Henry's Fork Foundation Research Summary

HFF Annual Meeting, June 19, 2015
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Topics

1. Habitat use by adult rainbow trout in Harriman State Park
2. Water-quality monitoring
3. Flow fluctuations downstream of Ashton Dam
4. Aquatic macroinvertebrate study
5. Harriman State Park angler survey: 2014 vs. 2008
6. Water supply

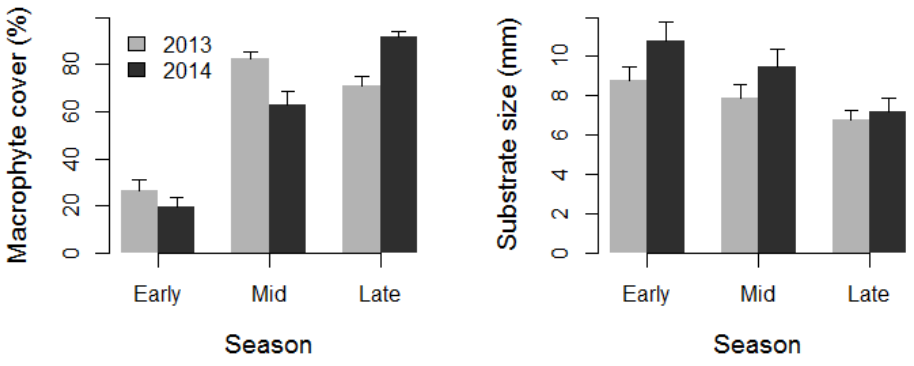
Habitat Use by Adult Rainbow Trout in Harriman State Park

Study overview and previous results

- Study is being conducted by Zach Kuzniar for his master's thesis at Grand Valley State University.
- Objectives are to 1) quantify habitat in Harriman State Park reach, 2) describe how habitat changes through the fishing season, and 3) assess micro-habitat selection by adult rainbow trout.
- Field work was conducted in 2013 and 2014; thesis and other publications will be completed this fall.
- Macrophytes (rooted aquatic plants) determine habitat in HSP and increase in cover through season.
- Macrophytes slow current velocity, increase depth, increase dissolved oxygen, and trap fine sediment.

New results on micro-habitat selection

- In both years, fish showed primary preference for deeper water. Odds of fish presence doubled for every one-inch increase in water depth.
- In 2013, when mid-season macrophyte cover exceeded 80% (see figure below), fish showed a secondary preference for areas with less macrophyte cover. Odds of fish presence decreased by a factor of 5 for every 10-percentage-point increase in cover. Because substrate size was inversely correlated with macrophyte cover and fish selected less cover, substrate size was incidentally larger at fish locations.
- In 2014, when mid-season macrophyte cover was only around 60%, fish showed no particular preference for or against any habitat characteristic other than deeper water.
- Abundant macrophytes are critical to providing preferred trout habitat (deeper water) in HSP.
- However, when macrophytes are especially abundant and water depth is high, fish appear to select localized areas of lower macrophyte cover, possibly to take advantage of feeding opportunities.



