Evaluation of Salmonflies in Montana's Rivers: Are Statewide Populations Really Declining?

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The fabled salmonfly hatch on Montana's rivers can be an exciting and frustrating angling experience all rolled into one; exciting because huge trout can be coaxed to the surface by giant dry flies (size 4 or 6's) and frustrating because, oftentimes, this sporadic hatch coincides with spring run-off, murky water and less than ideal fishing conditions. To add to the exasperation, a thousand like-minded fishermen from all parts of Montana and adjacent states are invading your favorite stretch of river. Successfully "hitting" the salmonfly hatch is both an art and a science; mixed with a lot of luck. Arrive too early and the fish are still focused on underwater nymphs; too late and the trout have stuffed themselves silly, already seen a thousand artificial stoneflies float overhead and are now extra selective when deciding to eat one more "floating steak", as I've heard these insects referred.

Background: Montana's rivers provide habitat for three salmonfly species: the famous, giant salmonfly (*Pteronarcys californica)*, the lesser known American salmonfly *(Pteronarcys dorsata)* and the smaller, least salmonfly (*Pteronarcella badia*) which can tolerate warmer water temperatures than the other two species. Ideal water temperature for *P. californica* development is 55.4-58º F, while *P. badia* is a presumably a few degrees warmer. These salmonfly species occur in many rivers across the state and co-occur in some (Figures 1 & 2, Appendix A & B), but only in a few rivers are they abundant enough to present anglers a worthwhile hatch. All three species have conservation ranks of G5 (NatureServe 2010), which means they are globally common and are yet to be ranked at the state level. Gaufin et al. (1972) cite the Missouri River in Cascade Co. as Montana's only distribution of the American salmonfly, but more recent studies report this species present in the lower Smith River as well (Bollman 2000). Salmonflies are easy to identify mostly by their tremendous size; these stoneflies (Order Plecoptera: Family Pteronarcyidae) often measure nearly three inches in length. As adults, they have a bright orange or red band behind the head and the underside of abdomen with broad wings containing dark veins. Salmonfly nymphs live on the bottom, crawling around on cobbles and feeding on large organic materials (leaves) in the spaces between rocks for three to sometimes four years. They require well-oxygenated water, so they thrive in swift, bouldery, riffly stretches of the river; narrow canyon reaches such as Yankee Jim Canyon of the Yellowstone, Alberton Gorge of the Clark Fork River, Big Hole Canyon between Glen and Wise River or Bear Trap Canyon of the Madison are ideal habitat.

Last season's tremendous salmonfly hatch on the Big Hole River surprised a lot of anglers in its extent and duration. "Many of our customers experienced their best success fishing the hatch in decades." said Roger Oettli of Great Divide Outfitters. Before this past spring's great hatch on the Big Hole, anecdotal and perhaps some scientific evidence exists that have lead many fishermen and fishing guides to declare that the salmonfly hatches occurring recently: "Are not what they used to be"and "in decline". Mark Canfield, a former fishing guide on the Smith and Missouri Rivers, as well as having a background in aquatic biology, reported to

Figure 1. Salmonfly (*Pteronarcys californica* and *P. dorsata*) locations across Montana with abundance determined by numbers in benthic samples.

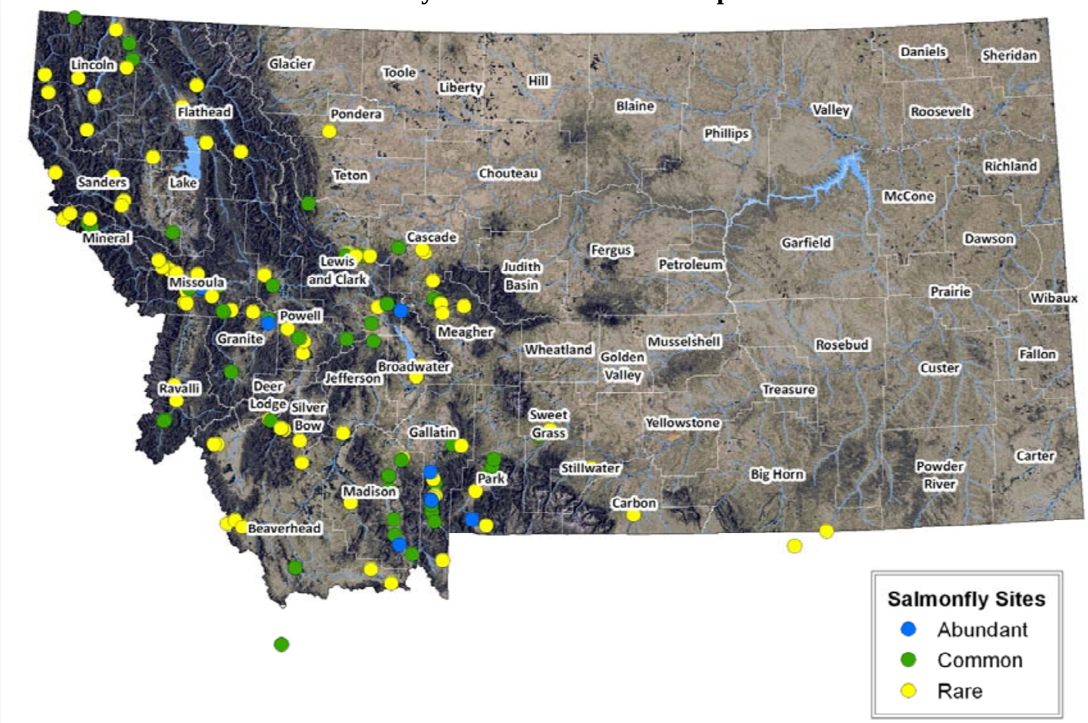
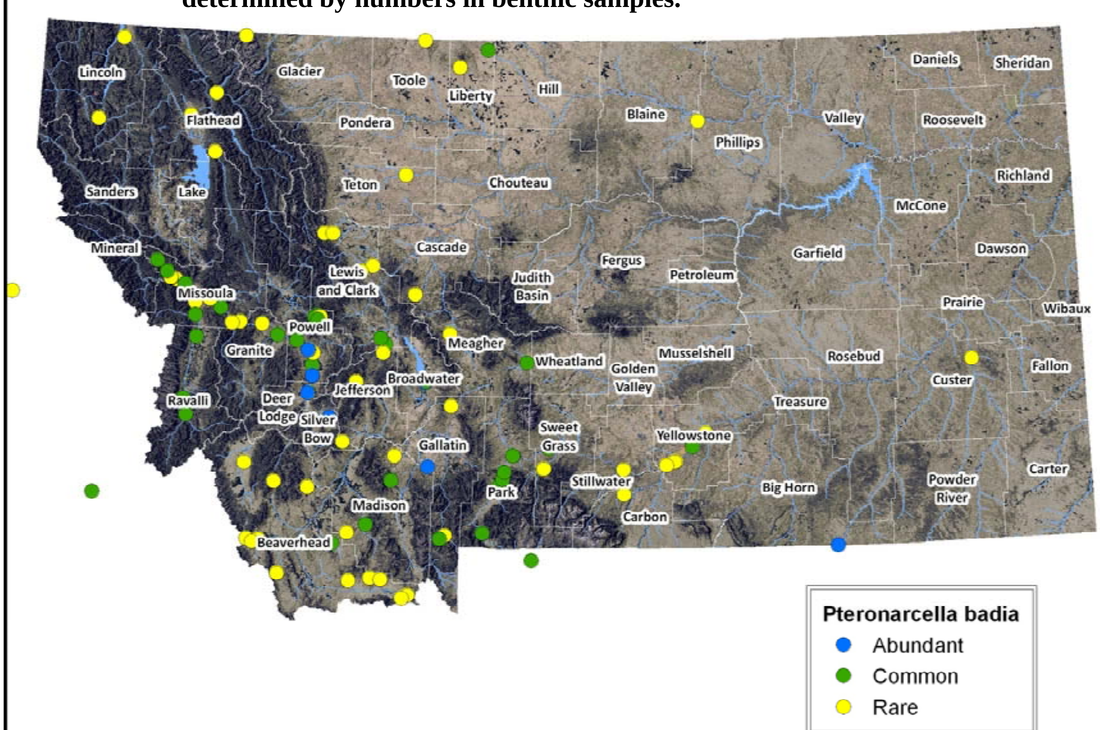


Figure 2. Least Salmonfly (*Pteronarcella badia*) locations across Montana with abundance determined by numbers in benthic samples.



me recently that many stonefly populations have undergone significant shifts since his years of guiding. "I used to regularly sample insect densities in repeated locations along the Smith River", Mark recounts …..“There have been some fairly radical changes on this river since "peak health" in 1992", not the least of which is the steady decline in the populations of the salmonfly. By Mark's sampling data, salmonfly densities in the upper Smith are now less than 10% of what they were in 1992-93 and in some reaches have disappeared altogether (see Smith River section). This apparent reduction of salmonflies has also been theorized to be occurring in many of our famous trout rivers including the Big Hole, Madison and Rock Creek. Are these reductions scientifically significant and credible or are they merely naturally occurring fluctuations and cyclical events overstated in their severity? It is not debatable that the cumulative effects of drought, dewatering and warmer water temperatures are surely implicated in the cause of many of the biological changes seen in rivers across the state (i.e. Big Hole grayling), but are they quantifiable for species of aquatic insects. Our goal of this study is to: (1) summarize salmonfly survey locations in the state's rivers; (2) summarize locations of long term data sets, (3) identify locations where long term trends with similar methods could be compared to determine significantly positive, negative or no changes, (4) survey public and professional anglers to obtain opinions on insect populations in the rivers hey spend time on.

Data Compilation

Numerous credible macroinvertebrate data sources (monitoring of aquatic insect populations by MT DEQ, PPL and other agencies) exist for many of our large trout streams and rivers to provide a scientific basis of water quality changes. I surmised that if sampled consistently, these multi-year data sets could be used to detect stonefly population trends; unfortunately many of these data sets are not as long-term as expected, and some data was unable to be obtained from the funding agency (PPL and BHRF) because of propriety issues or refusal. Data that are buried in technical reports, theses or in paper form sitting in filing cabinets were usually accessible and transcribed into the database. The goal of this effort is to mine data and compile enough scientifically credible data sources (into one place, see Table 1) across multiple heavily-fished, high-profile trout rivers (Big Hole, Clark Fork, Gallatin, Madison, Rock, Smith and Yellowstone Rivers) to make the determination if salmonfly populations are significantly increasing, declining or have remained stable. We are housing all data compiled in a publically accessible searchable database and web-enabled framework (http://mtnhp.org/Tracker/NHTMap.aspx) and added additional information to the jointly managed (w/ MTFWP) Field Guide http://fieldguide.mt.gov/detail_IIPLE2V020.aspx. We realized quickly in this process that many rivers fail to have consistent long-term data collected at particular sites over time; large spatial and temporal gaps exist in the data to render them useless for serious scientific analysis. One data set that is exceptional in its long-term completeness, replication and repeatability is a data series from six sampling sites on the Clark Fork River from 1956-2007 (Rhithron 2010-2 sites have all years included). Taxonomic reliability is always a concern in compiling data across numerous studies, some project efforts identified taxa to genus, others stopped at family, while others identified most to the species level. Since there are only two species of the genus *Pteronarcys* in MT with one species *P. dorsata* seemingly restricted to the Missouri and Smith Rivers, all reports of *Pteronarcys* (left at the genus level) in macroinvertebrate samples from other locations where upgraded to the species level for the sake of analysis. Any taxon in datasets labeled *Pteronarcella* was upgraded to *P. badia*, since this is the only species recorded for the state (Gustafson 2010).

