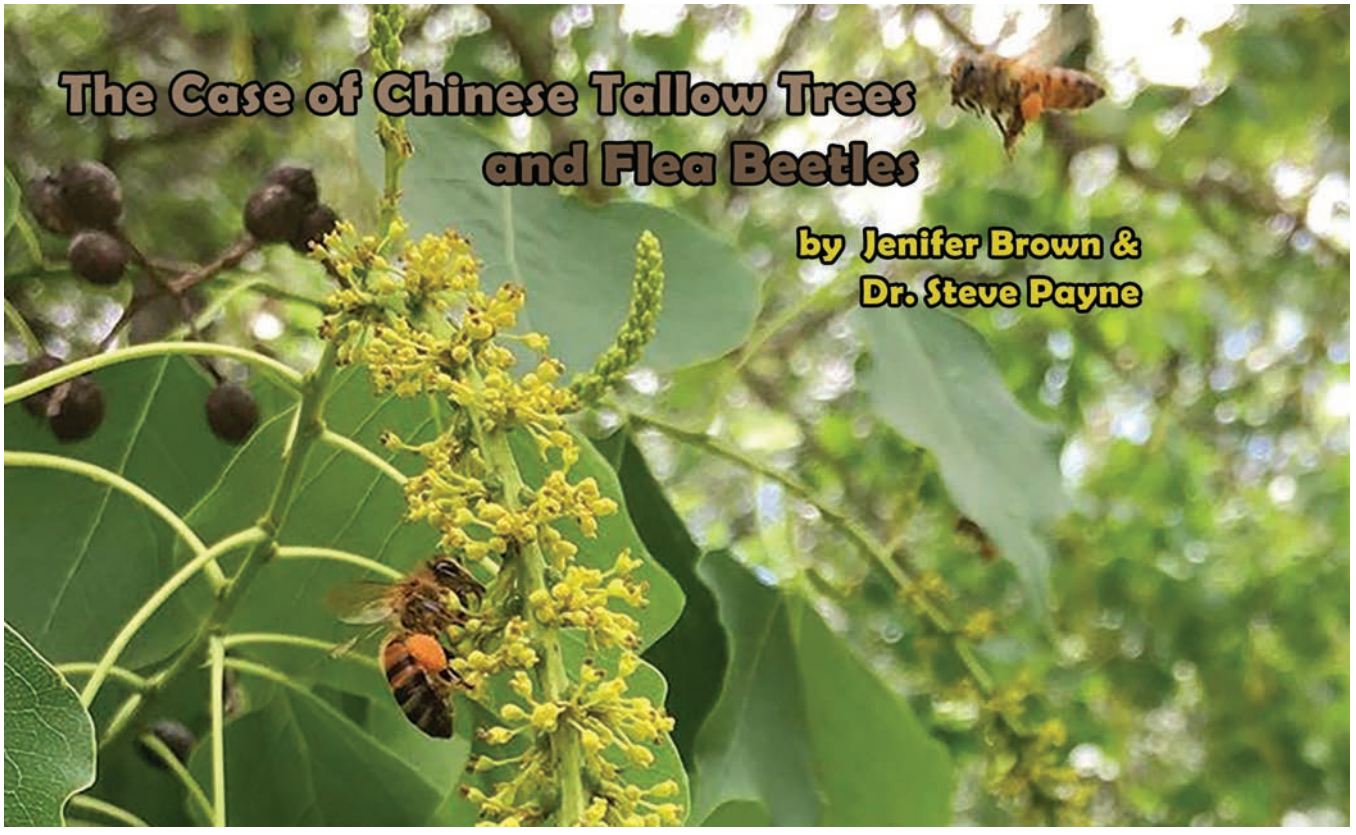

This article represents the direct or indirect contributions of many small-scale or commercial beekeepers and scientists interested in pollinator well-being. Some of these individuals helped in the drafting of a letter from officers and board members in the Louisiana and Texas Beekeeping Associations, the American Beekeeping Federation, and the American Honey Producers Association that was directed to many government legislators and officials in December 2017. This letter expressed numerous concerns and opposition to the introduction of a non-native type of flea beetle (*Bikasha collaris*) as a biological control for attacking Chinese tallow trees (*Triadica sebifera*).

