Regional District of East Kootenay:
Wasa, Ta Ta Creek, Skookumchuck
Mosquito Control Extended Service Area

2015 Final Report

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Executive Summary

Morrow BioScience Ltd. has been the mosquito control operations contractor for the Wasa/Ta Ta Creek/Skookumchuck area within the Regional District of East Kootenay for eighteen (18) seasons. One aspect to the success of this program includes the fact that field operations staff members are an integrated part of a nearby community, as they live and work next to the targeted areas. Thus, staff members are available to local residents and have a working knowledge of each mosquito development site. Since the commencement of our contract, considerable and continuing efforts have been made to reduce mosquito annoyance issues. To a large degree, these efforts have proven successful. They have resulted in the identification of new breeding habitats, an increase in monitoring activities, and increased public education platforms. Local residents and businesses have been an integral aspect to the success of this program.

The snowpack within nearby stations ranged from being closer to the minimum recorded snowpack to closer to the average recorded snowpack. The snowpack was depleted from each of the stations between early May and early June, due to temperature spikes in mid-April and into early June. The result of high regional ambient temperatures within this time frame was an increased amount of snow water to the Kootenay River at Fort Steele, leading to a peak in the River on 3 June. The greatest amount of precipitation received in 2015 was received in June. While it is unlikely that the moderate amount of precipitation greatly influenced River levels, it may have aided in the creation of associated seepage sites. Additionally, there were significant temperature spikes that occurred in mid-June and the end of June. Thus, as mosquito development sites were potentially being bolstered by precipitation input in June, the freshet was coming through the River system, and ambient temperatures were also at their highest for the season. The combination of these three factors created ideal floodwater mosquito development habitat and conditions.

In order to treat active mosquito development sites that were a result the environmental conditions above, multiple ground (hand/blower) treatments and one aerial campaign were conducted. Ground treatments began on 28 May and concluded on 18 June. A total of 129 ha (774 kg product) were treated by hand/blower in 2015. The only aerial campaign conducted in 2015 took place on 6 June. A total of 373.1 ha (2,239 kg) were treated in that campaign. Treatments were considered successful, which was verified by local assessments showing few adult mosquitoes in the vicinity. Two sites were affected by a beaver dam. These sites will be closely monitored in 2016 as water input collects in those areas. No complaint emails or calls were received. The regional field operations manager made a presentation to local residents at the Wasa Town Hall meeting. The presentation consisted of informing residents about mosquito control efforts conducted by MBL and also included recommendations for mosquito development site reduction measures.

In an effort to increase public awareness of mosquito control efforts, MBL will continue to work closely with locals to identify potential mosquito development habitat. Additionally, MBL will regularly update Facebook and Twitter accounts, along with regular blog entries on the Morrow BioScience website (morrowbioscience.com). MBL remains committed to continually improving monitoring, control, and public education efforts.

Introduction

Morrow BioScience Ltd. (MBL) has been the mosquito control contractor for the Wasa/Ta Ta Creek/Skookumchuck area since 1998. This report will outline the accomplishments made to date, discuss regional environmental conditions affecting mosquito populations and monitoring efforts, review the success in fulfilling the proposed deliverables, and present all final data.

It is MBL's goal to reduce mosquito nuisance within the contract area for each of our control programs. The general reduction in mosquito annoyance is due, in large part, to the thorough monitoring and timely treatments conducted by MBL field technicians. Field staff members have gained a thorough knowledge of each mosquito development site, know when those sites become active, and understand which aquatic input (i.e. snowmelt, precipitation, river level, etc.) most influences each site. Involved citizens within the contract areas further augment the understanding of these sites, by providing historical information about the ecology and geography of the area. Ultimately, this understanding enables field staff to appropriately time treatments resulting in the reduced need for large-scale treatments. In this way, the efficacy of the treatments that are applied is typically greater. MBL fosters the community involvement aspect to this mosquito-monitoring program and recognizes that it is an essential element to achieving the ultimate goal: mosquito nuisance reduction while remaining environmentally conscious.

MBL's corporate philosophy involves conducting effective mosquito control while achieving a low environmental impact. To achieve these objectives, MBL employs a consistent and frequent site-monitoring regime. Whenever possible, mosquito development sites are treated by hand or backpack blower, thus reducing the environmental impact of larger application methods (i.e., aerial applications). The success of this program is further supported by the fact that site visits can occur with little notice and as dictated by environmental circumstances because MBL's local field operations manager and field technician reside in the City of Cranbrook.

Significant Regional Environmental Conditions

Snowpack

Snowpack in influential basins is an important environmental variable to track, as it can reveal how severe the freshet may be at varying points in the season. Following the real-time snowpack levels will also indicate when the freshet has ended. As the freshet is the primary force affecting floodwater mosquitoes, it is a benefit to the overall success of the program to understand the freshet parameters throughout the season.

Snow survey stations take continuous snowpack measurements. Snow basin indices are then calculated from those measurements. In addition to these indices, 'percent of normal' calculations are also made. Specifically, when snow pack depths are measured, their heights are then compared to 'normal' heights (from comparable dates in previous seasons), revealing what 'percent of normal' the current levels are. These indices can aid field technicians in preparing for the freshet.

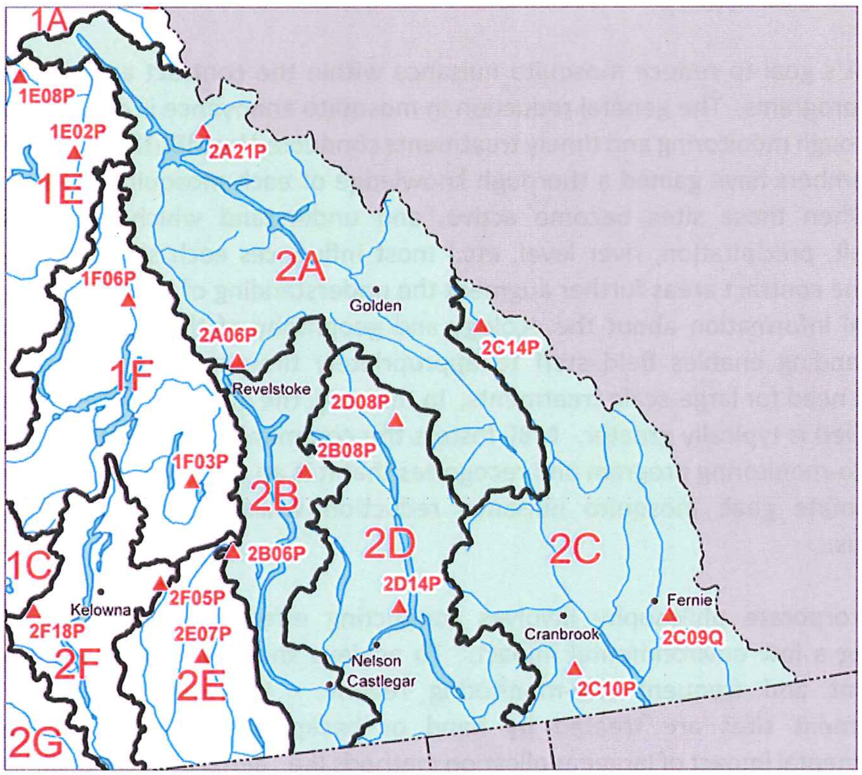

Figure 1. Columbia and Kootenay Basins Automated Snow Pillow Stations. Area 2C corresponds to the watershed that most affects the Kootenay River near Wasa/Ta Ta Creek/Skookumchuck. Stations 2C14P, 2C10P, and 2C09Q most influence snowpack concerns and the associated freshets for the mosquito control area. (http://bcrfc.env.gov.bc.ca/data/asp/realtime/).

