Boundary Hydroelectric Project (FERC No. 2144)

Study No. 13

Recreational Fishery Study

Final Report

Prepared for
Seattle City Light

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Study No. 13: Recreational Fishery Study
Final Report
Boundary Hydroelectric Project (FERC No. 2144)

1 INTRODUCTION

Recreational fishing (boat and bank) is one of the activities enjoyed at the Boundary Hydroelectric Project (Project) (Federal Energy Regulatory Commission [FERC] No. 2144). Information on the current level of recreational fishing activity in Boundary Reservoir was sparse at the time the relicensing process began, and additional information was needed to characterize recreational fishing resources and demand for recreational fishing opportunities at the Project. Recreational fishing in Boundary Reservoir and its tributaries is regulated by the Washington Department of Fish and Wildlife (WDFW) (see WDFW [2008] for current fishing regulations). Boundary Reservoir is currently open the entire year.

Sterile triploid rainbow trout have been planted at the Project to increase sport fishing harvest while minimizing the risk of hybridization with native species. Planting triploid rainbow trout as part of a recreational fish enhancement program can help balance the demands for both consumptive fishing opportunities and conservation of native stocks.

Information on the distribution and abundance of sport fish species was developed through Study 9, Fish Distribution, Timing, and Abundance Study Final Report (SCL 2009a). Study 13, Recreational Fishery Study (this study), was designed to obtain information about the level of effort and harvest in the recreational fishery and the level of angler satisfaction. Because Study 21, Recreation Resource Study Final Report (SCL 2009b), includes similar information and data collection methods, components of the two studies have been closely coordinated. Study 13 was also designed to obtain information regarding the movements, growth, and survival of stocked triploid rainbow trout and their contribution to the sport fishery in Boundary Reservoir.

Study 13 was conducted in support of the relicensing of the Project, as identified in the Revised Study Plan (RSP; SCL 2007) submitted by Seattle City Light (SCL) on February 14, 2007, and approved by the FERC in its Study Plan Determination letter dated March 15, 2007. This final report describes all field efforts, analyses, and the determination of Project effects and represents the completion of the study.

Study 13 had three main components:

- Recreational Creel and Angler Surveys
- Triploid Rainbow Trout Biotelemetry
- Triploid Rainbow Trout Management

The following discussion centers on presentation of data collected and analyzed under these three study components during the 2007 and 2008 study periods.

1.1. Recreational Creel and Angler Surveys

As noted above, the sport fishing season in Boundary Reservoir is open year-round while tributaries have open seasons from June 1 to October 31 (WDFW 2008). The daily limit for retaining trout (other than bull trout) is typically 5 fish of any size per angler, which is consistent with the WDFW 2007/2008 and 2008/2009 regulations for Boundary Reservoir. The daily limits for smallmouth bass (*Micropterus dolomieu*) and mountain whitefish (*Prosopium williamsoni*), both important local sportfish, are 10 and 15 fish per day, respectively. There is no minimum size limit for either species, but only 1 smallmouth bass over 14 inches may be retained. Additional details on size limits, catch limits, and seasons on these and other fish species can be found in the WDFW sport fishing regulations (WDFW 2008).

As noted above, baseline information on the level of recreational fishing activity in Boundary Reservoir was sparse, and additional information was needed to characterize the available recreational fishing resources, their current level of use, and the demand for recreational fishing opportunities at the Project.

Boundary Reservoir currently supports a recreational fishery that targets planted triploid rainbow trout and naturally reproducing populations of non-native warm and cool water species such as smallmouth bass and yellow perch (*Perca flavescens*). A baseline fisheries assessment conducted in 2000 indicated that most of the fish in Boundary Reservoir are not major sport species, as the authors determined that less than 9 percent were found to be trout or bass (McLellan and O'Connor 2001).

Access to Boundary Reservoir for recreational fishing occurs primarily from three boat ramps. SCL operates one boat ramp located at the Forebay Recreation Area. Other boat ramps are located at Metaline Waterfront Park (operated by the Town of Metaline) and near Box Canyon Dam at Campbell Park (operated by the Pend Oreille County Public Utility District [PUD]). Access for bank fishing occurs at these boat ramps and at other locations where roads provide access to or near the shoreline. Most of the shoreline access for bank fishing occurs in the upper reach of the reservoir.

Creel surveys are a useful method for understanding what species and how many fish are being captured in the sport fishery and where sport fishing effort is expended. During the summer of 1997, creel surveys indicated the Upper Reservoir Reach (the reach from Metaline Falls to Box Canyon Dam) was the most heavily fished area of the reservoir (R2 Resource Consultants 1998). Over 92 percent of the fishing effort in Boundary Reservoir was expended in the Upper Reservoir Reach on the 17 days surveyed over a 6-week period. Northern pikeminnow (*Ptychocheilus oregonensis*) were the most commonly caught sport fish (1.4 fish per hour) in the 1997 summer recreational fishery, although northern pikeminnow are not considered a popular catch. Rainbow trout (*Oncorhynchus mykiss*) were the second most commonly captured fish in the recreational fishery, but at a much lower frequency (less than 0.1 fish per hour) than northern pikeminnow. Excluding northern pikeminnow, combined sport fish catch rates in the Upper Reservoir Reach during the summer of 1997 were less than 0.2 sport fish per hour and 1.2 sport fish per angler (R2 Resource Consultants 1998).

In contrast, creel surveys at Box Canyon Reservoir between 1948 and 1969 yielded an average of approximately 3.5 sport fish per angler hour (FERC 2004). No information is available from the 1997 survey in Boundary Reservoir on whether northern pikeminnow were killed and discarded, kept, or released unharmed after capture. Presumably, most legal-sized trout were retained by anglers, but records for triploid rainbow trout suggest that some anglers release a substantial number of captured triploid rainbow trout (Solonsky 2005, as cited in SCL 2007).

Since 2002, the two-day annual springtime Bassin' Assassin Derby, hosted by the Western Star Bar and Grill (in Metaline), has been held in Boundary Reservoir. Only smallmouth bass caught by anglers are counted in the derby results. During 2006, SCL took advantage of the event to collect information on recreational fishing. SCL staff developed a questionnaire and used it to interview 59 anglers from 24 boats. A total of 135 anglers entered the derby, and 55 fish were weighed-in over the two-day event. The size of smallmouth bass recorded ranged from less than 1 pound to 4.1 pounds. Anglers reported catching 93 smallmouth bass during the derby and submitted 55 fish to be weighed for potential derby prizes. Fish lengths were available for 54 of the smallmouth bass weighed-in at the derby. Based upon length categories in Anderson and Neuman (1996), 1 fish (2 percent of measured submitted fish) would have been considered trophy-sized, 19 memorable (35 percent), 17 preferred (32 percent), and 14 (26 percent) quality-sized. Anglers reported catching several other species, including largemouth bass (*Micropterus salmoides*), walleye (*Stizostedion vitreum*), triploid rainbow trout, mountain whitefish, northern pikeminnow, peamouth (*Mylocheilus caurinus*), and sucker (*Catostomus* spp.). River flows through the reservoir were relatively high during the derby (in the range of 50,000 cubic feet per second), so reservoir velocities were relatively high and, according to anglers, fishing was difficult. Mean catch rate was about 0.2 smallmouth bass per angler per hour, based on interviews. A common comment by anglers interviewed during the 2006 derby was that high currents and the lack of a dock at the Metaline Waterfront Park boat ramp made access challenging.

The preceding summary describes the existing base of information about the level of effort and harvest in the recreational fishery and the level of angler satisfaction. The Recreational Creel and Angler Survey component of this study was designed to expand and update that information.

1.2. Triploid Rainbow Trout Biotelemetry

The limitations and rationale for biotelemetry monitoring for this study are discussed in the biotelemetry portion of the Study 9 Final Report (SCL 2009a). Movement and habitat use information for triploid rainbow trout is reported in this study similarly to the information reported for other species in Study 9 and Study 7, Mainstem Aquatic Habitat Modeling Study Final Report (SCL 2009c), respectively, and the current study has some of the same limitations as described in those studies. However, because availability of fish was not a major problem, sample sizes were larger for this component of the program.

1.3. Triploid Rainbow Trout Management

The triploid rainbow trout management component of Study 13 was addressed by two major categories of information. The first category addressed what is currently known about the status and behavior of stocked triploid rainbow trout in the reservoir including their movement within

the reservoir based on external tags, growth, survival rates, and information from anglers on catch locations. The second category was information about general and specific issues relating to current triploid rainbow trout management and how it may relate to future management options to consider for Boundary Reservoir. The information below describes common issues relating to triploid rainbow trout management that are relevant to Boundary Reservoir.

Stocking as a fisheries management practice can have many objectives, including compensation for lost or reduced fisheries from an environmental disturbance such as a dam, maintenance of stocks to offset overfishing, stock enhancement to increase harvests, and conservation to retain species threatened with extinction (Welcomme 1998). Accordingly, stocking results can be evaluated in multiple ways: achieving a self-sustaining natural population or maintaining the continued presence of an endangered species, meeting economic or political goals in commercial fisheries, or angler satisfaction in recreational fisheries (Cowx 1998).

Species introductions and stocking are distinct concepts. To be clear on terminology, introductions are movements outside of a species' or population's present range, and stocking generally refers to multiple placements of fish into an ecosystem from one external to it (Welcomme 1998). Thus, the triploid rainbow trout in Boundary Reservoir are both an introduction and a stocking. Where a stocked species is already native to the receiving waters, concerns often remain about introducing a non-local subpopulation, introduction of disease, genetic effects, and ecological imbalance and changes to community structure (Cowx 1998; Hindar et al. 1991).

The following is a summary of current triploid rainbow trout stocking practices in Washington State, based on an interview with Jim Uehara of the WDFW in November 2007. Mr. Uehara manages the WDFW triploid rainbow trout stocking program in Washington State and the policies and procedures internally reflect the regulatory policies applied to stocking by private hatcheries, such as the ongoing stocking program in Boundary Reservoir. Stocking of triploid rainbow trout by private parties into public waters requires a permit from WDFW, and the harvest of stocked trout is regulated by WDFW.

The majority of triploid rainbow trout stocking in Washington State is in lakes, although a few streams are also stocked when there are no concerns about effects on native fish populations. Approximately 43 lakes are stocked each year, with typically about 50,000 triploid rainbow trout averaging 1.5 pounds (about 1 year old). The triploid rainbow trout stocked have been females; this is not the specific intent of WDFW but rather a function of what private fish hatcheries have been providing (Uehara 2007).

WDFW's triploid rainbow trout stocking densities are determined by catch per unit of effort (CPUE), with a goal of 3.5 fish harvested per angler. Mr. Uehara said WDFW generally does not have enough fish to reach a lake's carrying capacity and, in any case, most fish are caught by anglers. He said the returns to the creel are very high for triploid rainbow trout, because they are easily caught. WDFW workers conduct creel surveys on opening day of the fishing season through exit surveys with anglers; all fish combined average about 3.5 fish per angler. The limit for retaining trout (other than bull trout) is typically five fish of any size per angler, which is consistent with the WDFW 2007/2008 and 2008/2009 regulations for Boundary Reservoir. The

triploid rainbow trout are identifiable by fin clips, or by their consistent size (about 1.5 pounds), and rounded fins (from hatchery conditions). Lakes on the west side of the Cascades tend to have fewer fish surviving beyond the season in which they are stocked, whereas lakes on the east side tend to have a higher overwinter rate (Uehara 2007).

WDFW also stocks triploid rainbow trout fingerlings in lakes. The timing and the size at stocking varies according to available supply, and other factors. Many different combinations of triploid fingerling stocking have occurred—some fingerlings are released in late spring for fishing about 1 year later, and some larger-than-fingerlings are stocked in lakes in the fall for fishing the following spring. Interestingly, WDFW has observed better return-to-creel with the fingerling plants (Uehara 2007).

Research suggests some triploid males may exhibit spawning behavior (though they would not have viable gametes) and displace wild males. According to Mr. Uehara of WDFW, the Idaho Department of Fish and Game studied the risk of stocked triploid males displacing wild males and found that triploid males had a very low probability of displacing wild males. Mr. Uehara also mentioned the use of triploid females for stocking for recreational fishing in Canada, but said that was because of superior growth and the desire for a "trophy" fishery (Uehara 2007).

WDFW buys the triploid rainbow trout from private facilities that are on an approved list of suppliers. The disease section in Appendix 1 includes a discussion of the policy for fish transfers from hatcheries.

A summary of the history of triploid planting by SCL in Boundary Reservoir is presented in Table 1.3-1. Because triploid rainbow trout released in Boundary Reservoir have been catchable size (generally >200 millimeters [mm] or about 8 inches), overwinter survival as carry-overs is not essential to maintain a sport fishery**.** However, if individuals survive for multiple years, there is the potential for higher growth rates by triploid rainbow trout relative to diploids, because energy is not expended on gamete production.

Table 1.3-1. Historical Boundary Reservoir triploid rainbow trout release information from May 2001 to April 4, 2008.

Date	Size (in.)	Location	No. of Fish [1]	Notes
May-2001	11-14	Box Canyon	2,100	1/2 tagged
Nov-2001	9-10	Boundary Dam	5,470	1/2 clipped adipose fin
Oct-2002	9-10	Jackies–Between Metaline and Box Canyon	6,050	
Oct-2002	1-3 lbs	Jackies–Between Metaline and Box Canyon	250	
Mar-2003	11-14	Box Canyon	3,300	
Oct-2003	11-14	Jackies–Between Metaline and Box Canyon	2,300	
Oct-2003	1-3lbs	Jackies–Between Metaline and Box Canyon	670	
Mar-2004	9-10	Boundary Dam	3,400	
28-Oct-04	9-11	Boundary Reservoir	2,000	
28-Oct-04	16-18	Boundary Reservoir	450	
28-Mar-05	9-11	Metaline Boat Launch	4,500	

Table 1.3-1, continued…

Date	Size (in.)	Location	No. of Fish [1]	Notes
7-Nov-05	9-11	Boundary Reservoir	4,500	
15-Mar-06	9-11	Metaline Boat Launch	4,500	
9-Nov-06	9-11	Boundary Reservoir	4,300	
29-Mar-07	9-11	Boundary Reservoir	1,580	Unmarked
29-Mar-07	9-11	Boundary Reservoir	500	Tagged
30-Mar-07	9-11	Boundary Reservoir	10	Radio transmitter
30-Mar-07	9-11	Box Canyon Tailrace Launch	10	Radio transmitter
30-Mar-07	9-11	Box Canyon Tailrace Launch	1,600	Unmarked
30-Mar-07	9-11	Box Canyon Tailrace Launch	500	Tagged
18-Oct-07	9-11	Box Canyon Tailrace Launch	1,600	Unmarked
18-Oct-07	9-11	Boundary Reservoir	1,580	Unmarked
18-Oct-07	9-11	Boundary Reservoir	500	Tagged
19-Oct-07	9-11	Box Canyon Tailrace Launch	500	Tagged
19-Oct-07	9-11	Box Canyon Tailrace Launch	10	Radio transmitter
19-Oct-07	9-11	Boundary Reservoir	10	Radio transmitter
2-Apr-08	9-11	Metaline Launch	1,300	Unmarked
2-Apr-08	12-13	Metaline Launch	700	Unmarked
3-Apr-08	9-11	Boundary Reservoir	750	Tagged
3-Apr-08	9-11	Boundary Reservoir	550	Unmarked
4-Apr-08	9-11	Box Canyon Tailrace Launch	750	Tagged
4-Apr-08	9-11	Box Canyon Tailrace Launch	550	Unmarked
Total Number of Triploid Rainbow Trout Released			**56,790**	

Note:
1 All fish released by Seattle City Light. Fish releases in October 2008 not shown.
Source: McGregor (2007)

2 STUDY OBJECTIVES

2.1. Overall Study Goals and Objectives

The overall goals for Study 13 were to:

1. Obtain information regarding the recreational fishery that can aid SCL and relicensing participants (RPs) in understanding the effects of the Project on recreational fisheries
2. Understand potential interactions between planted triploid rainbow trout and native salmonids
3. Determine whether opportunities to enhance the existing triploid rainbow trout stocking program are considered desirable and appropriate

The study objectives were to:

- Conduct recreational creel surveys (creel survey and angler survey components) that identify current recreational fishing activity and success rates (boat and bank) on the reservoir.
- Determine angler opinions and values regarding maintaining or improving recreational fishing opportunities in the future at Boundary Reservoir, addressing both native salmonids and non-salmonids.
- Use biotelemetry to identify movements of newly released and carry-over triploid rainbow trout in Boundary Reservoir.
- Identify potential positive and negative effects of the triploid rainbow trout stocking program.
- Evaluate habitat-use characteristics of triploid rainbow trout.
- Evaluate stocked triploid rainbow trout patterns of dispersal, growth, survival, and susceptibility to angling.

