Seasonal Moth Trapping for Detection of Adult Flights for Southwestern Corn Borer, Western Bean Cutworm, and Fall Armyworm in the Texas High Plains

Final Report

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Summary

The Moth Trapping project has been conducted during the 2011 – 2016 growing seasons from June through August to monitor the seasonal moth flights of Southwestern corn borer (SWCB), Western bean cutworm (WBC) and fall armyworm (FAW). The project has been conducted from Hale up to Dallam and across to Lipscomb by Texas A&M AgriLife County Extension agents. In 2016 ten county Extension agents monitored moth activity in eleven High Plains counties. Three pheromone bucket style traps were setup (one per pest species) in each of the 21 corn fields. This provided a total of 63 traps across the Texas High Plains for monitoring the real time abundance and flight duration of the three moth species. Each moth species have

distinctively different moth flights during the growing season. And, again there was considerable variability in a moth's abundance across counties in 2016 and differences from previous years. SWCB activity for the second moth flight was similar to the moth flight in 2013 and 2014 but lower compared to 2011. Counties with very little activity in 2016 were Hale, Hutchinson, Lipscomb, Ochiltree, Randall, Sherman and Swisher. Dallam, Hansford, Moore counties had a little heavier SWCB activity. Deaf Smith county continued to have the heaviest SWCB moth activity. The SWCB flights of second generation moths initiated on July 19, peaked on August 2, and steadily declined to August 30. The western bean cutworm flight activity in 2016 primarily occurred from June 28 to August 4, which was similar to 2015. WBC moth captures were more widespread in 2016 and 2015 compared to other years, but the number of moths captured across all locations were very low compared to other years. Fall armyworm moth activity was consistent all summer long, but there was heavier numbers from July 19 to August 23. FAW moth flights were more common all summer in Deaf Smith, Lipscomb, and Randall counties.

By monitoring the moth activity and reporting the findings through Texas A&M AgriLife Extension newsletters, news articles and phone contacts to producers, crop consultants, local ag suppliers, and ag-aviators. Those receiving the reports were able to assess when infestations were a potential threat for making management decisions. From the response of farmers, crop consultants, aerial applicators and other individuals the moth trapping project is meeting a critical need for corn producers in the Texas High Plains.

Introduction

There are approximately 1 million acres of corn grown in the Texas High Plains yearly. Producers that plant non-Bt corn for refuge requirements and for human food consumption are vulnerable to heavy damage from southwestern corn borer (SWCB), western bean cutworm (WBC), and fall armyworm (FAW) infestations. Depending on the Bt-corn hybrid a producer plants, a certain percentage of the corn acreage has to be planted to non-Bt corn hybrids as a refuge to prevent these corn pests from developing resistance to the Bt corn toxins. For corn grown in cotton producing areas (south of Amarillo, TX) the refuge acreage is 20% to 50% non-Bt corn acreage. Fields in non-cotton areas (north of Amarillo, TX) the refuge area is 5% to 20% non-Bt corn acreage or a 95% Bt – 5% non-Bt refuge in a bag hybrid. Also, some of the Bt corn hybrids with single gene toxins do not provide 100% protection against WBC and FAW infestations resulting in corn kernels being damaged from larvae feeding in the ear. Recently, there has been an increased incidence of damage even to the Bt-Herculex corn hybrid. Some food grade corn hybrids do not have the Bt technology and if a producer selects these hybrids then 100% of the corn acreage is susceptible to damage from these pests. Therefore, if just 20% of all corn grown on the Texas High Plains there can be 200,000 acres of corn annually not protected from these corn pests.

Knowing the moth activity during the growing season is critical to making informed management decisions. The activity of these three corn pests can occur at different times and at different infestation levels depending on seasonal weather conditions. This makes it difficult for producers, crop consultants, local ag suppliers, and ag-aviators to know when there will be damaging infestations and when to make timely insecticide applications for optimum control to minimize economic losses. Therefore to assist producers, crop consultants, local ag suppliers, and ag-aviators with knowing when these pests are active, a network of Texas A&M AgriLife County Extension Agents (CEA) across the Texas High Plains was organized to monitor the moth flight activity of SWCB, WBC, and FAW.

Objective

To provide current real time information to corn producers, crop consultants, local ag suppliers, and ag-aviators throughout the Texas High Plains about the activity of Southwestern corn borer (SWCB), Western bean cutworm (WBC) and fall armyworm (FAW) moth flights during the 2016 growing season.

Method and Materials

Thirteen county Extension agents setup pheromone bucket style traps in 11 Texas counties from Hale to Dallam and across to Lipscomb to monitor the weekly abundance and duration of the moth activity. A total of 63 traps (one per pest species) were setup in 21 corn producer's fields and monitored weekly starting June until the end of August. A spreadsheet with graphs was setup on google documents so each of the county extension agents could post data from their counties. Trap catches from each field in a county were summarized and made available weekly to producers, crop consultants, local ag suppliers, and ag-aviators through phone calls and text messages from the local county extension agents, newspaper articles, county extension agent newsletters, the Texas AgriLife Extension Panhandle Pest Update newsletters, and postings on the Texas AgriLife Extension website Insect Surveys (http://amarillo.tamu.edu/facultystaff/ed-bynum/insects/), Texas Panhandle Pest Update blog (http://txppipm.blogspot.com) , and on Texas Panhandle IPM twitter (https://twitter.com/txpipm).

Results and Discussion

Moth Trapping

Climatic conditions change from year to year which influences the flight activity and abundance of moths. Comparing moth trap catches between 2011 to 2016 show the importance of having a monitoring system each year to determine moth activity of SWCB, WBC, and FAW. The moth activity is really unique to a county and can be variable from year to year. In 2011, SWCB moths increased to extremely high numbers (3,000 to 5,000 per weekly trap catch) in Deaf Smith County and continued for an extended period of time from July 18 to August 29. The extended flight of SWCB moths indicated there was a 3rd generation of SWCB in 2011. In Dallam County, high numbers of SWCB moths were also trapped from July 25 to August 15 (Fig. 1). Comparatively, moderate SWCB activity was recorded in Sherman County while the remaining counties had relatively low levels of SWCB moth activity. In 2012, SWCB moth flights did not reach the high levels that were present in 2011 (Fig. 2). The second generation moth activity across the Texas High Plains was basically from July 17 to August 14. Counties with the highest numbers of SWCB moths during this time were Lipscomb, Parmer, and Dallam (Fig. 4). Dallam county had an early peak of SWCB (June 29) and Parmer county had a late flight of SWCB (Aug 28 to Sept 4). Counties with more moderate, but significant, SWCB flights were Deaf Smith, Hansford, Hutchinson, and Sherman. Counties with little or no SWCB activity were Gray, Hale, Ochiltree, Potter, Randal and Swisher. In 2013 and 2014 the overall densities of SWCB moths were similar but much lower than in 2011 and 2012 (Fig. 3 and Fig. 4). Still larval infestations from moths in both years were high enough to cause economic losses in fields across the High Plains. In both years, counties with the lightest activity were Gray, Hale, Hutchinson, Randall, and Swisher. In contrast, Deaf Smith, Dallam, Hartley, and Moore counties had much heavier activity of SWCB both years. Hansford, Ochiltree, and Lipscomb had

moderate levels of moth activity in 2013 and much lower activity in 2014. The flight activity of SWCB moths peaked a week earlier in 2013 compared to 2014. In 2015, there was a relatively high SWCB moth activity coming out of diapause during the first flight from June 16 to July 14 (Fig. 5). The second moth flight did not follow the typical increase from week to week until the flight peaks and then begins to decline. This SWCB moth activity in 2015 oscillated from week to week and then dropped off suddenly on August 25th. These oscillations appear to be associated with different peak activity of the moths in traps setout in Castro and Deaf Smith Counties. Overall, SWCB moth activity occurred in Castro, Dallam, Deaf Smith, Moore and Sherman Counties. All other counties had little to no SWCB moth activity. In 2016, the second generation moth flight began to increase on July 19, peaked on August 2, and declined to August 30. This activity was similar to the moth activity in 2013 and 2014 (Fig. 6). Counties with very little activity in 2016 were Hale, Hutchinson, Lipscomb, Ochiltree, Randall, Sherman and Swisher. Dallam, Hansford, Moore counties had a little heavier SWCB activity. Deaf Smith county continued to have the heaviest SWCB moth activity. This may be because there are producers in Deaf Smith county that still grow non-Bt white food corn.

WBC moth flight activity in 2011 was from June 14 to August 1 with predominately high numbers from June 27 to July 25 in Dallam, Hartley and Sherman counties (Fig. 7). Although moth trap catches were not extremely high in Moore County, trap catches showed WBC moths were present and active during this time. The rest of the counties had nominal to no activity of WBC. In contrast, WBC moth activity in 2012 was predominately for June 19 to July 10, but moths continued to be activity in low densities until August 7 (Fig. 8). This continued activity extended the application window for farmers to protect fields from larval infestations. In 2013, WBC moths captures were heaviest in Dallam, Hartley, Hansford, and Moore counties (Fig. 9). The flight activity of western bean cutworm moths did not begin until July 2 but continued until August 13. In 2014, the moth flight began July 1, about the same time as 2013 (Fig. 10), but the number of moths captured peaked earlier and were higher than in 2013. Conditions must have been favorable for WBC movement because moths were even captured in moderate levels in Deaf Smith, Castro, and Swisher counties. The WBC flight activity in 2015 occurred from June 23 to August 4, which was similar to 2011, earlier than 2013 and 2014, but later than 2012 (Fig. 11). WBC moth captures were more widespread in 2015 compared to other years. WBC moths were caught as far south and southeast as Castro, Deaf Smith, Parmer, Randall, and Swisher counties and over into Hansford, Hutchinson, and Ochiltree counties. In 2016, WBC moth flights were very low, with no more than a total of 500 moths for any sample week when all county collections were combined (Fig. 12). This was the lowest moth activity for any year of the moth trapping project. The WBC moth activity may have been adversely impacted by the extreme temperatures (>100^{o} + degrees) during June and July. Even with the low moth activity the distribution of moths were more wide spread across the High Plains. Dallam, Hartley, Deaf Smith, Hansford, Hutchinson, Moore, Ochiltree, Randall and Swisher counties were trapping WBC moths. Hale and Lipscomb were the only counties sampled that had very low moth captures.

