2015
LOWER DESCHUTES RIVER MACROINVERTEBRATE HATCH ACTIVITY SURVEY RESULTS

DESCHUTES RIVER ALLIANCE

Prepared for Deschutes River Alliance
by Rick Hafele
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Last, thanks to all those not mentioned here who care about the Deschutes River and have contributed hours of their time to better understand the river's ecology, and to all those who have provided critical financial support to understand and protect its health.

A thing is right when it trends to preserve the integrity, stability and beauty of the biotic community. It is wrong if it trends otherwise.

Aldo Leopold in "Meditations from the Wilderness" edited by Charles A.E. Brandt

INTRODUCTION

In 2015, Deschutes River guides continued to monitor adult aquatic insect activity, and report their observations using an online survey form created for this purpose. Between March and October guides completed and filed online 127 survey reports. This report assesses the results of these surveys and continues the ongoing effort to monitor changes in aquatic insect populations in the lower 100 miles of the Deschutes River.

In the two previous macroinvertebrate survey reports (DRA 2014, 2015), we discussed the environmental factors that can have major impacts on the life cycles and survival of aquatic macroinvertebrates. Two factors that continue to be of concern in the lower Deschutes River - the 100 miles from the Reregulation Dam of the Pelton-Round Butte Dam complex (PRB) to its confluence with the Columbia River - are higher water temperatures and extensive growth of unfavorable algae that have been occurring since the Selective Water Withdrawal Tower (SWW) at Round Butte Dam began operation in January 2010.

Under the new operation of the SWW, 100% surface water is released from Lake Billy Chinook (LBC) from November until mid to late May, and then a mix of bottom and surface water is released until November (Campbell 2015). This change from the year-round release of 100% bottom water prior to 2010, has resulted in warmer water temperatures in the lower Deschutes River during the late winter, spring, and early summer, with little or no cooling of water temperature from mid summer through fall (Figure 1). In addition, water quality studies by Oregon Department of Environmental Quality (DEQ) in the Crooked, Deschutes, and Metolius basins identified water quality in the Crooked and Deschutes rivers above LBC as “poor” and Metolius River as “excellent” (DEQ 2011). Since Crooked River water is warmer than the Metolius, surface water in LBC is primarily poor quality Crooked River water, while high quality Metolius River water stays along the bottom of the reservoir (DRA 2016).

It is well known that algal and aquatic invertebrate communities respond to changes in water quality (Bellinger & Sigee 2010, Hauer & Lamberti 2006). Therefore, one would expect the release of warmer, lower quality water from

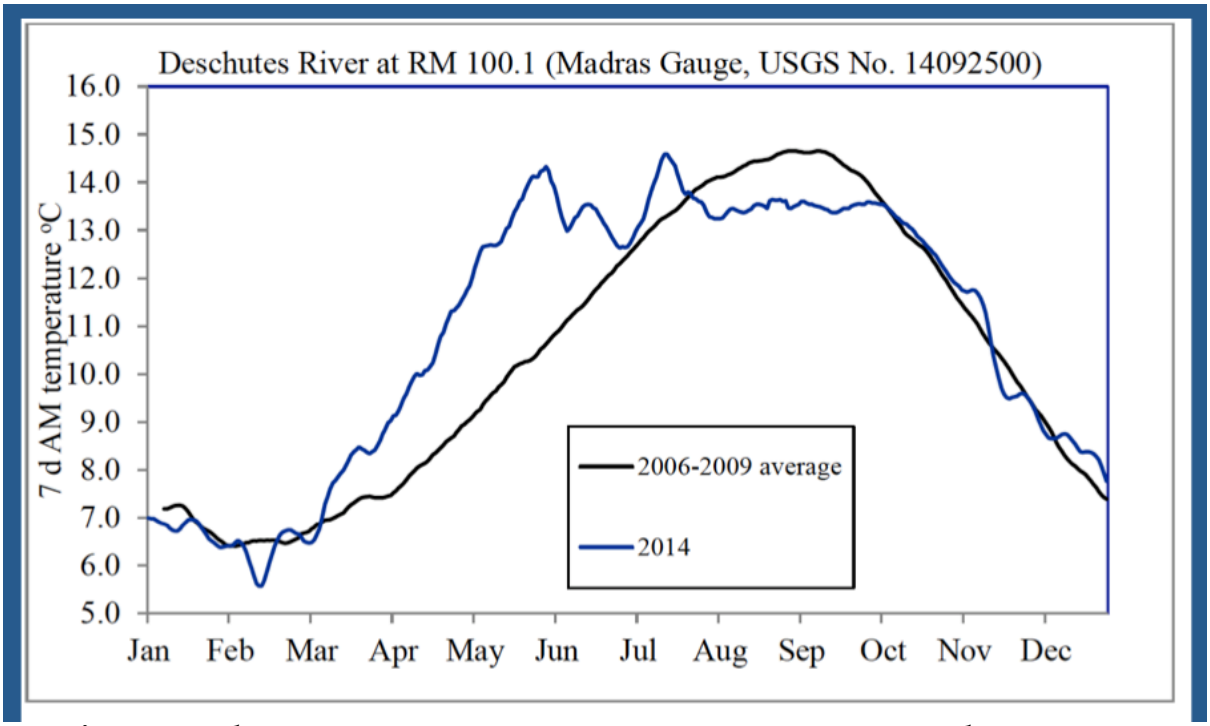

Figure 1: 7-day average maximum water temperature at Reregulation Dam tailrace in 2006-2009 (average), compared to observed 7-day average maximum temperature in 2014. (From Campbell 2015)

LBC to have some effect on the algal and insect communities in the lower Deschutes River. One change widely observed by guides and anglers of the Deschutes River since the SWW began operation is the prolific growth of algae, which includes two species of stalked diatoms that both degrade habitat and reduce the food available for macroinvertebrates (Figure 2).

Figure 2: Example of prolific algal growth on substrate in lower Deschutes River. Photo taken 1-mile below Rereg dam on April 1, 2016.

The ongoing observations of adult aquatic insect activity by highly experienced guides, continue to document adult insect activity throughout the seasons and provide a qualitative assessment of changes in timing and abundance of major insect hatches in the lower Deschutes River. These results not only provide information about changes to the insect community, but, because aquatic insects are a critical part of the food chain for both aquatic and terrestrial wildlife, they also provide important insights about the overall health of the lower Deschutes River ecosystem.

Beginning in the fall of 2015, the DRA also began routine sampling of the benthic, or stream bottom, invertebrate community using standard DEQ/EPA methods at two sites; Dizney Riffle, one mile below the PRB complex, and at Kaskela, 20 miles downstream. Samples were first collected in October 2015, then again in February, 2016, and will continue every other month through the summer of 2016. These data will be used along with the adult abundance data to identify any shifts in species composition and abundance, and will look closely at how the prolific growth of stalked diatoms might be impacting the aquatic invertebrate community.

