Potential for American Bullfrog spread in Grand Teton National Park

Management brief:

- Introduced American Bullfrogs are established in Kelly Warm Springs and Savage Ditch and have been observed in Ditch Creek.

- Their status and potential to spread to adjacent waters in Grand Teton National Park is unknown.

- We surveyed 24 sites within the Gros Ventre River floodplain and 13 sites within the Snake River floodplain for American Bullfrog presence and for potential for these habitats to support larval American Bullfrogs.

- We did not observe any American Bullfrogs at these 37 sites, though two juveniles were observed in Ditch Creek.

- Due to its proximity to Kelly Warm Springs and abundant warm, permanent backwaters the Gros Ventre River has high habitat suitability for American Bullfrogs. Snake River habitats appear to be less suitable since they are dominated by cold groundwater.

- Future American Bullfrog early detection work should focus most effort on the Gros Ventre River.

Background.

Introduced American bullfrogs (*Lithobates catesbeiana*; hereafter, bullfrog) have been implicated in the declines of multiple amphibian and reptile species around the globe (Ficetola et al. 2007). Their large size, high mobility, generalist eating habits, high fecundity and function as a disease vector makes the bullfrog an extremely successful invader and a threat to biodiversity (Lowe et al. 2000; Nentwig 2007). In Grand Teton National Park, bullfrogs were introduced to Kelly Warm Springs as early as the 1950s. Eradication of bullfrogs and the other introduced species in Kelly Warm Springs has been identified as a priority by Grand Teton National Park.

Pilot work by A. Sepulveda (USGS) and A. Ray (NPS) in August 2014 documented that bullfrogs now have multiple reproductive clutches per summer and have spread > 5 km

downstream of the irrigation ditch that drains the springs. Bullfrogs are now poised to invade adjacent waters, including the Gros Ventre River, Snake River and Ditch Creek, which provide wetland habitat for 4 species of native amphibians. Bullfrogs can thrive in larger rivers, as evidence by their abundance and spread in the Yellowstone River (Sepulveda et al. 2015). Moreover, valley-bottom habitats near Kelly Warm Springs have the highest amphibian richness in Grand Teton National Park (Ray et al. 2014) so bullfrog spread into these habitats could cause irreversible harm. Importantly, an adult bullfrog was observed in the Granite Creek Supplemental Ditch near Jackson Hole Resort in ~ 1990 by William Resor of the Snake River Ranch. It is not known if this bullfrog dispersed from Kelly Warm Springs, but it does underscore the need for a thorough survey of bullfrogs in waters that are proximate and distant from Kelly Warm Springs. For these reasons, information about bullfrog current and potential distribution is needed by Grand Teton National Park.

Objectives.

1. Assess bullfrog occupancy in the Kelly Warm Springs irrigation ditch, the Gros Ventre River and Snake River backwaters, and Ditch Creek in the Grand Teton valley.

2. Evaluate the potential for these habitats to support adult and larval bullfrogs.

Approach.

Bullfrog occupancy. We used visual surveys to assess bullfrog occupancy in the Gros Ventre River and Snake River (Fig. 1). We used aerial imagery to identify all publically accessible backwaters and side-channels of (1) the Gros Ventre River downstream of the NPS boundary at 43.640428° x -110.583970° to Spring Gulch Road and (2) the Snake River downstream of the Cottonwood Creek Road and Bar B-C Ranch to 43.607922° x -110.776360°. Our upstream boundaries were defined as ~ 5 km upstream from a potential source; for the Gros Ventre River, the source was Kelly Warm Springs and for the Snake River, the source was the confluence of Ditch Creek with the Snake River. The downstream boundaries were set by access, as private lands dominate the Gros Ventre River and the Snake River outside of the national park boundaries.

We then used a generated random tessellation sampling (GRTS) approach to select 30 sites in each river. At each site, we performed visual surveys following Sepulveda et al. (2014) and USGS-NPS protocol, which uses a dual-observer approach to estimate detection probability in a single visit (Gould et al. 2012). All habitats were surveyed to determine the presence of egg, larval or post-metamorphic amphibians. After each site was surveyed, we measured habitat characteristics (e.g., water temperature, depth, wetted area, and percent cover of emergent vegetation).

