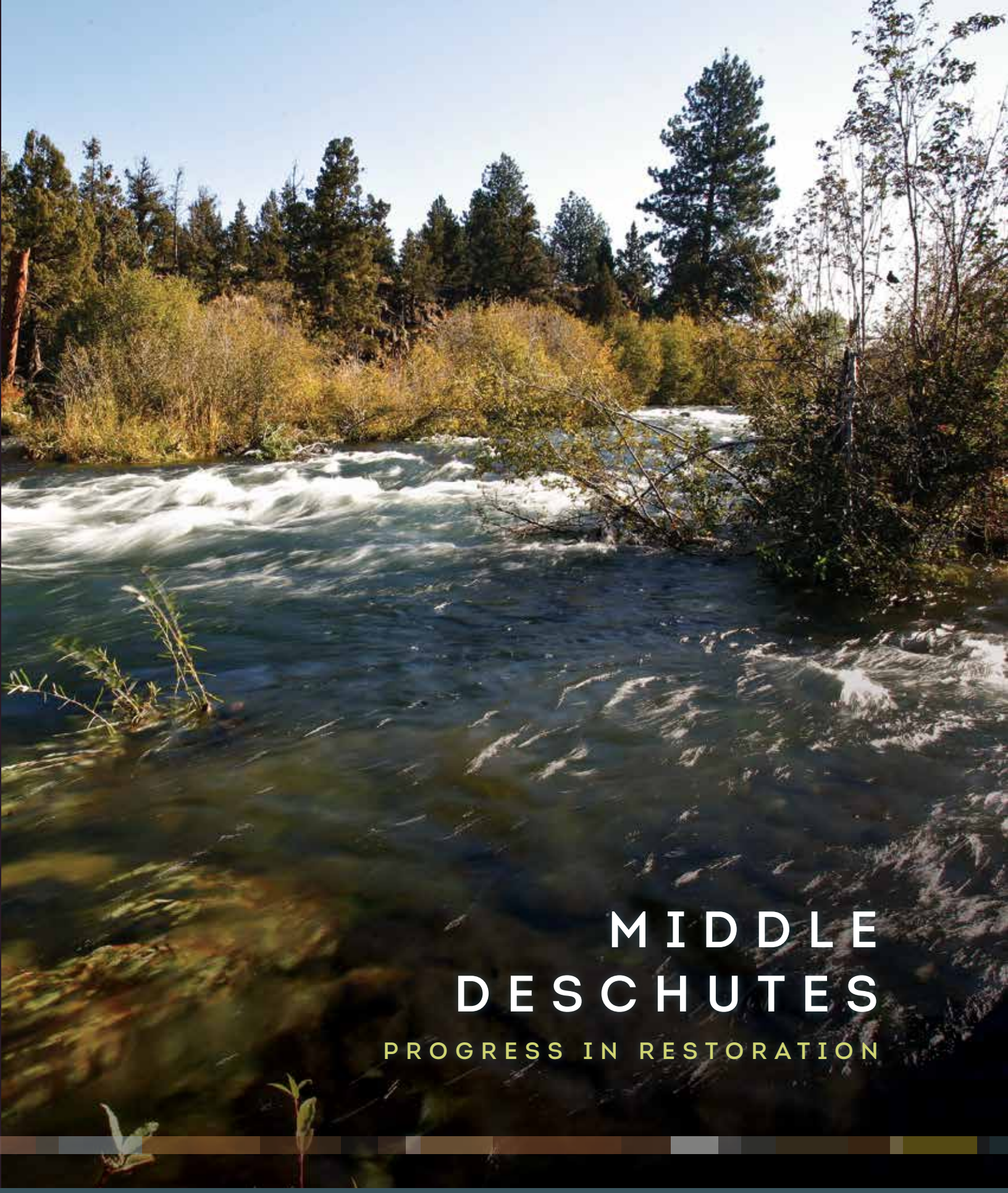

MIDDLE DESCHUTES

PROGRESS IN RESTORATION

Acknowledgements

PREPARED BY:

Upper Deschutes Watershed Council

Deschutes River Conservancy

Oregon Department of Fish and Wildlife

DESIGN & PRODUCTION FUNDED BY:

Oregon Watershed Enhancement Board

The information presented in this publication is based on the following technical reports available at www.upperdeschuteswatershedcouncil.org:

2013 Middle Deschutes Fisheries Monitoring Report: Fish Distribution and Abundance in the Middle Deschutes River (ODFW 2014)

2013 Middle Deschutes Fisheries Monitoring Report: Redband Trout Movement in the Middle Deschutes River (ODFW 2014)

Middle Deschutes River Instream Flow Restoration and Temperature Response 2001-2013 (UDWC 2014)

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Oregon Watershed Enhancement Board

Introduction

THE DESCHUTES RIVER WELLS OUT OF THE VOLCANIC high Cascades as cold, clean water, flowing 225 miles to the Columbia River. For millennia, salmon and steelhead traveled from the ocean up to Big Falls, a natural barrier to fish passage, to spawn and rear in the Deschutes and its tributaries. Upstream of Big Falls to the headwaters, redband trout and other native fish flourished in place of steelhead.

