Environmental concerns over the registration and use of neonicotinoid pesticides

Christy A. Morrissey

Associate Professor, Biology and School of Environment and Sustainability

University of Saskatchewan

History of Pesticide Use in North America

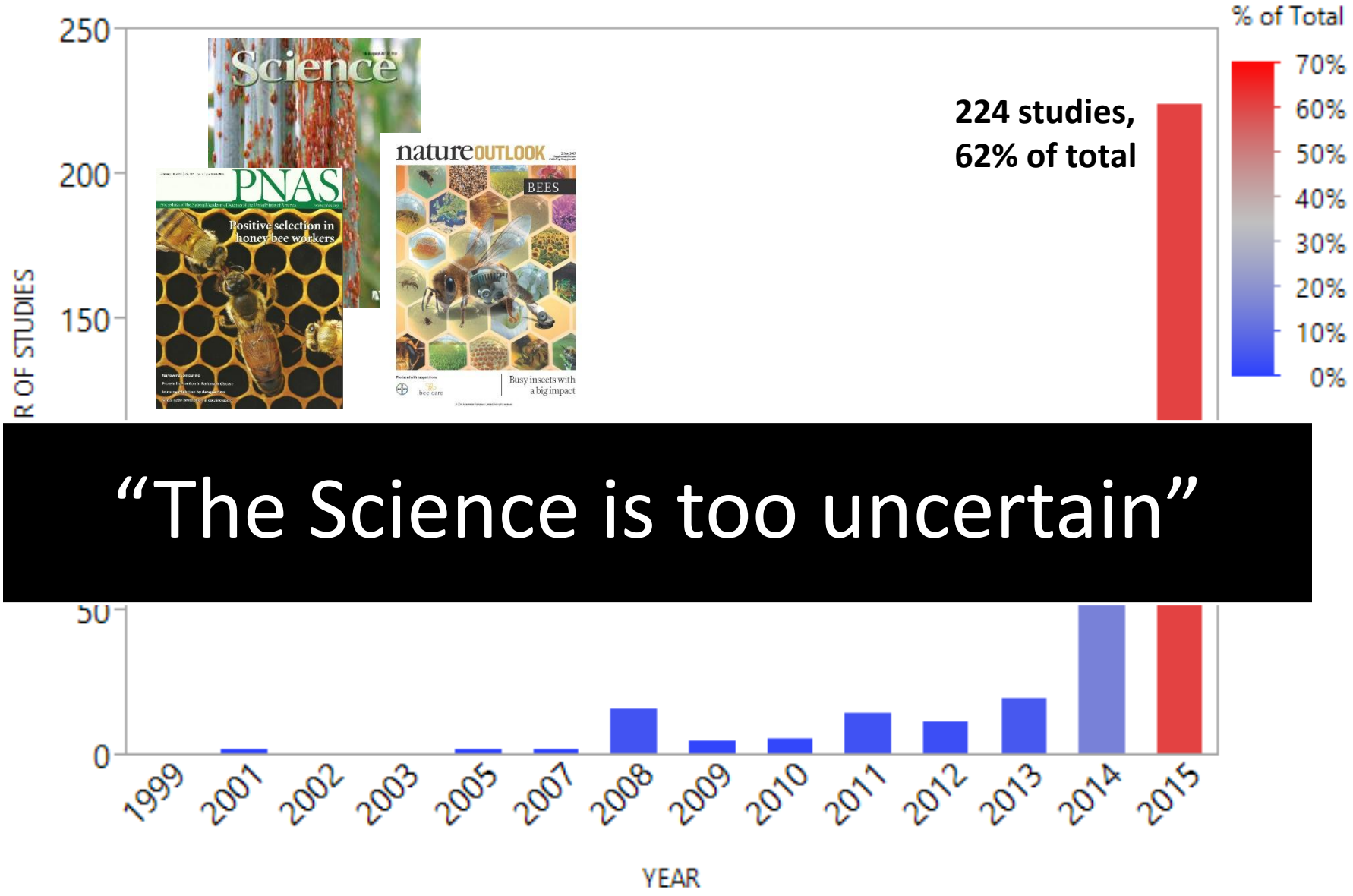
1960	1970	1980	1990	2000	2010
One farmer supplies **25.8 people** **Total US pesticide use** 617M lbs/year (1964) **OCs** leading insecticides	One farmer supplies **47.7 people** **Total US pesticide use** 760M lbs/year (1970)	One farmer supplies **75.7 people** **Total US pesticide use** 1,121M lbs/year (1980) **Peak pesticide use; OPs** leading insecticides	One farmer supplies **100 people**[1] **Total US pesticide use** 949M lbs/year (1990)[2] Roundup Ready™ **GMO crops** (1996)		**Total US pesticide use** 926M lbs/yr (2000); 857M lbs/yr (2007) **Neonicotinoids** leading insecticides

The latest evolution in insecticides: Neonicotinoids

Bayer CropScience

- Sold in 120 countries
- Registered for use on 140 crops
- 80% of global market share of seed treatments
- 30% of the insecticide market (Jeschke et al 2011)

Neonicotinoid published papers



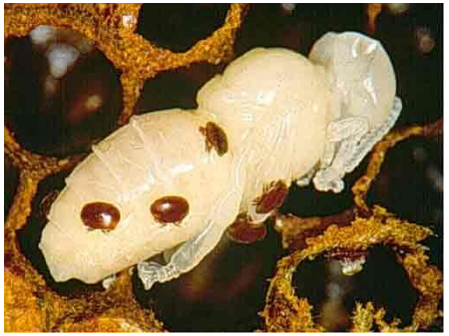
"The Science is too uncertain"

Bee studies dominate literature and headlines

Lab experiments: >150 studies to bees

- Chronic exposure causes **lethality** and **effects on foraging, learning, memory behaviour** at low environmentally relevant concentrations
- **Stress from mites, parasites and disease** lowers the toxicity thresholds