Study 13 included three components:

- Recreational Creel and Angler Surveys
- Triploid Rainbow Trout Biotelemetry
- Triploid Rainbow Trout Management

Specific objectives for the three components are discussed in the following sections.

2.2. Recreational Creel and Angler Surveys

As noted in objectives 1 and 2 above, the creel and angler surveys were intended to provide information about angling effort and catch rates and angler opinions about the fishing opportunities. Little existing information is available to discern the level of satisfaction by anglers for fishing in Boundary Reservoir or the desirability for expanded fishing opportunities (e.g., by increasing the abundance of specific sport fish species). In some cases, the desire of the recreational angler community for harvestable fish stocks may be in conflict with state and federal fish management objectives. Existing information about angling effort and catch rates and angler opinions about the fishing opportunities, which is summarized in Section 1.1, comprises primarily the results from a season-long survey conducted in 1997 and a brief weekend survey during the 2006 smallmouth bass derby.

Consequently, the recreational creel and angler surveys component of the study included the following four tasks designed to address the information needs identified for this study component:

1. Creel Survey—to develop information about fishing effort, catch and harvest rates, and target species through angler interviews.
2. Tagged Fish Reward Program—to distribute information about and implement a program to reward anglers for returning data about tagged fish they had caught.
3. Angler Survey—conducted in coordination with the Recreation, Land Use and Aesthetics (RLA) Workgroup to develop information about angler values and opinions related to the recreational fishery.

4. Smallmouth Bass Derby Monitoring—to conduct public outreach during the annual smallmouth bass tournament and collect information from derby participants.

2.3. Triploid Rainbow Trout Biotelemetry

The main purpose of the Biotelemetry study component was to obtain information on the behavior, habitat utilization, and periodicity of triploid rainbow trout released in Boundary Reservoir. The specific objectives of this component were as follows:

- Identify temporal and spatial movements of newly-released and carry-over triploid rainbow trout in Boundary Reservoir.
- Evaluate habitat use characteristics of triploid rainbow trout based on recorded habitat use data and positional data recorded, as part of the biotelemetry component of Study 9, and identify differences between newly released triploid rainbow trout and carry-over triploid rainbow trout.
- Analyze temporal or spatial movement patterns of tagged triploid rainbow trout and correlate with Box Canyon and/or Boundary operations.
- Based on habitat use data recorded as part of the biotelemetry component of Study 9, compare the habitat use data from radio- and combined acoustic and radio transmitter (CART)-tagged triploid rainbow trout and native salmonids (bull trout, westslope cutthroat throat, and mountain whitefish) and identify overlaps in habitat utilization. The implication of habitat overlap between triploid rainbow trout and native salmonids is addressed in the Triploid Rainbow Trout Management component of this study.

The triploid rainbow trout biotelemetry included the following tasks:

1. Internal radio tagging of pre-stocked spring-released triploid rainbow trout
2. Internal CART tagging of carry-over triploid rainbow trout
3. Fixed biotelemetry monitoring/mobile tracking, intensive tracking, and habitat data collection
4. Angler Outreach Program (coordinated with the Recreational Creel and Angler Surveys component [see Section 2.2] to recover transmitters and external tags attached to fish captured in the sport fishery)
5. Biotelemetry data processing, entry, and verification

2.4. Triploid Rainbow Trout Management

The main purpose of the triploid rainbow trout management component of Study 13 was to determine whether a triploid rainbow trout stocking program can be an effective protection, mitigation, and enhancement measure to pursue during the new license term. For this program to be effective, it must provide benefits to anglers and minimize adverse impacts to native fish species or other important fisheries in the area.

The triploid rainbow trout management component of Study 13 included the following tasks:

1. Triploid rainbow trout external tagging
2. Angler Outreach Program (coordinated with the Recreational Creel and Angler Surveys component [see Section 2.2] and the Study 9 Passive and Active studies to obtain information of time, location, and length of recaptured fish)

3. Habitat Use
4. Demographics
5. Management Options

In addition, the triploid rainbow trout management component utilized information on habitat use and demographics (i.e., location and movement) of triploid rainbow trout from the biotelemetry studies (see Section 2.3) to help evaluate management options.

The five tasks of the triploid rainbow trout management component were consolidated into two categories:

- Triploid Rainbow Trout External Tagging Program
- Triploid Rainbow Trout Issues and Management Options

2.4.1. Triploid Rainbow Trout External Tagging Program

The goals of the Triploid Rainbow Trout External Tagging Program of Study 13 were as follows:

- Summarize movement and distribution of triploid rainbow trout released in spring 2007, based on external tag recoveries data and data provided by Study 9.
- Based upon length and weight data provided as a result of tag returns (the Angler Outreach Program of Study 13), creel surveys, and Study 9, describe the post-stocking growth rate of stocked triploid rainbow trout.
- Summarize catch and harvest rate of triploid rainbow trout, based on tag returns and creel survey data.
- Summarize the temporal and spatial CPUE rate of triploid rainbow trout as recorded during Study 9 field sampling activities.
- Summarize habitat use data associated with external tag recoveries.

2.4.2. Triploid Rainbow Trout Issues and Management Options

The goals for the Triploid Rainbow Trout Issues and Management Options portion of Study 13 were as follows:

- Compare the movement and distribution of triploid rainbow trout based on external tag recoveries to biotelemetry movement data recorded as part of Study 9.
- Analyze the spatial distribution patterns of triploid rainbow trout captures and compare habitat use information developed from Study 9. Describe potential temporal and spatial habitat overlaps between triploid rainbow trout and bull trout, cutthroat trout, and smallmouth bass.
- In combination with the available scientific literature, use the results of the external tagging, recreation creel survey, biotelemetry, and the Study 9 reservoir fish distribution and abundance efforts to develop a range of alternative triploid rainbow trout management options for Boundary Reservoir. The discussion includes the potential benefits and drawbacks of alternative management options.

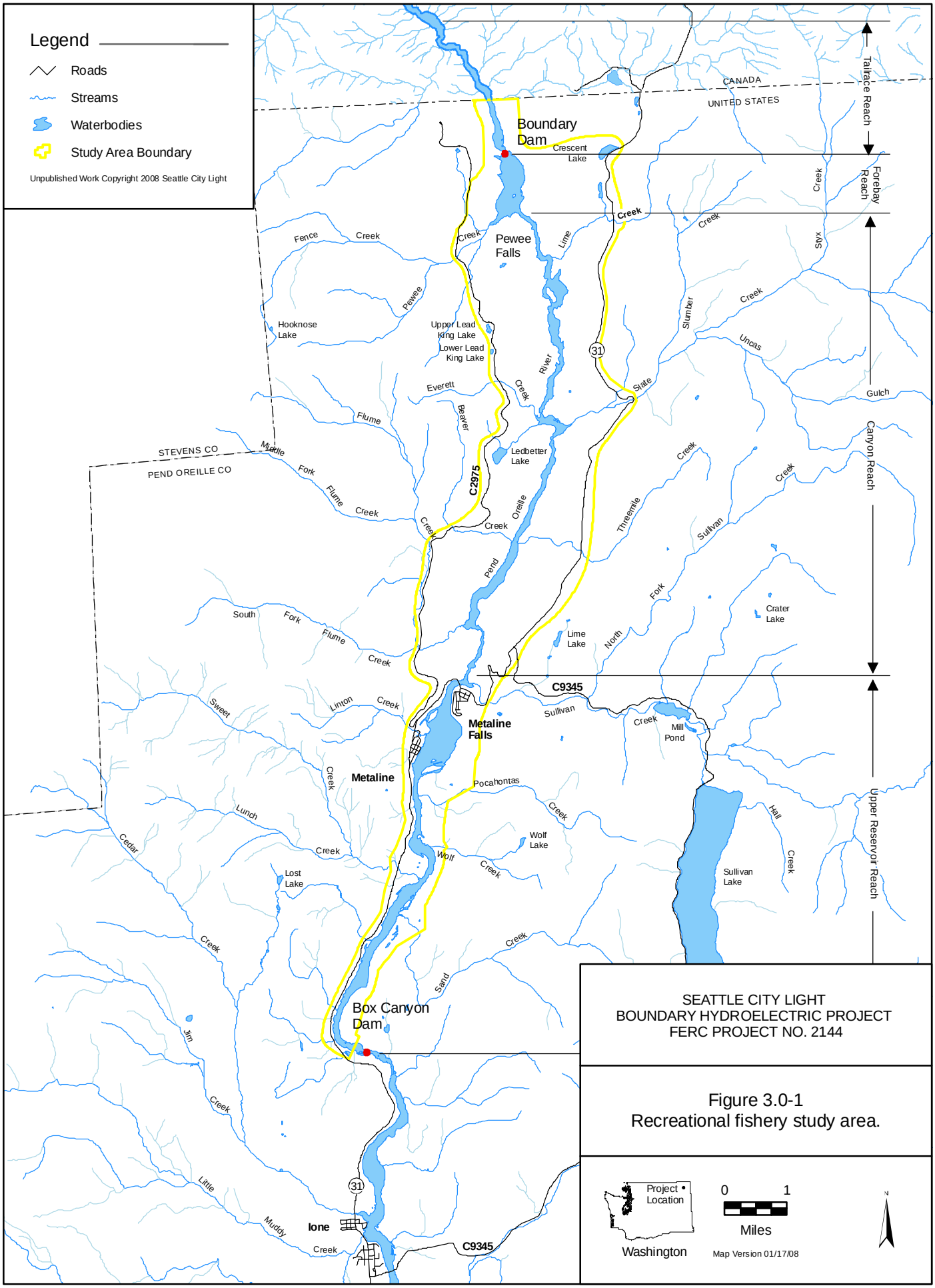
3 STUDY AREA

The study area for Study 13 was focused primarily on the reservoir surface, shoreline, and access points to Boundary Reservoir, with the reservoir area being characterized into three reaches: 1) the Upper Reservoir Reach, 2) Canyon Reach, and 3) the Forebay Reach (Figure 3.0-1). A fourth reach, the Tailrace[1] Reach, was also part of the study area. The extent of all four reaches is defined as follows:

- Upper Reservoir Reach—Box Canyon Dam downstream to Metaline Falls (Project river mile [PRM] 34.5 to PRM 26.8)
- Canyon Reach—Metaline Falls to downstream end of Z Canyon (PRM 26.8 to PRM 18.0)
- Forebay Reach—downstream end of Z Canyon to Boundary Dam (PRM 18.0 to PRM 17.0)
- Tailrace Reach—Boundary Dam to Red Bird Creek, British Columbia (PRM 17.0 to PRM 13.9)

Because Study 13 was implemented in conjunction with Study 21 (SCL 2009b), in 2007 the study area for the recreational creel and angler survey component of Study 13 was the same as the study area for the recreation surveys component of Study 21, as defined by the RLA Workgroup; this study area included some nearby areas beyond Boundary Reservoir, as indicated in Figure 3.0-1. The joint study area encompassed the reservoir and adjacent areas within which recreation use might be associated with the Project, as identified through SCL's study planning effort with the RPs. The study area defined for the recreation survey components of Study 21 included the area from the reservoir west to Pend Oreille County Road 2975, and from the reservoir east to State Route (SR) 31. Therefore, the 2007 study area for the creel and angler survey components of Study 13 included segments of tributary streams near the reservoir and Crescent Lake, but did not include recreational facilities at Mill Pond or Sullivan Lake, which are located east of SR 31. The 2008 creel survey component of Study 13 was focused on the access points to Boundary Reservoir and included the Upper Reservoir, Canyon, and Forebay reaches as described above.

[1] In this report, "Tailrace" is the term specifically used for the Boundary Dam Tailrace or Tailrace Reach (of the Project area). The term "tailrace" (i.e., no capitalization) is used for other tailrace designations (e.g., Box Canyon tailrace).



SEATTLE CITY LIGHT
BOUNDARY HYDROELECTRIC PROJECT
FERC PROJECT NO. 2144

Figure 3.0-1
Recreational fishery study area.

4 METHODS

4.1. Recreational Creel and Angler Surveys

4.1.1. Creel Survey

The RSP identified needs and objectives for creel survey work to be conducted at the Project. These included the need to identify the target species sought by anglers and to estimate the spatial and temporal level of effort, catch rate (i.e., kept or released), and harvest rate (i.e., fish kept). The recreation surveys component of Study 21 (SCL 2009b) included the same types of information and the same data collection method (i.e., surveys of recreational users in the field). Therefore, the scope of the creel survey work for Study 13 was coordinated with the RLA Workgroup, which developed guidance for the recreation surveys component of Study 21. The recreation survey tasks included an extensive field sampling program involving visitor counts and observations and administration of a questionnaire to Project-area recreational visitors during the 2007 recreation season. The Fish and Aquatics Workgroup was given the opportunity to review and comment on the angling-related portions of the visitor questionnaire developed for Study 21 and on the survey approach. An additional recreation survey task under Study 21 was administration of another questionnaire that was distributed to area residents by mail. Questions about angler effort and success were incorporated in the visitor and resident surveys administered as part of Study 21.

The design of survey questions and methodology for Study 21 (SCL 2009b) incorporated needs and objectives identified in the RSP for a creel survey. The RSP indicated the creel survey work was to be conducted during the 2007 and 2008 recreational fishery seasons at Boundary Reservoir and its tributaries. The recreation surveys for Study 21 were conducted during the 2007 recreation season. Because SCL did not plan to repeat this recreation survey program in 2008, the creel survey effort indicated in the RSP was conducted as a stand-alone effort during the 2008 season.

4.1.1.1. Field Sampling Program for 2007 Recreation Surveys

The Study 21 Final Report (SCL 2009a), primarily Section 4.1 and Appendix 1, provides a complete description of the methods used to conduct the recreation surveys (incorporating creel and angler survey study objectives) during the 2007 season. The following is a summary derived from the Study 21 Final Report (SCL 2009b).