The main snow basin that influences both the Kootenay River in the Wasa/Ta Ta Creek/Skookumchuck area is the 2C watershed (Figure 1). Within the 2E watershed, snow pack reported from each of the weather stations (i.e., Floe Lake - 2C14P, Morrissey Ridge - 2C09Q, Moyie Mountain - 2C10P; Figure 1) may have relevance to this program when attempting to determine freshet concerns. Prior to 2014 the River Forecast Centre reported the snowpack in terms of 'percent of normal'. Currently, the Centre reports a comparable value in Snow Water Equivalent (SWE). The SWE is essentially the amount of water that could be found in a designated snowpack if the snowpack were to melt.

The River Forecast Centre (http://bcrfc.env.gov.bc.ca/data) created Figures 2 - 4, which depicts the SWE throughout the 2015 season (through 30 November). The green line represents the real-time data collected for the 2015 mosquito season and the purple line shows the average SWE trajectory for each station. With the exception of the Floe Lake station (2C14), the general snowpacks (i.e., SWE) were well below normal (Figure 3, Figure 4). The Floe Lake station (Figure 2) had a snowpack that met or approached the average (green line). Despite the low snowpack in 2015, the general trajectory was the same as in previous years for each station (Figures 2 – 4).

The snowpack in each station experienced a melt in February, due to a general warming trend across this portion of the province. For the Moyie Mountain station (Figure 3) and the Morrissey Ridge station (Figure 4) most of the snowpack had started to melt significantly by mid-April. The snow didn't started to melt significantly in the Floe Lake station until mid-May (Figure 2). By the beginning of June all of the snow had melted from the Floe Lake station. The Moyie Mountain station had lost all of its snow by early May (Figure 3) and the Morrissey Ridge station had lost all of its snow by mid-May (Figure 4). Ultimately, this means that the Kootenay River had considerable input (due to melting of low to high elevation snowpack throughout the region) to the system from May through the mid-June.

By the end of June, the 2015 SWE levels were essentially zero. Therefore, the freshet was no longer contributing any significant water to the Kootenay River level in the Wasa/Ta Ta Creek/Skookumchuck area after that time. River level fluctuations within the mosquito season that occurred after mid-June would have been caused by precipitation input only (see 'Precipitation' for more information).

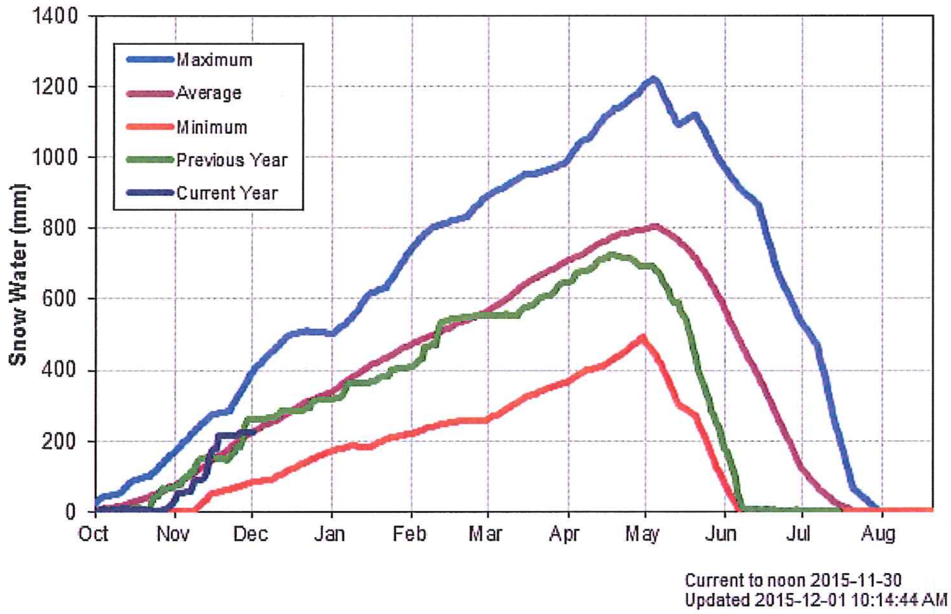

Figure 2. Automated snow pillow data as recorded at the Floe Lake Station (2C14P) in the 2C drainage. The green line represents data affecting the 2015 mosquito season (Jan – June). The dark blue line represents data acquired since October of 2015.

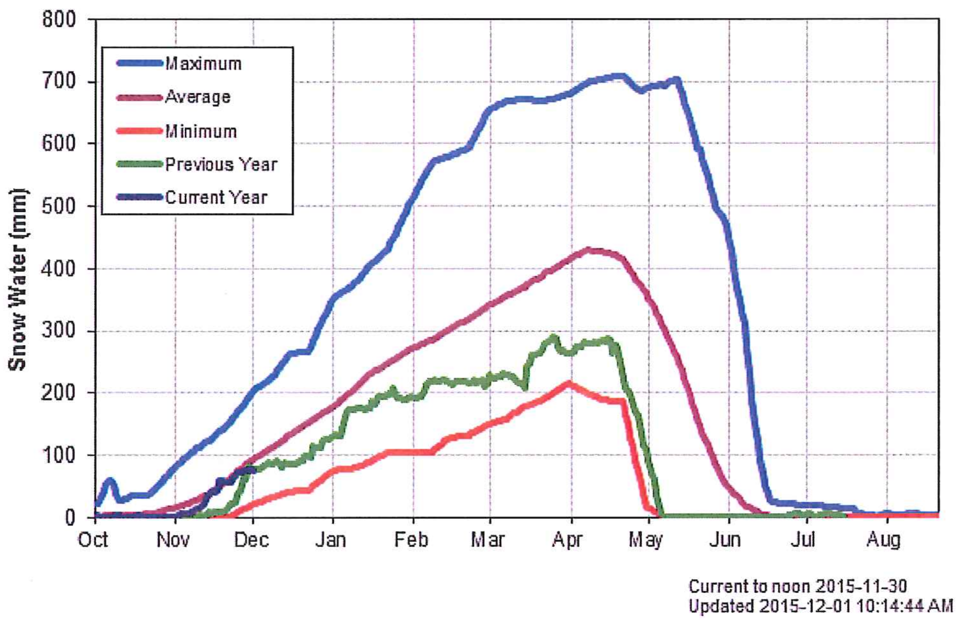

Figure 3. Automated snow pillow data as recorded at the Moyie Mountain Station (2C10P) in the 2C drainage. The green line represents data affecting the 2015 mosquito season (Jan – June). The dark blue line represents data acquired since October of 2015.