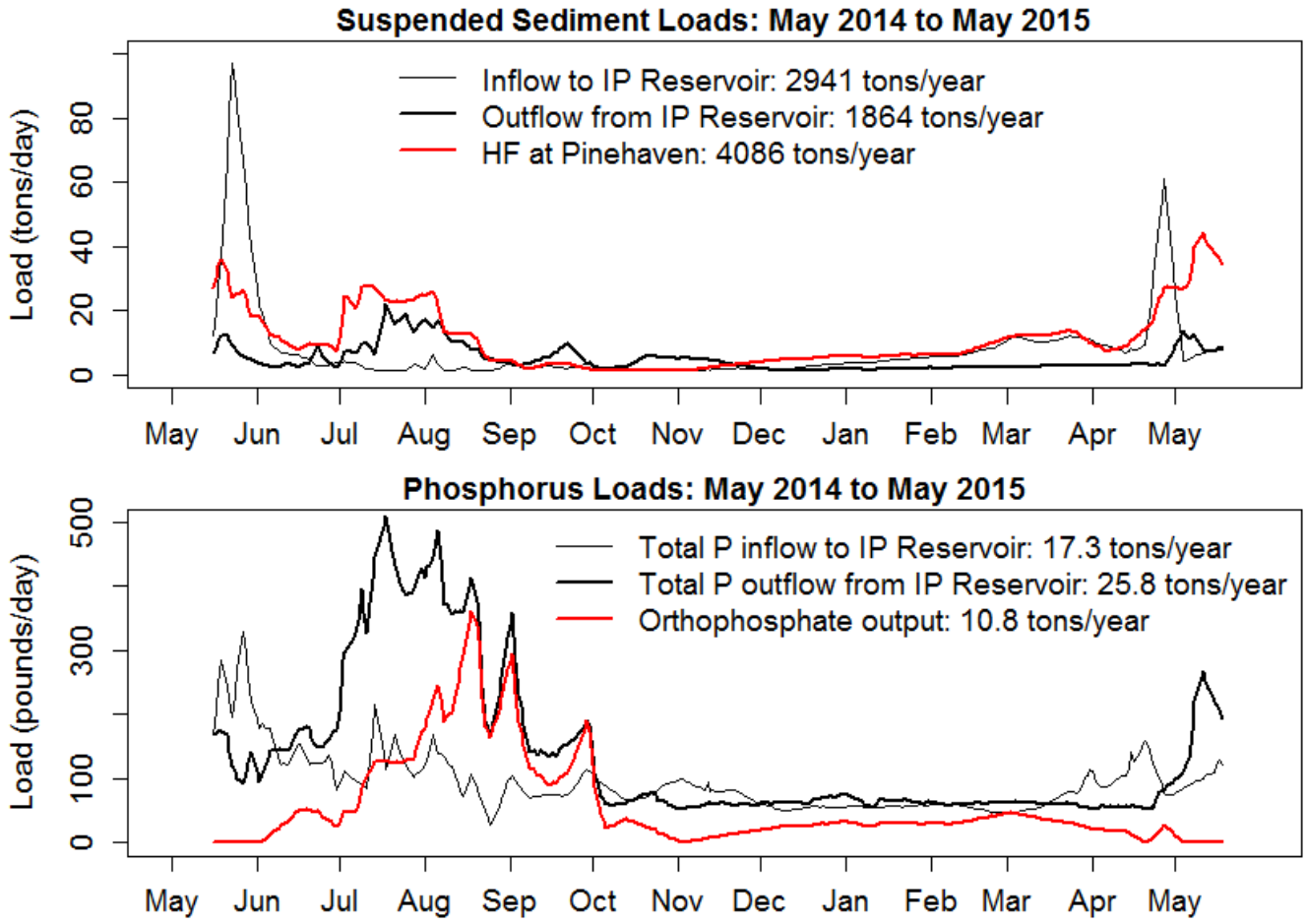
Water-quality Monitoring

Long-term network

- We have one full year of data from Flatrock, Sheridan Cr., Island Park Dam, and Pinehaven.
- Sampling sites recently added: Marysville Bridge, Ashton Dam, St. Anthony, and Parker-Salem Rd.
- We are measuring suspended sediment, total phosphorus, orthophosphate, temperature, dissolved oxygen, total dissolved solids, chlorophyll, blue-green algae, turbidity, and river depth.

Major results to date

- Water quality is optimal for trout survival at all locations, with the exception of low dissolved oxygen immediately downstream of Island Park Dam.
- Aquatic system productivity is greatest between Island Park Dam and Pinehaven, followed by Warm River to Ashton reach, but phosphorus concentrations below IP Dam can exceed recommended values.
- During 2014/2015, IP Reservoir stored 1077 tons of suspended sediment. Suspended sediment load at Pinehaven over twice that at IP Dam, possibly because of net export from Harriman reach when macrophyte biomass is low (winter, spring, early summer).
- During 2014/2015, release of phosphorus from IP Reservoir exceeded inflow by 50%; possible explanations are 1) unmeasured inputs of phosphorus directly into the reservoir itself and 2) release into water column of phosphorus stored in reservoir-bottom sediments.
- Inorganic ("ortho") phosphate was 42% of total phosphorus export over year and was majority of phosphorus export during late summer, suggesting release of phosphorus from reservoir sediments.