With European settlement, the constant flow of the Deschutes River was harnessed for agriculture and other uses, changing the character of the river. Since the early 1900's, the Deschutes River has served as the primary source of irrigation water for most of the irrigated agriculture in Central Oregon, including farmland near Bend, Redmond, Terrebonne and Madras. Most of the irrigation diversions are located near Bend, where summer irrigation withdrawals historically diverted up to 95% of the stream flow in the Deschutes River. As a result, the 40-mile reach of the Deschutes River located between the City of Bend and Lake Billy Chinook, known as the Middle Deschutes, typically flowed at approximately 30 cubic feet per second (cfs) during most of the summer, resulting in elevated water temperatures and degraded habitat conditions for beleaguered native fish populations.

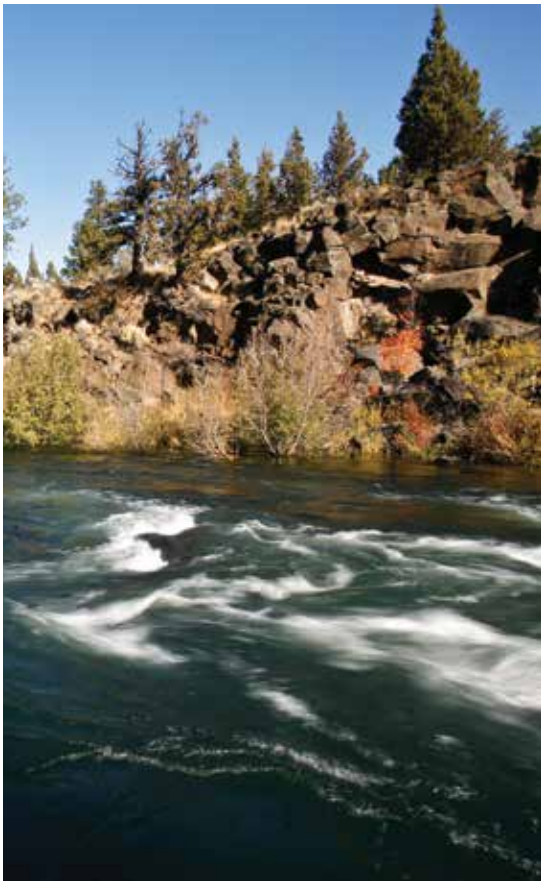
Beginning in 1999, the Deschutes River Conservancy (DRC), local irrigation districts and other partners began ambitious stream flow restoration efforts using a variety of innovative water conservation, acquisition and leasing approaches. This collaboration, sustained over more than a decade, has permanently restored more than 80 cfs of water to the Middle Deschutes. In addition, annual water leasing has increased summer stream flow by up to an additional 50 cfs each summer.

Alongside stream flow restoration efforts, restoration partners have carefully tracked the accompanying changes in the physical and biological characteristics of the river. The Upper Deschutes Watershed Council (UDWC) has worked closely with state agencies and others to monitor water temperature in the Middle Deschutes. This monitoring has allowed restoration partners to begin to describe the relationship between stream flow and water temperature at critical locations along the Middle Deschutes.

In 2012, Oregon Department of Fish and Wildlife launched a five-year study of the fish populations of the Middle Deschutes. New fish population data is improving our understanding of the status of native and non-native fish assemblages in the Middle Deschutes, which areas are supporting the greatest number of fish, and how characteristics of stream habitat may be influencing habitat selection by trout. This information will allow fisheries managers, irrigation districts and restoration partners to develop stream flow restoration projects that will provide the greatest ecological benefit to fish and the river ecosystem.

This report provides an overview of the current state of stream flow, water quality, and the Middle Deschutes fish community as of 2013. The purpose of this report is to provide a condensed overview of what these attributes say about the health of the Middle Deschutes while summarizing local efforts to restore a healthy river ecosystem. All of the information presented here has been distilled from a series of technical reports prepared by Oregon Department of Fish and Wildlife and Upper Deschutes Watershed Council, available at www.upperdeschuteswatershedcouncil.org.

Restoration & Monitoring Activities



SINCE 1999, THE DRC AND BASIN STAKEHOLDERS HAVE WORKED together in a collaborative effort to restore stream flow and improve water quality. As DRC and restoration partners have restored more and more flow to the Deschutes River, new possibilities for the river have emerged. Flows previously unimaginable during the irrigation season, and temperatures low enough to support salmon and trout rearing and migration, are starting to look achievable. With flow restoration and the potential for stream temperatures to improve, fish biologists long concerned with the effects of elevated temperatures on resident fish populations have an added incentive to study how fish are using habitat in relation to differences in temperature. Temperature data provide precise information about how temperature conditions are changing and inform flow restoration strategies, which in turn improve habitat when and where fish need it. The relationships and trust established over years of working together improve the ability of basin restoration partners to accomplish goals that maximize benefits to the river, while continuing to support important cultural values like agriculture and irrigation. These actions are occurring in concert to revitalize a thriving river community.

The restoration and monitoring efforts in the Middle Deschutes would not be possible without significant, long-term investments from key funders, partners and collaborators, all of whom share a common interest in restoring stream flow to support a healthy river.

