Environment and Natural Resources Trust Fund

M.L. 2022 Approved Work Plan

General Information

ID Number: 2022-091

Staff Lead: Mike Campana

Date this document submitted to LCCMR: June 10, 2022

Project Title: How Do Prescribed Fires Affect Native Prairie Bees?

Project Budget: $500,000

Project Manager Information

Name: Stuart Wagenius

Organization: Negaunee Institute for Plant Conservation Science and Action at the Chicago Horticultural Society

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Web Address: http://echinaceaproject.org/

Project Reporting

Date Work Plan Approved by LCCMR: June 27, 2022

Reporting Schedule: March 1 / September 1 of each year.

Project Completion: June 30, 2025

Final Report Due Date: August 14, 2025

Legal Information

Legal Citation: M.L. 2022, Chp. 94, Art. , Sec. 2, Subd. 03d

Appropriation Language: $500,000 the second year is from the trust fund to the commissioner of natural resources for an agreement with Negaunee Institute for Plant Conservation Science and Action at the Chicago Horticultural Society to investigate how prescribed fire in Minnesota's tallgrass prairies affects the nesting habitat, food resources, and diversity of ground-nesting bees.

Appropriation End Date: June 30, 2025

Narrative

Project Summary: Pollinators are declining in Minnesota's tallgrass prairies. We will investigate how prescribed fire affects the nesting habitat, food resources, and diversity of ground-nesting bees to make recommendations for prairie management.

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

Prescribed fire is widely used to maintain tallgrass prairie in Minnesota. Burning promotes native plant diversity, and a 21-year investigation from Dr. Wagenius' research group in Douglas County, MN (Echinacea Project) shows that fire also improves pollination. However, we know very little about how fires affect solitary bees – the most diverse and important pollinators in tallgrass prairie. Fire harms some insects and but benefits others. Natural resource managers currently lack clear guidance about prescribed fire and pollinator conservation. We do not know if fire directly threatens solitary bees, most of which nest belowground. We also don't know how prescribed fires affect bee nesting habitat or the nutritional quality of their food resources (pollen and nectar from wildflowers). Better understanding how prescribed fires influences solitary bee nesting habitat, food resources, and diversity is critical for providing recommendations about how prescribed fire should be used to promote pollinator conservation and healthy prairie. With over 25 years of experience researching insects and plants in western Minnesota, as well as active research investigating fire effects on prairie plants and pollination, the Echinacea Project is uniquely well-positioned to investigate how prescribed fire affects native solitary bees, and to develop guidelines for promoting pollinator conservation.

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

We propose to investigate how prescribed fires influence the nesting habitat, food resources, and diversity of ground-nesting solitary bees in Minnesota tallgrass prairie. This research is distinct from and complements previous ENRTF-funded projects that investigated habitat requirements of cavity-nesting solitary bees and cataloged native bee diversity in Minnesota. We will conduct prescribed burns in a sample of 50 prairie remnants and restorations in Douglas and Grant Counties, where we have been researching prairie plants and insects since 1995. We will characterize bee nesting habitat and survey solitary bees before and after prescribed burns to determine how fire affects nesting habitat and solitary bee diversity. In addition, we will repeat the pan trap surveys our research team began in 2004. This will allow us to characterize the population trends and habitat requirements of numerous solitary bee species (Activity 1). We will then investigate how fire influences food resources and pollinator activity by surveying flowering plant density, measuring the quantity and nutritional quality of pollen and nectar, and monitoring how frequently bees visit different wildflower species (Activity 2).

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 will provide guidelines and offer recommendations to conservation practitioners and policymakers about best management practices for maintaining healthy prairie plant and pollinator populations. The proposed research will directly inform conservation efforts in Minnesota tallgrass prairie by revealing how prescribed fire influences the nesting habitat, quantity and quality of food resources, and diversity of ground-nesting prairie bees. Additionally, our research will provide valuable information about nesting habitat requirements for different bee species, preferred wildflower species, and population trends.