Field studies: several published field studies have shown negative effects leading to colony collapse, but some key issues around experimental design



Godfray et al. 2014 Proc Roy Soc B

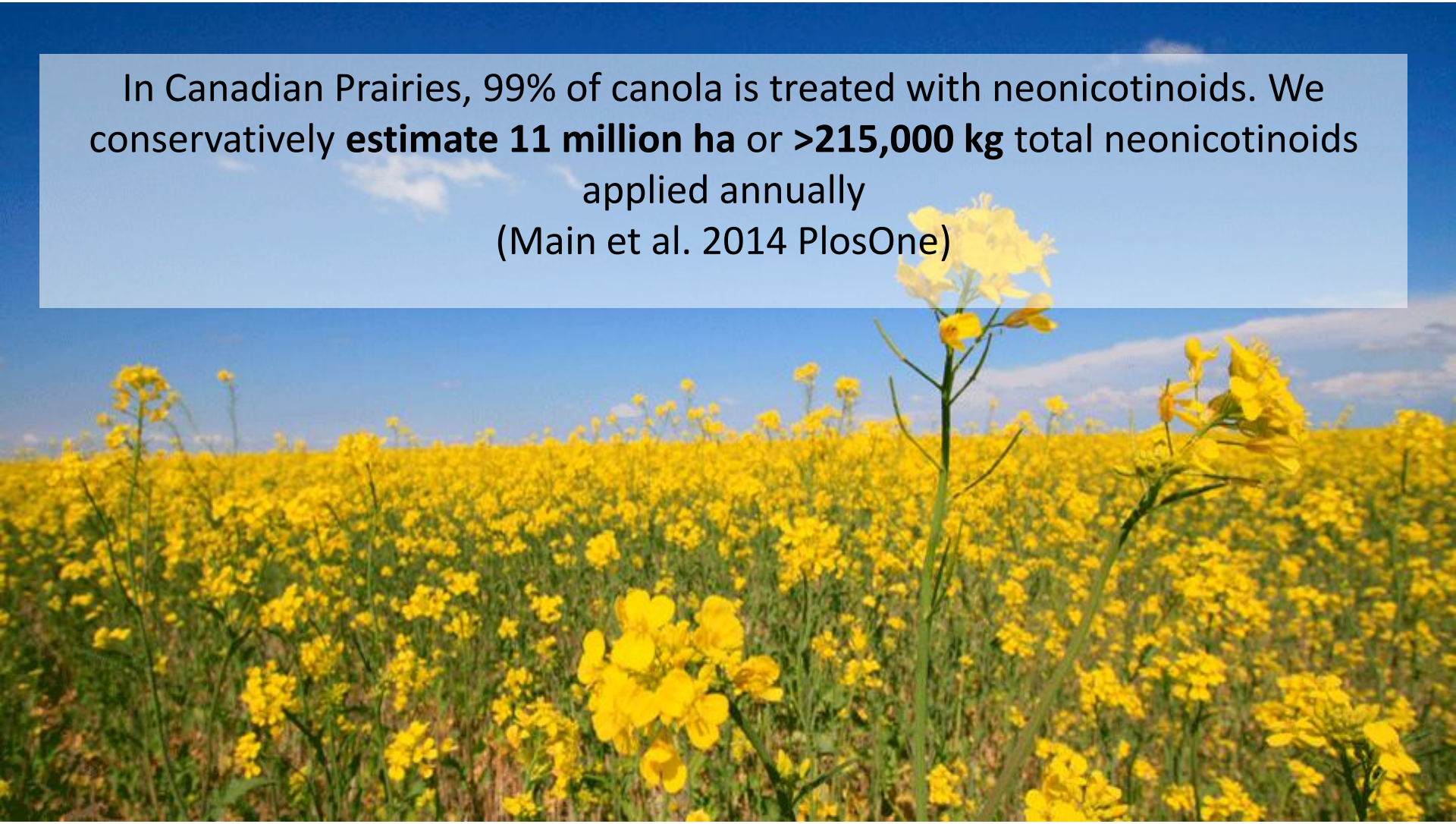
Neonic Environmental Issues Debated

- Crop protection needs
- Economic gains/losses

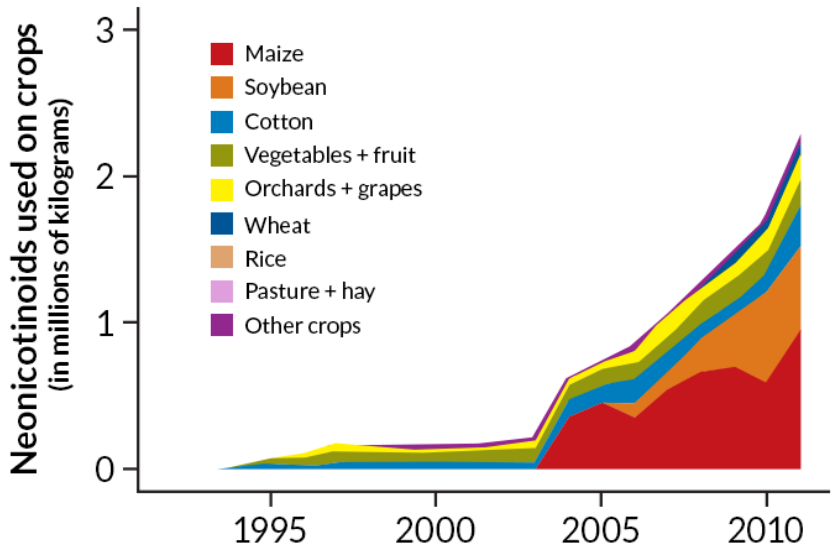
- Scale of Use
- Persistence
- Soil organisms
- Water contamination
- Aquatic insects
- Birds
- **Bees and other insect pollinators**

