2011 Monitoring Report

Riparian Vegetation Composition Monitoring FERC Project 184

Prepared for:

El Dorado Irrigation District
2890 Mosquito Road
Placerville, CA 95667

Contact:

Brian Deason
Hydroelectric Compliance Analyst
530/642-4064

Prepared by:

AECOM
2020 L Street, Suite 400
Sacramento, CA 95811

Contact:

Jennifer Burt, PhD
Ecologist
916/414-5800

AECOM

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INTRODUCTION

The El Dorado Irrigation District (EID) owns and operates the El Dorado Hydroelectric Project (Project No. 184), which is licensed by the Federal Energy Regulatory Commission (FERC). The Project No. 184 Monitoring Program[1] requires monitoring of riparian vegetation species composition at seven locations in the Project No. 184 region. The specific monitoring requirements for riparian vegetation species composition are defined in the *Project 184 Riparian Vegetation Species Composition Monitoring Plan* (Plan; EID 2010), which was approved by FERC on February 4, 2011.

Riparian vegetation species composition monitoring was conducted in 2000 (Harris and Lindquist 2000) as part of the relicensing of Project No. 184. The objectives of this monitoring effort were to assess whether herbaceous riparian meadow communities along regulated and unregulated streams in the project region differed in their vegetation lifeform composition, and whether noticeable differences in composition have taken place over time with streamflow regulation.

Streamflow regulation could affect riparian vegetation in several ways. Reduced groundwater levels can occur when streams incise to lower elevations or streamflows are reduced (Ponce and Lindquist 1990, Kattelman and Embury 1996). Groundwater levels could also be increased in an area due to augmented summer flows, or may rise with installation of instream structures or beaver dams (Ponce and Lindquist 1990). Changes in groundwater levels can subsequently cause shifts in vegetation composition from species adapted to high soil moisture to species adapted to drier conditions, or vice versa.

This report presents the results from the riparian vegetation species composition monitoring conducted in August and September 2011.

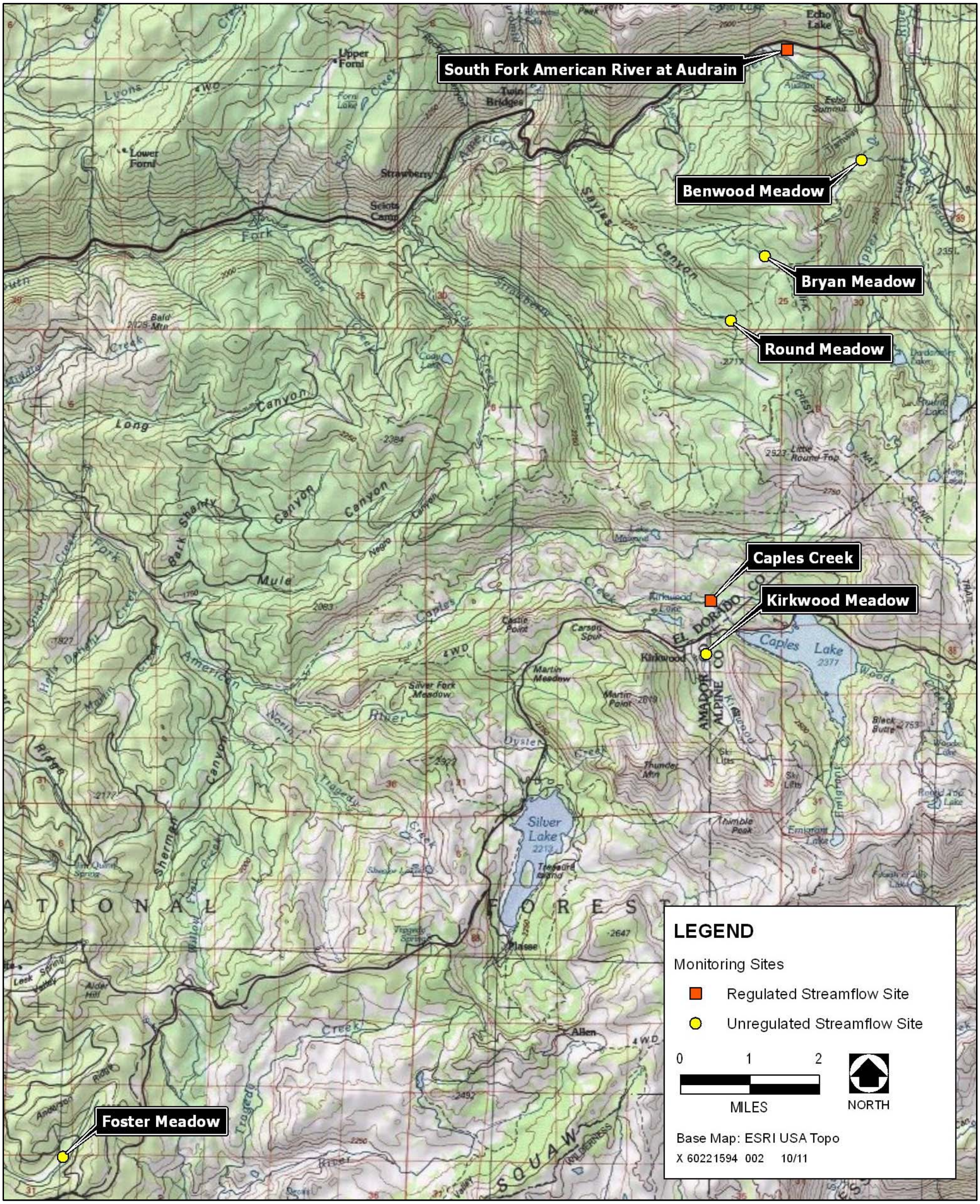
METHODS

Harris and Lindquist (2000) chose the study sites to have distinctive, relatively extensive (at least several hundred square feet) riparian meadows free from excessive forest or shrub cover. The regulated streamflow reaches affected by Project 184 sampled by Harris and Lindquist included: Caples Creek downstream from Caples Lake, and the South Fork of the American River downstream from the Echo Lake conduit at Audrain Meadow (SFAR at Audrain), and the South Fork of the American River in the vicinity of Phillips (SFAR at Phillips). Study sites on unregulated streams were selected in 2000 in consultation with U.S. Forest Service (El Dorado National Forest) staff and included Foster Meadow, Bryan Meadow, Benwood Meadow, Round Meadow, and Kirkwood Meadow. All sites are located at altitudes greater than 6000 feet. None were within active grazing allotments at the time of the initial monitoring, although they may have received limited grazing from horses passing through. Kirkwood Meadow is currently grazed by horses from nearby stables.

