Environment and Natural Resources Trust Fund

2022 Request for Proposal

General Information

Proposal ID: 2022-226

Proposal Title: Neonicotinoid Impacts on Minnesota Deer and Prairie Chickens

Project Manager Information

Name: Michelle Carstensen

Organization: MN DNR - Fish and Wildlife Division

Office Telephone: (651) 539-3309

Email: michelle.carstensen@state.mn.us

Project Basic Information

Project Summary: We will examine impacts of neonicotinoid exposure on game species in Minnesota by collecting samples from deer and prairie chickens where low and high neonicotinoid concentrations were previously determined.

Funds Requested: $1,060,000

Proposed Project Completion: December 31 2025

LCCMR Funding Category: Foundational Natural Resource Data and Information (A)

Project Location

What is the best scale for describing where your work will take place?

Statewide

What is the best scale to describe the area impacted by your work?

Statewide

When will the work impact occur?

During the Project and In the Future

Narrative

Describe the opportunity or problem your proposal seeks to address. Include any relevant background information.

Neonicotinoids are the most commonly used insecticides worldwide. Recent studies in Minnesota detected neonicotinoids in spleens of harvested deer and muscle of harvested greater prairie-chickens. Neonicotinoid-treated seed consumption by wildlife was documented at levels that might produce sub-lethal effects on survival and reproduction, which could act over time to reduce populations. A recent study of captive deer showed neonicotinoid exposure was linked to reduced body mass, activity levels, fawn survival, genital abnormalities, and jaw deformities. Our proposed research will evaluate the impact of neonicotinoid exposure on these two game species to determine how neonicotinoid exposure relates to survival and reproductive success, key contributors to changes in population size. We recently detected 61% of hunter-harvested deer sampled for neonicotinoids from across the state were exposed to these pesticides. Additionally, prairie-chickens have declined over the last decade largely due to landscape-scale habitat loss. Multiple population stressors such as habitat loss, disease, and pesticides can compound to affect populations more than one factor acting alone. Understanding factors that contribute to the health and sustainability of wildlife populations is essential to long-term population management. Sustainable wild game populations are necessary to maintain Minnesota's hunting heritage and natural resources for all Minnesotans.

What is your proposed solution to the problem or opportunity discussed above? i.e. What are you seeking funding to do? You will be asked to expand on this in Activities and Milestones.

Our previous research documented 71% of harvested prairie-chickens and 86% of spring samples from prairie-chicken mating-display grounds were positive for >1 neonicotinoid. Further, nearly a third of deer exposed to neonicotinoids in Minnesota displayed levels consistent with the adverse effects reported from the captive study. Based on this research, we will identify study areas with high and low neonicotinoid concentrations to collect samples from deer and the environment (e.g., water sources). We will relate concentrations in these collected samples to survival and reproduction of deer and prairie-chickens. Because neonicotinoids are excreted and do not bioaccumulate in mammals and birds like other pesticides, a negative detection does not mean the animal was not exposed, it just means exposure was not recent.

Repeated samples will be collected from radio-marked prairie-chickens throughout the spring and summer to examine neonicotinoid exposure throughout nesting and brood-rearing to determine if females exposed to neonicotinoids have lower reproductive success. We will compare movement and survival of radio-marked deer between areas with high and low neonicotinoid exposure, but are similar with respect to land use and predator composition, to establish potential effects of neonicotinoid exposure on deer.

What are the specific project outcomes as they relate to the public purpose of protection, conservation, preservation, and enhancement of the state's natural resources?

We know from our previous research that deer and prairie-chickens are exposed to neonicotinoids in Minnesota. However, that earlier work did not determine whether these exposures translate to impacts at the population-level by impacting survival and reproduction. The work described in this proposal will help determine whether deer and prairie-chickens are exposed to neonicotinoids at levels that could translate into larger population effects that could ultimately impact wildlife populations and the hunting opportunities that Minnesotans enjoy. This information is needed to manage and conserve wildlife populations in Minnesota.

