Lower Deschutes River Macroinvertebrate & Periphyton Study

Portland General Electric **and the** ***Confederated Tribes of Warm Springs Reservation of Oregon*** **began operation of a Selective Water Withdrawal (SWW) structure at Round Butte Dam in 2009. This structure was designed to facilitate reintroduction of sea-going salmon and steelhead upstream and to restore natural (i.e., without the dams) water temperature patterns in the Deschutes River downstream. A multi-year study of macroinvertebrates (insects, worms, etc.) and algae (periphyton) was conducted to document any changes in the aquatic ecosystem downstream before and after SWW installation.**

The study identified a diverse and productive aquatic community throughout the lower Deschutes River system. Dam discharge and temperatures have altered the community diversity and species composition at sites immediately downstream of the Project relative to those in other areas of the river. Effects were reduced beyond four miles downstream as the river reset to ambient conditions. Species that were abundant prior to SWW implementation remained abundant afterward, but seasonal changes in community composition and occurrence of some less common species were apparent. Differences may be due to shifts in life cycle timing from changing temperature patterns in the reservoir discharge to resemble natural conditions.

Study Design & Methods

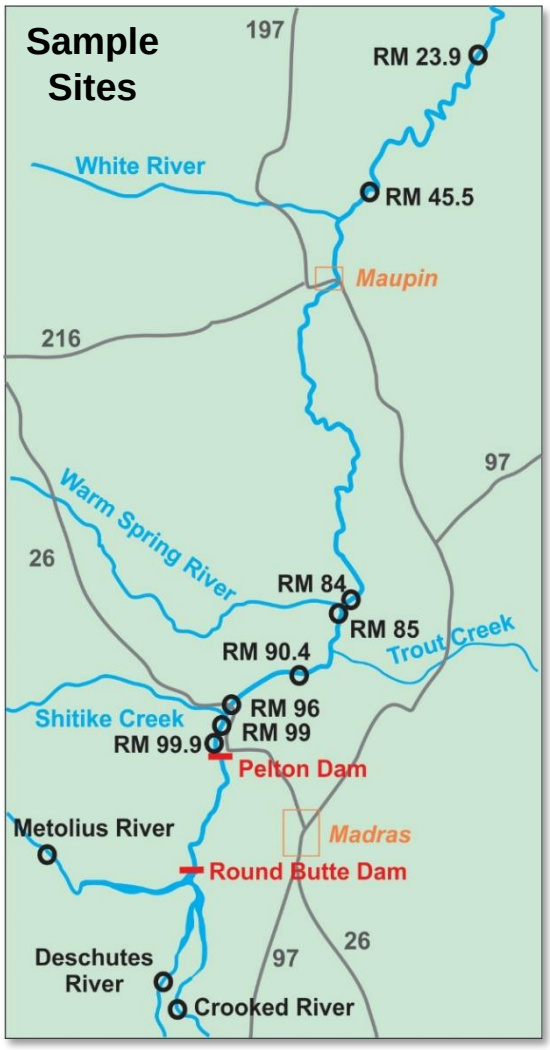
This study examined the abundance, diversity, species composition, and trophic (food web) structure of aquatic macroinvertebrates and periphyton at sites upstream and downstream from project reservoirs. These organisms are powerful ecosystem indicators of environmental change.

Project effects were evaluated based on:

1) Changes with increasing distance downstream from the project.
2) Differences between sites above and below the project.
3) Comparisons before and after project implementation.

Pre-SWW samples were collected in 1999-2001. Post-SWW samples were collected in 2013-2015. Two years of spring (May) and fall (October) samples were collected during both before and after periods. Sampling seasons were selected as indicators of SWW effects.

Sampling and laboratory analysis methods followed protocols established by the *Oregon Department of Environmental Quality (DEQ)* and the *U. S. Environmental Protection Agency (EPA)*. Macroinvertebrates were collected by dislodging organisms from the river bottom into collection nets. Periphyton was collected by scraping algae from river bottom rocks.



