Assessing Effects of Habitat Manipulation on Invertebrates in an Arctic Barrenlands Stream

by

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Abstract

As resource exploitation and development expands in northern Canada, threats to the ecological integrity of freshwater systems increase. In Canada, developments that could negatively affect aquatic ecosystems require offsetting or compensation measures. As a result of diamond mine development, a habitat compensation project was required to offset aquatic habitat losses at Diavik Diamond Mines Inc. (DDMI). The aim of the project was to convert West Island Stream (WIS), a stream that was generally inaccessible and impassable for fish, into a nature-like fishway that would improve ecological connectivity between Lac de Gras and a headwater lake, and thereby provide spawning and rearing habitat for fish, especially Arctic Grayling. Because reduced growth and production of young-of-year Arctic Grayling in a nearby constructed stream was attributed to lower densities and smaller sizes of benthic invertebrates, likely due to low amounts of autochthonous and allochthonous organic matter and homogeneous physical habitat, a Before-After-Control-Impact study was initiated to assess effects of DDMI's offsetting project on key components of stream habitat structure and function and on invertebrates. I examined more than 40 physicochemical and biological parameters of stream habitat, as well as density, biomass, diversity, and taxonomic composition of aquatic invertebrates, before and after fishway construction. Data from three reference pristine streams were also collected to establish standards against which characteristics of the fishway could be compared, and to provide a better picture of aquatic invertebrate assemblages in Barrenlands streams. Based on biotic and abiotic data collected over six years (four years pre-impact and two years post-impact), WIS presented generally successful post- habitat manipulations recovery, for both habitat structure and function and invertebrate assemblages. Although a reduction in organic matter input, presence, and accumulation was observed, these changes were likely due to riparian vegetation removal

from one of the stream banks during the manipulation, and I expect CPOM accumulation to increase as the riparian vegetation is reestablished. Conversion to the fishway also led to changes in substrate composition and flow, and best explains the observed shifts on invertebrate assemblages, especially in Simuliidae (which greatly increased in absolute and relative density and biomass) and Chironomidae (which decreased in absolute and relative density and biomass). For future studies I recommend limiting riparian vegetation removal to a single bank, and possibly leaving intermittent natural "green zones" that can mitigate possible effects of altered instream organic matter accumulation and invertebrate recolonization. I also recommend long-term monitoring to investigate trends in recovery of habitat variables and their effect on invertebrate assemblages and on fish populations.

Preface

This thesis is an original work by Christiane B. Uherek. The research project, of which this thesis is a part, received research licensing approval from the Aurora Research Institute (ARI), under the project name "Improving Habitat Connectivity to Enhance Productive Capacity of Arctic Freshwater Ecosystems", No. 15198, February 04, 2013. The license was renewed as No. 15417, February 14, 2014. No part of this thesis has been previously published.

This thesis is dedicated to my husband, Peter Uherek; my biggest supporter, my dearest friend, and the love of my life.

“In nature's infinite book of secrecy a little I can read.”

(William Shakespeare, Antony and Cleopatra: Act 1, Scene 2.)

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Chapter 1: General Introduction

1.1 Research Background

1.1.1 Northern Aquatic Habitats and Offsetting Measures

Northern landscapes are often characterized by abundant networks of lakes, rivers, streams and wetlands (Schindler 1998, Vincent and Hobbie 2000); indeed, lake-stream systems comprise up to 30% of the Barrenlands, a region of northern Canada (Spence *et al*. 2003). Although abundant, such freshwater ecosystems are among the least studied in North America, and life histories and habitat preferences of many organisms are poorly known (Schindler 2001, Evans *et al*. 2002). In addition, resource exploitation and development are expanding in northern Canada, altering physical, chemical and biological conditions of aquatic habitats and threatening the ecological integrity of freshwater systems. Thus, improving our understanding of the structure and function of northern aquatic ecosystems is very important for achieving sustainable resource development.

In Canada, the national legislation for conservation and management of fisheries and fish-bearing habitats is the Fisheries Act (hereafter, the Act), which provides legal context and regulates all development in and near water bodies that could result in degradation or destruction of habitat on which fish depend. Based on the Act, Fisheries and Oceans Canada (DFO) issued the Policy for the Management of Fish Habitat (hereafter, the Policy) (DFO 1986). Until 2012, the focus of the Policy was on protection of fish and fish habitat. Accordingly, for projects in which avoidance of harmful alteration, disruption or destruction (HADD) of fish habitat was not feasible, developers were required to provide habitat compensation to offset the HADD and to ensure no net loss (NNL) in productive capacity of habitat. Compensation was defined in the Policy as "*the replacement of natural habitat,* *increase in the productivity of existing habitat, or maintenance of fish production by artificial means, where mitigation techniques and other measures are not adequate to maintain habitats*" (DFO 1986). All fish species and their supporting systems were covered by this Policy.

In 2012, changes to the Act no longer specified HADD and NNL. The amended Act is to provide sustainability and protect the ongoing productivity of commercial, recreational and Aboriginal (CRA) fisheries (Government of Canada 2015). Consequently, DFO developed the Fisheries Protection Policy Statement and the Fisheries Productivity Investment Policy in 2013, both of which interpret and discuss key elements of the Fisheries Protection Provisions in the revised Act. Projects that cause serious harm to fish that are part of or support a CRA fishery are prohibited (Government of Canada 2015). Similar to the previous Policy (DFO 1986), projects that reduce CRA fisheries productivity, including impacts to habitat quality or quantity, may be authorized if full offsetting measures are in place to sustain that productivity (DFO 2013a, b, Government of Canada 2015). Note that in the amended Act, serious harm is defined as "*the death of fish or any permanent alteration to, or destruction of, fish habitat*" (Government of Canada 2015), while the term "compensation" was replaced by "offsetting".

The principles to offset serious harm (previously, to compensate HADD and to achieve NNL) remain largely unchanged, and restoration, enhancement, or development of habitat are still appropriate mitigation strategies (DFO 1986, 2013a, b, Government of Canada 2015). Nevertheless, under the amended Act, aquatic biodiversity may not be fully protected, as the organisms that are part of or support CRA fisheries need to be clearly specified, and that could leave threatened and endangered species and their habitats unprotected (Hutchings and Post 2013, Koops *et al*. 2013). Although fish are the focus of most offsetting projects under the former and the revised Act, the definition of fish habitat remains largely unchanged:

"*spawning grounds and any other areas, including nursery, rearing, food supply and migration areas, on which fish depend directly or indirectly in order to carry out their life processes*" (Government of Canada 2015). Thus, key food species that provide direct and indirect support to and could potentially limit the productivity of CRA fisheries are also protected as fish habitat (Kenchington *et al*. 2013, Koops *et al*. 2013).

Restoration ecology is a relatively young interdisciplinary field and the literature on aquatic habitat compensation/offsetting is both fragmented and not often subject to scientific review. These knowledge gaps can be addressed with peer-reviewed research that employs rigorous experimental design (Bradshaw 1996, Buijse *et al*. 2002, Quigley *et al*. 2006). Green (1979) proposed the Before-After-Control-Impact (BACI) study as a rigorous method to assess environmental disturbances. In essence, to evaluate potential impacts at a disturbed site, data are collected both before and after the impact at the site and compared with changes over the same periods at one or more undisturbed reference (or control) sites (Green 1979, 1993, Underwood 1991, 1992, 1994, Downes *et al*. 2002, Smith 2013).

However, several challenges to employing a BACI design exist when it involves an aquatic habitat that has received offsetting following a disturbance. To support processes such as colonization and succession of focal organisms, offsetting efforts should focus on restoring ecosystem functions (Bradshaw 1996). For example, reduced growth, abundance, and productivity of young-of-year (YOY) Arctic Grayling, *Thymallus arcticus* (Pallas) in a constructed Arctic stream could be largely attributed to lower densities and smaller sizes of their invertebrate prey, which in turn appeared to result from low amounts of autochthonous and allochthonous organic material and homogeneous physical habitat when compared to natural control streams (Jones *et al*. 2003a). Therefore, examining a diversity of ecosystem components can provide more complete understanding of habitats upon which fish depend

(Underwood 1991, Quigley and Harper 2006) and facilitate better assessment of responses to habitat alterations including those associated with compensation.

1.1.2 Aquatic Ecosystem Function

Productivity in aquatic systems is dependent on nutrient availability. The catchment of a stream can provide substantial amounts of nutrients that can be incorporated into stream channels (Hullar and Vestal 1989, Vincent and Laybourn-Parry 2008). Catchments with high landscape diversity can sustain a diversity of species at higher trophic levels (e.g., fish) (Lapointe *et al*. 2014). Most aquatic habitats in the Canadian north are nutrient-limited oligotrophic systems, highly dependent on riparian and littoral zones for organic matter (OM) inputs (Vincent and Hobbie 2000, Vincent and Laybourn-Parry 2008). Jones *et al*. (2003a) described Barrenlands streams as scant in nutrient concentration in comparison with Alaskan tundra streams and as the most nutrient-poor water bodies in North America, noting that they were also characterized by little variation in water chemistry.

Riparian areas provide a long list of benefits and fundamental ecological functions upon which in-stream communities depend (Milner and Gloyne-Phillips 2005). Jones *et al*. (2003a) found that many Barrenlands streams flow through a dense shrub zone. These high latitude systems are characterized by low decomposition rates, which results in significant amounts of leaves, wood pieces (WP), and coarse particulate organic matter (CPOM) accumulating in streams. Even when riparian vegetation occupies a small fraction of the banks of these aquatic systems, decaying instream litter (e.g., roots, leaves, twigs, and other wood pieces) plays a critical role in many biogeochemical processes (Dosskey *et al*. 2010), and represents a major source of OM to headwater streams, which is critical to aquatic invertebrate shredders that convert significant amounts of CPOM into fine particulate organic matter

(FPOM) as they feed or defecate, generating significant food resources for aquatic invertebrate collectors (Cummins *et al*. 1989), and ultimately supporting fish populations. In addition, riparian vegetation increases channel stability by protecting streambanks from erosion, moderates temperature along the stream, and provides diverse habitats for invertebrates and fish. Since, disturbances in riparian systems can affect both physical and biological processes in streams, offsetting efforts in lotic systems should aim to preserve or re-establish riparian and aquatic vegetation.

Periphyton, macrophytes, and bryophytes are also important in these habitats not only for their photosynthetic role, but because they provide physical habitat for invertebrates and fishes. An array of abiotic factors (e.g., temperature, light, and nutrient availability) can control periphyton growth, affecting diversity and biomass of herbivores (e.g., aquatic invertebrate scrapers and some fish species) (Frost and Elser 2002) and, indirectly, other higher trophic levels. For instance, aquatic plants were more abundant in reference streams when compared to the impacted stream in a Barrenlands study; tellingly, densities of aquatic invertebrate in the latter stream were also lower, leading to reduced growth rates of YOY Arctic Grayling (Jones *et al*. 2003b, Scrimgeour *et al*. 2011).

1.1.3 Aquatic Food Webs and Invertebrates

Invertebrates are essential to a productive aquatic environment, due to their vital role in transformation and translocation of energy and nutrients from autotrophs to vertebrates (Miller *et al*. 2010). Their diverse ecological patterns (e.g., behavior, niches, trophic relations, and life history) and sensitivity to a variety of pollutants can be used as indicators of the condition of an aquatic community (Mackay 1992, Moser and Minshall 1996, McCafferty 1998, Voshell 2002, Thorp and Covich 2010, Uherek and Gouveia 2014). An important strategy for increasing biodiversity and therefore ecosystem resistance and resilience is to increase biomass of lower trophic levels, including invertebrates (Miller *et al*. 2010), which then can support higher trophic levels.

Biodiversity of freshwater invertebrates decreases with increasing latitude (Oswood 1989). Although the species present at high latitudes are well adapted to cope with large seasonal changes, environmental extremes, continuous permafrost, and short growing seasons result in low productivity (Vincent and Laybourn-Parry 2008). And though invertebrate assemblages can often recover rapidly from disturbances (Yount and Niemi 1990), post-restoration recovery rates have been highly variable (Miller *et al*. 2010). For example, Scrimgeour *et al*. (2011, 2014) found lower densities and biomasses of zoobenthos in a constructed stream relative to control streams1-3 years after construction and only partial recovery after 14 years in their study streams in the Barrenlands. Miller *et al*. (2010) identified a number of studies (e.g., Nakano and Nakamura 2006, Pederson *et al*. 2007) in which invertebrate richness and density increased following restoration, as well as studies (e.g., Biggs *et al*. 1998, Purcell *et al*. 2002) that did not meet the expected pre-project levels of richness and density.

Freshwater invertebrates have numerous strategies to disperse within and among water bodies, including up- or downstream crawling, drifting, and aerial dispersal (Bilton *et al*. 2001, Merritt *et al*. 2008, Thorp and Covich 2010). The abundance of freshwater habitats in the Arctic Barrenlands should provide sources of invertebrate colonists for newly created or modified stream habitat (Sundermann *et al*. 2011). In fact, up to 85% of stomach contents of YOY Arctic Grayling consisted of two of the most rapidly colonizing invertebrate taxa in these systems, Chironomidae and Simuliidae (Jones *et al*. 2003a, Scrimgeour *et al*. 2011). Jones *et al*. (2008) suggested that Barrenlands post-disturbance monitoring plans should target a wide range of trophic levels of an ecosystem, especially aquatic invertebrates, preferably on a long-term basis. Overall, a multimetric approach seems particularly appropriate for assessing environmental projects related to aquatic ecosystems disturbances to understand their pre- and post-impact characteristics.

1.1.4 Habitat Compensation in the Barrenlands

In 1991, diamonds were discovered in the Canadian Barrenlands (Krajick 2001, Kjarsgaard and Levinson 2002), and within 10 years, several mines were being developed. Often, mine infrastructure occupies large spaces and potential negative effects can result. For example, as a result of mine development at Diavik Diamond Mines, Inc. (DDMI), 24 ephemeral streams were altered and 3 small fish-bearing lakes were permanently removed from the landscape to provide enough area for the mine site construction (DDMI 1998). Thus, there is a need for better understanding of northern aquatic systems and for monitoring environmental projects associated with these activities.

In accordance with the former Fisheries Act, DDMI was required to offset aquatic habitat losses that occurred during initial phases of DDMI development in 2001. At the end of 2012, DDMI implemented the construction of a nature-like fishway at West Island Stream (WIS), a lake outlet stream within the Lac de Gras (LDG), Northwest Territories, drainage basin that was inaccessible to fish. Nature-like fishways are designed with an "ecologically minded" philosophy aiming to mimic the characteristics of natural streams using on-site materials (Katopodis *et al*. 2001), such as boulders, rocks, and wood pieces. The goals of the project were to: 1) improve ecological connectivity between LDG and West Island Lake (WIL) through its single outlet stream WIS, by eliminating small cascades that acted as barriers to fish; 2) increase duration of summer flow in WIS using stream channelization to concentrate flow into a single, well-defined channel; and 3) provide spawning and rearing habitat for fish, especially Arctic Grayling.

1.1.5 BACI Design

BACI designs *sensu* Green (1979) are commonly used to assess and monitor projects that could result in potential environment impacts. The use of a rigorous study design that includes pre- and post-project monitoring at both manipulated and reference sites can help control for spatial and temporal variability of ecological responses (Green 1979, 1993, Underwood 1991, 1992, 1994, Downes *et al*. 2002, Smith 2013). Generally, the challenge of an impact assessment is to distinguish anthropogenic effects from natural variation (temporal and spatial) in ecosystems, which requires comparison between disturbed and undisturbed sites before and after the impact (Green 1979, 1993, Underwood 1991, 1992, 1994, Downes *et al*. 2002, Smith 2013). In a BACI context, BA (i.e., Before-After) represents the temporal part of the design, while CI (i.e., Control-Impact) represents the spatial context of the design (Green 1993).

The goal of a successful habitat restoration project in a BACI context is to find no significant interaction between the two sources of variation (i.e., treatment and time), indicating that no potential environmental impact post-activities resulted (Green 1979, 1993). However, it is important to note that in West Island compensation project context the study sites are different, and the focus is not on those differences (impact versus control sites) but in their responses to pre- and post- treatment periods. Importantly, the aforementioned compensation project aimed to change the stream and make it “fish-friendly”, and these results should be evaluated accordingly to the project goals. In this sense, a significant treatment*time interaction may not necessarily mean a bad outcome (i.e., potential environmental impact, as the project is not assessing impacts), but a difference between the baseline period and the post-manipulation period, in other words, a potentially desirable and expected result that reflects ecological connectivity improvement, increased duration of stream flow, and a stream channel that is accessible for fish, including those with limited capabilities of "jumping" natural barriers, such as cascades. Though monitoring of fish movement within WIS is beyond the scope of my research, my findings are valuable to evaluate the suitability of physical habitat for fish and autochthonous and allochthonous organic material availability to support invertebrates' recolonization and, therefore, fish.

1.2 Thesis Research

To monitor and assess this project, a BACI study was initiated in 2009. Biotic and abiotic baseline data from the unmodified WIS and three reference streams were collected during summers of 2009 to 2012, to document structure and function of the ecosystems, their ecological communities, and their relationships prior to the modification of WIS. Stream manipulation occurred during the end of summer 2012; therefore, data collected during summers of 2013 and 2014 in WIS and reference streams represented the post-impact period.

Data were analyzed qualitatively and quantitatively in a BACI framework to assess the effects of DDMI's habitat manipulation project on components of stream habitat structure and function (Chapter 2) and on invertebrates (Chapter 3), which are linked to fish spawning grounds, rearing habitat, and food supply needs, and ultimately to increase the productive capacity of an existing aquatic habitat for fish, a former Fisheries Act compensation requirement. Data from reference streams were used to establish temporal standards against which changes in the manipulated stream could be compared (Green 1979, 1993, Underwood 1991, 1992, 1994, Jones *et al*. 2003 a, b, 2008). Ultimately, I desired to help fill the gaps in our knowledge of ecological compensation and to contribute to make better predictions for future developments, compensation and restoration projects.

1.3 Research Questions

Based on biotic and abiotic data collected over six years (i.e., four years before habitat manipulation of WIS, and two years of post-impact data) from the "impacted" and reference streams, my research questions for the West Island compensation project were: 1) How habitat characteristics differed before (2009-2012) vs. after (2013-2014) offsetting activities in the manipulated stream relative to any changes in the reference streams? and 2) How invertebrate density, biomass, diversity, and taxonomic composition differ in WIS before vs. after offsetting activities and relative to the reference streams?

1.4 Organization of Thesis

My thesis contains four chapters, including two data chapters that are written in a paper-based format. Following this general introduction and research background, Chapter 2 examines stream habitat characteristics and Chapter 3 examines aquatic invertebrates of the manipulated and reference streams before and after manipulations, Chapter 4 concludes my thesis by discussing all results, together with recommendations for future studies.

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Chapter 2: Effects of Offsetting Activities on Stream Habitat Structure and Function in the Canadian Barrenlands

2.1 Introduction

Anthropogenic stresses can damage essentially pristine habitats. In many cases, environmental damage is perceived too late and the effects can be permanent. In Canada, developments that could negatively affect aquatic ecosystems require offsetting or compensation measures (e.g., habitat manipulation) under the Fisheries Act (hereafter, the Act). Prior to amendments that occurred in 2012, the Act focused on the protection of both fish and fish habitat. Currently, the Act focuses primarily on the protection, management, sustainability, and on-going productivity of commercial, recreational, and Aboriginal (CRA) fisheries (Government of Canada 2015). However, to ensure that target fisheries species are not under risk of serious harm or extirpation, protection of aquatic ecosystems are necessary (Hutchings and Post 2013, Rice *et al*. 2015).

Resource developments in northern Canada are becoming more common (Rheaume and Caron-Vuotari 2013) and are likely to generate abrupt changes to aquatic habitats and, consequently, to the resident biota. Projects to offset this damage are challenging as they are based on our imperfect ecological understanding of habitats and species needs (Bradshaw 1996). Regular monitoring can advance our understanding of northern ecosystems and provide baseline data for assessing impacts related to these activities and for developing offsetting strategies (Jones *et al*. 2003a, Lapointe *et al*. 2014).

Structural changes in a habitat can to lead to functional changes in the ecological community supported by that habitat (Hellawell 1986, Hieber *et al*. 2005). Therefore, compensation projects that alter aquatic habitat structure will likely affect aquatic communities (Quinn *et al*. 1997, Roni *et al*. 2002). Monitoring that incorporates multiple abiotic and biotic indexes, such as habitat characteristics, nutrients, organic matter, and indicator species, can provide a good assessment of a compensation project's effectiveness and of post-disturbance recovery rates (Green 1979, 1993, Hellawell 1986, Underwood 1991, Quigley and Harper 2006, Vincent and Laybourn-Parry 2008).

The distribution of aquatic organisms is affected by many different factors including, light, temperature, water quality, substrate type and stability, current speed, food availability, competition, and predation (Hellawell 1986, Vincent and Hobbie 2000, Merrit *et al*. 2008, Vincent and Laybourn-Parry 2008, Dosskey *et al*. 2010, Thorp and Covich 2010). In the Canadian Barrenlands, most aquatic systems are oligotrophic and highly dependent on riparian and littoral zones for allochthonous organic matter (OM) and nutrient inputs (Jones *et al*. 2003b). Due to this limited internal production of OM, as well as low decomposition rates in this region (Jones *et al*. 2003b), offsetting projects that result in total or partial removal of the riparian vegetation can have immediate and/or long-term impacts on ecosystem structure and functioning. While removal of vegetation from the riparian zone is often necessary during a compensation project's construction phase, post-disturbance revegetation measures can promote not only riparian area reestablishment, but also the recovery of its associated terrestrial and aquatic biota as well as instream OM (Hellawell 1986).

Riparian areas contribute instream wood pieces and leaf litter that provide habitat and food resources for invertebrates (Milner and Gloyne-Phillips 2005). As described by Hellawell (1986) and Mackay (1992), bankside shade provided by riparian vegetation affects light and temperature that influences, in turn, productivity of sestonic algae, periphyton, and macrophytes, which also provide food for many invertebrates and, ultimately, higher trophic levels (e.g., fish). In addition to altering riparian areas, compensation projects that involve channel modifications can affect oxygen concentrations, diversity of instream habitats, current velocities, and turbidity levels (Hellawell 1986), all of which can affect establishment, diversity and biomass of associated biota.

In 1991, diamonds were discovered in the Canadian Barrenlands (Krajick 2001, Kjarsgaard and Levinson 2002) and within 10 years, several mines were being developed. Aquatic habitat losses that occurred during the development of Diavik Diamond Mines, Inc. (DDMI) at Lac de Gras (LDG), Northwest Territories (NT), in 2001 required habitat compensation, in accordance with the former Fisheries Act.

The West Island compensation project was proposed by DDMI and their consultants and approved by Fisheries and Oceans Canada (DFO). The goals of the project were to: 1) improve ecological connectivity between LDG and West Island Lake (WIL) through its single outlet stream West Island Stream (WIS); 2) increase duration of summer flow in WIS; and 3) provide spawning and rearing habitat for fish. After four years of investigations on the undisturbed outlet stream and other reference streams, DDMI constructed a nature-like fishway by modifying WIS, at the end of summer 2012. Small cascades that acted as barriers to fish were eliminated, stream channelization concentrated flow into a single, well-defined channel, and suitable streambed materials (i.e., rocky substrate) were increased to provide spawning and rearing grounds for fish.

As part of the monitoring and assessment of this project, I examined physical, chemical, and biological characteristics of three undisturbed reference streams (REF) and the manipulated stream (WIS), before and after fishway construction. My basic objective was to determine how habitat characteristics differed before (2009-2012) vs. after (2013-2014) offsetting activities in the manipulated stream relative to any changes in the reference streams.

2.2 Study Area

The study area is located in the Canadian Barrenlands, centered around the DDMI site at LDG (64°30'41"N, 110°17'23"W; elevation 416 m; Figure 2.1), approximately 300 km northeast of Yellowknife (NT), 210 km south of the Arctic Circle, and about 100 km north of the tree line in the Southern Arctic Ecozone, within the continuous permafrost zone (DDMI 2009). This area is semi-arid, with ca. 290 mm average annual precipitation, 55% of which falls as snow. The mean annual temperature is -4.3°C with a summer mean of 10°C and maximum of 32.5°C and a winter mean of -31°C and minimum of -51.2°C., average wind speed is 20 km/h, and daylight hours with the sun above the horizon varying from 22 hours (June) to 2 hours (December) (DDMI 2009, Environment Canada 2016).

The landscape is classified as Southern Arctic Tundra and is characterized by numerous lakes, bedrock outcrops, boulder fields, till, and eskers (DDMI 2009). Wetter areas bordering lakes and streams are dominated by Dwarf Birch *Betula nana* (Linnaeus), Northern Labrador Tea *Rhododendron tomentosum* (Harmaja), willows (*Salix* spp.), sphagnum mosses (*Sphagnum* spp.), and sedge tussocks (*Carex* spp.) (DDMI 2009). Smaller streams in the Barrenlands generally flow over folded rock and glacial features, creating highly irregular drainage patterns. They are dominated hydrologically by a large snowmelt freshet promoting peak flows, followed by a flow decrease until freeze-up in autumn. After freshet, stream flow is dependent on lake outflows, but summer evaporation combined with shallow soils and continuous permafrost often lower lake levels below the outlet, which cuts off flow to the stream (Baki *et al*. 2012). This results in channels having pools of standing water or stream reaches becoming completely dry by mid to late summer.

WIS, the manipulated stream, is located approximately 8 km west of DDMI. WIS is an outlet stream originating from a 13.65 ha headwater lake WIL, with a drainage area of 30 ha.

WIS flows 420 m before emptying into LDG (Table 2.1, Figure 2.2). Two reference sites located within the LDG watershed were also studied. Reference 2 (Table 2.1, Figure 2.3) consisted of an 18.87 ha headwater lake (R2L), located approximately 6 km northwest of DDMI and connected to LDG by a 103 m outlet stream (R2S). Reference 6 (Table 2.1, Figure 2.4), located approximately 7 km southeast of DDMI, consisted of a chain of two lakes, the upper R6L1 (3.91 ha) and the lower R6L2 (6.82 ha), and two outlet streams, R6S1 (108 m) and R6S2 (177 m), with the latter draining into LDG. Thus, there were three reference streams (REF) in total (R2S, R6S1, R6S2), and one impacted stream (WIS).

Prior to habitat manipulation, fish access from LDG to WIS and WIL was limited due to a series of cascades located in the lowest portion of WIS. As well, limited post-freshet flow and a braided and poorly defined channel provided poor fish habitat (Figure 2.5). To improve ecological connectivity between WIL and LDG, increase duration of spring and summer flows in WIS, and provide spawning and rearing habitat for fish, especially Arctic Grayling, *Thymallus arcticus* (Pallas), a spring-spawning species, DDMI modified WIS at the end of summer 2012, using a nature-like fishway design. This type of design uses on-site natural materials (Katopodis *et al*. 2001) such as boulders, rocks, and wood pieces to mimic the characteristics of natural streams.

To achieve this, the stream was channelized to concentrate flow and a new channel section was created to bypass the lower-section cascades. Boulder-weirs, boulder-chokes, boulder-based step-pools, and rocky ramps were added to create more favorable hydraulics to facilitate fish movement (Figure 2.6; Courtice *et al*. 2016). During construction, the right bank (i.e., facing downstream) riparian vegetation was removed to provide access to the stream for heavy equipment. To prevent bank erosion, promote ecosystem productivity, and create different types of instream microhabitats that could be colonized by diverse invertebrate taxa, willow was replanted into the disturbed bank (i.e., right bank facing downstream) and wood pieces were added to the stream channel.

2.3 Methods

To help evaluate and monitor the WIS compensation project, with a focus on components of stream habitat structure and function, and on benthic invertebrates (Chapter 3), I used four years of pre-manipulation data (the Before period: 2009-2012) and collected post-manipulation data for two years (the After period: 2013-2014).

Data from the Before and After periods were collected and processed consistently following standard operational procedures described below. Data collected from the impacted stream (WIS) and control or reference streams (REF: R2S, R6S1, R6S2) were analyzed following a Before-After-Control-Impact (BACI) study design (Green 1979, 1993, Underwood 1991, 1992, 1994, Downes *et al*. 2002).

2.3.1 Sampling Procedures

To document habitat characteristics and to establish sampling locations for invertebrates, WIS was divided into lower, middle and upper reaches according to changes in topography. Within each reach, six habitat stations were selected by observing patterns in the water surface and changes in the streambed elevation, corresponding to three pools (i.e., lentic depositional habitat) and three riffles (i.e., lotic erosional habitat), for a total of 18 stations. Six habitat stations were assigned at both R6S1 and R6S2, corresponding to three pools and three riffles. Four habitat stations were identified in R2S, corresponding to two pools and two riffles. The number of habitat stations per stream was constrained by stream length. These stations were consistent for the REF streams during the entire study period; however, new habitat stations located within new lower, middle and upper reaches were assigned for WIS in 2013 after the fishway construction in late summer of 2012, due to changes in the physical characteristics of the stream channel.

Field seasons started in late May or early June, immediately after freshet, and ended in mid-August, by which time flows were minimal or had ceased. Each year, samples were collected and data were recorded at approximately the same time, to minimize seasonal variability. Stream habitat assessment was carried out within an area comprising 1 m upstream and 1 m downstream of each habitat station, unless specified otherwise. All data were recorded manually on field datasheets and then transferred to Excel (Versions 97-2016, Microsoft Corporation).

2.3.1.1 Habitat Structure: Physicochemical Characteristics

Channel width (m) was measured as the width of the actively scoured portion of the channel. Channel depth (m) was measured as the maximum vertical distance from the streambed to the top of the stream bank. I measured water depth (m) at10 locations evenly distributed along a cross-section of the stream. At each water depth point, I also recorded current velocity (m/s) at 0.6 m of depth (Harrelson *et al*. 1994) using a Marsh-McBirney flow meter (Model 2000 Flo-Mate).

Shape of both banks was recorded as straight, convex or concave. Stability of both banks was assessed qualitatively and recorded as low, moderate or high. Stream channel exposure was also assessed qualitatively and recorded as low, moderate or high, based on the exposure of the stream channel to the sun relative to riparian vegetation coverage. Turbulence at the water surface was classified qualitatively as low, moderate or high based on the range of turbulence observed among the four streams. At the whole stream scale, bank shape and stability, stream channel exposure, and turbulence were summarized as percentages for each variable class.

Streambed materials were quantified following the Wolman Pebble Counts Method (Wolman 1954). One count procedure was applied in each of the three REF streams and in each WIS reach. Starting at the downstream end of a fixed 30 m transect and working upstream in a zigzag pattern, I measured the intermediate axis (mm) of 100 particles picked from the bed of the channel, each particle one boot-length from the previous. Particles smaller than 4 mm were classified as fines, 4-63 mm as pebbles, 64-255 mm as cobbles, and greater than 256 mm as boulders (Table 2.2). Streambed substrate was then summarized as percentages of fines, pebbles, cobbles, and boulders at the whole stream scale.

Water temperature (°C) was measured with instream HOBO Pendant temperature loggers (Onset Computer Corporation), programmed using HOBOware Pro (Version 3.7.8, Onset Computer Corporation 2002-2016) to record water temperature hourly during the entire field season. Three loggers, one per reach, were deployed in WIS and one logger in each of the three REF streams.

I measured specific conductivity (µS/cm), dissolved oxygen (DO) (mg/L), and pH with a Hydrolab DataSonde 4 (Hydrolab Corporation). These variables were measured four times per field season at a single location in each WIS reach and in each REF stream. Results were recorded once the probes were completely submerged and stabilized in the stream channel without touching the streambed; care was taken to avoid streambed sediment disturbances during the procedure.

I collected water samples prior to any other work near or within the stream channel to avoid water column and sediment disturbance, and latex gloves were worn to minimize contamination. Acid-washed 1000 mL Nalgene amber bottles (Thermo Scientific) and lids were triple rinsed with stream water prior to sample collection and 2 liters of water were collected at the same location used for Hydrolab measurements in each of the three REF streams and in each WIS reach by submerging two bottles into the stream water column, avoiding the surface water film and without disturbing the streambed. Back in the laboratory, one bottle was refrigerated at 4°C and the other was frozen at -18°C for later processing.

For total suspended solids (TSS) analysis, the refrigerated bottle was shaken vigorously to re-suspend any precipitated matter and 100 mL was filtered onto a pre-weighed 4.7 cm GF/F glass microfiber filter (Whatman, Sigma-Aldrich) using a glass-filter suction apparatus. The filter was then double-folded and placed into a labeled aluminum weighing dish (Fisher Scientific), dried at 105°C (Isotemp Standard Lab Oven, Fisher Scientific) for 1 hour, transferred to a desiccator for 1 hour, and finally the dry mass (mg) of the sample was measured (Ohaus Explorer Balance, Sigma-Aldrich).

For chlorophyll-a (Chl-a) analysis, 300 mL of the refrigerated bottles was filtered through an acid-washed 4.7 cm GF/F glass microfiber filter (Whatman, Sigma-Aldrich) using a glass-filter suction apparatus. The filter was then double-folded, placed in a labeled petri dish, wrapped in tinfoil, and frozen at -18°C. Labeled samples were shipped to University of Alberta Biogeochemical Analytical Service Laboratory (BASL), Edmonton, Alberta, Canada, for determination of Chl-a (μg/L) by fluorometry using a Shimadzu RF-1501 Spectrofluorophotometer (Welschmeyer 1994).

For nutrient analyses, the frozen water sample was shipped to University of Alberta BASL for determination of total nitrogen (TN) and total phosphorus (TP) (μg/L) by flow injection analysis using a Lachat QuickChem QC8500 FIA Automated Ion Analyzer (Rice *et al*. 2004).

2.3.1.2 Habitat Structure: Biological Characteristics

At each station, composition of the riparian zone was based on visual estimates of percentages of rocks, soil, grasses/forbs, shrubs, and moss in an area comprising 1 m up-, down-, and away from the stream on each bank. Riparian composition was then grouped into two categories, "rocks and exposed soil" and "riparian vegetation" and summarized as percentages for analysis.

Coarse particulate organic matter (CPOM) samples were collected immediately after water samples were taken, before other instream work was carried out. A 500 mL plastic sample jar (8 cm in diameter x 10 cm high) was pressed firmly into the substrate as deeply as possible then quickly flipped up and pulled out of the stream to prevent sample loss. The lid was screwed back onto the jar and the samples were transported to the laboratory for processing within 48 hours. Laboratory procedures were based on density separation methodology (Tiemann and Betz 1979) to separate organic particles from inorganic matter. The sample was placed into a porcelain-coated metal sorting tray, water was added, the floating matter solution was then filtered through a 1-mm collection sieve. Each sample was elutriated this way until no more organic matter floated out. The organic matter was then placed into a pre-weighed tinfoil cup (Ohaus Explorer Balance, Sigma-Aldrich) and dried at 40°C (Isotemp Standard Lab Oven, Fisher Scientific) until stable mass was achieved to determine the final dry mass of CPOM, values were converted into area basis (g/m^2).

I collected epilithon samples immediately after collecting CPOM. The lid of a glass scintillation vial (17 mm or 28 mm diameter) was used to mark the sample collection area from the upper surface of a submerged rock, the collection area was then scraped towards the center of the lid imprint using a broad-edged knife and the collected periphyton scooped into the vial. If a suitable rock was unavailable, no sample was collected. Samples were frozen at -

18°C for further processing. Laboratory procedures were based on ash free dry mass (AFDM) methodology (Widbom 1984, Romanow and Witek 2011): pre-weighed 4.7 cm GF/F glass microfiber filters (Whatman, Sigma-Aldrich) were burned at 550°C for 4 hours in a muffle furnace (Thermo Scientific Lindberg) while de-ionized water was added to the vials and epilithon samples were thawed. Vials were shaken vigorously to break up the samples, which were then poured through the combusted filters using glass-filter suction apparatus. Filters were placed into labeled aluminum weighing dishes (Fisher Scientific), dried at 105°C (Isotemp Standard Lab Oven, Fisher Scientific) for 24 hours, and weighed. Filters were then burned at 550°C for 1 hour, rewetted, dried at 105°C until constant weight was achieved, reweighed, and AFDM (g/cm^2) was determined.

I collected all pieces of wood within a fixed 30 m transect in each stream that were > 100 mm long, completely or partially submerged in the stream channel, and were not attached to riparian vegetation. Total length (mm) and diameter (mm) at each end of the wood piece were measured to determine the instream wood volume (cm^3/m^2) using methodology adapted from Jones *et al*. (2008). All wood pieces were returned to the stream after measurements.

2.3.1.3 Habitat Function

I adapted methodology from Gulis and Suberkropp (2003) and Jones *et al*. (2008) to quantify instream leaf litter breakdown. Willow (*Salix* spp.) leaves were collected along stream banks, transported to the laboratory and air-dried for 2 weeks. Weighed portions (6 g or 8 g) of air-dried leaves were placed into litterbags (mesh size: 0.5 cm), which were double-folded and stapled closed creating a leaf pack (15.25 cm wide x 15.25 cm long) with equal amount of mesh bag on each side. One day before the leaf packs were placed in the streams, leaves were wetted with deionized water to make the packs heavy enough to sink, and on the following day four leaf packs (two in pools, two in riffles) were placed into each REF stream and 12 leaf packs (six in pools, six in riffles) were placed in WIS, four packs in each of the three WIS reaches. Deeper instream locations were selected to prevent air exposure as stream levels declined during the 1-month incubation period.

To determine dry mass of the material retained in the leaf packs after 1 month, packs were carefully removed from the stream avoiding leaf loss and returned to the laboratory for processing. The organic material was removed and rinsed out from the litterbags and placed into individual pre-weighed tinfoil cups and dried at 105°C until stable dry mass was achieved. Subtracting the tin weight, final dry mass (mg) was determined.

To assess instream transport and retention of allochthonous matter, I floated artificial debris mimicking wood pieces and leaves during 2013 and 2014 field seasons down a fixed 20 m transect in each stream using methodology adapted from Haga *et al*. (2002). The “wood” pieces, made of 6.35 mm diameter polyethylene pipe, were released at the upstream end of the transect, starting with 30 small pieces (10 cm), followed by 10 medium (20 cm), and then five large (30 cm) pieces. For any piece that was retained in the channel during a 10-minute trial rather than being flushed out of the transect, the distance travelled (m) and size were recorded, and the stream feature that retained the piece was classified as instream debris, instream vegetation, overhanging riparian vegetation, rocks/boulders or stream margin, plus free-floating and flushed out of the transect. The “leaves” (3 x 3 x 3 cm triangles of waterproof paper, n= 15) were released following the same protocol. Since all “leaves” had the same size only distance travelled and the retaining feature were recorded. Trials were replicated three times in each stream.

2.3.2 Statistical Analyses

All data from the WIS lower reach for 2014 were excluded from analysis because of an on-going stream-flow manipulation experiment that artificially altered flow rate. For the remaining data, measurements of each physical, chemical, and biological variable were averaged to determine one stream-year specific value (n = 23 stream-years, note that R2S was not sampled in 2009). These stream-year averages were tested for interaction between treatment (Control vs. Impact) and time (Before vs. After) in a before-after-control-impact (BACI) framework (Green 1979,1993, Underwood 1991, 1992, 1994, Downes *et al*. 2002) using linear mixed models in SPSS (Version 24, IBM Corporation 2016), with year as repeated factor and stream as subject. Importantly, in the West Island compensation project context, a significant interaction between the two sources of variation (treatment*time) would indicate a treatment-specific influence on the environmental factor between the Before period and the After-manipulation period. Results of statistical tests were considered significant when $P \leq 0.05$, and marginally significant when $0.05 < P \leq 0.10$, after performing the Benjamini and Hochberg (1995) adjustment to reduce the level of false discovery rate (FDR).

Instream transport and retention of artificial wood pieces and leaves were compared using linear mixed models in SPSS with stream as subject, and treatment and size as fixed factors. Average distance travelled (m) was calculated and used in the analyses to test the efficiency of the streams in retaining debris. Pieces not retained (i.e., flushed) were excluded from the distance travelled calculation, but included in a BACI framework qualitative (graphically) analysis.

Assumptions of homoscedasticity were tested using Levene's Test, and normality using Kolmogorov-Smirnov Test (IBM Corporation 2013a, b). Different transformation methods (i.e., $\log_{10}$, arcsine square-root) were used, if needed, to improve normality issues, but only the method that was the best fit for the distribution was applied to each analysis (Zar 2010, Gotelli and Ellison 2013).

In addition to univariate BACI analyses, data for bank shape and stability, stream exposure, turbulence, streambed materials, and riparian vegetation composition were also assessed qualitatively (graphically) in a BACI framework.

The predominant environmental gradients across the 23 stream-years were summarized using principal component analysis (PCA) in PC-ORD (Version 6.21, McCune and Mefford 2011) using all physicochemical and biological variables from the BACI study (Table 2.3, n = 41, note that neither treatment presented low stability during both periods in the right bank (i.e., facing downstream). The cross-products matrix was centered and standardized to achieve an equal-weighting of all responses. No responses (streams or environmental variables) were flagged as outliers given a cutoff of 2.5 standard deviations from the mean with the Euclidean distance measure. A randomization test based on eigenvalues (McCune and Grace 2002, Peres-Neto *et al*. 2005, Peck 2010) with 999 randomized runs was used to determine the maximum number of axes to interpret.

2.4 Results

2.4.1 Habitat Structure: Physicochemical Characteristics

Reference streams generally showed only small changes between the Before and After periods (Table 2.4). For the manipulated stream, the channelization process resulted in an increase of 0.73 m in the mean channel width of WIS, which emerged as a marginally significant treatment*time interaction in BACI analysis but not after Benjamini Hochberg (B-H) adjustments (Tables 2.4 and 2.5, Figure 2.7). For WIS, mean channel depth decreased by 0.10 m, mean water depth decreased by 0.06 m, and mean current velocity increased by 0.04

m/s after manipulation; however, no significant or marginally significant treatment*time interaction emerged from BACI or B-H analyses (Tables 2.4 and 2.5, Figures 2.8 to 2.10).

Changes in bank shape and bank stability for WIS were also observed in quantitative and qualitative analyses. An increase in concave shape with corresponding decrease in convex and straight shapes for the right bank (i.e., facing downstream), and increase in concave and convex shapes with corresponding decrease in straight shape for left bank (i.e., facing downstream) were observed post-construction, with the left bank also showing low stability after habitat manipulations which emerged as significant results in both, BACI and B-H analysis; however, neither BACI nor B-H detected significant differences for the other variables (Tables 2.4 and 2.5, Figures 2.11 and 2.12).

The widening of the stream channel and the removal of the right bank (i.e., facing downstream) riparian vegetation during the construction in WIS increased exposure of the entire stream to the sun and resulted in a significant treatment*time interaction for moderate exposure and marginally significant treatment*time interaction for low and high exposure in BACI analyses, but only moderate exposure retained significance after B-H adjustments (Tables 2.4 and 2.5, Figure 2.13).

Qualitative analysis also indicated that fishway construction in WIS eliminated areas with high turbulence (i.e., the lower reach cascades) compared to the Before period, which emerged as significant results in both, BACI and B-H analysis (Tables 2.4 and 2.5). BACI and B-H analyses did not detect a significant or marginally significant treatment*time for low and moderate turbulence (Tables 2.4 and 2.5, Figure 2.14).

After construction, there were some shifts in streambed material composition (Table 2.4, Figure 2.15), with decreases in fines and boulders and corresponding increases in pebbles and cobbles in WIS, from which cobble percentage emerged as a significant treatment*time interaction from BACI analyses and after B-H adjustments (Table 2.5, Figures 2.16 and 2.17).

Lastly, BACI and B-H analyses for mean temperature, conductivity, DO, pH, TSS, Chl-a, TN, and TP found no significant or marginally significant treatment*time interactions (Table 2.6, Figures 2.18 to 2.25).

2.4.2 Habitat Structure: Biological Characteristics

WIS habitat manipulations removed the right bank (i.e., facing downstream) riparian zone to facilitate equipment access during the construction period. Consequently, WIS-After right bank presented considerable decreases in grasses/forbs and shrubs, and mosses nearly disappeared, with a corresponding increase in rocks and exposed soil (Figure 2.26). The increase in rocks and exposed soil resulted in a significant treatment*time interaction (Table 2.6, Figure 2.27) and the decrease in riparian vegetation coverage produced a significant treatment*time interaction (Table 2.6, Figure 2.27), while the left bank (i.e., facing downstream) remained unaltered, resulting in no significant or marginally significant treatment*time interaction (Table 2.6, Figure 2.28). After B-H adjustments right bank rocks and exposed soil and right bank riparian vegetation remained significant (Table 2.6).

Although the removal of the riparian area affected only one bank of WIS, this change likely contributed to a decrease in allochthonous organic matter input after manipulation, this change associated with the channelization process likely resulted in lower levels of CPOM in the After period, and a significant treatment*time interaction emerged from BACI analysis, but not after B-H adjustments (Table 2.6, Figure 2.29).

There was no post-manipulation effect on epilithon growth. In fact, epilithon increased in both WIS and REF streams during the After period, resulting in no significant or marginally significant treatment*time interaction (Table 2.6, Figure 2.30). Similarly, wood pieces (WP) did not show significant or marginally significant treatment*time interaction (Table 2.6, Figure 2.31), in fact, WP increased in both treatments during the After period.

2.4.3 Habitat Function

Leaf packs lost similar mass during the incubation period in both WIS and REF streams, and neither BACI nor B-H detected significant or marginally significant treatment*time interaction for leaf litter breakdown (Table 2.6, Figure 2.32).

In 2013, the first year after fishway construction, REF streams were more efficient than WIS at retaining artificial wood pieces ($P = 0.02$, Figures 2.33 and 2.34), but not leaves ($P = 0.33$, Figures 2.33 and 2.35). Size of wood pieces was marginally significant in affecting the distance travelled before the object was retained ($P = 0.05$, Figure 2.34). Larger pieces were more likely to be retained and travelled shorter distances than smaller pieces. In contrast, retention of wood pieces ($P = 0.35$, Figures 2.33 and 2.34) and leaves ($P = 0.86$, Figures 2.33 and 2.35) did not differ between WIS and REF streams in 2014. Debris size, however, still affected instream retention dynamics ($P = 0.03$, Figure 2.34). During 2013 and 2014, the WIS instream feature that played the most important role in retaining “wood pieces” and “leaves” were instream debris and rocks/boulders. In contrast, overhanging riparian vegetation played the most critical role in retention of both subjects in REF streams, followed by stream margins and instream debris. Overall, WIS flushed (i.e., did not retain) more pieces than REF streams, which only flushed materials in 2014 (“wood pieces”: WIS 2013: $n = 4$, WIS 2014: $n = 5$, REF 2014: $n = 9$; “leaves”: WIS 2013: $n = 5$, WIS 2014: $n = 8$, REF 2014: $n = 7$).

2.4.4 PCA Ordination

Principal component analysis (PCA) was used to summarize all physicochemical and biological variables (n = 41) for the reference streams (REFs, n = 17 stream-years) and the impact stream (WIS, n = 6 stream-years) for the Before (2009-2012, 4 years) and for the After-manipulation period (2013-2014, 2 years) (Table 2.3, Figure 2.36). The eigenvalues randomization test based on 999 randomized runs recommended a four-axis solution (P = 0.03). I chose to represent graphically the pair of axes that explained the most variation and yielded the clearest visual representation. Axis 1 explained 19.44% of the variance, while axis 2 explained an additional 15.66%.

Centroids for both WIS and REF shifted from their initial positions between the two periods. The REF-After convex hull remained largely nested within REF-Before convex hull, with a slight shift that likely represents natural variation over time. WIS-Before partially overlapped REF-Before. WIS-Before and REF-Before shared similar channel and water depths, right and left banks shape and stability were also comparable, overall streambed materials, except fines, and riparian composition of right and left banks were also alike in both treatments, with the latter resulting in no high stream exposure in WIS and REF streams during the before period. WIS-After shifted away from WIS-Before, reflecting the overall changes that resulted from habitat manipulations.

Joint plots vectors indicate the direction and correlation of environmental variables with the two axes (only those with $r^2 \geq 0.400$ are shown). From a total of 13 environmental variables, smaller groups of correlated variables emerged: WIS Before-After vector parallels the “Exp H” (i.e., Stream Exposure High), “Cobbles”, and “Pebbles” vectors, suggesting an increase in these two streambed materials and extent of high exposure after manipulations; “EB R/S” (i.e., Right Bank Rocks/Exposed Soil) and “Ch Width” (i.e., Channel Width) vectors also showed some association with WIS Before-After vector, suggesting that right bank rocks and exposed soil and channel width increased in WIS during the after period.

In addition, “EBSh Str” (i.e., Right Bank Shape Straight) and “WBSH Str” (i.e., Left Bank Shape Straight) vectors showed a weaker association with WIS Before-After vector, indicating that right and left banks straight shape percentage composition decreased after the channelization process. Further, “EB Veget” (i.e., Right Bank Riparian Vegetation) and “WB Veget” (i.e., Left Bank Riparian Vegetation) appeared to be negatively correlated to WIS Before-After vector, which indicates that riparian vegetation coverage is highly associated with stream channel exposure to the sun. Finally, the REF Before-After vector somewhat parallels “EBSh Cvx” (i.e., Right Bank Shape Convex), “WBSh CCv” (i.e., Left Bank Shape Concave), and “CPOM” vectors, indicating the existence of a positive association of these variables with REF streams, both before and after manipulations. Overall, PCA ordinations seems consistent with univariate BACI results.

2.5 Discussion

Although Barrenlands streams are typically lake-outlet systems, with low sinuosity and multiple channels, and thus likely prone to share some characteristics, Jones *et al*. (2003a) nevertheless found some diversity in physical characteristics, including length, width, and streambed composition. The variation I observed among physical characteristics of WIS-Before and REF streams is consistent with this.

To improve the ecological connectivity of WIS, one of the compensation project’s goals, a wider and well defined channel was an objective of the fishway construction. Consequently, the manipulation of West Island Stream involved mostly in physical changes to the habitat that were also reflected in changes to some biological and ecosystem-function variables, while chemical variables remained within WIS-Before and REF streams ranges. Seven variables had significant treatment*time interaction in BACI analyses, supported by

PCA analysis: left bank low stability (↑), moderate stream exposure (↓), high turbulence (↓), cobbles (↑), right bank rocks and exposed soil (↑) and right bank riparian vegetation coverage (↓), and CPOM (↓). Three others had marginally significant interactions: channel width (↑), and low (↓) and high (↑) stream exposure. After applying the B-H FDR methodology, only left bank low stability, moderate stream exposure, high turbulence, cobbles, right bank rocks and exposed soil and right bank riparian vegetation retained significance, likely due to the small sample sizes that characterize this and most whole-system manipulations (Schindler 1974, 1980). Still, the overall changes to WIS were reflected in the PCA ordination, which shifted the two WIS-After points to well outside the REF and WIS-Before convex hulls.

In addition, channel modifications are often undertaken to enhance a stream's capacity to transport a larger discharge (Hellawell 1986), to reduce channel overflow, e.g., during spring freshet (a likely contributor to the multi-channel nature of WIS-Before). Another of the project's goals was to increase duration of summer flow in WIS. After construction, channel and water depths decreased in WIS, while mean channel width and current velocity increased, and areas with high turbulence were eliminated. Changes in bank shape and stability were also observed; right and left banks became more concave, which also increased areas with low stability after manipulations. However, from all these variables, only left bank low stability and high turbulence had significant interaction terms in my B-H adjusted BACI analysis.

Changes in substrate composition associated with removal of the streambed also resulted from the channelization process. Fines and boulders were less represented in WIS-After when compared to WIS-Before, while pebbles and cobbles substrate increased. Roni *et al*. (2008) reported in their meta-analysis that habitat rehabilitation projects that increased rocky substrates often had a positive impact in increasing fish spawning habitat. In addition, Jones and Tonn (2004a, b) reported that among many different ecosystem characteristics, adult

Arctic Grayling spawning habitat needs include rocky substrates, such as pebbles, cobbles, and gravel. Thus the difference between the baseline period and the post-manipulation period in cobble substrate composition could be assessed as a positive result that should increase spawning habitat for fish, particularly Arctic Grayling, one of the goals of the West Island compensation project.

WIS habitat manipulations resulted in no significant changes in various water-quality parameters. Temperature, conductivity, and pH were more variable among stream-years in REF streams than in WIS, while dissolved oxygen was more variable in WIS, and total suspended solids were highly variable in both treatments. These results are particularly important, given that these variables have an important influence in organisms' distribution (Vincent and Hobbie 2000, Vincent and Laybourn-Parry 2008, Dosskey *et al*. 2010), and since Barrenlands' aquatic systems are also characterized by little variation in water chemistry (Jones *et al*. 2003b) my results indicate that overall WIS-After remains within Barrenlands' aquatic systems chemical characteristics ranges.

The removal of the riparian vegetation from the right bank during construction resulted in significant increases of rocks and exposed soil on that bank, and decreased riparian vegetation. In turn, direct sun exposure generally increased in WIS after fishway construction. Nilsson *et al*. (2014) found that changes in riparian zones associated with habitat manipulation are not necessarily positive and can result in a slow recovery process. While the goal of stream restoration is to optimize stream channel function for targeted aquatic biota, fish in this case, direct or indirect changes in riparian vegetation can also alter hydrology, light, water temperature, nutrients, and allochthonous organic matter input (Hellawell 1986), ultimately affecting aquatic species (e.g., aquatic invertebrates, Chapter 3).

Mosses nearly disappeared after construction; grasses, forbs, and shrubs also decreased significantly and were replaced by rocks and exposed soil. Though alterations of riparian areas are difficult to avoid during the manipulation process (Hellawell 1986), the replanted willows appeared to have started a promising recolonization process along the impacted bank already during the second year after disturbances (C. Uherek, personal observation, July, 2014). Thus, I foresee the reestablishment of riparian vegetation as well as increases in stream coverage and shading within a few years after WIS manipulations, both of which are important environmental factors that influence the choice for habitat by adult Arctic Grayling seeking potential spawning grounds, as riparian vegetation also offers protection against predators (Jones and Tonn 2004 a, b).

Enlarged channels tend to have different substrate and overall shallower water flow, and former instream habitats may be destroyed simply by the removal or manipulation of streambed materials (Hellawell 1978, 1986). The channelization process likely reduced organic matter within the stream channel. BACI (but not B-H) analysis showed a significant treatment*time interaction for CPOM, with reduced instream CPOM after manipulations in WIS, likely due to the removal of streambed and/or riparian vegetation during the channel modification process. Further, the benthic fauna associated with WIS-Before substrate was also removed and community composition changes can be expected (Chapter 3). However, I expect CPOM to increase as the riparian vegetation is reestablished.

Changes in stream physical configurations can result in high turbidity leading to "blanketing effects" (Hellawell 1978, 1986) that can reduce photosynthesis, affect invertebrate assemblages (Chapter 3) and a stream's capacity to support fish (Quinn *et al*. 1997, Roni *et al*. 2002). Conversely, riparian zone removal can reduce channel shading so that algal growth is encouraged as a result of increased light penetration into the stream. Regardless, I found that epilithon growth was not affected by WIS habitat manipulations because both WIS and REF streams experienced increases in epilithon growth during the after period.

No post-manipulation impact emerged from leaf litter breakdown in BACI and B-H analysis, which could suggest that post-impact recolonization by invertebrates that feed on leaf litter was successful in WIS (Chapter 3), though it is important to mention that other factors influencing leaf litter processing, such as microbial activity, were not measured. Jones *et al*. (2008), found in their study that leaf packs incubated in reference streams retained significantly less leaf biomass in comparison to leaf packs incubated in a constructed stream, and that the former presented higher abundances of shredders when compared to the artificial stream. This seems particularly interesting given that after 14 years of its creation, abundance and biomass of invertebrates in this newly constructed stream had not yet converged with assemblages in reference streams (Scrimgeour *et al*. 2014). However, an important difference between the two studies is that WIS was modified from a previously existing stream, while Scrimgeour *et al*. (2014) studied a brand new stream blasted out of bedrock.

BACI and B-H results for wood pieces showed no significant treatment* time interaction, indicating that the manual addition of wood pieces along the stream channel had a positive impact after manipulations in WIS. The willow branches added to WIS also created a positive feedback regarding detrital input retention (e.g., new wood pieces and decaying leaves) (C. Uherek, personal observation, July, 2014), which is very important for the reestablishment of instream CPOM (Hellawell 1986, Mackay 1992). Importantly, while concerns regarding fish passage obstruction could be raised, WIS-After wider channel can facilitate fish passage despite the manually added wood pieces and the retention promoted by their addition.

Retention of debris increased in WIS from the first to the second year after manipulation. In 2013, the first year after manipulation, WIS was as efficient as REF streams in retaining leaves but not wood pieces. In 2014, however, retention of both types of debris did not differ between treatments. Size, however, appeared to be an important feature affecting retention dynamics in both treatments during both years after manipulations. Larger pieces were more easily retained by instream structures, while smaller pieces travelled longer distances before could be retained, otherwise were simply flushed out of the stream channel. My results seem to agree with Haga *et al*. (2002), which shown that the transport distance has a close relation to flow and also that instream features played an important role in stream retention dynamics, affecting subject's distance travelled, though an important difference between my study and Haga *et al*. (2002) is that I assessed the role that debris size played in retention dynamics on Barrenlands' streams.

While allochthonous input of wood is an important component of aquatic ecosystems because of wood's influence in the morphology and ecology of streams (Haga *et al*. 2002), the spacing between sites that retain wood and the amount of retained material are also important to ensure that the stream channel is not blocked and the stream access and passage for fish are not compromised. Habitat manipulation in WIS resulted in a wider stream channel in comparison with REF streams, thus effective stream retention may be critical to allochthonous matter retention and distribution within WIS channel especially during the first years after manipulation, while the stream is still in its adjustment period. Even considering that in the long term, continued accumulation of allochthonous material could potentially complicate stream accessibility and passage for fish, it is important to emphasize that wood pieces and leaves can be moved by snow, ice movement, and high flow events and those occur yearly following freshet in Barrenlands streams (C. Uherek, personal observation, June, 2014).

Consequences of physical disturbances as a result of offsetting projects on aquatic environments can have long term effects (Hellawel 1978, 1986). Monitoring can be used to determine the degree and rate of recovery of an ecosystem, and to establish whether there have been permanent disruptions or not. More importantly, lessons learned with these experiments (i.e., offsetting projects) should be reported to provide reliable information upon which future studies and projects can be based. Thus, a long term monitoring program at WIS would be valuable for understanding how similar ecosystem would perform during the following years after offsetting efforts, especially during the adjustment period (i.e., years immediately after offsetting), and after. Monitoring could also reveal whether the stream reverts to the undesired pre-manipulation state.

Furthermore, one cannot stress enough how important role the "green zone" surrounding water bodies plays. Riparian areas provide organic enrichment via detrital input, stimulating secondary production, along with a long list of other key ecological functions (Hellawell 1978, 1986). Therefore, my recommendation for future projects that involve stream habitat restoration or manipulation is to remove riparian vegetation only from one bank, possibly leaving intermittent natural "green zones" that can mitigate possible effects of shortage of instream organic matter accumulation, such as wood pieces, leaves, and ultimately CPOM and FPOM. Concomitantly, the channelization process should be avoided in these natural zones or should be performed by manual labor avoiding disturbances caused by heavy equipment, to provide natural corridors or buffer zones for the recolonization process.

Despite habitat manipulation efforts, the natural forces that created the original stream continue to operate (Hellawell 1986), and without additional efforts, WIS may eventually revert to something similar to its former state. In fact, changes in flow regime and in the physical configuration of the stream channel were observed during and right after 2014 freshet, the second year after manipulation (C. Uherek, personal observation, June, 2014), and initial stages of a new side-channel had developed in the lower reach of WIS (Figure 2.37). In addition, a meandering channel with deeper pools should be preferred over a non-sinuous one to encourage habitat diversity, and also to pre-empt the tendency of a straightened stream to return to something similar its pre-manipulation natural configuration. While WIS-After presented some meandering configuration, I observed that in areas of straightened or partially-straightened channel configuration, pools were being naturally created in fast run locations that are surrounded by large rocks and boulders often originating an underground flowing channel, and manipulation-created pools are becoming shallower as they are receiving more depositional material originated from these new-naturally created pools, both changes could potentially compromise fish movement in WIS.

Interestingly, this new configuration of WIS-After resembles the WIS-Before double-channeled area located in the lowest portion of the stream around the former cascade section before entering LDG (Figures 2.5 and 2.37). Further, this potential return to pre-manipulation natural configuration is likely due to the topographical slope in this section associated with natural events occurrence (e.g., freshet, stream overflow, snow and ice movement) and the tendency of WIS to return to its former multi-channeled configuration rather than the meandering channel itself given that other meandering areas did not present newly created side channels (C. Uherek, personal observation, June, 2014). Nevertheless, this changes could potentially result in stream flow decrease in the lower section of the constructed channel, previously designed to bypass cascades and to concentrate the flow in a single well defined channel. Thus, long term monitoring will be very important to assess changes in the habitat, in elaborating possible mitigation plans, and in bridging the gaps in our ecological knowledge of compensation and restoration projects.

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Table 2.1: The location and basic characteristics of the four lake-outlet stream study sites, located in the Barrenlands, Northwest Territories, Canada.

Site	Lake Name	Lake Size (ha)	Stream Name	Stream Length (m)	Treatment	Latitude	Longitude
West Island	WIL	13.65	WIS	420	WIS	64°31’40”N	110°26’8”W
Reference 2	R2L	18.87	R2S	103	REF	64°31'28"N	110°22'22"W
Reference 6	R6L1	3.91	R6S1	108	REF	64°26'46"N	110° 8'55"W
Reference 6	R6L2	6.82	R6S2	177	REF	64°26'51"N	110° 8'16"W

Table 2.2: Group and class size ranges for streambed materials based on Wolman Pebble Counts Method (adapted from Wolman 1954).

Range (mm)	Class	Group
0 - 0.0038	Clay	Fines
0.0039 - 0.0624	Silt	
0.0625 - 1.99	Sand	
2 - 3.99	Granule	
4 - 63	Pebble	Pebbles
64 - 255	Cobble	Cobbles
256	Boulder	Boulders

Table 2.3: Abbreviations used in the Principal Component Analysis (PCA) ordination of physical, chemical, and biological variables of the study streams.

#	Variable	Abbreviation
1	Channel Width (m)	Ch Width
2	Channel Depth (m)	Ch Depth
3	Water Depth (m)	Wt Depth
4	Current Velocity (m)	Velocity
5	Right Bank Shape Straight (%)	EBSh Str
6	Right Bank Shape Concave (%)	EBSh Ccv
7	Right Bank Shape Convex (%)	EBSh Cvx
8	Left Bank Shape Straight (%)	WBSh Str
9	Left Bank Shape Concave (%)	WBSh Ccv
10	Left Bank Shape Convex (%)	WBSh Cvx
11	Right Bank Stability Moderate (%)	EBSt M
12	Right Bank Stability High (%)	EBSt H
13	Left Bank Stability Low (%)	WBSt L
14	Left Bank Stability Moderate (%)	WBSt M
15	Left Banks Stability High (%)	WBSt H
16	Stream Exposure Low (%)	Exp L
17	Stream Exposure Moderate (%)	Exp M
18	Stream Exposure High (%)	Exp H
19	Turbulence Low (%)	Turb L
20	Turbulence Moderate (%)	Turb M
21	Turbulence High (%)	Turb H
22	Streambed Fines (%)	Fines
23	Streambed Pebbles (%)	Pebbles
24	Streambed Cobbles (%)	Cobbles
25	Streambed Boulders (%)	Boulders
26	Temperature (°C)	Temperat
27	Conductivity (µS/cm)	Conduct
28	Dissolved Oxygen (mg/L)	DO
29	pH	pH
30	TSS (mg)	TSS
31	Chl-a (µg/L)	Chl-a
32	TN (µg/L)	TN
33	TP (µg/L)	TP
34	Right Bank Rock/Soil (%)	EB R/S
35	Right Bank Riparian Vegetation (%)	EB Veget
36	Left Bank Rock/Soil (%)	WB R/S

37	Left Bank Riparian Vegetation (%)	WB Veget
38	CPOM (mg/m^2)	CPOM
39	Epilithon (mg/cm^2)	Epilith
40	WP (cm^3/m^2)	WP
41	Leaf Litter Breakdown (mg)	Leaf Lit

Table 2.4: Physical characteristics (mean, range) of the study streams of the two treatments, REF (n = 17 stream-years) and WIS (n = 6 stream-years), before (2009-2012) and after (2013-2014) habitat manipulations in WIS.

Variable	Before (2009-2012)		After (2013-2014)	
	WIS	REF	WIS	REF
Channel Width (m)	1.72 (0.42-3.50)	0.70 (0.35-1.40)	2.45 (1.25-3.87)	0.73 (0.36-1.37)
Channel Depth (m)	0.23 (0.05-0.67)	0.19 (0.05-0.46)	0.13 (0.04-0.39)	0.17 (0.10-0.32)
Water Depth (m)	0.15 (0-0.55)	0.14 (0-0.44)	0.09 (0-0.30)	0.12 (0-0.30)
Current Velocity (m/s)	0.02 (0-0.20)	0.05 (0-0.40)	0.06 (0-0.22)	0.07 (0-0.25)
Right Bank Shape				
Straight (%)	63	61	56	63
Concave (%)	23	21	36	18
Convex (%)	14	17	8	19
Left Bank Shape				
Straight (%)	71	58	47	53
Concave (%)	17	25	39	28
Convex (%)	13	16	14	19
Right Bank Stability				
Low (%)	0	0	0	0
Moderate (%)	18	24	22	15
High (%)	82	76	78	85
Left Bank Stability				
Low (%)	0	0	3	0
Moderate (%)	8	4	19	9
High (%)	92	96	78	91
Stream Exposure				
Low (%)	24	16	0	17
Moderate (%)	36	57	0	53
High (%)	40	27	100	31
Turbulence				
Low (%)	83	74	83	66
Moderate (%)	14	26	17	34
High (%)	3	0	0	0
Substrate Composition				
Fines (%)	46	65	37	72
Pebbles (%)	13	5	18	3
Cobbles (%)	4	7	18	6
Boulders (%)	37	24	27	19

Table 2.5: BACI P-Values of time*treatment interaction terms in univariate linear mixed model analyses and Benjamini and Hochberg (B-H) adjusted P-Values for physical variables from the four study streams (Control: REF (n = 17 stream-years) and Impact: WIS (n = 6 stream-years)). Arrows indicate direction of change of physical characteristics in WIS post-manipulation: increase (upward arrow), decrease (downward arrow), and equal sign (no change). Significant or marginally significant interactions are marked with an asterisk.

Variable	BACI P-Value	B-H P-Value	Increase/ Decrease
Channel Width (m)	P = 0.08*	P = 0.44	↑
Channel Depth (m)	P = 0.31	P = 0.84	↓
Water Depth (m)	P = 0.37	P = 0.84	↓
Current Velocity (m/s)	P = 0.68	P = 0.84	↑
Right Bank Shape Straight (%)	P = 0.98	P = 0.98	↓
Right Bank Shape Concave (%)	P = 0.87	P = 0.93	↑
Right Bank Shape Convex (%)	P = 0.47	P = 0.84	↓
Left Bank Shape Straight (%)	P = 0.90	P = 0.93	↓
Left Bank Shape Concave (%)	P = 0.59	P = 0.84	↑
Left Bank Shape Convex (%)	P = 0.43	P = 0.84	↑
Right Bank Stability Moderate (%)	P = 0.71	P = 0.84	↑
Right Bank Stability High (%)	P = 0.56	P = 0.84	↓
Left Bank Stability Low (%)	P < 0.01*	P = 0.01*	↑
Left Bank Stability Moderate (%)	P = 0.41	P = 0.84	↑
Left Bank Stability High (%)	P = 0.33	P = 0.84	↓
Stream Exposure Low (%)	P = 0.09*	P = 0.44	↓
Stream Exposure Moderate (%)	P < 0.01*	P = 0.01*	↓
Stream Exposure High (%)	P = 0.09*	P = 0.44	↑
Turbulence Low (%)	P = 0.65	P = 0.84	=
Turbulence Moderate (%)	P = 0.71	P = 0.84	↑
Turbulence High (%)	P < 0.01*	P = 0.01*	↓
Streambed Materials Fines (%)	P = 0.67	P = 0.84	↓
Streambed Materials Pebbles (%)	P = 0.91	P = 0.93	↑
Streambed Materials Cobbles (%)	P < 0.01*	P = 0.01*	↑
Streambed Materials Boulders (%)	P = 0.24	P = 0.84	↓

Table 2.6: BACI P-Values of time*treatment interaction terms in univariate linear mixed model analyses and Benjamini and Hochberg (B-H) adjusted P-Values for chemical and biological variables from the four study streams (Control: REF (n = 17 stream-years) and Impact: WIS (n = 6 stream-years)). Arrows indicate direction of change of physical characteristics in WIS post-manipulation: increase (upward arrow), and decrease (downward arrow). Significant interactions are marked with an asterisk.