Working Together

Successful restoration work in the Middle Deschutes requires that many local, state and federal partners and funders come together for a common cause. Primary restoration partners in the Middle Deschutes include:

Central Oregon Irrigation District

Crook County Improvement District No. 1 (Lone Pine)

Deschutes River Conservancy

North Unit Irrigation District

Oregon Department of Environmental Quality

Oregon Department of Fish and Wildlife

Oregon Department of Water Resources

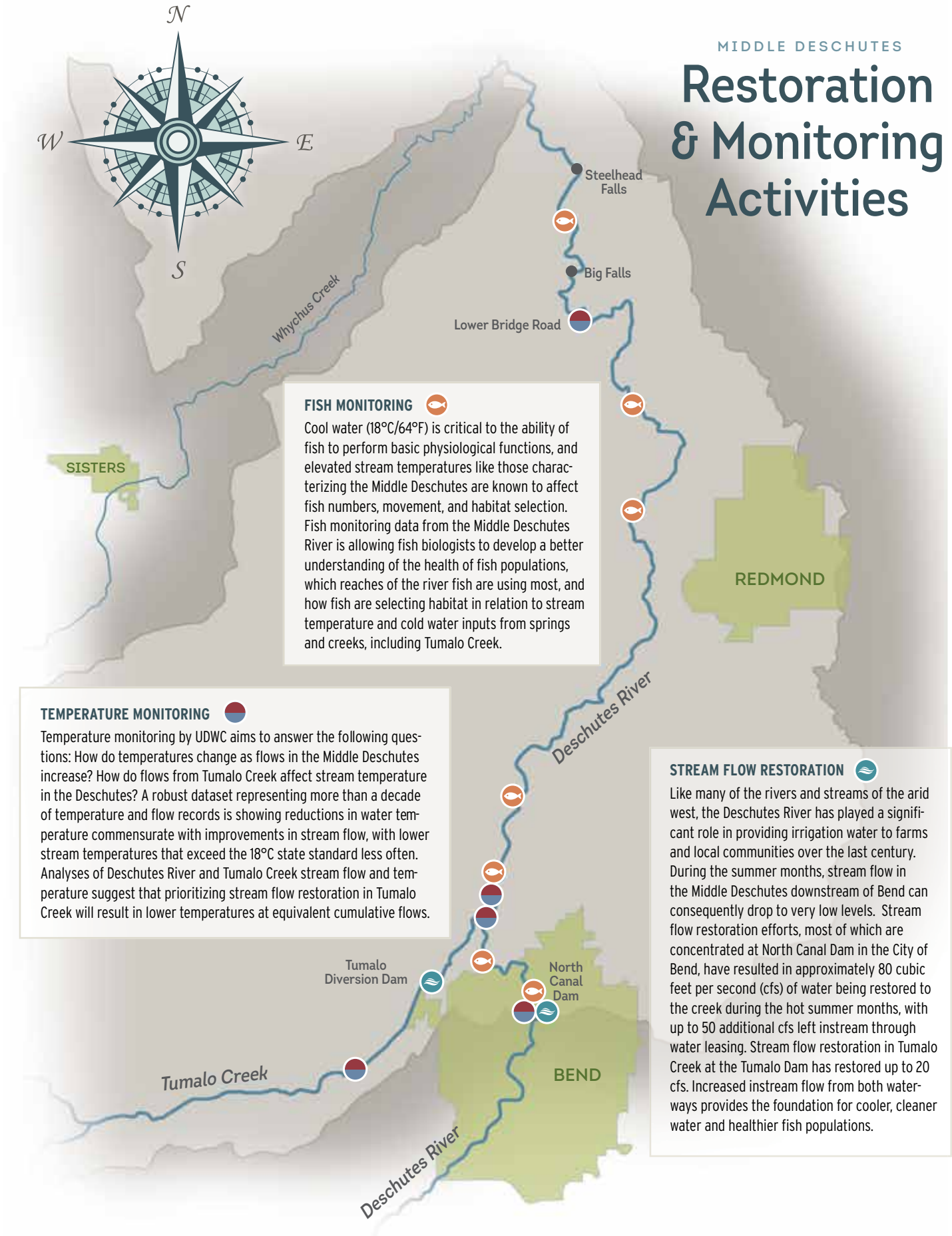
Swalley Irrigation District

Tumalo Irrigation District

Upper Deschutes Watershed Council

MIDDLE DESCHUTES

Restoration & Monitoring Activities



FISH MONITORING

Cool water (18°C/64°F) is critical to the ability of fish to perform basic physiological functions, and elevated stream temperatures like those characterizing the Middle Deschutes are known to affect fish numbers, movement, and habitat selection. Fish monitoring data from the Middle Deschutes River is allowing fish biologists to develop a better understanding of the health of fish populations, which reaches of the river fish are using most, and how fish are selecting habitat in relation to stream temperature and cold water inputs from springs and creeks, including Tumalo Creek.

TEMPERATURE MONITORING

Temperature monitoring by UDWC aims to answer the following questions: How do temperatures change as flows in the Middle Deschutes increase? How do flows from Tumalo Creek affect stream temperature in the Deschutes? A robust dataset representing more than a decade of temperature and flow records is showing reductions in water temperature commensurate with improvements in stream flow, with lower stream temperatures that exceed the 18°C state standard less often. Analyses of Deschutes River and Tumalo Creek stream flow and temperature suggest that prioritizing stream flow restoration in Tumalo Creek will result in lower temperatures at equivalent cumulative flows.

STREAM FLOW RESTORATION

Like many of the rivers and streams of the arid west, the Deschutes River has played a significant role in providing irrigation water to farms and local communities over the last century. During the summer months, stream flow in the Middle Deschutes downstream of Bend can consequently drop to very low levels. Stream flow restoration efforts, most of which are concentrated at North Canal Dam in the City of Bend, have resulted in approximately 80 cubic feet per second (cfs) of water being restored to the creek during the hot summer months, with up to 50 additional cfs left instream through water leasing. Stream flow restoration in Tumalo Creek at the Tumalo Dam has restored up to 20 cfs. Increased instream flow from both waterways provides the foundation for cooler, cleaner water and healthier fish populations.