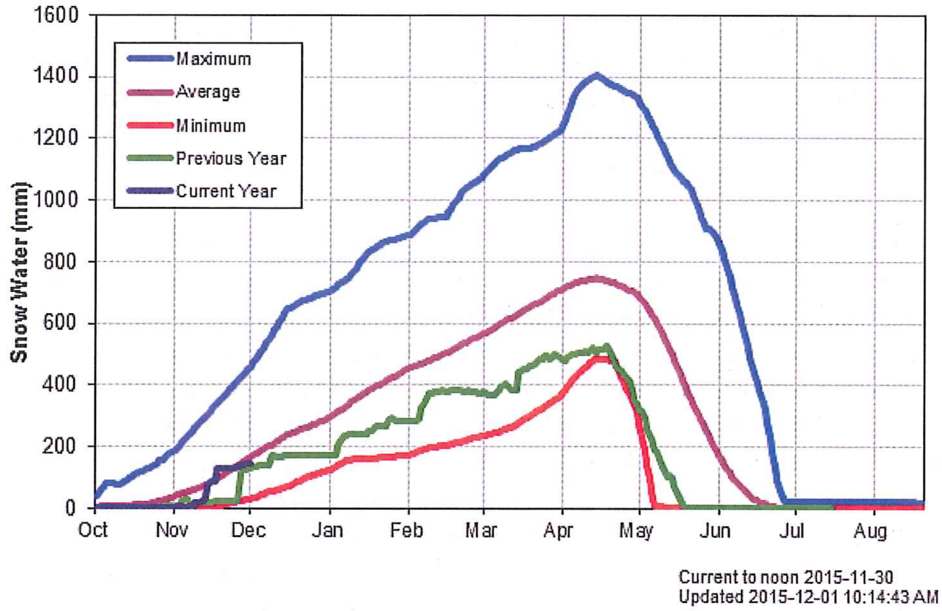

Figure 4. Automated snow pillow data as recorded at the Morrissey Ridge Station (2C09Q) in the 2C drainage. The green line represents data affecting the 2015 mosquito season (Jan – June). The dark blue line represents data acquired since October of 2015.

Ambient Temperature Records

Ambient temperature fluctuations can affect the Wasa/Ta Ta Creek/Skookumchuck mosquito control program in three main ways: 1) they can create snowmelt-fed mosquito development sites, 2) they can cause local river levels to increase, thus increasing mosquito development sites, and 3) they can establish the optimal environmental temperature threshold necessary for mosquito egg hatching. Snow melt-fed mosquito development sites are affected by ambient temperature spikes occurring in nearby snow basins. As ambient temperatures increase, snow melt increases, as well. Typically, when these conditions occur mosquito development sites can be created early in the season (ca. April).

Mosquito eggs remain dormant until ideal hatching conditions are present, which include water, low dissolved oxygen levels, and sufficiently high ambient temperatures. The ambient temperature increase (and lagging water temperature increase) is the final requirement for hatching of eggs laid in previous seasons (Horsfall and Trpis, 1967). When enough water has accumulated in a depression wherein mosquito eggs exist, high ambient temperatures may trigger a hatching event. Specifically, Horsfall and Trpis (1967) found that an ambient temperature of 15°C in the spring resulted in the highest hatching success for the floodwater mosquito, *Aedes sticticus*. (Note that field observation confirms that hatching can happen at considerably lower temperatures.)

Ambient temperatures more strongly influence sites that are shallow, relatively stagnant, and land-locked. The majority of sites within this mosquito control program are relatively shallow and/or stagnant. Larvae develop slower in cool water and much faster in warm water. In fact, when ambient temperatures reach 30°C, the transition from egg to adult can take as little as six days (Becker *et al.*, 2010).

Temperature and precipitation data were taken from the Cranbrook Airport weather station and will be used in this report as a proxy for what occurred in the Wasa/Ta Ta Creek/Skookumchuck area. Ambient (air) temperatures in the beginning of April were similar to previous seasons (Figure 5). However, a temperature spike mid-April likely helped melt a considerable amount of snow, contributing to the creation of snow-fed mosquito development sites and contributing to increases in Kootenay River levels. Between the beginning of April and the end of May the maximum daily ambient (air) temperature range and trend were not significantly different than previous seasons (Figure 5). However, there were significant temperature spikes that occurred in early June and toward the end of June that set the 2015 season apart from recent seasons. These two spikes occurred after a low-elevation snow had already come out of most of the region, it is likely that these temperature spikes helped bring out the last portion of the high-elevation snowpack. This resulted in the local peak to the Kootenay River, necessitating numerous treatments (see 'Larval Treatment' section). Additionally, the temperature spikes later in the season likely helped expedite the lifecycle of the very few adult mosquitoes that were not killed by early season treatment efforts.

The highest temperature recorded within the 2015 mosquito season was 36.5°C on 27 June (Figure 5). After the ambient temperature spike, the maximum daily ambient temperature fluctuated between approximately 36°C and 20°C through mid-August. After mid-August, the general trajectory in maximum ambient temperatures started to slowly decline (Figure 5). By this time in the season, most of the sites had been significantly reduced or the window for mosquito productivity had passed, such that no further mosquito hatches occurred.

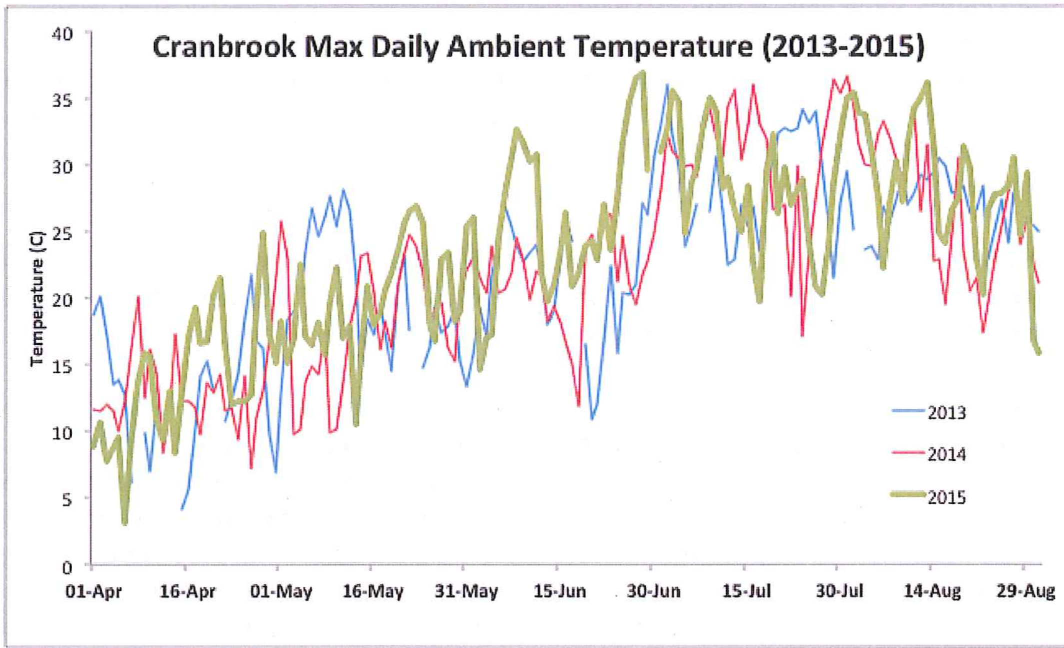

Figure 5. Maximum daily ambient temperature (°C) as recorded at the 'Cranbrook A' weather station (Climate ID: 1152105) 01 April - 31 August (2012-2015). Gaps in the data represent days wherein the monitoring station was not functioning properly.

