Ada County Mosquito Abatement District

2021 Annual Report

Jameson Rigg; Division Coordinator

Desireé Keeney; Deputy Director

12/10/2021

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https://adacounty.id.gov/weedpestmosquito/

Contents

Mission Statement

The mission of Ada County Mosquito Abatement District is to control mosquitoes that are both a nuisance and potential vector of disease to Ada County residents using the best available data and sound science practices through Integrated Mosquito Management (IMM).

District History

Ada County's original Mosquito Abatement District was the Three-Mile Creek District established in 1974, which included 12 square miles between Cloverdale and Cole Roads and Franklin and Columbia Roads. There were several district annexations made over the next few decades, and in 2004, Ada County Board of County Commissioners agreed to incorporate and operate what was then called the Southwest Ada County Mosquito Abatement District. Today, the district is known as Ada County Mosquito Abatement District (ACMAD) and covers 406 square miles, with most of the district encompassing major residential, rural and urban areas.

ACMAD Management and Staff

Adam Schroeder, Director
Desireé Keeney, Deputy Director
Jameson Rigg, Division Coordinator
Diana Beahm, Administration Specialist II
Additional Staff: 4 fulltime field employees, and up to 16 seasonal employees; 1 fulltime GIS Analyst (shared with Weed and Pest departments); 4 fulltime administration staff (shared with Weed and Pest departments).

Training and Education

Continuing education and training of staff is a primary objective of ACMAD's program in efforts to use the best management practices available. Most training also contributes to certification and continuing education credits through the Idaho State Department of Agriculture (ISDA). This extensive training is necessary for ACMAD's full time and seasonal staff to carry a Professional Applicator's license in the State of Idaho. On average, 6 full time staff and 2 seasonal staff were sent to education events for approximately 389 hours.

2021 Seminar/Training	People Sent	Hours	Total Hours
ADAPCO Vector Lab	6	7	42
AMCA Annual Meeting	6	40	240
IMVCA seminar	7	6	42
Forklift certification training	2	4	8
Solutions for Floodwater Mosquito Control Western US Floodwater Summit	6	3	15
UI Extension PSEP Fall Recertification Webinar	7	6	42

Table 1. ACMAD training seminar attendance.

Memberships, Affiliations, & Grants

ACMAD is an active member of several professional vector control associations. These memberships help to increase professional knowledge base by keeping ACMAD up to date on new abatement methods, best available science practices, and knowledge of potential legislation that will affect ACMAD operations and/or residents. ACMAD received no grants in 2021.

ACMAD is proudly affiliated with the following organizations:

- Idaho Mosquito and Vector Control Association (IMVCA)
- Northwest Mosquito and Vector Control Association (NWMVCA)
- American Mosquito Control Association (AMCA)

Integrated Mosquito Management

ACMAD follows an Integrated Mosquito Management (IMM) program which is designed to benefit and have minimal adverse effects on people, wildlife, domestic animals, and the environment. An IMM program includes education and prevention, cultural, physical, mechanical, biological, and chemical control. ACMAD recognizes that not all mosquito populations can be controlled using these methods, and there is no one way to use these practices due to variations in the mosquito population abundance, species diversity, time of year, development habitats and environmental conditions. ACMAD considers all methods carefully. In addition to adhering to IMM principles, ACMAD treatments are informed by cost-benefits analyses, efficacy projections, potential health effects, ecological impacts, and exposure to risk potential for vector-borne diseases.

Public Education

Public Education is a primary component of any IMM program. Through public education and outreach ACMAD can work to better inform the residents of Ada County about the best forms of protection and control options against mosquitoes, which may help to limit the interactions between mosquitoes and people and reduce the potential spread of WNV and other vector-borne diseases.

Listed below are some examples of public education and outreach conducted in 2021:

- ACMAD web presence through the Online Mosquito Tracker, social media, and Ada County website
- Face to face interactions with field staff and the public when working daily during the mosquito season, especially during WNV positive outbreaks
- Televised news interviews notifying the public of WNV and the aerial application
- Outreach at the Western Idaho Fair

History of WNV in Ada County

West Nile virus (WNV) was first detected in Ada County in 2005. By 2006, Idaho led the nation in human cases of WNV, with over 1,000 reported cases resulting in 23 WNV-related deaths. ACMAD has collected mosquitoes that they have confirmed are infected with WNV nearly every year since. WNV is an arthropod-borne flavivirus (arbovirus) disease passed between birds and mosquitoes in a cyclical fashion. Mammals can also be infected with the disease but are considered “dead-end hosts” or “incidental hosts” of the virus and are unable to pass the disease any further. However, mammals can contract the virus and become ill (Figure 1). On average, 80% of humans infected with WNV will not

present with symptoms (known as asymptomatic) or show only mild symptoms. Approximately 20% of infected individuals experience short-term and long-term effects of WNV. Some of the most commonly reported symptoms are fever, headaches and fatigue, rash; of those individuals, 1-5% will develop severe neurological symptoms (such as encephalitis or meningitis), which may result in paralysis or death (Centers for Disease Control and Prevention, 2013).

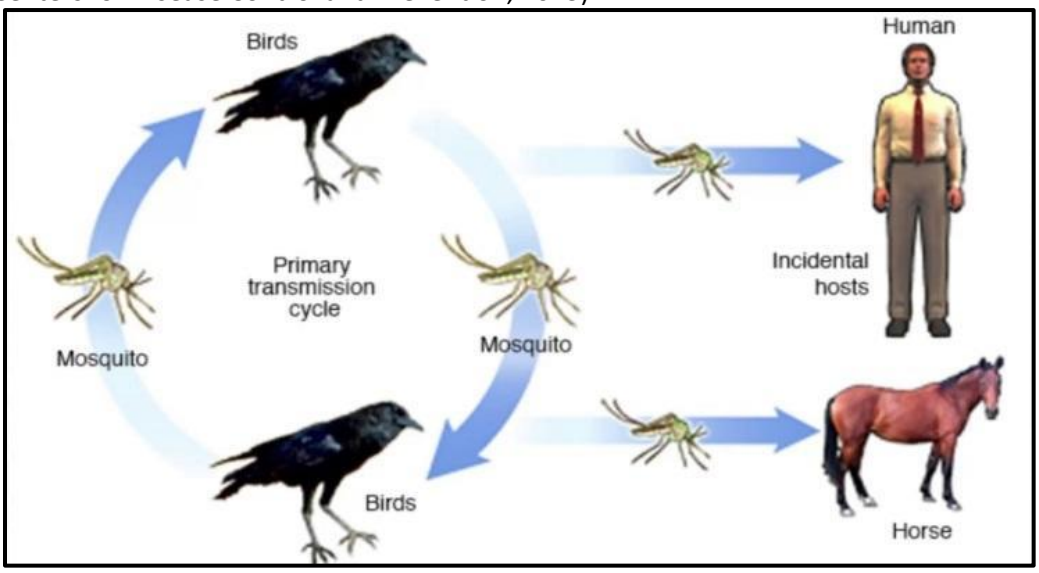

Figure 1. The transmission cycle of WNV, the most prevalent arbovirus in Ada County. Adapted from Mayo Foundation for Medical Education and Research.

As of October 28, 2021, the Idaho Department of Health and Welfare (IDHW) reported 15 human cases of WNV, with 2 cases resulting in death (Idaho Department of Health & Welfare, 2021). By this same date, there were 847 cases of WNV, with 45 cases resulting in death, nationwide (Centers for Disease Control and Prevention, 2021).

Mosquito Surveillance Operations

Ada County mosquito surveillance operations began on May 17th for the 2021 season and continued through September 16th, 2021 for a total of 18 weeks (weeks 20-37 shown in Figure 2).[1] ACMAD used carbon dioxide (CO_2) baited EVS light traps, which, on average, ran for 10 hours a night with 3-4 lbs. of dry ice as an attractant. A total of 2,011 mosquito surveillance traps were placed during the 2021 season. ACMAD used 565 total trap locations in Ada County, with 165 locations designated for WNV surveillance in 2021.[2] Two crews were deployed nightly placing 112 mosquito traps on average weekly, an increase in weekly mosquito trapping by 3% as compared to the previous 3 year average. The trap failure rate was 2.88% (n = 58) in 2021, which was much lower than 2020's failure rate of 4.87% (n = 113).

[1] A list of all week numbers with corresponding dates can be found in Appendix 1.

[2] A map depicting all surveillance sites can be found in Appendix 2.

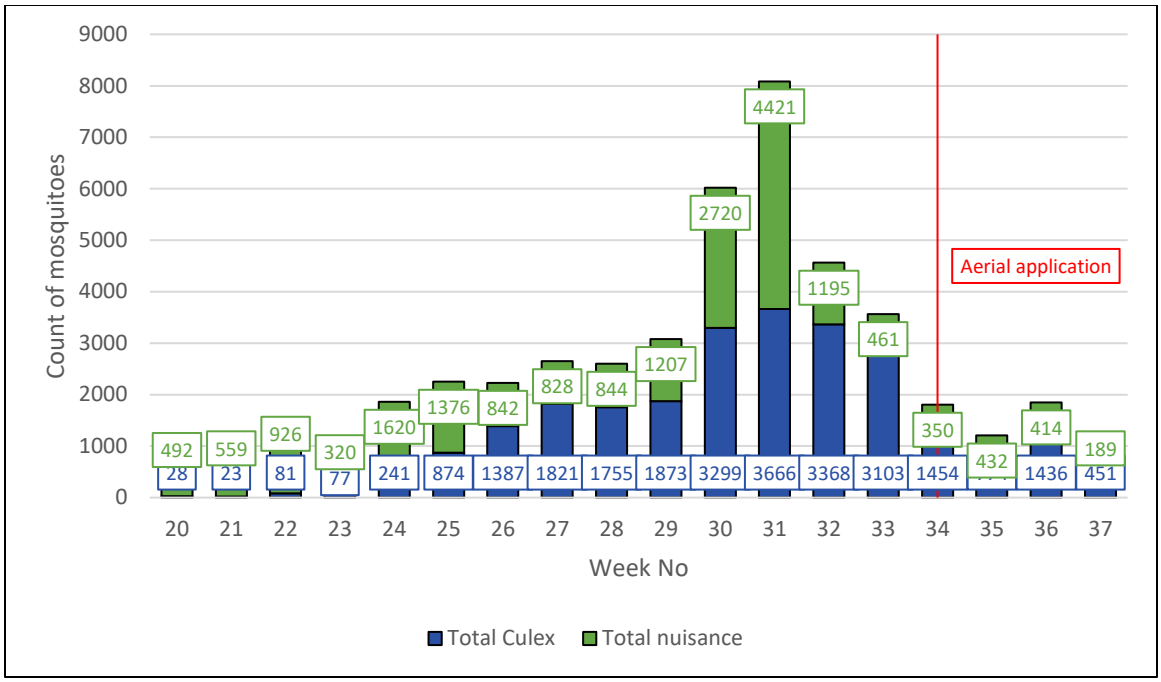

Figure 2. ACMAD's total mosquito sampling by week, with a distinction of important vector species (Culex tarsalis & Culex pipiens).