Variable	BACI P-Value	B-H P-Value	Increase/ Decrease
Temperature (°C)	P = 0.17	P = 0.74	↓
Conductivity (µS/cm)	P = 0.62	P = 0.84	↑
Dissolved Oxygen (mg/L)	P = 0.22	P = 0.84	↑
pH	P = 0.59	P = 0.84	↓
TSS (mg)	P = 0.81	P = 0.92	↓
Chl-a (µg/L)	P = 0.83	P = 0.92	↑
TN (µg/L)	P = 0.32	P = 0.84	↑
TP (µg/L)	P = 0.35	P = 0.84	↑
Right Bank Rocks/Exposed Soil (%)	P < 0.01*	P = 0.01*	↑
Right Bank Riparian Vegetation (%)	P < 0.01*	P = 0.01*	↓
Left Bank Rocks/Exposed Soil (%)	P = 0.53	P = 0.84	↓
Left Bank Riparian Vegetation (%)	P = 0.45	P = 0.84	↑
CPOM (mg/m^2)	P = 0.02*	P = 0.16	↓
Epilithon AFDM (mg/cm^2)	P = 0.62	P = 0.84	↑
WP (cm^3/m^2)	P = 0.58	P = 0.84	↑
Leaf Litter Breakdown (mg)	P = 0.51	P = 0.84	↑

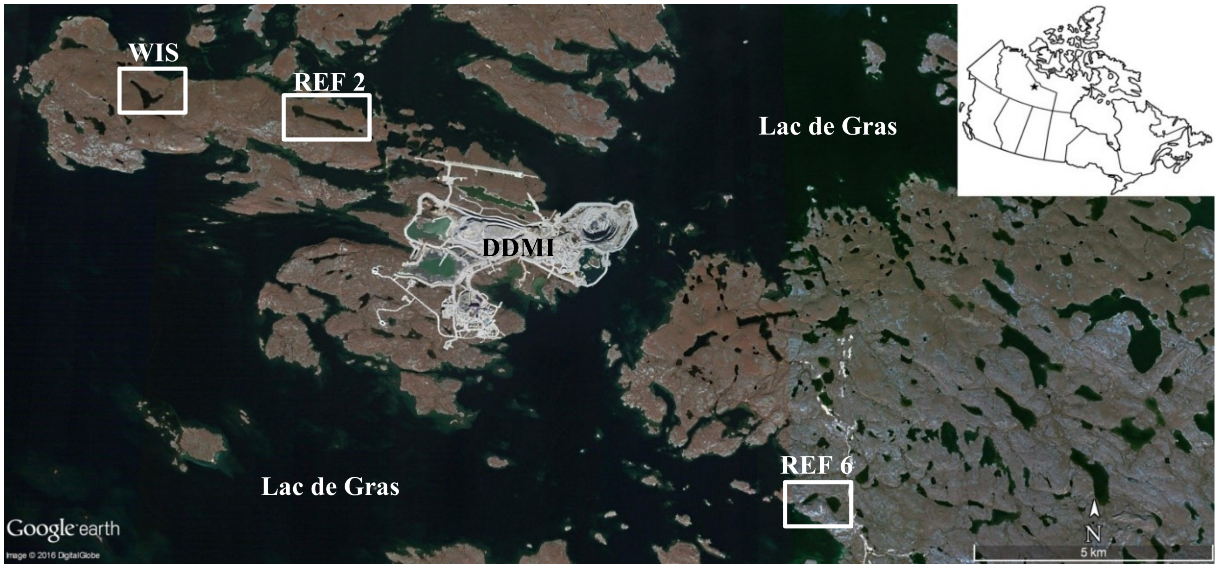


Figure 2.1: Image showing the location of Diavik Diamond Mines, Inc. (DDMI) and study sites (the manipulated West Island Stream (WIS), and the control sites Reference 2 (REF 2) and Reference 6 (REF 6)). Adapted from Google Earth. Insert shows the location of the study area in the Northwest Territories, Canada.

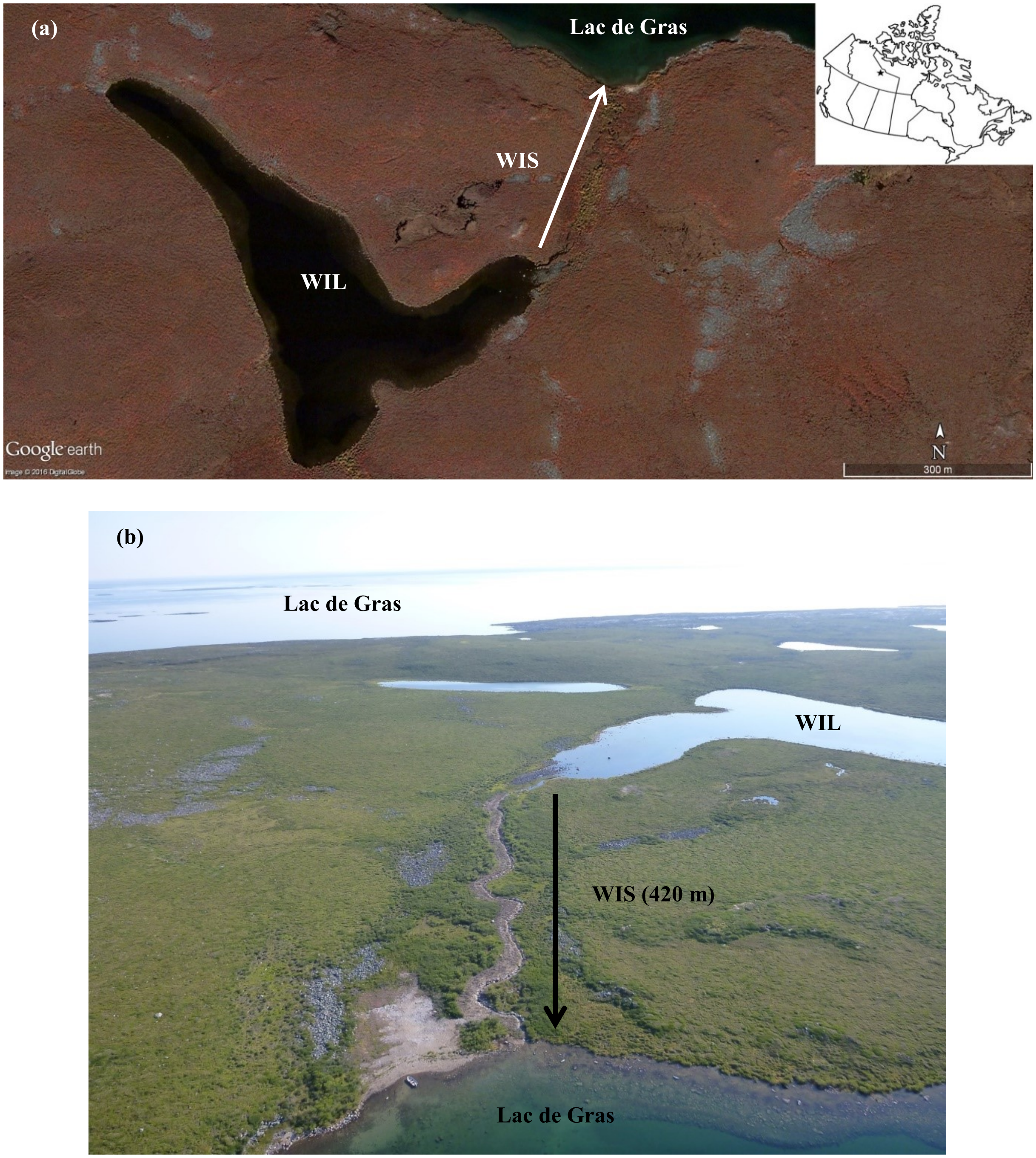


Figure 2.2: (a) West Island Lake (WIL) and West Island Stream (WIS), the manipulated stream, adapted from Google Earth. Insert shows the location of the study area in the Northwest Territories, Canada. (b) West Island Stream (WIS) after manipulation, showing the right bank riparian vegetation removed and left bank riparian zone preserved. Photo by C. Uherek, taken on August 10, 2013, facing south. Arrows indicate direction of flow.

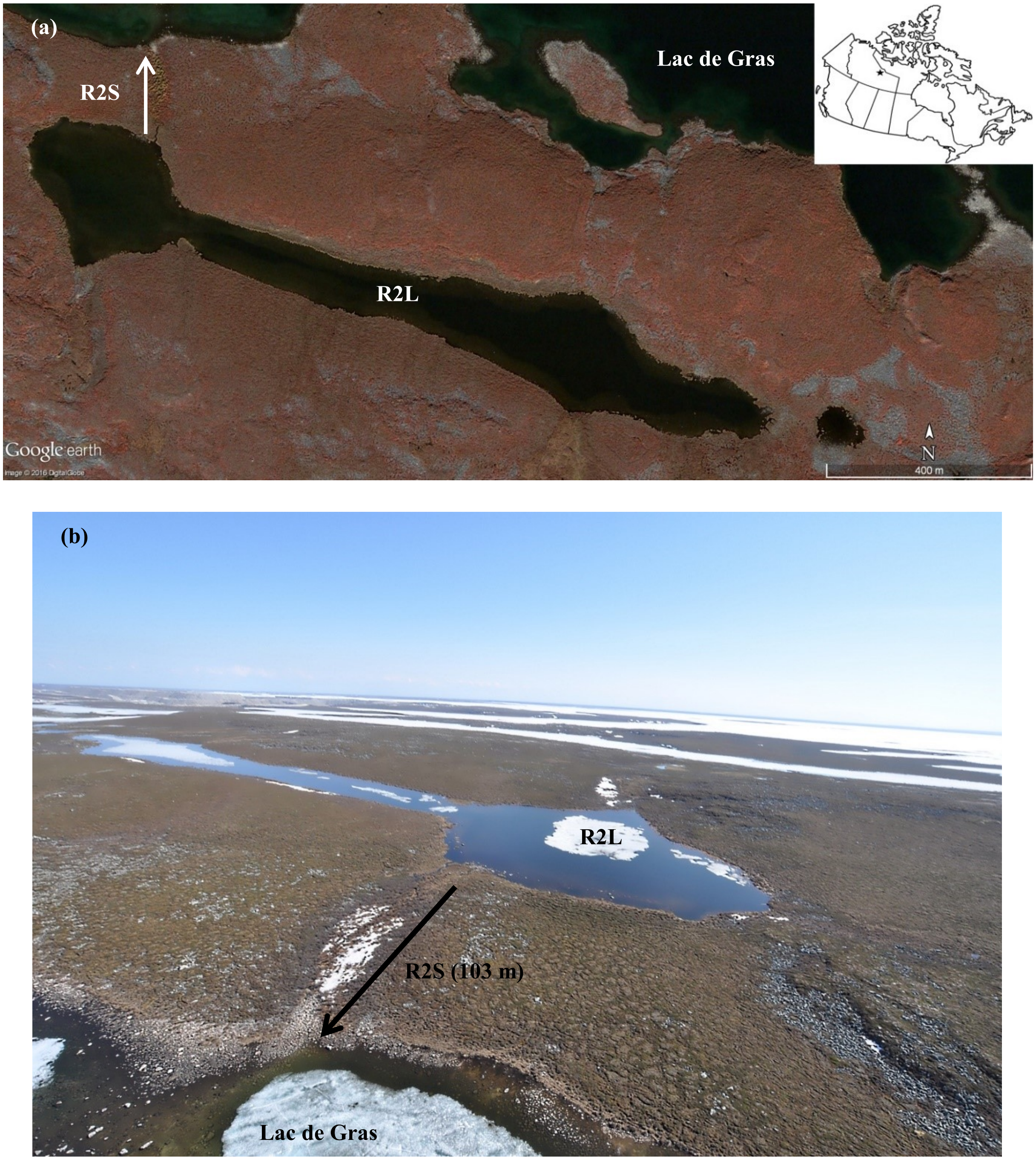


Figure 2.3: (a) Reference 2 Lake (R2L) and Stream (R2S), adapted from Google Earth. Insert shows the location of the study area in the Northwest Territories, Canada. (b) Reference 2 Stream (R2S). Photo by A. Erwin, taken on June 5, 2012, facing southeast. Arrows indicate direction of flow.

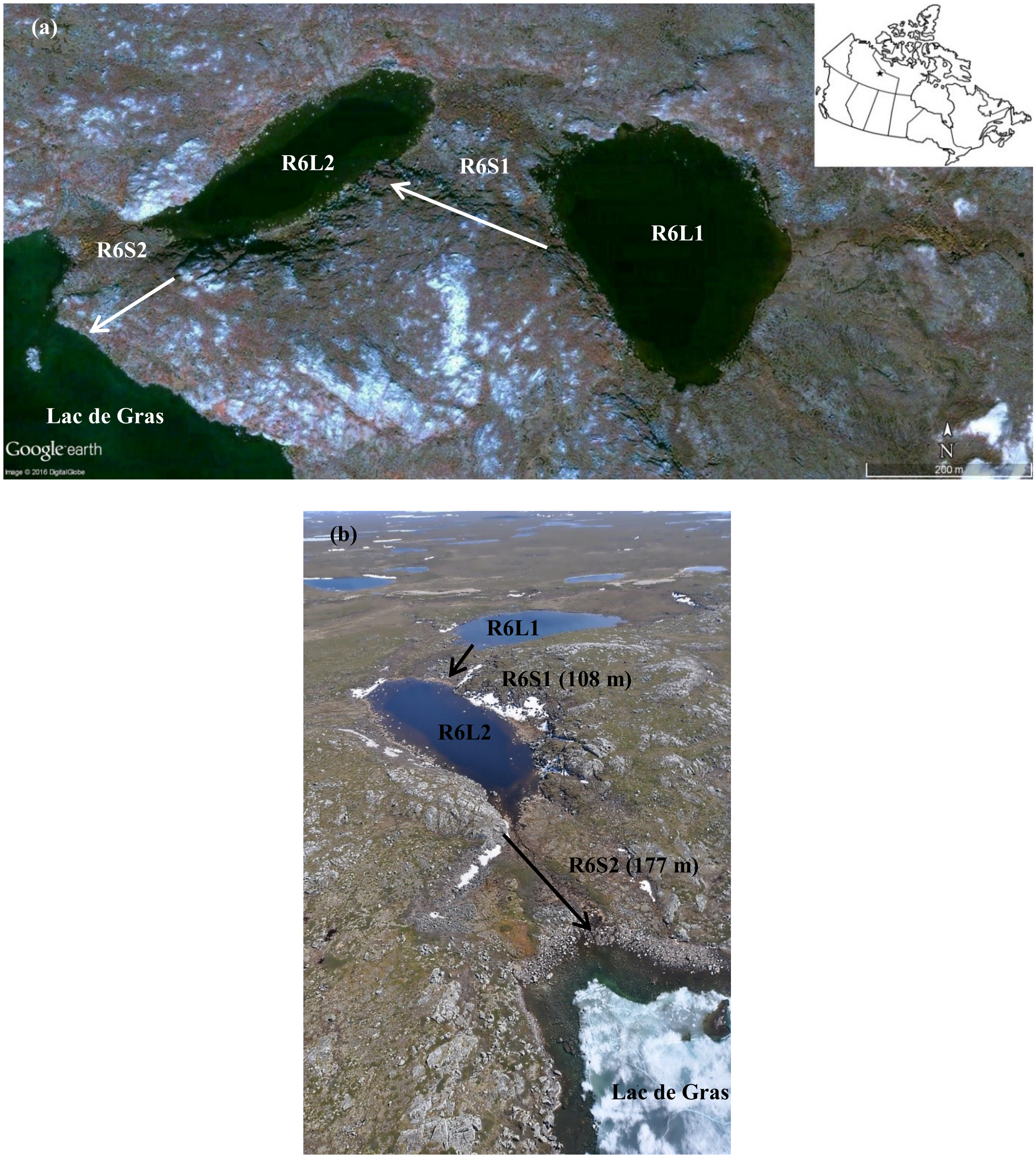


Figure 2.4: (a) Reference 6 lakes (R6L1 and R6L2) and streams (R6S1 and R6S2), adapted from Google Earth. Insert shows the location of the study area in the Northwest Territories, Canada. (b) Reference 6 lakes (R6L1 and R6L2) and streams (R6S1 and R6S2). Photo by A. Erwin, taken on June 9, 2012, facing east. Arrows indicate direction of flow.

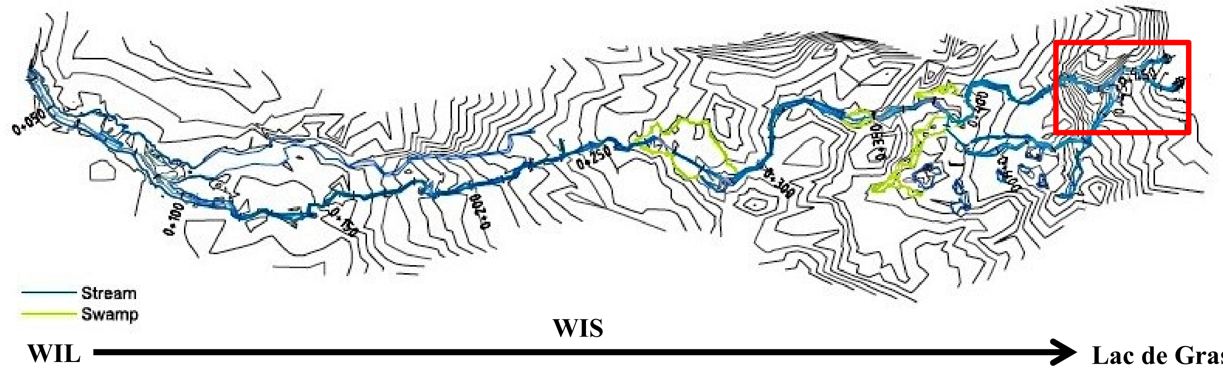


Figure 2.5: Topographical survey of West Island Stream (WIS) before manipulations, showing a braided channel (blue lines represents diffused stream flow and yellow lines represents wetland areas near to the stream channel). Cascades were located in the lowest portion of the outlet (represented by the red box) before entering LDG. Arrow indicates direction of flow. Adapted from Golder Associates Ltd. 2012.

Figure 2.6: (a) West Island Stream (WIS) before manipulations; photo by M. Hulsman, taken on July 29, 2010, facing south, and (b) after manipulations; photo by C. Uherek, taken on May 31, 2013, facing south. (c) The channelization process, photo by C. Cahill, taken on August 18, 2012, facing south; (d) the boulder addition process, photo by C. Cahill, taken on August 18, 2012, facing north, and (e) wood pieces addition, photo by C. Uherek, taken on July 3, 2013, facing south.

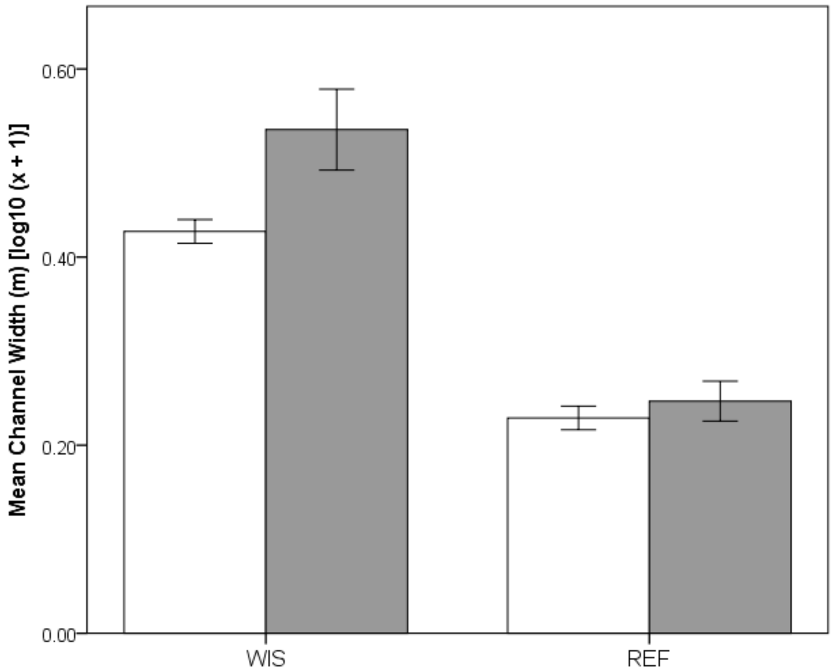


Figure 2.7: Mean (± 1 SE) channel width (m) [$\log_{10}$ (x+1)] of each treatment (Control: REF (n = 17 stream-years) and Impact: WIS (n = 6 stream-years)), before (2009-2012; white bars) and after (2013-2014; grey bars) habitat manipulations. Marginally significant treatment*time interaction detected in the univariate BACI analyses (P = 0.08), significance was not retained after B-H adjustments.

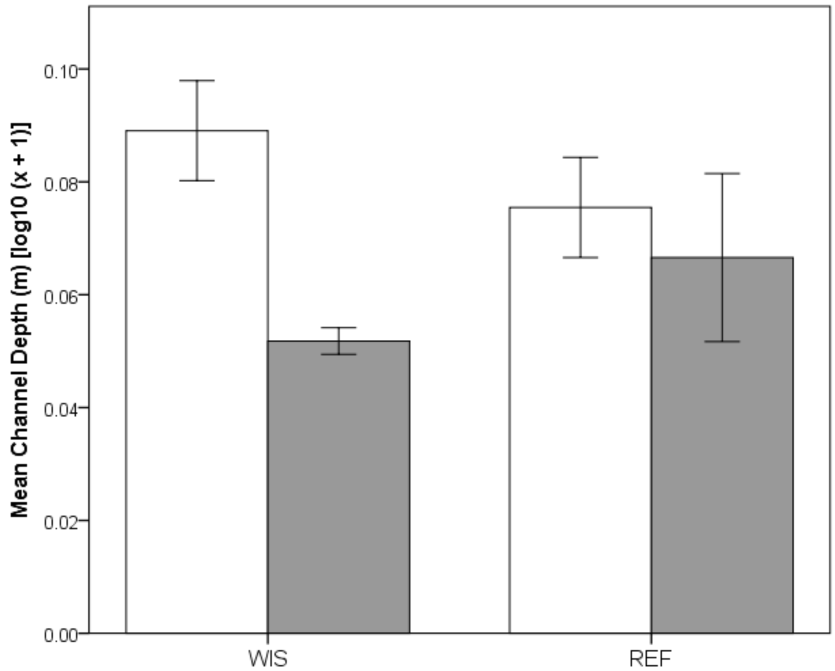


Figure 2.8: Mean (± 1 SE) channel depth (m) [$\log_{10}$ (x+1)] of each treatment (Control: REF (n = 17 stream-years) and Impact: WIS (n = 6 stream-years)), before (2009-2012; white bars) and after (2013-2014; grey bars) habitat manipulations.

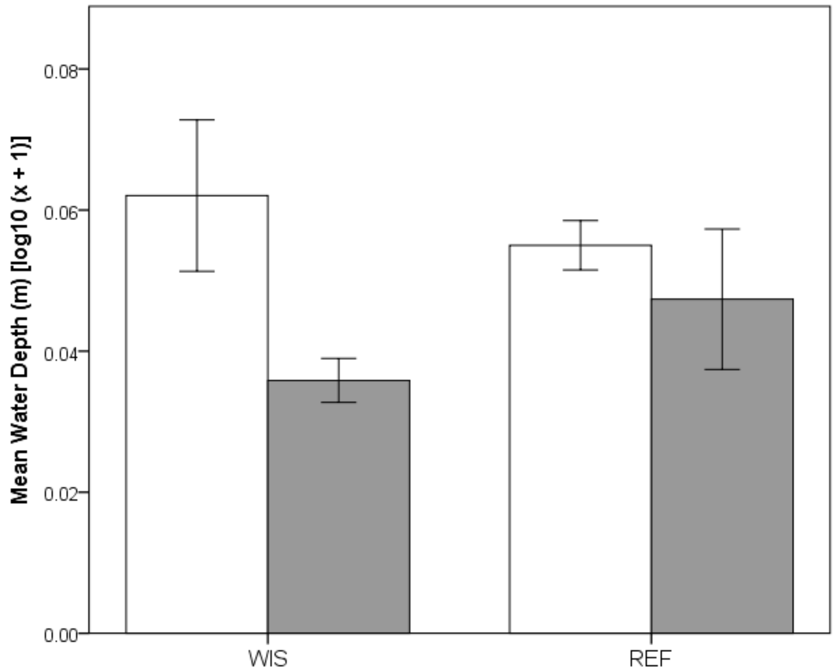


Figure 2.9: Mean (± 1 SE) water depth (m) [$\log_{10}$ (x+1)] of each treatment (Control: REF (n = 17 stream-years) and Impact: WIS (n = 6 stream-years)), before (2009-2012; white bars) and after (2013-2014; grey bars) habitat manipulations.

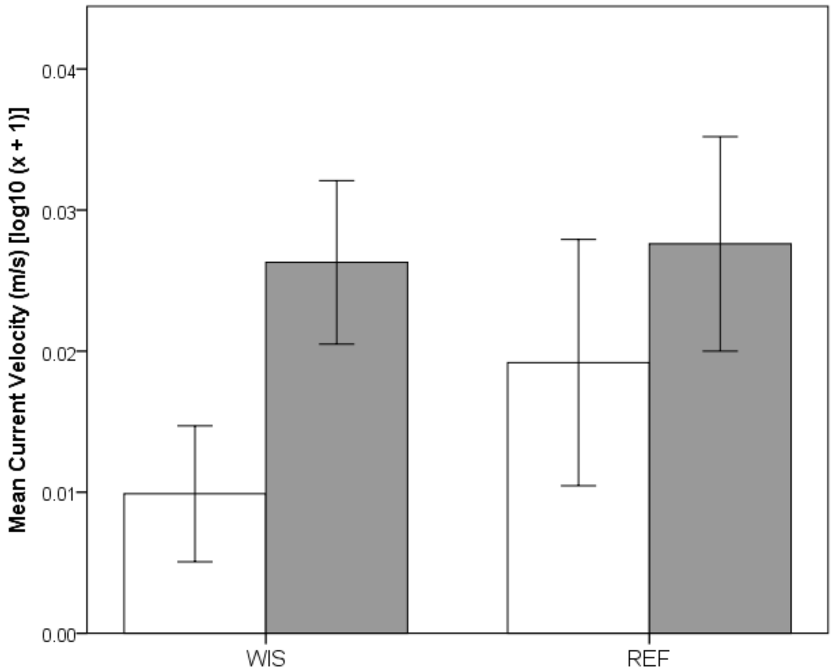


Figure 2.10: Mean (± 1 SE) current velocity (m/s) [$\log_{10}$ (x+1)] of each treatment (Control: REF (n = 17 stream-years) and Impact: WIS (n = 6 stream-years)), before (2009-2012; white bars) and after (2013-2014; grey bars) habitat manipulations.

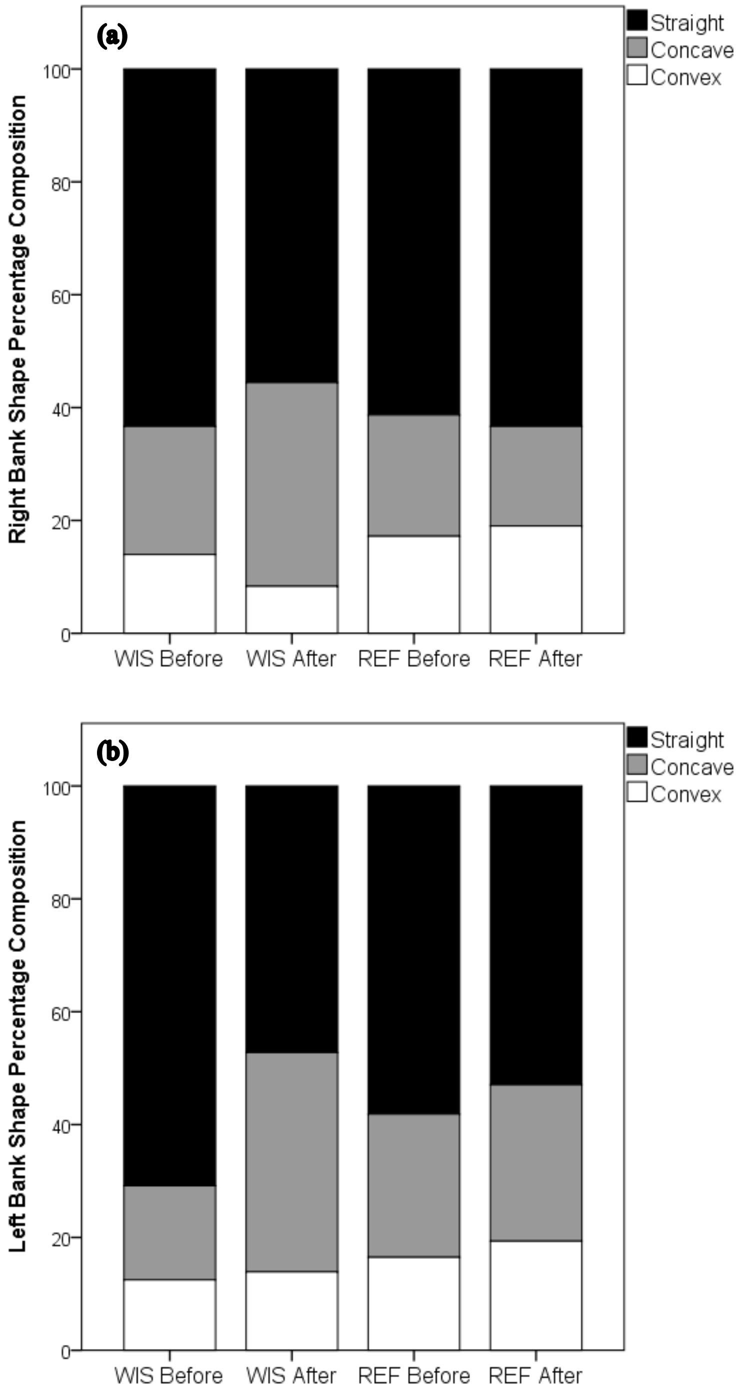


Figure 2.11: Bank shape percentage composition for (a) right and (b) left banks (i.e., facing downstream) of each treatment (Control: REF (n = 17 stream-years) and Impact: WIS (n = 6 stream-years)), before (2009-2012) and after (2013-2014) habitat manipulations.

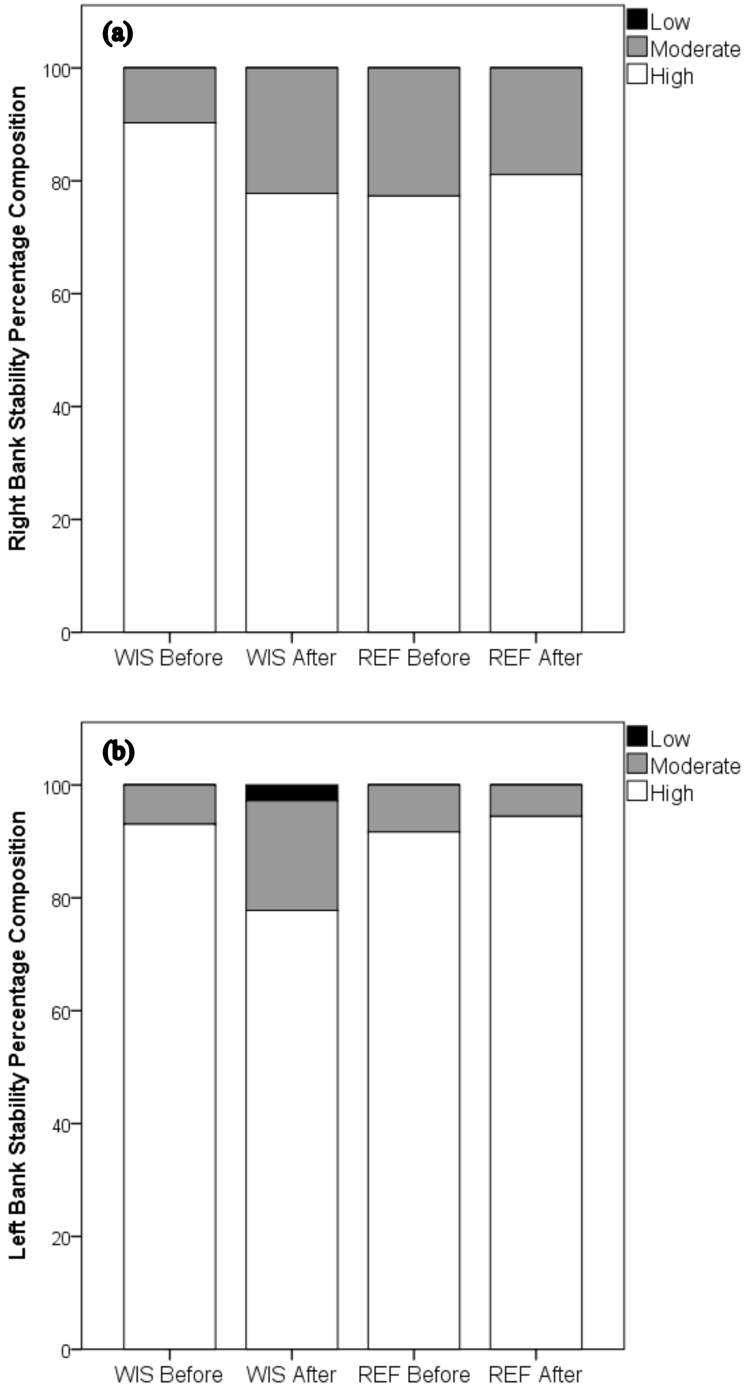


Figure 2.12: Bank stability percentage composition of (a) right and (b) left banks (i.e., facing downstream) of each treatment (Control: REF (n = 17 stream-years) and Impact: WIS (n = 6 stream-years)), before (2009-2012) and after (2013-2014) habitat manipulations. Significant treatment*time interactions were detected in the univariate BACI analyses for left bank low

stability before ($P < 0.01$) and after B-H adjustments ($P = 0.01$).

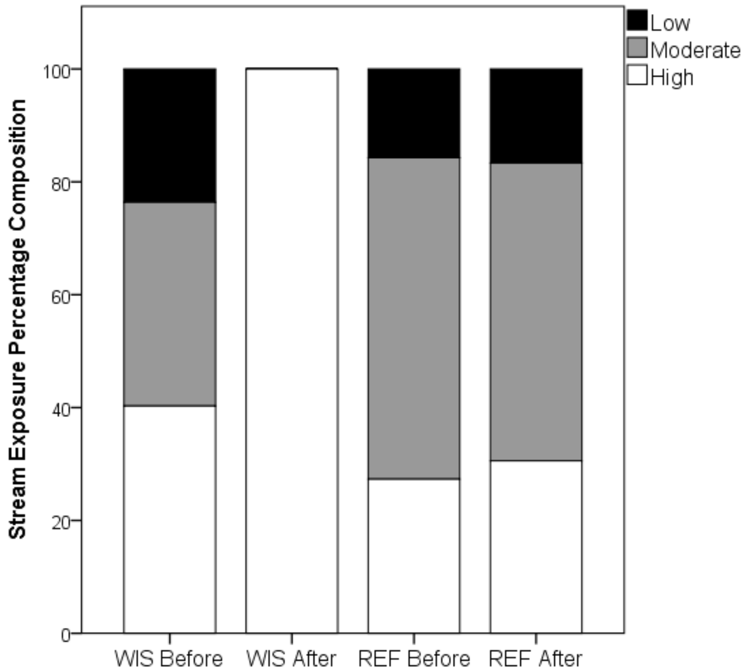


Figure 2.13: Stream exposure percentage composition of both treatments (Control: REF (n = 17 stream-years) and Impact: WIS (n = 6 stream-years)), before (2009-2012) and after (2013-2014) habitat manipulations. Significant treatment*time interactions were detected in the univariate BACI analyses for moderate exposure ($P < 0.01$), and were marginally significant for low and high exposure ($P = 0.09$), but only moderate exposure retained significance after B-H adjustments ($P = 0.01$).

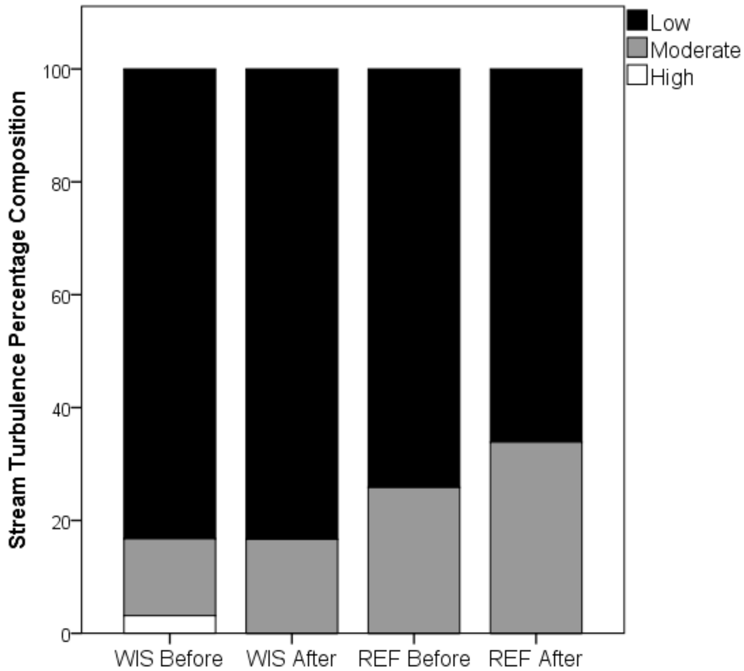


Figure 2.14: Turbulence percentage composition of both treatments (Control: REF (n = 17 stream-years) and Impact: WIS (n = 6 stream-years)), before (2009-2012) and after (2013-2014) habitat manipulations. Significant treatment*time interactions were detected in the univariate BACI analyses for high turbulence before (P < 0.01) and after B-H adjustments (P = 0.01).

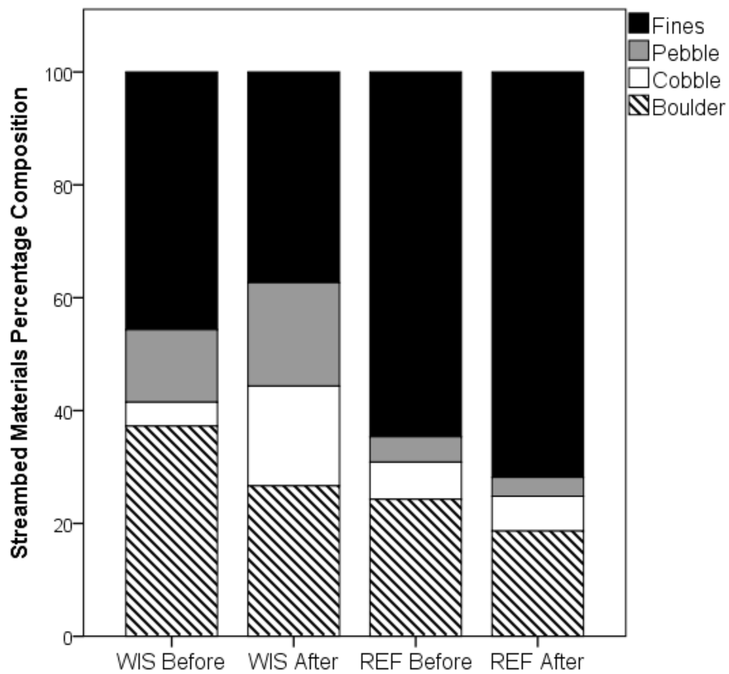


Figure 2.15: Overall streambed materials percentage composition of both treatments (Control: REF (n = 17 stream-years) and Impact: WIS (n = 6 stream-years)), before (2009-2012) and after (2013-2014) habitat manipulations.

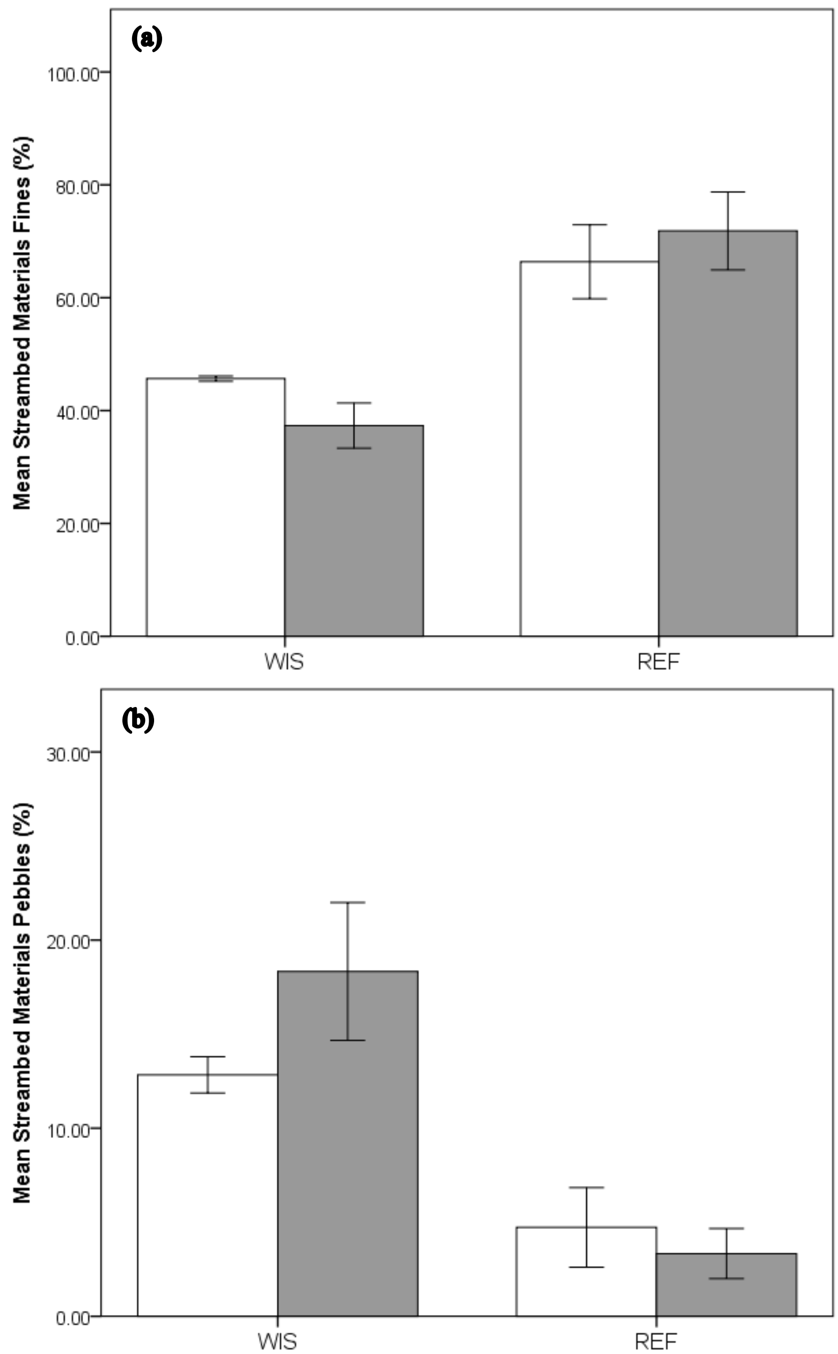


Figure 2.16: Mean (± 1 SE) streambed materials (a) fines (clay, silt, sand, granule) and (b) pebbles percentage composition of both treatments (Control: REF (n = 17 stream-years) and Impact: WIS (n = 6 stream-years)), before (2009-2012; white bars) and after (2013-2014; grey bars) habitat manipulations.

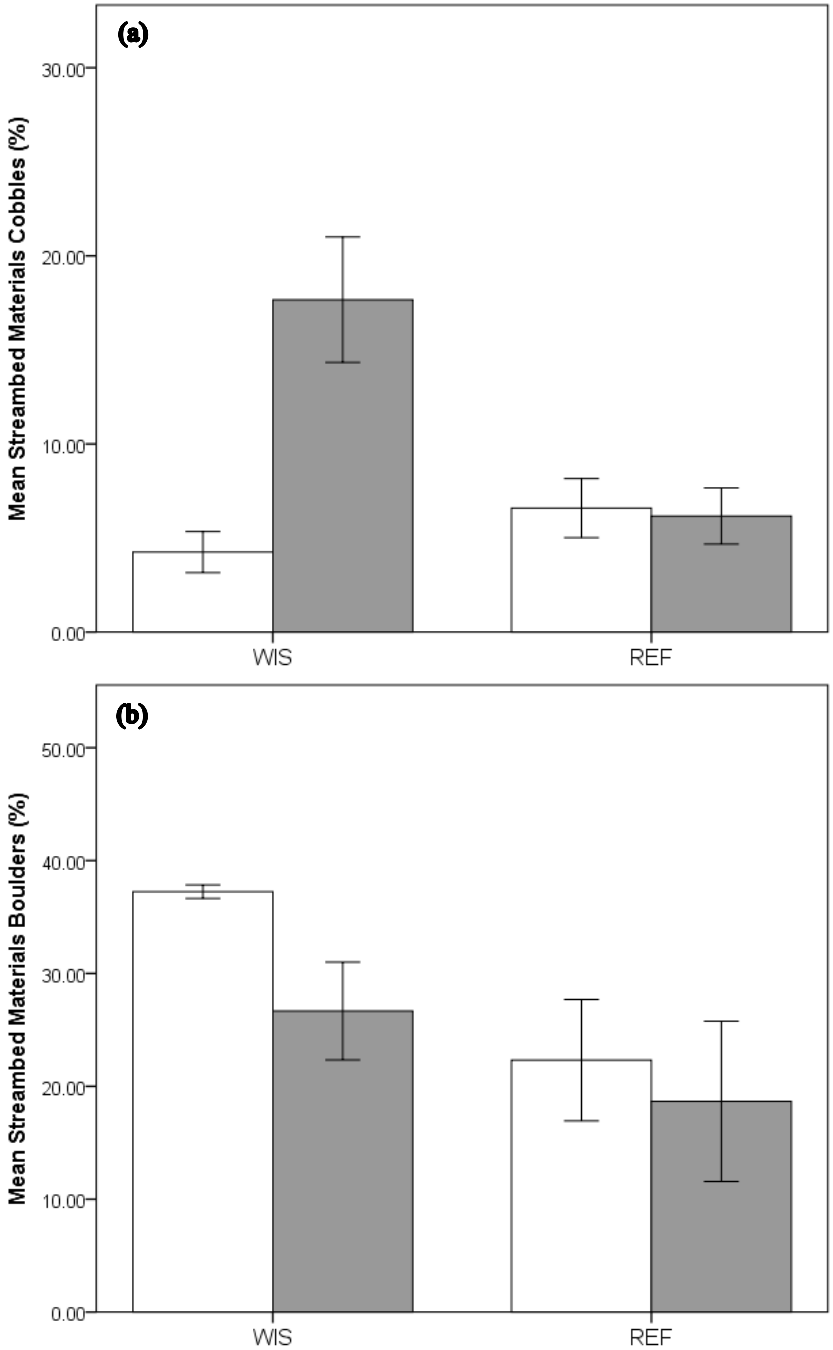


Figure 2.17: Mean (± 1 SE) streambed materials (a) cobbles and (b) boulders percentage composition of both treatments (Control: REF (n = 17 stream-years) and Impact: WIS (n = 6 stream-years)), before (2009-2012; white bars) and after (2013-2014; grey bars) habitat manipulations. Significant treatment*time interactions were detected in the univariate BACI analyses for cobbles before ($P < 0.01$) and after B-H adjustments ($P = 0.01$).

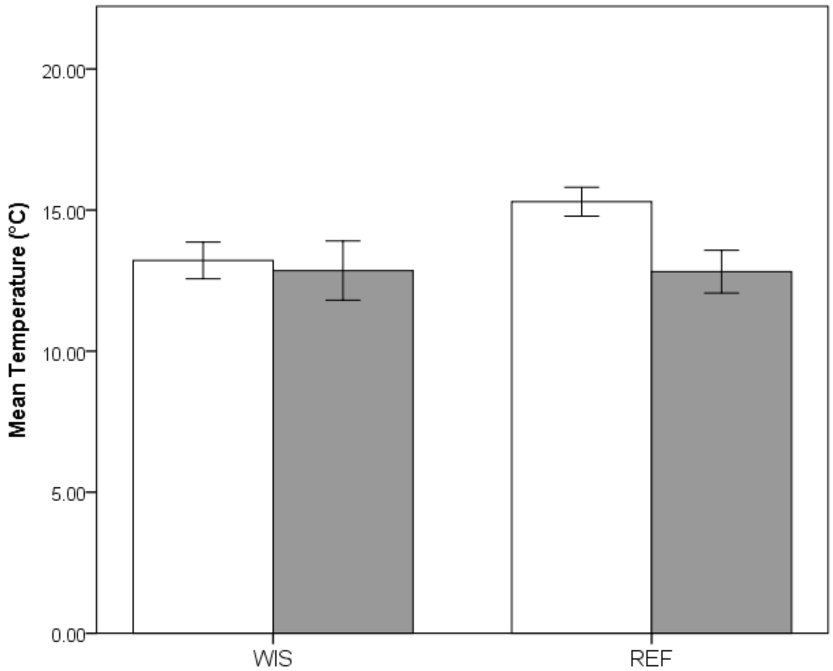


Figure 2.18: Mean (± 1 SE) temperature (°C) of both treatments (Control: REF (n = 17 stream-years) and Impact: WIS (n = 6 stream-years)), before (2009-2012; white bars) and after (2013-2014; grey bars) habitat manipulations.

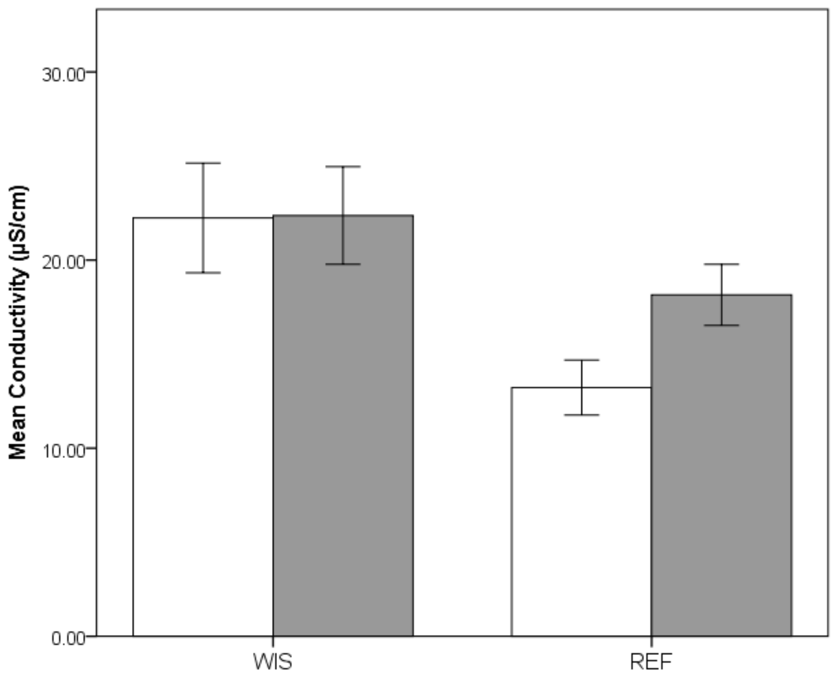


Figure 2.19: Mean (± 1 SE) conductivity (µS/cm) of both treatments (Control: REF (n = 17 stream-years) and Impact: WIS (n = 6 stream-years)), before (2009-2012; white bars) and after (2013-2014; grey bars) habitat manipulations.

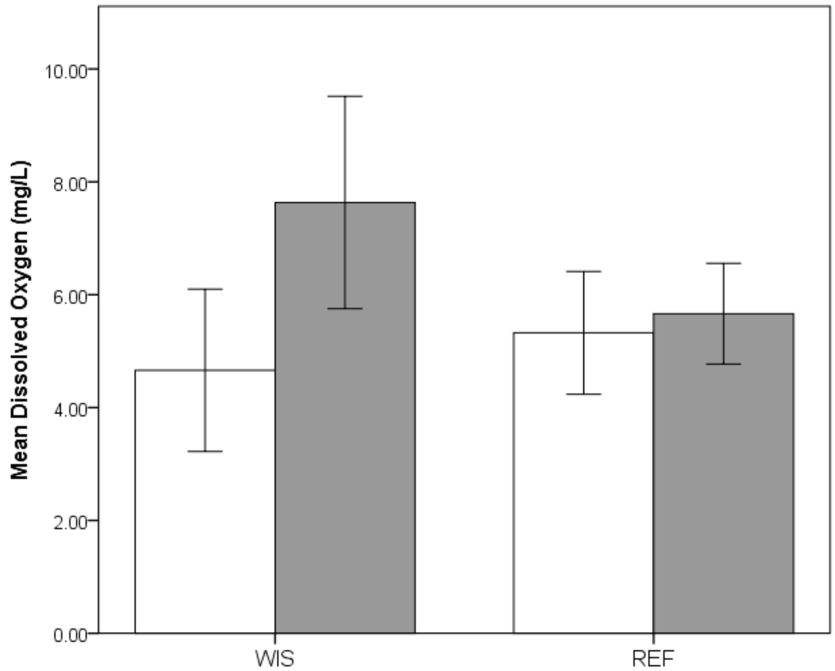


Figure 2.20: Mean (± 1 SE) dissolved oxygen (mg/L) of both treatments (Control: REF (n = 17 stream-years) and Impact: WIS (n = 6 stream-years)), before (2009-2012; white bars) and after (2013-2014; grey bars) habitat manipulations.

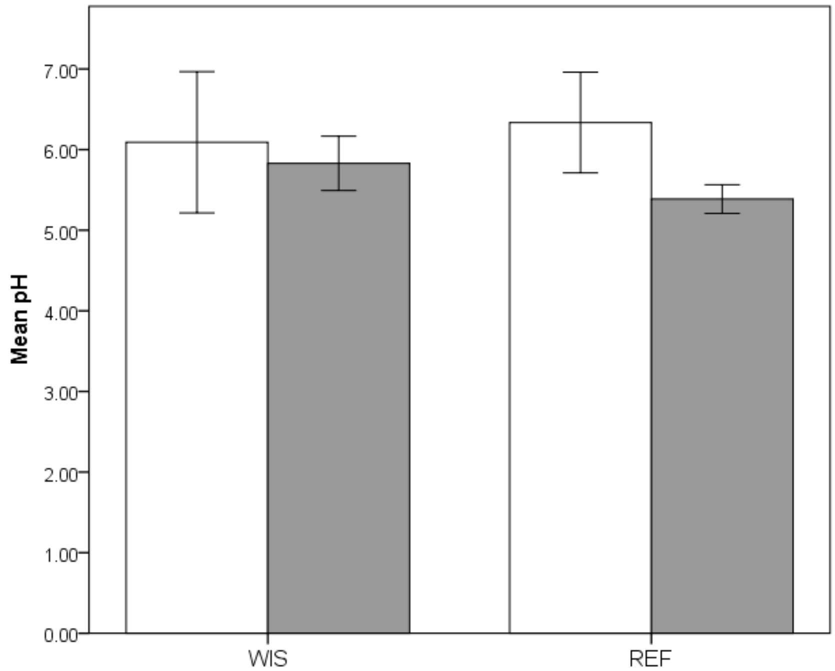


Figure 2.21: Mean (± 1 SE) pH of both treatments (Control: REF (n = 17 stream-years) and Impact: WIS (n = 6 stream-years)), before (2009-2012; white bars) and after (2013-2014; grey bars) habitat manipulations.

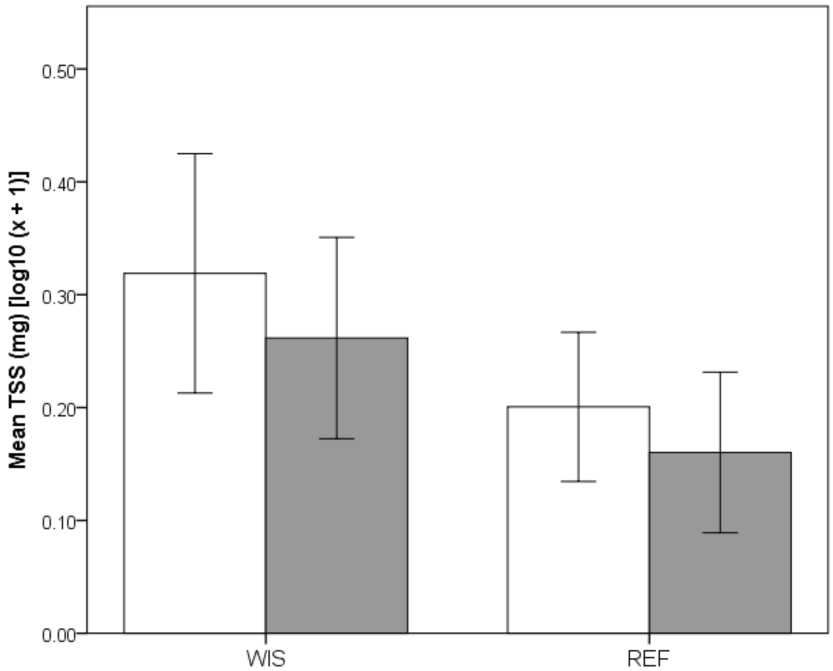


Figure 2.22: Mean (± 1 SE) total suspended solids (mg) [$\log_{10}$ (x+1)] of both treatments (Control: REF (n = 17 stream-years) and Impact: WIS (n = 6 stream-years)), before (2009-2012; white bars) and after (2013-2014; grey bars) habitat manipulations.

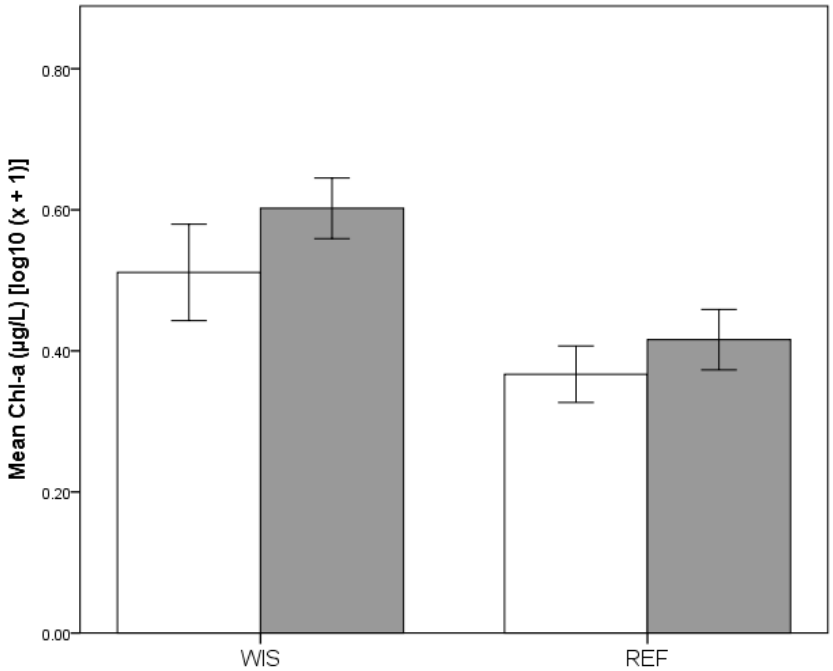


Figure 2.23: Mean (± 1 SE) chlorophyll-a (µg/L) [$\log_{10}$ (x+1)] of both treatments (Control: REF (n = 17 stream-years) and Impact: WIS (n = 6 stream-years)), before (2009-2012; white bars) and after (2013-2014; grey bars) habitat manipulations.

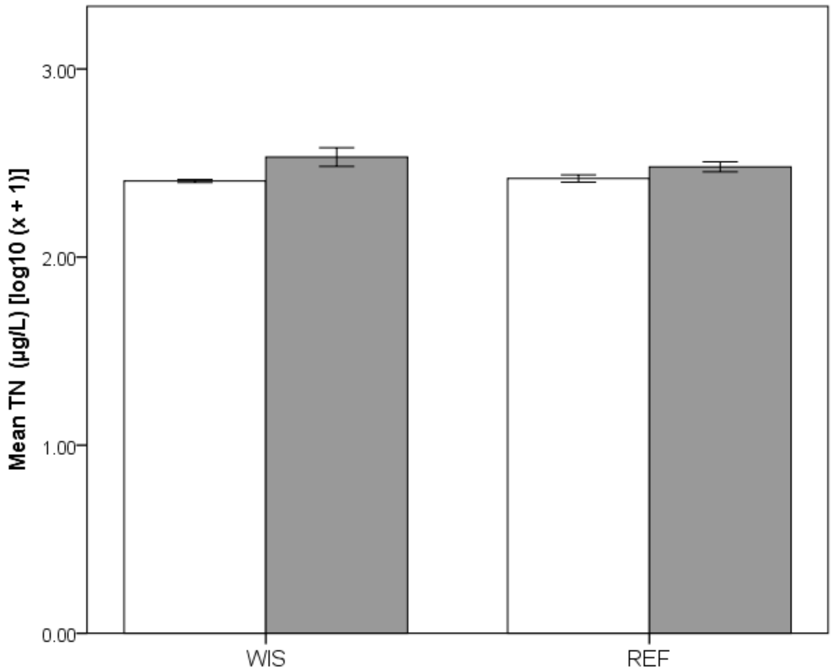


Figure 2.24: Mean (± 1 SE) total nitrogen (µg/L) [$\log_{10}$ (x+1)] of both treatments (Control: REF (n = 17 stream-years) and Impact: WIS (n = 6 stream-years)), before (2009-2012; white bars) and after (2013-2014; grey bars) habitat manipulations.

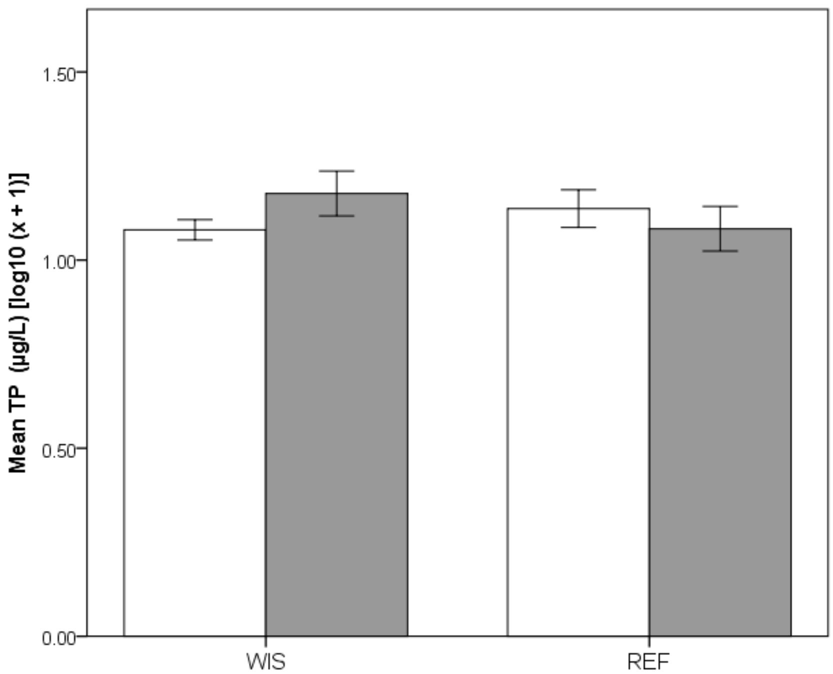


Figure 2.25: Mean (± 1 SE) total phosphorus (µg/L) [$\log_{10}$ (x+1)] of both treatments (Control: REF (n = 17 stream-years) and Impact: WIS (n = 6 stream-years)), before (2009-2012; white bars) and after (2013-2014; grey bars) habitat manipulations.

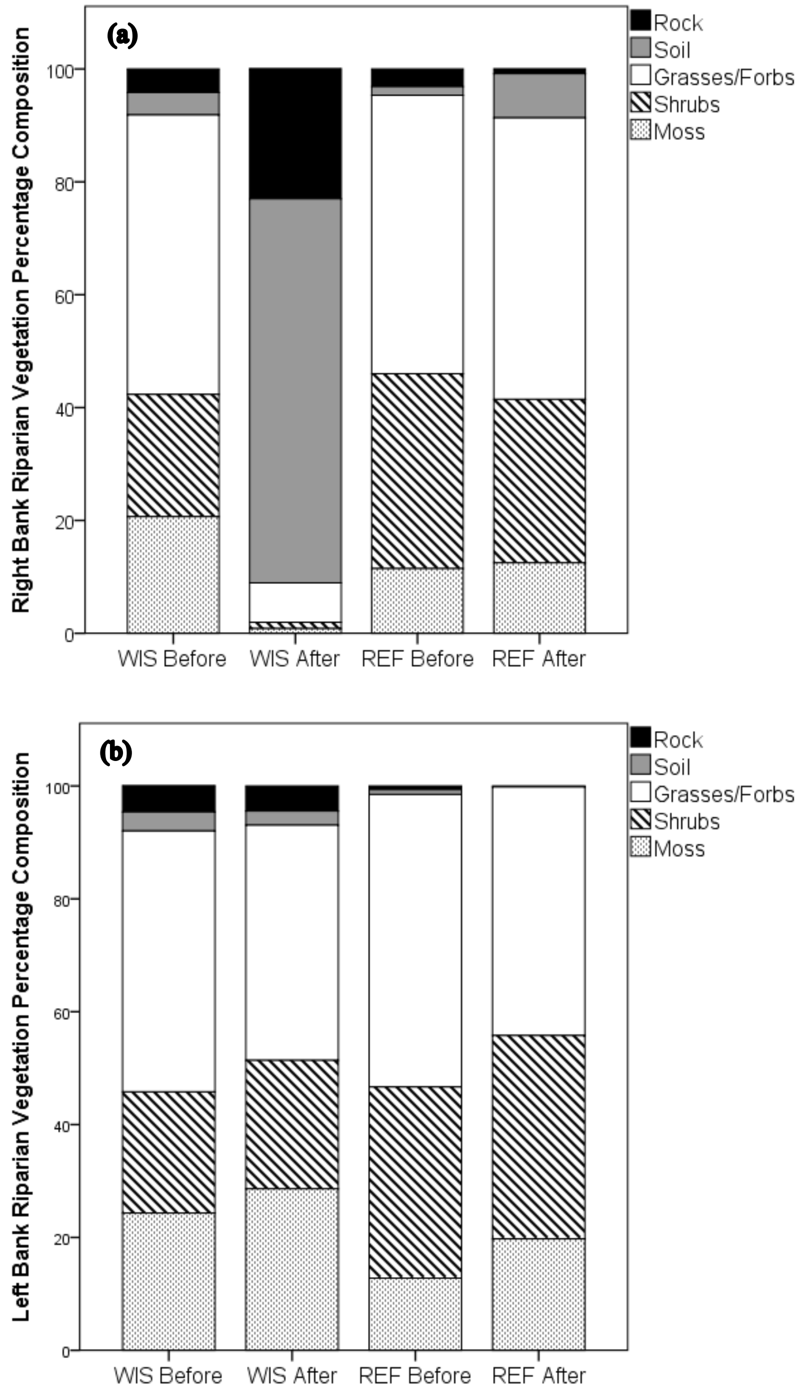
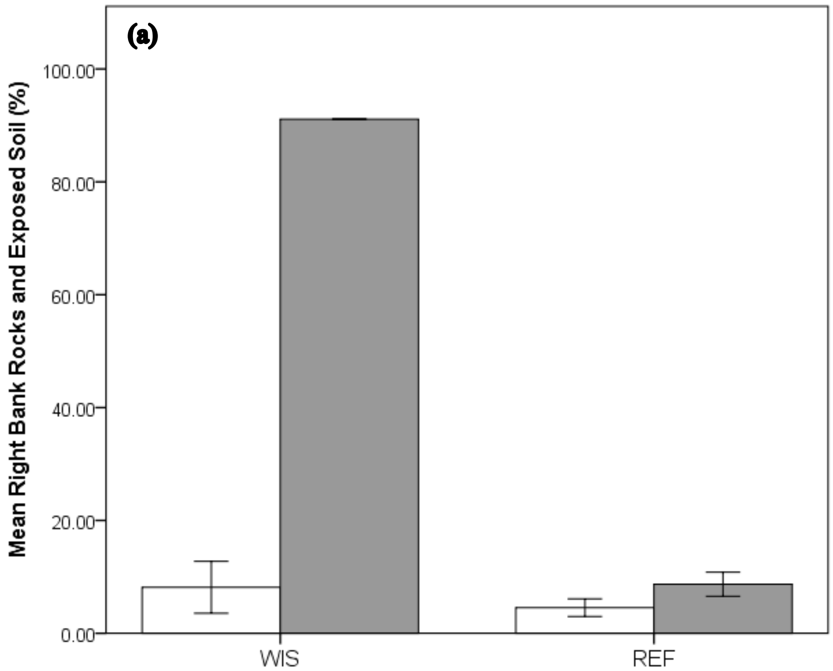


Figure 2.26: Riparian vegetation percentage composition (a) right and (b) left banks (i.e., facing downstream) of both treatments (Control: REF (n = 17 stream-years) and Impact: WIS (n = 6 stream-years)), before (2009-2012) and after (2013-2014) habitat manipulations.