Activities and Milestones

Activity 1: Assessing how neonicotinoids affect white-tailed deer movements and survival in Minnesota

Activity Budget: $776,328

Activity Description:
This research will build on a pilot study assessing white-tailed deer exposure to neonicotinoids in Minnesota using spleens collected from hunter-harvested deer. We will use information from that study to identify a high and low neonicotinoid exposure study area. We will capture and radiomark 120 adult female deer and place vaginal implant transmitters to facilitate capture and radiomarking of 180 fawns between 2 study areas over 2 years. We will collect biological samples from deer at capture and mortality, when possible, to establish potential recent neonicotinoid exposure. We cannot obtain multiple samples from each deer, so we will continue to collect hunter-harvested spleens within study areas to confirm that concentrations are temporally consistent within study area. We can then use study area as a proxy for potential exposure. We will monitor individual deer movement and survival and compare differences between study sites. If movement and survival rates differ (e.g., if deer in the high exposure site have decreased movements and survival compared to deer in the low exposure site), then that may indicate potential neonicotinoid exposure is negatively impacting deer. We will also collect environmental samples (e.g., water) to better assess potential point sources of exposure for deer.

Activity Milestones:

Description	Completion Date
Capture adult female white-tailed deer (Winters 2023 and 2024)	March 31 2024
Capture white-tailed deer fawns (Springs 2023 and 2024)	June 30 2024
Analyze data	May 31 2025
Monitor deer movement and survival	December 31 2025
Interpret results and write dissertation	December 31 2025

Activity 2: Relating spring and summer neonicotinoid exposures to survival and reproduction of greater prairie-chickens to evaluate potential population-level effects

Activity Budget: $283,672

Activity Description:
We will capture and radiomark 300 greater prairie-chickens as part of an ongoing study examining hen survival, nest success, and brood survival in northwestern Minnesota. This study area overlaps spatially with our previous neonicotinoid research on prairie-chickens that found >1 neonicotinoid detected in 86% of spring samples at varying concentrations. We will collect fecal pellet samples from female prairie-chickens when 1) they are captured in the spring on mating-display grounds, 2) when they are flushed off nests once to count eggs, and 3) when we obtain chick counts during the summer. Therefore, we anticipate collection of samples at 3 time periods for each radio-marked hen spaced at least 2 weeks apart. Fecal pellets will be analyzed for 7 neonicotinoids using a protocol we developed and published in the peer-review literature for birds. Neonicotinoids can be detected in fecal samples for at least 15 days after exposure, providing a longer window of detection than some other sample types (e.g., blood and some tissues). Concentrations of neonicotinoids in fecal pellets collected throughout the spring and summer will be used as predictors in analyses of hen survival, nest survival, and brood survival to relate exposure to survival and reproduction.

Activity Milestones:

Description	Completion Date
Capture greater prairie-chicken hens at mating-display grounds	June 30 2023
Monitor hen, nest, and brood survival throughout summer	August 31 2023

Analyze samples for neonicotinoids	March 31 2024
Interpret results and disseminate	June 30 2025

Project Partners and Collaborators

Name	Organization	Role	Receiving Funds
Dr. Joseph Bump	University of Minnesota - Twin Cities	Administer graduate students for the project	Yes
Dr. John Buchweitz	Dr. John Buchweitz Michig an State University, Veterinary Diagnostic Laboratory	Conduct mass spectrometry analysis on deer spleen samples to determine neonicotinoid prevalence and concentrations	Yes
Dr. Arno Wuenschmann	University of Minnesota-Twin Cities, Veterinary Diagnostic Laboratory	Conduct necropsies on deer and consult on health parameters	No
Dr. Jia Liu	Southern Illinois University Carbondale	Analyze prairie-chicken fecal pellet samples for neonicotinoids	Yes

Long-Term Implementation and Funding

Describe how the results will be implemented and how any ongoing effort will be funded. If not already addressed as part of the project, how will findings, results, and products developed be implemented after project completion? If additional work is needed, how will this be funded?

This project will provide information on reproduction and survival for two game species in Minnesota. White-tailed deer fawns are susceptible to multiple sources of mortality (e.g., predation, weather, resource availability). Given previous work established that increased levels of neonicotinoid exposure can reduce fawn survival in a captive setting, better understanding this relationship in a wild setting will improve our ability to manage this economically important species. Also, given prairie-chicken populations have declined over the past decade, understanding how neonicotinoids affect their reproduction and survival will help to manage populations. Additional funding will come from the Minnesota DNR.

