Timberline Aquatics, Inc.

6 January, 2020

Mr. Toby Stuart
Freestone Aquatics, Inc.

RE: Abell Ranch Macroinvertebrate Study

Dear Mr. Stuart:

The following provides a brief evaluation of the benthic macroinvertebrates that were collected as part of your 2019 study on Abell Ranch.

Background

Benthic macroinvertebrates (aquatic insects and other stream dwelling organisms) are an important part of every functioning aquatic ecosystem. These organisms have adapted over thousands of years to specific aquatic conditions and are therefore sensitive to changes in habitat and environmental disturbances. Benthic macroinvertebrates also represent an important part of the food web because they utilize algae and other lower life forms for food, and ultimately provide a food source for larger aquatic organisms such as fish. Through evolutionary processes, benthic macroinvertebrates have evolved with specific physical characteristics to ensure their survival in a variety of aquatic conditions. Some examples include: specialized mouth-parts for feeding (scraping algae, etc.), stream-line body shape for high velocity waters (found in certain mayflies), and creating cases for protection (exhibited by many caddisflies). These aquatic adaptations (along with their relatively long life-cycle) make them vulnerable to any changes in the aquatic environment such as pollutants or sedimentation. This vulnerability also makes benthic macroinvertebrates an important tool when studying changes in aquatic ecosystems. The results provided by reliable benthic macroinvertebrate sampling and accurate identifications can provide valuable information regarding water quality and the health of the aquatic environment.

Methods

The processing of samples for this study included the sorting, identification, and enumeration of benthic macroinvertebrates. All macroinvertebrates were sorted from each sample and separated into coarse taxonomic groups. Specimens were identified to a taxonomic level that was based on the available physical characteristics using a dissecting microscope. In most cases, this level of identification was genus or species for mayflies, stoneflies, caddisflies and many dipterans.

4219 Table Mountain Place, Suite A ◈ Fort Collins, CO 80526
Phone: (970) 266-9222 ◈ Web: http://www.timberlineaquatics.com ◈ E-mail: drees@timberlineaquatics.com

General Comments

April 2019

All of the specimens collected from the three study sites at Abell Ranch were identified and enumerated, resulting in a total of 47 different taxa found in April of 2019 (Table 1). Each sampling location supported a relatively balanced and diverse aquatic community; however, some improvements were observed at the downstream study sites (Figures 1, 3, and 5). The macroinvertebrate community at the upstream site (Site 1) was dominated by true flies (Diptera), while beetles (Coleoptera) and mayflies (Ephemeroptera) were also well-represented. Farther downstream, there was a detectable shift in macroinvertebrate community structure resulting in: 1) greater proportions of caddisflies (Trichoptera) at the middle and lower sampling locations (Sites 2 and 3, respectively), and 2) an increase in the relative abundance of mayflies and stoneflies (Plecoptera) in a downstream direction. The middle and lower study sites also appeared to support higher densities of benthic macroinvertebrates (Table 1).

Overall, most of the aquatic macroinvertebrates collected as part of this study are known to be fairly common in Colorado rivers and streams. The orders of insects that are often considered most sensitive to habitat alterations (and/or pollution) include Ephemeroptera, Plecoptera, and Trichoptera. Representatives from these orders were found at each of the three study sites; however, greater proportions were found in the middle and downstream portion of the study area (Figures 1, 3, and 5). For example, the relative abundance of mayflies increased from 24.14% at Site 1 to 50.60% at Site 3, and the number of taxa representing this group also increased at the downstream study sites (Table 1).

Other insect orders, such as Diptera and Coleoptera, are expected to be more tolerant to disturbances, and these two orders comprised a larger portion of the macroinvertebrate community at the upstream site (Site 1). The taxon demonstrating the highest relative abundance at the upstream site (Site1) was the riffle beetle (*Optioservus* sp.), a Coleopteran constituting 15.52% of the macroinvertebrate community (Table 1). Farther downstream the percent composition of *Optioservus* sp. was reduced to 10.85% and 6.45% at Sites 2 and 3, respectively (Table 1). While *Optioservus* sp. continued to be well-represented at all study sites, the percent composition was reduced in the downstream portion of the study area due to an increase in the abundance of sensitive taxa.