The pheromone lure for FAW moths is not as attractive to moths as lures for SWCB and WBC. Still the lures are effective enough to show patterns of moth flights during the growing season. FAW moth activity in 2011 began with relatively high numbers as shown by trap numbers June 6 in several counties, but activity dropped to low levels the rest of the growing season.(Fig 13). In 2012, FAW activity was relatively low from June 5 to August 21 (Fig. 14). From August 28 to September 18, FAW moth activity increased in during this time, particularly

in higher numbers in Deaf Smith and Parmer counties. The trap catches in Deaf Smith and Parmer counties were extended into September at the request of farmers wanting more information about late season activity of FAW. In 2013, FAW moths were captured in high numbers in Gray, Lipscomb, Parmer, and Randall counties throughout the growing season (Fig. 15). The FAW moth activity peaked on July 2 and there was another flight from Aug. 13 to Sept. 3. County Extension Agents from Deaf Smith and Lipscomb counties continued monitoring FAW until September 24 to provide information about late season activity of FAW. In 2014, the FAW moth activity was the heaviest compared to any year that this monitoring project had been capturing to date (Fig. 16). FAW activity was widespread across the Texas High Plains. There were three peaks of moth activity (June 24, July 15, and Aug. 19) during the growing season. Counties with the overall highest number of FAW moths were Lipscomb, Randall, Gray, Parmer, Ochiltree, and Deaf Smith counties. Fall armyworm moth activity in 2015 was consistent across all of the counties all summer long, but on June 9 and July 14 there were two main peak periods (Fig. 17). Countywide the FAW moth flights were more common in Lipscomb and Randall counties. During 2016, the FAW moth activity was consistent across the High Plains with the highest weekly numbers from July 26 to August 23. Deaf Smith, Lipscomb, and Randall counties had the greatest FAW moth numbers each week.

These moth trapping data demonstrate the variability and differences of flight patterns of the three moth species. Monitoring moth activity reveals that moth activity is different each year area wide and even within the counties. As farmers extend their planting dates into June, there will be fields across the Texas High Plains that will have activity of each of the moth species at different time periods. This means that fields are vulnerable to egg lay and larval damage from each of these different moths all season long. Therefore, by monitoring the moth activity and reporting the findings to producers, crop consultants, local ag suppliers, and ag-aviators, they are able to assess when infestations are a potential threat and when activity is not a threat.

Impact of Moth Trapping Project

After the 2011growing season was completed the results of the moth trapping survey project was reported to producers at several meetings sponsored by the county extension agents. These meetings were in Dalhart, Canyon, and Dumas, Stratford, Perryton, Morris, Pampa, and Hereford. These meetings increased individual awareness of the moth trapping project. At the meetings farmers and crop consultants wanted to know if the project was going to be continued in 2013. Their comments were that they liked having the data to help them confirm what they were seeing and to know what was happening in other areas of the Texas High Plains.

In 2012, farmers and consultants in Deaf Smith and Hutchinson request that their county agent increase the number of fields monitored and producers wanted traps on their fields. After visiting with consultants and farmers, the moth data from the trapping project was spread more by word of mouth. After each Panhandle Pest Update newsletter that contained moth trapping data, Mr. Russell French, Pioneer seed company representative, would forward the newsletter to other farmers, crop consultants, and company representatives on his email list.

In 2013, the response from farmers and consultants has continued to be very positive. Mr. Russell French continued forwarding the Panhandle Pest Update newsletter to his clientele list because of the importance of the moth trapping data to producers. From the response of farmers, crop consultants, aerial applicators and other individuals the moth trapping project is meeting a critical need to corn producers in the Texas High Plains.

In 2014, I setup a blog, Texas Panhandle Pest Update blog (http://txppipm.blogspot.com), and a twitter account, Texas Panhandle IPM twitter (https://twitter.com/txpipm) to better distribute information about the moth trapping project. I take the information from my Texas Panhandle Pest Update Newsletter and put it in the Texas Panhandle Pest Update blog. Then I tweet a short statement about a particular issue and direct it to my blog. Mr. Kerry Todd, Account Manager for Pioneer Hi-Bred has re-tweeted information to his clientele. I have 51 followers, but Mr. Todd has 540 followers. These new social media venues provide more opportunities for distributing the moth trapping monitoring project. Crop consultants, aerial applicators, and local ag-suppliers continue to request the weekly moth trapping results.

In 2015, all of the venues for informing producers, crop consultants, aerial applicators, and local ag-suppliers continued to be used during moth activity for these three moth species. The Panhandle IPM twitter account (https://twitter.com/txpipm) and the Texas Panhandle Pest Update newsletter have proven to be good methods for distributing the moth activity information because of others, like Mr. Kerry Todd, re-tweeting the message and Russell French forwarding the newsletter to his client list. Still the most important method of distributing the moth activity information is through the County Extension Agent. Each County Extension agent have their own way of distributing the information. Some make and receive phone calls while others send out emails and newsletters and others by word of mouth. Mike Bragg, County Extension Agent for Dallam and Hartley Counties, set up a text list using his cell phone to text crop consultants and others each week at a specific time with that weeks' moth counts. What happened was the consultants and others were expecting to receive the moth count information at the designated time and if Mr. Bragg was a little late reporting the consultants would call him for the information.

In 2016, the County Extension agents and I continued to provide the moth trapping data to producers, crop consultants, aerial applicators, and local ag-suppliers through many different venues.

A survey was conducted after the 2011 season to evaluated the importance of the trapping project to farmers, crop consultants, aerial applicators, and agribusinesses. From the survey, 54.5% of the respondents rated the trapping project as important and 36.4% rated the project as very important for a 90.9% satisfaction rating of the project. There were producers (45.4%), crop consultants (36.4%), local ag suppliers (18.2%), and aerial aviators (27.3%) responding to the questionnaire and as can be seen from those responding some individuals designated more than one occupation. One hundred percent of those responding indicated they got their information from their local County Extension agent by phone calls, text messages and other ways. And, 36.4% got information from The Texas A&M AgriLife Extension Panhandle Pest Update newsletter or from the Texas A&M AgriLife Extension website – Insect Surveys. The trapping data was used to help determine if the moth activity of a particular species (SWCB, WBC, FAW) was a threat or not a threat from one week to the next. This survey showed that individuals used the information in making management decisions. Forty-five percent indicated the moth trapping data helped them determine if the moth activity was a threat and another 45% indicated the data helped them determine that the moth activity was not a threat. If moths were not a threat 36% of the individuals indicated the information prevented them from making a spray application. But, when moth activity was a potential threat individuals scouted fields more frequently (54.5%), it helped them make better timing of their spray applications (27.3%), and 9% indicated there was a need to increase the number of spray applications based on the moth trapping information.

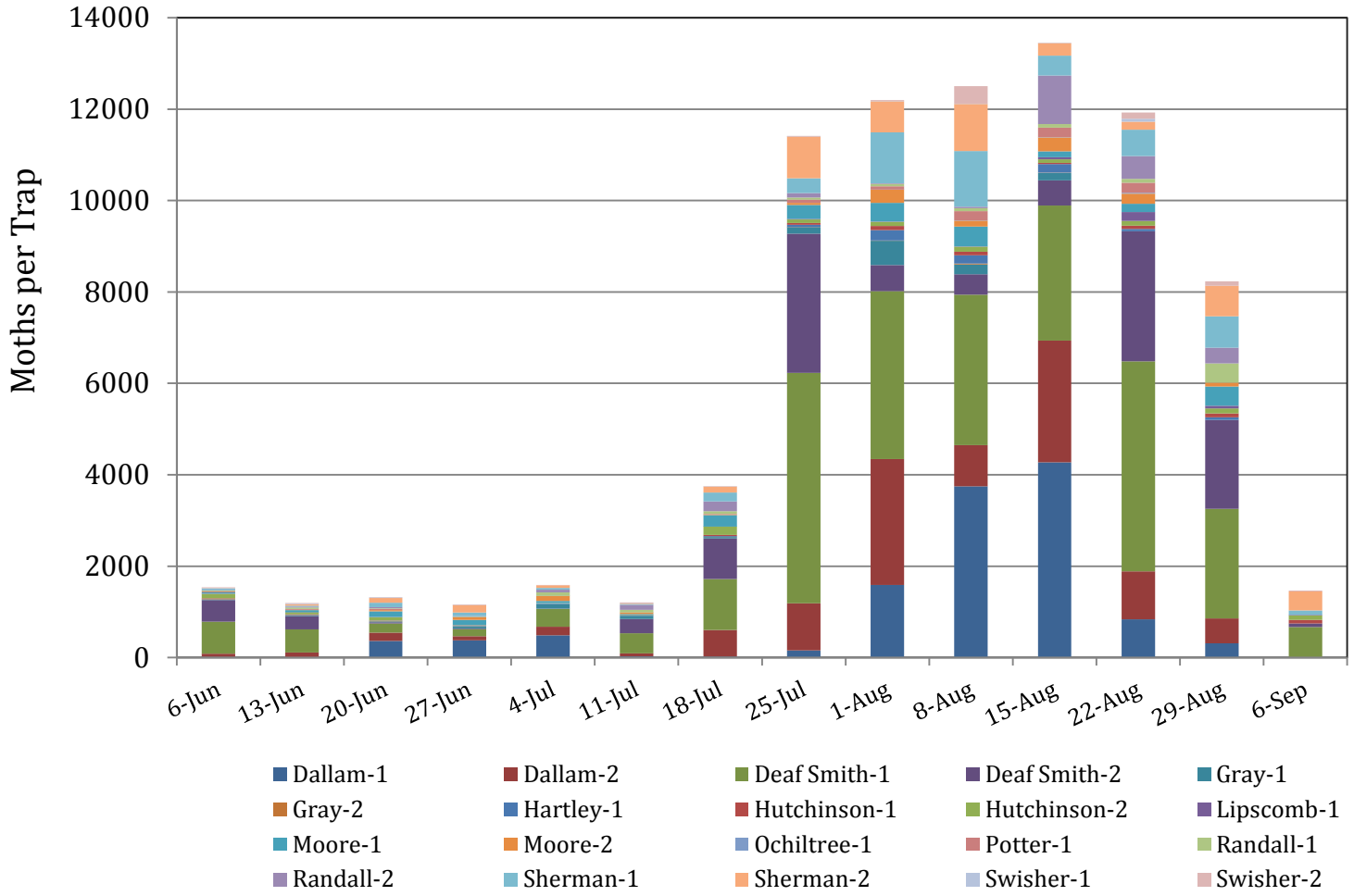
Comments from those filling out the questionnaire were that the moth trapping data "coincided with egg laying", "it confirms what I was seeing",

In 2014, Mr. Rick Auckerman, CEA – Deaf Smith County, gave out the questionnaire to individuals in his county. Many of the individuals that responded designated they had more than one occupation. Thirty-seven percent marked that they were producers, 62.5% marked crop advisor, 50% marked local ag supplier, and 37.5% marked they were ag aviators. Again, 100% indicated they got their information from Mr. Auckerman either by phone calls, text messages, or email. Twenty-five percent got their information from Mr. Aukerman's newsletter and another 25% got their information from The Texas A&M AgriLife Extension Panhandle Pest Update newsletter or from the Texas A&M AgriLife Extension website – Insect Surveys. Eighty-eight percent rated the value of the moth trapping data to be very important and 12% rated the data to be important for a combined rating of 100% important/very important. For the question of whether or not the moth trapping data helped in determining if the moth activity was a threat or not a threat, 87.5% marked that the data helped determine the moth activity was a threat to pending infestations. Although a low percentage of the responders (12.5%) marked moth activity was not a threat, 37.5% indicated the moth trapping data prevented a spray application. When moth activity was a threat individuals marked that they scouted fields more frequently (62.5%). And, 100% indicated the information helped make better timing of spray applications. There was an additional question in this survey that asked individuals to put an economic value ($/acre) of the moth trapping data to their situation. Most of the responders indicated the value was $10 to $20 per acre, but for a few the value of the project was up to $100 per acre. Comments were "confirmation of field observations", "gives us an idea of when and where we could have activity on each field", and "helps me make timely decisions on when to spray".