Table 1. Salmonfly study data aquisition summary for the major rivers investigated. DEQ= Montana Department of Evironmental Quality, BHRF=Big Hole River Foundation, MSU= Montana State University projects, UM=Univerisity of Montana projects, PPL=Pennsylvania Power and Light

Waterbody	# of Sample Sites	# with >1 year data	Years Covered	Data Accessible	Data Source(s)
Big Hole River	10	8	2002-pres	yes/no	DEQ/BHRF
Clark Fork River	14	6	1957-2007	yes	Rhithron/DEQ
Gallatin River	12	6	1990-2008	yes	DEQ/Rhithron
Madison River	8	6	1997-pres	yes	DEQ/PPL consultant
Rock Creek	3	2	2000-2008	yes	DEQ/UM
Smith River	8	4	1991-pres	yes	DEQ/NHP/consultant
Yellowstone River	16	16	1971-2005	yes	DEQ/USGS/EPA/ MSU/ consultant

Seasonal Data Factors

Because salmonflies hatch in late spring to early summer, adult reproduction, egg laying and 1st instar nymph development is taking place during the protocol index time period of macroinvertebrate sampling (June-September). Therefore, this year-class of nymphs is very small during July or August collections and may not even be recognized as members of the Pteronarcyidae stonefly family; this could greatly affect their recorded presence in a sample as occupying a stream reach. Nymphs of the last 2 years hatch are large, but potentially very low in density after being preyed upon by trout and other fish for multiple growing seasons. Therefore, the best sampling period to increase the potential of collecting and detecting salmonfly nymphs would be pre-runoff months of April or May.

Public & Professional Opinion Survey

I randomly identified 15 professional fishing guide/outfitter operations, 10 general public anglers and 10 fisheries biologists in the river basins of interest and emailed them a short survey questionnaire. If any participant that was contacted replied back to "opt out", either by saying that they do not fish anymore or that they couldn't add any information to the study, I selected another person and that "opt out" was not included in the response rate. We wanted to gauge the correlation of responses to the actual data for particular rivers in the state. Questions included:

1) **How many years have you been fishing? How many in Montana?**
2) **Which do you consider is your "home" river in Montana, where you spend the most time fishing?**
3) **Do you target the salmonfly hatch on this river?**
4) **If not, why?**
5) **If yes, in your opinion, has the salmonfly hatch numbers on this river decreased, increased, stayed about the same?**
6) **Do you travel to another Montana River to target the salmonfly hatch, if so which river?**
7) **In your opinion has the salmonfly hatch numbers on this river decreased, increased, stayed about the same?**
8) **Some fisherman say the salmonfly hatches 15-20 years ago on the Big Hole, Madison and Yellowstone were more abundant, "epic" even. Have you heard this? Do you agree or disagree?**
9) **What are some biological (insect or fish) related changes you have noticed on your home river since you've been fishing?**
10) **What factor do you contribute most to these changes? Drought, climate change, fishing pressure, or some other factor.**

Big Hole River

The salmonfly hatch on the Big Hole is nationally famous and generally occurs earlier than the hatch on the Madison River, so it seems that this river gets an inordinate amount of attention from outfitters and guides. The hatch moves upstream from the confluence with the Beaverhead all the way up to Wisdom by about four to five miles a day depending on the weather, although the heaviest densities are in the canyon reach from Glen to Wise River. Roger Oettli of Great Divide Outfitters reported the first salmonflies started emerging at Brownes Bridge on June 14, 2010 (GDO website). Long term benthic macroinvertebrate data for the Big Hole is surprisingly spotty and altogether lacking in sections for such a famous river. MT DEQ has data collected for ten sites from the upper to lower mainstem, but these collections only occurred in 2002 for 9 of these and 2003 & 2004 for the one site in Wise River. Five of the 10 DEQ sampling stations collected the salmonfly (avg. 1.4 individuals per sample). A study funded by the Big Hole River Foundation in 2002 sampled 8 sites along the Big Hole from High Road Fishing Access to Wisdom Bridge (McGuire 2002). That study was renewed in 2007 and now they have added additional sites and 4 years of macroinvertbrate data at the same sites as the 2002 study (Mike Bias, pers. comm., did not provide data). This data set will be beneficial to acquire to determine if populations of salmonflies have recovered from the effects of the drought. Despite this optimistic view of the last couple of good water years and subsequent abundant salmonfly hatches, the last 10+ years of drought have taken a serious toll on the Big Hole's aquatic communities. In sections where habitat has not been altered and where the effects of drought are tempered by reduced demands for irrigation water and …..hydrogeology (canyons), the quantity of salmonflies that hatch appear fairly stable from year to year. A fisheries professional commented, "In sections where sediment deposition has occurred and interstitial spaces are now filled (Melrose to Browns Bridge, in particular) the hatch has been diminished. The 'marginal' low-gradient habitats (downstream of Melrose) that used to consistently produce hatches now produce hatches that are sporadic and inconsistent. Consequently, the hatch appears limited or restricted to river sections where habitat is ideal and stable – with the canyon section being the best."

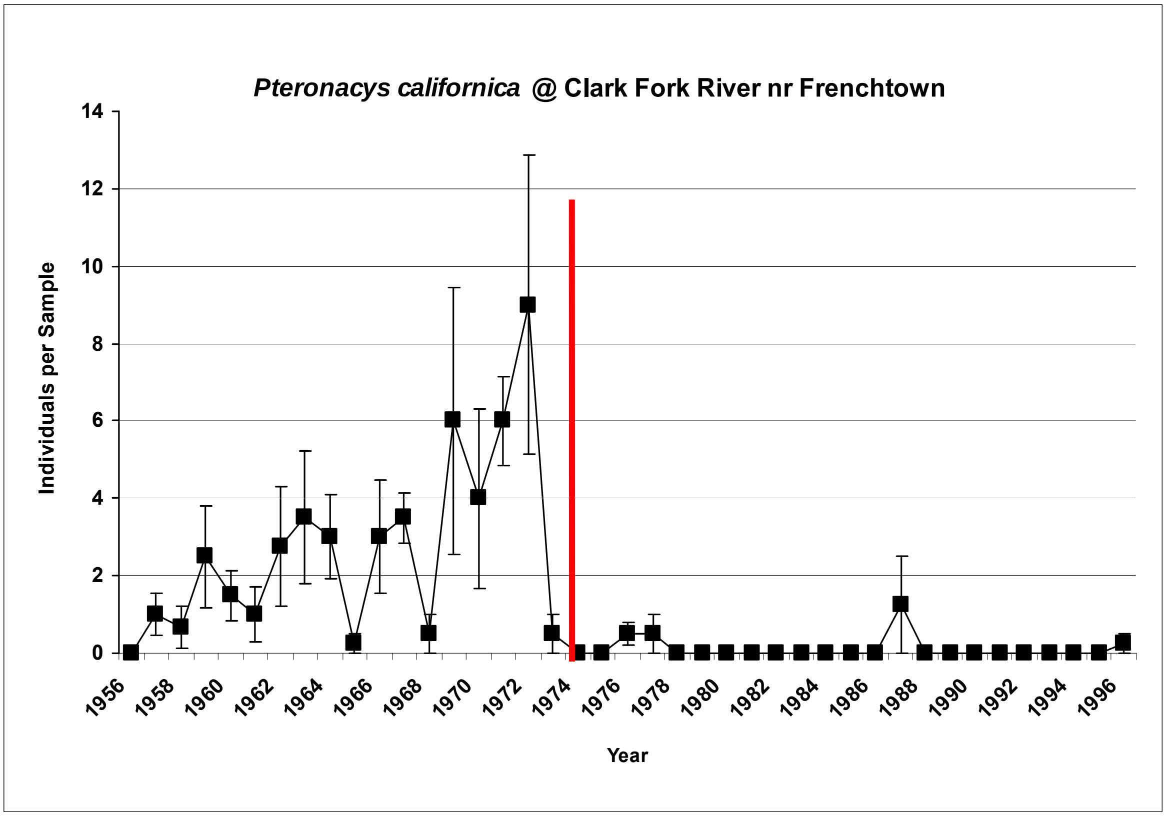
Conclusion: There are no long term macroinvertebrate data sets available pre-2000 within the Big Hole River Section between Wise River and Melrose to definitively conclude that populations of the giant salmonfly are fluctuating beyond normal natural variability. The macroinvertebrate sample sites above Wise River were ranked as impaired and had minimal salmonfly populations (McGuire 2003), likewise the five DEQ sample sites reporting salmonflies averaged 1.4 individuals per site, but these data collection years (2002-2004) were at the height of the drought, which may have caused temporary population reductions of these intolerant, long-lived stoneflies.

Clark Fork River

Until 1972 the Clark Fork River was plagued by severe water pollution that often made the water run red in color; all the aquatic life was wiped out in the upper river for about 100 miles downstream of Butte. The Environmental Protection Agency (EPA) designated the entire upper Clark Fork River a Superfund Site and from Butte to Milltown Dam it is the nation's largest pollution abatement project. The ecology of the Clark Fork has been gradually improving since then and now boasts respectable trout fishing and some trophy-class brown trout, especially downstream of Missoula. Tributary streams with good water quality (ex. Little Blackfoot, Rock Creek) have mediated the detrimental, chronic effects of mining as you proceed downstream. Despite improvements in some sections, fishing in the Clark Fork River from Beavertail State Park past Rock Creek to Schwartz Creek Bridge has declined in the last number of years; however, with the right conditions, this section can be outstanding during the salmonfly hatch (RCO website). MT FWP data document this low fish density in the section (Saffel et al. 2010). In the past, non-degraded tributary streams and rivers provide macroinvertebrate colonization pools to "restock" the mainstem Clark Fork River when a chemical or metals pollution spike occurs from a summer deluge or other sediment washing event. A couple of fairly recent (70's and 80's) fish kills in the river have undoubtedly had similar drastic effects on the recovering sensitive benthic macroinvertebrate fauna. During the years of 1974, 1978 & 1979, we see negative population shifts by salmonflies at four separate sampling locations above and below Missoula (see Figures 3-5); some of these populations have not recovered to the present. Salmonflies have been shown to be very sensitive to chemical pollutants, but one would think that given all these years a recovery would have happened. This suggests a continual source of pollution or something else that prevents their establishment. The least salmonfly has not appeared to have been affected as dramatically as the giant salmonfly (Figure 3 & 4). Salmonflies are not the best fliers, so dispersal would likely be slow, but after 30 years they should have made some inroads into reestablishing the populations from downstream or tributary streams. Having this long-term dataset (1956-2007) that utilized the same sampling protocols across all years was vital in detecting these changes. Therefore, I think we can conclude without a doubt that the Clark Fork River's salmonflies have significantly decreased in numbers since data has been collected at sites above and below Missoula. Without the long-term data, we would've never known the numbers of salmonflies were improving in river sections and then wham; populations got reduced drastically by a dose of something from upstream, never to return again.