Flow fluctuations downstream of Ashton Dam

- Fluctuations in flow downstream of Ashton Dam are of concern to anglers, fishery advocates, and irrigators. Stable flows no lower than 1000 cfs are desirable for irrigation diversion and fish habitat.
- River stage data collected upstream of Ashton Reservoir at our Marysville water-quality station were compared with stage at USGS gage station downstream of dam.
- Daily cycles in river flow of roughly 300 cfs originate in the Harriman State Park reach of the river and are caused by daily cycles of macrophyte photosynthesis and respiration (Fig. 1).
- The vast majority (97.37%) of variability in flow below Ashton Dam was due to variability in inflow (Fig. 2). The remainder was due to systematic daily cycles (0.094%), 75-minute temporal persistence (tendency for flow to remain constant for 75 minutes at a time, 1.78%), and random noise (0.765%).
- Stage downstream of Ashton Dam was systematically lower than that upstream by about 0.2 inches in the morning and higher by that same amount in the afternoon, although this daily cycle accounted for 3.6% of total variability in the stage differences and only 10% of the total amplitude of cycles.
- Observed daily cycles in flow would have negligible effect on river flow or ecology under unregulated flow conditions, but under regulated conditions, when 50% or more of the river's flow is diverted between Ashton and St. Anthony, these cycles result in flow dropping below 1000 cfs for several hours each day, even when mean flow remains well above 1000 cfs (Fig. 3).
- During the 2014 analysis period, flow fell below 1000 cfs at St. Anthony for 178 hours, whereas the 24-hour moving average of flow fell below 1000 cfs for only 38 ¾ hours during the same time period.
- Smoothing outflow from Ashton Dam would benefit irrigators and fisheries but would require operation of Ashton power plant outside of its authorized "run-of-river" mode.