Scale of Use

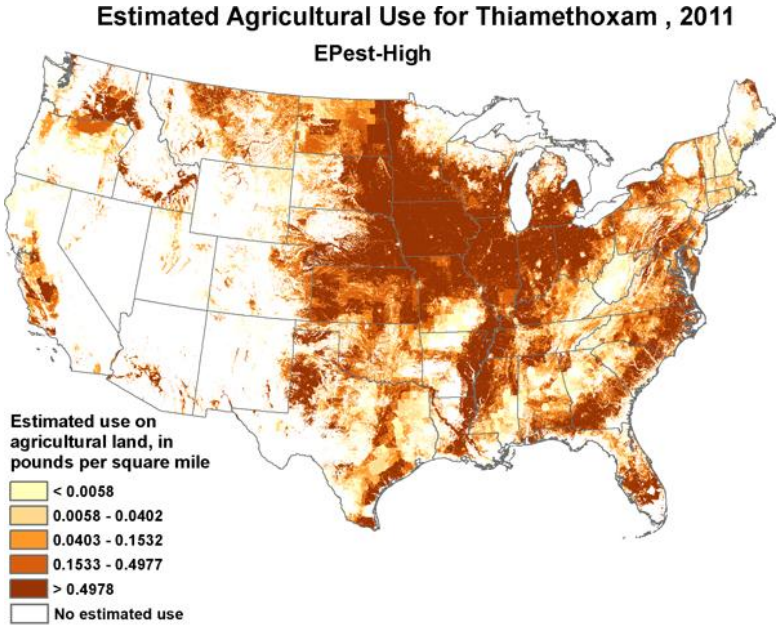
In Canadian Prairies, 99% of canola is treated with neonicotinoids. We conservatively **estimate 11 million ha** or **>215,000 kg** total neonicotinoids applied annually
(Main et al. 2014 PlosOne)



Neonicotinoid use in the United States **exceeds 2 million kg/year**



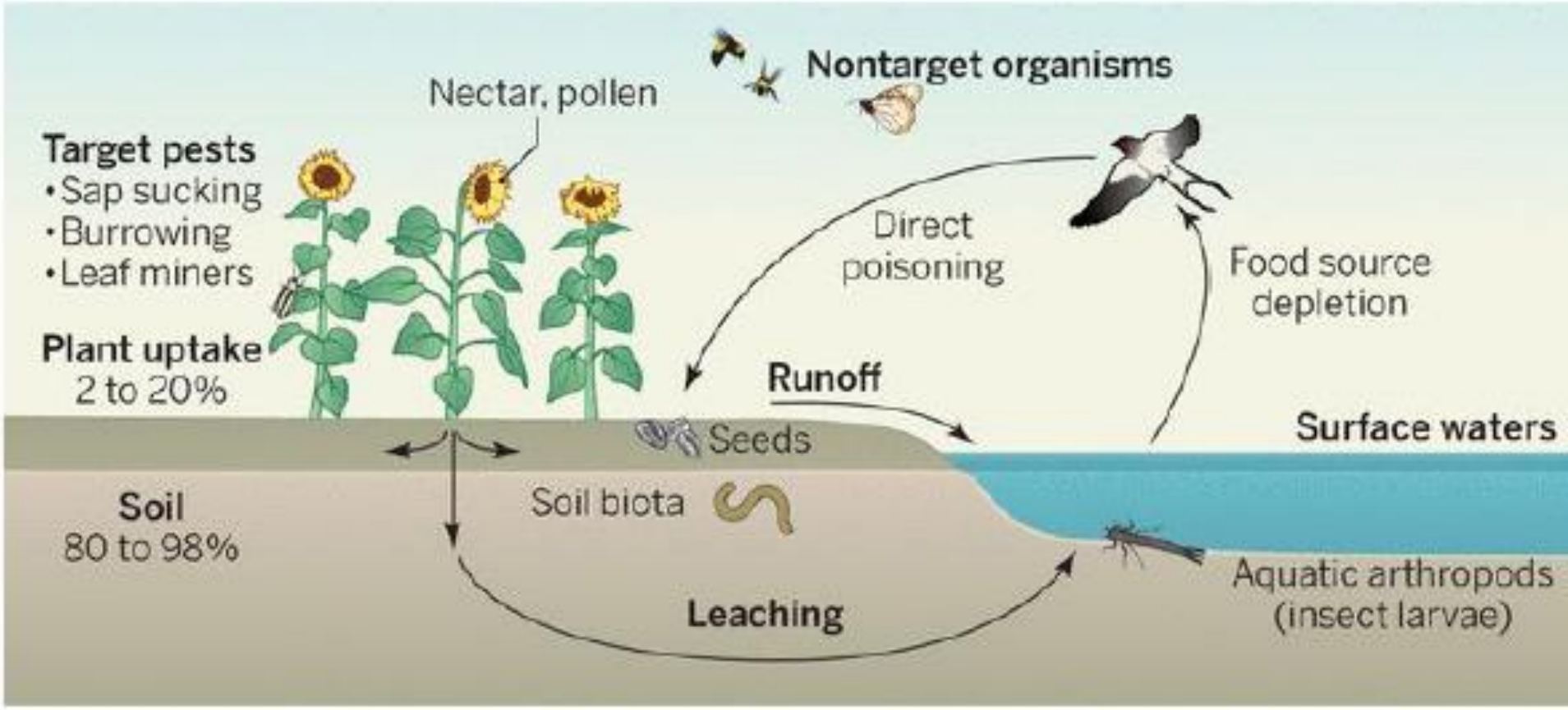
Douglas and Tooker 2015 ES&T



USGS National Water-Quality Assessment Program Pesticide National Synthesis Project

Environmental Persistence and Water Contamination

Neonicotinoids contaminate whole ecosystem



Sanchez-Bayo 2014:
"The problem with neonicotinoids"