During the 2021 season, ACMAD collected 44,907 mosquitoes, a 13% increase from the previous 3-year average of 39,772 mosquitoes collected annually. As seen in Figure 2, WNV vector species, *Culex pipiens* (n = 18,625) and *Culex tarsalis* (n = 7,086) composed an average of 57.25% mosquitoes trapped in 2021. In addition to monitoring the mosquito populations within Ada County, ACMAD tests all potential vector mosquitoes for WNV in-house with Rapid Analytic Measurement Platform (RAMP) testing; this allows for a same-day response to positive WNV pools and increases efficacy in controlling the potential spread of the disease.

Arbovirus Surveillance Operations in Ada County

ACMAD uses adult mosquito surveillance as a tool to monitor and reduce the spread of WNV. Upon collection of the traps set out the night before, mosquitoes are separated by species, and the important vector species, *Culex pipiens* and *Culex tarsalis*,are tested for WNV in a pool (1-50 individual *Culex spp.* of mosquitoes pooled together from a single site). In 2021, there were 107 WNV positive pools detected in 53 sites. 1 WNV positive pool was sampled from a deceased crow.[3] When compared with data from 2020, ACMAD saw an increase of 981.81% in WNV positive pools as well as a 191% increase in the overall mosquito population.

[3] A map depicting 2021 WNV+ locations can be found in Appendix 2.

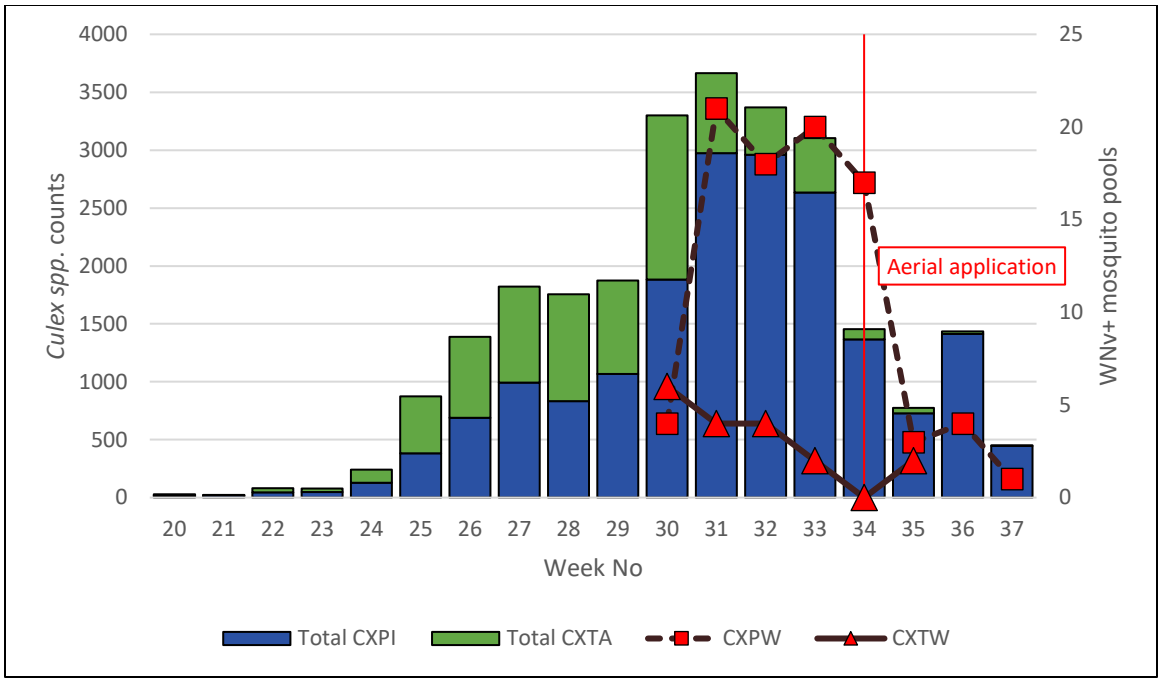

Figure 3. The above chart shows weekly Culex pipiens (CXPI) and Culex tarsalis (CXTA) collected samples and count of positive pools by each species (CXPW – Culex pipiens WNV+ (n = 88) and CXTW - Culex tarsalis WNV+ (n = 18)) for the 2021 season.

A total of 1,906 RAMP tests were analyzed during the 2021 season, with an average of 13 mosquitoes per pool. When necessary, Reverse Transcription Polymerase Chain Reaction (RT-PCR) testing for WNV was performed at the Idaho Bureau of Laboratories (IBL) on samples collected by ACMAD in accordance with the standard requirements and protocol designated by IDHW for confirmation of disease presence. Of the 97 samples that were sent to IBL,WNV was confirmed in 33 samples. The first mosquito pools to test positive for WNV were on July 27th, 2021 (during week 30). This was 2 weeks earlier than the 2020 season.

Arboviral Risk Assessment

Ada County uses both a *Minimum Infection Rate* (MIR) calculation to assess risk of arbovirus transmission to the public as a variable in the WNV response matric in addition to other factors and the CDC's *Vector Index Coefficient* (VIC). Ada County uses both assessments, along with other qualitative and quantitative factors within the surveillance area and further IMM tools, to assess potential risk of transmission and to make management decisions and respond quickly and accordingly.

Note: MIR is expressed as the number of positive pools/1,000 mosquitoes. In 2018 Ada County began quantifying transmission risk using the CDC's VIC. This calculation is more in depth than previously used risk coefficients and accounts for pool size, geospatial factors, as well as multiple vector species in an area (Centers for Disease Control and Prevention, 2013). *VIC is expressed as the percent change that a mosquito in any given mosquito trap within a predetermined spatial zone will test positive for WNV. While VIC does not have a designated threshold for epidemic levels, it is an important indicator of arbovirus disease risk in Ada County, as there are two WNV vector species with different habitat and population behaviors.*

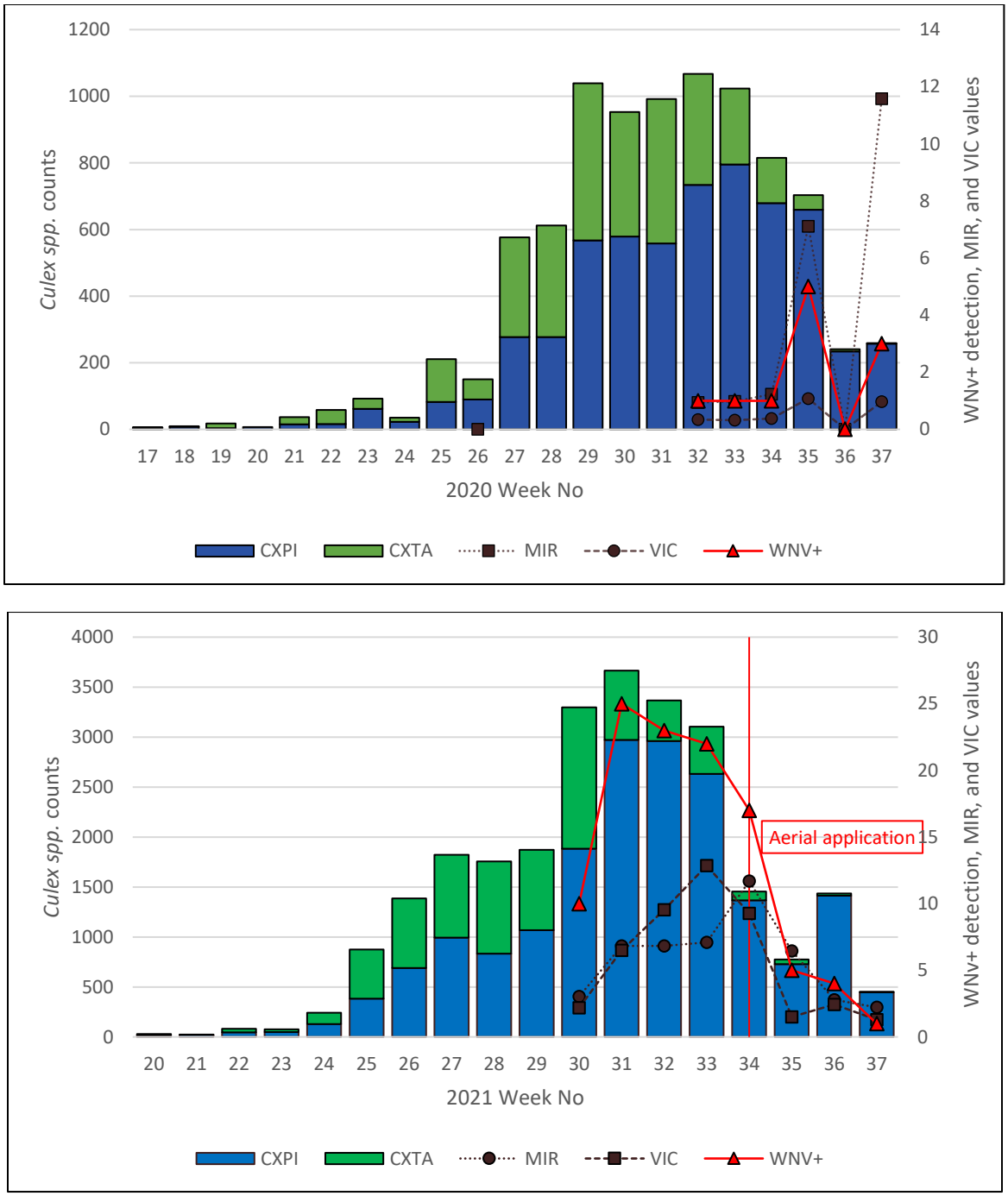

Figure 4. The minimum infection rate (MIR) and vector index coefficient (VIC) over time in 2021 (bottom graph) vs 2020 (top graph). These risk assessment coefficients help set thresholds for ground and/or aerial fogging and make best management decisions to reduce the spread of WNV.