Conclusion: Clark Fork salmonfly populations from Butte to Missoula were initially wiped out 100 years ago during the rampant mining days. In the Missoula area, salmonflies appeared to have been making a comeback in the reach from about Rock Creek downstream until the 1970's, when additional chemical/toxic pollution washed in from upstream and may be the reason populations were decimated again. Populations of salmonflies in the Alberton Gorge seem to be holding steady with review of the limited DEQ data collected in this river section.

Figure 3. Giant salmonfly (top) and Least salmonfly (bottom) sampling data below Missoula



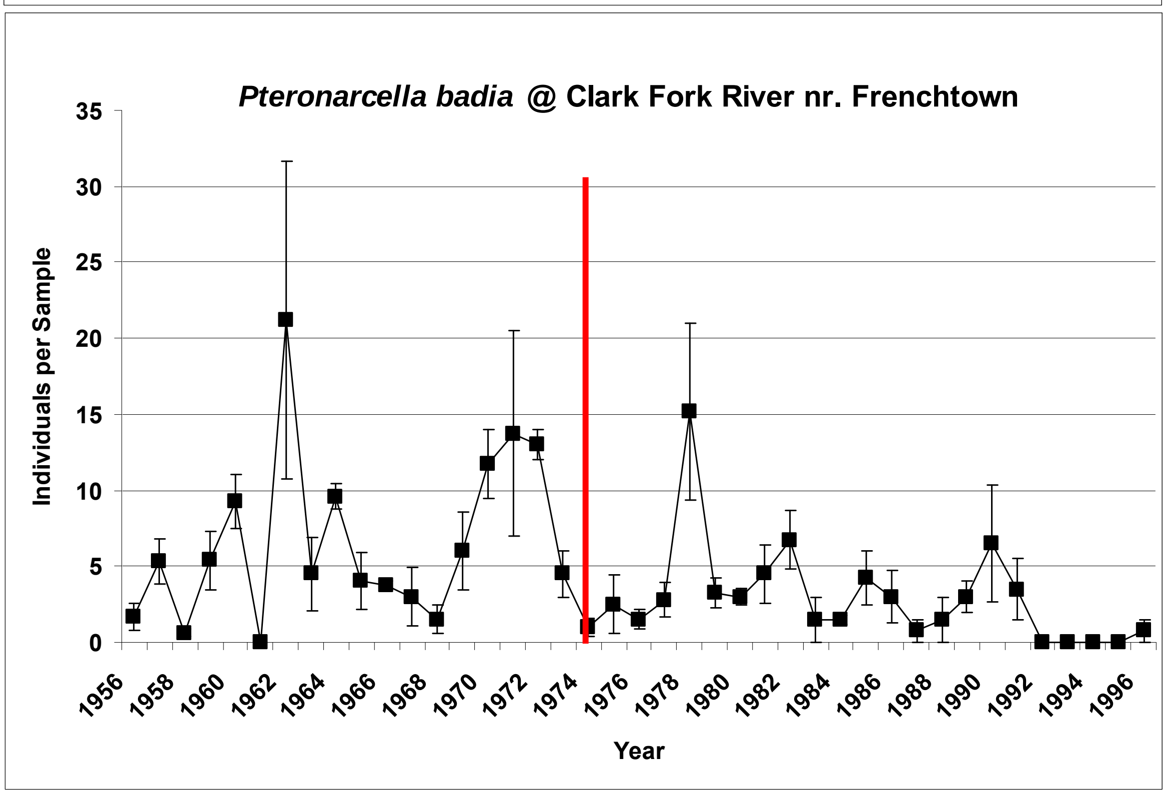
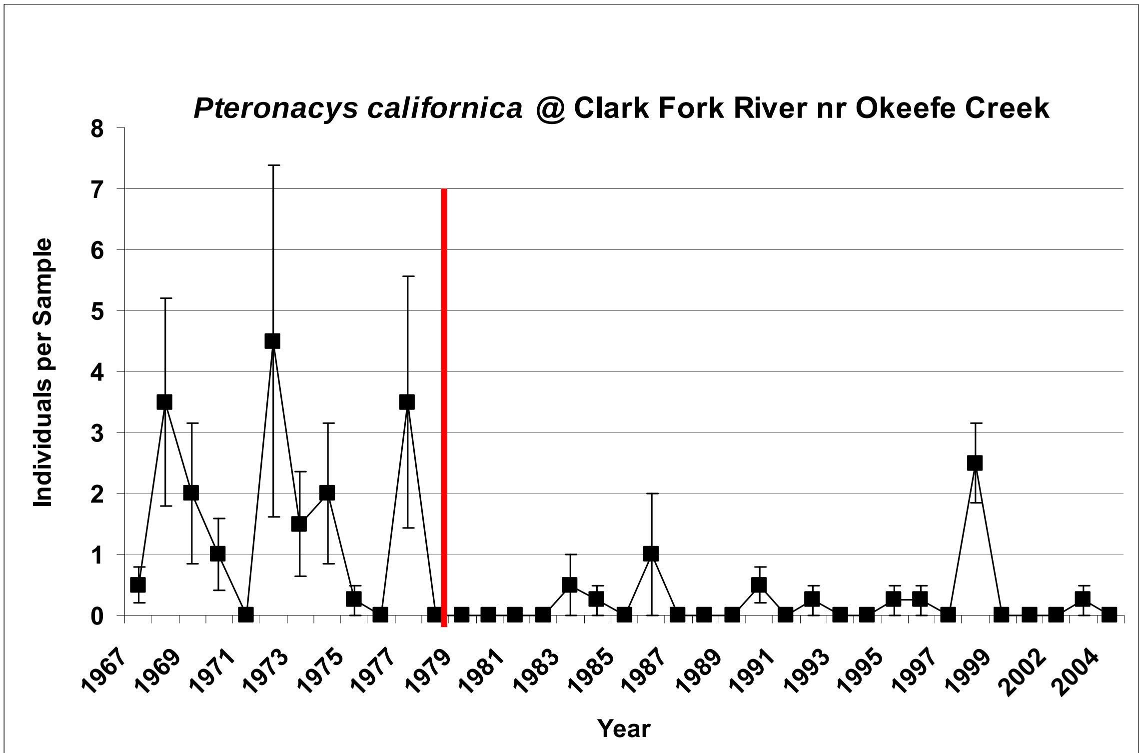


Figure 4. Giant salmonfly (top) and Least salmonfly (bottom) sampling data above Missoula



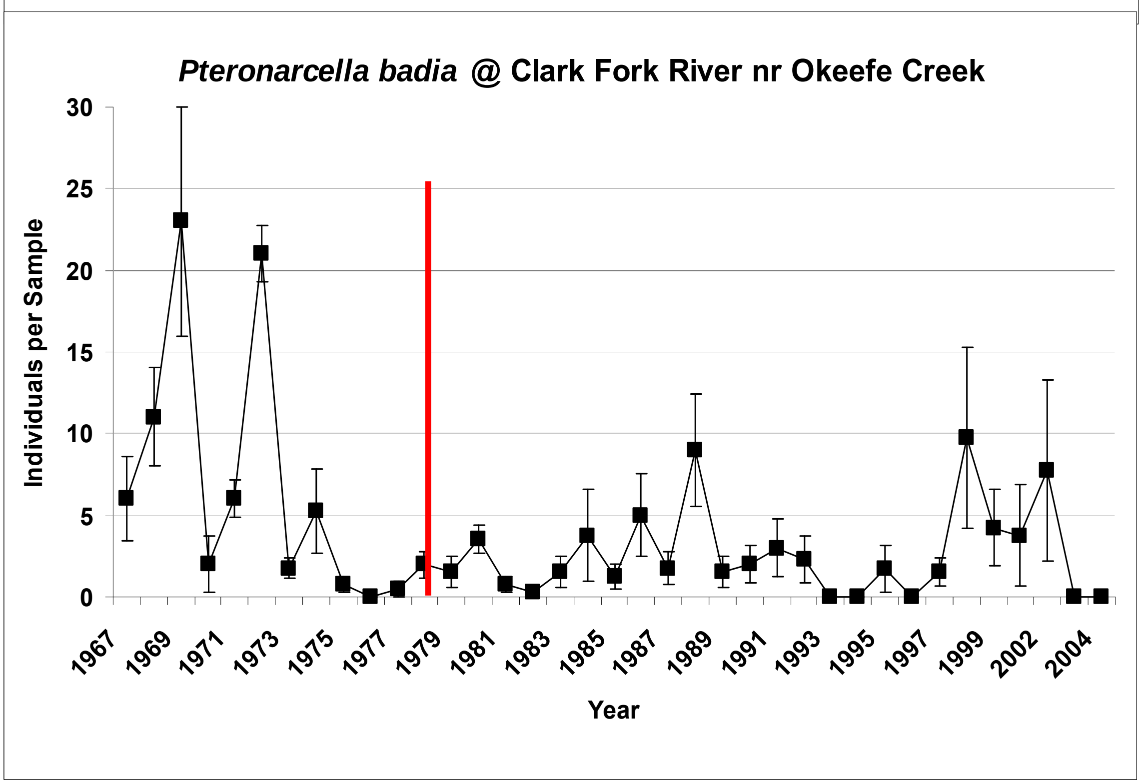
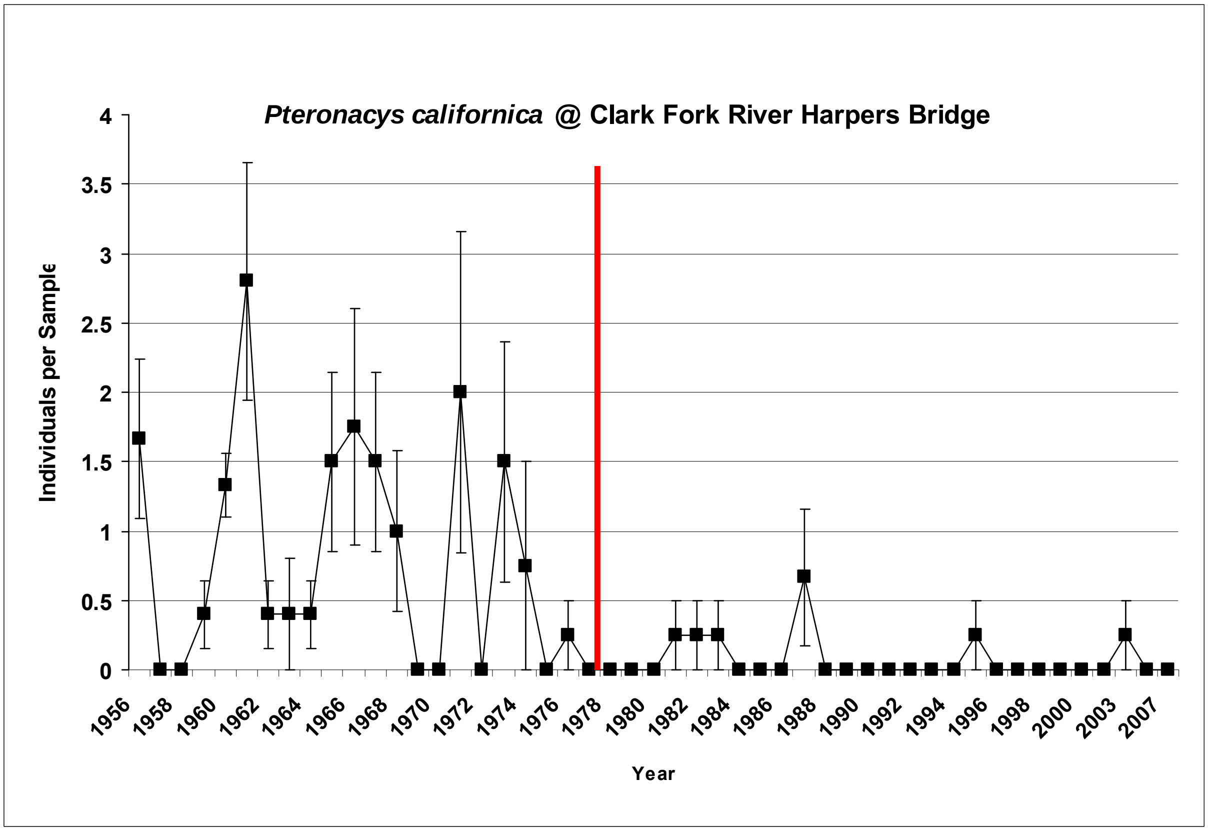
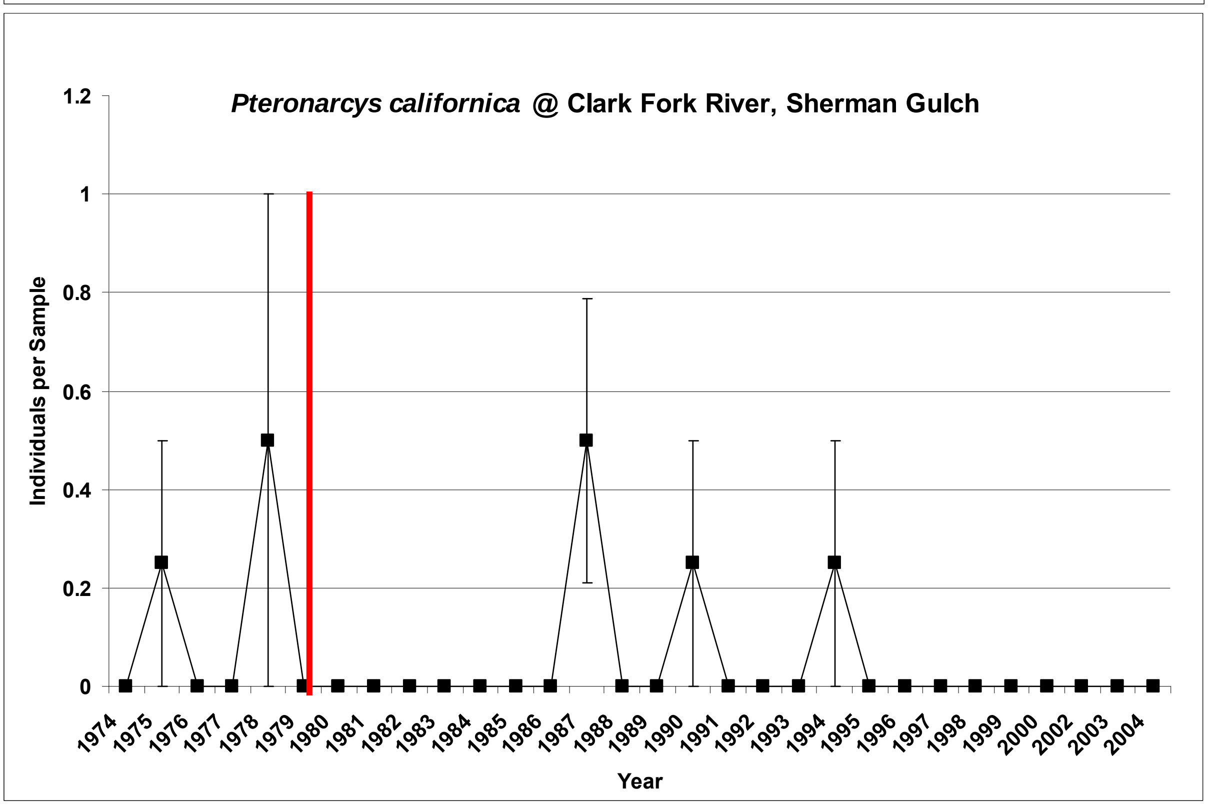


