Ada County Mosquito Abatement

2018 Annual Report

By Desiree Keeney, Deputy Director; and Rachel Pollreis, Division Coordinator

11/07/2018

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.

District History

Ada County's original Mosquito Abatement District (MAD) 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 the majority of the district covering major residential and urban areas.

ACMAD Management and Staff

Adam Schroeder, Director

Desireé Keeney, Deputy Director

Rachel Pollreis, Division Coordinator

Diana Beahm, Administration Operations Manager

Additional Staff: 4 Fulltime Field Employees, and up to 16 seasonal employees; 2 Fulltime GIS Analyst (shared with Weed and Pest); 4 Fulltime administration staff (shared with Weed and Pest).

Training and Education

Continuing education and training of staff is a primary objective of our program in efforts to use the best management practices available. The majority of training also contributes for recertification credits through the Idaho State Department of Agriculture to continue to carry a Professional Applicators license in the state of Idaho.

2018 Seminar/Training	People Sent	Hours	Total Hours
ATV Certification	5	3	15
IMVCA Spring Workshops	10	8	80
AMCA Annual Meeting	2	32	64
NWMVCA Spring Workshop	2	12	24
NWMVCA Fall Conference	2	16	32
Idaho Ag Expo	2	4	8
Idaho Pest Expo	2	12	24
SWIWCA Fall Seminar	3	8	24
Total Hours in Training			XX

Memberships and Affiliations

Ada County Mosquito Abatement District (ACMAD) belongs to several associations which increase education opportunities to our staff; keep ACMAD up to date on new abatement methods, and knowledge of potential legislation that will affect our operations and/or residents. 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 helps to promote a more sustainable program whenever possible. IMM is designed to benefit or to have minimal adverse effects on people, wildlife, domestic animals, and the environment. An Integrated Pest Management program includes education, cultural, physical and mechanical controls, biological control, and chemical control. We recognize 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, development habitats and environmental conditions. ACMAD considers all controls carefully, using the above variables as well as cost versus benefits, efficacy, health effects and ecological impacts.

Public Education

Public Education is the primary objective of any Integrated Mosquito Management program. Through public education and outreach we can better inform the residents of ACMAD about how to protect against mosquitoes, which limits the interactions between mosquitoes and people. This helps to control nuisance mosquito interactions and the spread of potential diseases such as West Nile Virus (WNV) and other vector borne diseases.

Some public education and outreach that was conducted in 2018:

- ACMAD website and Online Mosquito Tracker
- At the Western Idaho Fair outside the Agriculture Pavilion for Ada County Weed, Pest, and Mosquito Abatement
- Education Trailer at the Avimor Kids duathlon
- Laboratory tour for an individual interested in microbiology and entomology.
- The many face to face interactions of field staff when working on a daily basis during the mosquito season, especially during WNV positive outbreaks.

Mosquito Surveillance Operations

Ada County Mosquito Surveillance operations started April 30, 2018 and continued through September 25, 2018 for a total of 21 weeks (week 18-38).[1] The most commonly used trap was a carbon dioxide (CO_2)-baited EVS light traps, which on average ran for 10 hours a night, using 3-4 lbs of dry ice a night per trap as an attractant. Our trap failure rate was higher than normal, averaging 13.39%, most likely due to a combination of mechanical shortages, vandalism, field technician error, and battery malfunction.

There was a total of 613 adulticide treatment requests based on surveillance data which was determined by action thresholds set for vector count (5 *Culex spp*. or a positive WNV pool) and nuisance (>25 other species count) mosquito species trapped in a single trap night throughout the county. In addition to monitoring the mosquito populations within Ada County, ACMAD tests all potential vector mosquitoes for WNV in house through the use of Rapid Analytic Measurement Platform (RAMP) testing. This allows for a same-day response to potential WNV breakouts and increases efficacy in controlling the potential spread of disease. In 2018, there were **16 WNV positive pools within 14 trap locations found in Ada County**.[2] A decrease of 78.08% in WNV positive pools was seen, as well as a 52.68% decrease in overall mosquito population from 2017. We theorize this drop in population is mainly due to climate, as 2017 saw severe flooding from snowmelt, and a total yearly precipitation in Ada County of 13.13 inches. In 2018, the precipitation was only 8.50 inches with minimal flooding from snowmelt. The Center for Disease Control (CDC) reported that there were 15 human cases of West Nile Virus in Idaho as of October 30, 2018, with one case resulting in death. Nationwide, 2018 has seen 1,611 cases of West Nile virus with 68 cases resulting in death.

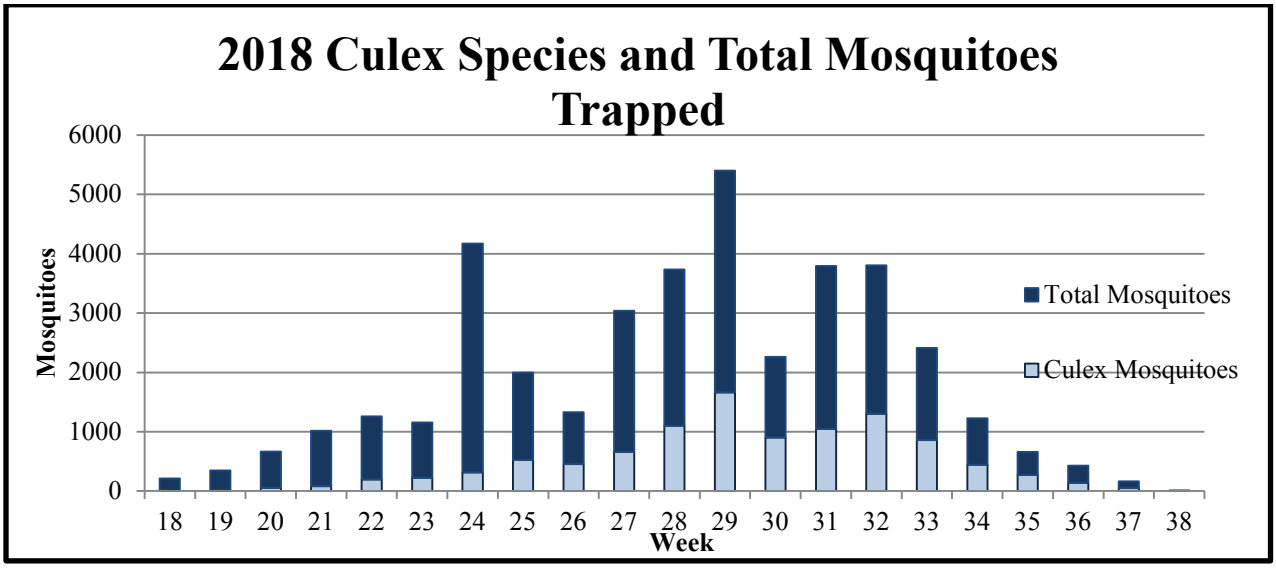

Figure 1 Shows weekly mosquito trap counts, with a distinction of important vector species (*Culex*).

[1] A list of all week numbers with corresponding dates can be found in Appendix 1.1.
[2] All WNV+ locations can be found in Appendix 1.3.

Arboviral Surveillance in Ada County

West Nile Virus was first detected in Ada County in 2005, and in 2006, Idaho led the nation in human contraction of West Nile Virus, with nearly 1,000 cases resulting in 23 WNV related deaths. Nearly every year since this outbreak, mosquitoes infected with West Nile Virus have been collected by Ada County Mosquito Abatement.

ACMAD uses mosquito surveillance as a tool to monitor and prevent the spread of West Nile Virus. A total of 434 trap locations are used in Ada County, with 164 used for WNV surveillance during 2018.[3] Surveillance was conducted four nights per week, with an average of 26 traps placed each night. Upon collection of these traps, mosquitoes were separated by species and the important vector species, *Culex pipiens* and *Culex tarsalis* are then tested for West Nile Virus.

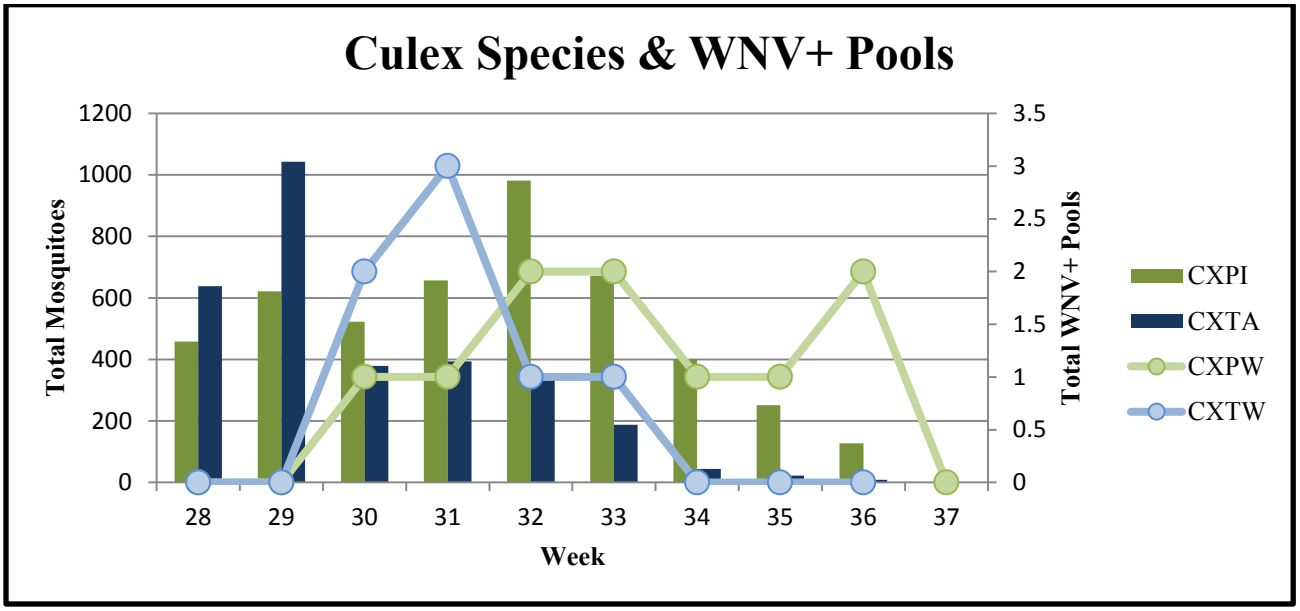

Figure 2 The following chart shows weekly *Culex pipiens* (CXPI) and *Culex tarsalis* (CXTA) trapped populations and number of positive pools by each species (CXPW-*Culex pipiens* WNV and CXTW-*Culex tarsalis* WNV).

