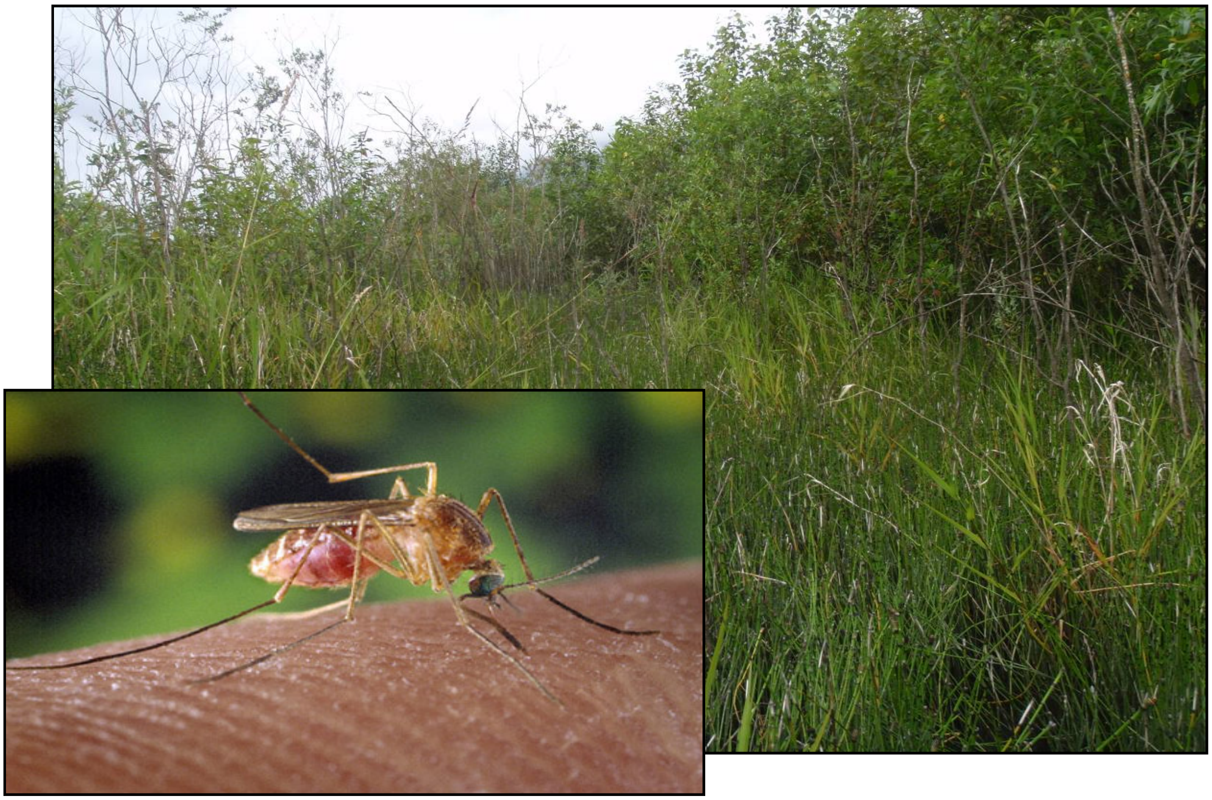
Columbia-Shuswap Electoral Area 'A'; Town of Golden Mosquito Control Program

2012 Final Report



Submitted to: Environmental Services Coordinator
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Executive Summary

The 2012 season marks the first season that MBL has operated mosquito control operations for the Columbia-Shuswap Regional District (CSRD). Throughout the past year, operations staff has been a key part of the local community, as they both live and work within the targeted areas. During this time MBL and local staff members have made significant improvements to the program, resulting in a considerable reduction in mosquito annoyance. A large part of this success has been the cooperative efforts with local businesses and residents.

This season was extraordinarily busy marking some of the highest water seen in the Columbia Floodplain. The high water is a result of higher-than-average snowpack. Frequent and heavy rain events through June further exacerbated the issue.

Hand treatments totaled 135 ha throughout the season. A further 1,685 ha were treated by helicopter between July 10 and August 13. Despite record high levels in the Columbia River, less product was applied aerially and applied over-all when compared to the previous three years.

Introduction

Morrow BioScience Ltd. (MBL) became the mosquito control contractor for the Town of Golden and Columbia Shuswap Regional District (CSRD) Electoral Area 'A' in 2012. This year (2012) marks the beginning of a three-year contract span. 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, present all final data, and identify potential issues for the 2013 mosquito abatement season.

In all of their control programs MBL has worked to reduce mosquito nuisance in and around the contract areas. The general reduction in mosquito annoyance is due, in large part, to the thorough monitoring conducted by MBL field technicians. Field staff have gained a thorough knowledge of each mosquito development site, know when those sites become active, and understand which aquatic input (i.e. snowmelt, freshet, etc.) most influences each site. The extensive understanding of the sites is further augmented by information provided by long-time residents. 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 pragmatic philosophy intertwines effective mosquito control with low environmental impact. As such, MBL specializes in hand treating sites whenever possible, as opposed to an immediate dependency on aerial applications. In order to effectively control mosquitoes MBL employs a consistent and frequent site-monitoring regime. Monitoring events are conducted in response to changing environmental conditions. Given that MBL's head field technician resides in the Town of Golden, site visits can occur with little or no notice.

Program Development

No maps were made available to MBL staff regarding the locations of mosquito development sites at the commencement of this contract. All information pertaining to the development sites was garnered based on addresses and general location descriptions. Over 100 known and potential larval developments sites were mapped this year (electronic data will be made available to the CSRD and Town of Golden before the start of the 2013 season).