The species list that was developed during April of 2019 provided an inventory of taxa that can be found during the spring season at the Abell Ranch. Sampling during other seasons may result in the detection of additional taxa or changes in the proportions of taxa as certain species progress through various life-stages. The information collected during April of 2019 provided baseline data that can be used in the assessment of future impacts or changes in habitat, water quality, etc.

Timberline Aquatics, Inc.

September 2019

Sampling continued in the fall (September) of 2019 to further evaluate the benthic macroinvertebrate communities at the three sites in the Abell Ranch study area. During September of 2019, these study sites collectively supported 50 different taxa in a relatively balanced and diverse aquatic community at each sampling location (Table 2). All three study sites supported similar aquatic communities that consisted mostly of mayflies and true-flies (Figures 2, 4, and 6). Mayflies in particular were well-represented at all three sites, and the percent composition of mayflies ranged from 42.37% at site Abell Lower to 54.78% at site Abell Upper. Stoneflies were poorly represented at all sampling locations during the fall season and this group was absent from the sample collected at Abell Middle. Apart from the reduction of stoneflies observed during the fall season, the variety of mayflies and caddisflies was an indication of relatively healthy aquatic conditions throughout the study area.

Other insect orders that are typically more tolerant to environmental disturbances are the Coleopterans (beetles) and the Dipterans (true-flies). These two groups were also well-represented at each of the three study sites; however, the percent composition of true-flies was highest in the middle and downstream portion of the study area during the fall season (Table 2).

Comparing macroinvertebrate data between seasons allowed for a more comprehensive evaluation of the aquatic community throughout the year. Seasonal shifts were observed at each of the study sites; however, most of the changes in macroinvertebrate community structure appeared to be related to natural changes in environmental conditions that occurred between the spring and fall seasons. Mayflies were well-represented during both seasons; however, the proportion of stoneflies in the samples decreased from the spring to the fall at all study sites (Figure 1 - 6). The number of mayfly taxa was also greater in the fall season, with 9 different taxa represented in the fall compared to five mayfly taxa that were observed during the spring season (Tables 1 and 2). Although some seasonal and spatial shifts were observed, all three sites remained supportive of relatively diverse and functioning aquatic communities during 2019.

Sincerely,

Timberline Aquatics, Inc.

David E. Rees
President
/dr

4219 Table Mountain Place, Suite A ◈ Fort Collins, CO 80526
Phone: (970) 266-9222 ◈ Web: http://www.timberlineaquatics.com ◈ E-mail: drees@timberlineaquatics.com

Timberline Aquatics, Inc.

Table 1. Macroinvertebrate data collected from three sites at South Platte River in April 2019.

South Platte River April 2019	Common Names	Abell Ranch Upstream	% Composition	Abell Ranch Middle	% Composition	Abell Ranch Lower	% Composition
Ephemeroptera							
Baetis (tricaudatus)	Blue-Winged Olive	15	8.62%	70	18.52%	67	13.51%
Ephemerella sp.	Pale Morning Dun	2	1.15%	12	3.17%	22	4.44%
Heptagenia sp.	Pale Evening Dun			1	0.26%	4	0.81%
Tricorythodes explicatus	Trico	25	14.37%	31	8.20%	81	16.33%
Paraleptophlebia sp.	Blue Quill			32	8.47%	77	15.52%
Plecoptera							
Claassenia sabulosa	Golden Stonefly	1	0.57%			3	0.60%
Isoperla sp.	Stripetail Stonefly	21	12.07%	49	12.96%	100	20.16%
Trichoptera							
Brachycentrus americanus	American Grannom	1	0.57%			1	0.20%
Culoptila sp.	Saddle-case Maker			20	5.29%	10	2.02%
Glossosoma sp.	Short-horned Sedge			1	0.26%		
Helicopsyche sp.	Speckled Peter	1	0.57%	13	3.44%	3	0.60%
Cheumatopsyche sp.	Little Sister Sedge			2	0.53%	3	0.60%
Hydropsyche occidentalis	Spotted Sedge	3	1.72%	25	6.61%	16	3.23%
Hydropsyche oslari	Spotted Sedge	1	0.57%				
Lepidostoma sp.	Little Brown Sedge					8	1.61%
Oecetis sp.	Long Horn Sedge			8	2.12%	6	1.21%
Diptera							
Chironomidae							
Cardiocladius sp.	Midge			1	0.26%		
Cricotopus/Orthocladius sp.	Midge	1	0.57%	2	0.53%	4	0.81%
Diamesa sp.	Midge	11	6.32%	3	0.79%		
Eukiefferiella sp.	Midge	16	9.20%	8	2.12%	9	1.81%
Lopescladius sp.	Midge					2	0.40%
Micropsectra/Tanytarsus sp.	Midge					1	0.20%
Microtendipes sp.	Midge	2	1.15%	2	0.53%	3	0.60%
Pagastia sp.	Midge	6	3.45%	9	2.38%	14	2.82%
Paracladopelma sp.	Midge			1	0.26%		
Parametriocnemus sp.	Midge	9	5.17%	4	1.06%	2	0.40%
Paratanytarsus sp.	Midge			1	0.26%		
Polypedilum sp.	Midge			1	0.26%		
Potthastia sp.	Midge	1	0.57%				
Synorthocladius sp.	Midge					2	0.40%
Thienemannimyia group	Midge	7	4.02%	3	0.79%	6	1.21%
Tvetenia sp.	Midge			8	2.12%		

