



Assessing Neonicotinoid Exposure in Free-ranging White-tailed Deer in Minnesota

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NATURAL RESOURCES**

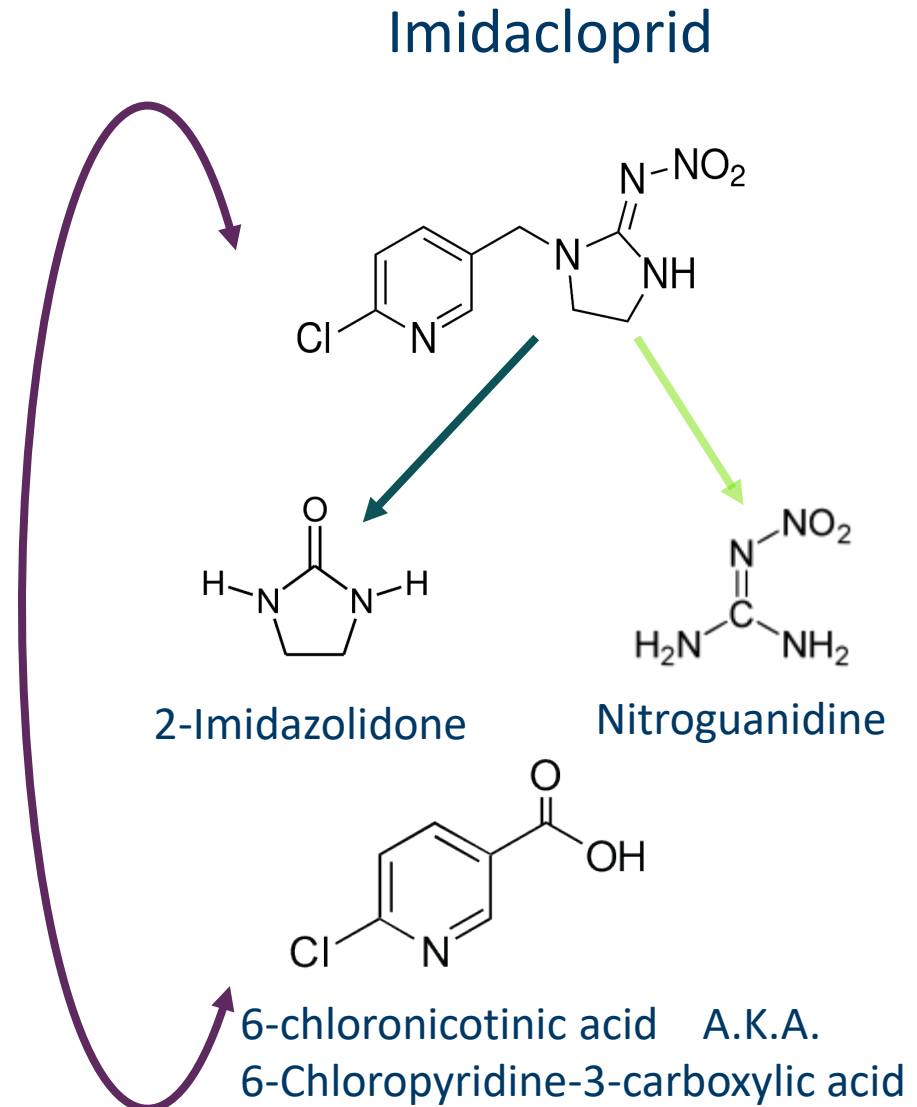



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Dr. Jon Lundgren | Ecdysis Foundation

Background on Neonicotinoids

- Category of insecticide commonly used across North America.
- Specificity to receptor sites on insects makes them less toxic to mammals; however, increasing concerns over potential adverse effects on wildlife
- The 3 most commonly used neonicotinoids (neonics) in the US include: imidacloprid, clothianidin, and thiamethoxam.
- Used on 98% of corn, soybean, wheat, cotton, and sorghum in North America
- Applied through seed treatments, in foliar sprays, granularly to pastures, and injected into trees.
- Also used in common household products like flea and tick collars for pets



Why this study?