In 2011, all sites were re-sampled except for the SFAR at Phillips, because it is located on private property and access was denied. EID consulted with the Forest Service regarding alternative locations for this transect and it

[1] Section 7 of the El Dorado Relicensing Settlement Agreement, U.S. Forest Service 4(e) Condition No. 37, and California State Water Resources Control Board Section 401 Clean Water Act Water Quality Certification Condition No. 13

was determined that the SFAR at Phillips transect would be conducted at the SFAR at Audrain site (the Plan required one transect at each of these sites). Subsequent to the 2011 monitoring EID determined the SFAR at Audrain site is also located on private property, but separated from existing developments. EID plans to obtain permission to enter before future monitoring efforts if possible. In total, data were collected at 14 transects at seven study sites (Exhibit 1); seven transects at regulated streamflow sites (Caples Creek and SFAR at Audrain) and seven transects at unregulated streamflow sites (Benwood Meadow, Bryan Meadow, Round Meadow, Kirkwood Meadow, and Foster Meadow).



Source: AECOM 2011

Exhibit 1 **Riparian Composition Monitoring Sites**

At each site, AECOM staff attempted to find transect markers from the 2000 study, but neither global positioning system (GPS) locations nor transect photographs from the 2000 study were available. No transect markers were relocated. Therefore, AECOM staff established new transects using the methodology described in Harris and Lindquist (2000). At Caples Creek, AECOM resurveyed three transects established in 2008 (EID 2009; Caples Creek transects 1–3) as directed by EID, and other transects were established at areas free from excessive woody cover and that were typical of the local vegetation, consistent with the site selection criteria employed by Harris and Lindquist (2000). Transects were 200 feet in length, perpendicular to and crossing the stream channel. Transects were marked temporarily with a tape measure secured with metal pegs at each end to hold it in place, and marked permanently at both ends with capped rebar, except at those sites located on private property (i.e., SFAR at Audrain and Kirkwood Meadow). AECOM staff recorded latitude and longitude of transect start and end points using GPS (Table B-1, Appendix B), and took photographs of each transect (Exhibit B-1, Appendix B).

Monitoring occurred in August through September, 2011, which corresponded to peak plant flowering at these high-elevation sites during this late snow-melt year. As specified in Harris and Lindquist (2000), a modified version of the step-point method (USDI/BLM 1996) was used to collect vegetation composition data. A pin was lowered at 1-foot intervals along each transect to identify vegetation and exposed ground-level "hits" for calculation of frequency and cover data. Hits were recorded to the species or genus level when possible, but analyzed by the following lifeform categories: sedge, rush, grass, forb, willow, (non-willow) shrub, and tree. Where no vegetation was present, abiotic cover categories (exposed bare ground, rock, litter and water) were also recorded and analyzed.

Analysis included tabulating hits of each vegetation lifeform category and abiotic cover type and calculating percent absolute and relative cover values for each category. Absolute percent cover (sometimes termed “percent frequency,” as in Harris and Lindquist [2000]) for each vegetation and abiotic cover category (where not vegetated) was calculated as the number of points along the transect that each category was present divided by the total number of points on the transect (i.e., 200). According to the data collection methods described in USDI/BLM 1996 and referenced by Harris and Lindquist (2000) for this study, a point may have multiple vegetation “hits” where species overlap, and thus absolute cover summed across categories generally adds up to greater than 100 percent.

AECOM staff directly followed the step-point methodology thoroughly described by USDI/BLM (1996), as referenced by Harris and Lindquist (2000). However, upon analyzing 2011 data and comparing with the data presented by Harris and Lindquist (2000), it became apparent that Harris and Lindquist, in fact, followed a modified version of their stated field methods and only recorded one lifeform type per point regardless of vegetation overlap. In their data, all cover categories per transect (including bare ground and water) sum exactly to 100 percent. Initially AECOM staff thought perhaps their data were relativized to present proportions (although bare ground and water were also included); however, some of their data are presented as frequencies that sum exactly to 200, indicating that this was not an artifact of proportion calculations. Since there is a great degree of vegetation overlap in these riparian communities, and AECOM staff did not know how Harris and Lindquist chose what to record at each point along their transects, AECOM could not have duplicated their methods even if AECOM had realized this modified methodology prior to the 2011 monitoring. As a result, the data AECOM collected in 2011 following the described methods (which allow for multiple species/lifeform hits at each point) are not directly quantitatively comparable to the data collected in 2000. However, qualitative comparisons between years can be made. Future monitoring efforts following USDI/BLM (1996) methods will be directly comparable to these 2011 data. Also, permanent transects and/or GPS locations were established in 2011, thus making future monitoring data more directly comparable.

AECOM also calculated relative cover of each lifeform group for analysis; this measure is a proportional cover value that excludes unvegetated areas from consideration (e.g., barren or open water) and better conveys relative dominance or prevalence of lifeform groups across sites that differ in the amount of total vegetative cover. For a transect, relative cover of a lifeform group is calculated as its absolute cover divided by the sum of the cover of all lifeform groups. As Harris and Lindquist noted, excluding non-vegetated areas from consideration of vegetation cover is potentially of interest in this study because Caples Creek had a particularly wide stream channel with more open water and exposed gravel than the other sites, thus leading to reduced absolute cover by vegetation categories. The meadow floodplain around the low-flow channel of the SFAR at Audrain monitoring site also had considerable cover by open water.

Statistical analyses were performed to determine if there were significant differences between cover (both absolute and relative) of different vegetation categories on regulated versus unregulated streams. Analyses were conducted using JMP 9.0 (SAS Institute, 2010) and Microsoft Office Excel (2007).