This significant public policy issue will affect many different stakeholders in this country, it is currently being decided, and early initiatives are being considered. We have been invited by the editor of *American Bee Journal* to present relevant information and views regarding this important issue. We appreciate this opportunity to share perspectives with other beekeepers and the public. We will start with some of the background information shared in a December 2017 letter to government officials and policy makers, and then attempt to explore broader implications from this particular introduction of a biological control. We will also raise some questions regarding this USDA decision-making and potential implementation process that partially contribute to opposition now voiced by many beekeepers and honey producers.

Beekeeping and the Chinese Tallow

Beekeepers in some parts of the USA may be unfamiliar with this key forage tree for Southern beekeepers. The Chinese tallow tree is now found in many Southern states, as well as in California. It is a major food source for honey bees, who in turn are a major contributor to agricultural crop pollination.

Nectar from this tree leads to significant honey production in at least four of these states, particularly Louisiana and Texas. Chinese tallow can be found in all parishes in Louisiana and many counties in Texas. There were over four million pounds of honey produced in 2016 in Louisiana, according to USDA statistics, and Chinese tallow forage is often the dominant, or at least a major, forage source for most Louisiana beekeepers. Through its contribution to pollination services and the production of honey, Chinese tallow contributes millions of dollars and numerous beekeeping industry jobs to the economies of both Louisiana and Texas.

Decades ago, in an article published in this journal, Hays (1979) states that Chinese tallow "has become the most successful tree nectar source ever introduced into the United States." He added that "[c]ertainly few trees combine the qualities of the tallow tree for the beekeeper." Among those qualities Hays describes is that the pollen and nectar from the tree tend to have less exposure to pesticides than row crops, and thus are healthier forage for bees.[1] James Tew very recently observed that the Chinese tallow tree which "blooms from April-June provides sustenance for our bees at a time when vast amounts of other sources have been destroyed for agricultural and cosmetic reasons."[2]

Steve Bernard, a successful commercial beekeeper and owner of Bernard Apiaries Inc. located in southern Louisiana, estimates that elimination of tallow trees would result in a $1.25 million annual loss for his business. A decrease in the Chinese tallow tree population or even worse, the complete elimination of the tallow tree by the introduction of this non-native insect, would greatly damage the commercial beekeeping industry statewide and nationally. Commercial beekeepers from other states

each year move thousands of colonies to Louisiana and Texas for the main purpose of capitalizing on the state's abundant forage, and particularly the tallow tree. This movement of commercial hives is often aimed specifically at servicing the migratory pollination process, with tallow providing key nourishment for the bees to pollinate crops and produce honey. Pollination services are of greater economic value to commercial producers, and to our national economy and welfare, than the honey produced directly from this forage. Yet, despite the well-documented value of Chinese tallow, significant economic and other benefits from these trees appear threatened and could easily be lost in the future by the introduction of non-native flea beetles as control agents.

Release of the *Bikasha collaris* into less than very carefully circumscribed and controlled settings could lead to disastrous consequences. The opportunity for the beetle to adapt and reproduce in new environments is still largely unknown. The editors of the book ***Biological Control: Measures of Success*** introduce the complex subject of biological control by explaining that "only around 10 per cent of attempts are successful" and that the success rate has changed little for a century. The editors also note that "biological control can cause harm, for instance when the released agent attacks a non-target organism of conservation or economic value (p. 1)."[3]

Mixed Blessings from Chinese Tallow

The Chinese tallow tree has unique characteristics. The Louisiana State University Ag Center Research and Extension provides an excellent description of this tree and its characteristics that is written and beautifully photographed by LSU professor G.A. Breitenbeck. The trunk, bark, leaf, seed, oil, invasiveness, pollinator forage, honey taste, wind/cold tolerance, and propagation characteristics of the tree are covered in this publication. Additional common names for it include the chicken tree, popcorn tree, candleberry tree, white waxberry tree, and Florida aspen. The USDA reclassified it some years ago as a *Triadica sebifera* (L.) Small, but its previous classification as *Sapium sebiferum* (L.) is still occasionally encountered. The trees are fast growing with a few eventually reaching heights up to 60 feet; most mature tallow trees are 30 feet or less in height.[4]

Although originally introduced in the USA in the early 1770s, Chinese tallow had very limited spread until many years later. The USDA established the Office of Foreign Seed and Plant Introduction in the early 1800s to study and promote non-native plant species for agricultural products. Chinese tallow trees, due to the high concentration of tallow in the seeds, were subsequently recommended and planted in the Gulf States for the establishment of soap and candle making businesses. Bright red foliage in the fall, rapid early growth, and shade potentials led others to choose these trees as ornamentals. Chinese tallow trees spread through promotion by those in the horticultural industry and through its own invasive characteristics.[5]

