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## **Background**

The assessment area is the Bagley Fire perimeter including streams draining from the fire perimeter. Public lands administered by the Shasta-Trinity National Forest and private lands are included in this assessment.

## **Objectives**

The objectives are to: 1) assess immediate impacts of the Bagley Fire on fisheries and aquatic resources within and directly downstream of the burned areas; and 2) inventory and evaluate future impacts caused or enhanced by the Bagley Fire on fisheries within and downstream of burned areas and determine what emergency response is necessary.

## **Issues**

This evaluation focuses on fish-bearing streams that drain areas exposed to substantial high and moderate severity fire. The main concern relates to potential impacts from elevated peak flows and sediment input/transport to resident fisheries, special status amphibians and mollusks, and aquatic habitat in the following streams:

- Lower McCloud River and tributaries including Ladybug Creek and Claiborne Creek.
- Squaw Creek and tributaries including North Fork and West Fork of Squaw Creek.
- Iron Canyon Creek (below dam) including Initial Creek.

The Bagley Fire burned approximately 4,131 acres of Riparian Reserve at high or moderate severity (Attachment 1, Table 2, displays RRs burned by watershed). The closest lentic habitat (and associated species such as Northwestern pond turtle) occurs in Shasta Lake and Pit River Reservoirs well downstream of the fire perimeter. Potential fire effects to aquatic and riparian habitat in these reservoirs are likely to be minor.

## **Observations and Analysis**

All streams draining from the fire perimeter end in Shasta Lake. Access to these streams by anadromous fish was eliminated in 1945 with construction of Shasta Dam. Resident fish species known, or suspected, to occur include rainbow trout, brown trout, Sacramento sucker, Sacramento pikeminnow, Sacramento squawfish, various sculpin species, and hardhead (Squaw Creek only). Special status amphibian species documented in affected streams include foothill yellow legged frog and tailed frog; one aquatic mollusk on the Forest Service Sensitive species list (nugget pebblesnail) has been documented in affected streams (lower McCloud River). Attachment 1 displays best available data on presence of aquatic special status species within streams impacted by the fire.

The McCloud River was home to the first Federal salmon breeding facility (Baird Hatchery), which was developed by Livingston Stone in 1872 as an effort to breed Pacific salmon to replenish dwindling Atlantic salmon stocks (Montgomery 2003). Today the McCloud River remains a popular trout-fishing stream, designated by the state as a blue ribbon fishery. Water quality below the dam has the potential to be impaired by fine glacial silt originating from Mount Shasta, and hydropower management has reduced and regulated flows to the detriment of salmonid habitat. The McCloud Dam diverts approximately 80% of baseflows to the Pit

River for hydroelectric generation. The Lower McCloud River still provides relatively high quality salmonid habitat, maximum pool depths at survey sites ranged from 7.8 feet to 15 feet (FERC TM-18, 2009).

Squaw Creek contains habitat features (deep pools and runs) that are critical to the production of large mature trout. The watershed has been considered relatively healthy with stream systems that are properly functioning. Fish-bearing tributaries within the fire perimeter include East Fork Squaw Creek, West Fork Squaw Creek, and Modin Creek. Many of the smaller tributaries are also functioning well, but are limited for fish habitat because of their small size and steeper gradients. These streams, though not important for fish habitat, are critical to the maintenance of proper water quality and sediment delivery. (Squaw Creek WA, 1999)

Iron Canyon Creek which begins below the dam, and potentially tributary Initial Creek, contain resident fish (rainbow and brown trout) and amphibians. Riparian ecosystems and aquatic habitat in Iron Canyon Creek have been degraded due to construction of the dam and generation of hydroelectric power (Iron Canyon WA, 1996). Present flows are insufficient to recreate or maintain pools, and reduced flows prevent flushing of larger sediments which accumulate and fill pools. Gravel replenishment is limited to tributaries below the dam, and high quality spawning and rearing habitat are generally absent. The majority of spawning gravel in Iron Canyon Creek is deposited in mid-channel pool tails or runs (FERC TM-40, 2009).

### Reconnaissance Method

All reconnaissance was completed by vehicle and foot access. Areas of high and moderate burn severity, and near stream burned areas, were the priority for field survey. Many fish-bearing streams within the fire perimeter were visited and brief searches were conducted for aquatic mollusks (none were observed). Field visits occurred between 9/11/12 and 9/15/12.