Significant Regional Environmental Conditions

Snowpack

The snowpack is an important variable to follow, as it can reveal how severe the freshet will be at varying points in the season. It will also specify when the freshet has ended. Snow basin indices are calculated based on measurements consistently made at designated snow survey stations. When snow amounts 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.

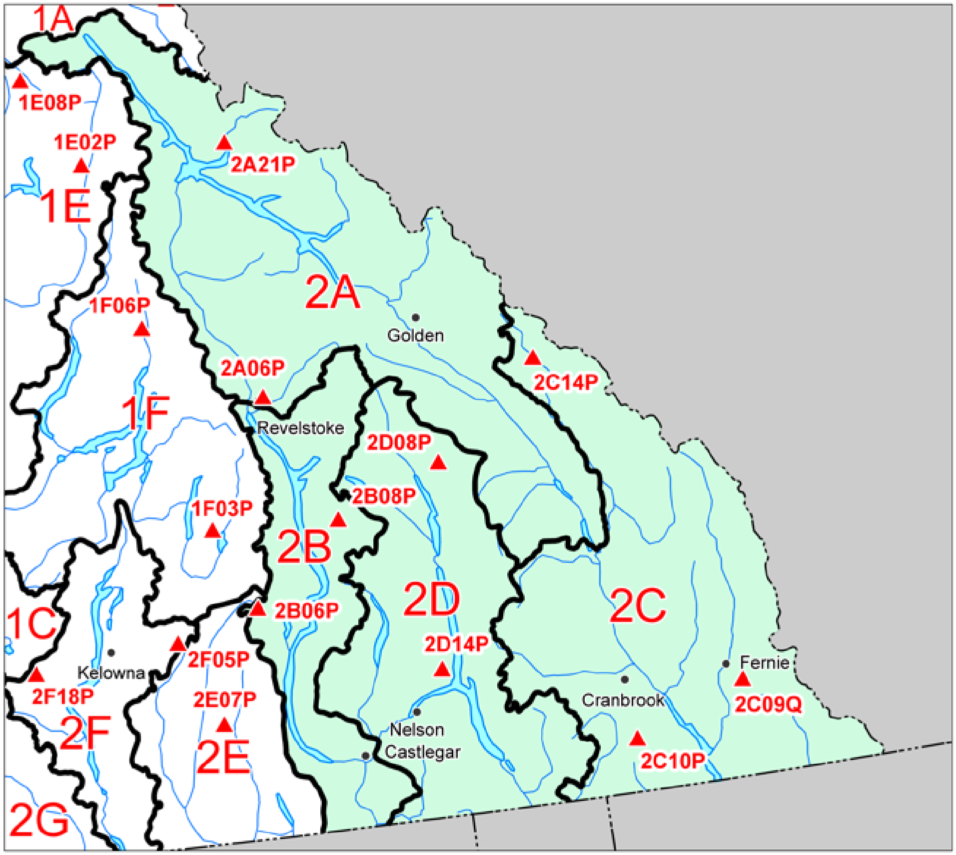

Figure 1 Eastern British Columbia watershed delineations. Area 2A corresponds to the watershed that most affects the Columbia River at Golden; Station 2A21P most influences snowpack concerns and the associated freshet for Golden, BC. (bcrfc.env.gov.bc.ca/data/asp/realtime/basin_columbia_kootenay).

The main basin that affects the Columbia River freshet is the 2A watershed (Figure 1). Specifically, snow pack reported from the weather station at Molson Creek (2A21P) is of most relevance to Golden and Electoral Area 'A' when attempting to determine freshet concerns (Figure 1). The 1 April snow survey report showed that the snow index for the Molson Creek station was 136 percent of normal. In fact, the snow index for Molson Creek in April. The larger-than-normal snowpack throughout the region was likely a result of La Nina conditions prevalent through March. Specifically, these conditions include a relatively high precipitation accumulation and colder ambient temperatures (i.e. 0.5°C – 1.5°C cooler).

By 1 May, La Nina weather patterns had weakened considerably; conditions in the Pacific Ocean had returned to normal. Although other areas in the Upper Columbia drainage basin had snow packs that had decreased, the Molson Creek snowpack was only 151 percent of normal. By the final determination date (15 June), that percentage had increased even further at 202 percent of normal. This high percentage later into the season suggests that the majority of water came from the Molson Creek drainage in early to mid June.

Figure 2, created by the River Forecast Centre (http://bcrfc.env.gov.bc.ca/data), depicts the automated snow pillow throughout the 2012 season. The green line represents the real-time data collected for 2011 and shows that it generally followed the average trajectory. Of particular interest, Figure 2 shows that the snow pillow had been depleted by the end of July. Therefore, the freshet was no longer contributing any significant water to the Columbia River by the beginning of August.