Precipitation Records

Along with snowmelt and ambient temperature, precipitation is an important environmental parameter to monitor in the Wasa/Ta Ta Creek/Skookumchuck area because it can greatly influence a number of mosquito development sites. Additionally, received in high enough frequency and amount, precipitation can directly affect local river levels. Precipitation in the form of rain can add to pre-existing sites or, if rain is received on top of snow, it can roll off of the snowpack and can pool in areas where mosquito development takes place.

In general, precipitation received to the general treatment area in 2015 was less than the previous two years (Figure 6). More specifically, the total accumulation in April and May was less than the previous two years. Given these low values, it is unlikely that the amount of precipitation accumulated at sites in April and May considerably amplified mosquito breeding habitat in snowmelt-fed sites or seepage sites. Thus, it is likely that mosquito habitat was primarily created by local snowmelt in the early portion of the season.

The precipitation accumulation total in June was the highest for the 2015 mosquito season (45.5 mm; Figure 6). This value is still considered moderate. However, this value might be sufficient to supplement existing mosquito development sites that were formed from earlier snowmelt. It may also have slightly elevated local Kootenay River levels. As mosquito development sites were being bolstered by precipitation input in June, ambient temperatures were also at their highest (Figure 5) for the season, and the local Kootenay River levels were rising due to regional snowmelt. The combination of these environmental factors created ideal floodwater mosquito development habitat and conditions.

Precipitation accumulation decreased considerably in July (30.8 mm; Figure 6). By August, precipitation accumulation was only approximately 13.6 mm. Thus, beyond July nuisance mosquito sites were no longer active largely due to a considerable reduction of habitat.

It is important to discuss the fact that as the snowmelt and floodwater mosquitoes are receding, container mosquitoes are likely increasing in abundance. Container mosquito species, such as *Culex* mosquitoes, can also be a nuisance. These species require sites that have stagnant, warm water for breeding and maturation. Specific sites include old tires, tree holes, birdbaths, and rain barrels, to name a few. It is possible that these container mosquitoes continued to be a nuisance through July and into August due to a sufficient amount of water in their favored environments and relatively high ambient temperatures.

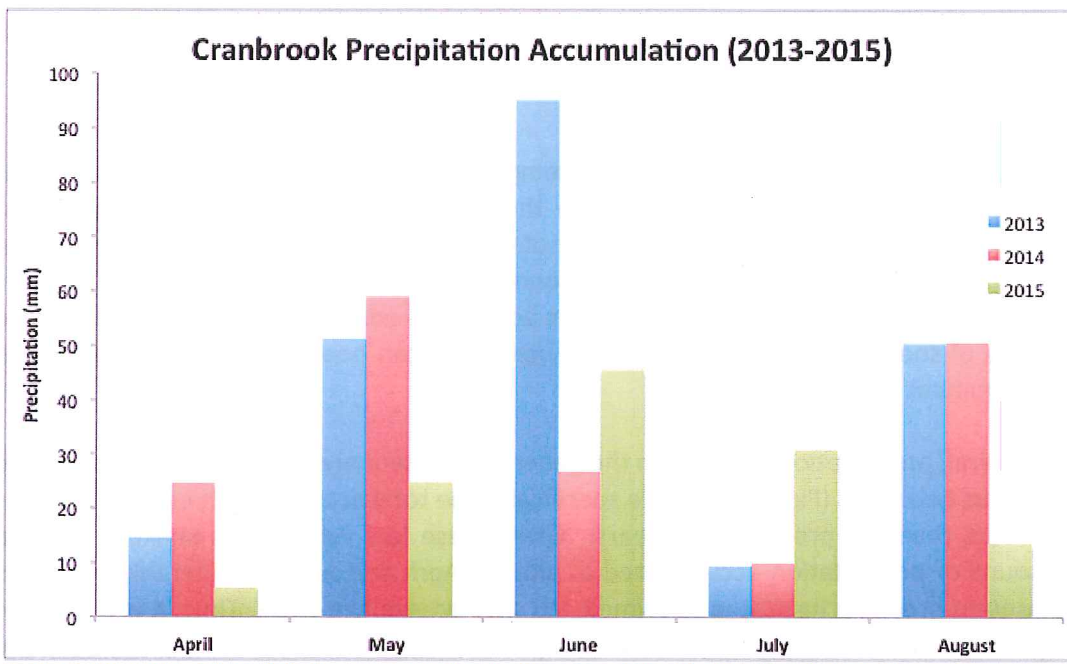

Figure 6. Monthly total precipitation accumulation (mm) as recorded at the 'Cranbrook A' weather station (Climate ID: 1152105) 01 April - 31 August (2012-2015).

River Monitoring

The Kootenay River primarily affects the floodwater mosquito abundance in the area around Wasa/Ta Ta Creek/Skookumchuck. The water levels in this river system are governed by two main influences: 1) local snowmelt and 2) the freshet as a result of regional snowmelt from the 2C region of the Columbia and Kootenay watershed (Figure 1). Frequent and large amounts of precipitation can also affect river levels, though typically to a lesser degree than the primary factors listed above.

There was a region-wide warming trend in March, which caused snow to melt in the 2C basin and the Kootenay River at Fort Steele to swell (Figure 7). It is likely that a considerable amount of the low elevation snowpack came out during this relatively warm stint. The early swell in the river systems wetted land adjacent to the rivers, thus wetting mosquito eggs. However, all environmental cues were not present (i.e., high ambient temperatures) for mosquito eggs to hatch.

River levels declined again into mid-April before rising in late April (Figure 7). Between late April and early June, the river levels rose fairly consistently, with few dips. The Kootenay River at Fort Steele peaked on 3 June (Figure 7), with a height of 3.43 m. This peak in both rivers wetted areas directly adjacent, as well as created seepage sites nearby. At this point, mosquito eggs had all of the necessary environmental cues for hatching. Given the high ambient temperatures within the region, mosquitoes developed at a rate higher than normal. All of these factors, taken together, necessitated an aerial treatment on 6 June (see 'Aerial Treatment Summary' section).