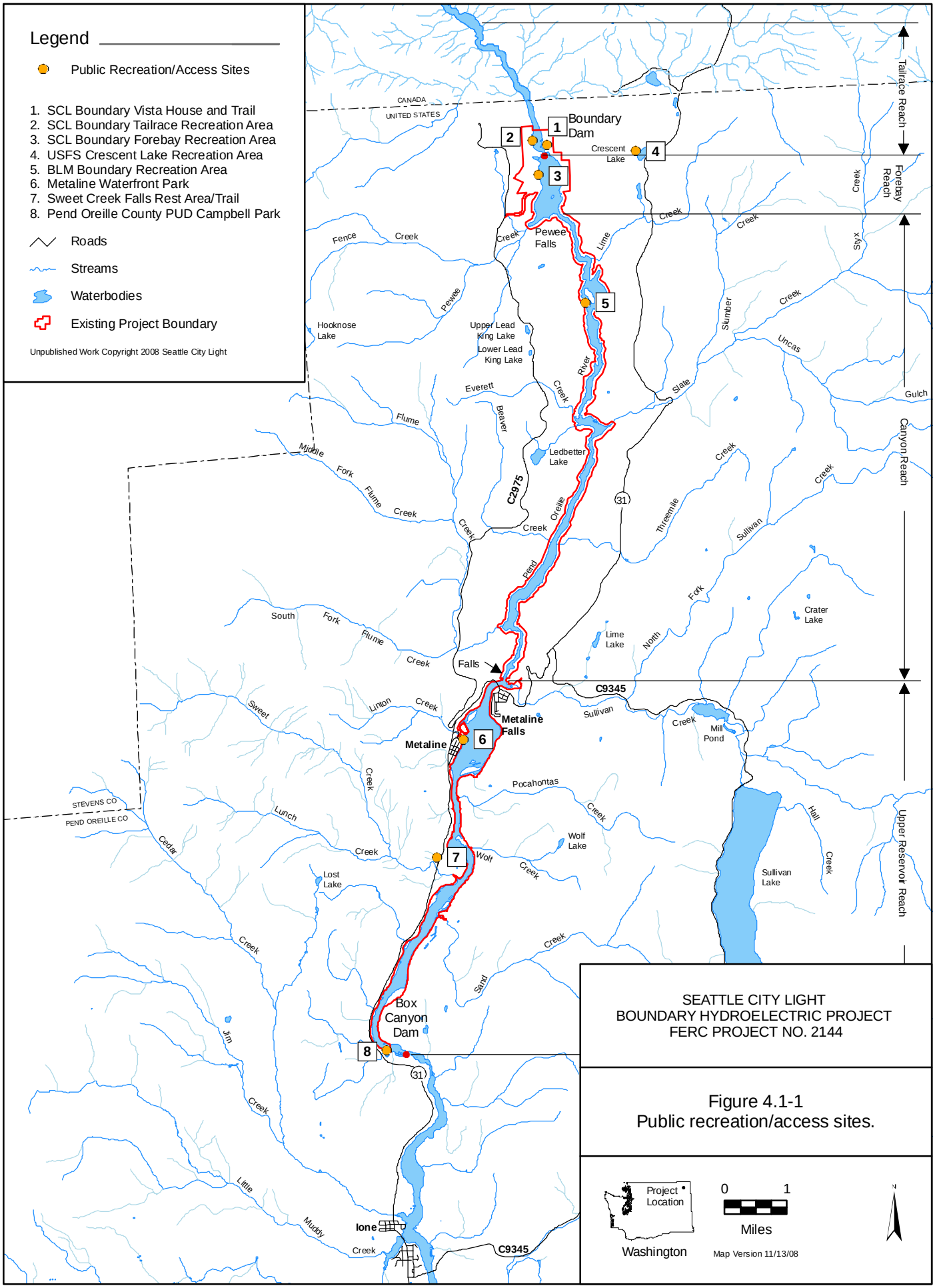
Staff from Tetra Tech implemented the visitor count and questionnaire components of the recreation surveys through a single, integrated field sampling program. The field program was initiated on May 19, 2007, and continued through the end of October 2007. The field program employed a multistage cluster sampling method to determine when and where sampling would occur at a given time. The first stage of the sampling design involved selecting a random sample of weekdays and a complete census of weekends and holidays to ensure extensive coverage of the main recreation season. Because the staff required to sample the entire study area during a given day would be prohibitively large, the sampling plan included a second stage with randomly selected combinations of sectors (geographic clusters) by day period (time clusters) to cover the various recreation sites and the early and late portions of each sampling day.

Based on study area geography (see Figure 4.1-1), access considerations, and the types and locations of recreational use, the study area was divided into six sectors for scheduling and execution of cluster sampling in the field. Two-person survey crews conducted sampling activities within a specific sector each time the sampling calendar required sampling to occur there on a given date and period of the day. For all six sectors, crews recorded visitor counts on standard forms and contacted visitors to distribute questionnaires. The crews attempted to contact all visitors encountered at each sampled sector during the corresponding time of day. Visitors who were willing to participate were handed a questionnaire, a pencil, and a self-addressed, postage-paid envelope. Visitors were instructed to return their completed survey directly to one of the crew members, deposit it in one of several drop boxes installed at recreation sites, or return it by mail. A copy of the survey is provided in Appendix 2.

The cluster sampling program used to implement the visitor count and questionnaire sampling provided comprehensive sampling coverage of developed and dispersed sites (including all three boat launches that provide water access to Boundary Reservoir), overnight and day users, and water-based and land-based activities within the study area. Sampling in the field was scheduled based on standard 6-hour blocks of time for sampling activity (including travel time and related activity, such as launching and trailering boats), divided between the a.m. and p.m. hours of the day. Because extended daylight hours occur during most of the summer, sampling was conducted from 1800 to 2000 hours (6 p.m. to 8 p.m.) during July and August. This was achieved by extending the work day from 12 to 14 hours (that is, two 7-hour periods) for July and August. Based on the number of sectors defined for the Project area, two daily time blocks, and the number of days in the season, 274 sampling sessions were scheduled to yield adequate coverage of the variability of recreational use at the Project.

Because overnight camping and multiple day-use activities at the Forebay Recreation Area make it a key recreation site, this sector received a level of sampling effort slightly larger than what would result from an even distribution among the six sectors. Likewise, Metaline Waterfront Park also had a larger sampling effort because it is highly accessible to visitors and appears to be a popular site. Based on indications of quite limited roaded dispersed use (i.e., recreational activity taking place on or near roads and away from developed recreational facilities) within the study area, effort allocated to sampling this sector of the study area (Sector 4) was reduced accordingly.

Tetra Tech staff collected completed visitor questionnaires directly from visitors, from drop boxes at several key locations, or through the mail throughout the study period. Tetra Tech processed the returned questionnaires, entered the survey responses, and tabulated and analyzed the responses using the Statistical Package for the Social Sciences (SPSS).


Legend
Public Recreation/Access Sites
1. SCL Boundary Vista House and Trail
2. SCL Boundary Tailrace Recreation Area
3. SCL Boundary Forebay Recreation Area
4. USFS Crescent Lake Recreation Area
5. BLM Boundary Recreation Area
6. Metaline Waterfront Park
7. Sweet Creek Falls Rest Area/Trail
8. Pend Oreille County PUD Campbell Park
Roads
Streams
Waterbodies
Existing Project Boundary
Unpublished Work Copyright 2008 Seattle City Light
CANADA
UNITED STATES
Boundary Dam
Crescent Lake
Pewee Falls
Hooknose Lake
Upper Lead King Lake
Lower Lead King Lake
Ledbetter Lake
Lime Lake
Crater Lake
Falls
Metaline Falls
Metaline
Mill Pond
Wolf Lake
Lost Lake
Sullivan Lake
Box Canyon Dam
Ione
STEVENS CO
PEND OREILLE CO
C2975
C9345
31
Tailrace Reach
Forebay Reach
Canyon Reach
Upper Reservoir Reach
SEATTLE CITY LIGHT
BOUNDARY HYDROELECTRIC PROJECT
FERC PROJECT NO. 2144
Figure 4.1-1
Public recreation/access sites.
Project Location
Washington
0
1
Miles
Map Version 11/13/08
N

4.1.1.2. Area Resident Questionnaire Administration

The Study 21 Final Report (SCL 2009b), primarily Section 4.1.3 and Appendix 4, provides a complete description of the methods used to conduct the area resident survey (incorporating creel and angler survey study objectives) during the 2007 season. In summary, the area resident questionnaire was developed using the same formatting guidelines discussed for the Project visitor questionnaire. The questionnaire focused on recreation-related issues and needs that apply specifically to area residents. It replicates many of the items in the visitor questionnaire, so that data from the two respondent groups can be compared, and includes some questions applicable specifically to area residents and not Project area visitors.

Following guidance from Salant and Dillman (1994) for conducting surveys by mail, Tetra Tech used a four-step mailing process to administer the area resident questionnaire. They included distribution of 1) a short pre-survey notice to tell people that the survey was coming; 2) a survey packet including a cover letter, the questionnaire, and pre-paid return envelope, mailed 1 week after the first mailing; 3) a postcard to thank those who had responded and remind those who had not responded to please return the questionnaire, sent 8 to 10 days after the survey packets were mailed; and 4), a new survey packet, sent approximately 4 weeks after the second mailing to all remaining valid addresses on the mailing list from which a survey had not been returned. Tetra Tech distributed the area resident questionnaire to a list of approximately 1,500 addresses in the British Columbia portion of the local area and 465 addresses in the Washington communities of Ione, Metaline, and Metaline Falls. Tetra Tech processed the returned questionnaires, entered the survey responses, and tabulated and analyzed the responses using the SPSS.

4.1.1.3. 2008 Creel Survey

The Study 13 Interim Report (SCL 2008) stated that SCL would conduct a creel survey at key Boundary Reservoir access points during the 2008 recreation season. SCL collaborated with relicensing participants on study methods during late winter and early spring 2008 and initiated the creel survey at the beginning of May. Field sampling for the survey continued through October 4, with the completion date established to allow sufficient time for analysis of the data and inclusion of the results in the final report. Implementation of the sampling program for the survey is summarized below.

4.1.1.3.1. 2008 Creel Survey Sampling Program

Recreational use at the Project varies by season, week, and day. Information provided in the Pre-Application Document (SCL 2006) and data collected during 2007 indicate that visitation to the Project is typically highest during approximately a 2-month period of the summer, extending from early July through the end of August or early September. Use of the Project area is considered to be quite low from late fall through early spring, begins to increase in April or May, and generally continues to build up to peak-season levels before declining after Labor Day. Visitor numbers on weekends and holidays tend to be consistently higher than on weekdays. Broad-based experience with typical patterns for most recreational uses and facilities of the type found at the Project indicates that overall activity levels within the day tend to peak in the early afternoon hours. Peak times for fishing and some other specific pursuits are presumably in the early morning or the evening, however, corresponding to when fish may be most active.

Field sampling activities for the 2008 creel survey was accomplished by a two-person survey crew based at the Tetra Tech field office in Ione. The study area was divided into two geographic sectors. The Upper Reservoir Reach comprised Sector 1, with sampling activity occurring at Metaline Waterfront Park and the boat ramp at Box Canyon Dam. The Lower Reservoir (Forebay and Canyon reaches) comprised Sector 2, with sampling activity occurring at the SCL Forebay Recreation Area. The crew conducted sampling activities within a specific sector each time sampling was required to occur there on a given date and period of the day. Crews recorded visitor counts and contacted anglers for interviews using the Angler Questionnaire for Study 13.1. Appendix 3a is a copy of the survey instrument.

The survey crew traveled to both sectors by car. Once on station, survey crews generally remained stationary, or nearly so, while observing and recording visitor counts. Crews attempted to contact all anglers returning from the reservoir to collect information about the angler's experience. If an access site was extremely busy at the time of sampling (a rare occurrence in 2008) they attempted to contact every second or third angler. Anglers observed fishing from shore were generally contacted as soon as they were observed.

Sampling in the field was scheduled based on a standard 8-hour block of time for sampling activity (including travel time). For the entire 2008 recreation season, daily start times for sampling periods varied from 6:00 a.m. to 11:00 a.m., with ending times ranging from 2:00 p.m. to 7:00 p.m.

Based on the two sectors defined for the sampling effort and 8-hour sampling periods, Tetra Tech estimated that field crews would spend approximately 712 sampling hours in the field for 2008. Table 4.1-1 provides a summary of the distribution of sampling activity and effort planned for the 2008 creel survey. Although survey crews needed to adjust or redirect their sampling activity on occasion, such as when access sites were not accessible due to flooding, these targets were met during the sampling season.

Table 4.1-1. Planned distribution of 2008 creel survey sampling activity.

Month	Total Sampling Days	Weekend Sampling Days	Weekdays Sampling Days	Sampling Hours/Month (personnel time in field)
May	17	8	9	136
June	17	8	9	136
July	18	8	10	144
August	17	8	9	136
September	18	8	10	144
October	2	1	1	16
Total	**89**	**41**	**48**	**712**

The sampling program for the 2008 creel survey included sampling from May 2 through October 4. Using a random number table, a simple random sample of all weekends and weekdays were drawn for each month of the season, so each day had equal probability of being drawn. Days

were drawn with the basic framework of 8 weekend days and 9 to 10 weekdays being selected per month, yielding a total of 41 weekend days and 48 weekdays during the season. One 2-person field crew worked on a full-time basis continuously from spring through fall to provide the planned level of sampling activity for the entire study period. The proposed sampling program and staffing plan resulted in 1,424 total hours of labor time in the field. This figure does not include time required for data entry at the field office, training of personnel, or time to mobilize for the study and process study results.

A detailed calendar of specific sampling locations by day period on individual dates was developed for each month of the study. Table 4.1-2 summarizes the allocation of sampling periods and effort by sector for the 2008 season. Ongoing management of the sampling program included accommodation for unplanned sampling disruptions due to adverse weather, external events, or personnel availability. For example, Metaline Waterfront Park was closed for approximately 4 weeks in May and June 2008 when flood waters inundated the boat ramp area. Sampling activity that was planned for this location during the closure was shifted to Box Canyon and the SCL Forebay Recreation Area. In general, the objective in making day-to-day adjustments was to replace missed sampling periods and locations with equivalent activity on days or periods that were otherwise not scheduled for sampling. Because of the extended duration of the flood-related closure, however, total sampling activity at Metaline Waterfront Park was unavoidably somewhat less than planned. Fishing activity was generally low during this part of the season, and relatively little activity was observed at the other access points.

Table 4.1-2. Sampling effort by weekend, weekday, and sector.

Sector	No. of Weekend Sample Periods	No. of Weekday Sample Periods	Crew Hours on Site
MWP and Box Canyon	16	19	560
Forebay	25	29	864
Total	**41**	**48**	**1424**

Note:
MWP – Metaline Waterfront Park

4.1.1.3.2. Data Analysis

The creel survey questionnaire included nine specific questions addressing the interview subject and information about their current fishing visit. The questionnaire included a space at the end for respondents to provide open-ended comments with any additional input they wanted to provide about how the fishery could be improved. The analysis of the completed surveys involved tabulating the responses to develop the frequency (number) and percentage distribution for each possible response to each question, and calculating measures of central tendency (for instance, mean and standard deviation) for the responses to a given question for which those measures are meaningful. The survey crews also maintained records on the dates, times, and locations for completed surveys.

4.1.2. Tagged Fish Reward Program

The second task for this portion of Study 13 was to implement, in coordination with Study 9 and the Triploid Rainbow Trout Management and Biotelemetry components of Study 13, a reward program for the reporting of tagged fish caught by recreational anglers. Activities for this study component included an angler outreach program to inform anglers about the program and provide directions for reporting harvest of tagged fish, and the reward program itself.

4.1.2.1. Angler Outreach Program

The angler outreach program employed three main tools to convey information about the Tagged Fish Reward Program: posters, fliers, and a toll-free telephone line. Development and deployment for these items are summarized below.

Posters. Laminated color posters with the following contents were prepared:

- A bold "Attention Anglers" heading and "REWARD for Reporting Catch of 2007 Yellow Floy-Tagged Fish" subheading (updated slightly for 2008)
- A brief explanation why SCL was studying fish movement
- A large picture of a fish with a yellow Floy tag
- A picture of a fish with a red streamer tag, indicating the fish contained a radio transmitter
- A request to release and report on any red-tagged fish caught
- A request to return tags and report on yellow-tagged fish, with instructions on how to return tags and the type of harvest information requested
- The toll-free hotline number (1-866-712-0067)
- A brief description of the $10 reward per tag and the seasonal prize drawings

Posters were placed in prominent locations at the key water access sites for boaters and bank anglers, specifically the boat ramps at the SCL Forebay Recreation Area, Metaline Waterfront Park, and Campbell Park (Pend Oreille County PUD, at Box Canyon Dam). The condition of the posters was checked periodically during the 2007 season, and posters were replaced as necessary. A copy of the poster is included in Appendix 4.

Fliers. Color 8 ½ x 11-inch fliers with the same information (condensed in size) as on the posters were prepared for placement at key public, commercial, or social facilities in the local area. Locations included local post offices in all three communities (Metaline, Metaline Falls, and Ione); the Western Star Bar and Grill and the Metaline Mini Mart in Metaline; the Box Canyon Motel; and the Riverview Inn, Los Sanchos Restaurant, Food Court, Country Hardware Store, and the Airport Kwikstop in Ione.

Toll-free telephone line. At the end of March 2007, a toll-free telephone number (1-866-712-0067) was established for anglers to use to report catches of tagged fish and/or obtain information about the tag reward program. The toll-free number was used exclusively for the tagged fish reward program. Calls on the toll-free number were routed to a phone in the Tetra Tech offices, where a staff member was assigned to answer calls, regularly check voicemail messages on the line and respond as needed, and record any information reported in the messages.

4.1.2.2. Reward Program

The purpose of the Tagged Fish Reward Program was to provide anglers with an incentive to report catch information for tagged fish. The incentive had to be attractive enough to entice anglers to provide the requested information, without being either cost-prohibitive or labor-intensive. A reward program was instituted in April 2007 through which each angler reporting a catch of a yellow Floy-tagged fish received a reward of $10 per tag. To ensure the reports could be validated, anglers were required to submit the tag to Tetra Tech, either by mail or by depositing the tag and their catch information in a drop box at the SCL Forebay Recreation Area or Campbell Park at Box Canyon Dam. (The drop boxes were installed for use in the Study 21 recreation survey program and were available for tag returns only during the 2007 season. For the 2008 season, however, postage-paid remit envelopes were placed at access sites for anglers to use in submitting tag reports.) In addition, the tag reports for each angler were entered into a quarterly drawing for all tags reported during that quarter, in which three tags were selected for cash prizes of $100, $75, and $50. Through the end of 2007, prizes were distributed for drawings based on all tags reported from March through May, June through August, and September through December 2007. The tag reward program was continued for the first 10 months of 2008, with three similar prize drawings for major portions of the season.