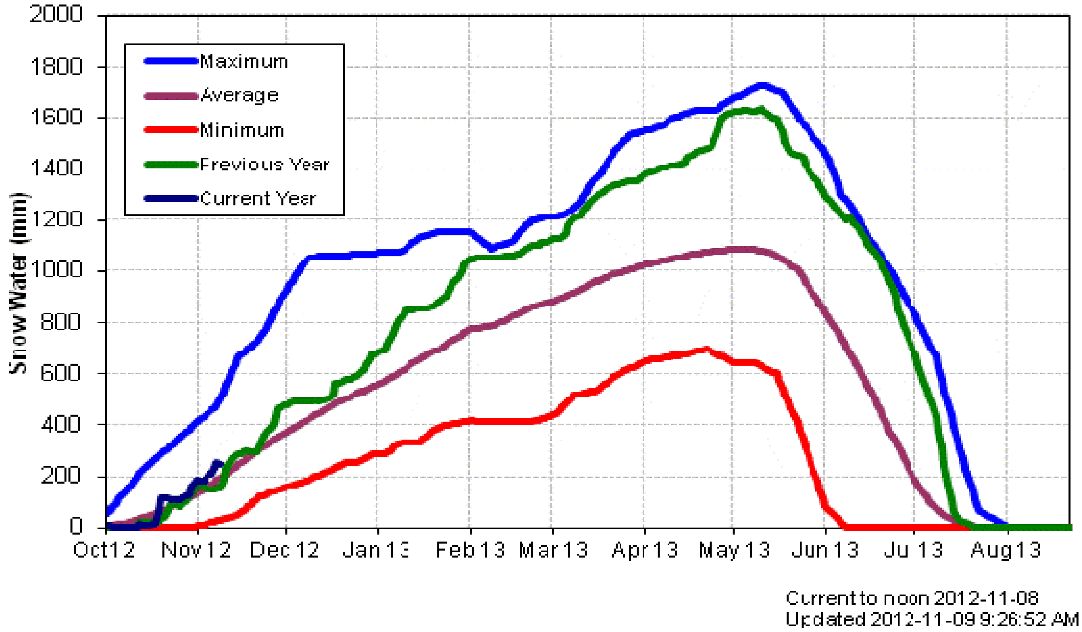

Figure 2. Molson Creek (2A21P) automated snow pillow real-time data for 2012 (green line). Figure created by the River Forecast Centre on 9 November 2012.

Ambient Temperature Records

Ambient temperatures influence water temperatures and certain water conditions (i.e. shallow, relatively stagnant, land-locked) are more directly affected. The majority of sites monitored by Morrow Bioscience Ltd. (MBL) are shallow and relatively stagnant. Thus, as the ambient temperatures begin to rise (typically in May), water temperatures rise, as well, creating an ideal environment for mosquito development. Larvae develop slower in cool water and much faster in warm water. In cold water the larvae take approximately 10 days to go from egg to 4^{th} instar. In very warm water this same transition can take as little as 4-5 days.

Ambient temperatures increased slowly from the beginning of May (Week 18) through the middle of July (Week 28; Figure 3). The unseasonably warm weather in late May likely occurred as La Nina weather patterns weakened, pushing a warm weather front through the area. This front likely melted a certain amount of the snow pillow and creating the ideal environment for early larvae to develop. Thus, certain higherelevation mosquito development sites around Golden and Electoral Area 'A' may have became active earlier than in previous years.

By June, average ambient temperatures declined slightly. When temperatures are relatively low, mosquito larvae do not mature as quickly. However, these populations require constant monitoring because even slight increases in ambient temperature can lead to maturation. Fortunately, MBL field technicians are familiar with the sites that typically become active first, and were able to treat them in time (i.e. when the larvae were in 2nd or 3rd instar).

The highest ambient temperature recorded for the 2012 mosquito season occurred on 10 July (22.8°C; Figure 3). At that point, the freshet was still relatively high. Reasons for the peak and implications for mosquito breeding areas will be discussed in subsequent sections. However, it is important to note that highest ambient temperatures of the season over-lapped with the peak of the Columbia River, creating optimal mosquito breeding environments.

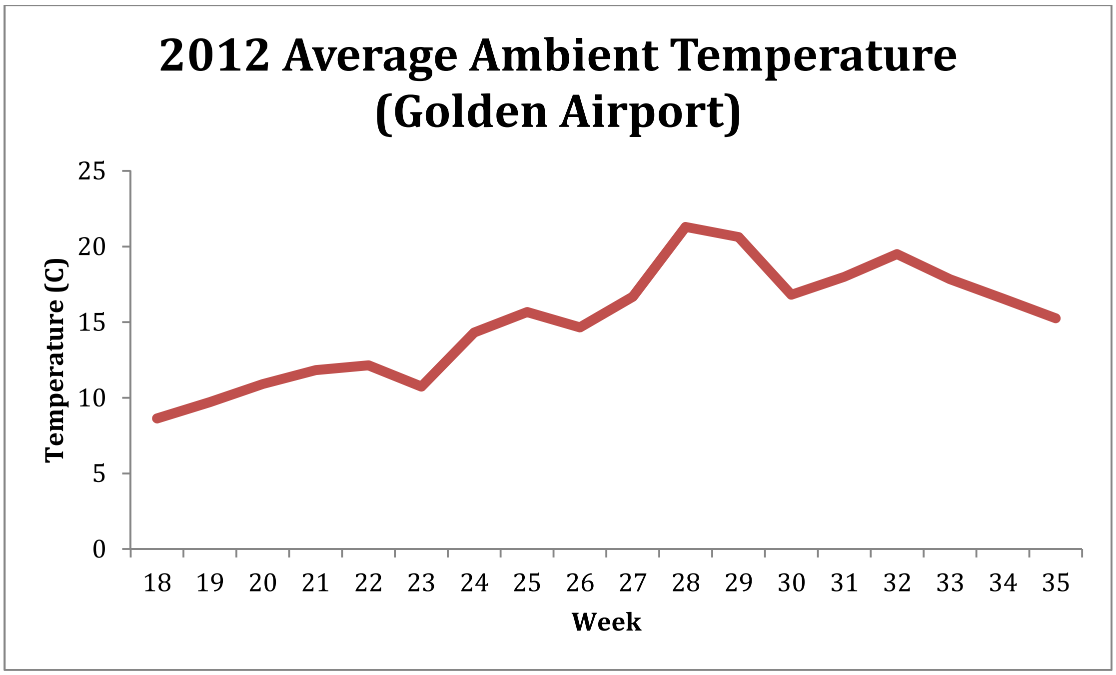

Figure 3 Average weekly temperature (oC) as recorded at the Golden, BC Airport 01 May - 31 August, 2012. Week 18 corresponds to 01 May and Week 35 corresponds to 31 August.