Other ENRTF Appropriations Awarded in the Last Six Years

Name	Appropriation	Amount Awarded
Moose Decline and Air Temperatures in Northeastern Minnesota	M.L. 2014, Chp. 226, Sec. 2, Subd. 05m	$600,000
Deer Movement Related to Potential CWD Prion Transmission	M.L. 2015, Chp. 76, Sec. 2, Subd. 10	$0
Game and Nongame Bird Pesticide Exposure	M.L. 2016, Chp. 186, Sec. 2, Subd. 03m	$349,000
Evaluate Prescribed Burning Techniques to Improve Habitat Management for Brushland Species	M.L. 2016, Chp. 186, Sec. 2, Subd. 08d	$267,000
Spruce Grouse as Indicators for Boreal Forest Connectivity	M.L. 2019, First Special Session, Chp. 4, Art. 2, Sec. 2, Subd. 03e	$350,000

Project Manager and Organization Qualifications

Project Manager Name: Michelle Carstensen

Job Title: Wildlife Health Program Supervisor

Provide description of the project manager's qualifications to manage the proposed project.
Dr. Michelle Carstensen has a B.S. in Animal Science from Cornell University (Ithaca, NY), and a M.S. and Ph.D. in wildlife conservation from the University of Minnesota (St. Paul, MN). Since 2004, she has been employed with the Minnesota Department of Natural Resources, Division of Wildlife, and currently serves as the division's Wildlife Health Program Supervisor. Michelle and her staff (8 full-time) are responsible for disease management of the state's wildlife populations and has coordinated surveillance efforts for a number of diseases including chronic wasting disease, bovine tuberculosis, and avian influenza. Current research projects are centered on parasites, diseases, and habitat use of moose, understanding of movement of wild deer impact spread of chronic wasting disease, and exposure of deer to neonicotinoids.

Organization: MN DNR - Fish and Wildlife Division

Organization Description:
A state natural resource agency dedicated to protecting and managing land, water, fish and wildlife, and providing access to outdoor recreation opportunities. The mission of the Minnesota Department of Natural Resources (DNR) is to "work with citizens to conserve and manage the state's natural resources, to provide outdoor recreation opportunities, and to provide for commercial uses of natural resources in a way that creates a sustainable quality of life." Our research will provide information needed to manage healthy wildlife populations of deer, prairie-chickens, and other wildlife species in Minnesota for the benefit of hunters, non-consumptive resource users, and future generations. The DNR Wildlife Research Group Leaders have reviewed our research proposal for its consistency with the agency's mission.

Budget Summary

Category / Name	Subcategory or Type	Description	Purpose	Gen. Ineligible	% Benefits	# FTE	Classified Staff?	$ Amount
Personnel								
Natural resource technicians		Full-time 4-month temporary hires (equates to 1.32 FTE) to help with fawn captures, monitoring survival, and conducting mortality investigations (4 technicians needed for each FY at $14,528 each)			25%	1.32		$116,943
							Sub Total	**$116,943**
Contracts and Services								
Michigan State University	Professional or Technical Service Contract	Neonicotinoid sampling, mass spectroscopy of deer spleens (200 samples/year from hunter-harvested deer and 30 samples/year from collared deer mortalities @ $100/sample for 2 years) and water samples (50 samples/year for 2 years @ $100/sample)				-		$56,000
Southern Illinois University Carbondale	Professional or Technical Service Contract	Analyze prairie-chicken fecal pellet samples for neonicotinoids (900 samples @$150/sample)				-		$135,000
Helicopter Capture Company - TBD	Professional or Technical Service Contract	Contract with helicopter capture company for deer captures (60 deer/year for 2 years @ $600/capture)				-		$72,000
University of Minnesota	Sub award	Univ. of Minnesota graduate student (2 PhD students) stipend, tuition, and books for the deer and prairie-chicken components each ($45,000/year for 3 years or $135,000 for each student)				-		$270,000
							Sub Total	**$533,000**
Equipment, Tools, and Supplies								
	Equipment	GPS collars and VITs for adult deer tracking	Adult GPS collars, equipped with bi-directional communication with vaginal implant transmitters for adult female deer to monitor movements and					$206,400