- Mammals and avian species are being exposed to neonics in their environment
 - Roy et al. (2020) documented 16 species of birds and 14 species of mammals eating neonic-treated seeds at spills
- Berhiem et al. conducted a study out of South Dakota in 2019 assessing the effects of neonics on captive deer.
 - Documented behavioral changes, decrease in reproductive organ size, and decreased fawn survival.
 - Average level for reduced fawn survival was reported at 0.33 ng/g.
 - Free-ranging North Dakota deer were tested and found neonic levels 3.5 times higher in the spleen than the captive deer in their study.



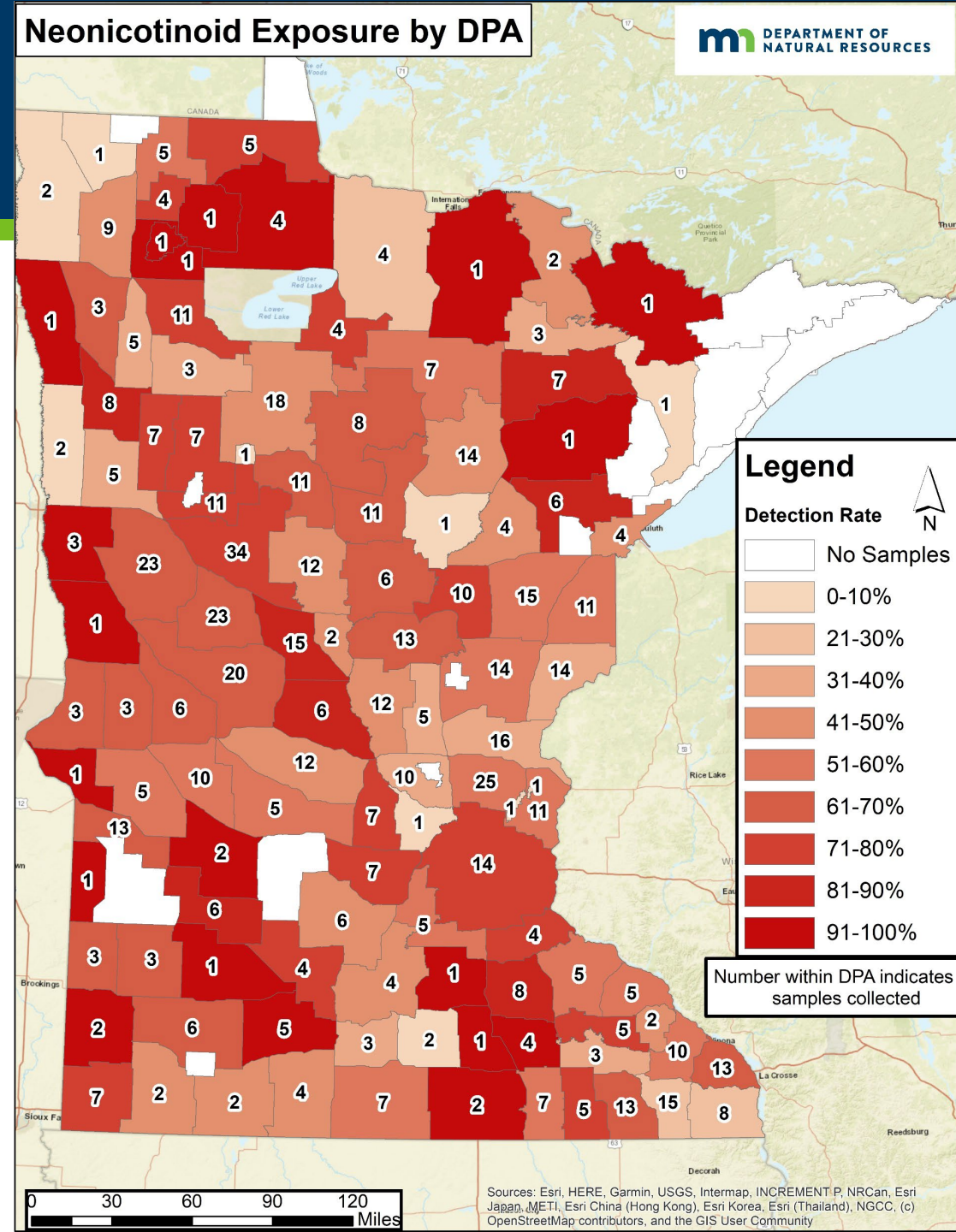
Neonic Pilot Project, Fall 2019

- Objectives:
 - Assess feasibility of utilizing hunters to obtain biological samples and metadata
 - Estimate exposure of neonics in deer across different regions of MN
 - Determine if high level exposure (>0.33 ng/g) is occurring and provide a basis for future study on fawn survival and recruitment.