Figure 5. Giant salmonfly collection data at 2 more sites below Missoula





Gallatin River

The Blue Ribbon Gallatin River's June/July hatch of salmonflies is spotty and usually occurs during the June high run-off period; thus, even Bozeman area guides said that they don't focus on the hatch (Robin Cunningham, Outfitter, pers. comm.). This lack of interest could also be a result of the Gallatin River from Yellowstone Park to the East Gallatin confluence being closed to float fishing (but not recreational floating) (Big Sky Fishing website).

Of the 12 identified macroinvertebrate sample sites along the Gallatin River only 6 of these have multi-year datasets, and 3 of these are MT DEQ monitoring sites further downstream near Interstate 90 and after the East Gallatin enters the mainstem which contain no salmonflies. Three sites further upstream in the canyon reach focus on monitoring changes in the Gallatin River around the Big Sky area (Blue Water Task Force, Rhithron 2010), but this data has such large temporal gaps (Table 2 & 3) or doesn't go back far enough (Table 4) that making any statements about the salmonfly populations would be pure speculation. The only conclusions to draw from these data are that salmonflies are still present at all sites and the Gallatin River near Spanish Creek appears to have a higher density

Table 2. ***Pteronarcys californica*** **in Gallatin River nr. Jack Smith Bridge**

Year	Individuals per Sample	# of Samples
1991	1	2
2007	1.5	2
2008	1	2

Table 3. Gallatin River up. Spanish Creek

Year	Individuals per Sample	# of Samples
1990	16	1
2008	13.5	2

Table 4. Gallatin River up. Buffalo Horn Creek

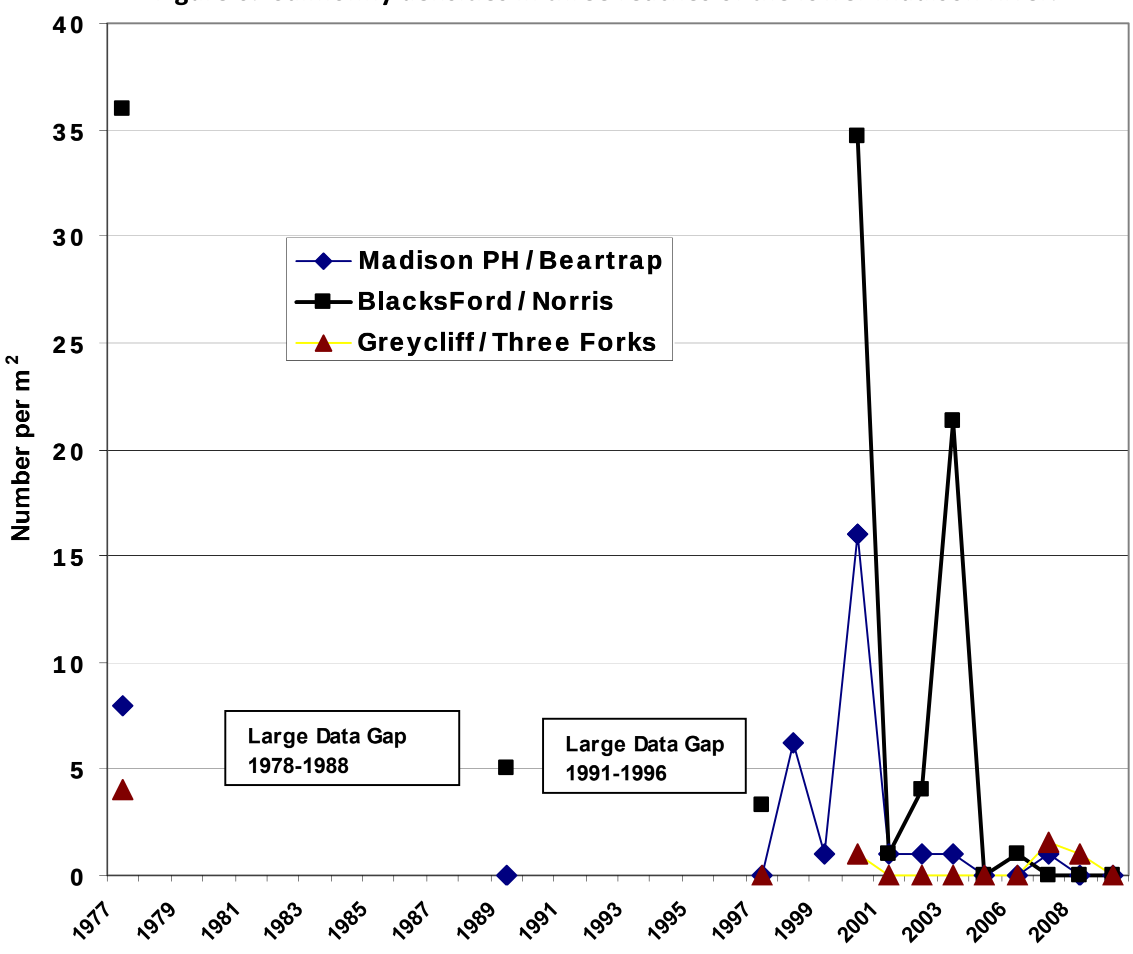
Year	Individuals per Sample	# of Samples
2005	1	1
2006	3	1
2007	1	1

Conclusion: We do not have sufficient data to definitively conclude that populations of the giant salmonfly are fluctuating beyond normal natural variability within the Gallatin River Canyon where data is available. There is one fairly long term macroinvertebrate data set (2000-2008, MT DEQ) at the downstream end of the Gallatin River where salmonfly populations are absent.

Madison River

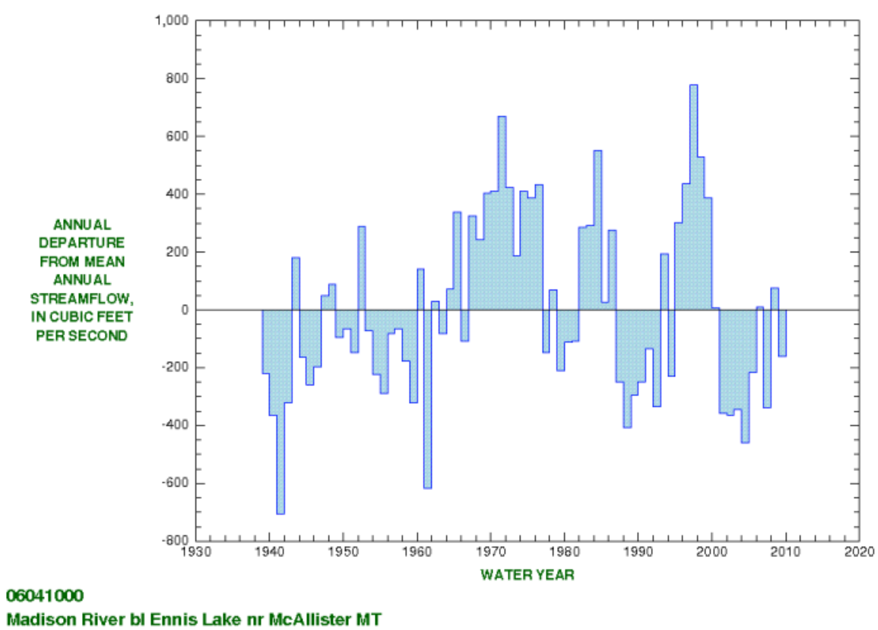
The Madison's June/July hatch of salmonflies is legendary and a major fishing event in the west (Madison River Fishing Co. website). Runoff flows typically last from late May through June, and the adult salmonflies begin to emerge around July 1 in the channels just above Ennis, and the hatch works its way upstream for the next three weeks. "Fly fishers from across the nation converge on the Madison in the hopes of catching many and large fish on the big dry salmonfly patterns" (MRFC website).
MT DEQ maintains data for one macroinvertebrate monitoring site located downstream on the Madison River near Interstate 90 which has recorded no salmonflies. *Pteronarcys californica* abundance was reported at 3 sites in the Madison River in 1989-90 (Hauer et al. 1991) (Figure 6). PPL Montana (formerly Montana Power) has been sampling macroinvertebrates since 1997 in 7 locations on the Madison River between Hebgan Lake to the town of Ennis and downstream to the Greycliff FAS. For the upper portion of the Madison River PPL monitoring section, "Salmonflies have been, and remain abundant …. Densities averaged greater than 20 individuals per square meter at all sites (below Hebgen Dam, below Quake Lake, Kirby, Varney Bridge and Ennis). No temporal trends were evident" (Dan McGuire, pers. comm.). Salmonflies are less abundant in the lower Madison River. Both the distribution and density appears to have declined in recent years (Figure 6). Densities were relatively high below the Bear Trap Canyon (Norris Bridge and Blacks Ford)

Figure 6. Salmonfly densities in three reaches of the lower Madison River.



in 1977, 2000 and 2003. We have collected few salmonflies in the lower river since 2003 (Dan McGuire, pers. comm. 2010). Much of this data is collected as part of environmental monitoring within FERC operation and relicensing reports.