4.1.3. Angler Survey

The RSP (SCL 2007) provides a separate description of the angler survey component of Study 13, which was designed to provide information about angler values and opinions regarding:

- Potential reduction, maintenance, or enhancement of the triploid rainbow trout stocking in Boundary Reservoir
- Potential reduction, maintenance, or enhancement of non-native sport fish (especially smallmouth bass, largemouth bass, and yellow perch) in Boundary Reservoir sport fishery
- Potential opportunities to catch native trout and less popular native fish, such as northern pike minnow and mountain whitefish in the sport fishery
- Potential reservoir pool level fluctuations and boat ramp access under operations scenarios
- Potential future fishery management goals at Boundary Reservoir
- Concerns about exotic macrophyte distribution and density

As discussed in Section 4.1.1, in 2007 the Recreational Creel Survey and Angler Survey components of Study 13 were conducted in tandem as a combined element of the recreation visitor survey component of Study 21, because these study components involved the same data collection method within the same geographic area. The survey administration content of Section 4.1.1 also applied to the angler survey work. Through other elements of the recreation visitor survey, additional information was also collected from anglers (and other survey participants) including their origin, party size, watercraft type, whether they fished from a boat or the bank, where they launched their boat, other activities enjoyed while in the Project area, where they were staying the night, other alternative fishing locations compared to the Project, and perceptions of crowding or conflicts encountered. The survey instrument developed for the joint 2007 recreation visitor survey and angler survey included 42 specific questions covering a

variety of topics. Because the survey addressed a relatively large scope, it was not possible to include specific questions addressing all individual topics of interest. Although the survey instrument did not include a question specifically asking for respondent feedback on the triploid rainbow trout stocking program (for example), pre-specified and open-ended responses to multiple questions in the survey can be analyzed to derive information applicable to the objectives identified above.

This creel and angler survey component of Study 13 was conducted during the 2007 recreational fishing season at Boundary Reservoir and some adjacent areas. In 2008, SCL conducted a creel survey effort as a stand-alone component of Study 13. Methods for this study activity are described in Section 4.1.1.3.

4.1.4. Smallmouth Bass Derby Monitoring

The scope for this task was to collect information on angler catch, effort, and approximate fishing location during the annual smallmouth bass derby that occurs at the Project under the sponsorship of local community interests. As described in the RSP, SCL planned to use this derby as an opportunity for public outreach to inform anglers about tagging and other fishery-related studies being conducted as part of relicensing, and the need to recover tags from harvested fish or tag information from fish captured and released. The general approach for this task was for SCL to distribute survey questions during the derby and/or interview anglers.

The 2007 smallmouth bass derby occurred on May 5 and 6. SCL staff was present at key reservoir access locations and contacted derby participants to obtain information related to their derby activities. SCL also obtained data from the tournament sponsor about the bass derby participants and their harvest during the 2007 event.

The 2008 smallmouth bass derby occurred on May 3 and 4. Tetra Tech initiated the 2008 creel survey on May 2 and survey crews were present at key reservoir access locations throughout the tournament. Crews contacted derby participants for interviews about their derby activities and completed standard creel survey forms for these interviews, as described in Section 4.1.1.3. Tetra Tech staff also obtained information about tournament participation and catch results for the 2008 derby from the tournament sponsor.

4.2. Triploid Rainbow Trout Biotelemetry

In spring and fall 2007, and spring 2008, about 4,200 triploid rainbow trout were released each period into Boundary Reservoir. For the spring 2007 and fall 2007 releases, approximately 30 triploid rainbow trout were obtained during each period for possible internal tagging with radio tags. Of these, 20 of the largest and healthiest fish were selected for radio tagging.

Radio tags were not implanted in the spring 2008. Through agreement with the RPs, a dedicated session for radio tagging of carry-over triploid rainbow trout and deployment of a large number of Floy tags in the spring 2008 triploid rainbow trout release were implemented as study modifications (SCL/RP meeting minutes for February 28, 2008, and March 25–27, 2008) to obtain additional information on the carry-overs and to provide a larger sample size for the Floy-tagged fish. In addition, the RPs agreed that no Floy tagging of fall 2008 triploid rainbow trout

releases would occur (SCL/RP meeting minutes for March 25–27, 2008) because any returns would mainly be after the field and reporting efforts were completed.

4.2.1. Equipment

Telemetry monitoring of triploid rainbow trout was conducted as part of the biotelemetry component of Study 9. A full description of the telemetry equipment used and deployed during Study 13 is provided in the Study 9 Final Report (SCL 2009a).

4.2.2. Internal Radio Tagging of Spring 2007 and Fall 2007 Released Triploid Rainbow Trout

The 20 fish selected for tagging were implanted with NTC-6-2 radio tags. The basic surgical tagging procedure is described in the Study 9 Final Report (SCL 2009a). Each radio-tagged fish was also marked with an external red streamer tag inserted at the base of the dorsal fin.

In spring 2007, the radio-tagged fish were kept overnight at the Pend Oreille County PUD's lab at Box Canyon Dam in continuous-flow fresh water holding tanks. In fall 2007, the radio-tagged fish were kept in a small holding pen in the Boundary Dam Forebay. After the holding period, the health of all fish was evaluated prior to their release. A fish was judged to be healthy if it appeared energetic and was able to maintain its position and orientation in the water column. Ten of the fish were released in the tailrace of Box Canyon Dam and 10 of the fish were transported to Boundary Dam and released in the Forebay Reach. At each release, the health of each fish was re-assessed and the tag numbers and release times were recorded.

4.2.3. Internal CART Tagging of Carry-over Triploid Rainbow Trout

Up to 40 carry-over triploid rainbow trout captured during Study 9 were planned for implantation with CH-TP11-18 CART tags. Carry-over triploid rainbow trout were identified based on physical criteria, which included total length, deformed or missing fins, and general body form. The classification of a rainbow trout-like fish as a triploid rainbow trout was subjective; consequently, some of the fish identified as carry-over triploid rainbow trout could have been resident non-native wild rainbow trout. However, non-native wild rainbow trout were in low densities in the reservoir.

Surgical tag implantation procedures were identical to procedures outlined in the Study 9 Final Report (SCL 2009a). In 2007, when water temperatures were in excess of 18ºC, fish selected for tagging were placed within the influence of a cold water tributary until the fish recovered from the tagging procedure and were actively swimming. The recovery period ranged from several hours to overnight, after which fish were released within the influence of a tributary. In 2008, due to the apparent low survival of 2007 salmonids tagged at 18°C or above, tag implantations were not conducted once reservoir water temperatures exceeded 16°C.

4.2.4. Fixed Biotelemetry Stations

Biotelemetry stations were installed at fixed locations as part of the Study 9 Biotelemetry component (SCL 2009a). The station locations are identified in Figure 4.2-1. In 2008, acoustic monitoring stations were deployed at the mouths of Sweet, Sullivan, and Sand creeks (Figure 4.2-1) to obtain additional information on depth and temperature of individual fish at these locations.

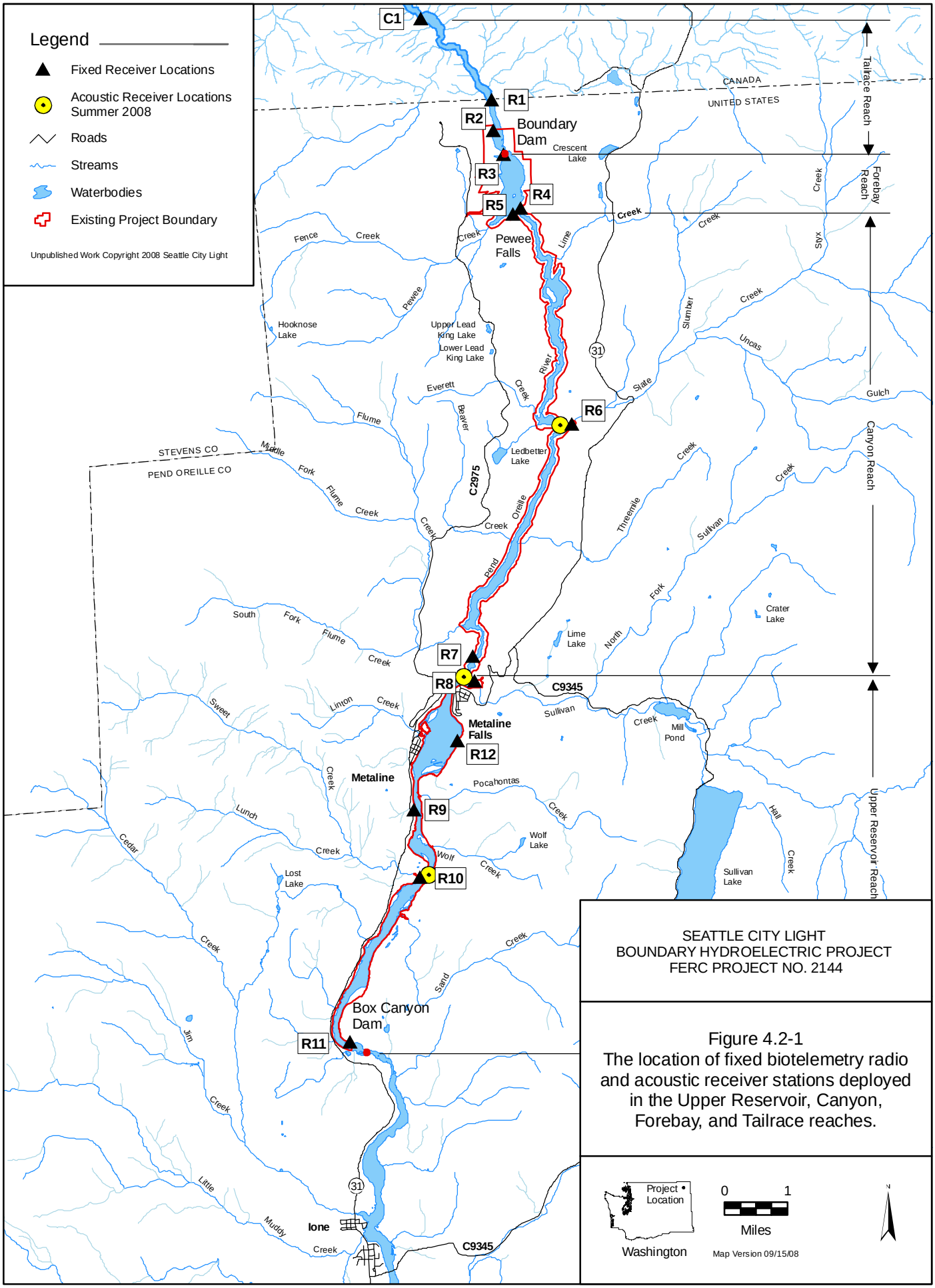


Figure 4.2-1
The location of fixed biotelemetry radio and acoustic receiver stations deployed in the Upper Reservoir, Canyon, Forebay, and Tailrace reaches.

4.2.5. Mobile Tracking, Intensive Tracking, and Habitat Data Collection

Mobile tracking of radio- and CART-tagged spring 2007 triploid rainbow trout and carry-over triploid rainbow trout was conducted concurrently with the tracking of other fish species following procedures outlined in the Study 9 Final Report (SCL 2009a). Positional data recorded included the recording time, date, fish tag number, and Universal Transverse Mercator coordinates at the representative fish location.

In 2007, incidental intensive tracking of triploid rainbow trout was performed in conjunction with the Study 9 intensive tracking component. During these monitoring sessions, CART tag sensor data from carry-over triploid rainbow trout were recorded if these fish were in the vicinity of other monitored fish species in Study 9. The intensive monitoring procedures are summarized in the Study 9 Final Report (SCL 2009a).

Habitat data recorded for located triploid rainbow trout were collected during each bi-weekly (i.e., every two weeks) mobile tracking session, but specific efforts were reduced for triploid rainbow trout to maximize time to locate and record habitat data for native salmonids and smallmouth bass. When recorded, the environmental parameters and data collection methods used to measure triploid rainbow trout habitat attributes were identical to the Habitat Suitability Indices (HSI) methodology outlined in the Study 9 Final Report (SCL 2009a). However, because velocity measurements were not considered to accurately depict a fish's location, they were discontinued in spring 2008 (through agreement with the RPs at the SCL/RP/FERC meetings, March 25 through 27, 2008). FERC approved these changes (Robinson 2008).

Habitat use information on triploid rainbow trout from Study 9 electrofishing was also incorporated into this (Study 13) report. For the Study 9 electrofishing efforts, habitat information was collected from March 2007 through February 2008 to provide field information for the development of the Habitat Suitability Curves (HSC) for Study 7. After this period, no additional habitat use (HSC data) information was collected under Study 9 electrofishing (through agreement with the RPs at the SCL/RP/FERC meetings, March 25 through 27, 2008).

4.3. Triploid Rainbow Trout Management

Triploid rainbow trout management methods involved:

1. A review of the external triploid rainbow trout tagging field component
2. An introductory discussion of the management issues and options based on results of field information (habitat use, demographics, and tag return information from external tagging/biotelemetry and Angler Outreach Program/Tag Reward Program) and literature

The methods for these are presented in this section.

4.3.1. External Tagging of Spring and Fall 2007 Triploid Rainbow Trout

In both the spring and fall 2007, approximately 4,200 triploid rainbow trout were delivered from the Soap Lake Fish Hatchery, located near Moses Lake, Washington, on March 29–30 and October 18–19, respectively. The external tagging objective was to tag 1,000 of these fish to be

released in two groups of 500, one group in the Forebay Reach and one in the tailrace of Box Canyon Dam in the Upper Reservoir Reach. Upon arrival of the fish from the hatchery, a total of 2,000 untagged fish were released directly into the tailrace of Box Canyon Dam and the Forebay Reach of Boundary Dam in groups of 1,000 at each location. The remaining 2,000 fish were transferred into one-half of a 20- by 20-foot floating net pen positioned adjacent to the Boundary Forebay boat dock.

The first 500 fish in each group were tagged with T-bar anchor tags manufactured by Floy Tag and Manufacturing Inc. Each tag was imprinted with a unique identification number, the words "Seattle City Light" and "Reward", and a phone number to call to report the tag information. The tags were inserted with MARK II needle applicator guns on the left side of the fish at the base of the dorsal fin.

Once tagged, the fork length of each fish was measured and the tag number and length recorded. The first 50 fish tagged were also measured for weight. After tagging, the first 500 tagged fish were released directly into the Forebay Reach. An additional 500 untagged fish were also released at the same time to facilitate mixing of tagged and untagged fish (Figure 4.3-1). The following day, 500 of the remaining 1,000 fish were tagged, measured for fork length, and released into the empty half of the net pen. Again, the first 50 fish of this group were measured for weight. Once tagged, the 500 tagged fish and the 500 untagged fish were transferred by dipnet into a holding tank and transported by truck to the Box Canyon Dam tailrace where they were released. During the spring 2008 release on April 3 and 4, the same basic procedures were followed with the exception that 4,600 fish were delivered, and of these, approximately 1,500 were tagged with T-bar anchor tags.

Figure 4.3-1. T-bar tagged triploid rainbow trout being held prior to release in Boundary Reservoir.

4.3.2. Triploid Rainbow Trout Issues and Management Options

The evaluation of alternative triploid rainbow trout management procedures was preliminarily assessed by literature review, interviews with the WDFW triploid program manager, and review of the results from the data collection efforts (biotelemetry monitoring and Tag Reward Program) conducted on triploid rainbow trout. The key factors are summarized in the results section of this report followed by discussion of potential future management options. Interview and literature review results are presented in Appendix 1.

4.4. Biotelemetry Data Processing, Entry, and Verification

Telemetry tracking data recorded for radio- and CART-tagged triploid rainbow trout were processed identically to and concurrently with telemetry data recorded during Study 9. Datasheets printed on water-resistant paper were developed for each aspect of the project where data were recorded in the field. All hardcopy field data recorded during surgical tag implantation, external tag release, mobile tracking, habitat use, and CART tag monitoring were entered manually into Microsoft® Excel® spreadsheets, followed by entry verification by a second person. Following verification, these data were imported into an Access® database.