During the 2018 season, ACMAD collected 28,885 mosquitoes. 10,405 *Culex* species were identified, and tested for West Nile Virus using RAMP testing. When necessary, Reverse Transcription Polymerase Chain Reaction (RT-PCR) testing for WNV or St. Louis encephalitis (SLE) was conducted at the Idaho Bureau of Laboratories on samples collected by ACMAD. A total of 1,246 RAMP tests were conducted during the 2018 season, which is an average of 8.35 mosquitoes per pool. 43 mosquito samples were sent to the Idaho Bureau of Laboratories; 15 samples due to suspected WNV or suspected SLE, and 28 samples due to RAMP errors. Of the 43 samples which were sent to the Idaho Bureau of Laboratories, West Nile Virus RNA was detected in 8 samples. St. Louis encephalitis was not found in Ada County during the 2018 season. The first mosquito pool to test positive for West Nile Virus was on August 1st, 2018 during week 30 which was two weeks later than in 2017. Thankfully, there were no reported human cases of West Nile Virus contracted in Ada County during 2018.

[3] A map with all surveillance sites can be found in Appendix 1.2.

Arbovirus Risk Assessment

Historically, vector control has relied on a *Minimum Infection Rate* (MIR) calculation to assess risk of arbovirus transmission to the public. MIR is expressed as the number of positive pools/1000 mosquitoes. This calculation has proven to be incommensurate, as it does not account for multiple vector species and relies on the assumption that only one infected mosquito exists in a positive pool (Weidong et. al.) While this may be the case for rare diseases, West Nile Virus has become common in the Western United States. *Figure 3* represents the MIR in Ada County during the 2018 season. MIR reached epidemic levels during week 36 (9/9/18-9/15/18) but quickly dropped to zero during the following week.

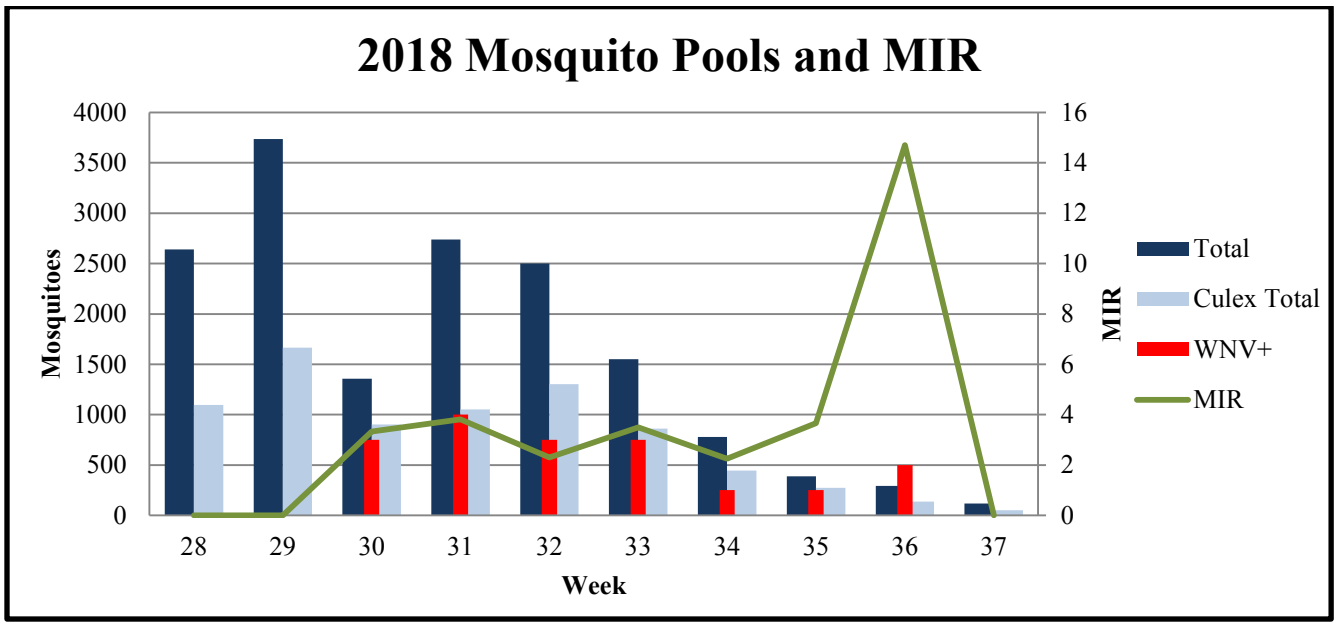

Figure 3 shows the minimum infection rate (MIR) over time in 2018. The MIR is one variable to help set thresholds for ground and/or aerial fogging and make best management decisions to reduce the spread of WNV.

In 2018, Ada County began quantifying transmission risk using the CDC's *Vector Index Coefficient* (VIC). This calculation is more in depth and accounts for pool size as well as multiple vector species in an area. VIC does not have a designated threshold for epidemic levels. However, VIC is an important indicator of arboviral disease risk in Ada County, as we have two WNV vector species with differing habitat and population behaviors.

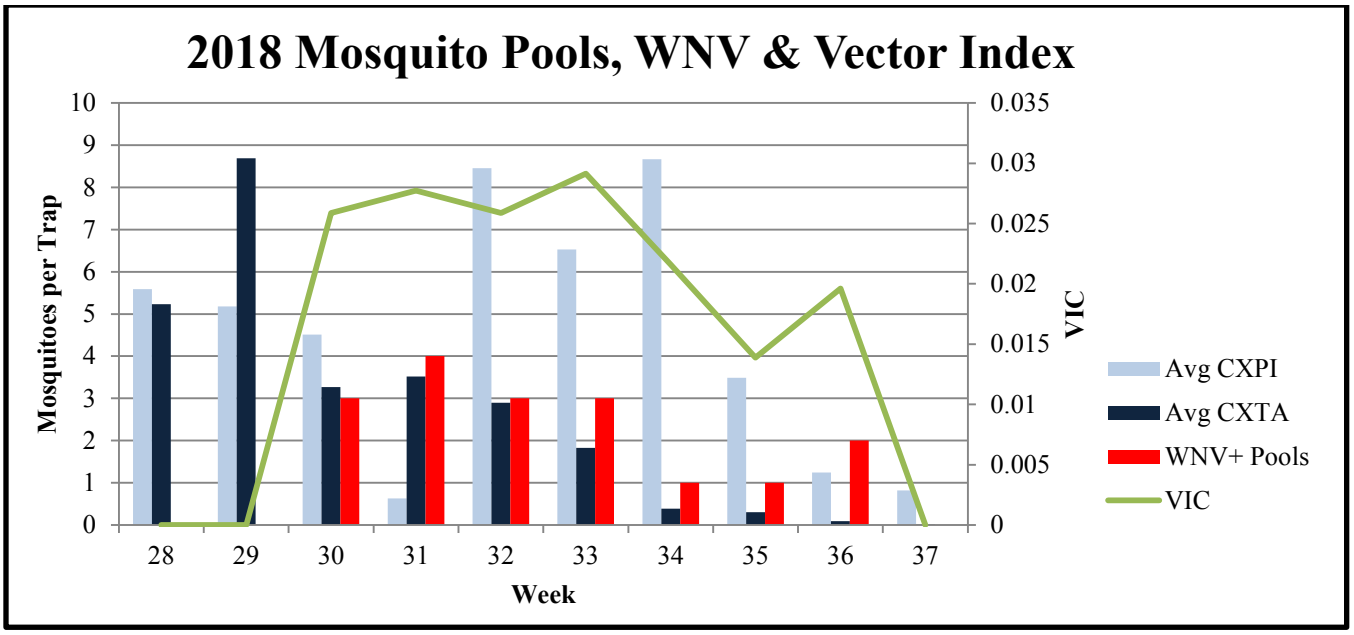

Figure 4 Shows the relationship between vector species, WNV, and VIC through the end of the 2018 season.

In a comparison between *Figure 3* and *Figure 4*, the distinction between these two risk assessment strategies is evident. In Figure 3, which represents MIR, a high point of 14.70 is seen during week 36. During week 36, two positive pools were detected, and a total of 136 Culex mosquitoes were trapped. In Figure 4, the high point is .029 during week 33, when 4 positive pools were detected and a total of 864 Culex mosquitoes were trapped. The distinction comes from the notion that the arbovirus patterns differ in *Culex pipiens* and *Culex tarsalis*. It is important for ACMAD and other vector control institutions to compare multiple factors when determining risk.

Mosquito Larviciding Operations

The larvicide department spent the first week of the 2018 season studying and testing for the Idaho State Department of Agriculture (ISDA) Pesticide Applicator license. The exams ensure each field technician is educated on federal and state pesticide laws and regulations. We had an 80% pass rate the first week, for both the " Laws & Safety" and the " Public Health" exams. During our second week of training we conducted in house product knowledge and safety training with our seasonal employees. After education and training on safety and regulations, the seasonal employees were trained in the field on best management practices.

This year the larvicide team was restructured, by pairing technicians in the field. The two person crew was a huge success as it allowed the driver to focus on safe driving practices and the second person to be the navigator, answer customer calls and a second set of eyes to look for new mosquito breeding sites. The two person crew also allowed one person to complete inspections and/or treatments on smaller sites while one person logged the data. Having two technicians familiar with an area facilitated in transition periods throughout the season.

Larval Site Inspections and Treatment Summary

Since 2017, ACMAD has mapped 3,200 new larvicide sites; bring the total monitored sites to 39,420.[4] Of the new sites, 82.12% are Drain Inlets (DIs), which are a favored oviposition habitat for *Culex pipiens*- an important vector for West Nile Virus. The larvicide crew inspected 97,852 sites this year, which was an 11.3% increase from 2017. This led to 62,293 treatments, 16.5% more than 2017. That is an average of 3,763 inspection and 2,395 treatments per week. The larvicide crew completed 376 public service requests this year and treated a total of 831 acres.