SURVEY METHODS 2015

The surveys in 2015 continued to use the online app developed in 2014 for recording and reporting survey results. Observations can be recorded for 17 different adult insects found on the lower Deschutes River (Table 1). For each taxa observed the level of abundance was recorded as either a "0" indicating none were observed, "1" as low numbers observed, "2" as moderate numbers seen, or "3" indicating high numbers were observed. Additional information covering date, location, weather, temperature (air and water if available), and fish activity was also recorded. To assure consistency in identification of specific adults, an all-day identification training session was held in Maupin, Oregon, on March 28, 2015, for all interested guides.

TABLE 1. Major hatches covered by surveys

MAYFLIES	STONEFLIES	CADDISFLIES	DIPTERA
Baetis sp. (Blue-winged Olive)	*Pteronarcys californica* (Salmonfly)	Brachycentridae (American Grannom)	Chironomidae (Midges)
Ephemerella excrucians (Pale Morning Duns)	*Hesperoperla pacifica* (Golden Stone)	*Rhyacophila* sp. (Green Rock Worms)	*Antocha* sp. (Crane Fly)
Heptagenia sp. (Pale Evening Duns)	Perlodidae (Yellow Sallies)	*Glossosoma* sp. (Saddle-case Caddis)	
Drunella grandis (Green Drake)	*Claassenia sabulosa* (Fall Stone)	*Hydropsyche sp.* (Net-spinning Caddis)	
Paraleptophlebia sp. (Mahogany Duns)		Hydroptilidae (Micro Caddis)	
		Dicosmoecus sp. (October Caddis)	

In 2015 a total of 127 survey forms were completed and uploaded to the online database. This compares to 100 surveys in 2014, and 33 in 2013 (note: the online app first become available in 2014). The number of surveys recorded by month in 2015 was as follows: March = 4 records; April = 11; May = 27; June = 25; July = 33; August = 19; September = 6; October = 2.

It is recognized that these surveys do not provide *quantitative* data on adult insect abundance. To gather such quantitative information would require complex sampling methods and a budget beyond the reach of a small non-profit organization such as the DRA. However, the survey data shown here still provides valuable information over extended periods of time (almost 8 months in 2015), and is the only information being collected that documents changes in adult emergence timing and abundance.

A more quantitative study of the benthic, or stream bottom, invertebrate community has recently been completed for PGE by R2 Resource Consultants, Inc. (Nightengale et.al. 2016). Like all benthic studies, the R2 study assessed only the nymphal and larval stages of aquatic invertebrates, and only in the spring (April/May) and fall (October). Benthic studies, when implemented and analyzed correctly, can provide important information about stream conditions and water quality (Rosenberg & Resh 1993). They do not, however, evaluate changes in adult insect emergence timing, or adult insect abundance over an extended period of time. That is the strength and importance of the survey data described in this report.

To maximize the accuracy and consistency of information gathered for these surveys, the surveys were completed only by guides with extensive experience fishing and observing hatch activity on the lower Deschutes River. In addition an identification training session was held for guides, and an identification guide for the Deschutes River was provided (Hafele 2015) for reference after the training session.

RESULTS & DISCUSSION

Results for 2015 are summarized in Tables 2-7. As noted in the Methods section a total of 127 surveys were submitted by guides in 2015. Table 2 provides an overview of abundance observations for the four major orders of insects: mayflies (Ephemeroptera), stoneflies (Plecoptera), caddisflies (Trichoptera), and Diptera. Because each order has multiple species being observed and recorded, the total number of observations for each order will add up to more than 127.

Results in 2015 generally showed lower abundance for most of the major insect hatches compared to 2014 and 2013 (see details under discussion for each Order later in report), with the majority of adult insect activity observed recorded as "0" (none observed) or "1" (low abundance), and very few recorded as "3" (high abundance) for any of the major insect orders (Table 2). Caddisflies had the highest abundance of adults observed with 46% of observations reported as "low" abundance, 43% reported as "moderate" abundance, and 16% as "high" abundance. Mayflies and stoneflies showed some of the lowest abundance:

TABLE 2. Summary table of adult abundance for the four major insect orders.
0 = none observed 1 = low abundance 2 = moderate abundance 3 = high abundance

	Mayfly Adults	Stonefly Adults	Caddis Adults	Diptera Adults
Total # of surveys submitted	127	127	127	127
# of observations with 0's recorded	56 = 44%	81 = 64%	8 = 6%	63 = 50%
# of observations with 1's recorded	57 = 45%	27 = 21%	59 = 46%	21 = 17%
# of observations 2's recorded	29 = 23%	28 = 22%	54 = 43%	28 = 22%
# of observations with 3's recorded	2 = 1.6%	4 = 3%	20 = 16%	15 = 12%
Data records range from March 26 to October 7, 2015 March - 4 records; April - 11; May - 27 records; June - 25 records; July - 33 records August - 19 records; Sept - 6 records; October - 2 records				

Stoneflies had the highest percent with no adults observed (64%), while mayflies had the lowest percent of observations noted as high abundance (1.6%).

To assess differences, if any, in insect activity from Warm Springs to the mouth of the Deschutes, the survey broke the river into the following six reaches that guides used to describe their location.

1) Warm Springs Bridge boat ramp to Trout Creek boat ramp
2) Trout Creek boat ramp to Whitehorse campground (just above Whitehorse rapid)
3) Whitehorse campground to Harpham boat ramp
4) Harpham boat ramp to Sandy Beach boat ramp
5) Pine Tree boat ramp to Mack's Canyon boat ramp
6) Mack's Canyon boat ramp to the mouth

The number of surveys submitted in 2015 makes it possible to look at the results in each of these reaches individually, with one exception; reach 2, Trout Creek to Whitehorse campground, had only one survey reported during 2015. This is not enough data to make useful comparisons to other reaches, so it is not included in this analysis.

Table 3 shows the total number of surveys submitted for each reach, as well as the dates from which information was collected (survey dates are shown in "( )" under each reach name). For example, in the reach from Harpham to Sandy Beach 38 surveys were submitted within a date range from March 30, to October 7. The greatest number of surveys were recorded in the Pine Tree to Mack's Canyon reach (50), followed by the Harpham to Sandy Beach reach (38). The fewest were recorded in the Whitehorse to Harpham reach (6), followed by Mack's Canyon to the mouth (11) and Warm Springs to Trout Creek (21). Since the number of surveys recorded in each reach was different, to compare results between reaches the abundance results are reported as a percent of the number of surveys submitted for that reach. Because several species was assessed within each order, the total percent of adult activity for each order within a reach will add up to more than 100 percent.