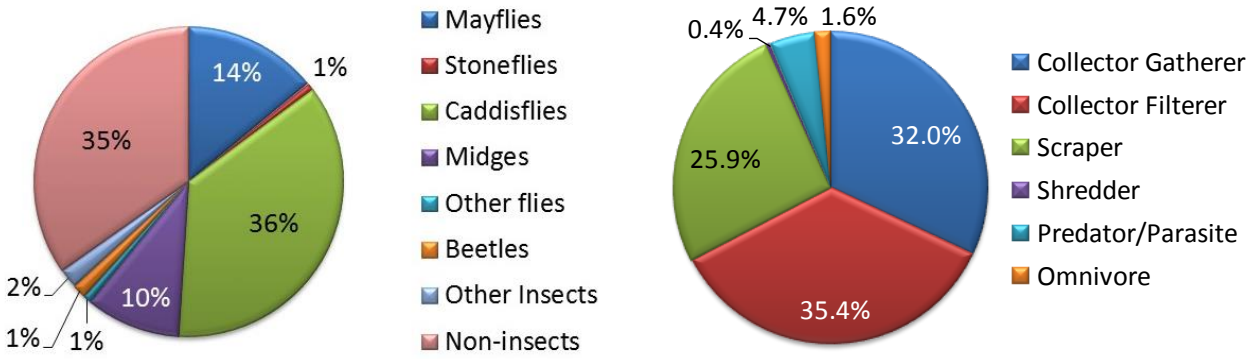
Resource Consultants

The Benthic Community

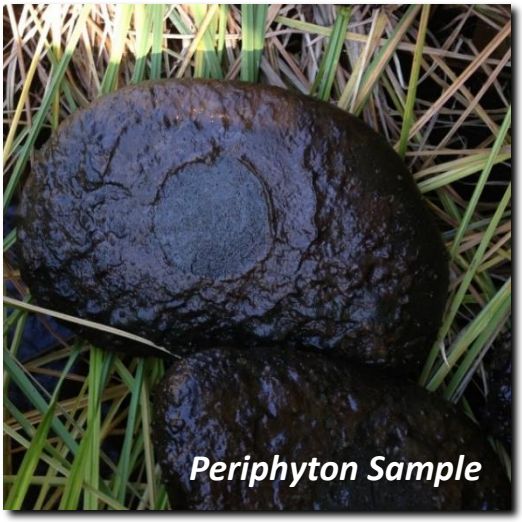
The lower Deschutes River ecosystem is tremendously productive and diverse. Benthic macro- invertebrate numbers were typically 10,000 or more organisms per square meter of substrate in productive riffle habitats during all sample years and seasons.

Sites supported 21 to 47 different species, with insects generally dominating. Mayflies (*Ephemeroptera*) and caddisflies (*Trichoptera*) were abundant. Midges (*Chironomidae*), other flies (*Diptera*), and beetles (*Coleoptera*) were also common. The stoneflies (*Plecoptera*) famous to Deschutes trout anglers were widely distributed and represented a significant biomass (proportion of total by weight) due to their large size. Non-insects included oligochaete worms, flatworms, and snails.

Representative Macroinvertebrate Community Composition in the Lower Deschutes River



Percentages by number of individuals at River Mile 85 (Fall 2014)