Stream Flow

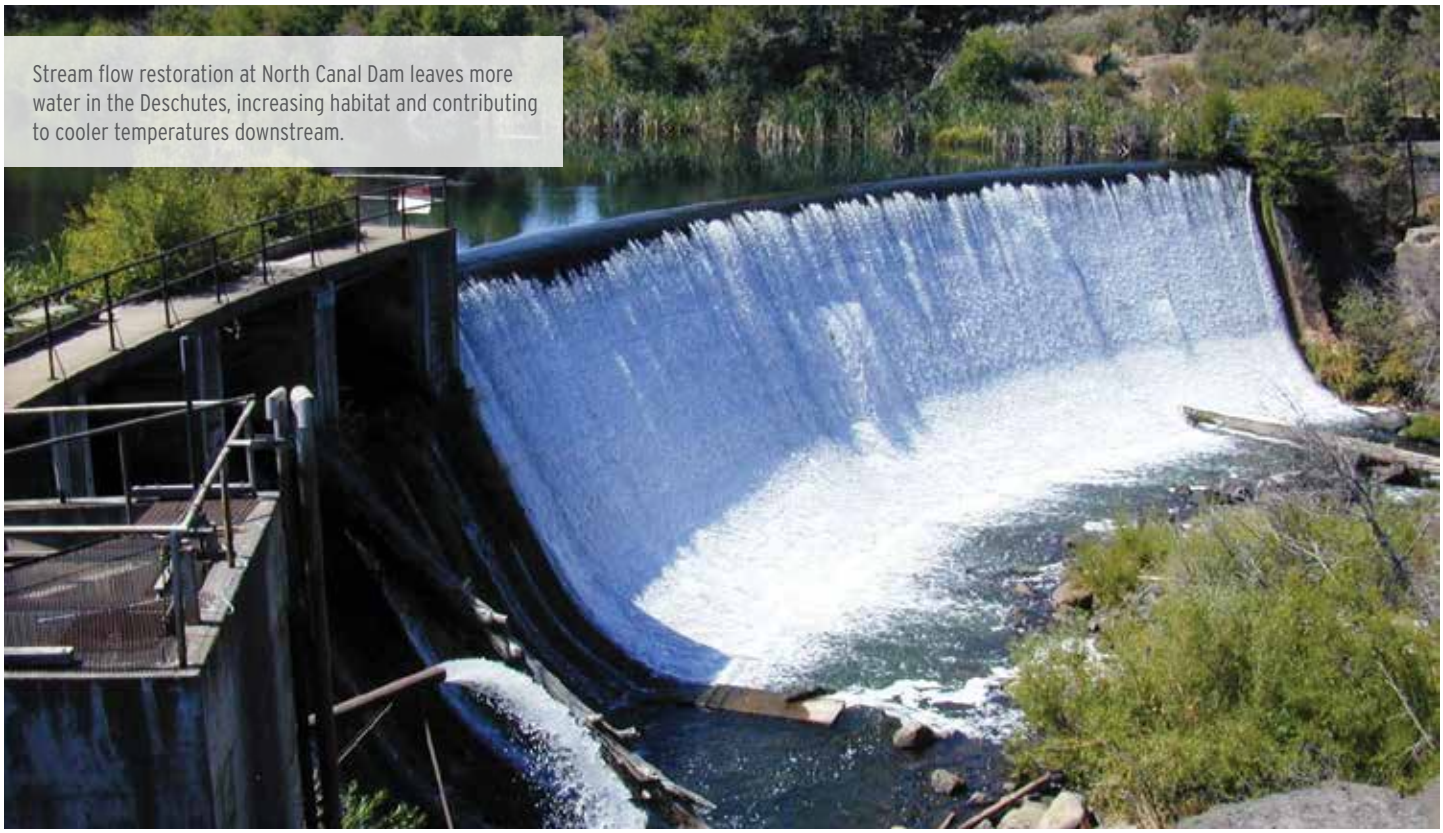
FISH HABITAT, WATER TEMPERATURE AND MANY OTHER CRITICAL ASPECTS of river health are closely linked to stream flow. With sufficient water in the Middle Deschutes, the water remains cool. The river is wider, providing access to more food, habitat, and shade from streamside riparian vegetation. Pools provide deep cover for hiding fish. When stream flow is depleted, however, water temperatures steadily rise and less habitat is available, creating conditions that are inhospitable for fish. Riparian vegetation may be dewatered and lost over years of consistently low flows, and the entire aquatic ecosystem can suffer from the cascading effects of significantly diminished flows.

In the Middle Deschutes, stream flow is an excellent indicator of restoration progress because flows are critically important for water quality, habitat, fish spawning and rearing, and many other ecological functions. In addition, stream flow can be readily measured over time to track long-term progress.

Irrigation diversions began on the Deschutes near Bend as early as 1890. By the 1920's almost the entire flow of the Deschutes had been appropriated for irrigation. During irrigation season, from March to November, stream flows were variable and inconsistent. As of 1950, as little as 15-20 cfs of the 1,250 cfs average natural flow was spilled over North Canal Dam.

In 1990 the Oregon Department of Fish and Wildlife applied for instream water rights for the Deschutes River and Tumalo Creek to increase flows to support fish populations hit hard by decades of poor flow conditions. The requested water right would allocate 250 cfs at North Canal Dam, and 32 cfs in Tumalo Creek at the Tumalo Irrigation District diversion, but would only provide for these flows after all senior water rights had been served. Into the 1990's, irrigation season flows hovered around 30 cfs.