Properties of Neonicotinoid insecticides

Extended half life in soil

High water solubility

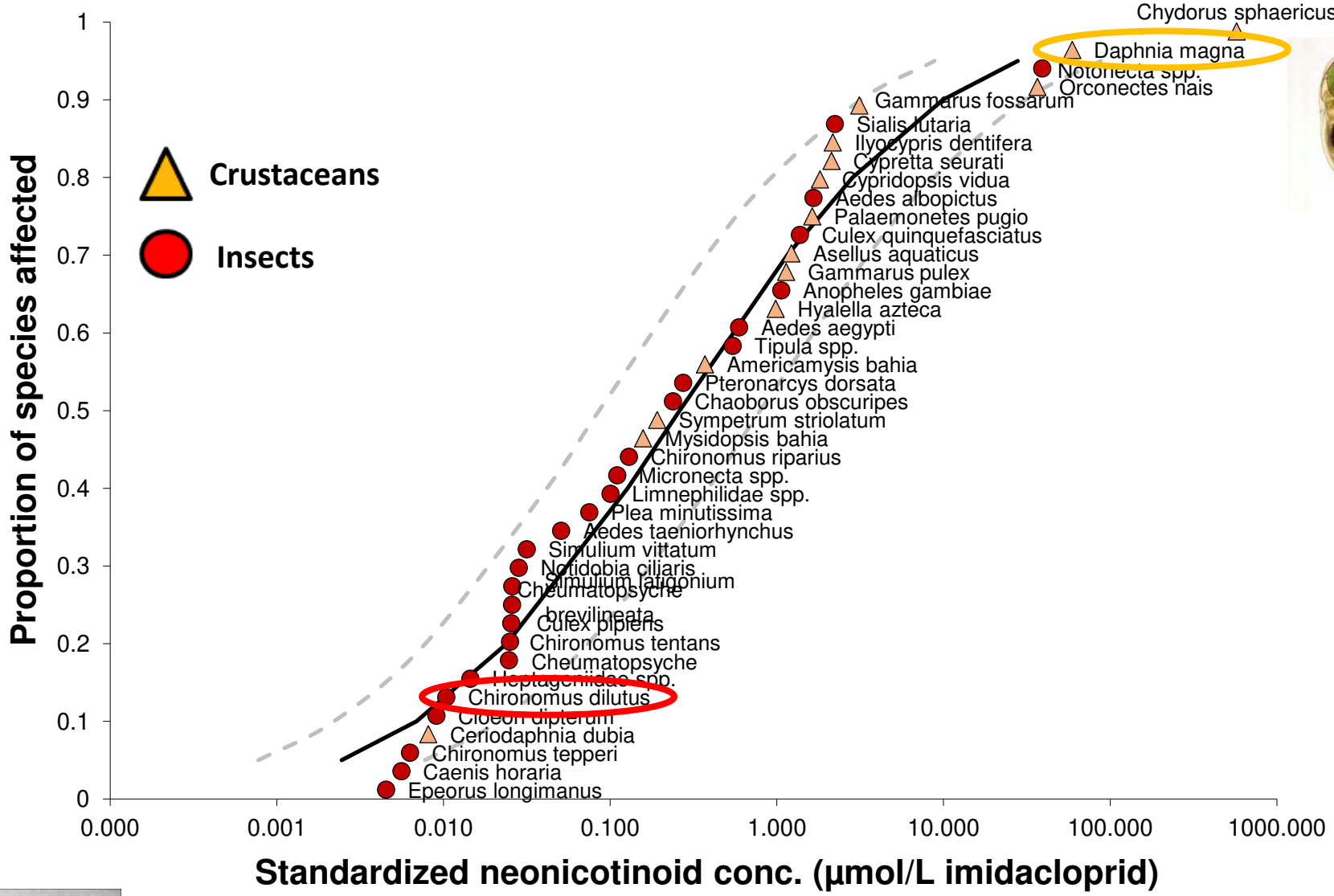
Stable to hydrolysis, Photolysis

- In the Prairies: **16-91%** of wetlands sampled contained at least 1 neonicotinoid (Main et al. 2014)
- Over **50% had >1 neonicotinoid (evidence of synergism)**
- Peak conc. **clothianidin = 3.3 µg/L ,thiamethoxam = 1.5 µg/L**
- Detections were frequent in spring before seeding occurs
- Routine detections in surface waters across Canada and worldwide

Can these levels cause harm?

