Farming for Native Bee Technology Transfer:

A Step-by-Step Guide for Understanding, Envisioning, Designing, Installing and Maintaining Wild Bee Habitats that Contribute Significantly to Crop Pollination

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Abstract

Farming for Native Bees: Technology Transfer is a two-year project that developed a series of technology diffusion video modules to effectively engage farmers in native bee habitat farming. The project is based on ongoing research, funded by the national level NRCS CIG program, which collaborates with farmers in Brentwood, Contra Costa Co., California to install and monitor high quality native bee habitat. The overarching goal of these projects is to address a key issue faced by US farmers: the precipitous decline of honey bee pollinators.

It is well known that producers adopt technologies at different rates and therefore effective strategies to encourage adoption must address those differences (Rogers 1963, USDA NRCS 2005, American Farm Trust 2013). There are many existing strategies to engage producers in native bee farming, including a variety of printed and online guides, webinars, and workshops. Despite the robust resources available to producers, widespread adoption of these practices remains elusive. In an effort to complement existing strategies, the modules parallel the Roger's Adoption-Diffusion model which remains the most commonly used method of implementing conservation practices within agricultural settings (USDA NRCS 2005, American Farm Trust 2013). While there are no guarantees for success, it is expected that modeling outreach strategies after the Adoption-Diffusion model will more effectively address the varying needs of producers and encourage adoption. This paper describes a case history account that uses the model to reach producers with new native bee farming information for agricultural implementation.

Introduction

Farming for Native Bees is an innovative, farmer-initiated project that addresses a growing agricultural threat: honey bee decline. Building on emerging research, the project develops and disseminates new technologies that use diverse native bee species to enhance crop pollination, namely, high quality native bee habitat. Chaplin-Kramer, et al (2011) estimated that 35-39% of pollination services required by California crops are provided by native bees. Given that most farmers do nothing to encourage native bees (i.e., a third of their crops are currently pollinated "for free"), the prospects for financial and other gains by investing in native bee habitat are significant.

Working closely with Frog Hollow, Enos and Dwelley Farms in Brentwood, Contra Costa Co., California, we have installed high quality habitats consisting of over 80 bee-attractive plant types with exceptional results: bee populations have more than tripled, several key native bee pollinators have been recorded regularly visiting crop flowers, and the project is now being replicated in Ventura County with avocado growers. Habitat design is based on 15 years of survey work on over 500 ornamental plant types in over 50 urban California gardens (Frankie et al. 2005, 2009a,b). Using frequency counts, pan traps and aerial netting, we have found that bee species will visit specific plant types at predictable levels, allowing

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us to select highly attractive plants that match the seasonal progression of native bees, thus maximizing pollination opportunities (Pawelek et al. 2009, 2010; Frankie et al. 2009a).

Farming for Native Bees is also evaluating farmer knowledge, beliefs, values, and needs in relation to their business investments in crop pollination. Regular communications about installation and maintenance, and in-depth interviews with farmers have provided important insights on the immense diversity of small farm operations, as well as how farmers make key decisions and adopt new technologies.

Using this information, the UCB Urban Bee Lab is developing a series of Technology Diffusion Modules that will educate farmers about native bees, their role in crop pollination, and how this role can be expanded to defend against honey bee declines through habitat construction.

Objectives:

Goals of *Farming for Native Bees: Technology Transfer* were to:

1. Develop an innovative technology that could be used to augment existing agency conservation recommendations.
2. Develop strategies to effectively educate and guide farmers in the process of integrating native bee habitat management into the agricultural working lands matrix.

Methods:

Drawing on results from the greater *Farming* project, the modules walk interested parties through progressive stages of education, planning, and implementation of native bee habitat. Formatted into short (20-30 minutes) videos featuring scenes with farmers, researchers, and others involved in farm operations, the modules cover the following topics:

1. *Why is Bee Pollination Important to the Resiliency and Sustainability of California Agriculture?*

Beginning at the global scale, this module describes how Colony Collapse Disorder and other factors are causing serious declines in honey bee populations around the world, as well as the impacts on agriculture and food security. Impacts on California agriculture are detailed, along with basic biological information about native bees.