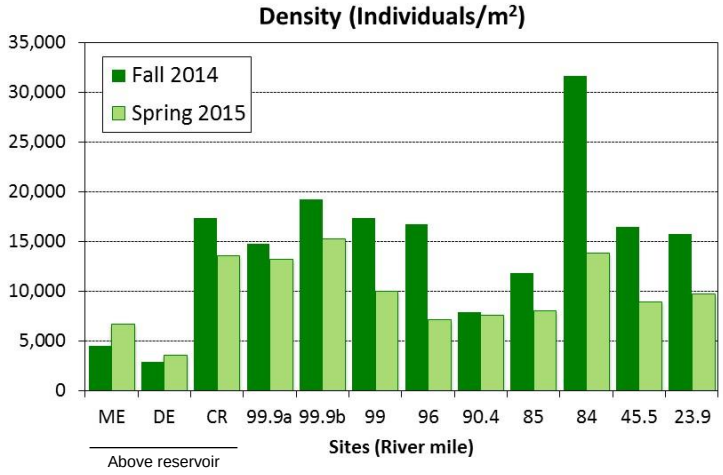
Aquatic food web productivity in the lower Deschutes is and has always been driven by algal plant growth rather than terrestrial inputs. As a result, the most common feeding groups during the growing season are scrapers/grazers of algae (e.g., snails) and filter-feeders of fine particulate matter within the water column (e. g., net-spinning caddis and blackfly larvae). Collector-gathers of fine particulate matter from the stream bottom (e. g., mayfly nymphs and midge larvae) are most common in spring when primary productivity is low.

Algae include microscopic single celled “hard” forms (diatoms) which make up the slippery film on rocks, and “soft” algae which form filamentous strands and clumps on rocks. The diatom community was extremely diverse including 17 to 56 types per site. However, 3 to 10 soft algae species generally dominated the mass of algae. Algal mass was greater in the fall than spring.

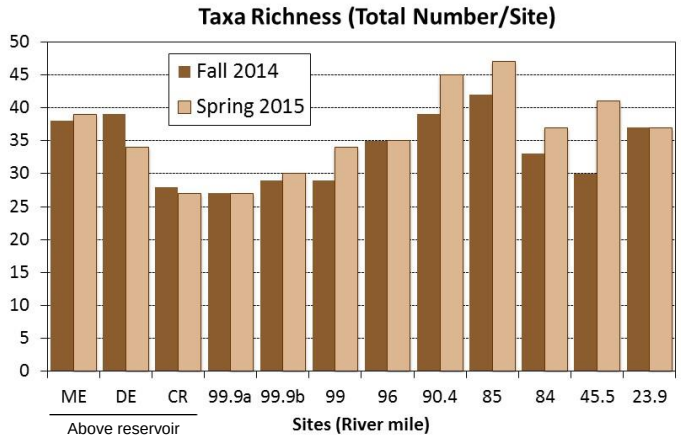
Reservoir Discharge Effects

Discharge of reservoir waters into a river typically creates a substantially different macroinvertebrate community immediately below the dams, but these effects are generally ameliorated (or diminish) as you move farther downstream. Such was the case on the Deschutes. Effects were most apparent within four miles of the reregulating dam located at River Mile 100. A more natural riverine community takes over downstream as the river resets to ambient conditions.

High densities of organisms were observed at all sites, with no consistent differences with increasing distance from the dams. Numbers were higher in fall than spring as smaller, younger organisms were more numerous following emergence and reproduction of adults over the summer. Taxa richness (number of species) was lower immediately downstream from the Project compared to sites farther downstream.



Non-insect taxa including oligochaete worms, flatworms, and snails predominated at sample sites within 4 miles of the project (Sites 99.9a, 99.9b, 991-3). Insects at these sites were primarily midge (chironomids), blackfly (simuliids), and net-spinning (hydropsychid) larvae. Filter-feeding insects and omnivores were abundant at these sites, taking advantage of zooplankton and phytoplankton entrained from Lake Billy Chinook. Omnivores (e.g., flatworms) prey on rotifers, protozoa, or zooplankton and also feed on detritus (dead particulate organic matter) likely supplied by the Project. Insects replace the non-insects farther downstream.



No consistent downstream trend was apparent for algae. Annual and seasonal differences dwarfed differences among sites during any given sampling period. Large differences were observed among years, particularly for soft algae.