Details of how telemetry data were screened and summarized are provided in the Study 9 Final Report (SCL 2009a).

4.4.1. Data Analysis Methods

4.4.1.1. Movement Data Comparison with Environmental Variables

Data analysis was limited to the telemetry data recorded from shore-based stations, mobile tracking, and intensive tracking surveys conducted between March 30, 2007, and September 19, 2008. Available telemetry movement data for each tagged fish were plotted as time series in relation to environmental variables (flow, temperature, and reservoir elevation). Capture location of triploid rainbow trout based on angler tag-return data and Study 9 fish capture efforts were plotted in relation to the triploid rainbow trout release location.

Evaluations were conducted to determine if statistical analyses of movement data in response to environmental variables were possible. However, due to an apparent high loss rate of radio-tagged fish and low recapture rates of externally tagged triploid rainbow trout released during 2007, the analyses were not possible. Consequently, analysis of the telemetry, angler tag return, and the recapture data were descriptive and relied on interpretation of the data to identify potential trends. Potential responses to environmental variables were also not analyzed in 2008 because even with the additional releases, there was not a substantial increase in the number of samples from relocations of live radio- and CART-tagged triploid rainbow trout, nor increased numbers of recaptures of externally tagged fish.

4.4.1.2. Triploid Rainbow Trout and Native Salmonid Habitat Use Comparison

Studies were conducted to provide a comparison of habitat use between triploid rainbow trout and native salmonids. However, due to low numbers of tagged native salmonids, combined with a high mortality rate of radio- and CART-tagged triploid rainbow trout, the amount of data recorded was insufficient to identify habitat use requirements of both triploid rainbow trout and native salmonids. Consequently, meaningful comparison of habitat and identification of potential habitat overlap was not possible.

4.4.1.3. Triploid Rainbow Trout Growth Rates

The overall growth rate was an estimate of relative weight change from release to recapture based partly on fish length changes. The change in fish length from released triploid rainbow trout for each of the three releases was estimated separately based upon length at release and recapture provided by angler tag-return data and Study 9 triploid rainbow trout recapture data and conversion to percent weight changes. The length measurement from angler returns was assumed to be total fish length, with relatively poor accuracy. Recapture length data, recorded during the Study 9 fish capture program, were also recorded as fork and total length. Growth rates were determined by converting the initial and recapture fish lengths to estimated weights. The recaptured weight was first determined by either actual field measurements, for most of the Study 9 fish captures, or by a length-weight regression for fish caught by anglers, which was based on measurements made during stocking of hatchery fish. The weight change was

converted to percent weight change per fish. The estimated percent weight changes were divided by days at large to determine an estimated growth rate as percent relative weight change per day.

4.4.1.4. Triploid Rainbow Trout Abundance and Survival

Quantitative and qualitative methods were used to estimate triploid rainbow trout abundance and survival. A coarse quantitative estimate of survival of spring 2007 triploid rainbow trout was based on the ratio of remaining live radio tagged fish to radio tagged fish either dead or suspected of being dead. The relative survival of the fall 2005 and spring 2006 triploid rainbow trout was also evaluated based on the length frequency of March 2006 captures, which included two size classes from fall 2005/spring 2006 triploid rainbow trout, and from fall 2006 plants. The relative rate of loss of spring 2007 triploid rainbow trout plants compared with carry-overs through the summer of 2007 was estimated using tag recovery growth rates applied to monthly catch length frequency information taken from Study 9.

4.4.1.5. Intensive Tracking Data Comparison with Environmental Variables

Studies were conducted during intensive mobile tracking to determine if a comparison of movements to environmental variables could be made. However, only a small amount of CART-tag sensor data from a triploid rainbow trout was recorded near the mouth of Sweet Creek during an intensive tracking session. Due to the low amount of data, statistical analysis of movement data and CART-tag sensor data in response to environmental variables was not possible, and analysis of the intensive tracking data was descriptive.

5 RESULTS

This section presents the results from the 2007 and 2008 recreational creel and angler survey, triploid rainbow trout biotelemetry, and triploid rainbow trout management components of Study 13.

5.1. Recreational Creel and Angler Surveys

5.1.1. Creel Survey

As discussed in Sections 4.1.1 and 4.1.3, in 2007 the recreational creel and angler survey components of Study 13 were implemented jointly as part of the recreation survey effort for Study 21. Questions based on the creel and angler survey objectives were included in the Project-area visitor questionnaire about angling activity and opinions. A similar set of questions was included in the area resident survey conducted as part of Study 21 (SCL 2009b). Results for all of the angling-related survey questions in both efforts are presented below in Section 5.1.1.1.

In 2008, SCL conducted a creel survey as a stand-alone component of Study 13, using a questionnaire oriented exclusively to fishing and focusing on the three key access points for Boundary Reservoir. Results for this activity are presented in Section 5.1.1.2.

5.1.1.1. 2007 Visitor and Area Resident Survey Programs

5.1.1.1.1. Project-Area Visitor Survey Response Summary

Among the 969 visitor questionnaires distributed during the 2007 field season, 600 usable surveys were returned. The sample size of 600 completed questionnaires is more than large enough to allow researchers to make inferences about the visitor population within approximately a 5 percent margin of error at the 95 percent confidence level. (That is, if the survey analysis reported that 60 percent of the sample population selected response "a" to a specific survey question, researchers could be 95 percent confident that the true response from the entire population would be within 5 percentage points of that response from the sample population, or that the true response would be between 55 and 65 percent.) While the true size of the visitor population is not known precisely, a sample size of 375 would be sufficient to provide a 5 percent margin of error at the 95 percent confidence level if the visitor population were 15,000 people. The actual sample size of 600 is sufficient to provide a 4 percent margin of error for a population size of 20,000 people. Therefore, the 600 completed surveys represent a sufficient sample size to allow application of results from the sample to the entire visitor population. The Study 21 Final Report (SCL 2009b) provides additional text and tables documenting distribution and return information for the Project-area visitor questionnaire.

The Project-area visitor questionnaire used in the 2007 sampling season included 42 specific questions addressing 10 categories of information (a blank copy is included as Appendix 2). The questions generally asked visitors to provide responses specific to their particular visit to the Boundary Reservoir Area. A map distributed with the questionnaire indicated the extent of the Boundary Reservoir Area, which is the same as the study area identified on Figure 3.0-1. Questions 10 through 15 addressed respondents' fishing activity and opinions, and Questions 16 through 19 related to boating and reservoir use. The analysis of the results involved tabulating the responses to develop the frequency for each possible response to each question, and calculating measures of central tendency (for instance, mean and standard deviation) for the responses to question for which those measures are meaningful. Most of the survey questions included "Other" as the final possible response, with space provided for the respondents to write in specific information. Lists of these open-ended responses are included in Appendix 3 to the Study 21 Final Report (SCL 2009b).

5.1.1.1.2. Area Resident Survey Response Summary

Residents returned 583 survey forms. Some of the returned surveys were blank (an option identified in the instructions to the recipients), but the large majority were either completed or the respondents indicated that they do not recreate in the study area (another option made available to the recipients). The 583 returned surveys represented an overall response rate of over 32 percent. The returns included 344 surveys from British Columbia residents and 239 from Washington residents. The response rate from the Washington communities within the sample area was 57 percent, more than double the response rate from the British Columbia portion of the sample area. The sample of 583 completed surveys is sufficient to provide better than a 4 percent margin of error at the 95 percent confidence level for the entire base area population of approximately 15,000 people. The sample of 239 completed surveys from Washington residents is sufficient to provide a 5.4 percent margin of error at the 95 percent confidence level for the approximately 900 Washington residents in the local area. The Study 21

Final Report (SCL 2009b) provides additional text and tables documenting distribution and return information for the area resident questionnaire.

The content of the area resident questionnaire is very similar to the visitor questionnaire described previously. (Therefore, a copy of this questionnaire is not included in Appendix 2; Appendix 4a to the Study 21 Final Report [SCL 2009b] is a full copy of the area resident questionnaire.) Questions 10 through 16 addressed respondents' fishing activity and opinions, and Questions 17 through 22 related to boating and reservoir use. Question 1 in the area resident questionnaire asked respondents if they had visited the Boundary Reservoir Area (defined as the area including the Pend Oreille River between Boundary and Box Canyon Dams and some of the lands next to the river, as indicated for the visitor questionnaire) for the purpose of recreation. Those who answered "Yes" to this question were directed to skip to Question 3 and the remainder of the survey. Respondents who answered "No" were directed to Question 2, which asked why they had not visited the Boundary Reservoir Area for recreation. Following Question 2, respondents who do not use the area for recreation were directed to skip to Question 41, where they could answer several questions about themselves and their companions. The returned questionnaires indicated that a substantial proportion of the area resident population had not visited the Boundary Reservoir Area for recreation, and therefore provided responses for only a few questions at the beginning and end of the form. Sample sizes varied by question, as discussed in Sections 5.1.1.1.5 and 5.1.1.1.6.

The analysis process for the area resident questionnaire results was the same as described previously for the visitor questionnaire. Most of the survey questions included "Other" as the final possible response, with space provided for the respondents to write in specific information. Lists of these open-ended responses are included in Appendix 4 to the Study 21 Final Report (SCL 2009b).

5.1.1.1.3. Visitor Survey Fishing Responses

Questions 10 through 15 of the visitor questionnaire addressed fishing activity in the study area. Respondents were requested to answer these questions only if they fished or planned to fish on their current visit to the Boundary Reservoir Area. The number of respondents for specific items in this part of the survey ranged from 150 to 227.

Question 10: Group Size for Visitors Fishing. Table 5.1-1 summarizes results for the number of people fishing per party for visitors who reported fishing during their visit to the Boundary Reservoir Area. This table is based on combined results for respondents indicating that they fished on the trip and the group-size information from survey Question 3. Group sizes reported by angler respondents ranged from 1 to 14 people. Groups of 2 anglers were most frequent response (the mode), reported by 35 percent of the sample. On average, about 3 people fished together in a group (mean = 2.9, standard deviation = 1.9).

Table 5.1-1. Number of people fishing per visitor party at Boundary Reservoir Area.

Fishing Group Size	Frequency	Percent of Sample[1]
1	39	17.4
2	79	35.3
3	41	18.3
4	36	16.1
5	16	7.1
6 or more	13	5.8

Note:
1 Based on 224 respondents.

Question 10: Number of Days and Average Hours per Day Fished. Table 5.1-2 summarizes results for the amount of time visitors spent fishing during their visit to Boundary Reservoir Area. The question asked the visitors who reported fishing to identify both the number of days fished per party and the number of hours per day spent fishing. The number of days fished per party ranged from 1 to 15 days. Over 40 percent of this sample reported fishing with their group for only 1 day. On average, visitors fished with their parties for 2.5 days (mean = 2.5, standard deviation = 2.4, median = 2.0). The amount of time fished per party per day ranged from 30 minutes to 12 hours. Nearly 40 percent of this sample reported fishing with their group for an average of 2 to 3 hours per day.

Table 5.1-2. Visitors' fishing frequency and duration.

Fishing Days	Frequency	Percent of Sample[1]
1	86	41.1
2	48	23.0
3	37	17.7
4	16	7.7
5	10	4.8
6 or more	12	5.7
Average Hours Fished/Day	**Frequency**	**Percent of Sample[2]**
1	20	9.2
2 – 3	82	37.8
4	37	17.1
5	16	7.4
6	34	15.7
8	10	4.6
Other[3]	12	5.5

Notes:
1 209 respondents.
2 217 respondents.
3 Other = 30 minutes (1 party), 1.5 hours (3 parties), 3.5 hours (3 parties), and > 8 hours (5 parties).

Question 11: Means of Fishing. Visitors who reported fishing were asked how they went fishing during their visit to the Boundary Reservoir Area. Nearly the same percentage of anglers reported that they fished from shore as from a boat. Figure 5.1-1 summarizes the results for this survey item. Seven anglers did not respond.

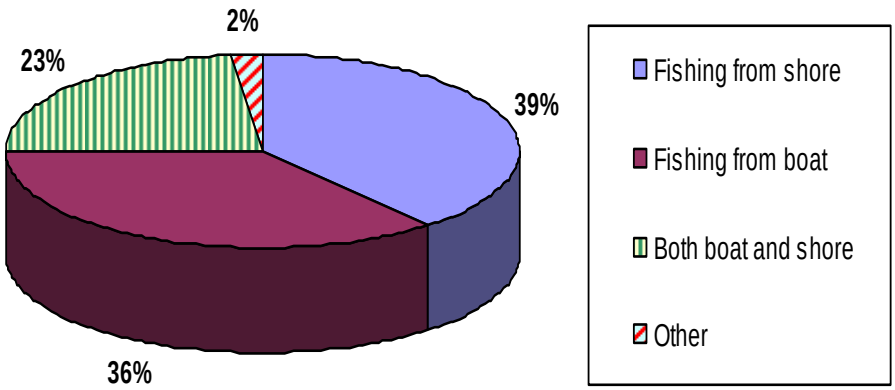


Figure 5.1-1. Responses to Question 11: How did you go fishing? (227 respondents)

Question 12: Fishing Locations. All survey respondents were provided with a map of the Boundary Reservoir Area and asked to report where they fished and/or intended to go fishing during their visit. The anglers who responded (n = 225) to this item provided 432 total responses, indicating that some anglers fished in multiple locations during that particular visit. Nearly 40 percent of the sample reported that they fished in the Forebay Reach of Boundary Reservoir, between Boundary Dam and the north end of the canyon. The second most frequent location reported for fishing was in the canyon area of Boundary Reservoir. Figure 5.1-2 summarizes the results of this question by reporting percentages of respondents indicating the respective locations.

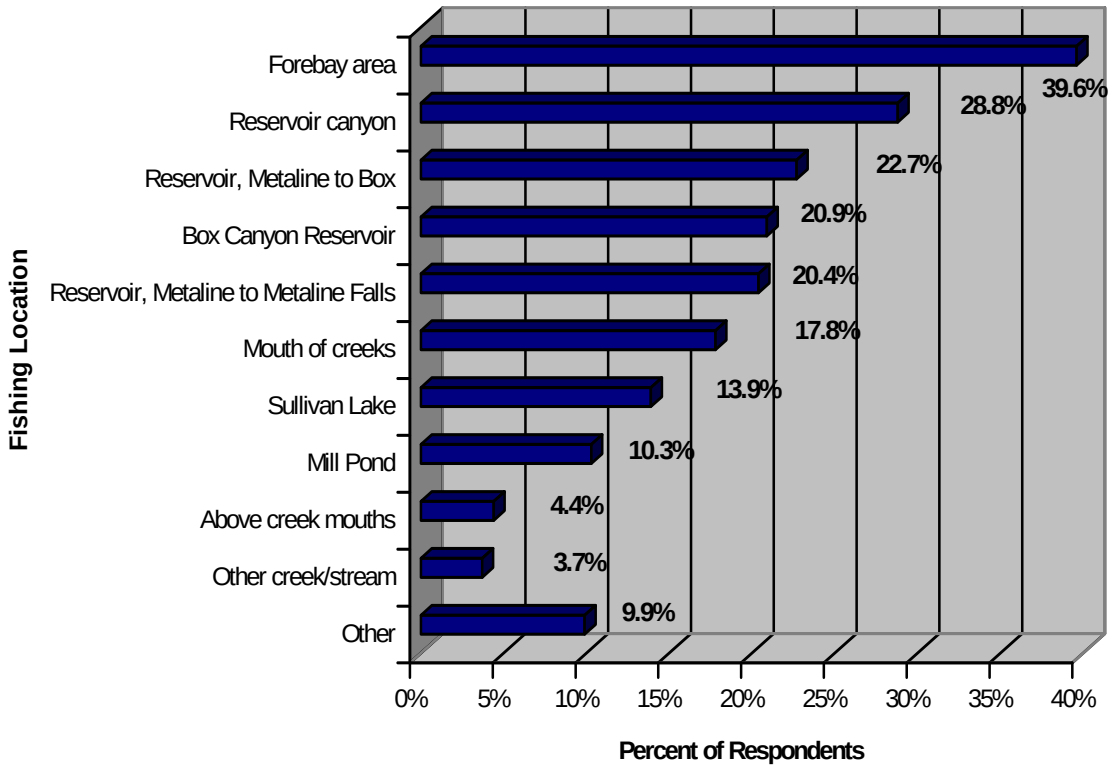


Figure 5.1-2. Responses to Question 12: In what places did/will you go fishing during this visit? (432 responses)

Question 13: Preferred Species of Catch. Anglers were asked to identify the species of fish they wanted to catch while fishing in the Boundary Reservoir Area. There were five choices listed in the questionnaire item, and respondents were instructed to circle all that applied. This sample (n = 218 respondents) provided 491 total responses, indicating that some anglers are interested in catching more than one species while fishing in the area. Figure 5.1-3 summarizes the results of this item. The most common response (26 percent of the total) was a desire to catch triploid rainbow trout. The response percentages for other trout and smallmouth bass were very similar, however, at approximately 24 percent and 25 percent, respectively. Given the error margin of approximately ± 6 percent for this sample, the response percentages for triploid rainbow trout, other trout, and smallmouth bass are statistically the same.