2. *What are Alternative Pollination Strategies for Small Farmers?*

Zeroing in on California, this module features several important native bee species and the biological characteristics that make them critical contributors to crop pollination, such as increased honey bee pollination, increased crop yields, resiliency of pollinator populations, and new marketing opportunities, among others. The module also introduces viewers to the *Farming for Native Bees* project.

3. *What is the UC Berkeley Urban Bee Lab doing for California Farmers?*

Partner farmers in Brentwood, California share their stories in this module. With onsite and interview footage, the farmers describe their experiences, from making the decision to participate, to designating areas for installations, learning to create and maintain habitat, to observing and monitoring native bees. Stories incorporate results from current NRCS-CIG *Farming for Native Bees* project.

4. *How do Small Farmers Implement Native Bee Farming?*

General guidelines for conventional and organic farmers are provided. This module also addresses potential risks as well as common questions and concerns that have come up through working with partner farmers, as well as workshops and presentations.

5. *Prescriptive treatments.*

This module helps farmers evaluate their farming operations, determine how bee farming might be best integrated, and measure the potential costs and benefits specific to their farms. Broken down into chapters, farmers can take as their starting point whatever topic most interests them.

6. *How will I know if it's Working?*

UC Berkeley Urban Bee Lab researchers share techniques used to identify bee species and monitor their diversity and abundance. Other measurements that may shed light on native bee populations, such as crop and honey yields, are detailed as well.

7. *What other Resources are Available to Farmers?*

This module provides links to online tools and information, as well as scientific and popular literature.

8. *Farming for Native Bees: the Next 10 Years*

Returning to the larger scale of California agriculture, this final module shares the Urban Bee Lab's vision of a growing movement to integrate native bee farming into operations across the state, ensuring the health of our agricultural economy and preserving native bee species on which it depends.

The modules are designed to adapt to needs, knowledge, and interest level of farmers with differing levels of native bee knowledge and diverse farming operations. Each module works independently, and viewers are invited to watch them in the given sequence, or to skip directly to those modules that most interest them. The presentation of content is of particular importance, and issues are addressed from the perspective of the farmer (their needs and priorities in relation to farming operations); use familiar language; provide meaningful and interesting case studies; and incorporate clips from farmers that give viewers a sense of sharing information (farmer to farmer) rather than top down education (researchers telling farmers what to do). This method is expected to be better received, and to inspire more trust and interest, than printed technical manuals currently in circulation.

In addition to the modules, a series of tools have been developed that correlate with each module. Tools include native bee profiles, a list of crops that are dependent on or enhanced by bee pollination, a map of a sample farm identifying sites for native bee habitat, habitat garden "prescriptions" that provide specific recommendations for several general farm types, and a list of plant and seed sources.

Results and Discussion

Producer adoption of new technologies remains one of the greatest challenges to the implementation of conservation efforts in agricultural landscapes. There are many existing strategies for engaging producers in native bee farming including a wide variety of printed and online materials, webinars, and workshops and field days. However widespread adoption of native bee farming practices remains elusive.

Recommended by USDA NRCS, the Roger's Adoption-Diffusion model (A-D) remains the most commonly used method of encouraging producer adoption of conservation technologies (Rogers 1963, USDA NRCS 2005, American Farm Trust 2013). When applied to agricultural producers, the A-D has six stages: 1) *Awareness* of the issue; 2) *Interest* in more information; 3) *Evaluation* of how technology can be applied to a producer's operation; 4) *Trial* testing at a specific site; 5) *Adoption* within a producer's operation; 6) *Adaptation* of the technology to an operation's needs. Although the A-D is presented sequentially, the model is dynamic with producers moving through each stage at different rates and orders depending on their own situations. They can also return to any given stage at any point during the adoption process. Constant through each stage is the vital need for current information (NRCS USDA 2005, American Farm Trust 2013).