The Kootenay River experienced a considerable drop in levels in mid-June after its peaks (Figure 7). After this point, local Kootenay River levels experienced minor spikes in response to precipitation events. By the end of July, river levels were considerably low for that time of the year and there was no concern of another peak occurring. Thus, after July, any input to the system would have been primarily from precipitation and would not have impacted floodwater mosquito development.

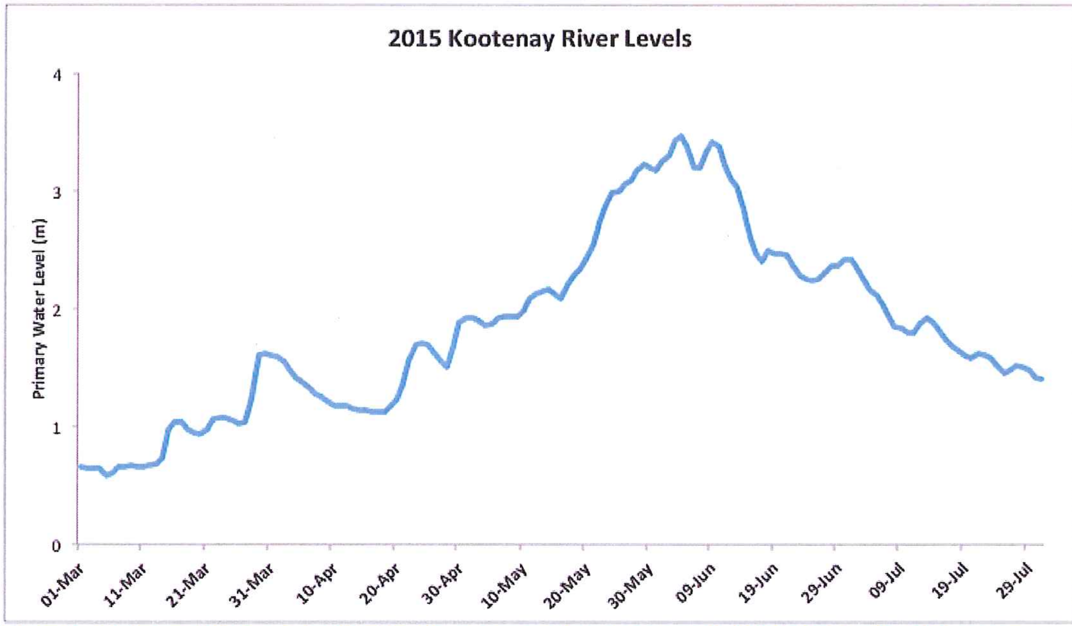

Figure 7. Maximum daily water level (m) for the Kootenay River at Fort Steele (08NG065) for the 2015 season.

Monitoring Methodology

The Wasa/Ta Ta Creek/Skookumchuck mosquito control program involves monitoring historically recognized and recently identified mosquito development sites. Although the monitoring area is relatively small, new sites may still be detected, especially in high-water years. At the peak of the season localized snowmelt occurs along with precipitation events that activate mosquito development sites.

When new sites are found they are entered into a mapping database and added to the monitoring schedule. Certain sites are monitored more frequently than others due to their propensity to either produce mosquitoes quickly (e.g., sites that are snowmelt-fed and shallow will typically produce mosquito larvae early in the season) or because certain sites are closer to population centres. Additionally, if sites have been altered at all due to natural (i.e., beaver dams) or human-influenced (i.e., draining a pond) reasons, MBL field staff will monitor those sites more closely to determine how the alterations may affect mosquito production.

This year there were 63 mosquito development sites monitored within the contract area. No new sites were added this year. In April and early May, all of the sites were visited at least once a week. The exception to this schedule is that the snowmelt-influenced sites are visited twice each week because they typically become active early. From mid-May through the end of June, each site is visited approximately twice a week.

During each visit, larval counts are made and the larval composition is distinguished between early instar (1st and 2nd) and late instar (3rd and 4th). Also at each visit, notes are made regarding pupal counts, which aid in determining whether or not a treatment has been missed at a particular site. MBL treatment protocol dictates that field technicians target the late 3rd instar and early 4th instar stages in order to leave more biomass in the water for predators who depend on larvae as a food source.

Larval Treatment

Larvicide Product Information

Mosquitoes in the larval phase are treated with Aquabac®. Aquabac® is considered a microbial larvicide, meaning that the active ingredient is a soil-borne bacteria. In this case, the bacterium is *Bacillus thuringiensis* var. *israelensis* (Bti). The mode of action for Bti is relatively simple and with a rather high degree of species specificity. Receptors within the mid-gut region of the mosquito larvae are specific to the toxin proteins that are produced alongside each bacterial spore. After the mosquito larvae ingest the toxin protein, disruption of the larval mid-gut cells occurs as a result of cleavage of the protoxins by mid-gut proteases. An osmotic imbalance across the mid-gut epithelial cell membranes occurs due to this binding, which causes considerable damage to the wall of the gut and quickly leads to larval death (Boisvert and Boisvert, 2000).

Due to the specificity of the mosquito larval midgut receptors to the Bti endotoxins, Bti is a relatively safe treatment option when considering non-target effects potential. Besides mosquitoes, Bti also has an effect on black fly larvae. A commonly voiced concern is whether or not Bti has effects on salmonids. There is a large body of evidence that suggests Bti does not directly affect salmonids. Numerous studies have demonstrated the general safety of exposing fish to Bti (Brown et al. 1998, Brown et al. 2002, Brown et al. 2004). Therefore, amounts of Bti applied in field treatments are highly unlikely to cause direct hazard to juvenile salmonids.

Ground Treatment Summary

The Wasa/Ta Ta Creek/Skookumchuck mosquito control program requires a large reliance on ground treatments with the use of a backpack blower. Staff are trained in blower application methods and calibration techniques. Field staff are able to access all sites by foot or quad.