These surveys have shown that this moth-trapping project is helping individuals make more informed management decisions for the three moth species being monitored across the Texas High Plains.

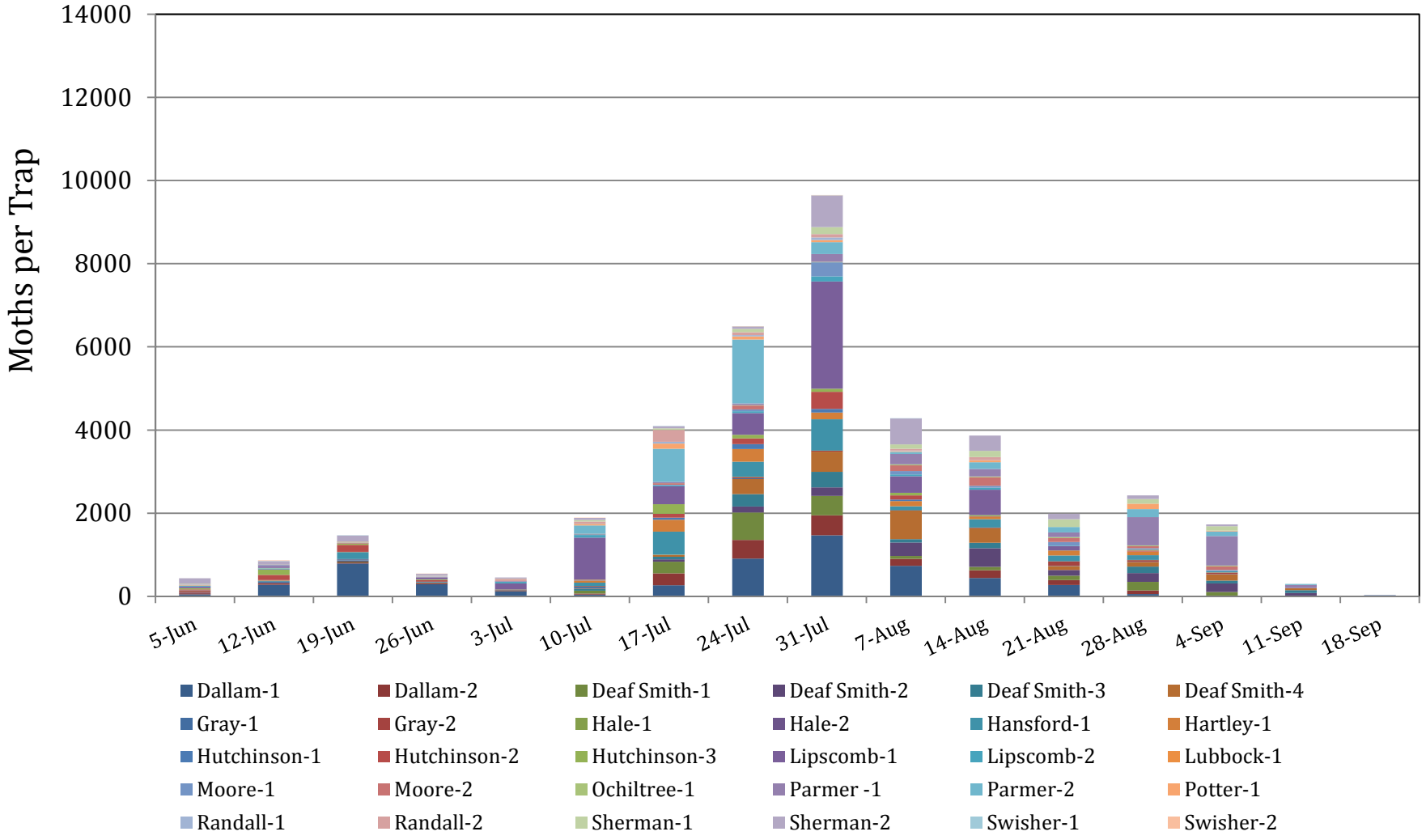
TEXAS A&M AGRILIFE EXTENSION

Figure 1. Southwestern Corn Borer 2011



TEXAS A&M AGRILIFE EXTENSION

Figure 2. Southwestern Corn Borer 2012



TEXAS A&M AGRILIFE EXTENSION

Figure 3. Southwestern Corn Borer - 2013