The A-D also classifies producers into different categories according to the rate they adopt new technologies. The first to adopt are innovators, followed by early adopters and early majority. The hardest groups to encourage adoption, but the most important to reach are the late majority and laggards. Each of these groups have different motivations, communities and sources of information (USDA NRCS 2005, American Farm Trust 2013). Early adopters are identified as a key group for conservation professionals to work with because they are often the among the most respected leaders within their communities owing to their cautious nature and tendencies to gather varied and reliable information before adopting a technology (USDA NRCS 2005).

Many existing strategies for engaging producers in native bee farming excel at addressing some A-D stages, but few address all. Printed and online materials in the form of educational pamphlets, brochures, and habitat planning guides provide information to farmers engaged in the Awareness, Interest, and Evaluation stages. Webinars are a more interactive format that allows for some one-on-one engagement providing resources during the Awareness, Interest, Evaluation and Trial stages. Workshops and field days are among the most effective strategies, addressing all stages of the A-D. Unfortunately, these workshops are often confined to certain regions and require producers to dedicate an entire day to participate, often during the busiest times of the year.

In an effort to complement existing strategies and fill information gaps, the modules attempt to address all stages of the A-D and employ several recommended approaches to effectively engage producers in adopting conservation technologies. The content of each module provides information relating to a minimum of one A-D stage: Module 1- Awareness and Interest; Module 2- Awareness and Interest; Module 3- Interest, Evaluation and Trial; Module 4) Interest, Evaluation, Adoption, and Adaptation; Module 5- Trial, Adoption, and Adaptation; Module 6- Interest and Adoption; Module 7- Interest and Adoption; and Module 8-Awareness and Interest. Structurally, the modules are dynamic like the A-D in how they address the different stages (e.g. Module 3—Interest, Evaluation and Trial; Module 8 Awareness and Interest) as well as in how they are to be viewed (according to need, not sequentially).

The modules draw on recommendations from USDA NRCS to increase the success rates of producer adoption. Two key recommendations are to work with early adopters to share information with the rest of their communities and use demonstrations to help producers evaluate opportunities for adoption within their own operations. The modules employ both by featuring interview clips from *Farming* partners and showcasing active native bee farming practices on their farms. Additionally, support from USDA NRCS in the development of the modules will also appeal to producers, as they are one of the most respected sources of information (American Farm Trust 2013).

Although the modules are designed to address all stages of the A-D, like all outreach strategies, there are shortcomings and no guarantees for success. One key aspect for successfully applying the A-D to agricultural technologies is providing producers with updated and timely information throughout the entire process. As new research emerges, it is expected that information in the modules may become out of date. In anticipation, the modules are intended to be periodically updated as new information and resources become available. Planned updates include new crop-specific prescriptive treatments, nesting habitat recommendations, and scientific and popular literature.

Like all media resources, the modules will not replace the need for one-on-one interactions between conservation professionals and producers. Person-to-person interactions serve a vital function in the adoption process facilitating information exchange, trust building, and providing operation-specific technical assistance. However, the modules can supplement these interactions by encouraging more interactions or facilitating more organized and informed interactions. They could also be used as tools during these interactions as a habitat planning resource.

The modules also do not address the obstacle of reaching late adopters and laggards. It is expected that the producers who will seek out the modules or will be directed to them will be innovators, early adopters or early majority. This shortcoming plagues many conservation technologies and conservation

professionals have struggled on how to successfully approach these critical groups (American Farm Trust 2013).

Conclusions

Emerging conservation technologies need comprehensive outreach strategies that address varying needs, motivations, and adoption rates of producers. Most existing strategies cannot meet all those criteria alone. Therefore, these approaches should complement one another in meeting those criteria and future efforts should strive to meet them all. However, these strategies cannot replace personal interactions between producers and conservation professionals, so they should be designed in such a manner that they can enhance these interactions using input from both groups. There are no guarantees that even well designed, comprehensive technologies will effectively encourage adoption so they must be adaptable and evolve with their audiences.

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