4219 Table Mountain Place, Suite A ◈ Fort Collins, CO 80526
Phone: (970) 266-9222 ◈ Web: http://www.timberlineaquatics.com ◈ E-mail: drees@timberlineaquatics.com

Table 1. cont. Macroinvertebrate data collected from three sites at South Platte River in April 2019.

Other Diptera							
Simulium sp.	Black Fly	5	2.87%	4	1.06%	5	1.01%
Coleoptera							
Optioservus sp.	Riffle Beetle	27	15.52%	41	10.85%	32	6.45%
Zaitzevia parvula	Riffle Beetle	2	1.15%	1	0.26%	2	0.40%
Haliplus sp.	Crawling Water Beetle	1	0.57%				
Lepidoptera							
Petrophila sp.	Crambid Snout Moth	3	1.72%	8	2.12%	3	0.60%
Odonata							
Ophiogomphus sp.	Dragonfly	1	0.57%	1	0.26%		
Miscellaneous							
Atractides sp.	Water Mite	2	1.15%			3	0.60%
Sperchon sp.	Water Mite	5	2.87%	1	0.26%	1	0.20%
Caecidotea sp.	Cress Bugs	3	1.72%				
Hyalella azteca	Amphipod	2	1.15%	1	0.26%		
Physa sp.	Snail					2	0.40%
Helobdella sp.	Leech			1	0.26%	1	0.20%
Lumbricidae	Earthworm			5	1.32%	2	0.40%
Tubificidae w/out hair chaetae	Earthworm			7	1.85%	1	0.20%
Nematoda	Roundworm			1	0.26%		
Totals		**174**		**378**		**496**	

4219 Table Mountain Place, Suite A ◈ Fort Collins, CO 80526
Phone: (970) 266-9222 ◈ Web: http://www.timberlineaquatics.com ◈ E-mail: drees@timberlineaquatics.com

Table 2. Macroinvertebrate data collected from three sites at South Platte River in September 2019.