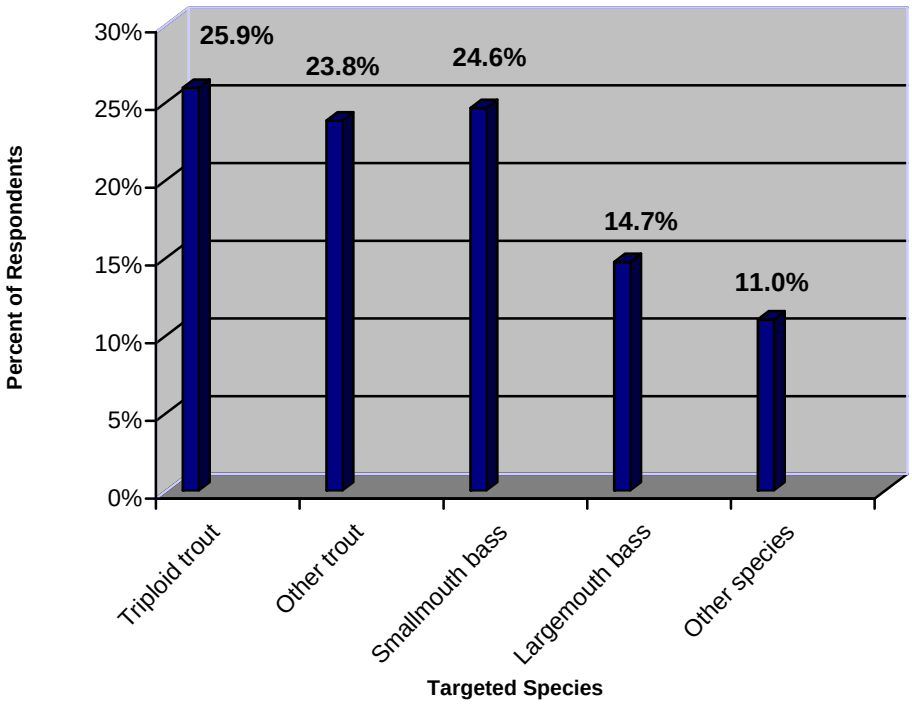


Figure 5.1-3. Responses to Question 13: What species of fish do you want to catch? (491 responses)

Question 14: Description of Fish Caught. Anglers were asked to report the numbers and size of fish caught by species during this particular visit to the Boundary Reservoir Area. Reported results are summarized below for triploid rainbow trout, other trout, smallmouth bass, and largemouth bass (Table 5.1-3). Because species composition varies among the water bodies available locally to anglers (for example, Box Canyon Reservoir has a higher density of largemouth bass than does Boundary Reservoir, whereas Boundary has a higher density of smallmouth bass), to some degree these results may reflect effort directed to local waters other than Boundary Reservoir.

Number of Fish Caught. The anglers sampled in this survey caught between 0 and 15 triploid rainbow trout, with the responses representing a combined total of 271 fish. Most anglers (61 percent) reported catching zero triploid rainbow trout on their visit. Similarly, the anglers sampled in this survey caught between 0 and 15 other trout, with the responses representing a combined total of 136 fish; 68 percent of the sample indicated they did not catch any other trout on their visit. The anglers sampled in this survey caught between 0 and 30 smallmouth bass during their visit, for a total of 595 fish. Nearly half of the sample reported no smallmouth bass harvest, whereas 30 percent caught either one to two fish or three to four fish. Only 18 respondents (12 percent of the total) indicated they caught largemouth bass on the visit. Those respondents caught between 0 and 6 largemouth bass during the visit, for a total of 34 fish.

Table 5.1-3. Numbers of fish caught for all species by anglers.

Species	Number of Fish Caught	Frequency	Percent of Sample[1]
Triploid rainbow trout	0	100	60.6
	1	19	11.5
	2	10	6.1
	3	12	7.3
	4 - 6	9	5.4
	8 - 10	11	6.7
	>10	4	2.4
Other trout	0	102	68.0
	1	18	12.0
	2	11	7.3
	3	8	5.3
	4	5	3.3
	>4	6	4.1
Smallmouth bass	0	82	48.8
	1 - 2	29	17.3
	3 - 4	22	13.1
	5 - 10	19	11.3
	12 - 30	16	9.5
Largemouth bass	0	128	87.7
	1	10	6.8
	2 - 6	8	5.5

Note:
1 165 respondents for triploid rainbow trout, 150 respondents for other trout, 168 respondents for smallmouth bass, and 146 respondents for largemouth bass.

Size of Fish Caught. Anglers reported various ranges in size for the fish that they caught. Because standardized size classes were not specified on the survey form, anglers reported fish sizes in a variety of ways (e.g., "8 to 20 inches") that often made it difficult to categorize fish length. Overall, triploid rainbow trout ranged in size from 4 to 27 inches, and other trout from 3 to 24 inches. Thirty-six different sizes and ranges were reported for triploid rainbow trout, of which 64 percent fell between 10 and 20 inches. Twenty-four different sizes and ranges were reported for other trout, with 67 percent between 10 and 20 inches.

Anglers reported sizes ranging from 1 to 20 inches for both smallmouth bass and largemouth bass. Forty-seven different sizes and ranges were reported for smallmouth bass, of which 45 percent of the responses (the largest group) fell between 8 and 16 inches. Fifteen different sizes and ranges were reported for largemouth bass, with 67 percent falling between 6 and 16 inches. Fish size information from these responses is summarized in Table 5.1-4.

Table 5.1-4. Size of fish caught for all species by anglers.

Species	Size	Frequency	Percent of Sample[1]
Triploid rainbow trout	Less than 10 inches	6	3.7
	10-12 inches	8	4.9
	12-14 inches	15	9.3
	14-16 inches	18	11.1
	Over 16 inches	4	2.5
	Other	11	6.8
Other trout	Less than 10 inches	6	4.7
	10-12 inches	4	2.7
	12-14 inches	15	10.0
	14-16 inches	6	4.7
	Over 16 inches	3	2.0
	Other	8	5.3
Smallmouth bass	Less than 10 inches	17	10.1
	10-12 inches	24	14.3
	12-16 inches	13	7.7
	Over 16 inches	2	1.2
	Other	29	17.3
Largemouth bass	Less than 10 inches	5	3.4
	10-12 inches	4	2.7
	Over 12 inches	6	4.1
	Other	2	1.4

Note:
1 165 respondents for triploid rainbow trout, 150 respondents for other trout, 168 respondents for smallmouth bass, and 146 respondents for largemouth bass.

Question 15: Fishing Satisfaction. Table 5.1-5 summarizes results for the question that asked anglers to rate their satisfaction with the fishing opportunities at Boundary Reservoir (in this instance, the question was specific to Boundary Reservoir, rather than the Boundary Reservoir Area). The most common rating reported (the mode) was average (5 on the numbered scale), which was selected by 24 percent of the sample. Approximately 14 percent of the respondents rated their satisfaction as below average (ratings of 1 to 4), whereas 62 percent considered their experience to be above average (ratings of 6 to 9). Based on the mean response of 6.3 and median of 7, visitors who fished on their visit to the area considered the fishing experience to be slightly to moderately above average.

Table 5.1-5. Visitors' ratings for satisfaction with fishing opportunities at Boundary Reservoir.

Rating[1]	Frequency	Percent of Sample[2]
1 (Very Poor)	10	4.6
2	3	1.4
3	10	4.6
4	7	3.2
5 (Average)	52	24.1
6	23	10.6
7	47	21.8
8	27	12.5
9 (Excellent)	37	17.1

Notes:
1 mean = 6.3, standard deviation = 2.1, median = 7.0, mode = 5.0.
2 216 respondents; percentages reflect rounding.

5.1.1.1.4. Visitor Survey Boating and Recreation Resource Responses

Question 16: Boat Use. Respondents were asked if they operated or rode in a boat or other watercraft during this particular visit to the Boundary Reservoir Area. The number of respondents for this question was 548. Approximately 43 percent of the sample reported using or operating a boat or other watercraft during their visit, whereas 57 percent indicated they did not use a boat.

Question 17: Location of Boat Launch Used. Visitors who reported using a boat or other watercraft on this visit were asked to identify the boat launch they used, and were instructed to circle all choices that applied. Of those who answered this question (n = 236), 78 percent said that they launched at the SCL Forebay Recreation Area. Figure 5.1-4 summarizes the results for boat launch use in the Boundary Reservoir Area for the 2007 visitor survey. The values in Figure 5.1-4 are the percentages of respondents, who could select more than one choice.

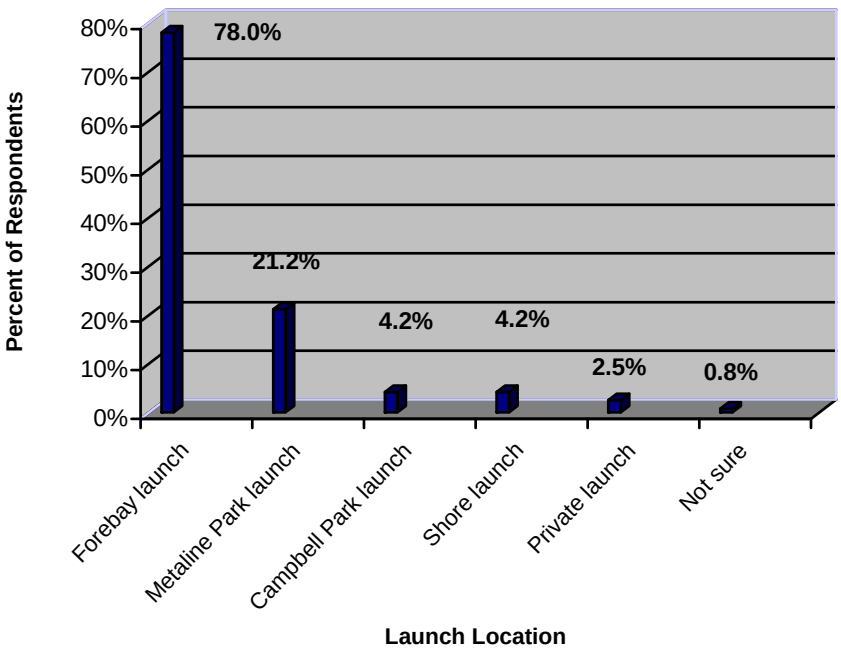


Figure 5.1-4. Responses to Question 17: Which boat launch did you use during this visit? (236 respondents)

Question 18: Boat Launch Adequacy. Visitors who used a boat launch were asked if the launch adequately met their needs for this particular visit. Over 90 percent of this sample of boaters (228 respondents) responded affirmatively that their needs had been met while using a launch, whereas 9 percent indicated the launch did not meet their needs.

Visitors who reported that their needs were not met were asked to describe any problems that they encountered launching their boats. These open-ended comments are listed in Appendix 3e of the Study 21 Final Report (SCL 2009b). Although these responses have not been formally categorized in the same manner as the pre-specified responses, they indicate that most boat launch problems were of two types. The most common type of issue among these open-ended comments involved the type or conditions of facilities present (or lacking) at the boat launches. At least 19 of the 31 comments included references that docks were either missing or needing repair, and/or that boat ramps were rough, too steep, too narrow, or in need of repair or resurfacing. At least 10 comments included some reference to low, high, or fluctuating water levels in the reservoir that made launching difficult or unreliable.

Question 19: Water Conditions. All respondents (not just those reporting use of a boat) were asked if the water conditions on the river or the reservoir caused them any problems during this particular visit. Figure 5.1-5 summarizes the results for this question. About 20 percent of the sample selected the response option that they did not access the river or the reservoir shoreline during this visit (and by inference had no problems with water conditions). Nearly 70 percent of the sample reported no problems. Approximately 10 percent of the sample reported that they had

experienced minor or major problems with water conditions during their visit. Forty-five respondents failed to answer this item.

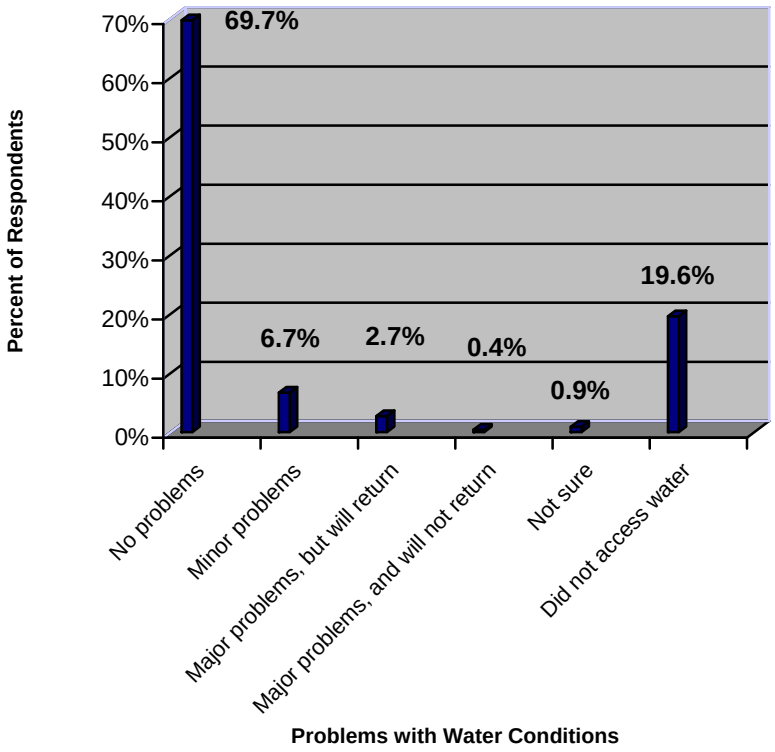


Figure 5.1-5. Responses to Question 19: Did the water conditions cause any problems for you during this visit? (555 respondents)

Visitors who reported that they had experienced any problems with water conditions were asked to provide describe those problems. Forty-one visitors (7.4 percent of this sample) wrote open-ended responses to this part of the question, which are listed in Appendix 3e of the Study 21 Final Report (SCL 2009b). In general, the most frequent problem described (in approximately 25 comments) related in some way to low and/or fluctuating water levels. Several of these comments suggested some prior knowledge of daily fluctuation patterns (specifically lower water levels later in the day), and some associated water levels with fishing difficulties. Three open-ended comments referenced problems or uncertainty associated with the rapids at Metaline Falls, and five comments identified milfoil as a problem.

Question 21: Recreation Improvements Needed. Visitors were asked to report, based on their experiences during this particular visit, whether they thought that any of the existing recreation opportunities in the study area were in need of improvement. Over 50 percent of the sample reported being satisfied with the recreation activities/facilities that are currently available at the Boundary Reservoir Area. Thirty percent of the sample reported that they would like other recreation activities or facilities at the Boundary Reservoir Area. These respondents were asked

to list what they would like to have at this destination in addition to what is currently available. The 168 respondents who answered Question 21 affirmatively generated a lengthy list of activities, facilities, or management actions, often in combination. Overall, the open-ended responses to Question 21 reflect more than 70 distinct ideas. Among the open-ended responses that could be grouped together, the most common themes involved improved restroom facilities (23 responses), recreational vehicle (RV) hookups and/or campsites (21 responses), and new or improved boat launch facilities (18 responses). A relatively small number of these responses addressed fishing-related topics. Among these comments, 7 suggested more or better fishing, 3 requested a fish cleaning station, and 2 identified a dock for fishing (1 of which specified an accessible fishing dock).