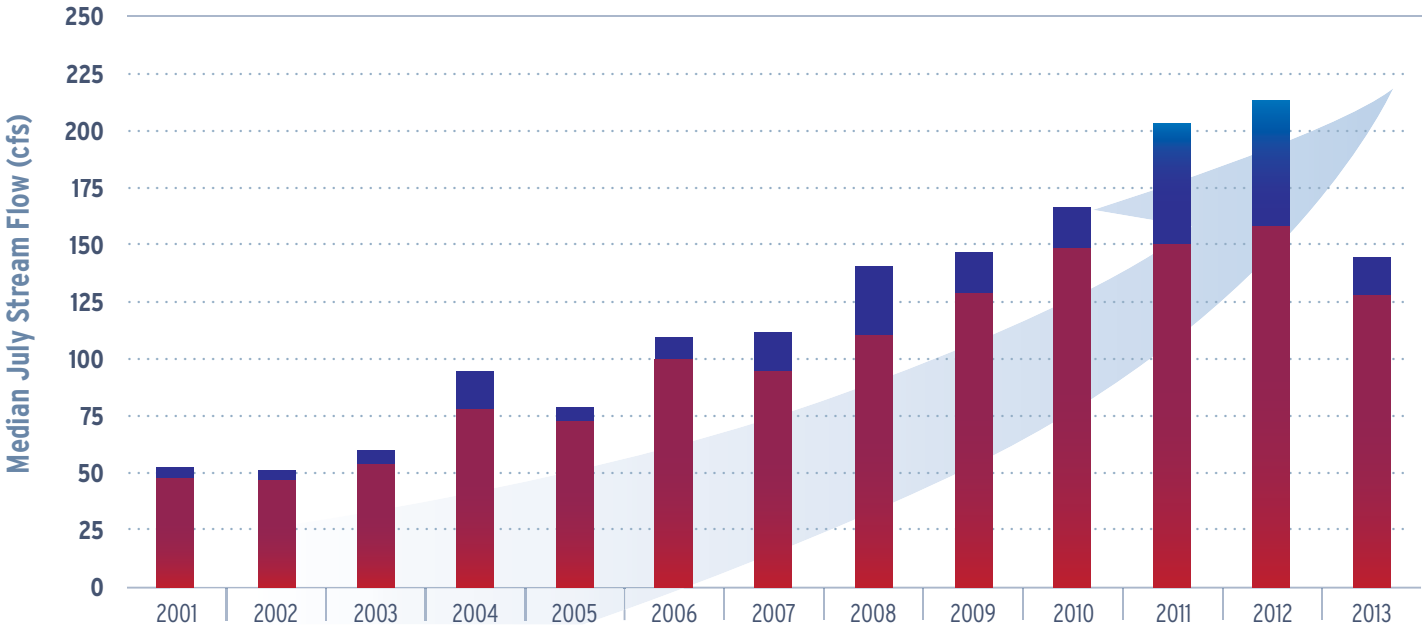
With the launch of stream flow restoration efforts by Deschutes River Conservancy in 1996, summer stream flows started to increase. Within a decade, over 100 cfs were protected instream in the Deschutes; by 2013 that number had climbed to 124 cfs, won through tremendous efforts and sustained collaboration on the part of irrigation districts, state agencies, and restoration partners. In Tumalo Creek, 20 cfs have been protected, and July flows now average 23 cfs. Higher flows have allowed restoration partners to better understand how flow restoration influences temperatures in the Deschutes.



Stream flow restoration at North Canal Dam leaves more water in the Deschutes, increasing habitat and contributing to cooler temperatures downstream.

Deschutes River & Tumalo Creek Stream Flow

Measured at North Canal Dam & below Tumalo Irrigation Diversion (2001-2013)



Deschutes River
at North Canal Dam

Tumalo Creek
below Tumalo Irrigation Diversion

Although stream flow varies with climate and weather patterns between years, stream flow restoration has resulted in an increasing trend in July flow over the last decade.