Project Location

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

County(s): Douglas, Grant, Pope, Stevens,

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

Activities and Milestones

Activity 1: Investigating how prescribed fire influences the nesting habitat and diversity of solitary, ground-nesting bees in Minnesota tallgrass prairie

Activity Budget: $255,000

Activity Description:
We will survey solitary bee diversity and nesting habitat before and after prescribed fires in a subset of 30 prairie remnants and 20 prairie restorations to determine how prescribed fire affects solitary bee nesting habitat and abundance. We will use emergence traps and detailed measures of soil and litter to characterize how prescribed burning influences the nesting habitat and diversity of solitary bees. In addition to these detailed investigations, we will repeat the broader-scale pan trap surveys our research team began in 2004 to reveal population trends and habitat requirements of numerous bee species. We will provide natural resource managers and policymakers with guidelines and recommendations about how prescribed fire affects solitary bees and their nesting habitat. In addition to disseminating results at regional and national scientific meetings, we will share results locally to interested groups. Summer interns from local high schools (2 per year) will present results at their school, FFA, 4H, and other groups. Additionally, we established an experimental plot at West Central Area High School in 2018 with science teacher and research collaborator VanKempen. He will present results of fire effects on plants and pollinators within the school's restored prairie at a statewide teacher conference.

Activity Milestones:

Description	Approximate Completion Date
Repeat general bee survey using pan traps	September 30, 2022
Conduct first round of prescribed burns	May 31, 2023
Complete first round of surveys of solitary nesting habitat and diversity	September 30, 2023
Conduct second round of prescribed burns	May 31, 2024
Complete second round of surveys of solitary nesting habitat and diversity	September 30, 2024
Analyze data and write papers for publication in peer-reviewed scientific journals	June 30, 2025
Develop and disseminate management guidelines and recommendations	June 30, 2025

Activity 2: Characterizing fire effects on food resources for bees and plant-pollinator interactions in Minnesota tallgrass prairie

Activity Budget: $245,000

Activity Description:
Healthy bee populations require sufficient quantity and quality of food (pollen and nectar). Fire could benefit bees by increasing the quantity or nutritional quality of these food resources. We will investigate how prescribed burns affect the density of flowering plants, the quantity and nutritional quality of both pollen and nectar, and the activity of pollinators within remnant and restored prairies where Dr. Wagenius and his team have been working since 1995. Most sites are owned by private landowners and many have not burned in >30 years. Assessment of fire effects on flower density and pollinator visitation will be particularly valuable because they can be compared to long-term datasets of annual variation of flowering in the absence of fire. We will measure quantity and quality of pollen and nectar from wildflowers before and after prescribed burns. Nutritional contents of pollen includes fat, protein, and micronutrients and nectar provides sugar, protein, and micronutrients. Results of these activities will reveal how fires affect food resources for bees and also pollination for plants. We will provide recommendations to managers and policymakers about which plant species are most nutritionally valuable for pollinators and how much fire affects the quantity and nutritional content of their diets.

Activity Milestones:

Description	Approximate Completion Date
Survey flower density	September 30, 2022
Collect pollen and nectar samples from prairie wildflowers & investigate pollinator visitation (first round))	September 30, 2023
Complete first round of nutritional analysis of pollen and nectar	February 28, 2024
Collect pollen and nectar samples, assess flower density, & investigate pollinator visition (second round)	September 30, 2024
Complete second round of nutritional analysis of pollen and nectar	February 28, 2025
Analyze data and write papers for publication in peer-reviewed scientific journals	June 30, 2025
Analyze data to write papers, develop and disseminate management guidelines	June 30, 2025

Project Partners and Collaborators

Name	Organization	Role	Receiving Funds
Dr. Rahul Roy	St. Catherine University	Dr. Roy is a molecular biologist specializing in pollen and nectar biology at St. Catherine University in St. Paul, MN. He will conduct biochemical assays to quantify the nutritional content of pollen and nectar.	Yes
Dr. Zach Portman	University of Minnesota Bee Lab	Dr. Portman is a bee taxonomist at the University of Minnesota in the Cariveau Native Bee Lab. His research focuses on the identification and taxonomy of Minnesota bees. We will contract Dr. Portman to identify our field-collected bee specimens.	Yes
John VanKempen	West Central Area High School	VanKempen is a high school science teacher at West Central High School (Barrett, MN) who has collaborated with the Echinacea Project on pollinator projects since 2018. VanKempen will lead the pan trapping investigation, assist with all other fieldwork, and serve as liaision to local communities.	Yes
Stacy Salvevold	Fergus Falls Wetland Management District, US Fish & Wildlife Service	Salvevold and members of the fire staff at Fergus Falls will coordinate the timing and location of prescribed burns of Waterfowl Production Areas in the study site so that they can be included in the proposed investigations of fire effects on native bees and pollination.	No

Dissemination

Describe your plans for dissemination, presentation, documentation, or sharing of data, results, samples, physical collections, and other products and how they will follow ENRTF Acknowledgement Requirements and Guidelines.
We will publish findings from Activities 1 & 2 in peer-reviewed scientific journals. We will present results of this research at local and regional conferences. We will produce research briefs of for conservation practitioners, policymakers, and the general public that summarize our findings and provide recommendations about burning. These will be posted on the project website: echinaceaproject.org. We will also share results with local landowners and groups interested in protecting and enhancing natural prairie resources via pamphlets, presentation, and in person. We will acknowledge the Environment and Natural Resources Trust Fund through use of the trust fund logo, or attribution language, or both on all project print and electronic media, publications, signage, and other communications and outreach.