In the comparison shown in Figure 4, the distinction between these two risk assessment strategies can be observed. In 2021 the maximum MIR (11.7) occurred during week 34, when 17 positive pools were detected from a total of 1,454 C*ulex spp*. mosquitoes. The maximum VIC (12.85%) occurred during week 33 (in 2020 the VIC remained below 2 all year) when 22 positive pools were detected from a total of 3,103 *Culex spp.* mosquitoes. VIC accounts for many factors missed by MIR assessments, including the

average number of infected vector species mosquitoes in each trap night in an area (Centers for Disease Control and Prevention, 2013). The distinction between risk assessment tools comes from the notion that the arbovirus patterns differ in *Culex pipiens (Cx. pipiens)* and C*ulex tarsalis (Cx. tarsalis)*. It is important for ACMAD to compare multiple risk assessment variables and monitor aberrations closely.

Species Composition Data

In 2021, ACMAD collected 44,907 mosquitoes during WNV surveillance: *Culex pipiens* (n = 18,625), *Aedes vexans* (n = 14,596), *Culex tarsalis* (n = 7,086), *Culiseta incidens* (n = 1,494), *Anopheles freeborni* (n = 1,409), *Aedes nigromaculis* (n = 743), *Culiseta inornata* (n = 490), *Aedes dorsalis* (n = 317), *Coquillettidia perturbans* (n = 98), *Aedes cinereus* (n = 44), *Aedes increpitus* (n = 4), *Aedes fitchii* (n = 1). In 2020, *Cx. pipiens* constituted 25% of sampled mosquitoes; in 2021, *Cx. pipiens* populations increased to 41% of the sampled population. The *Ae. vexans* population decreased from 52% composition in 2020 to 33% in 2021 and the *Cx. tarsalis* population increased from 13% in 2020 to 16% in 2021.

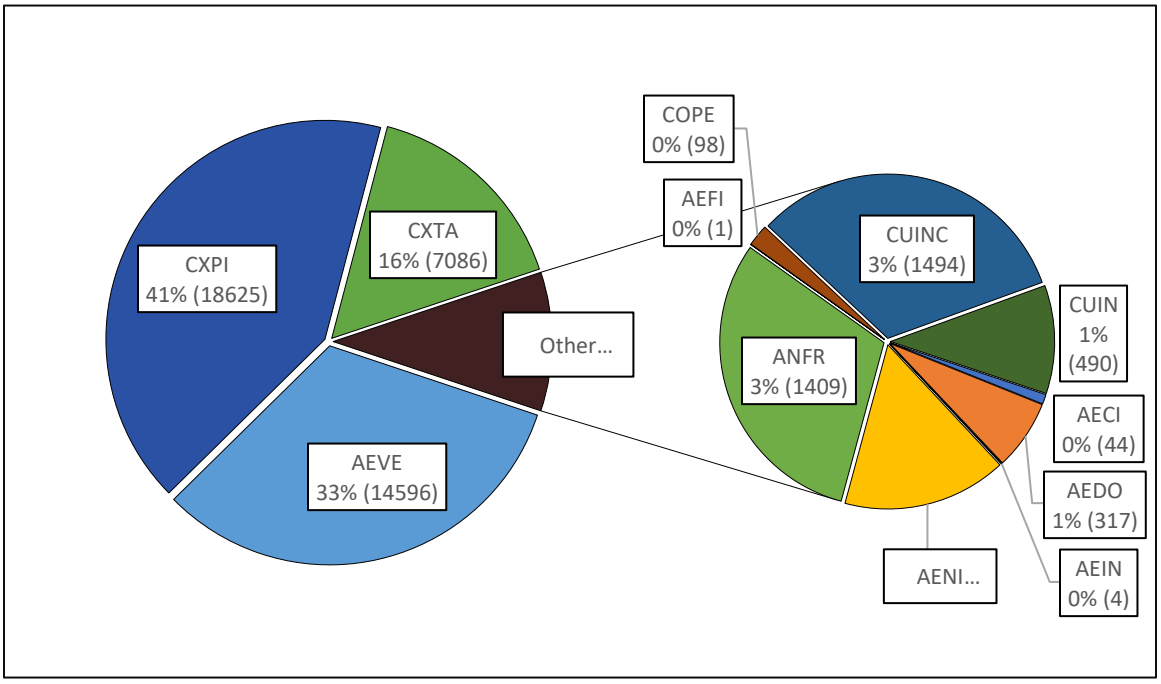

Figure 5. Species composition for mosquitoes sampled by surveillance traps.

Mosquito Surveillance & Climate Data

Typical precipitation for Ada County occurs mainly outside of the mosquito development season, meaning most mosquito development sources are caused by irrigation and landscaping. Figure 6 shows the total mosquito count and *Culex spp.* mosquitoes trapped by week number. *Culex spp*. activity peaks when nightly temperatures are averaging 60-70+°F, and then slows down when nightly average temperatures reach 52-54 °F or less, which is consistent with known *Culex spp.* behavior. The average temperatures this year were warm for an Ada county summer.

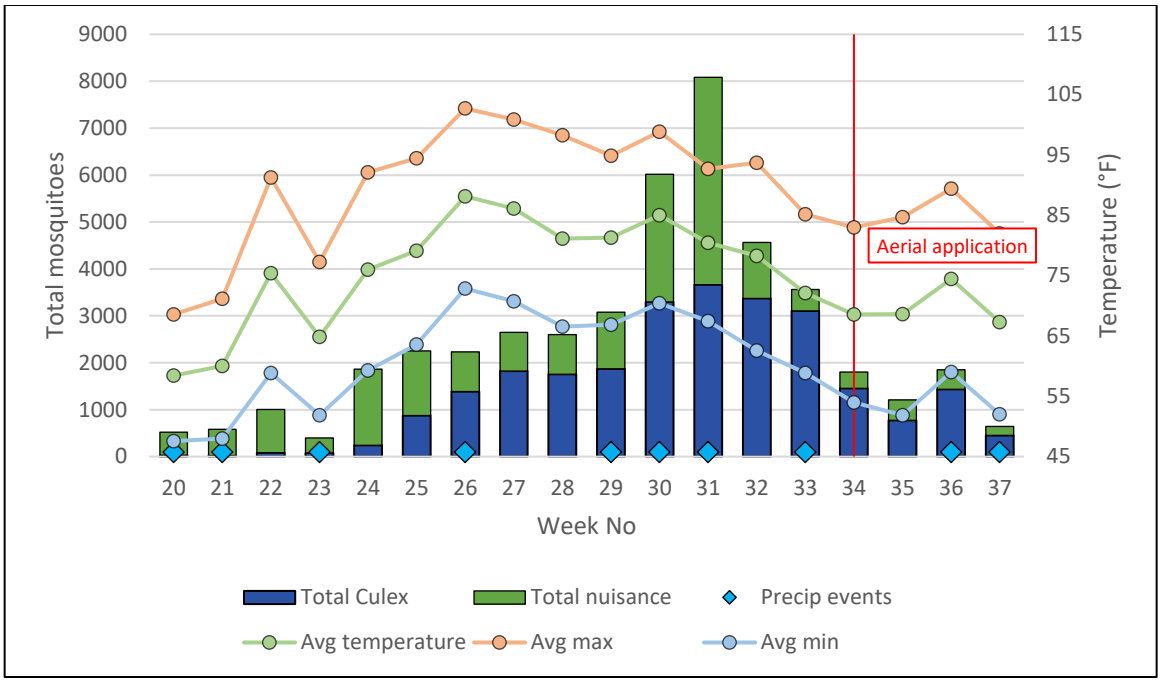

Figure 6. The correlation between mosquito population and climate.

Mosquito Larviciding Operations

As a preventative measure, ACMAD applies larvicides to known mosquito larval habitats. ACMAD internally maps persistent water sources for routine inspections and treatment. Suitable mosquito development sources vary and range from natural features such as ponds or marshes to artificial objects like tires or pool covers. As Ada County grows in population, artificial sources become the predominant development habitat—the preferred water sources for WNV vector species. ACMAD will routinely check known water sources for larvae presence and select the most appropriate control method.

The ACMAD larvicide division also responds to public and internal service requests. Citizens of Ada County can request a larvicide technician to check their private or other public property. ACMAD uses these opportunities as an avenue for public education as well as providing mosquito abatement services. When internal surveillance meets specific thresholds, larvicide technicians are dispatched to the location to find and eliminate brooding sites. In 2021, the larvicide division completed 417 public service requests and 263 internal service requests, which is a respective increase of 4 and 136 service requests relative to the 2020 season.[4]

Larval Site Inspections and Treatment Summary

ACMAD mapped 3,770 new sites this year, bringing the total number of active sites to 48,463. The larvicide division performed 99,532 inspections, which is a 20% reduction compared to last year. ACMAD made 61,263 larvicide applications, a 15% decrease from 2020. These applications covered 921 acres, a 1.1% decrease from 2020. Approximately 600 acres of this season's total acreage were treated with a UTV or backpack spreader.