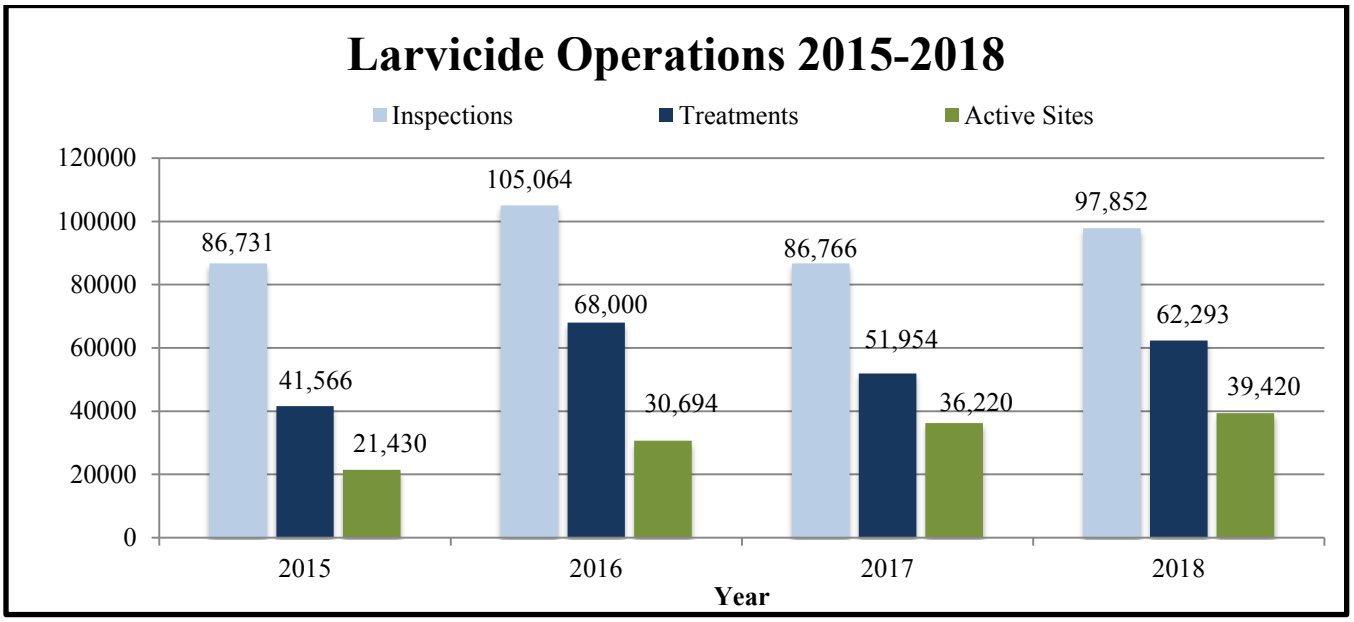

Figure 5 Larvicide Operation from 2015-2018. Since 2017, ACMAD has seen an increase in treatments, sites, and inspections.

Larval Development Habitat Summary

There are many different larval habitats in Ada County; most commonly treated are pasture and DIs. These locations are favored oviposition habitats for *Culex tarsalis* and *Culex pipiens* respectively, and these species are the two most important vectors for West Nile Virus in Ada County. As seen in *Figure 6,* 35.6% of acres treated in 2018 were pasture and 17.2% of acres treated were DIs. A total of 31,570 DIs are mapped in Ada County, making up 32.2% of ACMAD's larval breeding sites.

[4] All new larvicide sites are shown in Appendix 1.5.

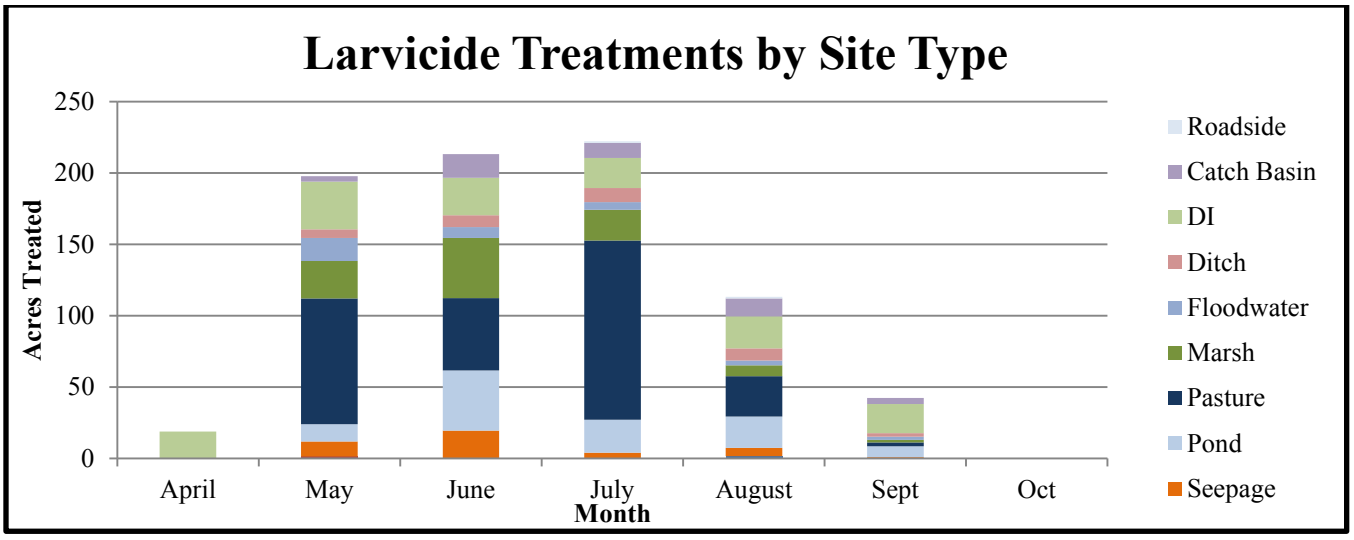

Figure 6 shows the acres treated by the ACMAD larvicide team, sorted by site category. Only categories with a monthly total >1 acre are displayed.

Larvicide Product Summary

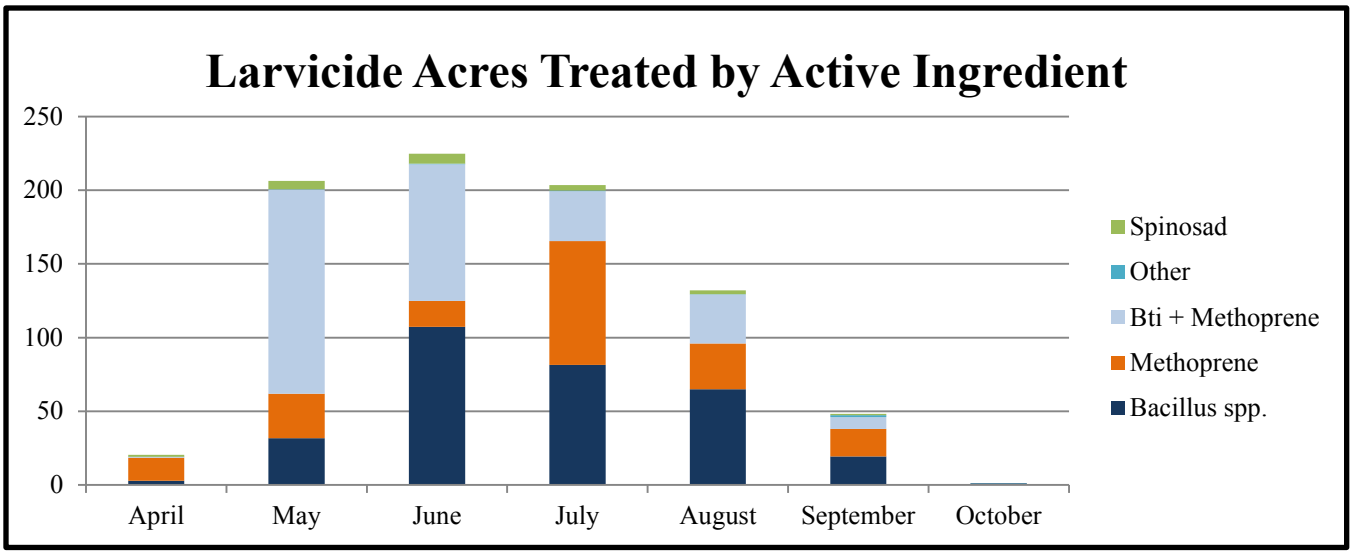

Figure 7 shows the active ingredients present in larvicide products used by ACMAD each month in 2018.

As seen in Figure 7, of the 831 acres treated by our larvicide team the vast majority are treated with biological control agents such as *Bacillus spp.* or Spinosad. Biological controls are an essential concept of Integrated Mosquito Management, and are interpreted as the use of biological factors or organisms to control mosquito populations. *Bacillus spp.* refers to a soil-dwelling bacterium which develops proteins that are toxic to insect larvae. Specific strains of *Bacillus* are toxic to specific insect larvae, such as *Bacillus thuingiensis* which targets mosquito larvae. *Bacillus spp.* does not leach into soil, and are effectively non-toxic to birds, fish, and other wildlife.

ACMAD also uses Methoprene to control mosquito larvae. Methoprene is an insect growth regulator commonly found in Altosid products, which is considered a biochemical pesticide because it controls pests through interference with the life cycle and prevents the larvae from reaching maturity. Methoprene is moderately toxic to some fish, as it can accumulate in fish tissue. Methoprene is relatively non-toxic to birds, and shows low toxicity to adult bees.

Mosquito Adulticiding Control and Operations

Our final line of defense against arboviral diseases is flying mosquito abatement, using Ultra Low Volume (ULV) application of adulticide insecticides. ACMAD uses ULV applicators mounted to a pick-up truck, which is then driven around the county and insecticide is released at designated locations to control adult flying mosquitoes. ULV applications release micron-sized droplets of pesticides, which are lethal to flying mosquitoes but do not have a fatal effect on larger beneficial insects such as dragonflies, butterflies, or moths (Johnson, 2010). While many of the adulticide products used by ACMAD are known to be harmful to bee populations, we take extreme care to avoid hives as well as limit our ULV applications to after dusk when bees have returned to their hive. Three different pesticides were used by our adulticide team this year: DeltaGuard with Deltamethrin as the active ingredient, as well as Envion 30-30 and Aquakontrol 30-30 with the active ingredient Permethrin. Figure 8 shows the composition of product used by ACMAD's adulticide department during 2018. A total of 51,967.2 acres were treated during 2018, with a total of 374.8 gallons of insecticide. This application rate comes out to be less than an ounce of insecticide per acre. In 2018, there were no aerial insecticide applications in Ada County.

