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SUMMER 2005

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The Friends of the Teton River is dedicated to understanding and improving ground and surface water resources in the Teton Basin, including the Teton **River, its tributaries** and wetlands. We will further this mission by conducting scientific research about the Teton watershed, effectively communicating this information to the public, and implementing on-the-ground improvement projects. In carrying out this mission we will actively cooperate and collaborate with all other groups, agencies and individuals working for the welfare of the Teton Basin.



# Hydrologic alteration in Teton Valley and its effect on cutthroat trout

BY ROB VAN KIRK Idaho State University

Five years ago, a large group of us attended the Teton River Forum, which ultimately led to the formation of FTR. The two dominant themes at this forum were hydrology and fish populations. In particular, we asked the questions:

1) How has the hydrology of the upper Teton River been affected by irrigation, especially by the change from flood to sprinkler irrigation that occurred in the 1960s? and

2) How do the river's fish populations respond to river flow?

With generous funding from FTR donor John Short, I and Amy Jenkins, now with Idaho Association of Soil Conservation Districts, set out to answer these questions. Here I provide a non-technical summary of our research. For details, refer to our full report, which is available from FTR or on the web at www.isu.edu/~vankrobe

### HYDROLOGY OF TETON VALLEY

Erosion of the mountains surrounding Teton Valley and deposition of eroded material covered the valley floor with a layer of cobble, gravel and finer sediments ("alluvium") that is as much as 1000 feet thick. This alluvium hosts the aquifer from which all residents and some farms in the valley get their water. This aquifer is highly conductive, meaning that water travels into and through it easily and quickly. Most water that enters this aquifer from the east emerges from springs located between Highway 33 and the





Tom Fenger, long-time fishing guide and FTR Board Member, taught local sixth graders fly fishing basics during Watershed Awareness Week.



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## CUTTHROAT <sup>IS From Page 1</sup>

Teton River and then flows into the river as surface water.

Trail, Fox, Darby, Teton and South Leigh creeks arise in the Tetons and display classical snowmelt-driven hydrology. These streams deliver very large peak flows during June and July but carry little water the rest of the year. Meanwhile, the spring creeks on the valley floor and the river itself, are dominated by ground water input, which results in relatively constant flow year-round. Our biggest research problem was to reconcile the large differences between the inputs to the valley's hydrologic system (snowmelt) and the outputs (ground water).

### **METHODS**

We refer to the actual hydrology of the system, as influenced by irrigation, as the "regulated" hydrology, and to the flow patterns that would be present in absence of irrigation and other human influences as the "natural" hydrology. Because no flow records exist for the Teton River prior to irrigation, we estimated natural flow by taking regulated flow, adding back in the known amount diverted for irrigation, and then subtracting the amount of this diverted flow that returns to the river. Essentially all of this return flow travels through the aquifer, so we constructed a mathematical model of surface and ground water flow that accounted for recharge into the aquifer from canal seepage, natural stream seepage, precipitation, and, in the case of flood irrigation practices, from application of water onto the ground. Once we calculated natural flow, we compared it to regulated flow under both sprinkler and flood irrigation practices. Lastly, we analyzed statistical relationships between flow and trout population variables.

### **RESULTS AND DISCUSSION**

About 50% of the annual flow of Teton Valley tributary streams is diverted for irrigation. Our model predicts that the total amount of water discharged from the springs on the east side of the river is greater with irrigation than under natural conditions (Figure 1). This is because delivery of irrigation water through the canal

system creates more surface area contact between surface water and the aquifer than if all of the surface water were left in natural stream channels, resulting in more recharge to the aquifer, and subsequently, more ground water discharged from the aquifer. About 35% of the surface water withdrawn from Teton Valley tributaries for irrigation returns to the river via the aquifer. Additionally, under flood irrigation practices, about 50% of the water actually applied to the ground was returned to the river via ground water flow. When irrigation began in the late 19th century, the amount of water reaching the river as surface flow in streams

About 50% of the annual flow of Teton Valley tributary streams is diverted for irrigation...

Under current irrigation practices, spring and early summer flows in the **Teton River** are about 35% lower than natural, and winter flows are about 35% greater than natural.

decreased, and the amount of water flowing through the aquifer increased. The switch to sprinkler irrigation reduced flow through the aquifer somewhat, but even under the current sprinkler irrigation system, spring discharge is greater than under natural conditions (Figure 1).