We will provide natural resource managers and policymakers with guidelines and recommendations about how prescribed fire affects solitary bees and their nesting habitat via our website and in presentations to interested groups (Activity 1). We will acknowledge the ENRTF following guidelines.

Summer interns from local high schools (2 per year from Douglas, Grant, Pope, or Stevens County) will present results at their school, FFA, 4H, and other groups. We will print posters, pamphlets, or exhibits to share information about prairies and native pollinators (Activities 1 & 2). We will acknowledge the ENRTF following guidelines.

Science teacher and research collaborator VanKempen will present results of fire effects on plants and pollinators within the school's restored prairie at a statewide teacher conference (Activity 1). He will acknowledge the ENRTF following guidelines.

Our results will reveal how fires affect food resources for bees and also pollination for plants. We will provide recommendations to managers and policymakers about which plant species are nutritionally valuable for pollinators and how much fire affects the quantity and nutritional content of their diets (Activity 2). We will acknowledge the ENRTF following guidelines.

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 work be funded?

Our research group, the Echinacea Project, investigates the biology, conservation, and restoration of plants and insects in tallgrass prairie. The research we propose here advances our 25-year efforts to conserve the diverse native bees and plants of Minnesota tallgrass prairie. We will publish findings from Activities 1 & 2 in peer-reviewed scientific journals, present results at local and regional conferences, and produce research briefs for conservation practitioners, policymakers, and the general public that summarize our findings and provide recommendations about burning.

Budget Summary

Category / Name	Subcategory or Type	Description	Purpose	Gen. Ineligible	% Benefits	# FTE	Classified Staff?	$ Amount
Personnel								
Postdoctoral Researcher		The Postdoctoral Researcher will supervise and coordinate field research activities. This individual will design and implement data collection workflows, manage data sets, conduct statistical analyses, serve as lead author for most peer-reviewed publications, and assist with the dissemination of research materials to natural resource managers, policymakers, scientists, and the general public.They will be based in Minnesota at least six months each calendar year.			28%	2.7		$214,000
Field assistants		We will hire one field technician in summer 2022 (3 months) and 2 field technicians in summer 2023 & summer 2024 (6 months). These individuals will help conduct pan trapping surveys, bee nesting habitat and emergence trapping surveys, pollen and nectar collection, and pollinator visitation surveys.			11%	2.25		$88,000
High School Research Interns (Participants)		Two local high school students will participate during summer 2023 and another two during summer 2024 for 10 weeks each summer. These interns from Alexandria, Minnewaska, Morris, or West Central Area will assist with all research activities and gain appreciation about Minnesota's rich natural resources. As part of the internship, students will develop a poster, pamphlet, or exhibit about prairie and native pollinators to share with school and civic groups.		X	0%	0.8		$20,000
High School Teacher Researcher (Participant)		John VanKempen, high school science teacher from West Central Area High School, will participate in all summer research activities, supervise pan trapping surveys, coordinate with local landowners and present research findings to educational organizations.		X	0%	0.39		$20,000
Supervisor of field assistants		The field supervisor will coordinate day-to-day research activities with the post-doctoroal researcher. This individual will supervise the field assistants and conduct pan trapping surveys, bee			11%	1		$48,500

