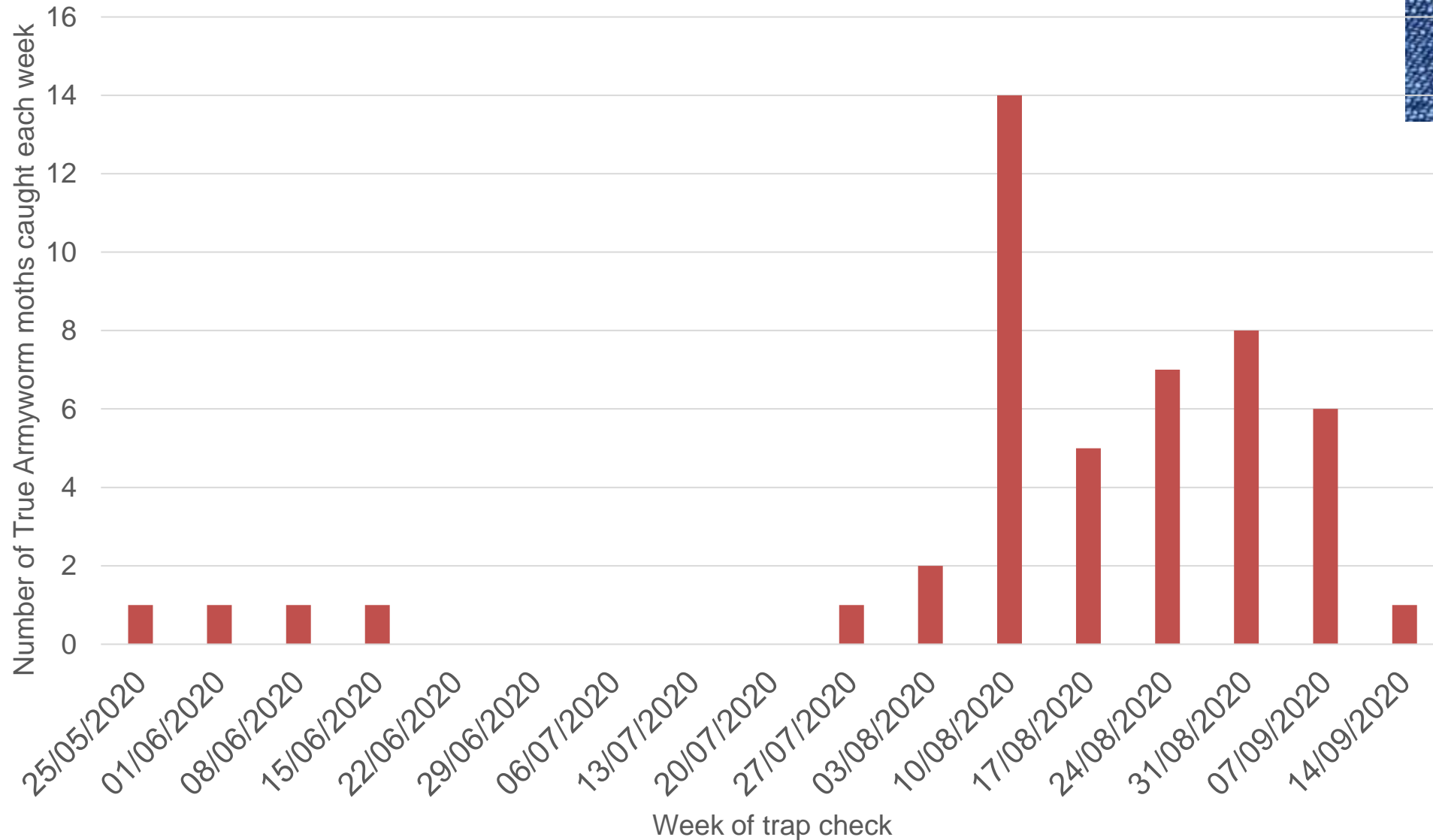
Explanation of next two graphs

- These data show two peaks in moth flight, both in the Fraser Valley and on Vancouver Island.
- The first peak is made up of immigrating moths.
- The second peak is BC resident moths.
- This info is from 2020, the year we caught the most moths in traps.