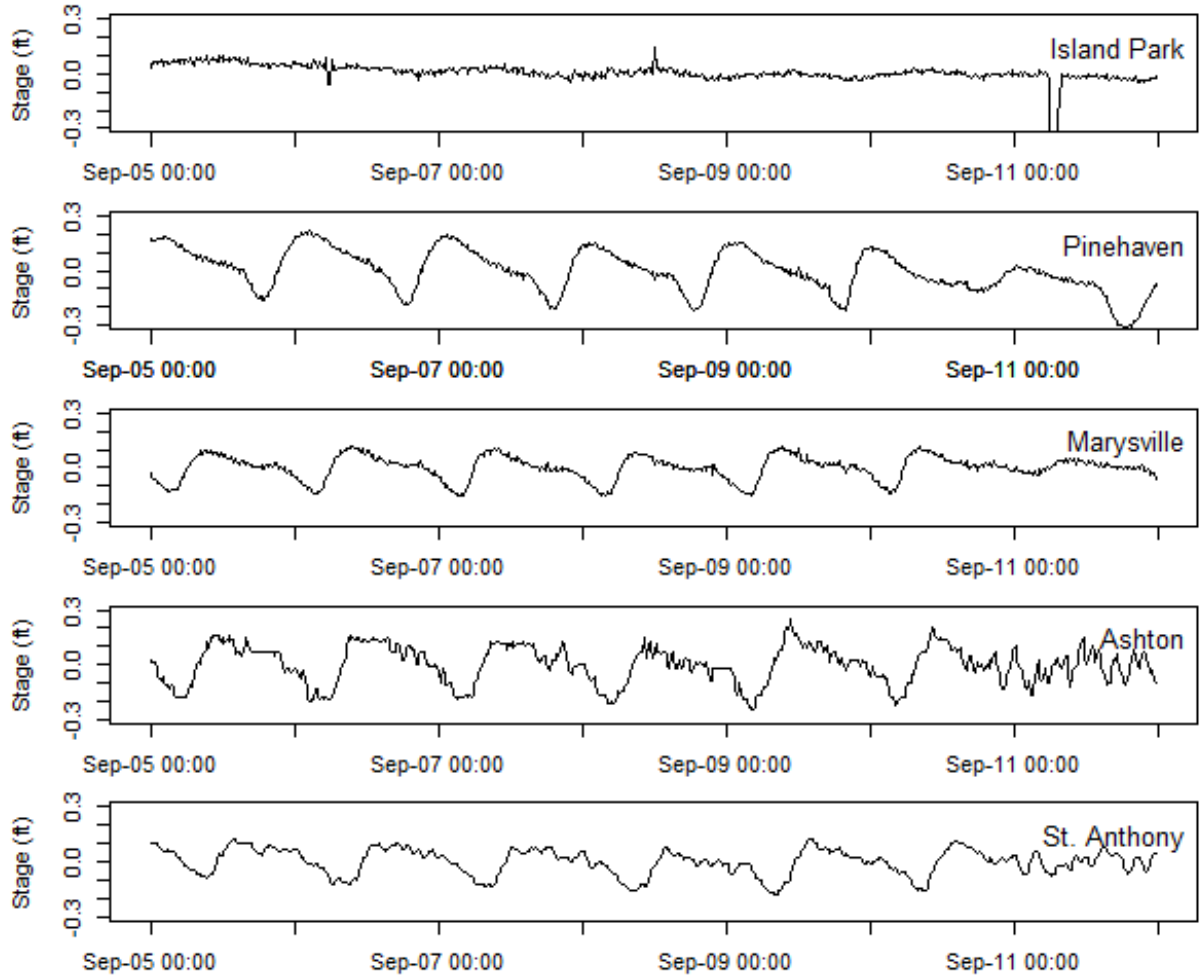


Fig. 1. River stage (relative to mean) at six locations on Henry's Fork, Sept. 5 – Sept. 12, 2014.