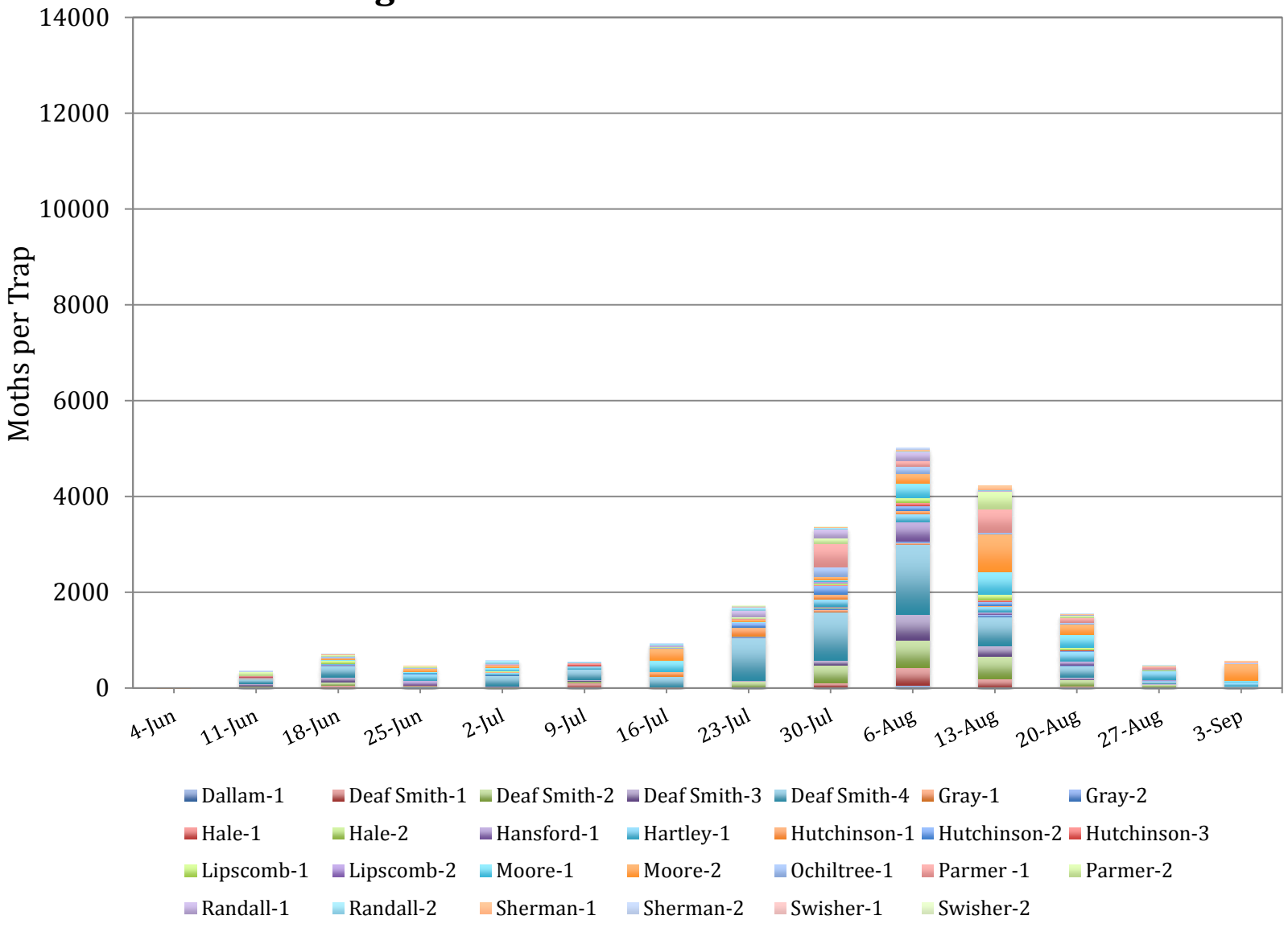


Figure 4. Southwestern Corn Borer 2014

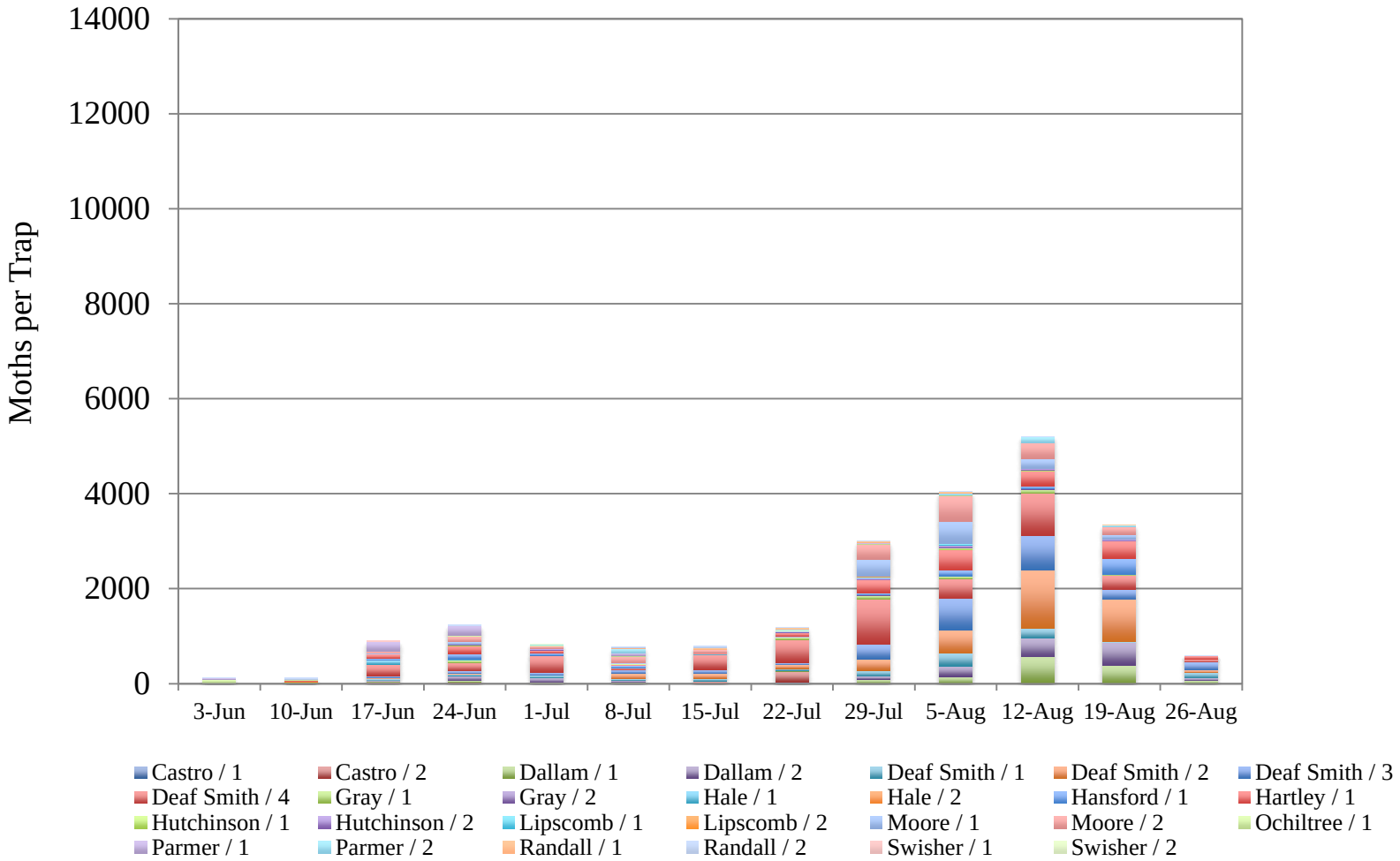
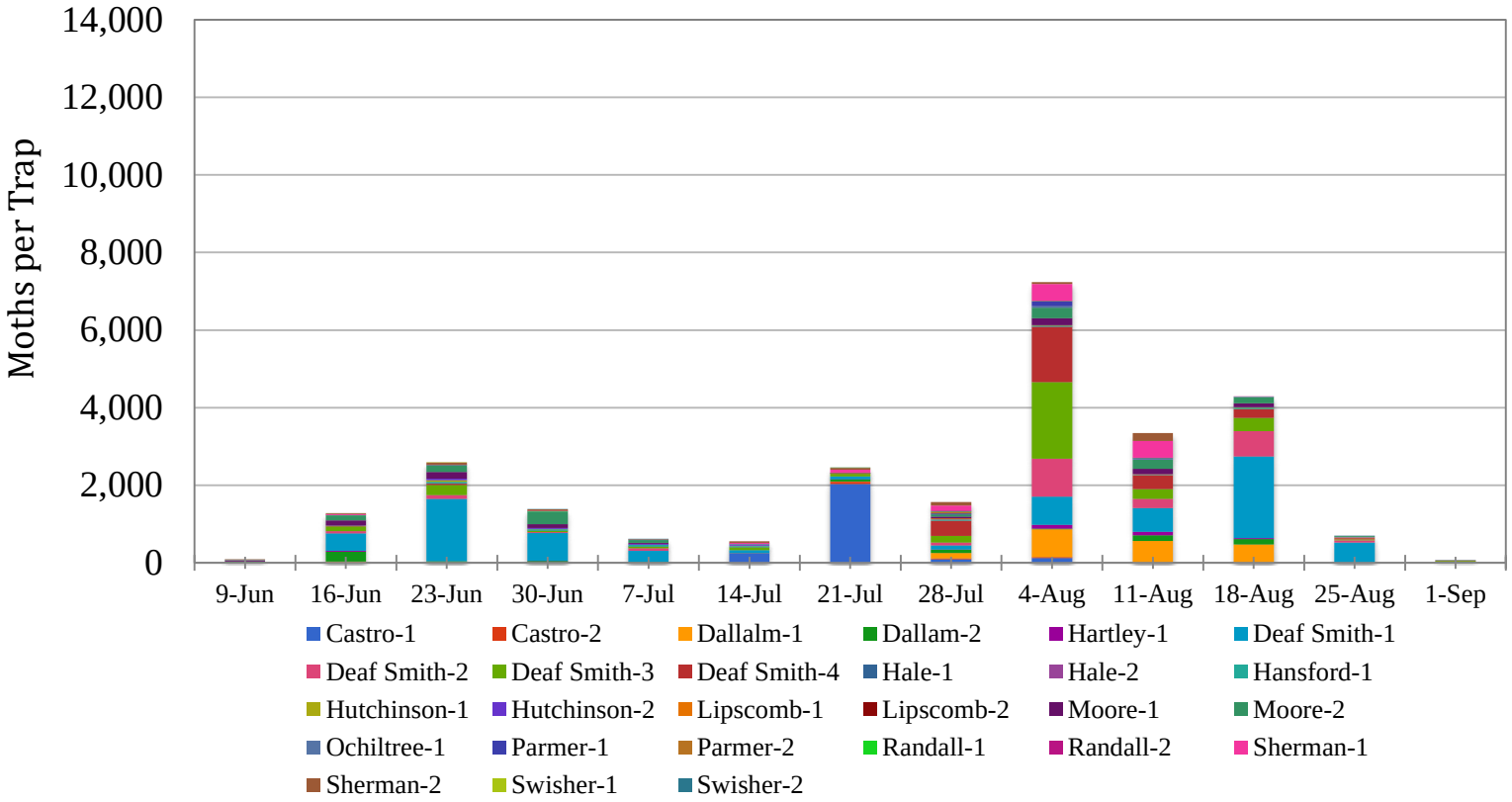


Figure 5. Southwestern Corn Borer 2015



TEXAS A&M AGRILIFE EXTENSION

Figure 6. Southwestern Corn Borer 2016

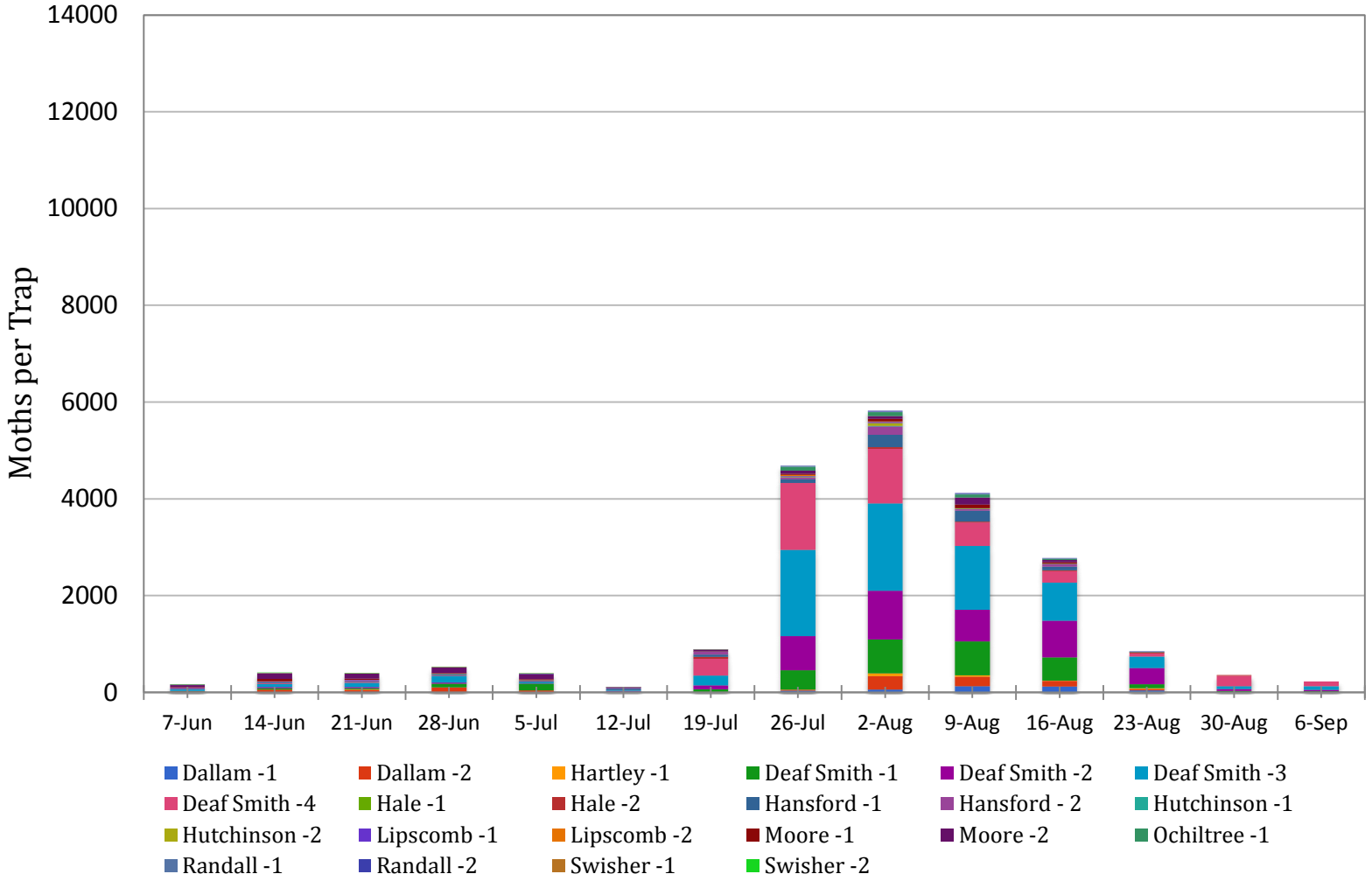


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Figure 7. Western Bean Cutworm 2011