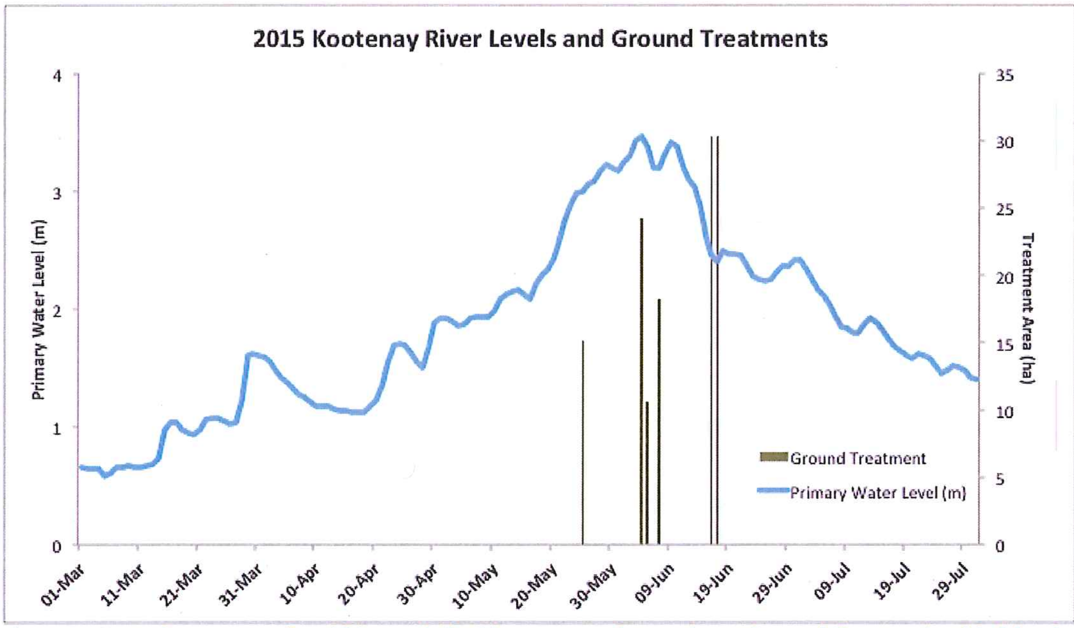

Figure 8. Ground treatments (hand/blower; ha) with respect to changes in maximum daily water level (m) for the Kootenay River at Fort Steele (08NG065) for the 2015 season.

In 2015, MBL field technicians applied approximately 774 kg, at a rate of 6kg/ha. Thus, approximately 129 ha, in total, were treated with the use of a backpack blower (Figure 8; Appendix I). Earlier in the season treatments tend to coincide with either a considerable melt of local snow (caused by increasing ambient temperatures) or a large amount of local precipitation. Monitoring began in early April, with the first treatment occurring on 25 May (Figure 8). Numerous treatments were required starting in early June (Figure 8) due to abnormally high ambient temperatures in that period, causing high-elevation snow to melt, and leading to a peak in the Kootenay River at Fort Steele. Approximately one day after treatments occurred, field staff monitored sites to ensure the treatments were efficacious. According to field staff, all early treatments were completely successful.

Another wave of treatments occurred mid-June after the peak in the Kootenay River (Figure 8). Larval activity in certain areas increased because ambient temperatures increased, providing ideal hatching conditions for mosquito egg hatching. The final treatment of the season occurred on 18 June (Figure 8) and was the result of a relatively large amount of precipitation received in the area accompanied by high river water and high ambient temperatures. The additional precipitation wetted mosquito development sites, again creating ideal mosquito development habitat.

There were alterations to two sites within the Wasa/Ta Ta Creek/Skookumchuck program in 2015, resulting in changes to their monitoring and treatment. Site 003 between Prairie Rd and Dump Rd remained uncharacteristically dry into the season. Upon investigation, a beaver dam was discovered between Site 003 and Site 002. This alteration was causing more water than usual to push into Site 002. The beaver dam also added water to Site

002 earlier than normal. Due to this earlier-than-normal influx of water to Site 002, it was treated later than usual. While treatment efficacy was not as complete as it typically would have been, MBL field technicians received no complaints. A note has been made regarding the site alternation and field technicians will be checking the site earlier and more frequently in 2016, should MBL be retained as the contractor for 2016/2017.

Aerial Treatment Summary

Aerial treatments are necessary whenever access to mosquito development sites is not possible by foot, quad, or canoe. Additionally, aerial treatments are typically conducted when there is a significantly high amount of mosquito larval activity or when high ambient temperatures result in rapid larval development occurring too quickly to treat all sites by hand. The total number of aerial treatments conducted within a given year is dependent upon the amount of water moving through or adding to the system and larval development time.

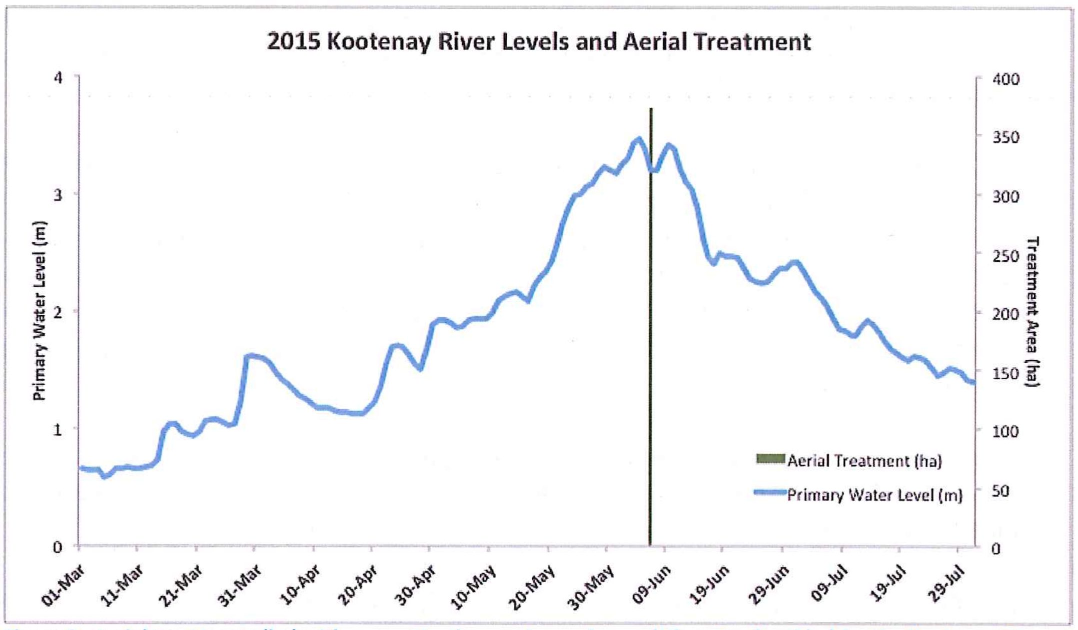

Figure 9. Aerial treatments (ha) with respect to changes in maximum daily water level (m) for the Kootenay River at Fort Steele (08NG065) for the 2015 season.

In 2015, a total of approximately 2,239 kg in aerial campaigns. Aerial treatments are applied at a rate of 6 kg/ha. Thus, the total area treated by MBL technicians was approximately 373.1 ha. Only one aerial campaigns was conducted in 2015 (Figure 9; Appendix 1). The aerial campaign occurred on 6 June (Figure 9); the need for the application was due to the peaking Kootenay River levels coupled with high ambient temperatures, which had created optimal mosquito hatching habitats. All sites treated by the helicopter were monitored within two days of the campaigns to ensure quality control. All of the treatments were deemed a success.

Public Relations

Direct communication between MBL staff and the public can occur in many circumstances. The most common direct interfacing with the public occurs when technicians are in the field. MBL technicians, while conducting site visits, are often asked questions by landowners or nearby residents. These encounters provide an excellent opportunity for public relations. The fact that technicians are visibly monitoring and treating lets residents know that attention is being given to mosquito abatement efforts. Additionally, an important outcome of these interactions can be the identification of new sites and larval mosquito activity by involved residents.

MBL contact information is disseminated when field technicians have direct communication with the public. Contact information for MBL includes an email, phone number, and social media sites (Twitter, Facebook). Another resource for public queries is the new MBL website (http://morrowbioscience.com). By providing the public with these resources and avenues of communication, it enables community members to follow-up with questions.

