Spring of 2015 Third Driest in 80 years

By Rob Van Kirk, HFF Senior Scientist, and Christina Morrisett, HFF intern from Stanford University

If you arrived on the Henry's Fork in late May or early June this year, you may not have realized that the watershed was experiencing a drought as bad as any since the Dust-Bowl years of the 1930s. The weather was cool and wet, vegetation was lush and green, and reservoirs throughout the upper Snake system were full. But only a few weeks later, 1600 cfs of irrigation water was being released from Island Park Reservoir, and lower Fall River had been reduced to a trickle.

In the weeks following Henry's Fork Day, we were inundated with phone calls about the water situation: "Why is so much water being released from Island Park Reservoir?" "The irrigators are taking more than their share." "Fall River has no water in it." And, nearly every day, we would receive a call from Fremont-Madison Irrigation District alerting us to yet another increase in delivery out of Island Park Reservoir.

What happened?

On the Henry's Fork, where nearly every drop of water belongs to a water right, streamflow is a balance between supply and demand. Supply comes from the natural flow of springs and streams at higher elevations, and demand comes from irrigation in the lower elevations. Water is diverted from the lower Henry's Fork and Fall River as needed for irrigation, up to the amount legally allowed under water rights. When natural flow cannot meet demand, storage is released from upstream reservoirs, but only enough to deliver water to the downstream-most user. The result is that streamflow will be very high between Island Park Reservoir and Ashton but very low downstream of St. Anthony. Somewhere in between, streamflow is "just right." On Fall River, the same principle applies, but the much smaller amount of storage there means that streamflow at a given point on the river is essentially just the difference between natural supply and cumulative diversion upstream.

In 2015, natural inflow to the upper Henry's Fork during April, May and June was the 3rd lowest since 1934 (top panel of Figure 1). Spring-time runoff was lower only in 1934 and 1977. Natural streamflow was low all winter, but still higher than that in 25% of all water years (bottom panel of Figure 1). In late March, melt of a near-record low snowpack resulted in streamflow that was actually above-average, but only because snowmelt occurred so early, not because the amount of runoff was large. By mid-April, natural flow fell back to the 25th percentile, and by mid-June, flow was lower than that in all but the driest years on record. The situation on Fall River was similar (top panel of Figure 2).