Precipitation

Precipitation, while not the major contributor to overall river levels in the Columbia River, can impact levels when the ground is saturated in influential basins. The precipitation total for May (Figure 4) was low in comparison to that recorded in June. It is unlikely that the amount of precipitation accumulated at sites in May considerably amplified mosquito breeding habitat.

Precipitation accumulated in June was greater than the total accumulated in May, July, and August together. The increased precipitation in June may have been due to the extreme phase of a naturally occurring weather cycle, La Nina. La Nina is a part of El Nino/Southern Oscillation (ENSO), which can create wetter than normal conditions for the parts of BC. This weather pattern occurs every few years and can last for two years at a time (www.elnino.noaa.gov). This unprecedented amount of precipitation likely increased Columbia River levels due to the fact that large amounts of precipitation was likely being infused into the system all along the River.

A lower amount of total precipitation, which occurred in July and August (Figure 4), meant that seepage sites connected to the Columbia River flood plane did not have as much water as earlier in the season. Therefore, as the Columbia River is relatively undeveloped (relatively fewer dams than downstream) above Golden, BC, sites likely continued to diminish as they responded to declining river levels. Accordingly, floodwater mosquito abundance began to lessen due to a reduced breeding habitat.

Container mosquito species, such as *Culex* mosquitoes, can also be a nuisance. Container species require sites that have stagnant, warm water for breeding and maturation. These sites can include old tires, tree holes, bird baths, and rain barrels, to name a few. Thus, after the June precipitation container nuisance mosquitoes also likely decreased, due to a decline in their favorable breeding habitats.

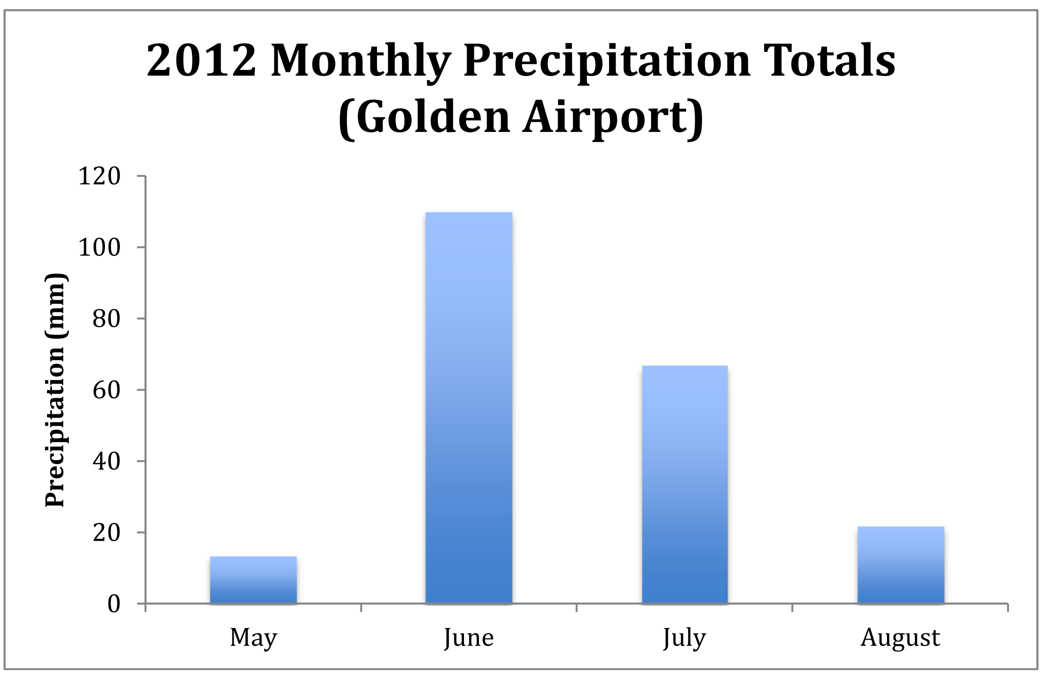

Figure 4 Monthly total precipitation accumulation (mm) as recorded at the Golden, BC Airport 01 May - 31 August, 2012.

Columbia River Levels

Floodwater mosquito abundance in the area around Golden and Electoral Area 'A' is primarily affected by river level variation of the Columbia River and, to a much lesser extent, the Kicking Horse. In turn, the water levels of the Columbia River are governed by three influences: local snowmelt, the freshet from the Upper Columbia basin, and the discharge of water from the Kicking Horse River. Frequent and large amounts of precipitation can also affect river levels, though typically to a lesser degree than the three primary factors.

In 2012, the Columbia River discharge rates reached the highest peak since 1974. Although the 2012 reported discharge rates appear to be an anomaly, there are underlying trends suggesting these 'anomalies' may become more frequent. According to the BC Ministry of Land, Water, and Air Protection (2002), the southern half of BC experienced an increase of precipitation between the years 1929 and 1995 of 2-4% per decade. According to that same report, the average ambient air temperature for BC has increased steadily each year between 1895 and 1995 (culminating in an approximate overall increase of 1.1%).