TABLE 3. Summary table of River Section hatch abundance.

0 = none observed 1 = low abundance 2 = moderate abundance 3 = high abundance

	Warm Springs to Trout Creek (4-29/9-19)	Whitehorse to Harpham (3-26/6-30)	Harpham to Sandy Beach (3-30/10-7)	Pine Tree to Mack's Canyon (3-26/8-31)	Mack's Canyon to Mouth (4-29/8-12)
# of surveys submitted for each reach	21	6	38	50	11
% Mayfly Abund = 0	24	50	29	54	82
% Mayfly Abund = 1	67	50	47	40	18
% Mayfly Abund = 2	19	33	29	14	18
% Mayfly Abund = 3	10	0	0	0	0
% Stonefly Abund = 0	67	33	63	66	73
% Stonefly Abund = 1	10	50	21	30	9
% Stonefly Abund = 2	24	17	32	12	27
% Stonefly Abund = 3	14	0	0	0	0
% Caddisfly Abund = 0	14	17	11	6	0
% Caddisfly Abund = 1	71	50	58	40	9
% Caddisfly Abund = 2	38	33	39	50	55
% Caddisfly Abund = 3	14	17	11	14	45
% Diptera Abund = 0	42	33	71	46	18
% Diptera Abund = 1	10	33	18	16	18
% Diptera Abund = 2	14	17	5	28	64
% Diptera Abund = 3	33	17	5	10	0
Data records range from March 26 to October 7, 2015 March - 4 records; April - 11; May - 27 records; June - 25 records; July - 33 records August - 19 records; Sept - 6 records; October - 2 records					

Note: Because there are individual observations for several species within each order, the total percent of observations within each order is greater than 100%.

Adults of all four major orders were observed in all five reaches, but differences between reaches can be seen. Mayflies, for example, had the highest abundance recorded at the upper most reach (Warm Springs to Trout Creek) where 10% of observations were noted as "high" abundance. This was the only reach where high abundance of mayflies was observed. The lowest abundance of mayflies was recorded in the farthest downstream reach (Mack's Canyon to Mouth), with 82% (9 out of 11) of surveys submitted indicating that no mayflies were seen.

Stonefly abundance did not vary as much between reaches, however, the upper most reach was the only section of river were high abundance was observed in 2015 (14% noted as "high"). The lowest reach, Mack's Canyon to Mouth, had the lowest abundance of stoneflies observed with 73% (8 out of 11) of surveys recording that no stoneflies were present.

Caddisfly abundance showed a different pattern from upstream to downstream than either mayflies or stoneflies. The greatest abundance of caddisflies was observed in the lowest reach of the river from Mack's Canyon to the mouth, where 55% of observations were noted as "moderate" abundance, and 45% as "high" abundance. The remaining reaches had relatively similar results with the majority of observations noted as "low" abundance, while "high" abundance ranged from 11% to 17% of the surveys.

The results for Diptera reflect only the abundance of the family Chironomidae or midges. The reason is that the other common Diptera listed on surveys is the crane fly *Antocha* sp. In 2015, *Antocha* was not observed in any reach throughout the entire season. As mentioned in previous reports, adult *Antocha* crane flies were once common and often abundant along the entire 100 miles of the lower Deschutes River from late June through August. Since the SWW tower began operation this species has all but completely disappeared.

The abundance of chironomids was highest in the upper most reach where 33% of the surveys recorded their abundance as high. The lowest abundance of chironomids appeared to be in the reach from Harpham to Sandy Beach. In this section 71% of surveys observed no chironomid adults. Chironomids were generally present in moderate numbers in the other reaches, with the lowest

reach from Mack's Canyon to the mouth showing the highest percent with "moderate" abundance (64%).

While information about the different insect orders provides a broad picture of insect activity, the activity of specific insects within each order provides a more detailed understanding of changes in adult insect numbers. The following discussion summarizes the results for each of the major hatches within each order.

MAYFLIES (EPHEMEROPTERA)

Six major mayfly hatches were listed on the survey forms and are summarized here (Table 4). Some, such as the March Browns (*Rhithrogena morrisoni*), emerge relatively early in the spring (mid March to late April) before a large number of surveys were completed. As a result, the data for March Browns may not reflect the full range of activity. In addition, the emergence period for different mayfly species varies, and does not cover the entire survey period from late-March to late-October. To account for this, the only surveys used to assess an individual hatch were those taken during their typical emergence period. As a result the number of surveys used to assess each hatch is different. That number is shown on Table 4 for each hatch, and ranged from 15 surveys for March browns, up to 127 surveys for blue-winged olives (BWOs).

The pale morning dun (*Ephemerella excrucians*) has typically been one of the most common and abundant mayflies in the lower Deschutes River, and its hatches can produce some of the best dry-fly fishing of the season. In 2015, 111 surveys were reported during its typical emergence period. The results found 19% of surveys recorded low abundance, 17% with moderate abundance, and just 2% with high abundance. Sixty-two percent of the

Photo by Rick Hafele

Pale Morning Dun (*Ephemerella excrucians*)

TABLE 4. Summary table of mayfly hatch abundance.
0 = none observed 1 = low abundance 2 = moderate abundance 3 = high abundance

	Blue-winged Olives	Pale Morning Duns	Pale Evening Duns	Green Drakes	Mahogany Duns	March Browns
Feeding Guild	Collector/ gatherer	Collector/ gatherer	Scrapers	Scrapers	Collector/ gatherer	Scraper
Total # of surveys with expected presence	127	111	96	37	46	15
% of surveys with none recorded	73%	62%	74%	89%	98%	67%
% with low #'s (1)	20%	19%	21%	11%	2%	20%
% with moderate #'s (2)	6%	17%	5%	0	0	13%
% with high #'s (3)	0	2%	0	0	0	0
Data records range from March 26 to October 7, 2015 March - 4 records; April - 11; May - 27 records; June - 25 records; July - 33 records August - 19 records; Sept - 6 records; October - 2 records						

surveys recorded no PMDs during the period they'd be expected to occur. These results are lower than those recorded in 2014, which found 35% with no PMDs observed, and indicates a continued decline in the PMD population in 2015.

Pale evening duns (PEDs) (*Heptagenia* sp.) also showed lower numbers of adults in 2015 compared to 2014. Out of 96 surveys submitted in 2015 during their emergence period, 0% were noted as high, just 5% as moderate, 21% as low, and 74% with no adults observed. In 2014, 39% of surveys reported no PED adults and the rest indicated low or moderate numbers.

Photo by Rick Hafele

Pale Evening Dun (*Heptagenia* sp.)