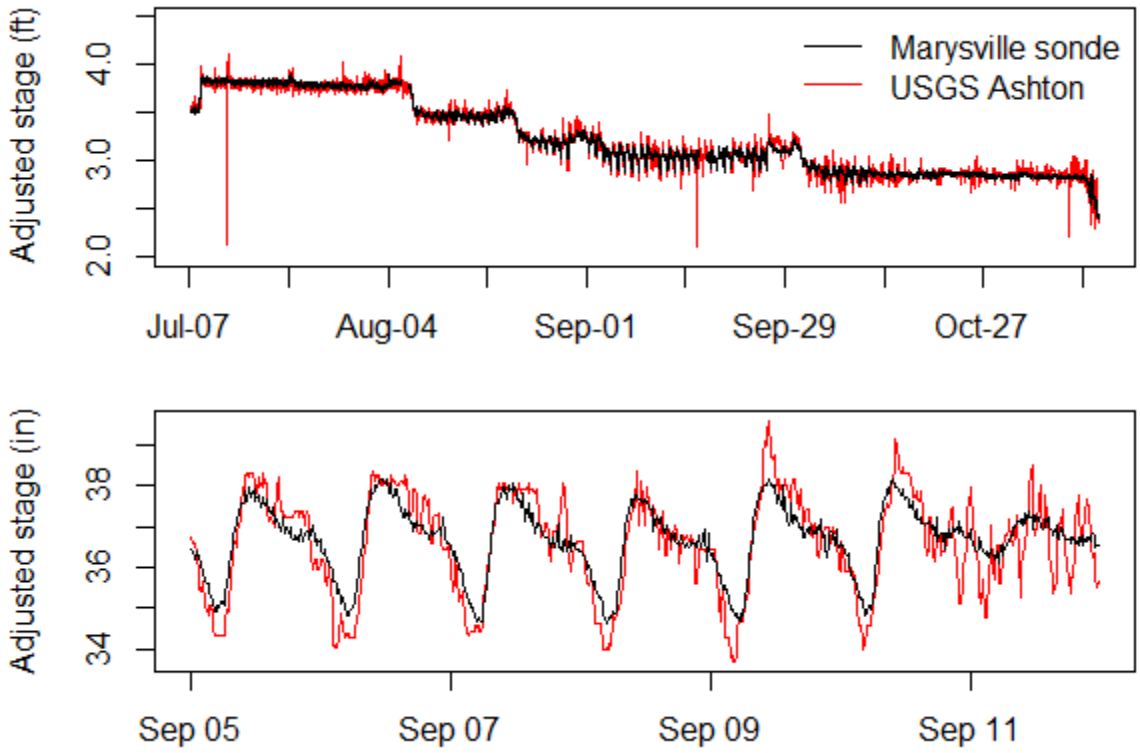


Fig. 2. Comparison of river stage above and below Ashton Reservoir over the whole analysis period (top) and September 5 through 12 (bottom). Bottom panel shows same time period as Fig. 1.

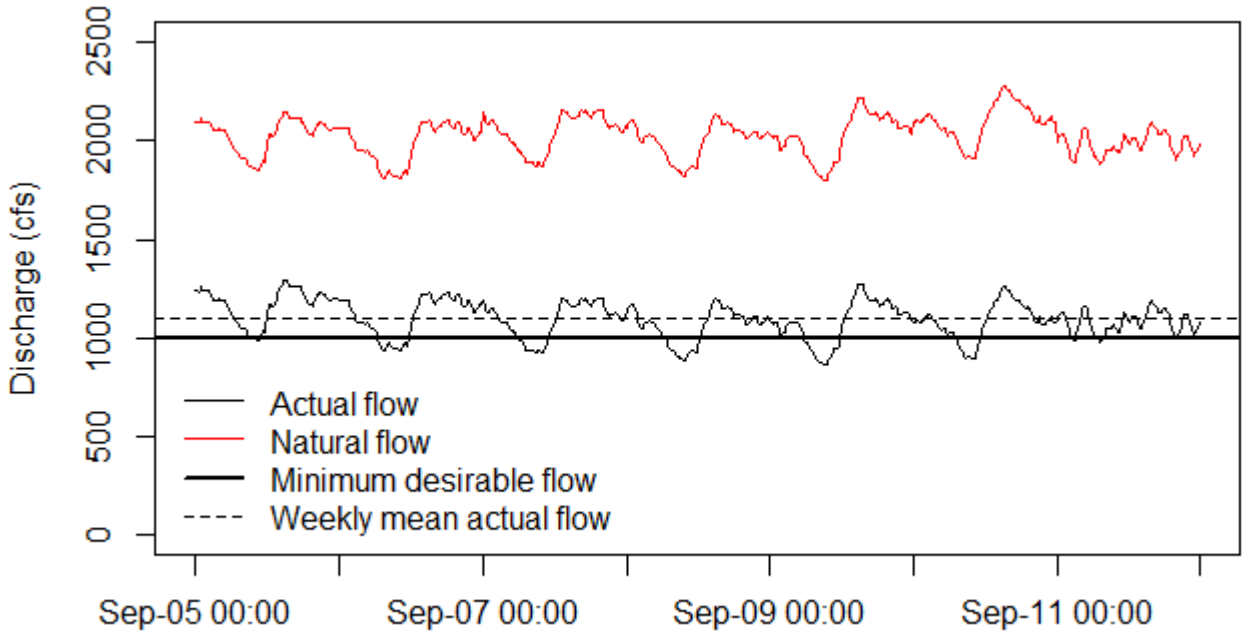


Fig. 3. Comparison of river flow at St. Anthony showing actual flow and its weekly mean, "natural" flow (flow in absence of irrigation diversions), minimum desirable flow. Note that over the week depicted (same is in Fig. 1), mean flow was greater than 1000 cfs, whereas daily fluctuations resulted in several hours per day when flow fell below 1000 cfs. Under "natural" conditions flow would never drop below 1000 cfs, even with the fluctuations.