Characterizing suitable bullfrog habitat. Water temperature, depth and presence of emergent and submergent vegetation are associated with bullfrog reproductive (i.e., eggs, larvae or juveniles) presence in western waters (e.g., Sepulveda et al. 2015). We collected information on these variables at all sites visited in Objective 1. In addition, we instrumented a subset of these sites with continuous temperature loggers to evaluate scope for growth (Fig. 2- 3). Loggers were placed in June and removed in October.

Results.

Bullfrog occupancy. We surveyed 21 sites within the Gros Ventre River floodplain and 10 of 30 sites within the Snake River floodplain from August 17 – August 22, 2015. Sites that were not surveyed were either dry, inaccessible, active irrigation ditches with steep banks, occupied by bison, or in bear closure areas (e.g., sites adjacent to Moose Road on the Snake River). We did not observe bullfrogs at any site.

Characterizing suitable bullfrog habitat. Only surveyed sites in the Gros Ventre River had water temperatures conducive to bullfrog reproduction and growth (i.e., > 23 °C; Figure 4). These suitable sites are backwater habitats located 1.2 km south of Kelly Warm Springs. Most Snake River sites were groundwater-influenced and much cooler (< 17 °C), with the exception of sites with an active connection to the Snake River.

Conclusion.

Our data suggest that backwater habitats near the Gros Ventre River have greater potential for successful bullfrog establishment than do Snake River habitats. Gros Ventre sites are more vulnerable because they are proximate to Kelly Warm Springs and there are multiple sites with summer water temperatures that can support breeding and larval growth. However, occupancy surveys in 2014 and 2015 at these sites did not

detect any bullfrogs. Nevertheless, these habitats should continue to be monitored each summer.

Three important observations also indicate that the Snake River is still vulnerable to bullfrogs and should also receive some monitoring attention. First, we found that the number of adult bullfrogs has increased with time (August 2014, July 2015, August 2015, September 2015) in Savage Ditch downstream of the Ditch Creek crossing. Second, two juvenile bullfrogs were observed in Ditch Creek adjacent to the Savage Ditch crossing and Ditch Creek drains directly into the Snake River. Third, ,an adult bullfrog was observed in the Granite Creek Supplemental Ditch near Jackson Hole Resort in ~ October of 1990 by William Resor of the Snake River Ranch.

Table 1. Gros Ventre River survey site locations and physical habitat characteristics.

Site	UTM E	UTM N	Water Temperature (°C)	Percent Shallows	Percent Emergent	Depth (m)
1	519769	4822905	13.5	76-100	0	0.5
2	519168	4823249	14.7	76-100	01-10	0.5-1
3	519218	4823361	15.1	51-75	01-10	0.5-1
4	519488	4823382	15.1	25-50	NA	1-2
5	519949	4823770	15.7	25-50	01-10	1-2
6	523324	4825867	17.5	76-100	01-10	1-2
7	531764	4830511	11.5	01-10	0	1-2
8	523473	4826113	18.5	51-75	01-10	1-2
9	524682	4827593	15.2	51-75	76-100	0.5-1
10	528935	4829554	18.1	76-100	0	0.5-1
11	529347	4829413	22.2	76-100	25-50	0.5
12	531293	4830277	14.1	11-25	76-100	1-2
13	522903	4824548	16.1	01-10	0	>2
14	531274	4830299	21	76-100	76-100	0.5
15	522565	4823901	11.7	25-50	76-100	1-2
16	524917	4827438	17.4	76-100	0	0.5-1
17	525917	4827910	13.5	11-25	11-25	>2
18	527851	4829578	18.8	25-50	0	0.5-1
19	530921	4829976	16.6	76-100	76-100	0.5
20	533315	4831472	21.7	25-50	11-25	0.5-1
21	533356	4831535	22.7	11-25	25-50	1-2

Table 2. Snake River survey site locations and physical habitat characteristics.