		nesting habitat and emergence trapping surveys, pollen and nectar collection, and pollinator visitation surveys.						
							Sub Total	**$390,500**
Contracts and Services								
Dr. Zach Portman (UMN Bee Laboratory)	Professional or Technical Service Contract	Identify field-collected bee specimens at rate of $2 per bee. Single-source provider selected due to the unique and expert skills required for accurate and efficient bee identification. This contract will be executed as part of Activity 1.		X		0.2		$6,000
St. Catherine University	Sub award	Summer salary to support Dr. Rahul Roy for 1.5 months each summer (2023 & 2024) while he conducts pollen and nectar nutritional assays. Dr. Roy's expertise in molecular biology as well as pollen and nectar biology uniquely positions him to collaborate on this project and perform the biochemical assays.				0.26		$18,500
St. Catherine University	Sub award	Dr. Roy will hire undergraduate students at St. Catherine University to assist with labwork needed to conduct nutritional assays of pollen and nectar. Students will work 20 hours/week over two 14-week periods. Dr. Roy is uniquely positioned to collaborate on this project and perform biochemical assays.				0.28		$9,000
							Sub Total	**$33,500**
Equipment, Tools, and Supplies								
	Tools and Supplies	Field supplies: 50 emergence traps ($200/trap) as well as pan traps, bee pinning supplies, pin flags, meter sticks, and other field supplies as well as replacement tools for burning.	These supplies are necessary to conduct proposed fieldwork outlined in Activities 1 & 2.					$12,000
	Tools and Supplies	Lab supplies for conducting chemical assays to quantify pollen & nectar nutrition. We plan to collect and analyze 400 pollen and 300 nectar samples. For each pollen sample, we will analyze carbohydrates ($6/sample), lipids ($6/sample), and total protein/amino acids ($5/sample) content. For all nectar samples we will analyze carbohydrate ($6/sample) and total protein/amino acid	These lab supplies are needed to quantify the nutritional content of field-collected pollen and nectar samples (Activity 2).					$14,000

		($5/sample) concentrations. We also request funds to analyze 100 nectar samples for micronutrients ($6/sample) content. In addition to the chemical analyses, we request $3300 to purchase lab supplies needed to conduct biochemical analyses (chemical reagents, multichannel pipettors, 6 well plates, tubes, tips, pestles)						
							Sub Total	**$26,000**
Capital Expenditures								
							Sub Total	**-**
Acquisitions and Stewardship								
							Sub Total	**-**
Travel In Minnesota								
	Miles/ Meals/ Lodging	Travel from research base in Douglas County to field sites in Douglas, Grant, Pope, and Stevens Counties. Estimated 120 miles per week per person at federal mileage reimbursement rate of $0.585/mile (2 individuals for 8 weeks during summer 2022 and 5 individuals for 16 weeks during summer 2023 & summer 2024).	Local travel to research sites within Douglas, Grant, Pope, and Stevens Counties.					$12,000
	Miles/ Meals/ Lodging	Housing near field sites for summer research crew ($1800/month): July - September 2022 (3 months), April - September 2023 (6 months), and April - September 2024 (6 months).	Renting a house near our study sites in rural western Minnesota minimizes travel and allows us to conduct research efficiently.					$27,000
							Sub Total	**$39,000**
Travel Outside Minnesota								
	Conference Registration Miles/ Meals/ Lodging	Requested funds include travel, meals, and incidentals for one individual.	We request funds for the post-doctoral researcher to travel to an Ecological Society of America or Conservation Biology meeting to present project findings. Attendance at one of these meetings will enhance our ability to	X				$1,500

			conduct the research, disseminate our results, and promote conservation of natural resources in Minnesota & beyond.					
							Sub Total	**$1,500**
Printing and Publication								
	Publication	Publication fees for peer-reviewed scientific papers	These publications will help disseminate our findings to practitioners, policymakers, and scientists across the state of Minnesota and more broadly.					$9,000
	Printing	Participant costs: print posters, pamphlets, or exhibits developed by high school interns to share information about prairies and native pollinators with their high schools and civic groups.	These presentations will help disseminate our findings to local landowners and groups interested in protecting and enhancing natural prairie resources.					$500
							Sub Total	**$9,500**
Other Expenses								
							Sub Total	**-**
							Grand Total	**$500,000**