Additional Comments. Following Question 42, the visitor questionnaire included space for visitors to provide any additional input or comments they had about how SCL could improve the management of the Boundary Reservoir Area. Respondents to the visitor survey included a total of more than 180 open-ended comments. Some of the comments were quite extensive, and many included multiple points. Approximately 55 comments offered suggestions that related to perceived recreation needs or resource management in the Project vicinity. Many of these additional comments echoed similar points (possibly made by the same respondents) in the responses to certain survey items, such as Question 21 (above). The most common topics among these responses referenced boat launch and/or dock facilities (9 responses), signage and information (8), restroom facilities (7), RV sites or facilities (6), and increased security patrolling and/or enforcement of rules in the developed facilities (6). Five of these 180 comments referenced enhanced fishing or more fishing areas, and 1 requested that the milfoil problem be solved.

5.1.1.1.5. Area Resident Survey Fishing Responses

Some of the area resident questionnaires returned in the mail were blank and a sizable proportion was from people who did not use the Boundary Reservoir Area for recreation, and therefore did not provide responses for most of the questions. Among those who reported using the area for recreation and identified their recreational activities, nearly 50 percent indicated they participated in fishing while in the area. Overall, approximately 150 area residents answered one or more questions regarding fishing in the Boundary Reservoir Area. The area residents who provided an address allowed researchers to determine that Washington residents accounted for 92.9 percent (n = 118) of the area residents who indicated they fished in the Boundary Reservoir area, while the remaining 7.1 percent were Canadian residents.

Question 10: How Long Have Area Residents Been Fishing in the Boundary Reservoir Area. Table 5.1-6 summarizes results for the number of years area residents reported they had been fishing in the Boundary Reservoir Area. The mean number of years across all respondents was just over 16 years. Over 28 percent of this sample reported they had been fishing in the area for more than 20 years, while 32 percent had been fishing in the Boundary Reservoir Area for 5 years or less.

Table 5.1-6. Number of years area residents have been fishing in the Boundary Reservoir Area.

Years Fishing	Frequency	Percent of Sample[1]
0-5	48	32.4
6-10	21	14.2
11-15	18	12.2
16-20	19	12.8
> 20	42	28.4

Note:
1 n = 148 respondents. Mean = 16.2 years, standard deviation = 13.9, median = 12, mode = 2 (6-10 years).

Question 11: Number of Days Per Year Fished. Question 11 asked area residents to identify how many days per year they fished in the Boundary Reservoir Area, by season. Table 5.1-7 summarizes these results. The number of days fished per respondent ranged from 0 to 60 for the spring and fall seasons, and 0 to 100 (a mathematical impossibility) for the summer. The mean number of days fished was highest in the summer, at 8.1 days, decreasing to 4.6 days in the fall, and less than 0.6 in the winter.

Table 5.1-7. Number of days area residents fished, by season, in the Boundary Reservoir Area.

Season	Minimum	Maximum	Mean	Median	Mode	SD
Spring[1] (Mar-May)	0	60	5.29	2.0	0	8.35
Summer[2] (Jun-Aug)	0	100	8.14	5.0	10	12.15
Fall[1] (Sep-Nov)	0	60	4.55	2.0	0	7.5
Winter[3] (Dec-Feb)	0	15	0.56	0.0	0	2.04

Notes:
1 n = 140 respondents.
2 n = 142 respondents.
3 n = 138 respondents.
SD – standard deviation.

Question 12: Means of Fishing. Area residents who reported fishing were asked how they usually fish in the Boundary Reservoir Area. Thirty-eight percent of the anglers reported that they fished from a boat, while 35 percent usually fished from shore and 26 percent fished both from a boat and from shore. Respondents who reported fishing from a boat were asked to identify the type of boat they used for fishing. The answers varied in specificity and included canoes, row boats, Zodiacs, pontoon boats, and motorboats.

Question 13: Fishing Locations. A map of the Boundary Reservoir Area was included in the questionnaire and area residents were asked to report where they usually went fishing in the area. The most common response, identified by nearly 50 percent of this sample, was the upper reach of Boundary Reservoir between Metaline and Box Canyon. Sullivan Lake (49 percent) and Mill Pond (40 percent) were the second and third most frequently identified areas. Figure 5.1-6 summarizes the results of this question, showing the percentages of respondents selecting the various locations.

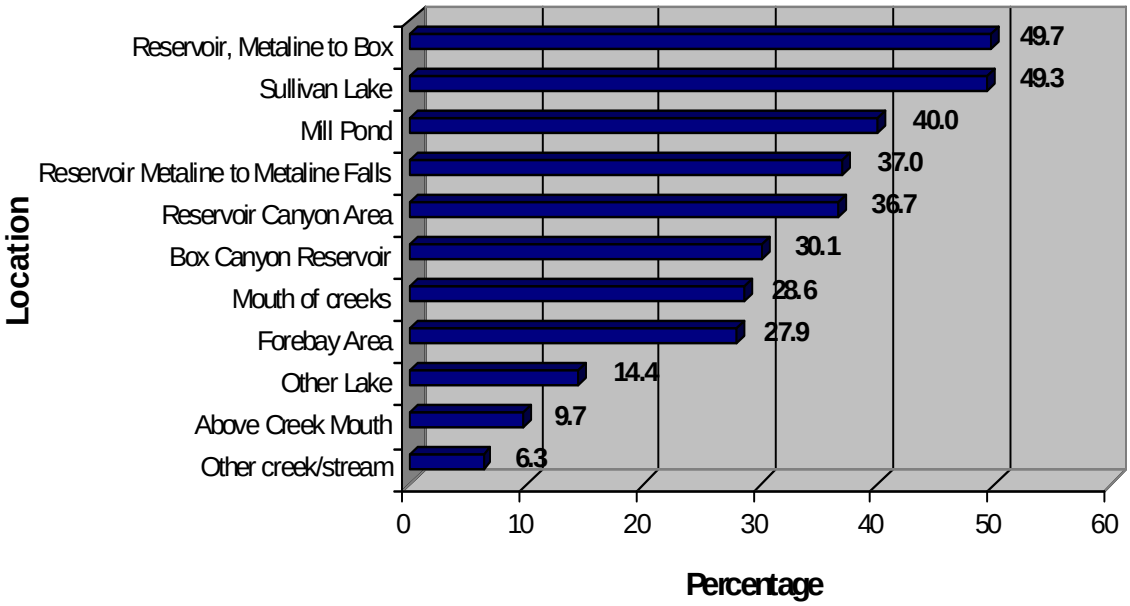


Figure 5.1-6. Area resident angler responses to Question 13: In what area(s) do you usually fish when you visit the Boundary Reservoir Area? (147 respondents)

Question 14: Preferred Species of Catch. Area resident anglers were asked what species of fish they usually tried to catch while fishing in the Boundary Reservoir Area. There were five choices (including "Other species") listed in the question, and respondents were instructed to circle all that applied. This sample (145 respondents) reported 343 total responses, indicating that many anglers are interested in catching more than one species while fishing in the area. Triploid rainbow trout were the most popular fish to try to catch (selected by 65 percent of the respondents), followed by other trout (63 percent) and smallmouth bass (53 percent). Given the error margin of approximately ± 8 percent for this sub-sample, in statistical terms the response percentages for triploid rainbow trout, other trout, and smallmouth bass could be the same. (For example, the true response from the entire population could be from 57 to 73 percent for triploid rainbow trout, and from 45 to 61 percent for smallmouth bass.) Figure 5.1-7 summarizes the results for this item.

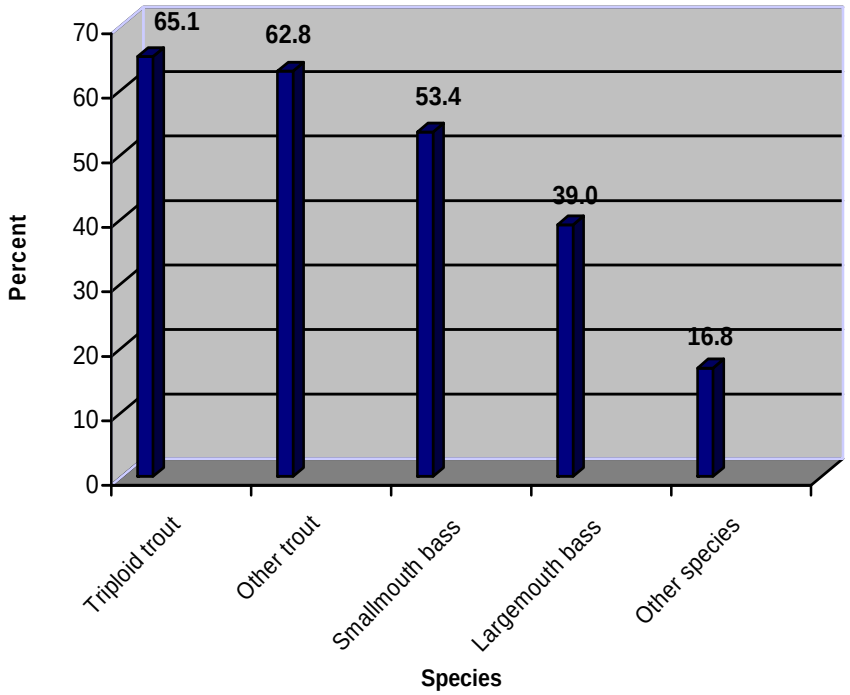


Figure 5.1-7. Area resident angler responses to Question 14: What species of fish do you usually try to catch? (145 respondents)

Question 15: Description of Fish Caught. Question 15 asked area residents to report the numbers and size of fish they typically catch by species during a fishing trip in the Boundary Reservoir Area. Reported results are summarized in Table 5.1-8. The anglers in this sample reported catching from 0 to 100 fish on a single trip, with the maximum figure reported for smallmouth bass (and seeming an unrealistically high number). The most common response for the number caught per trip (the mode) was 2 fish for all species except largemouth bass. The median reported harvest per trip was also 2 fish for triploid rainbow trout, largemouth bass and smallmouth bass, and 3 fish for other trout. Species reported in the "other fish" category included northern pikeminnow, pike, walleye, and tench.

Table 5.1-8. Number of fish typically caught by area residents on a fishing trip at the Boundary Reservoir Area.

Species	Minimum	Maximum	Mean	Median	Mode	SD
Triploid rainbow trout	0	24	3.90	2.0	2	3.98
Other trout	1	30	4.58	3.0	2	6.12
Smallmouth bass	0	100	5.67	2.0	2	13.57
Largemouth bass	0	20	3.44	2.0	1	4.17
Other fish 1	1	20	5.35	4.0	2	4.89
Other fish 2	2	4	2.17	2.0	2	1.60

Notes:
Table entries are based on data from 162 respondents.
SD – standard deviation.

Table 5.1-9 summarizes the fish size component of the Question 15 responses. Based on the range of the responses, the survey analysts established four different size categories. Across all species, the most common sizes reported were in the 10- to 18-inch size class; this category accounted for a combined 54 percent of all responses to this question. Among responses for triploid rainbow trout that fit into the size categories (i.e., discounting the "Other size" responses), 70 percent were in the 10- to 18-inch size range and 13 percent were in the over-18-inch category.

Table 5.1-9. Size range of fish typically caught by area residents in the Boundary Reservoir Area.

Species	Size Range of Fish (Inches)									
	Under 6		6-9		10-18		Over 18		Other Size[1]	
	Frequency	%	Frequency	%	Frequency	%	Frequency	%	Frequency	%
Triploid rainbow trout	2	1.0	6	3.0	33	16.7	6	3.0	13	6.6
Other trout	2	1.0	2	1.0	33	16.7	2	1.0	12	6.1
Smallmouth bass	2	1.0	6	3.0	21	10.6	3	1.5	16	8.1
Largemouth bass	0	0.0	2	1.0	13	6.6	0	0.0	4	2.0
Other fish	3	1.5	1	0.5	6	3.0	5	2.5	5	2.5
Total	**9**	**4.5**	**17**	**8.5**	**106**	**53.6**	**16**	**8.0**	**50**	**25.3**

Notes:
n = 198 responses.
1 Other Size of fish are responses that were not numbers (i.e., small) or sizes that did not fit into the size categories.

Question 16: Fishing Satisfaction. Table 5.1-10 summarizes results for the question that asked area resident anglers to rate their satisfaction with the fishing opportunities in the Boundary Reservoir Area. The responses were based on a scale ranging from 1 to 9, with 1 representing "Very Poor" and 9 representing "Excellent." The most common rating reported among the nine classes (the mode) was 5, "Average," which was selected by 35 respondents (25 percent of this sample). Approximately 19 percent of the respondents rated their satisfaction as below average (combining all ratings of 1 to 4), whereas 57 percent rated their satisfaction as above average

(ratings of 6 to 9). Based on the mean response of 6.96 and the median of 5.4, the area resident anglers considered the fishing experience to be slightly to moderately above average.

Table 5.1-10. Area residents' satisfaction with fishing opportunities in the Boundary Reservoir Area.

Rating	Frequency	Percent of Sample[1]
1 Very Poor	1	0.7
2	6	4.2
3	7	4.9
4	13	9.1
5 Average	35	24.5
6	25	17.5
7	26	18.2
8	18	12.6
9 Excellent	12	8.4

Note:
1 n = 143 respondents; mean = 6.96, standard deviation = 1.9, median = 5.4, mode = 5.

5.1.1.1.6. Area Resident Survey Boating and Recreation Resource Responses

The area resident survey included a series of questions similar to those in the visitor survey concerning use of a boat, boat launch locations and adequacy, and problems encountered with water conditions. The area resident responses to those questions are summarized below.

Question 17: Boat Use. Area residents were asked if they often operated or rode in a boat or other watercraft for pleasure or travel on Boundary Reservoir when they visit the area for recreation. Approximately 47 percent of the area resident respondents reported that they often operated or rode in a boat or other watercraft on Boundary Reservoir, while 53 percent reported no such boat use.

Question 20: Location of Boat Launch Used. Of the area residents who reported using a boat or other watercraft on Boundary Reservoir, boat launch use was evenly divided between Metaline Waterfront Park and the SCL Forebay Recreation Area. Seventy percent said that they usually used the launch at Metaline Waterfront Park, and 69 percent identified the SCL Forebay Recreation Area as a common launch location (respondents were directed to circle all responses that applied, and many identified multiple launch locations). In addition, 15 percent of the area residents reported that they often launched at Box Canyon Dam, and 8 percent often launched directly from shore. Figure 5.1-8 summarizes the results for boat launch use on Boundary Reservoir by area residents.

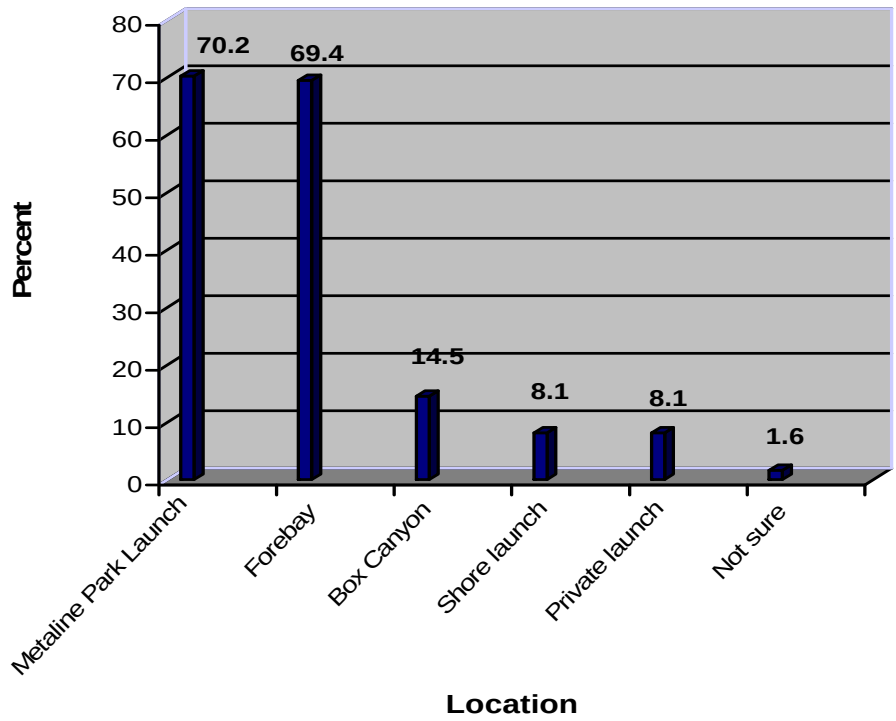


Figure 5.1-8. Area resident angler responses to Question 20: Which boat launch do you usually use at Boundary Reservoir? (124 respondents)

Question 21: Boat Launch Adequacy. Those who reported using a boat launch were asked if the boat launch adequately met their needs. Approximately 68 percent of the resident respondents to this question reported that the boat launch they used adequately met their needs, whereas 32 percent indicated that it did not. The area residents who reported that their launching needs were not met provided 36 open-ended comments about problems they encountered. These entries included 15 comments that specifically mentioned some aspect of the facilities at the Metaline Waterfront Park launch, and three comments referencing problems with launching a boat at Box Canyon Dam. Some area residents discussed problems with low or fluctuating water levels, such as returning to a launch in the afternoon and having difficulty taking out their boat.