Aquatic Macroinvertebrate Study

- DNA-based identification of aquatic invertebrates will allow rapid and inexpensive use of invertebrate samples for monitoring water and habitat quality, studying trout diet, and other applications. Once DNA database is created, individuals are identified by automated DNA detection in "insect slurry".

"Master" list of Henry's Fork invertebrates

- First step was to develop a master list of invertebrate taxa ("groups") for the watershed. List based on previous HFF sampling contained 129 taxa.
- Based on March 2015 sampling and updated taxonomy, the new list contains 202 taxa. Increase in number of taxa primarily resulted from addition of a large number of chironomid ("midge") species.
- 29 taxa on the original list were modified to account for misspellings, mis-identification of individuals in earlier sampling and changes to taxonomy. For example, *Ephemerella infrequens*, one of the mayflies commonly known as the Pale Morning Dun, is now considered a subspecies of *E. dorothea*.

Quantitative results of March 2015 Sampling

- In March 2015, we implemented a four-year study to monitor invertebrates at Flatrock, Last Chance, Osborne Bridge, Ashton (upstream of Ashton Reservoir), and St. Anthony.
- Abundance of aquatic macroinvertebrates ranged from 31,353 individuals per square meter of stream bottom at Ashton to 86,538 individuals per square meter at Osborne Bridge.
- Although all five sites had roughly the same number of species in the samples, diversity was greatest at Ashton and St. Anthony, due to more uniform abundance across the species.
- Water and habitat quality, based on Hilsenhoff's Biotic Index, ranged from good to excellent at all sites except Osborne Bridge, where water and habitat quality was rated as "fair."
- Percentage of so-called "EPT taxa"—mayflies (***E****hemperoptera*), stoneflies (***P****lecoptera*), and caddisflies (***T****richoptera*)—was much lower at Osborne Bridge than at any other site. The number of non-insect species (mostly oligochaete worms) was much greater at Osborne Bridge. This particular invertebrate assemblage reflects fine substrate. However, even with low %EPT, abundance was so high at Osborne Bridge that the number of EPT individuals was greater there than at all other sites except Flatrock.

Summary of quantitative sampling of macroinvertebrates in March 2015.

	Flatrock	Last Chance	Osborne	Ashton	St. Anthony
Abundance (per square meter)	55,480	31,911	86,538	31,353	45,626
Number of species	31	33	30	39	32
Shannon's Diversity Index[1]	2.21	2.86	2.35	3.08	2.94
Maximum possible Shannon Index	3.40	3.50	3.40	3.63	3.47
Hilsenhoff Biotic Index (HBI)[2]	3.00	3.55	5.94	4.53	4.98
Water quality (based on HBI)	Excellent	Very Good	Fair	Good	Good
% Mayflies, stoneflies, caddisflies	60.7	57.2	30.3	45.3	42.4
% Chironomids (midges)	20.4	15.7	29.0	28.8	27.1
% Other insects	3.2	8.3	2.0	4.2	6.7
% Non-insects	15.7	18.8	38.7	21.7	23.7

1. Shannon's Diversity Index has a minimum value of 0, which occurs when a species assemblage consists of only one species. The maximum possible Shannon Index occurs when each species occurs at the same abundance. Higher values indicate more diversity.
2. HBI is a weighted average of tolerances to water-quality and habitat degradation. Tolerances range from 1 for the most sensitive (intolerant) taxa to 10 for the taxa most tolerant of degradation. Thus, the lower the HBI on a 1-10 scale, the higher the quality of aquatic habitat.