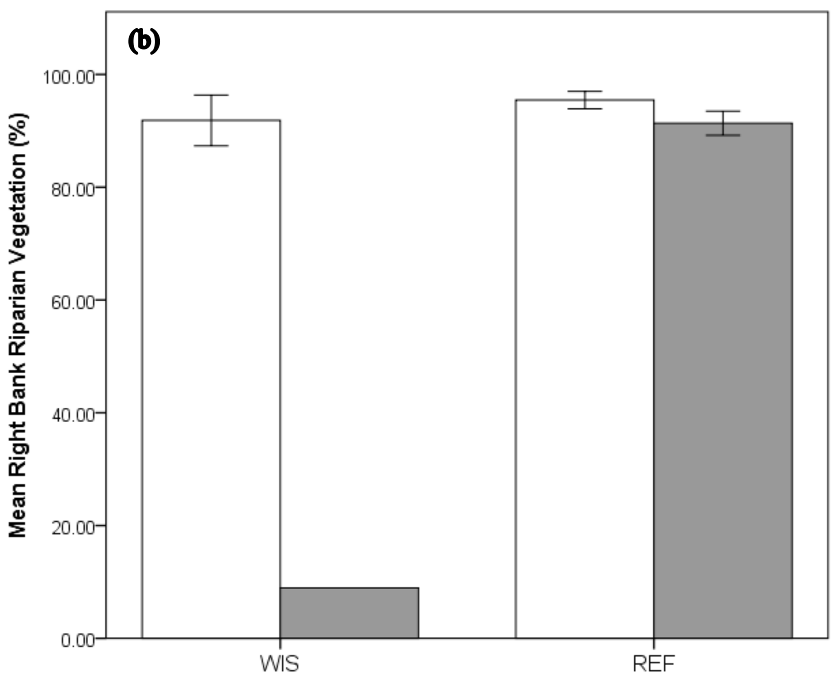


Figure 2.27: Mean (± 1 SE) right bank (a) rocks and exposed soil and (b) riparian vegetation of both treatments (Control: REF (n = 17 stream-years) and Impact: WIS (n = 6 stream-years)), before (2009-2012; white bars) and after (2013-2014; grey bars) habitat manipulations. Significant treatment*time interactions were detected in the univariate BACI

analyses for rocks and exposed soil and for riparian vegetation coverage before ($P < 0.01$) and after B-H adjustments ($P = 0.01$).

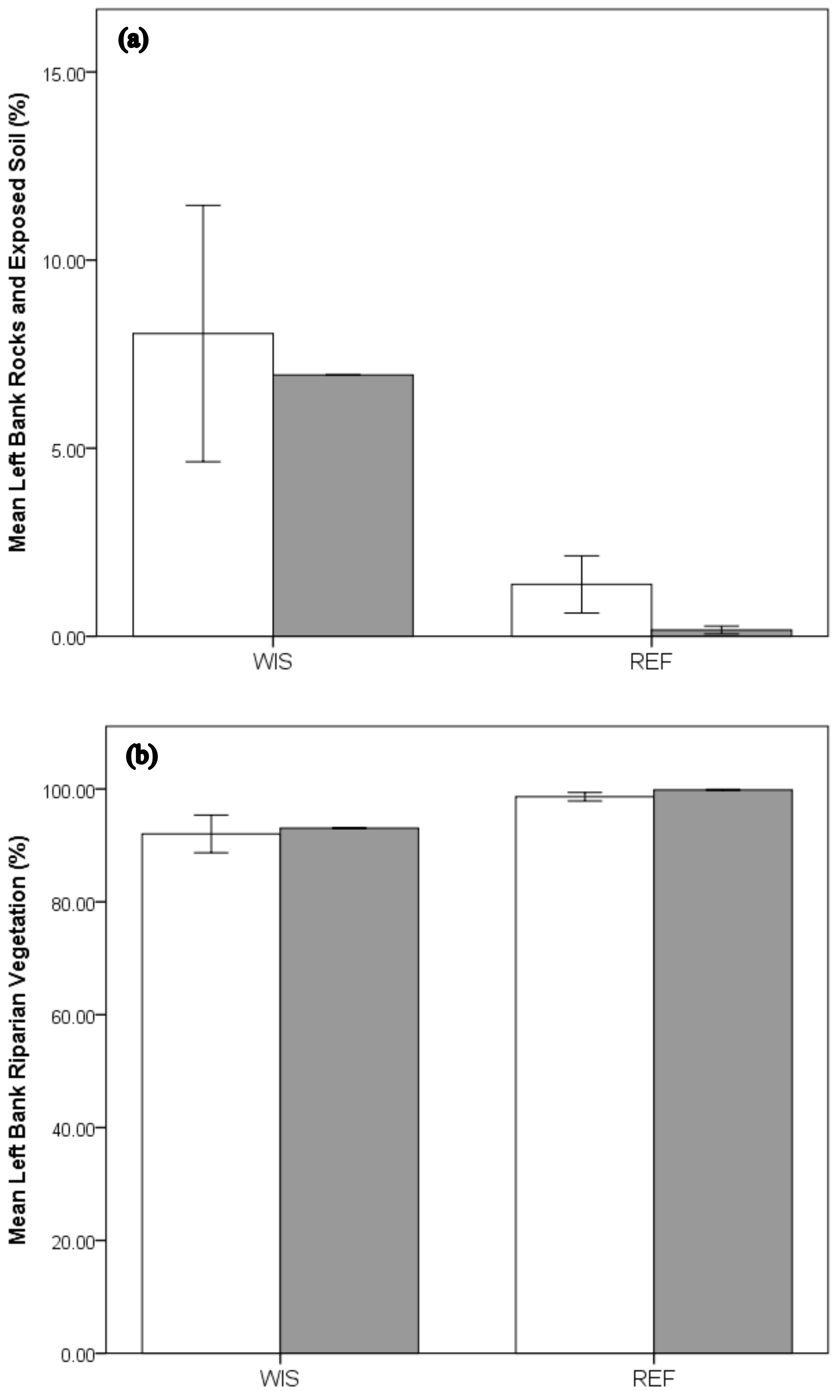


Figure 2.28: Mean (± 1 SE) left bank (a) rocks and exposed soil and (b) riparian vegetation of both treatments (Control: REF (n = 17 stream-years) and Impact: WIS (n = 6 stream-years)), before (2009-2012; white bars) and after (2013-2014; grey bars) habitat manipulations.

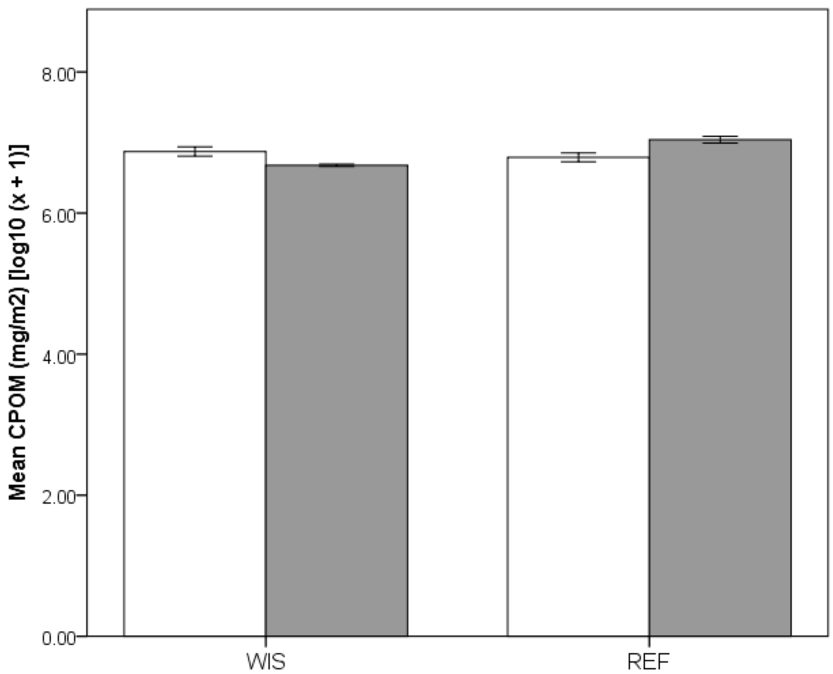


Figure 2.29: Mean (± 1 SE) coarse particulate organic matter (mg/m^2) [$\log_{10}$ (x+1)] of both treatments (Control: REF (n = 17 stream-years) and Impact: WIS (n = 6 stream-years)), before (2009-2012; white bars) and after (2013-2014; grey bars) habitat manipulations. Significant treatment*time interaction was detected in the univariate BACI analyses (P = 0.02), but significance was not retained after B-H adjustments.

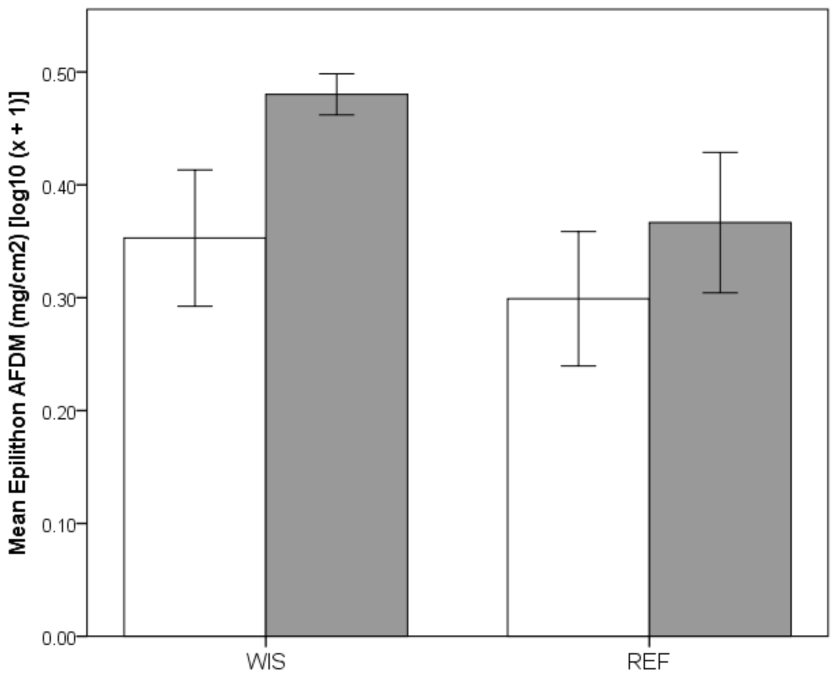


Figure 2.30: Mean (± 1 SE) epilithon ash free dry mass (mg/cm^2) [$\log_{10}$ (x+1)] of both treatments (Control: REF (n = 17 stream-years) and Impact: WIS (n = 6 stream-years)), before (2009-2012; white bars) and after (2013-2014; grey bars) habitat manipulations.

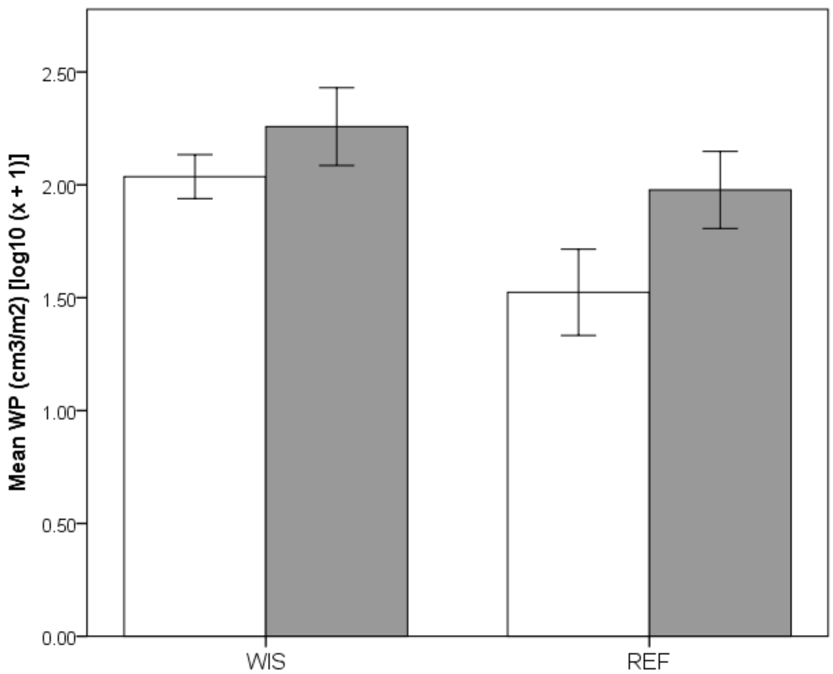


Figure 2.31: Mean (± 1 SE) wood pieces (cm^3/m^2) [log_{10} (x+1)] of both treatments (Control: REF (n = 17 stream-years) and Impact: WIS (n = 6 stream-years)), before (2009-2012; white bars) and after (2013-2014; grey bars) habitat manipulations.

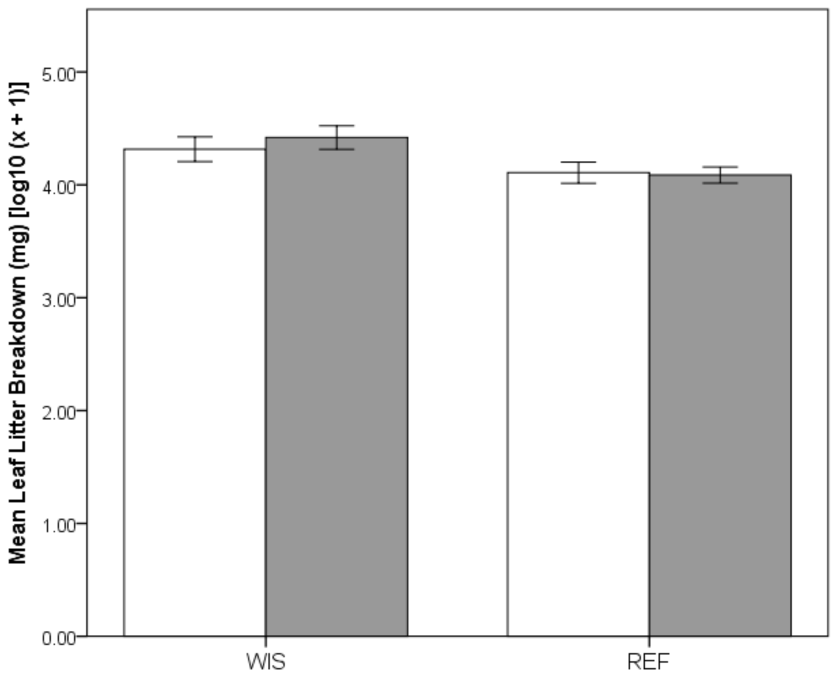


Figure 2.32: Mean (± 1 SE) leaf litter breakdown (mg) [$\log_{10}$ (x+1)] of both treatments (Control: REF (n = 17 stream-years) and Impact: WIS (n = 6 stream-years)), before (2009-2012; white bars) and after (2013-2014; grey bars) habitat manipulations.

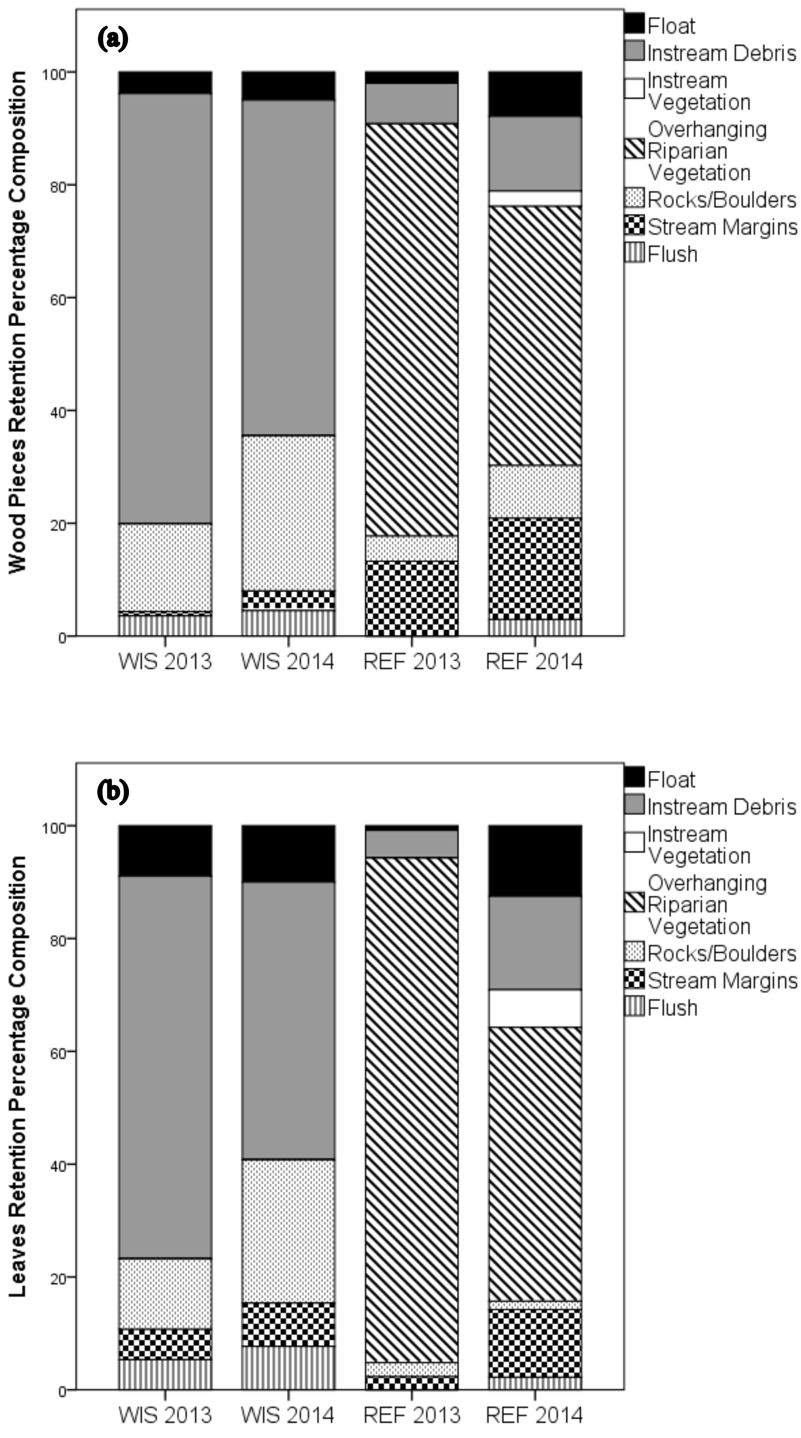


Figure 2.33: Overall retention of artificial (a) wood pieces and (b) leaves of both treatments (Control: REF (n = 6 stream-years) and Impact: WIS (n = 2 stream-years)), after habitat manipulations, during 2013 and 2014 field seasons. Categories represents the percentage retained by each different instream features.

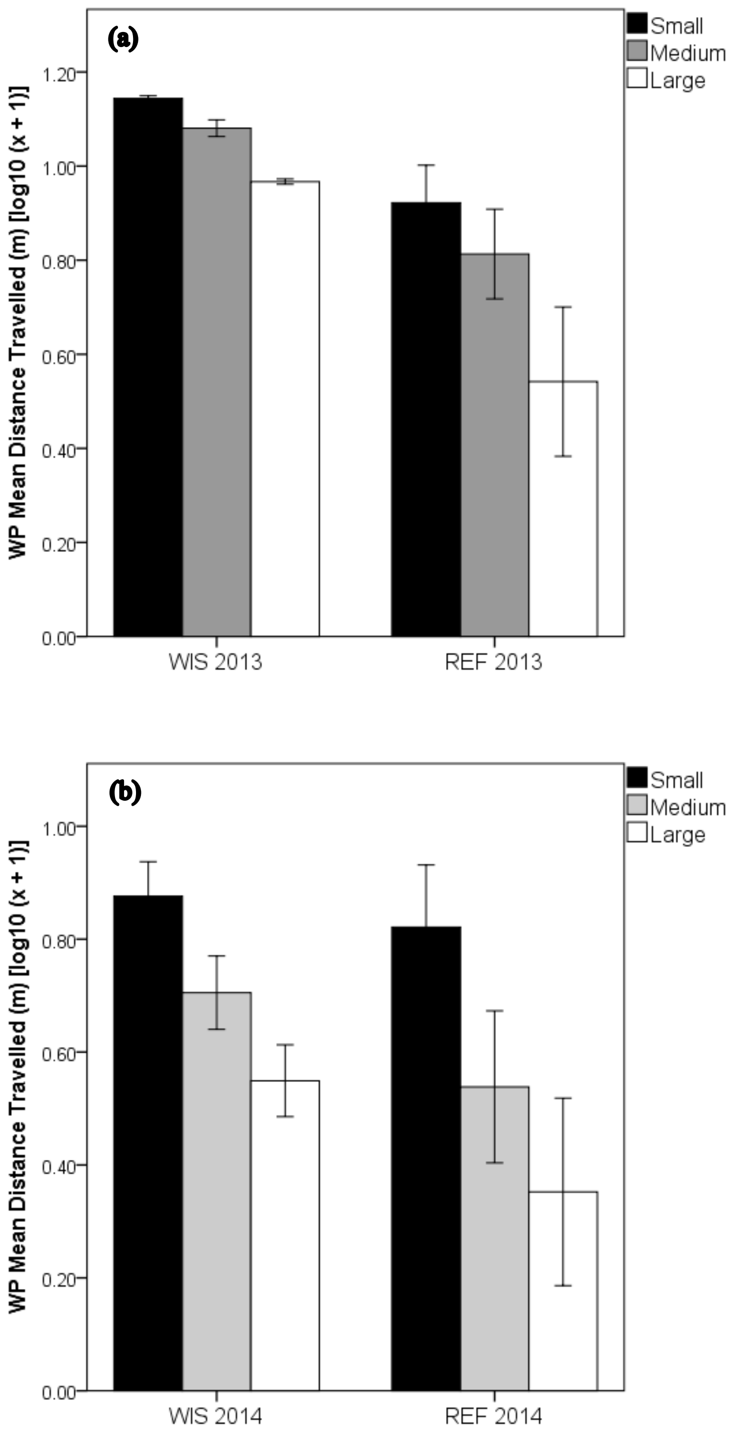


Figure 2.34: Artificial wood pieces mean (± 1 SE) distance travelled (m) [$\log_{10}$ (x+1)] of both treatments (Control: REF (n = 6 stream-years) and Impact: WIS (n = 2 stream-years)), after habitat manipulations in (a) 2013, and (b) 2014.

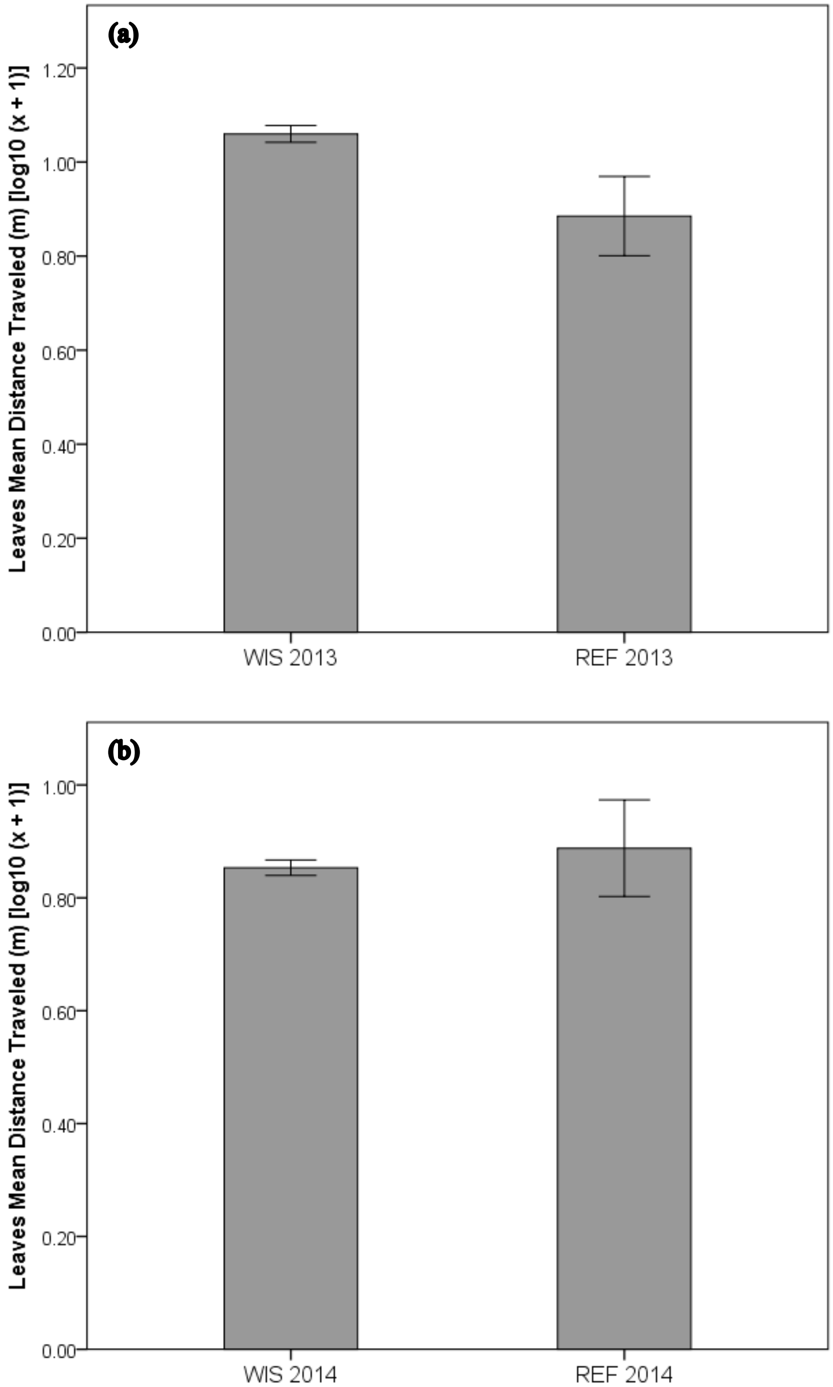


Figure 2.35: Artificial leaves mean (± 1 SE) distance travelled (m) [$\log_{10}$ (x+1)] of both treatments (Control: REF (n = 6 stream-years) and Impact: WIS (n = 2 stream-years)), after habitat manipulations in (a) 2013, and (b) 2014.

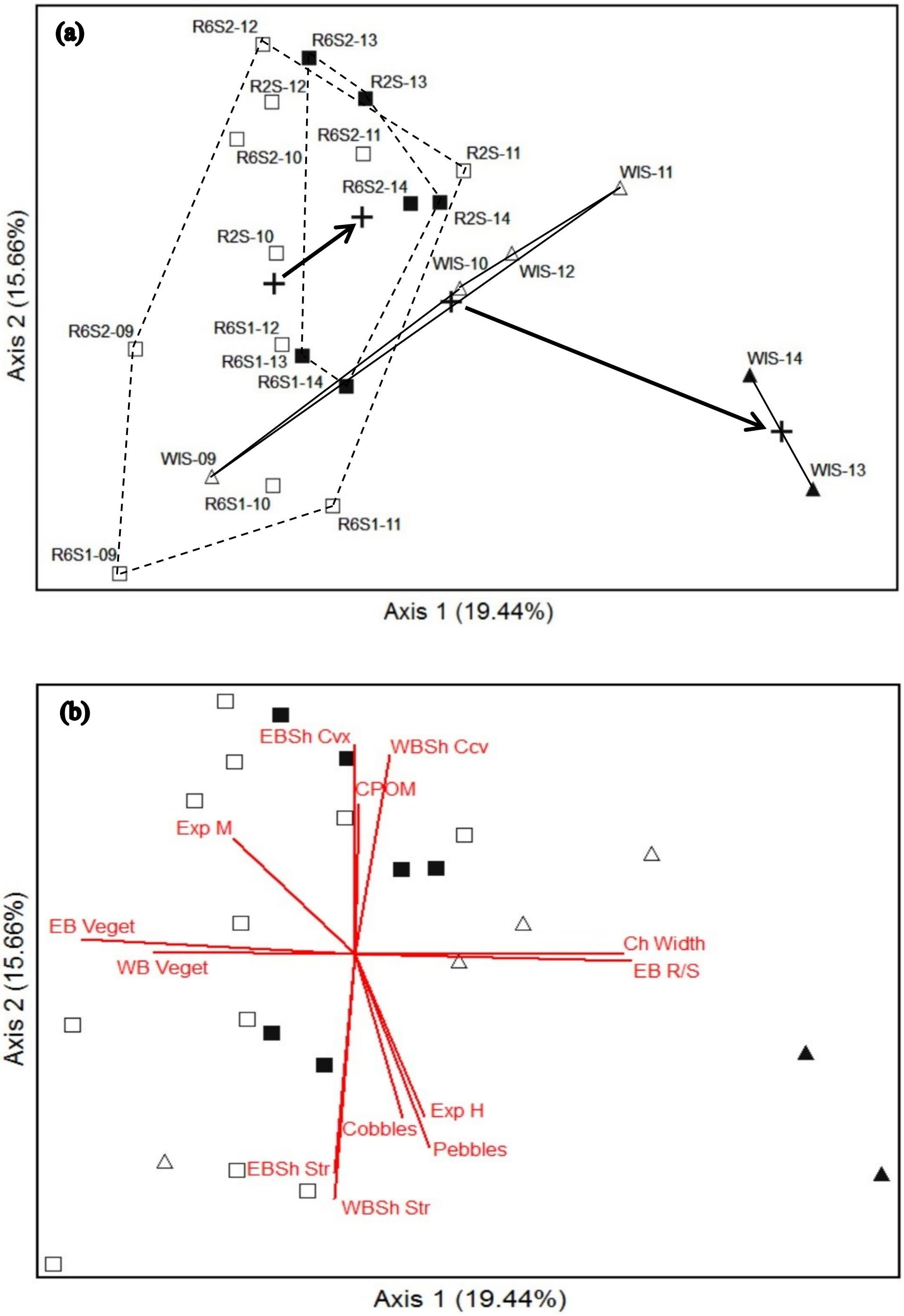


Figure 2.36: Principal component analysis (PCA) ordination of both treatments (Control: REF (n = 17 stream-years) and Impact: WIS (n = 6 stream-years)), before (2009-2012) and after (2013-2014) manipulations. Variables included in the analysis were Channel Width (m), Channel Depth (m), Water Depth (m), Current Velocity (m/s), Right Bank Shape Straight (%),

Right Bank Shape Concave (%), Right Bank Shape Convex (%), Left Bank Shape Straight (%), Left Bank Shape Concave (%), Left Bank Shape Convex (%), Right Bank Stability Moderate (%), Right Bank Stability High (%), Left Bank Stability Low (%), Left Bank Stability Moderate (%), Left Banks Stability High (%), Stream Exposure Low (%), Stream Exposure Moderate (%), Stream Exposure High (%), Turbulence Low (%), Turbulence Moderate (%), Turbulence High (%), Streambed Fines (%), Streambed Pebbles (%), Streambed Cobbles (%), Streambed Boulders (%), Temperature (°C), Conductivity (µS/cm), Dissolved Oxygen (mg/L), pH, TSS (mg), Chl-a (µg/L), TN (µg/L), TP (µg/L), Right Bank Rock/Soil (%), Right Bank Riparian Vegetation (%), Left Bank Rock/Soil (%), Left Bank Riparian Vegetation (%), CPOM (mg/m2), Epilithon (mg/cm2), WP (cm3/m2), Leaf Litter Breakdown (mg). Convex hulls (a) represent the control (dashed lines and squares) and the impact (continuous lines and triangles) sites, with arrows indicating centroid positions (+) before (open symbols) and after (closed symbols) manipulation of WIS. Note the lack of a convex hull for WIS-After due to only two stream-years. Joint plots vectors (b) show the associations of 13 environmental variables with the two axes; the direction of the vectors indicate the direction of increasing values of each variable, while vector length reflects the magnitude of the association (r^2 cutoff value: 0.400; vector scaling 100%).

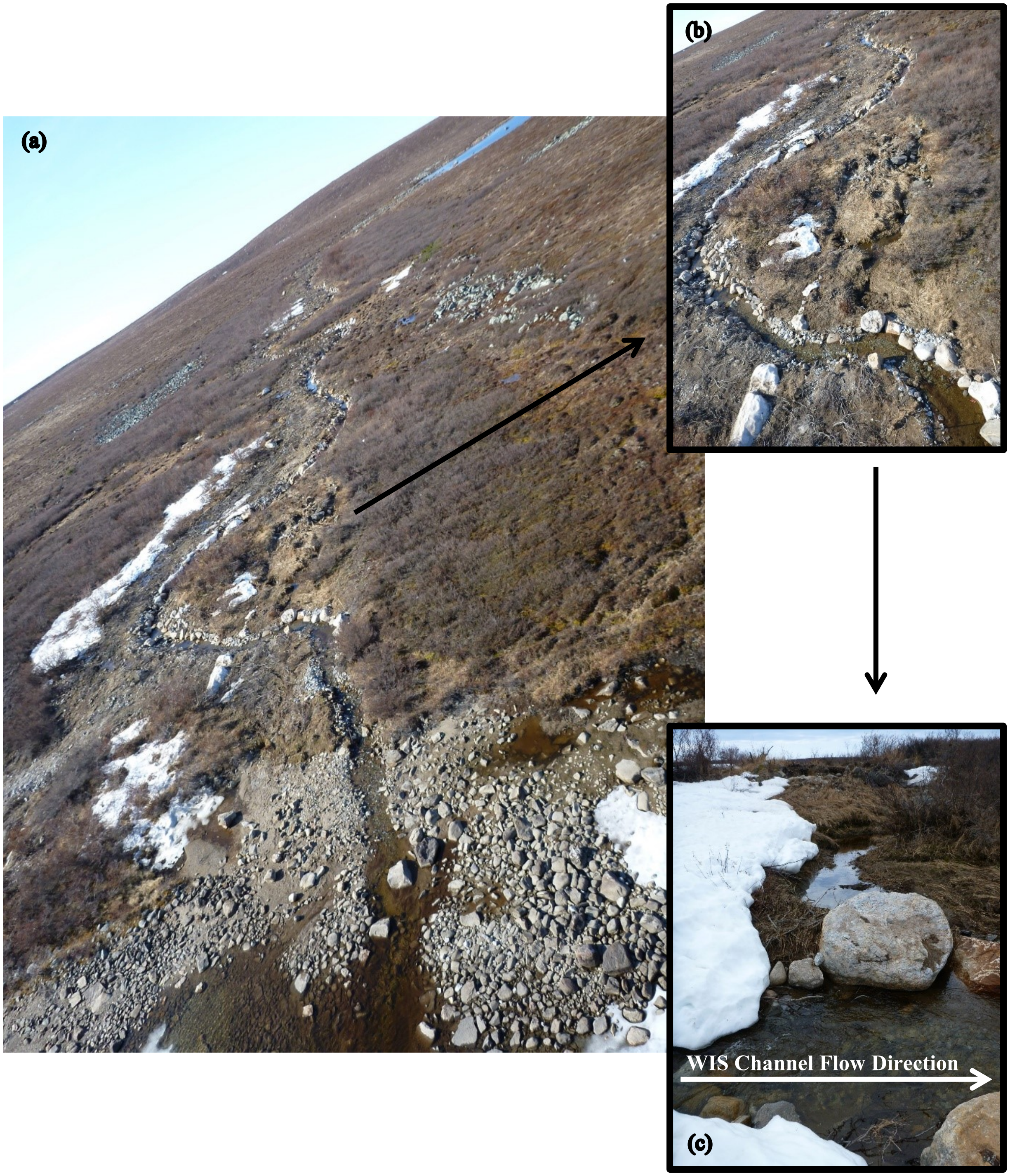


Figure 2.37: (a) West Island Stream (WIS) after manipulations; photo by C. Uherek, taken on June 09, 2014, facing south (b) natural changes to the physical configuration of the stream channel; photo by C. Uherek, taken on June 09, 2014, facing south, and (c) naturally created side-channel in detail, photo by C. Uherek, taken on June 01, 2014, facing southeast.

Chapter 3: Characteristics of Aquatic Invertebrate Assemblages in the Canadian Barrenlands Before and After Offsetting Activities

3.1 Introduction

In Canada, developments in or near water bodies that could result in reductions to fisheries productivity requires offsetting measures under the Fisheries Act (hereafter, the Act). Until 2012, the goal of the Act was to protect fish and fish habitat; in 2012, amendments to the Act changed the focus to protect and manage the sustainability and on-going productivity of commercial, recreational, and Aboriginal (CRA) fisheries (Government of Canada 2015).

Due to differences between the former and the amended Act, concerns regarding the protection of aquatic habitats and aquatic biodiversity were raised and a scientific framework was necessary to clarify what comprises a CRA fishery, to what extent aquatic habitats were protected, and what measures and standards would be required to offset serious harm to fish (Hutchings and Post 2013, Rice *et al*. 2015). Although fish are the predominant focus of most offsetting projects, the protection, management, and sustainability of fisheries depend on ecosystem productivity and functioning (Kenchington *et al*. 2013, Rice *et al*. 2015). Therefore, plants and animals that provide direct and indirect support for CRA fisheries, including invertebrates (Scrimgeour *et al*. 2014), should be also investigated as indicators and components of productivity (Kenchington *et al*. 2013, Koops *et al*. 2013, Bradford *et al*. 2014).

The process of habitat offsetting (e.g., stream manipulation) can disrupt particular habitat structures and processes, such as riparian vegetation cover or wood and leaf litter recruitment (Roni *et al*. 2002), which in turn can affect specific invertebrate guilds (e.g., shredders, collectors) due to the reduced allochthonous input (Milner and Gloyne-Phillips

2005). On the other hand, those same disruptions can be beneficial for other guilds (e.g., scrapers), since decreased shading of a stream can lead to an increase in autochthonous periphytic production (Quinn *et al*. 1997). In these circumstances, invertebrate assemblages are expected to undergo succession as the riparian zone is reestablished (Milner *et al*. 2001, 2008, 2011) and, consequently, the availability and production of organic matter is also reestablished. Ultimately, post-restoration composition and diversity of invertebrates are determined by habitat quality and quantity, resource availability, substrate preferences and local pool of available colonizers.

In addition, movement of organisms between habitat patches can affect how quickly a restored region is recolonized. Freshwater invertebrates use diverse dispersal mechanisms, including downstream drift, upstream migration, and aerial movement to reach new areas (Bilton *et al*. 2001). Subsequently, successful colonization and/or establishment is also linked to the waterbody's substrate, hydraulics, food availability, competition, and predation (Vincent and Hobbie 2000, Vincent and Laybourn-Parry 2008, Dosskey *et al*. 2010).

Because of their diverse dispersal mechanisms, invertebrates can often recover rapidly from disturbances (Yount and Niemi 1990), although observed post-restoration recovery rates have been highly variable among different habitats (Miller *et al*. 2010). For example, Scrimgeour *et al*. (2011, 2014) found lower densities and biomasses of benthic invertebrates in a constructed stream relative to reference streams1-3 years after construction and only partial recovery after 14 years in their study streams in the Barrenlands. Miller *et al*. (2010) identified a number of studies (e.g., Nakano and Nakamura 2006, Pederson *et al*. 2007) in which invertebrate richness and density increased following restoration, as well as studies (e.g., Biggs *et al*. 1998, Purcell *et al*. 2002) that did not meet the expected pre-project levels of richness and density.

Besides restrictions related to specific habitats, the size and diversity of the regional species pool can also affect the speed and effectiveness of post-disturbance colonization by freshwater invertebrates. For example, in northern climates successful colonists can be restricted to species that can both cope with both extremely low winter temperatures and occasional high peaks in summer (Miller and Stout 1989, Palmer *et al*. 1992, Brown *et al*. 2003). However, many Arctic regions contain an abundance of pristine aquatic habitats that should provide numerous sources of potential invertebrate colonists for newly created or restored stream habitat (Sundermann *et al*. 2011).

Increasing exploitation of natural resources in northern Canada has increased the need to understand northern ecosystems better, particularly towards protection and management of aquatic habitats and their organisms (Lapointe *et al*. 2014) and in designing of methods to mitigate impacts on the environment (Jones *et al*. 2003a). However, habitat offsetting projects are complex and there is a positive relationship between successful restoration (and other kinds of offsetting and compensation projects) and our ecological understanding of a system (Bradshaw 1996).

In 1991, diamonds were discovered in the Canadian Barrenlands (Krajick 2001, Kjarsgaard and Levinson 2002) and within 10 years, several mines were being developed. As a result of development of Diavik Diamond Mines, Inc. (DDMI) at Lac de Gras (LDG), Northwest Territories (NT), and in accordance with the former Fisheries Act, a habitat compensation project was required to offset aquatic habitat losses that occurred during the initial phases of DDMI's development in 2001.

The West Island compensation project was proposed by DDMI and their consultants and was approved by Fisheries and Oceans Canada (DFO). The goals of the project were to: 1) improve ecological connectivity between LDG and West Island Lake (WIL) through its single outlet stream West Island Stream (WIS), by eliminating small cascades that acted as barriers to fish; 2) increase duration of summer flow in WIS using stream channelization to concentrate flow into a single, well-defined channel; and 3) provide spawning and rearing habitat for fish. After four years of investigations on the undisturbed outlet stream and other reference streams, DDMI constructed a nature-like fishway, modifying what had been a relatively impassable natural outlet stream, at the end of summer 2012. As part of the monitoring and assessment of this project, benthic invertebrates were collected three years before (2010-2012) and two years after (2013-2014) habitat manipulation from WIS and the three other reference streams (REF).

To assess the effects of DDMI's habitat manipulation project on invertebrates and on components of stream habitat structure and function, (Chapter 2), my research used a Before-After-Control-Impact (BACI) study design (Green 1979, 1993, Underwood 1991, 1992, 1994, Downes *et al*. 2002). BACI designs compare the responses of a manipulated site both to its pre-manipulation state and to non-manipulated reference sites both before and after the time of manipulation by testing for statistical interaction between the two sources of variation: treatment (control or reference vs. impact sites) * time (before vs. after manipulation or impact). In a BACI context, a successful project should show no difference between responses of impacted versus reference sites, indicating that the state of the manipulated site was reestablished to the pre-manipulation period. It is important to note that the BACI design does not require the treatment sites (i.e., manipulated and reference streams) to be identical; the focus is on their respective changes between the pre- and post- treatment periods.

More importantly, West Island compensation project aimed to change the stream to achieve the project's goal, thus BACI results should be evaluated accordingly. In this case, an interaction may not necessarily mean a bad outcome but differences between the baseline period and the post-manipulation period that indicates a treatment-specific effect on the measured environmental variable or invertebrate assembly that shows ecological connectivity improvement, increased duration of stream flow, and a stream channel that is accessible and provides habitat and food resources for fish. In brief, having WIS-After results identical to WIS-Before would indicate a potential failure in this habitat enhancement project, as during the before period WIS stream channel had limited access and did not provide an aquatic corridor for resident fish.

In this study, I compared stream invertebrates (density, biomass, diversity, and taxonomic composition) in reference streams (control sites) to those in the manipulated stream (impact site) three years before and during the first two years after the manipulation. My basic objective was to address the question: How invertebrate density, biomass, diversity, and taxonomic composition differ in WIS before vs. after offsetting activities, and relative to the reference streams?

3.2 Study Area

The study area is located in the Canadian Barrenlands, centered around the DDMI site at LDG (64°30’41”N, 110°17’23”W; elevation 416 m; Figure 2.1), approximately 300 km northeast of Yellowknife (NT), 210 km south of the Arctic Circle, and about 100 km north of the tree line in the Southern Arctic Ecozone, within the continuous permafrost zone (DDMI 2009). This area is semi-arid, with ca. 290 mm average annual precipitation, 55% of which falls as snow. The mean annual temperature is -4.3°C with a summer mean of 10°C and maximum of 32.5°C and a winter mean of -31°C and minimum of -51.2°C., average wind speeds is 20 km/h, and daylight hours with the sun above the horizon varying from 22 hours (June) to 2 hours (December) (DDMI 2009, Environment Canada 2016).

The landscape is classified as Southern Arctic Tundra and is characterized by numerous lakes, bedrock outcrops, boulder fields, till, and eskers (DDMI 2009). Vegetation is characterized by the presence of shrubs, grasses, forbs, mosses, and lichens; wetter areas bordering lakes and streams are dominated by Dwarf Birch *Betula nana* (Linnaeus), Northern Labrador Tea *Rhododendron tomentosum* (Harmaja), willows (*Salix* spp.), sphagnum mosses (*Sphagnum* spp.), and sedge tussocks (*Carex* spp.) (DDMI 2009). Smaller streams in the Barrenlands generally flow over folded rock and glacial features, creating highly irregular drainage patterns. They are dominated hydrologically by a large snowmelt freshet promoting peak flows, followed by a flow decrease until freeze-up in autumn. Post-freshet, stream flow is dependent on lake outflows, but summer evaporation combined with shallow soils and continuous permafrost often lower lake levels below the outlet, which causes outflow cut off (Baki *et al*. 2012). This results in channels having standing water or becoming completely dry by mid to late summer.

WIS, the manipulated site, is located approximately 8 km west of DDMI. WIS is an outlet stream originating from a 13.65 ha headwater lake, WIL, with a drainage area of 30 ha; WIS flows 420 m before emptying into LDG (Table 2.1, Figure 2.2). Two reference sites also located within the LDG watershed, were selected for this study: (a) Reference 2 (Table 2.1, Figure 2.3), consisting of a 18.87 ha headwater lake (R2L), located approximately 6 km northwest of DDMI, connected to LDG by a 103 m outlet stream (R2S); and (b) Reference 6 (Table 2.1, Figure 2.4), located approximately 7 km southeast of DDMI, consisting of a chain of two lakes, the upper R6L1 (3.91 ha) and the lower R6L2 (6.82 ha), and two outlet streams, R6S1 (108 m) and R6S2 (177 m), with the latter draining into LDG. Thus, there were three reference streams (REF) in total (R2S, R6S1, R6S2) acting as controls, and there was one impacted stream (WIS) for the BACI design.

Prior to habitat manipulation, fish access from LDG to WIS and WIL was limited due to a series of cascades located in the lowest portion of the outlet before entering LDG. As well, limited post-freshet flow and a braided and poorly defined channel provided poor fish habitat (Figure 2.5). To improve ecological connectivity between WIL and LDG, increase duration of spring and summer flows in WIS, and provide spawning and rearing habitat for fish, especially Arctic Grayling, *Thymallus arcticus* (Pallas), a spring-spawning species, DDMI modified WIS at the end of summer 2012, using a nature-like fishway design, which uses on-site natural materials (Katopodis *et al*.2001) such as boulders, rocks, and wood pieces, to mimic the characteristics of natural streams.

To achieve this, the stream was channelized to concentrate flow and a new channel section was created to bypass the lower-section cascades. Boulder-weirs, boulder-chokes, boulder-based step-pools, and rocky ramps were added to create more favorable hydraulics to facilitate fish movement (Figure 3.6; Courtice *et al*. 2016). During construction, the right bank (i.e., facing downstream) riparian vegetation was removed to facilitate heavy equipment access. To prevent bank erosion, promote ecosystem productivity, and create different types of instream microhabitats that could be colonized by diverse invertebrate taxa, willow was replanted into the disturbed bank (i.e., right bank facing downstream) and wood pieces were placed along the stream channel.

3.3 Methods

To help evaluate and monitor the WIS compensation project, with a focus on benthic invertebrates and components of stream habitat structure and function (Chapter 2), I used four years of pre-manipulation biotic and abiotic data (the Before period: 2009-2012) and collected post-manipulation data for two years (the After period: 2013-2014). However, invertebrates were not sampled during 2009.

Data from the Before and After periods were collected and processed consistently following standard operational procedures described below. Data collected from the impact stream (WIS) and control or reference streams (REF: R2S, R6S1, R6S2) were analyzed following a Before-After-Control-Impact (BACI) study design (Green 1979, 1993, Underwood 1991, 1992, 1994, Downes *et al*. 2002).

3.3.1 Sampling Procedures

To document habitat characteristics and to establish sampling locations for invertebrates, WIS was divided into lower, middle and upper reaches according to changes in topography. Within each reach, six habitat stations were selected by observing patterns in the water surface and changes in the streambed elevation, corresponding to three pools (i.e., lentic depositional habitat) and three riffles (i.e., lotic erosional habitat), for a total of 18 stations to characterize these two different types of stream habitats. In addition, six habitat stations were assigned at both R6S1 and R6S2, corresponding to three pools and three riffles. Finally, four habitat stations were identified in R2S, corresponding to two pools and two riffles. The number of habitat stations was constrained by the stream length. Although these stations were fixed during the entire study period for the REF streams, new habitat stations located within new lower, middle and upper reaches were reassigned for WIS after the fishway construction due to changes in the physical characteristics of the stream channel.

Field season started in late May or early June, immediately after freshet, and ended in mid-August, by which time flows were minimal or ceased altogether. Each year, samples were collected and data were recorded at approximately the same time, to minimize seasonal variability. Although invertebrates were sampled twice per year (mid-June and mid-July), the

June sample was preferred for identification procedures given that the flow ceased in some streams or portions of streams by mid-July in some years.

At each station, benthic aquatic invertebrates were collected using a 30 x 30 cm Surber sampler with a 243 μm mesh net. With the net frame submerged in the stream at a depth equal to or lower than the height of the sampler and the base of the sampler firmly embedded into the substrate, the streambed area within the sampler base was disturbed by hand to a depth of *circa* 5 cm, and any rocks were visually inspected and cleaned of all invertebrates, using the stream flow to carry dislodged organisms and sediment into the collecting net. To avoid interfering with samples of other stations, the sampling procedure started at the most downstream station of each stream and moved progressively upstream. Using a 250 μm sieve, the sample was then transferred to a 500 mL plastic sample jar, and samples were preserved immediately in 95% ethanol. At sediment-rich stations, subsampling procedures were necessary, i.e., the substrate contained in the Surber net was sub-divided, with only a portion of the total preserved, and the remaining unused portion of the sample was returned to the stream sampled location. Sample jars were labeled, sealed, and shipped to Cordillera Consulting, Summerland, British Columbia, Canada, for processing.

3.3.2 Sorting, Processing, and Identification Procedures

Samples were processed by Cordillera Consulting according to their internal standard procedures for the sorting and identification of benthic invertebrates. Upon arrival, samples were logged into a data base and label information was recorded for future cross reference.

First, each sample jar was elutriated to separate dense inorganic material (e.g., sand and gravel) from the organic portion; after elutriation, the inorganic fragments were examined under a dissecting microscope for attached animals such as molluscs and trichopterans that were then added to the organic portion. Ethanol was added to the sample as necessary to keep the concentration above 70%.

Second, organic debris (e.g., leaves, twigs) and large clumps of algae were inspected under a dissecting microscope, and any animals discovered were returned to the sorted sample. Finally, the remaining organic material was examined. If 600 animals or fewer were present and counted in a sample, all individuals were identified; if > 600 animals were present, a 27 cm x 27 cm x 15 cm Marchant Box Sub-sampler (Marchant 1989) was used to achieve a minimum of 300 counted organisms.

Invertebrates were sorted initially to order or family levels. In cases of damaged or fragmented specimens, only heads were counted. This preliminary sorting procedure excluded Nemata and Platyhelminthes (inadequate sampling procedures), Porifera (colonial), Cladocera, Copepoda and Ostracoda (primarily from the upstream lake), and terrestrial drop-ins. The sorted portion of the debris was preserved separately. At least 10% of randomly chosen post-sorting samples were tested to make sure that sorting efficiency was 95% or greater, in cases that this requirement was not met, the entire sample was re-checked. Sorting efficiency was calculated by dividing the number of organisms missed by the total organism found and multiplying by 100 to arrive at the percentage.

Finally, sorted organisms were identified to the finest practical taxonomic level (FPTL) (usually genus or species), using over 25 major taxonomic keys (e.g., Clifford 1991, Thorp and Covich 1991, Merritt and Cummins 2007). The Integrated Taxonomic Information System (ITIS 2016) and the Canadian Aquatic Biomonitoring Network (CABIN 2014) were used to standardize nomenclature and classification.

3.3.3 Biomass Calculations

Biomass was calculated following procedures described in Benke *et al*. (1999), using digital measurements. Specimens were placed in a petri dish in 70% ethanol under a dissecting microscope (Olympus SZX16) with a slide micrometer at all available magnification of the microscope to allow the program to properly determine the length of the line segments on the invertebrate in millimeters. A microscope mounted camera (Infinity 2-C3, Lumenera Corporation, 2002) was used to capture images of the invertebrates to the Infinity Capture Image Software (Version 6.5.2, Lumenera Corporation, 2002-2014). Images were then imported into Cordillera BioMass Picker (Version 1.0.10, SageKey Software, 2010-2014), a length-to-weight conversion program, and dry mass (DM) was calculated in milligrams. When more than 10 individuals of the same taxa were present in each sample, a minimum of 10 measurements were taken to cover the variation in length among all individuals per sample.

To calculate the biomass for oligochaetes within each sample, a derived constant for worms was created by using whole organisms, counting and drying the worms, and then calculating an average weight; this average weight was then multiplied by the number of worms in the sample. Prostigmata, Oribatida, and Hydridae were excluded from the biomass calculations, since there were no regression tables on biomass data available that could be applied into the length-to-weight conversion program formulae.

3.3.4 Statistical Analyses

Of the 135 FPTL identified (Appendix 1), most taxa were at the genus level (117 genera), 18 at species level, and the remainder at various higher taxonomic ranks. Identification protocols differed between years at Cordillera Consulting, and so for consistency across the period of the study, I grouped taxa into the finest rank (e.g., class, order, suborder, and/or family) that permitted the inclusion of all animals. This resulted in 19 taxa for density analysis and 16 taxa for biomass analysis (Table 3.2). Individual samples were averaged to determine one stream-year specific value (n = 20 stream-years).

Prior to analysis (Table 3.3), Diptera: Chaoboridae (n = 5, only in 2014) were excluded because these are standing water animals, and likely drifted into the surber sampler during the field sampling process; Lepidoptera: Noctuidae (n = 2, in 2010 to order level; n = 3 in 2012 to order level; and n = 1, in 2013 to family level) and Odonata (n = 4, only in 2010) were also deleted because a lower identification level was necessary to confirm if these animals were actually in-stream generated and not merely terrestrial drop-ins; Amphipoda (n = 2, only in 2012) were also removed due to inadequate sampling procedure possibly resulting in its rarity; Tardigrada (n = 155, in 2010; n = 250, in 2011; n = 237, in 2012; n = 76, in 2013; and n = 59, in 2014) were deleted due to inadequate sampling and sorting procedure for this taxa, as these are small bodied animals that could pass through the sieve mesh resulting in its underestimated abundance.

Nonmetric Multidimensional Scaling (NMS) and the NMS Scores procedure were used with the Sorensen (Bray-Curtis) distance measure in PC-ORD (Version 6.21, McCune and Mefford 2011) to analyze invertebrate assemblages (McCune and Grace 2002, Peck 2010). Using the outlier analysis summary of PC-ORD, no responses (streams or taxa) were flagged as outliers, given a cutoff of 2.5 standard deviations from the mean. Shannon's Diversity Index (H) was calculated using PC-ORD.

To create control-stream models which could be used as a predictive model for the BACI study, I initially analyzed only reference sites (REF; n = 15 stream-years sample units) with NMS, separately for density (19 taxa) and biomass (16 taxa). A randomized stress test with 250 randomized runs was used to determine the appropriate dimensionality (Clarke 1993, Clarke and Ainsworth 1993, McCune and Grace 2002, Peck 2010). After verifying consistency of interpretation among several autopilot runs, a NMS final ordination with 500 runs was calculated with the recommended dimensionality, and an orthogonal axis rotation was used to best interpret the results of uncorrelated axes. Using the results of these ordinations, coordinates for WIS (n = 5 stream-years sample units) were then calculated for density and biomass using the NMS Scores procedure (McCune and Grace 2002, Peck 2010) to determine whether the impact site changed after manipulation relative to its own 'before' period and to the reference sites, and these scores were added to the response matrix. No responses (streams or taxa) were flagged as having a poor fit for the model.

To quantify multivariate changes that occurred in WIS invertebrate assemblages relative to the reference sites, I tested density and biomass for treatment*time interaction (e.g., Leps and Smilauer 2003) using redundancy analyses in CANOCO (Version 4.56, ter Braak and Smilauer 2011).

Total density, total biomass, and density and biomass for each individual taxon (density: 19 taxa; biomass: 16 taxa), and Shannon's Diversity Index (H) calculated for density and biomass were also tested for treatment*time interaction in a before-after-control-impact (BACI) framework (Green 1979,1993, Underwood 1991, 1992, 1994, Downes *et al*. 2002) using linear mixed models in SPSS (Version 24, IBM Corporation 2016), with year as a repeated factor and stream as subject.

Taxonomic percentage composition for density and biomass were calculated using PC-ORD and graphed in SPSS. For a better graphic visualization, I grouped particular taxa into larger units: Ephemeroptera, Plecoptera, and Trichoptera were grouped into "EPT"; Ceratopogonidae, Dixidae, Dolichopodidae, Empididae, Muscidae, and Tipulidae were grouped as "Other Diptera"; Hemiptera, Prostigmata, Oribatida, Pisidiidae, Gastropoda, and

Hydridae formed an “Other Invertebrates” category. Coleoptera, Chironomidae, Simuliidae, and Oligochaeta were represented as independent categories.

Data were tested for homogeneity of variances using Levene’s Statistic Test, and for normality using Kolmogorov-Smirnov Test (IBM Corporation 2013a, b). Density and biomass data were log transformed [$\log_{10}(x + 1)$] to improve the comparability of responses across sample units and to reduce the influence of highly abundant taxa (Zar 2010, Gotelli and Ellison 2013) before analyses in PC-ORD, CANOCO, and SPSS. Results of statistical tests were considered significant when $p \leq 0.05$, and marginally significant when $0.05 < P \leq 0.10$, after performing the Benjamini and Hochberg (1995) adjustment to reduce the level of false discovery rate (FDR). A significant interaction between the two sources of variation (treatment*time) indicate a treatment-specific influence on invertebrate assemblage between the baseline period and the post-manipulation period. Only taxa with significant or marginally significant time*treatment interaction in BACI analysis were graphed.

3.4 Results

From a total of 270,594 identified animals, 794 organisms (i.e., Diptera: Chaoboridae, Lepidoptera: Noctuidae and Odonata, Amphipoda, and Tardigrada) were deleted from the dataset due to sampling and/or identification inadequacy (Table 3.3), and the remainder were grouped in 19 and 16 taxa categories for density and biomass, respectively, to permit inclusion of all animals. These categories were included in univariate and multivariate statistical analyses and in Benjamini and Hochberg (B-H) adjustments (Tables 3.2 and 3.3).

3.4.1 Invertebrate Density: Multivariate Analyses

For the 19 taxa used for the density analyses (Table 3.2), a relatively low coefficient of variation in total density for streams (REF = 17.59%, WIS = 11.31%) indicated comparability of densities across the streams-years. In contrast, a high coefficient of variation for taxa (REF = 82.52%, WIS = 85.49%) indicated that the dominance and/or rarity of taxa varied across stream-years.

The Monte Carlo Test of significance based on 250 randomized runs recommended a two-axis solution for REF stream data (P = 0.004). The resulting ordination had a final stress of 12.66. The two axes explained 85.2% of the variation in the REF streams dataset with the majority being explained by axis one (REF; Figure 3.7). The proportion of variation explained declined when WIS data were added: axis 1 = 32.9%, axis 2 = 34.6% (Figure 3.8). Joint plots vectors indicate the direction and extent of increase of taxa density having a $r^2 \geq 0.300$ of association with the two axes.

In the after period, the REF centroid shifted from the initial position; based on the taxon vectors, this shift possibly reflected a decrease in Oribatida and Hemiptera, and an increase in Trichoptera and Simuliidae, which was recorded only once in reference streams (R2S-13, n = 1) during the entire study (Figure 3.7).

In contrast, the Before and After centroids for WIS were quite similar, but this was due to divergent positions for the two After-period stream-years, rather than a lack of temporal variation. In 2013, the first year after manipulation, WIS fell within the control-stream After convex hull. However, in 2014, WIS diverged from the ordination space of the REF streams, although both WIS-2013 and WIS-2014 were only marginally outside of the WIS-Before convex hull, indicating that the invertebrate assemblages were still fairly similar to the WIS-Before assemblages (Figure 3.8).

Overall, the multivariate BACI analysis did not detect a significant treatment*time interaction for invertebrate density (Monte Carlo permutation (n = 499), P = 0.11).

3.4.2 Invertebrate Biomass: Multivariate Analyses

For the NMS analysis based on biomass of the 16 invertebrate taxa, the Monte Carlo Test of significance supported a two-axis solution (P = 0.004). The resulting ordination for REF data had a final stress of 7.22. The two axes explained 91.4% of the variation in the reference dataset (REF, Figure 3.9). For all treatments combined, the proportion of variation explained declined slightly: axis 1 = 50.9%, axis 2 = 36.7% (Figure 3.10). Joint plots vectors indicate the direction and extent of increase of taxa biomass having a $r^2 \geq 0.300$ of association with the two axes.

The After data for REF sites remained largely nested within the Before data (Figure 3.9). During the Before period, WIS assemblages varied considerably year-to-year, but two of three years were contained within the REF-Before convex hull (Figure 3.10). In 2013, first year after manipulation, WIS was situated outside of the REF-After convex hull, but in 2014, WIS returned to the ordination space of the REF streams. Taxon vectors (Figure 3.10) indicated this shift may have been due to a large increase in Simuliidae biomass (see Univariate Analyses, below).

The multivariate BACI analysis did not identify a significant treatment*time interaction for invertebrate biomass (Monte Carlo permutation (n = 499), P = 0.50).

3.4.3 Univariate Analyses

No significant treatment*time interaction emerged from the BACI and B-H analyses for either total density (Table 3.4, Figure 3.11) or biomass (Table 3.5, Figure 3.11). While both treatments showed a decrease in invertebrate density during the After period, biomass increased in WIS and decreased in REF during this period. Likewise, there was no significant treatment*time interaction for Shannon's Diversity Index (H) based on density (P = 0.75)

(Figure 3.12) or on biomass (P = 0.68) (Figure 3.12). Diversity analyses using density data showed a slight decrease in the After period for both WIS and REF, whereas the same analyses using biomass data showed a slight increase for both treatments.

Univariate BACI analyses for density of individual taxa found significant treatment*time interaction for Simuliidae (Table 3.4, Figure 3.13) and Trichoptera (Table 3.4, Figure 3.13), but no significance was retained after B-H adjustments (Table 3.4). Densities of both taxa increased in WIS after manipulation, but decreased in REF streams. Similarly, univariate BACI analyses for biomass of individual taxa detected significant treatment*time interaction for Simuliidae, Tipulidae, Hemiptera, and Gastropoda (Table 3.5, Figures 3.14 and 3.15), but only Hemiptera and Gastropoda retained significance after B-H adjustments (Table 3.5).

After manipulation, Dolichopodidae, Gastropoda, and Pisidiidae were no longer present in WIS samples, suggesting that these taxa were sensitive to modifications made to the stream. However, Dolichopodidae and Pisidiidae also decreased in REF streams, and Gastropoda were also not detected in REF streams during the after period.

3.4.4 Taxonomic Composition Analyses

All streams were primarily dominated by dipterans. During both Before and After periods, Chironomidae was the most abundant taxon, followed by Simuliidae and Oligochaeta. Although WIS was dominated by Chironomidae before manipulations, their relative and absolute density and biomass decreased during the After period, with a corresponding increase of Simuliidae (Figures 3.16 and 3.17). A marginal decrease in EPT relative density was observed for both stream types in the After period, and “Other Invertebrate” taxa nearly disappeared in WIS after manipulations (Figure 3.16).

3.5 Discussion

Overall, I found that the manipulations of WIS did not strongly affect its invertebrate assemblages relative to natural inter-year variation and relative to reference streams. Although some taxa increased or decreased in relative density and/or biomass, no significant treatment*time interactions were detected in the multivariate analyses for density or biomass. Likewise, no significant treatment*time interaction emerged from univariate BACI analyses for total density, total biomass, or diversity. However, BACI analyses for individual taxa found significant treatment*time interactions for densities of Simuliidae and Trichoptera, and for biomass of Simuliidae, Tipulidae, Hemiptera, and Gastropoda, but only Hemitera and Gastropoda biomasses retained significance after B-H adjustments suggesting that there was some effect of stream manipulation on these taxonomic groups. Sensitivity to disturbances was potentially observed for Dolichopodidae, Gastropoda, and Pisidiidae, which were no longer present in WIS after stream manipulations, though their disappearance in WIS may be due to a more general change to streams in the Lac de Gras area rather than being specific to manipulation of WIS.

Species turnover can be driven by a wide range of ecological, geographical and physical effects (Peck 2010), and though the multivariate analyses indicated that both treatments presented shifts in invertebrate assemblages, indicating natural temporal variation in REF streams, structural changes made to the physical habitat of WIS (Chapter 2) likely produced some of the changes in the invertebrate assemblage of the manipulated stream, with Chironomidae and Simuliidae presenting some of the strongest shifts.

The invertebrate fauna of Barrenlands streams is similar to that of Alaskan tundra streams, and are largely dominated by Diptera, particularly Chironomidae followed by Simuliidae (Jones *et al*. 2003a). Chironomidae can be found in diverse aquatic habitats and include all functional feeding groups, whereas Simuliidae are restricted to lotic habitats and filter particles from water that flows through their labral fans (Hynes 1970, Oswood 1989, Merrit and Cummins 2007). The WIS channelization process (Chapter 2) decreased fine substrates and increased coarse substrates, and increased riffle habitat with stable substrate, which possibly benefited Simuliidae. Likewise, a post-construction increase in Tipulidae biomass in WIS, shown as a significant treatment*time interaction in univariate BACI analysis and even though the significance level was not retained after B-H adjustments, this change could be related to their preference for lotic but sheltered habitats beneath rocks (Thorp and Covich 1991). The absolute and relative decreases in Chironomidae in WIS might be attributable to their more generalist habits and the preference of most taxa for standing-water habitats (Clifford 1991).

In aquatic food webs, invertebrates are a major link between autotrophs and larger heterotrophs, particularly fish. Prey availability directly affects fish recruitment and growth. In Barrenlands streams, Jones *et al*. (2003b and 2008) identified 19 invertebrate taxa from stomachs of young-of-year (YOY) Arctic Grayling. Chironomidae and Simuliidae dominated YOY stomachs, and lotic macroinvertebrates were strongly preferred over lentic-derived microcrustaceans, despite the latter being more abundant in the lake-outlet streams studied by these authors. While dipterans dominated the benthos in both WIS and REF streams in my study during both Before and After periods, density and biomass of Chironomidae decreased after the manipulation, with a corresponding increase in Simuliidae density and biomass. Thus, this change in taxonomic composition in WIS might not have a major impact on food availability or growth rate of Arctic Grayling using the stream.

Neither ordinations nor univariate BACI analysis for total density revealed strong evidence of effects on the WIS invertebrate assemblage after manipulations. WIS-13 and

WIS-14 were located just outside the WIS-Before convex hull. WIS appeared to have a slightly different invertebrate assemblage when compared to all REF streams, even in the Before period. Both ordinations and univariate BACI analysis showed more pronounced evidence of changes to invertebrate assemblages in WIS-After, driven primarily by increases in Simuliidae density and biomass and decreases in density and biomass of Chironomidae, the two cosmopolitan taxa in these systems (Scrimgeour *et al*. 2014).

Ephemeroptera, Plecoptera and Trichoptera (EPT) are considered sensitive indicator taxa (Hellawell 1986), and as a group they showed a marginal decrease in relative density and biomass after manipulations in WIS. In contrast, BACI analysis revealed a significant treatment*time interaction for Trichoptera, as its density increased in WIS after manipulation, but no significance levels were maintained after B-H adjustments. The latter result could reflect improved habitat structure, after manipulations in WIS (Chapter 2), specifically, to the addition of wood pieces along the WIS stream channel, which in turn, improved detrital retention (C. Uherek, personal observation, July, 2014). These improved conditions for Trichoptera could then have contributed to similar rates of leaf litter breakdown in WIS and REF streams during the after period (Chapter 2).

Oswood (1989) classified the aquatic fauna in high latitudes as simplified when compared to low latitude systems, and similar to inland Alaskan streams, Hemiptera, Odonata, and Coleoptera were also rare or absent in my studied sites. Interestingly, Hemiptera biomass emerged as a significant treatment*time interaction in BACI and B-H analysis, with a considerable decrease in WIS after manipulations, but appearing for the first time in REF streams during the After period. Further, while Jones *et al*. (2003b) detected small numbers of hemipterans in YOY Arctic Grayling stomachs, recently, Cutting *et al*. (2016) found that this taxon dominated the diets of Arctic Grayling in southern streams in the United States, highlighting the ability of these fish to cope with differences in invertebrate food availability.