The primary effects of irrigation on the hydrologic regime of the Teton River have been decreased flow due to diversion of surface water during the summer irrigation season and increased flow during the late summer, fall, and winter due to return flow through the aquifer (Figure 2). These effects were greatest under flood irrigation practices but are statistically and ecologically significant under sprinkler irrigation practices. Irrigation, in addition to removing some water from the system to support crops, has decreased the amount of water flowing through streams and increased the amount flowing through the aquifer, thus shifting the hydrologic regime from one dominated by runoff to a much more constant one dominated by ground water. The natural hydrologic regime of the upper Teton River closely resembles that of the upper Snake River, which drains similar topography and geology on the east side of the Teton crest. The regulated Teton River more closely resembles the Henry's Fork, which is dominated by ground water flowing from the base of young lava flows on the east side of the Yellowstone Plateau. Under current irrigation practices, spring and early summer flows in the Teton River are about 35% lower than natural, and winter flows are about 35% greater than natural. This, in a nutshell, answers question number 1.

The answer to question 2 is more complicated. At the discussions five years ago, the general consensus of those who have been around for many years was that the switch to sprinkler irrigation had decreased late summer river flows, thereby reducing fish habitat and the number of trout in the river. There was also some general agreement that the big peak flow of 1997 scoured aquatic vegetation from the river, resulting in further loss of trout habitat and loss of aquatic insects that live on this vegetation. A common hypothesis was that if late summer flows were higher and early spring peak flows were lower, conditions would be more favorable for trout. and as a result. many people favored a return to flood irrigation practices in Teton Valley to help make flows more constant year-IN CONTINUED ON PAGE 7



FIGURE 1. Modeled total discharge from Teton Valley springs on the east side of the river.



FIGURE 2. Mean hydrographs for the upper Teton River under natural conditions, flood irrigation (regulated 1930s-1950s), and sprinkler irrigation (regulated 1988-2000).



FIGURE 3. Percentage of Yellowstone cutthroat in the upper Teton River trout population as a function of maximum/minimum discharge ratio.



Linsey Hayes and kids got slimy with trout anatomy.



Kids got their hands dirty with NRCS soil scientist Brad Duncan.

Kim Kaiser taught groundwater principles and helped students build their own ice cream aquifer.



# Boys & girls " Teton River

Boy and Girl Scouts joined Anna Lindstedt, FTR Education Director, in the month of April to "scout" their watershed. The April theme for the Boy Scouts of America was "Waterways of the U.S.A." A first and second grade Cub scout troop from Alta, WY collected macroinvertebrates on Teton Creek and learned the importance of keeping their watershed clean for the health of even the tiniest bug found there. Driggs, ID girl scout troop #285 joined Anna in Teton Canyon to identify macroinvertebrates and other riparian wildlife, like the water ouzels they saw diving into the creek. Afterwards, the girls volunteered their time to collect trash and clean up the Rainey Access site on the Teton River. The six girl scouts earned an Earth Connections and Eco-Action badge for their hard work and dedication to learning.

### WATERSHED CURRICULUM UPDATE

The Teton Watershed Curriculum is now in the review process and drafts have been distributed to qualified Teton Valley teachers, the Teton Science School, Grand Targhee Institute, and the Teton Valley school district. The FTR Education Director will finalize the curriculum this summer and offer teacher workshops in the fall to implement lesson plans for the field and the classroom.

### Project A.W.A.R.E. Awards Education Grant

Anna was awarded a \$995 grant from the Project AWARE Foundation for the purchase of hands-on interpretive resource materials to enhance FTR's educational programming. These in-classroom resources include a groundwater model and macroinvertebrate dichotomous keys. Teachers will be able to utilize these resources in conjunction with the Teton Watershed Curriculm in 2005-6 school year. In the future, FTR hopes to provide educators in Teton Valley and the region with more quality learning tools for their classrooms.

### **CLASSROOM UPDATE**

More projects than ever were "tackled" by Teton Valley students in the classroom this winter and spring. Sharon Gusa's fourth graders are watching Henry's

# Scouting" the watershed

Lake Yellowstone Cutthroat Trout grow via the troutin-the-classroom program sponsored by Trout Unlimited. The Education Director taught numerous labs including a pH and water quality lab at the middle school level. Anna also prepared high school students for the Idaho Envirothon competition in Challis; presenting how changing land use practices impact aquatic ecosystems.

### WATER AWARENESS WEEK

On May 11-12, Teton Valley sixth graders joined Friends of the Teton River and over 14,000 other students across the state of Idaho who participated in Water Awareness Week activities. About 100 students braved the rainy weather to learn about the importance of water to their community and environment from the experts. This year's stations focused on water and the life it supports, including riparian wildlife, plants, soils, and fish taught by representatives from the U.S. Forest Service, the Natural Resources Conservation Service, Idaho Fish and Game, the Idaho Department of Environmental Quality and FTR. New this year, and a hit with the kids, was a fly casting station taught by Quincy Liby of World Cast Anglers and Tom Fenger and Brian Berry of the Teton Valley Lodge. Thanks to all the experts and volunteers for making Water Awareness Week a success!