The lower Madison population may be impacted by suboptimal habitat (thermal regime and substrate) during droughts. McGuire reports that neither Fraley (1978) nor Hauer et al. (1991) mentioned vascular plants in their site descriptions, but describes "Extensive beds (mostly *Ranunculus*) have existed from Norris to Cobblestone for at least a decade. This is a major habitat change!" McGuire's interpretation of the data and comments correlates with what we've been hearing about the salmonfly hatches below Ennis Lake, "severely diminished to absent." Greycliff Fishing Access has seen a "complete loss of this stonefly taxa" from samples since the early 2000's. This scientific evidence also lines up with statements from long-time fisherman in our survey, "The Lower Madison and Upper Madison river certainly seem to have lessened hatches, especially the Lower Madison, the hatch on the stretch from Warm Springs to Blacks Ford (below Beartrap Canyon) seems almost non-existent. The Upper Madison has been spotty, but it's a hatch that is always spotty." According to the PPL consultant, the salmonfly populations in the Madison River below Hebgen Lake have appeared healthier the past few years, since the water levels in the lake and release flows have increased. The major cause of this stonefly decline in the lower Madison reaches is the often cited compounding factors of increased sediment levels in the cobbles due to drought or dam-induced lessened flushing flows coupled with warmer water temperatures; USGS gaged flows below Ennis have been below normal for 24 of the last 32 years (Figure 6.2).



Conclusion: Salmonfly populations in the Madison River below Beartrap Canyon downstream ~20 river miles have been severely reduced over the past 15 years. There are no long term macroinvertebrate data sets available within the Madison River Section upstream of Ennis to Hebgen Lake to definitively conclude that populations of the giant salmonfly are fluctuating beyond normal natural variability, but populations appear to be "healthier during good flow years". Most outfitters and long time fisherman accept the natural fluctuations of the hatch in this upper reach and mainly focused their sentiments on the "lost salmonfly hatch" below Beartrap Canyon; PPL data confirms this reduction and/or absence of salmonfly nymphs in this reach.

Rock Creek (Clark Fork Basin)

The two most important stonefly hatches on this river are the salmonfly hatch and the golden stone hatch (Rock Creek Outfitters website). The salmonfly hatch usually occurs during the middle of runoff, which usually runs from late May to late June, although earlier emergences of the salmonfly have been reported (Rockwell and Newell 2009). This river has become the salmonfly mecca for Missoula anglers and thus receives substantial fishing pressure during this hatch period. Despite this river's fishing popularity, MT DEQ has only sampled this river in three locations (Appendix A); one location downstream near the confluence with the Clark Fork River has longer-term monitoring data (2000-2008 DEQ EDAS) with 3 replicates taken in 2000 & 2001 and a single sample taken each year between 2002-2008 (Table 5). This data reveals that Rock Creek macroinvertebrate communities may have felt the affects of drought events with an apparent absence (*in actuality very low densities) of the salmonfly (*Pteronarcys californica*) from 2004-2007. It is somewhat apparent based on the data that a couple of salmonfly age classes are missing at the sample site during the worse years of the drought (Table 5). Although, low abundances observed here are typical of large, long-lived invertebrate taxa. There are also reports (RCO website) that the stonefly, *Skwala sp.* is increasing its numbers in lower stretches of the river. This community shift is another indicator of warming water temperatures in the river, since this stonefly is more tolerant of warm water, but a full community analysis is beyond the scope of this project.

Table 5. Salmonflies at Rock Creek nr. Clinton

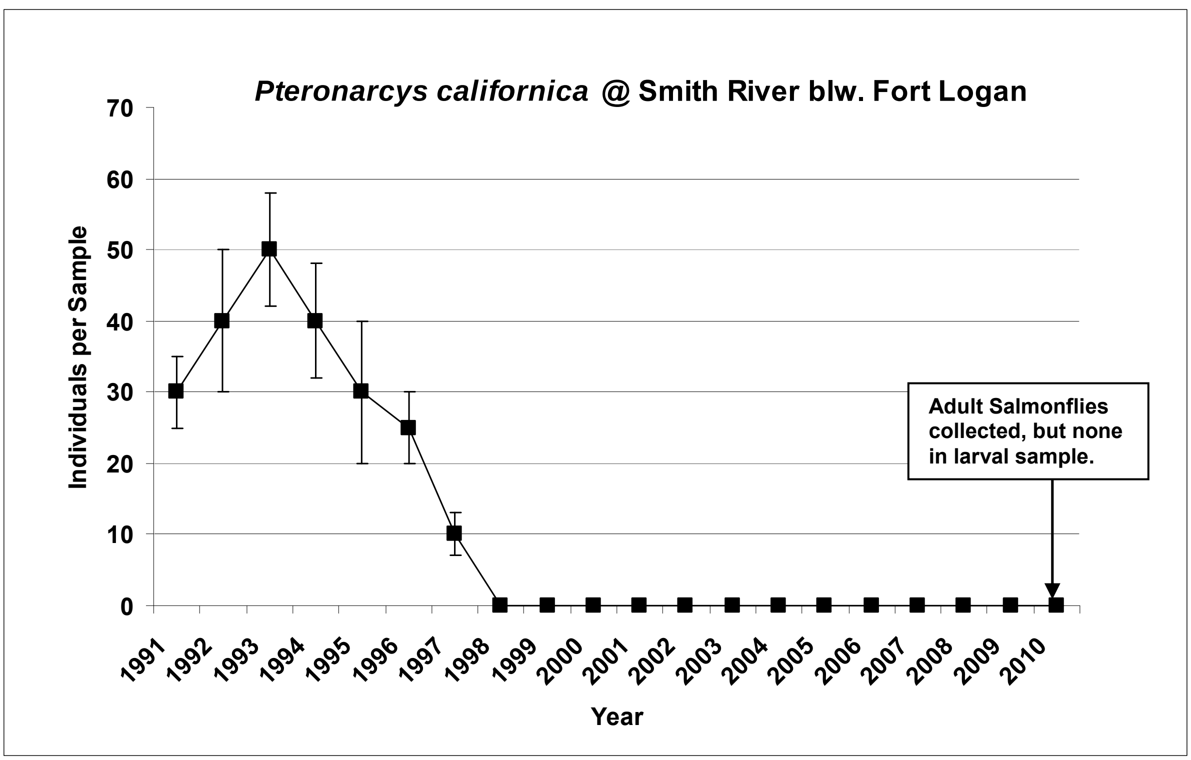
Year	Individuals per Sample	# of Samples
2000	1.33	3
2001	1.75	3
2002	1	1
2003	1	1
2004	0	1
2005	0	1
2006	0	1
2007	0	1
2008	1	1

Conclusion: There is one long term macroinvertebrate data set at the downstream end of Rock Creek where salmonfly populations might already be expected to be in lower densities than in the canyon reaches. Therefore, beyond the affects of missing year classes during the more extreme drought years, we do not have sufficient data to definitively conclude that populations of the giant salmonfly are fluctuating beyond normal natural variability within Rock Creek.

Smith River

The Smith River is formed by the confluence of the North and South Fork approximately 4 miles southwest of White Sulphur Springs, MT. It flows 41 miles to a canyon entrance where it confluences with a major tributary, Sheep Creek at Camp Baker. The Smith River within the permit float section (from Camp Baker downstream to Deep Creek) has a strong salmonfly hatch that occurs from May through late June, depending on weather and river conditions (pers. observation 2004-2007, Big Sky Fishing 2010). Surprisingly, for such a popular fishing, floating and recreation designation, this river section lacks macroinvertebrate sampling data; especially, long-term data consistently collected at various stations capable of monitoring stonefly populations. In fact, benthic samples taken by the MT Natural Heritage Program at 2 sites in the canyon reach in June of 2008 are the only standardized samples that I could find while data searching. We did compile a benthic sample dataset from Mark Canfield (unpublished) that he has been collecting since 1991 at 3 sites near the Smith River Wildlife Management Area approximately 10 river miles upstream of Camp Baker (Figure 7). Since 1991, Mark has documented an alarming trend with increasing siltation and changing macroinvertebrate commumities at these sites; especially the decline and loss of *Pteronarcys californica* and increases in more tolerant stoneflies. Only with the recent last 2 high water years do some populations above Camp Baker seem to be showing signs of recovery, based on the presence of adults in 2010 (Figure 7).

Figure 7. Salmonfly sampling data provided by M. Canfield above Camp Baker



There are also reports (M. Canfield, unpublished) that a golden stonefly, *Hesperoperla pacifica* is increasing its numbers in this stretch of the river. This community shift is another indicator of warming water temperatures in the river, since this stonefly species is slightly more tolerant of warm water, but a full community analysis is beyond the scope of this project. I will additionally add that this Smith River reach contains a declining population of the Western Pearlshell Mussel that will likely die out in the next 20 years due to the degrading stream conditions (Stagliano 2010).

Conclusion: There are no long term macroinvertebrate data sets within the Smith River Float Permit Section to definitively conclude that populations of the giant salmonfly are fluctuating beyond normal natural variability. The sites above the Camp Baker put-in have shown a significant decreasing trend in habitat conditions and salmonfly populations for the 20 years of data examined (M. Canfield, unpublished, Stagliano pers. observation), while populations downriver in the canyon may be experiencing less of a decline because numerous tributaries below Camp Baker (Sheep, Spring, Rock and Tenderfoot Creek) add significant flows of colder less impacted water to the Smith. Further downstream near the take out of the permit float section at Eden Bridge and then Truly Bridge, there are just a few years of widely spaced sampling data, but salmonfly populations would be reaching thermal tolerance limits and expected to be at low densities at these downstream transitional sites (Bollman 2000).