South Platte River							
September 2019		Abell Ranch Upstream	% Comp.	Abell Ranch Middle	% Comp.	Abell Ranch Lower	% Comp.
	Common Names						
Ephemeroptera							
Acentrella sp.	Tiny Blue-Winged Olive	2	0.56%	4	1.25%	1	0.32%
Baetis (tricaudatus)	Blue-Winged Olive	124	34.83%	79	24.61%	62	20.00%
Pseudocloeon dardanum	Tiny Blue-Winged Olive	7	1.97%	8	2.49%	15	4.84%
Ephemerella sp.	Pale Morning Dun	1	0.28%				
Serratella micheneri	Little Western Dark Hendrickson	3	0.84%	4	1.25%	2	0.65%
Heptagenia sp.	Pale Evening Dun					3	0.97%
Tricorythodes explicatus	Trico	45	12.64%	33	10.28%	43	13.87%
Choroterpes inornata	Dark Quill	2	0.56%	5	1.56%	3	0.97%
Paraleptophlebia sp.	Blue Quill	11	3.09%	3	0.93%	8	2.58%
Plecoptera							
Claassenia sabulosa	Golden Stone	2	0.56%				
Isoperla sp.	Stripetail	1	0.28%			3	0.97%
Trichoptera							
Brachycentrus americanus	American Grannom	1	0.28%	1	0.31%	1	0.32%
Culoptila sp.	Saddle-case Maker					1	0.32%
Helicopsyche sp.	Speckled Peter			1	0.31%	1	0.32%
Cheumatopsyche sp.	Little Sister Sedge	2	0.56%				
Hydropsyche occidentalis	Spotted Sedge	21	5.90%	18	5.61%	18	5.81%
Hydropsyche oslari	Spotted Sedge	4	1.12%	3	0.93%	1	0.32%
Hydroptila sp.	Varicolored Microcaddisfly	5	1.40%	7	2.18%	9	2.90%
Lepidostoma sp.	Little Brown Sedge					1	0.32%
Oecetis sp.	Long Horn Sedge	2	0.56%	3	0.93%	3	0.97%
Diptera							
Chironomidae							
Cardiocladius sp.	Midge	2	0.56%				
Cricotopus/Orthocladius sp.	Midge	1	0.28%	4	1.25%	4	1.29%
Eukiefferiella sp.	Midge	5	1.40%	24	7.48%	10	3.23%
Lopescladius sp.	Midge			1	0.31%	1	0.32%
Micropsectra/Tanytarsus sp.	Midge			1	0.31%		
Polypedilum sp.	Midge	4	1.12%	8	2.49%	2	0.65%
Rheocricotopus sp.	Midge	1	0.28%	1	0.31%		
Rheotanytarsus sp.	Midge					1	0.32%
Synorthocladius sp.	Midge	1	0.28%			2	0.65%
Thienemanniella sp.	Midge					1	0.32%
Thienemannimyia group	Midge	1	0.28%				
Tvetenia sp.	Midge	2	0.56%			1	0.32%

4219 Table Mountain Place, Suite A ◈ Fort Collins, CO 80526
Phone: (970) 266-9222 ◈ Web: http://www.timberlineaquatics.com ◈ E-mail: drees@timberlineaquatics.com

Table 2. cont. Macroinvertebrate data collected from three sites at South Platte River in September 2019.

Other Diptera							
Ceratopogoninae	Biting Midge					1	0.32%
Simulium sp.	Black Fly	65	18.26%	91	28.35%	91	29.35%
Coleoptera							
Optioservus sp.	Riffle Beetle	16	4.49%	7	2.18%	10	3.23%
Zaitzevia parvula	Riffle Beetle	1	0.28%			1	0.32%
Lepidoptera							
Petrophila sp.	Crambid Snout Moth	1	0.28%	1	0.31%	1	0.32%
Odonata							
Argia sp.	Damselfly	1	0.28%				
Ophiogomphus sp.	Dragonfly			1	0.31%		
Miscellaneous							
Atractides sp.	Water Mite	4	1.12%			1	0.32%
Sperchon sp.	Water Mite					1	0.32%
Pisidium sp.	Pea Clam					1	0.32%
Dugesia sp.	Flatworm	11	3.09%	4	1.25%	1	0.32%
Physa sp.	Snail	1	0.28%			1	0.32%
Erpobdellidae	Leech	1	0.28%				
Helobdella sp.	Leech	1	0.28%				
Lumbricidae	Earthworm	1	0.28%	1	0.31%		
Naididae	Earthworm			1	0.31%	3	0.97%
Tubificidae w/out hair chaetae	Earthworm	1	0.28%	7	2.18%	1	0.32%
Nematoda	Roundworm	2	0.56%				
Totals		**356**		**321**		**310**	

4219 Table Mountain Place, Suite A ◈ Fort Collins, CO 80526
Phone: (970) 266-9222 ◈ Web: http://www.timberlineaquatics.com ◈ E-mail: drees@timberlineaquatics.com