Upstream Control Sites

The Crooked, Deschutes, and Metolius rivers were sampled upstream from the reservoir before and after SWW implementation. These sites serve as study controls for describing the aquatic community in areas unaffected by the project. Sites are not true controls because stream sizes are different. However, upstream sites help us understand normal variability in the aquatic community independent of dam effects. For instance, changes in occurrence of some species (e. g., *Antocha* craneflies) in both control and downstream sites after SWW implementation suggest this change was due to regional factors rather than SWW-specific effects.

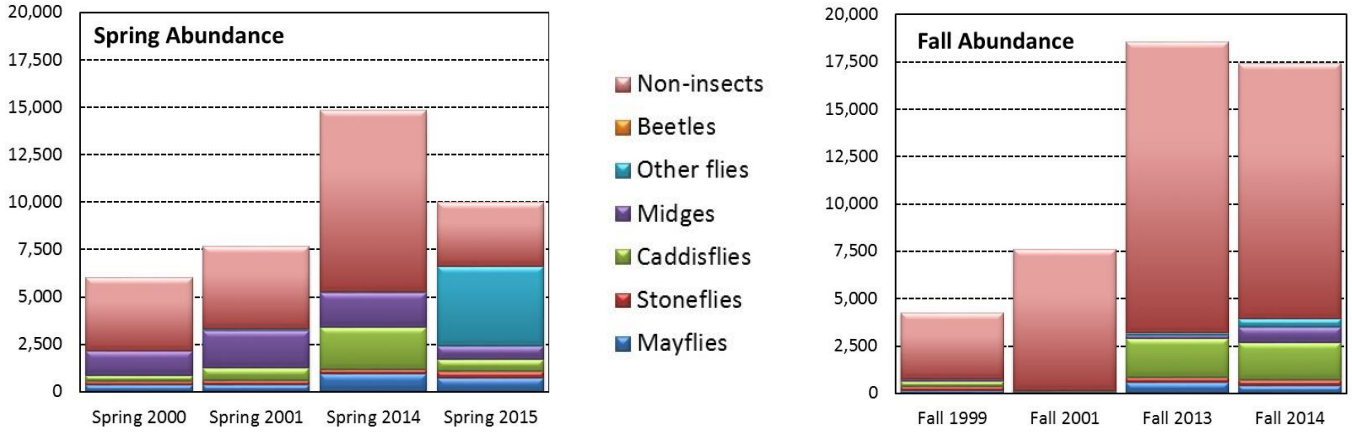
Macroinvertebrates were generally less dense upstream from the reservoirs but similar in diversity to sites four or more miles downstream from the dam. In contrast, the periphyton species composition in upstream sites was distinctly different than from that in the lower Deschutes River. Differences in animal and plant communities likely reflect inherent differences in habitat between the lower mainstem Deschutes River and upstream tributaries.

Before & After Selective Water Withdrawal Implementation

Small but significant differences were seen in the macroinvertebrate community before and after SWW implementation, particularly in the area immediately below the dams. Species that were abundant prior to SWW implementation remained abundant after SWW implementation. However, seasonal changes in numbers of several species were observed. For instance, post-SWW densities were higher in the fall for net-spinning caddis larvae, Giant Stonefly, and *Baetis* and *Ephemerella* mayfly nymphs. Golden Stone nymph densities were lower during spring in post-SWW sampling. Effective comparisons of pre- and post-SWW periphyton samples were limited by inconsistent laboratory analyses that are available for pre-SWW analyses.

Macroinvertebrate differences may be due to shifts in life cycle timing from restoration of more-natural temperature patterns downstream from the Project after SWW implementation. Resulting differences in generation time, and hatch timing affect the numbers, sizes and types of organisms present at any given time of the year. Downstream abundance may also have benefited from the abundant food supply provided by reservoir surface waters.

Changes in Macroinvertebrate Species Composition 1 Mile Below Dam



Relative abundance by number of individuals at River Mile 99