### Findings and Recommendations

This analysis relied upon observations gathered from reconnaissance and interviews of local experts, along with review of best available information and current scientific literature. In general, specific guidance for identifying where and when fires pose threats to native fishes is still lacking; managers are left to rely on general conceptual guidance from theory and a handful of case studies (Dunham et al 2003).

### **Lower McCloud River**

The fire burned in close proximity to the McCloud River roughly from the dam downstream 5 miles, and along the south side of Hawkins Creek for several miles upstream of the McCloud River. Burn severity in these areas was generally low or unburned, with small pockets of moderate severity (Attachment 3, Photo 1). The result was a mosaic of underburn and un-burned condition with little to no loss of overstory/shade-providing vegetation. Adverse effects to fish habitat are not expected due to fire activity in these areas and there are no recommendations for BAER treatments. Recommended treatments described below in Ladybug Creek watershed would reduce potential post-fire sediment transport and deposition to fisheries habitat in the Lower McCloud River.

### *Ladybug Creek*

The area of concern in this watershed is Bones Gulch which experienced high severity fire within near stream areas in upper Ladybug Creek watershed (Attachment 3, Photo 2). Bones Gulch drains to Ladybug Creek just

upstream of the McCloud River and the lower reaches of Bones Gulch and Ladybug Creek are owned by the Nature Conservancy. Special status aquatic species known to occur in Ladybug Creek include resident trout and tailed frog.

### Recommendations

Treatments to reduce hillslope erosion in the high severity fire areas of Bones Gulch would benefit aquatic species and habitat in Ladybug Creek and McCloud River by reducing potential fine sediment delivery. Bones Gulch burned at high severity across stream channels in the upper portion of the watershed. Substantial increases in hillslope erosion, along with riparian zones that are temporarily unable to filter fine sediment, result in a high probability of sediment-related impacts to aquatic habitat in Ladybug Creek. Habitat conditions would probably improve over the next several years as peak flows move fine sediment downstream, gravel and wood are recruited, and vegetation reestablishes along channels in the upper watershed. Hillslope stabilization treatments (mulching) in high severity areas would provide for reduction in hillslope erosion during those first few years before vegetation is reestablished along channels.

As described in the hydrology report, elevated sediment delivery due to the fire is expected in the Lower McCloud River; most fine sediments would be moved through the system during the first year post-fire followed by more coarse sediments. The precise degree to which this would impact trout spawning and rearing habitat is uncertain. Based on the results of case studies described in scientific literature,<sup>1</sup> adverse effects of the Bagley Fire on fish and fish habitat in the Lower McCloud River are not likely to be significant or long-lasting. As mentioned earlier, the McCloud River has a rich history of providing high quality salmonid habitat and is designated by the state as a blue ribbon fishery. Potential sediment delivery to fisheries habitat there is of elevated concern.

The Bones Gulch area drains land within several miles upstream of the McCloud River, it burned at high severity and within near stream areas, has treat-able slopes on Forest Service administered land, and treatments have the potential to be effective in reducing fine sediment delivery to Ladybug Creek and the Lower McCloud River. Reducing fine sediment delivery to the lower McCloud River would also benefit habitat for Forest Service Sensitive species including foothill yellow legged frog and nugget pebblesnail (aquatic mollusk). The Forest Service should work with The Nature Conservancy on if, and how, this treatment is implemented. The Nature Conservancy owns the lower portions of Bones Gulch and Ladybug Creek and this area was part of a recent paired watershed study which needs to be considered along with any BAER recommendations.

### **Squaw Creek**

This watershed had the greatest percentage of land area affected by fire. The upper watersheds within the larger Squaw Creek watershed (Jessie Creek-Horse Creek and West Fork Squaw Creek-Modin Creek HUC7s) were entirely affected by the fire (Table 1). Most high severity fire occurred near the top of the watershed around Happy Hunting Grounds and McKenzie Mountain (burn severity map in Attachment 2) including entire sections of what used to be young plantations on private timberland. The upper reaches of North Fork Squaw Creek also experienced high severity fire but not in near stream areas and a smaller proportion of the watershed burned. West Fork Squaw Creek is the fish-bearing stream that experienced substantial near stream high severity fire; resident trout habitat in this stream will likely be adversely affected by elevated peak flows and sediment input due to the fire (Attachment 3, Photo 4).