Classified Staff or Generally Ineligible Expenses

Category/Name	Subcategory or Type	Description	Justification Ineligible Expense or Classified Staff Request
Personnel - High School Research Interns (Participants)		Two local high school students will participate during summer 2023 and another two during summer 2024 for 10 weeks each summer. These interns from Alexandria, Minnewaska, Morris, or West Central Area will assist with all research activities and gain appreciation about Minnesota's rich natural resources. As part of the internship, students will develop a poster, pamphlet, or exhibit about prairie and native pollinators to share with school and civic groups.	Our summer research team includes 1-2 interns from local high schools funded by the National Science Foundation. They are classified as participants instead of employees. We would do the same for ENRTF-funded interns.
Personnel - High School Teacher Researcher (Participant)		John VanKempen, high school science teacher from West Central Area High School, will participate in all summer research activities, supervise pan trapping surveys, coordinate with local landowners and present research findings to educational organizations.	Our summer research team includes 1-2 secondary school science teachers funded by the National Science Foundation. They are classified as participants instead of employees. We would do the same for ENRTF-funded teacher researchers.
Contracts and Services - Dr. Zach Portman (UMN Bee Laboratory)	Professional or Technical Service Contract	Identify field-collected bee specimens at rate of $2 per bee. Single-source provider selected due to the unique and expert skills required for accurate and efficient bee identification. This contract will be executed as part of Activity 1.	Single-source provider selected due to the unique and expert skills required for accurate and efficient identification of Minnesota bees.
Travel Outside Minnesota	Conference Registration Miles/Meals/Lodging	Requested funds include travel, meals, and incidentals for one individual.	Travel to a conference outside the state of Minnesota for postdoctoral researcher to participate in formal presentation of project findings.

Non ENRTF Funds

Category	Specific Source	Use	Status	$ Amount
State				
			State Sub Total	**-**
Non-State				
In-Kind	The Chicago Botanic Garden's Federally-negotiated indirect cost rate is 55%. This rate is applied to MTDC, which excludes participant support costs ($500K - 41K).	Unrecovered indirect costs associated with this proposal.	Secured	$252,450
In-Kind	In kind from USFWS for conducting prescribed burns.	Fire staff from Fergus Falls will burn Waterfowl Production Areas in study area.	Secured	$10,000
			Non State Sub Total	**$262,450**
			Funds Total	**$262,450**

Attachments

Required Attachments

Visual Component

File: 252ff170-742.pdf

Alternate Text for Visual Component

Three panels, each with an illustration and a question: 1) Native bees before and after a prairie fire, "Does burning affect bees?"; 2) Bees seeking locations to nest with inset photo of bee, "Do more bees nest in burned areas?"; and 3) Bees and seeking food with inset USDA nutrition label, "Does fire affect the nutritional value of pollen and nectar?"...

Financial Capacity

File: b80071bf-1c0.pdf

Board Resolution or Letter

Title	File
Board Letter	96e60ee9-1ec.pdf

Optional Attachments

Support Letter or Other

Title	File
revised research addendum	b25e5793-ef9.pdf
Background Check Certification Form	6a210fac-a2d.pdf

Difference between Proposal and Work Plan

Describe changes from Proposal to Work Plan Stage

1. Because we have so little time to plan for the 2022 season and hire personnel, we have scaled back expectations for fieldwork in 2022 and delayed the start of the post-doctoral researcher.

2. To keep the budget aligned with inflation (travel, housing, and wages), we have increased budgets in several categories.

3. We added a new category of personnel (Supervisor of field assistants - 1 FTE) to increase our capacity to conduct fieldwork during the summers of 2023 & 2024.

4. We updated the in kind contributions provided by the Chicago Botanic Garden and the US Fish & Wildlife Service.

5. We clarified that we will conduct prescribed burns prior to the 2023 and 2024 flowering seasons and made several minor changes based on recommendations by peer reviewers.

Additional Acknowledgements and Conditions:

The following are acknowledgements and conditions beyond those already included in the above workplan:

Do you understand and acknowledge the ENRTF repayment requirements if the use of capital equipment changes?

N/A

Do you agree travel expenses must follow the "Commissioner's Plan" promulgated by the Commissioner of Management of Budget or, for University of Minnesota projects, the University of Minnesota plan?

Yes, I agree to the Commissioner's Plan.

