USDA APHIS
National Honey Bee Pests and Diseases Survey

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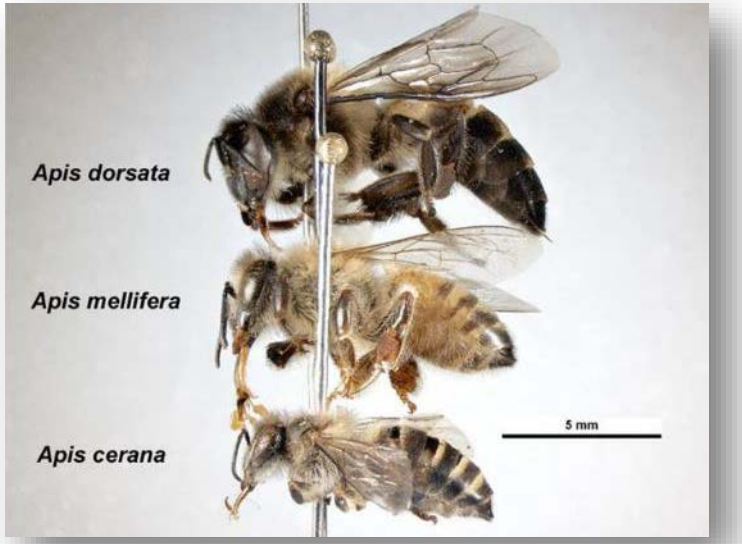
Primary objective

- Surveillance of potentially invasive pests and pathogens
  - *Tropilaelaps*, *Apis cerana*



Secondary objectives

- Geographical and temporal distribution of existing threats:
  - Pests and diseases
    Nosema, Varroa, Viruses
  - Pesticides

NEW

- Longitudinal monitoring as a better predictor of colony health

Importance of APHIS NHBDS results

- Provide context to honey bee health studies
- Nation-wide database of disease levels comparable across years

- Free disease diagnostics to the beekeeper

History

- **2009**: Pilot survey in 3 states
  - Test sampling methodology
- **2010**: Limited survey in 13 state
  - Increased state participation
  - Data sampled over much of calendar year
- **2011**: National Survey in 34 states
- **2012**: National Survey in 34 states
- **2013**: National Survey in 30 states
  - Puerto Rico, Guam and Grenada
- **2014**: National Survey in 20 states
  - Little/no funding for states to survey
  - Puerto Rico, Guam and Grenada

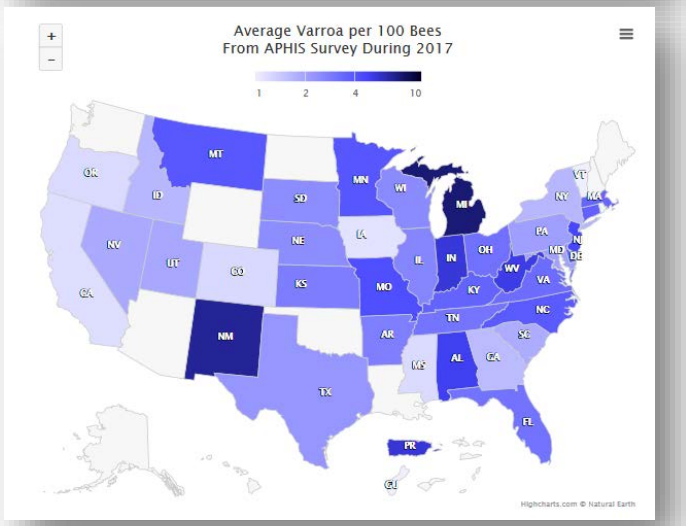
History

- June 20, 2014 **Presidential Memorandum** directed USDA and EPA to co-chair a Pollinator Health Taskforce to take steps to develop new public-private partnerships and increase citizen engagement.

- USDA Pollinator Working Group Chaired by Deputy Secretary
  - White House Strategy to Protect Pollinators
  - Pollinator Research Action Plan (PRAP)

History

- **2015**: 38 states and Puerto Rico.
- **2016**: 39 states, Puerto Rico, and Guam
  - Sampling >1100 apiaries
  - Highest participation to date
  - Highlights the importance that the survey receives funding
- **2017**: 43 states and territories
- **2018**: 42 states and territories



Sample types

Includes:	**Target:**
Bump test	*Tropilaelaps*
Alcohol sample	*Apis cerana* *Varroa* *Nosema* (not species specific)
Live bee box	Viruses Lake Sinai virus-2 (LSV-2) Acute bee paralysis virus (ABPV) Chronic bee paralysis virus (CBPV) Deformed wing virus (DWV) Kashmir bee virus (KBV) Israeli acute paralysis virus (IAPV) *Varroa Destructor* Virus (VDV-1) NEW
Wax sample	Pesticides (200 targets)
Pre-sampling survey	Demographics and management info

Sampling protocol

- In each participating state: 2 approaches of sampling
- 24 total samples (as previous years)

General sampling

14 beekeepers = 14 samples

Plan 3 or 4 sampling periods

Samples:

- Bump sample
- Alcohol sample
- Live bee sample

NEW Longitudinal sampling

5 beekeepers = 10 samples

Spring sample & Fall sample

Colonies to be identified by stickers

- Bump sample
- Alcohol sample
- Live bee sample
- **Wax sample**

Sampling protocol

General sampling

Longitudinal sampling

As before, prioritize beekeepers :

- Managing large operations
- Queen/package/nucs producers
- In areas at high risk for exotics invasion

Requirements for participation:

- Minimum 10 colonies
- NEW Commitment to take online Loss and Management Survey (point of contact: UMD)
- NEW Pre-sampling survey to be handed at time of sampling

Sampling protocol

General sampling

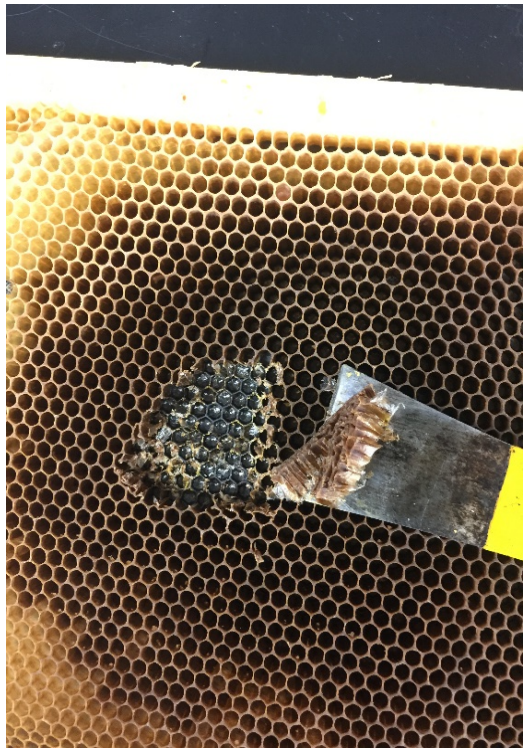
Longitudinal sampling

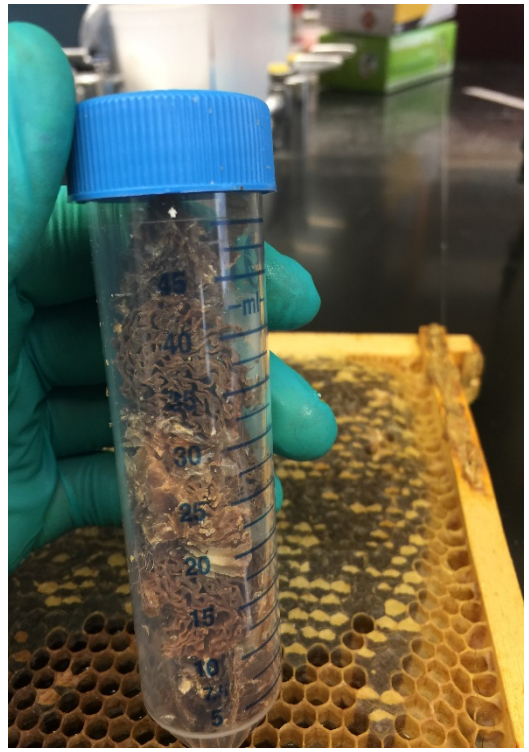
NEW

In the yard, make sure that colonies are picked **at random**. Particularly, colonies should NOT be preferentially sampled because they seem “healthy” or “sickly”

Wax sampling

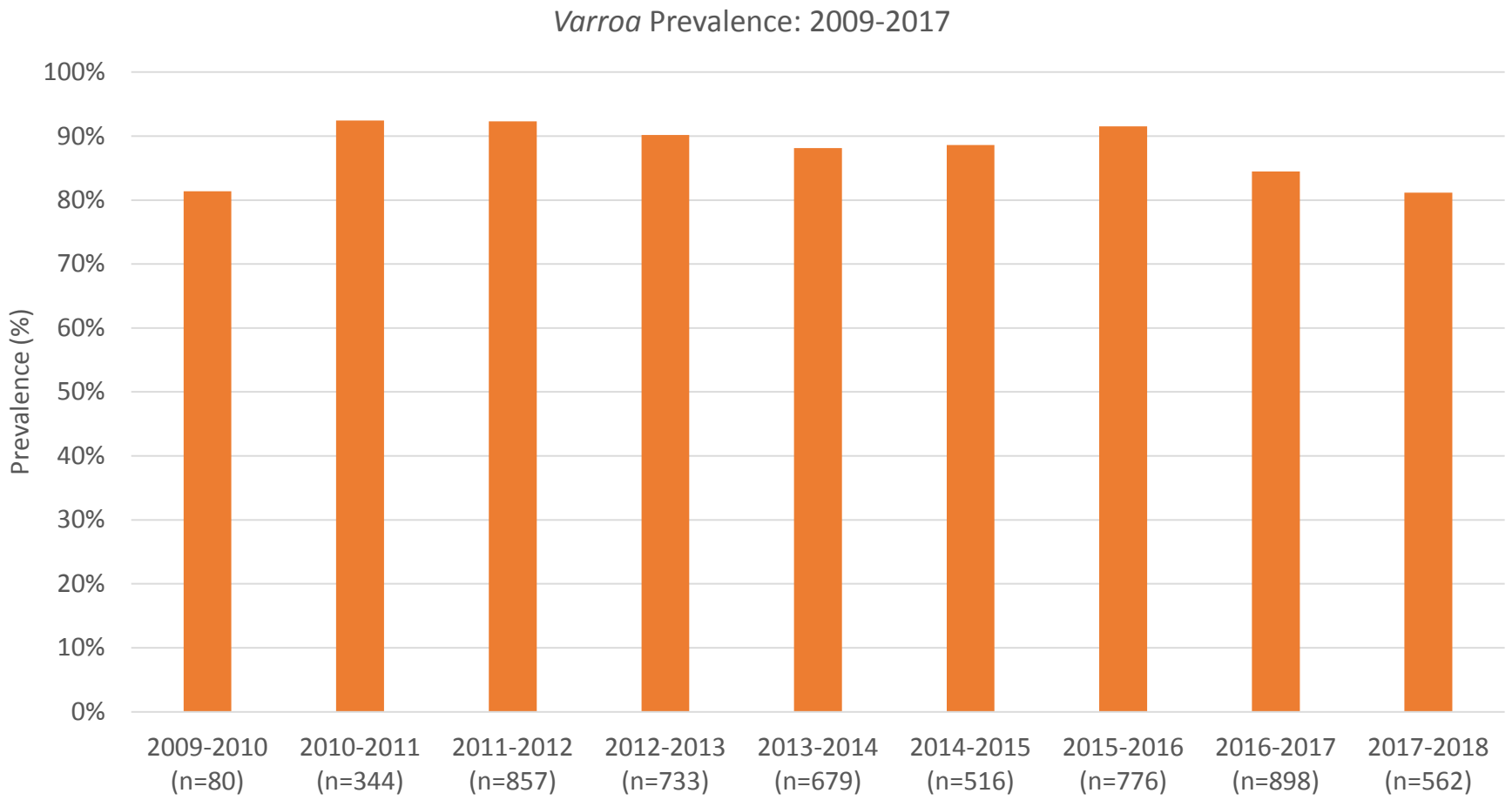
- Total # of pesticide residues in wax shown* to be a better predictor of colony mortality and queen events (a predictor of imminent colony mortality)
- A small section of wax is cut out from a brood frame
- Sent to USDA AMS Lab in NC



