Consortium on Law and Values in Health, Environment & the Life Sciences
2019-20 Proposal Cover Page

To use checkboxes, place cursor on box; right click; select Properties; select Checked under Default value

Applicant Information

Applicant name(s):	**Margaret (Maggie) Shanahan**	Email: **mshanaha@umn.edu**	
Project title:	**Thinking outside the box: building beekeeping practices that support the natural behaviors that stingless bees need to be healthy**		
Department:	**Entomology**	College: **College of Food, Agricultural, and Natural Resource Sciences**	
Degree program:	**PhD**		
Faculty advisor:	**Marla Spivak**	Faculty advisor email: **spiva001@umn.edu**	☐ No advisor
Dept. Head:	**Sujaya Rao**	Dept. Head's email: **sujaya@umn.edu**	
Dean:	**Brian Buhr**	Dean's email: **bbur@umn.edu**	

How did you hear about this funding opportunity?
☐ ACCU ☐ Consortium website ☐ The Brief ☒ Dept. email/newsletter ☐ Law School email ☐ Other

Funding

Total amount of funding requested: **$7,000**

Executive summary (maximum 200 words)

Stingless bees have been managed for millennia by indigenous and *campesino* communities throughout Latin America, and stingless beekeeping continues to contribute substantially to the lives and livelihoods of smallholder farmers across the global south. Now, the threat of stingless bee decline necessitates a careful assessment of the evolving management practices that could affect the future of this important biocultural relationship. In honey bees, scientists have found that the collection of antimicrobial resins, called propolis, supports colony health. This discovery has inspired beekeepers to reimagine hive design to more closely match habitats found in nature. However, the role of propolis in stingless bee health has not been explored. This project will bring together a diverse group of collaborators to assess nesting spaces in terms of their ability to stimulate propolis collection, and compare colony health and individual bee immune responses in high-propolis and low-propolis colonies. Our results will inform management recommendations for stingless beekeepers in Mexico and around the world. More broadly, this project will foster an interdisciplinary collaboration that brings together honey bee research, traditional stingless bee knowledge, and the science of social immunity to support the resilience of these essential pollinators.

Approvals

Check all appropriate approvals required for your proposal. It is not necessary to have all approvals at the time of proposal submission; however, approvals must be obtained prior to receipt of funding. If you have applied for approval but have not yet received it, indicate that below.

IRB required? ☐ Yes ☐ No ☒ NA	☐ If yes, is application pending?	Approval date or number:
Other/s required? ☐ Yes ☐ No ☒ NA	☐ If yes, is application pending?	Specify type of approval:

Checklist—for reviewer use only. DO NOT COMPLETE.

- ☐ The proposal is 1000 words or less excluding budget, biographies, references and citations.
- ☐ The proposal includes a work plan with a specific timeline using months or quarters to identify work to be done and completion dates.
- ☐ The proposal includes a 1-2 paragraph biography of the applicant and all co-investigators.
- ☐ The budget form is complete including the funds sought for this project, other pending applications for this project, and the amount/source of matching or other funds.
- ☐ The applicant's faculty advisor is copied on the application email. Professional students w/o advisors check No Advisor.
- ☐ All necessary approvals are pending or received.

Background: As myriad environmental stressors threaten bee populations and beekeeper livelihoods, beekeepers, researchers, and conservationists seek solutions to support stingless bees. Stingless bees are social, honey-producing bees native to tropical regions. They pollinate at least 18 major crops,[1] produce high-value honeys with unique medicinal properties,[2] and figure strongly in the cultural identity of many indigenous groups.[3] Stingless beekeeping has been practiced for millennia, and continues contribute substantially to the livelihoods of smallholder farmers across the global south, particularly in Latin America.[4] Due to agricultural intensification, deforestation, and the continuing impacts of colonization, stingless beekeeping experienced severe declines in the 20th century.[5] Fortunately, stingless beekeepers and conservation groups are now breathing new life into this ancient practice, offering hope for the conservation of a rich biocultural relationship and important resource for farmers.