Historically PEDs, while generally not as abundant as PMDs, often occurred in moderate to large numbers from early June until late July.

The remaining three mayflies recorded on the surveys - blue-winged olives (*Baetis* sp.), green drakes (*Drunella grandis*), and mahogany duns (*Paraleptophlebia* sp.) - were all observed in low numbers. Mahogany duns, for example, were almost completely absent in 2015 with only 2% of surveys noting low abundance of adults, and the rest (98%) reporting no adults present. Similar results were observed for green drakes, with 89%of surveys (33 out of 37 surveys submitted during green drake emergence period) reporting no green drake adults, and the remaining 11% recording low numbers of green drakes. The four observations of green drake adults were all recorded in May, and in the section of river from Harpham boat ramp to Sandy Beach.

Photos by Rick Hafele

Blue-winged Olive (*Baetis* sp.)

Green Drake (*Drunella grandis*)

Mahogany Dun (*Paraleptophlebia*)

Species of the genus *Baetis*, or Blue-winged olives (BWOs), are some of the most prolific mayflies in streams throughout Oregon and the West, including the Deschutes. Good BWO emergence often occurs in late winter and early spring as well as late fall, outside the window in which the surveys were collected. As a result these surveys don't provide a complete picture for BWO abundance. However, BWO adults were recorded in all five reaches of the river, and in every month that surveys were completed from March through October. The results show that the majority of surveys (73%) saw no BWO adults during those months. Of those surveys that did see BWO adults, none were observed in high abundance, with the rest reported as low (20%) or moderate (6%).

Overall, the results for mayflies in 2015 show a general decline from 2014 (Figure 3). This is best shown by the percent of surveys that recorded no adults for the different mayfly hatches. In 2014 the percent with no adults observed

ranged from 35% for PMDs, up to 76% for BWOs. In 2015 the range was from 62% (PMDs) up to 98% (Mahogany duns). Unfortunately this continues the trend of low adult emergence of some the most important mayfly species on the river.

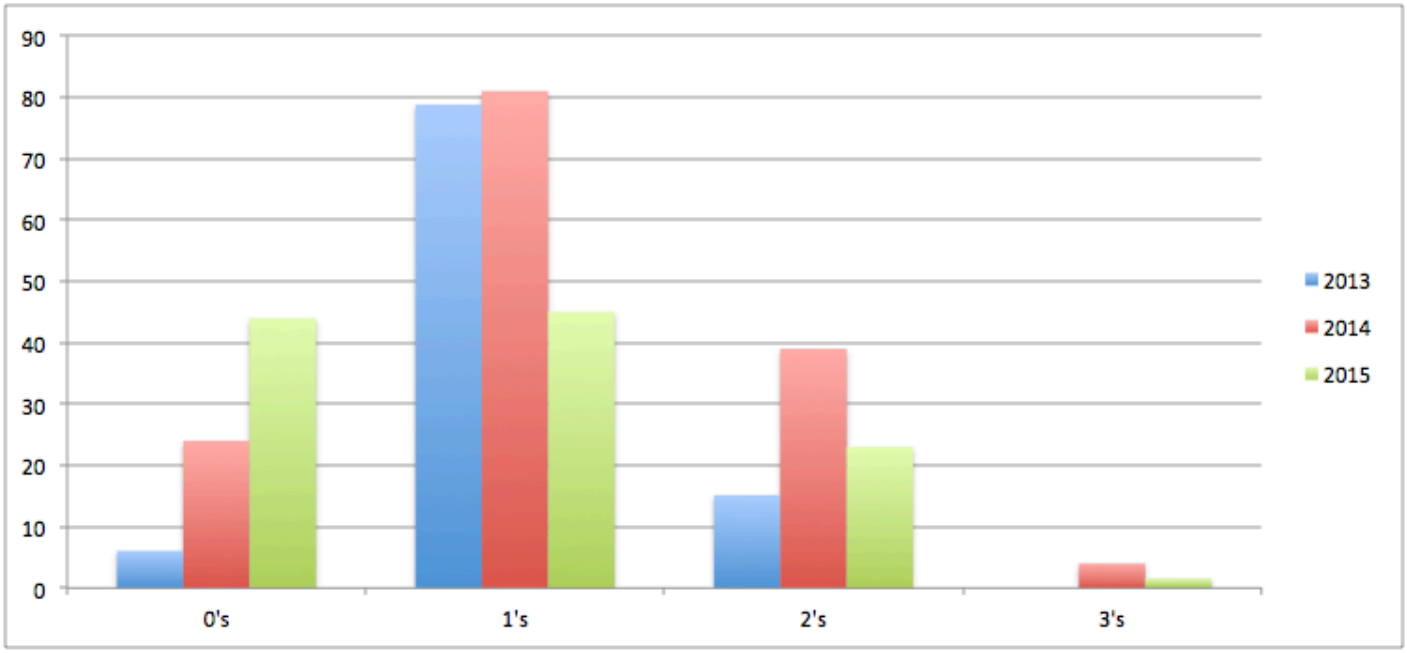

Figure 3. Comparison of percent mayfly adult abundance for all hatches between years: 2013, 2014, and 2015. 0 = no adults observed; 1 = low numbers observed; 2 = moderate numbers observed; 3 = high numbers observed.

STONEFLIES (PLECOPTERA)

Six different stoneflies are covered by the surveys, but results are only shown for three (Table 5). That's because two groups, the spring stone (*Skwala americana*) and the little brown stones (families Nemouridae, Capniidae, and Leuctriidae) primarily emerge as adults outside the period when surveys were collected, and the fall stone (*Claassenia sabulosa*) is a short-winged flightless stonefly that emerges from mid-September to late October. Because it is flightless and tends to hide in shoreline vegetation during the day, it commonly goes unseen. As a result the data for these stoneflies do not accurately reflect their presence on the river. That leaves three stoneflies with enough information to provide an assessment of their abundance: salmonflies (*Pteronarcys californica*), golden stones (*Hesperoperla pacifica*), and yellow sallies (several species in the family Perlodidae).