[4] A map depicting the distribution of larvicide service requests can be found in Appendix 3 and a chart depicting the distribution by city can be found in Appendix 5.

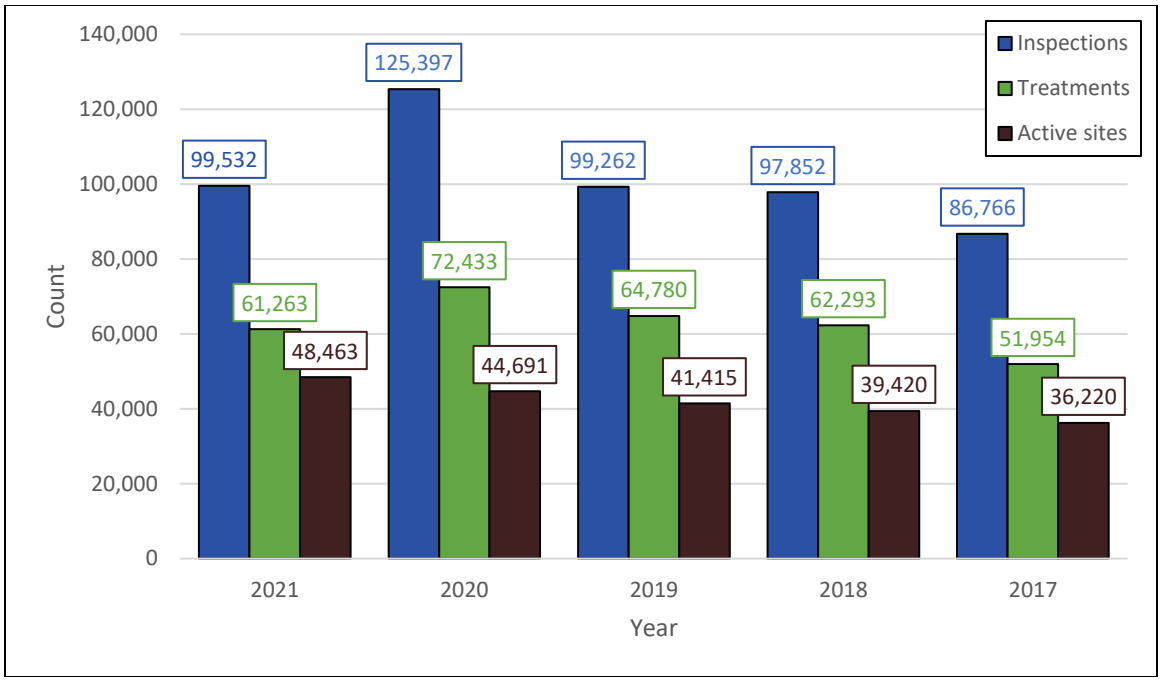

Figure 7. Annual Larvicide Division operations from 2017-2021.

After the mosquito season ended in October, full time staff mapped additional Drain Inlets (DIs) and storm drains in new construction areas and on new roads. Eighty percent of the active sites mapped by ACMAD are DIs, a favored oviposition habitat for *Cx. pipiens*, an important vector for WNV. DIs are significantly increasing annually with the development of Ada County.

Larval Development Habitat Summary

There are many different larval habitats in Ada County, the most monitored and treated were pastures and DIs. These locations are favored oviposition habitats for *Ae. vexans*, *Cx. tarsalis,* and *Cx. pipiens*. As seen in Figure 8, 60% of acres treated in 2021 were pastures, and only 10% of acres treated were DIs. A total of 57,089 DIs were monitored in Ada County, making up 57% of ACMAD's total larvicide treatments.

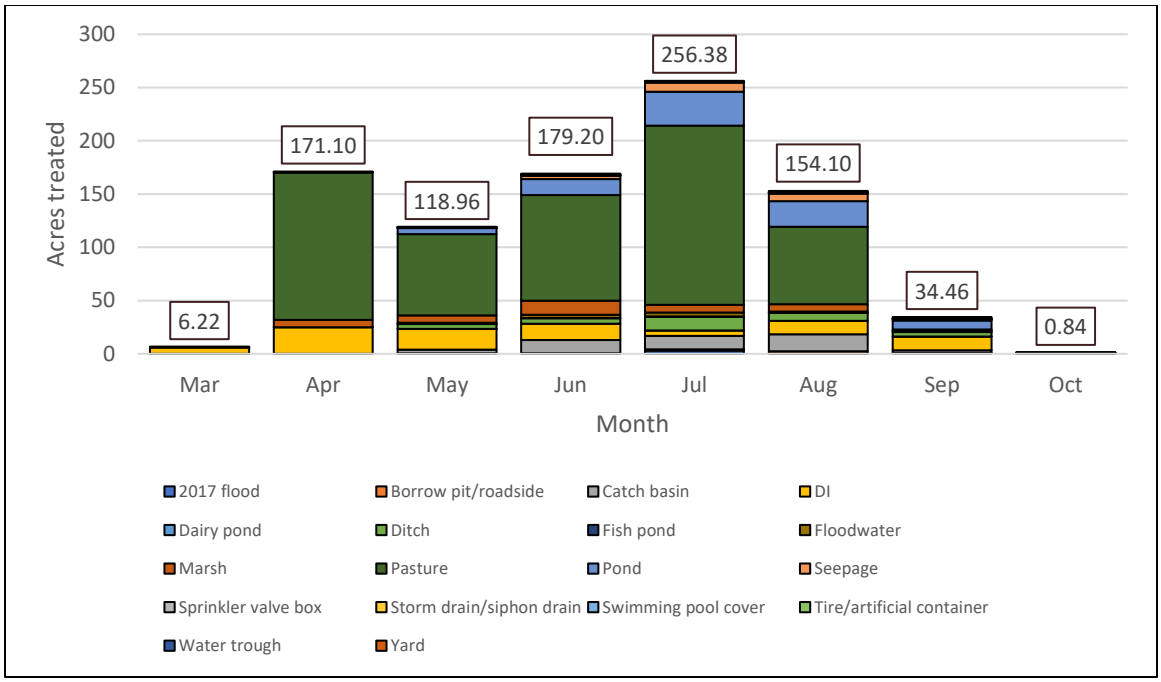

Figure 8. Acres treated by the ACMAD Larvicide division, sorted by site category. The numbers above the columns show the total acreage treated for that month.

Larvicide Product Summary

Historically, the vast majority of larvicide treatments use biological control methods. As seen in Figure 9, either a biological or mix of biological and biochemical control agents were used in 47% of the 921 acres treated in 2021. The predominant biological control ACMAD uses is a natural bacterium *Bacillus spp. (Bti. or Bs). Bacillus spp.* are soil-dwelling or aerobic spore-bearing bacteria which develop proteins toxic to insect larvae. Certain strains of *Bacillus spp.* are toxic to specific insect larvae, such as *Bacillus thuringiensis israelensis* (*Bti.*) which targets only mosquito and black fly larvae. *Bacillus spp.* do not leach into soil and are effectively non-toxic to humans, birds, fish, domestic pets, livestock, and other wildlife. ACMAD uses Spinosad, a natural bacterial byproduct, as an additional biological control agent. Biological controls are an essential concept of IMM. Many of these formulations used by ACMAD are Organic

Materials Review Institute certified (organic).

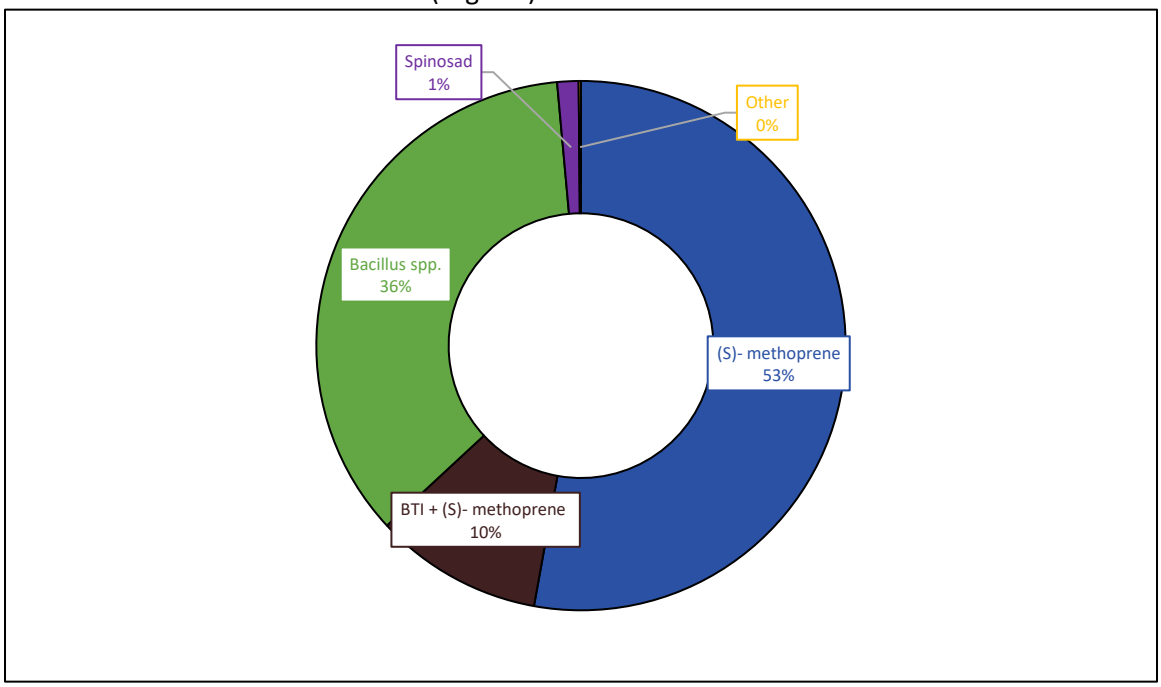

Figure 9. Active ingredients present in larvicide applications for 2021.