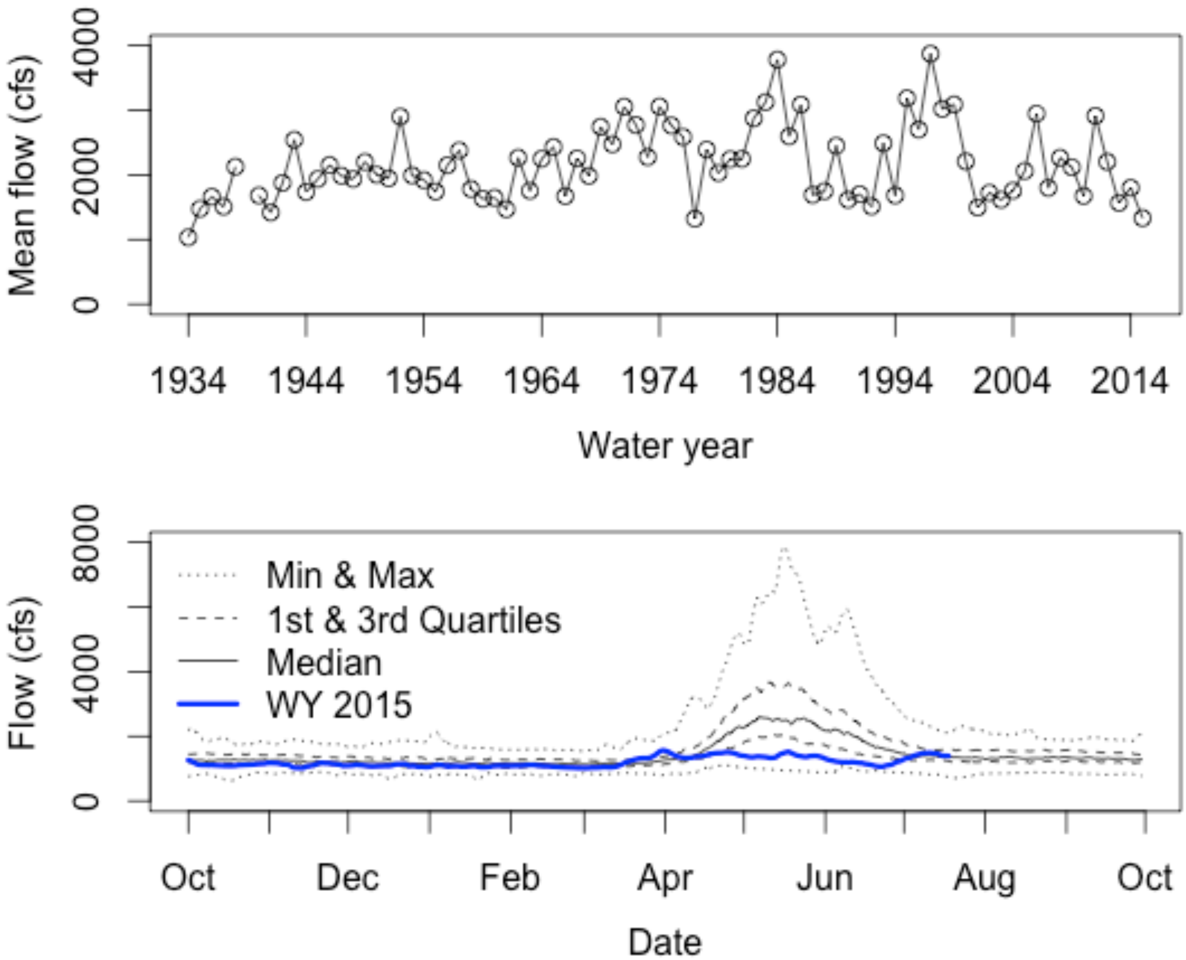
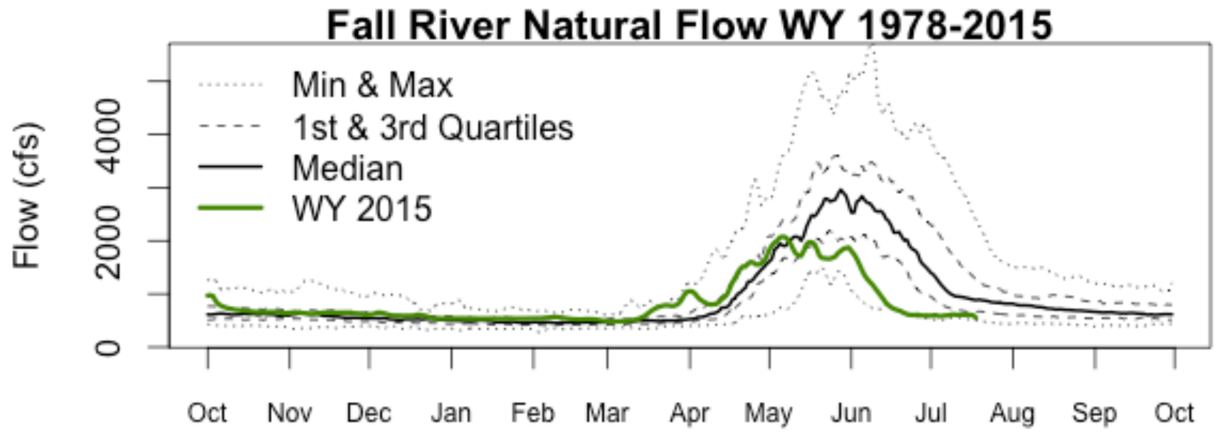


Figure 1. Natural inflow to the Henry's Fork between Henry's Lake and Ashton for water years 1934-2015 (water year 1939 is omitted because of data limitations). Top panel shows mean April-June flow, by water year. Bottom panel shows daily flow for water year 2015 in comprison to statistical summaries for all water years.