Site	UTM E	UTM N	Water Temperature (°C)	Percent Shallows	Percent Emergent	Depth (m)
1	518684	4829952	17.1	76-100	0	0.5
2	518347	4829579	11.8	76-100	76-100	0.5
3	519565	4831604	12.1	76-100	0	0.5
4	522510	4832489	13.7	1-10	1-10	0.5-1
5	522838	4832890	13.7	1-10	0	0.5-1
6	523361	4834864	20.9	76-100	25-50	1-2
7	523586	4834560	16.2	25-50	1-10	> 2
8	518070	4828326	12.8	76-100	25-50	0.5-1
9	520779	4832526	8.7	76-100	1-10	0.5-1
10	523978	4834910	14.8	51-75	11-25	1-2

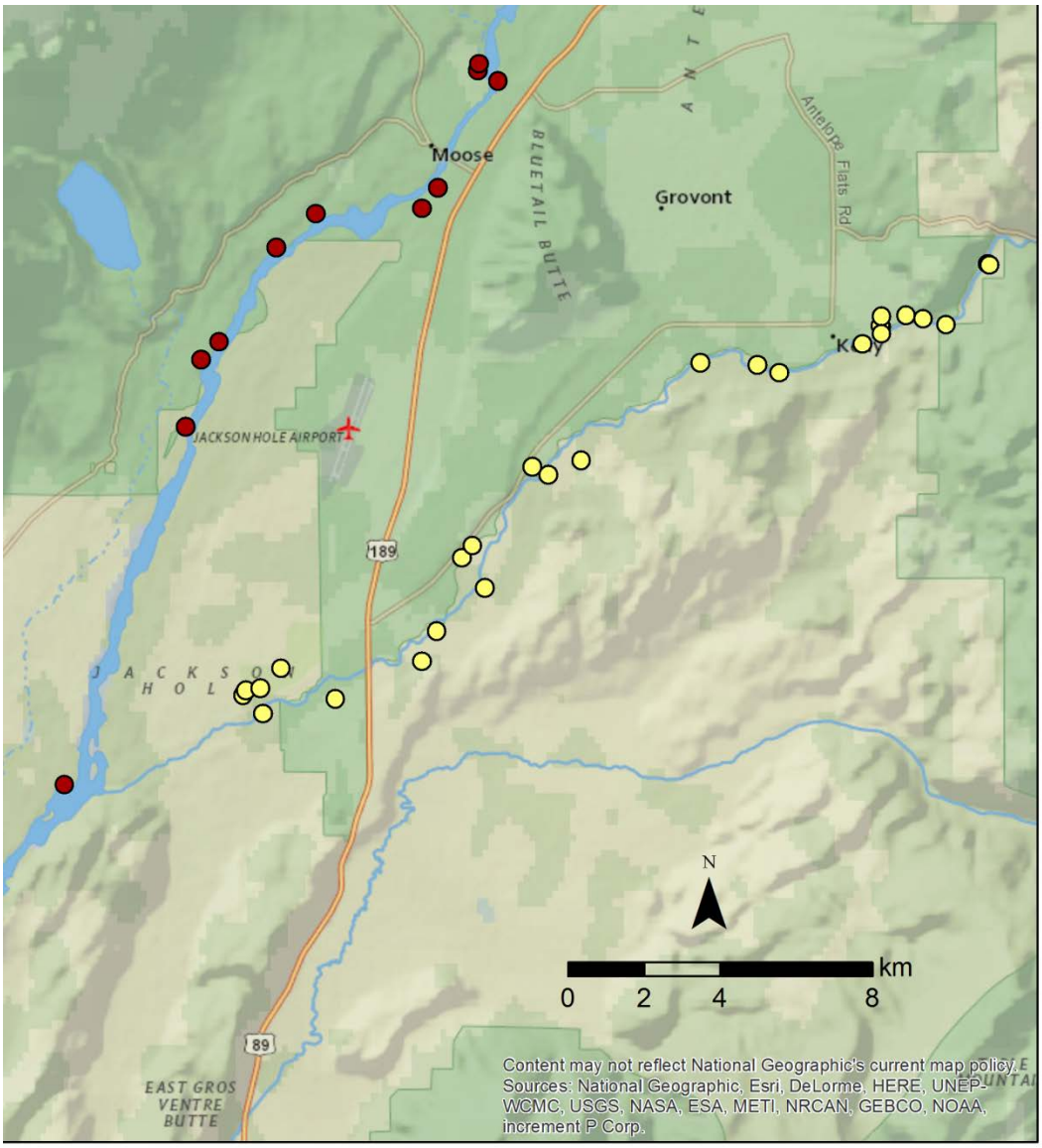

Figure 1. Survey site locations on the Gros Ventre River (yellow) and Snake River (red).