Summary and ELISA Results

- 799 spleens samples collected
- 61% of spleen samples contained neonics
 - Mean concentration of 0.36 ng/g (range from 0 to 6.0 ng/g)
 - Exposure was classified into 4 categories: High (≥ 0.33 ng/g), Medium (0.165-0.329 ng/g), Low (0.001-0.164 ng/g) and Zero (0.0 ng/g)
 - 29% had concentrations in the High category; high enough to potentially affect fawn survival
 - Mass spectrometry results of a subset of samples (n=57) confirmed presence metabolites indicative of multiple parent compounds that likely get metabolized prior to accumulation in spleen
- Concentrations did not vary by agricultural use category
- Exposure in deer was statewide, including the forest zone and metropolitan areas
- There was no variation detected by age and sex



Study Continuation, Fall 2021

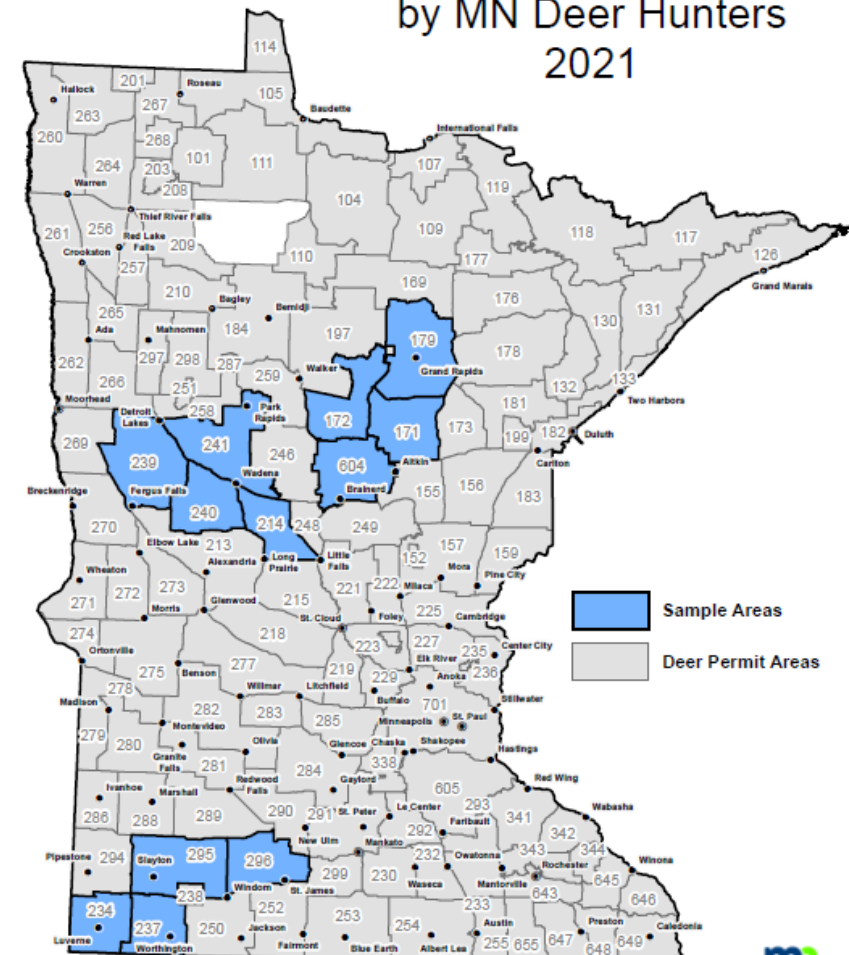
Fall 2021 Sampling

- Targeted sampling in 12 Deer Permits Areas (DPAs) in 3 ecoregions, pairing high/low DPAs from 2019 data
- Goal to solicit 4,800 hunters and collect 2,400 spleens
 - Recruited only 1,770 hunters; 27% success rate
- 496 spleen samples were collected
 - ELISA results suggested **94% exposure to neonics** (64% ≥ 0.33 ng/g)
 - Mass spectrometry results improved relationship to ELISA results ($R^2 = 0.88$)