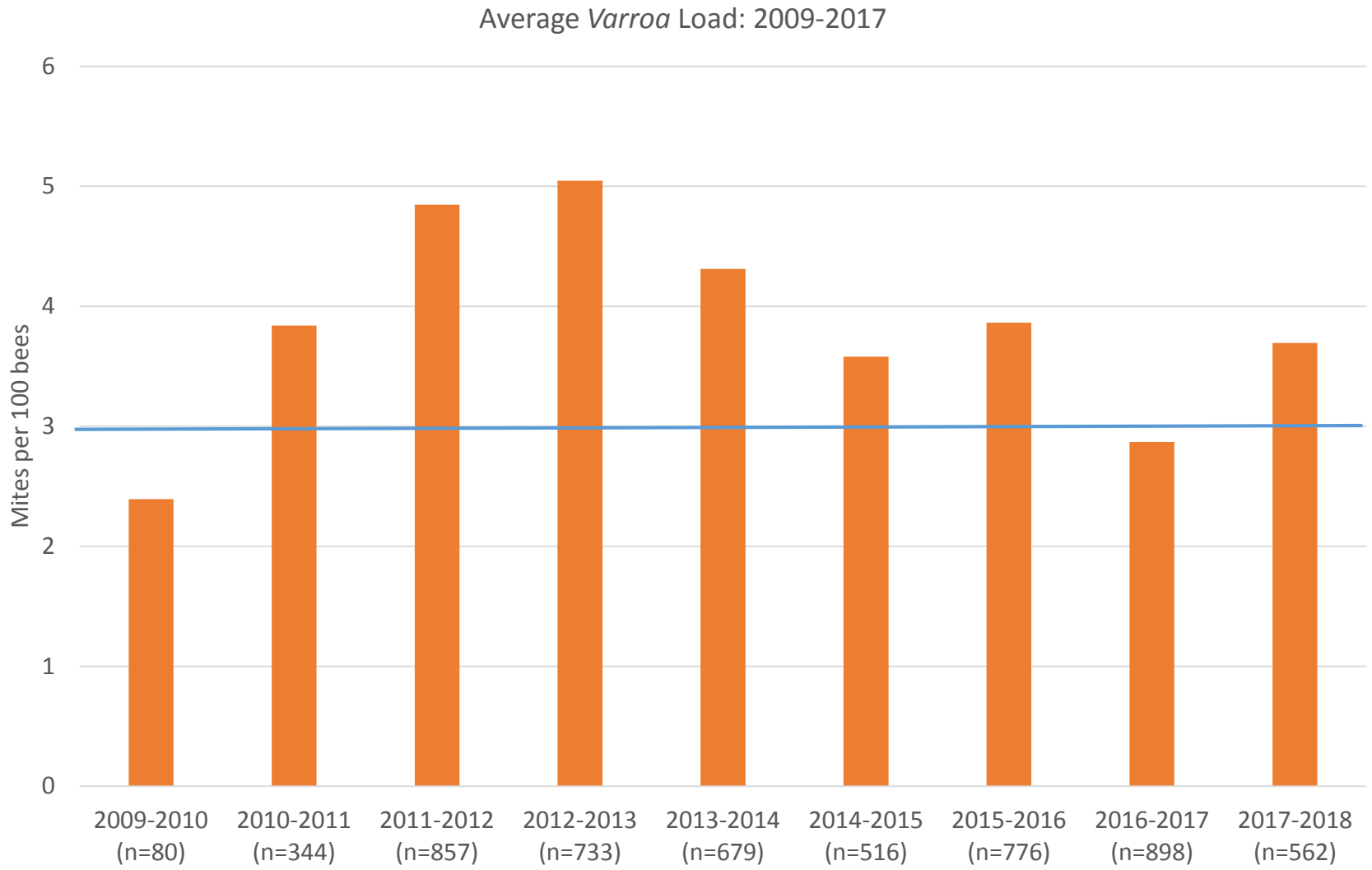


Traynor, K. S. et al. In-hive Pesticide Exposome: Assessing risks to migratory honey bees from in-hive pesticide contamination in the Eastern United States. Sci. Rep. **6, 33207; doi: 10.1038/srep33207 (2016).*