However, as stingless beekeeping grows, beekeeping practices increasingly shift away from traditional management, towards a more intensive management regime (e.g. feeding colonies to stimulate rapid growth; transporting colonies to agricultural fields for pollination services). In recent years, honey bee scientists have found that many of these practices are detrimental to honey bee health, and contribute to the massive colony losses that occur in the U.S. every year.[6] These discoveries, though they emerge in a separate context and study system, may nevertheless have important implications for stingless beekeepers and the health of their bees. Therefore, I have initiated an interdisciplinary collaboration between the honey bee and stingless bee research communities. **The aim of this collaboration is to study and support beekeeping practices that understand and uphold the natural behaviors that bees need to be healthy.** Because immune function is central to bee health, our first area of focus is social immunity, specifically propolis collection.[7]

Project overview: In the wild, stingless and honey bee colonies use propolis to cover the rough inner surfaces of the hollow tree cavities where they nest.[8] For decades, beekeepers actively removed propolis from honey bee colonies, unaware of its benefits to bees.[9] Now, a growing body of research demonstrates that this 'propolis envelope' reduces clinical signs of brood diseases and allows bees' immune systems to better respond to acute threats.[10,11,12] As a result, beekeepers are working to re-incorporate propolis into the honey bee hive. At the same time, however, the amount of propolis found in stingless bee hives is declining as stingless beekeepers increasingly transfer managed colonies from propolis-rich hollow logs to bare wooden boxes, and even actively remove the bees' propolis stores.[13] Little is known about the therapeutic value of propolis to stingless bees, but if propolis-rich environments support stingless bee immune systems (as occurs in honey bees), then removing propolis will likely have negative consequences for stingless bee health.

The objectives of this study are to:

1. Assess the effects of changing management practices on propolis collection and colony health
2. Develop management recommendations for stingless beekeepers in Mexico and around the world
3. Foster interdisciplinary collaboration to promote sustainable beekeeping practices

My project brings together a diverse group of collaborators, including stingless and honey bee researchers, beekeepers, and educators from El Colegio de la Frontera Sur (ECOSUR) and the University of Minnesota (UMN). Our study organism is *Scaptotrigona mexicana*, a common, tree-nesting stingless bee managed in both traditional and intensive beekeeping operations

throughout Mexico. Our partners at ECOSUR have managed *S. mexicana* for over 30 years and maintain active colonies in several locations in Chiapas, Mexico.

Methods: This project involves three components. First, I will monitor propolis foraging behavior and quantify propolis deposition in 30 colonies established in rough wooden boxes (a close approximation of traditional hollow log hives) and smooth wooden boxes (current industry standard) over the course of one year. Second, I will test whether a propolis-rich environment supports colony health in stingless bees, using management techniques to manipulate the amount of propolis in each colony and comparing health outcomes.[9] Third, I will use non-infectious bacterial compounds to challenge the immune systems of individual bees, and compare immune activity and survivorship in high-propolis and low-propolis colonies.[14]

Proposed use of funding: I am currently two months into my first field trip to Chiapas, which began in December 2019. Even early in their development, our colonies are already beginning to line the corners of their hives with propolis. However, propolis collection is a slow process, and it will take several months for these colonies to build up sufficient propolis stores for us to accurately evaluate the efficacy of different hive designs and the impact of a propolis-rich hive environment on colony health and individual immunocompetence. The Consortium Research Award will allow me to return to Chiapas at the eight- and twelve-month marks, in July and December of 2020, to document propolis collection and perform bioassays at these critical time points. I will work with technicians Miguel Guzmán (ECOSUR) and Héctor Morales Urbina (UMN) on colony management and data collection.

Project timeline

December 2019 – March 2020 (in progress): Establish fifty stingless bee colonies in smooth, rough, high-propolis, and low-propolis hives; quantify baseline colony health and foraging behavior.

July 2020: Document rainy season foraging behavior; conduct bioassays to compare bee health in high-propolis and low-propolis hives.

December 2020 – March 2021: Quantify total propolis accumulated across treatments over the course of one year; conduct bioassays to compare bee health in high-propolis and low-propolis hives.

April 2021: Present preliminary results to collaborators and stingless beekeeping community through ECOSUR's Bees and Education initiative.