Although removal of riparian vegetation resulted in an increase in sun exposure for WIS channel (Chapter 2), no major changes were observed in epilithon growth. In fact, both treatments (WIS and REF) had increased epilithon growth during the After period. Surprisingly, Gastropoda (which, as grazers, might be expected to increase with epilithon) disappeared from both WIS and REF streams in the After period. Albeit, this change could also be attributed to trophic cascades effects, as predators may determine the compositions of gastropods in aquatic environments (Thorp and Covich 1991). On the other hand, Dolichopodidae and Pisidiidae, also no longer detected in WIS-After, continued to be sampled in REF streams, however, in smaller numbers compared to the Before period, perhaps reflecting a sensitivity to general environmental change.

My BACI study teased apart the short-term (1-2 years) changes to WIS invertebrate assemblages that were likely due to manipulation from those due to natural temporal variation, and generally reflected successful recolonization after the habitat manipulation; however, a long term monitoring program would be valuable to help understand how and when the invertebrate assemblages would potentially resemble WIS-Before and REF streams. This seems especially important given that another study involving nearby streams in the Barrenlands found that abundance and biomass of invertebrates in a newly constructed stream had not yet converged with assemblages in reference streams 14 years after its creation (Scrimgeour *et al*. 2014). An important difference between these is that WIS was modified from a previously existing stream, while the stream studied by Scrimgeour *et al*. (2014) was blasted out of a bedrock substrate, and therefore lacked a pre-existing invertebrate fauna. Thus the convergence with reference streams was, presumably, the goal.

In addition to experiencing natural environmental stresses, aquatic habitats are often challenged by human development that can negatively affect their biota. Habitat restoration is often applied to mitigate these disturbances. In cases like that, robust approaches to assessing restoration projects should include multiple biological and physicochemical variables and, more importantly, report pre- and post-project monitoring conditions. Based on my findings, I recommend long-term monitoring to investigate trends in recovery of habitat variables and their effect on invertebrate assemblages, and ultimately fish, with the goals of quantifying improvements and using this knowledge in future environmental offsetting projects.

3.6 Literature Cited

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Table 3.1: The location and basic characteristics of the four lake-outlet stream study sites, located in the Barrenlands, Northwest Territories, Canada.

Site	Lake Name	Lake Size (ha)	Stream Name	Stream Length (m)	Treatment	Latitude	Longitude
West Island	WIL	13.65	WIS	420	WIS	64°31’40”N	110°26’8”W
Reference 2	R2L	18.87	R2S	103	REF	64°31'28"N	110°22'22"W
Reference 6	R6L1	3.91	R6S1	108	REF	64°26'46"N	110° 8'55"W
Reference 6	R6L2	6.82	R6S2	177	REF	64°26'51"N	110° 8'16"W

Table 3.2: Taxa and taxonomic abbreviations used in Nonmetric Multidimensional Scaling (NMS) and in NMS Scores ordinations for invertebrate assemblages. All taxa listed were used in density analyses. Prostigmata, Oribatida, and Hydridae were excluded from biomass analyses.

#	Taxa	Abbreviation
1	Annelida: Oligochaeta	C_Oligoc
2	Arthropoda: Arachnida: Oribatida	O_Oribat
3	Arthropoda: Arachnida: Trombidiformes: Prostigmata	SO_Prost
4	Arthropoda: Insecta: Coleoptera	O_Coleop
5	Arthropoda: Insecta: Diptera: Ceratopogonidae	Ceratopo
6	Arthropoda: Insecta: Diptera: Chironomidae	Chironom
7	Arthropoda: Insecta: Diptera: Dixidae	Dixidae
8	Arthropoda: Insecta: Diptera: Dolichopodidae	Dolichop
9	Arthropoda: Insecta: Diptera: Empididae	Empidida
10	Arthropoda: Insecta: Diptera: Muscidae	Muscidae
11	Arthropoda: Insecta: Diptera: Simuliidae	Simuliid
12	Arthropoda: Insecta: Diptera: Tipulidae	Tipulida
13	Arthropoda: Insecta: Ephemeroptera	O_Epheme
14	Arthropoda: Insecta: Hemiptera	O_Hemipt
15	Arthropoda: Insecta: Plecoptera	O_Plecop
16	Arthropoda: Insecta: Trichoptera	O_Tricho
17	Cnidaria: Hydrozoa: Anthoathecatae: Hydridae	Hydridae
18	Mollusca: Bivalvia: Veneroida: Pisidiidae	Pisidiid
19	Mollusca: Gastropoda	C_Gastro

Table 3.3: Numbers of invertebrates collected and analyzed statistically during both periods, before (2010-2012) and after (2013-2014) manipulations, in the four lake-outlet stream study sites, located in the Barrenlands, Northwest Territories, Canada.

Year	Total Identified Animals	Number Deleted Prior to Analysis	Total Analyzed Animals
2010	80,964	161	80,803
2011	73,046	250	72,796
2012	56,496	242	56,254
2013	30,249	77	30,172
2014	29,839	64	29,775
Totals	270,594	794	269,800

Table 3.4: BACI P-Values of time*treatment interaction terms in univariate linear mixed model analyses and Benjamini and Hochberg (B-H) adjusted P-Values of total and single taxa based on density from the four study streams (Control: REF (n = 15 stream-years) and Impact: WIS (n = 5 stream-years)). Arrows indicate direction of change in WIS post-manipulation: increase (upward arrow) or decrease (downward arrow. Significant interactions are marked with an asterisk.

Taxa	BACI P-Value	B-H P-Values	Increase/ Decrease
All Taxa Total	P = 0.77	P = 0.86	↓
Oligochaeta	P = 0.53	P = 0.75	↑
Oribatida	P = 0.15	P = 0.74	↓
Prostigmata	P = 0.66	P = 0.83	↓
Coleoptera	P = 0.75	P = 0.86	↓
Ceratopogonidae	P = 0.20	P = 0.74	↓
Chironomidae	P = 0.46	P = 0.74	↓
Dixidae	P = 0.41	P = 0.74	↓
Dolichopodidae	P = 0.95	P = 0.95	↓
Empididae	P = 0.56	P = 0.75	↑
Muscidae	P = 0.28	P = 0.74	↑
Simuliidae	P = 0.04*	P = 0.40	↑
Tipulidae	P = 0.35	P = 0.74	↑
Ephemeroptera	P = 0.34	P = 0.74	↓
Hemiptera	P = 0.48	P = 0.74	↓
Plecoptera	P = 0.26	P = 0.74	↑
Trichoptera	P = 0.01*	P = 0.20	↑
Hydridae	P = 0.43	P = 0.74	↓
Pisidiidae	P = 0.14	P = 0.74	↓
Gastropoda	P = 0.94	P = 0.95	↓

Table 3.5: BACI P-Values of time*treatment interaction terms in univariate linear mixed model analyses and Benjamini and Hochberg (B-H) adjusted P-Values of total and single taxa based on biomass from the four study streams (Control: REF (n = 15 stream-years) and Impact: WIS (n = 5 stream-years)). Arrows indicate direction of change in WIS post-manipulation: increase (upward arrow) or decrease (downward arrow. Significant interactions are marked with an asterisk. Prostigmata, Oribatida, and Hydridae were excluded from biomass analyses.

Taxa	BACI P-Values	B-H P-Values	Increase/ Decrease
All Taxa Total	P = 0.26	P = 0.74	↑
Oligochaeta	P = 0.76	P = 0.81	↓
Oribatida	N/A	N/A	N/A
Prostigmata	N/A	N/A	N/A
Coleoptera	P = 0.65	P = 0.76	↓
Ceratopogonidae	P = 0.67	P = 0.76	↓
Chironomidae	P = 0.63	P = 0.76	↓
Dixidae	P = 0.92	P = 0.92	↓
Dolichopodidae	P = 0.36	P = 0.74	↓
Empididae	P = 0.15	P = 0.51	↑
Muscidae	P = 0.53	P = 0.75	↓
Simuliidae	P = 0.03*	P = 0.17	↑
Tipulidae	P = 0.04*	P = 0.17	↑
Ephemeroptera	P = 0.39	P = 0.74	↓
Hemiptera	P < 0.01*	P = 0.01*	↓
Plecoptera	P = 0.48	P = 0.75	↓
Trichoptera	P = 0.33	P = 0.74	↑
Hydridae	N/A	N/A	N/A
Pisidiidae	P = 0.49	P = 0.75	↓
Gastropoda	P < 0.01*	P = 0.01*	↓

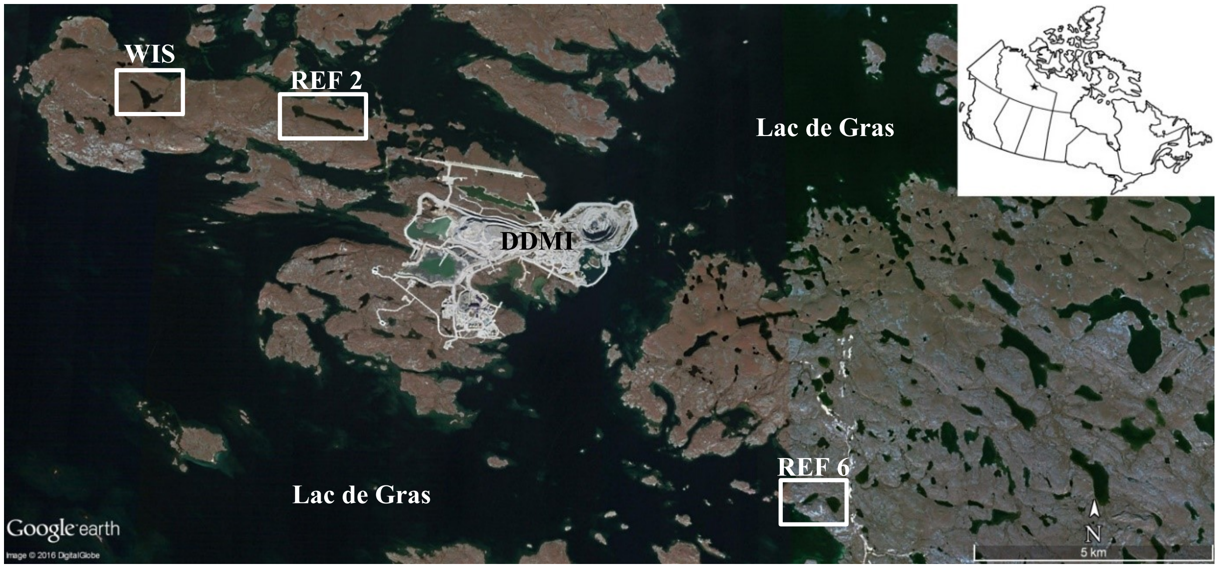


Figure 3.1: Image showing the location of Diavik Diamond Mines, Inc. (DDMI) and study sites (the manipulated West Island Stream (WIS), and the control sites Reference 2 (REF 2) and Reference 6 (REF 6)). Adapted from Google Earth. Insert shows the location of the study area in the Northwest Territories, Canada.

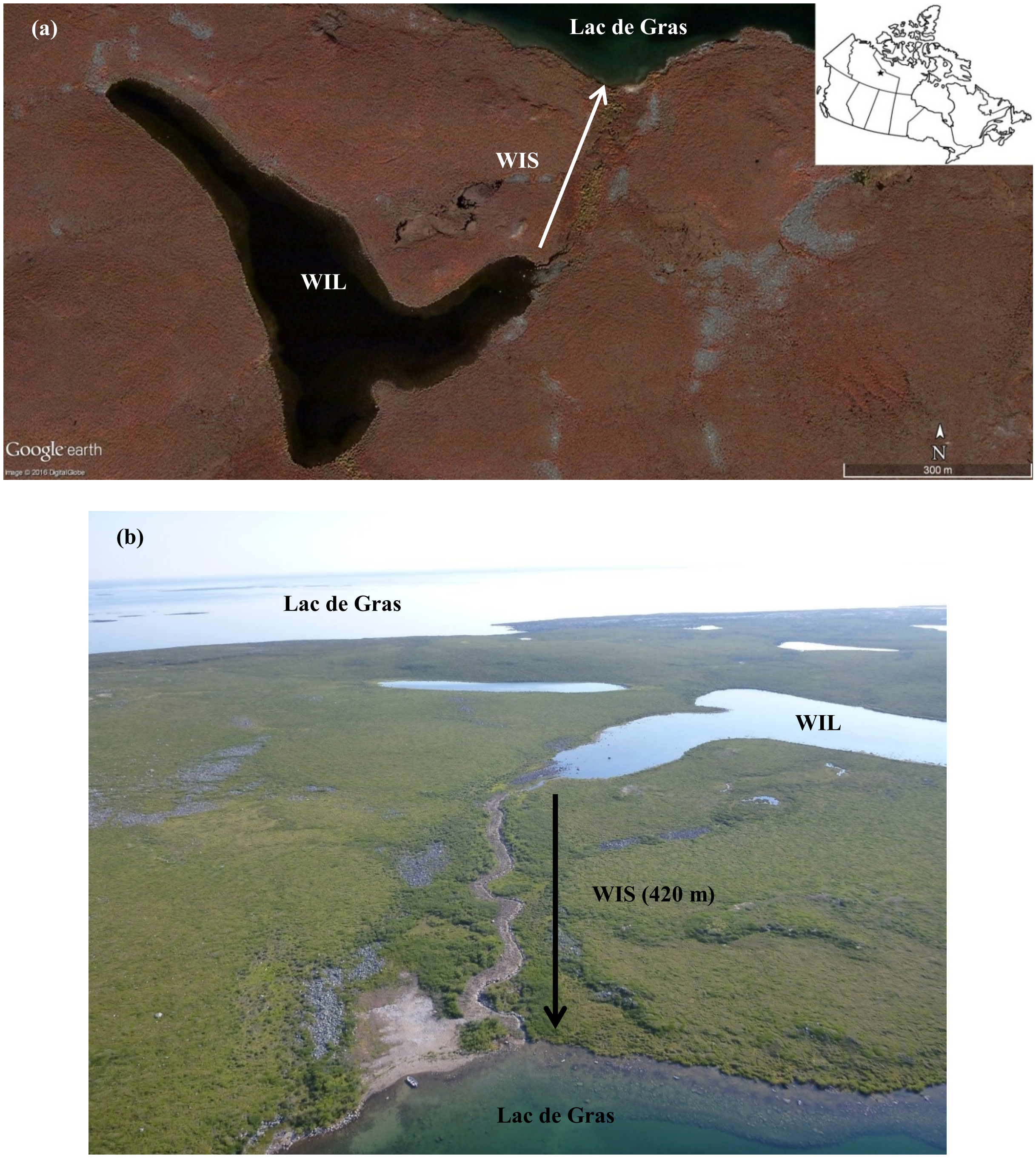


Figure 3.2: (a) West Island Lake (WIL) and West Island Stream (WIS), the manipulated stream, adapted from Google Earth. Insert shows the location of the study area in the Northwest Territories, Canada. (b) West Island Stream (WIS) after manipulation, showing the right bank riparian vegetation removed and left bank riparian zone preserved. Photo by C. Uherek, taken on August 10, 2013, facing south. Arrows indicate direction of flow.

Figure 3.3: (a) Reference 2 Lake (R2L) and Stream (R2S), adapted from Google Earth. Insert shows the location of the study area in the Northwest Territories, Canada. (b) Reference 2 Stream (R2S). Photo by A. Erwin, taken on June 5, 2012, facing southeast. Arrows indicate direction of flow.

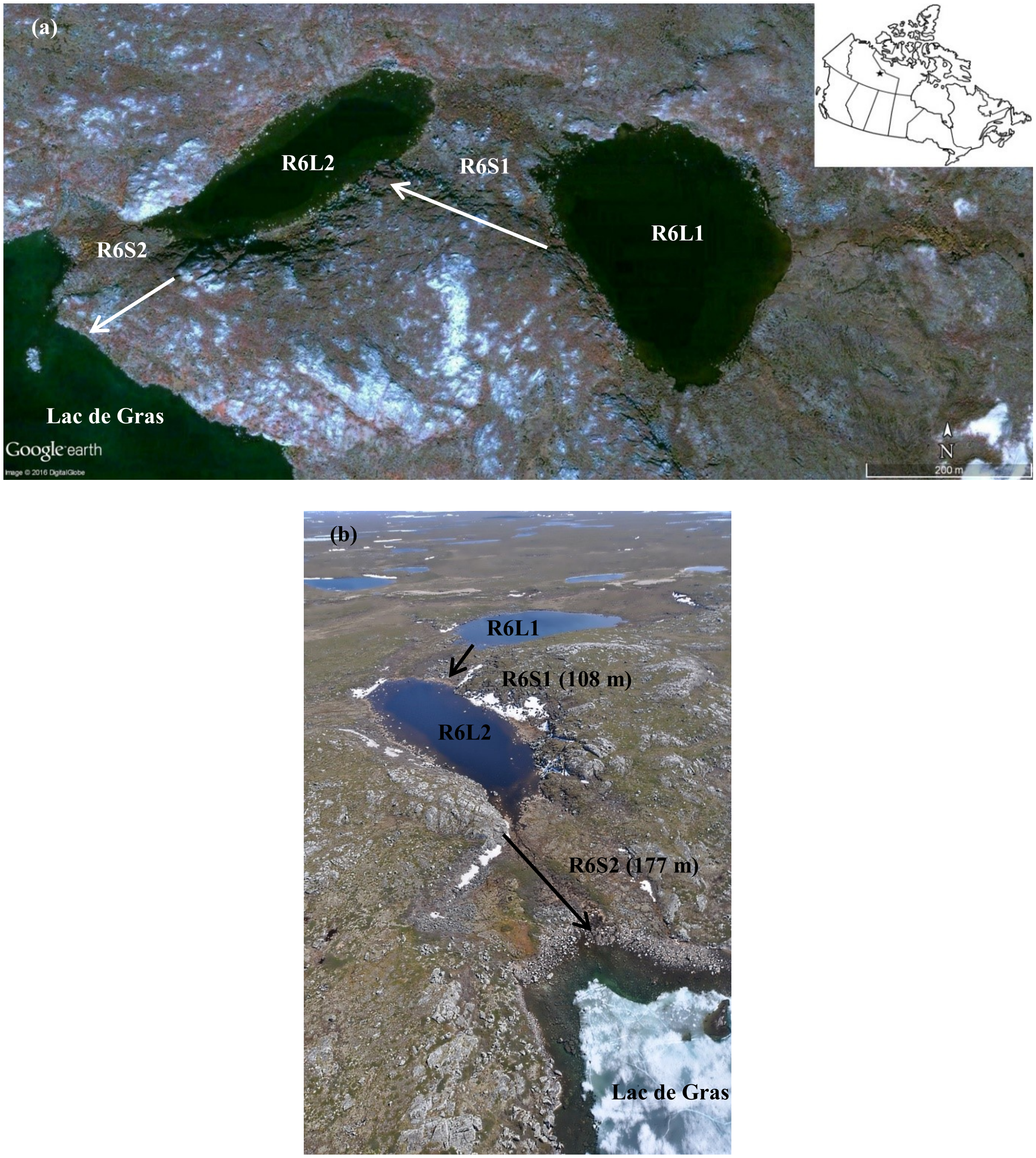


Figure 3.4: (a) Reference 6 lakes (R6L1 and R6L2) and streams (R6S1 and R6S2), adapted from Google Earth. Insert shows the location of the study area in the Northwest Territories, Canada. (b) Reference 6 lakes (R6L1 and R6L2) and streams (R6S1 and R6S2). Photo by A. Erwin, taken on June 9, 2012, facing east. Arrows indicate direction of flow.

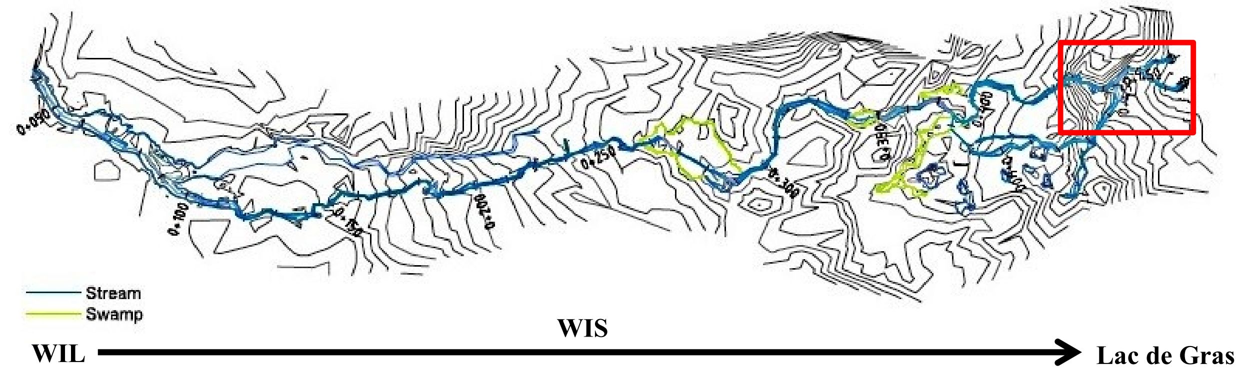
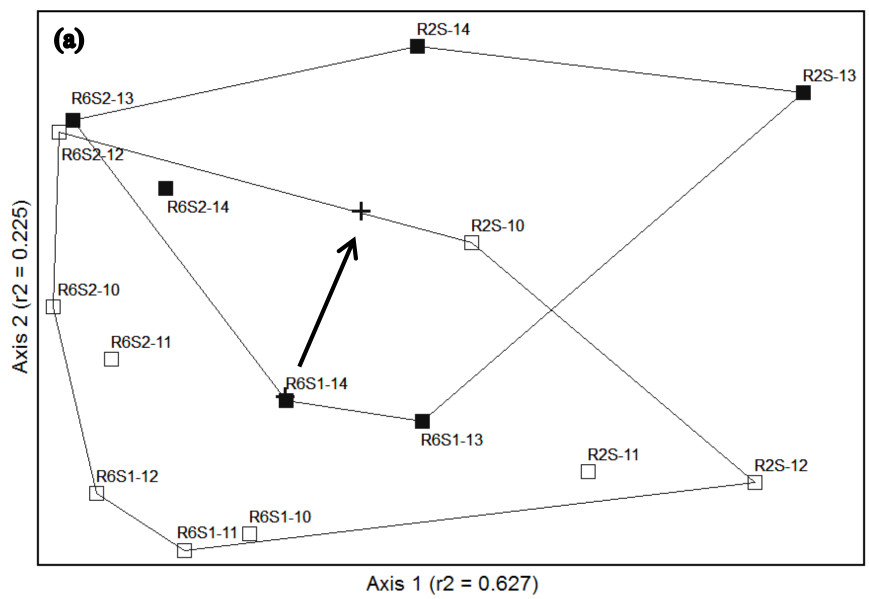


Figure 3.5: Topographical survey of West Island Stream (WIS) before manipulations, showing a braided channel (blue lines represents diffused stream flow and yellow lines represents wetland areas near to the stream channel). Cascades were located in the lowest portion of the outlet (represented by the red box) before entering LDG. Arrow indicates direction of flow. Adapted from Golder Associates Ltd. 2012.

Figure 3.6: (a) West Island Stream (WIS) before manipulations; photo by M. Hulsman, taken on July 29, 2010, facing south, and (b) after manipulations; photo by C. Uherek, taken on May 31, 2013, facing south. (c) The channelization process, photo by C. Cahill, taken on August 18, 2012, facing south; (d) the boulder addition process, photo by C. Cahill, taken on August 18, 2012, facing north, and (e) wood pieces addition, photo by C. Uherek, taken on July 3, 2013, facing south.



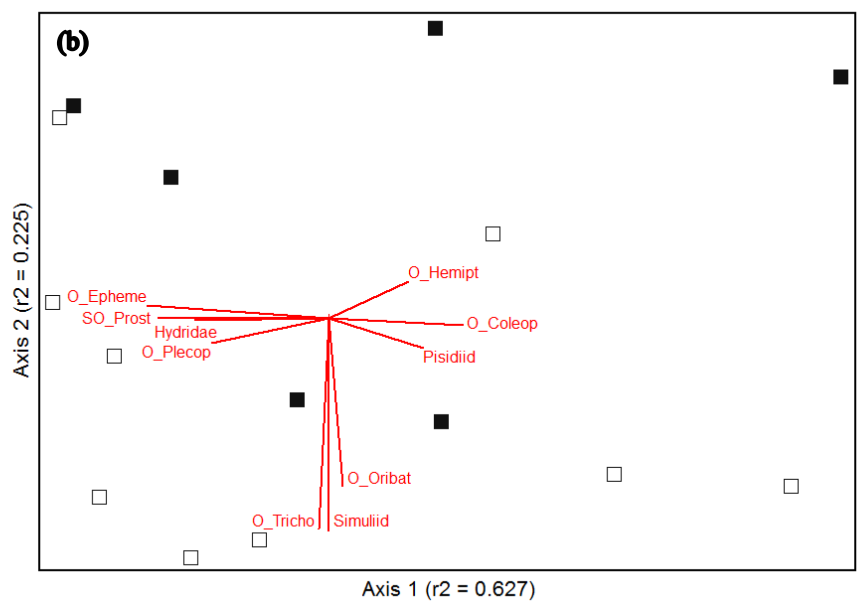
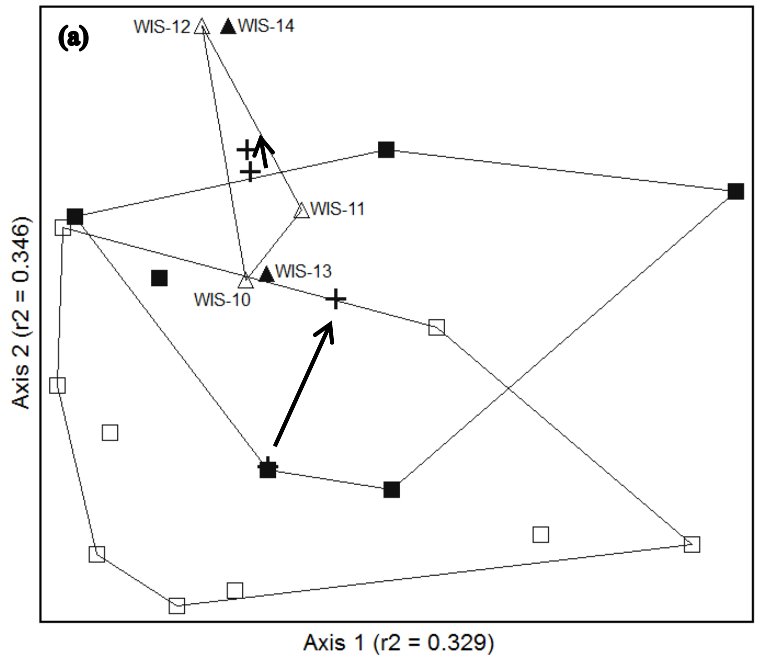


Figure 3.7: Nonmetric multidimensional scaling (NMS) scatterplots for invertebrate assemblages, based on density, for control or reference streams (REF, n = 15 stream-years), before (2010-2012; white squares) and after (2013-2014; black squares) manipulations. Convex hulls (a) encompass all stream-years sampled in each period, and represent the control-stream model; arrows indicate movement of centroid positions (+) before and after the WIS manipulation in ordination space. Joint plot vectors (b) show the strength and direction of

relationships of individual taxa to the ordination axes (r^2 cutoff value for vectors: 0.300; vector scaling 70%).



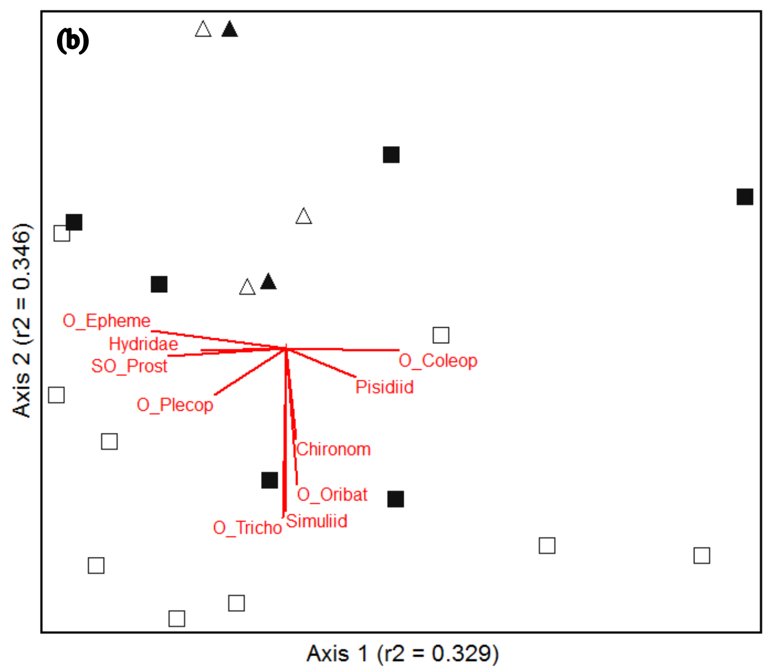


Figure 3.8: Nonmetric multidimensional scaling (NMS) Scores scatterplots for invertebrate assemblages, based on density, for both treatments (Control: REF (n = 15 stream-years) and Impact: WIS (n = 5 stream-years)), before (2010-2012, white squares and triangles) and after (2013-2014, black squares and triangles) manipulations. Convex hulls (a) encompass all stream-years sampled in each period, and represent the control-stream model (squares) and the

impact (triangles) sites with arrows indicating centroid positions (+) before and after WIS manipulation. Note the lack of convex hulls for WIS-After due to there being only two stream-years. Joint plots vectors (b) show the relationships of multiple taxa to the ordination axes (r^2 cutoff value for vectors: 0.300; vector scaling 70%).

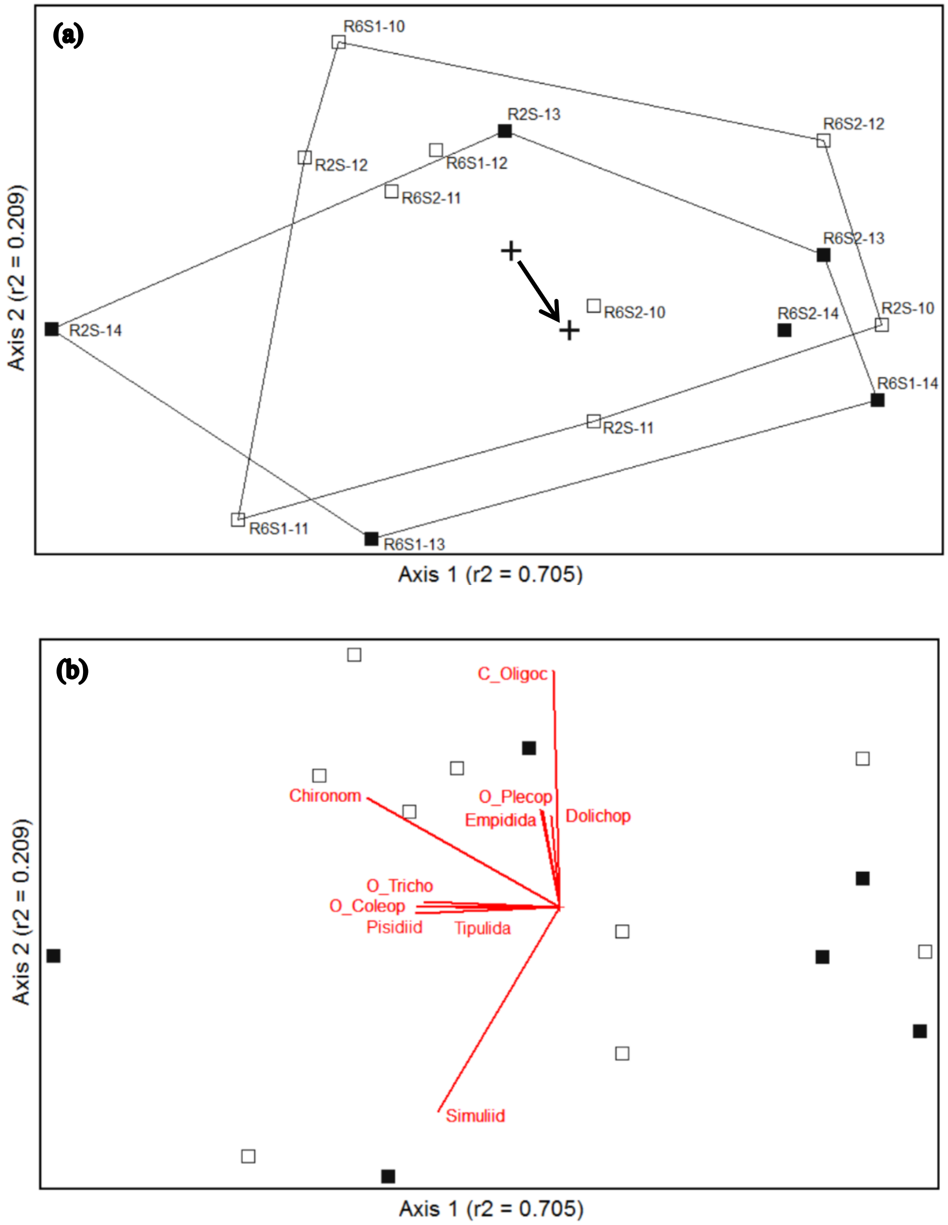
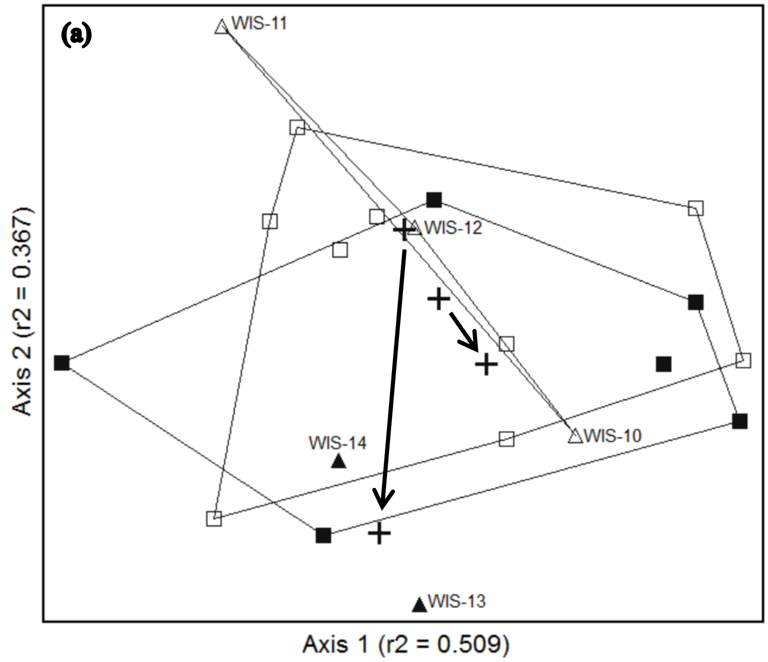


Figure 3.9: Nonmetric multidimensional scaling (NMS) scatterplots for invertebrate assemblages, based on biomass, for reference streams (REF, n = 15 stream-years), before (2010-2012, white squares) and after (2013-2014, black squares) manipulations. Convex hulls (a) encompass all stream-years sampled in each period, and represent the control-stream model; arrows indicate movement of centroid position (+) before and after the WIS manipulation in ordination space. Joint plots vectors (b) show the strength and direction of

relationships of individual taxa to the ordination axes (r^2 cutoff value for vectors: 0.300; vector scaling 100%).



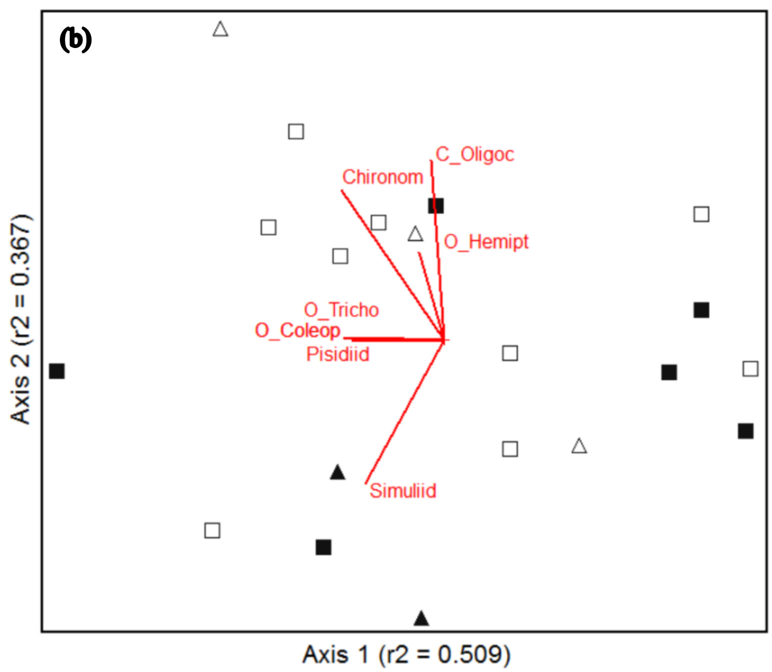


Figure 3.10: Nonmetric multidimensional scaling (NMS) Scores scatterplots for invertebrate assemblages, based on biomass, for both treatments (Control: REF (n = 15 stream-years) and Impact: WIS (n = 5 stream-years)), before (2010-2012, white squares and triangles) and after (2013-2014, black squares and triangles) manipulations. Convex hulls (a) encompass all

stream-years sampled in each period, and represent the control-stream model (squares) and the impact (triangles) sites with arrows indicating centroid position (+) before and after. Note the lack of convex hulls for WIS-After due to there being only two stream-years. Joint plots vectors (b) show the relationship of multiple taxa to the ordination axes (r^2 cutoff value for vectors: 0.300; vector scaling 100%).

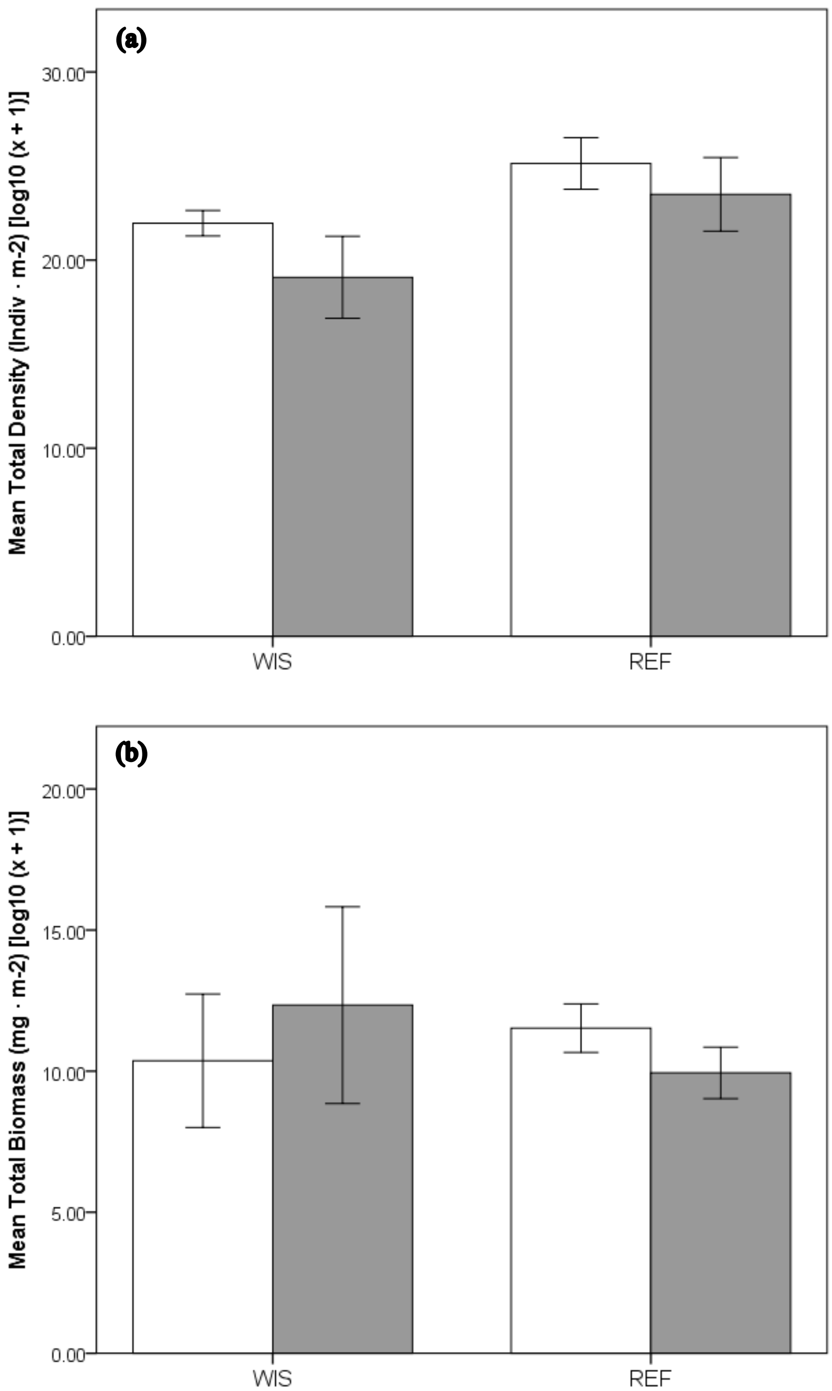


Figure 3.11: (a) Mean (± 1 SE) total density (indiv · m-2) [$\log_{10}$ (x + 1)] and (b) mean (± 1 SE) total biomass (mg · m-2) [$\log_{10}$ (x + 1)] of invertebrate assemblages of both treatments (Control: REF (n = 15 stream-years) and Impact: WIS (n = 5 stream-years)), before (2009-2012; white bars) and after (2013-2014; grey bars) habitat manipulations.

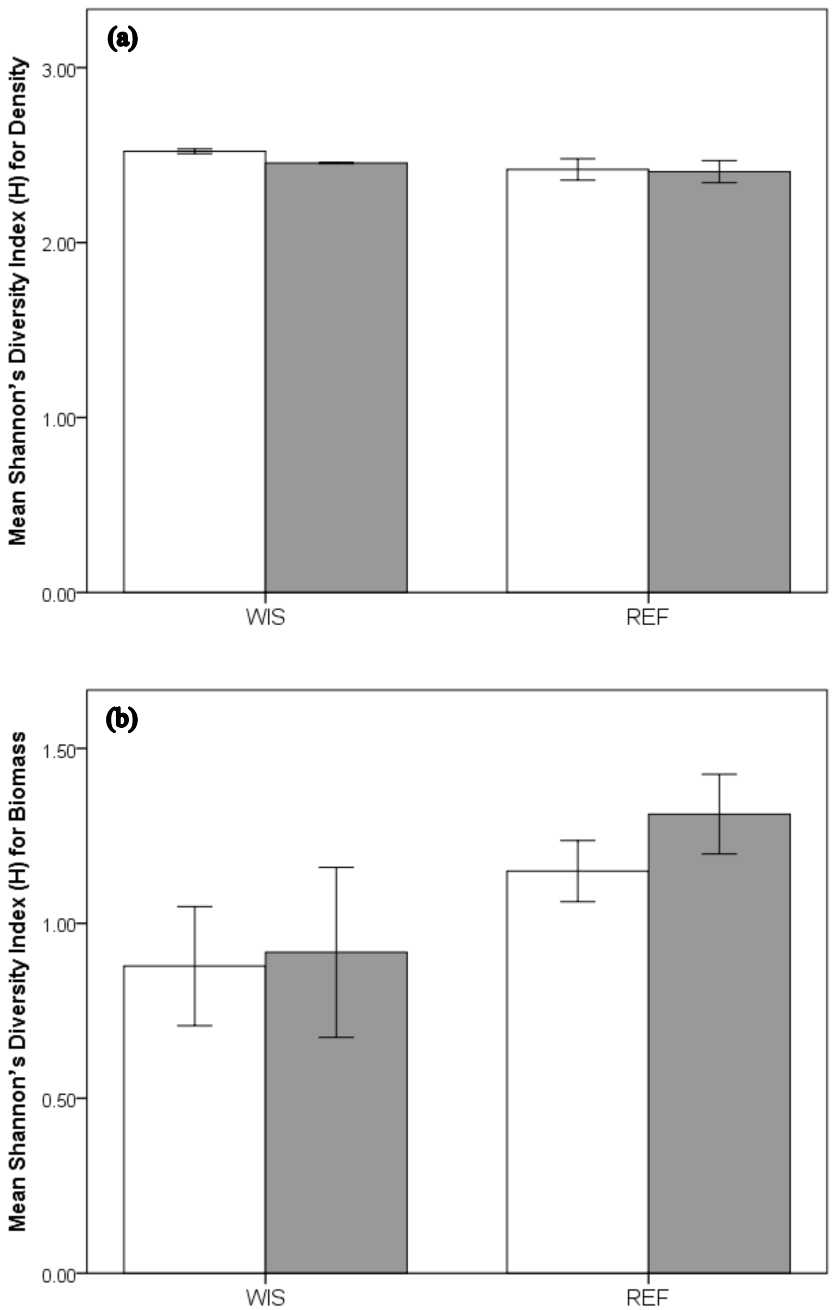
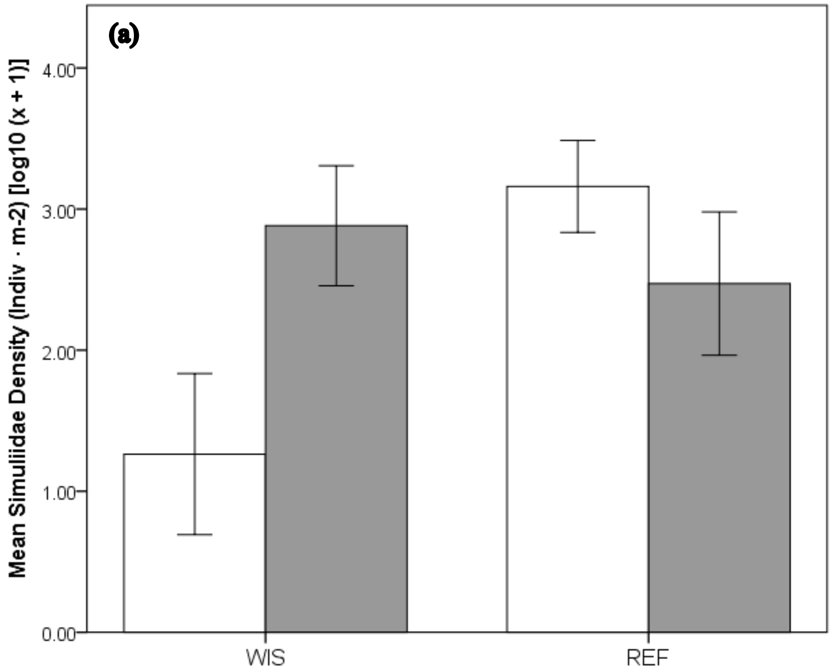


Figure 3.12: Shannon's Diversity Index (H) of invertebrate assemblages (mean ± 1 SE), based on density (a) and biomass (b), of both treatments (Control: REF (n = 15 stream-years) and Impact: WIS (n = 5 stream-years)), before (2009-2012; white bars) and after (2013-2014; grey bars) habitat manipulations.



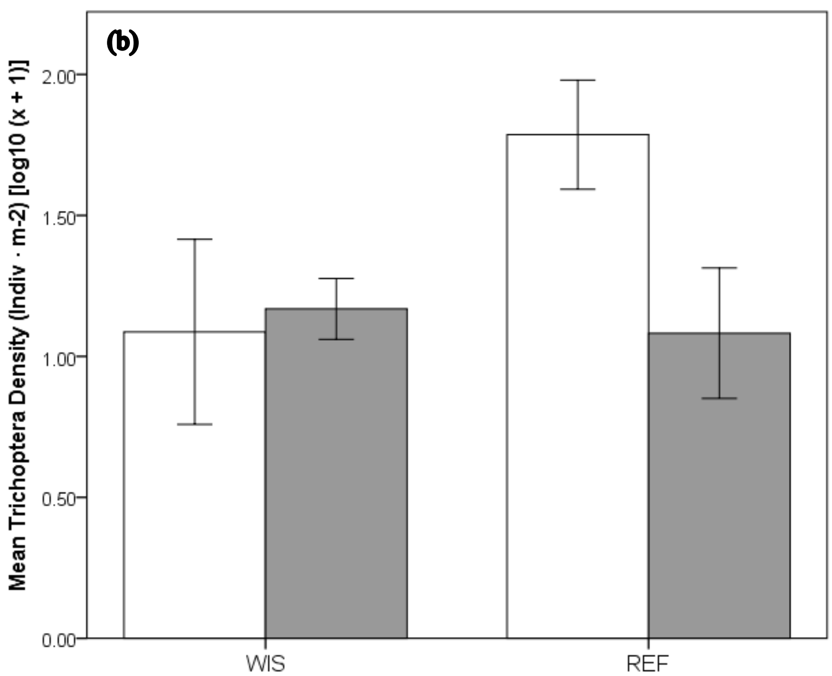


Figure 3.13: (± 1 SE) densities of (a) Simuliidae and (b) Trichoptera of both treatments (Control: REF (n = 15 stream-years) and Impact: WIS (n = 5 stream-years)), before (2009-2012; white bars) and after (2013-2014; grey bars) habitat manipulations. Significant treatment*time interaction detected in the univariate BACI analyses for Simuliidae (P = 0.04)

and Trichoptera ($P = 0.01$), no significance levels were retained after B-H adjustments.

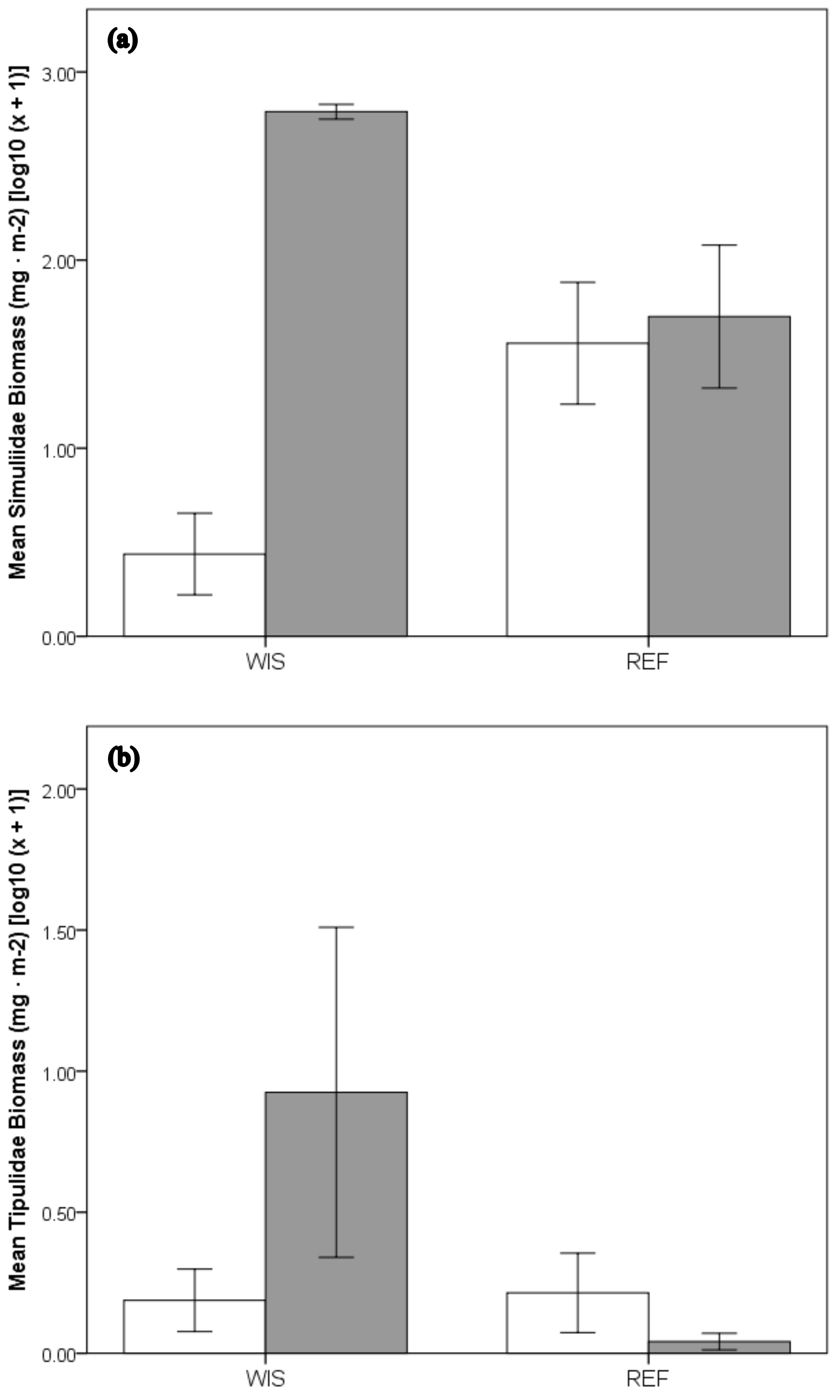


Figure 3.14: (± 1 SE) Biomasses of (a) Simuliidae and (b) Tipulidae for both treatments (WIS and REF), before (2010-2012) and after (2013-2014) manipulations. of both treatments (Control: REF (n = 15 stream-years) and Impact: WIS (n = 5 stream-years)), before (2009-2012; white bars) and after (2013-2014; grey bars) habitat manipulations. Significant

treatment*time interaction detected in the univariate BACI analyses for Simuliidae (P = 0.03) and Tipulidae (P = 0.04), no significance levels were retained after B-H adjustments.

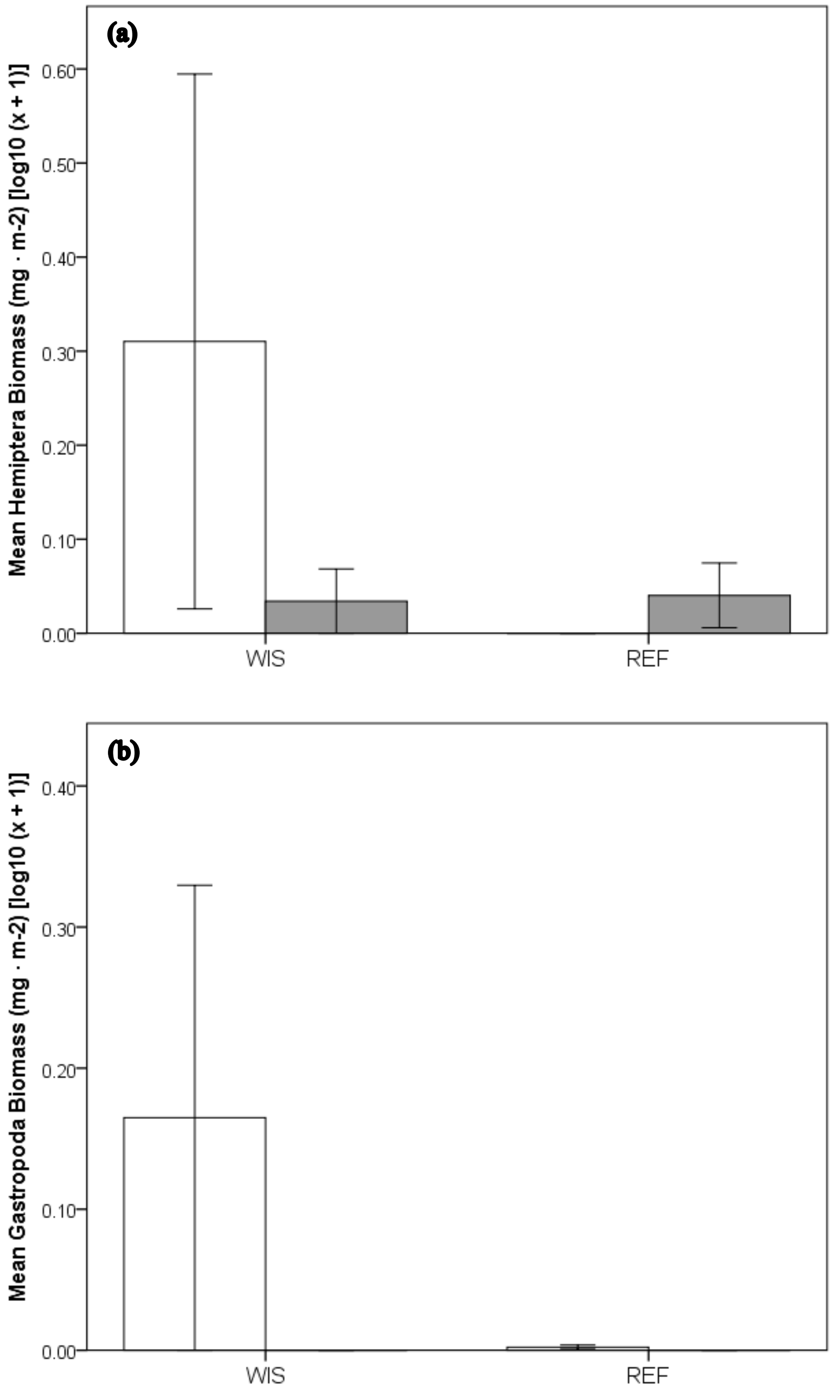


Figure 3.15: (± 1 SE) Biomasses of (a) Hemiptera and (b) Gastropoda of both treatments (Control: REF (n = 15 stream-years) and Impact: WIS (n = 5 stream-years)), before (2009-2012; white bars) and after (2013-2014; grey bars) habitat manipulations. Significant treatment*time interaction detected in the univariate BACI analyses for Hemiptera ($P < 0.01$)

and Gastropoda ($P < 0.01$), and after B-H adjustments for both taxa ($P = 0.01$).

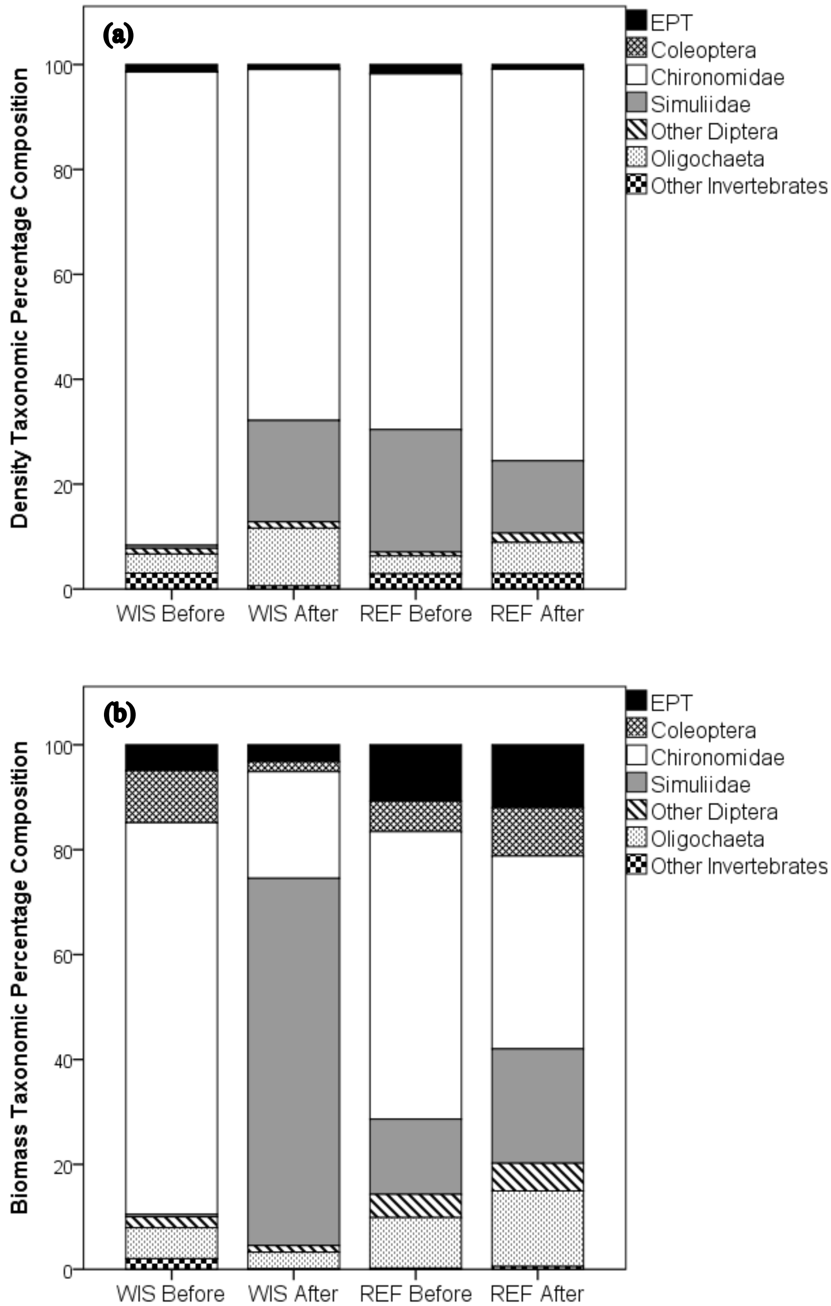


Figure 3.16: Percentage composition of invertebrate assemblages, based on density (a) and biomass (b), for both treatments (WIS and REF), before (2010-2012) and after (2013-2014) manipulations.

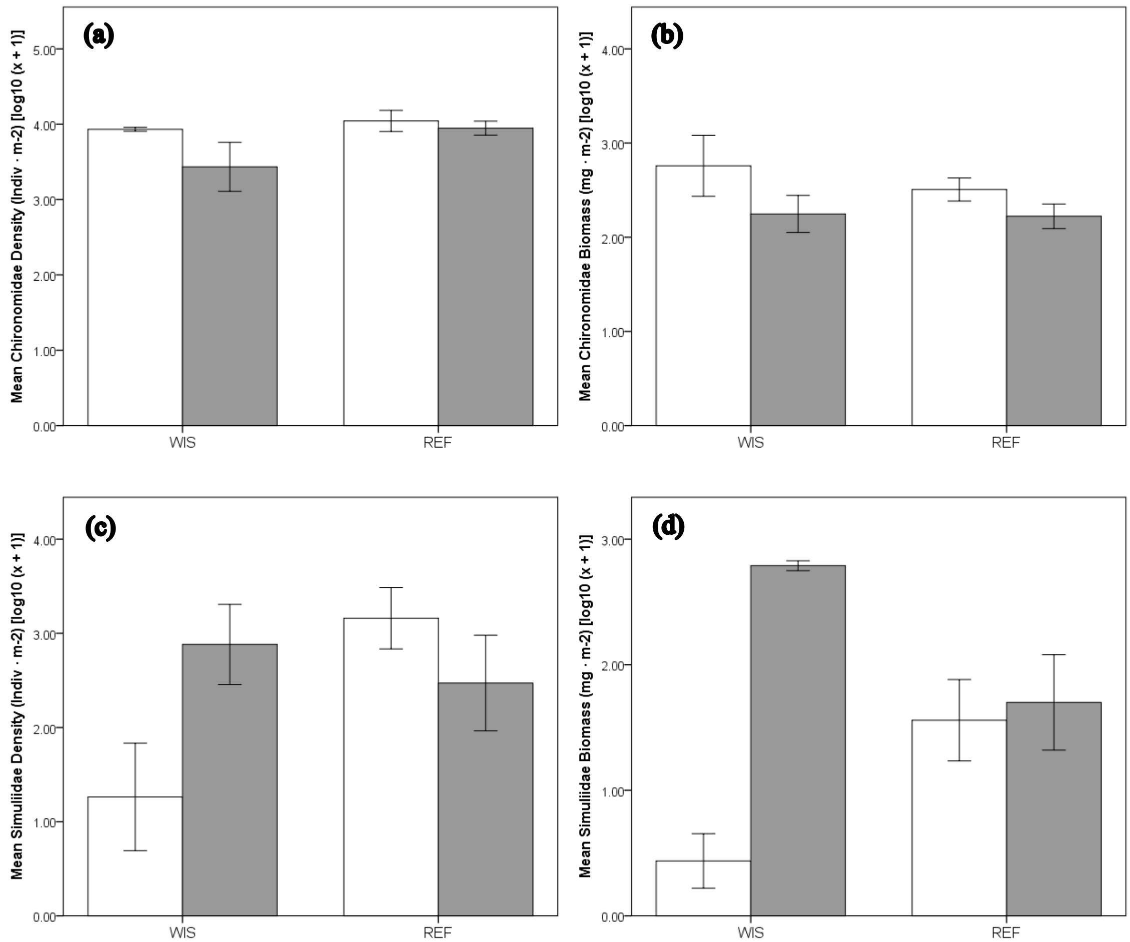


Figure 3.17: A comparison of mean (± 1 SE) density and biomass of the two most dominant taxa in the studied streams: (a) Chironomidae density, (b) Chironomidae biomass, (c) Simuliidae density, and (d) Simuliidae biomass, of both treatments (Control: REF (n = 15 stream-years) and Impact: WIS (n = 5 stream-years)), before (2009-2012; white bars) and after (2013-2014; grey bars) habitat manipulations.

Chapter 4: Concluding Discussion and Recommendations

4.1 Habitat Compensation in the Canadian Arctic

Northern Canada has experienced an expansion in mining developments during the recent decades. Since the discovery of diamonds in the Canadian Arctic in the early 1990s (Krajick 2001, Kjarsgaard and Levinson 2002), diamond exploration and mining has increased considerably in the Barrenlands region. While diamond mining is an important economic driver for northern regions (Rheaume and Caron-Vuotari 2013), resource development should be undertaken with caution, given the negative effects that can result from excavation and other mining related activities. For example, as a result of development of Diavik Diamond Mines, Inc. (DDMI) at Lac de Gras (LDG), Northwest Territories (NT), 24 ephemeral streams were modified and 3 small fish-bearing lakes were permanently removed from the landscape to provide enough area for the mine site construction (DDMI 1998).

As a result of diamond exploration at DDMI and in accordance with the former Fisheries Act (DFO 1986), a habitat compensation project was required to offset these aquatic habitat losses that occurred during the initial phases of DDMI's mine development. Proposed by DDMI and their consultants and approved by Fisheries and Oceans Canada (DFO), the primary goal of the West Island Compensation Project was to create accessible habitat for fish, especially Arctic Grayling, *Thymallus arcticus* (Pallas). Consequently, a previously impassable lake-outlet stream within the LDG drainage basin was transformed into a nature-like fishway at the end of summer 2012. There is thus a need for better understanding of northern aquatic systems and for monitoring environmental projects associated with these activities that could be used as baseline data for future projects in this region.

My research used a Before-After-Control-Impact (BACI) design (Green 1979, 1993, Underwood 1991, 1992, 1994, Downes *et al*. 2002) to assess the effects of DDMI's West Island Compensation Project on components of stream habitat structure and function (Chapter 2) and on aquatic invertebrates (Chapter 3). In a BACI framework, BA (i.e., Before-After) represents the temporal part of the design, while CI (i.e., Control-Impact) represents the spatial component of the design (Green 1993). To implement the BACI study design, three pristine streams, also located within LDG watershed, were selected as control or reference (REF) streams for the study. Four years (2009-2012) of data from the unmodified West Island Stream (WIS) and the REF streams were collected prior to the fishway construction and two years (2013-2014) of post-construction data were collected to documents the effects of such a project in Barrenlands' lake-outlet stream.

BACI design tests for interaction between the two sources of variation (treatment*time) and a significant result indicates the existence of an effect of the treatment, in this case the manipulation of WIS. BACI designs are often used when disturbances are expected to have negative effects on the environment (e.g., Roberts *et al*. 1998, Desrosiers *et al*. 2006). However, in West Island compensation project context, the desired result was to create positive effects on the manipulated stream with regard to its capacity to support fish. Specifically, the West Island compensation project aimed to allow fish to move into and through WIS by 1) improving ecological connectivity between LDG and West Island Lake (WIL) through its single outlet stream WIS, 2) increasing duration of summer flow in WIS, and 3) providing spawning and rearing habitat for fish, especially Arctic Grayling.

The West Island compensation project could be considered to be a failure if there were no treatment* time interactions, i.e., no Before-After difference in WIS variables relative to natural temporal changes that happened over the years in the REF streams. The challenge of my project was to interpret significant interactions: Where they were positive for achieving the goals of the project, and, conversely, how should the lack of a significant interaction for any given factor be interpreted with respect to the project's goals (Table 4.1). In addition, given the multiple variables tested, I performed a Benjamini-Rochberg (1995) adjustment to reduce the false discovery rate related to the nature of the multiple tests and inferences performed.

To achieve ecological connectivity improvement in WIS, the habitat manipulation project involved mostly physical changes to the stream which reflected in changes to few biological variables, while chemical variables remained within WIS-Before and REF streams ranges. Importantly, the manipulations of WIS did not strongly affects its invertebrate assemblages when WIS-Before and WIS-After periods were compared and relative to REF streams. Overall, WIS presented an encouraging recovery following the construction of the nature-like fishway for both habitat variables (Chapter 2) and aquatic invertebrate assemblages (Chapter 3), especially when compared to other stream-habitat compensation projects that have been performed in the Canadian Barrenlands (e.g., Jones *et al*. 2003a, 2003b, 2008).