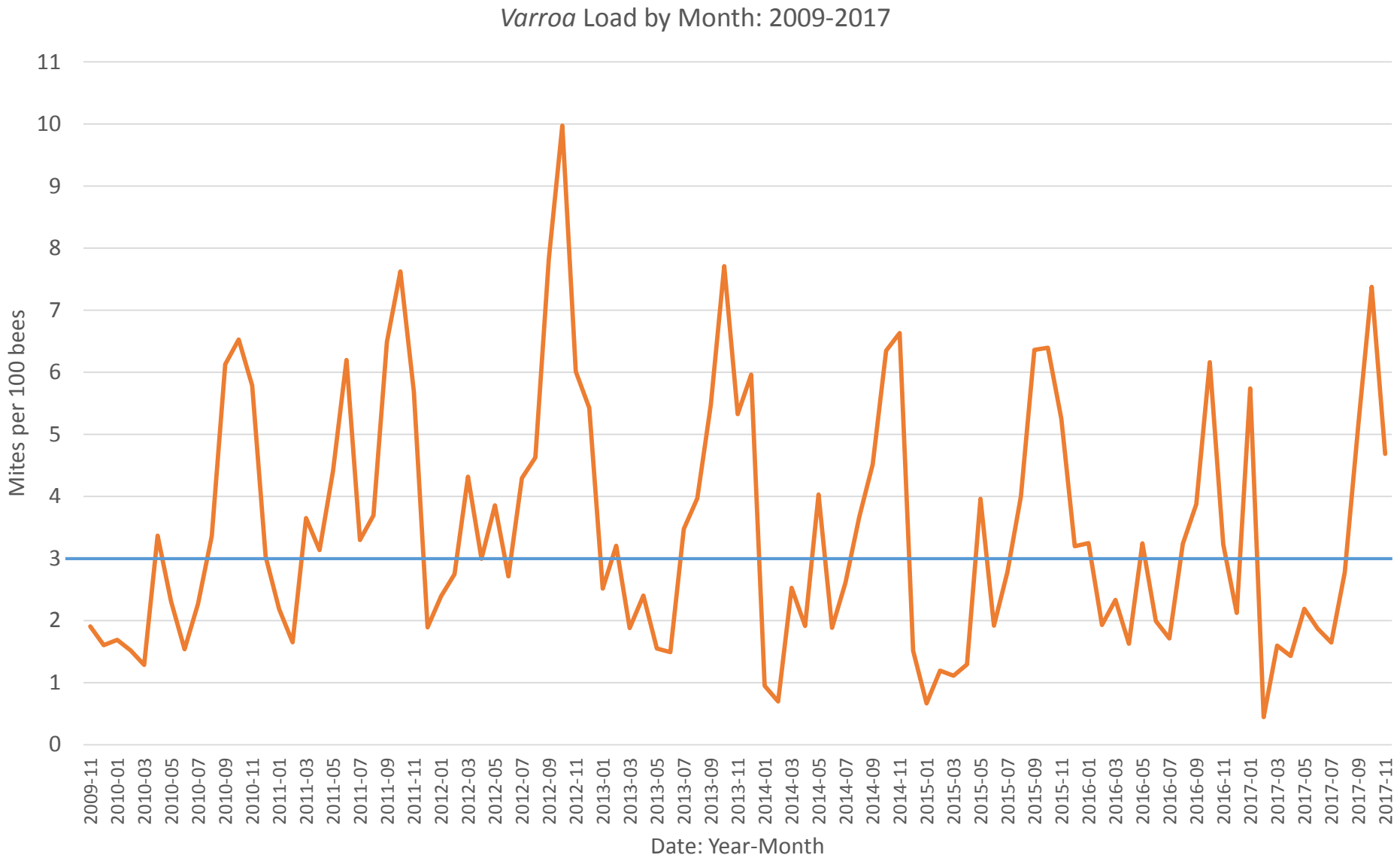
Varroa Prevalence by year



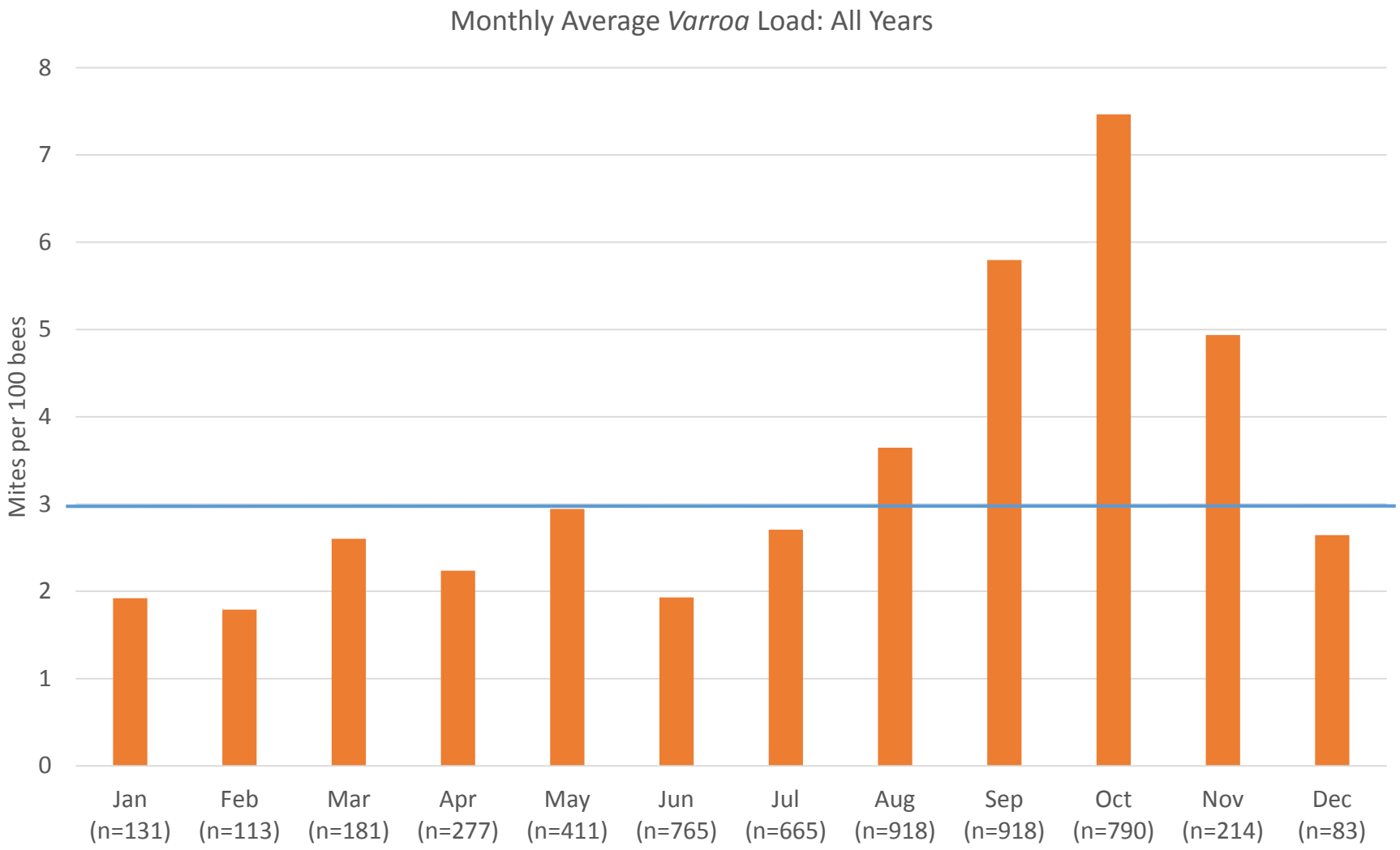
Average *Varroa* Load by year



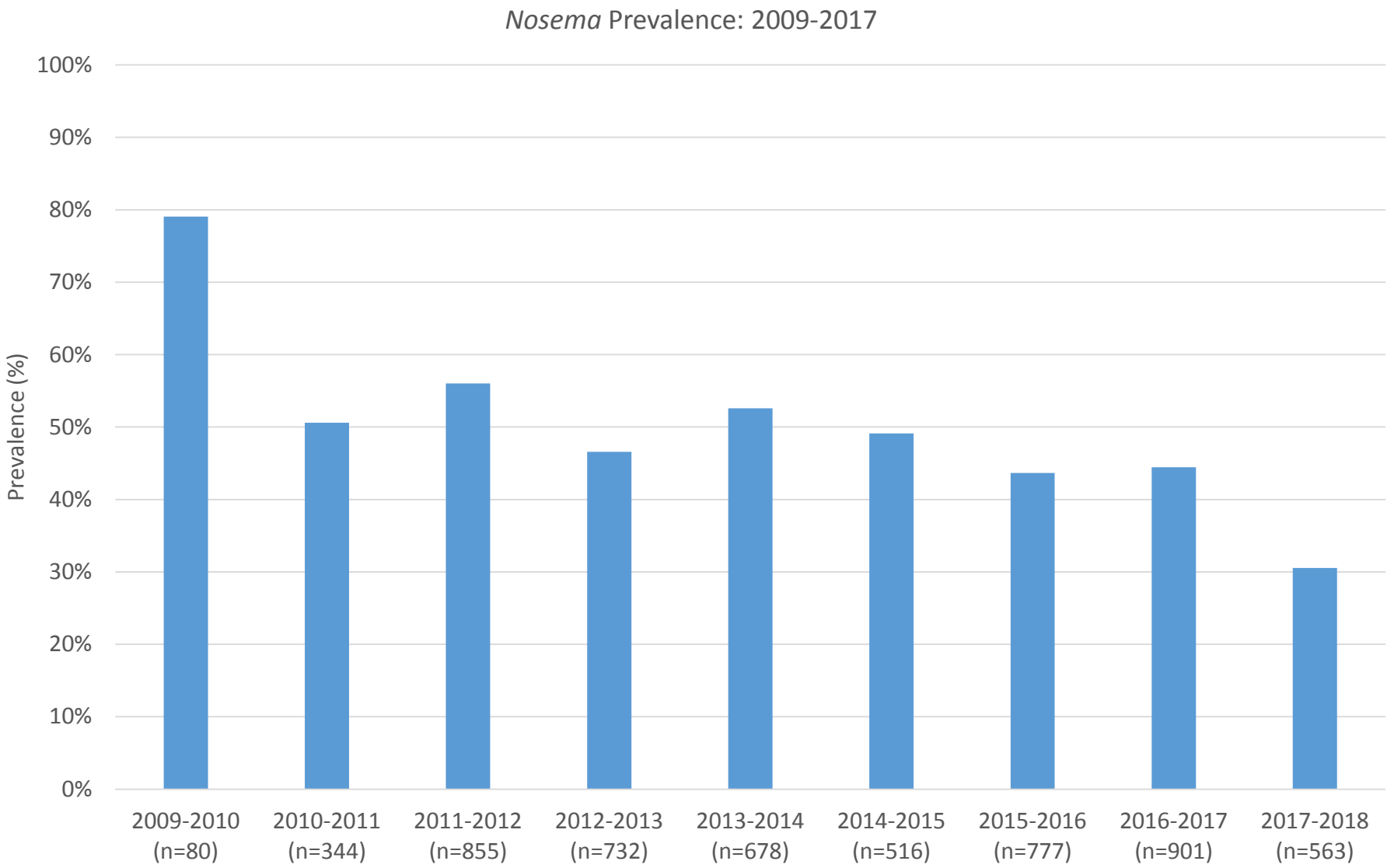
Varroa Seasonality



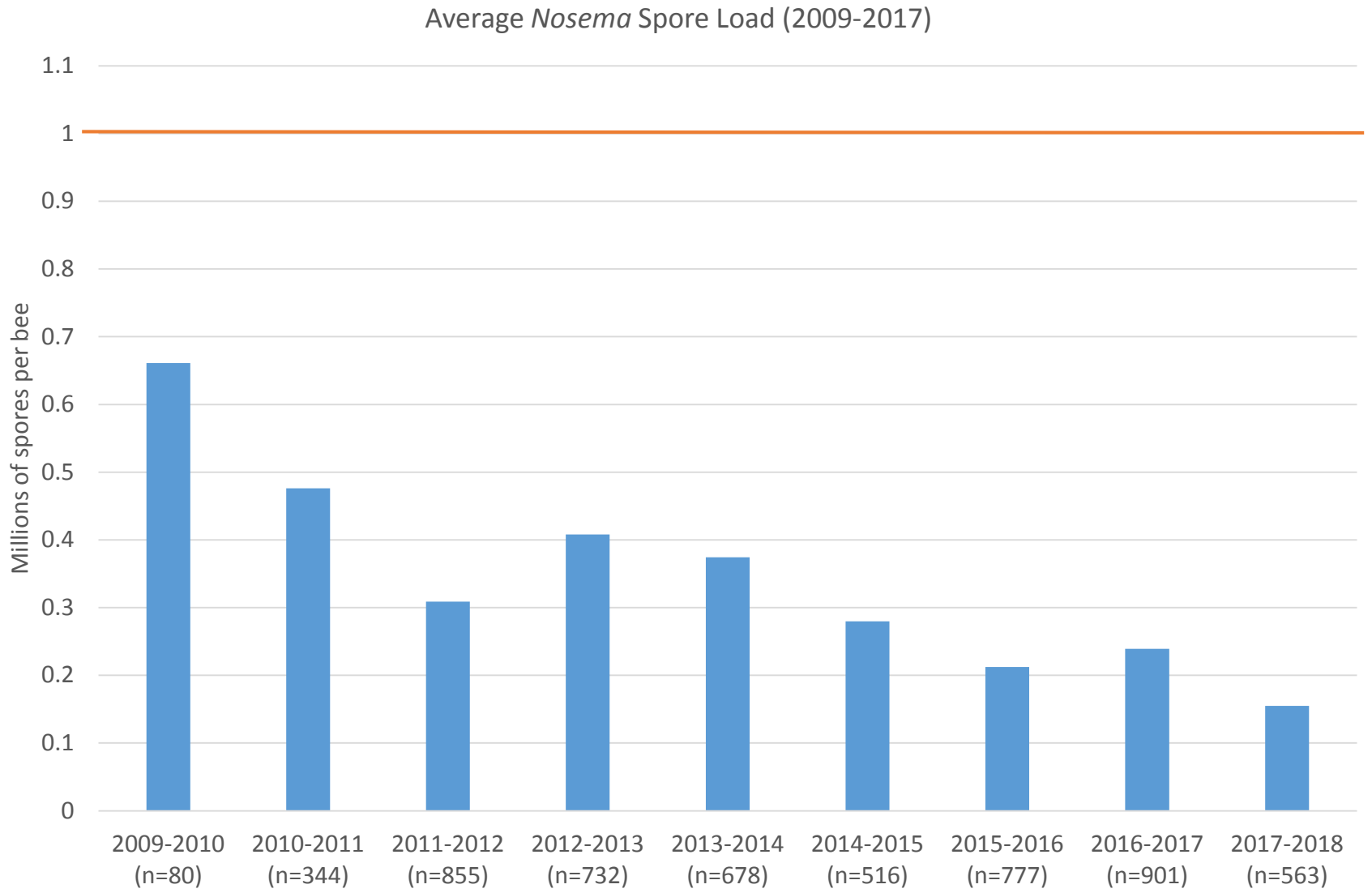
Varroa Seasonality



Nosema Prevalence by year

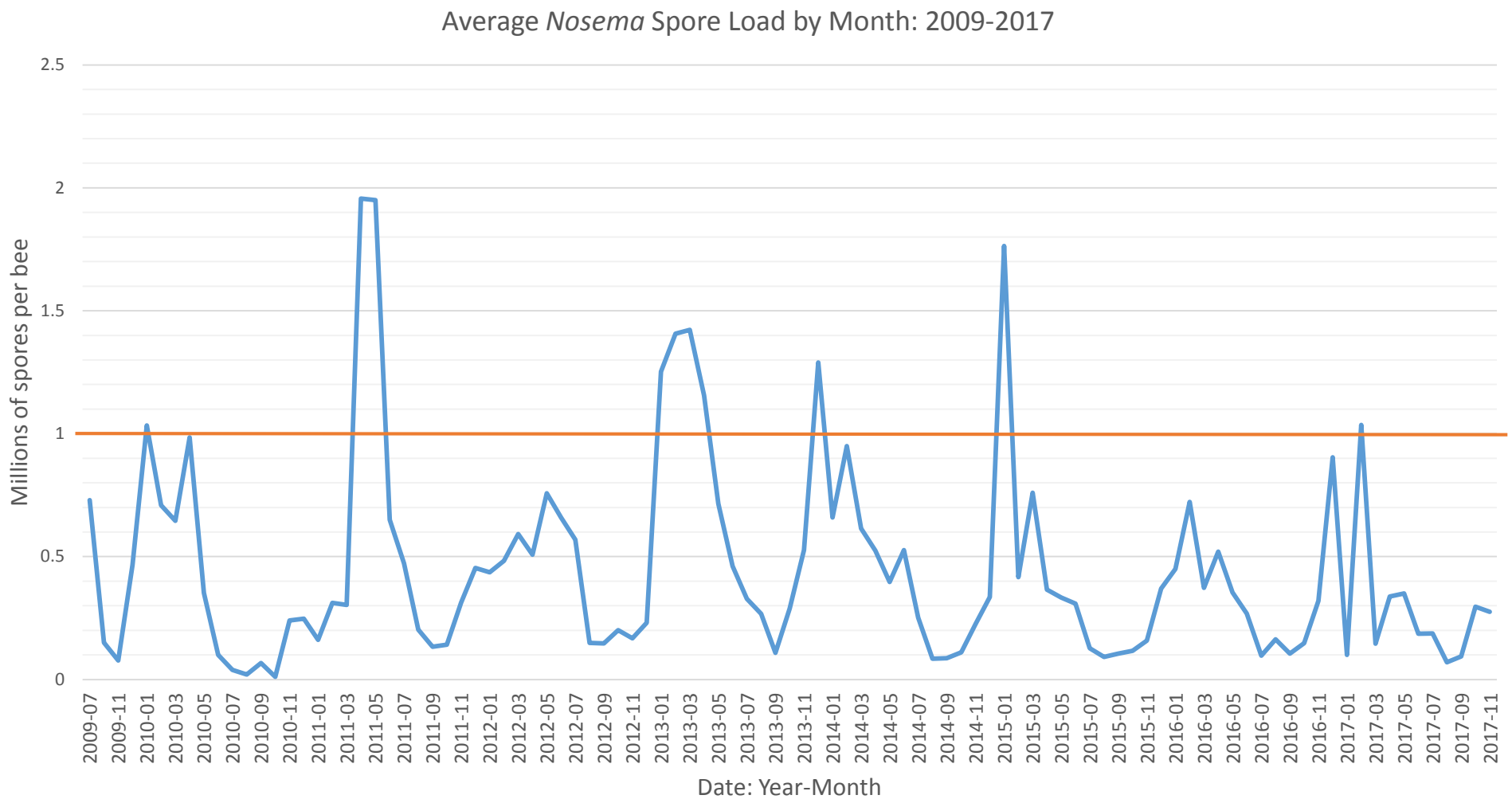


Average Nosema Load by year