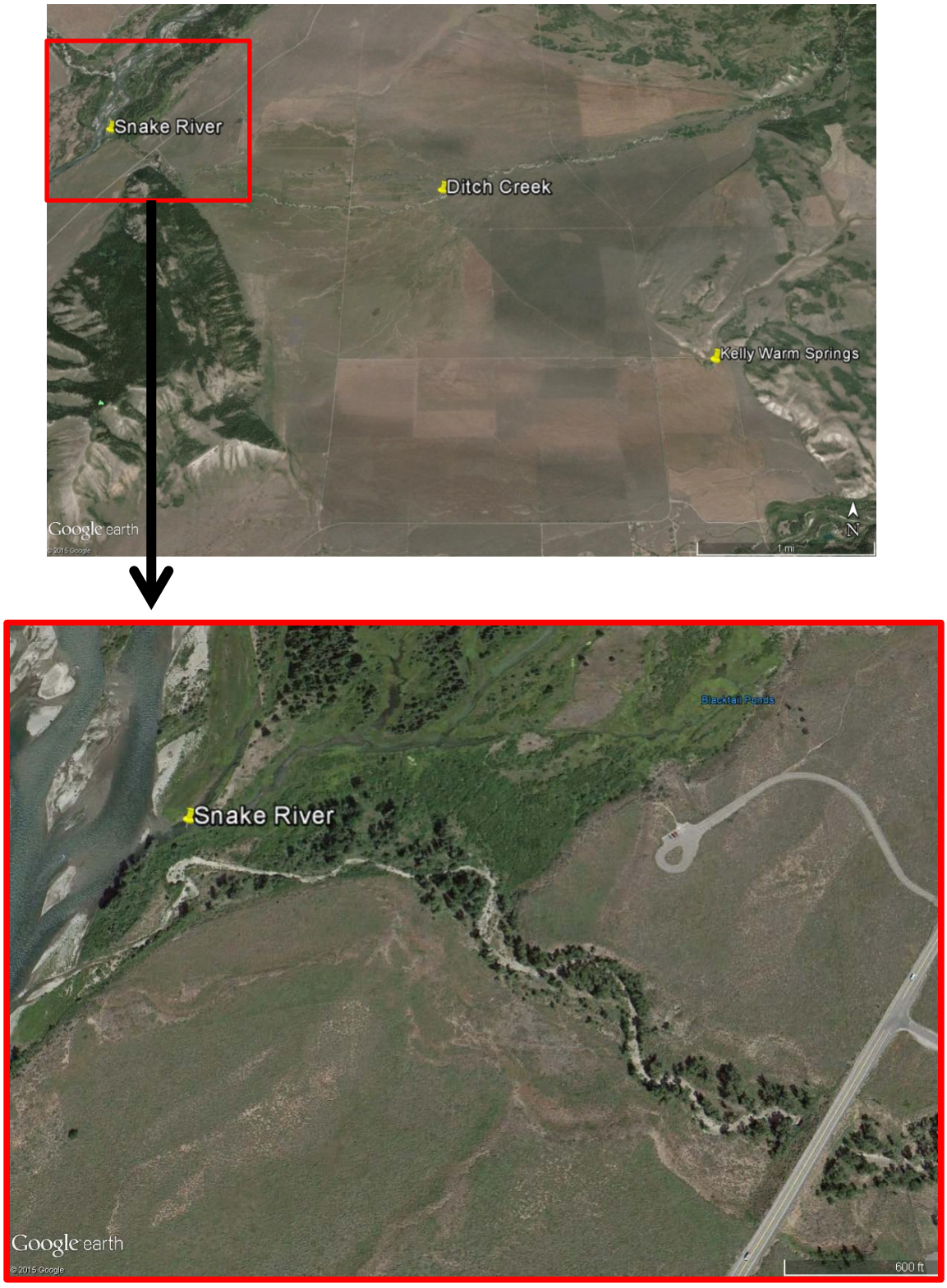

Figure 2. Water temperature location on the Snake River relative to Ditch Creek and Kelly Warm Springs.