Conclusion: Deer exposure to neonics may be ubiquitous across all ecoregions

- Future research is aimed at improved understanding of seasonal exposure rates, determining best tissues for detections of neonics (including ante-mortem options), and ultimately a fawn survival study

Neonicotinoid Sample Areas
by MN Deer Hunters
2021





Earlier Work on Neonic Exposure in Prairie-chickens and Other Wildlife During 2016-2017

Science of the Total Environment 856 (2023) 159120

Contents lists available at ScienceDirect



ELSEVIER

Science of the Total Environment

journal homepage: www.elsevier.com/locate/scitotenv

High population prevalence of neonicotinoids in sharp-tailed grouse and greater prairie-chickens across an agricultural gradient during spring and fall

Charlotte L. Roy^{a,*}, Da Chen^{b,1}

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Environmental Toxicology

Sublethal and Lethal Methods to Detect Recent Imidacloprid Exposure in Birds with Application to Field Studies

Charlotte L. Roy,^{a,*} Mark D. Jankowski,^b Julia Ponder,^c and Da Chen^d

Science of the Total Environment 682 (2019) 271–281

Contents lists available at ScienceDirect



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Multi-scale availability of neonicotinoid-treated seed for wildlife in an agricultural landscape during spring planting☆

Charlotte L. Roy^{a,*}, Pamela L. Coy^a, Da Chen^b, Julia Ponder^c, Mark Jankowski^{c,d}

Environmental Research 190 (2020) 109830

Contents lists available at ScienceDirect



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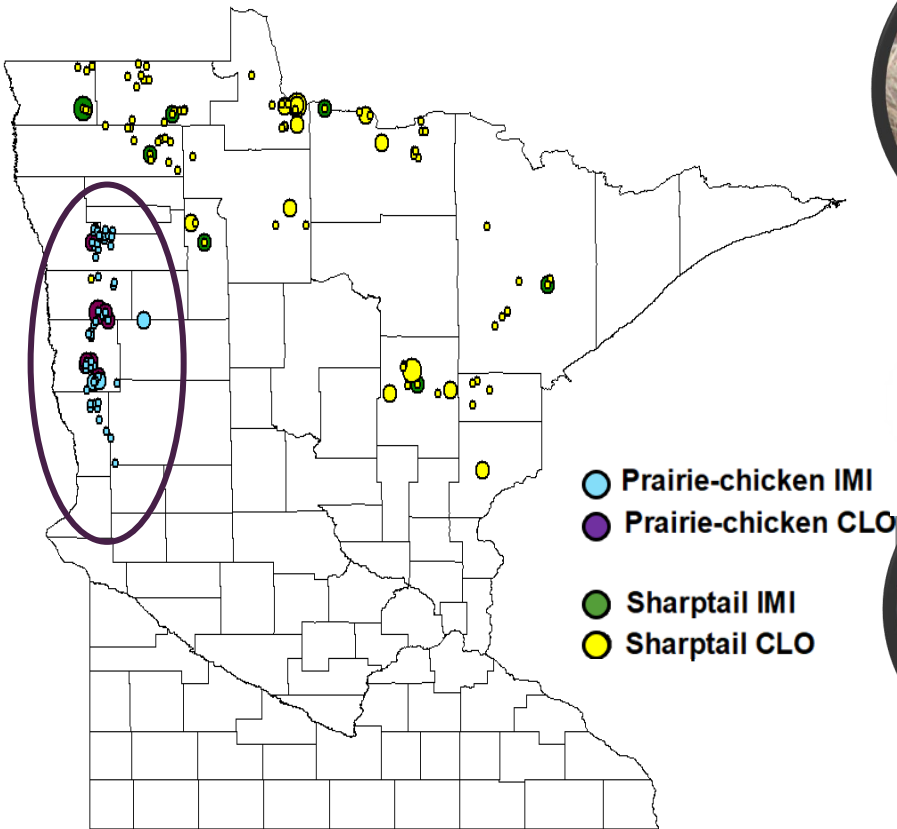
journal homepage: www.elsevier.com/locate/envres