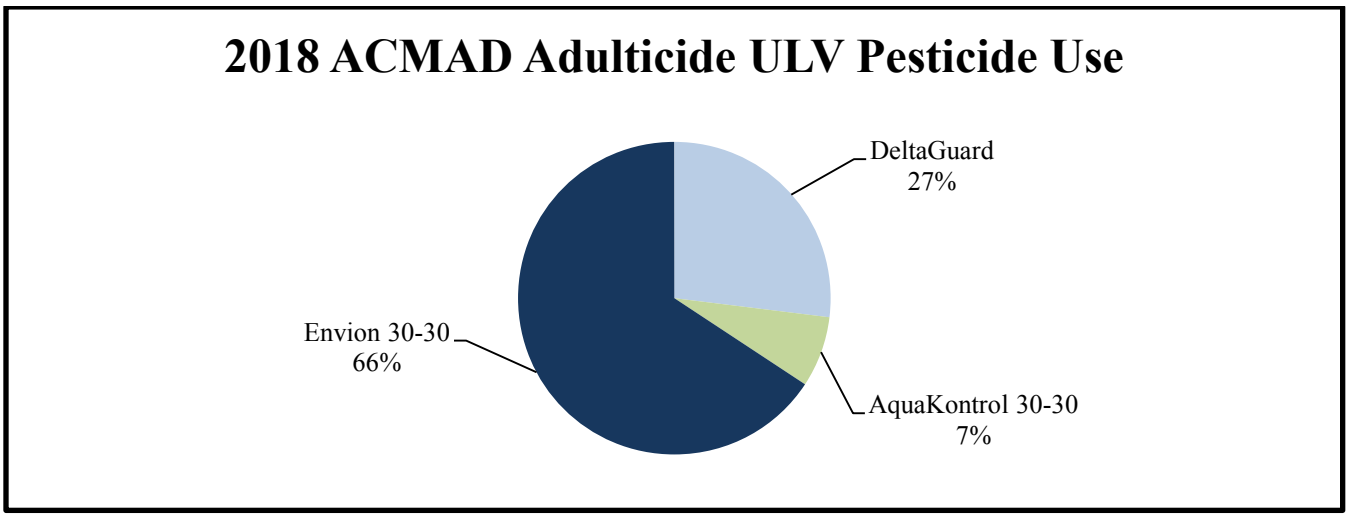

Figure 8 shows the composition of ACMAD adulticide product used for ULV treatment in 2018.

Treatment Summary

ULV applications are based on public requests, West Nile Virus response, and mosquito population thresholds determined by surveillance. If a surveillance site traps more than 5 vector mosquitoes, or 25 nuisance mosquitoes, the action threshold has been met, and adulticide is dispatched to the location. If West Nile Virus is found by the surveillance team, the adulticide team is dispatched

within 12 hours with ULV fogging occurring within 1 square mile.[5] *Culex* mosquitoes are not known to travel over a mile from their hatch location.

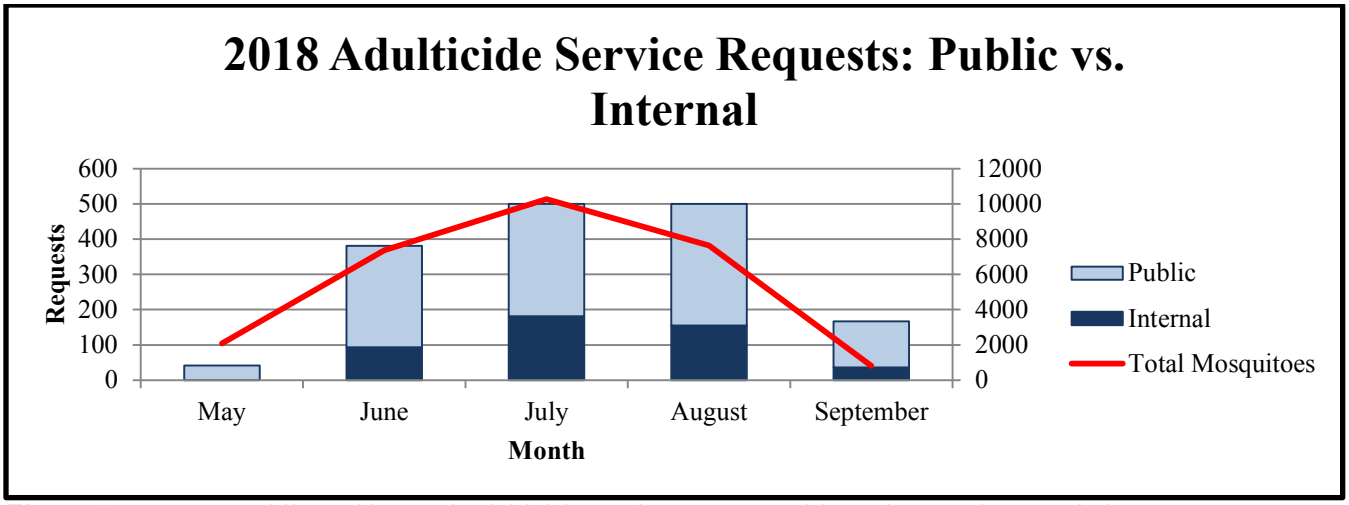

Figure 9 compares public and internal adulticide service requests with total mosquito population.

As seen in *Figure 9*, the adulticide team responded to 2,171 service requests- 613 prompted by internal action thresholds and 1,558 requests from Ada County residents throughout the 2018 season. All public mosquito complaints were followed up with a ULV application, and many were verified with surveillance traps. Public service requests and internal service requests (non-WNV) receive an identical response from the adulticide team, so we can assume similar efficacy. Through analysis of the 2018 surveillance data, we have determined a 52.77% decrease in mosquito sampling following a ULV application. When a WNV positive mosquito sample is determined, the adulticide team's 1-mile application results in a 70.60% decrease in mosquito sampling (*Figure 10)*.

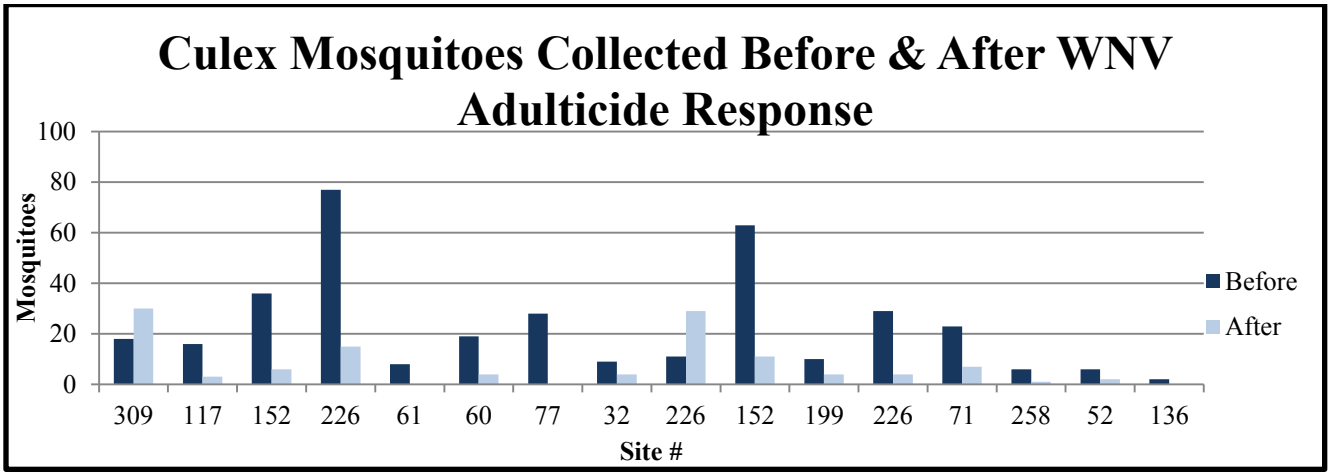

Figure 10 A visual display of the mosquito population response to WNV induced ULV applications from ACMAD. Each surveillance site was trapped, treated within 12 hours, and then a follow-up trap was placed within 4 days.

[5] Location of 1-mile ULV applications can be found in Appendix 1.3.

Mosquito Population Dynamics

Mosquito Surveillance & Climate Data

Ada County had record-breaking snowfall the winter of 2017, with 38.7 inches total. Due to this snowpack, Ada County saw immense flooding during the spring and summer of 2017. With the Boise River reaching a high flow rate of 9,300 cubic feet per second (cfs), flooding occurred all across the county resulting in inaccessible mosquito breeding (Sowell). The winter of 2018 saw 19.5 inches of snow, and the Boise River flow only reached 6,500 cfs, which is below what the Boise Fire Department determines to be flood stage cfs (Moeller). These differences were felt by ACMAD, with a decrease in surveillance mosquito sampling as well as a decrease in WNV positive pools. *Figure 11* shows the total mosquito count compared to the *Culex* mosquitoes trapped by week. This is compared with temperature, which follows a similar pattern. Peak *Culex* activity occurs when nightly temperatures are averaging 60-70+° F, and then slows down when nightly average temperatures reach 52-54° F. The temperatures were typical of an Ada County summer, with a relatively dry season. During week 34 the average temperatures fell close to 10° F from records of 2017 averages. Even during the peak in temperature seen during week 35, 2018 had a much cooler late summer than in the past.

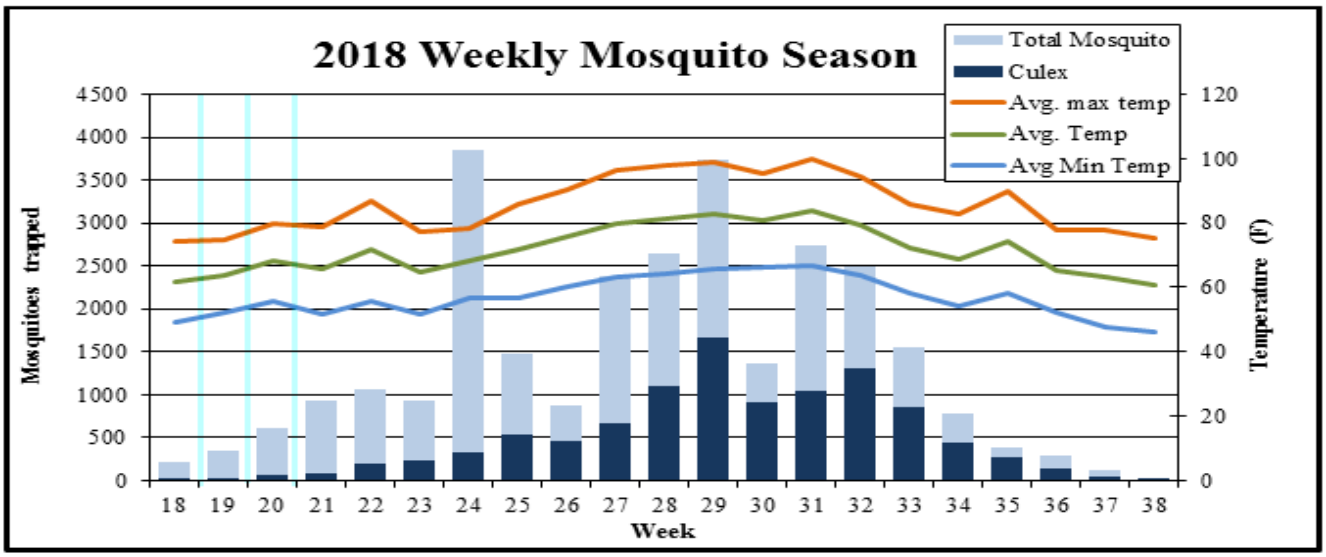

Figure 11 shows the correlation between mosquito population and climate. The three vertical blue lines represent the only precipitation to take place during the 2018 mosquito season.