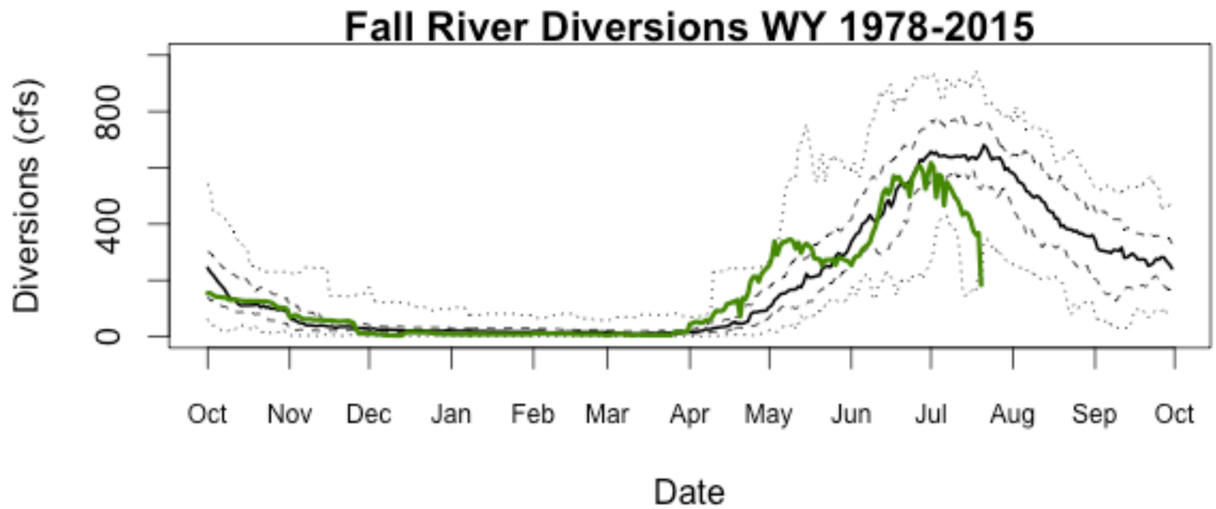


Figure 2. Top panel shows daily flow for water year 2015 in comparison to statistical summaries for all water years within the 1978-2015 period. Bottom panel shows daily diversions.

What does spring-time runoff tell us about the total annual water flow? A simple linear regression shows us that mean spring-time runoff is a strong predictor of total flow for the whole water year (remember that the water year runs from October 1 through September 30; see Figure 3). Variability around the line is due to the relationship between the previous and current water year. Points above the line are years when total water-year flow was higher than expected based on spring runoff and points below the line are years when total water-year flow was lower than expected based on spring runoff. The Henrys Lake to Ashton Dam reach is primarily groundwater fed, especially during the winter. As a result, winter flow – what hydrologists call "baseflow" – is dependent on precipitation during the previous year. For instance, if the previous year is wet, there is more groundwater available for the following water year's winter flow; if it's dry, there is less available. As a result, if a high-runoff year follows a dry year, total water-year flow will be a little lower than predicted by runoff alone, because flow between October and April was low. These are the points below the regression line. On the other hand, if a low-runoff year follows a wet year, then total water-year flow will be higher than predicted by runoff alone. These are the points above the line.

Regardless of the small variability around the regression line, it predicts that 2015 is on track to being one of the driest on record.