Riparian vegetation was preserved on the left bank of WIS (i.e., facing downstream), but removed from the right bank (i.e., facing downstream), which resulted in significant treatment*time interactions in BACI and Benjamini and Hochberg (B-H) analyses for right bank rocks and exposed soil, which increased (↑), and right bank riparian vegetation coverage, which decreased (↓). The most pronounced effect was on mosses, which nearly disappeared during the After period, while grasses, forbs, and shrubs presented significant decreases and were replaced by increases in rocks and bare soil.

The riparian vegetation removal also reduced stream coverage leading to high stream channel exposure to the sun in WIS-After, which may have increased instream primary productivity. However, because both WIS and the unmodified REF streams had increases in epilithon growth during the After period there was no clear effect of the treatment. And though increases in epilithon were observed in both treatments, scrapers such as Gastropoda disappeared not only from WIS, but also from REF streams in the After period, which could indicate that the observed increases in epilithic algae resulted from the disappearance of snails. While the absence of specific taxa such as Gastropoda in WIS-After could be related to their sensitivity to disturbances, their simultaneous disappearance in both modified and undisturbed streams could also be associated with other reasons such as predator-prey interactions, inadequate sampling techniques, rare taxa, or even potential identification issues. Consequently, I am unable to assess the effects of the fishway construction on this taxon and identify the reason for their disappearance among my studied streams during the After period.

The partial removal of riparian vegetation, together with the channelization process, which resulted in total removal of the original streambed materials, best explains the reduced presence and accumulation of instream CPOM in WIS during the After period which emerged as a significant interaction in BACI analysis, albeit no significance was retained after B-H adjustments. CPOM should increase over time, however, as riparian vegetation is reestablished and produces more litter. Instream retention of new wood pieces and leaf litter was and will be further encouraged by the manually added willow branches to the stream channel after construction (C. Uherek, personal observation, June, 2014).

Oligotrophic northern streams are highly dependent on riparian vegetation for inputs of organic matter (Jones *et al*. 2003a). These inputs are critical to invertebrate shredders and collectors (Cummins *et al*. 1989). Shredders have been reported as a critical invertebrate guild that plays a key role in decomposition processes in these high latitude systems (Benstead and Huryn 2011), since microbial decomposition rates could be limited by the short growing season and long winters. Importantly, instream leaf litter breakdown in WIS was not affected by manipulations.

EPT (Ephemeroptera, Plecoptera and Trichoptera) are often considered ecosystem health indicator taxa that are sensitive to environmental disturbances (Hellawell 1986), and possibly one of the most efficient of the macroinvertebrate indices for biomonitoring (Wallace *et al*. 1996). Density and biomass of Trichoptera, an important shredder group, increased in WIS after manipulation. On the other hand, Ephemeroptera density and biomass decreased, while Plecoptera presented an increase in density but a decrease in biomass. Thus, the only marginal decrease in relative density and biomass that EPT showed as a group after manipulations in WIS can be viewed as encouraging. However, Dolichopodidae (WIS-Before n = 5) and Pisidiidae (WIS-Before n = 104) disappeared from WIS after manipulations, revealing a possible sensitivity to cope with environmental disturbances or simply their limited abilities to move among habitat patches and colonize new systems.

Jones *et al*. (2003a) described Barrenlands streams as multi-channeled lake-outlet systems with low sinuosity that nevertheless present some variation in physical characteristics, including length, width, and streambed composition. I found that some physical characteristics did indeed vary both spatially and temporally among my studied streams, but reference streams generally showed only small changes between the before and after periods, while the channelization process in WIS resulted in an increase in mean channel width after manipulations. In West Island compensation project context, the stream enlargement was a positive outcome, to enhance connectivity for fish to move from LDG to WIL through WIS.

The channelization process also affected bank shape and stability. In addition, changes in the physical configuration of the stream channel were observed during and right after the 2014 freshet, the second year after manipulations, and a potentially new side-channel has been created in the lower reach of WIS just prior to it entering LDG (C. Uherek, personal observation, June 2014). This new configuration of WIS-After resembles the WIS-Before sinuous and double-channeled area located in the lowest portion of the stream near the former cascade section. Thus, unless additional steps are taken, it seems likely that the WIS channel will eventually revert to something similar to its former state and possibly become a multi-channeled stream once again. This changes could potentially affect stream flow and result in a decrease in water depth in the lower reach of the constructed channel compromising the project's goal of enhancing ecological connectivity and duration of summer flow, and ultimately, fish habitat availability and accessibility.

Likewise, changes in substrate composition and an increase in stream flow derived from the channelization process were observed, and these changes likely explain shifts in invertebrate assemblages. All assemblages were dominated by Chironomidae before construction at WIS. Following WIS manipulations this was still true for REF streams; however, in WIS after manipulations, Simuliidae increased at the apparent expense of Chironomidae, possibly taking advantage of coarser substrate and faster flowing waters for filtering particles in suspension in the water column (Hynes 1970, Oswood 1989). On the other hand, though densities and biomass of the more generalist Chironomidae decreased post-impact, I expect that these will increase in the future as instream organic matter accumulation increases.

WIS recolonization suggests that aerial oviposition was the most important dispersal mechanism used by invertebrates to move between aquatic habitats in the Barrenlands given their observed high numbers not only in my analyses but in their explicit massive presence in WIS while I was performing field work and collecting data (C. Uherek, personal observation, June 2014), though research on dispersal and recolonization of aquatic invertebrates is still lacking in that region. Successful recolonization of WIS by invertebrates after construction is critical for achieving DDMI's West Island Compensation Project goal, since prey availability directly affects fish recruitment and growth. For example, among 19 invertebrate taxa identified in young-of-year (YOY) Arctic Grayling stomach contents, the two dominant groups were Chironomidae and Simuliidae, with the dominance of one or another varying accordingly to instream production (Jones *et al*. 2003b). Thus, this change in taxonomic composition of Chironomidae (↓) and Simuliidae (↑) in WIS should not have a major impact in feeding preferences, size, and development of YOY Arctic Grayling.

WIS habitat manipulations had no impacts on temperature, conductivity, dissolved oxygen, pH, total suspended solids, and nutrients. This was not unexpected because many of these stream variables are strongly influenced by the headwater lakes (Kling *et al*. 2000). Furthermore, although Arctic Grayling have not naturally colonized the stream during the timeframe of my study, a recent experiment of Arctic Grayling movement in WIS (D. Noddin, University of Alberta, unpublished data), suggests that stream connectivity have been established for both adult and YOY Arctic Grayling.

4.2 Recommendations for Future Studies

Northern environments are not only subjected to poor growing conditions and a short growing season due to long winters (Forbes and Jefferies 1999), but anthropogenic disturbances can have immediate and/or long-term impacts in these systems structure and functioning. While disturbances produced by habitat compensation projects can have both desirable positive and undesirable negative long term effects, my results based on two years of after habitat manipulations data in WIS were very positive and encouraging.

Therefore, based on my findings, I recommend minimizing riparian vegetation removal, e.g., from only a single bank, leaving intermittent natural “green zones” that can mitigate possible negative effects of restricted instream organic matter presence and accumulation and invertebrate re-establishment. Additionally, streambed modifications should be avoided in these latter areas, or if performed, should be done manually avoiding the use of heavy equipment. I also recommend creating a naturally meandering channel to facilitate organic matter retention, and deeper pools, since WIS has shown a tendency to naturally create pools in fast flowing water locations that are surrounded by large rocks, which results in shallower manipulation-created pools as they receive more sediments originated from the former (C. Uherek, personal observation, June 2014).

For future monitoring projects in the Barrenlands I recommend measurements of turbidity levels that without further added costs can be obtained using the same equipment used to measure dissolved oxygen, conductivity, and pH during this project. Also a comparison of all variables among reaches within a single stream as well as among all studied streams can be valuable to distinguish within and among aquatic systems patterns. Further, based on my preliminary findings in another project also in the Barrenlands involving not only LDG watershed systems but also Lac du Sauvage (NT) aquatic systems, I recommend measurements of salinity levels given that members of the Order Anostraca were found in nearby streams (C. Uherek, unpublished data). Importantly, I recommend the use of electronic data sheets that can be managed using devices such as tablets (e.g., iPad) during the data collection process preferably by more than one field personnel, the data obtained can be cross checked using appropriated program to minimize data entry errors and to optimize data analyses time, especially in long-term monitoring projects.

Finally, I also emphasize and recommend and long-term monitoring of modified streams, although given that recovery rates after restoration activities (including offsetting and compensation) have been highly variable (Miller *et al*. 2010), it is hard to define the timeframe for "long-term". This monitoring should include investigation of trends in recovery of habitat variables and their effects on invertebrate assemblages and on fish communities, which will allow for better quantification of improvements and use of this knowledge in future environmental restoration projects.

4.3 Literature Cited

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Table 4.1: Predicted and observed changes to physicochemical and biological habitat variables (Chapter 2). Arrows indicate direction of change in WIS post-manipulation: increase (upward arrow), decrease (downward arrow), and no change (left-right arrow). Superscript numbers indicate levels of statistically significant interaction: non-significant results ("1"), P-Value ≤ 0.10 before B-H ("2"), and P-Value ≤ 0.10 after B-H ("3"). Plus or minus signs indicates the outcome effect: desirable results ("+"), undesirable results ("-"), or neutral results ("±") according to the projects goals.

Variable	Prediction	BACI Result	Outcome Assessment	Comment
Channel Width (m)	↑	$\uparrow^{2}$	+	A wider and well defined channel improves connectivity.
Channel Depth (m)	↑	$\downarrow^{1}$	-	A deeper channel creates ideal pools for adult fish to rest.
Water Depth (m)	↓	$\downarrow^{1}$	-	Fish movement can be facilitated with an adequate flow.
Current Velocity (m/s)	↑	$\uparrow^{1}$	+	Reflects an increase in duration of summer flow.
Right Bank Shape Straight (%)	↔	$\downarrow^{1}$	±	
Right Bank Shape Concave (%)	↔	$\uparrow^{1}$	±	
Right Bank Shape Convex (%)	↔	$\downarrow^{1}$	±	
Left Bank Shape Straight (%)	↔	$\downarrow^{1}$	±	
Left Bank Shape Concave (%)	↔	$\uparrow^{1}$	±	
Left Bank Shape Convex (%)	↔	$\uparrow^{1}$	±	
Right Bank Stability Moderate (%)	↑	$\uparrow^{1}$	-	Unstable banks can affect channel configuration.
Right Bank Stability High (%)	↓	$\downarrow^{1}$	-	High stability helps maintain channel configuration.
Left Bank Stability Low (%)	↑	$\uparrow^{3}$	-	Unstable banks can affect channel configuration.
Left Bank Stability Moderate (%)	↑	$\uparrow^{1}$	-	Unstable banks can affect channel configuration.
Left Bank Stability High (%)	↓	$\downarrow^{1}$	-	High stability helps maintain channel configuration.
Stream Exposure Low (%)	↓	$\downarrow^{2}$	-	Channel exposure can increase water temperature.

Stream Exposure Moderate (%)	↓	↓[3]	-	Channel exposure can increase water temperature.
Stream Exposure High (%)	↑	↑[2]	-	Increases in stream primary productivity can result.
Turbulence Low (%)	↔	↔	±	
Turbulence Moderate (%)	↔	↑[1]	+	
Turbulence High (%)	↓	↓[3]	+	Variation in turbulence can affect oxygen levels.
Streambed Materials Fines (%)	↓	↓[1]	+	Invertebrate groups associated can be affected.
Streambed Materials Pebbles (%)	↑	↑[1]	+	Increases fish spawning grounds.
Streambed Materials Cobbles (%)	↑	↑[3]	+	Increases fish spawning grounds.
Streambed Materials Boulders (%)	↑	↓[1]	+	Helps maintain channel configuration.
Temperature (°C)	↑	↓[1]	±	Some species are sensitive to temperature variation.
Conductivity (µS/cm)	↔	↑[1]	±	
Dissolved Oxygen (mg/L)	↔	↑[1]	+	
pH	↔	↓[1]	±	
TSS (mg)	↑	↓[1]	+	Used as a proxy for post-disturbance turbidity levels.
Chl-a (µg/L)	↑	↑[1]	+	Reflects sestonic algae levels.
TN (µg/L)	↔	↑[1]	±	
TP (µg/L)	↔	↑[1]	±	
Right Bank Rocks/Exposed Soil (%)	↑	↑[3]	-	Affects organic allochthonous inputs to streams.
Right Bank Riparian Vegetation (%)	↓	↓[3]	-	Affects organic allochthonous inputs to streams.
Left Bank Rocks/Exposed Soil (%)	↔	↓[1]	+	
Left Bank Riparian Vegetation (%)	↔	↑[1]	+	
CPOM (mg/m^2)	↓	↓[2]	-	Affects food availability for invertebrate shredders.
Epilithon AFDM (mg/cm^2)	↑	↑[1]	+	Affects food availability for invertebrate scrappers.
WP (cm^3/m^2)	↓	↑[1]	+	Provides habitat and food for aquatic animals.
Leaf Litter Breakdown (mg)	↓	↑[1]	+	Reflects invertebrate recolonization process.

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Appendix I

Table A1-1: 2010 Raw Invertebrate Data.

Site	R2S	R2S	R2S	R2S	R2S	R2S	R2S
Year	2010	2010	2010	2010	2010	2010	2010
CC#	CC111078	CC120836	CC111079	CC120835	CC111080	CC120837	CC111081
Habitat	Pool	Pool	Riffle	Riffle	Riffle	Riffle	Riffle
Phylum: Arthropoda							
Subphylum: Hexapoda							
Class: Insecta							
Order: Ephemeroptera							
Family: Baetidae							
Acerpenna							
Acerpenna pygmaea							
Baetis							
Baetis bicaudatus							
Baetis tricaudatus							
Family: Ephemerellidae							
Caudatella							
Family: Heptageniidae							
Epeorus							
Ironodes							
Rhithrogena							
Family: Leptophlebiidae							
Order: Plecoptera							
Family: Capniidae							
Family: Leuctridae							
Family: Nemouridae						4	3
Amphinemura							
Malenka							
Nemoura							
Ostrocerca							
Zapada							

Site	R2S	R2S	R2S	R2S	R2S	R2S	R2S
Year	2010	2010	2010	2010	2010	2010	2010
CC#	CC111078	CC120836	CC111079	CC120835	CC111080	CC120837	CC111081
Habitat	Pool	Pool	Riffle	Riffle	Riffle	Riffle	Riffle
Zapada oregonensis							
Family: Perlodidae							
Order: Trichoptera							
Micrasema							
Family: Hydropsychidae							
Hydropsyche							
Family: Hydroptilidae							
Agraylea							
Oxyethira							
Family: Limnephilidae							
Clostoeca disjuncta							
Ecclisomyia							
Limnephilus							
Family: Molannidae							
Molanna flavicornis							
Molanna distinctus							
Family: Phryganeidae							
Agrypnia							
Family: Rhyacophilidae							
Rhyacophila							
Order: Coleoptera				2	8		
Family: Dytiscidae		4					3
Agabus							
Colymbetes							
Hydroporus							
Oreodytes							

Site	R2S	R2S	R2S	R2S	R2S	R2S	R2S
Year	2010	2010	2010	2010	2010	2010	2010
CC#	CC111078	CC120836	CC111079	CC120835	CC111080	CC120837	CC111081
Habitat	Pool	Pool	Riffle	Riffle	Riffle	Riffle	Riffle
Stictotarsus							
Family: Hydraenidae							
Hydraena							
SubFamily: Hydroporinae							
Family: Hydrophilidae							
Hydrochus						4	
Family: Psephenidae							
Family: Staphylinidae							
Order: Diptera							
Family: Ceratopogonidae							
Atrichopogon							
Bezzia/Palpomyia							6
Culicoides							
Dasyhelea							
Forcipomyia							
Mallochohelea					17		
Probezzia							
Sphaeromias							
Family: Chaoboridae							
Eucorethra							
Family: Chironomidae							
SubFamily: Chironominae							
Fissimentum							
Tribe: Chironomini							
Chironomus							
Cryptochironomus							

Site	R2S	R2S	R2S	R2S	R2S	R2S	R2S
Year	2010	2010	2010	2010	2010	2010	2010
CC#	CC111078	CC120836	CC111079	CC120835	CC111080	CC120837	CC111081
Habitat	Pool	Pool	Riffle	Riffle	Riffle	Riffle	Riffle
Endochironomus							
Microtendipes							
Microtendipes pedellus							
Phaenopsectra							
Polypedilum							
Stictochironomus							
Tribelos							
Tribe: Tanytarsini							
Cladotanytarsus							
Micropsectra			85				
Paratanytarsus	4						
Rheotanytarsus				8			
Tanytarsus		104				48	
SubFamily: Diamesinae							
Protanypus							
Tribe: Diamesini							
Pagastia							
Potthastia							
SubFamily: Orthocladiinae		16		12		12	212
Brillia							
Cricotopus							
Diplocladius			362				
Diplocladius cultriger							
Eukiefferiella							
Georthocladius							
Heterotanytarsus							

Site	R2S	R2S	R2S	R2S	R2S	R2S	R2S
Year	2010	2010	2010	2010	2010	2010	2010
CC#	CC111078	CC120836	CC111079	CC120835	CC111080	CC120837	CC111081
Habitat	Pool	Pool	Riffle	Riffle	Riffle	Riffle	Riffle
Heterotrissocladius							
Hydrobaenus							
Limnophyes							
Metriocnemus							
Nanocladius							
Orthocladius							
Orthocladius complex			415	8			
Parakiefferiella							
Paralimnophyes arcticus							
Paraphaenocladius	4		246		242		133
Psectrocladius		36					
Psiloptarus							
Pseudosmittia							
Rheocricotopus	12						
Tvetenia							
Tvetenia bavarica							
Tvetenia vitracies							
Zalutschia							
Zalutschia briani							
Zalutschia tatrica				4			
Zalutschia zalutschicola							
Tribe: Corynoneurini							
Corynoneura		8		76		116	
Tribe: Orthocladiini							
Chaetocladius							
SubFamily: Podonominae							

Site	R2S	R2S	R2S	R2S	R2S	R2S	R2S
Year	2010	2010	2010	2010	2010	2010	2010
CC#	CC111078	CC120836	CC111079	CC120835	CC111080	CC120837	CC111081
Habitat	Pool	Pool	Riffle	Riffle	Riffle	Riffle	Riffle
Lasiodiamesa							
Paraboreochlus							
Trichotanypus							
SubFamily: Prodiamesinae							
Prodiamesa							
Tribe: Boreochlini							
Boreochlus							
SubFamily: Tanypodinae							
Labrundinia							
Tribe: Pentaneuriini							
Ablabesmyia							
Nilotanypus							
Thienemannimyia							
Tribe: Procladiini							
Djalma batista							
Procladius	8						
Family: Dixidae							
Dixella			8	6			
Family: Dolichopodidae							6
Rhaphium							
Family: Empididae							
Clinocera						8	
Chelifera/Metachela							
Oreogeton		8		2			
Family: Muscidae							
Limnophora							

Site	R2S	R2S	R2S	R2S	R2S	R2S	R2S
Year	2010	2010	2010	2010	2010	2010	2010
CC#	CC111078	CC120836	CC111079	CC120835	CC111080	CC120837	CC111081
Habitat	Pool	Pool	Riffle	Riffle	Riffle	Riffle	Riffle
Family: Simuliidae		16	31	122		8	
Prosimulium							
Simulium		20		298			6
Family: Tipulidae			8				
Erioptera							
Limnophila							
Ormosia							
Tipula							
Order: Hemiptera							
Family: Corixidae							
Sigara							
Family: Gerridae							
Gerris							
Order: Lepidoptera							
Family: Noctuidae							
Order: Odonata							
Subphylum: Crustacea							
Class: Malacostraca							
Order: Amphipoda							
Subphylum: Chelicerata							
Class: Arachnida							
Order: Trombidiformes							
SubOrder: Prostigmata		4					
Neobrachypoda							
Pionopsis							
Family: Arrenuridae							

Site	R2S	R2S	R2S	R2S	R2S	R2S	R2S
Year	2010	2010	2010	2010	2010	2010	2010
CC#	CC111078	CC120836	CC111079	CC120835	CC111080	CC120837	CC111081
Habitat	Pool	Pool	Riffle	Riffle	Riffle	Riffle	Riffle
Arrenurus							
Family: Hydryphantidae							
Family: Hygrobatidae							
Hygrobates							
Family: Lebertiidae							
Lebertia							
Family: Limnesiidae							
Limnesia							
Family: Limnocharidae							
Limnochares							
Family: Mideopsidae							
Mideopsis							
Family: Oxidae							
Oxus							
Family: Pionidae							
Piona							
Family: Sperchontidae							
Sperchon							
Sperchonopsis							
Family: Unionicolidae							
Neumania							
Family: Halacaridae							
Order: Oribatida							
Family: Hydrozetidae		8	108	18	25	32	15
Phylum: Mollusca							
Class: Bivalvia							

Site	R2S	R2S	R2S	R2S	R2S	R2S	R2S
Year	2010	2010	2010	2010	2010	2010	2010
CC#	CC111078	CC120836	CC111079	CC120835	CC111080	CC120837	CC111081
Habitat	Pool	Pool	Riffle	Riffle	Riffle	Riffle	Riffle
Order: Veneroida							
Family: Pisidiidae	12	4					
Pisidium							
Class: Gastropoda							
Order: Heterostropha							
Family: Valvatidae							
Phylum: Annelida							
Subphylum: Clitellata							
Class: Oligochaeta				16			
Order: Lumbriculida							
Family: Lumbriculidae							
Order: Tubificida							
Family: Enchytraeidae							
Enchytraeus		4	15			56	
Family: Lumbricidae							
Family: Naididae		8				16	3
Chaetogaster							
Chaetogaster diaphanus							
Nais							
Pristina							
Family: Tubificidae							
Phylum: Cnidaria							
Class: Hydrozoa							
Order: Anthoathecatae							
Family: Hydridae							
Hydra			8	2		8	

Site	R2S	R2S	R2S	R2S	R2S	R2S	R2S
Year	2010	2010	2010	2010	2010	2010	2010
CC#	CC111078	CC120836	CC111079	CC120835	CC111080	CC120837	CC111081
Habitat	Pool	Pool	Riffle	Riffle	Riffle	Riffle	Riffle
Phylum: Tardigrada							

Site	R2S	R6S1	R6S1	R6S1	R6S1	R6S1	R6S1
Year	2010	2010	2010	2010	2010	2010	2010
CC#	CC120838	CC111093	CC111097	CC120825	CC111094	CC111098	CC111100
Habitat	Riffle	Riffle	Riffle	Riffle	Pool	Pool	Pool
Phylum: Arthropoda							
Subphylum: Hexapoda							
Class: Insecta							
Order: Ephemeroptera							
Family: Baetidae							
Acerpenna							
Acerpenna pygmaea							
Baetis							
Baetis bicaudatus							
Baetis tricaudatus							
Family: Ephemerellidae							
Caudatella							
Family: Heptageniidae							
Epeorus							
Ironodes							
Rhithrogena							
Family: Leptophlebiidae							
Order: Plecoptera							
Family: Capniidae							
Family: Leuctridae							
Family: Nemouridae		98					
Amphinemura							
Malenka							
Nemoura							
Ostrocerca							
Zapada							

Site	R2S	R6S1	R6S1	R6S1	R6S1	R6S1	R6S1
Year	2010	2010	2010	2010	2010	2010	2010
CC#	CC120838	CC111093	CC111097	CC120825	CC111094	CC111098	CC111100
Habitat	Riffle	Riffle	Riffle	Riffle	Pool	Pool	Pool
Zapada oregonensis							
Family: Perlodidae							
Order: Trichoptera					1		
Micrasema							
Family: Hydropsychidae							
Hydropsyche							
Family: Hydroptilidae							
Agraylea							
Oxyethira		3					
Family: Limnephilidae							
Clostoeca disjuncta		3					
Ecclisomyia							
Limnephilus	4		48			2	
Family: Molannidae							
Molanna flavicornis					1	1	
Molanna distinctus							
Family: Phryganeidae							
Agrypnia							
Family: Rhyacophilidae							
Rhyacophila							
Order: Coleoptera							
Family: Dytiscidae						1	
Agabus							
Colymbetes							
Hydroporus							
Oreodytes					2		

Site	R2S	R6S1	R6S1	R6S1	R6S1	R6S1	R6S1
Year	2010	2010	2010	2010	2010	2010	2010
CC#	CC120838	CC111093	CC111097	CC120825	CC111094	CC111098	CC111100
Habitat	Riffle	Riffle	Riffle	Riffle	Pool	Pool	Pool
Stictotarsus							
Family: Hydraenidae							
Hydraena							
SubFamily: Hydroporinae							
Family: Hydrophilidae							
Hydrochus							
Family: Psephenidae							
Family: Staphylinidae							
Order: Diptera							
Family: Ceratopogonidae							
Atrichopogon							
Bezzia/Palpomyia		18		4	4	1	
Culicoides							
Dasyhelea							
Forcipomyia							
Mallochohelea				4			
Probezzia		15		8	1	1	
Sphaeromias							
Family: Chaoboridae							
Eucorethra							
Family: Chironomidae							
SubFamily: Chironominae							
Fissimentum							
Tribe: Chironomini							
Chironomus							
Cryptochironomus							

Site	R2S	R6S1	R6S1	R6S1	R6S1	R6S1	R6S1
Year	2010	2010	2010	2010	2010	2010	2010
CC#	CC120838	CC111093	CC111097	CC120825	CC111094	CC111098	CC111100
Habitat	Riffle	Riffle	Riffle	Riffle	Pool	Pool	Pool
Endochironomus							
Microtendipes					110		105
Microtendipes pedellus							
Phaenopsectra							
Polypedilum		45					
Stictochironomus			48		3	7	87
Tribelos							
Tribe: Tanytarsini							
Cladotanytarsus							
Micropsectra		5643	144		2000	129	320
Paratanytarsus		30	96		311	15	
Rheotanytarsus				4			
Tanytarsus	420			196			
SubFamily: Diamesinae							
Protanypus							
Tribe: Diamesini							
Pagastia							
Potthastia							
SubFamily: Orthocladiinae					608		
Brillia							
Cricotopus							
Diplocladius							
Diplocladius cultriger							
Eukiefferiella							
Georthocladius							
Heterotanytarsus							

Site	R2S	R6S1	R6S1	R6S1	R6S1	R6S1	R6S1
Year	2010	2010	2010	2010	2010	2010	2010
CC#	CC120838	CC111093	CC111097	CC120825	CC111094	CC111098	CC111100
Habitat	Riffle	Riffle	Riffle	Riffle	Pool	Pool	Pool
Heterotrissocladius			54		2		
Hydrobaenus							
Limnophyes							
Metriocnemus							
Nanocladius							
Orthocladius							
Orthocladius complex		5455				4	
Parakiefferiella							
Paralimnophyes arcticus							
Paraphaenocladius							
Psectrocladius		348	240		20	24	152
Psiloptarus							
Pseudosmittia							
Rheocricotopus							
Tvetenia							
Tvetenia bavarica							
Tvetenia vitracies							
Zalutschia							
Zalutschia briani							
Zalutschia tatrica				820			
Zalutschia zalutschicola							
Tribe: Corynoneurini							
Corynoneura	12			8			
Tribe: Orthocladiini							
Chaetocladius							
SubFamily: Podonominae							

Site	R2S	R6S1	R6S1	R6S1	R6S1	R6S1	R6S1
Year	2010	2010	2010	2010	2010	2010	2010
CC#	CC120838	CC111093	CC111097	CC120825	CC111094	CC111098	CC111100
Habitat	Riffle	Riffle	Riffle	Riffle	Pool	Pool	Pool
Lasiodiamesa							
Paraboreochlus							
Trichotanypus							
SubFamily: Prodiamesinae							
Prodiamesa							
Tribe: Boreochlini							
Boreochlus							
SubFamily: Tanypodinae							
Labrundinia							
Tribe: Pentaneuriini							
Ablabesmyia							
Nilotanypus							
Thienemannimyia		18			17	1	
Tribe: Procladiini							
Djalma batista							
Procladius			144		182	17	16
Family: Dixidae							
Dixella							
Family: Dolichopodidae							
Rhaphium							
Family: Empididae							
Clinocera							
Chelifera/Metachela							
Oreogeton							
Family: Muscidae							
Limnophora		27					

Site	R2S	R6S1	R6S1	R6S1	R6S1	R6S1	R6S1
Year	2010	2010	2010	2010	2010	2010	2010
CC#	CC120838	CC111093	CC111097	CC120825	CC111094	CC111098	CC111100
Habitat	Riffle	Riffle	Riffle	Riffle	Pool	Pool	Pool
Family: Simuliidae		547	769	4			17
Prosimulium							
Simulium		139	18269	168		79	
Family: Tipulidae							
Erioptera							
Limnophila							
Ormosia							
Tipula							
Order: Hemiptera							
Family: Corixidae							
Sigara							
Family: Gerridae							
Gerris							
Order: Lepidoptera							
Family: Noctuidae							
Order: Odonata							
Subphylum: Crustacea							
Class: Malacostraca							
Order: Amphipoda							
Subphylum: Chelicerata							
Class: Arachnida							
Order: Trombidiformes							
SubOrder: Prostigmata						16	
Neobrachypoda							
Pionopsis							
Family: Arrenuridae							

Site	R2S	R6S1	R6S1	R6S1	R6S1	R6S1	R6S1
Year	2010	2010	2010	2010	2010	2010	2010
CC#	CC120838	CC111093	CC111097	CC120825	CC111094	CC111098	CC111100
Habitat	Riffle	Riffle	Riffle	Riffle	Pool	Pool	Pool
Arrenurus							
Family: Hydryphantidae							
Family: Hygrobatidae							
Hygrobates							
Family: Lebertiidae							
Lebertia		17					
Family: Limnesiidae							
Limnesia							
Family: Limnocharidae							
Limnochares							
Family: Mideopsidae							
Mideopsis							
Family: Oxidae							
Oxus							
Family: Pionidae							
Piona							
Family: Sperchontidae							
Sperchon							
Sperchonopsis							
Family: Unionicolidae							
Neumania							
Family: Halacaridae				4			
Order: Oribatida							
Family: Hydrozetidae	12	200	96	176	85	52	16
Phylum: Mollusca							
Class: Bivalvia							

Site	R2S	R6S1	R6S1	R6S1	R6S1	R6S1	R6S1
Year	2010	2010	2010	2010	2010	2010	2010
CC#	CC120838	CC111093	CC111097	CC120825	CC111094	CC111098	CC111100
Habitat	Riffle	Riffle	Riffle	Riffle	Pool	Pool	Pool
Order: Veneroida							
Family: Pisidiidae				12	117	16	29
Pisidium					2	4	
Class: Gastropoda							
Order: Heterostropha							
Family: Valvatidae							
Phylum: Annelida							
Subphylum: Clitellata							
Class: Oligochaeta		17			17	16	
Order: Lumbriculida							
Family: Lumbriculidae		12					2
Order: Tubificida							
Family: Enchytraeidae							
Enchytraeus	24						8
Family: Lumbricidae							
Family: Naididae	24		48			3	
Chaetogaster							
Chaetogaster diaphanus							
Nais							
Pristina							
Family: Tubificidae							
Phylum: Cnidaria							
Class: Hydrozoa							
Order: Anthoathecatae							
Family: Hydridae							
Hydra	16			8			

Site	R2S	R6S1	R6S1	R6S1	R6S1	R6S1	R6S1
Year	2010	2010	2010	2010	2010	2010	2010
CC#	CC120838	CC111093	CC111097	CC120825	CC111094	CC111098	CC111100
Habitat	Riffle	Riffle	Riffle	Riffle	Pool	Pool	Pool
Phylum: Tardigrada	4	17		4	33		

Site	R6S1	R6S1	R6S1	R6S1	R6S1	R6S1	R6S2
Year	2010	2010	2010	2010	2010	2010	2010
CC#	CC111095	CC111101	CC120826	CC111096	CC111099	CC111102	CC111103
Habitat	Pool	Pool	Pool	Riffle	Riffle	Riffle	Pool
Phylum: Arthropoda							
Subphylum: Hexapoda							
Class: Insecta							
Order: Ephemeroptera							
Family: Baetidae							
Acerpenna							
Acerpenna pygmaea							
Baetis							
Baetis bicaudatus			8				
Baetis tricaudatus							
Family: Ephemerellidae							
Caudatella							
Family: Heptageniidae							
Epeorus							
Ironodes							
Rhithrogena							
Family: Leptophlebiidae							
Order: Plecoptera				1			
Family: Capniidae							
Family: Leuctridae							
Family: Nemouridae						1	
Amphinemura							
Malenka							
Nemoura			4	2			
Ostrocerca							1
Zapada			48				

Site	R6S1	R6S1	R6S1	R6S1	R6S1	R6S1	R6S2
Year	2010	2010	2010	2010	2010	2010	2010
CC#	CC111095	CC111101	CC120826	CC111096	CC111099	CC111102	CC111103
Habitat	Pool	Pool	Pool	Riffle	Riffle	Riffle	Pool
Zapada oregonensis							
Family: Perlodidae							
Order: Trichoptera	4						
Micrasema							
Family: Hydropsychidae							
Hydropsyche							
Family: Hydroptilidae							
Agraylea							
Oxyethira		1		24		6	
Family: Limnephilidae	20						
Clostoeca disjuncta				5			
Ecclisomyia							
Limnephilus					1		
Family: Molannidae							
Molanna flavicornis							
Molanna distinctus							
Family: Phryganeidae							
Agrypnia							
Family: Rhyacophilidae							
Rhyacophila							
Order: Coleoptera							
Family: Dytiscidae						2	
Agabus							
Colymbetes							
Hydroporus							
Oreodytes							

Site	R6S1	R6S1	R6S1	R6S1	R6S1	R6S1	R6S2
Year	2010	2010	2010	2010	2010	2010	2010
CC#	CC111095	CC111101	CC120826	CC111096	CC111099	CC111102	CC111103
Habitat	Pool	Pool	Pool	Riffle	Riffle	Riffle	Pool
Stictotarsus							
Family: Hydraenidae							
Hydraena							
SubFamily: Hydroporinae							
Family: Hydrophilidae							
Hydrochus							
Family: Psephenidae							
Family: Staphylinidae							
Order: Diptera							
Family: Ceratopogonidae							
Atrichopogon							
Bezzia/Palpomyia	12	3					
Culicoides							
Dasyhelea							
Forcipomyia							
Mallochohelea			4	1	4		
Probezzia						5	
Sphaeromias							
Family: Chaoboridae							
Eucorethra							
Family: Chironomidae						812	
SubFamily: Chironominae							
Fissimentum							
Tribe: Chironomini							
Chironomus	68						77
Cryptochironomus							

Site	R6S1	R6S1	R6S1	R6S1	R6S1	R6S1	R6S2
Year	2010	2010	2010	2010	2010	2010	2010
CC#	CC111095	CC111101	CC120826	CC111096	CC111099	CC111102	CC111103
Habitat	Pool	Pool	Pool	Riffle	Riffle	Riffle	Pool
Endochironomus							
Microtendipes		8					
Microtendipes pedellus							
Phaenopsectra							
Polypedilum				223			
Stictochironomus	136	46					11
Tribelos							
Tribe: Tanytarsini							
Cladotanytarsus							
Micropsectra	1228	42		589	5	157	67
Paratanytarsus				4	112		52
Rheotanytarsus							
Tanytarsus			184				
SubFamily: Diamesinae							
Protanypus							
Tribe: Diamesini							
Pagastia							
Potthastia							
SubFamily: Orthocladiinae	120						
Brillia							
Cricotopus							
Diplocladius							
Diplocladius cultriger							
Eukiefferiella						443	
Georthocladius							
Heterotanytarsus							

Site	R6S1	R6S1	R6S1	R6S1	R6S1	R6S1	R6S2
Year	2010	2010	2010	2010	2010	2010	2010
CC#	CC111095	CC111101	CC120826	CC111096	CC111099	CC111102	CC111103
Habitat	Pool	Pool	Pool	Riffle	Riffle	Riffle	Pool
Heterotrissocladius				154			
Hydrobaenus							79
Limnophyes							20
Metriocnemus							
Nanocladius							
Orthocladius							
Orthocladius complex	40		176			10	
Parakiefferiella							
Paralimnophyes arcticus							
Paraphaenocladius							
Psectrocladius	928	115		544	1	36	
Psiloptarus							
Pseudosmittia							
Rheocricotopus	20						
Tvetenia							
Tvetenia bavarica							
Tvetenia vitracies							
Zalutschia							
Zalutschia briani							
Zalutschia tatrica				2			
Zalutschia zalutschicola							
Tribe: Corynoneurini							
Corynoneura			8	169			
Tribe: Orthocladiini							
Chaetocladius						176	
SubFamily: Podonominae							

Site	R6S1	R6S1	R6S1	R6S1	R6S1	R6S1	R6S2
Year	2010	2010	2010	2010	2010	2010	2010
CC#	CC111095	CC111101	CC120826	CC111096	CC111099	CC111102	CC111103
Habitat	Pool	Pool	Pool	Riffle	Riffle	Riffle	Pool
Lasiodiamesa							
Paraboreochlus			12				
Trichotanypus							
SubFamily: Prodiamesinae							
Prodiamesa							
Tribe: Boreochlini							
Boreochlus							
SubFamily: Tanypodinae							
Labrundinia							
Tribe: Pentaneuriini							
Ablabesmyia							
Nilotanypus							
Thienemannimyia	16						
Tribe: Procladiini							
Djalma batista							
Procladius	88	5				35	5
Family: Dixidae							
Dixella							
Family: Dolichopodidae							
Rhaphium							
Family: Empididae							
Clinocera			16	1			
Chelifera/Metachela							
Oreogeton							
Family: Muscidae							
Limnophora				1			

Site	R6S1	R6S1	R6S1	R6S1	R6S1	R6S1	R6S2
Year	2010	2010	2010	2010	2010	2010	2010
CC#	CC111095	CC111101	CC120826	CC111096	CC111099	CC111102	CC111103
Habitat	Pool	Pool	Pool	Riffle	Riffle	Riffle	Pool
Family: Simuliidae		93	20		16		
Prosimulium							
Simulium			240	1	51		
Family: Tipulidae							
Erioptera							
Limnophila							
Ormosia							
Tipula							
Order: Hemiptera							
Family: Corixidae							
Sigara							
Family: Gerridae							
Gerris							
Order: Lepidoptera							
Family: Noctuidae							
Order: Odonata							
Subphylum: Crustacea							
Class: Malacostraca							
Order: Amphipoda							
Subphylum: Chelicerata							
Class: Arachnida							
Order: Trombidiformes							
SubOrder: Prostigmata	16		12	8	8		
Neobrachypoda							
Pionopsis							
Family: Arrenuridae							

Site	R6S1	R6S1	R6S1	R6S1	R6S1	R6S1	R6S2
Year	2010	2010	2010	2010	2010	2010	2010
CC#	CC111095	CC111101	CC120826	CC111096	CC111099	CC111102	CC111103
Habitat	Pool	Pool	Pool	Riffle	Riffle	Riffle	Pool
Arrenurus							
Family: Hydryphantidae							
Family: Hygrobatidae							
Hygrobates							
Family: Lebertiidae							
Lebertia	4						4
Family: Limnesiidae							
Limnesia							
Family: Limnocharidae							
Limnochares							
Family: Mideopsidae							
Mideopsis							
Family: Oxidae							
Oxus							
Family: Pionidae							
Piona							
Family: Sperchontidae							
Sperchon							
Sperchonopsis							
Family: Unionicolidae							
Neumania				8			
Family: Halacaridae			8				
Order: Oribatida							
Family: Hydrozetidae	36	3	40	23	44	183	8
Phylum: Mollusca							
Class: Bivalvia							

Site	R6S1	R6S1	R6S1	R6S1	R6S1	R6S1	R6S2
Year	2010	2010	2010	2010	2010	2010	2010
CC#	CC111095	CC111101	CC120826	CC111096	CC111099	CC111102	CC111103
Habitat	Pool	Pool	Pool	Riffle	Riffle	Riffle	Pool
Order: Veneroida							
Family: Pisidiidae	12			41	9		
Pisidium	4			4	1		
Class: Gastropoda							
Order: Heterostropha							
Family: Valvatidae							
Phylum: Annelida							
Subphylum: Clitellata							
Class: Oligochaeta							
Order: Lumbriculida							
Family: Lumbriculidae			4				
Order: Tubificida							
Family: Enchytraeidae							
Enchytraeus		3					
Family: Lumbricidae			4				
Family: Naididae	20		20	9	5		16
Chaetogaster							
Chaetogaster diaphanus							
Nais							
Pristina							
Family: Tubificidae							
Phylum: Cnidaria							
Class: Hydrozoa							
Order: Anthoathecatae							
Family: Hydridae							
Hydra			4				1

Site	R6S1	R6S1	R6S1	R6S1	R6S1	R6S1	R6S2
Year	2010	2010	2010	2010	2010	2010	2010
CC#	CC111095	CC111101	CC120826	CC111096	CC111099	CC111102	CC111103
Habitat	Pool	Pool	Pool	Riffle	Riffle	Riffle	Pool
Phylum: Tardigrada							

Site	R6S2	R6S2	R6S2	R6S2	R6S2	R6S2	R6S2
Year	2010	2010	2010	2010	2010	2010	2010
CC#	CC111105	CC111109	CC111106	CC111110	CC120827	CC111104	CC111107
Habitat	Pool	Pool	Riffle	Riffle	Riffle	Riffle	Riffle
Phylum: Arthropoda							
Subphylum: Hexapoda							
Class: Insecta							
Order: Ephemeroptera							
Family: Baetidae							
Acerpenna							
Acerpenna pygmaea							
Baetis	13		106				48
Baetis bicaudatus							
Baetis tricaudatus							
Family: Ephemerellidae							
Caudatella							
Family: Heptageniidae							
Epeorus							
Ironodes							
Rhithrogena							
Family: Leptophlebiidae							
Order: Plecoptera							
Family: Capniidae					2		
Family: Leuctridae							
Family: Nemouridae							
Amphinemura							
Malenka							
Nemoura			2	1			
Ostrocerca							
Zapada							

Site	R6S2	R6S2	R6S2	R6S2	R6S2	R6S2	R6S2
Year	2010	2010	2010	2010	2010	2010	2010
CC#	CC111105	CC111109	CC111106	CC111110	CC120827	CC111104	CC111107
Habitat	Pool	Pool	Riffle	Riffle	Riffle	Riffle	Riffle
Zapada oregonensis							
Family: Perlodidae							
Order: Trichoptera							
Micrasema							
Family: Hydropsychidae							
Hydropsyche							
Family: Hydroptilidae							
Agraylea							
Oxyethira				52			
Family: Limnephilidae							
Clostoeca disjuncta							
Ecclisomyia							
Limnephilus	2		1				5
Family: Molannidae							
Molanna flavicornis							
Molanna distinctus							
Family: Phryganeidae							
Agrypnia							
Family: Rhyacophilidae							
Rhyacophila							
Order: Coleoptera							
Family: Dytiscidae							
Agabus							
Colymbetes							
Hydroporus							
Oreodytes							

Site	R6S2	R6S2	R6S2	R6S2	R6S2	R6S2	R6S2
Year	2010	2010	2010	2010	2010	2010	2010
CC#	CC111105	CC111109	CC111106	CC111110	CC120827	CC111104	CC111107
Habitat	Pool	Pool	Riffle	Riffle	Riffle	Riffle	Riffle
Stictotarsus							
Family: Hydraenidae							
Hydraena							
SubFamily: Hydroporinae							
Family: Hydrophilidae							
Hydrochus							
Family: Psephenidae							
Family: Staphylinidae							
Order: Diptera							
Family: Ceratopogonidae							
Atrichopogon							
Bezzia/Palpomyia							
Culicoides							
Dasyhelea							
Forcipomyia							
Mallochohelea			2		2	2	5
Probezzia			1				
Sphaeromias							
Family: Chaoboridae							
Eucorethra							
Family: Chironomidae							
SubFamily: Chironominae							
Fissimentum							
Tribe: Chironomini							
Chironomus	100	30					
Cryptochironomus							

Site	R6S2	R6S2	R6S2	R6S2	R6S2	R6S2	R6S2
Year	2010	2010	2010	2010	2010	2010	2010
CC#	CC111105	CC111109	CC111106	CC111110	CC120827	CC111104	CC111107
Habitat	Pool	Pool	Riffle	Riffle	Riffle	Riffle	Riffle
Endochironomus							
Microtendipes							
Microtendipes pedellus							
Phaenopsectra							
Polypedilum							
Stictochironomus	14						5
Tribelos							
Tribe: Tanytarsini							
Cladotanytarsus							
Micropsectra	355	364	5				
Paratanytarsus						7	
Rheotanytarsus							
Tanytarsus					50		
SubFamily: Diamesinae							
Protanypus	2						
Tribe: Diamesini							
Pagastia							
Potthastia							
SubFamily: Orthocladiinae						12	
Brillia							
Cricotopus			48				105
Diplocladius							
Diplocladius cultriger							
Eukiefferiella		191	118	4265			81
Georthocladius							
Heterotanytarsus	27						

Site	R6S2	R6S2	R6S2	R6S2	R6S2	R6S2	R6S2
Year	2010	2010	2010	2010	2010	2010	2010
CC#	CC111105	CC111109	CC111106	CC111110	CC120827	CC111104	CC111107
Habitat	Pool	Pool	Riffle	Riffle	Riffle	Riffle	Riffle
Heterotrissocladius							
Hydrobaenus	20					8	
Limnophyes						6	
Metriocnemus							
Nanocladius							
Orthocladius							
Orthocladius complex							
Parakiefferiella							
Paralimnophyes arcticus							
Paraphaenocladius							
Psectrocladius				798			24
Psiloptarus							
Pseudosmittia							
Rheocricotopus		9	3		14		
Tvetenia							
Tvetenia bavarica			130				62
Tvetenia vitracies							
Zalutschia							
Zalutschia briani							
Zalutschia tatrica					220		
Zalutschia zalutschicola				7			
Tribe: Corynoneurini							
Corynoneura	6		2				
Tribe: Orthocladiini							
Chaetocladius		14	40				
SubFamily: Podonominae	18						

Site	R6S2	R6S2	R6S2	R6S2	R6S2	R6S2	R6S2
Year	2010	2010	2010	2010	2010	2010	2010
CC#	CC111105	CC111109	CC111106	CC111110	CC120827	CC111104	CC111107
Habitat	Pool	Pool	Riffle	Riffle	Riffle	Riffle	Riffle
Lasiodiamesa							
Paraboreochlus							
Trichotanypus							
SubFamily: Prodiamesinae							
Prodiamesa							
Tribe: Boreochlini							
Boreochlus							
SubFamily: Tanypodinae							
Labrundinia							
Tribe: Pentaneuriini							
Ablabesmyia							
Nilotanypus							
Thienemannimyia							
Tribe: Procladiini							
Djalma batista							
Procladius	10	43		10			
Family: Dixidae							
Dixella							
Family: Dolichopodidae							
Rhaphium							
Family: Empididae							
Clinocera					2	2	
Chelifera/Metachela							
Oreogeton							
Family: Muscidae							
Limnophora				1			

Site	R6S2	R6S2	R6S2	R6S2	R6S2	R6S2	R6S2
Year	2010	2010	2010	2010	2010	2010	2010
CC#	CC111105	CC111109	CC111106	CC111110	CC120827	CC111104	CC111107
Habitat	Pool	Pool	Riffle	Riffle	Riffle	Riffle	Riffle
Family: Simuliidae		9	6		22		
Prosimulium							
Simulium	2		354		6		38
Family: Tipulidae							
Erioptera							
Limnophila							
Ormosia							
Tipula							
Order: Hemiptera							
Family: Corixidae							
Sigara							
Family: Gerridae							
Gerris							
Order: Lepidoptera		2					
Family: Noctuidae							
Order: Odonata							
Subphylum: Crustacea							
Class: Malacostraca							
Order: Amphipoda							
Subphylum: Chelicerata							
Class: Arachnida							
Order: Trombidiformes							
SubOrder: Prostigmata			1	50	6		
Neobrachypoda							
Pionopsis							
Family: Arrenuridae							

Site	R6S2	R6S2	R6S2	R6S2	R6S2	R6S2	R6S2
Year	2010	2010	2010	2010	2010	2010	2010
CC#	CC111105	CC111109	CC111106	CC111110	CC120827	CC111104	CC111107
Habitat	Pool	Pool	Riffle	Riffle	Riffle	Riffle	Riffle
Arrenurus							
Family: Hydryphantidae							
Family: Hygrobatidae							
Hygrobates							
Family: Lebertiidae							
Lebertia						1	
Family: Limnesiidae							
Limnesia							
Family: Limnocharidae							
Limnochares							
Family: Mideopsidae							
Mideopsis							
Family: Oxidae							
Oxus							
Family: Pionidae							
Piona							
Family: Sperchontidae							
Sperchon							
Sperchonopsis							
Family: Unionicolidae							
Neumania	9			1			
Family: Halacaridae							
Order: Oribatida							
Family: Hydrozetidae	11	18	8		26		
Phylum: Mollusca							
Class: Bivalvia							

Site	R6S2	R6S2	R6S2	R6S2	R6S2	R6S2	R6S2
Year	2010	2010	2010	2010	2010	2010	2010
CC#	CC111105	CC111109	CC111106	CC111110	CC120827	CC111104	CC111107
Habitat	Pool	Pool	Riffle	Riffle	Riffle	Riffle	Riffle
Order: Veneroida							
Family: Pisidiidae							
Pisidium							
Class: Gastropoda					2		
Order: Heterostropha							
Family: Valvatidae							
Phylum: Annelida							
Subphylum: Clitellata							
Class: Oligochaeta						8	
Order: Lumbriculida							
Family: Lumbriculidae	2			1			5
Order: Tubificida							
Family: Enchytraeidae							
Enchytraeus				1			
Family: Lumbricidae							
Family: Naididae	30	16	2	3			10
Chaetogaster							
Chaetogaster diaphanus							
Nais							
Pristina							
Family: Tubificidae							
Phylum: Cnidaria							
Class: Hydrozoa							
Order: Anthoathecatae							
Family: Hydridae							
Hydra							

Site	R6S2	R6S2	R6S2	R6S2	R6S2	R6S2	R6S2
Year	2010	2010	2010	2010	2010	2010	2010
CC#	CC111105	CC111109	CC111106	CC111110	CC120827	CC111104	CC111107
Habitat	Pool	Pool	Riffle	Riffle	Riffle	Riffle	Riffle
Phylum: Tardigrada	9	9					

Site	R6S2	R6S2	R6S2	R6S2	WIS	WIS	WIS
Year	2010	2010	2010	2010	2010	2010	2010
CC#	CC111111	CC111108	CC111112	CC120828	CC111082	CC111083	CC120819
Habitat	Riffle	Pool	Pool	Pool	Riffle	Pool	Pool
Phylum: Arthropoda							
Subphylum: Hexapoda							
Class: Insecta							
Order: Ephemeroptera							
Family: Baetidae							
Acerpenna							
Acerpenna pygmaea							
Baetis		9					
Baetis bicaudatus							
Baetis tricaudatus							
Family: Ephemerellidae							
Caudatella							
Family: Heptageniidae							1
Epeorus							
Ironodes							
Rhithrogena							
Family: Leptophlebiidae							
Order: Plecoptera							
Family: Capniidae							
Family: Leuctridae							
Family: Nemouridae	1		6				
Amphinemura							
Malenka							
Nemoura	1						
Ostrocerca							
Zapada							

Site	R6S2	R6S2	R6S2	R6S2	WIS	WIS	WIS
Year	2010	2010	2010	2010	2010	2010	2010
CC#	CC111111	CC111108	CC111112	CC120828	CC111082	CC111083	CC120819
Habitat	Riffle	Pool	Pool	Pool	Riffle	Pool	Pool
Zapada oregonensis							
Family: Perlodidae							
Order: Trichoptera							
Micrasema							
Family: Hydropsychidae							
Hydropsyche							
Family: Hydroptilidae							
Agraylea							
Oxyethira			17				
Family: Limnephilidae			4		32		
Clostoeca disjuncta							
Ecclisomyia							
Limnephilus							
Family: Molannidae							
Molanna flavicornis							
Molanna distinctus							
Family: Phryganeidae							
Agrypnia							
Family: Rhyacophilidae							
Rhyacophila							
Order: Coleoptera							
Family: Dytiscidae			2				1
Agabus			2				
Colymbetes							
Hydroporus							
Oreodytes							

Site	R6S2	R6S2	R6S2	R6S2	WIS	WIS	WIS
Year	2010	2010	2010	2010	2010	2010	2010
CC#	CC111111	CC111108	CC111112	CC120828	CC111082	CC111083	CC120819
Habitat	Riffle	Pool	Pool	Pool	Riffle	Pool	Pool
Stictotarsus							
Family: Hydraenidae							
Hydraena							
SubFamily: Hydroporinae							
Family: Hydrophilidae							
Hydrochus							
Family: Psephenidae							
Family: Staphylinidae							
Order: Diptera							
Family: Ceratopogonidae							
Atrichopogon							
Bezzia/Palpomyia					32		1
Culicoides							
Dasyhelea							
Forcipomyia							
Mallochohelea			2				
Probezzia							
Sphaeromias							
Family: Chaoboridae							
Eucorethra							
Family: Chironomidae		36					
SubFamily: Chironominae							
Fissimentum							
Tribe: Chironomini				2			
Chironomus	1				64		
Cryptochironomus							

Site	R6S2	R6S2	R6S2	R6S2	WIS	WIS	WIS
Year	2010	2010	2010	2010	2010	2010	2010
CC#	CC111111	CC111108	CC111112	CC120828	CC111082	CC111083	CC120819
Habitat	Riffle	Pool	Pool	Pool	Riffle	Pool	Pool
Endochironomus							
Microtendipes							
Microtendipes pedellus							
Phaenopsectra							
Polypedilum							
Stictochironomus		5	14	6			
Tribelos							
Tribe: Tanytarsini			1393				
Cladotanytarsus							
Micropsectra	130		1701		2592	4976	
Paratanytarsus							
Rheotanytarsus							
Tanytarsus				8			11
SubFamily: Diamesinae							
Protanypus							
Tribe: Diamesini							
Pagastia							
Potthastia							
SubFamily: Orthocladiinae							
Brillia							
Cricotopus		8	90				
Diplocladius							
Diplocladius cultriger			10	19			
Eukiefferiella	656	18					
Georthocladius							
Heterotanytarsus							

Site	R6S2	R6S2	R6S2	R6S2	WIS	WIS	WIS
Year	2010	2010	2010	2010	2010	2010	2010
CC#	CC111111	CC111108	CC111112	CC120828	CC111082	CC111083	CC120819
Habitat	Riffle	Pool	Pool	Pool	Riffle	Pool	Pool
Heterotrissocladius							
Hydrobaenus							
Limnophyes							1
Metriocnemus							
Nanocladius							
Orthocladius							
Orthocladius complex							10
Parakiefferiella							
Paralimnophyes arcticus							
Paraphaenocladius							
Psectrocladius	28		30			96	20
Psiloptarus							
Pseudosmittia							
Rheocricotopus		18					5
Tvetenia							
Tvetenia bavarica							
Tvetenia vitracies							
Zalutschia							
Zalutschia briani							
Zalutschia tatrica				4			8
Zalutschia zalutschicola	304		1253				
Tribe: Corynoneurini							
Corynoneura	48						29
Tribe: Orthocladiini							
Chaetocladius	17	25					
SubFamily: Podonominae							

Site	R6S2	R6S2	R6S2	R6S2	WIS	WIS	WIS
Year	2010	2010	2010	2010	2010	2010	2010
CC#	CC111111	CC111108	CC111112	CC120828	CC111082	CC111083	CC120819
Habitat	Riffle	Pool	Pool	Pool	Riffle	Pool	Pool
Lasiodiamesa							
Paraboreochlus							2
Trichotanypus							
SubFamily: Prodiamesinae							
Prodiamesa							
Tribe: Boreochlini							
Boreochlus							
SubFamily: Tanypodinae							
Labrundinia							
Tribe: Pentaneuriini							
Ablabesmyia							
Nilotanypus							
Thienemannimyia							3
Tribe: Procladiini							
Djalma batista							
Procladius			20		256	232	1
Family: Dixidae							1
Dixella							
Family: Dolichopodidae							
Rhaphium							
Family: Empididae							
Clinocera			2				
Chelifera/Metachela							
Oreogeton							
Family: Muscidae							
Limnophora	2						

Site	R6S2	R6S2	R6S2	R6S2	WIS	WIS	WIS
Year	2010	2010	2010	2010	2010	2010	2010
CC#	CC111111	CC111108	CC111112	CC120828	CC111082	CC111083	CC120819
Habitat	Riffle	Pool	Pool	Pool	Riffle	Pool	Pool
Family: Simuliidae	5		4				
Prosimulium							
Simulium		34					9
Family: Tipulidae							
Erioptera							
Limnophila							
Ormosia							
Tipula							
Order: Hemiptera							
Family: Corixidae							
Sigara							
Family: Gerridae							
Gerris							
Order: Lepidoptera							
Family: Noctuidae							
Order: Odonata							
Subphylum: Crustacea							
Class: Malacostraca							
Order: Amphipoda							
Subphylum: Chelicerata							
Class: Arachnida							
Order: Trombidiformes							
SubOrder: Prostigmata	16			1			1
Neobrachypoda							
Pionopsis							
Family: Arrenuridae							

Site	R6S2	R6S2	R6S2	R6S2	WIS	WIS	WIS
Year	2010	2010	2010	2010	2010	2010	2010
CC#	CC111111	CC111108	CC111112	CC120828	CC111082	CC111083	CC120819
Habitat	Riffle	Pool	Pool	Pool	Riffle	Pool	Pool
Arrenurus							
Family: Hydryphantidae							
Family: Hygrobatidae							
Hygrobates							
Family: Lebertiidae							
Lebertia					32	16	
Family: Limnesiidae							
Limnesia							
Family: Limnocharidae							
Limnochares							
Family: Mideopsidae							
Mideopsis							
Family: Oxidae							
Oxus							
Family: Pionidae							
Piona							
Family: Sperchontidae							
Sperchon							
Sperchonopsis							
Family: Unionicolidae							
Neumania							
Family: Halacaridae							
Order: Oribatida							
Family: Hydrozetidae			2	1			13
Phylum: Mollusca							
Class: Bivalvia							

Site	R6S2	R6S2	R6S2	R6S2	WIS	WIS	WIS
Year	2010	2010	2010	2010	2010	2010	2010
CC#	CC111111	CC111108	CC111112	CC120828	CC111082	CC111083	CC120819
Habitat	Riffle	Pool	Pool	Pool	Riffle	Pool	Pool
Order: Veneroida							
Family: Pisidiidae							
Pisidium							
Class: Gastropoda							
Order: Heterostropha							
Family: Valvatidae							
Phylum: Annelida							
Subphylum: Clitellata							
Class: Oligochaeta							
Order: Lumbriculida							
Family: Lumbriculidae			4	2		16	1
Order: Tubificida							
Family: Enchytraeidae							
Enchytraeus			50				
Family: Lumbricidae							
Family: Naididae	29	23	43	2		16	2
Chaetogaster							
Chaetogaster diaphanus							
Nais							
Pristina							
Family: Tubificidae							
Phylum: Cnidaria							
Class: Hydrozoa							
Order: Anthoathecatae							
Family: Hydridae							
Hydra				1			

Site	R6S2	R6S2	R6S2	R6S2	WIS	WIS	WIS
Year	2010	2010	2010	2010	2010	2010	2010
CC#	CC111111	CC111108	CC111112	CC120828	CC111082	CC111083	CC120819
Habitat	Riffle	Pool	Pool	Pool	Riffle	Pool	Pool
Phylum: Tardigrada			17				

Site	WIS	WIS	WIS	WIS	WIS	WIS	WIS
Year	2010	2010	2010	2010	2010	2010	2010
CC#	CC120821	CC111064	CC111084	CC111065	CC111085	CC111066	CC111086
Habitat	Pool	Riffle	Riffle	Pool	Pool	Riffle	Riffle
Phylum: Arthropoda							
Subphylum: Hexapoda							
Class: Insecta							
Order: Ephemeroptera							
Family: Baetidae							
Acerpenna							
Acerpenna pygmaea							
Baetis	1	1	38		36	1	13
Baetis bicaudatus	3		28		4		4
Baetis tricaudatus							
Family: Ephemerellidae		1					
Caudatella							
Family: Heptageniidae							
Epeorus							
Ironodes							
Rhithrogena		1					
Family: Leptophlebiidae							
Order: Plecoptera							
Family: Capniidae							
Family: Leuctridae							
Family: Nemouridae							
Amphinemura							
Malenka							
Nemoura							
Ostrocerca							
Zapada							

Site	WIS	WIS	WIS	WIS	WIS	WIS	WIS
Year	2010	2010	2010	2010	2010	2010	2010
CC#	CC120821	CC111064	CC111084	CC111065	CC111085	CC111066	CC111086
Habitat	Pool	Riffle	Riffle	Pool	Pool	Riffle	Riffle
Zapada oregonensis							
Family: Perlodidae				4			
Order: Trichoptera							
Micrasema							
Family: Hydropsychidae							
Hydropsyche							
Family: Hydroptilidae							
Agraylea							
Oxyethira							
Family: Limnephilidae							
Clostoeca disjuncta							
Ecclisomyia							
Limnephilus			6		4		
Family: Molannidae							
Molanna flavicornis							
Molanna distinctus							
Family: Phryganeidae							
Agrypnia							
Family: Rhyacophilidae							
Rhyacophila							
Order: Coleoptera							
Family: Dytiscidae		1					
Agabus							
Colymbetes							
Hydroporus							
Oreodytes							

Site	WIS	WIS	WIS	WIS	WIS	WIS	WIS
Year	2010	2010	2010	2010	2010	2010	2010
CC#	CC120821	CC111064	CC111084	CC111065	CC111085	CC111066	CC111086
Habitat	Pool	Riffle	Riffle	Pool	Pool	Riffle	Riffle
Stictotarsus							
Family: Hydraenidae							
Hydraena							
SubFamily: Hydroporinae							
Family: Hydrophilidae							
Hydrochus							
Family: Psephenidae							
Family: Staphylinidae							
Order: Diptera							
Family: Ceratopogonidae							
Atrichopogon							
Bezzia/Palpomyia					4	1	13
Culicoides							
Dasyhelea							
Forcipomyia							
Mallochohelea			1				
Probezzia			1				
Sphaeromias							
Family: Chaoboridae							
Eucorethra							
Family: Chironomidae							
SubFamily: Chironominae							
Fissimentum							
Tribe: Chironomini							
Chironomus						49	13
Cryptochironomus							

Site	WIS	WIS	WIS	WIS	WIS	WIS	WIS
Year	2010	2010	2010	2010	2010	2010	2010
CC#	CC120821	CC111064	CC111084	CC111065	CC111085	CC111066	CC111086
Habitat	Pool	Riffle	Riffle	Pool	Pool	Riffle	Riffle
Endochironomus				4			
Microtendipes							
Microtendipes pedellus							
Phaenopsectra							
Polypedilum		30					
Stictochironomus						22	22
Tribelos							
Tribe: Tanytarsini							
Cladotanytarsus		55					
Micropsectra			971		568	16	22
Paratanytarsus							
Rheotanytarsus							17
Tanytarsus	127						
SubFamily: Diamesinae							
Protanypus							
Tribe: Diamesini							
Pagastia							
Potthastia							
SubFamily: Orthocladiinae	47		20				
Brillia							
Cricotopus							
Diplocladius		20					
Diplocladius cultriger							
Eukiefferiella		29					
Georthocladius							
Heterotanytarsus							

Site	WIS	WIS	WIS	WIS	WIS	WIS	WIS
Year	2010	2010	2010	2010	2010	2010	2010
CC#	CC120821	CC111064	CC111084	CC111065	CC111085	CC111066	CC111086
Habitat	Pool	Riffle	Riffle	Pool	Pool	Riffle	Riffle
Heterotrissocladius							
Hydrobaenus							
Limnophyes		23				16	
Metriocnemus							
Nanocladius							
Orthocladius							
Orthocladius complex							
Parakiefferiella							
Paralimnophyes arcticus							
Paraphaenocladius							
Psectrocladius			10	68			770
Psiloptarus						144	
Pseudosmittia							
Rheocricotopus				4			
Tvetenia							
Tvetenia bavarica							
Tvetenia vitracies		48					
Zalutschia							
Zalutschia briani							
Zalutschia tatrica							
Zalutschia zalutschicola							
Tribe: Corynoneurini							
Corynoneura	80	18	47		50		
Tribe: Orthocladiini							
Chaetocladius				8			
SubFamily: Podonominae							

Site	WIS	WIS	WIS	WIS	WIS	WIS	WIS
Year	2010	2010	2010	2010	2010	2010	2010
CC#	CC120821	CC111064	CC111084	CC111065	CC111085	CC111066	CC111086
Habitat	Pool	Riffle	Riffle	Pool	Pool	Riffle	Riffle
Lasiodiamesa							
Paraboreochlus							
Trichotanypus							
SubFamily: Prodiamesinae							
Prodiamesa							
Tribe: Boreochlini							
Boreochlus							
SubFamily: Tanypodinae							
Labrundinia							
Tribe: Pentaneuriini							
Ablabesmyia						57	
Nilotanypus							
Thienemannimyia							
Tribe: Procladiini							
Djalma batista							
Procladius		1	64		39		
Family: Dixidae							
Dixella							
Family: Dolichopodidae							
Rhaphium							
Family: Empididae							
Clinocera			1		7		
Chelifera/Metachela							
Oreogeton							
Family: Muscidae							
Limnophora							

Site	WIS	WIS	WIS	WIS	WIS	WIS	WIS
Year	2010	2010	2010	2010	2010	2010	2010
CC#	CC120821	CC111064	CC111084	CC111065	CC111085	CC111066	CC111086
Habitat	Pool	Riffle	Riffle	Pool	Pool	Riffle	Riffle
Family: Simuliidae					4		
Prosimulium							
Simulium	33	45	39				
Family: Tipulidae							
Erioptera							
Limnophila							
Ormosia							
Tipula							
Order: Hemiptera							
Family: Corixidae							
Sigara							
Family: Gerridae							
Gerris							
Order: Lepidoptera							
Family: Noctuidae							
Order: Odonata							
Subphylum: Crustacea							
Class: Malacostraca							
Order: Amphipoda							
Subphylum: Chelicerata							
Class: Arachnida							
Order: Trombidiformes							
SubOrder: Prostigmata	1	2					
Neobrachypoda							
Pionopsis							
Family: Arrenuridae							

Site	WIS	WIS	WIS	WIS	WIS	WIS	WIS
Year	2010	2010	2010	2010	2010	2010	2010
CC#	CC120821	CC111064	CC111084	CC111065	CC111085	CC111066	CC111086
Habitat	Pool	Riffle	Riffle	Pool	Pool	Riffle	Riffle
Arrenurus							
Family: Hydryphantidae							
Family: Hygrobatidae							
Hygrobates							
Family: Lebertiidae							
Lebertia							
Family: Limnesiidae							
Limnesia							
Family: Limnocharidae							
Limnochares							
Family: Mideopsidae							
Mideopsis							
Family: Oxidae							
Oxus	1						
Family: Pionidae							
Piona							
Family: Sperchontidae							
Sperchon							
Sperchonopsis							
Family: Unionicolidae							
Neumania							4
Family: Halacaridae							
Order: Oribatida							
Family: Hydrozetidae	4	1	8		25	48	13
Phylum: Mollusca							
Class: Bivalvia							

Site	WIS	WIS	WIS	WIS	WIS	WIS	WIS
Year	2010	2010	2010	2010	2010	2010	2010
CC#	CC120821	CC111064	CC111084	CC111065	CC111085	CC111066	CC111086
Habitat	Pool	Riffle	Riffle	Pool	Pool	Riffle	Riffle
Order: Veneroida							
Family: Pisidiidae							
Pisidium				4			
Class: Gastropoda							
Order: Heterostropha							
Family: Valvatidae		1					
Phylum: Annelida							
Subphylum: Clitellata							
Class: Oligochaeta							
Order: Lumbriculida							
Family: Lumbriculidae		3	1			2	
Order: Tubificida							
Family: Enchytraeidae							
Enchytraeus			8				
Family: Lumbricidae							
Family: Naididae	32	2	25		79		4
Chaetogaster							
Chaetogaster diaphanus							
Nais							
Pristina							
Family: Tubificidae							
Phylum: Cnidaria							
Class: Hydrozoa							
Order: Anthoathecatae							
Family: Hydridae							
Hydra	1						

Site	WIS	WIS	WIS	WIS	WIS	WIS	WIS
Year	2010	2010	2010	2010	2010	2010	2010
CC#	CC120821	CC111064	CC111084	CC111065	CC111085	CC111066	CC111086
Habitat	Pool	Riffle	Riffle	Pool	Pool	Riffle	Riffle
Phylum: Tardigrada	3						