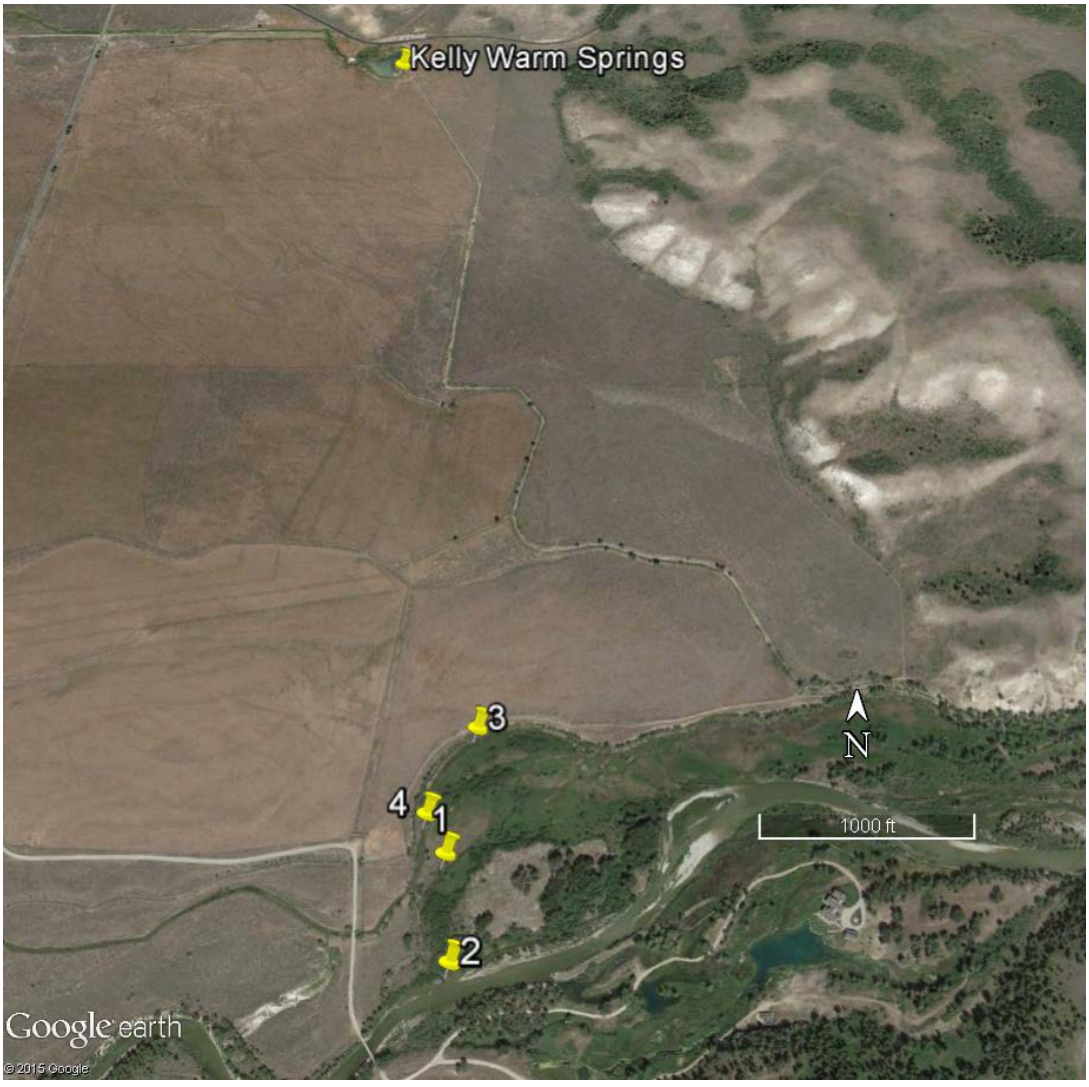

Figure 3. Water temperature locations (1 – 4) adjacent to the Gros Ventre River relative to Kelly Warm Springs.