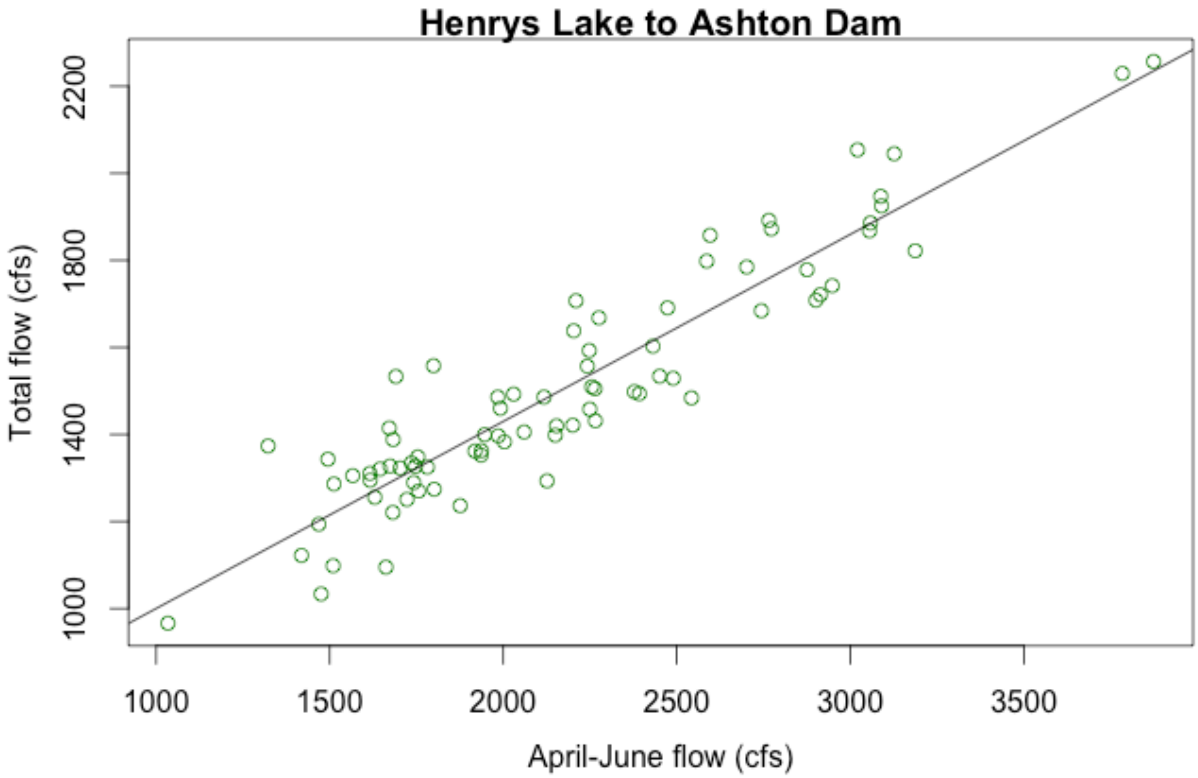


Figure 3. Linear regression of total annual flow between Henry's Lake and Ashton Dam versus April-June flows in the reach.

As for demand, the warm, dry spring allowed farmers to plant crops nearly a month earlier than usual, resulting in high irrigation demand in April (bottom panel of Figure 2). The early snowmelt was sufficient to meet this demand without need for reservoir releases. Then, just as the snowmelt was receding in early May, a month of rainy weather reduced irrigation demand substantially. This allowed reservoirs to fill—not because supply increased but because demand decreased. As soon as the rain quit in early June, demand increased at the same time that supply was decreasing. This occurs every year, but usually not until July. As a result, delivery of storage water from Island Park Reservoir began about three weeks earlier than average. The amount of delivery – about 1600 cfs – was not abnormally high for the middle of irrigation season, but it was extremely high for June, prompting many of the calls we received (Figure 4).