ACMAD also uses (S)-Methoprene to control mosquito larvae. (S)-Methoprene is an insect growth regulator, which is considered a biochemical pesticide. Instead of a chemical poison, (S)-Methoprene controls pests through interference of the life cycle and prevents the larvae and pupae from reaching maturity. (S)-Methoprene has no adverse effect on fish, waterfowl, mammals, or beneficial insects according to the Environmental Protection Agency (EPA) registered and approved label. Typically, (S)-Methoprene has long-term residual activity which helps reduce labor costs and increase mosquito inspection efficiencies and larval source reduction. (S)–Methoprene usage increased by 26% this season due to a stronger reliance on long term residual effects.

Mosquito Adulticiding Control and Operations

The final line of defense against arboviral diseases and nuisance adult mosquitoes is Ultra Low Volume (ULV) application of adulticide insecticides. ACMAD uses ULV foggers mounted to a pick-up truck, which is then driven throughout the county after dusk, and releases an EPA-approved pesticide at designated locations to control flying adult mosquitoes. ULV foggers release micron-sized droplets of insecticides, which are lethal to flying mosquitoes by contact but are not lethal to larger beneficial insects such as dragonflies, butterflies, or moths (Scheier III & Peterson, 2010). ACMAD also takes a proactive approach avoid the release of adulticide products into water bodies with fish and near known honeybee hive locations. ULV applications only take place after dusk when bees have returned to their hive and are not actively flying or foraging on plants. An estimated total of 71,008 acres (this number is with a rounded buffer on the GIS lines and completely dependent on wind direction and the industry standard of 300 ft.) were treated during 2021. An aerial application was utilized on August 25th and is discussed below.

The 2021 adulticide season started on June 7th, 2021 (week 23) and ended on October 2nd (week 39). Traditionally, the adulticide division conducts its nightly operations with 3 technicians using truck

mounted ULV foggers. ACMAD implemented a 4th fogger on August 8th, 2021. This 4th fogger was utilized a total of 7 times to help combat against the large quantity of internal and external service requests and in response to WNV locations.

Adulticiding Treatment Summary

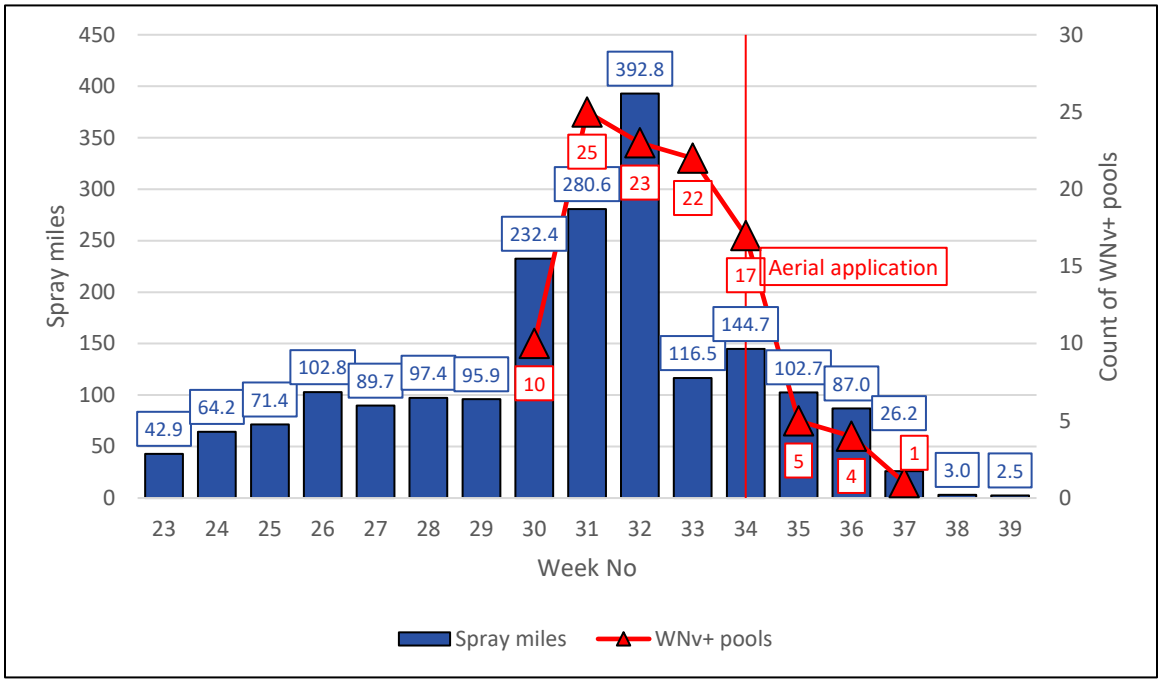

Figure 10. Weekly spray miles for 2021 with WNV+ pools. A total of 563 gals of insecticide was used in 2021.

ULV applications are based on public requests, WNV response, and mosquito population thresholds, as determined by surveillance. If a surveillance site traps more than 5 vector mosquitoes, or 25+ nuisance mosquitoes, and if the action threshold has been met, an adulticide applicator is dispatched to the location within 48 hours. If WNV is found by the surveillance team, the adulticide team is dispatched within 12 hours and a ULV application is made to all accessible roads within 1 mi^2 of the positive location which can also be seen through the positive correlation of spray miles within the same week of positive pools as seen in Figure 10. This is because *Culex spp.* mosquitoes are not normally known to travel over a mile from their hatch location, but mosquito behavior can be dependent on species and blood source availability.

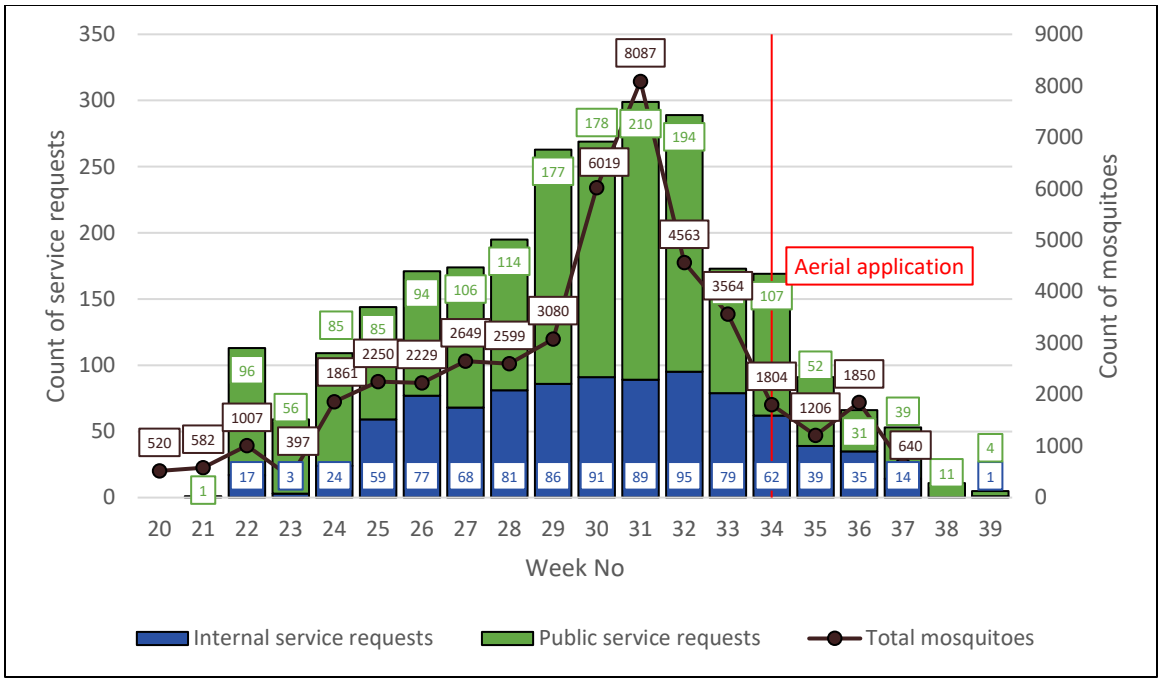

Figure 11. Comparison of public and internal adulticide service requests with total mosquito population sampled by week.

As seen in Figure 11, the adulticide team responded to 2,654 service requests; 920 requests prompted by internal action thresholds, and 1,734 requests from Ada County residents through the 2021 season.[5] This is an increase of 348 and 139 service requests for internal surveillance and residential compared to 2020, respectively.

Aerial Application

ACMAD implemented an aerial application of Dibrom to reduce the adult vector mosquito populations and to break the WNV transmission cycle within local mosquito populations. The aerial application targeted areas with high concentrations of WNV: Kuna, Star, and part of Meridian. The application was administered in 2 separate spray blocks on the same night, one targeting Kuna and the other focusing on Star and Meridian.[6] The application was originally scheduled to occur on Thursday, August 19th, 2021 but was postponed due to weather and rescheduled for Tuesday, August 24th,2021. This date was then rescheduled by order of the Board of Ada County Commissioners and completed on August 25th, 2021.

[5] A map depicting the distribution of larvicide service requests can be found in Appendix 4 and a map depicting the distribution by city can be found in Appendix 5.

[6] A map depicting the aerial adulticide spray blocks can be found in Appendix 6.