An increase in winter temperatures allows for the survivorship and eventual range expansion of destructive forest pests, such as the mountain pine beetle (*Dentroctonus ponderosae*) and the larch beetle (*Dendroctonus simplex*). The resulting deforestation significantly reduces tree abundance and, thus, reduces the canopy (Picketts et al., 2012). Because the tree canopy captures snow, a reduced canopy allows for more snow accumulation on the ground surface, which potentially leads to a greater snow pack. Furthermore, the freshet is potentially magnified by the fact that there are fewer roots to absorb runoff.

Monitoring Methodology

The Golden and Electoral Area 'A' mosquito control program involves monitoring historically recognized mosquito development sites within the Columbia Floodplain area (Donald to Harrogate). Although the monitoring area is relatively small, new sites are continually detected especially in high water years. High water means that the potential for seepage site development is also high. As there are numerous low-lying farms and benches throughout the floodplain, these areas are at a greater risk for the development of seepage from the Columbia River. When new sites are found they are entered into a GPS database and monitored on the same schedule as are the historical sites.

There are a total of 107 mosquito development sites in the Golden and Electoral Area 'A' Mosquito Control program. In April and early May, the sites are visited at least once a week with the exception of the snowmelt-influenced sites, which are visited twice because they typically become active early. From mid-May through mid-August, each site is visited at least twice a week.

Aedes mosquitoes are the most common nuisance mosquitoes within the CSRD. As opposed to other mosquitoes (i.e., *Culex*, *Culisetta, Anopholes*), *Aedes* lay their eggs on damp substrate in areas with a high flooding potential; they are often called 'floodwater' mosquitoes for this very reason. If the water flooding the eggs is sufficiently warm, contains a low enough dissolved oxygen (DO) content, and is organically rich (which contributes to a decreased DO content), hatching will commence (Gjullin et al. 1950).

Larval counts are made upon each visit and counts are distinguished between early instar (1st and 2nd) and late (3rd and 4th). Also at each visit, notes are made regarding pupae counts, which aid in distinguishing 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

Larval mosquitoes are treated with Aquabac®. Aquabac® is considered a microbial larvicide, meaning that the active ingredient is a soil-borne bacteria. In this case, the bacteria 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 midgut 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 midgut cells occurs as a result of cleavage of the protoxins by midgut proteases. An osmotic imbalance across the midgut 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). Bti has four specific endotoxins (Beaty and Marquardt, 1996).

Due to the specificity of the mosquito larval midgut receptors to the Bti endotoxins, Bti is a relatively safe treatment option. 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). Hurst et al. (2007) subjected the crimson-spotted rainbowfish (*Melanotaenia duboulayi)* to 10 times the effective field concentration of Bs, Bti, and s-methoprene and reported no effects on their swimming performance. Sternberg et al. (2012) subjected juvenile coho salmon (*Oncorhynchus kisutch*) to the maximum recommended amount of a Bti product in two separate standard static toxicity tests (USEPA, 1996). No overt effects were observed on behavior or detected in fish weight. Therefore, amounts of Bti applied in field treatments are highly unlikely to cause direct hazard to juvenile salmonids.

Treatment Summary (Historic – Golden; Electoral 'A', BC)

A heavy focus on ground treatments for the 2012 season appears to have resulted in a decrease in requirement for aerial larviciding efforts, despite the highest water levels since 1974 (Figure 5). The reduction in aerial treatment amounts is a reflection of MBL's highly-focused hand treatment approach. Subsequent seasons will determine if this pattern will be sustained.

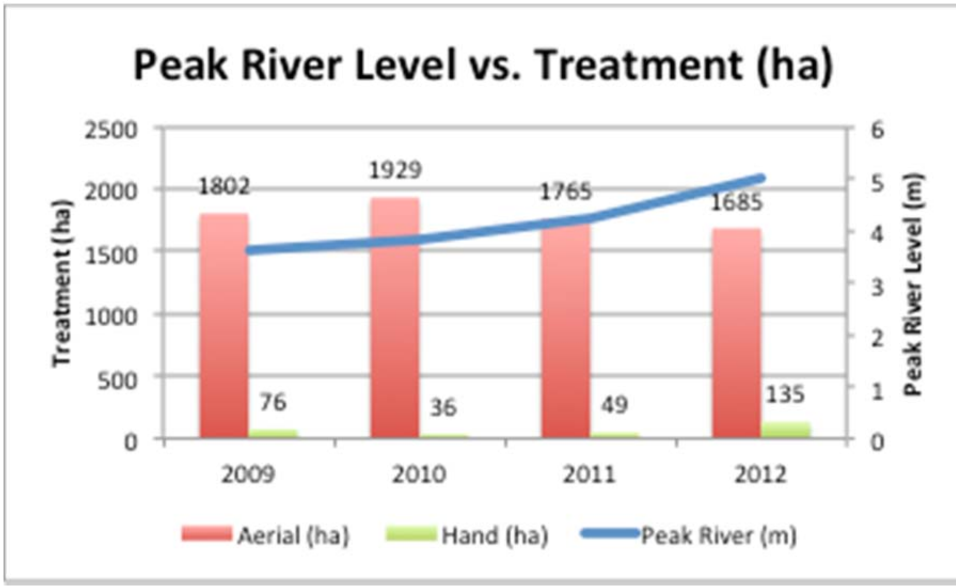

Figure 5. Peak Columbia River level (m) along with corresponding bti application totals (ha) for 2009 – 2012. Note that the 2012 peak river level was higher, as were ground treatments, while aerial amounts were lower.

Hand Treatments

Whenever possible, MBL field technicians conduct hand treatments. Field staff are able to access sites by foot, quad, or canoe. These modes of transport are considerably less environmentally impactful than are aerial treatment methods and, thus, are heavily relied upon. This emphasis on hand treatment is borne-out in Figure 5.