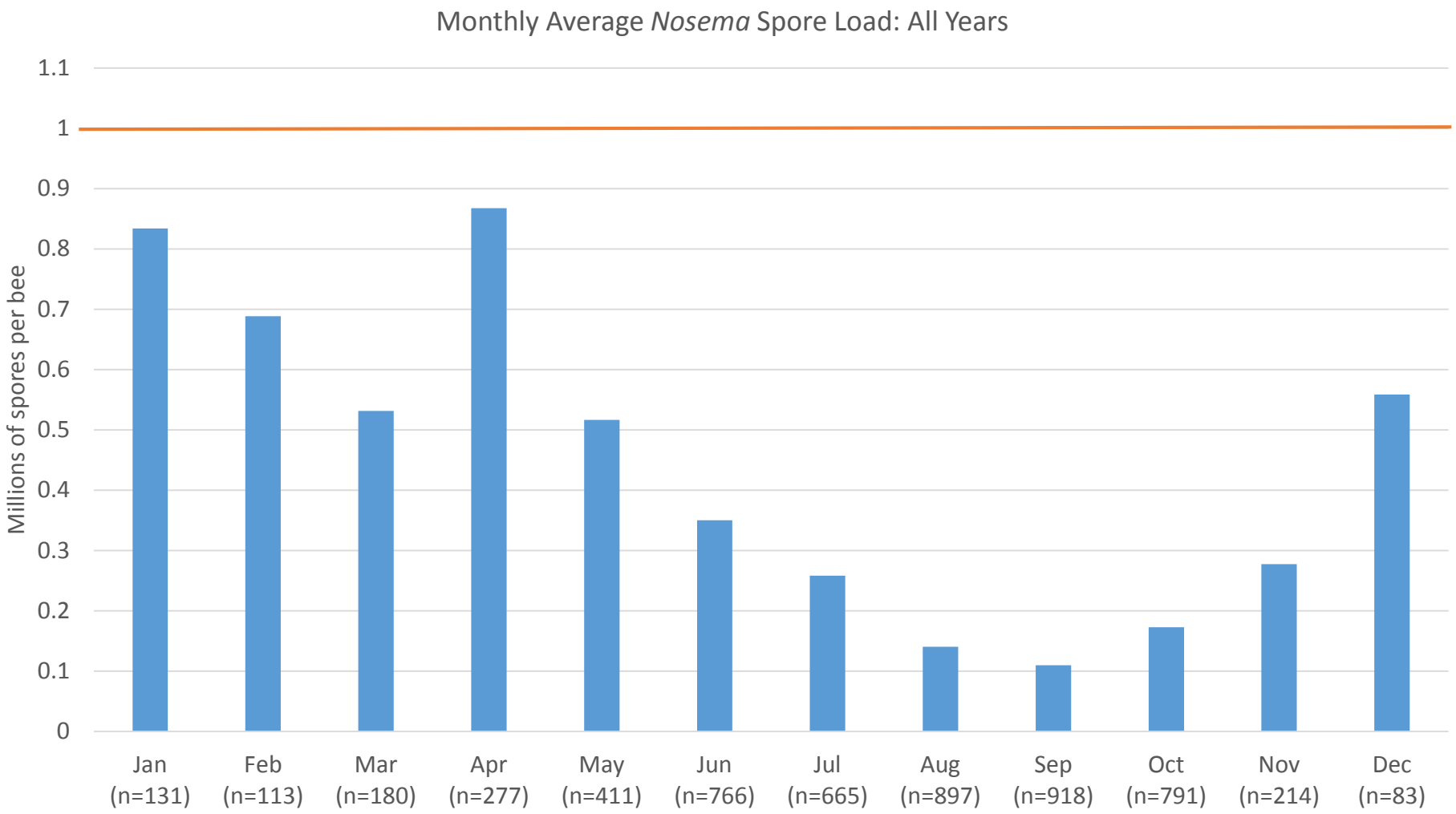


Economic threshold for nosema is 1 million spores per bee

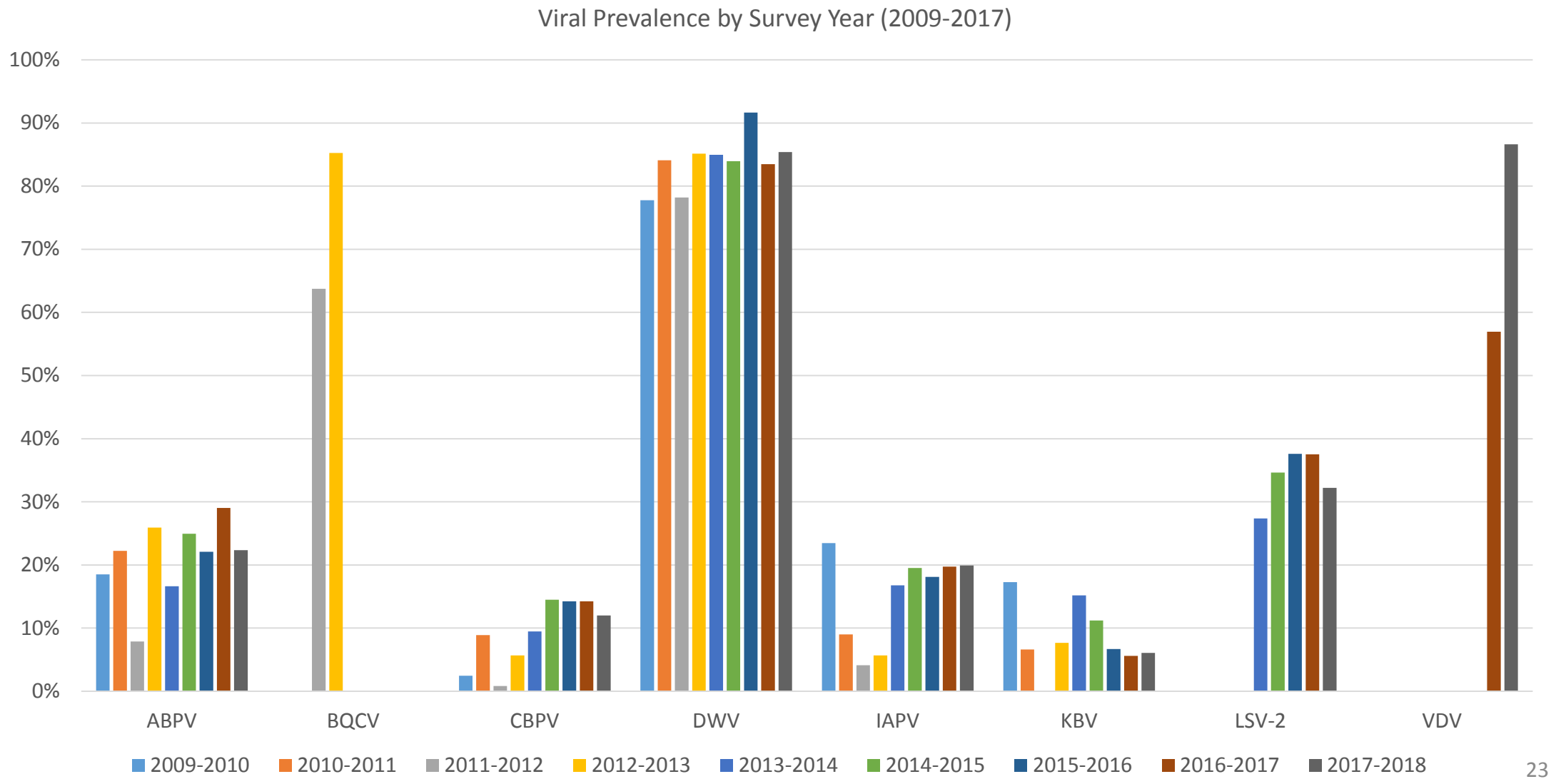
Nosema Seasonality



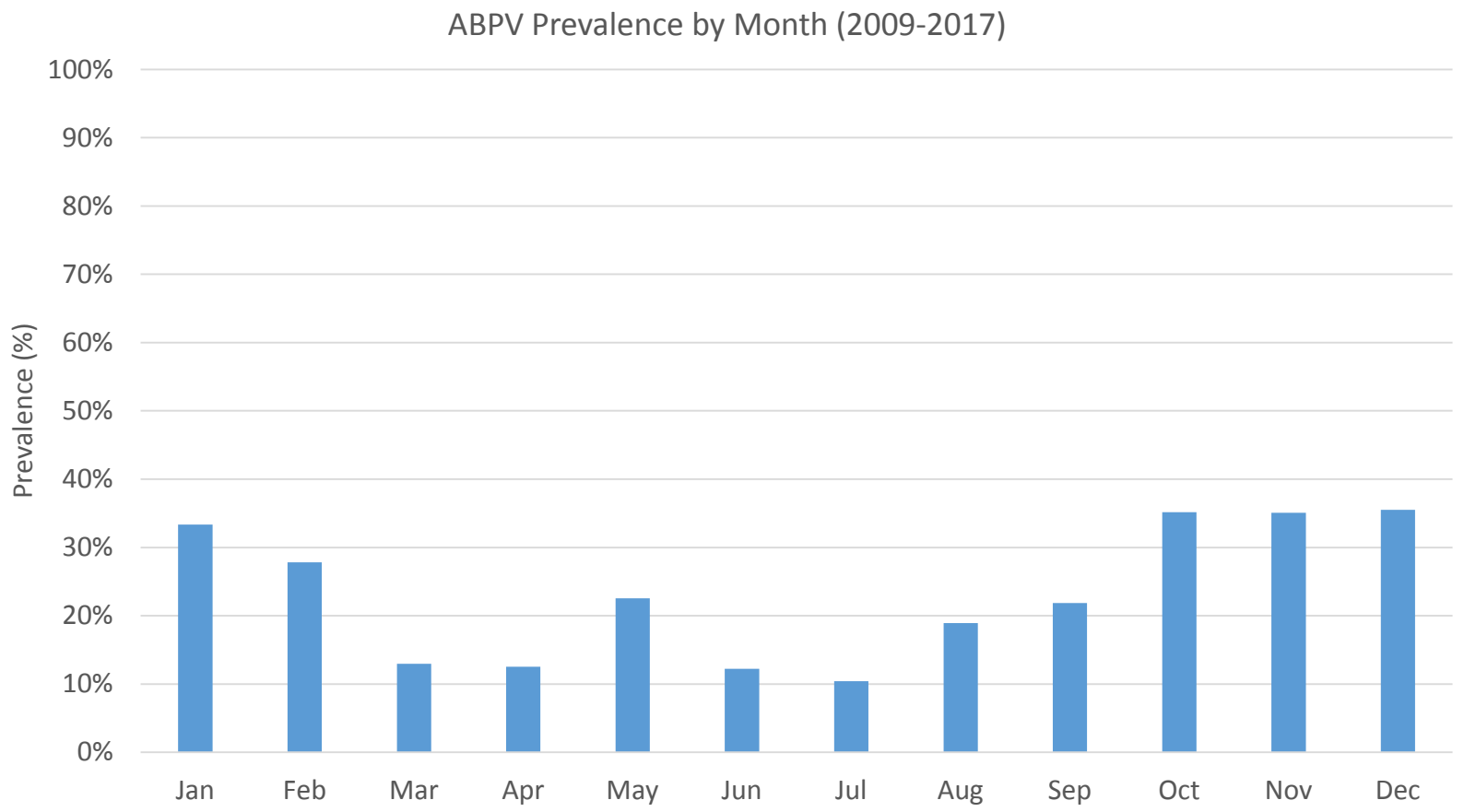
Nosema Seasonality



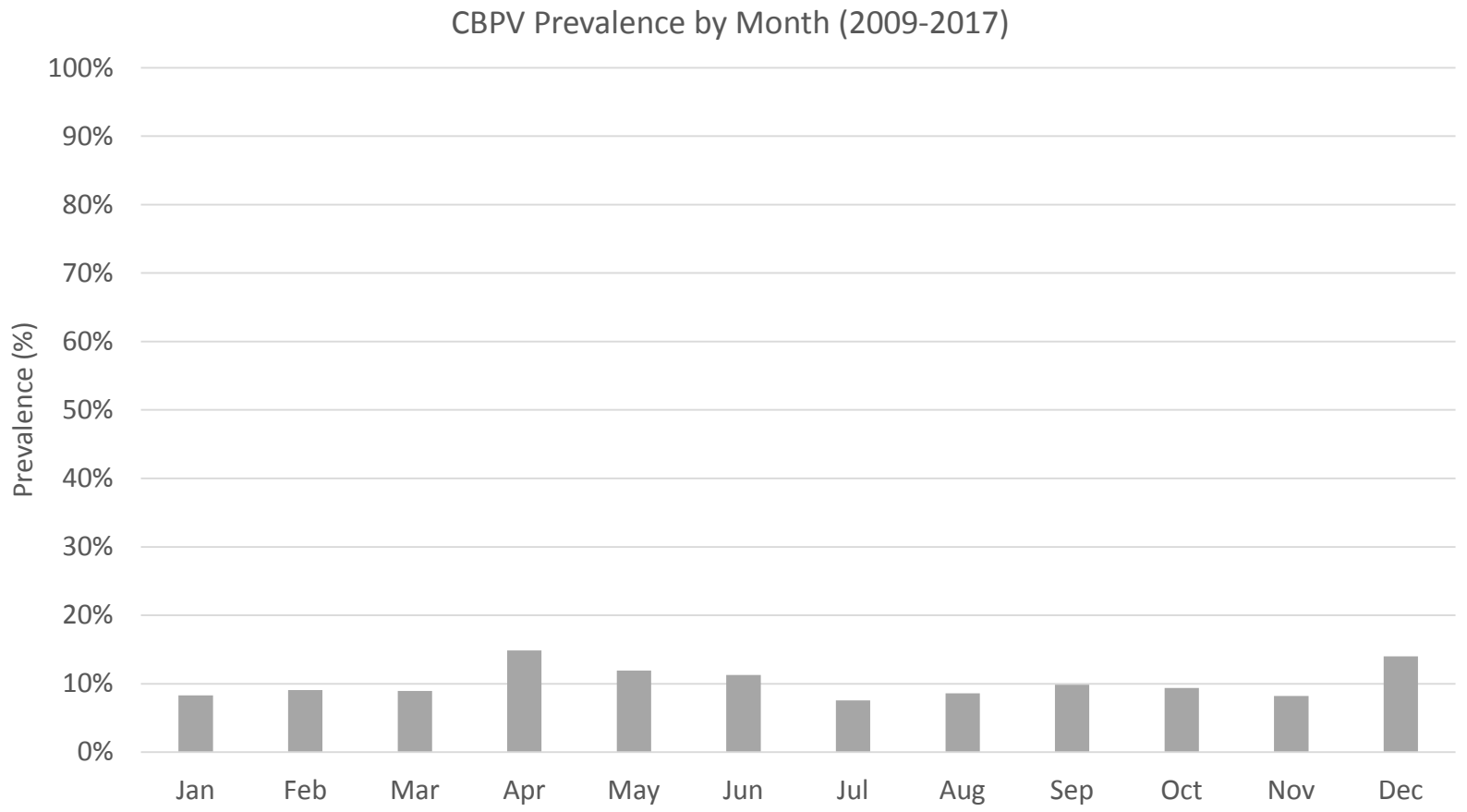
Viral Prevalence over the years



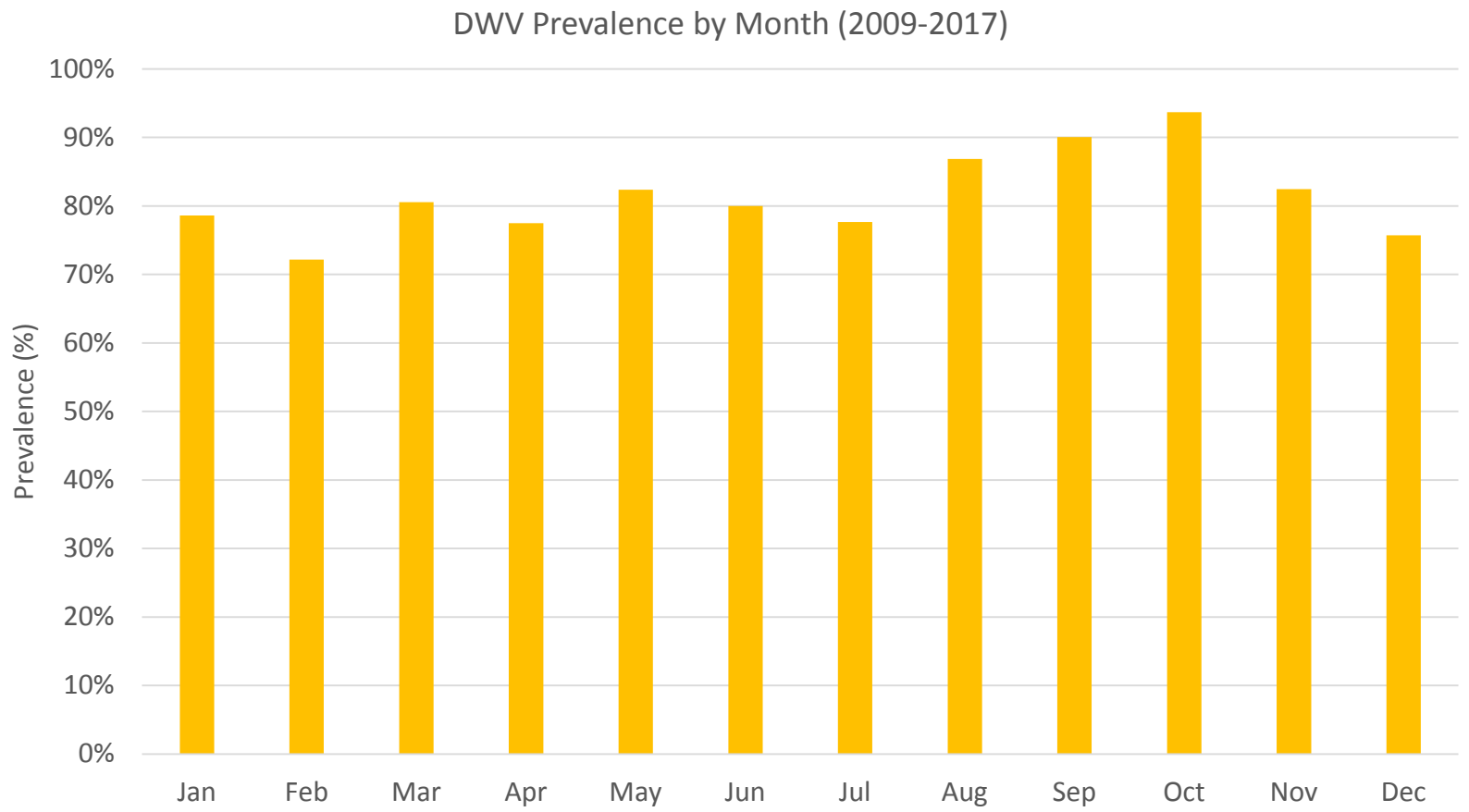
Viral Seasonality: ABPV



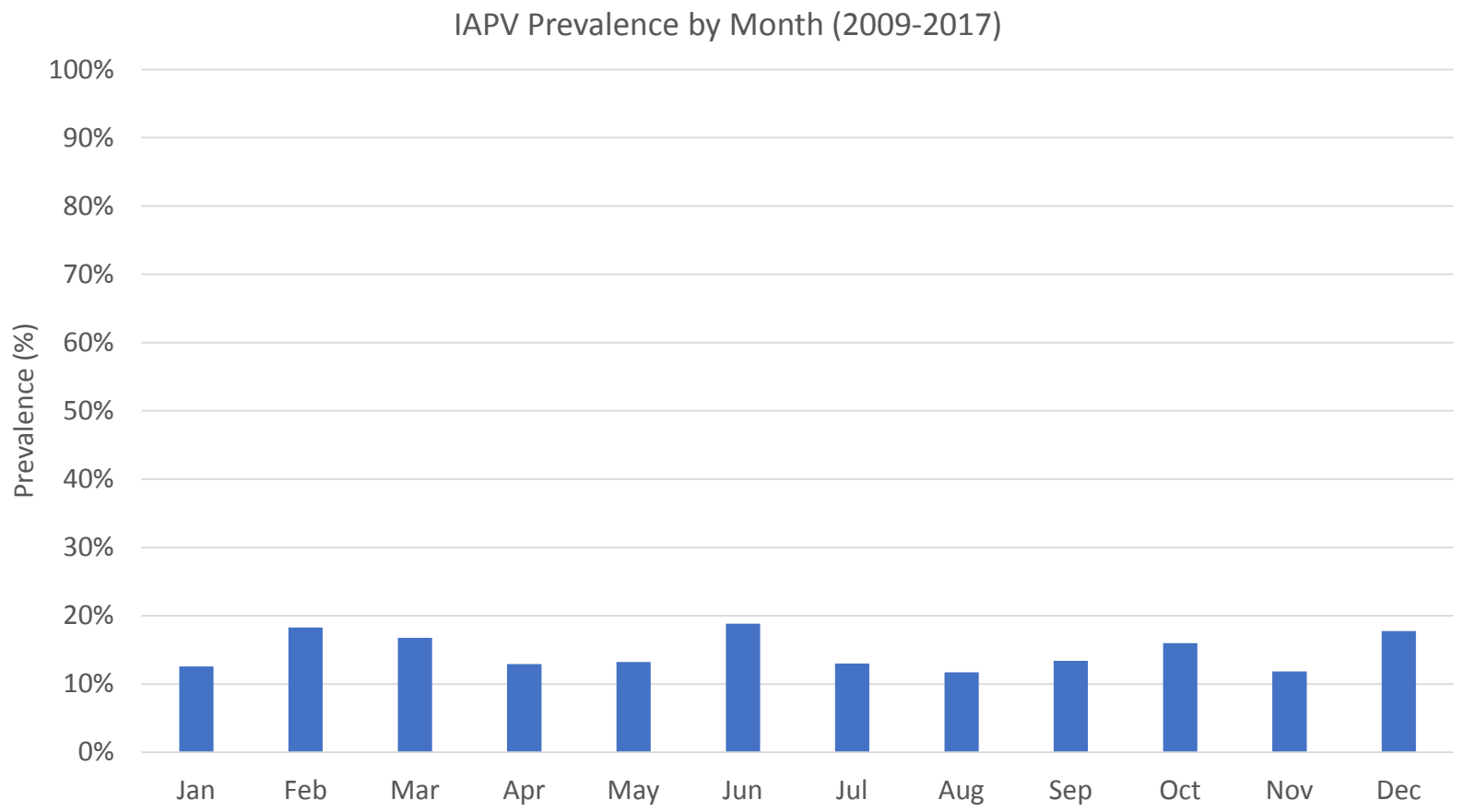