TABLE 5. Summary table of stonefly hatch abundance.
0 = none observed 1 = low abundance 2 = moderate abundance 3 = high abundance

	Salmonfly	Golden Stone	Yellow Sallies
Feeding Guild	Shredder	Predator	Predator
Total # of surveys with expected presence	40	40	74
% of surveys with none recorded	25%	31%	50%
% with low #'s (1)	25%	15%	23%
% with moderate #'s (2)	43%	55%	27%
% with high #'s (3)	7%	10%	0
Data records range from March 26 to October 7, 2015 March - 4 records; April - 11; May - 27 records; June - 25 records; July - 33 records August - 19 records; Sept - 6 records; October - 2 records			

The first observed adults of salmonflies and golden stones was on April 26th, in the Pine Tree to Macks Canyon reach of river. Adults of both species were last observed on June 3rd, in the Warm Springs to Trout Creek reach. A total of 40 surveys were submitted during this period. The results in 2015 compared to 2014 for salmonflies and golden stones are somewhat mixed. The percent of reported adults in high abundance was down in 2015 compared to 2014 for both species: 7% high abundance for salmonflies in 2015 compared to 17% in 2014, while golden stones had 10% reported high in 2015, and 14% in 2014. On the other

Photos by Rick Hafele

Salmonfly (*Pteronarcys californica*)

Golden Stone (*Hesperoperla pacifica*)

hand, the percent recorded as moderate abundance was higher in 2015, with 43% and 55% reported for salmonflies and golden stones, respectively, compared to 17% and 28% in 2014. The percent of surveys with no adults observed in 2015, was lower for salmonflies (25% in 2015; 41% in 2014), but higher for golden stones (31% in 2015; 5% in 2014). Overall, the majority of observations for both species were recorded as low or moderate, which is similar to the results in 2014.

Photo by Rick Hafele

Yellow Sally (family Perlodidae)

Yellow sallies is the common name applied to a number of stonefly species in the family Perlodidae. June and July is the historical time of year for peak adult activity of these stoneflies, but based on survey results they appear to be emerging earlier: the first adults were recorded on April 26th in the Pine Tree to Macks Canyon reach, and the latest was seen June 30th in the Whitehorse campground to Harpham boat ramp reach. A total of 74 surveys were submitted during the period of yellow sally adult activity.

Yellow sally adults were seen in all five reaches of the river. They appeared to be most common and abundant in the reach from Harpham to Sandy Beach, but also common in the Pine Tree to Macks Canyon reach. The Macks Canyon to mouth reach recorded the fewest number (only observed twice in moderate numbers). While widespread in the river, the numbers of adults were characterized primarily as low (23% of surveys) or moderate (27%), with none reported as high abundance, compared to 3% as high in 2014. No adults were seen in 50% of the surveys. These results show a slight decline from 2014 (43% reported zero adults in 2014).

Like mayflies, overall stonefly adult abundance reported in 2015 was lower compared to 2014, with 64% of surveys reporting no stonefly adults in 2015, compared to 51% reporting no adults in 2014 (Figure 4).

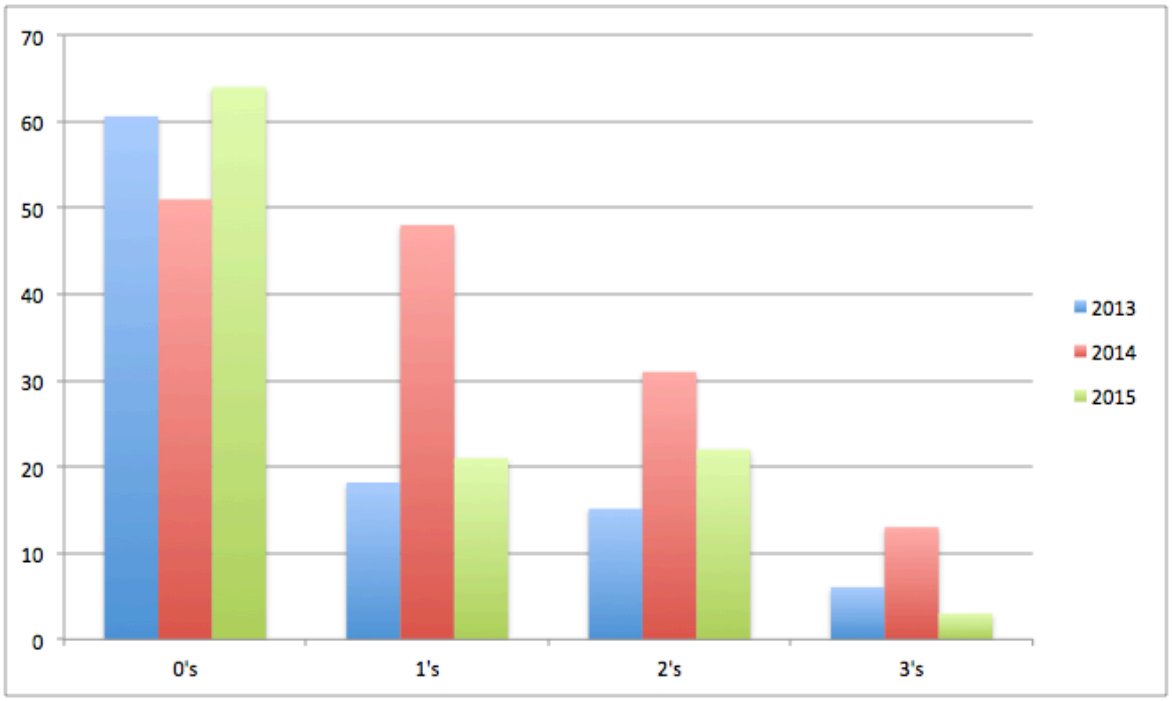

Figure 4. Comparison of percent stonefly adult abundance for all hatches between years: 2013, 2014, and 2015. 0 = no adults observed; 1 = low numbers observed; 2 = moderate numbers observed; 3 = high numbers observed.

CADDISFLIES (TRICHOPTERA)

In 2015, caddisflies were once again the most common order of adults recorded on the surveys with just 6% of the surveys showing no adults present (Table 2). Six different caddisfly taxon were recorded by the surveys (Table 6). Five of the six (exception October caddis) were observed in all reaches of the river. Saddle-case caddis were recorded every month of the 2015 study (late March - early October). The least common caddis was the October caddis (*Dicosmoecus* sp), which was noted on just three surveys, all from the Harpham to Sandy Beach reach. Two of the three noted their abundance as "low," and one as "moderate." October caddis, as their name implies, is a late fall hatch usually beginning on the Deschutes in mid September and lasting until late October. Only eight surveys were submitted for September and October, with seven from the Harpham to Sandy Beach reach and just one from Warm Springs to Trout Creek. As a result the data don't adequately represent the presence of October caddis in the rest of the river.