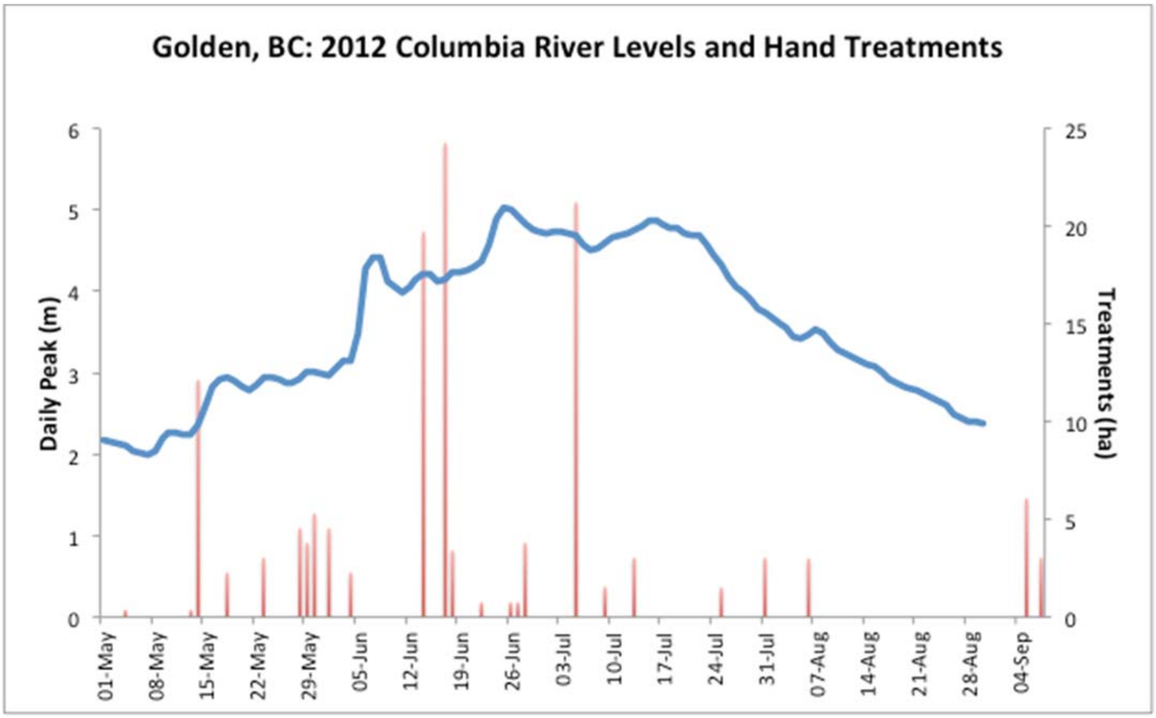

Figure 6. Hand treatments with respect to changes in river levels for the 2012 season.

In 2012, MBL field technicians applied approximately 808 kg, at a rate of 6kg/ha. Thus, approximately 135 ha, in total, were treated by hand. Hand treatments tend to coincide with either a rise in river level (Figure 6) or a rise in ambient temperature (Figure 3), or both. Early season treatments, which tend to occur from mid-April through mid-May, are often applied to sites that are primarily governed by snowmelt.

In 2012, the largest concentration of hand treatments occurred between the middle of May and the End of July (Figure 6). The final hand treatment occurred on September 7, as river levels were beginning to recede. In an average year, with considerably lower river levels, the final hand treatments are often applied earlier.

Aerial Treatments

Aerial treatments are necessary whenever access to mosquito development sites is not possible by foot, quad, or canoe. Aerial treatments are typically conducted when there is a significant amount of mosquito larval activity, as well. The total number of aerial treatments conducted within a given year is dependent upon the amount of water moving through the system.