Port Alberni True Armyworm catch, 11 traps, May-Sept 2020, grass field edges, total moths = 155



Fraser Valley True Armyworm catch, 11 traps, May-Sept 2020, grass field edges, total moths = 48



Forecasting outbreaks?

1. Use of pheromone traps to watch for high levels of immigrating moths in May-June
 - Level of concern: Over 30 moths per day
2. Scout fields for larvae June-July.
3. If found, plan a ground spray

Traps and field scouting



Forecasting Outbreaks?

- Weather:
 - In 2017, the year of the outbreak, **spring (April) was rainy and stormy**, and this may have contributed to massive immigration of moths.
 - Subsequent years were not as wet and stormy, and there were no outbreaks.
- Northern California armyworm populations are monitored each year and have similar high and low years as BC.
 - Currently low populations, due to severe drought
 - https://rice.ucanr.edu/Armyworm_traps/



True Armyworm in BC

<https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/agriculture-and-seafood/animal-and-crops/plant-health/phu-true-armyworm.pdf>



True Armyworm (*Mythimna unipuncta*)

June 2018

True armyworm (*Mythimna unipuncta*, formerly *Pseudaletia unipuncta*) is a North American agricultural pest in the insect family Noctuidae. During April and May, true armyworm moths may migrate from southern USA and Mexico on wind currents to parts of Southern Canada including B.C., Manitoba, and Ontario. True armyworm is not known to overwinter in Canada.

Hosts

True armyworm prefers grass crops such as cereals, pasture, grass hay and corn. However, under high populations, true armyworm larvae may also feed on broad leaf plants. Adults feed on flower nectar or other sweet sources.

Damage

Young larvae will skeletonize grass foliage and eat small holes in leaves. From the third instar and older, larvae will devour entire leaves. Larvae will also sometimes feed on developing seed heads and corn tassels and ears. Once an area is sufficiently defoliated, larvae will move in a group to other grass stands to resume feeding. True armyworms can cause significant but often patchy crop damage in only a few days, and can cause rapid crop devastation when the larvae population is high. In southwest B.C., the first generation of larvae, feeding in June and July, can cause significant crop loss to grass hay and cereals. The second generation of larvae in August and September can be even more destructive, affecting both grass and corn crops. 2017 was the first year damage was recorded for this pest in B.C.



4 other species of interest

- Some we have seen in BC before
 - Corn Earworm
 - Western Yellowstriped Armyworm
- Additional species of armyworms are causing damage to crops in eastern Canada
 - Western Bean Cutworm
 - Fall Armyworm

Surveyed with traps in 2021 and 2022 in Fraser Valley and caught none

Corn Earworm



© Natalie McNair

<http://mothphotographersgroup.msstate.edu/species.php?hodges=11068>



Western yellowstriped armyworm moth.

Fall Armyworm



© Carol Wolf

<http://mothphotographersgroup.msstate.edu/species.php?hodges=9666>

Western Bean Cutworm



© Nolie Schneider

<http://mothphotographersgroup.msstate.edu/species.php?hodges=10878>



Olive Green. Cutworm, *Dargida procincta*

Native species, one to keep an eye on.

- Feeds on grasses
- Common in fields in south west BC, we see it every year. Seen on equipment at hay cutting, and seemed higher this year.
- At least 2 generations per year

- Bright green larvae that turn dark before pupating in the soil.
- Moth is distinctive, no others with this pattern.



Where do we go from here?

There is value in some level of survey for forage pests

yes

- Survey with traps and visual searches for True armyworm and other moth/caterpillar species of concern
- Encourage vigilance in watching fields for larvae if trap counts are high
- Communication, outreach, updates, between govt and industry within BC
- Do we have other species? Could they become issues in BC?
- Multi-province communication and survey
 - For example: Western Forum on Pest Management, Prairie Pest Monitoring Network



Questions?

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