TABLE 6. Summary table of caddisfly hatch abundance.
0 = none observed 1 = low abundance 2 = moderate abundance 3 = high abundance

	American Grannom	Green Rock Worms	Net-spinning Caddis	Saddle-case Caddis	Micro Caddis	October Caddis
Feeding Guild	Filterer	Predator	Filterer	Scraper	Scraper	Scraper
Total # of surveys with expected presence	76	125	120	127	112	8
% of surveys with none recorded	91%	73%	23%	64%	81%	63%
% with 1's recorded	8%	9%	27%	22%	4%	25%
% with 2's recorded	1%	15%	34%	13%	11%	12%
% with 3's recorded	0	3%	16%	1%	4%	0
Data records range from March 26 to October 7, 2015 March - 4 records; April - 11; May - 27 records; June - 25 records; July - 33 records August - 19 records; Sept - 6 records; October - 2 records						

One caddis of particular concern and interest is the net-spinning caddis. This group of caddis is made up of several species in two different genera - *Hydropsyche* and *Cheumatopsyche* - both of the family Hydropsychidae. These caddisflies have historically produced prolific hatches throughout the summer (primarily from mid-June through mid August) along the entire hundred miles of the lower river. It was common for these caddis to approach nuisance levels in the late evening as they swarmed to lay eggs, and just as often swarmed campers' lanterns and ended up adding considerable protein to one's evening meal. Since the completion of the SWW however, such large swarms have been rare if not entirely missing along most of the river.

Photo by Rick Hafele

Net-spinning Caddis (*Hydropsyche* sp.)

Survey results in 2015, continue to show a reduced number of net-spinning caddis, even though they were one of the most commonly observed hatches on the river with 23% of the expected surveys listing no adults present (Table 6). Third, they were most common during the summer months with adults observed in 36%% of April surveys, 63% of May surveys, 84% of June surveys, 94% of July surveys, 89% of August surveys, and 33% of September surveys. The presence of adults in April and May (the earliest recorded adult was April 20th) suggests emergence is starting earlier, but the bulk of adult activity was in June, July, and August. Sixteen percent of the surveys recorded adults present in high numbers. While this is the highest of all caddis, it still represents just 19 surveys with high numbers out of 120 surveys submitted during the April through September emergence period. Moderate and low numbers of adults were recorded in 34% and 27% of the surveys, respectively (Table 6). Though net-spinning caddis were widespread during the summer, the results reflect the general lack of large numbers of adults that were once common place. These results are very similar to those recorded in 2014.

Saddle-case caddis (*Glossosoma* sp.) are small caddis that often occur in large numbers. Their larval stage scrapes diatoms from the surface of cobble and boulder substrate in moderate to fast riffle habitat. This genus includes several species, and adults can be abundant in late winter and early spring before survey records began. Survey results, however, found them present throughout the seven month survey period and in all six reaches of the river, but not in large numbers. High numbers of adults were reported on just one occasion. The remaining surveys showed low numbers present 22% of the time, moderate numbers present 13%, and no adults seen on 64% of the surveys (Table 6). These are nearly identical to the results found in 2014. Because saddle-case caddis feed on diatoms in the same habitat being heavily grown over by stalk-forming diatoms that don't provide suitable food, their populations could easily be impacted.

Photo by Rick Hafele

Saddle-case Caddis (*Glossosoma* sp.)

Micro-caddis (family Hydroptilidae) include a variety of species that emerge over a widespread period with large numbers of adults typically common throughout the summer. They are even smaller than saddle-case caddis, but live in similar habitat and also feed by scraping diatoms from the substrate's surface. A total of 4% of surveys reported high numbers, 11% moderate numbers, 4% low numbers, and 81% had no adults reported (Table 6). This is a decline from results reported in 2014 (64% with no adults reported), but their small size can make them difficult to see. However, adults are quite active during the day and evening, and when abundant they can be a nuisance by flying around your face and swarming around camp lanterns and stoves.

Green rock worms (*Rhyacophila* sp.) and American grannoms (family Brachycentridae) both commonly emerge in the spring and fall, with some emergence occurring before surveys started. Therefore, these survey results don't represent their overall abundance. However, green rock worm adults should be present from March through May, and again in September and October. In 2015, they were reported in March through August with the highest abundance observed in April. Overall, 3% of surveys reported high abundance, 15% moderate, 9% low, and 73% none.

Photo by Rick Hafele

Green Rock Worm caddis (*Rhyacophila* sp.)

American grannom adults showed the largest decline compared to 2014, with 91% of surveys recording no adults (64% in 2014), 8% low abundance (27% in 2014), 1% moderate (9% in 2014). These results indicate continued depressed populations.

As previously mentioned, caddisflies were the most abundant adult aquatic insects of the those recorded on the Deschutes during the survey period, and for several hatches showed similar results when compared to 2014 (Figure 5). However, while they were widespread (found in all reaches of the river) and present throughout the entire survey period, the general lack of large numbers of adults is a continuing change from past conditions.

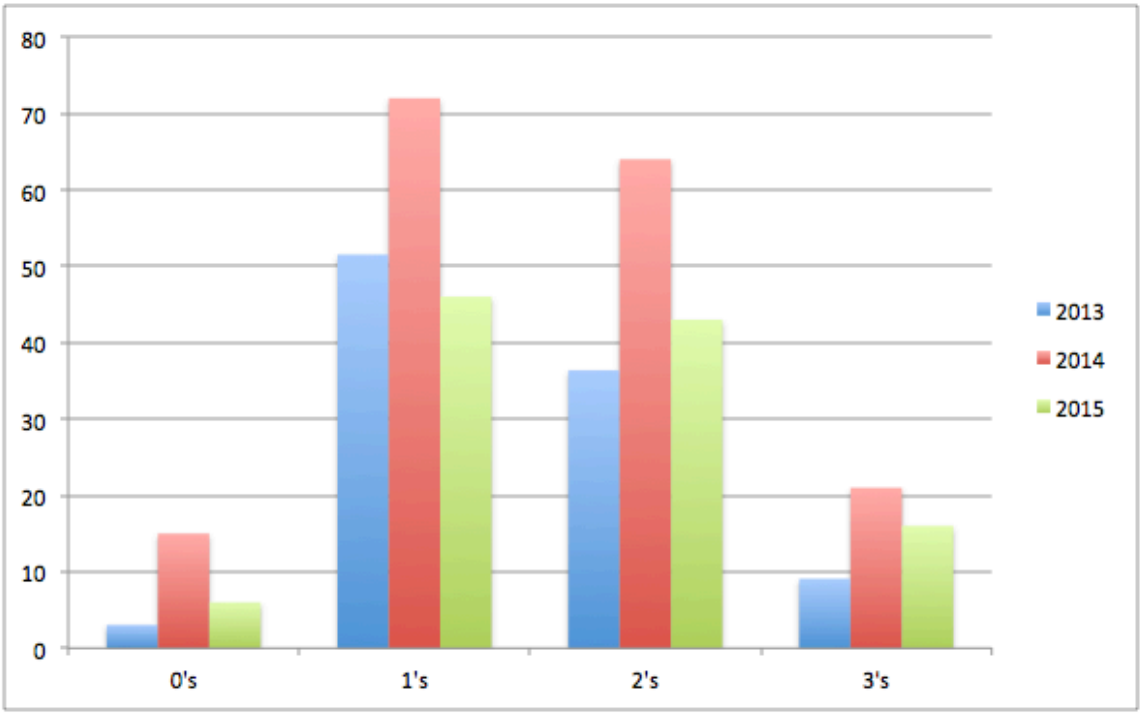

Figure 5. Comparison of percent caddisfly adult abundance for all hatches between years: 2013, 2014, and 2015. 0 = no adults observed; 1 = low numbers observed; 2 = moderate numbers observed; 3 = high numbers observed.