Viral Seasonality: CBPV



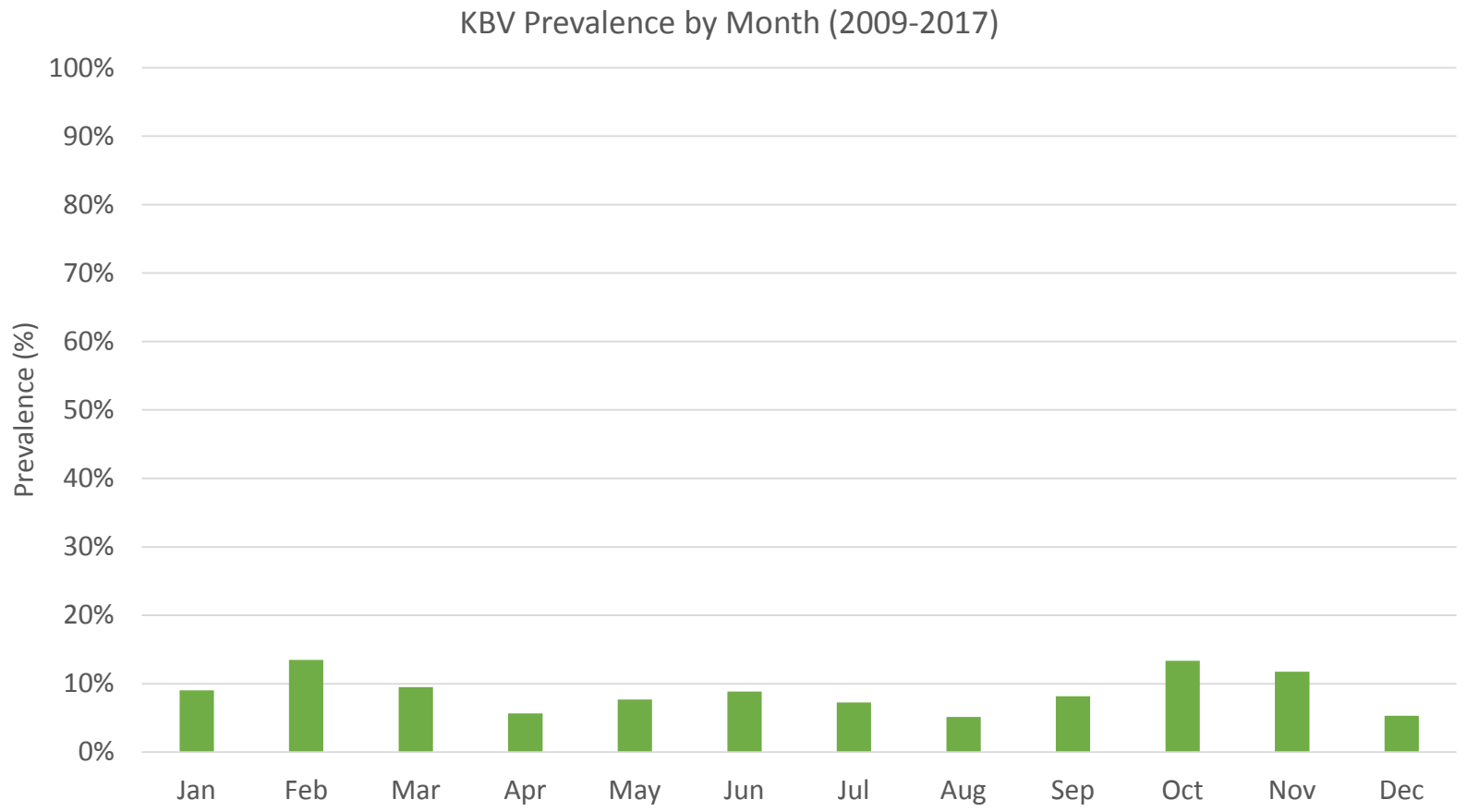
Viral Seasonality: DWV



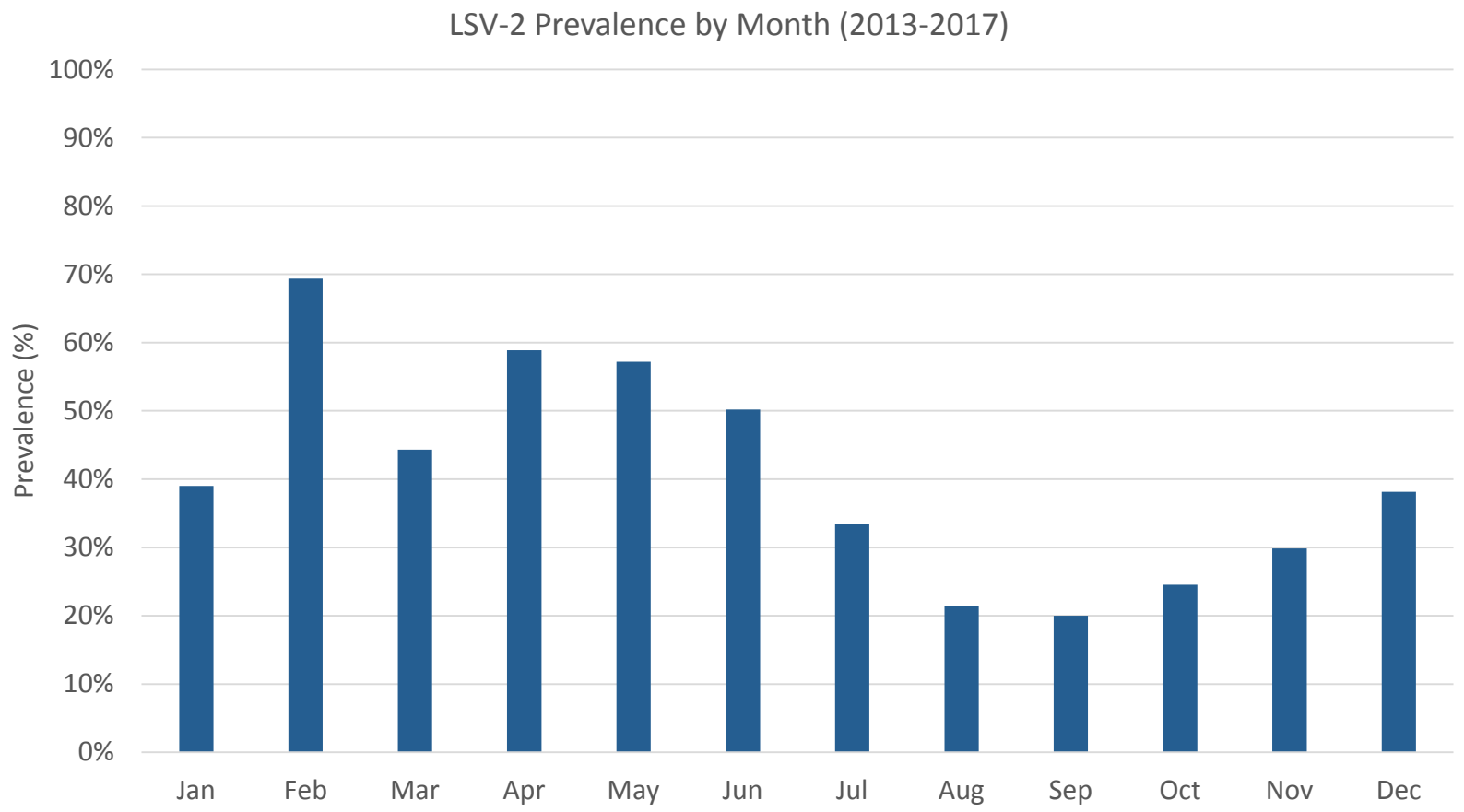
Viral Seasonality: IAPV



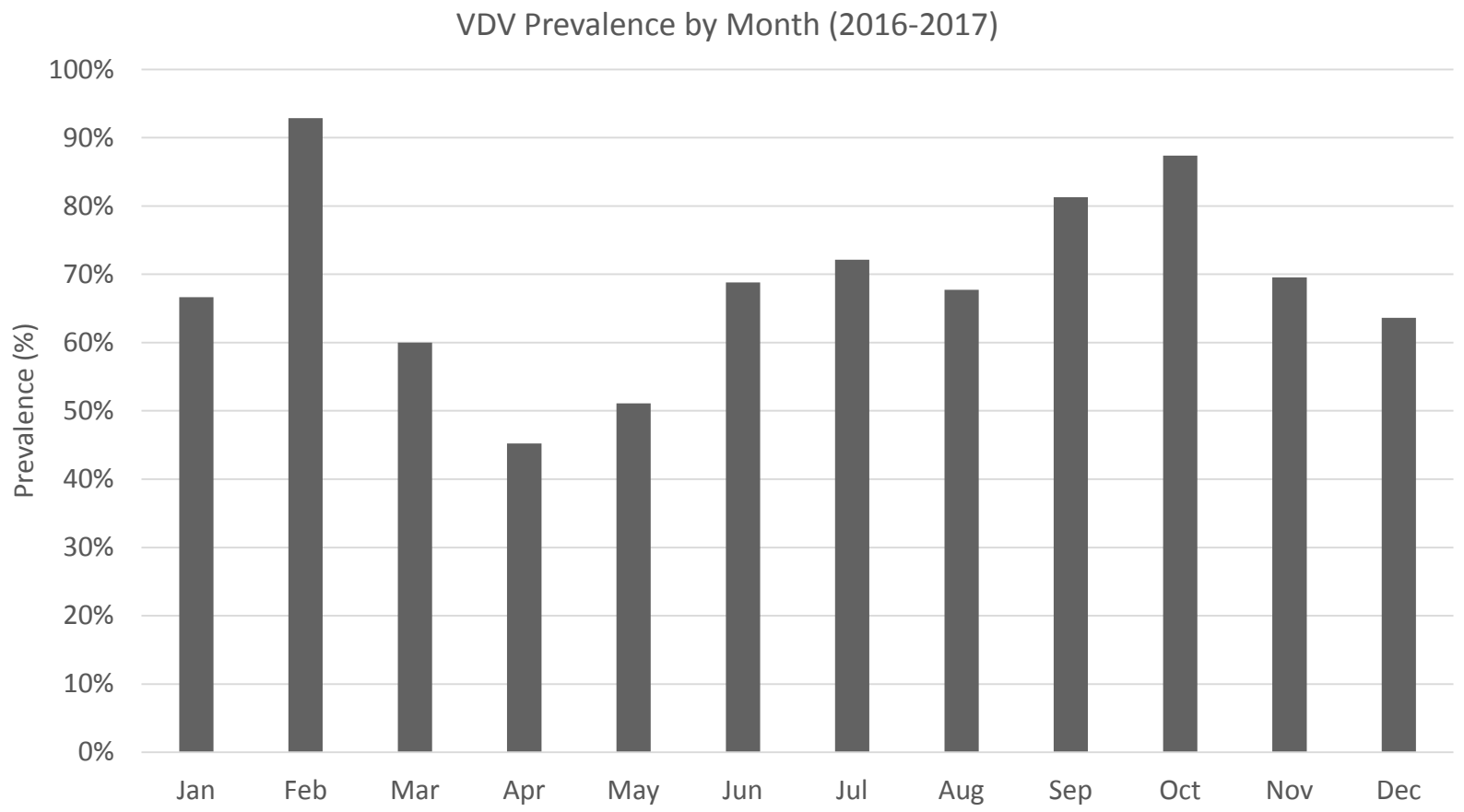
Viral Seasonality: KBV



Viral Seasonality: LSV-2



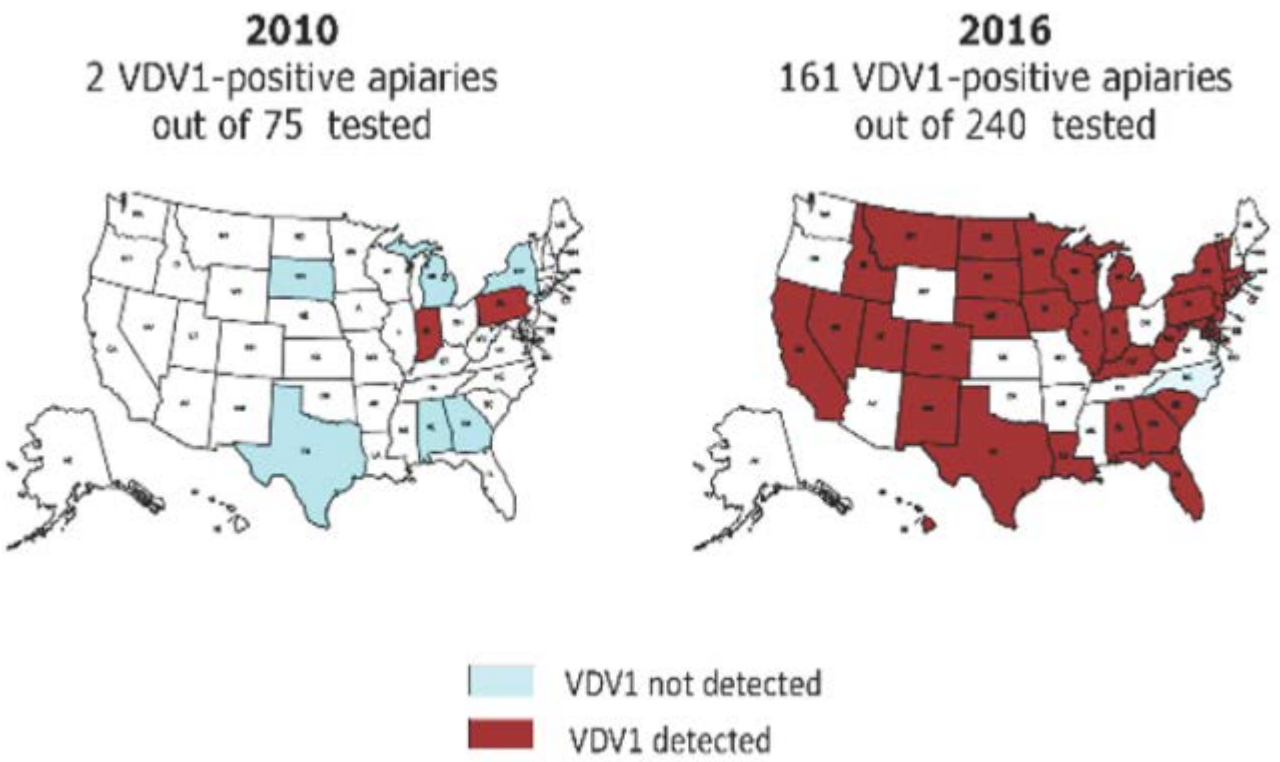
Viral Seasonality: VDV



VDV: *Varroa Destructor* Virus