Anna teaches Boy Scouts about aquatic insects.



Girl scouts explore and earn a badge on Teton Creek.



Sara Sams, right, and FTR Secretary Phyllis Anderson, left, helped teach sixth graders about plant identification during Water Awareness Week.



Anna holds up a mayfly for kids to identify.

## Successful grants lead to a project packed summer

#### BY BONNIE SELF

Friends of the Teton River is excited to report the results of a successful grant writing campaign this past winter. With allocated funds, FTR is gearing up for continued fundraising efforts

and a project packed summer. Below is a summary of foundations, governmental entities and nonprofit organizations that will help make summer 2005 projects possible. We sincerely thank them all for their support and generosity.

**Teton Creek Restoration.** FTR has received a total of \$30,200 from the Arthur B. Schultz Foundation, Trout Unlimited Embrace-a-Stream, Idaho Fish and Wildlife Foundation and the National Fish and Wildlife One Fly Foundation to complete restoration work on Teton Creek, an important tributary for the native Yellowstone cut-throat trout (YCT).

**Teton Headwater Tributary Assessment.** With Mike Lien, FTR Research Associate, heading the project, FTR has hired 5 temporary staff to assess the fish populations in the headwater tributaries in the National Forest. Since the YCT have experienced a drastic decline in the main stem of the Teton River, FTR feels that YCT populations in the tributaries could be vitally important to persistence of the species in the upper Teton watershed. FTR received a wide range of grants totaling \$52,000 from the National Fish and Wildlife Foundation General Matching Program,

### THANK YOU to the following members, donors and foundations for their generous contributions during March, April and May, 2005.

Bank of Jackson Hole Amanda & Thomas Bryan Community Foundation of Jackson Hole Allan & Laurie Crary Jeff & Marissa Cushman Skip Dempesy & Kathie Martin Gary Edington & GJE Realty, Inc. EPA Regional Geographic Initiative Federation of Fly Fishers Mr. & Mrs. Peter Fenger Alice & John Finley Lou Gaylord Geordie & Kim Gillett Grand Targhee Ski Resort Richard Hokin Debbie Hunter Idaho Department of Environmental Quality	Jackson State Bank & Trust Kathy Johnson Jorgensen Architects Bill Kelly Jeff & Darcy Klausmann Lyle Kunz Joanne LaBelle Richard W. Lewis Mike Lien Dave Luebbe James Mataisz Richard Miller Terri Mitchell National Forest Foundation Walter Paskey Daniel Paruso John & Kristy Pehrson Henry Phibbs & Leslie Peterson Michael Potter	Laura Rogers Charlie & Bo Ross Brooke & Donn Saindon Katie & Baker Salsbury John Short, Ph.D. John & Nancy Siverd Snake River Cutthroats Sotheby's International Realty Community Service Fund Georgie Stanley Andy Steele Targhee Institute Environmental Foundation Teton Telecom Erica Tremblay Trout Unlimited Western Water Project Ms. Gayle Valentine William A. Ward Drick Wicherson & dt
Environmental Quality	Michael Potter	Mr. Robert R. Ward
Industries Foundation	Janna Rankin & Art Frakt	Clair Yost

Matching donations sought Snake River Cutthroats, Federation of Fly Fishers, Community Foundation of Jackson Hole, Targhee Institute Environmental Foundation, Teton Valley Trout Unlimited, National Forest Foundation, and Henry's Fork Watershed Coun-

cil to hire the assessment crew. This project is being completed in partnership with the U.S. Forest Service, who is contributing expertise, equipment and vehicles.

Water Quality Testing. FTR will complete its fourth summer of water quality testing with \$15,450 of funding from the Teton Conservation District in Wyoming, Idaho Department of Environmental Quality (DEQ) and Teton Telecom. The water quality data is vital to determining water quality trends over time and identifying pollutants of concern.

**E. coli Sourcing.** FTR received a \$10,000 grant from the EPA Regional Geographic Initiative to fund lab analysis to determine the source of E. coli bacteria in Woods Creek. FTR will involve the Teton Regional Land Trust, District 7 Health, City of Driggs and Victor, Teton County Idaho, Idaho DEQ, Environmental Protection Agency, Teton Soil Conservation District, Natural Resources Conservation Service and private landowners in all stages of the process.

**Irrigation Diversion Study.** With a FRIMA grant of \$7,000, FTR will assess the status of irrigation diversions in the upper Teton watershed and use the data to improve fish passage.