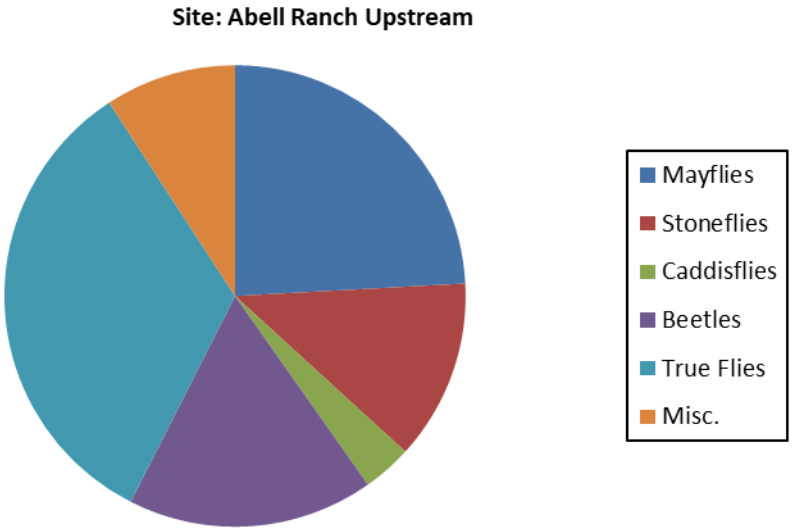

Figure 1. Percent composition of major benthic macroinvertebrate orders collected from Site 1 (Abell Ranch Upstream) on 9 April 2019.

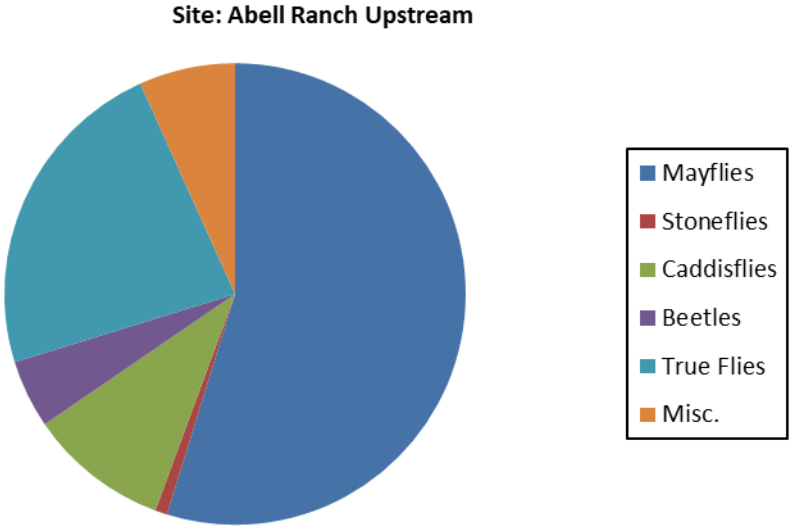

Figure 2. Percent composition of major benthic macroinvertebrate orders collected from Site 1 (Abell Ranch Upstream) on September 2019.

4219 Table Mountain Place, Suite A ◈ Fort Collins, CO 80526
Phone: (970) 266-9222 ◈ Web: http://www.timberlineaquatics.com ◈ E-mail: drees@timberlineaquatics.com

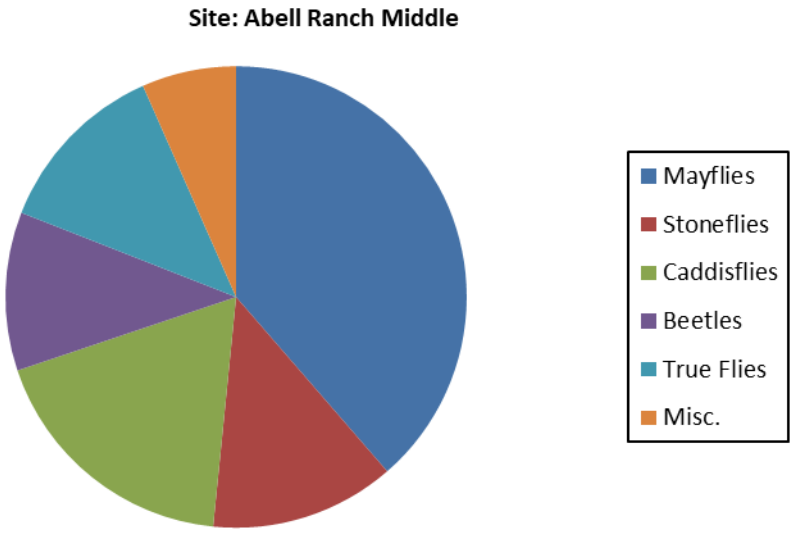

Figure 3. Percent composition of major benthic macroinvertebrate orders collected from Site 2 (Abell Ranch Middle) on 9 April 2019.