Stream Temperature

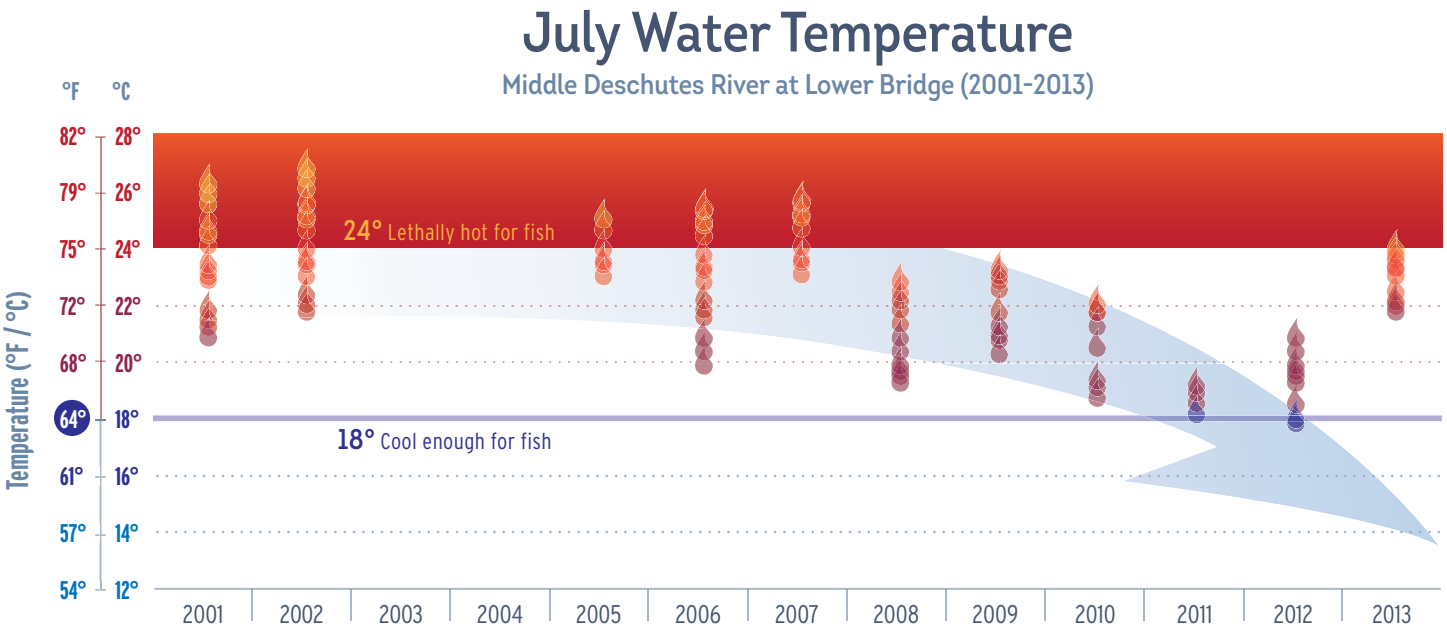
THE DESCHUTES RIVER AND TUMALO CREEK SPRING FROM THE HIGH CASCADES AS AN ABUNDANCE OF COLD, clean water ideal for redband and steelhead trout. Tumalo Creek cascades down from the Three Sisters Wilderness, flowing freely with no impoundments and minimal diversion, until a couple miles above the confluence with the Deschutes. The creek remains cold up to the point of diversion at River Mile 2.8, where the majority of the flow is diverted for irrigation. The water remaining below the diversion warms quickly, more so when flows are lower.

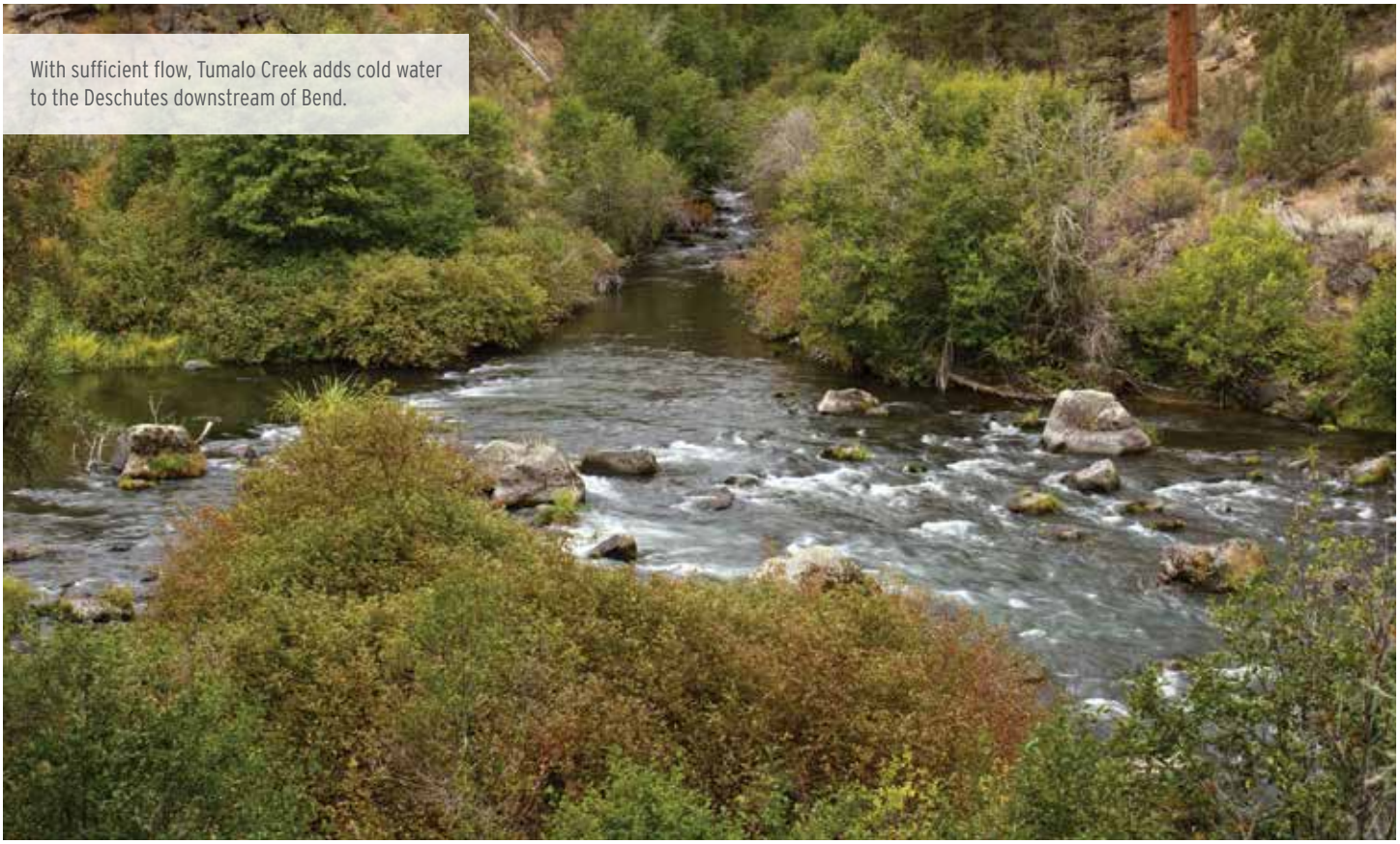
The Deschutes, unlike Tumalo, flows only a few miles from its headwaters before filling two consecutive reservoirs, Crane Prairie and Wickiup. Water stored during the winter is heated by summer temperatures. Flows released for irrigation from the reservoirs are cooled by tributaries upstream of Bend, but warm up again on the way downstream.