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<sup>1</sup> Most literature reviewed is listed in References section.

**Table 1. Subwatersheds (within Squaw Creek Watershed) most impacted by fire.**

HUC7 watershed	Watershed area (acres)	Acres high severity fire (% of watershed)	Acres high and moderate severity fire in Riparian Reserves	Acres moderate severity fire (% of watershed)	Acres low severity fire (% of watershed)	Acres very low (% of watershed)
Jessie Creek-Horse Creek	7,125	1,603 (22%)	496 (H) 552 (M)	1,640 (23%)	2,945 (41%)	937 (13%)
West Fork Squaw Creek-Modin Creek	10,303	1,407 (14%)	442 (H) 490 (M)	1,734 (17%)	4,552 (44%)	2,603 (25%)

Squaw Creek is expected to experience significantly elevated peak flows as a result of the fire (see hydrology report). Trout spawning and rearing habitat in West Fork Squaw Creek and mainstem Squaw Creek are likely to be adversely affected, at least for the next few years, due to sedimentation of spawning gravels and filling of pools. Depending on the size/intensity of storms during the next few years (before vegetation can reestablish along channels), elevated flows may also cause longer term impacts to trout habitat such as widening of channels and loss of undercut banks. As described in the geology report, there is a risk of debris flows triggering high in the watershed as a result of high severity fire, unstable areas, and compromised road/stream crossings. Under the worse-case scenario, a longer term reduction in the quality of fish habitat in Squaw Creek is possible; however it is probably more likely that fish habitat will recover to near pre-fire levels within 10 years.

Slope stabilization treatments in high severity burned areas in the upper watershed would be beneficial to fish habitat in West Fork Squaw Creek and lower Squaw Creek. However due to steep slopes (greater than 60%) and checkerboard private ownership, treatments would likely not be effective and therefore are not proposed by the BAER team (see soils and geology reports). Road crossing upgrade/stabilization work would also benefit aquatic habitat in Squaw Creek by reducing chronic sediment inputs and lowering the risk of debris flows.

**Iron Canyon Creek**

Fire effects of concern for fisheries/aquatics is the substantial area of high and moderate severity burn that occurred just below the dam and across near stream areas of Iron Canyon Creek and an unnamed tributary (Attachment 3, Photo 5). Depending upon the size/intensity of storms that occur prior to reestablishment of vegetation along stream channels, post-fire sediment inputs may pose a significant risk (at least for several years) to the occurrence of trout spawning habitat in Iron Canyon Creek. Especially because flows are reduced and regulated due to hydropower management, sediment delivered to Iron Canyon Creek due to hillslope erosion and mass wasting is likely to settle and adversely impact the already-marginal spawning and rearing trout habitat that occurs there.

Several Forest Service road segments (37N33, A and C spurs) also transport sediment to streams due to mass wasting (active landslide) and failing crossings; these effects would likely be exacerbated by the fire.

### Recommendations

Treatments to reduce hillslope erosion, mass wasting, and road-related sediment transport in this watershed were considered. The BAER team is recommending stormproofing and road/stream crossing stabilization actions on the appropriate Forest Service roads (see Engineering report), these treatments would reduce sediment-related impacts to the trout fishery in Iron Canyon Creek. Although not within the scope of this analysis, water management agencies could consider increasing flows in Iron Canyon Creek to simulate natural peak flows that may help move fine sediment downstream from trout spawning habitat into Pit River Reservoir.

### **Monitoring**

Due to the lack of ESA-listed species or habitat, there is no fisheries-related monitoring proposed. Opportunistic monitoring of trout spawning habitat conditions (substrate embeddedness) is encouraged in LadyBug Creek, Squaw Creek including West Fork Squaw Creek, Modin Creek, and Iron Canyon Creek.

### **Consultation**

Because effects from the fire would not involve any aquatic species or habitat listed under the Endangered Species Act, there is no need for consultation with regulatory agencies.