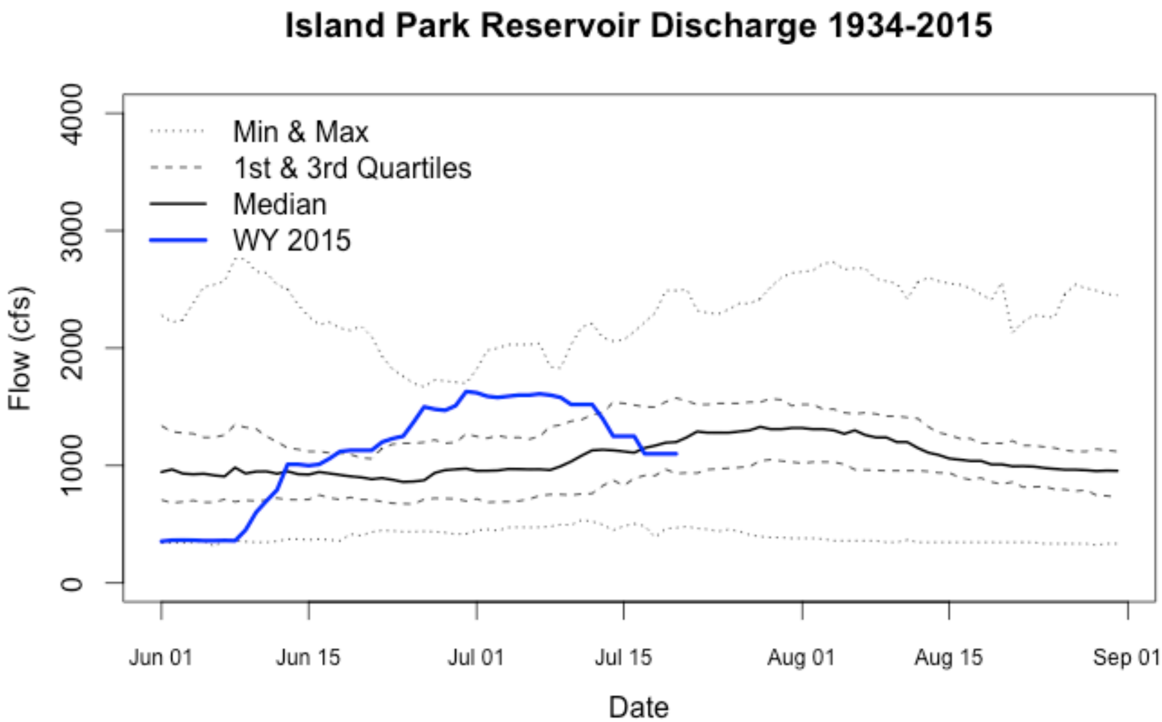


Figure 4. Discharge from Island Park Reservoir for water year 2015 in comparison to a statistical summary for all water years in the 1934-2015 period.

Meanwhile, on Fall River, demand used 100% of supply. Irrigation diversions were at their average for the month of June, but supply was near record lows (Figure 2). Only a release of 75 cfs from Grassy Lake kept a little water in the lower few miles of the river. Again, this is a routine occurrence during below-average water years, but this year it occurred about one month earlier than usual. In the lower Henry's Fork, demand increased faster than releases from Island Park Reservoir could keep up, and streamflow dropped to near-record lows for a few days at a time downstream of St. Anthony.

Fortunately, the hot, dry weather lasted for only a few weeks, and on July 5, cooler temperatures and rain showers lowered demand (bottom panel of Figure 2) and slightly increased supply. Additionally, early planting led to early ripening, halting irrigation of most grain crops several weeks earlier than normal. By mid-July, irrigation delivery from Island Park Reservoir had dropped substantially (Figure 4), and streamflows throughout the lower part of the watershed returned to average.

Climate-change models predict less snow, earlier runoff, and warmer temperatures for the Henry's Fork region. We have experienced all of these conditions during each of the past three years, although it is impossible to link specific conditions in any particular year to climate change. In fact, our analysis of several different hydrologic variables has failed to yield any significant trends other than greater year-to-year variability. Nonetheless, if years like this are an indication of the future, HFF and its partners are going to have to develop and implement new strategies for managing our rivers and fisheries if we are going to maintain the wild trout angling opportunities we have come to expect. The framework for some of these strategies has already been developed through the Henry's Fork Basin Study, and we will continue to pursue those strategies that appear to hold the greatest opportunity for maintaining wild trout in the face of a more highly variable climate.