DIPTERA

Only two Diptera were reported on the surveys; midges (family Chironomidae), and the small crane fly of the genus *Antocha*. Midges include many different species that live and feed in a wide range of habitats in the river, and often occur in large numbers. However, because of the very small size of larvae and adults, they often go unseen and are easily overlooked. Results for midges show adults were not recorded in 50% of the surveys, but were noted as present in high numbers 12% of the time, and in moderate and low numbers in 22% and 16% of the surveys, respectively (Table 7). These results are nearly identical to the 2014 results (Figure 6). Adult midges were reported in all months surveyed except September and October, and from all river reaches.

TABLE 7. Summary table of Diptera hatch abundance.
0 = none observed 1 = low abundance 2 = moderate abundance 3 = high abundance

	Chironomids	**Crane Flies (*Antocha* sp)**
Feeding Guild	Varied	Collector/gatherer
Total # of surveys with expected presence	127	77
% with none recorded	50%	100%
% of 1's recorded	16%	0
% of 2's recorded	22%	0
% of 3's recorded	12%	0
Data records range from March 26 to October 7, 2015 March - 4 records; April - 11; May - 27 records; June - 25 records; July - 33 records August - 19 records; Sept - 6 records; October - 2 records		

The *Antocha* crane fly continues to show one of the most dramatic declines of any aquatic insect in the river following SWW implementation. In the years before SWW, *Antocha* adults were abundant along the entire lower river from June through August. In 2014, adults were observed in very low numbers on just

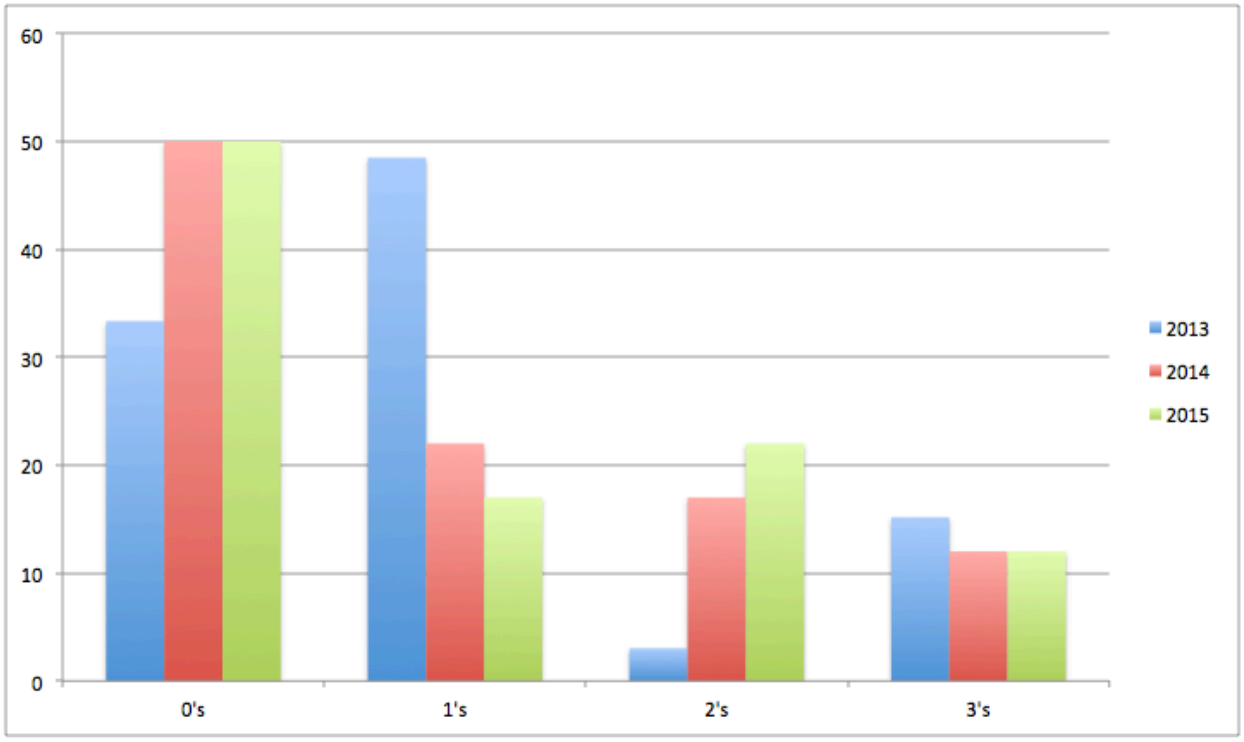

Figure 6. Comparison of percent chironomid (midge) adult abundance for all hatches between years: 2013, 2014, and 2015. 0 = no adults observed; 1 = low numbers observed; 2 = moderate numbers observed; 3 = high numbers observed.

three occasions; twice in the Harpham to Sandy Beach reach (once May 10, and once July 22), and once in the Mack's Canyon to mouth reach on August 14. In 2015, there were no reports of seeing any adult *Antocha*. This unusual decline indicates that *Antocha* is particularly sensitive to the changes that have occurred in the river. The specific reason for their sensitivity is not known, but *Antocha* lays its eggs in the splash zone of boulders and cobble protruding just above the water's surface. This habitat has been heavily impacted by stalked diatoms as well as the dense growth of other algal species such as *Cladophora*. These changes may be

Photo by Rick Hafele

Crane Fly (*Antocha* sp)

preventing successful egg laying or egg development by *Antocha*. The presence or absence of *Antocha* adults could provide an important and easily observed indicator of future river conditions.

It should be noted that the R2 study (Nightengale et. al. 2016) found a decline in *Antocha* numbers in both the Crooked River and Deschutes River above LBC in 2014-2016 when compared to 1999-2001, while no such decline was observed in the Metolius River. The R2 report concludes, "Most likely, this change is a result of a broader environmental pattern as opposed to a project-related effect" (page 100). An alternative conclusion is that the conditions that caused a decline in the Crooked and Deschutes rivers have now been passed downstream with the surface water into the lower Deschutes River. This is also indicated by another macroinvertebrate study from Whychus Creek (a tributary to the Deschutes River above LBC) that collected samples in 2005, 2009, and from 2011-2014, and found *Antocha* present throughout the study (Mazzacano 2015). The continued presence of *Antocha* in the Metolius River and Whychus Creek suggests that the large decline in the Crooked River and Deschutes River above LBC, and disappearance from the lower Deschutes River, is due to factors occurring in the Crooked and Deschutes rivers rather than a result of a broader environmental pattern.