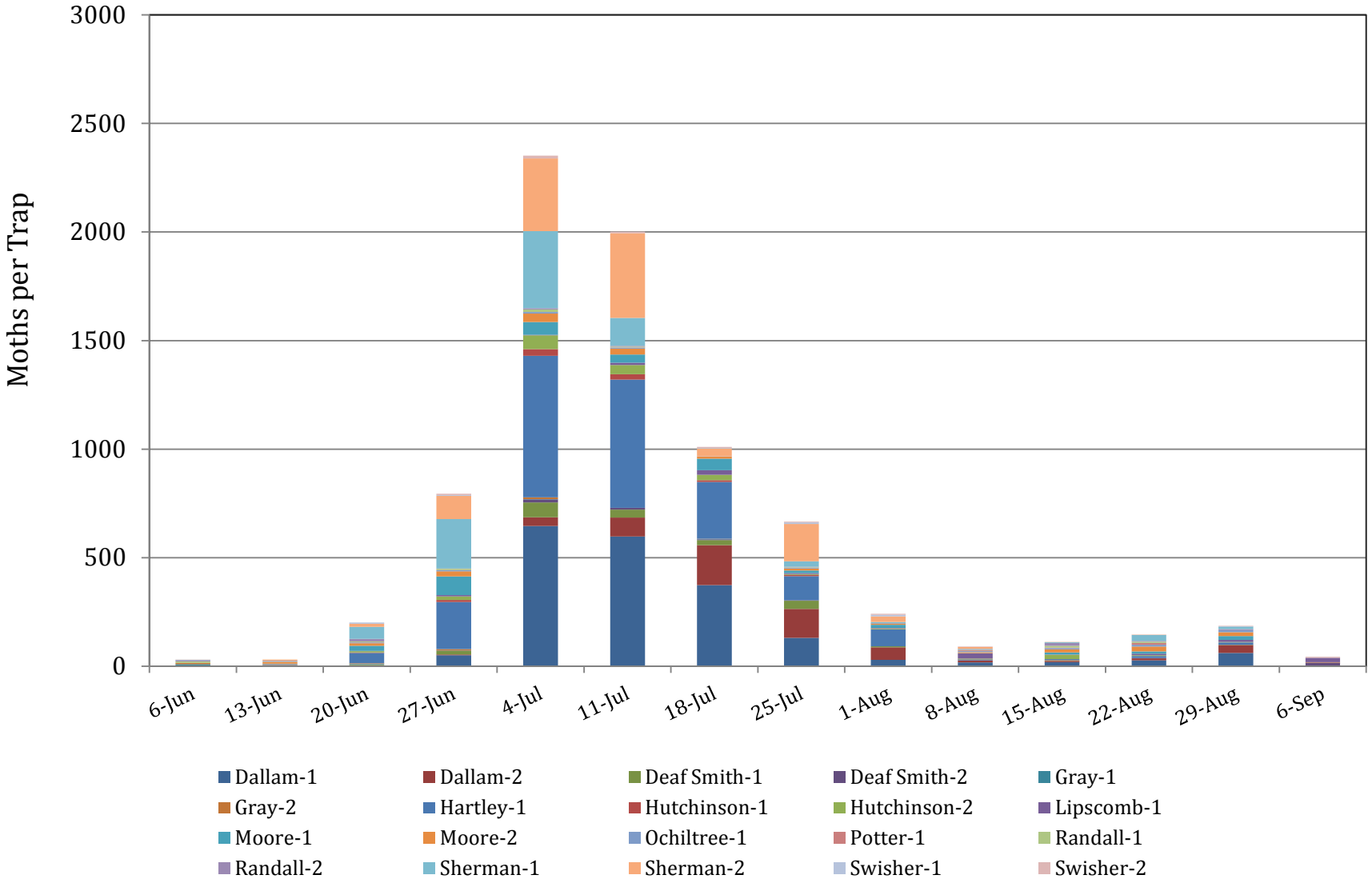

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Figure 8. Western Bean Cutworm 2012

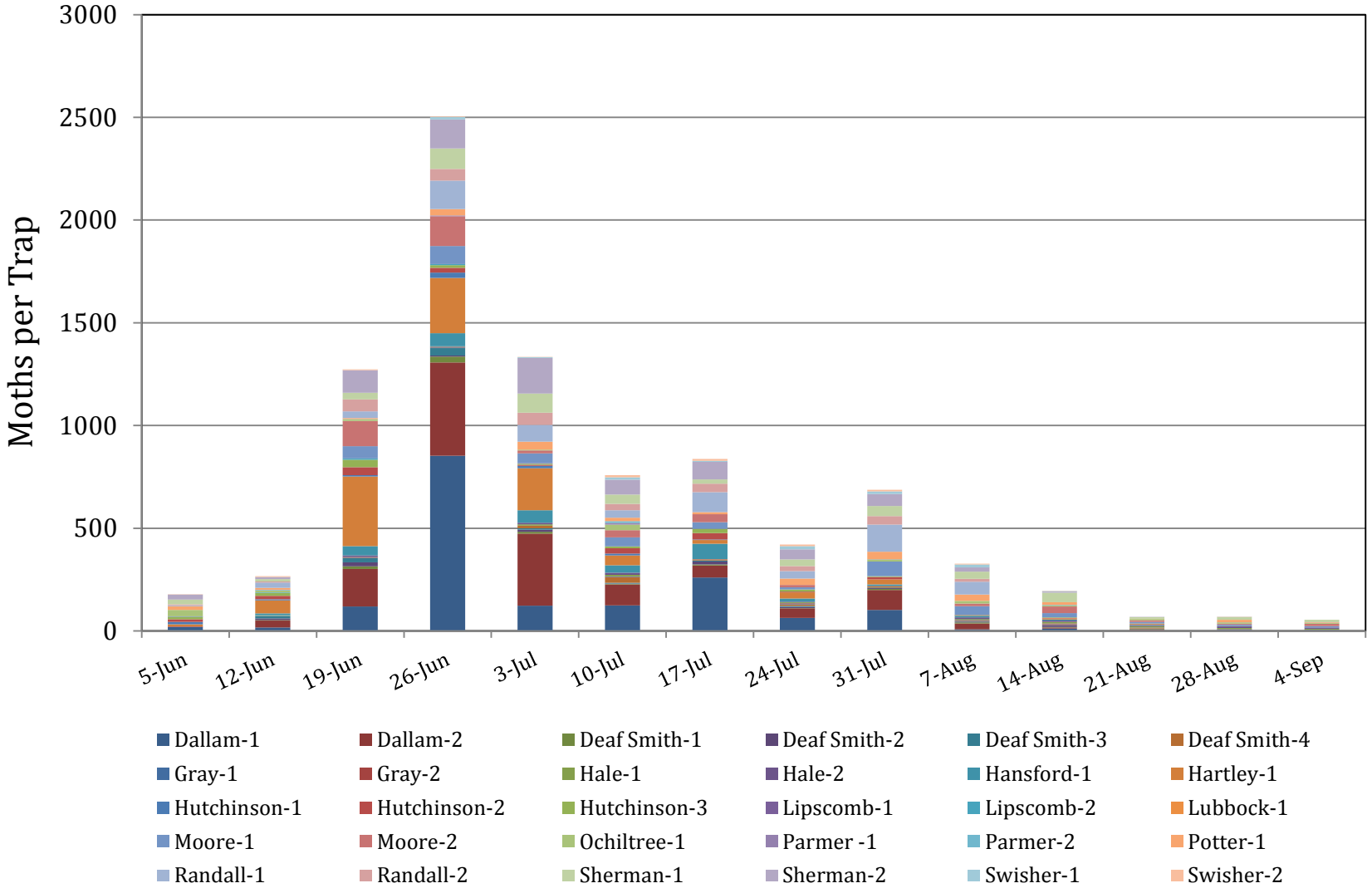

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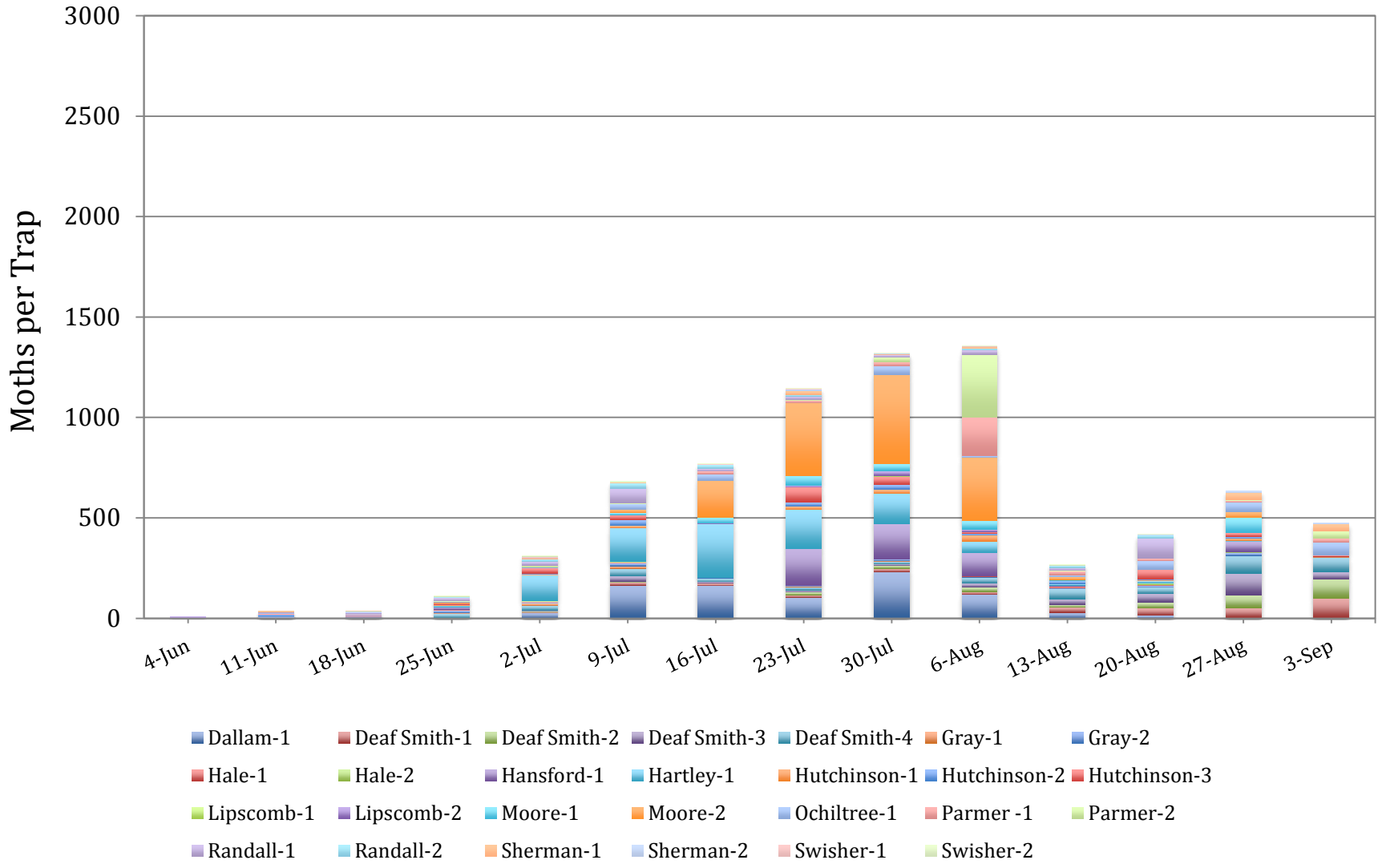
Figure 9. Western Bean Cutworm - 2013