### **References**

- Bisson, P.A., B.E. Rieman, C. Luce, P.F. Hessburg, D.C. Lee, J.L. Kershner, G.H. Reeves, R.E. Gresswell (2003). Fire and aquatic ecosystems of the western USA: current knowledge and key questions. *Forest Ecology & Management* 178:213-229.
- Burton, Timothy A. (2005). Fish and stream habitat risks from uncharacteristic wildfire: observations from 17 years of fire-related disturbances on the Boise National Forest, Idaho. *Forest Ecology and Management* 211: 140-149.
- Dunham, J.B., M.K. Young, R.E. Gresswell, and B.E. Rieman (2003). Effects of fire on fish populations: landscape perspectives on persistence of native fishes and nonnative fish invasions. *Forest Ecology and Management* 178:183-196.
- FERC, McCloud-Pit Project (2009). Technical Memorandum 18 (TM-18), Fish Populations in Project-Affected Stream Reaches (FA-S3). November 16, 2009.
- FERC, McCloud-Pit Project (2009). Technical Memorandum 40 (TM-40), Instream Flow Study on Iron Canyon Creek (FA-S1). July 10, 2009.
- Iron Canyon Watershed Analysis (1996). USDA, Shasta-Trinity National Forest. March 26, 1996.
- Montgomery, David (2003). *King of Fish: the thousand –year run of salmon*. Westview Press.
- Squaw Creek Watershed Analysis (1999). USDA, Shasta-Trinity National Forest. April 1, 1999.

**ATTACHMENT 1**

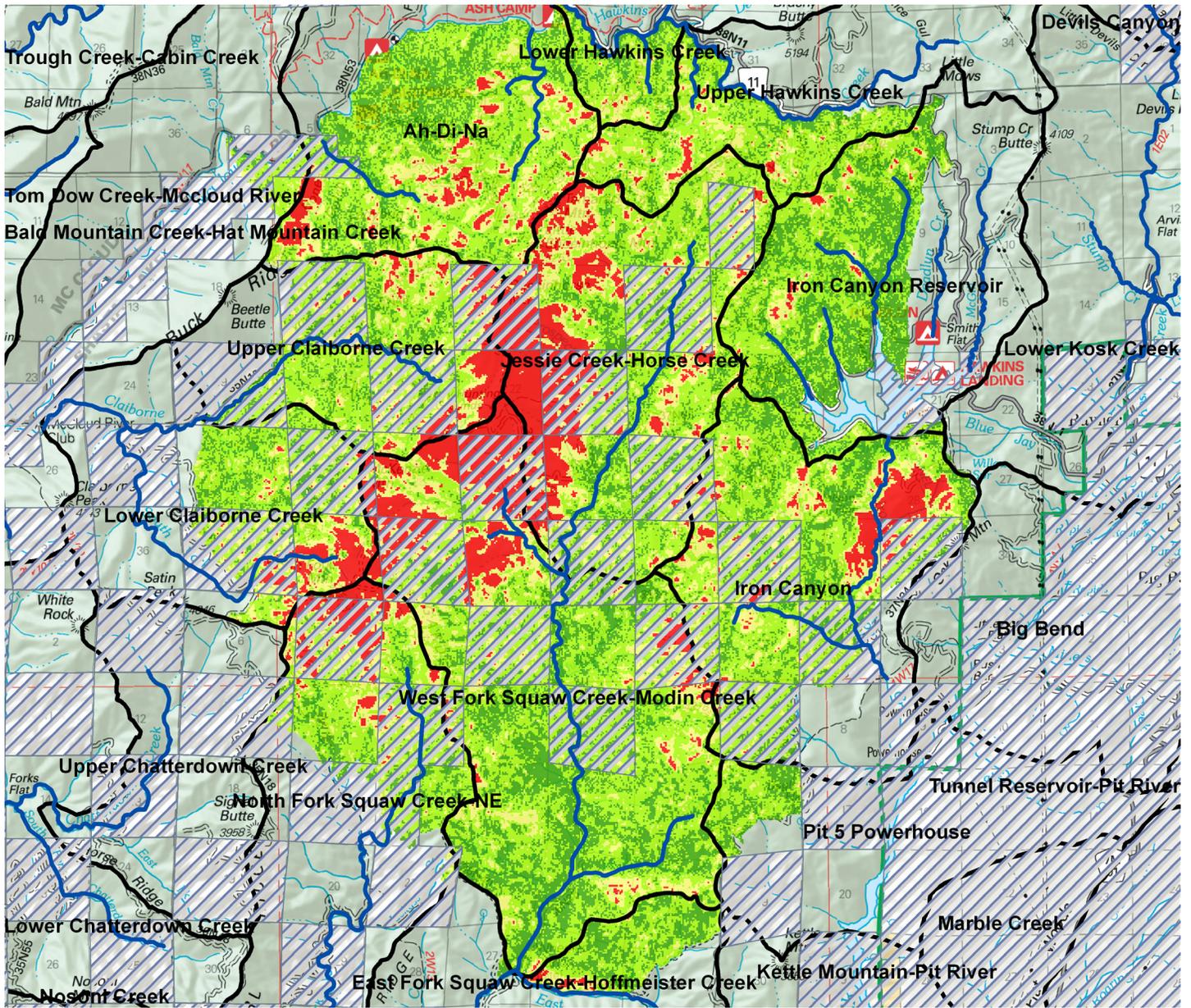
**Table 1.** Special status aquatic species presence within streams draining Bagley Fire area, **Forest Service Sensitive species are in bold text.** For all species except rainbow trout, the source of presence/absence information is in parentheses.