Yellowstone River

The macroinvertebrate data for the Yellowstone River has a few large spatial and temporal gaps with only three consistently visited sites in the upper basin documented to contain the giant salmonfly. The macroinvertebrate database compiled by MTNHP contained data from the Stadnyk (1971), Newell (1975) and Schwer (1976) studies, the EPA Western Pilot study on the Yellowstone River (1992 and 2000), and data from the USGS NAWQA website from 2001 (data dates 1992, 1999 and 2000). Additional data was downloaded from the EPA STORET database (data from 2001 and 2003) (see Table 1). Newell (1975) and Stadnyk (1971) reported *Pteronarcys californica* at five sampling stations from Yellowstone National Park boundary downstream past Livingston to the Grey Bear Fishing Access Site, a reach of approximately 69 miles. Subsequent sampling events in 1994, 1999 and 2000 (EPA 2000, USGS 2001) did not collect this species downstream of Livingston, an occupancy reduction of ~20 river miles (see Figure 8). We could not assess population abundance measures between dates because the sampling methods were significantly different, but could document the presence and absence of these species at sites   This occupancy reduction was also documented for the least salmonfly, *Pteronarcella badia* which was reported by Newell (1975) and (Schwehr1976) to occur from the Yellowstone National Park boundary downstream past Billings to Huntley (Figure 9). While more recent sampling has only documented this species to occur as far down as the Laurel area, a significant range reduction of ~25 miles (EPA 2000, USGS 2001) (Figure 9). Potential reasons for this disappearance at downstream sites include a warming of water temperatures and diminishing spring flushing flows. The “transitional” area between warm and cold water fisheries has also been progressively proceeding upstream with warm water fish occupying additional river miles past Reed Point and fewer salmonids collected down towards Billings. There are also enough data available to support the trend that a warm-water tolerant stonefly, *Acroneuria abnormis* is increasing its numbers and upstream distribution in this stretch of the river. This community shift is another indicator of warming water temperatures in the river, since this stonefly is more tolerant of warm water, but a full community analysis is beyond the scope of this project.

Conclusion: Based on wide gaps in spatial and temporal data, we cannot definitively conclude that existing populations of the giant and least salmonfly are fluctuating beyond normal natural variability within the upper portion of the Yellowstone River. But we can say, quite certainly, that *Pteronarcys californica* and *Pteronarcella badia* now occupy 20 and 25 miles less of the Yellowstone River than they did 25 years ago, respectively. Additionally, *Pteronarcella badia* appears to be in much lower densities (i.e. below detection levels) in the middle portion of the Yellowstone between Livingston and Billings than in the 1970’s when this species was collected in good numbers at all sites in this reach.

Figure 8. Giant salmonfly collection data in the Yellowstone River from the 1970's (top) and 1994-2005 (bottom).

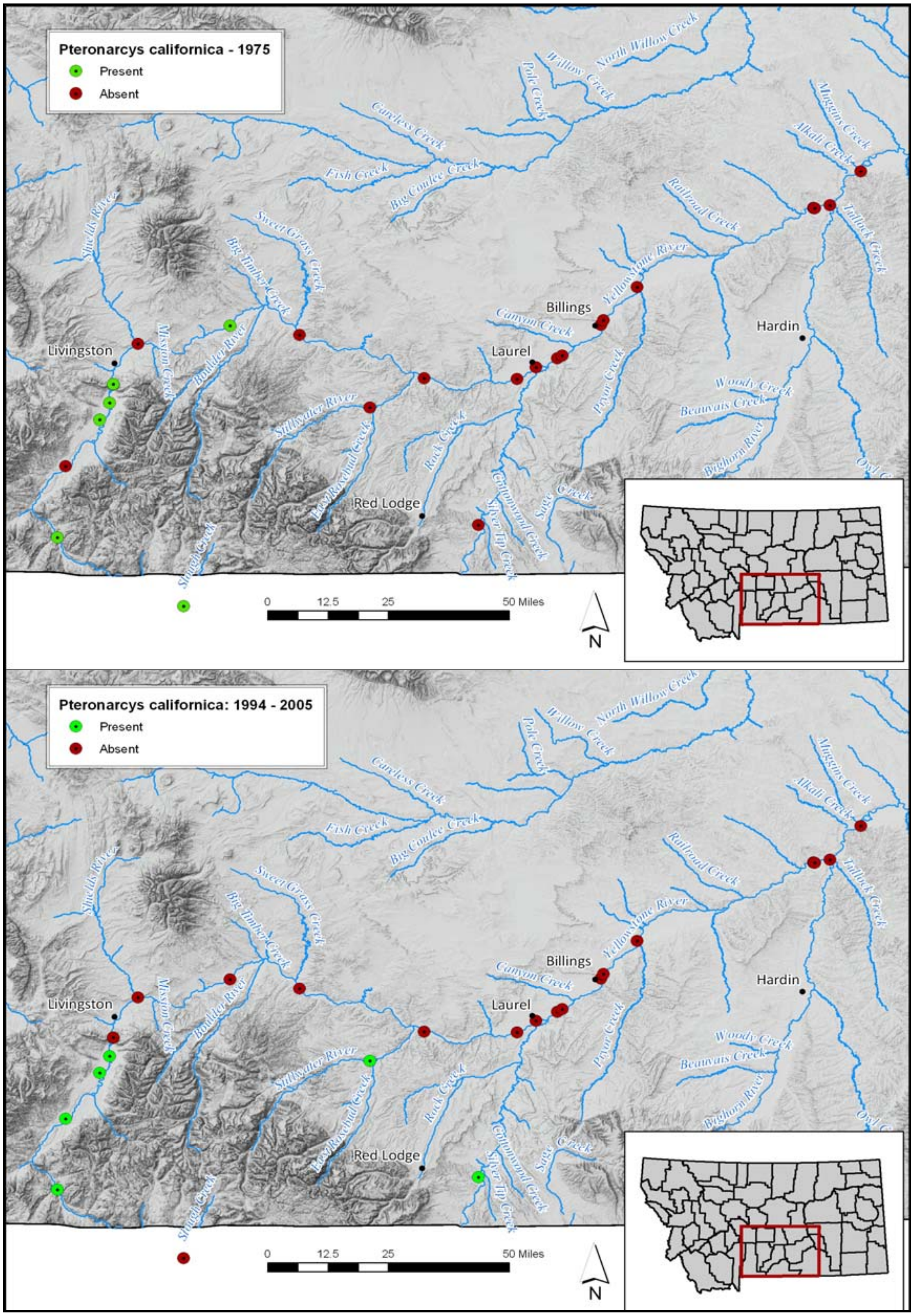
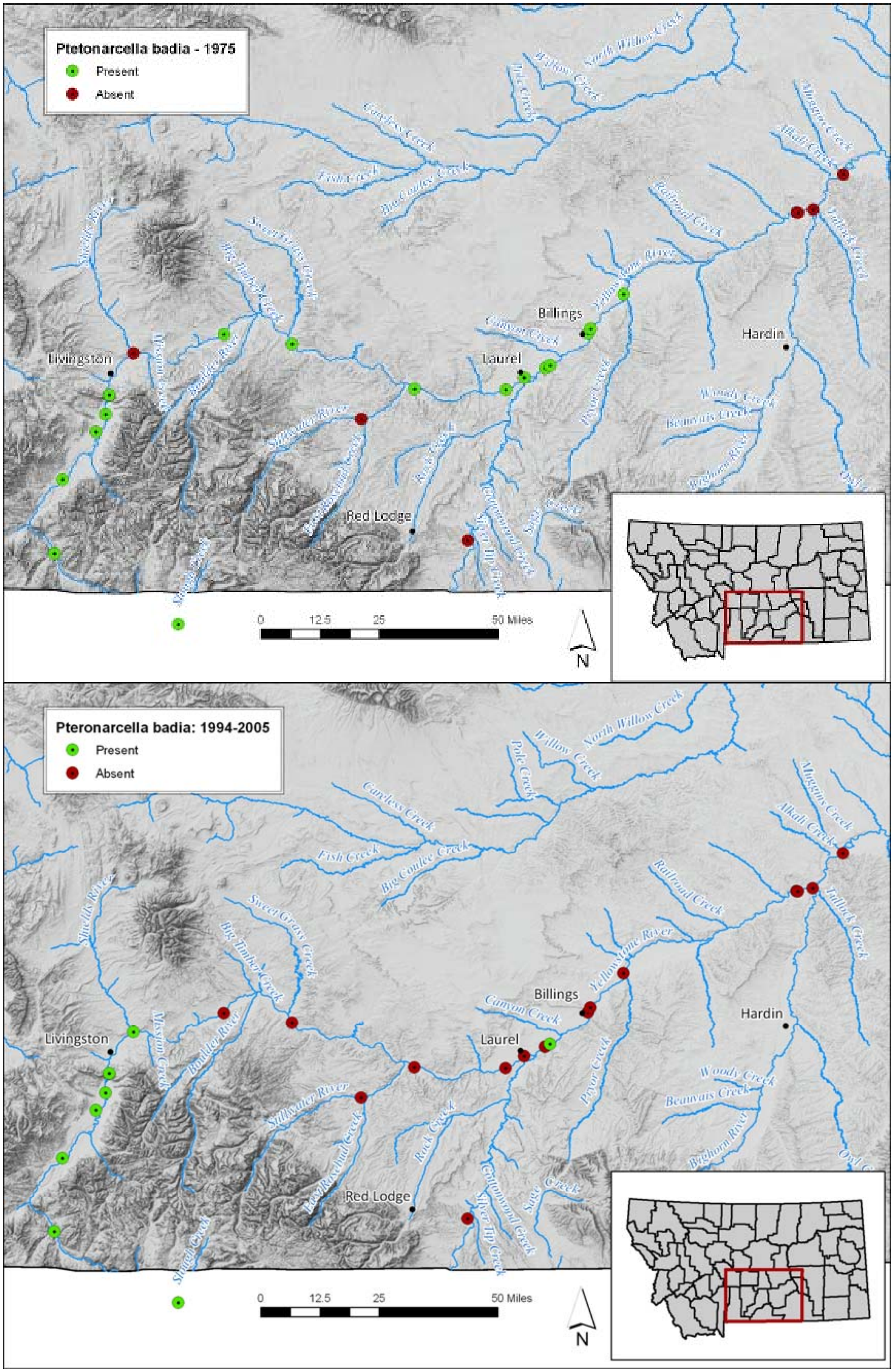


Figure 9. Least salmonfly collection data in the Yellowstone River from the 1970's (top) and 1994-2005 (bottom).



Opinion Survey Results

While not scientific per se, fisherman, professional guides and fisheries biologists spend a significant amount of time on their local rivers and can provide a wealth of anecdotal knowledge and informed opinions where true scientific evidence is lacking. The responses in Table 6 correspond to the questions asked in the email survey from the methods section on page 5. The average number of years that the survey participants (n=24) have spent fishing is 30.6, and 21.4 of those have been on the rivers of Montana. The breakdowns of particular interest groups are described below (Table 6). Overall, if the participants fished the salmonfly hatch on their home river, 45% thought the salmonfly numbers have been about the same through the years, while 17% thought the numbers have decreased. If the Big Hole or Madison River was not listed as their home river, 90% of participants said they traveled to

Table 6. Opinion Survey Resonses for 35 surveys sent (15, 10, 10 per group). (=) means, the same, no change, (Δ)- a change, (NA)-not applicable, (-)-Decreased, (+)-Increased

Survey Group	Response Rate	Avg. # of Years Fishing	Avg. # of Years in MT	Home River (1st Rank)	Home River (2nd Rank)	Home River (3rd Rank)	3) Target Salmonfy	5) Salmonfly Hatch Numbers
Professional Guides	60%	32	28	Madison	Blackfoot	Gallatin	yes/yes/no	= (55%), NA (22%), (-) (22%)
Fisheries Biologists	50%	30	25	Big Hole	Blackfoot	Madison	yes/yes/yes	= (60%), NA (20%), (-) (20%)
General Fisherman	100%	29	14	Missouri	Big Hole	Blackfoot	no/yes/yes	= (20%), NA (70%), (-) (10%)

Table 6. Opinion Survey Resonses (cont.)