Chinese tallow is an important crop for oil seed in its native China. Tallow leaves have been used to treat bacterial infections in birds and fish there. The kernel oil also has promising potential for biodiesel and bioenergy production.[6] Tallow trees are used extensively in China to protect waterways from erosion, and these trees are frequently located along ditches, streams and bayous in the Deep South.[7] Breitenbeck in an earlier publication notes that "[t]he invasive potential of the tallow tree merits serious consideration. So does the opportunity to restore economic prosperity to many of the most impoverished areas of Louisiana by converting many thousands of acres of marginal land currently colonized by the tallow tree to a highly profitable, low-input bioenergy crop. Because of the ability of the tallow tree to flourish on marginal land, it can be produced without adversely affecting our ability to produce food. This perennial oilseed crop does not require routine cultivation of the soil and therefore also can serve to prevent soil erosion and reduce pollution of surface waters while sequestering atmospheric carbon dioxide in its biomass."[8]

Bees on Tallow

Invasiveness and Biological Controls

The continuing spread of Chinese tallow trees has led some scientists, and stakeholders negatively impacted by this development, to try to discover effective methods to eliminate these trees, or at least try to control their spread and negative impact. Timber and forest product corporations that are heavily invested in Louisiana and Texas are obviously one key stakeholder with a major concern about tallow tree emergence in areas that have been cleared and reforested. Forestry officials in national and state government are also key stakeholders. Costs

of likely future timber losses and control measures for Chinese tallow over the next 20 years in Texas, Louisiana, and Mississippi have been estimated in the range of 200 million to 400 million dollars.[9]

Some Southern states are beginning to enact invasive weed eradication programs in response to negative impacts on certain stakeholders, and Chinese tallow is often placed high on their lists of invasive plants. The Pollinator Stewardship Council warns, though, that such eradication programs often have no plan to restore a native plant in place of the eliminated invasive or understand that many invasive plants are nectar and pollen sources for honey bees. "Many invasive plants are growing where nothing else will; have limited pesticide exposure, and therefore support millions of pollinators whose native habitat is dwindling."[10]

There are mechanical, physical and chemical controls for the elimination of invasive trees and plants, but biological controls are often viewed as a more cost-effective control option or supplement. Plaisance reports in a recent Associated Press (AP) news article that controlled fires and herbicide sprays from helicopters of tallow trees have not stopped their spread, and that cutting them down works only when each stump is immediately treated with chemicals.[11]

Certain state government officials and researchers in the South are actively seeking funding for research and testing of the non-native flea beetle, *Bikasha collaris*, as a biological control for Chinese tallow trees. Louisiana State University has recently advertised a master's assistantship for the purpose of the selected student joining researchers there for further research and testing on the effectiveness of this flea beetle in combatting Chinese tallow.

Scientists have examined several different insect species for biological control of Chinese tallow. The biology and host range of a primitive leaf-feeding beetle, *Heterapoderopsis bicallosicollis*, were studied between July 2008 and February 2010. Testing indicated that this particular beetle's feeding and oviposition might not be limited to the target and included several valued North American natives. Its release as a control for tallow trees was viewed as posing unacceptable risks, so testing of this particular species was discontinued, and the quarantine colony destroyed.[12]

More promise in early testing, as far as specificity and impact against tallow, has been discovered for the flea beetle, *Bikasha collaris*, and the defoliating caterpillar, *Gadirtha fusca*, according to Wheeler, Dyer and others.[13] Wheeler, Duncan and Wright, following earlier and favorable results with the flea beetles impact on tallow, report another positive early testing result associated with the flea beetle feeding tendencies. They simulated a spillover event by transferring adult flea beetles to three closely related species of this tallow. Their results indicated during pre-release studies that when tallow-fed adults were forced to feed on these non-target species, the risk of spillover impact appears very low. They view the flea beetle as a biological control that will likely only be able to sustain a population on the target of tallow.[14]

The USDA Agriculture Plant Health Inspection Service – Plant Protection & Quarantine (APHIS-PPQ) is the federal agency charged with reviewing testing and permit applications for the introduction of most novel organisms to the United States. APHIS-PPQ's Technical Advisory Group (TAG) specifically evaluates the safety of biological controls and makes recommendations concerning testing protocols and permits for the introduction of these biological controls. Their multi-step testing and permitting process for the flea beetle has passed through early steps in 2017, and a public comment period is part of its later steps. If these steps are all approved, the flea beetle, *Bikasha collaris*, could be released sometime in 2018, according to Plaisance's report.[15]