SUMMARY

In 2015, Deschutes River guides submitted 127 surveys evaluating the abundance of adult aquatic insects. This continues the increase in surveys submitted from 2014 (100 surveys submitted), and 2013 (33 surveys submitted). This is largely due to the use of the online app developed for filling out and submitting the survey. Because of the increased number of surveys, the data in 2014 and 2015 provide a more complete picture of adult aquatic insect activity throughout the lower Deschutes River, and will help document how aquatic insects continue to respond to changes in water management in the lower Deschutes River.

The survey divided the lower hundred miles of the Deschutes into six reaches. Adults of the four major orders of aquatic insects (mayflies, stoneflies, caddisflies, and Diptera) were represented in all six reaches and in all months within the survey period; late-March through early October.

As in 2014, the results from 2015 show that aquatic adults are generally not abundant. The hatches with the largest percent of "high" numbers reported were net-spinning caddis (16%), midges (12%), and golden stoneflies (10%). Of all the mayflies reported (e.g. pale morning duns, pale evening duns, blue-winged olives) only pale morning duns were seen in high abundance (2%). In total, the abundance of mayfly and stonefly adults both showed a decline in 2015 when compared to 2014 (Figures 3 & 4). Caddisflies were again the most common adults reported, but they were also mostly observed in low to moderate numbers and often not seen at all: Depending on the species the percent of surveys without any caddis adults observed ranged from 23-91% (Table 6). The most common caddis was the net-spinning caddis (family Hydropsychidae). This is an iconic hatch on the Deschutes, and though large numbers of adults were observed, "high" abundance was noted on just 19 out 120 surveys (16%) collected during their emergence period. Other caddis showed much lower abundance.

Another question was, do differences in adult abundance exist along the length of the river from Warm Springs Bridge to the mouth? This was evaluated by breaking the river into six reaches. While the data are limited in some reaches, there were enough surveys in 2015 to look at possible differences between five of them. Differences were noted, but most were relatively small. Reach differences were most pronounced for mayflies and stoneflies, which had a higher abundance of adults reported from the upper most reach (Warm Springs to Trout Creek), and for caddisflies, which had their highest abundance observed in the lowest reach, Mack's Canyon to mouth. The remaining hatches show mostly similar results from the upper river to the lower river (Table 3).

Last, as described in the Diptera section, *Antocha* crane flies remain the most impacted aquatic insect on the river. Adults once could be seen throughout the summer along the entire lower river bouncing around streamside vegetation

and forming egg-laying swarms around the protruding tops of boulders near shore. Since SWW implementation they have virtually disappeared. In the surveys collected in 2015, no *Antocha* adults were reported being seen.

There is no direct evidence that link the low numbers of observed adults to a specific cause. However, changes in the algal community have also been observed since SWW implementation, particularly the proliferation of two previously unreported species of stalk-forming diatoms. These diatoms appear to negatively impact both habitat and food resources for many of the aquatic insects, including a possible disruption of egg laying habitat for *Antocha* crane flies. The continued proliferation of these algae appears to be linked to surface water withdrawal at Round Butte Dam, and possible changes in nutrient levels and other water quality conditions in the lower Deschutes River. PGE has been engaged in a two year study to assess such impacts, and has completed the first year of data collection, but has yet to provide any preliminary results. The Deschutes River Alliance has also started more in-depth monitoring of water quality parameters (pH, dissolved oxygen, temperature, turbidity, conductivity, and chlorophyll-a) in the lower river one mile below the Reregulation Dam tailrace. These data are being collected every hour using a state-of-the-art continuous data probe that was purchased through a very generous gift from a river property owner that has become very concerned about the ongoing decline in river conditions. Results from this data sonde will provide critical information about daily and seasonal water quality conditions.

Finally in 2015, guides and long-time anglers on the lower Deschutes River continued to comment on the widespread disappearance of insect feeding birds such as swallows and nighthawks, as well as bats. Swallows, for example, were such a common sight from spring through the summer one gave them little thought, and their nests often formed crowded colonies on cliffs near the river. In recent years, however, swallows have become rare enough that one is pleasantly surprised to see a few feeding over the river. The evening call of nighthawks, or the darting flight of bats at dusk, have also become rare events. Such changes clearly show the strong link between the river and the land, as well as how important the health of the river's aquatic life is to the entire ecosystem.

REFERENCES

Bellinger, E. G. and D. C. Sigee. 2010. *Freshwater Algae: Identification and Use as Bioindicators*. Wiley-Blackwell, Hoboken, NJ.

Campbell, L. 2015. Pelton Round Butte Project (FERC No. 2030) 2014 Water Quality Monitoring Report. Portland General Electric.

Deschutes River Alliance. 2014. 2013 Lower Deschutes River Macroinvertebrate Hatch Activity Survey Results.

http://images.wolfpk.com/deschutesriveralliance/pdf

Deschutes River Alliance. 2015. 2014 Lower Deschutes River Macroinvertebrate Hatch Activity Survey Results.

http://images.wolfpk.com/deschutesriveralliance/pdf

Deschutes River Alliance. 2016. 2015 Lake Billy Chinook Water Quality Study Results. http://images.wolfpk.com/deschutesriveralliance/pdf

Hafele, R. 2015. *Identification Guide to the Major Hatches of the Deschutes River*. Wilsonville, OR.

Hauer, F.R. and G. A. Lamberti (Eds.). 2006. *Methods in Stream Ecology* (2nd ed.). Academic Press, San Diego, CA.

Mazzacano, C. A. 2015. Effectiveness Monitoring in Whychus Creek; Benthic Macroinvertebrate Communities in 2005, 2009, and 2011-2014. Xerces Society, Portland, OR.

Nightengale, T., A. Shelly, and R. Beamesderfer. 2016. Final Report: Lower Deschutes River Macroinvertebrate & Periphyton Study. Prepared for PGE by, R2 Resource Consultants, Inc., Redmond, WA.

Oregon Department of Environmental Quality. 2011. Water Quality Status and Action Plan: Deschutes Basin. Updated Sept. 6, 2011, by Bonnie Lamb, 11-WQ-043.

Rosenberg, D. M. and V. H. Resh, eds. 1993. *Freshwater Biomonitoring and Benthic Macroinvertebrates*. New Your: Chapman & Hall.