Stream	Rainbow trout	<b>Hardhead</b>	<b>Foothill yellow legged frog</b>	Tailed Frog	<b>Aquatic Molluscs</b>
Lower McCloud River	Yes	Probably not (FERC TM-08, 2007)	Yes (FERC TM-29, 2009)		<i>Fluminicola seminalis</i> or nugget pebblesnail (FERC TM-69, 2008)
Ladybug Creek	Yes			Yes (FERC TM-09, 2007)	
Claiborne Creek	Yes				
Squaw Creek	Yes	Assumed to occur (Squaw Creek WA, 1999)	Yes (Squaw Creek WA, 1999)	Probably not (Squaw Creek WA, 1999)	
West Fork Squaw Creek	Yes				
Modin Creek	Yes		Possibly (tadpoles observed during 9/12/12 field visit)		
Iron Canyon Creek	Yes	Probably not (Iron Canyon WA, 1999)			
Initial Creek	Yes	Probably not (Iron Canyon WA, 1999)		Yes (Iron Canyon WA, 1996)	

**Table 2. Acres of Riparian Reserves affected by Bagley Fire by HUC7.**

HUC 7 Name	High	Mod	Low	Very Low Unburned	% High/Mod
Iron Canyon Reservoir	11	68	622	641	6
Iron Canyon	198	462	1155	482	29
Pit 5 Powerhouse		2	55	58	2
Jessie Creek – Horse Creek	496	552	1317	488	37
West Fork Squaw Creek- Modin Creek	442	490	1641	1270	24
East Fork Squaw Creek – Hoffmeister Creek	2	24	121	105	10
North Fork Squaw Creek – NE	64	151	487	185	24
Upper Hawkins Creek	10	113	459	153	17
Lower Hawkins Creek		20	173	111	7
Upper Claiborne Creek	98	297	748	211	29
Lower Claiborne Creek	76	187	435	171	30
Ah-Di-Na	92	270	978	509	20
Bald Mountain Creek-Hat Mountain Creek		6	54	22	7

## ATTACHMENT 2 Burned Area Reflectance Classification



Fish bearing streams within the fire perimeter are shown in blue line and checkerboard private ownership is highlighted. High severity fire is red and dark green is very low or unburned. HUC7 boundaries are outlined in black.

## ATTACHMENT 3

### Photos



**Photo 1. Lower McCloud River, The Nature Conservancy Property. Representative of most near stream burned areas along the McCloud River, mostly underburn with little to no loss of overstory vegetation.**



**Photo 2. Bones Gulch, tributary to Ladybug Creek had substantial high severity fire within near stream areas.**



**Photo 3. Squaw Creek upstream of Modin Creek. Representative of lower reaches of Squaw Creek within fire perimeter, a mosaic of underburn to un-burned within near stream areas.**



**Photo 4. High severity fire near (below) Happy Hunting Grounds, looking down towards West Fork Squaw Creek.**



**Photo 5. Tributary to Iron Canyon Creek which experienced substantial high severity fire across multiple drainages. The sediment trapping/buffering capacity of near stream riparian zones is mostly eliminated, and fine sediment from hillslope erosion will be directly transmitted streams.**