Harriman State Park Angler Attitude Survey: 2014 vs. 2008

Overview of survey

- Survey done in 2008 was repeated identically in 2014 to assess attitudes of HSP anglers.
- Sample size was 616 unique anglers in 2008 and 356 in 2014. For anglers who were interviewed more than once, one interview was selected at random to represent that angler.
- We recorded basic angler characteristics such as years of experience fishing HSP, average number of days per year fished in HSP, and home state. We also recorded information such as number of fish caught on the interview day and number of days fished in HSP this season prior to the interview day.
- Anglers were asked to rank, on a 1-10 scale, their satisfaction with seven key attributes of the HSP fishing experience: 1) number of fish caught, 2) size of fish caught, 3) opportunities to fish to rising fish, 4) number of other anglers, 5) quality of hatches, 6) condition of fish habitat, and 7) overall aesthetics. Anglers were also asked to rank the importance they place on these features.
- Anglers were also asked to rank their fishing experience on the interview day, both overall and in comparison with previous years and decades.
- Lastly, anglers were asked whether they approve or disapprove of managing the HSP fishery for wild trout or managing the fishery with stocked trout.
- Statistical analysis included direct comparison of angler characteristics and attitudes between years, identification of variables that predicted angler satisfaction, and comparison of angler satisfaction between years after accounting for these predictor variables.

Major results

- When compared with 2008, the angler population in 2014 had an average of 4.5 more years of experience fishing HSP, fished about 10 more days per year, and had fished HSP an average of 1.5 more days during the current season prior to the day of the interview.
- Mean catch per outing per interviewee on HSP was 1.2 fish in 2008 and 0.63 fish in 2014.
- During both years, most anglers were from ID (23.2%), UT (16.6%), CA (14.5%), and MT (8.4%).
- During both years, anglers overwhelmingly favored wild trout and disapproved of stocked trout.
- Anglers showed very little difference between years in the importance they placed on each of the seven aspects of the HSP fishing experience (Fig. 1).
- Anglers showed higher satisfaction in 2014 with all aspects of the angling experience except aesthetics, which ranked only slightly lower but still extremely high, and number of other anglers, which ranked much lower in 2014. Increased satisfaction with the other attributes was generally reflected in significantly more rankings of "10" on the 10-point scale.
- Angler satisfaction with quality of angling was much higher in 2014, both overall and in comparison with previous experiences, even in comparison with the 1980s.
- In general angler satisfaction:
    - increased with the number of fish caught on the day of the interview,
    - was higher during September and October than during the other months, and
    - decreased with years of experience and with importance placed on a given aspect (see Table 1).
- Dependence of angler attitudes on these factors did not differ between years.
- Even after accounting for these factors, anglers still ranked fishing much better in 2014 (e.g., Fig. 2).
- Conclusion: In 2014, a more experienced and harder-to-satisfy population of anglers, who caught half as many fish, were more satisfied with the quality of fishing, number of fish caught, size of fish, quality of hatches, opportunities to fish to rising fish, and habitat quality.

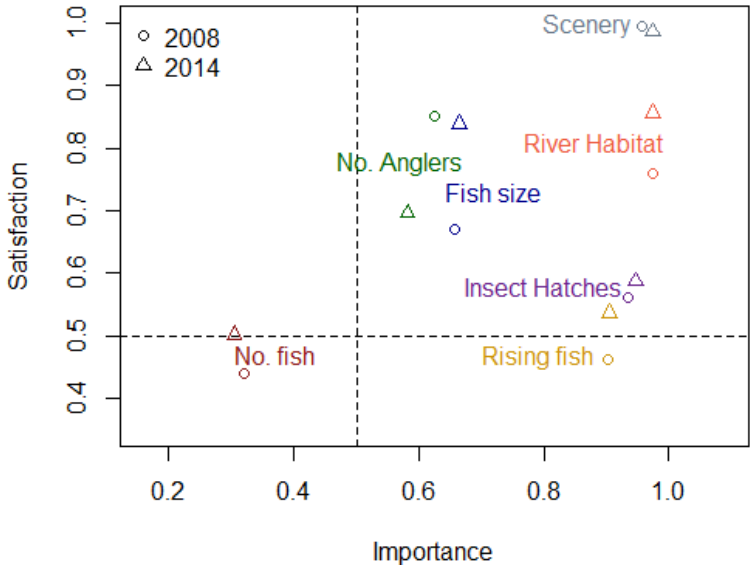


Fig. 1. Angler satisfaction versus importance, plotted as fraction of interviewees that ranked the attribute above average (6 through 10 on the 1-10 scale). Dashed lines indicate equal fractions above vs. below average.