Species Composition Data

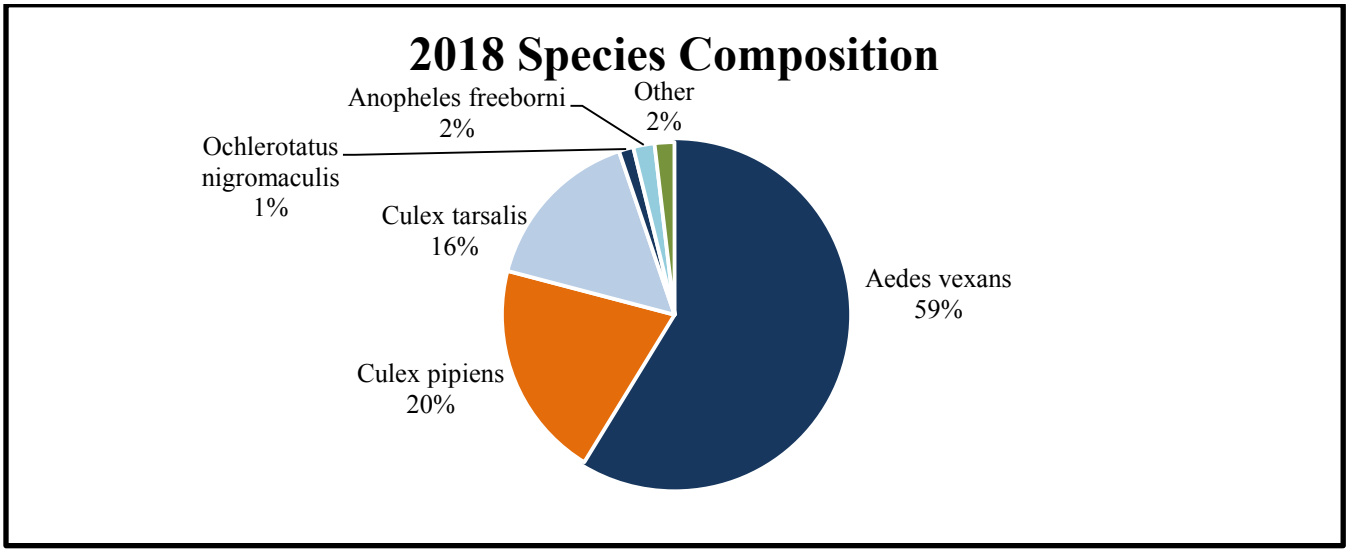

Figure 12 shows species composition for 98% of mosquitoes sampled by EVS light traps, the remaining 2% (Other) is composed of *Culiseta inornata* (n=202), *Coquillettidia perturbans* (n=109), *Ochlerotatus dorsalis* (n=210), *and Culiseta incidens* (n=16).

In 2018, we collected 28,885 mosquitoes during WNV surveillance: *Aedes vexans* (n=16,971), *Culex pipiens* (n=5,874), *Culex tarsalis* (n=4,531), *Anopheles freeborni* (n=577), *Ochlerotatus nigromaculis* (n=395), Ochlerotatus dorsalis (n=210), *Culiseta inornata* (n=202), *Culiseta incidens* (n=16) and *Coquillettidia perturbans* (n=109). In 2017, *Aedes vexans* only constituted 18.25% of sampled mosquitoes, which grew to 58.75% in 2018. *Culex pipiens* stayed constant at just above 20%. *Culex tarsalis* dropped from 47.24% in 2017 to just 15.68% in 2018. The reversal of dominant species between *Aedes vexans* and *Culex tarsalis* could be the result of many factors, such as the 2017 flood season, urbanization of the Treasure Valley, or lack of summer precipitation during 2018.

Projects and Field Trials

Gravid Traps

Gravid traps were incorporated into ACMAD's nightly surveillance routine in early July in efforts to find WNV presence before it descended from the treetops. Culex pipiens and Culex tarsalis prefer to feed on avian species in early summer, which completes the transmission cycle and magnifies WNV infection. WNV is passed between birds and mosquitoes, while mammals are considered "dead end hosts" of the virus, unable to pass the disease any further. It is important to stop WNV transmission cycle in the early stages. Gravid traps attract gravid mosquitoes, which is the term given to female mosquitoes carrying eggs. These gravid *Culex* species have spent most of their adult life in the canopy, and descend only for oviposition. During the 2018 surveillance season, WNV presence was not found in any mosquitoes collected by Gravid Traps.

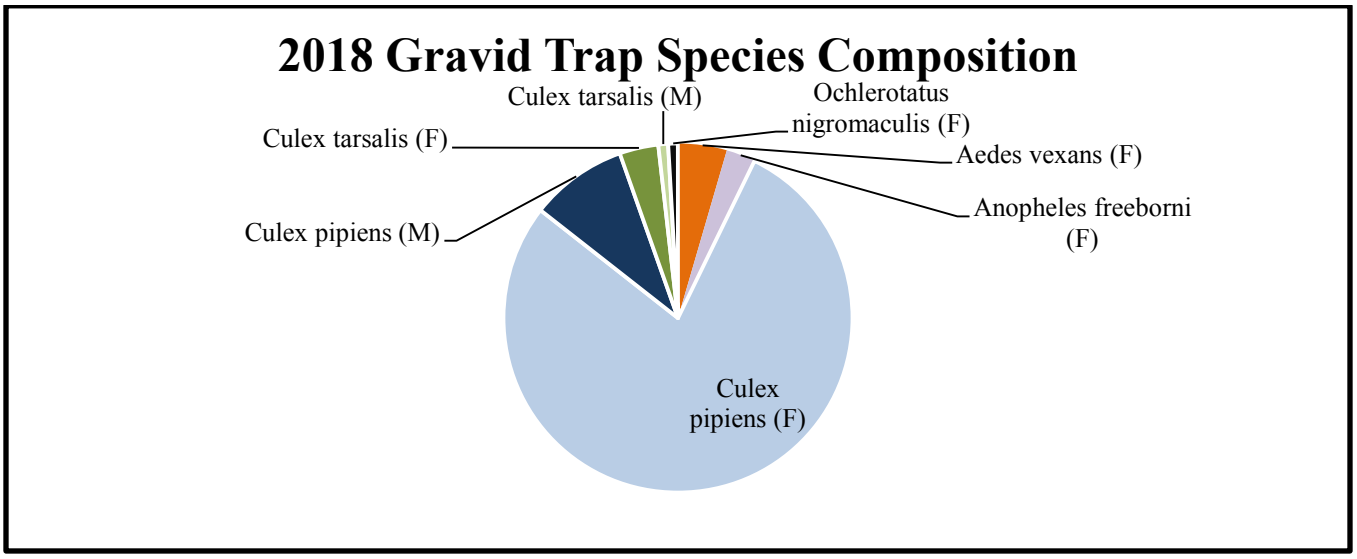

Figure 13 Species composition from Gravid Trap sampling. M stands for male mosquitoes, F stands for female mosquitoes.

Rotational Traps

ACMAD uses the Collection Bottle Rotator trap to study a high priority area over a long period of time, as it can be programed to sample multiple nights in a row, or consecutive hours, each sample stored individually. During this study, the rotational trap was left out for over two weeks (9/7/18-9/25/18). These dates were chosen to correlate to the harvesting and sowing of Eagle Island's grass hay. Surveillance site #164 was the location for this test, as it is in a central location of Eagle Island State Park. During the testing period, the park was cutting their fields and selling the grass hay, which was once a mosquito habitat. Due to this change in habitat, it is hypothesized that the mosquito population at Eagle Island State Park will be more active than usual. Using the sampling bottles on the rotational trap, mosquitoes were sampled from 7:00pm-9:00am each night from Sept 7, 2018 – Sept 25, 2018. In 2018, the transition from summer to fall was brief. With temperatures dropping as low as 38°F during this field trial, the mosquito sampling was very low. In fact, no mosquitoes were collected during

the second week of the project. This study will be continued in the early summer, as Eagle Island's grass hay is harvest 3 times throughout the year.

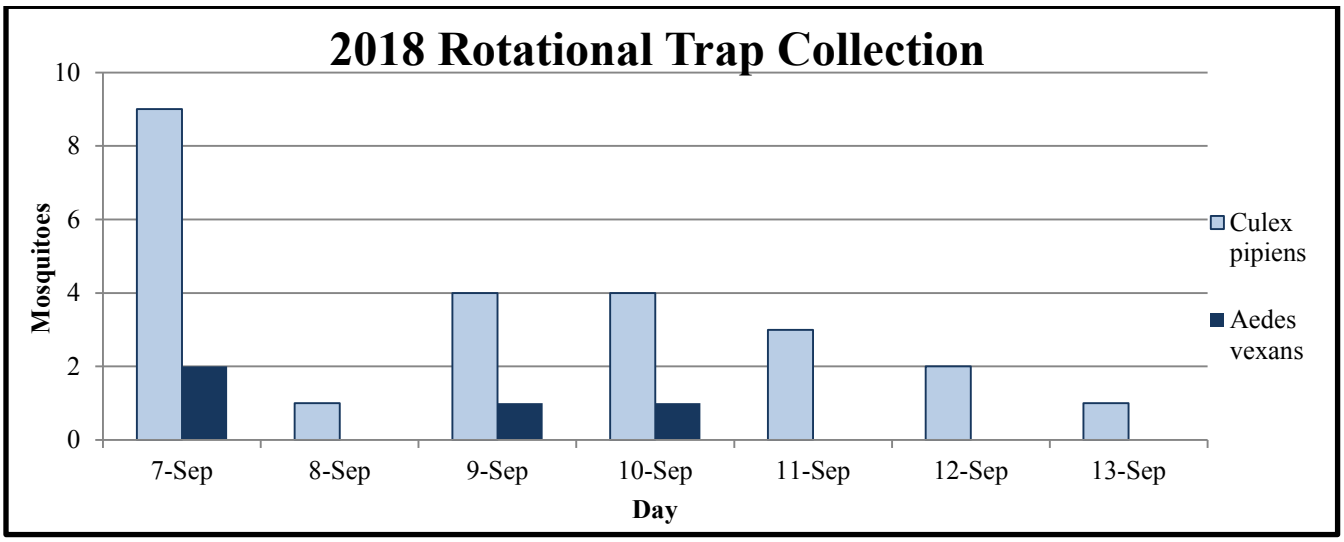

Figure 14 represents samples from the rotational trap from 9/7/18-9/13/18. Unfortunately, no mosquitoes were collected during the second week of the project due to low temperatures.