AECOM focused on analyzing transect cover values rather than presence/absence at individual points (which was the approach of the 2000 study). Statistical analyses require independent data points, and AECOM did not consider data points at one-foot intervals along a transect to be independent of each other. Thus AECOM considered transects to be the unit of sampling for purpose of statistical analyses. AECOM also conducted Analysis of Variance (ANOVA) analyses to determine whether any cover values differed significantly between transects on regulated and unregulated streams (with regulated/unregulated treatment degrees of freedom (df)=1 and error df =12). Except where noted, data met ANOVA assumptions of normality and homoscedascicity of residuals without transformation. Where a response variable had significantly different variances between regulated and unregulated transects (violating an assumption of ANOVA), t-tests for unequal variances were used.

However, to retain comparability with the Harris and Lindquist study (2000), AECOM also conducted chi-square analyses on the frequency data treating individual points as sampling units as discussed below.

RESULTS

A total of 14 transects were conducted across seven sites. Seven of these transects were located at sites with regulated streamflow (Caples Creek and South Fork American River), while the other seven were located at sites with unregulated streamflows in the project area (Exhibit 1). Transect data and statistical comparisons of cover at regulated and unregulated sites are summarized herein. Appendix A lists plant species typical of each site. Appendix B presents transect location data and transect photographs.

Table 1 presents absolute cover data for each lifeform group and cover by abiotic categories (i.e., bare ground, rock, litter and water) where no vegetation was present. Data for each transect are presented along with means and calculated standard errors pooled for regulated and unregulated sites. Absolute cover data, grouped as in Harris and Lindquist (2000), are graphically presented for regulated and unregulated streams in Exhibit 2.

Table 2 presents relative cover values for vegetation categories of Harris and Lindquist (2000), where relative cover is a measure of proportional vegetative cover after excluding exposed open water and other unvegetated portions of the transect, and accounting for overlapping vegetation layers. For these relative cover data, Exhibit 3 presents a graphical comparison of regulated and unregulated sites.

To compare results with those found by Harris and Lindquist (2000), AECOM conducted chi-square analyses on presence/absence data for the same categories they used (shown in Exhibit 2) across all points. This analysis method considers individual points as the unit of sampling rather than transects, and is thus more likely to show significant effects than a more conservative ANOVA approach based on transects as the unit of sampling. The chi-square analyses indicated that frequencies of sedges/rushes and forbs were significantly higher on unregulated streams than on regulated streams ($p<0.001$). Chi-square analyses also indicated significantly greater exposed water frequencies on regulated streams than on unregulated streams ($p<0.001$).

Table 1
Absolute Cover (%) by Category and Transect

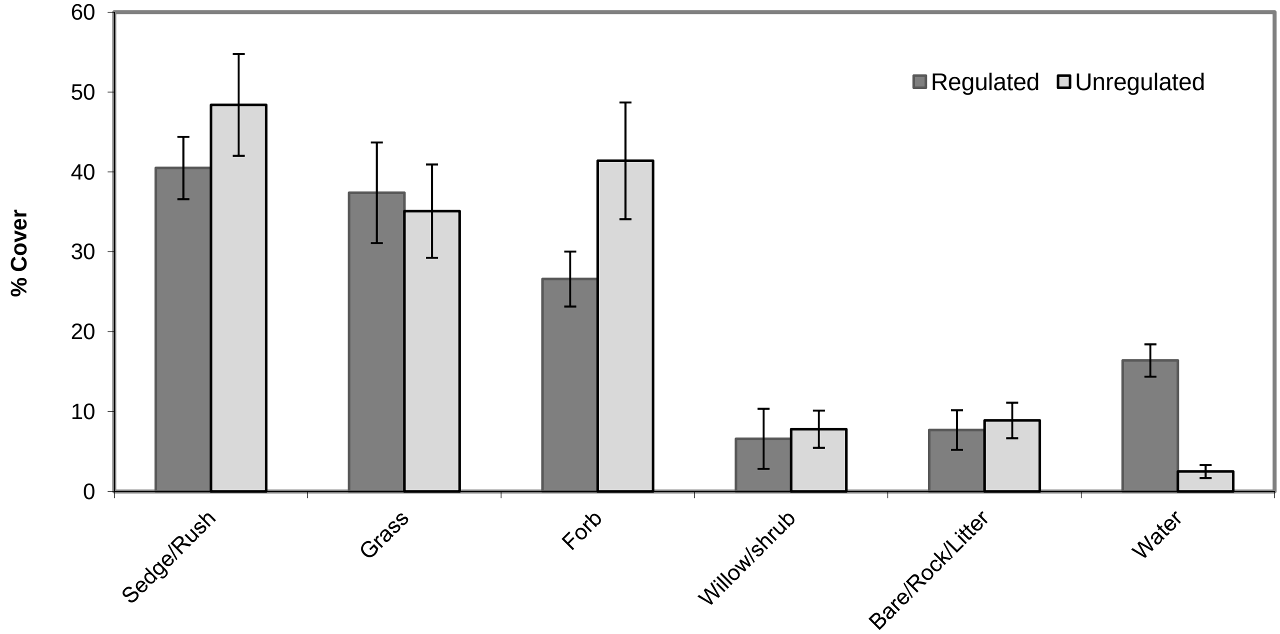
Site and Transect	Flow Type	Sedge	Grass	Rush	Forb	Shrub	Willow	Tree	Bare	Rock	Litter	Water
Caples Creek 1	Regulated	45.5	51	0	16	0	5	0	7	0	5	12
Caples Creek 2	Regulated	25	46.5	0	39.5	1.5	26.5	0	3	12	1	12
Caples Creek 3	Regulated	33.5	54	0	25	0	9	21.5	2	0	1.5	14.5
Caples Creek 4	Regulated	45	29	0	23.5	0	3.5	9.5	1	11	3.5	11
Caples Creek 5	Regulated	32	48.5	0	22	0	1	0	1	0	2	19.5
SFAR at Audrain 1	Regulated	40.5	12	10	39	0	0	0	3	0	0.5	24.5
SFAR at Audrain 2	Regulated	48.5	20.5	3.5	21	0	0	0	0.5	0	0	21.5
Mean ± 1 SE		*38.6±3.3*	*37.4±6.3*	*1.9±1.4*	*26.6±3.4*	*0.2±0.2*	*6.4±3.6*	*4.4±3.1*	*2.5±0.8*	*3.3±2.1*	*1.9±0.7*	*16.4±2.0*
Benwood Meadow 1	Unregulated	61.5	30.5	2	18	0	0	0	10.5	0	2	2
Bryan Meadow 1	Unregulated	27	56	0	53.5	0	6	0	4	0	1	0
Bryan Meadow 2	Unregulated	60	50	0	30	0	12.5	0	2.5	0	1.5	0.5
Foster Meadow 1	Unregulated	17	24.5	5.5	75	0	0	0	4.5	0	2	4
Kirkwood Creek 1	Unregulated	42	30.5	16.5	50.5	0	16	0	2.5	0	2.5	5.5
Kirkwood Creek 2	Unregulated	28	11.5	31	31	0	8.5	0	17.5	1.5	1.5	4.5
Round Meadow 1	Unregulated	46	43	2	31.5	0	11.5	0	5.5	0	3.5	1
Mean ± 1 SE		*40.2±6.4*	*35.1±5.8*	*8.1±4.4*	*41.4±7.3*	*0±0*	*7.8±2.3*	*0±0*	*6.7±2.1*	*0.2±0.2*	*2.0±0.3*	*2.5±0.8*