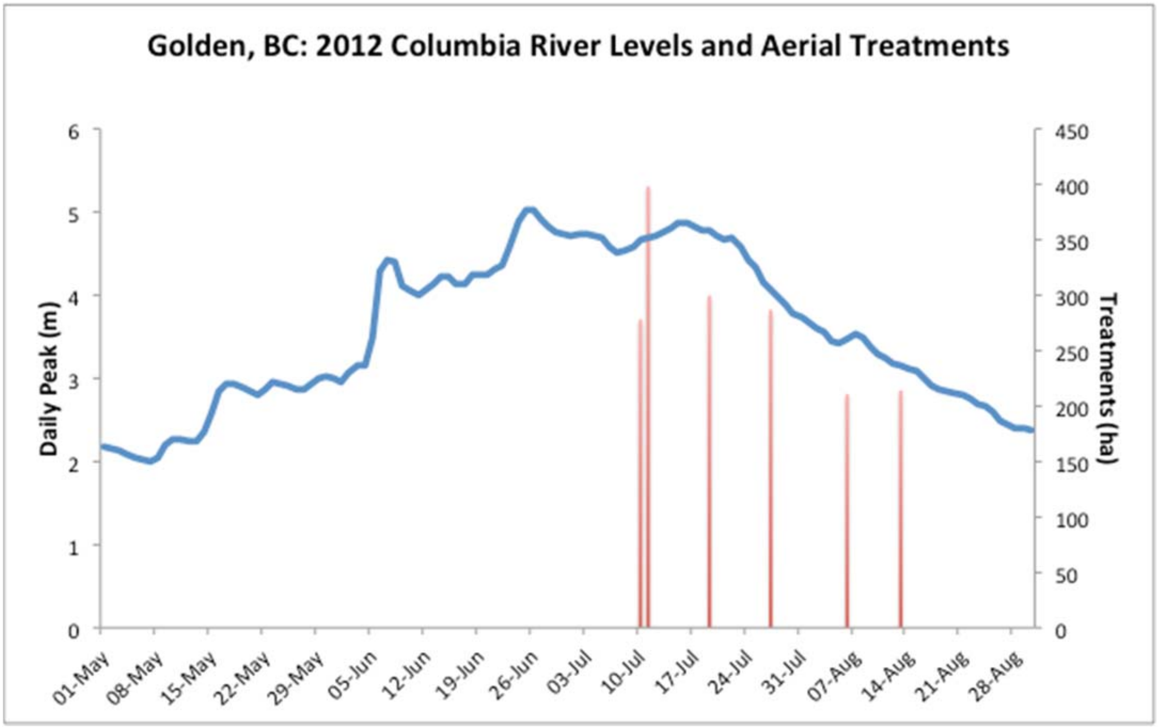

Figure 7. Aerial treatments (ha) with respect to the daily peak of the Columbia River (m) for the 2012 season.

In 2012, MBL field technicians applied a total of approximately 7,162 kg. Aerial treatments are applied at a rate of ~4.25 kg/ha. Thus, the total area treated by MBL technicians was approximately 1,685 ha. The first aerial application occurred on 10 July (Figure 7); the need for the early application was due to the freshet. The final application was conducted on August 13.

Future Work

Future work in the CSRD will focus on three main components: the continual search for potential mosquito development sites, optimally timed treatments, and the further expansion of the citizen involvement component. Each aspect is integral to a successful program. Together with the experience gained from the 2012 season, MBL anticipates the emphasis put on each of these program goals will create the most effective and efficient program possible.

Mosquito development sites can vary from year-to-year, largely depending on the Columbia River levels. While MBL field technicians are able to predict where new, potential sites may arise based on finding low-lying areas, citizen awareness of potential areas on private land will aid considerably in site discovery. Thus, it is imperative that citizens have the ability to directly contact field technicians to make them aware of potential sites. It is also important that citizens relay concerns to field technicians with regards to abnormally high adult mosquito numbers, as technicians may be able to better pin-point formerly unknown sites. Information regarding MBL contacts will be posted in a public place, as well as disseminated within door knockers at the beginning of the season. If requested by the CSRD, a public meeting will be planned for the end of the 2013 season in Golden to discuss preliminary results from that year and address any concerns.

MBL will continue to treat known sites as effectively and efficiently as possible. One element that will aid in this effort will be the use of a GPS device while conducting aerial treatments. GPS-guided aerial applications will ensure that sites are targeted more specifically and will reduce potential drift.

References

BC Ministry of Water, Land and Air Protection. 2002. Indicators of Climate Change for British Columbia. Available online: www.enf.gov.bc.ca/cas/pdfs/indcc.pdf. Accessed June 28.

Beaty BJ, Marquardt WC. 1996. The Biology of Disease Vectors. University Press of Colorado. Niwot, Colorado. 632 pp.

Boisvert M, Boisvert J. 2000. Effects of *Bacillus thuringiensis* var. *israelensis* on target and non-target organisms: A review of laboratory and field experiments. *Biocontrol Sci Tech* 10:517-561.

Brown MD, Thomas D, Mason P, Greenwood JG, Kay BH. 1998. Acute toxicity of selected pesticides to the Pacific blue-eye, *Pseudomugil signifier* (Pisces). *J Am Mosq Control Assoc* 14:463-466.

Brown MD, Carter J, Thomas D, Purdie DM, Kay BH. 2002. Pulse-exposure effects of selected insecticides to juvenile Australian crimson-spotted rainbowfish (Melanotaenia duboulayi). *J Econ Entomol* 95:294-298.

Brown MD, Watson TM, Carter J, Purdie DM, Kay BH. 2004. Toxicity of VectoLex (*Bacillus sphaericus*) products to selected Australian mosquito and non-target species. *J Econ Entomol* 97:51-58.

GJullin CM, Yates WW, Stage HH. 1950. Studies on Aedes vexans (Meig.) and Aedes sticticus (Meig.), Flood-water Mosquitoes, in the Lower Columbia River Valley. Annals Entomological Society of America 43: 262-275.

Hurst TP, Kay BH, Ryan PA, Brown MD. 2007. Sublethal effects of mosquito larvicides on swimming performance of larvivorous fish *Melanotaenia duboulayi* (Atheriniformes: Melanotaeniidae). *J Econ Entomol* 100(1): 61-65.

Sternberg M, Grue C, Conquest C, Grassley J, King K. 2012. Efficacy, Fate, and Potential Effects on Salmonids of Mosquito Larvicides in Catch Basins in Seattle, Washington. J Am Mosq Control Assoc 23(3): pages # tbd.

USEPA. 1996. *Ecological Effects Test Guidelines – OPPTS 850.1075 Fish Acute Toxicity Test, Freshwater and Marine.* Washington D.C.: USA EPA 712-C-96-118. 13 p.