Pesticide Resistance Testing

Pesticide Resistance testing is a necessary step to ensure that the most effective insecticides are being used in the field. Using the CDC Bottle Bioassay protocols, insecticide resistance was monitored at four sites in three different locations in Ada County. Each site was tested for resistance to Malathion and Permethrin. Insecticides with Permethrin as an active ingredient make up 73% of the total adulticide chemical used by ACMAD. Malathion is historically a very common insecticide used in the private and public sector, although Malathion has not been used by ACMAD in recent years. The four sites were chosen by the frequency of our division' s application of insecticide, as well as private sector applications in 2018.

Samples were collected from surveillance trap locations in Eagle, Star, and Meridian. The first round of testing was conducted on June 6th, sampling from the Star location and testing a resistance to Malathion. During the June 6th Malathion experiment, *Aedes vexans* (n=39) mosquitoes were exposed to the pesticide and had a 97.5% mortality rate at the diagnostic time. One individual of *Culex tarsalis* was included and showed a possible resistance but the results are inconclusive at this time due to the individual *Culex tarsalis* being the outlier. This mortality rate indicates the mosquitoes are highly susceptible to Malathion at the time of testing. During the August 1st Malathion experiment, only *Aedes* vexans (n=32) were tested, resulting in an 82.33% mortality rate at the diagnostic time which indicates susceptibility.

On June 6th, mosquitoes collected in Star (n=40) were tested for resistance to Permethrin. This testing resulted in a 100% mortality rate at the diagnostic time. During the August 1st Permethrin experiment *Aedes vexans* (n=29) mosquitoes collected from Eagle were tested and had an 82.7% mortality rate at the diagnostic time. On August 3rd, *Culex pipiens* (n=10) collected in Meridian showed

a mortality rate of 16.67% at the diagnostic time, with a 100% mortality rate after 130 minutes. The mosquitoes collected in Meridian on August 3rd indicate resistance, which requires further testing. We intend to monitor any signs of resistance during 2019, and respond accordingly.

Exotic Aedes Surveillance

ACMAD continued research on two important vector species, *Aedes aegypti* and *Aedes albopictus*, neither of which have a known population in Idaho. These exotic *Aedes* species are known to spread Zika, dengue, chikungunya, and other viruses. To ensure the absence of these mosquitoes, we used BG sentinel traps placed in nurseries which import plants from states with a known *Aedes aegypti* or *Aedes albopictus* population. BG Sentinel traps were placed 231 times at 6 different nurseries in Ada County.[6] As of 2018, there is no evidence of *Aedes aegypti* or *Aedes albopictus* in Ada County. We will continue this research during our next season using BG Sentinel traps with a variety of lures.

A total of 612 mosquitoes of 5 species were captured and identified. The totals of each species and their abundance are presented in Figure 15. The main species captured, accounting for 85% of all mosquitos caught, was *Culex pipiens*. The second most abundant species was *Culex tarsalis* which accounted for 10%. A small amount of *Anopheles freeborni* (2%), *Aedes vexans* (2%) and *Ochlerotatus nigromaculis* (1%) were also caught. No *Aedes aegypti, Aedes albopictus*, or any other exotic species were found.

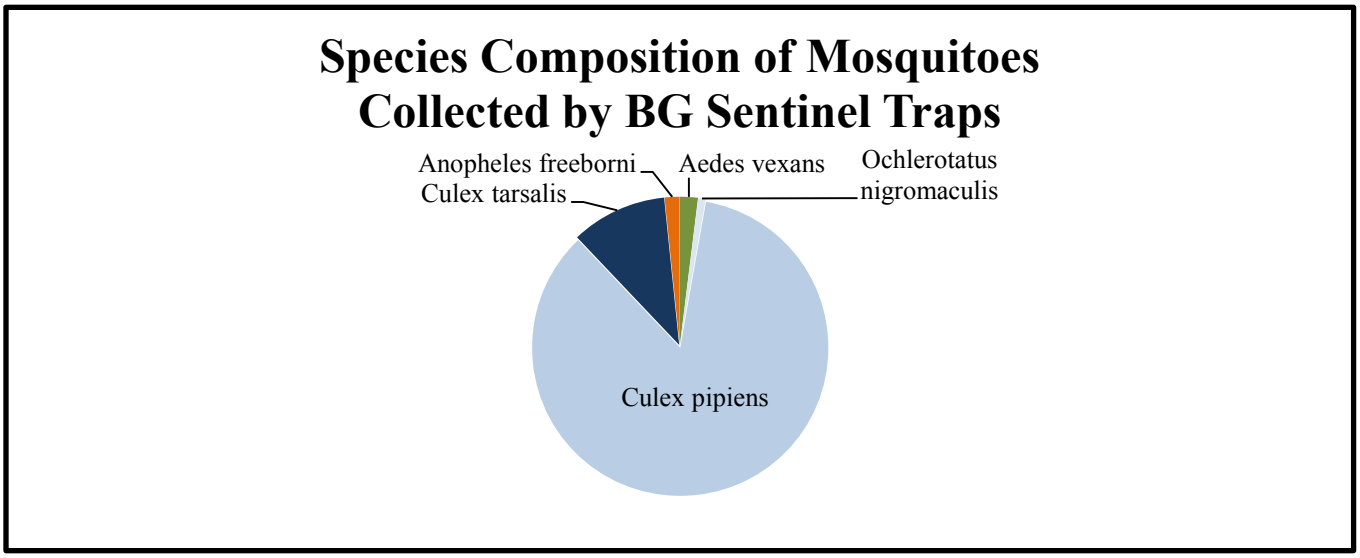

Figure 15 shows mosquito abundance from exotic *Aedes* surveillance. Notice, there were no *Aedes aegypti* or *Aedes albopictus* discovered in Ada County during 2018.

It was also found that the traps containing a lure and octanol were the most effective in attracting mosquitoes (*Figure 16*). However, this is a measurement of efficacy for the species which were found in this research. We plan to continue to use a multitude of lures and attractants in effort to detect any exotic or invasive mosquito species which may be present in the area.

[6] All 6 nursery locations can be found in Appendix 1.4.

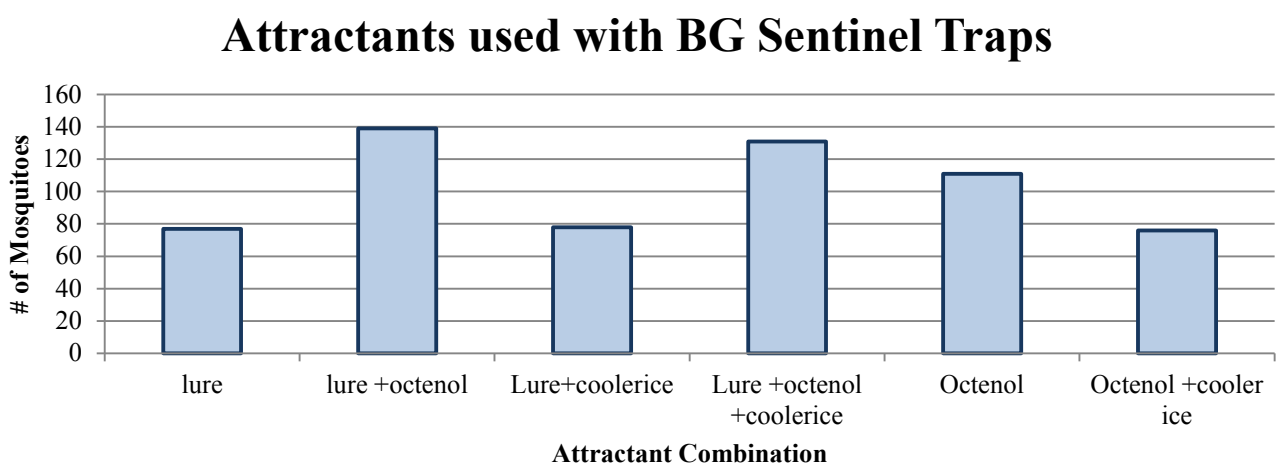

Figure 16 a multitude of lures and attractants were used in combination with BG sentinel traps in efforts to discover if exotic *Aedes* mosquitoes had a population in Ada County.

Conclusion

2018 was a warm, relatively dry season in which cool weather came early, with temperatures dropping below 2017 averages by week 34. There was an increase in treated larval breeding sites, inspections completed, and an increase in mapped breeding sites. 2,628 DIs were mapped in efforts to limit WNV vector habitat. Sites that we found a significant increase in frequency of larvae were treated or pretreated and these sites which would normally produce vector species of mosquitoes were effectively controlled via larvicide treatments. We also saw more floodwater species in surveillance and this is also confirmed through public complaints coming a week after surveillance data showing total population abundance (*Figure 9*).

We had 16 positive WNV pools during the 2018 season, which was a 78.08% decrease in disease occurrence from 2017. Additionally, larvicide crews focused many efforts on long-term treatments in storm drains and DIs this year right from the beginning of the season which helped reduce historically known high *Culex* trap locations. Overall, the larvicide crews increased inspections and treatments significantly this year which is needed for monitoring storm drains and DIs, however as development continues within ACMAD and rural areas become more urban, we will need continue to develop the program and increase staff in order to cover the volume of these mosquito development sources and the number of residents within ACMAD as it also continues to increase. ACMAD's adulticide department was successful in using best management practices to diminish mosquito population by 52.77% after regular ULV application, and 70.60% after a 1-mile WNV response application.