Notes: Absolute percent cover is calculated for each group as the number of hits on a transect for each category divided by the total number of points on the transect (200). Due to overlapping vegetation layers, these cover values sum to greater than 100 percent. SE = standard error

Table 2
Relative Cover (%) by Lifeform Group and Transect

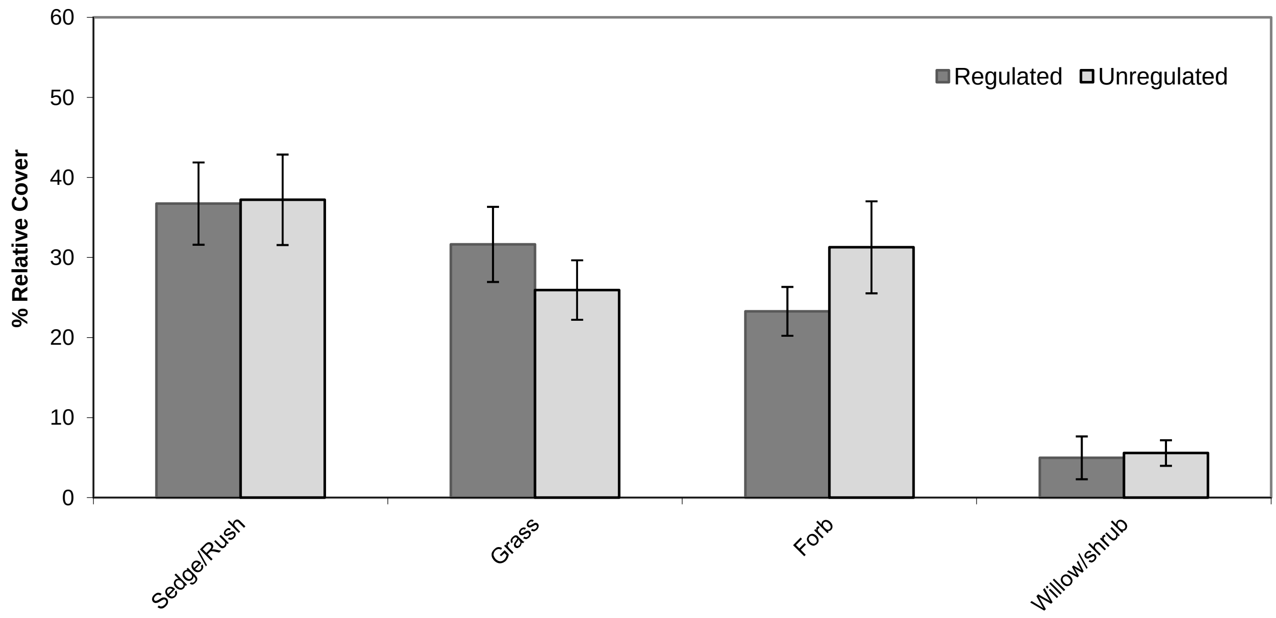
Site and Transect	Flow Type	Sedge	Grass	Rush	Forb	Shrub	Willow	Tree
Caples Creek 1	Regulated	38.7	43.4	0.0	13.6	0.0	4.3	0.0
Caples Creek 2		18.0	33.5	0.0	28.4	1.1	19.1	0.0
Caples Creek 3		23.4	37.8	0.0	17.5	0.0	6.3	15.0
Caples Creek 4		40.7	26.2	0.0	21.3	0.0	3.2	8.6
Caples Creek 5		30.9	46.9	0.0	21.3	0.0	1.0	0.0
SFAR at Audrain 1		39.9	11.8	9.9	38.4	0.0	0.0	0.0
SFAR at Audrain 2		51.9	21.9	3.7	22.5	0.0	0.0	0.0
Mean ± SE		*34.8±4.4*	*31.6±4.7*	*1.9±1.4*	*23.3±3.1*	*0.2±0.2*	*4.8±2.5*	*3.4±2.3*
Benwood Meadow 1	Unregulated	54.9	27.2	1.8	16.1	0.0	0.0	0.0
Bryan Meadow 1		18.9	39.3	0.0	37.5	0.0	4.2	0.0
Bryan Meadow 2		39.3	32.8	0.0	19.7	0.0	8.2	0.0
Foster Meadow 1		13.9	20.1	4.5	61.5	0.0	0.0	0.0
Kirkwood Creek 1		27.0	19.6	10.6	32.5	0.0	10.3	0.0
Kirkwood Creek 2		25.5	10.5	28.2	28.2	0.0	7.7	0.0
Round Meadow 1		34.3	32.1	1.5	23.5	0.0	8.6	0.0
Mean ± 1 SE		*30.6±5.2*	*25.9±3.7*	*6.7±3.9*	*31.3±5.7*	*0±0*	*5.6±1.6*	*0±0*