TEXAS A&M AGRILIFE EXTENSION

Figure 10. Western Bean Cutworm 2014

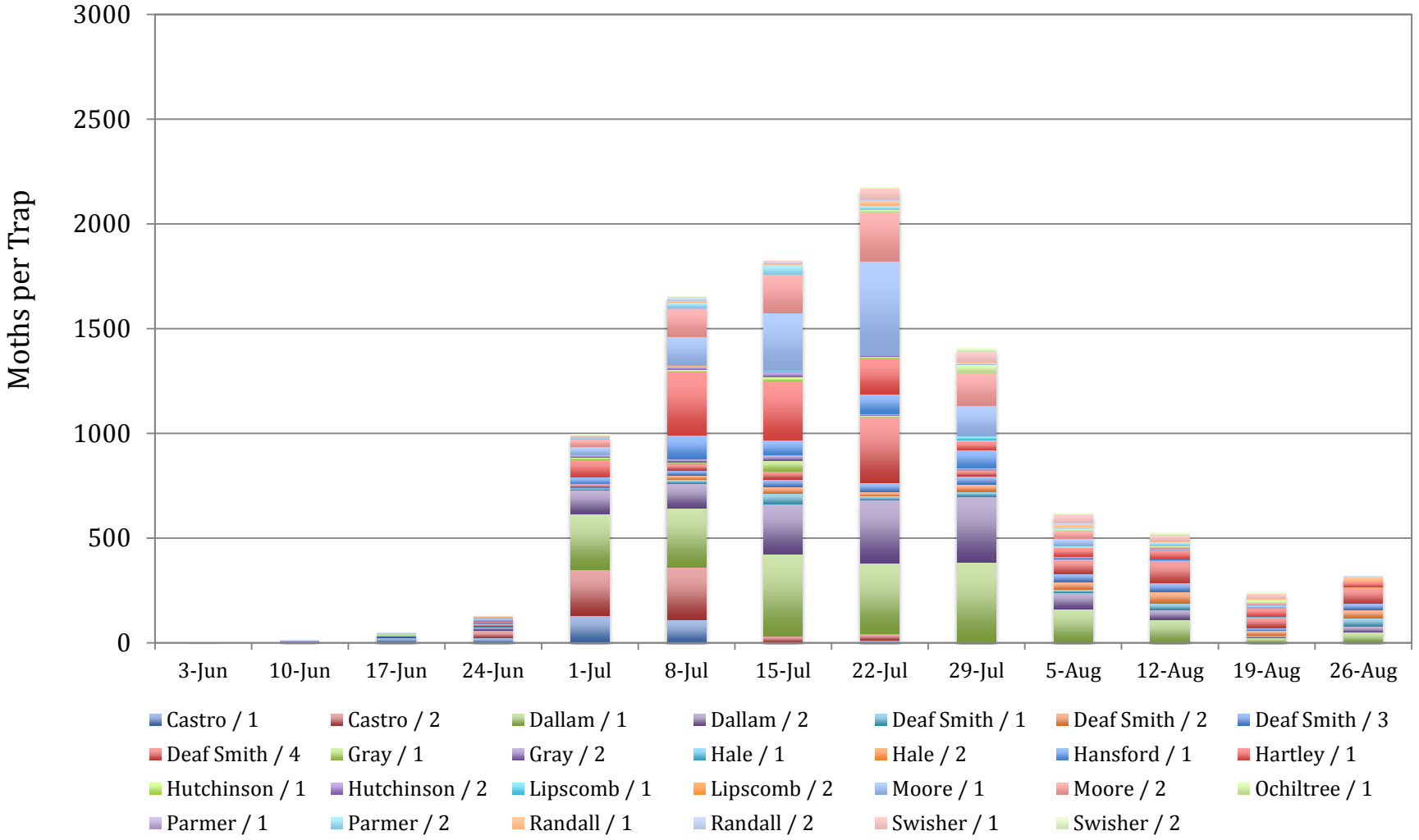


Figure 11. Western Bean Cutworm 2015

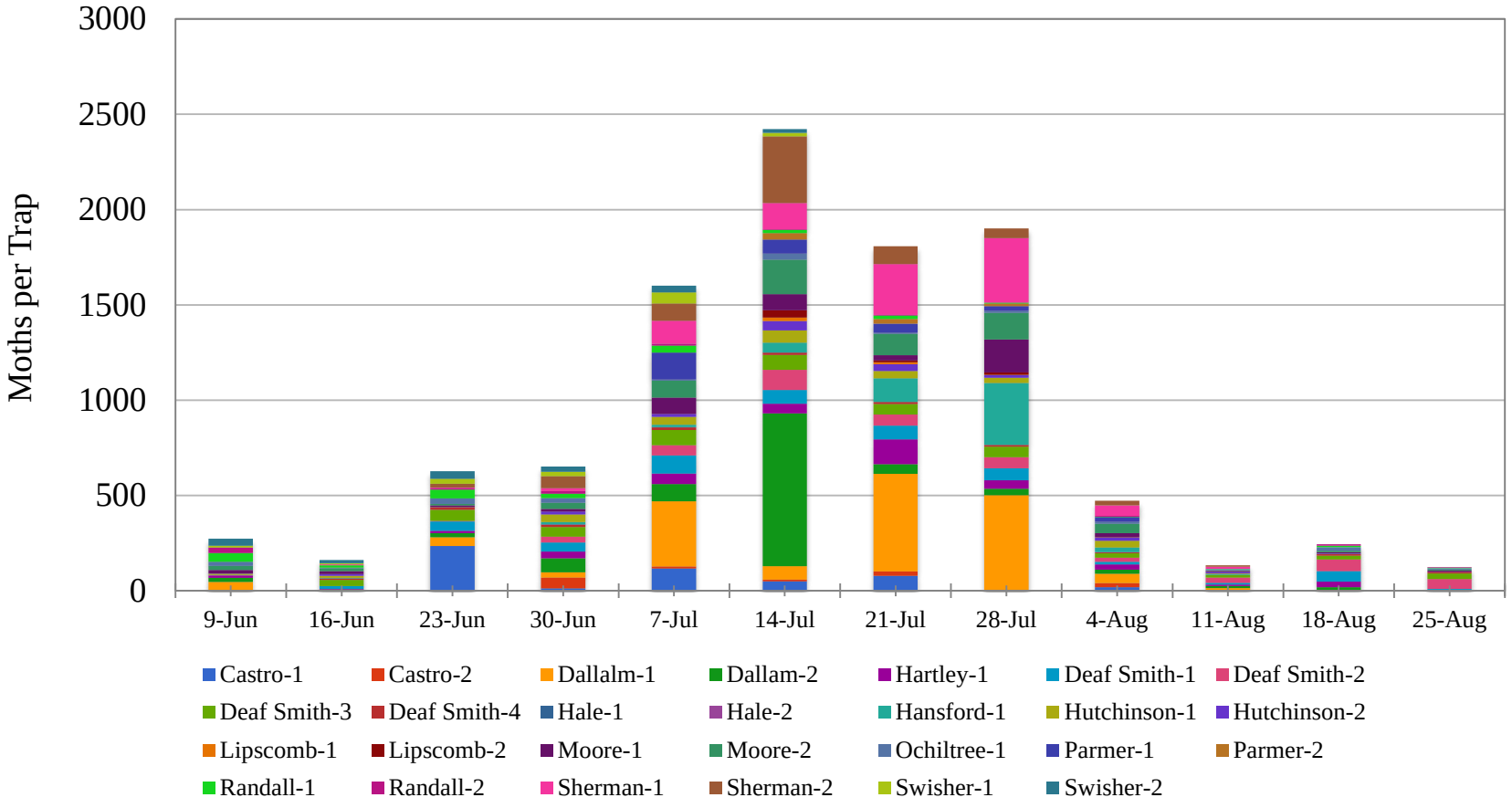
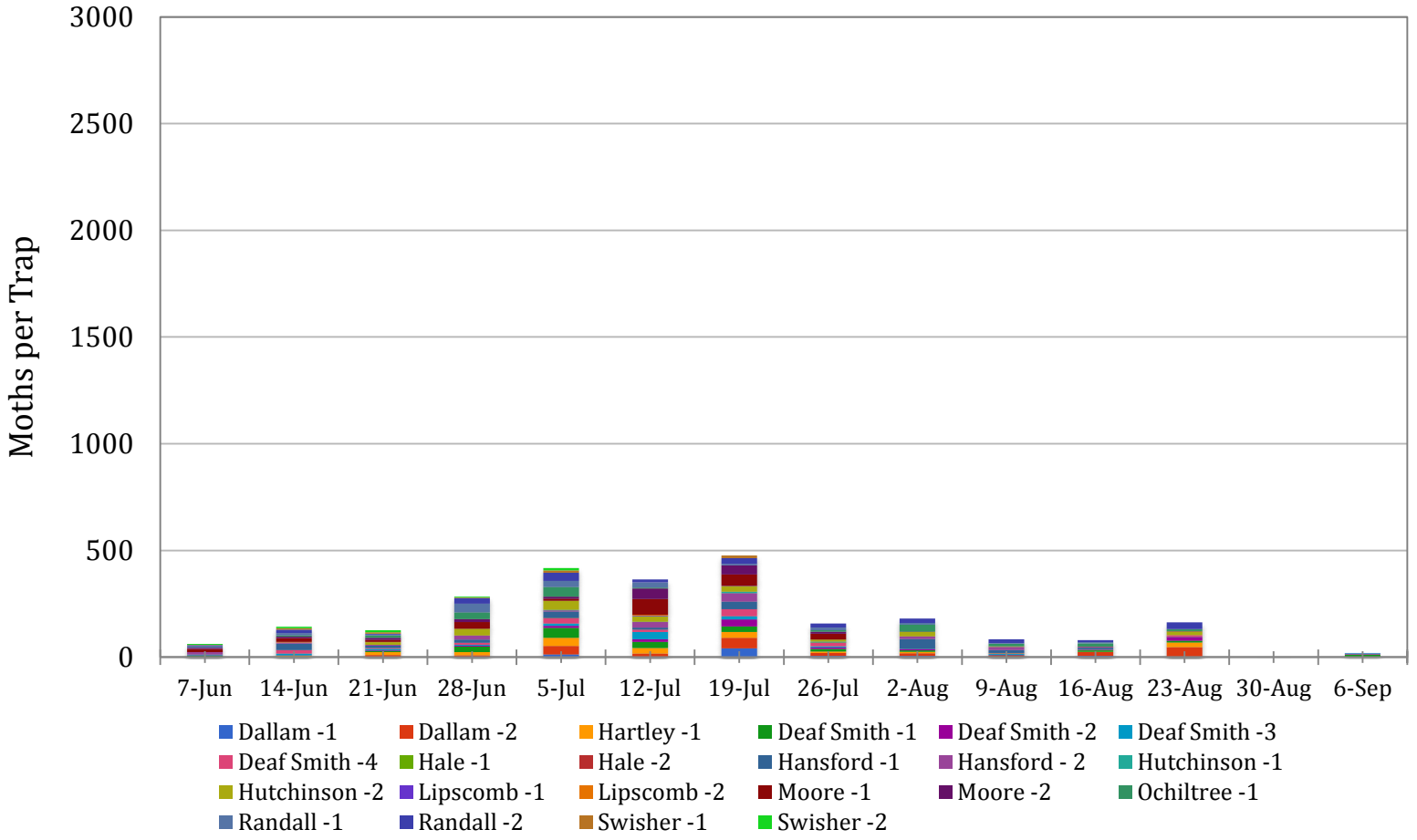