Site	WIS	WIS	WIS	WIS	WIS	WIS	WIS
Year	2010	2010	2010	2010	2010	2010	2010
CC#	CC111067	CC120820	CC111087	CC111088	CC120822	CC120824	CC111068
Habitat	Riffle	Riffle	Pool	Pool	Pool	Pool	Riffle
Phylum: Arthropoda							
Subphylum: Hexapoda							
Class: Insecta							
Order: Ephemeroptera							
Family: Baetidae							
Acerpenna							
Acerpenna pygmaea							
Baetis		7	1				
Baetis bicaudatus			1				
Baetis tricaudatus							
Family: Ephemerellidae							
Caudatella							
Family: Heptageniidae							
Epeorus							
Ironodes							
Rhithrogena							
Family: Leptophlebiidae							
Order: Plecoptera							
Family: Capniidae							
Family: Leuctridae							
Family: Nemouridae							
Amphinemura							
Malenka							
Nemoura							
Ostrocerca							
Zapada							

Site	WIS	WIS	WIS	WIS	WIS	WIS	WIS
Year	2010	2010	2010	2010	2010	2010	2010
CC#	CC111067	CC120820	CC111087	CC111088	CC120822	CC120824	CC111068
Habitat	Riffle	Riffle	Pool	Pool	Pool	Pool	Riffle
Zapada oregonensis							
Family: Perlodidae							
Order: Trichoptera							
Micrasema							
Family: Hydropsychidae							
Hydropsyche							
Family: Hydroptilidae							
Agraylea							
Oxyethira							
Family: Limnephilidae							2
Clostoeca disjuncta							
Ecclisomyia							
Limnephilus		1					
Family: Molannidae							
Molanna flavicornis							
Molanna distinctus							
Family: Phryganeidae							
Agrypnia							
Family: Rhyacophilidae							
Rhyacophila							
Order: Coleoptera							1
Family: Dytiscidae	3			3			
Agabus							1
Colymbetes							
Hydroporus							
Oreodytes							

Site	WIS	WIS	WIS	WIS	WIS	WIS	WIS
Year	2010	2010	2010	2010	2010	2010	2010
CC#	CC111067	CC120820	CC111087	CC111088	CC120822	CC120824	CC111068
Habitat	Riffle	Riffle	Pool	Pool	Pool	Pool	Riffle
Stictotarsus							
Family: Hydraenidae							
Hydraena							
SubFamily: Hydroporinae							
Family: Hydrophilidae							
Hydrochus							
Family: Psephenidae							
Family: Staphylinidae							
Order: Diptera							
Family: Ceratopogonidae							
Atrichopogon							
Bezzia/Palpomyia	1	1	1	3		4	1
Culicoides							
Dasyhelea							
Forcipomyia							
Mallochohelea	1						
Probezzia							
Sphaeromias							
Family: Chaoboridae							
Eucorethra							
Family: Chironomidae	1						
SubFamily: Chironominae							
Fissimentum							
Tribe: Chironomini							
Chironomus	35						
Cryptochironomus							

Site	WIS	WIS	WIS	WIS	WIS	WIS	WIS
Year	2010	2010	2010	2010	2010	2010	2010
CC#	CC111067	CC120820	CC111087	CC111088	CC120822	CC120824	CC111068
Habitat	Riffle	Riffle	Pool	Pool	Pool	Pool	Riffle
Endochironomus							
Microtendipes							
Microtendipes pedellus							
Phaenopsectra					34		
Polypedilum							
Stictochironomus	26		10	14			
Tribelos			60				
Tribe: Tanytarsini							
Cladotanytarsus						8	
Micropsectra			35				
Paratanytarsus							
Rheotanytarsus							
Tanytarsus		1				8	
SubFamily: Diamesinae							
Protanypus							
Tribe: Diamesini							
Pagastia							
Potthastia							
SubFamily: Orthocladiinae							45
Brillia					1		
Cricotopus							
Diplocladius							
Diplocladius cultriger						880	21
Eukiefferiella							13
Georthocladius							
Heterotanytarsus							

Site	WIS	WIS	WIS	WIS	WIS	WIS	WIS
Year	2010	2010	2010	2010	2010	2010	2010
CC#	CC111067	CC120820	CC111087	CC111088	CC120822	CC120824	CC111068
Habitat	Riffle	Riffle	Pool	Pool	Pool	Pool	Riffle
Heterotrissocladius							
Hydrobaenus							
Limnophyes						4	
Metriocnemus							
Nanocladius							
Orthocladius							
Orthocladius complex							
Parakiefferiella							
Paralimnophyes arcticus							
Paraphaenocladius							
Psectrocladius		7	85	63	11	56	
Psiloptarus	22						
Pseudosmittia							
Rheocricotopus	300	4				100	58
Tvetenia							
Tvetenia bavarica							
Tvetenia vitracies							
Zalutschia							
Zalutschia briani							
Zalutschia tatrica							
Zalutschia zalutschicola							
Tribe: Corynoneurini							
Corynoneura	11	160		6	17	64	
Tribe: Orthocladiini							
Chaetocladius							
SubFamily: Podonominae							

Site	WIS	WIS	WIS	WIS	WIS	WIS	WIS
Year	2010	2010	2010	2010	2010	2010	2010
CC#	CC111067	CC120820	CC111087	CC111088	CC120822	CC120824	CC111068
Habitat	Riffle	Riffle	Pool	Pool	Pool	Pool	Riffle
Lasiodiamesa							
Paraboreochlus							3
Trichotanypus							
SubFamily: Prodiamesinae							
Prodiamesa							3
Tribe: Boreochlini							
Boreochlus							
SubFamily: Tanypodinae							
Labrundinia							
Tribe: Pentaneuriini							
Ablabesmyia							
Nilotanypus							
Thienemannimyia							
Tribe: Procladiini							
Djalma batista	3						
Procladius		1	45				
Family: Dixidae							
Dixella							
Family: Dolichopodidae							
Rhaphium							
Family: Empididae							
Clinocera							
Chelifera/Metachela							
Oreogeton							
Family: Muscidae							
Limnophora							

Site	WIS	WIS	WIS	WIS	WIS	WIS	WIS
Year	2010	2010	2010	2010	2010	2010	2010
CC#	CC111067	CC120820	CC111087	CC111088	CC120822	CC120824	CC111068
Habitat	Riffle	Riffle	Pool	Pool	Pool	Pool	Riffle
Family: Simuliidae				3			
Prosimulium							
Simulium	7				2	48	44
Family: Tipulidae							
Erioptera							
Limnophila							
Ormosia	1						
Tipula							
Order: Hemiptera							
Family: Corixidae							
Sigara							
Family: Gerridae							
Gerris							
Order: Lepidoptera							
Family: Noctuidae							
Order: Odonata							
Subphylum: Crustacea							
Class: Malacostraca							
Order: Amphipoda							
Subphylum: Chelicerata							
Class: Arachnida							
Order: Trombidiformes							
SubOrder: Prostigmata		3			4		2
Neobrachypoda							
Pionopsis							
Family: Arrenuridae							

Site	WIS	WIS	WIS	WIS	WIS	WIS	WIS
Year	2010	2010	2010	2010	2010	2010	2010
CC#	CC111067	CC120820	CC111087	CC111088	CC120822	CC120824	CC111068
Habitat	Riffle	Riffle	Pool	Pool	Pool	Pool	Riffle
Arrenurus							
Family: Hydryphantidae							
Family: Hygrobatidae							
Hygrobates							
Family: Lebertiidae							
Lebertia							
Family: Limnesiidae							
Limnesia							
Family: Limnocharidae							
Limnochares							
Family: Mideopsidae							
Mideopsis							
Family: Oxidae							
Oxus							
Family: Pionidae							
Piona							
Family: Sperchontidae							
Sperchon							
Sperchonopsis							
Family: Unionicolidae							
Neumania	2		2				
Family: Halacaridae							
Order: Oribatida							
Family: Hydrozetidae	1	3	2	6	5	44	17
Phylum: Mollusca							
Class: Bivalvia							

Site	WIS	WIS	WIS	WIS	WIS	WIS	WIS
Year	2010	2010	2010	2010	2010	2010	2010
CC#	CC111067	CC120820	CC111087	CC111088	CC120822	CC120824	CC111068
Habitat	Riffle	Riffle	Pool	Pool	Pool	Pool	Riffle
Order: Veneroida							
Family: Pisidiidae							
Pisidium							
Class: Gastropoda							
Order: Heterostropha							
Family: Valvatidae							
Phylum: Annelida							
Subphylum: Clitellata							
Class: Oligochaeta							
Order: Lumbriculida							
Family: Lumbriculidae	3		3	9	4		
Order: Tubificida							
Family: Enchytraeidae							
Enchytraeus							
Family: Lumbricidae							
Family: Naididae		5	3	3	2	32	5
Chaetogaster							
Chaetogaster diaphanus							
Nais							
Pristina							
Family: Tubificidae							
Phylum: Cnidaria							
Class: Hydrozoa							
Order: Anthoathecatae							
Family: Hydridae							
Hydra							

Site	WIS	WIS	WIS	WIS	WIS	WIS	WIS
Year	2010	2010	2010	2010	2010	2010	2010
CC#	CC111067	CC120820	CC111087	CC111088	CC120822	CC120824	CC111068
Habitat	Riffle	Riffle	Pool	Pool	Pool	Pool	Riffle
Phylum: Tardigrada		3				48	

Site	WIS
Year	2010
CC#	CC120823
Habitat	Riffle
Phylum: Arthropoda	
Subphylum: Hexapoda	
Class: Insecta	
Order: Ephemeroptera	
Family: Baetidae	
Acerpenna	
Acerpenna pygmaea	
Baetis	44
Baetis bicaudatus	
Baetis tricaudatus	
Family: Ephemerellidae	
Caudatella	
Family: Heptageniidae	
Epeorus	
Ironodes	
Rhithrogena	
Family: Leptophlebiidae	
Order: Plecoptera	
Family: Capniidae	
Family: Leuctridae	
Family: Nemouridae	
Amphinemura	
Malenka	
Nemoura	
Ostrocerca	
Zapada	

Site	WIS
Year	2010
CC#	CC120823
Habitat	Riffle
Zapada oregonensis	
Family: Perlodidae	
Order: Trichoptera	4
Micrasema	
Family: Hydropsychidae	
Hydropsyche	
Family: Hydroptilidae	
Agraylea	
Oxyethira	
Family: Limnephilidae	
Clostoeca disjuncta	
Ecclisomyia	
Limnephilus	8
Family: Molannidae	
Molanna flavicornis	
Molanna distinctus	
Family: Phryganeidae	
Agrypnia	
Family: Rhyacophilidae	
Rhyacophila	
Order: Coleoptera	
Family: Dytiscidae	
Agabus	
Colymbetes	
Hydroporus	
Oreodytes	

Site	WIS
Year	2010
CC#	CC120823
Habitat	Riffle
Stictotarsus	
Family: Hydraenidae	
Hydraena	
SubFamily: Hydroporinae	
Family: Hydrophilidae	
Hydrochus	
Family: Psephenidae	
Family: Staphylinidae	
Order: Diptera	
Family: Ceratopogonidae	
Atrichopogon	
Bezzia/Palpomyia	
Culicoides	
Dasyhelea	
Forcipomyia	
Mallochohelea	4
Probezzia	
Sphaeromias	
Family: Chaoboridae	
Eucorethra	
Family: Chironomidae	
SubFamily: Chironominae	
Fissimentum	
Tribe: Chironomini	
Chironomus	
Cryptochironomus	

Site	WIS
Year	2010
CC#	CC120823
Habitat	Riffle
Endochironomus	
Microtendipes	
Microtendipes pedellus	
Phaenopsectra	
Polypedilum	
Stictochironomus	
Tribelos	
Tribe: Tanytarsini	
Cladotanytarsus	
Micropsectra	
Paratanytarsus	
Rheotanytarsus	
Tanytarsus	32
SubFamily: Diamesinae	
Protanypus	
Tribe: Diamesini	
Pagastia	
Potthastia	
SubFamily: Orthocladiinae	
Brillia	
Cricotopus	
Diplocladius	
Diplocladius cultriger	28
Eukiefferiella	
Georthocladius	
Heterotanytarsus	

Site	WIS
Year	2010
CC#	CC120823
Habitat	Riffle
Heterotrissocladius	
Hydrobaenus	
Limnophyes	
Metriocnemus	
Nanocladius	
Orthocladius	
Orthocladius complex	
Parakiefferiella	
Paralimnophyes arcticus	
Paraphaenocladius	
Psectrocladius	36
Psiloptarus	
Pseudosmittia	8
Rheocricotopus	
Tvetenia	
Tvetenia bavarica	
Tvetenia vitracies	
Zalutschia	
Zalutschia briani	
Zalutschia tatrica	
Zalutschia zalutschicola	
Tribe: Corynoneurini	
Corynoneura	820
Tribe: Orthocladiini	
Chaetocladius	
SubFamily: Podonominae	

Site	WIS
Year	2010
CC#	CC120823
Habitat	Riffle
Lasiodiamesa	
Paraboreochlus	
Trichotanypus	8
SubFamily: Prodiamesinae	
Prodiamesa	
Tribe: Boreochlini	
Boreochlus	
SubFamily: Tanypodinae	
Labrundinia	
Tribe: Pentaneuriini	
Ablabesmyia	
Nilotanypus	
Thienemannimyia	
Tribe: Procladiini	
Djalma batista	
Procladius	
Family: Dixidae	
Dixella	4
Family: Dolichopodidae	
Rhaphium	
Family: Empididae	
Clinocera	
Chelifera/Metachela	
Oreogeton	
Family: Muscidae	
Limnophora	

Site	WIS
Year	2010
CC#	CC120823
Habitat	Riffle
Family: Simuliidae	
Prosimulium	
Simulium	4
Family: Tipulidae	
Erioptera	
Limnophila	
Ormosia	
Tipula	
Order: Hemiptera	
Family: Corixidae	
Sigara	
Family: Gerridae	
Gerris	
Order: Lepidoptera	
Family: Noctuidae	
Order: Odonata	4
Subphylum: Crustacea	
Class: Malacostraca	
Order: Amphipoda	
Subphylum: Chelicerata	
Class: Arachnida	
Order: Trombidiformes	
SubOrder: Prostigmata	
Neobrachypoda	
Pionopsis	
Family: Arrenuridae	

Site	WIS
Year	2010
CC#	CC120823
Habitat	Riffle
Arrenurus	
Family: Hydryphantidae	
Family: Hygrobatidae	
Hygrobates	
Family: Lebertiidae	
Lebertia	
Family: Limnesiidae	
Limnesia	
Family: Limnocharidae	
Limnochares	
Family: Mideopsidae	
Mideopsis	
Family: Oxidae	
Oxus	
Family: Pionidae	
Piona	
Family: Sperchontidae	
Sperchon	
Sperchonopsis	
Family: Unionicolidae	
Neumania	
Family: Halacaridae	
Order: Oribatida	
Family: Hydrozetidae	48
Phylum: Mollusca	
Class: Bivalvia	

Site	WIS
Year	2010
CC#	CC120823
Habitat	Riffle
Order: Veneroida	
Family: Pisidiidae	
Pisidium	
Class: Gastropoda	
Order: Heterostropha	
Family: Valvatidae	
Phylum: Annelida	
Subphylum: Clitellata	
Class: Oligochaeta	
Order: Lumbriculida	
Family: Lumbriculidae	
Order: Tubificida	
Family: Enchytraeidae	
Enchytraeus	20
Family: Lumbricidae	
Family: Naididae	16
Chaetogaster	
Chaetogaster diaphanus	
Nais	
Pristina	
Family: Tubificidae	
Phylum: Cnidaria	
Class: Hydrozoa	
Order: Anthoathecatae	
Family: Hydridae	
Hydra	

Site	WIS
Year	2010
CC#	CC120823
Habitat	Riffle
Phylum: Tardigrada	8

Table A1-2: 2011 Raw Invertebrate Data.

Site	R2S	R2S	R2S	R2S	R2S	R2S	R6S1
Year	2011	2011	2011	2011	2011	2011	2011
CC#	CC121500	CC121501	CC121502	CC121503	CC121504	CC121505	CC121506
Habitat	Pool	Pool	Riffle	Riffle	Riffle	Riffle	Riffle
Phylum: Arthropoda							
Subphylum: Hexapoda							
Class: Insecta							
Order: Ephemeroptera							
Family: Baetidae							
Acerpenna							
Acerpenna pygmaea							
Baetis							
Baetis bicaudatus							
Baetis tricaudatus							
Family: Ephemerellidae							
Caudatella							
Family: Heptageniidae							
Epeorus							
Ironodes							
Rhithrogena							
Family: Leptophlebiidae							
Order: Plecoptera							
Family: Capniidae							
Family: Leuctridae							
Family: Nemouridae							
Amphinemura							
Malenka							
Nemoura							
Ostrocerca							
Zapada							

Site	R2S	R2S	R2S	R2S	R2S	R2S	R6S1
Year	2011	2011	2011	2011	2011	2011	2011
CC#	CC121500	CC121501	CC121502	CC121503	CC121504	CC121505	CC121506
Habitat	Pool	Pool	Riffle	Riffle	Riffle	Riffle	Riffle
Zapada oregonensis							
Family: Perlodidae							
Order: Trichoptera						1	
Micrasema							
Family: Hydropsychidae							
Hydropsyche							
Family: Hydroptilidae							
Agraylea							
Oxyethira							
Family: Limnephilidae		2	1	12	2	2	
Clostoeca disjuncta							
Ecclisomyia				2		1	
Limnephilus							
Family: Molannidae							
Molanna flavicornis							
Molanna distinctus							
Family: Phryganeidae							
Agrypnia							
Family: Rhyacophilidae							
Rhyacophila							
Order: Coleoptera							
Family: Dytiscidae		2	1	6	7	1	
Agabus							
Colymbetes							
Hydroporus							
Oreodytes							

Site	R2S	R2S	R2S	R2S	R2S	R2S	R6S1
Year	2011	2011	2011	2011	2011	2011	2011
CC#	CC121500	CC121501	CC121502	CC121503	CC121504	CC121505	CC121506
Habitat	Pool	Pool	Riffle	Riffle	Riffle	Riffle	Riffle
Stictotarsus							
Family: Hydraenidae							
Hydraena							
SubFamily: Hydroporinae							
Family: Hydrophilidae							
Hydrochus							
Family: Psephenidae							
Family: Staphylinidae							
Order: Diptera							
Family: Ceratopogonidae						1	
Atrichopogon							
Bezzia/Palpomyia	8	11	10	40	1	2	36
Culicoides							
Dasyhelea							
Forcipomyia							
Mallochohelea							73
Probezzia							36
Sphaeromias							
Family: Chaoboridae							
Eucorethra							
Family: Chironomidae							
SubFamily: Chironominae							
Fissimentum							
Tribe: Chironomini							
Chironomus		2					
Cryptochironomus							

Site	R2S	R2S	R2S	R2S	R2S	R2S	R6S1
Year	2011	2011	2011	2011	2011	2011	2011
CC#	CC121500	CC121501	CC121502	CC121503	CC121504	CC121505	CC121506
Habitat	Pool	Pool	Riffle	Riffle	Riffle	Riffle	Riffle
Endochironomus							
Microtendipes							
Microtendipes pedellus							
Phaenopsectra							
Polypedilum				10			
Stictochironomus							
Tribelos							
Tribe: Tanytarsini						12	
Cladotanytarsus							
Micropsectra							
Paratanytarsus							109
Rheotanytarsus							
Tanytarsus		12					545
SubFamily: Diamesinae							
Protanypus							
Tribe: Diamesini							
Pagastia							
Potthastia							
SubFamily: Orthocladiinae	32	267		350	63	25	727
Brillia							
Cricotopus							
Diplocladius							
Diplocladius cultriger							327
Eukiefferiella	16						
Georthocladius							
Heterotanytarsus							

Site	R2S	R2S	R2S	R2S	R2S	R2S	R6S1
Year	2011	2011	2011	2011	2011	2011	2011
CC#	CC121500	CC121501	CC121502	CC121503	CC121504	CC121505	CC121506
Habitat	Pool	Pool	Riffle	Riffle	Riffle	Riffle	Riffle
Heterotrissocladius							
Hydrobaenus							
Limnophyes							
Metriocnemus							
Nanocladius							
Orthocladius	296						
Orthocladius complex		123	165	140	177	31	509
Parakiefferiella							
Paralimnophyes arcticus	64		2		11	14	
Paraphaenocladius							
Psectrocladius		36		10			
Psiloptarus							
Pseudosmittia							
Rheocricotopus							
Tvetenia							
Tvetenia bavarica							
Tvetenia vitracies							
Zalutschia							
Zalutschia briani					17	15	
Zalutschia tatrica							
Zalutschia zalutschicola							
Tribe: Corynoneurini							
Corynoneura	32		2	6	8		182
Tribe: Orthocladiini							
Chaetocladius							
SubFamily: Podonominae							

Site	R2S	R2S	R2S	R2S	R2S	R2S	R6S1
Year	2011	2011	2011	2011	2011	2011	2011
CC#	CC121500	CC121501	CC121502	CC121503	CC121504	CC121505	CC121506
Habitat	Pool	Pool	Riffle	Riffle	Riffle	Riffle	Riffle
Lasiodiamesa							
Paraboreochlus							
Trichotanypus							
SubFamily: Prodiamesinae							
Prodiamesa							
Tribe: Boreochlini							
Boreochlus							
SubFamily: Tanypodinae							
Labrundinia							
Tribe: Pentaneuriini							
Ablabesmyia							
Nilotanypus							
Thienemannimyia							
Tribe: Procladiini							
Djalma batista							
Procladius			1				
Family: Dixidae							
Dixella							
Family: Dolichopodidae							
Rhaphium							
Family: Empididae							
Clinocera							
Chelifera/Metachela							
Oreogeton							
Family: Muscidae							
Limnophora							

Site	R2S	R2S	R2S	R2S	R2S	R2S	R6S1
Year	2011	2011	2011	2011	2011	2011	2011
CC#	CC121500	CC121501	CC121502	CC121503	CC121504	CC121505	CC121506
Habitat	Pool	Pool	Riffle	Riffle	Riffle	Riffle	Riffle
Family: Simuliidae						1	32655
Prosimulium							
Simulium	3472	84	43	14	35		
Family: Tipulidae							
Erioptera							
Limnophila							
Ormosia							
Tipula							
Order: Hemiptera							
Family: Corixidae							
Sigara							
Family: Gerridae							
Gerris							
Order: Lepidoptera							
Family: Noctuidae							
Order: Odonata							
Subphylum: Crustacea							
Class: Malacostraca							
Order: Amphipoda							
Subphylum: Chelicerata							
Class: Arachnida							
Order: Trombidiformes							
SubOrder: Prostigmata	8						
Neobrachypoda							
Pionopsis							
Family: Arrenuridae							

Site	R2S	R2S	R2S	R2S	R2S	R2S	R6S1
Year	2011	2011	2011	2011	2011	2011	2011
CC#	CC121500	CC121501	CC121502	CC121503	CC121504	CC121505	CC121506
Habitat	Pool	Pool	Riffle	Riffle	Riffle	Riffle	Riffle
Arrenurus							
Family: Hydryphantidae							
Family: Hygrobatidae							
Hygrobates							
Family: Lebertiidae							
Lebertia							
Family: Limnesiidae							
Limnesia							
Family: Limnocharidae							
Limnochares							
Family: Mideopsidae							
Mideopsis							
Family: Oxidae							
Oxus							
Family: Pionidae							
Piona							
Family: Sperchontidae							
Sperchon							
Sperchonopsis							
Family: Unionicolidae							
Neumania							
Family: Halacaridae							
Order: Oribatida							
Family: Hydrozetidae		5	17	30	15	16	73
Phylum: Mollusca							
Class: Bivalvia							

Site	R2S	R2S	R2S	R2S	R2S	R2S	R6S1
Year	2011	2011	2011	2011	2011	2011	2011
CC#	CC121500	CC121501	CC121502	CC121503	CC121504	CC121505	CC121506
Habitat	Pool	Pool	Riffle	Riffle	Riffle	Riffle	Riffle
Order: Veneroida							
Family: Pisidiidae							
Pisidium		21					
Class: Gastropoda							
Order: Heterostropha							
Family: Valvatidae							
Phylum: Annelida							
Subphylum: Clitellata							
Class: Oligochaeta							
Order: Lumbriculida							
Family: Lumbriculidae						1	
Order: Tubificida							
Family: Enchytraeidae				16			
Enchytraeus							
Family: Lumbricidae							
Family: Naididae	8	5	4		16	13	73
Chaetogaster							
Chaetogaster diaphanus							
Nais							
Pristina							
Family: Tubificidae							
Phylum: Cnidaria							
Class: Hydrozoa							
Order: Anthoathecatae							
Family: Hydridae							
Hydra							

Site	R2S	R2S	R2S	R2S	R2S	R2S	R6S1
Year	2011	2011	2011	2011	2011	2011	2011
CC#	CC121500	CC121501	CC121502	CC121503	CC121504	CC121505	CC121506
Habitat	Pool	Pool	Riffle	Riffle	Riffle	Riffle	Riffle
Phylum: Tardigrada		4					

Site	R6S1	R6S1	R6S1	R6S1	R6S1	R6S2	R6S2
Year	2011	2011	2011	2011	2011	2011	2011
CC#	CC121507	CC121508	CC121509	CC121510	CC121511	CC121512	CC121513
Habitat	Pool	Riffle	Pool	Pool	Riffle	Riffle	Pool
Phylum: Arthropoda							
Subphylum: Hexapoda							
Class: Insecta							
Order: Ephemeroptera							
Family: Baetidae							
Acerpenna							
Acerpenna pygmaea							
Baetis							
Baetis bicaudatus							
Baetis tricaudatus		8				8	
Family: Ephemerellidae							
Caudatella							
Family: Heptageniidae							
Epeorus							
Ironodes							
Rhithrogena							
Family: Leptophlebiidae							
Order: Plecoptera	8	192	21	2	1	104	
Family: Capniidae							
Family: Leuctridae							
Family: Nemouridae		8					
Amphinemura		24		2		8	
Malenka					3		
Nemoura							
Ostrocerca							
Zapada							

Site	R6S1	R6S1	R6S1	R6S1	R6S1	R6S2	R6S2
Year	2011	2011	2011	2011	2011	2011	2011
CC#	CC121507	CC121508	CC121509	CC121510	CC121511	CC121512	CC121513
Habitat	Pool	Riffle	Pool	Pool	Riffle	Riffle	Pool
Zapada oregonensis							
Family: Perlodidae							
Order: Trichoptera	8	56			10		
Micrasema							
Family: Hydropsychidae							
Hydropsyche							
Family: Hydroptilidae					1		
Agraylea					1		
Oxyethira							
Family: Limnephilidae				2			8
Clostoeca disjuncta							
Ecclisomyia							
Limnephilus							
Family: Molannidae							
Molanna flavicornis							
Molanna distinctus							
Family: Phryganeidae							
Agrypnia						8	
Family: Rhyacophilidae							
Rhyacophila							
Order: Coleoptera							
Family: Dytiscidae				2			
Agabus							
Colymbetes							
Hydroporus							
Oreodytes							

Site	R6S1	R6S1	R6S1	R6S1	R6S1	R6S2	R6S2
Year	2011	2011	2011	2011	2011	2011	2011
CC#	CC121507	CC121508	CC121509	CC121510	CC121511	CC121512	CC121513
Habitat	Pool	Riffle	Pool	Pool	Riffle	Riffle	Pool
Stictotarsus							
Family: Hydraenidae							
Hydraena							
SubFamily: Hydroporinae							
Family: Hydrophilidae							
Hydrochus							
Family: Psephenidae							
Family: Staphylinidae							
Order: Diptera							
Family: Ceratopogonidae							
Atrichopogon							
Bezzia/Palpomyia	8			6		16	
Culicoides							
Dasyhelea							
Forcipomyia							
Mallochohelea				2			
Probezzia		16				8	
Sphaeromias							
Family: Chaoboridae							
Eucorethra							
Family: Chironomidae							
SubFamily: Chironominae							
Fissimentum							
Tribe: Chironomini							
Chironomus			11				
Cryptochironomus							

Site	R6S1	R6S1	R6S1	R6S1	R6S1	R6S2	R6S2
Year	2011	2011	2011	2011	2011	2011	2011
CC#	CC121507	CC121508	CC121509	CC121510	CC121511	CC121512	CC121513
Habitat	Pool	Riffle	Pool	Pool	Riffle	Riffle	Pool
Endochironomus							
Microtendipes	280		37	14		160	
Microtendipes pedellus							
Phaenopsectra							19
Polypedilum							
Stictochironomus	24		32	18			
Tribelos							
Tribe: Tanytarsini	200	480	693	250	20	1200	
Cladotanytarsus							
Micropsectra	240			16	24	80	
Paratanytarsus							
Rheotanytarsus							
Tanytarsus							35
SubFamily: Diamesinae							
Protanypus							
Tribe: Diamesini							
Pagastia							
Potthastia							
SubFamily: Orthocladiinae	320	640	1013	180	13	1960	
Brillia							
Cricotopus							
Diplocladius							
Diplocladius cultriger							
Eukiefferiella							
Georthocladius							1
Heterotanytarsus							

Site	R6S1	R6S1	R6S1	R6S1	R6S1	R6S2	R6S2
Year	2011	2011	2011	2011	2011	2011	2011
CC#	CC121507	CC121508	CC121509	CC121510	CC121511	CC121512	CC121513
Habitat	Pool	Riffle	Pool	Pool	Riffle	Riffle	Pool
Heterotrissocladius	200					40	7
Hydrobaenus							
Limnophyes							
Metriocnemus						40	
Nanocladius							
Orthocladius							
Orthocladius complex						160	
Parakiefferiella							
Paralimnophyes arcticus					15	240	
Paraphaenocladius							
Psectrocladius							10
Psiloptarus							
Pseudosmittia							
Rheocricotopus							
Tvetenia							
Tvetenia bavarica							
Tvetenia vitracies							
Zalutschia							
Zalutschia briani	2000				7		
Zalutschia tatrica							
Zalutschia zalutschicola							
Tribe: Corynoneurini							
Corynoneura		224	48	36	14	280	
Tribe: Orthocladiini							
Chaetocladius							
SubFamily: Podonominae							

Site	R6S1	R6S1	R6S1	R6S1	R6S1	R6S2	R6S2
Year	2011	2011	2011	2011	2011	2011	2011
CC#	CC121507	CC121508	CC121509	CC121510	CC121511	CC121512	CC121513
Habitat	Pool	Riffle	Pool	Pool	Riffle	Riffle	Pool
Lasiodiamesa							
Paraboreochlus							
Trichotanypus							
SubFamily: Prodiamesinae							
Prodiamesa							
Tribe: Boreochlini							
Boreochlus							8
SubFamily: Tanypodinae							
Labrundinia							
Tribe: Pentaneuriini							
Ablabesmyia							
Nilotanypus							
Thienemannimyia							
Tribe: Procladiini							
Djalma batista							
Procladius	8			2	2		4
Family: Dixidae							
Dixella							
Family: Dolichopodidae							
Rhaphium						8	1
Family: Empididae							
Clinocera						8	
Chelifera/Metachela							
Oreogeton							
Family: Muscidae							
Limnophora							

Site	R6S1	R6S1	R6S1	R6S1	R6S1	R6S2	R6S2
Year	2011	2011	2011	2011	2011	2011	2011
CC#	CC121507	CC121508	CC121509	CC121510	CC121511	CC121512	CC121513
Habitat	Pool	Riffle	Pool	Pool	Riffle	Riffle	Pool
Family: Simuliidae	64		16	4		152	
Prosimulium							
Simulium		304	5			304	1
Family: Tipulidae							
Erioptera							
Limnophila							
Ormosia							
Tipula							
Order: Hemiptera							
Family: Corixidae							
Sigara							
Family: Gerridae							
Gerris							
Order: Lepidoptera							
Family: Noctuidae							
Order: Odonata							
Subphylum: Crustacea							
Class: Malacostraca							
Order: Amphipoda							
Subphylum: Chelicerata							
Class: Arachnida							
Order: Trombidiformes							
SubOrder: Prostigmata	56		5	6	1		
Neobrachypoda							
Pionopsis							
Family: Arrenuridae							

Site	R6S1	R6S1	R6S1	R6S1	R6S1	R6S2	R6S2
Year	2011	2011	2011	2011	2011	2011	2011
CC#	CC121507	CC121508	CC121509	CC121510	CC121511	CC121512	CC121513
Habitat	Pool	Riffle	Pool	Pool	Riffle	Riffle	Pool
Arrenurus							
Family: Hydryphantidae							
Family: Hygrobatidae							
Hygrobates							
Family: Lebertiidae							
Lebertia	8						
Family: Limnesiidae							
Limnesia					1		
Family: Limnocharidae							
Limnochares							
Family: Mideopsidae							
Mideopsis							
Family: Oxidae							
Oxus							
Family: Pionidae							
Piona							
Family: Sperchontidae							
Sperchon							
Sperchonopsis							
Family: Unionicolidae							
Neumania							
Family: Halacaridae	8			2			
Order: Oribatida							
Family: Hydrozetidae	24	192	27	58	3	64	11
Phylum: Mollusca							
Class: Bivalvia							

Site	R6S1	R6S1	R6S1	R6S1	R6S1	R6S2	R6S2
Year	2011	2011	2011	2011	2011	2011	2011
CC#	CC121507	CC121508	CC121509	CC121510	CC121511	CC121512	CC121513
Habitat	Pool	Riffle	Pool	Pool	Riffle	Riffle	Pool
Order: Veneroida							
Family: Pisidiidae							
Pisidium	8						
Class: Gastropoda				2			
Order: Heterostropha							
Family: Valvatidae							
Phylum: Annelida							
Subphylum: Clitellata							
Class: Oligochaeta							
Order: Lumbriculida							
Family: Lumbriculidae				2			
Order: Tubificida							
Family: Enchytraeidae							
Enchytraeus							
Family: Lumbricidae							
Family: Naididae	16	56	21	20	6	120	2
Chaetogaster							
Chaetogaster diaphanus							
Nais							
Pristina							
Family: Tubificidae							
Phylum: Cnidaria							
Class: Hydrozoa							
Order: Anthoathecatae							
Family: Hydridae							
Hydra			16	68	2	8	

Site	R6S1	R6S1	R6S1	R6S1	R6S1	R6S2	R6S2
Year	2011	2011	2011	2011	2011	2011	2011
CC#	CC121507	CC121508	CC121509	CC121510	CC121511	CC121512	CC121513
Habitat	Pool	Riffle	Pool	Pool	Riffle	Riffle	Pool
Phylum: Tardigrada		16		16			

Site	R6S2	R6S2	R6S2	R6S2	WIS	WIS	WIS
Year	2011	2011	2011	2011	2011	2011	2011
CC#	CC121514	CC121515	CC121516	CC121517	CC121518	CC121519	CC121520
Habitat	Pool	Riffle	Riffle	Pool	Pool	Riffle	Riffle
Phylum: Arthropoda							
Subphylum: Hexapoda							
Class: Insecta							
Order: Ephemeroptera							
Family: Baetidae							
Acerpenna							
Acerpenna pygmaea			1				
Baetis		11					
Baetis bicaudatus							
Baetis tricaudatus		9					
Family: Ephemerellidae							
Caudatella							
Family: Heptageniidae							
Epeorus							
Ironodes							
Rhithrogena							
Family: Leptophlebiidae							
Order: Plecoptera							
Family: Capniidae							
Family: Leuctridae							
Family: Nemouridae							
Amphinemura							
Malenka							
Nemoura							
Ostrocerca							
Zapada							

Site	R6S2	R6S2	R6S2	R6S2	WIS	WIS	WIS
Year	2011	2011	2011	2011	2011	2011	2011
CC#	CC121514	CC121515	CC121516	CC121517	CC121518	CC121519	CC121520
Habitat	Pool	Riffle	Riffle	Pool	Pool	Riffle	Riffle
Zapada oregonensis							
Family: Perlodidae							
Order: Trichoptera		2			4		
Micrasema							
Family: Hydropsychidae							
Hydropsyche							
Family: Hydroptilidae							
Agraylea				1			
Oxyethira							
Family: Limnephilidae							
Clostoeca disjuncta							
Ecclisomyia							
Limnephilus							
Family: Molannidae							
Molanna flavicornis							
Molanna distinctus							
Family: Phryganeidae							
Agrypnia							
Family: Rhyacophilidae							
Rhyacophila							
Order: Coleoptera							
Family: Dytiscidae			1				
Agabus							
Colymbetes							
Hydroporus							
Oreodytes							

Site	R6S2	R6S2	R6S2	R6S2	WIS	WIS	WIS
Year	2011	2011	2011	2011	2011	2011	2011
CC#	CC121514	CC121515	CC121516	CC121517	CC121518	CC121519	CC121520
Habitat	Pool	Riffle	Riffle	Pool	Pool	Riffle	Riffle
Stictotarsus							
Family: Hydraenidae							
Hydraena			1				
SubFamily: Hydroporinae							
Family: Hydrophilidae							
Hydrochus							
Family: Psephenidae							
Family: Staphylinidae							
Order: Diptera							
Family: Ceratopogonidae							
Atrichopogon							
Bezzia/Palpomyia	2	5		2	88	44	16
Culicoides							
Dasyhelea							
Forcipomyia							
Mallochohelea		5	1				
Probezzia				2			
Sphaeromias							
Family: Chaoboridae							
Eucorethra							
Family: Chironomidae							
SubFamily: Chironominae							
Fissimentum	4	98					
Tribe: Chironomini							
Chironomus	10				12		
Cryptochironomus					16		40

Site	R6S2	R6S2	R6S2	R6S2	WIS	WIS	WIS
Year	2011	2011	2011	2011	2011	2011	2011
CC#	CC121514	CC121515	CC121516	CC121517	CC121518	CC121519	CC121520
Habitat	Pool	Riffle	Riffle	Pool	Pool	Riffle	Riffle
Endochironomus							
Microtendipes						60	
Microtendipes pedellus							
Phaenopsectra	40						
Polypedilum							
Stictochironomus	10	16			20	112	60
Tribelos							
Tribe: Tanytarsini							
Cladotanytarsus						52	
Micropsectra	490	434	32	94	28		160
Paratanytarsus							
Rheotanytarsus							
Tanytarsus							
SubFamily: Diamesinae							
Protanypus							
Tribe: Diamesini							
Pagastia							
Potthastia							
SubFamily: Orthocladiinae					180	80	
Brillia							
Cricotopus							
Diplocladius							
Diplocladius cultriger							
Eukiefferiella							
Georthocladius							
Heterotanytarsus							

Site	R6S2	R6S2	R6S2	R6S2	WIS	WIS	WIS
Year	2011	2011	2011	2011	2011	2011	2011
CC#	CC121514	CC121515	CC121516	CC121517	CC121518	CC121519	CC121520
Habitat	Pool	Riffle	Riffle	Pool	Pool	Riffle	Riffle
Heterotrissocladius							
Hydrobaenus							
Limnophyes							
Metriocnemus							
Nanocladius							
Orthocladius							
Orthocladius complex							
Parakiefferiella							
Paralimnophyes arcticus		11					
Paraphaenocladius							
Psectrocladius	56	25		7			60
Psiloptarus							
Pseudosmittia							
Rheocricotopus							
Tvetenia			15	43			
Tvetenia bavarica							
Tvetenia vitracies							
Zalutschia							
Zalutschia briani	50			3	260	640	180
Zalutschia tatrica							
Zalutschia zalutschicola							
Tribe: Corynoneurini							
Corynoneura			8	17	92		
Tribe: Orthocladiini							
Chaetocladius							
SubFamily: Podonominae							

Site	R6S2	R6S2	R6S2	R6S2	WIS	WIS	WIS
Year	2011	2011	2011	2011	2011	2011	2011
CC#	CC121514	CC121515	CC121516	CC121517	CC121518	CC121519	CC121520
Habitat	Pool	Riffle	Riffle	Pool	Pool	Riffle	Riffle
Lasiodiamesa							
Paraboreochlus							
Trichotanypus							
SubFamily: Prodiamesinae							
Prodiamesa							
Tribe: Boreochlini							
Boreochlus							
SubFamily: Tanypodinae							
Labrundinia							
Tribe: Pentaneuriini							
Ablabesmyia							
Nilotanypus							
Thienemannimyia							
Tribe: Procladiini							
Djalma batista							
Procladius	4	14			152	140	680
Family: Dixidae							
Dixella							
Family: Dolichopodidae							
Rhaphium							
Family: Empididae							
Clinocera							
Chelifera/Metachela							
Oreogeton							
Family: Muscidae							
Limnophora		2					

Site	R6S2	R6S2	R6S2	R6S2	WIS	WIS	WIS
Year	2011	2011	2011	2011	2011	2011	2011
CC#	CC121514	CC121515	CC121516	CC121517	CC121518	CC121519	CC121520
Habitat	Pool	Riffle	Riffle	Pool	Pool	Riffle	Riffle
Family: Simuliidae		16	1				
Prosimulium							
Simulium		14	9	1		8	
Family: Tipulidae							
Erioptera							
Limnophila							
Ormosia							
Tipula							
Order: Hemiptera							
Family: Corixidae							
Sigara							
Family: Gerridae							
Gerris							
Order: Lepidoptera							
Family: Noctuidae							
Order: Odonata							
Subphylum: Crustacea							
Class: Malacostraca							
Order: Amphipoda							
Subphylum: Chelicerata							
Class: Arachnida							
Order: Trombidiformes							
SubOrder: Prostigmata	8	5			4		4
Neobrachypoda							
Pionopsis							
Family: Arrenuridae							

Site Year CC# Habitat	R6S2 2011 CC121514 Pool	R6S2 2011 CC121515 Riffle	R6S2 2011 CC121516 Riffle	R6S2 2011 CC121517 Pool	WIS 2011 CC121518 Pool	WIS 2011 CC121519 Riffle	WIS 2011 CC121520 Riffle
Arrenurus							
Family: Hydryphantidae							
Family: Hygrobatidae							
Hygrobates							
Family: Lebertiidae							
Lebertia		2		4		4	4
Family: Limnesiidae							
Limnesia							
Family: Limnocharidae							
Limnochares							
Family: Mideopsidae							
Mideopsis							
Family: Oxidae							
Oxus							
Family: Pionidae							
Piona							
Family: Sperchontidae							
Sperchon							
Sperchonopsis							
Family: Unionicolidae							
Neumania							
Family: Halacaridae							
Order: Oribatida							
Family: Hydrozetidae	14	34	3	7	4	76	44
Phylum: Mollusca							
Class: Bivalvia							

Site	R6S2	R6S2	R6S2	R6S2	WIS	WIS	WIS
Year	2011	2011	2011	2011	2011	2011	2011
CC#	CC121514	CC121515	CC121516	CC121517	CC121518	CC121519	CC121520
Habitat	Pool	Riffle	Riffle	Pool	Pool	Riffle	Riffle
Order: Veneroida							
Family: Pisidiidae					28	12	
Pisidium					20	8	
Class: Gastropoda							
Order: Heterostropha							
Family: Valvatidae							
Phylum: Annelida							
Subphylum: Clitellata							
Class: Oligochaeta	2		1				
Order: Lumbriculida							
Family: Lumbriculidae	6				12	4	
Order: Tubificida							
Family: Enchytraeidae							
Enchytraeus							
Family: Lumbricidae							
Family: Naididae	26	43	14	20			
Chaetogaster							
Chaetogaster diaphanus							
Nais							
Pristina							
Family: Tubificidae							
Phylum: Cnidaria							
Class: Hydrozoa							
Order: Anthoathecatae							
Family: Hydridae							
Hydra							

Site	R6S2	R6S2	R6S2	R6S2	WIS	WIS	WIS
Year	2011	2011	2011	2011	2011	2011	2011
CC#	CC121514	CC121515	CC121516	CC121517	CC121518	CC121519	CC121520
Habitat	Pool	Riffle	Riffle	Pool	Pool	Riffle	Riffle
Phylum: Tardigrada	6	57					

Site	WIS	WIS	WIS	WIS	WIS	WIS	WIS
Year	2011	2011	2011	2011	2011	2011	2011
CC#	CC121521	CC121522	CC121523	CC121524	CC121525	CC121526	CC121527
Habitat	Pool	Riffle	Riffle	Riffle	Pool	Pool	Riffle
Phylum: Arthropoda							
Subphylum: Hexapoda							
Class: Insecta							
Order: Ephemeroptera							
Family: Baetidae			1				
Acerpenna							
Acerpenna pygmaea							
Baetis							
Baetis bicaudatus							
Baetis tricaudatus							
Family: Ephemerellidae							
Caudatella							
Family: Heptageniidae							
Epeorus							
Ironodes							
Rhithrogena							
Family: Leptophlebiidae							
Order: Plecoptera				3			
Family: Capniidae							
Family: Leuctridae							
Family: Nemouridae							
Amphinemura							
Malenka							
Nemoura							
Ostrocerca							
Zapada							

Site	WIS	WIS	WIS	WIS	WIS	WIS	WIS
Year	2011	2011	2011	2011	2011	2011	2011
CC#	CC121521	CC121522	CC121523	CC121524	CC121525	CC121526	CC121527
Habitat	Pool	Riffle	Riffle	Riffle	Pool	Pool	Riffle
Zapada oregonensis							
Family: Perlodidae							
Order: Trichoptera		8				2	2
Micrasema							
Family: Hydropsychidae							
Hydropsyche							
Family: Hydroptilidae							
Agraylea			1				
Oxyethira							
Family: Limnephilidae			5				
Clostoeca disjuncta							
Ecclisomyia							
Limnephilus							
Family: Molannidae							
Molanna flavicornis							
Molanna distinctus							
Family: Phryganeidae							
Agrypnia							
Family: Rhyacophilidae							
Rhyacophila							
Order: Coleoptera							
Family: Dytiscidae			8				
Agabus							
Colymbetes							
Hydroporus							
Oreodytes							

Site	WIS	WIS	WIS	WIS	WIS	WIS	WIS
Year	2011	2011	2011	2011	2011	2011	2011
CC#	CC121521	CC121522	CC121523	CC121524	CC121525	CC121526	CC121527
Habitat	Pool	Riffle	Riffle	Riffle	Pool	Pool	Riffle
Stictotarsus							
Family: Hydraenidae							
Hydraena							
SubFamily: Hydroporinae							
Family: Hydrophilidae							
Hydrochus							
Family: Psephenidae							
Family: Staphylinidae							
Order: Diptera							
Family: Ceratopogonidae							
Atrichopogon							
Bezzia/Palpomyia	5		1	8			2
Culicoides							
Dasyhelea							
Forcipomyia							
Mallochohelea							
Probezzia							
Sphaeromias							
Family: Chaoboridae							
Eucorethra							
Family: Chironomidae							
SubFamily: Chironominae							
Fissimentum							
Tribe: Chironomini							
Chironomus							
Cryptochironomus							

Site	WIS	WIS	WIS	WIS	WIS	WIS	WIS
Year	2011	2011	2011	2011	2011	2011	2011
CC#	CC121521	CC121522	CC121523	CC121524	CC121525	CC121526	CC121527
Habitat	Pool	Riffle	Riffle	Riffle	Pool	Pool	Riffle
Endochironomus							
Microtendipes							
Microtendipes pedellus							
Phaenopsectra							
Polypedilum							
Stictochironomus	107	80	15				
Tribelos							
Tribe: Tanytarsini	293						
Cladotanytarsus	107						
Micropsectra				413	1260	304	190
Paratanytarsus		12					
Rheotanytarsus							
Tanytarsus	80	300	24				
SubFamily: Diamesinae							
Protanypus							
Tribe: Diamesini							
Pagastia							
Potthastia							
SubFamily: Orthocladiinae				200	44	40	170
Brillia							
Cricotopus							
Diplocladius							
Diplocladius cultriger							
Eukiefferiella							
Georthocladius							
Heterotanytarsus							

Site	WIS	WIS	WIS	WIS	WIS	WIS	WIS
Year	2011	2011	2011	2011	2011	2011	2011
CC#	CC121521	CC121522	CC121523	CC121524	CC121525	CC121526	CC121527
Habitat	Pool	Riffle	Riffle	Riffle	Pool	Pool	Riffle
Heterotrissocladius							
Hydrobaenus							
Limnophyes							
Metriocnemus							
Nanocladius							
Orthocladius							
Orthocladius complex							
Parakiefferiella							
Paralimnophyes arcticus			7				
Paraphaenocladius							
Psectrocladius	27						
Psiloptarus							
Pseudosmittia							
Rheocricotopus							
Tvetenia							
Tvetenia bavarica							
Tvetenia vitracies							
Zalutschia							
Zalutschia briani	320	48		80			70
Zalutschia tatrica							
Zalutschia zalutschicola							
Tribe: Corynoneurini							
Corynoneura				35		53	66
Tribe: Orthocladiini							
Chaetocladius							
SubFamily: Podonominae							

Site	WIS	WIS	WIS	WIS	WIS	WIS	WIS
Year	2011	2011	2011	2011	2011	2011	2011
CC#	CC121521	CC121522	CC121523	CC121524	CC121525	CC121526	CC121527
Habitat	Pool	Riffle	Riffle	Riffle	Pool	Pool	Riffle
Lasiodiamesa							
Paraboreochlus							
Trichotanypus							
SubFamily: Prodiamesinae							
Prodiamesa							
Tribe: Boreochlini							
Boreochlus							
SubFamily: Tanypodinae							
Labrundinia							
Tribe: Pentaneuriini							
Ablabesmyia	27	16	14				
Nilotanypus							
Thienemannimyia							
Tribe: Procladiini							
Djalma batista							
Procladius	933	700	160	16	20	32	30
Family: Dixidae							
Dixella				3			
Family: Dolichopodidae							
Rhaphium							
Family: Empididae							
Clinocera						2	4
Chelifera/Metachela							
Oreogeton							
Family: Muscidae							
Limnophora							

Site	WIS	WIS	WIS	WIS	WIS	WIS	WIS
Year	2011	2011	2011	2011	2011	2011	2011
CC#	CC121521	CC121522	CC121523	CC121524	CC121525	CC121526	CC121527
Habitat	Pool	Riffle	Riffle	Riffle	Pool	Pool	Riffle
Family: Simuliidae		4	3				
Prosimulium							
Simulium			2				
Family: Tipulidae							
Erioptera							
Limnophila							
Ormosia							
Tipula							
Order: Hemiptera							
Family: Corixidae							
Sigara							
Family: Gerridae							
Gerris							
Order: Lepidoptera							
Family: Noctuidae							
Order: Odonata							
Subphylum: Crustacea							
Class: Malacostraca							
Order: Amphipoda							
Subphylum: Chelicerata							
Class: Arachnida							
Order: Trombidiformes							
SubOrder: Prostigmata		8	1	3		2	6
Neobrachypoda							
Pionopsis							
Family: Arrenuridae							

Site	WIS	WIS	WIS	WIS	WIS	WIS	WIS
Year	2011	2011	2011	2011	2011	2011	2011
CC#	CC121521	CC121522	CC121523	CC121524	CC121525	CC121526	CC121527
Habitat	Pool	Riffle	Riffle	Riffle	Pool	Pool	Riffle
Arrenurus							
Family: Hydryphantidae							
Family: Hygrobatidae							
Hygrobates							
Family: Lebertiidae							
Lebertia							
Family: Limnesiidae							
Limnesia							
Family: Limnocharidae							
Limnochares							
Family: Mideopsidae							
Mideopsis							
Family: Oxidae							
Oxus							
Family: Pionidae							
Piona							
Family: Sperchontidae							
Sperchon							
Sperchonopsis							
Family: Unionicolidae							
Neumania							
Family: Halacaridae			1				
Order: Oribatida							
Family: Hydrozetidae	27	40	6		4	2	8
Phylum: Mollusca							
Class: Bivalvia							

Site	WIS	WIS	WIS	WIS	WIS	WIS	WIS
Year	2011	2011	2011	2011	2011	2011	2011
CC#	CC121521	CC121522	CC121523	CC121524	CC121525	CC121526	CC121527
Habitat	Pool	Riffle	Riffle	Riffle	Pool	Pool	Riffle
Order: Veneroida							
Family: Pisidiidae							
Pisidium							
Class: Gastropoda			1				
Order: Heterostropha							
Family: Valvatidae							
Phylum: Annelida							
Subphylum: Clitellata							
Class: Oligochaeta							
Order: Lumbriculida							
Family: Lumbriculidae		8	1	8	4	2	
Order: Tubificida							
Family: Enchytraeidae							
Enchytraeus							
Family: Lumbricidae							
Family: Naididae	11	4	3	35	20	64	80
Chaetogaster							
Chaetogaster diaphanus							
Nais							
Pristina							
Family: Tubificidae							
Phylum: Cnidaria							
Class: Hydrozoa							
Order: Anthoathecatae							
Family: Hydridae							
Hydra							

Site	WIS	WIS	WIS	WIS	WIS	WIS	WIS
Year	2011	2011	2011	2011	2011	2011	2011
CC#	CC121521	CC121522	CC121523	CC121524	CC121525	CC121526	CC121527
Habitat	Pool	Riffle	Riffle	Riffle	Pool	Pool	Riffle
Phylum: Tardigrada		4		3		11	4

Site	WIS	WIS	WIS	WIS	WIS	WIS	WIS
Year	2011	2011	2011	2011	2011	2011	2011
CC#	CC121528	CC121529	CC121530	CC121531	CC121532	CC121533	CC121534
Habitat	Pool	Riffle	Riffle	Pool	Pool	Pool	Pool
Phylum: Arthropoda							
Subphylum: Hexapoda							
Class: Insecta							
Order: Ephemeroptera							
Family: Baetidae							
Acerpenna							
Acerpenna pygmaea							
Baetis			78	14	11		4
Baetis bicaudatus							
Baetis tricaudatus			2	13		3	41
Family: Ephemerellidae							
Caudatella							
Family: Heptageniidae							
Epeorus							
Ironodes							
Rhithrogena							
Family: Leptophlebiidae							
Order: Plecoptera							
Family: Capniidae							
Family: Leuctridae							
Family: Nemouridae							
Amphinemura							
Malenka							
Nemoura							
Ostrocerca							
Zapada							

Site	WIS	WIS	WIS	WIS	WIS	WIS	WIS
Year	2011	2011	2011	2011	2011	2011	2011
CC#	CC121528	CC121529	CC121530	CC121531	CC121532	CC121533	CC121534
Habitat	Pool	Riffle	Riffle	Pool	Pool	Pool	Pool
Zapada oregonensis							
Family: Perlodidae							
Order: Trichoptera							
Micrasema							
Family: Hydropsychidae							
Hydropsyche							
Family: Hydroptilidae							
Agraylea							
Oxyethira							
Family: Limnephilidae							
Clostoeca disjuncta							
Ecclisomyia							
Limnephilus							
Family: Molannidae							
Molanna flavicornis							
Molanna distinctus							
Family: Phryganeidae							
Agrypnia							
Family: Rhyacophilidae							
Rhyacophila							
Order: Coleoptera							
Family: Dytiscidae							
Agabus							
Colymbetes			2				
Hydroporus							
Oreodytes							

Site	WIS	WIS	WIS	WIS	WIS	WIS	WIS
Year	2011	2011	2011	2011	2011	2011	2011
CC#	CC121528	CC121529	CC121530	CC121531	CC121532	CC121533	CC121534
Habitat	Pool	Riffle	Riffle	Pool	Pool	Pool	Pool
Stictotarsus							
Family: Hydraenidae							
Hydraena							
SubFamily: Hydroporinae							
Family: Hydrophilidae							
Hydrochus							
Family: Psephenidae							
Family: Staphylinidae							
Order: Diptera							
Family: Ceratopogonidae							
Atrichopogon							
Bezzia/Palpomyia	2	24	69	8	5	3	12
Culicoides							
Dasyhelea							
Forcipomyia							
Mallochohelea							
Probezzia							
Sphaeromias		16					
Family: Chaoboridae							
Eucorethra							
Family: Chironomidae							
SubFamily: Chironominae					79		
Fissimentum							
Tribe: Chironomini							
Chironomus	5	92	57	16	116		
Cryptochironomus							

Site	WIS	WIS	WIS	WIS	WIS	WIS	WIS
Year	2011	2011	2011	2011	2011	2011	2011
CC#	CC121528	CC121529	CC121530	CC121531	CC121532	CC121533	CC121534
Habitat	Pool	Riffle	Riffle	Pool	Pool	Pool	Pool
Endochironomus							
Microtendipes							
Microtendipes pedellus							
Phaenopsectra						464	41
Polypedilum			11				
Stictochironomus	8	112	87	16	195	240	57
Tribelos							
Tribe: Tanytarsini							
Cladotanytarsus							
Micropsectra	70	300	240	60	389	112	320
Paratanytarsus							
Rheotanytarsus							
Tanytarsus		36			53		11
SubFamily: Diamesinae							
Protanypus							
Tribe: Diamesini							
Pagastia							
Potthastia							
SubFamily: Orthocladiinae	30	104		18	42		
Brillia							
Cricotopus							
Diplocladius							
Diplocladius cultriger							
Eukiefferiella							
Georthocladius							
Heterotanytarsus							

Site	WIS	WIS	WIS	WIS	WIS	WIS	WIS
Year	2011	2011	2011	2011	2011	2011	2011
CC#	CC121528	CC121529	CC121530	CC121531	CC121532	CC121533	CC121534
Habitat	Pool	Riffle	Riffle	Pool	Pool	Pool	Pool
Heterotrissocladius							9
Hydrobaenus							
Limnophyes							
Metriocnemus							
Nanocladius							
Orthocladius							
Orthocladius complex							
Parakiefferiella							
Paralimnophyes arcticus							
Paraphaenocladius							
Psectrocladius		76	23				
Psiloptarus							
Pseudosmittia							
Rheocricotopus							
Tvetenia							
Tvetenia bavarica							
Tvetenia vitracies							
Zalutschia							
Zalutschia briani	15	80				128	
Zalutschia tatrica							
Zalutschia zalutschicola							
Tribe: Corynoneurini							
Corynoneura	11						
Tribe: Orthocladiini							
Chaetocladius							
SubFamily: Podonominae							

Site	WIS	WIS	WIS	WIS	WIS	WIS	WIS
Year	2011	2011	2011	2011	2011	2011	2011
CC#	CC121528	CC121529	CC121530	CC121531	CC121532	CC121533	CC121534
Habitat	Pool	Riffle	Riffle	Pool	Pool	Pool	Pool
Lasiodiamesa							
Paraboreochlus							
Trichotanypus							
SubFamily: Prodiamesinae							
Prodiamesa							
Tribe: Boreochlini							
Boreochlus							
SubFamily: Tanypodinae							
Labrundinia							
Tribe: Pentaneuriini							
Ablabesmyia							
Nilotanypus							
Thienemannimyia							
Tribe: Procladiini							
Djalma batista							
Procladius	29	220	126	16	737	176	
Family: Dixidae							
Dixella							
Family: Dolichopodidae							
Rhaphium							
Family: Empididae							
Clinocera				1			
Chelifera/Metachela							
Oreogeton							
Family: Muscidae							
Limnophora							

Site	WIS	WIS	WIS	WIS	WIS	WIS	WIS
Year	2011	2011	2011	2011	2011	2011	2011
CC#	CC121528	CC121529	CC121530	CC121531	CC121532	CC121533	CC121534
Habitat	Pool	Riffle	Riffle	Pool	Pool	Pool	Pool
Family: Simuliidae	3				11		
Prosimulium							
Simulium				1		3	5
Family: Tipulidae							
Erioptera	2						
Limnophila							
Ormosia							
Tipula							
Order: Hemiptera							
Family: Corixidae							
Sigara		8					
Family: Gerridae							
Gerris							
Order: Lepidoptera							
Family: Noctuidae							
Order: Odonata							
Subphylum: Crustacea							
Class: Malacostraca							
Order: Amphipoda							
Subphylum: Chelicerata							
Class: Arachnida							
Order: Trombidiformes							
SubOrder: Prostigmata	4	8	41	2			5
Neobrachypoda							
Pionopsis							
Family: Arrenuridae							

Site	WIS	WIS	WIS	WIS	WIS	WIS	WIS
Year	2011	2011	2011	2011	2011	2011	2011
CC#	CC121528	CC121529	CC121530	CC121531	CC121532	CC121533	CC121534
Habitat	Pool	Riffle	Riffle	Pool	Pool	Pool	Pool
Arrenurus							
Family: Hydryphantidae							
Family: Hygrobatidae							
Hygrobates							
Family: Lebertiidae							
Lebertia			2			6	
Family: Limnesiidae							
Limnesia							
Family: Limnocharidae							
Limnochares							
Family: Mideopsidae							
Mideopsis							
Family: Oxidae							
Oxus							
Family: Pionidae							
Piona				1			
Family: Sperchontidae							
Sperchon							
Sperchonopsis							
Family: Unionicolidae							
Neumania							
Family: Halacaridae							
Order: Oribatida							
Family: Hydrozetidae	26	52	69	4	16	38	20
Phylum: Mollusca							
Class: Bivalvia							

Site	WIS	WIS	WIS	WIS	WIS	WIS	WIS
Year	2011	2011	2011	2011	2011	2011	2011
CC#	CC121528	CC121529	CC121530	CC121531	CC121532	CC121533	CC121534
Habitat	Pool	Riffle	Riffle	Pool	Pool	Pool	Pool
Order: Veneroida							
Family: Pisidiidae							
Pisidium							
Class: Gastropoda							
Order: Heterostropha							
Family: Valvatidae							
Phylum: Annelida							
Subphylum: Clitellata							
Class: Oligochaeta		4		1			
Order: Lumbriculida							
Family: Lumbriculidae	5	8	11			26	5
Order: Tubificida							
Family: Enchytraeidae							
Enchytraeus							
Family: Lumbricidae				2			
Family: Naididae	1			5			69
Chaetogaster							
Chaetogaster diaphanus							
Nais							
Pristina							
Family: Tubificidae							
Phylum: Cnidaria							
Class: Hydrozoa							
Order: Anthoathecatae							
Family: Hydridae							
Hydra							

Site	WIS	WIS	WIS	WIS	WIS	WIS	WIS
Year	2011	2011	2011	2011	2011	2011	2011
CC#	CC121528	CC121529	CC121530	CC121531	CC121532	CC121533	CC121534
Habitat	Pool	Riffle	Riffle	Pool	Pool	Pool	Pool
Phylum: Tardigrada	12		21	4	74	6	

Site	WIS
Year	2011
CC#	CC121535
Habitat	Riffle
Phylum: Arthropoda	
Subphylum: Hexapoda	
Class: Insecta	
Order: Ephemeroptera	
Family: Baetidae	
Acerpenna	
Acerpenna pygmaea	
Baetis	16
Baetis bicaudatus	
Baetis tricaudatus	70
Family: Ephemerellidae	
Caudatella	
Family: Heptageniidae	
Epeorus	
Ironodes	
Rhithrogena	
Family: Leptophlebiidae	
Order: Plecoptera	
Family: Capniidae	
Family: Leuctridae	
Family: Nemouridae	
Amphinemura	
Malenka	
Nemoura	
Ostrocerca	
Zapada	

Site	WIS
Year	2011
CC#	CC121535
Habitat	Riffle
Zapada oregonensis	
Family: Perlodidae	
Order: Trichoptera	
Micrasema	
Family: Hydropsychidae	
Hydropsyche	
Family: Hydroptilidae	
Agraylea	
Oxyethira	
Family: Limnephilidae	5
Clostoeca disjuncta	
Ecclisomyia	
Limnephilus	
Family: Molannidae	
Molanna flavicornis	
Molanna distinctus	
Family: Phryganeidae	
Agrypnia	
Family: Rhyacophilidae	
Rhyacophila	
Order: Coleoptera	
Family: Dytiscidae	
Agabus	
Colymbetes	
Hydroporus	
Oreodytes	

Site	WIS
Year	2011
CC#	CC121535
Habitat	Riffle
Stictotarsus	
Family: Hydraenidae	
Hydraena	
SubFamily: Hydroporinae	
Family: Hydrophilidae	
Hydrochus	
Family: Psephenidae	
Family: Staphylinidae	
Order: Diptera	
Family: Ceratopogonidae	
Atrichopogon	
Bezzia/Palpomyia	4
Culicoides	
Dasyhelea	
Forcipomyia	
Mallochohelea	
Probezzia	
Sphaeromias	
Family: Chaoboridae	
Eucorethra	
Family: Chironomidae	49
SubFamily: Chironominae	
Fissimentum	
Tribe: Chironomini	
Chironomus	
Cryptochironomus	

Site	WIS
Year	2011
CC#	CC121535
Habitat	Riffle
Endochironomus	
Microtendipes	
Microtendipes pedellus	
Phaenopsectra	
Polypedilum	
Stictochironomus	
Tribelos	
Tribe: Tanytarsini	
Cladotanytarsus	
Micropsectra	68
Paratanytarsus	
Rheotanytarsus	
Tanytarsus	
SubFamily: Diamesinae	
Protanypus	
Tribe: Diamesini	
Pagastia	
Potthastia	
SubFamily: Orthocladiinae	
Brillia	
Cricotopus	
Diplocladius	
Diplocladius cultriger	
Eukiefferiella	
Georthocladius	
Heterotanytarsus	

Site	WIS
Year	2011
CC#	CC121535
Habitat	Riffle
Heterotrissocladius	5
Hydrobaenus	
Limnophyes	
Metriocnemus	1
Nanocladius	
Orthocladius	
Orthocladius complex	
Parakiefferiella	
Paralimnophyes arcticus	
Paraphaenocladius	
Psectrocladius	9
Psiloptarus	
Pseudosmittia	
Rheocricotopus	
Tvetenia	
Tvetenia bavarica	
Tvetenia vitracies	
Zalutschia	
Zalutschia briani	
Zalutschia tatrica	
Zalutschia zalutschicola	
Tribe: Corynoneurini	
Corynoneura	32
Tribe: Orthocladiini	
Chaetocladius	
SubFamily: Podonominae	

Site	WIS
Year	2011
CC#	CC121535
Habitat	Riffle
Lasiodiamesa	
Paraboreochlus	
Trichotanypus	
SubFamily: Prodiamesinae	
Prodiamesa	
Tribe: Boreochlini	
Boreochlus	5
SubFamily: Tanypodinae	
Labrundinia	
Tribe: Pentaneuriini	
Ablabesmyia	
Nilotanypus	
Thienemannimyia	
Tribe: Procladiini	
Djalma batista	
Procladius	
Family: Dixidae	
Dixella	
Family: Dolichopodidae	
Rhaphium	
Family: Empididae	
Clinocera	
Chelifera/Metachela	
Oreogeton	
Family: Muscidae	
Limnophora	

Site	WIS
Year	2011
CC#	CC121535
Habitat	Riffle
Family: Simuliidae	
Prosimulium	
Simulium	
Family: Tipulidae	
Erioptera	
Limnophila	
Ormosia	
Tipula	
Order: Hemiptera	
Family: Corixidae	
Sigara	
Family: Gerridae	
Gerris	
Order: Lepidoptera	
Family: Noctuidae	
Order: Odonata	
Subphylum: Crustacea	
Class: Malacostraca	
Order: Amphipoda	
Subphylum: Chelicerata	
Class: Arachnida	
Order: Trombidiformes	
SubOrder: Prostigmata	1
Neobrachypoda	
Pionopsis	
Family: Arrenuridae	

Site	WIS
Year	2011
CC#	CC121535
Habitat	Riffle
Arrenurus	
Family: Hydryphantidae	
Family: Hygrobatidae	
Hygrobates	
Family: Lebertiidae	
Lebertia	
Family: Limnesiidae	
Limnesia	
Family: Limnocharidae	
Limnochares	
Family: Mideopsidae	
Mideopsis	
Family: Oxidae	
Oxus	
Family: Pionidae	
Piona	
Family: Sperchontidae	
Sperchon	
Sperchonopsis	
Family: Unionicolidae	
Neumania	
Family: Halacaridae	
Order: Oribatida	
Family: Hydrozetidae	16
Phylum: Mollusca	
Class: Bivalvia	

Site	WIS
Year	2011
CC#	CC121535
Habitat	Riffle
Order: Veneroida	
Family: Pisidiidae	
Pisidium	
Class: Gastropoda	
Order: Heterostropha	
Family: Valvatidae	
Phylum: Annelida	
Subphylum: Clitellata	
Class: Oligochaeta	
Order: Lumbriculida	
Family: Lumbriculidae	4
Order: Tubificida	
Family: Enchytraeidae	
Enchytraeus	
Family: Lumbricidae	
Family: Naididae	95
Chaetogaster	
Chaetogaster diaphanus	
Nais	
Pristina	
Family: Tubificidae	
Phylum: Cnidaria	
Class: Hydrozoa	
Order: Anthoathecatae	
Family: Hydridae	
Hydra	

Site	WIS
Year	2011
CC#	CC121535
Habitat	Riffle
Phylum: Tardigrada	12

Table A1-3: 2012 Raw Invertebrate Data.