Notes: Relative percent cover is calculated for each group as the absolute cover by that group divided by the sum of absolute cover by all vegetation groups. Thus, relative cover values sum to 100 percent, and are irrespective of differences that may occur among transects in terms of channel width/open water or bare ground.
SE = standard error



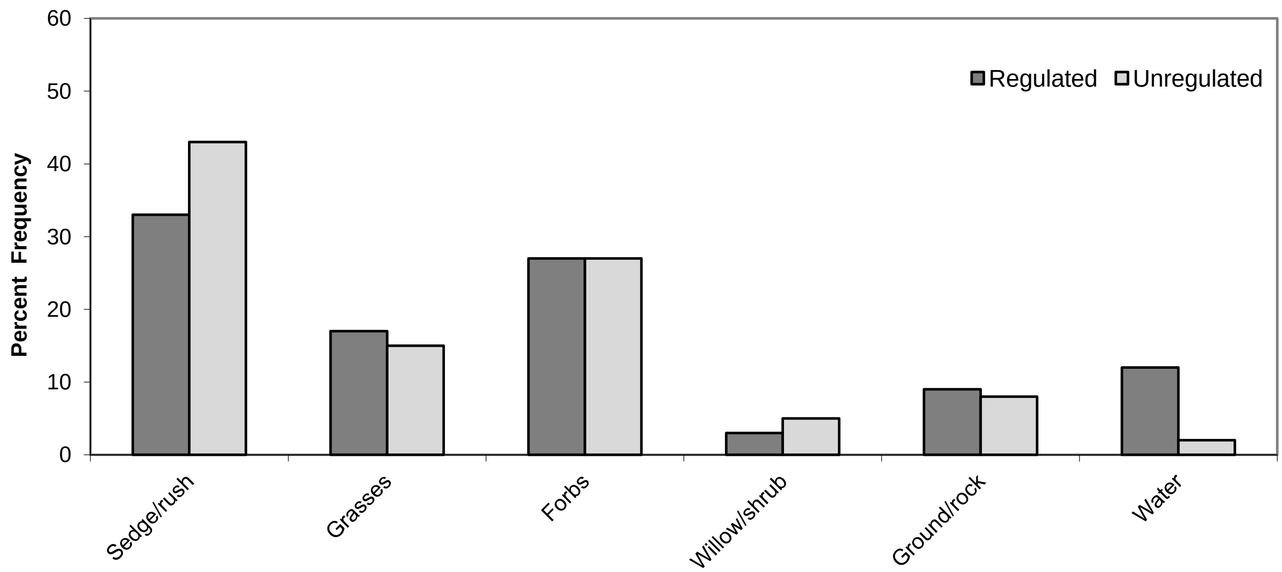
Notes: Lifeform categories are grouped as in Harris and Lindquist (2000), with bare/rock/litter and open water (no vegetation) also shown.
Means ± 1 standard error (SE) are shown for 7 regulated and 7 unregulated transects.

Exhibit 2 Comparison of Absolute Percent Cover Values of Regulated and Unregulated Sites in 2011



Notes: Lifeform categories are grouped as in Harris and Lindquist (2000) across regulated and unregulated streamflow sites.
Relative cover is calculated as the absolute cover of each lifeform group on a transect divided by the sum of absolute cover across lifeforms, and thus is a measure of proportion of vegetation dominance, excluding differences across sites with regards to quantity of open water or exposed bare ground.
Means ± 1 standard error (SE) are shown for 7 regulated and 7 unregulated transects.

Exhibit 3 Comparison of Relative Cover Values of Regulated and Unregulated Sites in 2011



Notes:
Figure is from Harris and Lindquist (2000).
Numbers are not directly comparable with 2011 data (see Methods for explanation) but qualitative comparisons with Exhibit 2 indicate that differences between regulated and unregulated streams have not dramatically changed since 2000.

Exhibit 4 Frequency Percentages at Regulated and Unregulated Sites in 2000.

However, when percent cover by categories was compared across regulated and unregulated streamflow transects using ANOVA (and where needed, t-tests for unequal variances on transect-level cover data), most of these differences were not statistically significant. Only cover by water remained significantly different between streamflow types; this result is also apparent in Exhibit 2. Cover by water had unequal variance across streamflow types (more variable at regulated sites), so an unequal variance t-test was used (and was significant at $p<0.001$).

Relative cover for vegetation categories was also compared statistically across regulated and unregulated streamflow sites using ANOVA or unequal variance t-tests where needed. Most relative lifeform categories did not require transformation to meet assumptions, except for willow/shrub relative cover, which was log transformed and for which an unequal variance t-test was required for comparisons of regulated and unregulated sites. However, no statistically significant differences in relative cover were detected for any lifeform group ($p>0.10$ for all comparisons).

DISCUSSION

Species composition did not statistically differ between regulated and unregulated streamflow sites in 2011 (Appendix A). All sites had dense herbaceous communities with nearly complete vegetative cover except where open water or gravel bars were present, with exposed bare ground, rock, and litter comprising less than 20 percent absolute cover on each transect (Table 1). Kirkwood Meadow had noticeably greater bare ground than other areas (particularly Transect 2); this was likely because of grazing and disturbance by horses.

Cover did not significantly differ between regulated and non-regulated streams using ANOVA analysis for any vegetation or cover category, whether evaluating absolute or relative cover values. Among sites, vegetation differed in the relative composition by lifeforms (see Tables 1 and 2 and Exhibits 2 and 3); but these differences were not statistically significant. However, some differences in vegetation category frequencies were statistically significant using the chi-square analysis methodology that was used by Harris and Lindquist (2000), which treats points as the unit of sampling rather than transects. The chi-square analysis on vegetation frequency data indicated that 2011 cover by sedges/rushes and forbs was significantly greater on unregulated streams than on regulated streams.