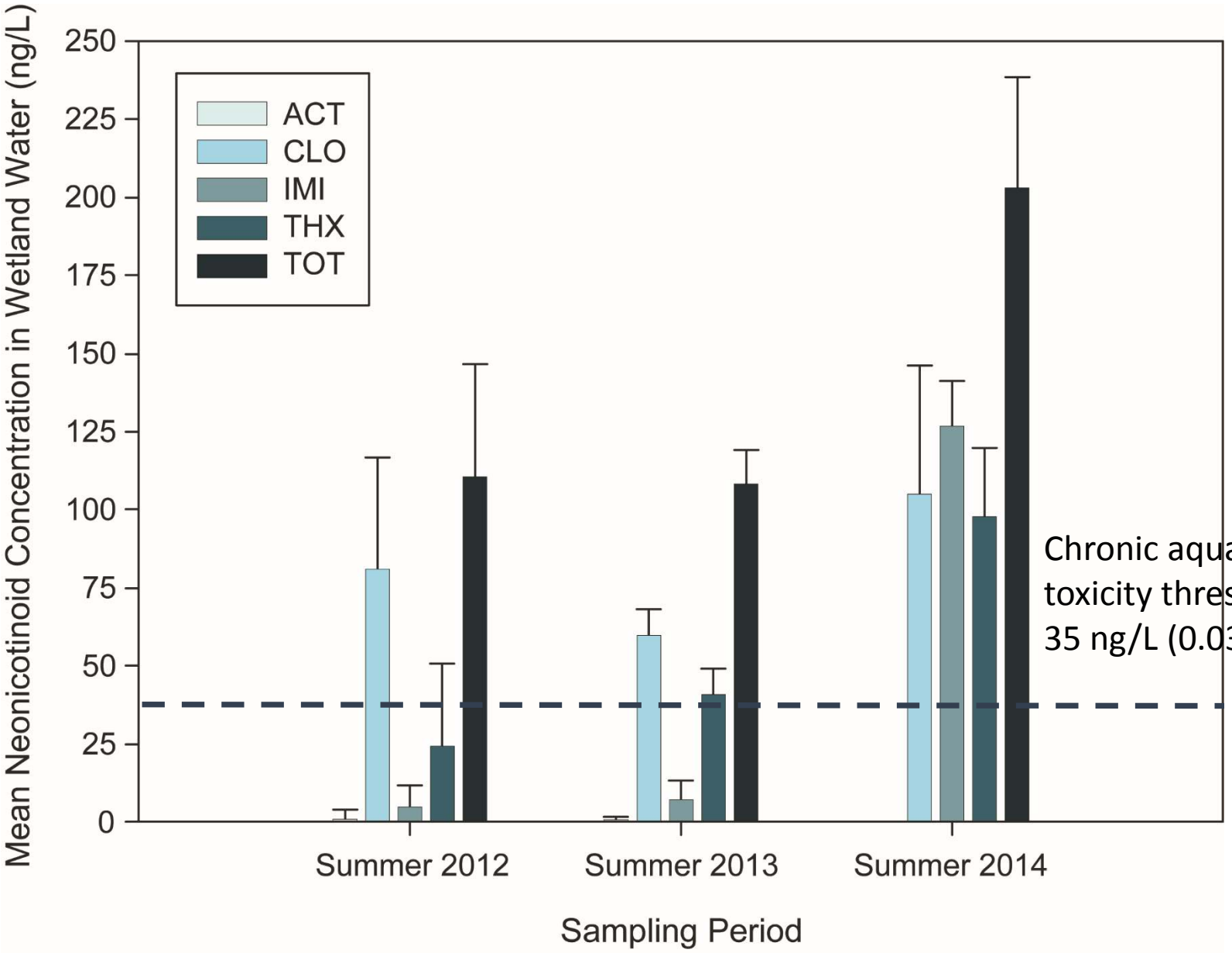
Toxicity to Aquatic invertebrates

Neonicotinoid acute toxicity to aquatic invertebrates

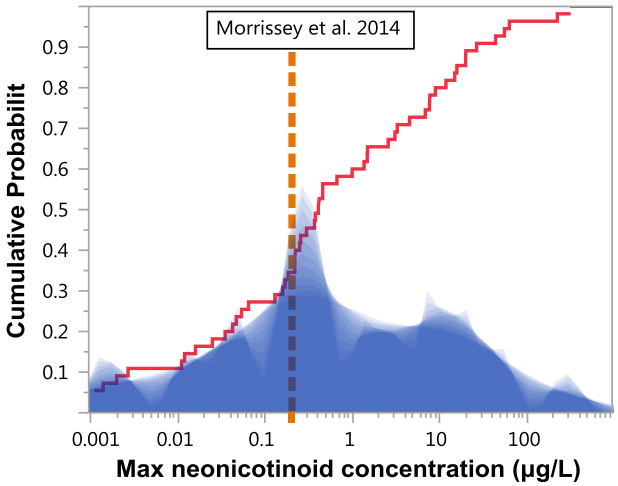


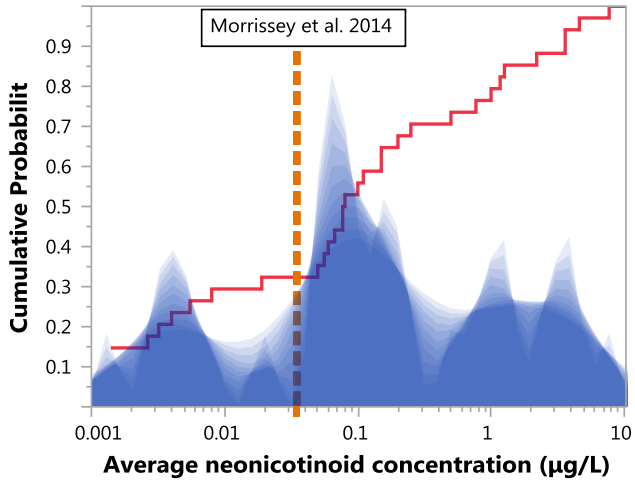
Morrissey et al in 2015 Environment International

Wetland Water Neonicotinoid Concentrations in Saskatchewan



Worldwide Exceedance of <u>Acute and Chronic</u> threshold concentrations in surface waters