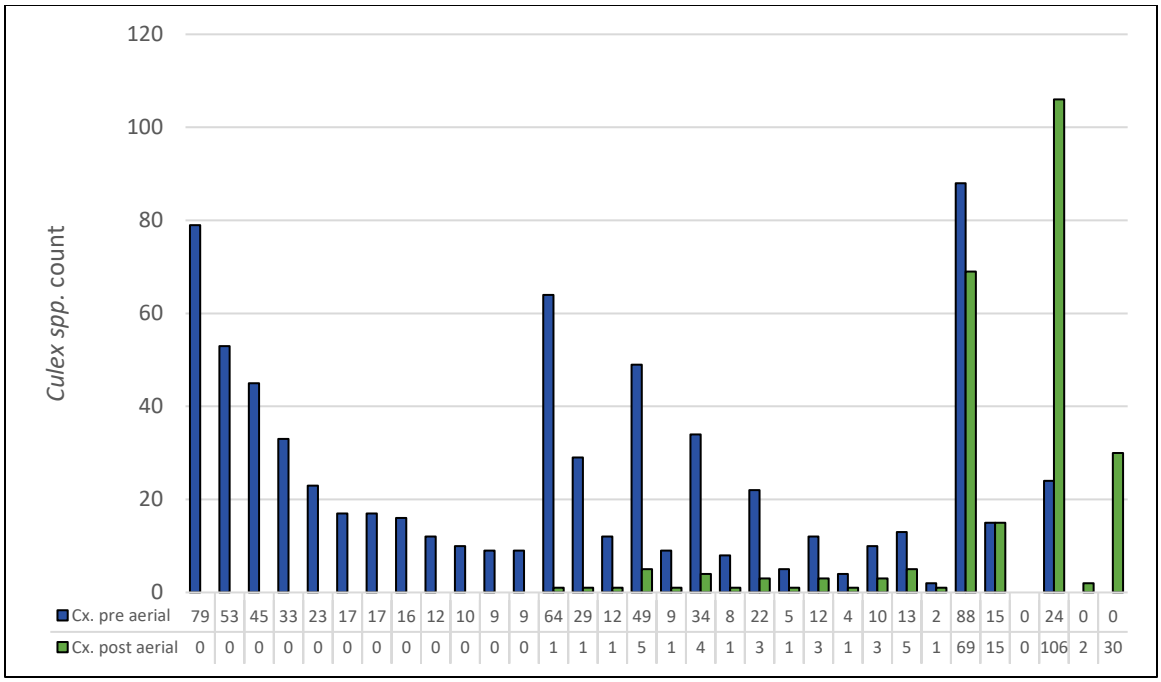

Figure 12. Change in Cx. spp. surveillance counts post aerial.

Thirty-two surveillance sites were sampled prior to and after the application. Figure 12 shows the timing of the aerial application in respect to total surveyed mosquitoes. Of the 32 surveillance sites, 27 saw a significant decrease in *Culex spp.* counts, 2 saw no change, and 3 saw an increase. This increase or no change is likely contributed to the edge effect of the aerial application block and the site sampled was on the edge of the treatment zone. Another reason for this was while concentrated efforts of the short staffed larvicide division tried to find immature mosquito sources for pre-hatch treatments, there was still an unfound untreated development source allowing for the consistent influx in population abundance in the area. Shortly after the aerial application, a few development sources near these surveillance sites were discovered and treated. Sixteen of these sites observed a 90% or greater reduction in *Culex spp.* Prior to the aerial application ACMAD sampled 723 *Culex spp*. The night after the aerial ACMAD sampled 253 *Culex spp.* observing a 65% reduction in total *Culex spp.* counts.

As discussed in "Adulticiding Treatment Summary", August saw a record number of service requests and the impacts of the aerial applications can be seen in Figure 11. The aerial application occurred on calendar week 34. Week 33 saw 222 total service requests and week 35 had 102 service requests, a 54% reduction.

ACMAD announced the intent to employ an aerial application to the public on August 17th through a press release, the official ACMAD website, and various social media platforms such as Facebook and Nextdoor. Several delays and misinformation created a small and vocal group of individuals who contacted ACMAD to voice their disagreement with the decision to utilize an aerial application. ACMAD received approximately 295 calls, with roughly 197 (67%) calls as negative/hostile. Concerns reached the Board of Ada County Commissioners who then delayed the application another day. Alternatively, ACMAD also received positive feedback from individuals within the community and majority of support to help the community with public health and vector disease risk reduction.

After the final delay, the aerial applications were conducted on August 25th. Referencing Figure 4, it is apparent that ACMAD's goals of reducing MIR and VIC were successful. MIR dropped from 7.1 in week 33 to 6.5 in week 35 (-8.5%) and VIC dropped from .129 in week 33 to .015 in week 35 (-88.4%). VIC peaked in week 33 and MIR peaked in week 34 at 11.7. This data shows the application was effective at breaking the WNV transmission cycle within the mosquito population, while the application would have been better 2 to 3 weeks earlier to break the cycle, it still had a significant impact on continued WNV risk to the public.

Projects and Field Trials

In contrast to previous years, ACMAD did not participate in any projects or field trials. The prevalence of WNV detection demanded continuous action.

Pesticide Resistance Testing

Pesticide resistance testing is a necessary step to evaluate that the most effective insecticides are being used to combat adult flying mosquitoes. Using the CDC Bottle Bioassay protocols, insecticide resistance was monitored at different locations in Ada County. These locations were tested for resistance to the technical-grade active ingredient Permethrin, ACMAD's primary active ingredient adulticide. The two testing locations were chosen by the frequency and density of historical applications of insecticide containing the active ingredient, by public and private sector applicators throughout the years.

Permethrin

Samples were collected from surveillance trap locations in Kuna and Star on July 20th,2021 from field collected mosquitoes. These *Cx. tarsalis* and *Ae. vexans* were tested for Permethrin resistance by exposing them to 15.0 µg Permethrin and had a 100% mortality rate at the diagnostic time.

Discussion and Conclusion

ACMAD detected 107 WNV+ pools in 2021, surpassing the previous record high of 90 set in 2013. The adulticide division was impacted the most by the amount of WNV positive pools as this response procedure is time intensive, so in high WNV years, this has a major impact on resources and field operations. Typically, ACMAD has a same-day response procedure after a positive WNV detection, which involves a 1 mi^2 ground ULV application the same night and a larvicide inspection the following day at the site of detection. There were days where the count of positive pools was too large for the adulticide division to meet same-day treatment goals. For example, on August 24th the surveillance division detected 11 WNV positive pools from 11 unique sites, but not all sites could be treated or were only partially treated due to an inability to spray within a full radial mile. The hot WNV season required an aerial application to be implemented in 2021 with the goal to break the transmission cycle in the adult mosquito population and help public health by reducing the risk of infection to the community.

Employees from the other divisions would offer their assistance despite their own pressing workload, often working long days throughout the peak mosquito and WNV season. Public service requests were often delayed as internal WNV positive service requests had to be addressed first. While a WNV+ response isn't as impactful for the larvicide division as it is for the adulticide division, addressing these internal service requests pulls resources from completing public service requests and routine inspections.

Obtaining and retaining technicians for the larvicide division was particularly challenging. There were no returning larvicide technicians this year. Typically, the larvicide division hires 12-15 seasonal technicians. This year the crew filled 53% of the available positions on average, reaching a maximum 60% in July. This reduced workforce impacted operations, resulting in a reduction of site inspections and treatments and increasing service request response time as well as increase in s-methoprene applications to increase treatment efficacy at immature development sources.

Surveillance summary

The standout statistic from surveillance this season was the count of WNV+ detections. However, there was a noticeable change in mosquito population composition. This season, vector species comprised 57% of sampled mosquitoes. The only other time vector species have comprised most of the sampled mosquitoes was in 2017, where they made up 69% of the samples and resulted in two aerial applications as well. Other than these 2 occurrences, ACMAD typically expects 38% of the sampled mosquitoes to be identified as *Cx. spp.* This increase in *Cx. spp.* directly causes an increase in WNV testing, which results in more internal service requests for the adulticide and larvicide divisions. Various factors affect local mosquito population dynamics including weather, natural environmental cycles, habitat suitability, and more. ACMAD's larvicide and adulticide operations also influence mosquito populations.

Initially, the surveillance division intended to implement projects and field trials. However, the logistics of completing these projects in an exceptionally busy season were unfeasible. In 2022 the surveillance division intends to revisit these projects which include implementing new mosquito traps, attractants, and conducting adulticide efficacy field trials.

Larvicide summary

Since 2017, ACMAD has observed an annual increase in larvicide site inspections and treatments. However, these both decreased from 2020 to 2021. This decrease is expected due to the nature of the environment, political, economic and social climates following the COVID-19 pandemic; these numbers of inspections and treatments were similar in2019 and 2018.

Due to the lack of staffing, this season placed a higher emphasis on the use of long-term residual treatment. When adequately staffed, ACMAD uses a combination of short-term treatments (< 1-month residual control), long term treatments, remediation through mechanical controls and education. Short term controls cost less per day, but more frequent inspections, however, it also allows ACMAD to monitor an area for changes more routinely in a specific area. Long term treatments also have an important place in integrated mosquito management allowing for more operational flexibility and reduced labor frequency whichare ideal in certain areas of the district or specific development sources.

Despite the large workload and staffing issues, the larvicide division was able to address all public and internal service requests. While most service requests were promptly inspected, once WNV became established, impacts on larvicide service requests this season were occasionally delayed in response time. A few locations from internal surveillance service requests kept reoccurring due to an inability to findthe mosquito development sources within an area. Some locations had a higher frequency of return service request inspections in 2021 which was unusual and may be attributed to short staffing and the ability to maintain an area routinely.

Looking forward to 2022, ACMAD intends to implement drone technology into its larvicide division. Utilizing a drone will make large scale applications quicker, allowing seasonal technicians to allocate more time to conduct inspections. Another 2022 goal will be group training of seasonal technicians which was limited or ineffective in 2021.

Adulticide summary

The count of total service requests the adulticide division received increased from 2020 to 2021 as well as an increase in acres treated. Despite the large number of WNV detections, the total amount of service requests and the distribution of service request source (internal vs. external) are comparable to previous years. However, frequent equipment repairs mid-season and the significant increase in WNV positive service requests affected the adulticide division's ability to respond quickly.