It is difficult to draw conclusions from these results regarding differences in lifeform cover between sites with regulated and unregulated streamflow. One difficulty is that many lifeform groups do not uniformly represent specific hydrological or ecological requirements. Sedges and rushes are typical wet meadow plants, and have especially high value for streambank stabilization. Some sedges are associated with dry upland areas in the Sierra Nevada, but essentially all sedges observed at these monitoring sites were hydrophytic (associated with wetter sites). Similarly, grasses can include upland or wetland species and many of the grasses observed in this study are hydrophytic. Forbs include all broad-leaved herbaceous plants, for example clover, yarrow, and lupines, and also include species associated with wetter and drier sites. Thus, as a lifeform group, forbs are probably not a reliable indicator of hydrologic conditions in this region. Willows are riparian-associated species, but no differences in willow cover were detected between regulated and unregulated streams using either analysis method. Tree cover consisted entirely of scattered stands of lodgepole pines (*Pinus contorta*) in the Caples Creek corridor; this species was mostly confined to the margins of the other sampled meadows and thus not present along transects sampled at other sites.

Cover by exposed open water was significantly greater at regulated streamflow sites compared to unregulated streamflow sites. The two regulated streamflow sites (SFAR at Audrain and Caples Creek) differ from one another hydrologically and ecologically, but both had more extensive surface water than the unregulated streamflow meadows at the time of sampling. The SFAR at Audrain Meadow site had a narrow and shallow low-flow channel at grade with the rest of the meadow and not visually apparent from afar. During the time of sampling in 2011, the low-flow channel was overbanked and much of the area was under an inch or two of water for most of the length of the transects. The cover by water category analyzed in this report only considered “exposed” water where vegetation was not also present, but if ground-level “hits” of water that also had vegetation present are also considered, SFAR at Audrain transects were 70 to 99 percent covered by very shallow water at the time of sampling (September 8 and 10, 2011). The vegetation of this meadow was diverse and characterized by species with very high moisture requirements (for example, buckbean, gentian, and hooded ladies-tresses; see Appendix A).

In comparison, Caples Creek had a wide, meandering and visually obvious channel that was incised below the level of the surrounding floodplain, and was characterized by higher peak flows and fluvial deposition and sediment movement than the other stream reaches considered. The greater cover by open water at this site was the result of a wide creek channel, not standing water in the meadow or floodplain. Unregulated streamflow sites were mostly intermediate between Caples Creek and the SFAR at Audrain site in terms of surface soil moisture around the low-flow channel; these sites were all characterized by relatively narrow low-flow channels with water levels near or just below the grade of the surrounding meadows at the time of sampling.

As mentioned previously, 2000 and 2011 riparian composition data are not directly statistically comparable, because the field methods used in 2000 apparently differed from the referenced methods, and these differences were not documented (see Methods). Also, transect locations had to be reestablished in 2011 because no data on specific transect locations from 2000 were available. The apparent 2000 methodology would have resulted in smaller cover values than the referenced methods (USDI/BLM 1996), which were used in 2011 data collection. Thus, in the absence of any change in cover during 2000–2011, 2011 cover values for individual vegetation categories would be somewhat greater than those presented in the 2000 report. The 2000 relative cover values by lifeform group may be closer approximates to the percent frequency values they were presented as, but are also not directly comparable to 2011 data.

However, a qualitative comparison of the 2011 data to the 2000 data reveals that differences between regulated and unregulated streams have not apparently increased over time. Harris and Lindquist (2000) found statistically significant differences in frequencies of all lifeform groups between regulated and unregulated streams using chi-square analyses on point data. However, chi-square analyses of 2011 data only identified significant relationships between lifeform group and stream type (regulated versus unregulated) for sedges/rushes and forbs with slightly greater frequencies on unregulated streams than regulated streams; Harris and Lindquist had found the opposite trend for forbs in 2000. These differences were not significant using transect-level ANOVA or t-test analyses.

The figure from the Harris and Lindquist 2000 report which compares cover across regulated and unregulated streamflow sites is presented as Exhibit 4 for qualitative comparison. Comparing the 2000 data in Exhibit 4 with the 2011 data in Exhibit 2 indicates that the qualitative differences between regulated and unregulated sites remain essentially the same, with slightly less sedge/rush cover, slightly more grass cover, and much greater water cover on regulated sites (which was a significant difference between stream types during both monitoring periods). One difference between 2000 and 2011 monitoring results was that the 2011 data indicated a trend towards higher forb frequencies/cover on unregulated sites in 2011 (which was statistically significant using a chi-square test), while Harris and Lindquist found statistically greater forb frequencies on regulated sites in 2000.

CONCLUSIONS

The 2000 and 2011 riparian vegetation composition monitoring results indicate that both regulated and unregulated stream sites have robust and diverse herbaceous riparian communities, with no obvious ecological conversion to upland conditions over the period of monitoring. Differences in cover or frequencies of vegetation lifeform categories between regulated and unregulated sites were generally biologically insignificant (means differed little between site types) and/or statistically insignificant when analyzing transect-level data. Differences noted in forb cover (greater at regulated sites in 2000 and trending towards greater at unregulated sites in 2011) are ecologically inconclusive, since forbs as a group are not a reliable hydrological indicator. Furthermore, more statistical differences were found in 2000 than in 2011 indicating that differences between regulated and unregulated sites for most measured variables have, if anything, lessened over time.

REFERENCES

USDI/BLM. 1996. Sampling vegetation attributes: integrated technical reference. USDI/BLM. Report No. BLM/RS/ST-96/002-1730. Available online at: http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb1044175.pdf

Harris, R.R. and D. Lindquist. 2000. Composition of Riparian Herb Communities on Streams with Regulated and Unregulated Streamflow, El Dorado National Forest, California. October, 2000. Available online at: http://www.project184.org/doc_lib/documents/2010/2010ERCmaterials/AppendixA-2000a.pdf

EID. *See* El Dorado Irrigation District.