ACMAD Goals

Goals from 2017…

Increase remediated sites by setting goals for each larvicide area and track through computer program.

- ✓ Our larvicide team inspected 11,086 more sites than in 2017, due to a restructuring of zones and implementing two-person teams.

Work on implementing a DI treatment bicycle team.

- ✓ Goal in progress- during the winter of 2018 we plan to compile a program for DI treatments which can keep up with this fast paced strategy.

Continue to improve upon training programs for start of year and mid-year training of seasonal staff

- ✓ Goal in Progress– With an 80% pass rate this year, we have made improvements to our curriculum. We plan to further develop our training program this year.

Continue to work with new Public Education Specialist to increase education and public outreach.

- ✓ ACMAD recently welcomed a new Public Education Specialist to the team. We look forward to improving public education and outreach in the future.

Goals for 2019…

1. Strengthen our Integrated Mosquito Management practices by implementing more biological and mechanical mosquito controls.

2. Continue to improve upon training programs for start of year and mid-year training of seasonal staff.

3. DI Bicycle Crew: continue to develop project & build software program.

4. Preparing the next generation of vector control professionals and epidemiologists by offering internships through local colleges and universities.

Works Cited

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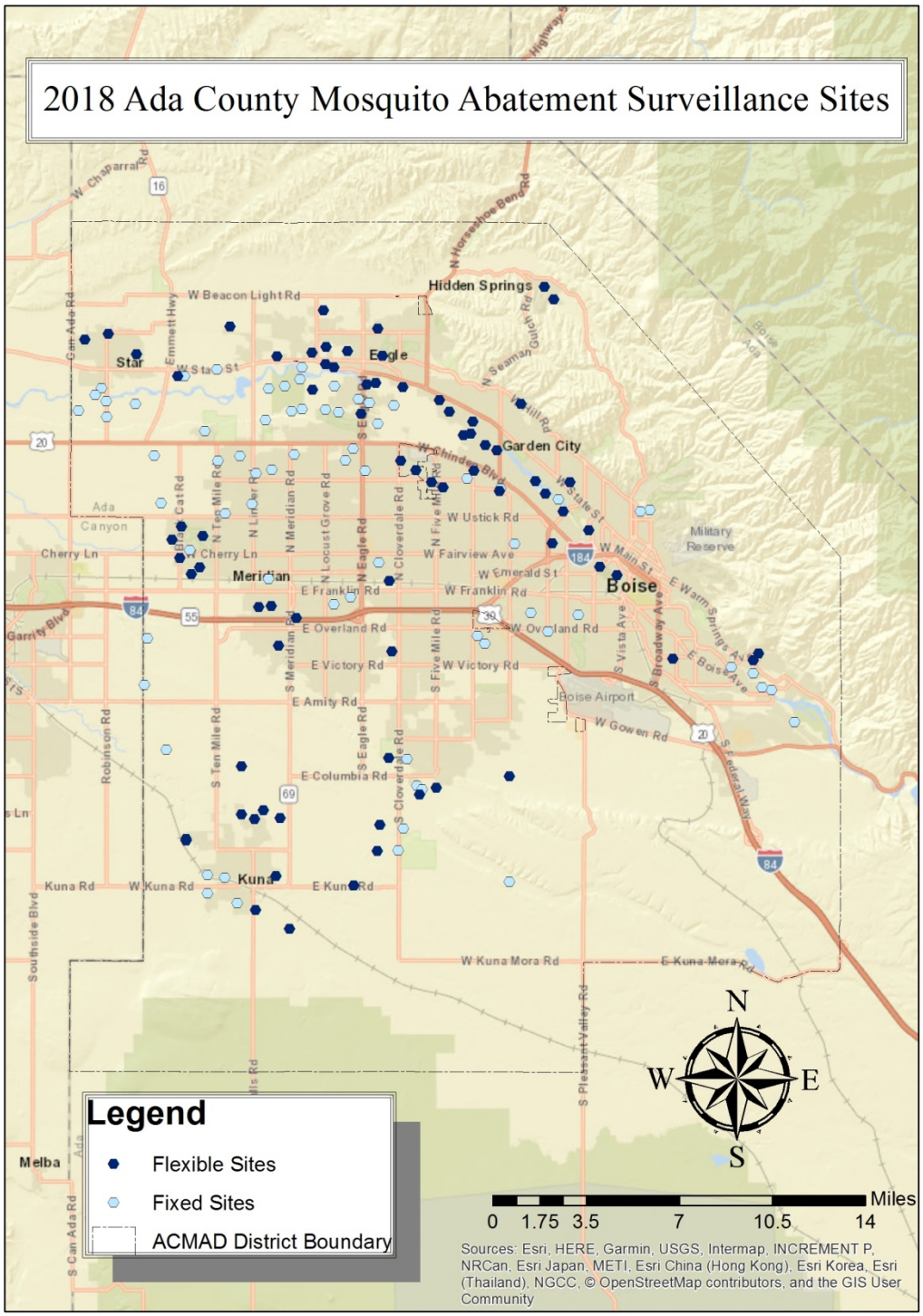
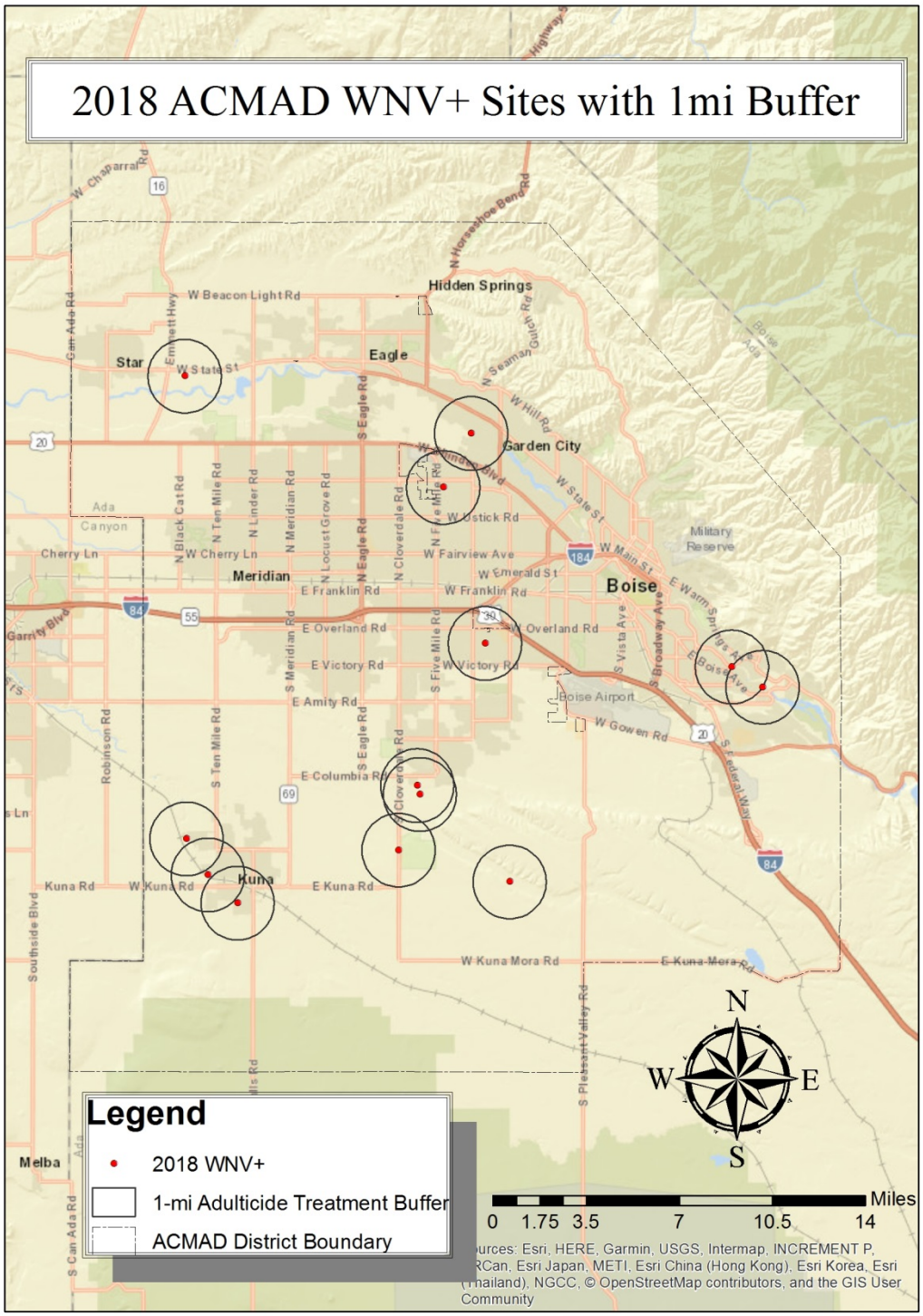
Appendix 1.1

Week	Dates
18	May 6, 2018 - May 12, 2018
19	May 13, 2018 - May 19, 2018
20	May 20, 2018 - May 26, 2018
21	May 27, 2018 - June 2, 2018
22	June 3, 2018 - June 9, 2018
23	June 10, 2018 - June 16, 2018
24	June 17, 2018 - June 23, 2018
25	June 24, 2018 - June 30, 2018
26	July 1, 2018 - July 7, 2018
27	July 8, 2018 - July 14, 2018
28	July 15, 2018 - July 21, 2018
29	July 22, 2018 - July 28, 2018
30	July 29, 2018 - August 4, 2018
31	August 5, 2018 - August 11, 2018
32	August 12, 2018 - August 18, 2018
33	August 18, 2018 - August 25, 2018
34	August 26, 2018 - September 1, 2018
35	September 2, 2018 - September 8, 2018
36	September 9, 2018 - September 15, 2018
37	September 16, 2018 - September 22, 2018
38	September 23, 2018 - September 29, 2018