July 2021: Submit final report to the Consortium.

Significance: This research is interdisciplinary in that it brings together the U.S.-based honey bee research community and Mexico-based stingless bee science and management. These fields share much in common, and in many ways their fates are linked, but language and logistical barriers often impede direct collaboration. We see this project as the first step in a deep and fruitful dialogue, which will inform the science of social immunity, provide concrete tools for stingless beekeepers, and create a reflective space for the beekeepers and scientists supporting bee health in Latin America and around the world.

Collaborator Biographies

Maggie Shanahan (applicant) is a third-year PhD student in the Department of Entomology. As an undergraduate, Maggie spent summers working as a beekeeper and research technician at the UMN Bee Lab. After receiving her B.S. in Biology at the University of Puget Sound in 2013, Maggie relocated to Chiapas, Mexico on a Fulbright fellowship to research the organic beekeeping movement in collaboration with the Bee Research Team at ECOSUR, led by Dr. Rémy Vandame. In addition to her Fulbright Fellowship, Maggie was awarded a Fulbright Social Engagement Grant to bring her research to the broader community, and began working with local beekeepers to coordinate bee management workshops for youths. She later worked with colleagues at ECOSUR to found the Bees and Education Team and launched a six-month workshop series on stingless bee management and conservation. Given her background in honey bees and propolis research and her experience with stingless beekeeping in southern Mexico, Maggie is uniquely qualified to connect the honey bee and stingless bee research communities. Her hope is that stingless beekeepers might avoid the patterns and practices that have proven so detrimental to honey bee health.

Marla Spivak, Ph.D., is coordinator and principal investigator of the Honey Bee Lab at the UMN. Dr. Spivak is an expert in social immunity. She and her students pioneered research on propolis collection and colony health in honey bees, and are working with honey bee keepers to implement propolis as a tool to support colony health in day-to-day beekeeping operations. In her work, Dr. Spivak strives to connect the beekeeping and research communities on both a local and global scale. Dr. Spivak has conducted research in Central America and has collaborated with Dr. Vandame previously. She looks forward to connecting the honey bee and stingless bee worlds to forward impactful research and sustainable management.

Rémy Vandame, Ph.D., is coordinator and principal investigator of the Bee Research Team at ECOSUR. Dr. Vandame studies landscape ecology, biodiversity, and ecology of native bees. He and his team collaborate extensively with beekeepers and community organizations that work with stingless bees and honey bees. In 2016, he worked with Maggie Shanahan and Yliana Delfin to establish the Bees and Education Team, a branch of the bee team focused on beekeeper engagement and outreach. Witnessing the rapid growth of stingless beekeeping in Mexico, and having experience with the intensification of honey bee management as well, it was Dr. Vandame who first expressed that value of connecting these separate but related systems. He proposed to investigate "lessons that stingless beekeepers could learn from the challenges that honey beekeepers have faced", a central theme of this research.

Miguel Angel Guzmán Díaz is the lead stingless bee technician at ECOSUR. His background is in agricultural chemistry and he holds a master's degree in biotechnology. Miguel has worked with the ECOSUR Bee Team since 1988 and is responsible for maintaining dozens of stingless bee colonies in multiple locations throughout Chiapas. Miguel has published several technical manuals on stingless bee management and conservation. He connects with the beekeeping community through conferences, seminars, symposia, and short courses.

Héctor Morales Urbina is a beekeeping technician at the UMN Bee Research Facility. He is originally from Chiapas, Mexico and has extensive experience working with both honey bees and stingless bees. Héctor brings a diverse set of skills to both field and lab work.