Site	R2S	R2S	R2S	R2S	R2S	R6S1	R6S1
Year	2012	2012	2012	2012	2012	2012	2012
CC#	CC130453	CC130454	CC130455	CC130456	CC130457	CC130458	CC130459
Habitat	Pool	Pool	Riffle	Riffle	Riffle	Riffle	Pool
Phylum: Arthropoda							
Subphylum: Hexapoda							
Class: Insecta							
Order: Ephemeroptera							
Family: Baetidae							
Acerpenna							
Acerpenna pygmaea							
Baetis							
Baetis bicaudatus							
Baetis tricaudatus							
Family: Ephemerellidae							
Caudatella							
Family: Heptageniidae							
Epeorus							
Ironodes							
Rhithrogena							
Family: Leptophlebiidae							
Order: Plecoptera						75	6
Family: Capniidae							
Family: Leuctridae							
Family: Nemouridae							
Amphinemura							
Malenka							
Nemoura							
Ostrocerca							
Zapada							

Site	R2S	R2S	R2S	R2S	R2S	R6S1	R6S1
Year	2012	2012	2012	2012	2012	2012	2012
CC#	CC130453	CC130454	CC130455	CC130456	CC130457	CC130458	CC130459
Habitat	Pool	Pool	Riffle	Riffle	Riffle	Riffle	Pool
Zapada oregonensis							
Family: Perlodidae							
Order: Trichoptera						25	
Micrasema							
Family: Hydropsychidae							
Hydropsyche							
Family: Hydroptilidae							
Agraylea						25	13
Oxyethira							
Family: Limnephilidae							
Clostoeca disjuncta							
Ecclisomyia							
Limnephilus	40				7		
Family: Molannidae							
Molanna flavicornis							
Molanna distinctus							
Family: Phryganeidae							
Agrypnia							
Family: Rhyacophilidae							
Rhyacophila							
Order: Coleoptera							
Family: Dytiscidae	20		20				6
Agabus							
Colymbetes							
Hydroporus							
Oreodytes							

Site	R2S	R2S	R2S	R2S	R2S	R6S1	R6S1
Year	2012	2012	2012	2012	2012	2012	2012
CC#	CC130453	CC130454	CC130455	CC130456	CC130457	CC130458	CC130459
Habitat	Pool	Pool	Riffle	Riffle	Riffle	Riffle	Pool
Stictotarsus							
Family: Hydraenidae							
Hydraena							
SubFamily: Hydroporinae							
Family: Hydrophilidae							
Hydrochus							
Family: Psephenidae							
Family: Staphylinidae							
Order: Diptera							
Family: Ceratopogonidae							
Atrichopogon							
Bezzia/Palpomyia				15			
Culicoides							
Dasyhelea							
Forcipomyia							
Mallochohelea							
Probezzia							
Sphaeromias					4		
Family: Chaoboridae							
Eucorethra							
Family: Chironomidae		4757					
SubFamily: Chironominae							169
Fissimentum							
Tribe: Chironomini							
Chironomus					4		
Cryptochironomus							

Site	R2S	R2S	R2S	R2S	R2S	R6S1	R6S1
Year	2012	2012	2012	2012	2012	2012	2012
CC#	CC130453	CC130454	CC130455	CC130456	CC130457	CC130458	CC130459
Habitat	Pool	Pool	Riffle	Riffle	Riffle	Riffle	Pool
Endochironomus							
Microtendipes							
Microtendipes pedellus							831
Phaenopsectra							
Polypedilum	180		100	54			
Stictochironomus							
Tribelos							
Tribe: Tanytarsini							
Cladotanytarsus							
Micropsectra							
Paratanytarsus						300	
Rheotanytarsus							
Tanytarsus	7400	4757	7000	2038	1011	175	69
SubFamily: Diamesinae							
Protanypus							
Tribe: Diamesini							
Pagastia							
Potthastia							
SubFamily: Orthocladiinae							300
Brillia							
Cricotopus							
Diplocladius							
Diplocladius cultriger							
Eukiefferiella							
Georthocladius							
Heterotanytarsus							

Site	R2S	R2S	R2S	R2S	R2S	R6S1	R6S1
Year	2012	2012	2012	2012	2012	2012	2012
CC#	CC130453	CC130454	CC130455	CC130456	CC130457	CC130458	CC130459
Habitat	Pool	Pool	Riffle	Riffle	Riffle	Riffle	Pool
Heterotrissocladius							
Hydrobaenus							
Limnophyes				8			
Metriocnemus							
Nanocladius							
Orthocladius							
Orthocladius complex						563	
Parakiefferiella							125
Paralimnophyes arcticus							
Paraphaenocladius							
Psectrocladius							
Psiloptarus							
Pseudosmittia							
Rheocricotopus							
Tvetenia							
Tvetenia bavarica							
Tvetenia vitracies							
Zalutschia							
Zalutschia briani							
Zalutschia tatrica							
Zalutschia zalutschicola							
Tribe: Corynoneurini							
Corynoneura			60			2313	344
Tribe: Orthocladiini							
Chaetocladius							
SubFamily: Podonominae							

Site	R2S	R2S	R2S	R2S	R2S	R6S1	R6S1
Year	2012	2012	2012	2012	2012	2012	2012
CC#	CC130453	CC130454	CC130455	CC130456	CC130457	CC130458	CC130459
Habitat	Pool	Pool	Riffle	Riffle	Riffle	Riffle	Pool
Lasiodiamesa							
Paraboreochlus							
Trichotanypus							
SubFamily: Prodiamesinae							
Prodiamesa							
Tribe: Boreochlini							
Boreochlus							
SubFamily: Tanypodinae							
Labrundinia							
Tribe: Pentaneuriini							
Ablabesmyia							
Nilotanypus							
Thienemannimyia							
Tribe: Procladiini							
Djalma batista							
Procladius					4		
Family: Dixidae							
Dixella					11		
Family: Dolichopodidae							
Rhaphium							
Family: Empididae							
Clinocera							
Chelifera/Metachela							
Oreogeton							
Family: Muscidae							
Limnophora						38	

Site	R2S	R2S	R2S	R2S	R2S	R6S1	R6S1
Year	2012	2012	2012	2012	2012	2012	2012
CC#	CC130453	CC130454	CC130455	CC130456	CC130457	CC130458	CC130459
Habitat	Pool	Pool	Riffle	Riffle	Riffle	Riffle	Pool
Family: Simuliidae			20		4	176	13
Prosimulium							
Simulium			280	8			
Family: Tipulidae							
Erioptera							
Limnophila							
Ormosia							
Tipula							
Order: Hemiptera							
Family: Corixidae							
Sigara							
Family: Gerridae							
Gerris							
Order: Lepidoptera							
Family: Noctuidae							
Order: Odonata							
Subphylum: Crustacea							
Class: Malacostraca							
Order: Amphipoda							
Subphylum: Chelicerata							
Class: Arachnida							
Order: Trombidiformes							
SubOrder: Prostigmata							13
Neobrachypoda							
Pionopsis							
Family: Arrenuridae							

Site	R2S	R2S	R2S	R2S	R2S	R6S1	R6S1
Year	2012	2012	2012	2012	2012	2012	2012
CC#	CC130453	CC130454	CC130455	CC130456	CC130457	CC130458	CC130459
Habitat	Pool	Pool	Riffle	Riffle	Riffle	Riffle	Pool
Arrenurus							
Family: Hydryphantidae							
Family: Hygrobatidae							
Hygrobates						13	6
Family: Lebertiidae							
Lebertia						13	13
Family: Limnesiidae							
Limnesia							
Family: Limnocharidae							
Limnochares							
Family: Mideopsidae							
Mideopsis							
Family: Oxidae							
Oxus							
Family: Pionidae							
Piona							
Family: Sperchontidae							
Sperchon							
Sperchonopsis							
Family: Unionicolidae							
Neumania							
Family: Halacaridae							
Order: Oribatida							
Family: Hydrozetidae	80	29	20	31	15	63	
Phylum: Mollusca							
Class: Bivalvia							

Site	R2S	R2S	R2S	R2S	R2S	R6S1	R6S1
Year	2012	2012	2012	2012	2012	2012	2012
CC#	CC130453	CC130454	CC130455	CC130456	CC130457	CC130458	CC130459
Habitat	Pool	Pool	Riffle	Riffle	Riffle	Riffle	Pool
Order: Veneroida							
Family: Pisidiidae	20						
Pisidium		28					
Class: Gastropoda							
Order: Heterostropha							
Family: Valvatidae							
Phylum: Annelida							
Subphylum: Clitellata							
Class: Oligochaeta	400						
Order: Lumbriculida							
Family: Lumbriculidae				8		13	6
Order: Tubificida							
Family: Enchytraeidae							
Enchytraeus	20	14					
Family: Lumbricidae							
Family: Naididae	160	71	980	323	119	13	19
Chaetogaster							
Chaetogaster diaphanus							
Nais	80	43					13
Pristina						25	
Family: Tubificidae							
Phylum: Cnidaria							
Class: Hydrozoa							
Order: Anthoathecatae							
Family: Hydridae							
Hydra						13	25

Site	R2S	R2S	R2S	R2S	R2S	R6S1	R6S1
Year	2012	2012	2012	2012	2012	2012	2012
CC#	CC130453	CC130454	CC130455	CC130456	CC130457	CC130458	CC130459
Habitat	Pool	Pool	Riffle	Riffle	Riffle	Riffle	Pool
Phylum: Tardigrada		29	40	31	15	38	

Site	R6S1	R6S1	R6S1	R6S1	R6S2	R6S2	R6S2
Year	2012	2012	2012	2012	2012	2012	2012
CC#	CC130460	CC130461	CC130462	CC130463	CC130464	CC130465	CC130466
Habitat	Riffle	Pool	Pool	Riffle	Riffle	Pool	Riffle
Phylum: Arthropoda							
Subphylum: Hexapoda							
Class: Insecta							
Order: Ephemeroptera							
Family: Baetidae							
Acerpenna							
Acerpenna pygmaea							
Baetis		2					13
Baetis bicaudatus							
Baetis tricaudatus					2		18
Family: Ephemerellidae							
Caudatella							
Family: Heptageniidae							
Epeorus							
Ironodes			2				
Rhithrogena							
Family: Leptophlebiidae							
Order: Plecoptera	106	4	6		5		
Family: Capniidae							
Family: Leuctridae							
Family: Nemouridae			2				
Amphinemura	17			11			
Malenka							
Nemoura							
Ostrocerca							
Zapada							

Site	R6S1	R6S1	R6S1	R6S1	R6S2	R6S2	R6S2
Year	2012	2012	2012	2012	2012	2012	2012
CC#	CC130460	CC130461	CC130462	CC130463	CC130464	CC130465	CC130466
Habitat	Riffle	Pool	Pool	Riffle	Riffle	Pool	Riffle
Zapada oregonensis							
Family: Perlodidae							
Order: Trichoptera	111	4	12	129	2		3
Micrasema							
Family: Hydropsychidae							
Hydropsyche							
Family: Hydroptilidae							
Agraylea			3				
Oxyethira	11						
Family: Limnephilidae							
Clostoeca disjuncta							
Ecclisomyia							
Limnephilus							
Family: Molannidae							
Molanna flavicornis							
Molanna distinctus							
Family: Phryganeidae							
Agrypnia							
Family: Rhyacophilidae							
Rhyacophila							
Order: Coleoptera							
Family: Dytiscidae							
Agabus	6			4	1		
Colymbetes							
Hydroporus							
Oreodytes							

Site	R6S1	R6S1	R6S1	R6S1	R6S2	R6S2	R6S2
Year	2012	2012	2012	2012	2012	2012	2012
CC#	CC130460	CC130461	CC130462	CC130463	CC130464	CC130465	CC130466
Habitat	Riffle	Pool	Pool	Riffle	Riffle	Pool	Riffle
Stictotarsus							
Family: Hydraenidae							
Hydraena							
SubFamily: Hydroporinae							
Family: Hydrophilidae							
Hydrochus							
Family: Psephenidae							
Family: Staphylinidae							
Order: Diptera							
Family: Ceratopogonidae							
Atrichopogon							
Bezzia/Palpomyia				11		2	10
Culicoides							
Dasyhelea							
Forcipomyia							
Mallochohelea							
Probezzia							
Sphaeromias							
Family: Chaoboridae							
Eucorethra							
Family: Chironomidae							
SubFamily: Chironominae		141					
Fissimentum							
Tribe: Chironomini							
Chironomus			51			30	
Cryptochironomus							

Site	R6S1	R6S1	R6S1	R6S1	R6S2	R6S2	R6S2
Year	2012	2012	2012	2012	2012	2012	2012
CC#	CC130460	CC130461	CC130462	CC130463	CC130464	CC130465	CC130466
Habitat	Riffle	Pool	Pool	Riffle	Riffle	Pool	Riffle
Endochironomus							
Microtendipes							
Microtendipes pedellus	250	48	8				
Phaenopsectra							
Polypedilum							
Stictochironomus		26		46	3	9	
Tribelos							
Tribe: Tanytarsini							
Cladotanytarsus							
Micropsectra					39		188
Paratanytarsus							
Rheotanytarsus							
Tanytarsus	78	54	20	129		272	275
SubFamily: Diamesinae							
Protanypus							
Tribe: Diamesini							
Pagastia							
Potthastia							
SubFamily: Orthocladiinae	167	54			180		50
Brillia							
Cricotopus							
Diplocladius							
Diplocladius cultriger							
Eukiefferiella							
Georthocladius							
Heterotanytarsus						25	13

Site	R6S1	R6S1	R6S1	R6S1	R6S2	R6S2	R6S2
Year	2012	2012	2012	2012	2012	2012	2012
CC#	CC130460	CC130461	CC130462	CC130463	CC130464	CC130465	CC130466
Habitat	Riffle	Pool	Pool	Riffle	Riffle	Pool	Riffle
Heterotrissocladius							
Hydrobaenus							
Limnophyes							3
Metriocnemus						2	
Nanocladius							
Orthocladius							
Orthocladius complex							
Parakiefferiella		228			35		
Paralimnophyes arcticus							
Paraphaenocladius							
Psectrocladius							
Psiloptarus							
Pseudosmittia							
Rheocricotopus							
Tvetenia							
Tvetenia bavarica							
Tvetenia vitracies							
Zalutschia			208	536			
Zalutschia briani							
Zalutschia tatrica							
Zalutschia zalutschicola							
Tribe: Corynoneurini							
Corynoneura	917	102	72	232	82	9	115
Tribe: Orthocladiini							
Chaetocladius							
SubFamily: Podonominae							

Site	R6S1	R6S1	R6S1	R6S1	R6S2	R6S2	R6S2
Year	2012	2012	2012	2012	2012	2012	2012
CC#	CC130460	CC130461	CC130462	CC130463	CC130464	CC130465	CC130466
Habitat	Riffle	Pool	Pool	Riffle	Riffle	Pool	Riffle
Lasiodiamesa							
Paraboreochlus							
Trichotanypus							
SubFamily: Prodiamesinae							
Prodiamesa							
Tribe: Boreochlini							
Boreochlus							
SubFamily: Tanypodinae		13					
Labrundinia							
Tribe: Pentaneuriini							
Ablabesmyia							
Nilotanypus							
Thienemannimyia							
Tribe: Procladiini							
Djalma batista							
Procladius			2		11	28	
Family: Dixidae							
Dixella							
Family: Dolichopodidae							
Rhaphium							
Family: Empididae							
Clinocera				4			
Chelifera/Metachela							
Oreogeton							
Family: Muscidae							
Limnophora	11			7			

Site	R6S1	R6S1	R6S1	R6S1	R6S2	R6S2	R6S2
Year	2012	2012	2012	2012	2012	2012	2012
CC#	CC130460	CC130461	CC130462	CC130463	CC130464	CC130465	CC130466
Habitat	Riffle	Pool	Pool	Riffle	Riffle	Pool	Riffle
Family: Simuliidae	83		7			14	
Prosimulium							
Simulium			2				
Family: Tipulidae							
Erioptera							
Limnophila						2	
Ormosia							
Tipula				4			
Order: Hemiptera							
Family: Corixidae							
Sigara							
Family: Gerridae							
Gerris							
Order: Lepidoptera							
Family: Noctuidae							
Order: Odonata							
Subphylum: Crustacea							
Class: Malacostraca							
Order: Amphipoda			2				
Subphylum: Chelicerata							
Class: Arachnida							
Order: Trombidiformes							
SubOrder: Prostigmata	6	15	8	7	3	4	13
Neobrachypoda							
Pionopsis							
Family: Arrenuridae							

Site	R6S1	R6S1	R6S1	R6S1	R6S2	R6S2	R6S2
Year	2012	2012	2012	2012	2012	2012	2012
CC#	CC130460	CC130461	CC130462	CC130463	CC130464	CC130465	CC130466
Habitat	Riffle	Pool	Pool	Riffle	Riffle	Pool	Riffle
Arrenurus							
Family: Hydryphantidae					1		
Family: Hygrobatidae							
Hygrobates							
Family: Lebertiidae							
Lebertia	6			4	2		8
Family: Limnesiidae							
Limnesia							
Family: Limnocharidae							
Limnochares							
Family: Mideopsidae							
Mideopsis							
Family: Oxidae							
Oxus							
Family: Pionidae							
Piona				21			
Family: Sperchontidae							
Sperchon							
Sperchonopsis							
Family: Unionicolidae							
Neumania							
Family: Halacaridae			2				
Order: Oribatida							
Family: Hydrozetidae	89	2	5	18	14	12	
Phylum: Mollusca							
Class: Bivalvia							

Site	R6S1	R6S1	R6S1	R6S1	R6S2	R6S2	R6S2
Year	2012	2012	2012	2012	2012	2012	2012
CC#	CC130460	CC130461	CC130462	CC130463	CC130464	CC130465	CC130466
Habitat	Riffle	Pool	Pool	Riffle	Riffle	Pool	Riffle
Order: Veneroida							
Family: Pisidiidae							
Pisidium				4			
Class: Gastropoda							
Order: Heterostropha							
Family: Valvatidae							
Phylum: Annelida							
Subphylum: Clitellata							
Class: Oligochaeta							
Order: Lumbriculida							
Family: Lumbriculidae		4				19	18
Order: Tubificida							
Family: Enchytraeidae							
Enchytraeus		2					
Family: Lumbricidae							
Family: Naididae		7	5		10	89	70
Chaetogaster							
Chaetogaster diaphanus			2		1		
Nais		2	2				
Pristina			6				
Family: Tubificidae							
Phylum: Cnidaria							
Class: Hydrozoa							
Order: Anthoathecatae							
Family: Hydridae							
Hydra		9	42		25	2	3

Site	R6S1	R6S1	R6S1	R6S1	R6S2	R6S2	R6S2
Year	2012	2012	2012	2012	2012	2012	2012
CC#	CC130460	CC130461	CC130462	CC130463	CC130464	CC130465	CC130466
Habitat	Riffle	Pool	Pool	Riffle	Riffle	Pool	Riffle
Phylum: Tardigrada	11		9	4	7	7	3

Site	R6S2	R6S2	WIS	WIS	WIS	WIS	WIS
Year	2012	2012	2012	2012	2012	2012	2012
CC#	CC130467	CC130468	CC130469	CC130470	CC130471	CC130472	CC130473
Habitat	Riffle	Pool	Pool	Riffle	Riffle	Pool	Riffle
Phylum: Arthropoda							
Subphylum: Hexapoda							
Class: Insecta							
Order: Ephemeroptera							
Family: Baetidae				5			
Acerpenna							
Acerpenna pygmaea							
Baetis							
Baetis bicaudatus							
Baetis tricaudatus	13						
Family: Ephemerellidae							
Caudatella							
Family: Heptageniidae							
Epeorus							
Ironodes							
Rhithrogena							
Family: Leptophlebiidae							
Order: Plecoptera	2						
Family: Capniidae							
Family: Leuctridae							
Family: Nemouridae							
Amphinemura							
Malenka							
Nemoura							
Ostrocerca							
Zapada							

Site	R6S2	R6S2	WIS	WIS	WIS	WIS	WIS
Year	2012	2012	2012	2012	2012	2012	2012
CC#	CC130467	CC130468	CC130469	CC130470	CC130471	CC130472	CC130473
Habitat	Riffle	Pool	Pool	Riffle	Riffle	Pool	Riffle
Zapada oregonensis							
Family: Perlodidae							
Order: Trichoptera						3	
Micrasema							
Family: Hydropsychidae							
Hydropsyche							
Family: Hydroptilidae							
Agraylea							
Oxyethira							
Family: Limnephilidae		1					
Clostoeca disjuncta							
Ecclisomyia							
Limnephilus							
Family: Molannidae							
Molanna flavicornis							
Molanna distinctus							
Family: Phryganeidae							
Agrypnia							
Family: Rhyacophilidae							
Rhyacophila							
Order: Coleoptera							
Family: Dytiscidae							
Agabus							7
Colymbetes							
Hydroporus					7		
Oreodytes							

Site	R6S2	R6S2	WIS	WIS	WIS	WIS	WIS
Year	2012	2012	2012	2012	2012	2012	2012
CC#	CC130467	CC130468	CC130469	CC130470	CC130471	CC130472	CC130473
Habitat	Riffle	Pool	Pool	Riffle	Riffle	Pool	Riffle
Stictotarsus							
Family: Hydraenidae							
Hydraena							
SubFamily: Hydroporinae							
Family: Hydrophilidae							
Hydrochus							
Family: Psephenidae							
Family: Staphylinidae							
Order: Diptera							
Family: Ceratopogonidae							
Atrichopogon							
Bezzia/Palpomyia	3	2	5	35	20		
Culicoides							
Dasyhelea							
Forcipomyia							
Mallochohelea							
Probezzia							
Sphaeromias							
Family: Chaoboridae							
Eucorethra							
Family: Chironomidae							1017
SubFamily: Chironominae			6	275			
Fissimentum							
Tribe: Chironomini							
Chironomus							
Cryptochironomus			3				

Site	R6S2	R6S2	WIS	WIS	WIS	WIS	WIS
Year	2012	2012	2012	2012	2012	2012	2012
CC#	CC130467	CC130468	CC130469	CC130470	CC130471	CC130472	CC130473
Habitat	Riffle	Pool	Pool	Riffle	Riffle	Pool	Riffle
Endochironomus							
Microtendipes							
Microtendipes pedellus			4		53		
Phaenopsectra				30			
Polypedilum							
Stictochironomus	4	3	3	35			20
Tribelos							
Tribe: Tanytarsini					153		
Cladotanytarsus			14				
Micropsectra	120	41	36	430	1493	816	883
Paratanytarsus							
Rheotanytarsus							
Tanytarsus							
SubFamily: Diamesinae							
Protanypus							
Tribe: Diamesini							
Pagastia							
Potthastia							
SubFamily: Orthocladiinae	20			100			
Brillia							
Cricotopus							
Diplocladius							
Diplocladius cultriger							
Eukiefferiella							
Georthocladius							
Heterotanytarsus	3	7					

Site	R6S2	R6S2	WIS	WIS	WIS	WIS	WIS
Year	2012	2012	2012	2012	2012	2012	2012
CC#	CC130467	CC130468	CC130469	CC130470	CC130471	CC130472	CC130473
Habitat	Riffle	Pool	Pool	Riffle	Riffle	Pool	Riffle
Heterotrissocladius							
Hydrobaenus							
Limnophyes							
Metriocnemus							
Nanocladius							
Orthocladius							
Orthocladius complex							
Parakiefferiella							
Paralimnophyes arcticus							
Paraphaenocladius							
Psectrocladius						3	
Psiloptarus							
Pseudosmittia							
Rheocricotopus							
Tvetenia							
Tvetenia bavarica							
Tvetenia vitracies							
Zalutschia	85	15	23	365	73	109	90
Zalutschia briani							
Zalutschia tatrica							
Zalutschia zalutschicola							
Tribe: Corynoneurini							
Corynoneura	38	19		55			
Tribe: Orthocladiini							
Chaetocladius							
SubFamily: Podonominae							

Site	R6S2	R6S2	WIS	WIS	WIS	WIS	WIS
Year	2012	2012	2012	2012	2012	2012	2012
CC#	CC130467	CC130468	CC130469	CC130470	CC130471	CC130472	CC130473
Habitat	Riffle	Pool	Pool	Riffle	Riffle	Pool	Riffle
Lasiodiamesa							
Paraboreochlus							
Trichotanypus							
SubFamily: Prodiamesinae							
Prodiamesa							
Tribe: Boreochlini							
Boreochlus							
SubFamily: Tanypodinae			2	80	20		
Labrundinia							
Tribe: Pentaneuriini							
Ablabesmyia							
Nilotanypus							
Thienemannimyia							
Tribe: Procladiini							
Djalma batista							
Procladius			5	55	80	56	17
Family: Dixidae							
Dixella							
Family: Dolichopodidae							
Rhaphium							
Family: Empididae							
Clinocera							
Chelifera/Metachela							
Oreogeton							
Family: Muscidae							
Limnophora							

Site	R6S2	R6S2	WIS	WIS	WIS	WIS	WIS
Year	2012	2012	2012	2012	2012	2012	2012
CC#	CC130467	CC130468	CC130469	CC130470	CC130471	CC130472	CC130473
Habitat	Riffle	Pool	Pool	Riffle	Riffle	Pool	Riffle
Family: Simuliidae		1					
Prosimulium							
Simulium							
Family: Tipulidae							
Erioptera							
Limnophila							
Ormosia							
Tipula							
Order: Hemiptera							
Family: Corixidae				5			
Sigara							
Family: Gerridae							
Gerris							
Order: Lepidoptera							
Family: Noctuidae							
Order: Odonata							
Subphylum: Crustacea							
Class: Malacostraca							
Order: Amphipoda							
Subphylum: Chelicerata							
Class: Arachnida							
Order: Trombidiformes							
SubOrder: Prostigmata	3	2			7		3
Neobrachypoda							
Pionopsis							
Family: Arrenuridae							

Site	R6S2	R6S2	WIS	WIS	WIS	WIS	WIS
Year	2012	2012	2012	2012	2012	2012	2012
CC#	CC130467	CC130468	CC130469	CC130470	CC130471	CC130472	CC130473
Habitat	Riffle	Pool	Pool	Riffle	Riffle	Pool	Riffle
Arrenurus							
Family: Hydryphantidae							
Family: Hygrobatidae							
Hygrobates							
Family: Lebertiidae							
Lebertia							
Family: Limnesiidae							
Limnesia							
Family: Limnocharidae							
Limnochares							
Family: Mideopsidae							
Mideopsis							
Family: Oxidae							
Oxus							
Family: Pionidae							
Piona							
Family: Sperchontidae							
Sperchon							
Sperchonopsis							
Family: Unionicolidae							
Neumania							
Family: Halacaridae							
Order: Oribatida							
Family: Hydrozetidae	1			15	33	6	27
Phylum: Mollusca							
Class: Bivalvia							

Site	R6S2	R6S2	WIS	WIS	WIS	WIS	WIS
Year	2012	2012	2012	2012	2012	2012	2012
CC#	CC130467	CC130468	CC130469	CC130470	CC130471	CC130472	CC130473
Habitat	Riffle	Pool	Pool	Riffle	Riffle	Pool	Riffle
Order: Veneroida							
Family: Pisidiidae			5	5	13		
Pisidium			4	5			
Class: Gastropoda							
Order: Heterostropha							
Family: Valvatidae							
Phylum: Annelida							
Subphylum: Clitellata							
Class: Oligochaeta							
Order: Lumbriculida							
Family: Lumbriculidae	2	1	1		7		
Order: Tubificida							
Family: Enchytraeidae							
Enchytraeus							
Family: Lumbricidae							
Family: Naididae	11	6		30	20	6	20
Chaetogaster				15			3
Chaetogaster diaphanus							
Nais				5	27		
Pristina				10	20		
Family: Tubificidae							
Phylum: Cnidaria							
Class: Hydrozoa							
Order: Anthoathecatae							
Family: Hydridae							
Hydra				90	120	25	

Site	R6S2	R6S2	WIS	WIS	WIS	WIS	WIS
Year	2012	2012	2012	2012	2012	2012	2012
CC#	CC130467	CC130468	CC130469	CC130470	CC130471	CC130472	CC130473
Habitat	Riffle	Pool	Pool	Riffle	Riffle	Pool	Riffle
Phylum: Tardigrada	3	1					3

Site	WIS	WIS	WIS	WIS	WIS	WIS	WIS
Year	2012	2012	2012	2012	2012	2012	2012
CC#	CC130474	CC130475	CC130476	CC130477	CC130478	CC130479	CC130480
Habitat	Riffle	Riffle	Pool	Pool	Riffle	Pool	Riffle
Phylum: Arthropoda							
Subphylum: Hexapoda							
Class: Insecta							
Order: Ephemeroptera							
Family: Baetidae							
Acerpenna							
Acerpenna pygmaea							
Baetis		3		14			
Baetis bicaudatus							
Baetis tricaudatus		3		32	8		
Family: Ephemerellidae							
Caudatella							
Family: Heptageniidae							
Epeorus							
Ironodes							
Rhithrogena							
Family: Leptophlebiidae							
Order: Plecoptera							
Family: Capniidae							
Family: Leuctridae							
Family: Nemouridae							
Amphinemura							
Malenka							
Nemoura							
Ostrocerca							
Zapada							

Site	WIS	WIS	WIS	WIS	WIS	WIS	WIS
Year	2012	2012	2012	2012	2012	2012	2012
CC#	CC130474	CC130475	CC130476	CC130477	CC130478	CC130479	CC130480
Habitat	Riffle	Riffle	Pool	Pool	Riffle	Pool	Riffle
Zapada oregonensis							
Family: Perlodidae							
Order: Trichoptera							
Micrasema							
Family: Hydropsychidae							
Hydropsyche							
Family: Hydroptilidae							
Agraylea							
Oxyethira							
Family: Limnephilidae							
Clostoeca disjuncta							
Ecclisomyia							
Limnephilus							
Family: Molannidae							
Molanna flavicornis							
Molanna distinctus							
Family: Phryganeidae							
Agrypnia							
Family: Rhyacophilidae							
Rhyacophila							
Order: Coleoptera							
Family: Dytiscidae							
Agabus				2			
Colymbetes							
Hydroporus		3					
Oreodytes							

Site	WIS	WIS	WIS	WIS	WIS	WIS	WIS
Year	2012	2012	2012	2012	2012	2012	2012
CC#	CC130474	CC130475	CC130476	CC130477	CC130478	CC130479	CC130480
Habitat	Riffle	Riffle	Pool	Pool	Riffle	Pool	Riffle
Stictotarsus							
Family: Hydraenidae							
Hydraena							
SubFamily: Hydroporinae							
Family: Hydrophilidae							
Hydrochus							
Family: Psephenidae							
Family: Staphylinidae							
Order: Diptera							
Family: Ceratopogonidae							
Atrichopogon							
Bezzia/Palpomyia	4					1	24
Culicoides							
Dasyhelea							
Forcipomyia							
Mallochohelea							
Probezzia							
Sphaeromias							
Family: Chaoboridae							
Eucorethra							
Family: Chironomidae						1	
SubFamily: Chironominae							
Fissimentum							
Tribe: Chironomini							
Chironomus		22				52	18
Cryptochironomus							

Site	WIS	WIS	WIS	WIS	WIS	WIS	WIS
Year	2012	2012	2012	2012	2012	2012	2012
CC#	CC130474	CC130475	CC130476	CC130477	CC130478	CC130479	CC130480
Habitat	Riffle	Riffle	Pool	Pool	Riffle	Pool	Riffle
Endochironomus							
Microtendipes							
Microtendipes pedellus							
Phaenopsectra							
Polypedilum							
Stictochironomus	7	16	6		34	7	32
Tribelos							
Tribe: Tanytarsini							
Cladotanytarsus							
Micropsectra	1141	446					
Paratanytarsus							
Rheotanytarsus							
Tanytarsus			420	138	180	35	44
SubFamily: Diamesinae							
Protanypus					2		
Tribe: Diamesini							
Pagastia							
Potthastia							
SubFamily: Orthocladiinae							21
Brillia							
Cricotopus							
Diplocladius							
Diplocladius cultriger							
Eukiefferiella							
Georthocladius							
Heterotanytarsus							

Site	WIS	WIS	WIS	WIS	WIS	WIS	WIS
Year	2012	2012	2012	2012	2012	2012	2012
CC#	CC130474	CC130475	CC130476	CC130477	CC130478	CC130479	CC130480
Habitat	Riffle	Riffle	Pool	Pool	Riffle	Pool	Riffle
Heterotrissocladius				148			
Hydrobaenus							
Limnophyes							
Metriocnemus							
Nanocladius							
Orthocladius							
Orthocladius complex							
Parakiefferiella							
Paralimnophyes arcticus							
Paraphaenocladius							
Psectrocladius		41		16			
Psiloptarus							
Pseudosmittia							
Rheocricotopus							
Tvetenia							
Tvetenia bavarica							
Tvetenia vitracies							
Zalutschia							
Zalutschia briani							
Zalutschia tatrica							
Zalutschia zalutschicola							
Tribe: Corynoneurini							
Corynoneura		232	94		320	8	13
Tribe: Orthocladiini							
Chaetocladius							
SubFamily: Podonominae							

Site	WIS	WIS	WIS	WIS	WIS	WIS	WIS
Year	2012	2012	2012	2012	2012	2012	2012
CC#	CC130474	CC130475	CC130476	CC130477	CC130478	CC130479	CC130480
Habitat	Riffle	Riffle	Pool	Pool	Riffle	Pool	Riffle
Lasiodiamesa							
Paraboreochlus							
Trichotanypus							
SubFamily: Prodiamesinae							
Prodiamesa							
Tribe: Boreochlini							
Boreochlus							
SubFamily: Tanypodinae							
Labrundinia							
Tribe: Pentaneuriini							
Ablabesmyia							1
Nilotanypus							
Thienemannimyia							
Tribe: Procladiini							
Djalma batista							
Procladius					6	78	5
Family: Dixidae							
Dixella					2	1	
Family: Dolichopodidae							
Rhaphium		3					
Family: Empididae							
Clinocera							
Chelifera/Metachela							
Oreogeton							
Family: Muscidae							
Limnophora							1

Site	WIS	WIS	WIS	WIS	WIS	WIS	WIS
Year	2012	2012	2012	2012	2012	2012	2012
CC#	CC130474	CC130475	CC130476	CC130477	CC130478	CC130479	CC130480
Habitat	Riffle	Riffle	Pool	Pool	Riffle	Pool	Riffle
Family: Simuliidae							
Prosimulium							
Simulium							
Family: Tipulidae							
Erioptera						1	
Limnophila							
Ormosia							
Tipula							
Order: Hemiptera							
Family: Corixidae							
Sigara							
Family: Gerridae							
Gerris							
Order: Lepidoptera		3					
Family: Noctuidae							
Order: Odonata							
Subphylum: Crustacea							
Class: Malacostraca							
Order: Amphipoda							
Subphylum: Chelicerata							
Class: Arachnida							
Order: Trombidiformes							
SubOrder: Prostigmata			4	6		2	
Neobrachypoda							
Pionopsis							
Family: Arrenuridae							

Site	WIS	WIS	WIS	WIS	WIS	WIS	WIS
Year	2012	2012	2012	2012	2012	2012	2012
CC#	CC130474	CC130475	CC130476	CC130477	CC130478	CC130479	CC130480
Habitat	Riffle	Riffle	Pool	Pool	Riffle	Pool	Riffle
Arrenurus							
Family: Hydryphantidae							
Family: Hygrobatidae							
Hygrobates							
Family: Lebertiidae							
Lebertia							
Family: Limnesiidae							
Limnesia							
Family: Limnocharidae							
Limnochares							
Family: Mideopsidae							
Mideopsis							
Family: Oxidae							
Oxus							
Family: Pionidae							
Piona							
Family: Sperchontidae							
Sperchon							
Sperchonopsis							
Family: Unionicolidae							
Neumania							
Family: Halacaridae							
Order: Oribatida							
Family: Hydrozetidae	4			6		2	1
Phylum: Mollusca							
Class: Bivalvia							

Site	WIS	WIS	WIS	WIS	WIS	WIS	WIS
Year	2012	2012	2012	2012	2012	2012	2012
CC#	CC130474	CC130475	CC130476	CC130477	CC130478	CC130479	CC130480
Habitat	Riffle	Riffle	Pool	Pool	Riffle	Pool	Riffle
Order: Veneroida							
Family: Pisidiidae							
Pisidium							
Class: Gastropoda							
Order: Heterostropha							
Family: Valvatidae							
Phylum: Annelida							
Subphylum: Clitellata							
Class: Oligochaeta							
Order: Lumbriculida							
Family: Lumbriculidae		14		24			6
Order: Tubificida							
Family: Enchytraeidae							
Enchytraeus				54			
Family: Lumbricidae							
Family: Naididae	15	173	198	50	46	11	12
Chaetogaster					4		
Chaetogaster diaphanus							
Nais							
Pristina							
Family: Tubificidae							
Phylum: Cnidaria							
Class: Hydrozoa							
Order: Anthoathecatae							
Family: Hydridae							
Hydra	4		8	2	2	1	

Site	WIS	WIS	WIS	WIS	WIS	WIS	WIS
Year	2012	2012	2012	2012	2012	2012	2012
CC#	CC130474	CC130475	CC130476	CC130477	CC130478	CC130479	CC130480
Habitat	Riffle	Riffle	Pool	Pool	Riffle	Pool	Riffle
Phylum: Tardigrada				8		5	

Site	WIS	WIS	WIS	WIS	WIS	WIS
Year	2012	2012	2012	2012	2012	2012
CC#	CC130481	CC130482	CC130483	CC130484	CC130485	CC130486
Habitat	Riffle	Pool	Pool	Pool	Pool	Riffle
Phylum: Arthropoda						
Subphylum: Hexapoda						
Class: Insecta						
Order: Ephemeroptera						
Family: Baetidae						
Acerpenna						
Acerpenna pygmaea						
Baetis				1	4	
Baetis bicaudatus						
Baetis tricaudatus		1			23	2
Family: Ephemerellidae						
Caudatella						
Family: Heptageniidae						
Epeorus						
Ironodes						
Rhithrogena						
Family: Leptophlebiidae						
Order: Plecoptera						
Family: Capniidae						
Family: Leuctridae						
Family: Nemouridae						
Amphinemura						
Malenka						
Nemoura						
Ostrocerca						
Zapada						

Site	WIS	WIS	WIS	WIS	WIS	WIS
Year	2012	2012	2012	2012	2012	2012
CC#	CC130481	CC130482	CC130483	CC130484	CC130485	CC130486
Habitat	Riffle	Pool	Pool	Pool	Pool	Riffle
Zapada oregonensis						
Family: Perlodidae						
Order: Trichoptera						
Micrasema						
Family: Hydropsychidae						
Hydropsyche						
Family: Hydroptilidae						
Agraylea						
Oxyethira						
Family: Limnephilidae						
Clostoeca disjuncta						
Ecclisomyia						
Limnephilus						
Family: Molannidae						
Molanna flavicornis						
Molanna distinctus						
Family: Phryganeidae						
Agrypnia						
Family: Rhyacophilidae						
Rhyacophila						
Order: Coleoptera						
Family: Dytiscidae					1	
Agabus						
Colymbetes						
Hydroporus						
Oreodytes						

Site	WIS	WIS	WIS	WIS	WIS	WIS
Year	2012	2012	2012	2012	2012	2012
CC#	CC130481	CC130482	CC130483	CC130484	CC130485	CC130486
Habitat	Riffle	Pool	Pool	Pool	Pool	Riffle
Stictotarsus						
Family: Hydraenidae						
Hydraena						
SubFamily: Hydroporinae						
Family: Hydrophilidae						
Hydrochus						
Family: Psephenidae						
Family: Staphylinidae						
Order: Diptera						
Family: Ceratopogonidae						
Atrichopogon						
Bezzia/Palpomyia	1				2	
Culicoides						
Dasyhelea						
Forcipomyia						
Mallochohelea						
Probezzia						
Sphaeromias						
Family: Chaoboridae						
Eucorethra						
Family: Chironomidae					1	
SubFamily: Chironominae						
Fissimentum						
Tribe: Chironomini						
Chironomus	22	18	152	119	20	
Cryptochironomus						

Site	WIS	WIS	WIS	WIS	WIS	WIS
Year	2012	2012	2012	2012	2012	2012
CC#	CC130481	CC130482	CC130483	CC130484	CC130485	CC130486
Habitat	Riffle	Pool	Pool	Pool	Pool	Riffle
Endochironomus						
Microtendipes						
Microtendipes pedellus						
Phaenopsectra						
Polypedilum						
Stictochironomus		4	391	29	26	
Tribelos						
Tribe: Tanytarsini						
Cladotanytarsus						
Micropsectra						
Paratanytarsus						
Rheotanytarsus						
Tanytarsus	5	25	557	15	78	47
SubFamily: Diamesinae						
Protanypus						
Tribe: Diamesini						
Pagastia						
Potthastia						
SubFamily: Orthocladiinae						
Brillia						
Cricotopus						
Diplocladius						
Diplocladius cultriger						1
Eukiefferiella						
Georthocladius						
Heterotanytarsus						

Site	WIS	WIS	WIS	WIS	WIS	WIS
Year	2012	2012	2012	2012	2012	2012
CC#	CC130481	CC130482	CC130483	CC130484	CC130485	CC130486
Habitat	Riffle	Pool	Pool	Pool	Pool	Riffle
Heterotrissocladius						
Hydrobaenus						
Limnophyes						
Metriocnemus						
Nanocladius						
Orthocladius						
Orthocladius complex						
Parakiefferiella						
Paralimnophyes arcticus						
Paraphaenocladius						
Psectrocladius	1	39		14		
Psiloptarus						
Pseudosmittia						
Rheocricotopus						
Tvetenia						
Tvetenia bavarica						
Tvetenia vitracies						
Zalutschia						
Zalutschia briani						
Zalutschia tatrica						
Zalutschia zalutschicola						
Tribe: Corynoneurini						
Corynoneura	48	73	91	11	57	57
Tribe: Orthocladiini						
Chaetocladius						
SubFamily: Podonominae						

Site	WIS	WIS	WIS	WIS	WIS	WIS
Year	2012	2012	2012	2012	2012	2012
CC#	CC130481	CC130482	CC130483	CC130484	CC130485	CC130486
Habitat	Riffle	Pool	Pool	Pool	Pool	Riffle
Lasiodiamesa						
Paraboreochlus						
Trichotanypus	2	1			1	
SubFamily: Prodiamesinae						
Prodiamesa						
Tribe: Boreochlini						
Boreochlus						
SubFamily: Tanypodinae						
Labrundinia						
Tribe: Pentaneuriini						
Ablabesmyia						
Nilotanypus						
Thienemannimyia						
Tribe: Procladiini						
Djalma batista						
Procladius		165	187		89	
Family: Dixidae						
Dixella						
Family: Dolichopodidae						
Rhaphium				2		
Family: Empididae						
Clinocera			4			
Chelifera/Metachela						
Oreogeton						
Family: Muscidae						
Limnophora						

Site	WIS	WIS	WIS	WIS	WIS	WIS
Year	2012	2012	2012	2012	2012	2012
CC#	CC130481	CC130482	CC130483	CC130484	CC130485	CC130486
Habitat	Riffle	Pool	Pool	Pool	Pool	Riffle
Family: Simuliidae					1	
Prosimulium						
Simulium						
Family: Tipulidae						
Erioptera						
Limnophila						
Ormosia						
Tipula						
Order: Hemiptera						
Family: Corixidae						
Sigara						
Family: Gerridae						
Gerris						
Order: Lepidoptera						
Family: Noctuidae						
Order: Odonata						
Subphylum: Crustacea						
Class: Malacostraca						
Order: Amphipoda						
Subphylum: Chelicerata						
Class: Arachnida						
Order: Trombidiformes						
SubOrder: Prostigmata						1
Neobrachypoda						
Pionopsis						
Family: Arrenuridae						

Site	WIS	WIS	WIS	WIS	WIS	WIS
Year	2012	2012	2012	2012	2012	2012
CC#	CC130481	CC130482	CC130483	CC130484	CC130485	CC130486
Habitat	Riffle	Pool	Pool	Pool	Pool	Riffle
Arrenurus						
Family: Hydryphantidae						
Family: Hygrobatidae						
Hygrobates						
Family: Lebertiidae						
Lebertia						
Family: Limnesiidae						
Limnesia						
Family: Limnocharidae						
Limnochares						
Family: Mideopsidae						
Mideopsis						
Family: Oxidae						
Oxus						
Family: Pionidae						
Piona						
Family: Sperchontidae						
Sperchon						
Sperchonopsis						
Family: Unionicolidae						
Neumania						
Family: Halacaridae						
Order: Oribatida						
Family: Hydrozetidae	1	3	4	5	4	3
Phylum: Mollusca						
Class: Bivalvia						

Site	WIS	WIS	WIS	WIS	WIS	WIS
Year	2012	2012	2012	2012	2012	2012
CC#	CC130481	CC130482	CC130483	CC130484	CC130485	CC130486
Habitat	Riffle	Pool	Pool	Pool	Pool	Riffle
Order: Veneroida						
Family: Pisidiidae						
Pisidium						
Class: Gastropoda						
Order: Heterostropha						
Family: Valvatidae						
Phylum: Annelida						
Subphylum: Clitellata						
Class: Oligochaeta						
Order: Lumbriculida						
Family: Lumbriculidae		1		1	1	1
Order: Tubificida						
Family: Enchytraeidae						
Enchytraeus		1			2	5
Family: Lumbricidae						
Family: Naididae		8	4		10	18
Chaetogaster						
Chaetogaster diaphanus		7			1	
Nais	3	3				
Pristina		1				
Family: Tubificidae						
Phylum: Cnidaria						
Class: Hydrozoa						
Order: Anthoathecatae						
Family: Hydridae						
Hydra		10		6	10	

Site	WIS	WIS	WIS	WIS	WIS	WIS
Year	2012	2012	2012	2012	2012	2012
CC#	CC130481	CC130482	CC130483	CC130484	CC130485	CC130486
Habitat	Riffle	Pool	Pool	Pool	Pool	Riffle
Phylum: Tardigrada		2	13	1	2	5

Table A1-4: 2013 Raw Invertebrate Data.

Site	R2S	R2S	R2S	R2S	R6S1	R6S1	R6S1
Year	2013	2013	2013	2013	2013	2013	2013
CC#	CC140091	CC140092	CC140093	CC140094	CC140065	CC140066	CC140067
Habitat	Pool	Pool	Riffle	Riffle	Riffle	Pool	Riffle
Phylum: Arthropoda							
Subphylum: Hexapoda							
Class: Insecta							
Order: Ephemeroptera							
Family: Baetidae							
Acerpenna							
Acerpenna pygmaea							
Baetis							
Baetis bicaudatus							
Baetis tricaudatus							
Family: Ephemerellidae							
Caudatella							
Family: Heptageniidae							
Epeorus							
Ironodes							
Rhithrogena							
Family: Leptophlebiidae							
Order: Plecoptera							
Family: Capniidae							
Family: Leuctridae							
Family: Nemouridae							
Amphinemura							
Malenka							
Nemoura							
Ostrocerca							
Zapada							

Site	R2S	R2S	R2S	R2S	R6S1	R6S1	R6S1
Year	2013	2013	2013	2013	2013	2013	2013
CC#	CC140091	CC140092	CC140093	CC140094	CC140065	CC140066	CC140067
Habitat	Pool	Pool	Riffle	Riffle	Riffle	Pool	Riffle
Zapada oregonensis							
Family: Perlodidae							
Order: Trichoptera							
Micrasema							
Family: Hydropsychidae							
Hydropsyche							
Family: Hydroptilidae							
Agraylea							
Oxyethira							
Family: Limnephilidae							14
Clostoeca disjuncta							
Ecclisomyia							
Limnephilus			1				
Family: Molannidae							
Molanna flavicornis							
Molanna distinctus							
Family: Phryganeidae							
Agrypnia							
Family: Rhyacophilidae							
Rhyacophila					9		
Order: Coleoptera							
Family: Dytiscidae							
Agabus							
Colymbetes							
Hydroporus							
Oreodytes							

Site	R2S	R2S	R2S	R2S	R6S1	R6S1	R6S1
Year	2013	2013	2013	2013	2013	2013	2013
CC#	CC140091	CC140092	CC140093	CC140094	CC140065	CC140066	CC140067
Habitat	Pool	Pool	Riffle	Riffle	Riffle	Pool	Riffle
Stictotarsus							
Family: Hydraenidae							
Hydraena							
SubFamily: Hydroporinae		2	4			7	
Family: Hydrophilidae							
Hydrochus							
Family: Psephenidae							
Family: Staphylinidae							
Order: Diptera							
Family: Ceratopogonidae							
Atrichopogon							
Bezzia/Palpomyia					9	17	7
Culicoides							
Dasyhelea						3	
Forcipomyia							
Mallochohelea							
Probezzia							
Sphaeromias							
Family: Chaoboridae							
Eucorethra							
Family: Chironomidae		3	1	14			
SubFamily: Chironominae	20						
Fissimentum							
Tribe: Chironomini							
Chironomus	14	14	8	29		10	
Cryptochironomus							

Site	R2S	R2S	R2S	R2S	R6S1	R6S1	R6S1
Year	2013	2013	2013	2013	2013	2013	2013
CC#	CC140091	CC140092	CC140093	CC140094	CC140065	CC140066	CC140067
Habitat	Pool	Pool	Riffle	Riffle	Riffle	Pool	Riffle
Endochironomus							
Microtendipes							
Microtendipes pedellus					45	533	164
Phaenopsectra							
Polypedilum							
Stictochironomus							
Tribelos							
Tribe: Tanytarsini							
Cladotanytarsus							
Micropsectra	1			79		433	
Paratanytarsus					9		
Rheotanytarsus							
Tanytarsus	13	402	426	2193		37	
SubFamily: Diamesinae							
Protanypus							
Tribe: Diamesini							
Pagastia							
Potthastia		1					
SubFamily: Orthocladiinae			78				464
Brillia							
Cricotopus					255		
Diplocladius							
Diplocladius cultriger							
Eukiefferiella							
Georthocladius							
Heterotanytarsus							

Site	R2S	R2S	R2S	R2S	R6S1	R6S1	R6S1
Year	2013	2013	2013	2013	2013	2013	2013
CC#	CC140091	CC140092	CC140093	CC140094	CC140065	CC140066	CC140067
Habitat	Pool	Pool	Riffle	Riffle	Riffle	Pool	Riffle
Heterotrissocladius				7			
Hydrobaenus							
Limnophyes					9		
Metriocnemus							
Nanocladius							
Orthocladius							
Orthocladius complex	2	6	2				
Parakiefferiella							
Paralimnophyes arcticus							
Paraphaenocladius							
Psectrocladius					55	133	50
Psiloptarus							
Pseudosmittia							
Rheocricotopus							
Tvetenia							
Tvetenia bavarica							
Tvetenia vitracies							
Zalutschia					82		
Zalutschia briani							
Zalutschia tatrica							
Zalutschia zalutschicola							
Tribe: Corynoneurini							
Corynoneura	1				145		86
Tribe: Orthocladiini							
Chaetocladius							
SubFamily: Podonominae							

Site	R2S	R2S	R2S	R2S	R6S1	R6S1	R6S1
Year	2013	2013	2013	2013	2013	2013	2013
CC#	CC140091	CC140092	CC140093	CC140094	CC140065	CC140066	CC140067
Habitat	Pool	Pool	Riffle	Riffle	Riffle	Pool	Riffle
Lasiodiamesa							
Paraboreochlus							
Trichotanypus							
SubFamily: Prodiamesinae							
Prodiamesa							
Tribe: Boreochlini							
Boreochlus							
SubFamily: Tanypodinae							
Labrundinia							
Tribe: Pentaneuriini							
Ablabesmyia			2			13	
Nilotanypus							
Thienemannimyia							
Tribe: Procladiini							
Djalma batista							
Procladius		1					
Family: Dixidae							7
Dixella							
Family: Dolichopodidae							
Rhaphium							
Family: Empididae		1					
Clinocera							
Chelifera/Metachela							
Oreogeton						3	
Family: Muscidae							
Limnophora							

Site	R2S	R2S	R2S	R2S	R6S1	R6S1	R6S1
Year	2013	2013	2013	2013	2013	2013	2013
CC#	CC140091	CC140092	CC140093	CC140094	CC140065	CC140066	CC140067
Habitat	Pool	Pool	Riffle	Riffle	Riffle	Pool	Riffle
Family: Simuliidae	2		5	14	1609		1036
Prosimulium							
Simulium					1100	17	186
Family: Tipulidae							
Erioptera							
Limnophila							
Ormosia							
Tipula							
Order: Hemiptera							
Family: Corixidae							
Sigara							
Family: Gerridae							
Gerris	1						
Order: Lepidoptera							
Family: Noctuidae							
Order: Odonata							
Subphylum: Crustacea							
Class: Malacostraca							
Order: Amphipoda							
Subphylum: Chelicerata							
Class: Arachnida							
Order: Trombidiformes							
SubOrder: Prostigmata	2	1				3	
Neobrachypoda							
Pionopsis							
Family: Arrenuridae							

Site	R2S	R2S	R2S	R2S	R6S1	R6S1	R6S1
Year	2013	2013	2013	2013	2013	2013	2013
CC#	CC140091	CC140092	CC140093	CC140094	CC140065	CC140066	CC140067
Habitat	Pool	Pool	Riffle	Riffle	Riffle	Pool	Riffle
Arrenurus							
Family: Hydryphantidae							
Family: Hygrobatidae							
Hygrobates							
Family: Lebertiidae							
Lebertia					18		
Family: Limnesiidae							
Limnesia							
Family: Limnocharidae							
Limnochares							
Family: Mideopsidae							
Mideopsis							
Family: Oxidae							
Oxus							
Family: Pionidae							
Piona							
Family: Sperchontidae							
Sperchon							
Sperchonopsis							
Family: Unionicolidae							
Neumania							
Family: Halacaridae						3	
Order: Oribatida							
Family: Hydrozetidae	10	5	31	14	27	73	129
Phylum: Mollusca							
Class: Bivalvia							

Site	R2S	R2S	R2S	R2S	R6S1	R6S1	R6S1
Year	2013	2013	2013	2013	2013	2013	2013
CC#	CC140091	CC140092	CC140093	CC140094	CC140065	CC140066	CC140067
Habitat	Pool	Pool	Riffle	Riffle	Riffle	Pool	Riffle
Order: Veneroida							
Family: Pisidiidae		6					
Pisidium						7	
Class: Gastropoda							
Order: Heterostropha							
Family: Valvatidae							
Phylum: Annelida							
Subphylum: Clitellata							
Class: Oligochaeta							
Order: Lumbriculida							
Family: Lumbriculidae	2		2				
Order: Tubificida							
Family: Enchytraeidae							
Enchytraeus			3				21
Family: Lumbricidae							
Family: Naididae			60	14			
Chaetogaster					9	7	
Chaetogaster diaphanus							
Nais	1	11	5	14	36	3	57
Pristina							
Family: Tubificidae	10				9	30	57
Phylum: Cnidaria							
Class: Hydrozoa							
Order: Anthoathecatae							
Family: Hydridae							
Hydra							

Site	R2S	R2S	R2S	R2S	R6S1	R6S1	R6S1
Year	2013	2013	2013	2013	2013	2013	2013
CC#	CC140091	CC140092	CC140093	CC140094	CC140065	CC140066	CC140067
Habitat	Pool	Pool	Riffle	Riffle	Riffle	Pool	Riffle
Phylum: Tardigrada	2		1				

Site	R6S1	R6S1	R6S1	R6S2	R6S2	R6S2	R6S2
Year	2013	2013	2013	2013	2013	2013	2013
CC#	CC140068	CC140069	CC140070	CC140085	CC140086	CC140087	CC140088
Habitat	Pool	Pool	Riffle	Riffle	Pool	Pool	Riffle
Phylum: Arthropoda							
Subphylum: Hexapoda							
Class: Insecta							
Order: Ephemeroptera							
Family: Baetidae							
Acerpenna							
Acerpenna pygmaea							
Baetis							
Baetis bicaudatus							
Baetis tricaudatus							31
Family: Ephemerellidae							
Caudatella							
Family: Heptageniidae							
Epeorus							
Ironodes							
Rhithrogena							
Family: Leptophlebiidae							
Order: Plecoptera							
Family: Capniidae							
Family: Leuctridae							
Family: Nemouridae							
Amphinemura							
Malenka							
Nemoura							
Ostrocerca							
Zapada							

Site	R6S1	R6S1	R6S1	R6S2	R6S2	R6S2	R6S2
Year	2013	2013	2013	2013	2013	2013	2013
CC#	CC140068	CC140069	CC140070	CC140085	CC140086	CC140087	CC140088
Habitat	Pool	Pool	Riffle	Riffle	Pool	Pool	Riffle
Zapada oregonensis							
Family: Perlodidae							
Order: Trichoptera							
Micrasema							
Family: Hydropsychidae							
Hydropsyche							
Family: Hydroptilidae							
Agraylea							
Oxyethira							
Family: Limnephilidae		12	2				
Clostoeca disjuncta							
Ecclisomyia							
Limnephilus	4						
Family: Molannidae							
Molanna flavicornis							
Molanna distinctus							
Family: Phryganeidae							
Agrypnia							
Family: Rhyacophilidae							
Rhyacophila							
Order: Coleoptera							
Family: Dytiscidae							
Agabus			1				
Colymbetes							
Hydroporus							
Oreodytes							

Site	R6S1	R6S1	R6S1	R6S2	R6S2	R6S2	R6S2
Year	2013	2013	2013	2013	2013	2013	2013
CC#	CC140068	CC140069	CC140070	CC140085	CC140086	CC140087	CC140088
Habitat	Pool	Pool	Riffle	Riffle	Pool	Pool	Riffle
Stictotarsus							
Family: Hydraenidae							
Hydraena							
SubFamily: Hydroporinae							
Family: Hydrophilidae							
Hydrochus							
Family: Psephenidae							
Family: Staphylinidae							
Order: Diptera							
Family: Ceratopogonidae					1		
Atrichopogon					1		
Bezzia/Palpomyia	16	6	2	8		39	40
Culicoides							
Dasyhelea			2				
Forcipomyia							
Mallochohelea							
Probezzia							
Sphaeromias							
Family: Chaoboridae							
Eucorethra							
Family: Chironomidae							
SubFamily: Chironominae							
Fissimentum							
Tribe: Chironomini	216	206	40	176	95	24	15
Chironomus		35					
Cryptochironomus							

Site	R6S1	R6S1	R6S1	R6S2	R6S2	R6S2	R6S2
Year	2013	2013	2013	2013	2013	2013	2013
CC#	CC140068	CC140069	CC140070	CC140085	CC140086	CC140087	CC140088
Habitat	Pool	Pool	Riffle	Riffle	Pool	Pool	Riffle
Endochironomus							
Microtendipes							
Microtendipes pedellus	204	335					
Phaenopsectra							
Polypedilum							
Stictochironomus	12				15	12	15
Tribelos							
Tribe: Tanytarsini							
Cladotanytarsus	16						
Micropsectra	228	382	65	149	35		45
Paratanytarsus							
Rheotanytarsus							
Tanytarsus	140	188	24	59	25		21
SubFamily: Diamesinae							
Protanypus				3			
Tribe: Diamesini							
Pagastia							
Potthastia							
SubFamily: Orthocladiinae	140		185	284	115	40	38
Brillia							
Cricotopus		241					
Diplocladius							
Diplocladius cultriger							
Eukiefferiella					1		
Georthocladius							
Heterotanytarsus			5	8			

Site	R6S1	R6S1	R6S1	R6S2	R6S2	R6S2	R6S2
Year	2013	2013	2013	2013	2013	2013	2013
CC#	CC140068	CC140069	CC140070	CC140085	CC140086	CC140087	CC140088
Habitat	Pool	Pool	Riffle	Riffle	Pool	Pool	Riffle
Heterotrissocladius				41			
Hydrobaenus							
Limnophyes					2		
Metriocnemus							
Nanocladius							
Orthocladius							
Orthocladius complex							
Parakiefferiella							
Paralimnophyes arcticus							
Paraphaenocladius							
Psectrocladius						25	26
Psiloptarus							
Pseudosmittia							
Rheocricotopus							
Tvetenia							
Tvetenia bavarica							
Tvetenia vitracies							
Zalutschia	160	312	30		55		
Zalutschia briani							
Zalutschia tatrica							
Zalutschia zalutschicola							
Tribe: Corynoneurini							
Corynoneura	32	53	17	8			21
Tribe: Orthocladiini							
Chaetocladius							
SubFamily: Podonominae							

Site	R6S1	R6S1	R6S1	R6S2	R6S2	R6S2	R6S2
Year	2013	2013	2013	2013	2013	2013	2013
CC#	CC140068	CC140069	CC140070	CC140085	CC140086	CC140087	CC140088
Habitat	Pool	Pool	Riffle	Riffle	Pool	Pool	Riffle
Lasiodiamesa							
Paraboreochlus							
Trichotanypus							
SubFamily: Prodiamesinae							
Prodiamesa							
Tribe: Boreochlini							
Boreochlus							
SubFamily: Tanypodinae							
Labrundinia							
Tribe: Pentaneuriini							
Ablabesmyia	4	12	2				
Nilotanypus							
Thienemannimyia							
Tribe: Procladiini							
Djalma batista							
Procladius			1	8	85	37	2
Family: Dixidae							
Dixella							
Family: Dolichopodidae							
Rhaphium							
Family: Empididae							
Clinocera							
Chelifera/Metachela							
Oreogeton	12	6	1				
Family: Muscidae							
Limnophora							

Site	R6S1	R6S1	R6S1	R6S2	R6S2	R6S2	R6S2
Year	2013	2013	2013	2013	2013	2013	2013
CC#	CC140068	CC140069	CC140070	CC140085	CC140086	CC140087	CC140088
Habitat	Pool	Pool	Riffle	Riffle	Pool	Pool	Riffle
Family: Simuliidae			13	19			5
Prosimulium							
Simulium			16				
Family: Tipulidae							
Erioptera							
Limnophila							
Ormosia							
Tipula					1		
Order: Hemiptera							
Family: Corixidae							
Sigara							
Family: Gerridae							
Gerris							
Order: Lepidoptera							
Family: Noctuidae							
Order: Odonata							
Subphylum: Crustacea							
Class: Malacostraca							
Order: Amphipoda							
Subphylum: Chelicerata							
Class: Arachnida							
Order: Trombidiformes							
SubOrder: Prostigmata	16		1	5		3	2
Neobrachypoda							
Pionopsis							
Family: Arrenuridae							

Site	R6S1	R6S1	R6S1	R6S2	R6S2	R6S2	R6S2
Year	2013	2013	2013	2013	2013	2013	2013
CC#	CC140068	CC140069	CC140070	CC140085	CC140086	CC140087	CC140088
Habitat	Pool	Pool	Riffle	Riffle	Pool	Pool	Riffle
Arrenurus			1				
Family: Hydryphantidae							
Family: Hygrobatidae							
Hygrobates							
Family: Lebertiidae							
Lebertia			1			1	18
Family: Limnesiidae							
Limnesia							
Family: Limnocharidae							
Limnochares							
Family: Mideopsidae							
Mideopsis			1				
Family: Oxidae							
Oxus							
Family: Pionidae							
Piona							
Family: Sperchontidae							
Sperchon							
Sperchonopsis							
Family: Unionicolidae							
Neumania				3			
Family: Halacaridae			1				
Order: Oribatida							
Family: Hydrozetidae	28	59	16	24	9	3	2
Phylum: Mollusca							
Class: Bivalvia							

Site	R6S1	R6S1	R6S1	R6S2	R6S2	R6S2	R6S2
Year	2013	2013	2013	2013	2013	2013	2013
CC#	CC140068	CC140069	CC140070	CC140085	CC140086	CC140087	CC140088
Habitat	Pool	Pool	Riffle	Riffle	Pool	Pool	Riffle
Order: Veneroida							
Family: Pisidiidae							
Pisidium			3				
Class: Gastropoda							
Order: Heterostropha							
Family: Valvatidae							
Phylum: Annelida							
Subphylum: Clitellata							
Class: Oligochaeta							
Order: Lumbriculida							
Family: Lumbriculidae						11	
Order: Tubificida							
Family: Enchytraeidae							
Enchytraeus	4	6	15	3			
Family: Lumbricidae							3
Family: Naididae							
Chaetogaster							
Chaetogaster diaphanus							
Nais			10	11		7	
Pristina							
Family: Tubificidae	20	18	13	24	79	46	58
Phylum: Cnidaria							
Class: Hydrozoa							
Order: Anthoathecatae							
Family: Hydridae							
Hydra	8		1	24	15	25	

Site	R6S1	R6S1	R6S1	R6S2	R6S2	R6S2	R6S2
Year	2013	2013	2013	2013	2013	2013	2013
CC#	CC140068	CC140069	CC140070	CC140085	CC140086	CC140087	CC140088
Habitat	Pool	Pool	Riffle	Riffle	Pool	Pool	Riffle
Phylum: Tardigrada	20		8		7	9	

Site	R6S2	R6S2	WIS	WIS	WIS	WIS	WIS
Year	2013	2013	2013	2013	2013	2013	2013
CC#	CC140089	CC140090	CC140047	CC140048	CC140049	CC140050	CC140051
Habitat	Riffle	Pool	Riffle	Pool	Pool	Pool	Riffle
Phylum: Arthropoda							
Subphylum: Hexapoda							
Class: Insecta							
Order: Ephemeroptera							
Family: Baetidae							
Acerpenna							
Acerpenna pygmaea							
Baetis							
Baetis bicaudatus							
Baetis tricaudatus	15	1					
Family: Ephemerellidae							
Caudatella							
Family: Heptageniidae							
Epeorus							
Ironodes							
Rhithrogena							
Family: Leptophlebiidae							
Order: Plecoptera							
Family: Capniidae							
Family: Leuctridae							
Family: Nemouridae							
Amphinemura	2						
Malenka							
Nemoura							
Ostrocerca							
Zapada							

Site	R6S2	R6S2	WIS	WIS	WIS	WIS	WIS
Year	2013	2013	2013	2013	2013	2013	2013
CC#	CC140089	CC140090	CC140047	CC140048	CC140049	CC140050	CC140051
Habitat	Riffle	Pool	Riffle	Pool	Pool	Pool	Riffle
Zapada oregonensis						3	
Family: Perlodidae							
Order: Trichoptera							
Micrasema							
Family: Hydropsychidae							
Hydropsyche							
Family: Hydroptilidae							
Agraylea							
Oxyethira							
Family: Limnephilidae							
Clostoeca disjuncta							
Ecclisomyia							
Limnephilus		1	9	4	3	3	
Family: Molannidae							
Molanna flavicornis							
Molanna distinctus							
Family: Phryganeidae							
Agrypnia							
Family: Rhyacophilidae							
Rhyacophila							
Order: Coleoptera							
Family: Dytiscidae							
Agabus							
Colymbetes							
Hydroporus							
Oreodytes							

Site	R6S2	R6S2	WIS	WIS	WIS	WIS	WIS
Year	2013	2013	2013	2013	2013	2013	2013
CC#	CC140089	CC140090	CC140047	CC140048	CC140049	CC140050	CC140051
Habitat	Riffle	Pool	Riffle	Pool	Pool	Pool	Riffle
Stictotarsus							
Family: Hydraenidae							
Hydraena							
SubFamily: Hydroporinae			2				1
Family: Hydrophilidae							
Hydrochus							
Family: Psephenidae	1						
Family: Staphylinidae							
Order: Diptera							
Family: Ceratopogonidae							
Atrichopogon							
Bezzia/Palpomyia	5	11		20	9		3
Culicoides							
Dasyhelea							
Forcipomyia							
Mallochohelea			4				
Probezzia							
Sphaeromias							
Family: Chaoboridae							
Eucorethra							
Family: Chironomidae							1
SubFamily: Chironominae							
Fissimentum							
Tribe: Chironomini	13						
Chironomus							1
Cryptochironomus							

Site	R6S2	R6S2	WIS	WIS	WIS	WIS	WIS
Year	2013	2013	2013	2013	2013	2013	2013
CC#	CC140089	CC140090	CC140047	CC140048	CC140049	CC140050	CC140051
Habitat	Riffle	Pool	Riffle	Pool	Pool	Pool	Riffle
Endochironomus							
Microtendipes						4	
Microtendipes pedellus			76	40			
Phaenopsectra							
Polypedilum							
Stictochironomus							
Tribelos							
Tribe: Tanytarsini							
Cladotanytarsus							
Micropsectra	62	93	370	1040		21	8
Paratanytarsus							
Rheotanytarsus							
Tanytarsus		32	43		749	374	199
SubFamily: Diamesinae							
Protanypus							
Tribe: Diamesini							
Pagastia							
Potthastia							
SubFamily: Orthocladiinae							
Brillia							
Cricotopus							
Diplocladius							
Diplocladius cultriger							
Eukiefferiella	34						4
Georthocladius							
Heterotanytarsus							

Site	R6S2	R6S2	WIS	WIS	WIS	WIS	WIS
Year	2013	2013	2013	2013	2013	2013	2013
CC#	CC140089	CC140090	CC140047	CC140048	CC140049	CC140050	CC140051
Habitat	Riffle	Pool	Riffle	Pool	Pool	Pool	Riffle
Heterotrissocladius	5	12				4	5
Hydrobaenus							
Limnophyes							
Metriocnemus							
Nanocladius	2						
Orthocladius							
Orthocladius complex							
Parakiefferiella							
Paralimnophyes arcticus							
Paraphaenocladius							
Psectrocladius	5	18					
Psiloptarus							
Pseudosmittia							
Rheocricotopus							
Tvetenia							
Tvetenia bavarica							
Tvetenia vitracies							
Zalutschia	29	22	98	48	154	16	54
Zalutschia briani							
Zalutschia tatrica							
Zalutschia zalutschicola							
Tribe: Corynoneurini							
Corynoneura	3			4		4	11
Tribe: Orthocladiini							
Chaetocladius							
SubFamily: Podonominae							