Table 1. Predictors of angler satisfaction with various attributes of angling experience. "+" indicates increase in satisfaction, – indicates decrease in satisfaction, blank indicates no effect of that predictor on satisfaction.

Satisfaction with:	2014 vs. 2008	Fish caught	Years fished HSP	Interviewed in Sep/Oct	Days fished HSP this year	Importance
Number of fish caught	+	+			+	–
Size of fish caught	+					
Rising fish	+	+	–	+		
Other anglers	–			+		
Hatches	+	+	–			–
Fish habitat	+		–	+		
Aesthetics						
Overall fishing	+	+	–	+		NA
Fishing compared to all past	+	+		+		NA
Fishing compared to 2000s	+	+		+		NA
Fishing compared to 1990s	+	+				NA
Fishing compared to 1980s	+	+				NA

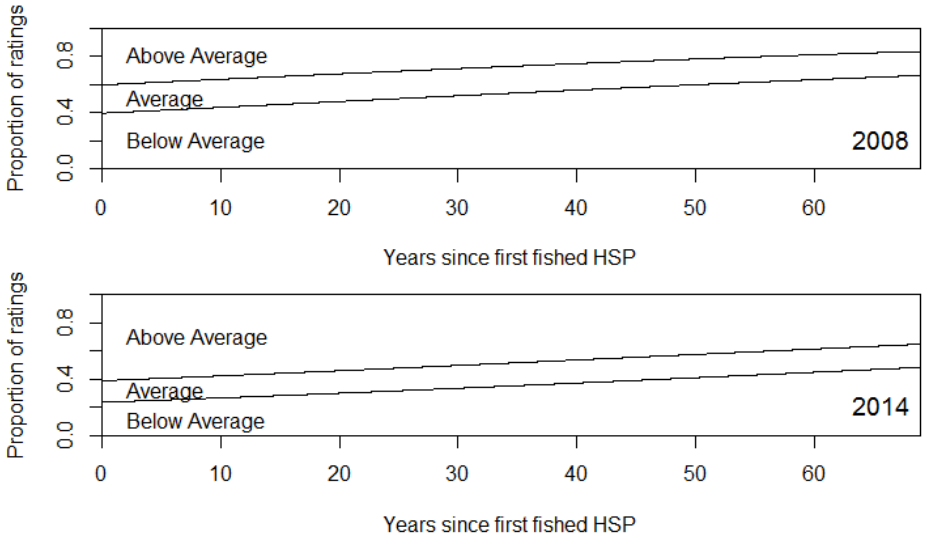


Fig. 2. Angler satisfaction with number of rising fish as a function of years of experience fishing HSP.

Water Supply

- Winter outflow from Island Park Dam averaged 274 cfs, compared to a 35-year mean of 365 cfs.
- However, storing water earlier in fall allowed winter outflow to be proportionally higher (36th percentile of years) than it would have been based solely on water availability (28th percentile of years). Drought management planning process continues to result in higher winter flows than under old management.
- April 1 snow-water-equivalent was lowest on record at key sites near Island Park.
- Mean April-June runoff into Island Park Reservoir was 492 cfs; lowest since 1979 was 537 cfs in 1992.
- Rain in May satisfied irrigation demand and allowed all irrigation storage rights in the upper Snake River system to fill. However, rain did not increase streamflow.
- Even with rain, irrigation delivery from Island Park Reservoir began on June 12.
- Streamflows in upper Henry's and Fall River watersheds are at record lows; barring substantial rain, Island Park Reservoir will be drafted to around 20% of capacity by the end of summer. In 2013, Island Park was drafted to 25% of capacity.
- Discharge from Island Park Reservoir right now is around 1100 cfs, roughly average for late June.
- Need to keep water in the river at St. Anthony for both fisheries and irrigation is driving need for continued increases in delivery of storage water from Island Park Reservoir.
- Teton River is experiencing a moderate snowmelt runoff, but once that recedes in 10 days or so, releases from Island Park Reservoir will increase to at least 1500 cfs to meet demand on the Teton River.