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Consortium on Law and Values in Health, Environment the Life Sciences
Proposal Budget

Project Title: Thinking outside the box: Building beekeeping practices that support the natural behaviors that stingless bees need to be healthy

	Provide justification along with costs.		**Requested funding**
	Category& instructions	**Justification**	**Amount**
1	Your stipend (maximum amount is $5,000)		$0
2	Speaker honoraria (for colloquia)	___ speakers x $ _____ honorarium	$0
3	Supplies & Services *Identify and explain use here or in the body of your proposal.*	***Bioassay materials*** *$475 purchase reagents + $100 delivery on ice = $575* *I estimate that reagents (lipopolysaccharide, buffer solution, enzymes, etc.) will cost $475, and shipping fees will cost and additional $100.* ***Basic hive management materials*** *$40 masking tape + $10 mesh netting + $10 assorted syringes = $60* *These materials include masking tape to seal cracks in vulnerable colonies, mesh netting to control pest pressure from phorid flies, and sterile syringes to manipulate honey resources.* ***Equipment transport*** *2 suitcases * $50/suitcase * 2 round trips = $200* *Luggage fees to transport research equipment (e.g. dissecting scope and other lab equipment to be borrowed from UMN Bee Research Facility). I anticipate transporting two large suitcases to Chiapas from Minnesota, and back.* ***Postage fees: sending samples back to UMN for analysis*** *2 packages * $100 per package = $200* *Virus and lipid assays will be performed on whole bee samples collected from resin-rich and resin poor colonies to determine individual bee and colony health. These samples must be shipped in ethanol or on ice.* ***Stipend for research technician*** *1 day/wk * 52 wks * $50/day = $2,600* *Because this is an international project and our research colonies are located in Chiapas, we will hire a research technician to serve as a local point person, taking weekly trips to the bee yard for colony management and upkeep.* ***Fuel costs for weekly trips to field site*** *$10/trip * $4 trips/month*12 months = $480* *Fuel for field vehicle for weekly trips to and from field site in Cacahoatán, Chiapas.*	$4,115
4	Equipment *Identify and explain use. Allowable only if the equipment is necessary for this project. All equipment must be given to your dept. at the completion of your project.*	***Miniature infrared video camera with tripod for propolis foraging observations*** *$80/camera * 6 cameras = $480* *Video cameras will be placed alongside hive entrances to record foraging behavior for 10-minute intervals. This will improve the speed and accuracy of foraging observations, and facilitate sharing with other lab groups and beekeepers. Cameras will be donated to the Spivak Lab when experiment is complete.*	$480
5	Travel *Indicate the purpose of the travel, estimated dates of travel, transportation, housing and allowable per diem costs (see travel.umn.edu).*	***Round-trip airfare between Minneapolis, Minnesota and Tapachula, Chiapas*** *$800/trip * 2 trips = $1,600 total* *Round-trip flights to Tapachula (nearest airport) routing through Mexico City or Cancun cost between $600 and $800. I will travel to Tapachula at the eight-month and twelve-month mark to evaluate resin deposition and colony health, and conduct bioassays.* ***Local transportation*** *$1/day * 105 days = $105* *Local bus fare in Cacahoatán is $1/day.* ***Lodging near field site in Cacahoatán, July 2020*** *$20/day * 14 days = $280* *The S. mexicana research colonies are located in the small town of Cacahoatán, Chiapas, approximately 30 minutes from Tapachula. AirBnbs and hotel costs in the area range from $18-$25 USD/night, plus booking and cleaning fees. For the July field trip, I will look for short-term lodging options. For the December 2019 – March 2020 field trip, I plan to rent a small apartment near the field site. Since I will not be paying rent in Minneapolis for that time period, I will pay this expense and per diem expenses out of pocket.* ***Per diem expenses, July 2020*** *$30/day x 14 days = $420* *Kitchen access may be limited in temporary lodging for my July stay. This will cover Breakfast, lunch, and dinner in Cacahoatán, Chiapas.*	$2,405
	TOTAL BUDGET		$7,000

Other funding: List other or matching funding you have requested for this project.

Funding source	**Amount**
NSF Graduate Research Fellowship: applicant stipend (obtained)	$34,000/year

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ECOSUR: in-kind support in the form of access to fifty research colonies, technical support, and lab space (obtained)	$8,000
The UMN Bee Research Facility: in-kind support in the form of lab equipment (dissecting scope, micropipettes, thermocouples) and technical support (obtained)	$8,000
International Thesis Research Travel Grant (requested)	$5,000
Garden Club of America Centennial Pollinator Fellowship (requested)	$4,000