Wildlife consumption of neonicotinoid-treated seeds at simulated seed spills

Charlotte L. Roy^{*}, Pamela L. Coy

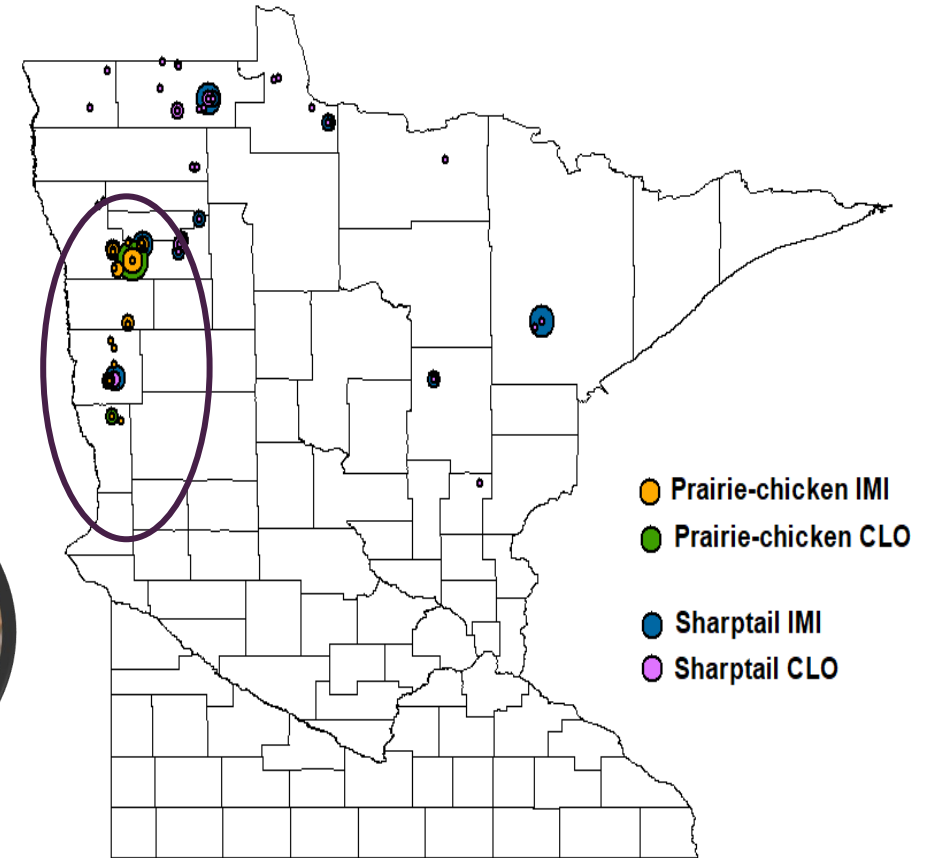
Spring fecal concentrations from leks

Spring Detections:
80% prairie-chickens
93% sharp-tailed grouse



Fall liver concentrations in hunter-harvested birds

Fall Detections:
76% prairie-chickens
90% sharp-tailed grouse



Next Steps for Prairie-Chicken Research

- Possible exposure sources include water, soil, invertebrates, treated seeds, plants exposed to neonics through spray, dust, or grown from treated seed, etc.
- Exposure risk may extend beyond sites of application
- High exposure may or may not result in population level effects → Need to link exposure to reproduction & survival to determine population impact, if any
- Ephemeral detection (no bioaccumulation) means that some individuals may test negative that were exposed
- Individuals might be exposed multiple times and repeated exposures could be more impactful than a single exposure
- Compare:
 - Survival and reproductive success of birds with multiple detections during the spring/summer to birds with one or no detections of neonics (i.e., non-invasively sample birds more than once per season)
 - Survival and reproductive success of birds with very high detected concentrations to birds with low or no detected concentrations during different phases of reproduction (e.g., egg laying, incubation, brood-rearing)

Questions?



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