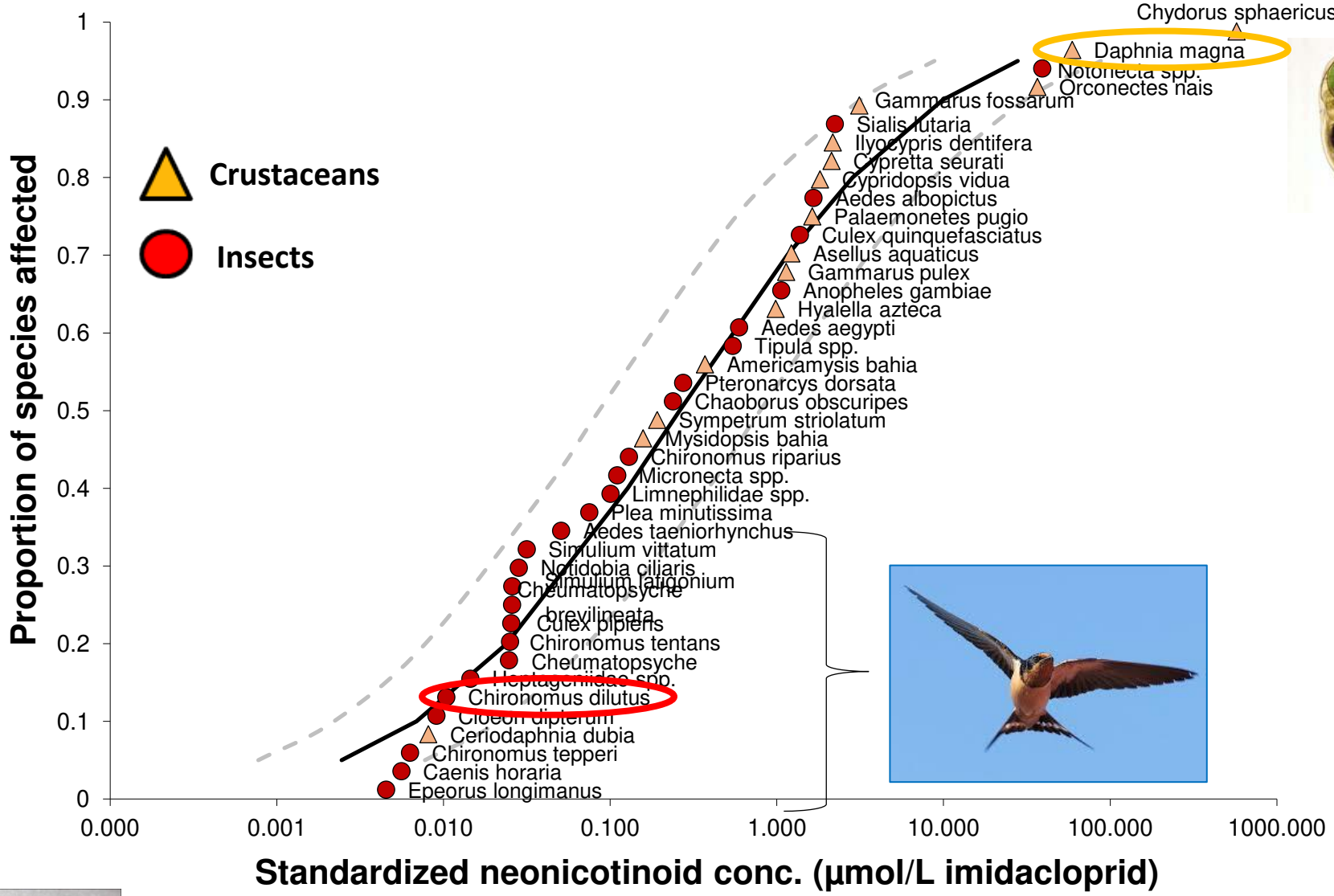


****81% (22/27) studies exceeded acute threshold of 0.2 µg/L**

****74% (14/19) studies exceeded chronic threshold of 0.035 µg/L**

Morrissey et al. 2015
Environ International

Neonicotinoid acute toxicity to aquatic invertebrates



Morrissey et al in 2015 Environment International

Effects on insectivorous and seed eating birds

What are Tree swallows are telling us about the quality of Prairie farmland?

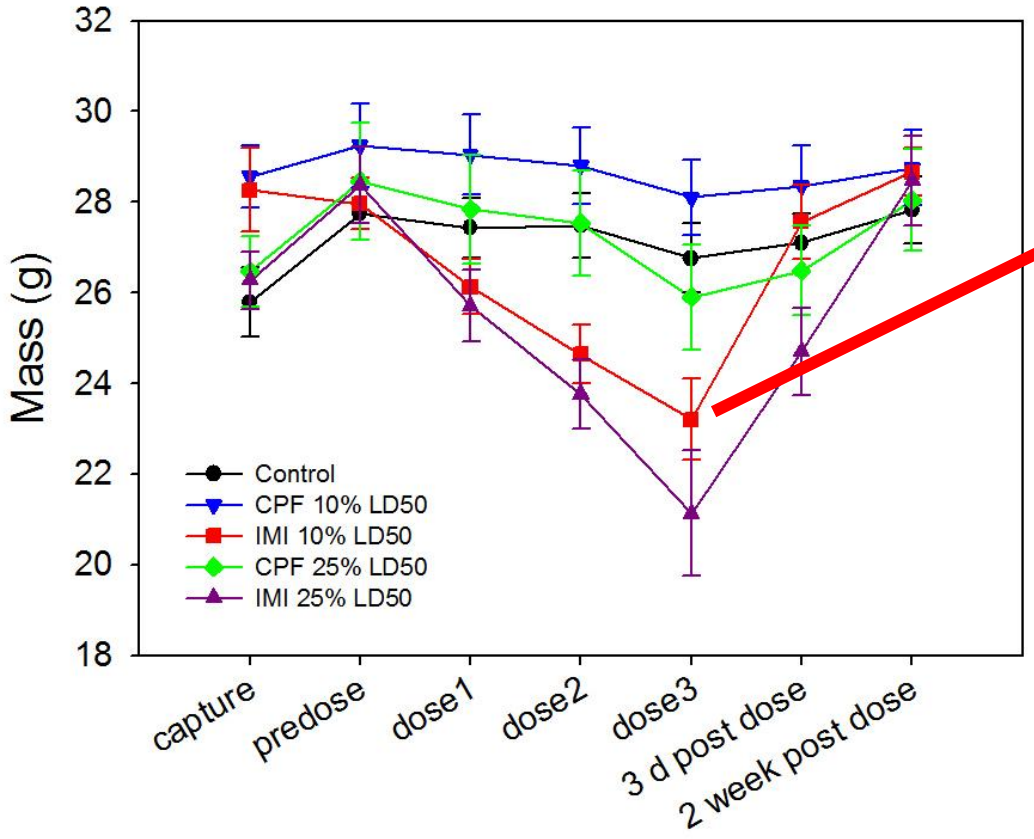
4 year study….