Figure 12. Western Bean Cutworm - 2016



TEXAS A&M AGRILIFE EXTENSION

Figure 13. Fall Armyworm 2011

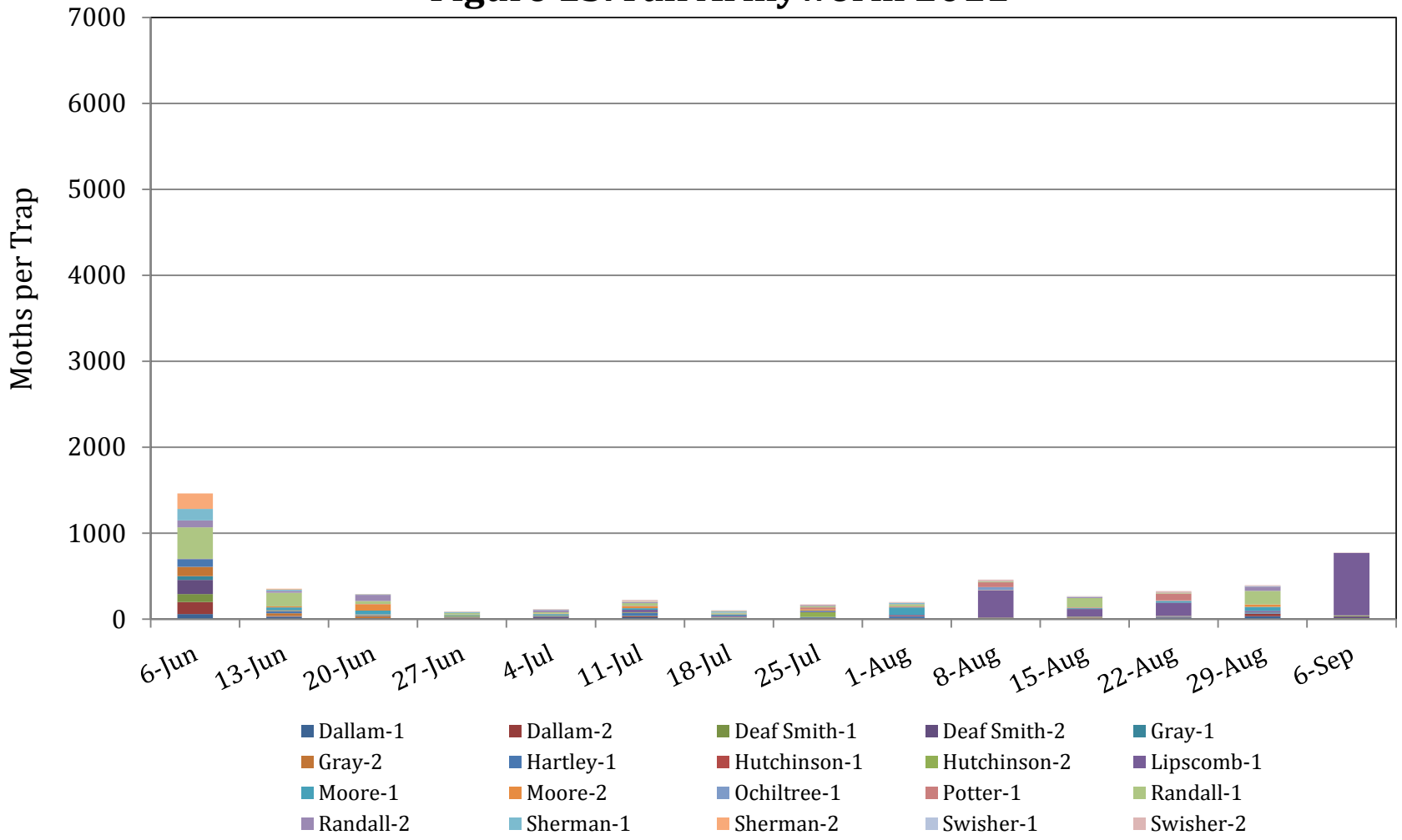


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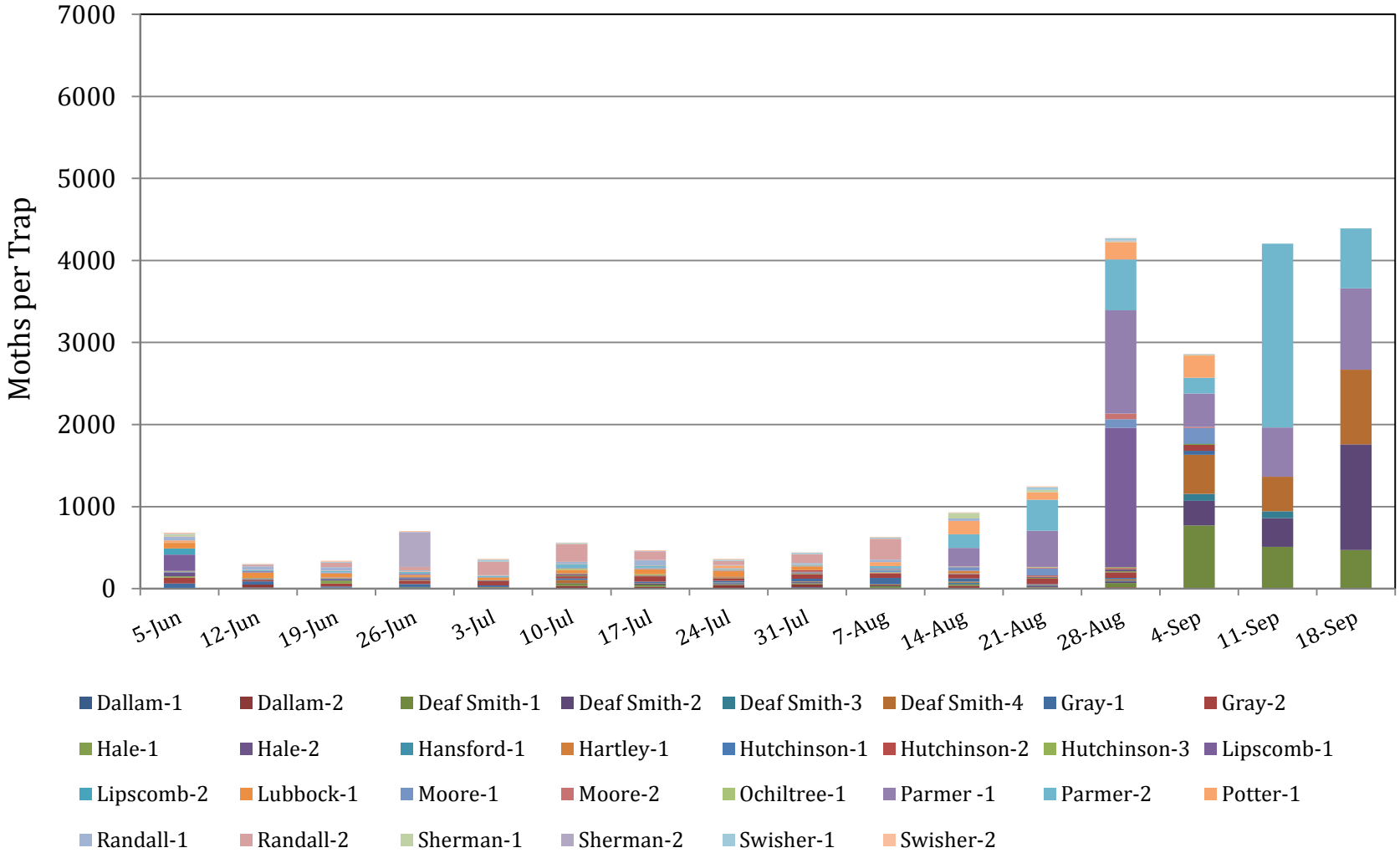
Figure 14. Fall Armyworm 2012