The implementation of an aerial application helped ACMAD reach its goal of reducing MIR and VIC. Vector species populations and total service requests were reduced the following week and never returned to pre-application counts. Post aerial application, two sites saw an increase in vector species amounts. The site that saw the largest vector species increase was located on the border of one of the spray blocks, and it was found later that the mosquito source was outside of the application area.

Through planning, collaboration amongst the other divisions, and utilizing an aerial application, ACMAD was able to reduce VIC and MIR and break the WNV transmission cycle in adult mosquito populations at that point in time as seen in Fig. 4.

Conclusion summary

This season each division of ACMAD experienced their own distinct challenges. The larvicide division experienced staffing issues, surveillance encountered record WNV detections, and adulticide was hit with high workloads. Despite the many adversities ACMAD had to overcome, the hard work, experience, and wide skill set of the seasonal technicians and full-time staff were able to meet the challenges directly. While there was some social media upset with the announcement of an aerial application, this was very minor compared to the silent majority and total community support of the ACMAD and helping to protect public health. Typically, "hot" WNV years are followed by a less challenging season. ACMAD looks forward to the upcoming season and intends to re-implement traditional training techniques and projects.

ACMAD Goals

Goals for 2021

I) Improve upon mid-season training for all seasonal staff to ensure *Best Management Practices* are followed.
   a) As in 2020, more one on one training was conducted throughout the season, the labor shortage made our traditional and preferred training strategies unfeasible.

II) Conduct Adulticide efficacy field trial and operational analysis.
   a) This project was cancelled once again due to WNV prevalence

III) Strengthen public education on land management practices with the help of our Public Information Officer.
   a) ACMAD outreach attendance is listed in Table 1.

Goals for 2022

I) Improve upon mid-season training for all seasonal staff to ensure *Best Management Practices* are followed
II) Conduct Adulticide efficacy field trial and operational analysis.
III) Strengthen public education on land management practices with the help of our Public Information Officer.
IV) Increase public education and outreach to continue to adapt and improve our IMM

Works Cited

CDC. (2013, June 14). *West Nile Virus in the United States: Guidelines for Surveillance, Prevention, and Control*. Retrieved from Centers for Disease Control and Prevention: https://www.cdc.gov/westnile/resources/pdfs/wnvGuidelines.pdf

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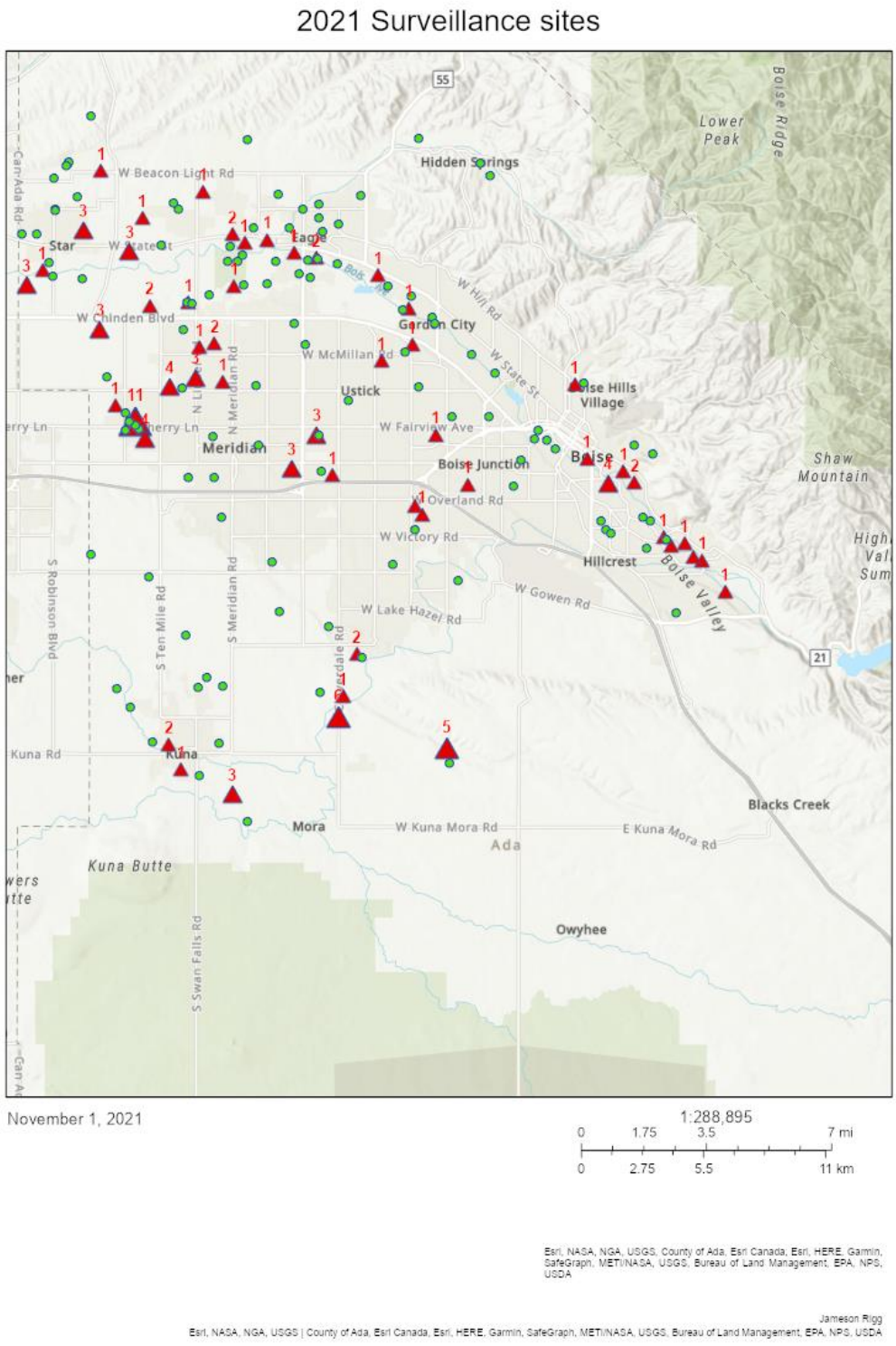
Appendices

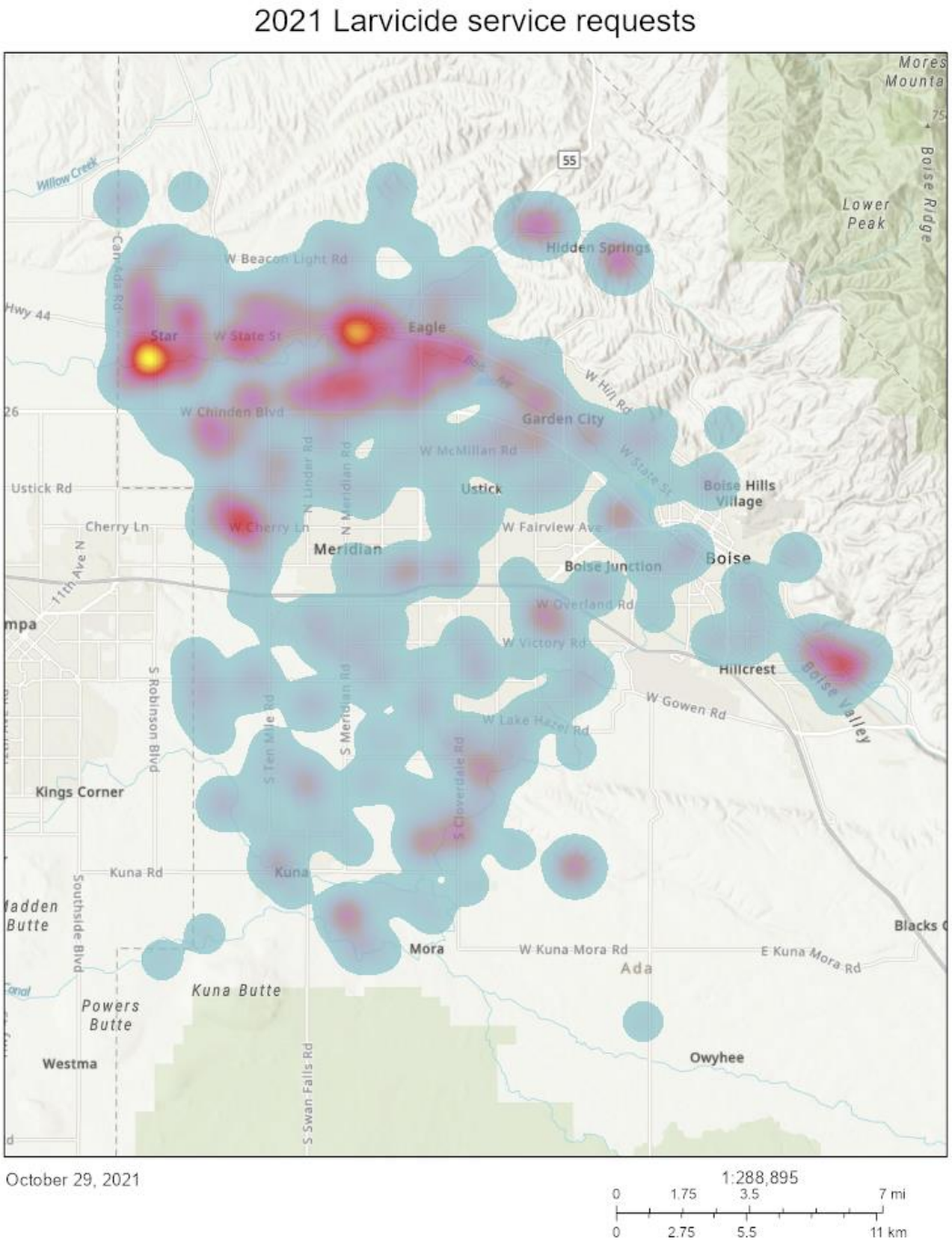
Appendix 1. Week number by start and end dates.