- Swallow **Reproduction** similar across sites
- Insect **diet** is primarily aquatic origin- swallows are very selective though nestlings are fed a larger range of prey
- High aquatic insect food supply was physiologically important for reducing **oxidative stress**

Crop intensive sites:

- Higher **wetland neonicotinoid concentrations**
- Poorer nestling **body condition**
- Increased **foraging rates** and time spent away from nestbox
- Lower adult **return rates**

Exposure to imidacloprid (but not chlorpyrifos) caused significant decrease in WCSP body mass

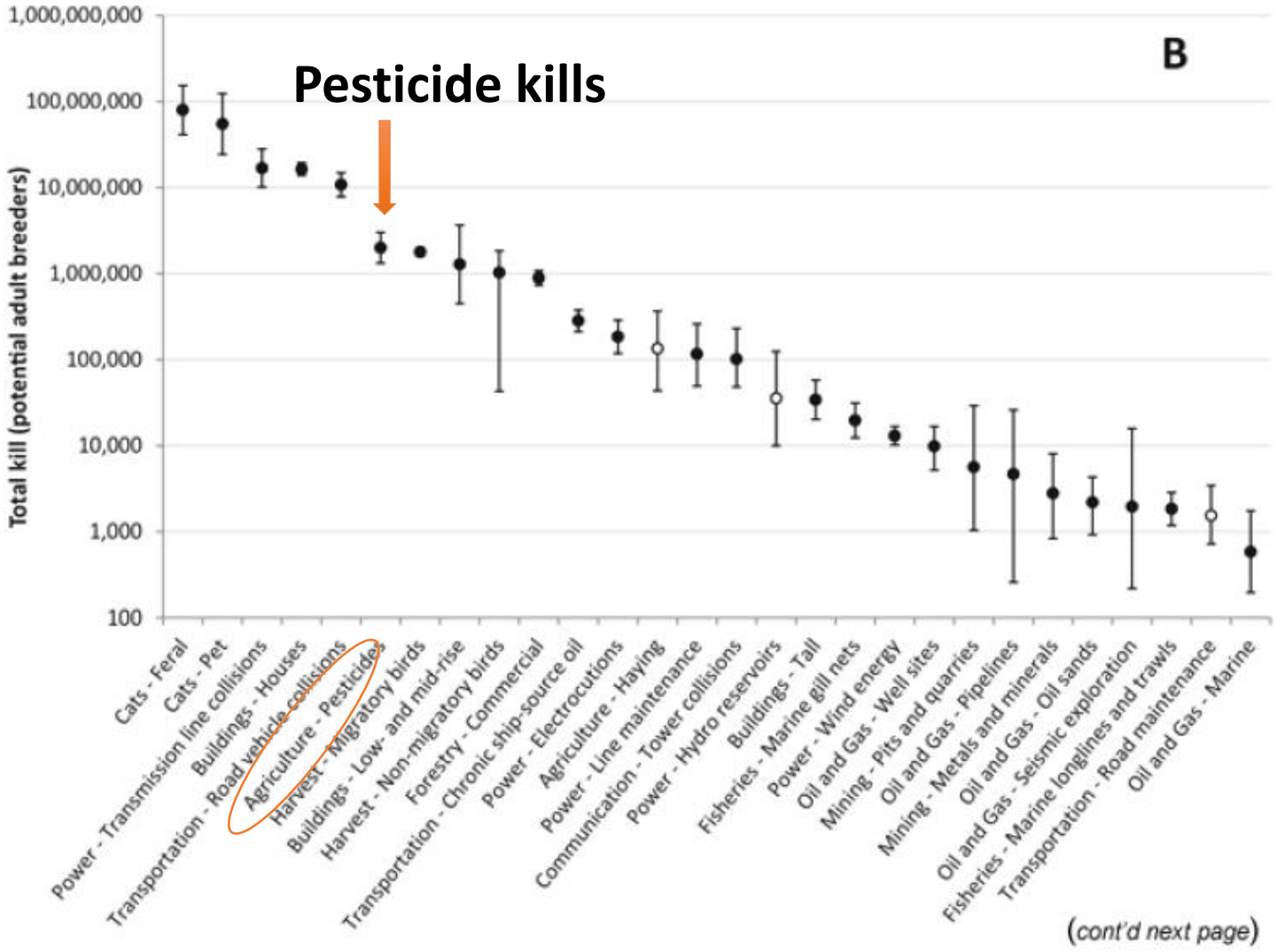


Equivalent to eating
0.3 corn seeds/day or
3.8 canola seeds/day

LD50 HOSP= 41mg/kg

M. Eng et al. unpublished data

Causes of Avian mortality in Canada



Calvert et al. 2013 Avian Conserv and Ecol

Neonicotinoid Issues Debated

- **Crop protection needs**
- **Economic gains/losses**

Least controversial

- **Scale of Use**
- **Persistence**
- **Water contamination**
- **Soil organisms**
- **Aquatic insects**
- **Birds**
- **Bees and other insect pollinators**