TEXAS A&M AGRILIFE EXTENSION

Figure 15. Fall Armyworm - 2013

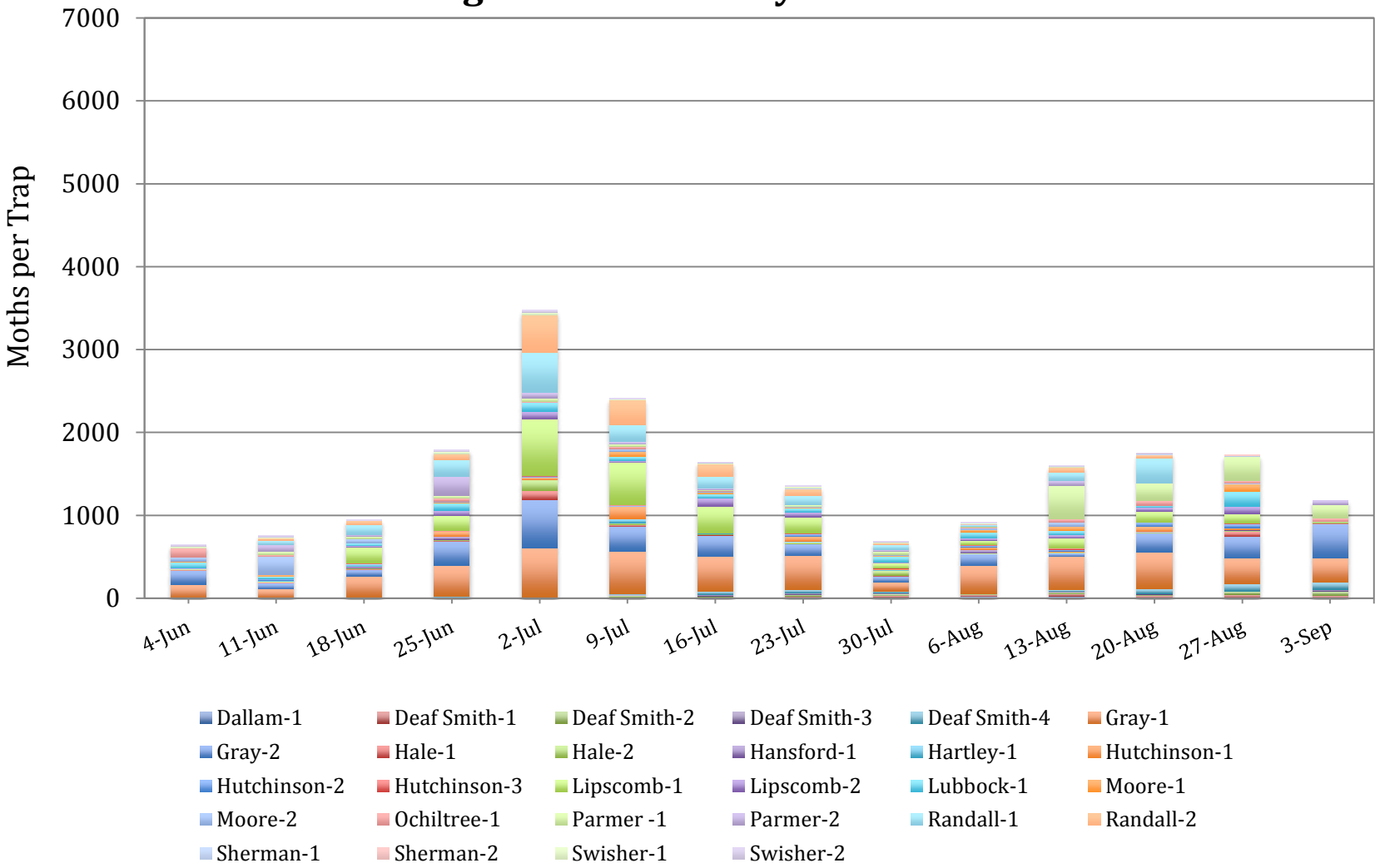


Figure 16. Fall Armyworm - 2014

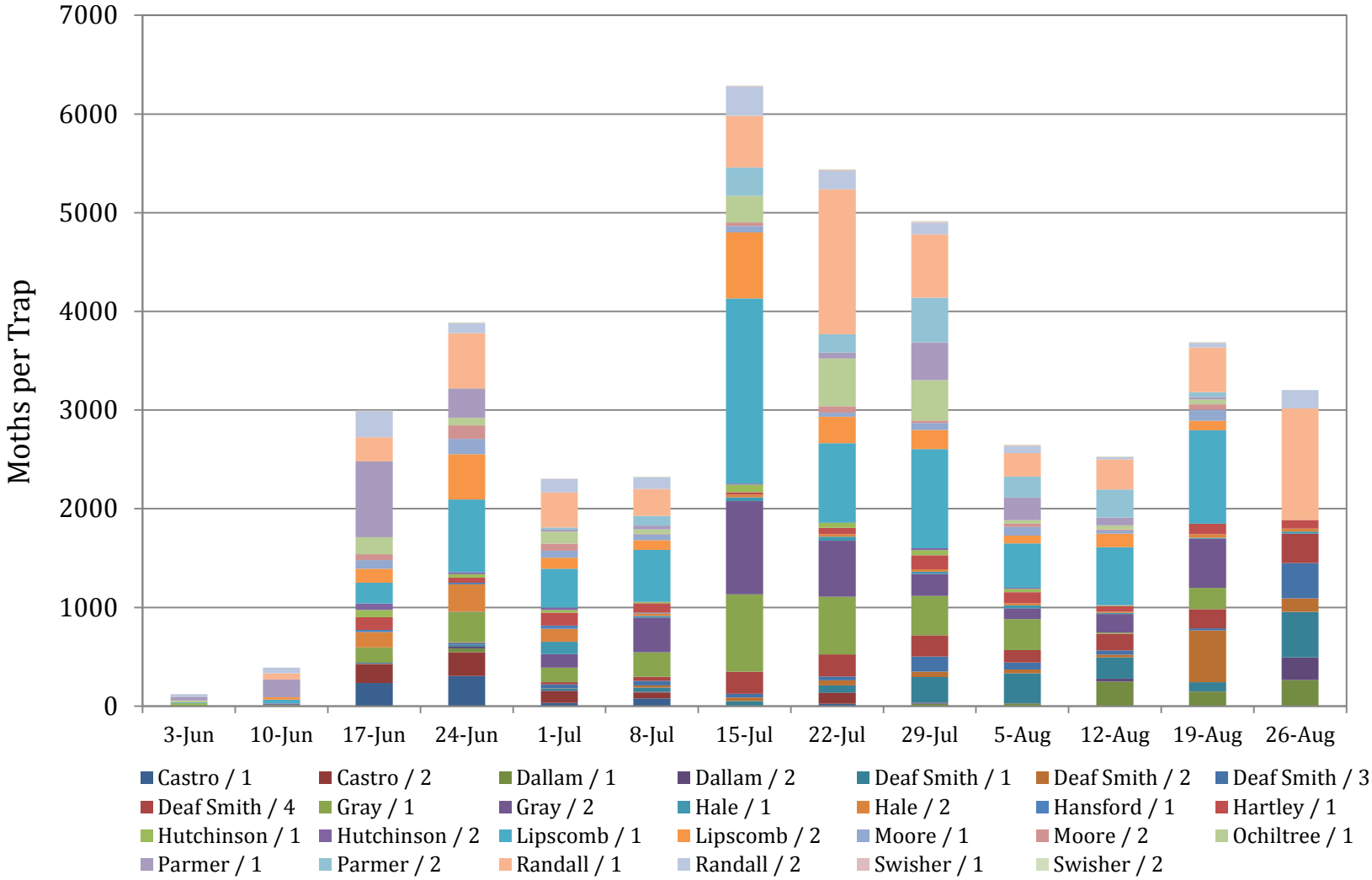


Figure 17. Fall Armyworm 2015

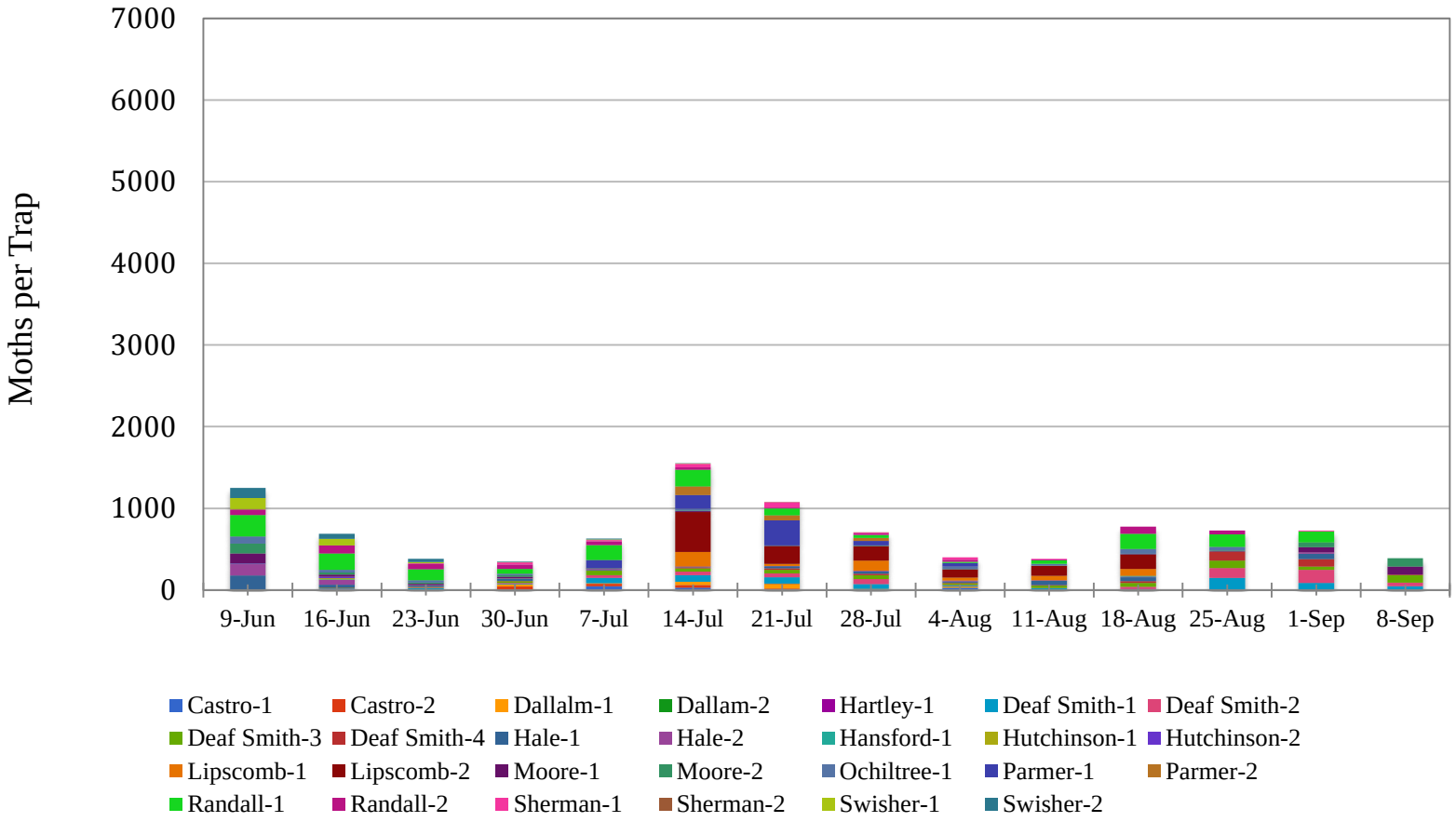


Figure 18. Fall Armyworm 2016