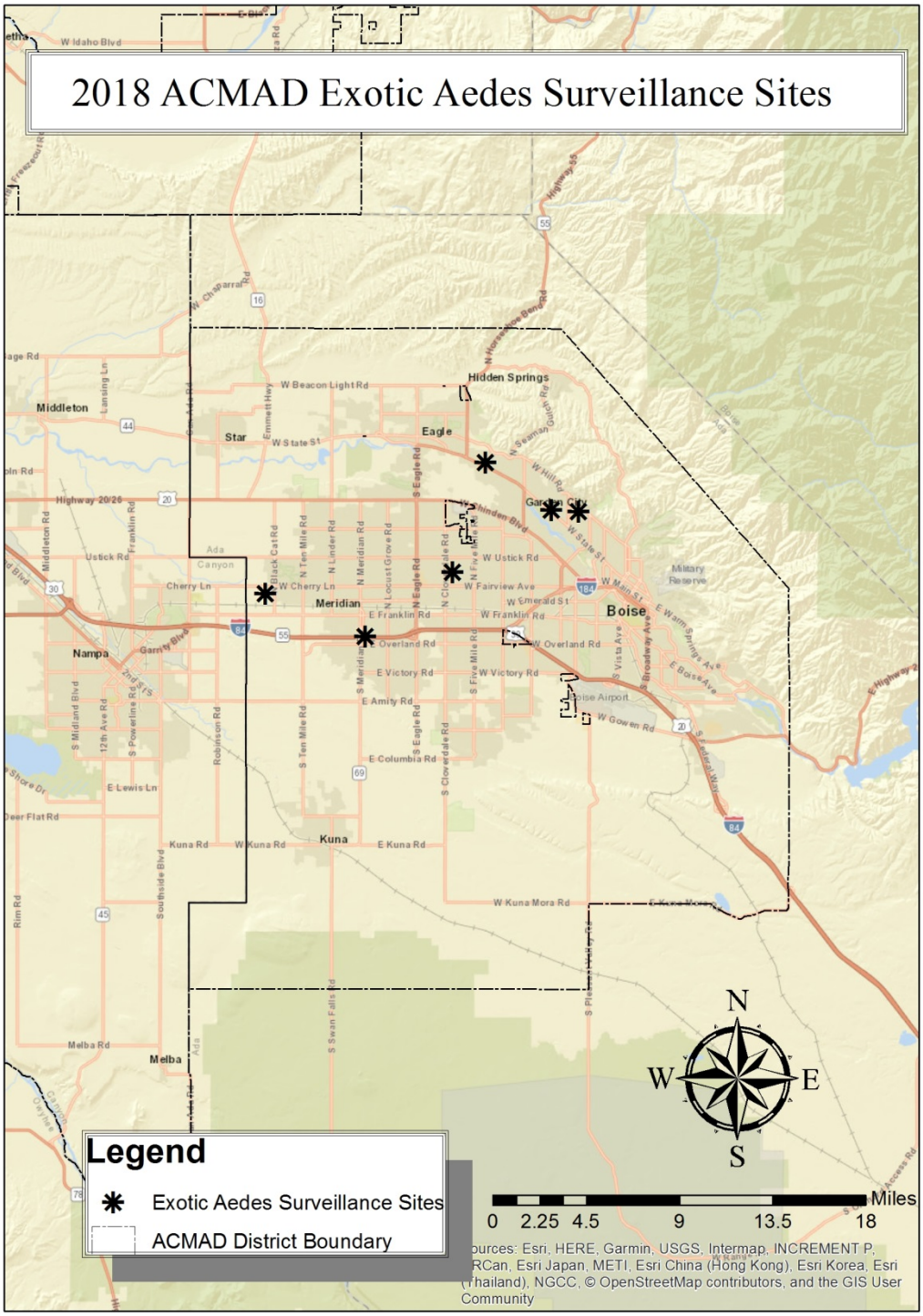
Appendix 1.2


2018 Ada County Mosquito Abatement Surveillance Sites
Hidden Springs
Eagle
Star
Garden City
Meridian
Boise
Kuna
Melba
Ada Canyon
Military Reserve
Boise Airport
W Beacon Light Rd
W Ustick Rd
W Fairview Ave
W Franklin Rd
E Franklin Rd
W Overland Rd
E Overland Rd
W Victory Rd
E Victory Rd
E Amity Rd
W Gowen Rd
E Columbia Rd
W Kuna Rd
E Kuna Rd
W Kuna Mora Rd
E Kuna Mora Rd
Cherry Ln
W Main St
E Warm Springs Ave
E Boise Ave
Legend
Flexible Sites
Fixed Sites
ACMAD District Boundary
N
W
E
S
Miles
0 1.75 3.5 7 10.5 14
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, © OpenStreetMap contributors, and the GIS User Community

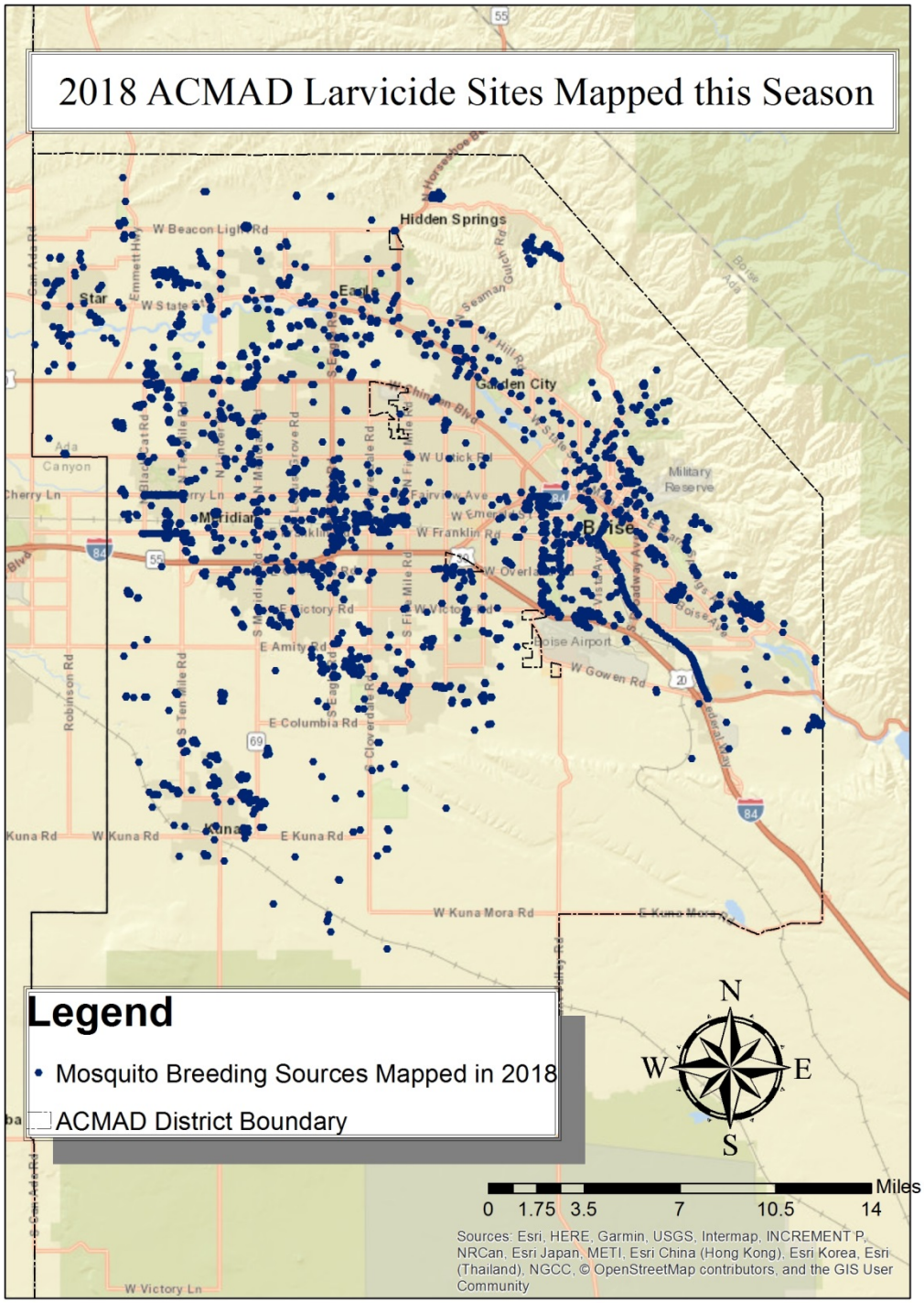
Appendix 1.3


2018 ACMAD WNV+ Sites with 1mi Buffer
Hidden Springs
Eagle
Star
Garden City
Boise
Meridian
Kuna
Melba
Ada
Canyon
Military Reserve
Boise Airport
W Beacon Light Rd
W State St
W Hill Rd
W Fairview Ave
W Franklin Rd
E Franklin Rd
E Overland Rd
W Overland Rd
E Victory Rd
W Victory Rd
E Amity Rd
E Columbia Rd
W Gowen Rd
W Kuna Rd
E Kuna Rd
Kuna Rd
W Kuna Mora Rd
E Kuna Mora Rd
W Cherry Ln
Cherry Ln
W Main St
E Warm Springs Ave
E Boise Ave
S Federal Way
S Eagle Rd
N Eagle Rd
N Meridian Rd
S Meridian Rd
N Five Mile Rd
S Five Mile Rd
N Cloverdale Rd
S Cloverdale Rd
S Ten Mile Rd
N Ten Mile Rd
N Linder Rd
N Locust Grove Rd
N Black Cat Rd
Robinson Rd
S Vista Ave
Broadway Ave
S Pleasant Valley Rd
Southside Blvd
Garrity Blvd
N Horseshoe Bend Rd
N Seaman Gulch Rd
Emmett Hwy
Can Ada Rd
S Can Ada Rd
W Chaparral Rd
Legend
2018 WNV+
1-mi Adulticide Treatment Buffer
ACMAD District Boundary
N
W
E
S
Miles
0 1.75 3.5 7 10.5 14
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, ...RCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, © OpenStreetMap contributors, and the GIS User Community

Appendix 1.4


2018 ACMAD Exotic Aedes Surveillance Sites
Middleton
Star
Eagle
Hidden Springs
Meridian
Boise
Nampa
Kuna
Melba
Legend
Exotic Aedes Surveillance Sites
ACMAD District Boundary
N
W
E
S
Miles
0 2.25 4.5 9 13.5 18
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, © OpenStreetMap contributors, and the GIS User Community

Appendix 1.5


2018 ACMAD Larvicide Sites Mapped this Season
Hidden Springs
Star
Eagle
Garden City
Meridian
Boise
Military Reserve
Boise Airport
Kuna
W Kuna Mora Rd
Legend
Mosquito Breeding Sources Mapped in 2018
ACMAD District Boundary
N
W
E
S
Miles
0 1.75 3.5 7 10.5 14
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, © OpenStreetMap contributors, and the GIS User Community

Appendix 1.6

Appendix 1.6 will contain the adulticide route map once it is complete.