El Dorado Irrigation District [EID]. 2010. Riparian Vegetation Species Composition Monitoring Plan, FERC Project No. 184. Version 1.0 July, 2010. Available online at: http://www.project184.org/doc_lib/documents/2011/RVCMP-FINAL.pdf

_____. 2009. Caples Lake Main Dam Emergency Repair Project: Caples Creek Stream Channel and Riparian Community Monitoring Report November 2008 to July 2009. Prepared by EN2 Resources. September 8, 2009. Available online at: http://www.project184.org/doc_lib/documents/2010/2008-2009_CaplesRiparianStreamMonRpt.pdf

Kattelmann, R. and M. Embury. 1996. Riparian areas and wetlands. Sierra Nevada Ecosystem Project: Final Report to Congress, vol. 111, Assessments, Commissioned Reports, and Background information. Davis: University of California, Centers for Water and Wildland Resources Report No. 38. Available online at: http://pubs.usgs.gov/dds/dds-43/VOL_III/VIII_C05.PDF

Ponce, V.M. and D.S. Lindquist, 1990. Management of Baseflow Augmentation: A Review. *Water Resources Bulletin* **26**: 259–268.

APPENDIX A

Plant Species Observed

Species lists compiled during riparian vegetation composition data collection, September 8–28, 2011. Site lists include species observed on transects or otherwise prevalent at the site and are not comprehensive.

Scientific Name	Common Name
Caples Creek	
Achillea millefolium	yarrow
Antennaria corymbosa	flat-top pussytoes
Artemisia douglasiana	mugwort
Aster occidentalis	western mountain aster
Calamagrostis canadensis	bluejoint
Carex heteronuera	different-nerve sedge
Carex leporinella	bog hare sedge
Carex nebrascensis	Nebraska sedge
Carex sp.	sedge
Carex utriculata	southern beaked sedge
Castilleja miniata	giant paintbrush
Dactylis glomerata	orchardgrass
Deschampsia caespitosa	tufted hairgrass
Elymus glaucus	blue wildrye
Epilobium ciliatum	hairy willowherb
Erigeron coulteri	Coulter’s daisy
Festuca rubra	red fescue
Galium trifidum	trifid bedstraw
Gentiana newberryi	alpine gentian
Gnaphalium palustre	cudweed
Heracelum lanatum	cow parsnip
Hordeum brachyantherum	meadow barley
Ligusticum grayi	Gray’s lovage
Lupinus polyphyllus	large-leaved lupine
Lupinus sp.	lupine
Mertensia ciliata var. *stomatechoides*	bluebell
Muhlenbergia filiformis	slender muhly
Pinus contorta	lodgepole pine
Poa sp.	bluegrass
Polygonum bistortoides	bistort
Potentilla gracilis	slender cinquefoil
Ribes nevadense	Sierra currant
Rumex paucifolius	alpine sheep sorrel
Salix lemmonii	Lemmon’s willow
Salix lucida	shining willow

Scientific Name	Common Name
Senecio triangularis	arrowleaf ragwort
Smilacena stellata	starry false lily of the valley
Solidago canadensis	Canada goldenrod
Taraxacum officinale	common dandelion
Thalictrum fendleri	Fendler's meadow-rue
Torreyochloa pallida	California alkali grass
Trifolium longipes	longstalk clover
Veratrum californicum	corn lily
Veronica peregrina	purslane speedwell
South Fork American River at Audrain	
Aster alpigenus ssp. *andersonii*	alpine aster
Carex limosa	mud sedge
Carex nebrascensis	Nebraska sedge
Carex utriculata	southern beaked sedge
Carex sp.	sedge
Dodecatheon alpinum	alpine shootingstar
Eleocharis sp.	spikerush
Gentiana calycosa	explorer's gentian
Juncus balticus	mountain rush
Juncus dubius	questionable rush
Menyanthes trifoliata	buckbean
Muhlenbergia filiformis	slender muhly
Polygonum bistortoides	bistort
Potentilla gracilis	slender cinquefoil
Salix eastwoodiae	Eastwood's willow
Salix lutea	yellow willow
Spiranthes romanzoffiana	hooded ladies-tresses
Trifolium longipes	longstalk clover
Benwood Meadow	
Achillea millefolium	yarrow
Allium validum	swamp onion
Aster alpigenus ssp. *andersonii*	alpine aster
Carex nebrascensis	Nebraska sedge
Carex sp.	sedge
Deschampsia caespitosa	tufted hairgrass
Deschampsia elongata	slender hairgrass
Dodecatheon alpinum	alpine shootingstar
Eleocharis sp.	spikerush
Erigeron sp.	wild daisy

Scientific Name	Common Name
Juncus orthophyllus	straightleaf rush
Muhlenbergia filiformis	slender muhly
Pedicularis attollens	little elephant heads
Perideridia parishii	yampah
Polygonum bistortoides	bistort
Salix eastwoodiae	Eastwood's willow
Sphenosciadium capitellatum	ranger's buttons
Bryan Meadow	
Agrostis sp.	bentgrass
Allium validum	swamp onion
Aster alpigenus ssp. *andersonii*	alpine aster
Caltha leptosepala	white marsh marigold
Carex sp.	sedge
Carex echinata ssp. *echinata*	star sedge
Deschampsia caespitosa	tufted hairgrass
Deschampsia elongata	slender hairgrass
Dodecatheon alpinum	alpine shootingstar
Eleocharis sp.	spikerush
Epilobium ciliatum	hairy willowherb
Hordeum brachyantherum	meadow barley
Mimulus guttatus	seep monkeyflower
Mimulus primuloides	primrose monkeyflower
Muhlenbergia filiformis	slender muhly
Perideridia parishii	yampah
Pinus contorta	lodgepole pine
Polygonum bistortoides	bistort
Rumex salicifolius	willow dock
Salix eastwoodiae	Eastwood's willow
Salix orestra	Sierra willow
Sambucus racemosa	red elderberry
Senecio scorzonella	Sierra ragwort
Senecio triangularis	arrowleaf ragwort
Trifolium longipes	longstalk clover
Veratrum californicum	corn lily
Foster Meadow	
Achnatherum nelsonii	Columbia needlegrass
Agrostis sp.	bentgrass
Aster alpigenus ssp. *andersonii*	alpine aster
Aster occidentalis	western mountain aster