The local MBL program manager made a presentation to local residents on 1 June 2015 at the Wasa Town Hall meeting. The presentation consisted of informing residents about mosquito control efforts conducted by MBL and also included recommendations for mosquito development site reduction measures. Additionally, the local MBL program manager, Kendra Lewis, met with Kevin Paterson in September to discuss the repair for the Thunderhoof Ranch culvert. Repairing this culvert may reduce mosquito development habitat.

No complaint calls were received to the Mosquito Hotline this year. Similarly, no complaint emails were received either. Field staff were often approached by locals complimenting their mosquito control efforts and results for 2015.

Maintaining positive public relations remains a high priority for MBL. Public relations occur on several levels: in-person communication with members of the public, the mosquito hotline, presentations to staff and politicians, responding to e-mails, and continuing our social media presence. We continue to look for new areas to expand this aspect of our program and to improve our communication techniques.

Social Media

This year, 2015, is the fourth consecutive year in which MBL had a social media presence online. There are five main goals for MBL's social media presence: 1) provide timely and up-to-date information regarding conditions pertinent to mosquito production, 2) relay MBL's current efforts to control mosquitoes, 3) inform the public about MBL's efforts at social sustainability, 4) provide the community with opportunities to get involved with related public events, and 5) offer a platform for mosquito-related discussion amongst involved citizens and the MBL team.

Facebook (facebook.com/morrowmosquito) remains the primary avenue for MBL to disseminate mosquito-related information. As unseasonably warm weather settled in across the province in February, 2015, regular MBL announcements regarding the up-coming season and staff preparedness were posted. As well, MBL used this site to post MBL's volunteer efforts for river clean-ups and tree-planting events and to inform the public about scientifically-relevant news. The MBL team also used Facebook as a venue to solicit suggestions for MBL's new website.

The total number of followers on the MBL Facebook page is currently 101. This number has increased by 25 since the end of MBL's first season on Facebook (2012). Another way to gauge how many people are looking at or responding to MBL's posts is by considering MBL's "reach". Specifically, each time a follower interacts with the MBL page a subset of their "friends" is exposed to the information that the original follower commented on or "liked". In this way the maximum reach was 224, which is low in comparison to previous years. Low snowpacks and precipitation throughout the province in 2015 likely meant that the public was less concerned about mosquito control work than they had been in previous years.

Another aspect to MBL's social media outreach strategy is the use of Twitter (@morrowmosquito). Utilizing Twitter allows the opportunity for community members to follow, in real-time, our activities and updates relating to mosquito control issues. An average of one "tweet" a day is sent out throughout the mosquito season. Some of these "tweets" were forwarded from other sources if those messages were mosquito-related.

To date, the maximum number of followers on Twitter is 125. This is an increase of 37 followers from 2014. Part of the reason for the increase in followers through this method is the link between the Twitter account and the Facebook account. Each time a "tweet" was sent out via Twitter, it was also posted to the Facebook page. This way the Twitter feeds reached as many people per day as did the Facebook posts. Twitter and Facebook accounts are also linked to the new Morrow BioScience website, enabling visitors to easily connect with each account. Notable Twitter followers include local municipalities and media.

Tweets typically consisted of the following:

- Notification of changes in environmental conditions that might lead to mosquito development
- Updates on adult mosquito levels
- Notification of planned treatments, when necessary
- Photos of field staff and wildlife in the course of operations
- Reminders and notification of public events such as river clean-up days
- Links to WNv activity updates relevant to MBL programs

MBL Website

The new MBL website (morrowbioscience.com) was launched on March 26, 2015. This site was developed in an effort to allow clients and the public to have access to information about MBL's background, activities, outreach, and staff members. The website is continually being refined as MBL further develops our programs.

Currently, the site contains information about MBL's philosophy, staff background, and current projects. The site outlines MBL's services and relevant news, including a blog updated monthly throughout the mosquito season. Of particular importance is the 'Contact' tab which allows a person to directly send a message to MBL. Additionally, there are links to MBL's Facebook account and Twitter feed, so interested individuals may have real-time updates on MBL's activities.

Future additions to the website will include the local contact information for field technicians and their assigned projects. There will also be a science-focused section that will have links to relevant peer-reviewed literature, important websites, and information about the Bti product used by MBL. Feedback specific to MBL's website is welcome.

West Nile Virus Surveillance

The Government of Canada conducts on-going surveillance of West Nile virus (WNv) cases in humans between mid-April and the end of October. As of 17 October, no human clinical cases of WNv in British Columbia were reported to Health Canada. A total of 60 cases were reported across Canada; all cases were in either Quebec, Ontario, or Saskatchewan. It should be noted that Health Canada includes any WNv human cases that are deemed probable or confirmed. Cases may include WNv neurological syndrome, WNv non-neurological syndrome, and WNv unclassified/unspecified (http://www.healthycanadians.gc.ca/diseases-conditions-maladies-affections/disease-maladie/west-nile-nil-occidental/surveillance-eng.php). Also according to the Government of Canada, no dead birds or mosquito pools tested positive for WNv in British

Columbia in 2015. The British Columbia Center for Disease has not yet published their annual surveillance report for 2015.

As Washington State, Idaho State, and Montana State border British Columbia, it is important to follow WNv activity in those areas, as well. To date, there are 23 human cases of WNv recorded in Washington State; all cases originated in the south-central portion of the state. Additionally, 157 mosquitoes pools, 36 horses/other mammals, and 7 birds tested positive for the virus[1].

As of 29 September, Idaho State reported a total of 13 symptomatic WNv cases[2]. Additionally, five horses/mules and nine mosquito pools tested positive for the virus. All cases were reported in the central or southern portion of the state.

Montana State, which is directly south of Cranbrook, reported three cases of WNv[3]. As the 2015 WNv surveillance report has not yet been published, there was no clear availability of data regarding mammal, bird, or mosquito pool WNv test information. This information is current to 10 November.

Future Work

If MBL is selected as the future contractor, work in the Wasa/Ta Ta Creek/Skookumchuck area will focus on expanding the community involvement and education portion to our program, continuing to search for potential development sites, and increasing monitoring events for certain sites (i.e., 002, 003) during the 2016 season. Updates for this program will also be posted to the MBL Facebook site and Twitter account. These education opportunities will serve as a platform to inform residents about mosquito control and to field questions/concerns as they pertain to control efforts.

Mosquito development sites can vary from year-to-year, largely depending on regional snowpack, ambient temperatures, and local precipitation accumulation. Additionally, the Wasa/Ta Ta Creek/Skookumchuck program has a few sites that have been altered, which require consistent monitoring. Due to the changing environmental variables and site-specific alterations, MBL greatly values the local citizens' abilities to report potentially new mosquito development sites. Citizen awareness adds invaluable knowledge to the MBL field technician's abilities at being able to predict where new, potential sites may arise based on finding low-lying areas. Thus, it is imperative that citizens have the ability

[1] http://www.doh.wa.gov/DataandStatisticalReports/DiseasesandChronicConditions/WestNileVirus/HumanCasesbyCountyofLikelyExposure
[2] http://www.doh.wa.gov/DataandStatisticalReports/DiseasesandChronicConditions/WestNileVirus/HumanCasesbyCountyofLikelyExposure
[3] http://www.cdc.gov/westnile/statsmaps/preliminarymapsdata/histatedate.html

to directly contact field technicians to make them aware of potential sites. Involved citizens can directly contact the field operations manager, Kendra Lewis, can phone the mosquito hotline, or can send a message through the Morrow BioScience website comment platform.