Site	R6S2	R6S2	WIS	WIS	WIS	WIS	WIS
Year	2013	2013	2013	2013	2013	2013	2013
CC#	CC140089	CC140090	CC140047	CC140048	CC140049	CC140050	CC140051
Habitat	Riffle	Pool	Riffle	Pool	Pool	Pool	Riffle
Lasiodiamesa							
Paraboreochlus							
Trichotanypus							
SubFamily: Prodiamesinae							
Prodiamesa							
Tribe: Boreochlini							
Boreochlus							4
SubFamily: Tanypodinae							
Labrundinia							
Tribe: Pentaneuriini							
Ablabesmyia							
Nilotanypus				4			
Thienemannimyia							
Tribe: Procladiini							
Djalma batista							
Procladius		3	28	20	3	3	
Family: Dixidae							
Dixella							
Family: Dolichopodidae							
Rhaphium		1					
Family: Empididae	3	1					
Clinocera							
Chelifera/Metachela							
Oreogeton					3	6	6
Family: Muscidae							
Limnophora							

Site	R6S2	R6S2	WIS	WIS	WIS	WIS	WIS
Year	2013	2013	2013	2013	2013	2013	2013
CC#	CC140089	CC140090	CC140047	CC140048	CC140049	CC140050	CC140051
Habitat	Riffle	Pool	Riffle	Pool	Pool	Pool	Riffle
Family: Simuliidae		2		8			
Prosimulium							
Simulium	25	3	7				
Family: Tipulidae	1						
Erioptera							
Limnophila							
Ormosia							
Tipula						1	
Order: Hemiptera							
Family: Corixidae							
Sigara							
Family: Gerridae							
Gerris							
Order: Lepidoptera							
Family: Noctuidae	1						
Order: Odonata							
Subphylum: Crustacea							
Class: Malacostraca							
Order: Amphipoda							
Subphylum: Chelicerata							
Class: Arachnida							
Order: Trombidiformes							
SubOrder: Prostigmata	2		4				1
Neobrachypoda							
Pionopsis							
Family: Arrenuridae							

Site Year CC# Habitat	R6S2 2013 CC140089 Riffle	R6S2 2013 CC140090 Pool	WIS 2013 CC140047 Riffle	WIS 2013 CC140048 Pool	WIS 2013 CC140049 Pool	WIS 2013 CC140050 Pool	WIS 2013 CC140051 Riffle
Arrenurus							
Family: Hydryphantidae							
Family: Hygrobatidae							
Hygrobates							
Family: Lebertiidae							
Lebertia	1	1					1
Family: Limnesiidae							
Limnesia							
Family: Limnocharidae							
Limnochares							
Family: Mideopsidae							
Mideopsis							
Family: Oxidae							
Oxus							
Family: Pionidae							
Piona							
Family: Sperchontidae							
Sperchon							
Sperchonopsis							
Family: Unionicolidae							
Neumania	1						
Family: Halacaridae							
Order: Oribatida							
Family: Hydrozetidae	1	4		4	11		
Phylum: Mollusca							
Class: Bivalvia							

Site	R6S2	R6S2	WIS	WIS	WIS	WIS	WIS
Year	2013	2013	2013	2013	2013	2013	2013
CC#	CC140089	CC140090	CC140047	CC140048	CC140049	CC140050	CC140051
Habitat	Riffle	Pool	Riffle	Pool	Pool	Pool	Riffle
Order: Veneroida							
Family: Pisidiidae							
Pisidium							
Class: Gastropoda							
Order: Heterostropha							
Family: Valvatidae							
Phylum: Annelida							
Subphylum: Clitellata							
Class: Oligochaeta							
Order: Lumbriculida							
Family: Lumbriculidae	5	2	7	8		1	1
Order: Tubificida							
Family: Enchytraeidae							
Enchytraeus						1	
Family: Lumbricidae		1					
Family: Naididae					14		
Chaetogaster				8			1
Chaetogaster diaphanus							
Nais	2		48	120	20	19	14
Pristina							
Family: Tubificidae	32	20	4	28			
Phylum: Cnidaria							
Class: Hydrozoa							
Order: Anthoathecatae							
Family: Hydridae							
Hydra				4			2

Site	R6S2	R6S2	WIS	WIS	WIS	WIS	WIS
Year	2013	2013	2013	2013	2013	2013	2013
CC#	CC140089	CC140090	CC140047	CC140048	CC140049	CC140050	CC140051
Habitat	Riffle	Pool	Riffle	Pool	Pool	Pool	Riffle
Phylum: Tardigrada		3	4	4			2

Site	WIS	WIS	WIS	WIS	WIS	WIS	WIS
Year	2013	2013	2013	2013	2013	2013	2013
CC#	CC140052	CC140053	CC140054	CC140055	CC140056	CC140057	CC140058
Habitat	Riffle	Pool	Riffle	Pool	Riffle	Pool	Riffle
Phylum: Arthropoda							
Subphylum: Hexapoda							
Class: Insecta							
Order: Ephemeroptera							
Family: Baetidae							
Acerpenna							
Acerpenna pygmaea							
Baetis							
Baetis bicaudatus							
Baetis tricaudatus						1	
Family: Ephemerellidae							
Caudatella							
Family: Heptageniidae							
Epeorus							
Ironodes							
Rhithrogena							
Family: Leptophlebiidae							
Order: Plecoptera							
Family: Capniidae							
Family: Leuctridae							
Family: Nemouridae							
Amphinemura							
Malenka							
Nemoura							
Ostrocerca							
Zapada							

Site	WIS	WIS	WIS	WIS	WIS	WIS	WIS
Year	2013	2013	2013	2013	2013	2013	2013
CC#	CC140052	CC140053	CC140054	CC140055	CC140056	CC140057	CC140058
Habitat	Riffle	Pool	Riffle	Pool	Riffle	Pool	Riffle
Zapada oregonensis							
Family: Perlodidae							
Order: Trichoptera							
Micrasema							
Family: Hydropsychidae							
Hydropsyche							
Family: Hydroptilidae							
Agraylea							
Oxyethira							
Family: Limnephilidae							
Clostoeca disjuncta							
Ecclisomyia							
Limnephilus			3			1	
Family: Molannidae							
Molanna flavicornis							
Molanna distinctus							
Family: Phryganeidae							
Agrypnia							
Family: Rhyacophilidae							
Rhyacophila							
Order: Coleoptera							
Family: Dytiscidae							
Agabus							
Colymbetes							
Hydroporus							
Oreodytes							

Site	WIS	WIS	WIS	WIS	WIS	WIS	WIS
Year	2013	2013	2013	2013	2013	2013	2013
CC#	CC140052	CC140053	CC140054	CC140055	CC140056	CC140057	CC140058
Habitat	Riffle	Pool	Riffle	Pool	Riffle	Pool	Riffle
Stictotarsus							
Family: Hydraenidae							
Hydraena							
SubFamily: Hydroporinae			3	3			
Family: Hydrophilidae							
Hydrochus							
Family: Psephenidae							
Family: Staphylinidae							
Order: Diptera							
Family: Ceratopogonidae							
Atrichopogon							
Bezzia/Palpomyia	2			6			2
Culicoides							
Dasyhelea							
Forcipomyia							
Mallochohelea							
Probezzia							
Sphaeromias							
Family: Chaoboridae							
Eucorethra							
Family: Chironomidae	1						
SubFamily: Chironominae							
Fissimentum							
Tribe: Chironomini							
Chironomus		3	3				
Cryptochironomus							

Site	WIS	WIS	WIS	WIS	WIS	WIS	WIS
Year	2013	2013	2013	2013	2013	2013	2013
CC#	CC140052	CC140053	CC140054	CC140055	CC140056	CC140057	CC140058
Habitat	Riffle	Pool	Riffle	Pool	Riffle	Pool	Riffle
Endochironomus							
Microtendipes			7				
Microtendipes pedellus							
Phaenopsectra							
Polypedilum							
Stictochironomus							
Tribelos							
Tribe: Tanytarsini							
Cladotanytarsus							
Micropsectra	2	47	90	56		3	194
Paratanytarsus							
Rheotanytarsus							
Tanytarsus	67	781	570	336	17	91	350
SubFamily: Diamesinae							
Protanypus							
Tribe: Diamesini							
Pagastia							
Potthastia							
SubFamily: Orthocladiinae						130	28
Brillia							
Cricotopus							
Diplocladius							
Diplocladius cultriger							
Eukiefferiella	29		167	153	94	57	
Georthocladius							
Heterotanytarsus							

Site	WIS	WIS	WIS	WIS	WIS	WIS	WIS
Year	2013	2013	2013	2013	2013	2013	2013
CC#	CC140052	CC140053	CC140054	CC140055	CC140056	CC140057	CC140058
Habitat	Riffle	Pool	Riffle	Pool	Riffle	Pool	Riffle
Heterotrissocladius	2	28	27	19		17	6
Hydrobaenus							
Limnophyes							
Metriocnemus							
Nanocladius							
Orthocladius							
Orthocladius complex	58	22	67	89	11	57	8
Parakiefferiella							
Paralimnophyes arcticus							
Paraphaenocladius							
Psectrocladius							
Psiloptarus							
Pseudosmittia							
Rheocricotopus							
Tvetenia	5				17	39	2
Tvetenia bavarica							
Tvetenia vitracies							
Zalutschia			80				6
Zalutschia briani							
Zalutschia tatrica							
Zalutschia zalutschicola							
Tribe: Corynoneurini							
Corynoneura	2		10	3		1	2
Tribe: Orthocladiini							
Chaetocladius							
SubFamily: Podonominae							

Site	WIS	WIS	WIS	WIS	WIS	WIS	WIS
Year	2013	2013	2013	2013	2013	2013	2013
CC#	CC140052	CC140053	CC140054	CC140055	CC140056	CC140057	CC140058
Habitat	Riffle	Pool	Riffle	Pool	Riffle	Pool	Riffle
Lasiodiamesa							
Paraboreochlus							
Trichotanypus							
SubFamily: Prodiamesinae							
Prodiamesa							
Tribe: Boreochlini							
Boreochlus							
SubFamily: Tanypodinae							
Labrundinia							
Tribe: Pentaneuriini							
Ablabesmyia							
Nilotanypus							
Thienemannimyia							
Tribe: Procladiini							
Djalma batista							
Procladius	1	17					2
Family: Dixidae							
Dixella							
Family: Dolichopodidae							
Rhaphium							
Family: Empididae							
Clinocera							
Chelifera/Metachela							
Oreogeton	1	3	13	8	6	3	10
Family: Muscidae							
Limnophora							

Site	WIS	WIS	WIS	WIS	WIS	WIS	WIS
Year	2013	2013	2013	2013	2013	2013	2013
CC#	CC140052	CC140053	CC140054	CC140055	CC140056	CC140057	CC140058
Habitat	Riffle	Pool	Riffle	Pool	Riffle	Pool	Riffle
Family: Simuliidae			3			10	
Prosimulium							
Simulium	2		3	11	1856	17	
Family: Tipulidae					6		
Erioptera							
Limnophila		3					
Ormosia							
Tipula			3				
Order: Hemiptera							
Family: Corixidae				3			
Sigara							
Family: Gerridae							
Gerris							
Order: Lepidoptera							
Family: Noctuidae							
Order: Odonata							
Subphylum: Crustacea							
Class: Malacostraca							
Order: Amphipoda							
Subphylum: Chelicerata							
Class: Arachnida							
Order: Trombidiformes							
SubOrder: Prostigmata	2					1	
Neobrachypoda							
Pionopsis							
Family: Arrenuridae							

Site	WIS	WIS	WIS	WIS	WIS	WIS	WIS
Year	2013	2013	2013	2013	2013	2013	2013
CC#	CC140052	CC140053	CC140054	CC140055	CC140056	CC140057	CC140058
Habitat	Riffle	Pool	Riffle	Pool	Riffle	Pool	Riffle
Arrenurus							
Family: Hydryphantidae							
Family: Hygrobatidae							
Hygrobates							
Family: Lebertiidae							
Lebertia		3					
Family: Limnesiidae							
Limnesia							
Family: Limnocharidae							
Limnochares		3		3			
Family: Mideopsidae							
Mideopsis							
Family: Oxidae							
Oxus							
Family: Pionidae							
Piona							
Family: Sperchontidae							
Sperchon							
Sperchonopsis							
Family: Unionicolidae							
Neumania							
Family: Halacaridae							
Order: Oribatida							
Family: Hydrozetidae							2
Phylum: Mollusca							
Class: Bivalvia							

Site	WIS	WIS	WIS	WIS	WIS	WIS	WIS
Year	2013	2013	2013	2013	2013	2013	2013
CC#	CC140052	CC140053	CC140054	CC140055	CC140056	CC140057	CC140058
Habitat	Riffle	Pool	Riffle	Pool	Riffle	Pool	Riffle
Order: Veneroida							
Family: Pisidiidae							
Pisidium							
Class: Gastropoda							
Order: Heterostropha							
Family: Valvatidae							
Phylum: Annelida							
Subphylum: Clitellata							
Class: Oligochaeta							
Order: Lumbriculida							
Family: Lumbriculidae			10	83			2
Order: Tubificida							
Family: Enchytraeidae							
Enchytraeus							
Family: Lumbricidae							
Family: Naididae		6					
Chaetogaster	1						58
Chaetogaster diaphanus							
Nais	11				6		4
Pristina							
Family: Tubificidae	12		20	47			
Phylum: Cnidaria							
Class: Hydrozoa							
Order: Anthoathecatae							
Family: Hydridae							
Hydra				3			

Site	WIS	WIS	WIS	WIS	WIS	WIS	WIS
Year	2013	2013	2013	2013	2013	2013	2013
CC#	CC140052	CC140053	CC140054	CC140055	CC140056	CC140057	CC140058
Habitat	Riffle	Pool	Riffle	Pool	Riffle	Pool	Riffle
Phylum: Tardigrada	3			11			

Site	WIS	WIS	WIS	WIS	WIS	WIS
Year	2013	2013	2013	2013	2013	2013
CC#	CC140059	CC140060	CC140061	CC140062	CC140063	CC140064
Habitat	Riffle	Riffle	Pool	Pool	Pool	Riffle
Phylum: Arthropoda						
Subphylum: Hexapoda						
Class: Insecta						
Order: Ephemeroptera						
Family: Baetidae	4	5				
Acerpenna						
Acerpenna pygmaea						
Baetis						
Baetis bicaudatus						
Baetis tricaudatus						
Family: Ephemerellidae						
Caudatella						
Family: Heptageniidae						
Epeorus						
Ironodes						
Rhithrogena						
Family: Leptophlebiidae						
Order: Plecoptera						
Family: Capniidae						
Family: Leuctridae						
Family: Nemouridae						
Amphinemura						
Malenka						
Nemoura						
Ostrocerca						
Zapada						

Site	WIS	WIS	WIS	WIS	WIS	WIS
Year	2013	2013	2013	2013	2013	2013
CC#	CC140059	CC140060	CC140061	CC140062	CC140063	CC140064
Habitat	Riffle	Riffle	Pool	Pool	Pool	Riffle
Zapada oregonensis						
Family: Perlodidae						
Order: Trichoptera						
Micrasema						
Family: Hydropsychidae						
Hydropsyche						
Family: Hydroptilidae						
Agraylea						
Oxyethira						
Family: Limnephilidae						
Clostoeca disjuncta						
Ecclisomyia						
Limnephilus			1		5	
Family: Molannidae						
Molanna flavicornis						
Molanna distinctus						
Family: Phryganeidae						
Agrypnia						
Family: Rhyacophilidae						
Rhyacophila						
Order: Coleoptera						
Family: Dytiscidae						
Agabus						
Colymbetes						
Hydroporus						
Oreodytes						

Site	WIS	WIS	WIS	WIS	WIS	WIS
Year	2013	2013	2013	2013	2013	2013
CC#	CC140059	CC140060	CC140061	CC140062	CC140063	CC140064
Habitat	Riffle	Riffle	Pool	Pool	Pool	Riffle
Stictotarsus						
Family: Hydraenidae						
Hydraena						
SubFamily: Hydroporinae	2					
Family: Hydrophilidae						
Hydrochus						
Family: Psephenidae						
Family: Staphylinidae						
Order: Diptera						
Family: Ceratopogonidae						
Atrichopogon						
Bezzia/Palpomyia					5	
Culicoides						
Dasyhelea						
Forcipomyia						
Mallochohelea						
Probezzia						
Sphaeromias						
Family: Chaoboridae						
Eucorethra						
Family: Chironomidae		5				
SubFamily: Chironominae						
Fissimentum						
Tribe: Chironomini						
Chironomus	2			1	2	
Cryptochironomus						

Site	WIS	WIS	WIS	WIS	WIS	WIS
Year	2013	2013	2013	2013	2013	2013
CC#	CC140059	CC140060	CC140061	CC140062	CC140063	CC140064
Habitat	Riffle	Riffle	Pool	Pool	Pool	Riffle
Endochironomus						
Microtendipes						
Microtendipes pedellus						
Phaenopsectra						
Polypedilum						
Stictochironomus						
Tribelos						
Tribe: Tanytarsini						
Cladotanytarsus						
Micropsectra	19	11	10	38	15	3
Paratanytarsus						
Rheotanytarsus						
Tanytarsus	342	53	75	270	646	27
SubFamily: Diamesinae						
Protanypus						
Tribe: Diamesini						
Pagastia						
Potthastia						
SubFamily: Orthocladiinae	43		22		44	10
Brillia						
Cricotopus						
Diplocladius						
Diplocladius cultriger						
Eukiefferiella	64	47			10	1
Georthocladius						
Heterotanytarsus						

Site	WIS	WIS	WIS	WIS	WIS	WIS
Year	2013	2013	2013	2013	2013	2013
CC#	CC140059	CC140060	CC140061	CC140062	CC140063	CC140064
Habitat	Riffle	Riffle	Pool	Pool	Pool	Riffle
Heterotrissocladius	15		9	8	34	1
Hydrobaenus						
Limnophyes						
Metriocnemus						
Nanocladius						
Orthocladius						
Orthocladius complex	34			7	15	2
Parakiefferiella						
Paralimnophyes arcticus						
Paraphaenocladius						
Psectrocladius						
Psiloptarus						
Pseudosmittia						
Rheocricotopus						
Tvetenia	17	26				
Tvetenia bavarica						
Tvetenia vitracies						
Zalutschia	6	95				7
Zalutschia briani						
Zalutschia tatrica						
Zalutschia zalutschicola						
Tribe: Corynoneurini						
Corynoneura	9	5	1		2	
Tribe: Orthocladiini						
Chaetocladius						
SubFamily: Podonominae						

Site	WIS	WIS	WIS	WIS	WIS	WIS
Year	2013	2013	2013	2013	2013	2013
CC#	CC140059	CC140060	CC140061	CC140062	CC140063	CC140064
Habitat	Riffle	Riffle	Pool	Pool	Pool	Riffle
Lasiodiamesa						
Paraboreochlus						
Trichotanypus						
SubFamily: Prodiamesinae						
Prodiamesa						
Tribe: Boreochlini						
Boreochlus						
SubFamily: Tanypodinae						
Labrundinia						
Tribe: Pentaneuriini						
Ablabesmyia						
Nilotanypus						
Thienemannimyia						
Tribe: Procladiini						
Djalma batista						
Procladius	2				2	
Family: Dixidae						
Dixella						
Family: Dolichopodidae						
Rhaphium						
Family: Empididae						
Clinocera						
Chelifera/Metachela						
Oreogeton	15		1	1	2	
Family: Muscidae						
Limnophora						

Site	WIS	WIS	WIS	WIS	WIS	WIS
Year	2013	2013	2013	2013	2013	2013
CC#	CC140059	CC140060	CC140061	CC140062	CC140063	CC140064
Habitat	Riffle	Riffle	Pool	Pool	Pool	Riffle
Family: Simuliidae	2	168				
Prosimulium						
Simulium	17	1184				
Family: Tipulidae						
Erioptera						
Limnophila						
Ormosia						
Tipula						
Order: Hemiptera						
Family: Corixidae					2	
Sigara						
Family: Gerridae						
Gerris						
Order: Lepidoptera						
Family: Noctuidae						
Order: Odonata						
Subphylum: Crustacea						
Class: Malacostraca						
Order: Amphipoda						
Subphylum: Chelicerata						
Class: Arachnida						
Order: Trombidiformes						
SubOrder: Prostigmata			1		7	
Neobrachypoda						
Pionopsis						
Family: Arrenuridae						

Site	WIS	WIS	WIS	WIS	WIS	WIS
Year	2013	2013	2013	2013	2013	2013
CC#	CC140059	CC140060	CC140061	CC140062	CC140063	CC140064
Habitat	Riffle	Riffle	Pool	Pool	Pool	Riffle
Arrenurus						
Family: Hydryphantidae						
Family: Hygrobatidae						
Hygrobates						
Family: Lebertiidae						
Lebertia						
Family: Limnesiidae						
Limnesia						
Family: Limnocharidae						
Limnochares						
Family: Mideopsidae						
Mideopsis						
Family: Oxidae						
Oxus						
Family: Pionidae						
Piona						
Family: Sperchontidae						
Sperchon						
Sperchonopsis						
Family: Unionicolidae						
Neumania						
Family: Halacaridae						
Order: Oribatida						
Family: Hydrozetidae			4	5	2	
Phylum: Mollusca						
Class: Bivalvia						

Site	WIS	WIS	WIS	WIS	WIS	WIS
Year	2013	2013	2013	2013	2013	2013
CC#	CC140059	CC140060	CC140061	CC140062	CC140063	CC140064
Habitat	Riffle	Riffle	Pool	Pool	Pool	Riffle
Order: Veneroida						
Family: Pisidiidae						
Pisidium						
Class: Gastropoda						
Order: Heterostropha						
Family: Valvatidae						
Phylum: Annelida						
Subphylum: Clitellata						
Class: Oligochaeta						
Order: Lumbriculida						
Family: Lumbriculidae	2			1	2	
Order: Tubificida						
Family: Enchytraeidae						
Enchytraeus			3			1
Family: Lumbricidae						
Family: Naididae						1
Chaetogaster			9		12	
Chaetogaster diaphanus						
Nais	9		10	8	22	
Pristina						
Family: Tubificidae	8					
Phylum: Cnidaria						
Class: Hydrozoa						
Order: Anthoathecatae						
Family: Hydridae						
Hydra				1		

Site	WIS	WIS	WIS	WIS	WIS	WIS
Year	2013	2013	2013	2013	2013	2013
CC#	CC140059	CC140060	CC140061	CC140062	CC140063	CC140064
Habitat	Riffle	Riffle	Pool	Pool	Pool	Riffle
Phylum: Tardigrada			2			

Table A1-5: 2014 Raw Invertebrate Data.

Site	R2S	R2S	R2S	R2S	R6S1	R6S1	R6S1
Year	2014	2014	2014	2014	2014	2014	2014
CC#	CC150090	CC150091	CC150092	CC150093	CC150094	CC150095	CC150096
Habitat	Pool	Pool	Riffle	Riffle	Riffle	Pool	Riffle
Phylum: Arthropoda							
Subphylum: Hexapoda							
Class: Insecta							
Order: Ephemeroptera							
Family: Baetidae					80	2	20
Acerpenna							
Acerpenna pygmaea							
Baetis							
Baetis bicaudatus							20
Baetis tricaudatus							
Family: Ephemerellidae							
Caudatella			2				
Family: Heptageniidae							
Epeorus							
Ironodes							
Rhithrogena							
Family: Leptophlebiidae			2				
Order: Plecoptera			3				
Family: Capniidae							
Family: Leuctridae	7						
Family: Nemouridae			2				
Amphinemura							
Malenka							
Nemoura							20
Ostrocerca							
Zapada							

Site	R2S	R2S	R2S	R2S	R6S1	R6S1	R6S1
Year	2014	2014	2014	2014	2014	2014	2014
CC#	CC150090	CC150091	CC150092	CC150093	CC150094	CC150095	CC150096
Habitat	Pool	Pool	Riffle	Riffle	Riffle	Pool	Riffle
Zapada oregonensis							
Family: Perlodidae							
Order: Trichoptera						2	
Micrasema							
Family: Hydropsychidae							
Hydropsyche							
Family: Hydroptilidae							
Agraylea							
Oxyethira							
Family: Limnephilidae							
Clostoeca disjuncta							
Ecclisomyia							
Limnephilus			2			5	
Family: Molannidae							
Molanna flavicornis							
Molanna distinctus						5	
Family: Phryganeidae							
Agrypnia							
Family: Rhyacophilidae							
Rhyacophila							
Order: Coleoptera							
Family: Dytiscidae							
Agabus							
Colymbetes							
Hydroporus							
Oreodytes							

Site	R2S	R2S	R2S	R2S	R6S1	R6S1	R6S1
Year	2014	2014	2014	2014	2014	2014	2014
CC#	CC150090	CC150091	CC150092	CC150093	CC150094	CC150095	CC150096
Habitat	Pool	Pool	Riffle	Riffle	Riffle	Pool	Riffle
Stictotarsus	6						
Family: Hydraenidae							
Hydraena							
SubFamily: Hydroporinae	3		2				
Family: Hydrophilidae			2				
Hydrochus							
Family: Psephenidae							
Family: Staphylinidae	3						
Order: Diptera							
Family: Ceratopogonidae							
Atrichopogon							
Bezzia/Palpomyia		3				5	
Culicoides				6	20		
Dasyhelea							
Forcipomyia			2	78			
Mallochohelea							
Probezzia							
Sphaeromias							
Family: Chaoboridae							
Eucorethra							
Family: Chironomidae	23	3	3			2	20
SubFamily: Chironominae							
Fissimentum							
Tribe: Chironomini							
Chironomus	27	23	12				
Cryptochironomus							

Site	R2S	R2S	R2S	R2S	R6S1	R6S1	R6S1
Year	2014	2014	2014	2014	2014	2014	2014
CC#	CC150090	CC150091	CC150092	CC150093	CC150094	CC150095	CC150096
Habitat	Pool	Pool	Riffle	Riffle	Riffle	Pool	Riffle
Endochironomus							
Microtendipes							
Microtendipes pedellus							
Phaenopsectra							
Polypedilum	60		38			93	60
Stictochironomus						12	
Tribelos							
Tribe: Tanytarsini							
Cladotanytarsus							
Micropsectra	847	863	325	917	20	362	280
Paratanytarsus							
Rheotanytarsus							
Tanytarsus							
SubFamily: Diamesinae							
Protanypus							
Tribe: Diamesini							
Pagastia							
Potthastia							
SubFamily: Orthocladiinae							
Brillia							
Cricotopus							
Diplocladius							
Diplocladius cultriger							
Eukiefferiella	63	51	42	367	260	67	500
Georthocladius							
Heterotanytarsus							

Site	R2S	R2S	R2S	R2S	R6S1	R6S1	R6S1
Year	2014	2014	2014	2014	2014	2014	2014
CC#	CC150090	CC150091	CC150092	CC150093	CC150094	CC150095	CC150096
Habitat	Pool	Pool	Riffle	Riffle	Riffle	Pool	Riffle
Heterotrissocladius				111			
Hydrobaenus							
Limnophyes							
Metriocnemus				11			
Nanocladius							
Orthocladius							
Orthocladius complex			2		20		20
Parakiefferiella							
Paralimnophyes arcticus							
Paraphaenocladius							
Psectrocladius	13	9	2				20
Psiloptarus							
Pseudosmittia							
Rheocricotopus							
Tvetenia							
Tvetenia bavarica							
Tvetenia vitracies							
Zalutschia							
Zalutschia briani							
Zalutschia tatrica							
Zalutschia zalutschicola							
Tribe: Corynoneurini							
Corynoneura	17	6	17	17	2840	76	1640
Tribe: Orthocladiini							
Chaetocladius							
SubFamily: Podonominae							

Site	R2S	R2S	R2S	R2S	R6S1	R6S1	R6S1
Year	2014	2014	2014	2014	2014	2014	2014
CC#	CC150090	CC150091	CC150092	CC150093	CC150094	CC150095	CC150096
Habitat	Pool	Pool	Riffle	Riffle	Riffle	Pool	Riffle
Lasiodiamesa							
Paraboreochlus							
Trichotanypus							
SubFamily: Prodiamesinae							
Prodiamesa							
Tribe: Boreochlini							
Boreochlus							
SubFamily: Tanypodinae							
Labrundinia						2	
Tribe: Pentaneuriini							
Ablabesmyia							
Nilotanypus							
Thienemannimyia	13	3	53	6		2	
Tribe: Procladiini							
Djalma batista							
Procladius	3	6				5	
Family: Dixidae							
Dixella	3						
Family: Dolichopodidae							
Rhaphium							
Family: Empididae						14	20
Clinocera							
Chelifera/Metachela						2	
Oreogeton					20		
Family: Muscidae							
Limnophora							

Site	R2S	R2S	R2S	R2S	R6S1	R6S1	R6S1
Year	2014	2014	2014	2014	2014	2014	2014
CC#	CC150090	CC150091	CC150092	CC150093	CC150094	CC150095	CC150096
Habitat	Pool	Pool	Riffle	Riffle	Riffle	Pool	Riffle
Family: Simuliidae					980	12	640
Prosimulium							1520
Simulium			3		1760	12	2040
Family: Tipulidae							
Erioptera							
Limnophila							
Ormosia	13		2		20		20
Tipula				6			
Order: Hemiptera							
Family: Corixidae							
Sigara							
Family: Gerridae							
Gerris							
Order: Lepidoptera							
Family: Noctuidae							
Order: Odonata							
Subphylum: Crustacea							
Class: Malacostraca							
Order: Amphipoda							
Subphylum: Chelicerata							
Class: Arachnida							
Order: Trombidiformes							
SubOrder: Prostigmata				17			
Neobrachypoda							
Pionopsis							
Family: Arrenuridae							

Site	R2S	R2S	R2S	R2S	R6S1	R6S1	R6S1
Year	2014	2014	2014	2014	2014	2014	2014
CC#	CC150090	CC150091	CC150092	CC150093	CC150094	CC150095	CC150096
Habitat	Pool	Pool	Riffle	Riffle	Riffle	Pool	Riffle
Arrenurus							
Family: Hydryphantidae							
Family: Hygrobatidae							
Hygrobates							
Family: Lebertiidae							
Lebertia							
Family: Limnesiidae							
Limnesia							
Family: Limnocharidae							
Limnochares							
Family: Mideopsidae							
Mideopsis							
Family: Oxidae							
Oxus							
Family: Pionidae							
Piona							
Family: Sperchontidae							
Sperchon							
Sperchonopsis							
Family: Unionicolidae							
Neumania							
Family: Halacaridae							
Order: Oribatida	7		8	6	80	2	200
Family: Hydrozetidae							
Phylum: Mollusca							
Class: Bivalvia							

Site	R2S	R2S	R2S	R2S	R6S1	R6S1	R6S1
Year	2014	2014	2014	2014	2014	2014	2014
CC#	CC150090	CC150091	CC150092	CC150093	CC150094	CC150095	CC150096
Habitat	Pool	Pool	Riffle	Riffle	Riffle	Pool	Riffle
Order: Veneroida							
Family: Pisidiidae							
Pisidium	10	23			20	5	
Class: Gastropoda							
Order: Heterostropha							
Family: Valvatidae							
Phylum: Annelida							
Subphylum: Clitellata							
Class: Oligochaeta							
Order: Lumbriculida							
Family: Lumbriculidae			5			10	
Order: Tubificida							
Family: Enchytraeidae							
Enchytraeus							
Family: Lumbricidae							
Family: Naididae							
Chaetogaster							
Chaetogaster diaphanus							
Nais							
Pristina							
Family: Tubificidae	3	29	15	300	280	69	180
Phylum: Cnidaria							
Class: Hydrozoa							
Order: Anthoathecatae							
Family: Hydridae							
Hydra							

Site	R2S	R2S	R2S	R2S	R6S1	R6S1	R6S1
Year	2014	2014	2014	2014	2014	2014	2014
CC#	CC150090	CC150091	CC150092	CC150093	CC150094	CC150095	CC150096
Habitat	Pool	Pool	Riffle	Riffle	Riffle	Pool	Riffle
Phylum: Tardigrada					20		

Site	R6S1	R6S1	R6S1	R6S2	R6S2	R6S2	R6S2
Year	2014	2014	2014	2014	2014	2014	2014
CC#	CC150097	CC150098	CC150099	CC150100	CC150101	CC150102	CC150103
Habitat	Pool	Pool	Riffle	Riffle	Pool	Pool	Riffle
Phylum: Arthropoda							
Subphylum: Hexapoda							
Class: Insecta							
Order: Ephemeroptera							
Family: Baetidae						5	
Acerpenna							
Acerpenna pygmaea							
Baetis						5	15
Baetis bicaudatus	4	2					
Baetis tricaudatus							
Family: Ephemerellidae							
Caudatella							
Family: Heptageniidae							
Epeorus		2					
Ironodes							
Rhithrogena							
Family: Leptophlebiidae							
Order: Plecoptera							
Family: Capniidae							
Family: Leuctridae							
Family: Nemouridae							
Amphinemura							
Malenka							
Nemoura							
Ostrocerca							
Zapada							

Site	R6S1	R6S1	R6S1	R6S2	R6S2	R6S2	R6S2
Year	2014	2014	2014	2014	2014	2014	2014
CC#	CC150097	CC150098	CC150099	CC150100	CC150101	CC150102	CC150103
Habitat	Pool	Pool	Riffle	Riffle	Pool	Pool	Riffle
Zapada oregonensis							
Family: Perlodidae							
Order: Trichoptera							
Micrasema							
Family: Hydropsychidae			3				5
Hydropsyche							2
Family: Hydroptilidae							
Agraylea							
Oxyethira							
Family: Limnephilidae							
Clostoeca disjuncta							
Ecclisomyia							
Limnephilus							
Family: Molannidae							
Molanna flavicornis							
Molanna distinctus	4						
Family: Phryganeidae							
Agrypnia							
Family: Rhyacophilidae							
Rhyacophila							
Order: Coleoptera							
Family: Dytiscidae							
Agabus							
Colymbetes							
Hydroporus		1					
Oreodytes							

Site	R6S1	R6S1	R6S1	R6S2	R6S2	R6S2	R6S2
Year	2014	2014	2014	2014	2014	2014	2014
CC#	CC150097	CC150098	CC150099	CC150100	CC150101	CC150102	CC150103
Habitat	Pool	Pool	Riffle	Riffle	Pool	Pool	Riffle
Stictotarsus							
Family: Hydraenidae							
Hydraena							
SubFamily: Hydroporinae							
Family: Hydrophilidae							
Hydrochus							
Family: Psephenidae							
Family: Staphylinidae							
Order: Diptera							
Family: Ceratopogonidae							
Atrichopogon							
Bezzia/Palpomyia	16		10	5	14	27	34
Culicoides							
Dasyhelea							
Forcipomyia				5			
Mallochohelea							
Probezzia							
Sphaeromias							
Family: Chaoboridae							
Eucorethra					5		
Family: Chironomidae	8	6	48	33	29	5	
SubFamily: Chironominae							
Fissimentum							
Tribe: Chironomini							
Chironomus		1	12			9	
Cryptochironomus							

Site	R6S1	R6S1	R6S1	R6S2	R6S2	R6S2	R6S2
Year	2014	2014	2014	2014	2014	2014	2014
CC#	CC150097	CC150098	CC150099	CC150100	CC150101	CC150102	CC150103
Habitat	Pool	Pool	Riffle	Riffle	Pool	Pool	Riffle
Endochironomus							
Microtendipes	4						
Microtendipes pedellus							
Phaenopsectra							
Polypedilum	72	66		110	81	227	
Stictochironomus	252		7	8		5	5
Tribelos							
Tribe: Tanytarsini							
Cladotanytarsus							
Micropsectra	1040	79	278	210	933	886	559
Paratanytarsus							
Rheotanytarsus							
Tanytarsus							
SubFamily: Diamesinae							
Protanypus							
Tribe: Diamesini							
Pagastia							2
Potthastia							
SubFamily: Orthocladiinae							
Brillia							
Cricotopus							
Diplocladius							
Diplocladius cultriger							
Eukiefferiella				60			
Georthocladius							
Heterotanytarsus				13	5		

Site	R6S1	R6S1	R6S1	R6S2	R6S2	R6S2	R6S2
Year	2014	2014	2014	2014	2014	2014	2014
CC#	CC150097	CC150098	CC150099	CC150100	CC150101	CC150102	CC150103
Habitat	Pool	Pool	Riffle	Riffle	Pool	Pool	Riffle
Heterotrissocladius	64		5	3	76		
Hydrobaenus							
Limnophyes							
Metriocnemus				3			
Nanocladius							
Orthocladius							
Orthocladius complex	36	1		8		227	
Parakiefferiella							
Paralimnophyes arcticus							
Paraphaenocladius				113			
Psectrocladius						23	7
Psiloptarus							
Pseudosmittia							
Rheocricotopus							
Tvetenia							2
Tvetenia bavarica							
Tvetenia vitracies							
Zalutschia							
Zalutschia briani							
Zalutschia tatrica							
Zalutschia zalutschicola							
Tribe: Corynoneurini							
Corynoneura	172	27	112	228	214		49
Tribe: Orthocladiini							
Chaetocladius							
SubFamily: Podonominae							

Site	R6S1	R6S1	R6S1	R6S2	R6S2	R6S2	R6S2
Year	2014	2014	2014	2014	2014	2014	2014
CC#	CC150097	CC150098	CC150099	CC150100	CC150101	CC150102	CC150103
Habitat	Pool	Pool	Riffle	Riffle	Pool	Pool	Riffle
Lasiodiamesa							
Paraboreochlus							
Trichotanypus							
SubFamily: Prodiamesinae							
Prodiamesa							
Tribe: Boreochlini							
Boreochlus							
SubFamily: Tanypodinae							
Labrundinia							
Tribe: Pentaneuriini							
Ablabesmyia							
Nilotanypus							
Thienemannimyia		1	2				
Tribe: Procladiini							
Djalma batista							
Procladius	44	1		15	62	18	
Family: Dixidae							
Dixella							
Family: Dolichopodidae							
Rhaphium							
Family: Empididae					5		
Clinocera							
Chelifera/Metachela							
Oreogeton							
Family: Muscidae							
Limnophora							

Site	R6S1	R6S1	R6S1	R6S2	R6S2	R6S2	R6S2
Year	2014	2014	2014	2014	2014	2014	2014
CC#	CC150097	CC150098	CC150099	CC150100	CC150101	CC150102	CC150103
Habitat	Pool	Pool	Riffle	Riffle	Pool	Pool	Riffle
Family: Simuliidae							7
Prosimulium							
Simulium	4		20	25	5		9
Family: Tipulidae							
Erioptera							
Limnophila							
Ormosia		1					
Tipula							
Order: Hemiptera							
Family: Corixidae							
Sigara							
Family: Gerridae							
Gerris							
Order: Lepidoptera							
Family: Noctuidae							
Order: Odonata							
Subphylum: Crustacea							
Class: Malacostraca							
Order: Amphipoda							
Subphylum: Chelicerata							
Class: Arachnida							
Order: Trombidiformes							
SubOrder: Prostigmata		5			5	18	
Neobrachypoda							
Pionopsis	4						
Family: Arrenuridae							

Site	R6S1	R6S1	R6S1	R6S2	R6S2	R6S2	R6S2
Year	2014	2014	2014	2014	2014	2014	2014
CC#	CC150097	CC150098	CC150099	CC150100	CC150101	CC150102	CC150103
Habitat	Pool	Pool	Riffle	Riffle	Pool	Pool	Riffle
Arrenurus							
Family: Hydryphantidae							
Family: Hygrobatidae							
Hygrobates							
Family: Lebertiidae							
Lebertia							2
Family: Limnesiidae							
Limnesia							
Family: Limnocharidae							
Limnochares							
Family: Mideopsidae							
Mideopsis							
Family: Oxidae							
Oxus							
Family: Pionidae							
Piona							
Family: Sperchontidae							
Sperchon							
Sperchonopsis							
Family: Unionicolidae							
Neumania							
Family: Halacaridae							
Order: Oribatida	4	18	2	13	5		2
Family: Hydrozetidae							
Phylum: Mollusca							
Class: Bivalvia							

Site	R6S1	R6S1	R6S1	R6S2	R6S2	R6S2	R6S2
Year	2014	2014	2014	2014	2014	2014	2014
CC#	CC150097	CC150098	CC150099	CC150100	CC150101	CC150102	CC150103
Habitat	Pool	Pool	Riffle	Riffle	Pool	Pool	Riffle
Order: Veneroida							
Family: Pisidiidae							
Pisidium	24		27	5			
Class: Gastropoda							
Order: Heterostropha							
Family: Valvatidae							
Phylum: Annelida							
Subphylum: Clitellata							
Class: Oligochaeta							
Order: Lumbriculida							
Family: Lumbriculidae			7		24	9	10
Order: Tubificida							
Family: Enchytraeidae							
Enchytraeus							
Family: Lumbricidae							
Family: Naididae							
Chaetogaster							
Chaetogaster diaphanus							
Nais							
Pristina							
Family: Tubificidae	4	7	25		57	14	93
Phylum: Cnidaria							
Class: Hydrozoa							
Order: Anthoathecatae							
Family: Hydridae							
Hydra		4		28	14		2

Site	R6S1	R6S1	R6S1	R6S2	R6S2	R6S2	R6S2
Year	2014	2014	2014	2014	2014	2014	2014
CC#	CC150097	CC150098	CC150099	CC150100	CC150101	CC150102	CC150103
Habitat	Pool	Pool	Riffle	Riffle	Pool	Pool	Riffle
Phylum: Tardigrada		3					

Site	R6S2	R6S2	WIS	WIS	WIS	WIS	WIS
Year	2014	2014	2014	2014	2014	2014	2014
CC#	CC150104	CC150105	CC150072	CC150073	CC150074	CC150075	CC150076
Habitat	Riffle	Pool	Riffle	Pool	Pool	Pool	Riffle
Phylum: Arthropoda							
Subphylum: Hexapoda							
Class: Insecta							
Order: Ephemeroptera							
Family: Baetidae							
Acerpenna							
Acerpenna pygmaea							
Baetis		3					2
Baetis bicaudatus							
Baetis tricaudatus	5	1					
Family: Ephemerellidae							
Caudatella							
Family: Heptageniidae							
Epeorus							
Ironodes							
Rhithrogena							
Family: Leptophlebiidae							
Order: Plecoptera							
Family: Capniidae							
Family: Leuctridae							
Family: Nemouridae							
Amphinemura		4					
Malenka							
Nemoura							
Ostrocerca							
Zapada							

Site	R6S2	R6S2	WIS	WIS	WIS	WIS	WIS
Year	2014	2014	2014	2014	2014	2014	2014
CC#	CC150104	CC150105	CC150072	CC150073	CC150074	CC150075	CC150076
Habitat	Riffle	Pool	Riffle	Pool	Pool	Pool	Riffle
Zapada oregonensis							
Family: Perlodidae							
Order: Trichoptera							
Micrasema		1					
Family: Hydropsychidae							
Hydropsyche							
Family: Hydroptilidae							
Agraylea							
Oxyethira							
Family: Limnephilidae					1		
Clostoeca disjuncta							
Ecclisomyia							
Limnephilus			1	1	1		
Family: Molannidae							
Molanna flavicornis							
Molanna distinctus							
Family: Phryganeidae							
Agrypnia							
Family: Rhyacophilidae							
Rhyacophila							
Order: Coleoptera							
Family: Dytiscidae							
Agabus							1
Colymbetes							
Hydroporus							
Oreodytes							

Site	R6S2	R6S2	WIS	WIS	WIS	WIS	WIS
Year	2014	2014	2014	2014	2014	2014	2014
CC#	CC150104	CC150105	CC150072	CC150073	CC150074	CC150075	CC150076
Habitat	Riffle	Pool	Riffle	Pool	Pool	Pool	Riffle
Stictotarsus							
Family: Hydraenidae							
Hydraena							
SubFamily: Hydroporinae			2				
Family: Hydrophilidae							
Hydrochus							
Family: Psephenidae							
Family: Staphylinidae							
Order: Diptera							
Family: Ceratopogonidae					1		
Atrichopogon							
Bezzia/Palpomyia	2		2			1	
Culicoides							
Dasyhelea							
Forcipomyia							
Mallochohelea							
Probezzia							
Sphaeromias							
Family: Chaoboridae							
Eucorethra							
Family: Chironomidae	1	1	1	14	2	7	26
SubFamily: Chironominae							
Fissimentum							
Tribe: Chironomini							
Chironomus						2	
Cryptochironomus							

Site	R6S2	R6S2	WIS	WIS	WIS	WIS	WIS
Year	2014	2014	2014	2014	2014	2014	2014
CC#	CC150104	CC150105	CC150072	CC150073	CC150074	CC150075	CC150076
Habitat	Riffle	Pool	Riffle	Pool	Pool	Pool	Riffle
Endochironomus			5			1	
Microtendipes							
Microtendipes pedellus							
Phaenopsectra							
Polypedilum			2	2	1	4	1
Stictochironomus		1					1
Tribelos							
Tribe: Tanytarsini							
Cladotanytarsus							
Micropsectra	36	183	277	190	78	81	31
Paratanytarsus							
Rheotanytarsus				1			
Tanytarsus							
SubFamily: Diamesinae							
Protanypus							
Tribe: Diamesini							
Pagastia							
Potthastia							
SubFamily: Orthocladiinae							
Brillia							
Cricotopus							
Diplocladius							
Diplocladius cultriger							
Eukiefferiella	9	5					5
Georthocladius							
Heterotanytarsus		1					

Site	R6S2	R6S2	WIS	WIS	WIS	WIS	WIS
Year	2014	2014	2014	2014	2014	2014	2014
CC#	CC150104	CC150105	CC150072	CC150073	CC150074	CC150075	CC150076
Habitat	Riffle	Pool	Riffle	Pool	Pool	Pool	Riffle
Heterotrissocladius					1	1	
Hydrobaenus							
Limnophyes							
Metriocnemus			2	2	1	3	
Nanocladius							
Orthocladius							
Orthocladius complex			2	4	4	7	21
Parakiefferiella							
Paralimnophyes arcticus							
Paraphaenocladius	2	4		3			21
Psectrocladius		3					
Psiloptarus							
Pseudosmittia							
Rheocricotopus							
Tvetenia	2						
Tvetenia bavarica							
Tvetenia vitracies							
Zalutschia							
Zalutschia briani							
Zalutschia tatrica							
Zalutschia zalutschicola							
Tribe: Corynoneurini							
Corynoneura	8	5				1	3
Tribe: Orthocladiini							
Chaetocladius							
SubFamily: Podonominae							

Site	R6S2	R6S2	WIS	WIS	WIS	WIS	WIS
Year	2014	2014	2014	2014	2014	2014	2014
CC#	CC150104	CC150105	CC150072	CC150073	CC150074	CC150075	CC150076
Habitat	Riffle	Pool	Riffle	Pool	Pool	Pool	Riffle
Lasiodiamesa						3	1
Paraboreochlus							
Trichotanypus							
SubFamily: Prodiamesinae							
Prodiamesa							
Tribe: Boreochlini							
Boreochlus							
SubFamily: Tanypodinae							
Labrundinia							
Tribe: Pentaneuriini							
Ablabesmyia							
Nilotanypus							
Thienemannimyia			1			1	3
Tribe: Procladiini							
Djalma batista							
Procladius		1	7	1	2	10	
Family: Dixidae							
Dixella	1				2		
Family: Dolichopodidae							
Rhaphium							
Family: Empididae					2	1	5
Clinocera							
Chelifera/Metachela							
Oreogeton							
Family: Muscidae							
Limnophora							

Site	R6S2	R6S2	WIS	WIS	WIS	WIS	WIS
Year	2014	2014	2014	2014	2014	2014	2014
CC#	CC150104	CC150105	CC150072	CC150073	CC150074	CC150075	CC150076
Habitat	Riffle	Pool	Riffle	Pool	Pool	Pool	Riffle
Family: Simuliidae	2	4	1	6	8	2	39
Prosimulium				3	7	3	75
Simulium	11	5	1				
Family: Tipulidae							
Erioptera							
Limnophila							
Ormosia	1						
Tipula							
Order: Hemiptera							
Family: Corixidae							
Sigara							
Family: Gerridae							
Gerris							
Order: Lepidoptera							
Family: Noctuidae							
Order: Odonata							
Subphylum: Crustacea							
Class: Malacostraca							
Order: Amphipoda							
Subphylum: Chelicerata							
Class: Arachnida							
Order: Trombidiformes							
SubOrder: Prostigmata	12					4	
Neobrachypoda							
Pionopsis							
Family: Arrenuridae							

Site	R6S2	R6S2	WIS	WIS	WIS	WIS	WIS
Year	2014	2014	2014	2014	2014	2014	2014
CC#	CC150104	CC150105	CC150072	CC150073	CC150074	CC150075	CC150076
Habitat	Riffle	Pool	Riffle	Pool	Pool	Pool	Riffle
Arrenurus							
Family: Hydryphantidae							
Family: Hygrobatidae							
Hygrobates							
Family: Lebertiidae							
Lebertia		1					
Family: Limnesiidae							
Limnesia							
Family: Limnocharidae							
Limnochares							
Family: Mideopsidae							
Mideopsis							
Family: Oxidae							
Oxus							
Family: Pionidae							
Piona							
Family: Sperchontidae							
Sperchon		1					
Sperchonopsis		1					
Family: Unionicolidae							
Neumania							
Family: Halacaridae							
Order: Oribatida						2	
Family: Hydrozetidae							
Phylum: Mollusca							
Class: Bivalvia							

Site	R6S2	R6S2	WIS	WIS	WIS	WIS	WIS
Year	2014	2014	2014	2014	2014	2014	2014
CC#	CC150104	CC150105	CC150072	CC150073	CC150074	CC150075	CC150076
Habitat	Riffle	Pool	Riffle	Pool	Pool	Pool	Riffle
Order: Veneroida							
Family: Pisidiidae							
Pisidium	5	1					
Class: Gastropoda							
Order: Heterostropha							
Family: Valvatidae							
Phylum: Annelida							
Subphylum: Clitellata							
Class: Oligochaeta							
Order: Lumbriculida							
Family: Lumbriculidae		13	10			5	
Order: Tubificida							
Family: Enchytraeidae							
Enchytraeus							
Family: Lumbricidae							
Family: Naididae							
Chaetogaster							
Chaetogaster diaphanus							
Nais							
Pristina							
Family: Tubificidae	75			15	1		169
Phylum: Cnidaria							
Class: Hydrozoa							
Order: Anthoathecatae							
Family: Hydridae							
Hydra							1

Site	R6S2	R6S2	WIS	WIS	WIS	WIS	WIS
Year	2014	2014	2014	2014	2014	2014	2014
CC#	CC150104	CC150105	CC150072	CC150073	CC150074	CC150075	CC150076
Habitat	Riffle	Pool	Riffle	Pool	Pool	Pool	Riffle
Phylum: Tardigrada			2	1			3

Site	WIS	WIS	WIS	WIS	WIS	WIS	WIS
Year	2014	2014	2014	2014	2014	2014	2014
CC#	CC150077	CC150078	CC150079	CC150080	CC150081	CC150082	CC150083
Habitat	Riffle	Pool	Riffle	Pool	Riffle	Pool	Riffle
Phylum: Arthropoda							
Subphylum: Hexapoda							
Class: Insecta							
Order: Ephemeroptera							
Family: Baetidae		1			1		
Acerpenna							
Acerpenna pygmaea							
Baetis			1	1			
Baetis bicaudatus							
Baetis tricaudatus							
Family: Ephemerellidae							
Caudatella							
Family: Heptageniidae							
Epeorus							
Ironodes							
Rhithrogena							
Family: Leptophlebiidae							
Order: Plecoptera							
Family: Capniidae							
Family: Leuctridae							
Family: Nemouridae					1		
Amphinemura							
Malenka							
Nemoura			1	1	1		
Ostrocerca							
Zapada							

Site	WIS	WIS	WIS	WIS	WIS	WIS	WIS
Year	2014	2014	2014	2014	2014	2014	2014
CC#	CC150077	CC150078	CC150079	CC150080	CC150081	CC150082	CC150083
Habitat	Riffle	Pool	Riffle	Pool	Riffle	Pool	Riffle
Zapada oregonensis							
Family: Perlodidae							
Order: Trichoptera							
Micrasema							
Family: Hydropsychidae							
Hydropsyche							
Family: Hydroptilidae							
Agraylea							
Oxyethira							
Family: Limnephilidae							
Clostoeca disjuncta							
Ecclisomyia							
Limnephilus		1		4			
Family: Molannidae							
Molanna flavicornis							
Molanna distinctus							
Family: Phryganeidae							
Agrypnia							
Family: Rhyacophilidae							
Rhyacophila							
Order: Coleoptera							
Family: Dytiscidae							
Agabus			1				
Colymbetes							
Hydroporus							
Oreodytes							

Site	WIS	WIS	WIS	WIS	WIS	WIS	WIS
Year	2014	2014	2014	2014	2014	2014	2014
CC#	CC150077	CC150078	CC150079	CC150080	CC150081	CC150082	CC150083
Habitat	Riffle	Pool	Riffle	Pool	Riffle	Pool	Riffle
Stictotarsus							
Family: Hydraenidae							
Hydraena							
SubFamily: Hydroporinae		1					
Family: Hydrophilidae		1	2				
Hydrochus							
Family: Psephenidae							
Family: Staphylinidae							
Order: Diptera							
Family: Ceratopogonidae					1		
Atrichopogon							
Bezzia/Palpomyia				2			
Culicoides							
Dasyhelea		1					
Forcipomyia							
Mallochohelea							
Probezzia							
Sphaeromias							
Family: Chaoboridae							
Eucorethra							
Family: Chironomidae	9	6	6	22	3	2	1
SubFamily: Chironominae							
Fissimentum							
Tribe: Chironomini							
Chironomus	1	3		18	1		2
Cryptochironomus							

Site	WIS	WIS	WIS	WIS	WIS	WIS	WIS
Year	2014	2014	2014	2014	2014	2014	2014
CC#	CC150077	CC150078	CC150079	CC150080	CC150081	CC150082	CC150083
Habitat	Riffle	Pool	Riffle	Pool	Riffle	Pool	Riffle
Endochironomus		3		1			
Microtendipes							
Microtendipes pedellus							
Phaenopsectra							
Polypedilum	1	4		24			
Stictochironomus				6	4	5	1
Tribelos							
Tribe: Tanytarsini							
Cladotanytarsus							
Micropsectra	74	320	17	114	12	4	7
Paratanytarsus							
Rheotanytarsus							
Tanytarsus							
SubFamily: Diamesinae							
Protanypus							
Tribe: Diamesini							
Pagastia							
Potthastia							
SubFamily: Orthocladiinae							
Brillia							
Cricotopus	1						
Diplocladius							
Diplocladius cultriger							
Eukiefferiella			15		6		4
Georthocladius							
Heterotanytarsus							

Site	WIS	WIS	WIS	WIS	WIS	WIS	WIS
Year	2014	2014	2014	2014	2014	2014	2014
CC#	CC150077	CC150078	CC150079	CC150080	CC150081	CC150082	CC150083
Habitat	Riffle	Pool	Riffle	Pool	Riffle	Pool	Riffle
Heterotrissocladius				12	4	1	4
Hydrobaenus							
Limnophyes							
Metriocnemus	2						2
Nanocladius							
Orthocladius							
Orthocladius complex	9	5	15	56	34	9	20
Parakiefferiella							
Paralimnophyes arcticus							
Paraphaenocladius	10	17	6	26			
Psectrocladius	1						
Psiloptarus							
Pseudosmittia							
Rheocricotopus							
Tvetenia							
Tvetenia bavarica							
Tvetenia vitracies							
Zalutschia							
Zalutschia briani							
Zalutschia tatrica							
Zalutschia zalutschicola							
Tribe: Corynoneurini							
Corynoneura							1
Tribe: Orthocladiini							
Chaetocladius							
SubFamily: Podonominae							

Site	WIS	WIS	WIS	WIS	WIS	WIS	WIS
Year	2014	2014	2014	2014	2014	2014	2014
CC#	CC150077	CC150078	CC150079	CC150080	CC150081	CC150082	CC150083
Habitat	Riffle	Pool	Riffle	Pool	Riffle	Pool	Riffle
Lasiodiamesa				1			1
Paraboreochlus							
Trichotanypus							
SubFamily: Prodiamesinae							
Prodiamesa							
Tribe: Boreochlini							
Boreochlus							
SubFamily: Tanypodinae							
Labrundinia							
Tribe: Pentaneuriini							
Ablabesmyia		4					
Nilotanypus							
Thienemannimyia		1					
Tribe: Procladiini							
Djalma batista							
Procladius		5					
Family: Dixidae					1		
Dixella							
Family: Dolichopodidae							
Rhaphium							
Family: Empididae	1	9	2	1	1		2
Clinocera							
Chelifera/Metachela							
Oreogeton							
Family: Muscidae	1						
Limnophora					1		

Site	WIS	WIS	WIS	WIS	WIS	WIS	WIS
Year	2014	2014	2014	2014	2014	2014	2014
CC#	CC150077	CC150078	CC150079	CC150080	CC150081	CC150082	CC150083
Habitat	Riffle	Pool	Riffle	Pool	Riffle	Pool	Riffle
Family: Simuliidae	2	1	12	24	28		
Prosimulium			6	25	31		
Simulium						1	1
Family: Tipulidae							
Erioptera							
Limnophila							
Ormosia							
Tipula							
Order: Hemiptera		1					
Family: Corixidae							
Sigara							
Family: Gerridae							
Gerris							
Order: Lepidoptera							
Family: Noctuidae							
Order: Odonata							
Subphylum: Crustacea							
Class: Malacostraca							
Order: Amphipoda							
Subphylum: Chelicerata							
Class: Arachnida							
Order: Trombidiformes							
SubOrder: Prostigmata		2					
Neobrachypoda							
Pionopsis							
Family: Arrenuridae							

Site	WIS	WIS	WIS	WIS	WIS	WIS	WIS
Year	2014	2014	2014	2014	2014	2014	2014
CC#	CC150077	CC150078	CC150079	CC150080	CC150081	CC150082	CC150083
Habitat	Riffle	Pool	Riffle	Pool	Riffle	Pool	Riffle
Arrenurus							
Family: Hydryphantidae							
Family: Hygrobatidae							
Hygrobates							
Family: Lebertiidae							
Lebertia							
Family: Limnesiidae							
Limnesia							
Family: Limnocharidae							
Limnochares							
Family: Mideopsidae							
Mideopsis							
Family: Oxidae							
Oxus							
Family: Pionidae							
Piona							
Family: Sperchontidae							
Sperchon							
Sperchonopsis							
Family: Unionicolidae							
Neumania							
Family: Halacaridae							
Order: Oribatida		5					
Family: Hydrozetidae							
Phylum: Mollusca							
Class: Bivalvia							

Site	WIS	WIS	WIS	WIS	WIS	WIS	WIS
Year	2014	2014	2014	2014	2014	2014	2014
CC#	CC150077	CC150078	CC150079	CC150080	CC150081	CC150082	CC150083
Habitat	Riffle	Pool	Riffle	Pool	Riffle	Pool	Riffle
Order: Veneroida							
Family: Pisidiidae							
Pisidium							
Class: Gastropoda							
Order: Heterostropha							
Family: Valvatidae							
Phylum: Annelida							
Subphylum: Clitellata							
Class: Oligochaeta							
Order: Lumbriculida							
Family: Lumbriculidae		15	9	5	3	7	
Order: Tubificida							
Family: Enchytraeidae							
Enchytraeus							
Family: Lumbricidae							
Family: Naididae							
Chaetogaster							
Chaetogaster diaphanus							
Nais							
Pristina							
Family: Tubificidae	2	13		70	25		10
Phylum: Cnidaria							
Class: Hydrozoa							
Order: Anthoathecatae							
Family: Hydridae							
Hydra							

Site	WIS	WIS	WIS	WIS	WIS	WIS	WIS
Year	2014	2014	2014	2014	2014	2014	2014
CC#	CC150077	CC150078	CC150079	CC150080	CC150081	CC150082	CC150083
Habitat	Riffle	Pool	Riffle	Pool	Riffle	Pool	Riffle
Phylum: Tardigrada	3	14	5	2			

Site	WIS	WIS	WIS	WIS	WIS	WIS
Year	2014	2014	2014	2014	2014	2014
CC#	CC150084	CC150085	CC150086	CC150087	CC150088	CC150089
Habitat	Riffle	Riffle	Pool	Pool	Pool	Riffle
Phylum: Arthropoda						
Subphylum: Hexapoda						
Class: Insecta						
Order: Ephemeroptera						
Family: Baetidae	2					
Acerpenna						
Acerpenna pygmaea						
Baetis	3	1		1		
Baetis bicaudatus						
Baetis tricaudatus						
Family: Ephemerellidae						
Caudatella						
Family: Heptageniidae						
Epeorus						
Ironodes						
Rhithrogena						
Family: Leptophlebiidae						
Order: Plecoptera						
Family: Capniidae						
Family: Leuctridae						
Family: Nemouridae						
Amphinemura						
Malenka						
Nemoura	2					
Ostrocerca						
Zapada						

Site	WIS	WIS	WIS	WIS	WIS	WIS
Year	2014	2014	2014	2014	2014	2014
CC#	CC150084	CC150085	CC150086	CC150087	CC150088	CC150089
Habitat	Riffle	Riffle	Pool	Pool	Pool	Riffle
Zapada oregonensis						
Family: Perlodidae						
Order: Trichoptera						
Micrasema						
Family: Hydropsychidae						
Hydropsyche						
Family: Hydroptilidae						
Agraylea						
Oxyethira						
Family: Limnephilidae	1		2			
Clostoeca disjuncta						
Ecclisomyia						
Limnephilus		4		1		
Family: Molannidae						
Molanna flavicornis						
Molanna distinctus						
Family: Phryganeidae						
Agrypnia						
Family: Rhyacophilidae						
Rhyacophila						
Order: Coleoptera						
Family: Dytiscidae						
Agabus	2	1		1		
Colymbetes						
Hydroporus						
Oreodytes						

Site	WIS	WIS	WIS	WIS	WIS	WIS
Year	2014	2014	2014	2014	2014	2014
CC#	CC150084	CC150085	CC150086	CC150087	CC150088	CC150089
Habitat	Riffle	Riffle	Pool	Pool	Pool	Riffle
Stictotarsus						
Family: Hydraenidae						
Hydraena						
SubFamily: Hydroporinae						
Family: Hydrophilidae	2					
Hydrochus						
Family: Psephenidae						
Family: Staphylinidae						
Order: Diptera						
Family: Ceratopogonidae						
Atrichopogon						
Bezzia/Palpomyia	1					
Culicoides						
Dasyhelea						
Forcipomyia						
Mallochohelea						
Probezzia						
Sphaeromias						
Family: Chaoboridae						
Eucorethra						
Family: Chironomidae	18	7	4	10	2	2
SubFamily: Chironominae						
Fissimentum						
Tribe: Chironomini						
Chironomus			1			
Cryptochironomus						

Site	WIS	WIS	WIS	WIS	WIS	WIS
Year	2014	2014	2014	2014	2014	2014
CC#	CC150084	CC150085	CC150086	CC150087	CC150088	CC150089
Habitat	Riffle	Riffle	Pool	Pool	Pool	Riffle
Endochironomus						
Microtendipes						
Microtendipes pedellus						
Phaenopsectra						
Polypedilum						
Stictochironomus	6		1			
Tribelos						
Tribe: Tanytarsini						
Cladotanytarsus						
Micropsectra	22	27	13	9	1	16
Paratanytarsus						
Rheotanytarsus						
Tanytarsus						
SubFamily: Diamesinae						
Protanypus						
Tribe: Diamesini						
Pagastia		1	1			
Potthastia						
SubFamily: Orthocladiinae						
Brillia						
Cricotopus						
Diplocladius						
Diplocladius cultriger						
Eukiefferiella	23	3	1	11	1	10
Georthocladius						
Heterotanytarsus						

Site	WIS	WIS	WIS	WIS	WIS	WIS
Year	2014	2014	2014	2014	2014	2014
CC#	CC150084	CC150085	CC150086	CC150087	CC150088	CC150089
Habitat	Riffle	Riffle	Pool	Pool	Pool	Riffle
Heterotrissocladius	22	9	8	8	1	1
Hydrobaenus						
Limnophyes						
Metriocnemus	4					
Nanocladius						
Orthocladius						
Orthocladius complex	21	13	1	14		9
Parakiefferiella						
Paralimnophyes arcticus						
Paraphaenocladius						
Psectrocladius						
Psiloptarus						
Pseudosmittia						
Rheocricotopus						
Tvetenia						
Tvetenia bavarica						
Tvetenia vitracies						
Zalutschia						
Zalutschia briani						
Zalutschia tatrica						
Zalutschia zalutschicola						
Tribe: Corynoneurini						
Corynoneura	1	1		1		
Tribe: Orthocladiini						
Chaetocladius						
SubFamily: Podonominae						

Site	WIS	WIS	WIS	WIS	WIS	WIS
Year	2014	2014	2014	2014	2014	2014
CC#	CC150084	CC150085	CC150086	CC150087	CC150088	CC150089
Habitat	Riffle	Riffle	Pool	Pool	Pool	Riffle
Lasiodiamesa	1		1			
Paraboreochlus						
Trichotanypus						
SubFamily: Prodiamesinae						
Prodiamesa						
Tribe: Boreochlini						
Boreochlus						
SubFamily: Tanypodinae						
Labrundinia						
Tribe: Pentaneuriini						
Ablabesmyia						
Nilotanypus						
Thienemannimyia						
Tribe: Procladiini						
Djalma batista						
Procladius						
Family: Dixidae						
Dixella				1		
Family: Dolichopodidae						
Rhaphium						
Family: Empididae	2	1				
Clinocera						
Chelifera/Metachela						
Oreogeton						1
Family: Muscidae						
Limnophora						

Site	WIS	WIS	WIS	WIS	WIS	WIS
Year	2014	2014	2014	2014	2014	2014
CC#	CC150084	CC150085	CC150086	CC150087	CC150088	CC150089
Habitat	Riffle	Riffle	Pool	Pool	Pool	Riffle
Family: Simuliidae	32	13		46		
Prosimulium	83					
Simulium		1		11		
Family: Tipulidae						
Erioptera						
Limnophila						
Ormosia						
Tipula						
Order: Hemiptera						
Family: Corixidae						
Sigara						
Family: Gerridae						
Gerris						
Order: Lepidoptera						
Family: Noctuidae						
Order: Odonata						
Subphylum: Crustacea						
Class: Malacostraca						
Order: Amphipoda						
Subphylum: Chelicerata						
Class: Arachnida						
Order: Trombidiformes						
SubOrder: Prostigmata	1		4			
Neobrachypoda	1					
Pionopsis						
Family: Arrenuridae						

Site	WIS	WIS	WIS	WIS	WIS	WIS
Year	2014	2014	2014	2014	2014	2014
CC#	CC150084	CC150085	CC150086	CC150087	CC150088	CC150089
Habitat	Riffle	Riffle	Pool	Pool	Pool	Riffle
Arrenurus						
Family: Hydryphantidae						
Family: Hygrobatidae						
Hygrobates						
Family: Lebertiidae						
Lebertia						
Family: Limnesiidae						
Limnesia						
Family: Limnocharidae						
Limnochares						
Family: Mideopsidae						
Mideopsis						
Family: Oxidae						
Oxus						
Family: Pionidae						
Piona						
Family: Sperchontidae						
Sperchon						
Sperchonopsis						
Family: Unionicolidae						
Neumania						
Family: Halacaridae						
Order: Oribatida						2
Family: Hydrozetidae						
Phylum: Mollusca						
Class: Bivalvia						

Site	WIS	WIS	WIS	WIS	WIS	WIS
Year	2014	2014	2014	2014	2014	2014
CC#	CC150084	CC150085	CC150086	CC150087	CC150088	CC150089
Habitat	Riffle	Riffle	Pool	Pool	Pool	Riffle
Order: Veneroida						
Family: Pisidiidae						
Pisidium						
Class: Gastropoda						
Order: Heterostropha						
Family: Valvatidae						
Phylum: Annelida						
Subphylum: Clitellata						
Class: Oligochaeta						
Order: Lumbriculida						
Family: Lumbriculidae	3		5			2
Order: Tubificida						
Family: Enchytraeidae						
Enchytraeus						
Family: Lumbricidae						
Family: Naididae						
Chaetogaster						
Chaetogaster diaphanus						
Nais						
Pristina						
Family: Tubificidae	28	10	46	5	1	96
Phylum: Cnidaria						
Class: Hydrozoa						
Order: Anthoathecatae						
Family: Hydridae						
Hydra						

Site	WIS	WIS	WIS	WIS	WIS	WIS
Year	2014	2014	2014	2014	2014	2014
CC#	CC150084	CC150085	CC150086	CC150087	CC150088	CC150089
Habitat	Riffle	Riffle	Pool	Pool	Pool	Riffle
Phylum: Tardigrada		1		2		3