			survival ($1,720/ea for 60 deer per year over 2 years)					
	Equipment	VHF deer collars for fawn tracking	Fawn VHF collars to monitor movements and survival ($234/ea for 90 deer per year over 2 years)					$42,120
	Equipment	Vaginal implant transmitters	Vaginal Implant Transmitters to be inserted in pregnant females to aid in fawn captures ($243/ea for 60 deer per year over 2 years) and bi-directional data fees to communicate with the adult GPS collar ($96/implant for a total of 120 implants)					$40,680
	Equipment	Data Fees for Deer Collars	Data subscription and transmission fees ($180/collar subscription and $135/collar transmission fees for a total of 120 adult deer) for GPS collars					$37,800
	Tools and Supplies	Deer capture supplies	Capture supplies, immobilization drugs, and field investigation biological sampling supplies (4,000/year)					$8,000
	Tools and Supplies	Sampling kits	Spleens sampling supplies for deer hunter kits and mailing costs for self-mailers (400 kits/year for 2 years at $4.64/ea)					$3,712
	Tools and Supplies	Shipping fees	Shipping costs for mailing fecal samples to the lab ($250/shipment on dry ice overnight)					$500
							Sub Total	**$339,212**
Capital Expenditures								
							Sub Total	**-**
Acquisitions and Stewardship								
							Sub Total	**-**
Travel In Minnesota								
	Miles/ Meals/ Lodging	Fleet vehicle mileage @$0.55/mi, estimated 30,000 miles/year using 4 vehicles each field season; food,	Travel to field sites to monitor collar fawns for survival and investigating					$44,500

		and lodging ($14,000/year for 2 years); 8 technicians total (4 per year)	mortalities, overnight stays and meal stipends for all field technicians					
							Sub Total	**$44,500**
Travel Outside Minnesota								
							Sub Total	**-**
Printing and Publication								
							Sub Total	**-**
Other Expenses								
		Direct and Necessary Costs	Direct and necessary costs cover HR Support ($4,394),Safety Support ($680), Financial Support ($7,285), Communication Support ($2,622), IT Support ($9,348), and Planning Support ($2,017)					$26,345
							Sub Total	**$26,345**
							Grand Total	**$1,060,000**

Classified Staff or Generally Ineligible Expenses

Category/Name	Subcategory or Type	Description	Justification Ineligible Expense or Classified Staff Request

Non ENRTF Funds

Category	Specific Source	Use	Status	Amount
State				
In-Kind	Minnesota Game and Fish Fund; Minnesota Statutes, section 97A.055, subd. 4b.	MNDNR Wildlife Health Program: Dr. Michelle Carstensen, project management, field necropsies, analyze, write, outreach; 36 mos, 10% effort	Secured	$13,500
In-Kind	Minnesota Game and Fish Fund; Minnesota Statutes, section 97A.055, subd. 4b.	MNDNR Forest Wildlife Populations & Research Group: Dr. Charlotte Roy, project management for the prairie-chicken activity, fieldwork, data analysis, writing, outreach, supervising graduate student; 36 mos, 15% effort	Secured	$38,941
In-Kind	Minnesota Game and Fish Fund; Minnesota Statutes, section 97A.055, subd. 4b.	MNDNR Farmland Research Group: Dr. Eric Michel, project management for the deer activity, fieldwork, data analysis, writing, outreach, supervising graduate student; 36 mos, 25% effort	Secured	$47,727
In-Kind	Minnesota Game and Fish Fund; Minnesota Statutes, section 97A.055, subd. 4b.	MNDNR Farmland Research Group: Michaela Rice, fieldwork; 36 mos, 5% effort	Secured	$7,261
In-Kind	Minnesota Game and Fish Fund; Minnesota Statutes, section 97A.055, subd. 4b.	MNDNR Farmland Research Group: Brian Haroldson, fieldwork; 36 mos, 5% effort	Secured	$10,995
			State Sub Total	**$118,424**
Non-State				
			Non State Sub Total	**-**
			Funds Total	**$118,424**

Attachments

Required Attachments

Visual Component

File: 0c0331ba-48e.pdf

Alternate Text for Visual Component

Heat map depicting neonicotinoid prevalence and concentrations from hunter harvested deer in Minnesota. Map depicting relative concentrations of neonicotinoids in prairie chickens in Minnesota. Photos of prairie chicken, white-tailed deer fawn, and typical seed spill with seeds coated in neonicotinoids....