- Discovered in the US by Dr. Eugene Ryabov working with Dr. Jay Evans at the USDA BRL in Beltsville, MD.
- Using RNA sequencing, VDV1 was detected in 66% of National Survey samples in 2016, but detected in only 2.7% of colonies tested in 2010
- VDV1 is in the same family of viruses with Deformed Wing Virus (detected in 90% of all colonies)
- Evidence of DWV-VDV1 recombinants in the US
  - More virulent

VDV: *Varroa Destructor* Virus

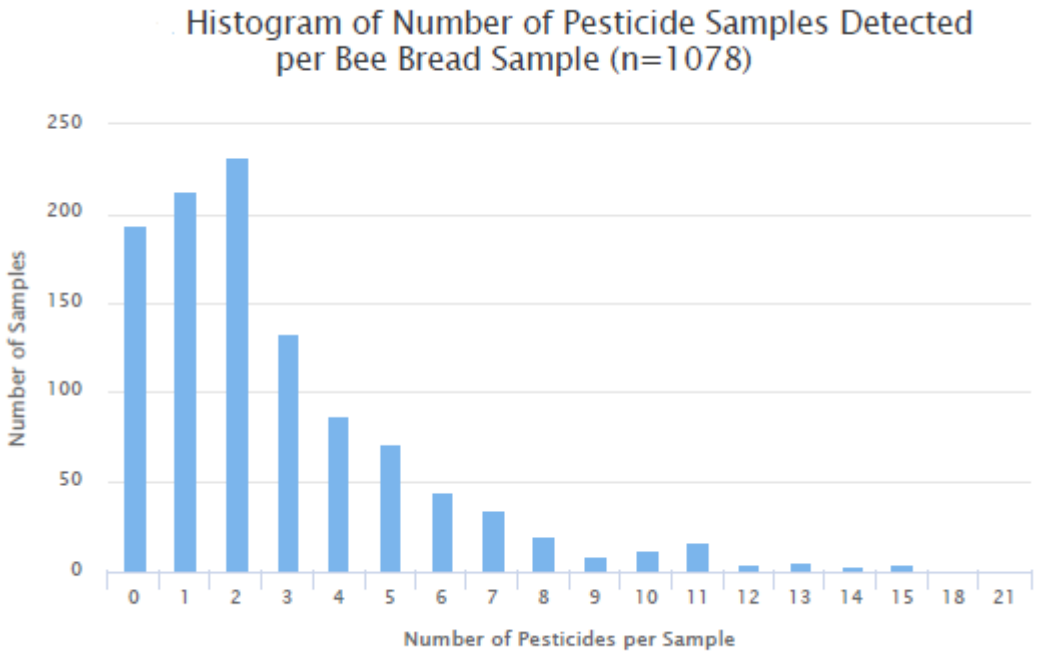


- Published December 12, 2017 in *Nature Scientific Reports*
- VDV1 has been added to the list of viruses for the National Honey Bee Survey.

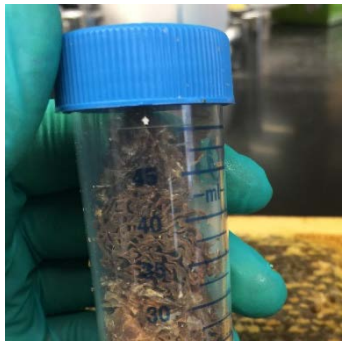
- We also plan to go back and run our archived samples from 2011-2015 to track how the virus spread