Appendix I – Treatment Records

DATE		LOCATION	PRODUCT	APPLIED (kg)	AREA (ha)	MODE
Jul	10	Airport Rd	Aquabac	218.4	51.388	Aerial
Jul	10	Golf Course	Aquabac	200.2	47.106	Aerial
Jul	10	LP	Aquabac	236.6	55.671	Aerial
Jul	10	LP	Aquabac	254.8	59.953	Aerial
Jul	10	Golf Course	Aquabac	273	64.235	Aerial
Jul	11	Parson Campground	Aquabac	254.8	59.953	Aerial
Jul	11	south of town	Aquabac	254.8	59.953	Aerial
Jul	11	south of town	Aquabac	254.8	59.953	Aerial
Jul	11	south of town	Aquabac	254.8	59.953	Aerial
Jul	11	Reflection Lake	Aquabac	254.8	59.953	Aerial
Jul	11	Habart and Nicolson	Aquabac	254.8	59.953	Aerial
Jul	11	south of town	Aquabac	163.8	38.541	Aerial
Jul	19	south of town	Aquabac	254.8	59.953	Aerial
Jul	19	south of town	Aquabac	254.8	59.953	Aerial
Jul	19	south of town	Aquabac	254.8	59.953	Aerial
Jul	19	south of town	Aquabac	254.8	59.953	Aerial
Jul	19	south of town	Aquabac	254.8	59.953	Aerial
Jul	27	north of town	Aquabac	182	42.824	Aerial
Jul	27	north of town	Aquabac	254.8	59.953	Aerial
Jul	27	north of town	Aquabac	273	64.235	Aerial
Jul	27	north of town	Aquabac	254.8	59.953	Aerial
Jul	27	north of town	Aquabac	254.8	59.953	Aerial
Aug	6	Clair Joiner	Aquabac	882.7	207.694	Aerial
Aug	13	Reflection Lake	Aquabac	910	214.118	Aerial
May	4	2260 Holmes Deakin Rd	Aquabac	2.28	0.380	Blower
May	14	Reflection Lake	Aquabac	27.3	4.550	Blower
May	14	1822 Schiesser Rd	Aquabac	45.5	7.583	Blower
May	23	Moberly Flats	Aquabac	18.2	3.033	Blower
May	28	Adoplh Johnson Rd	Aquabac	27.3	4.550	Blower
May	29	Dwyer Lake (Donald)	Aquabac	18.2	3.033	Blower
May	30	Kettleson swamp	Aquabac	31.85	5.308	Blower
Jun	1	1810 Schiesser Rd - Olin swamp	Aquabac	27.3	4.550	Blower
Jun	14	Oberg Johnson Rd - Downey Property	Aquabac	118.3	19.717	Blower
Jun	17	Golf Course	Aquabac	145.6	24.267	Blower
Jun	18	Simpson Property	Aquabac	4.55	0.758	Blower
Jun	18	2200 Holmes Deakin Rd	Aquabac	13.65	2.275	Blower
Jun	22	1542 Campbell Rd - Benedict Property	Aquabac	4.55	0.758	Blower
Jun	26	Hartley Rd - Simon Propoerty	Aquabac	4.55	0.758	Blower
Jun	27	Holmes Deakin Rd - Irving Propoerty	Aquabac	4.55	0.758	Blower
Jun	28	Airport Rd	Aquabac	22.75	3.792	Blower
Jul	5	Golf Course	Aquabac	127.4	21.233	Blower
Jul	9	Adolph Johnson Rd	Aquabac	2.37	0.395	Blower

Jul	9	Adolph Johnson Rd	Aquabac	2.37	0.395	Blower
Jul	9	1321 Hartley Rd	Aquabac	4.55	0.758	Blower
Jul	13	Wiseman Rd	Aquabac	9.1	1.517	Blower
Jul	13	Upper Golden Donald Rd	Aquabac	9.1	1.517	Blower
Jul	25	4364 Adair Rd	Aquabac	4.55	0.758	Blower
Jul	25	Pat Stabo Property	Aquabac	4.55	0.758	Blower
Jul	31	1735 Oberg Johnson	Aquabac	18.2	3.033	Blower
Aug	6	Al Bercham	Aquabac	18.2	3.033	Blower
Sep	5	Reflection Lake	Aquabac	36.4	6.067	Blower
Sep	7	Golf Course	Aquabac	18.2	3.033	Blower
May	13	HD & Blaeberry School	Aquabac	2.28	0.380	Hand
May	18	end of Golden Upper Rd	Aquabac	13.65	2.275	Hand
May	29	Hwy 1 W by scale	Aquabac	4.55	0.758	Hand
Jun	4	Adolph Johnson	Aquabac	9.1	1.517	Hand
Jun	4	Upper Golden Donald - Willex	Aquabac	4.55	0.758	Hand
Jun	18	Upper Golden Donald - Duce Property	Aquabac	2.28	0.380	Hand

SUMMARY	Kilograms	Hectares
Total Hand	808	135
Total Aerial	7162	1685

Appendix II – Door Knocker Example

Front

Mosquito Service

Morrow BioScience Ltd. personnel were here to monitor the mosquito development site associated with your property. We have left this notice in the absence of confirmed access permission to or through your property. MBL staff will attempt to contact you by phone; however, it is possible that the Town of Golden does not have your contact information associated with this site.

Please refer to the back of this card for more information.

Morrow BioScience Ltd.

Back

Program Information

- The aim of this program is to catalogue and monitor significant bodies of standing water for the presence of mosquito larvae.
- Larvae are controlled with a bacterial pesticide under Pest Mgmt. Plan No. 742-0001-11/16

MBL Contact Information and Options

Email:

Phone:

Town of Golden Contact Information

Phone:

Fax:

Personal Protection Tips

- Wear long sleeves and long pants. Light colours and a loose fit protect from the sun and are less attractive to mosquitoes
- Repellents with DEET are the most effective. Read the label directions carefully before applying
- Limit outdoor activity when mosquitoes are the most active (usually dawn and dusk)

Mosquito Reduction Around Your Home

- Ensure all doors and windows have screens that are in good condition
- Change water in all outdoor containers at least every 4 days
- Report standing water to either the Town of Golden or to Morrow BioScience Ltd.

Morrow BioScience Ltd.

Project Contacts at Morrow BioScience Ltd.

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