Scientific Name	Common Name
Carex sp.	sedge
Carex aquatilis var. *aquatilis*	water sedge
Carex utriculata	southern beaked sedge
Danthonia californica	California oatgrass
Delphinium glaucum	mountain larkspur
Eleocharis sp.	spikerush
Epilobium ciliatum	hairy willowherb
Erigeron coulteri	Coulter's daisy
Eriogonum spergulinum	spurry buckwheat
Gnaphalium palustre	cudweed
Heracelum lanatum	cow parsnip
Juncus dubius	questionable rush
Juncus xiphioides	iris-leaved rush
Lupinus polyphyllus	large-leaved lupine
Mimulus guttatus	seep monkeyflower
Mimulus primuloides	primrose monkeyflower
Muhlenbergia filiformis	slender muhly
Perideridia parishii	yampah
Polygonum bistortoides	bistort
Potentilla gracilis	slender cinquefoil
Senecio triangularis	arrowleaf ragwort
Torreyochloa pallida	California alkali grass
Veratrum californicum	corn lily
Kirkwood Meadow	
Achillea millefolium	yarrow
Aster occidentalis	western mountain aster
Carex sp.	sedge
Carex illota	sheep sedge
Carex leporinella	bog hare sedge
Carex nebrascensis	Nebraska sedge
Deschampsia caespitosa	tufted hairgrass
Juncus sp.	rush
Juncus xiphioides	iris-leaved rush
Lupinus sp.	lupine
Muhlenbergia filiformis	slender muhly
Perideridia parishii	yampah
Poa sp.	bluegrass
Polygonum bistortoides	bistort
Achnatherum nelsonii	Columbia needlegrass

Scientific Name	Common Name
Agrostis scabra	rough bentgrass
Antennaria sp.	pussytoes
Carex filifolia	threadleaf sedge
Carex utriculata	southern beaked sedge
Castilleja miniata	giant paintbrush
Eriogonum spergulinum	spurry buckwheat
Gayophytum diffusum	ground smoke
Juncus covillei	Coville's rush
Juncus mexicanus	Mexican rush
Mimulus primuloides	primrose monkeyflower
Penstemon heterodoxus	Sierra penstemon
Potentilla drummondii	Drummond's cinquefoil
Potentilla glandulosa	glandular cinquefoil
Potentilla gracilis	slender cinquefoil
Salix eastwoodiae	Eastwood's willow
Salix lemmonii	Lemmon's willow
Salix lucida	shining willow
Salix orestra	Sierra willow
Trifolium longipes	longstalk clover
Trifolium sp.	clover
Veratrum californicum	corn lily
Round Meadow	
Aster occidentalis	western mountain aster
Calamagrostis canadensis	bluejoint
Carex leporinella	bog hare sedge
Carex nebrascensis	Nebraska sedge
Carex utriculata	southern beaked sedge
Deschampsia caespitosa	tufted hairgrass
Hordeum brachyantherum	meadow barley
Juncus balticus	mountain rush
Polygonum bistortoides	bistort
Polygonum douglasii	Douglas' knotweed
Salix jepsonii	Jepson's willow
Senecio scorzonella	Sierra ragwort
Trifolium longipes	longstalk clover

APPENDIX B

Transect Locations and Photographs

Transects were reestablished in 2011 following methods described in Harris and Lindquist (2000). Caples Creek transects 1–3 were established in 2008 for an emergency dam repair monitoring project (EID 2009) and resampled for this study.

Table B-1
Transect Locations

Site and Transect	Start/End	Latitude (d.dd° N)	Longitude (d.dd° W)
Benwood Meadow 1	Start	38.80116	120.03179
	End	38.8013	120.03114
Bryan Meadow 1	Start	38.78074	120.05779
	End	38.78122	120.05753
Bryan Meadow 2	Start	38.7802	120.05654
	End	38.78075	120.05624
Caples Creek 1	Start	38.7084	120.06979
	End	38.7089	120.06984
Caples Creek 2	Start	38.70888	120.07187
	End	38.70942	120.07188
Caples Creek 3	Start	38.70884	120.07309
	End	38.70937	120.07303
Caples Creek 4	Start	38.70913	120.0713
	End	38.70906	120.07065
Caples Creek 5	Start	38.7098	120.06822
	End	38.71038	120.06821
Foster Meadow 1	Start	38.59382	120.24481
	End	38.59348	120.24441
Kirkwood Meadow 1	Start	38.70067	120.07335
	End	38.70045	120.07397
Kirkwood Meadow 2	Start	38.69881	120.07282
	End	38.69837	120.0732
Round Meadow 1	Start	38.76712	120.06681
	End	38.76767	120.0666
South Fork American River 1	Start	38.82459	120.05153
	End	38.82409	120.05166
South Fork American River 2	Start	38.82445	120.05245
	End	38.82394	120.05235

Note:
Latitude and longitude are given in decimal degrees for transect start and endpoints (datum WGS84).


View NE of start of Benwood Meadow Transect 1


View SW of end of Benwood Meadow Transect 1

View north of start of Bryan Meadow Transect 1

View south of end of Bryan Meadow Transect 1

View north of start of Bryan Meadow Transect 2

View south of end of Bryan Meadow Transect 2

View north of start of Caples Creek Transect 1

View south of end of Caples Creek Transect 1

View north of start of Caples Creek Transect 2

View south of end of Caples Creek Transect 2

View north of start of Caples Creek Transect 3

View south of end of Caples Creek Transect 3


View east of start of Caples Creek Transect 4


View west of end of Caples Creek Transect 4


View north of start of Caples Creek Transect 5


View south of end of Caples Creek Transect 5

View east of start of Foster Meadow Transect 1

View west of end of Foster Meadow Transect 1

View SW of start of Kirkwood Meadow Transect 1

View NE of end of Kirkwood Meadow Transect 1

View south of start of Kirkwood Meadow Transect 2

View north of end of Kirkwood Meadow Transect 2

View north of start of Round Meadow Transect 1

View south of end of Round Meadow Transect 1

View south of start of South Fork American River at Audrain Transect 1

View north of end of South Fork American River at Audrain Transect 1

View SE of start of South Fork American River at Audrain Transect 2

View NW of end of South Fork American River at Audrain Transect 2