Entomologists Heimpel and Mills stress that "the biological control record includes a far greater number of failures than successes (p. 48)." Obstacles to greater introduction success have been the reluctance of sponsors to fund a final and open-ended phase of a biological control program,[16] as well as "a lack of interest among practitioners once the project appears to be achieving the desired outcome (p. 49)."[17]

The management of invasive plants has been referred to as "wicked problem" by Seastedt, with inherent uncertainties and local outcomes having both positive and negative consequences differentially affecting various groups of stakeholders. He believes that the track record for the current suite of biological control releases on invasive plants could be improved through better involvement of policy makers, scientists, managers, and other stakeholders.[18]

We still have much to learn about Chinese tallow itself, much less a non-native insect's feeding effect on it. Pile, et al. tell us that "Our understanding of the degree to which Chinese tallow alters the plant communities it invades is limited. Knowledge gaps include the full effects of Chinese tallow invasion at multiple scales and levels of organization within communities and ecosystems." They add that current management focuses "mostly on the efficacies of the prescribed treatments specifically in controlling Chinese tallow without considering the ecology of the plant communities subjected to the invasion control efforts."[19] Even plant and animal scientists can disagree strongly concerning estimates of the overall ecological and economic costs/benefits of particular species, such as Chinese tallow, as well as the anticipated costs/benefits of specific control options.

Warner comments that the APHIS-PPQ's Technical Advisory Group "is composed only of representatives of various federal agencies, and critics have charged that the process is closed to public review and biased favorably toward biological controls." Among ethically problematic features in this permit decision-making process are the following noted by Warner:

1) The process tends to be of a more adversarial character than is found in many countries, making negotiation and compromise more difficult;
2) Because the research scientist applies for the permit to release an agent, this means the research scientist becomes within the process more of an advocate for the biological control release;
3) Data on the biological control proposed for introduction may be held confidentially by APHIS-PPQ, because it might involve a yet-to-be-published research article by the scientist, and this can prevent data related to research and testing being available to other researchers and the public; and
4) There is no forum for public participation in biological control regulatory decisions in the USA (p. 285).[20]

Warner further urges that introducing "a biological control agent requires negotiating social values"

and that "some form of social consent is necessary for the application of public interest science. To foster sustained public engagement over time, the designation of particular invasive species as needing control should be separated from specific management actions, including the proposed solution of a biological control introduction (p. 290)." In light of such criticisms of existing USDA decision-making processes, it seems necessary to urge broader cost/benefit analysis and more stakeholder voice and dialogue in reaching decisions and taking particular actions regarding the introduction of this potential non-native herbivore.

Conclusions

Beekeeping and honey producing association leaders acknowledge recent research and claims that invasive Chinese tallow is leading to significant losses by certain important economic and ecological stakeholders. Introduction of the *Bikasha collaris* flea beetle as part of overall control for the spread of Chinese tallow could well have benefits, such as decreasing the amount of chemicals used by private and public land managers to control tallow encroachment. Yet there are likely to be creative and effective control alternatives for tallow encroachment to be discovered, whereas impacted beekeepers and honey producers do not have an alternative forage source comparable to existing Chinese tallow.

Clearly, many beekeepers and honey producers have strong reservations about the specifics and extent of this biological agent's introduction, if or when this is actually approved. We have questions as well:

- Are multiple stakeholder risks and consequences, such as potential effects on pollinators, truly being factored into this particular decision and its potential implementation?
- Are there plans for anticipating or reacting quickly to limit any unanticipated and adverse consequences?
- Are USDA officials and researchers keenly aware of the economic and social consequences of significant tallow tree reduction for stakeholders such as beekeepers and honey producers?
- Are these officials and researchers willing to allow beekeepers and honey producers to have a "seat at the table" for future decisions, negotiations and plans concerning any actual introduction of flea beetles?

We have yet to encounter this kind of openness and inclusion. Thus, at this time, we respectfully urge opposition to the introduction of the non-native *Bikasha collaris* flea beetle for the biological control of the Chinese tallow tree. All research and experimentation with such a potentially dangerous biological control species should be questioned vigorously, or at the very least, closely scrutinized and carefully monitored, so it does not lead to irreversible damage to existing Chinese tallow and cause great harm to pollinator populations, the beekeeping industry, and ultimately the entire agriculture sector.

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