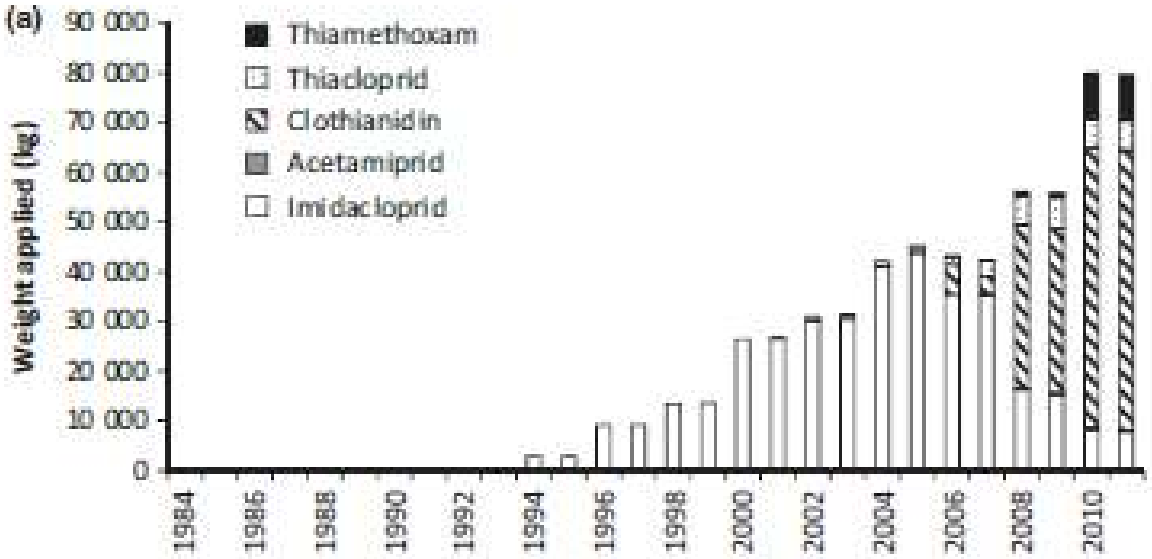
More controversial

Crop Protection Needs

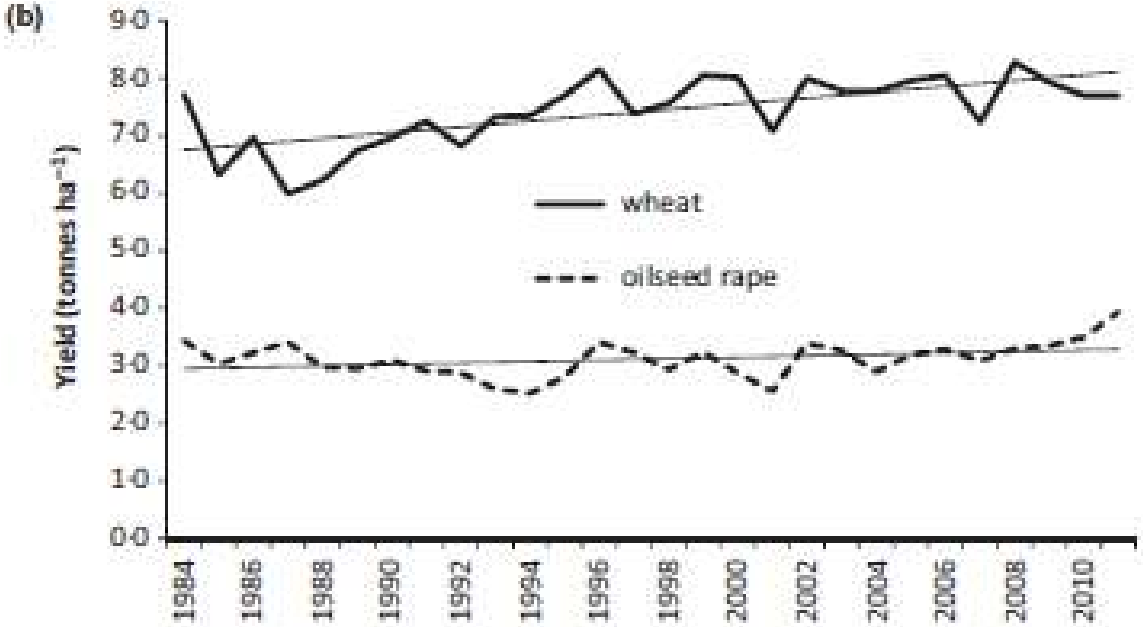
USEPA 2014 Report "Benefits of Neonicotinoid Seed Treatments to Soybean Production"

- "Across the United States (2008-2012), **1,151,000 pounds of imidacloprid and thiamethoxam were used** as seed treatments on soybeans". page 4

- "This analysis provides evidence that U.S. soybean growers derive limited to **no benefit from neonicotinoid seed treatments** in most instances. Published data indicate that most usage of neonicotinoid seed treatments **does not protect soybean yield any better than doing no pest control**." page 13



Annual use of neonics in UK



Annual production of wheat and oilseed rape

Goulson 2013.

J Applied Ecology

FRANCE banned neonicotinoid use on sunflower and maize since 2004…

- Productivity was not affected, yields peaked in 2007
- EU placed 2 year moratorium on neonicotinoids with no unusual yield losses reported

SO what's the latest in the regulatory world…

Jan 6, 2016 Health Canada announces "no **potential risk to bees**" from **seed treatments** of neonicotinoids. Risks to wild pollinators still being considered.

June 1, 2016 Health Canada **no longer grants new conditional registrations** for pesticides (neonics are almost all conditional)

2017 Ontario (and possibly Quebec) plan to roll out enforcement for **80% reduction in neonicotinoid use** to protect pollinator health

November 23, 2016

Health Canada announced plan to **phase out imidacloprid** in 3-5 years because of risks to aquatic ecosystems

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Health Canada proposes ban of controversial neonicotinoid pesticide

Current use of imidacloprid is 'not sustainable' says Health Canada in draft risk assessment on the pesticide

By Lisa Johnson, CBC News Posted: Nov 23, 2016 4:59 PM PT | Last Updated: Nov 24, 2016 2:46 PM PT

It’s not enough to just ban 1 chemical!!!

Lets talk about other solutions…

Interested in participating in research on sustainable conservation farming???

Christy.morrissey@usask.ca

Thank you!!!

Funding:

NSERC CRSNG

Fisheries and Oceans Canada / Pêches et Océans Canada

Environment Canada / Environnement Canada

Consequences of intensive agricultural practices dependent on insecticide seed treatments

- Resistance in target pests
- Outbreaks of nontarget pests
- Long term soil degradation and crop yields
- Increasing farm input costs
- Water and soil pollution with detrimental effects to invertebrate diversity
- Direct and cascading indirect effects to wildlife (including birds)

Solution: "Conservation/ Ecological Agriculture"

1. Reduce mechanical soil disturbance and focus on soil quality
2. Cultivate a wider range of natural and managed species, crop varieties, cover crops, intercrops to increase resiliency
3. Use Integrated Pest Management of pests, disease and weeds
4. Maintain and restore wetland and riparian areas and use water efficient crops

Save and Grow: A policymaker's guide to the sustainable intensification of smallholder crop production