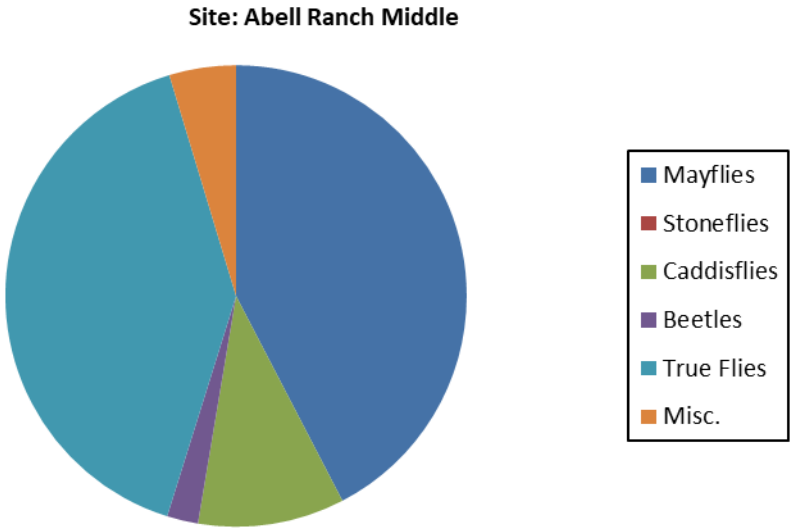

Figure 4. Percent composition of major benthic macroinvertebrate orders collected from Site 2 (Abell Ranch Middle) on September 2019.

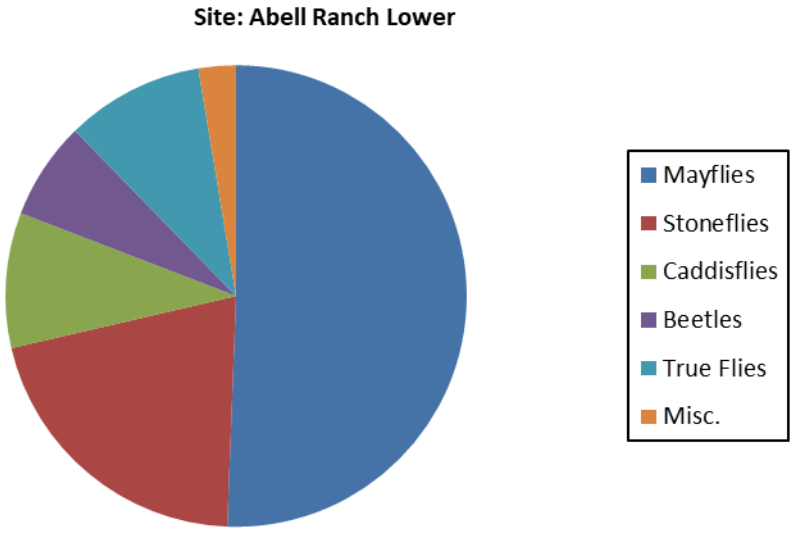

Figure 5. Percent composition of major benthic macroinvertebrate orders collected from Site 3 (Abell Ranch Lower) on 9 April 2019.

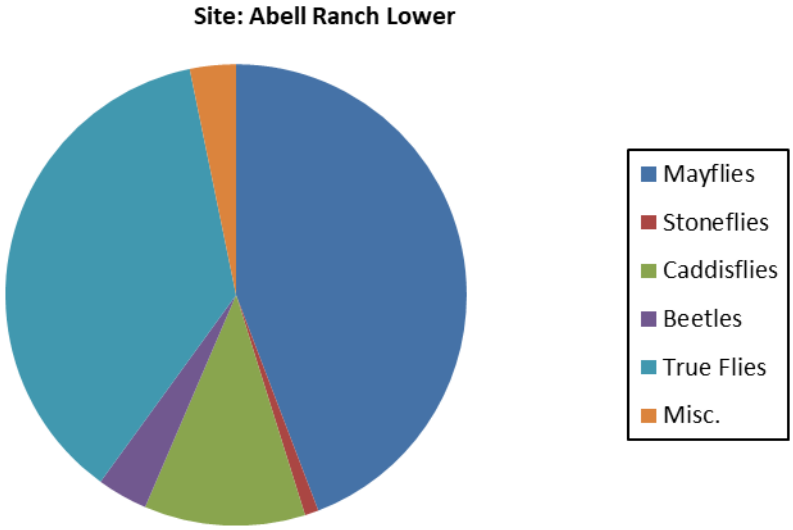

Figure 6. Percent composition of major benthic macroinvertebrate orders collected from Site 3 (Abell Ranch Lower) on September 2019.