Survey Group	6) Travel to another MT River for Salmonfly Hatch	7) On this river Salmonfly Hatch Numbers	8) Epic salmonfly hatches 20 years ago	9) Biological Changes Noticed	10) What factor(s) do you contribute most to these changes?
Professional Guides	Madison(44%) Big Hole (22%)	= (77%), (-)(23%)	NO (55%) YES (45%)	(+) Sediment (100%) Aquatic Species Δ (20%)	Drought, H_2O temps (89%) Fishing Pressure (77%) Dam effects (11%)
Fisheries Biologists	Madison(40%) No travel (40%)	= (60%), (-)(20%) NA (20%)	NO (40%) YES (60%)	(+) Sediment (100%), Aquatic Species Δ (20%)	Drought, H_2O temps (80%) Fishing Pressure (50%) Dam effects (30%)
General Fisherman	Big Hole (50%) Madison (20%)	= (70%), (+)(10%) NA (20%)	NO (50%) YES (50%)	(+) Sediment (50%), Aquatic Species Δ (50%)	Drought, H_2O temps (90%) Fishing Pressure (60%) Dam effects (20%)

one of these rivers to fish the salmonfly hatch; of those 69% believed that the salmonfly hatches were about the same, while 21.5% (slightly higher in the guide group) thought that the hatches have lessened through the years.

It was about an even 50/50 split on average when asked the question, "Do you agree or disagree that the salmonfly hatches 15-20 years ago on the Big Hole, Madison and Yellowstone were more abundant, "epic" even. Have you heard this? Fewer guides 45% agreed with this statement, while more fisheries biologists 60% did. Many participants cited nostalgia for the "good ole days" as the driver in believing this was true, while in reality many guides said the salmonfly hatches on the Blackfoot, Big Hole and Rock Creek the last 2 years have rivaled what they have seen in all their years on the rivers. One outfitter said, "This is the typical BS phenomenon that you get from a populace that likes to lament about how good things "used to be." Although, for those that did fish the salmonfly hatches in sections of the Madison and Big Hole that no longer are producing those hatches, the good ole days on those river sections are truly gone. Another reason included in the survey for thinking that those past days were better, was "fishing pressure was much less back than, and you had a better chance of enjoying yourself."

The overwhelming, across the board agreement about the "biological changes" happening in the rivers that we fish is the increase in sediments and silt; 100% of guides and fishery biologists and 50% of general fisherman cite this habitat degradation as the most noticeable change occurring on their rivers (Table 6). The second most mentioned biological change noted was a shift in aquatic species communities, both fish and insects. Prevalent responses included, "higher brown trout numbers", "brown trout in river sections were they weren't before", "loss of westslope cutthroat and rainbows from certain river reaches", and on the plus side in the Missouri River this last year, "increases in the number of rainbow trout juveniles indicating a good spawn the past couple years". For the invertebrates, common changes noted were an "increase in smaller insect hatches," "better hatches of caddis and tricos where there used to be more stoneflies" and "increases in the number of crayfish and a decline of stonefly nymphs". These aforementioned insect and invertebrate changes are directly correlated to the filling of interstitial spaces in cobbles with silt and sediments coupled with warmer water temperatures.

The unanimous reason cited by participants for the increase in fine sediments and the corresponding biological changes was <u>drought (86%)</u>, and the long-term effects of decreased flushing flows and warmer water temperatures. Additional side-effects of the drought and in addition to it are dam-related (20%); factors such as not being able to release full spring flushing flows because of reservoir levels or having to top release warm water because of dam operation issue (Madison River 2008) have all contributed to sediment build up in the cobbles and gravels suffocating intolerant insect life (stoneflies, large mayflies), while allowing other smaller insects to thrive (tricos, BWO mayflies and certain caddis species).

While not explicitly related to most biological changes mentioned in the survey, but overwhelmingly addressed as a change seen on their rivers was fishing pressure (62%). It seems that all groups interviewed, from guides to biologists, are frustrated with the increased amount of boat and angler pressure on Montana's rivers. The crowding aspect of trying to fish the salmonfly hatch or any hatch could indeed have diminished the enjoyment factor of the angling experience and cause some folks to wish for the "good ole days" of less crowded conditions, regardless of how good the hatch is. A few examples of the type of angling pressure that fisherman mentioned in the survey, from a fisheries biologist, "Back in the day when I did flyfish 100 days a year, mostly the Bitterroot, I loved to fish during the Skwala hatch……it was the hordes of flyfishing snobs that overtook the Bitterroot during the Skwala hatch that forced me off the river."

One fisherman commented while fishing the Big Hole, "on a weekday, we are talking over 50 boats on the water! While fishing (the salmonfly hatch), we did see a good number of bugs, but I believe a large factor in reduced catch rates is directly related to the number of boats on the water." Similarly commenting on the perceived trout inactivity during a hatch, "On these Blue Ribbon Rivers, there is an extreme amount of fishing pressure. Fish are being pursued from dawn til dusk."

Conclusions

To address the question posed in the objectives: Are Statewide Populations of Salmonflies declining? We offer three answers—1) yes, at the statewide, broad-scale view of distribution and river-mile occupancy, we have lost a significant portion of salmonfly populations in the state's rivers. A quick calculation extrapolating lost river benthic habitat based on real data, professional opinion and on presumed species occupancy before dams were built or mining effects, we have realized a loss of ~350 river miles, ~70 miles of this has been documented within the last 30 years. Our more recent losses have been attributable to loss of habitat through siltation or increasing water temperatures beyond the species thermal limits.

The second answer to the question: 2) yes and no, salmonfly populations within some individual rivers have indeed declined in the last 20 years, four river sections in particular are highlighted by strong data or professional analysis; the Big Hole from Melrose to Browns Bridge and below Melrose, the Madison River below Ennis Lake, the Smith River above Camp Baker, and the Clark Fork below the Milltown Dam site and below Missoula. There are also sections of rivers (Big Hole, Rock Creek) that have experienced salmonfly decreases during the worse years of the drought, but have been shown by data or professional opinion to have rebounded in the last few "good water" years.

The third answer to the question: 3) we do not have sufficient data to answer this question for many sections of our rivers. The common theme running through this study was the lack of long term macroinvertebrate data sets on most of our major rivers. Project-generated (theses, watershed grants, etc.) macroinvertebrate samples were generally taken for 1 or 2 years with minimal visits per site and large gaps between projects; thus, we find large temporal gaps in data. The value of scientifically based, replicated monitoring can be seen in the Clark Fork River's 50 year data set; without the long-term data we would've never known the numbers of salmonflies were improving in certain river reaches until the 1970's when populations suffered a significant set back by exposure to metals from upstream sources, yet to return again to some sites. If we had examined the last 10 years of that Clark Fork data across all six sites, we would've concluded that salmonflies were largely absent from those reaches.

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Appendix A. ***Pteronarcys californica*** **and** ***P. dorsata*** **collection sites across Montana with relative abundance based on numbers in benthic samples. R= rare, C=common, A= abundant**

Waterbody	Latitude_Dec	Longitude_Dec	Relative Abundance	Waterbody	Latitude_Dec	Longitude_Dec	Relative Abundance
Bear Creek	45.0640	-110.6388	R	Dearborn River	47.1986	-112.0931	R
Beaver Creek	46.7878	-111.9069	R	Dearborn River	47.1988	-112.1099	C
Beaver Creek	46.8171	-111.8010	C	Dearborn River	47.1954	-112.0174	C
Beaver Creek	46.8171	-111.8058	C	Dearborn River MFork	47.2104	-112.2754	R
Beaver Creek	47.5956	-112.7533	C	Dearborn River MFork	47.1524	-112.2267	R
Big Hole North Fork	45.6442	-113.6519	R	Deep Creek	46.2935	-111.4685	R
Big Hole River	45.8597	-113.0836	R	Deep Creek	46.3010	-111.4546	R
Big Hole River	45.5267	-112.7008	R	Deep Creek	46.3230	-111.4011	R
Big Hole River	45.7014	-112.7344	R	Dry Creek	46.2437	-111.4476	R
Big Hole River	45.7847	-112.9139	R	Dry Creek	46.2436	-111.4516	R
Big Hole River	45.8494	-113.0681	C	Dupuyer Creek	48.1808	-112.5433	R
Birch Creek	44.0692	-112.8397	C	Fish Creek	45.7719	-112.2547	R
Bitterroot River	46.8533	-114.0989	C	Fish Creek South Fork	46.9883	-113.9823	R
Bitterroot River	46.0922	-114.1742	C	Fisher River	48.3474	-115.3119	R
Bitterroot River	46.8523	-114.1000	R	Fisher River	48.0847	-115.3746	R
Bitterroot River	45.9735	-114.1410	R	Fisher River	48.3567	-115.3158	C
Bitterroot River	46.0920	-114.1749	R	Flathead R, N Fork	48.4933	-114.1253	R
Bitterroot River	46.8523	-114.1000	R	Flathead River Sfork	47.9842	-113.5637	R
Blackfoot River	46.9003	-113.7550	C	Flint Creek	46.6285	-113.1512	A
Blackfoot River	46.8997	-113.7562	C	Fortine Creek	48.5980	-114.9590	C
Blackfoot River	47.0137	-113.2231	R	Fortine Creek	48.6717	-114.8978	C
Blackfoot River	46.9333	-113.1147	C	Fortine Creek	48.7936	-114.9533	C
Bloody Dick Creek	45.0166	-113.4978	R	Gallatin River	45.1692	-111.2414	C
Bloody Dick Creek	45.0427	-113.4087	R	Gallatin River	45.2819	-111.2239	C
Bloody Dick Creek	44.9940	-113.3274	R	Gallatin River	45.2780	-111.2291	R
Boulder River	45.8339	-109.9381	R	Gallatin River	45.0900	-111.2132	C
Bridger Creek	45.7092	-111.0264	C	Gallatin River	45.2259	-111.2493	C
Bridger Creek	45.7003	-110.9289	R	Gallatin River	45.3951	-111.2070	C
Clark Fork River	47.0233	-114.3359	R	Gallatin River	45.4265	-111.2325	C
Clark Fork River	47.0139	-114.3105	R	Gallatin River	45.2986	-111.2038	R
Clark Fork River	46.9933	-114.2287	R	Gallatin River	45.2816	-111.2252	R
Clark Fork River	46.8743	-114.0666	C	Gallatin River	45.4849	-111.2702	A
Clark Fork River	46.8826	-113.9312	A	Gallatin River	45.2656	-111.2577	A
Clark Fork River	46.8826	-113.9312	A	Gallatin River	45.2572	-111.2500	A
Clark Fork River	46.8217	-113.8081	R	Garden Creek	45.2242	-112.1417	R
Clark Fork River	46.7166	-113.5804	R	Jocko River	47.3122	-114.2982	C
Clark Fork River	46.7121	-113.3309	R	Keeler Creek	48.3572	-115.8590	R
Clark Fork River	46.6612	-113.1486	C	Little Bitterroot River	47.9007	-114.5832	R
Clark Fork River	46.5901	-112.9276	R	Little Blackfoot River	46.5200	-112.7922	R
Clark Fork River	46.4009	-112.7423	R	Little Blackfoot River	46.5195	-112.7934	C
Clark Fork River	46.4969	-112.7372	R	Little Thompson River	47.7280	-115.0250	R
Clark Fork River	45.1572	-109.0088	R	Little Thompson River	47.5426	-114.8845	R
				Lolo Creek	46.7558	-114.1133	R

Appendix A. cont.