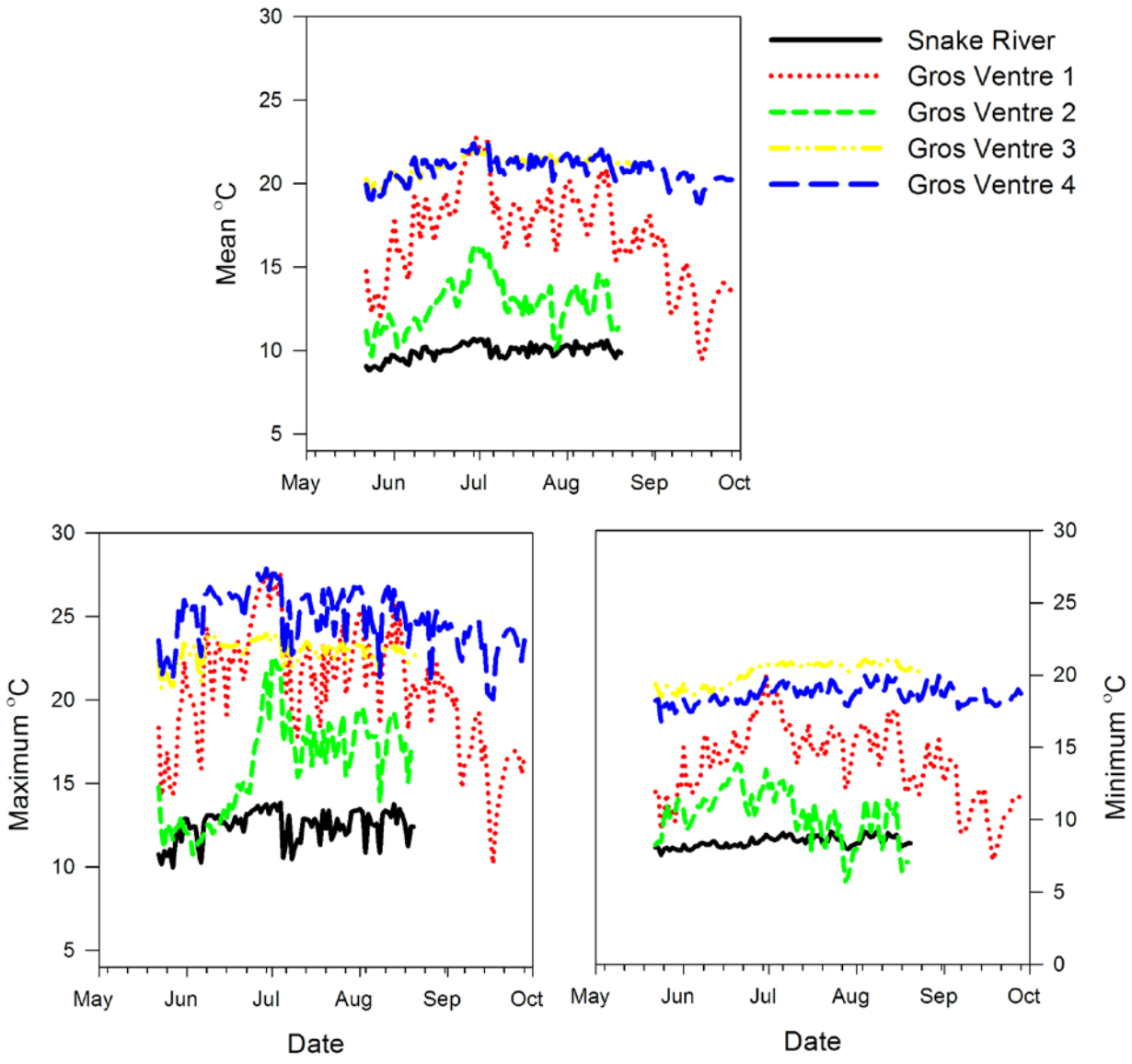

Figure 4. Mean, maximum and minimum water temperatures from a backwater on the Snake River and from backwater and side-channel habitats in the Gros Ventre River in summer 2015.