While redband trout are very hardy fish, they require relatively cool water. The State of Oregon has identified 18°C / 64°F as a maximum temperature standard to protect these fish. By the time the Deschutes River reaches Bend, stream temperatures are often already 18°C / 64°F or warmer. Thirty-two miles downstream at Lower Bridge Road, temperatures in the creek can reach or exceed 24°C / 75°F, conditions that are lethal for fish and are well above the state identified limit.

The relationship between water temperature and stream flow has been very well documented over years of study. Restoring flow on the Deschutes in Bend reduces the rate at which the water heats up as it flows downstream, and restoring flow in Tumalo Creek delivers cold water that actively reduces Deschutes temperatures. With consistent increases in summer flows since 2001, July temperatures at Lower Bridge Road have shown a marked reduction, but temperatures still exceed the 18°C / 64°F standard in low water years. (e.g. 2013)

New analyses show that restoring flow in Tumalo Creek can achieve a greater cooling effect than restoring the same amount of flow in the Deschutes. This information suggests a new approach to stream flow restoration that prioritizes increasing flows in Tumalo Creek. The continued progress in flow restoration is an important trend that will ultimately bring valuable benefits for the water temperature in the Middle Deschutes River.





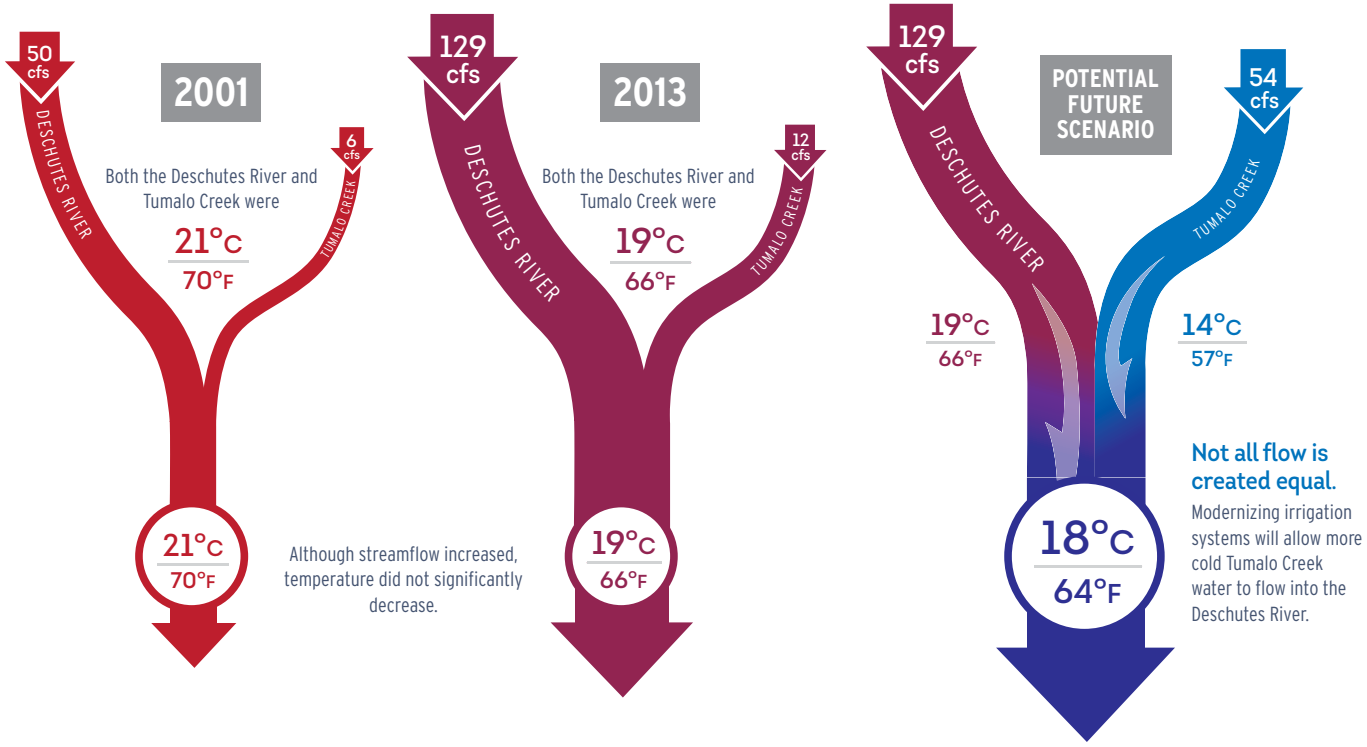
With sufficient flow, Tumalo Creek adds cold water to the Deschutes downstream of Bend.