**Education.** With a Donald C. Brace Foundation and EPA Education grant totaling \$18,700, FTR hired an education director to write a local watershed curriculum, teach in classrooms and provide field trips for students and adults. With Project AWARE and EPA Education dollars of \$5,000, FTR has purchased an interactive groundwater model as well as boots, kicknets and thermometers to be used by local students. With a Scheid scholarship, FTR has chosen two Teton High School students to work with FTR on all the above projects.

Though FTR has received several grants this winter, we are currently requesting individual donations to complete project financial goals. Since a majority of governmental grants require matching contributions, membership and donor dollars can help meet these needs. FTR believes that a diversified stream of revenues is vitally important for a financially healthy and successful nonprofit. If you would like to assist with any of the above projects by donating volunteer time or project dollars please contact Bonnie Self at 208-354-3871. Any assistance in protecting the Teton watershed would be greatly appreciated.

## CUTTHROAT IN From Page 3

round. These ideas all turn out to be correct if we consider only nonnative rainbow and brook trout. It is no coincidence that the most celebrated trout fisheries in the world are those in rivers with very stable flow regimes resulting either from regulation at dams or from natural input of ground water. Decades of research have shown that stable year-round flows benefit rainbow trout populations and that in these stable systems, aquatic vegetation plays an important role in providing trout cover and food. There is little doubt that managing surface and ground water to maintain



Douglas Self, Driggs City Planner, volunteers at FTR's fourth annual River Cleanup. Thanks goes to Teton Telecom and all the FTR volunteers who helped beautify the valley.

a more constant, ground water-dominated hydrologic regime in the Teton River would sustain a larger, more stable population of nonnative brook and rainbow trout.

However, when it comes to native cutthroat trout, the conclusion is just the opposite. Extensive research I have done on the South Fork Snake shows that cutthroat trout have a competitive advantage over rainbow trout only when peak flows are high relative to previous winter flows (high maximum/minimum discharge ratio). We found this same relationship in the Teton River (Figure 3 on Page 3). Higher values of the maximum/minimum ratio are typical of runoff-dominated streams, and lower values are typical of ground waterdominated streams. Across the entire upper Snake River basin, rainbow trout have not displaced cutthroat in any stream reach with a maximum/minimum ratio exceeding 14.5, and cutthroat do not dominate any streams with a maximum/minimum ratio less than 10. Mean maximum/minimum ratio in the upper Teton River averaged 19.0 under natural conditions and 10.6 currently. Low maximum/minimum ratios in the years following the 1997 high flow event have allowed rainbow and brook trout to recover. while cutthroat numbers have plummeted.

There are a number of reasons why low maximum/minimum ratios favor rainbow over cutthroat, most resulting from differences in spawning and rearing behavior between the two species. Furthermore, shift in hydrologic regime from one dominated by surface water to one dominated by ground water alters physical processes in the stream channel and flood plain to create a stream with less complex habitat structure, less woody riparian vegetation, higher width-to-depth ratios and a greater dependence upon aquatic vegetation to provide trout and insect habitat. Although these characteristics are typical of ground water dominated systems, they do not favor cutthroat trout when nonnative trout are present.

#### CONCLUSION

If the management objective for the upper Teton River is to maintain large populations of brook and rainbow trout, then a return to flood irrigation is likely to be just the ticket. However, this would drive the hydrologic regime further away from one that will favor cutthroat trout. Recovering cutthroat trout in the upper Teton River will ultimately require restoration of the valley's runoff-dominated hydrologic regime.

### IS VOLUNTEERS WANTED!

FTR NEEDS SHERPAS! We'll be conducting an assessment of Yellowstone cutthroat trout populations in Teton tributary streams this summer. Part of the summer the crews will have to camp out in the high country and that's where our volunteer sherpas come in. We will have a lot of equipment to carry, as well as camping gear, so we need folks to help pack it in. We'll be going in on Monday with the crew and carrying gear to their camp (and then hiking out on the same day). On Thursday we'll hike in and help them carry out the gear. If you'd like to help give Lyn or Mike a call at 354-3871.

# Annual Meeting, River Party & Auction will be held July 9 Help FTR celebrate five years

Please join Friends of the Teton River for our 5th year celebration at the Annual Party and Auction on July 9, 2005 from 6-9 pm. Share an evening of music, food and fun with friends by the beautiful Teton River at a property south of the Teton Valley Lodge. Celebrate successes and hear about FTR's exciting upcoming projects. Bid on auction items including a drift boat, fly rod, fishing trips, dinner party, artwork, bluegrass tickets and much more. Cost is \$15 per person or \$25 per couple and kids are free. Membership, which is vital to all our work. is included. Tickets can be purchased at the FTR office at 36 East Little Avenue in advance or at the door. Please call Bonnie at 354-3871 with any questions, or to get directions. We sincerely hope to see you there!



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