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

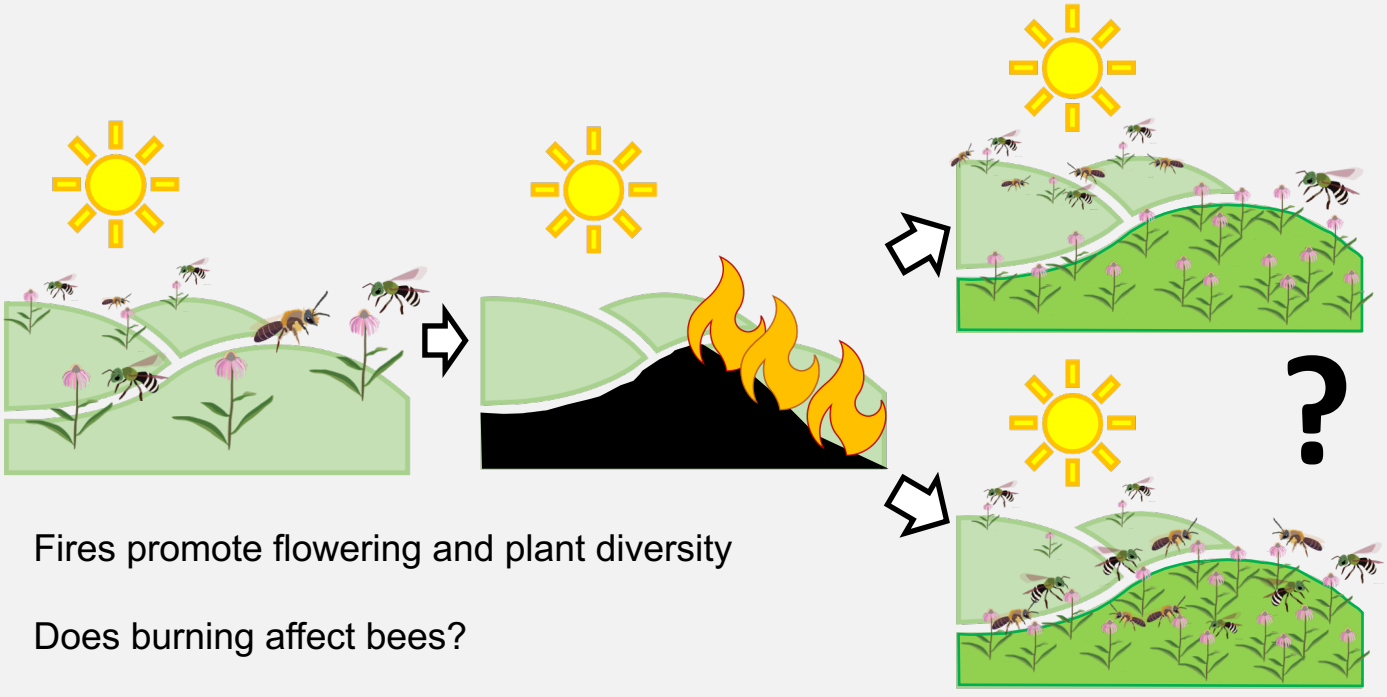
Does your project include original, hypothesis-driven research?

Yes

Does the organization have a fiscal agent for this project?

No

How do prescribed burns influence native, ground-nesting bees in Minnesota prairie?



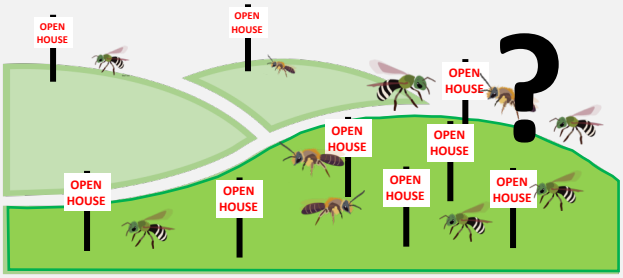
Fires promote flowering and plant diversity

Does burning affect bees?

Nesting habitat

Bees nesting belowground may be protected from fire

Do more bees nest in burned areas?



Food quantity & quality

More plants flower after fire

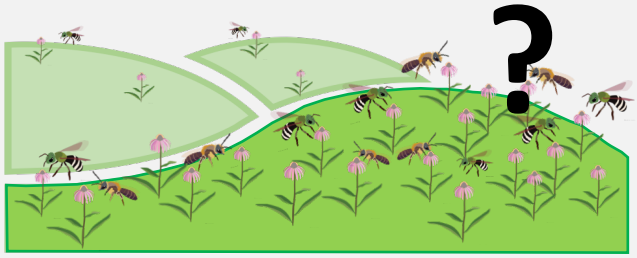
Does fire affect the nutritional value of pollen and nectar?

Nutrition Facts

Serving Size 3 oz. (85g)
Serving Per Container 2

Amount Per Serving	
Calories 200	Calories from Fat 120
	% Daily Value*
Total Fat 15g	**20 %**
Saturated Fat 5g	**28 %**
Trans Fat 3g	
Cholesterol 30mg	**10 %**
Sodium 650mg	**28 %**
Total Carbohydrate 30g	**10 %**
Dietary Fiber 0g	**0 %**
Sugars 5g	
Protein 5g	
Vitamin A 5% •	Vitamin C 2%
Calcium 15% •	Iron 5%

*Percent Daily Values are based on a 2,000 calorie diet. Your Daily Values may be higher or lower depending on your calorie needs.



Plant and bee images by Karen Bai