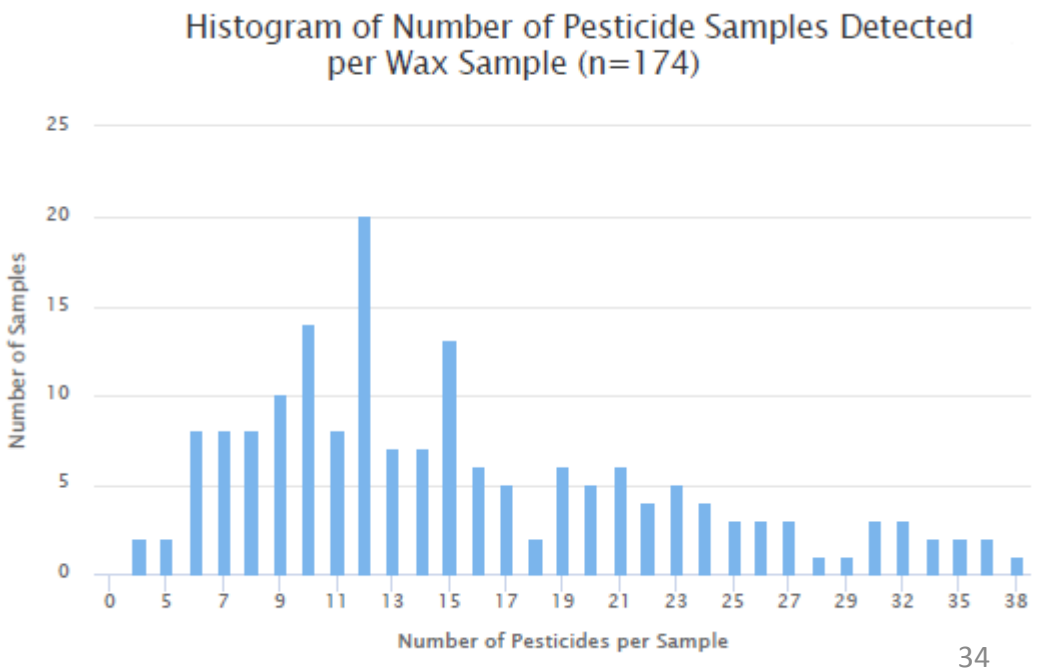
Pesticides

2011-2016



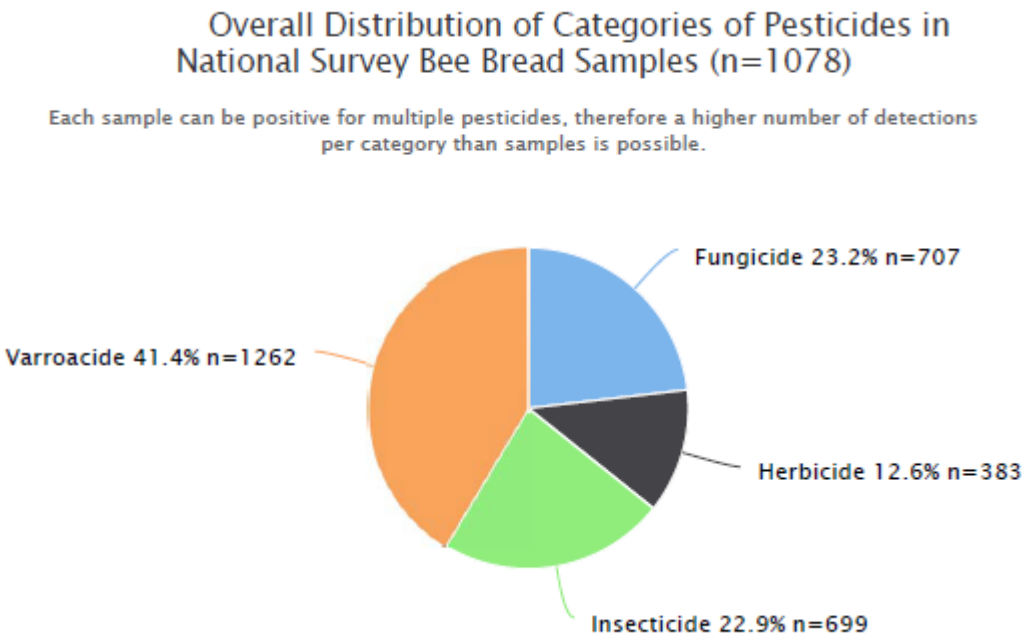
2017



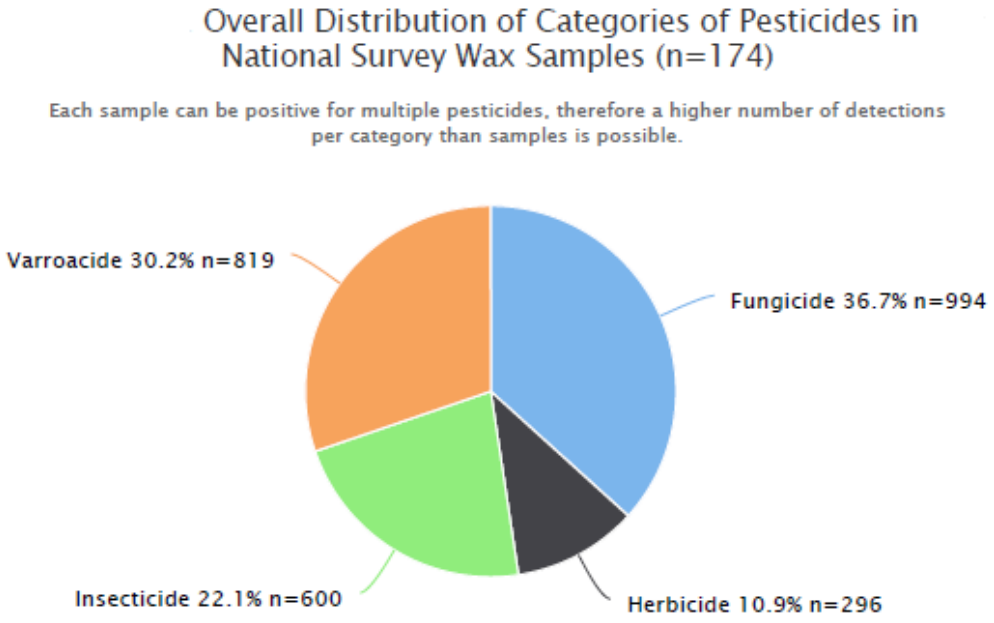


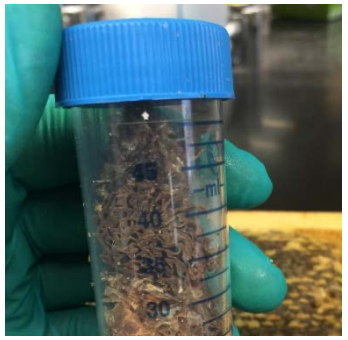
Pesticides

2011-2016



2017





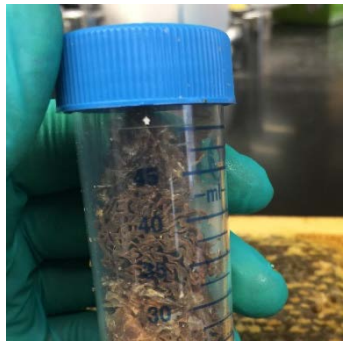
Pesticides

Bee Bread

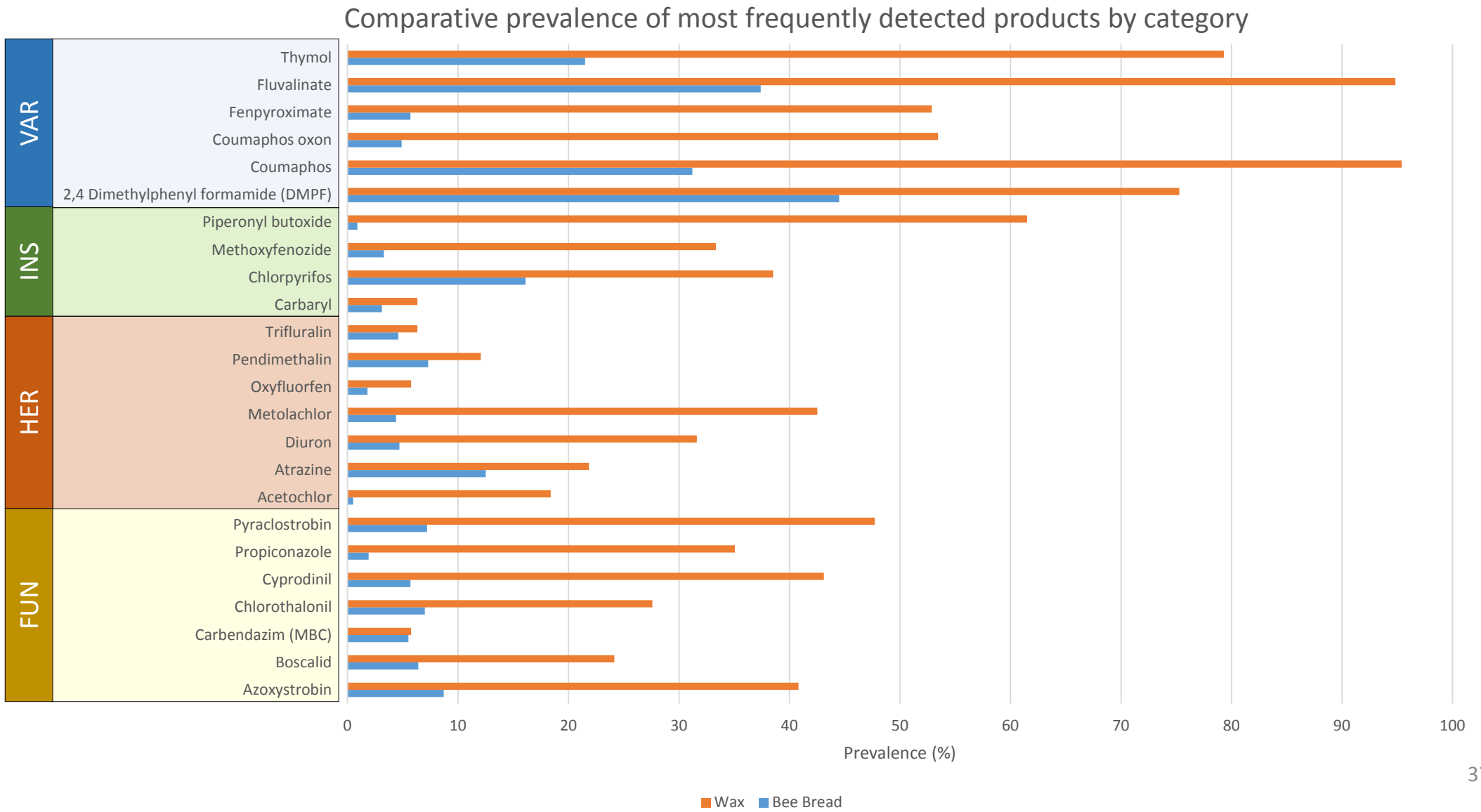
- n=1078, 3051 detections
- 2.8 average pesticide detections per sample
- 17.9% of samples had no pesticides detected

Wax

- n=174, 2709 detections
- 15.5 average pesticide detections per sample
- No samples with 0 pesticide detections

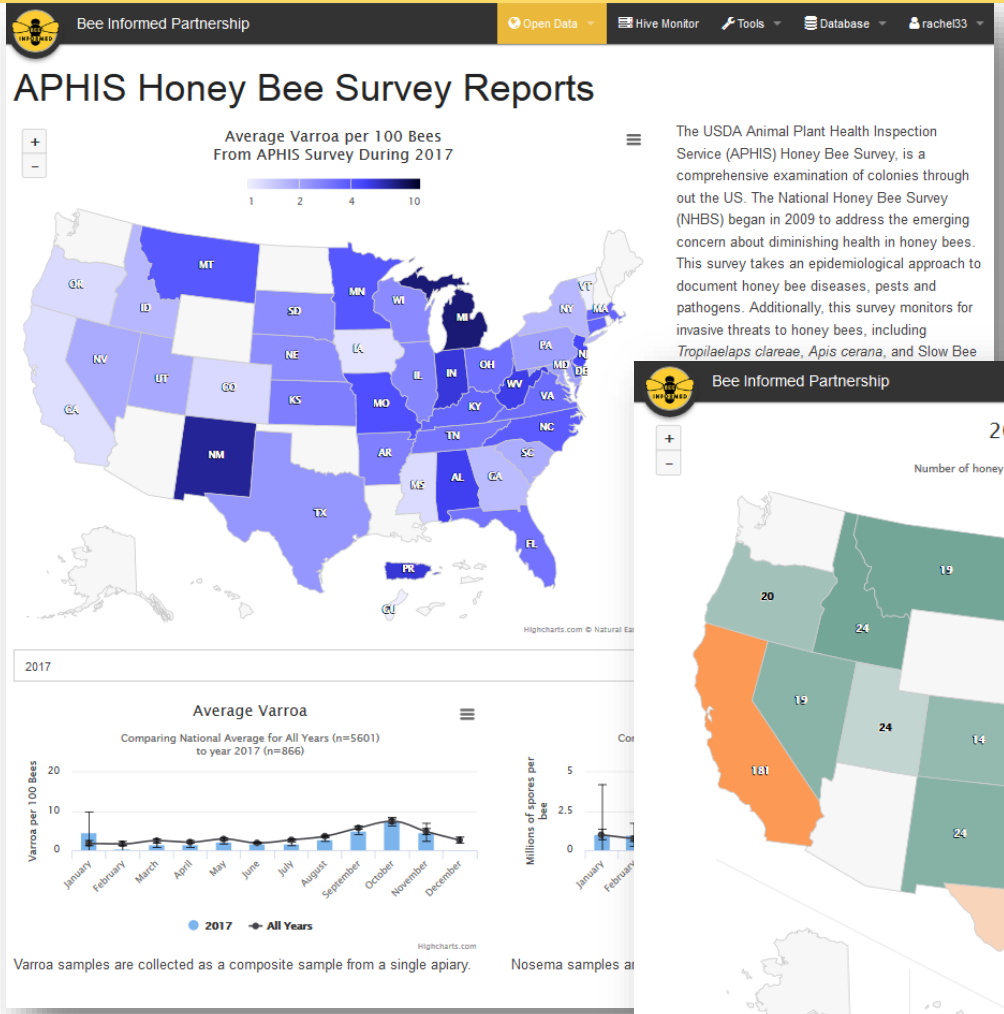


Pesticides

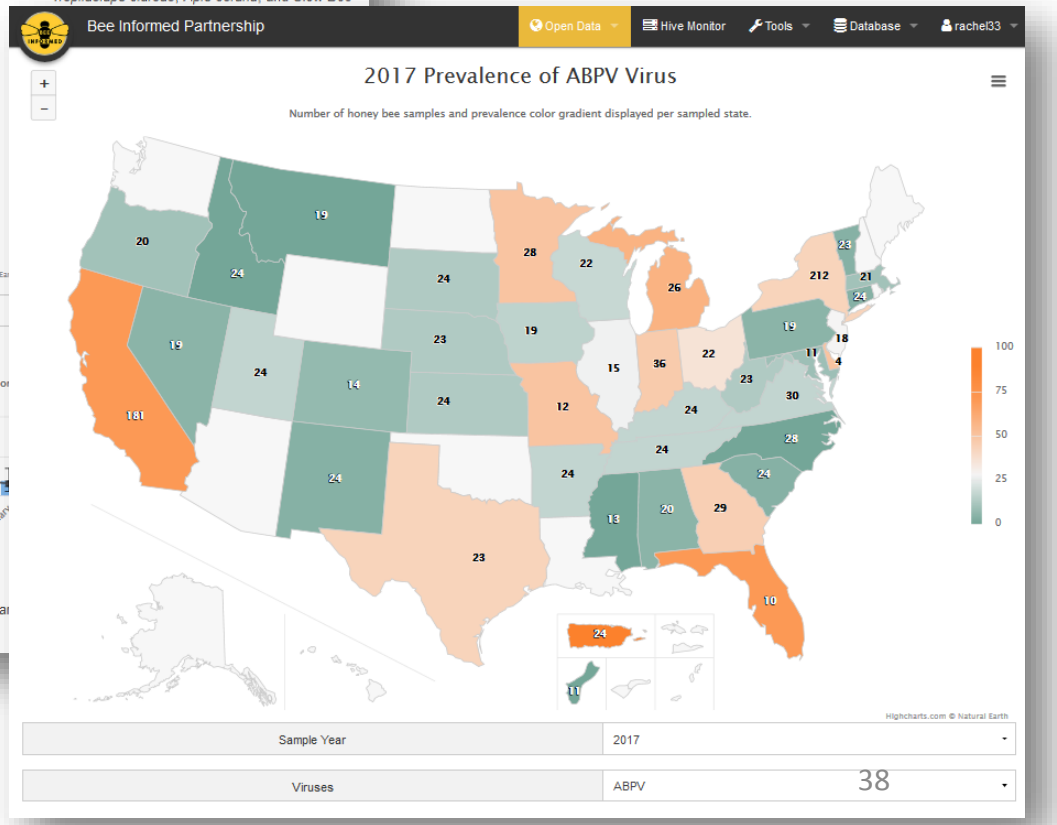

Comparative prevalence of most frequently detected products by category
VAR
Thymol
Fluvalinate
Fenpyroximate
Coumaphos oxon
Coumaphos
2,4 Dimethylphenyl formamide (DMPF)
INS
Piperonyl butoxide
Methoxyfenozide
Chlorpyrifos
Carbaryl
HER
Trifluralin
Pendimethalin
Oxyfluorfen
Metolachlor
Diuron
Atrazine
Acetochlor
FUN
Pyraclostrobin
Propiconazole
Cyprodinil
Chlorothalonil
Carbendazim (MBC)
Boscalid
Azoxystrobin
0
10
20
30
40
50
60
70
80
90
100
Prevalence (%)
Wax
Bee Bread

Explore the data online

All of this information is also available online!
Go to:
bip2.beeinformed.org
State Reports



Virus Heat Map!



Acknowledgements

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- USDA ARS Honey Bee Lab in Beltsville, MD
- University of Maryland Honey Bee Lab