Week number	Start date	End date
17	April 25, 2021	May 1, 2021
18	May 2, 2021	May 8, 2021
19	May 9, 2021	May 15, 2021
20	May 16, 2021	May 22, 2021
21	May 23, 2021	May 29, 2021
22	May 30, 2021	June 5, 2021
23	June 6, 2021	June 12, 2021
24	June 13, 2021	June 19, 2021
25	June 20, 2021	June 26, 2021
26	June 27, 2021	July 3, 2021
27	July 4, 2021	July 10, 2021
28	July 11, 2021	July 17, 2021
29	July 18, 2021	July 24, 2021
30	July 25, 2021	July 31, 2021
31	August 1, 2021	August 7, 2021
32	August 8, 2021	August 14, 2021
33	August 15, 2021	August 21, 2021
34	August 22, 2021	August 28, 2021
35	August 29, 2021	September 4, 2021
36	September 5, 2021	September 11, 2021
37	September 12, 2021	September 18, 2021
38	September 19, 2021	September 25, 2021
39	September 26, 2021	October 2, 2021

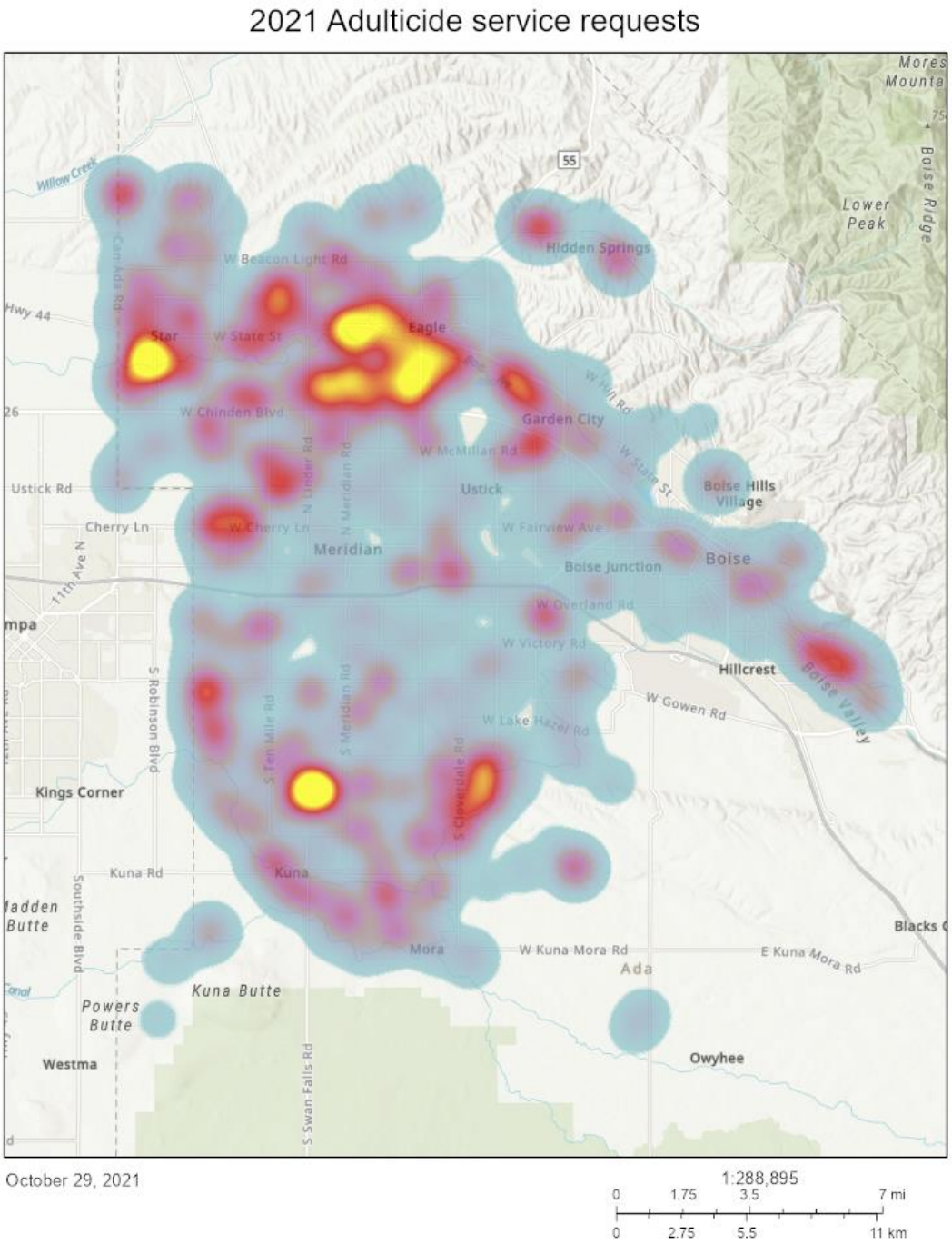
Appendix 2. Distribution of surveillance sites and WNV+ detection. Green circles indicate surveillance site locations. Red triangles represent WNV+ positive detections and numbers indicate the quantity of WNV+ positive pools.



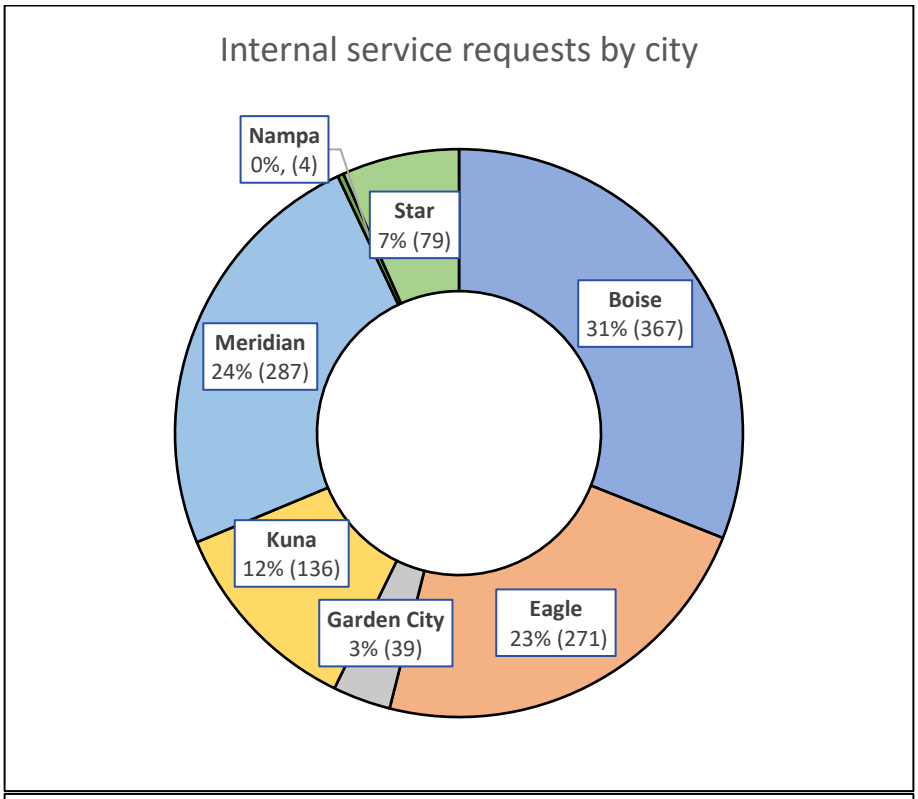
Appendix 3. Distribution of Larvicide service requests.

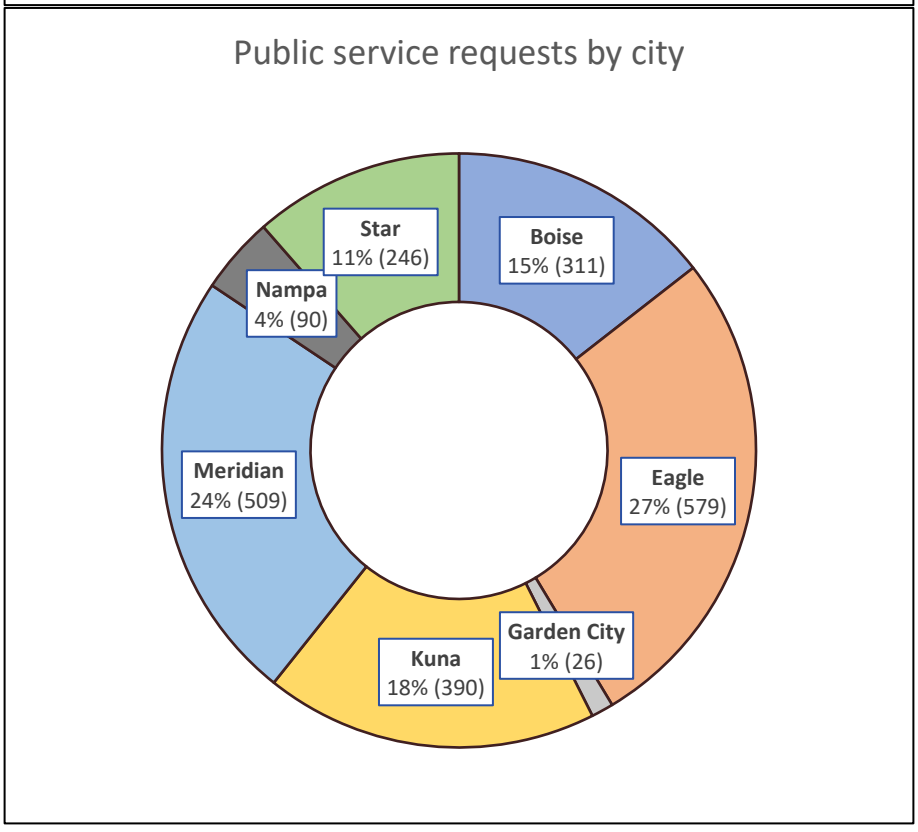


Appendix 4. Distribution of Adulticide service requests.



Appendix 5. Distribution of service requests by city and source.





Appendix 6. Aerial adulticide spray blocks.