Stream Temperature

At the Deschutes River-Tumalo Creek Confluence

What makes trout happy?

24°C 75°F	20°C 68°F	18°C 64°F	14°C 57°F
Lethally hot	Getting warmer	**Cool enough**	Nice & chilly



Not all flow is created equal.

Modernizing irrigation systems will allow more cold Tumalo Creek water to flow into the Deschutes River.

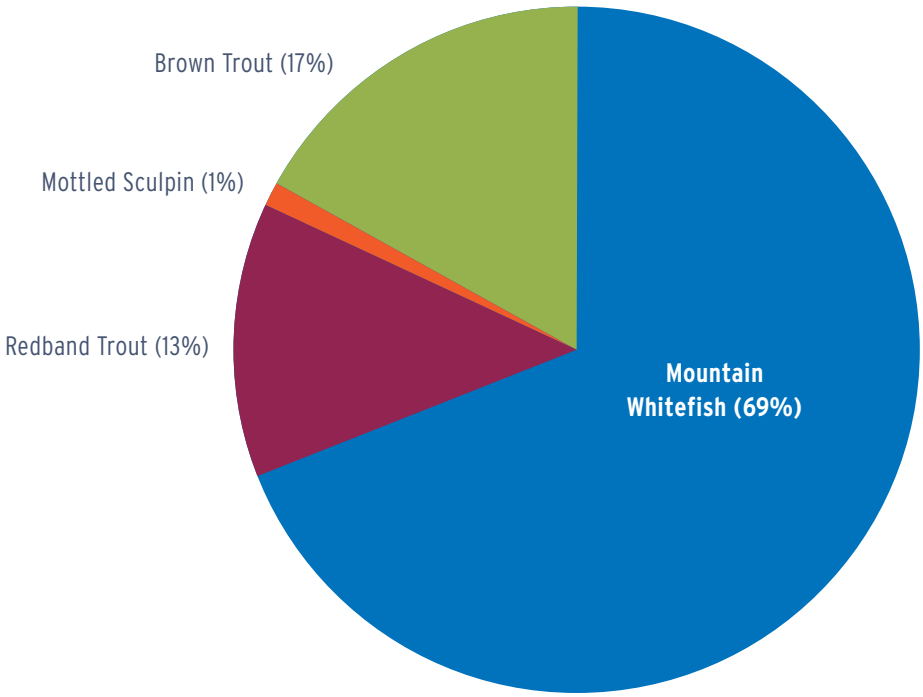
PHOTO **BRIAN HUDSPETH**

Fish Populations

THE CONCERTED EFFORTS OF RESTORATION PARTNERS ON THE MIDDLE Deschutes River aim to restore flow and water quality conditions that ultimately will support thriving native fish populations. But until recently, while changes in stream flow and temperature had been closely tracked alongside stream flow restoration, no information existed to evaluate how fish might be responding to changes in flow and temperature. The most recent data available on Middle Deschutes fish populations were from coarse-scale, qualitative surveys conducted in the 1980's.

Fish Populations

in the Middle Deschutes River (2013)



Mountain whitefish, a native species in the same family as salmon and trout, accounted for over 2/3 of fish captured in the Middle Deschutes as of 2013. Native redband and non-native brown trout together accounted for not quite a third of total captures. These two species have similar life histories and may have been similarly affected by the changes in stream flow and temperature that accompanied the advent of irrigation in the Upper Deschutes subbasin.

In 2012 Oregon Department of Fish and Wildlife, in partnership with the Oregon Watershed Enhancement Board and the Upper Deschutes Watershed Council, launched a five-year monitoring study to obtain new information about fish populations in the Middle Deschutes and to begin to describe how fish are using habitat in relation to temperature and flow conditions. Fish monitoring is showing that mountain whitefish, a native species in the same family as trout, is the dominant species in the Middle Deschutes, making up 70% of the fish recorded. Redband and brown trout were recorded in approximately equal numbers, each representing about 15% of the total fish count.

Very few large redband, and relatively few small redband or brown trout, were observed, in contrast to slightly higher numbers of medium-size redband, raising questions about what factors may be limiting large and small size classes for the two species, respectively. Two years of sampling and data analysis have allowed biologists to improve sampling techniques and the quality of the resulting data, which increases the amount of confidence restoration partners can put in what we are learning about fish populations.

Over the short term, fish data will show how native redband and introduced brown trout populations are faring, and in which reaches of the Middle Deschutes they are most abundant. Tracking fish outfitted with radio transmitters will show how widely individual fish range. Comparison of fish abundance (how many), distribution (where) and movement in relation to temperature and stream flow will provide information about where along the river temperature and flow conditions are best for fish and allow restoration partners to prioritize stream flow restoration actions accordingly. Over the long term, with sustained gains in stream flow and corresponding reductions in stream temperature, biologists may be able to show a connection between changes in stream conditions and healthier native fish populations.

PHOTO **BRIAN HUDSPETH**

To learn more about the restoration and monitoring discussed in this report:

UPPER DESCHUTES WATERSHED COUNCIL

VISIT www.RestoreTheDeschutes.org
WRITE PO Box 1812 Bend, OR 97709
CALL 541 382 6103

DESCHUTES RIVER CONSERVANCY

VISIT www.DeschutesRiver.org
WRITE 700 NW Hill St. Bend, OR 97701
CALL 541 382 4077