Administrative Use

Does your project include restoration or acquisition of land rights?

No

Does your project have potential for royalties, copyrights, patents, or sale of products and assets?

No

Do you understand and acknowledge IP and revenue-return and sharing requirements in 116P.10?

N/A

Do you wish to request reinvestment of any revenues into your project instead of returning revenue to the ENRTF?

N/A

Does your project include original, hypothesis-driven research?

Yes

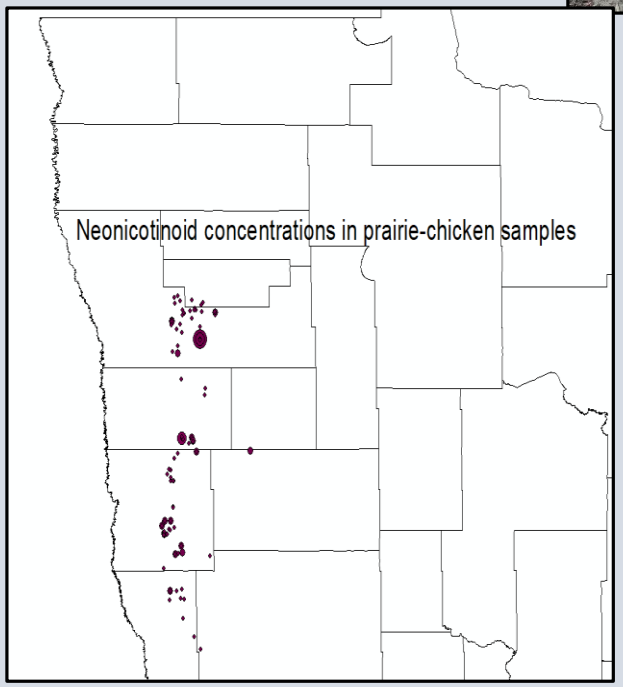
Does the organization have a fiscal agent for this project?

No

Prairie-chicken populations have been in decline for the past decade in Minnesota.

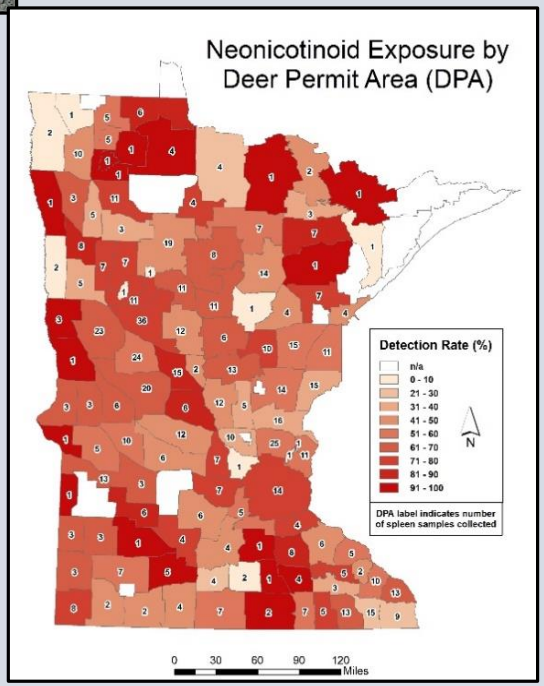
Corn, soybean, and wheat seeds are coated with neonicotinoids. These seeds become available to wildlife during the planting season via seed spills.

White-tailed deer are an iconic game species in Minnesota.



Map depicting relative concentrations of neonicotinoids in prairie-chickens in Minnesota. Larger circles indicate greater neonicotinoid concentrations.

Neonicotinoid availability increases during the spring planting season for agricultural crops. Neonicotinoids occur at various concentrations in both prairie-chickens and white-tailed deer in Minnesota. Given prairie-chickens experienced population declines over the past decade and neonicotinoids can negatively affect fawn survival, we will assess how neonicotinoids affect behavior, reproduction and survival for prairie-chickens and white-tailed deer.



Heat map depicting neonicotinoid prevalence and concentrations from hunter-harvested deer in Minnesota. Colors indicate a detection with concentrations increasing with dark red.