Finally, MBL will be providing the Regional District of East Kootenay with a mid-season summary in addition to a final report for the Wasa/Ta Ta Creek/Skookumchuck area. The report will summarize the mosquito control program activities up to mid-season (ca. mid-May), 2016. Specifically, the report will discuss current environmental conditions affecting mosquito populations and monitoring efforts, outline the progress to date for the proposed deliverables, present any preliminary data, and identify potential issues for the duration of the mosquito season. The information presented will be meant to provide a snapshot of the season. A more systematic analysis of each of these points will be presented in the final report for 2016.

Each specified focal point is integral to a successful program. MBL is dedicated to providing each of our programs with the best mosquito control possible, consistent communication, and the commitment to continually pursue areas in which to improve.

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Appendix I – 2015 Treatment Record

Site	Date	Treatment Method	Treatment area (ha)	Treatment Amount (kg)
RDEK050	25-May	Blower	9.10	54.60
RDEK048	25-May	Blower	6.07	36.40
RDEK050	04-Jun	Blower	24.27	145.60
RDEK050	05-Jun	Blower	9.10	54.60
RDEK018	05-Jun	Blower	1.52	9.10
RDEK050	06-Jun	Aerial	57.63	345.80
RDEK001	06-Jun	Aerial	30.33	182.00
RDEK002	06-Jun	Aerial	30.33	182.00
RDEK028	06-Jun	Aerial	27.30	163.80
RDEK042	06-Jun	Aerial	24.27	145.60
RDEK010	06-Jun	Aerial	18.20	109.20
RDEK003	06-Jun	Aerial	15.17	91.00
RDEK005	06-Jun	Aerial	15.17	91.00
RDEK006	06-Jun	Aerial	15.17	91.00
RDEK007	06-Jun	Aerial	15.17	91.00
RDEK008	06-Jun	Aerial	15.17	91.00
RDEK014	06-Jun	Aerial	15.17	91.00
RDEK015	06-Jun	Aerial	15.17	91.00
RDEK016	06-Jun	Aerial	15.17	91.00
RDEK043	06-Jun	Aerial	12.13	72.80
RDEK048	06-Jun	Aerial	12.13	72.80
RDEK029	06-Jun	Aerial	9.10	54.60
RDEK049	06-Jun	Aerial	6.07	36.40
RDEK051	06-Jun	Aerial	6.07	36.40
RDEK004	06-Jun	Aerial	3.03	18.20
RDEK018	06-Jun	Aerial	3.03	18.20
RDEK022	06-Jun	Aerial	3.03	18.20
RDEK045	06-Jun	Aerial	3.03	18.20
RDEK047	06-Jun	Aerial	3.03	18.20
RDEK055	06-Jun	Aerial	3.03	18.20
RDEK005	07-Jun	Blower	6.07	36.40
RDEK002	07-Jun	Blower	4.55	27.30
RDEK008	07-Jun	Blower	3.03	18.20
RDEK001	07-Jun	Blower	1.52	9.10
RDEK010	07-Jun	Blower	1.52	9.10
RDEK025	07-Jun	Blower	0.76	4.55
RDEK023	07-Jun	Blower	0.76	4.55
RDEK028	16-Jun	Blower	15.17	91.00
RDEK029	16-Jun	Blower	6.83	40.95
RDEK027	16-Jun	Blower	4.55	27.30
RDEK022	16-Jun	Blower	0.76	4.55
RDEK023	16-Jun	Blower	0.76	4.55
RDEK024	16-Jun	Blower	0.76	4.55
RDEK025	16-Jun	Blower	0.76	4.55
RDEK026	16-Jun	Blower	0.76	4.55
RDEK042	18-Jun	Blower	9.86	59.15
RDEK043	18-Jun	Blower	6.07	36.40
RDEK004	18-Jun	Blower	4.55	27.30
RDEK028	18-Jun	Blower	3.03	18.20
RDEK029	18-Jun	Blower	3.03	18.20
RDEK045	18-Jun	Blower	2.28	13.65
RDEK007	18-Jun	Blower	1.52	9.10

Appendix II – Monitoring and Treatment Records 2015

Site ID Number	Sample/ Treat Date	Larvae Per Dip	Main Instar	Treatment Method	Pesticide Product	Quantity Used (kg)	Application Rate	Area (ha)
RDEK048	03-May	0			Aquabac	0	6	0.00
RDEK048	10-May	0			Aquabac	0	6	0.00
RDEK001	15-May	0			Aquabac	0	6	0.00
RDEK002	15-May	0			Aquabac	0	6	0.00
RDEK003	15-May	0			Aquabac	0	6	0.00
RDEK004	15-May	0			Aquabac	0	6	0.00
RDEK005	15-May	0			Aquabac	0	6	0.00
RDEK015	15-May	0			Aquabac	0	6	0.00
RDEK050	25-May	50	2	Blower	Aquabac	54.6	6	9.10
RDEK048	25-May	50	2	Blower	Aquabac	36.4	6	6.07
RDEK001	25-May	0			Aquabac	0	6	0.00
RDEK002	25-May	0			Aquabac	0	6	0.00
RDEK003	25-May	0			Aquabac	0	6	0.00
RDEK004	25-May	0			Aquabac	0	6	0.00
RDEK005	25-May	0			Aquabac	0	6	0.00
RDEK047	25-May	0			Aquabac	0	6	0.00
RDEK006	26-May	0			Aquabac	0	6	0.00
RDEK007	26-May	0			Aquabac	0	6	0.00
RDEK008	26-May	0			Aquabac	0	6	0.00
RDEK009	26-May	0			Aquabac	0	6	0.00
RDEK010	26-May	0			Aquabac	0	6	0.00
RDEK011	26-May	0			Aquabac	0	6	0.00
RDEK015	27-May	0			Aquabac	0	6	0.00
RDEK016	27-May	0			Aquabac	0	6	0.00
RDEK017	27-May	0			Aquabac	0	6	0.00
RDEK018	27-May	0			Aquabac	0	6	0.00
RDEK019	27-May	0			Aquabac	0	6	0.00
RDEK020	27-May	0			Aquabac	0	6	0.00
RDEK021	27-May	0			Aquabac	0	6	0.00
RDEK022	27-May	0			Aquabac	0	6	0.00
RDEK042	28-May	0			Aquabac	0	6	0.00
RDEK043	28-May	0			Aquabac	0	6	0.00
RDEK044	28-May	0			Aquabac	0	6	0.00
RDEK045	28-May	0			Aquabac	0	6	0.00