Waterbody	Latitude Dec	Longitude Dec	Relative Abundance	Waterbody	Latitude_ Dec	Longitude_ Dec	Relative Abundance
Lolo Creek	46.7517	-114.0920	R	South Meadow Creek	45.4475	-111.7289	C
Lolo Creek	46.7528	-114.0917	R	St Regis River	47.4061	-115.4917	R
Lynch Creek	47.4981	-114.9096	R	St Regis River	47.3431	-115.2803	C
Madison River	44.7799	-111.1130	R	St Regis River	47.2986	-115.2344	C
Madison River	45.5851	-111.5763	R	Stillwater River	48.3206	-114.2786	C
Madison River	45.5905	-111.5762	R	Stillwater River	45.5285	-109.4684	R
Madison River	45.0974	-111.6624	C	Swamp Creek	48.6020	-114.9680	A
Madison River	44.8252	-111.4498	C	Swamp Creek	48.6025	-114.9614	R
Madison River	44.9753	-111.6469	C	Swan River	48.0425	-113.9747	R
Madison River	44.9002	-111.5922	A	Tenmile Creek	46.5276	-112.2539	C
Madison River	45.5746	-111.5936	C	Tobacco River	48.8970	-115.1220	C
Metzel Creek	44.6956	-111.8972	R	Tobacco River	48.7990	-114.9530	R
Middle Fork Dearborn	47.1929	-112.2911	C	Tobacco River	48.8985	-115.1231	R
Missouri River	47.2705	-111.6951	C	Tom Creek	44.5900	-111.6694	R
Nez Perce	45.8017	-114.2708	C	Tongue River	44.9966	-106.8800	R
Ninemile Creek	47.0281	-114.3969	R	Tongue River	44.8840	-107.2391	R
Ninemile Creek	47.0819	-114.4392	R	Trail Creek	45.6428	-113.6925	R
O'Dell Creek	45.3408	-111.7180	C	Trout Creek	47.7235	-115.6987	R
Pipe Creek	48.4893	-115.5222	R	Trout Creek	46.7670	-111.6492	C
Prickly Pear Creek	46.6607	-111.9754	C	Trout Creek	46.7659	-111.6468	A
Prickly Pear Creek	46.5161	-111.9478	C	Twelvemile Creek	47.3725	-115.2625	R
Rock Creek	46.6958	-113.6647	C	Twelvemile Creek	47.3760	-115.2590	R
Rock Creek	46.2262	-113.5385	C	Bitterroot River WF	45.8149	-114.2534	C
Rock Creek	46.7072	-113.6725	C	Bitterroot River WF	45.8050	-114.2623	C
Sheep Creek	44.6869	-112.7256	C	Whitefish River	48.3206	-114.2786	R
Sheep Creek	46.8116	-110.9228	R	Wise River	45.7931	-112.9503	R
Sheep Creek	46.8116	-110.9276	R	Wise River	45.7919	-112.9516	R
Sheep Creek	44.6869	-112.7256	C	Wise River	45.7921	-112.9513	R
Silver Creek	47.3611	-115.5661	R	Wise River	45.7931	-112.9503	R
Smith River	46.8710	-111.2708	R	Yaak River	48.4956	-115.9183	R
Smith River	46.8693	-111.2723	C	Yaak River North Fork	48.9700	-115.6200	C
Smith River	46.8469	-111.2099	C	Yellowstone River	45.1119	-110.7936	A
Smith River	46.8280	-111.1924	R	Yellowstone River	45.3380	-110.7632	R
Smith River	47.0106	-111.2892	R	Yellowstone River	45.4850	-110.6220	C
Smith River	47.2362	-111.3888	R	Yellowstone River	45.5385	-110.5810	C
Smith River	47.2616	-111.4207	R	Yellowstone River	45.7862	-110.0686	C
Smith River	46.7553	-111.1719	R	Yellowstone River	45.5972	-110.5653	C
South Fork Dearborn	47.1935	-112.1845	R				

Appendix B. ***Pteronarcella badia*****, the least salmonfly, collection sites across Montana with relative abundance based on numbers in benthic samples. R= rare, C=common, A= abundant**

Waterbody	Lat_Dec	Long_Dec	Relative Abundance	Waterbody	Lat_Dec	Long_Dec	Relative Abundance
Belly River	48.9690	-113.6826	R	Flathead R, Middle Fork	48.5056	-113.9933	C
Big Hole River	45.6153	-113.4578	R	Flint Creek	46.6285	-113.1512	C
Bitterroot River	46.8533	-114.0989	R	Ford Creek	47.4417	-112.6671	R
Bitterroot River	45.9663	-114.1350	C	Ford Creek	47.4456	-112.5641	R
Bitterroot River	46.0922	-114.1742	C	Gallatin River	45.0900	-111.2132	R
Bitterroot River	46.8533	-114.0989	C	Polaris, MT	45.4744	-113.1200	R
Bitterroot River	46.8523	-114.1000	R	Jack Creek	45.1624	-112.0871	C
Bitterroot River	46.5823	-114.0627	C	Jefferson Creek	46.7922	-112.7150	C
Blacktail Creek	45.9930	-112.5321	A	Jefferson Creek	46.7922	-112.7150	C
Blacktail Deer Creek	45.0053	-112.4450	C	Jefferson Creek	46.7761	-112.7383	C
Bloody Dick Creek	44.9940	-113.3274	R	Little Blackfoot River	46.5200	-112.7922	R
Bloody Dick Creek	45.0166	-113.3928	R	Little Blackfoot River	46.5195	-112.7934	A
Bloody Dick Creek	45.0112	-113.2574	R	Lolo Creek	46.7528	-114.0917	C
Bloody Dick Creek	44.9940	-113.3274	R	Long Creek	44.7421	-112.0195	R
Cataract Creek	46.2851	-112.2438	R	Long Creek	44.7421	-112.0195	R
Clark Fork River	46.3153	-112.7344	A	McCalla Creek	45.3114	-115.1173	C
Clark Fork River	46.3174	-112.7362	A	Medicine Lodge Creek	44.7514	-113.0362	R
Clark Fork River	46.4969	-112.7372	R	Metzel Creek	44.7306	-111.9011	R
Clark Fork River	46.4009	-112.7423	C	Middle Boulder River	45.6225	-110.1297	R
Clark Fork River	46.1867	-112.7679	C	Middle Boulder River	45.6256	-110.1220	R
Clark Fork River	46.5901	-112.9276	C	Middle Fork Flathead River	48.5056	-113.9933	R
Clark Fork River	46.7121	-113.3309	R	Mill-Willow Creeks Bypass	46.1828	-112.7765	C
Clark Fork River	46.7166	-113.5804	R	Morris Creek trib	46.8414	-116.1837	R
Clark Fork River	46.8222	-113.8065	C	Musselshell River	46.4625	-110.3182	C
Clark Fork River	46.8826	-113.9312	R	Ninemile Creek	47.1650	-114.5578	C
Clark Fork River	46.9176	-114.2081	R	Ninemile Creek	47.0819	-114.4392	C
Clark Fork River	46.9312	-114.2104	R	Ninemile Creek	47.0376	-114.3933	C
Clark Fork River	46.9933	-114.2287	C	Ninemile Creek	47.0313	-114.3930	C
Clark Fork River	47.0233	-114.3359	R	Nine Mile Creek	47.0281	-114.3946	C
Clover Creek East Fork	44.7142	-112.2525	R	North Meadow Creek	45.5127	-111.8174	C
Corral Creek	44.6140	-111.6043	R	North Willow Creek	45.7072	-111.7882	R
Corral Creek	48.7816	-111.1448	R	People's Creek	48.3638	-108.3579	R
Corral Creek	44.6140	-111.6043	R	Powder River	46.4253	-105.3064	R
Dearborn River	47.1986	-112.0931	R	Prickly Pear Creek	46.5875	-111.9193	C
Fork	47.1524	-112.2267	R	Prickly Pear Creek	46.6331	-111.9790	C
Deep Creek	46.2935	-111.4685	A	Prickly Pear Creek	46.5161	-111.9478	R
Deep Creek	46.3010	-111.4546	C	Rock Creek	46.7072	-113.6725	R
Deer Creek	48.9831	-111.5660	R	Sage Creek	48.9192	-110.8209	C
Elk Ck	45.6267	-111.4140	R	Shields River	45.7262	-110.4629	C
Elk Creek	46.9814	-111.6029	C	Shields River	45.7297	-110.4669	C
Elk Creek	45.6267	-111.4143	A	Silver Bow Creek	46.1819	-112.7776	R
Elk Creek	46.6781	-111.1951	R	Sixteenmile Creek	46.1090	-111.1681	R
Fawn Creek	48.2496	-115.3521	R				
Fish Creek	45.8062	-112.3722	R				

Appendix B. cont.

Waterbody	Lat_Dec	Long_Dec	Relative Abundance
Stillwater River	48.3206	-114.2786	R
Swan River	48.0425	-113.9747	R
Sweetwater Creek	45.0903	-112.2917	R
Taylor Ck	45.0617	-111.2650	C
Teton River	47.9222	-111.7443	R
Tobacco River	48.8970	-115.1220	R
Tom Creek	44.5900	-111.6694	R
Tongue River	44.9966	-106.8800	A
Warm Springs Creek	46.1814	-112.7826	A
Washington Creek	46.7811	-112.6702	R
Washington Creek	46.7625	-112.7000	C
Whitefish River	48.3206	-114.2786	R
Willow Ceek	45.4381	-112.7422	R
Willow Creek	45.4253	-109.2306	R
Willow Creek	45.4381	-112.7422	R
Yellowstone River	45.9036	-108.3199	R
Yellowstone River	45.8000	-108.4667	C
Yellowstone River	45.7862	-108.4771	C
Yellowstone River	45.7862	-110.0686	C
Yellowstone River	45.7581	-109.7697	R
Yellowstone River	45.6896	-108.6449	R
Yellowstone River	45.6861	-108.6531	R
Yellowstone River	45.6813	-108.6664	R
Yellowstone River	45.6539	-108.7581	R
Yellowstone River	45.6214	-109.2372	R
Yellowstone River	45.6172	-108.8395	R
Yellowstone River	45.5972	-110.5653	C
Yellowstone River	45.5964	-110.5661	C
Yellowstone River	45.5385	-110.5810	C
Yellowstone River	45.4850	-110.6220	C
Yellowstone River	45.3380	-110.7632	R
Yellowstone River	45.1119	-110.7936	C
Yellowstone River	44.9008	-110.2556	C