Question 22: Water Conditions. Approximately 44 percent of the area resident sample reported they had not encountered problems with the water conditions while boating on Boundary Reservoir and 36 percent indicated water conditions had caused them minor problems. Eighteen respondents (approximately 15 percent of the area resident sample) selected one of the responses characterizing problems with water conditions as major. Table 5.1-11 summarizes the area resident responses to this question. This sample provided 38 open-ended responses describing specific problems encountered. These responses included some specific problems, such as difficulty passing through the falls area near Metaline due to water fluctuations (7 responses) or difficulty launching or retrieving boats due to low or changing water levels (9 responses). Some of the open-ended responses were more general statements such as “low

water" or "water levels change daily." One of these comments included a reference to milfoil as an apparent issue.

Table 5.1-11. Area residents who reported problems with water conditions while boating on Boundary Reservoir.

Response	Frequency	Percent of Sample[1]
No problems	54	43.5
Minor problems	45	36.3
Major problems, but would not keep me from returning	18	14.5
Major problems, that would keep me from returning	4	3.2
I'm not sure	3	2.4

Note:
1 124 respondents; percentages reflect rounding.

Question 24: Recreation Improvements Needed. Area residents were asked if, based on their experiences, they thought any of the existing recreation opportunities in the Boundary Reservoir Area were in need of improvement. The most common response, selected by 39 percent of the sample (106 of the 273 respondents for this question), was that they were satisfied with the recreation activities/facilities that are currently available at the Boundary Reservoir Area. Approximately 31 percent (85 respondents) indicated they would like to see other recreation activities or facilities. These respondents provided open-ended comments identifying the activity or facility improvements they would like to see. Boating-related input included 24 comments with some reference to more or better boat docks and/or launches. Approximately 30 comments addressed other facility-related topics, such as disabled access, better maintenance of grounds, additional bathrooms and trashcans, trails for hiking/walking, biking or horses, and better beach/swimming area. Four respondents identified a desire for more or better fishing (including one requesting that crappie *[Pomoxis nigromaculatus]* and walleye be stocked), two comments addressed fishing access, and one indicated milfoil should be removed from the river.

Additional Comments. At the end of the area resident questionnaire, space was provided for respondents to provide additional input or comments they had about how SCL could improve the management of the Boundary Reservoir Area. Respondents included a total of 67 open-ended comments, some of which were rather extensive while others were quite brief and simple. Approximately 12 of these comments offered general or specific suggestions that appear to relate in some way to perceived recreation needs or resource management in the Project vicinity. These included two comments with references to milfoil, one each requesting more access for shore fishing and more fish, and one comment stating that water fluctuations has resulted in a recent decrease in the size and quality of trout caught.

5.1.1.1.7. Comparison of Visitor and Area Resident Survey Fishing and Boating Responses

A brief comparison of the visitors' and area residents' responses to survey questions about fishing and boat use is summarized below. Based on general consistencies between these two sets of results, in-depth analysis of similarities and differences in the results does not appear to be needed and has not been performed.

Question 10/11: Number of Days Fished. The visitors' responses to Question 10 represent a mean of 2.5 days of fishing activity per respondent on their current visit. The mean for the residents who reported fishing amounted to 18.5 days per year per respondent.

Question 11/12: Means of Fishing. Area residents and visitors appear to have very similar patterns for means of fishing. Among visitors, 39 percent reported fishing from shore, 36 percent from a boat, and 23 percent from boat shore and boat. Corresponding figures for area residents were 38 percent, 35 percent, and 26 percent, respectively.

Question 12/13: Location Fished. Visitor responses showed a considerably greater tendency to fish the northern reaches of Boundary Reservoir. Forty percent of visitors reported fishing in the Forebay Reach, compared to 27 percent for area residents. By contrast, 23 percent of visitors reported fishing between Metaline and Box Canyon, whereas 50 percent of area residents fished that area (the most frequent location indicated by residents). Area residents also showed a strong tendency to fish water bodies other than Boundary Reservoir, with reported figures of 49 percent for Sullivan Lake, 40 percent for Mill Pond, and 28 percent for Box Canyon Reservoir.

Question 13/14: Preferred Species. Species preference among visitors was evenly divided between triploid rainbow trout, other trout, and smallmouth bass. Although high percentages of area residents also selected those species, residents indicated a slightly greater tendency to fish for triploid rainbow trout (65 percent) and other trout (63 percent), versus 53 percent for smallmouth bass and 39 percent for largemouth bass.

Question 14/15: Fish Caught. For each species, large percentages of visitors reported catching zero fish on their visit, and the mean harvest number was one fish or less in each case. By contrast, the catch reports for area residents represented means of about 4 triploid rainbow trout, 5 other trout, or 6 smallmouth bass per outing.

Question 15/16: Fishing Satisfaction. Approximately 62 percent of the visitors responding to this question assigned ratings of above average (6 or higher) to their satisfaction with the fishing opportunities, whereas 57 percent of area residents reported above-average satisfaction. Eight percent of residents rated their satisfaction as excellent, compared to 17 percent of visitors.

Question 16/17: Boat Use. The results for the question on boat use are very similar for visitors and area residents: 43 percent of the visitor respondents and 47 percent of the area residents reported using a boat on their visit(s) to the area.

Question 17/20: Location of Boat Launch Used. Of the area residents who reported using a boat or other watercraft, 70 percent said that they often launched at Metaline Waterfront Park,

whereas 69 percent identified the SCL Forebay Recreation Area as a common launch location. The corresponding responses from the 2007 visitor survey were 78 percent for the Forebay launch and only 21 percent for Metaline. In addition, 15 percent of the area residents reported that they often launched at Box Canyon Dam (compared to 4 percent for visitors), and 8 percent often launched directly from shore (versus 4 percent for visitors).

Question 18/21: Boat Launch Adequacy. Area residents appear to be less satisfied with the conditions at the local boat launches than are visitors. Approximately 68 percent of the resident respondents to this question reported that the boat launch they used adequately met their needs, whereas 32 percent indicated that it did not. In comparison, only 9 percent of the visitor sample indicated the launch they used did not meet their needs.

Question 19/22: Water Conditions. Approximately 44 percent of the area resident sample reported they had not encountered problems with the water conditions while boating on Boundary Reservoir and 36 percent indicated water conditions had caused them minor problems. Among visitors, nearly 70 percent of the sample reported no problems and 7 percent reported minor problems. Nearly 15 percent of the area resident sample selected one of the responses characterizing problems with water conditions as major, compared to 3 percent for the visitor sample.

Question 21/24: Recreation Improvements. Approximately 30 percent of the visitor survey sample and 31 percent of the area resident sample indicated they would like to see various types of recreation resource improvements. The most common topics among these comments were related to recreation facilities such as boat launches, restrooms, and campsites. Small numbers of comments from each sample (five visitors and four are residents) addressed desires for enhanced fishing opportunities, and a few comments indicated milfoil was an issue.

5.1.1.2. 2008 Creel Survey

Sampling for the 2008 creel survey began May 2 and continued through October 4. Survey crews contacted anglers at the primary water access points on Boundary Reservoir, which are the boat launches at the SCL Forebay Recreation Area, Metaline Waterfront Park, and Box Canyon Dam. They also contacted anglers at known bank-fishing locations, primarily the USGS gaging station near Box Canyon Resort, on an opportunistic basis (essentially, if anglers were observed from the road as a survey crew was passing by).

Survey crews attempted to contact all angler parties observed at a site during the sampling period and ask if one person in each party would agree to be interviewed. The objective was to contact anglers when they returned from the water, to be able to gather information such as fishing success and effort on completion of the day's fishing activity. Interviews with anglers fishing from shore were attempted whenever the opportunity was present; in those cases, data on time spent fishing and fishing success were necessarily based on the fishing visit up to that time.

5.1.1.2.1. Response Summary

The following discussion summarizes key data for the sampling effort and the sample population for the 2008 creel survey effort. This information is based on the responses from all surveys

completed from May 5 through the end of the sampling season. Results from sampling conducted May 2 through May 4 are not included in the main creel survey database and are reported separately in Section 5.1.4, because these surveys were completed during the annual smallmouth bass tournament during the first weekend of the 2008 sampling season. The anglers surveyed during the tournament weekend represent a different population from those surveyed during the remainder of the season, because the tournament anglers had a specific focus on smallmouth bass and their activity patterns reflect conditions associated with a special event. Presenting the results from the tournament-weekend surveys separately avoids potential bias in the responses for some of the questions.

Survey Locations

Survey crews completed interviews with 235 anglers during the May 5–October 4 creel survey season. Table 5.1-12 summarizes the distribution of these surveys by location. Over 62 percent of the 235 total surveys were completed at the SCL Forebay Recreation Area. Locations for almost all of the remaining surveys were divided between Metaline Waterfront Park (23 percent of the total) and the boat launch at Box Canyon Dam (15 percent). Only one survey (0.4 percent of the total) was conducted at the gaging station or another shoreline location.

Table 5.1-12. Location for surveys completed during 2008 creel survey.

Location Survey was Administered	Frequency	Percent
SCL Forebay Recreation Area	146	62.1
Metaline Waterfront Park	53	22.6
Box Canyon Dam	35	14.9
USGS gaging station/other location	1	0.4
Total	**235**	**100.0**

Surveys Completed by Month

The survey crews recorded the date and location for every completed survey. Table 5.1-13 indicates the number of surveys completed by month during the sampling season. Survey activity was relatively light in May and June before increasing during the peak summer months, with 27 percent of the total completed in July and 31 percent in August. Activity levels for fishing and other water-based recreational use were inhibited by a period of high flows and flooding in the local area, which included an extended closure of Metaline Waterfront Park from approximately May 23 to June 20 because of flooding.

Table 5.1-13. Number of surveys completed by month for 2008 creel survey.

Month Survey Administered	Frequency	Percent
May	27	11.5
June	30	12.8
July	64	27.2
August	72	30.6
September	39	16.6
October	3	1.3
Total	**235**	**100.0**

5.1.1.2.2. Responses to 2008 Creel Survey

The creel survey questionnaire included nine specific questions addressing the interview subject and information about their current fishing visit. The questionnaire included a space at the end for respondents to provide open-ended comments with any additional input they wanted to provide about how the fishery could be improved. This section of the report provides a summary of the processed results from analysis of the responses. The analysis involved tabulating the responses to develop the frequency (number) and percentage distribution for each possible response to each question, and calculating measures of central tendency (for instance, mean and standard deviation) for the responses to a given question for which those measures are meaningful. The percentages that are reported are based on the number of survey participants responding to each question, and not on the total number of completed surveys (235). For some questions, the number of respondents is somewhat less than 235.

The sample size of 235 completed questionnaires is large enough to allow researchers to make inferences about the overall angler population within approximately a 6 percent margin of error at the 95 percent confidence level. (That is, if the survey analysis reported that 60 percent of the sample population selected response "a" to a specific survey question, researchers could be 95 percent confident that the true response from the entire population would be within 6 percentage points of that response from the sample population, or that the true response would be between 54 and 66 percent.) While the true size of the angler population is not known precisely, a sample size of 278 would be sufficient to provide a 5 percent margin of error at the 95 percent confidence level if the angler population were 1,000. The actual sample size of 235 would be sufficient to provide a 5 percent margin of error for an angler population size of 600, and a 6 percent margin of error for an angler population size of 1,800. Based on the extensive sampling effort expended in 2008, it is highly unlikely that the angler population is larger than 1,800. Therefore, the creel survey database represents a sufficient sample size to allow application of results from the sample to the overall angler population.

Results are provided for each question in the survey, in sequential order. For each survey question, there is a graph or table summarizing the tabulation of responses and a brief narrative. Some of the survey questions included "Other" as the final possible response, with space provided for the respondents to write in specific information. Because those open-ended responses can cover a variety of subject matter and can be difficult to interpret, they are not

specified in the tabulated response data. The open-ended responses are included in Appendix 3b and have been reviewed for generalizations evident from those data.

Question 1: Group Size. Question 1 asked anglers how many people were fishing in their group. Responses are summarized in Table 5.1-14. The most common reply was from anglers fishing in pairs (100 respondents, or 43 percent of the sample). Almost 36 percent of the anglers reported fishing by themselves. One angler reported being in a group of more than five people. The median group size for this sample was 1.34 people. Based on the sample size (235) and the median group size (1.34 people), this represents a total of 315 anglers among groups sampled during the season.

Table 5.1-14. Number of people per group reported fishing during 2008 creel survey.

Number of People Fishing	Frequency	Percent[1]
1	84	35.7
2	100	42.6
3	38	16.2
4	11	4.7
5	2	0.9
Total	**235**	**100.0**

Note:
1 Percentage entries reflect rounding

Question 2: Time Spent Fishing. Anglers were asked in Question 2 to identify the approximate times they had started and ended fishing for the day. In addition to the starting and ending times, responses to this question provided data on duration of fishing activity and angler effort.

Starting and Ending Times

Initial results for Question 2 are summarized in Table 5.1-15. Twelve percent of the respondents indicated they had started fishing before 8:00 a.m., whereas 35 percent started between 8:00 and 11:00 a.m. The ending times were primarily during the latter part of the day, with largest proportion ending their fishing activity between 1:00 and 4:00 p.m.

Table 5.1-15. Starting and ending times reported by anglers during 2008 creel survey.

Approximate Start Time	Frequency	Percent	Approximate End Time	Frequency	Percent
5:00–7:59 a.m.	29	12.3	7:00–10:59 a.m.	29	12.3
8:00–10:59 a.m.	83	35.4	11:00 a.m.–12:59 p.m.	60	25.6
11:00 a.m.–12:59 p.m.	59	25.1	1:00 p.m.–3:59 p.m.	93	39.5
1:00 p.m. or later	64	27.2	4:00 p.m. or later	53	22.6
Total	**235**	**100.0**		**235**	**100.0**

Angler Effort

Activity durations for the anglers interviewed during the season were calculated from the start and end times reported. Durations ranged from a low of 10 minutes to a high of 870 minutes (14.5 hours). Almost 73 percent of the respondents indicated they had fished less than 200 minutes, while durations exceeded 400 minutes (6.7 hours) for 16 percent of the sample.

Total fishing effort reported by the sample was calculated by multiplying the fishing durations calculated from the Question 2 responses by the group size responses in Question 1. Results for this calculation are provided in Table 5.1-16. The resulting effort estimates per group ranged from 10 minutes to nearly 3,000 minutes (50 hours). Total effort for the group was less than 3 hours for 45 percent of the respondents, and was from 3 hours to 6 hours for another 23 percent. The mean estimated effort was 349 minutes (5.8 hours) per group, although the large standard deviation (379.7) indicates a large variance in the effort per group during the season. The median effort duration is approximately 240 minutes (6 hours) per group. Multiplying this figure by the 235 respondents results in an estimated total effort by the sample population of approximately 940 hours of fishing activity over the season.

Table 5.1-16. Angler effort distribution reported in 2008 creel survey.

Angler Effort	Frequency	Percent
1 hour or less (60 min)	32	13.6
1–3 hours (61-180 min)	74	31.5
3–6 hours (181–360 min)	55	23.4
6–9 hours (361–540 min)	33	14.1
9–12 hours (541–720 min)	23	9.7
12–15 hours (721–900 min)	4	1.7
15–18 hours (901–1,080 min)	3	1.3
18–21 hours (1,081–1,260 min)	4	1.7
21–24 hours (1,261–1,440 min)	2	0.9
Over 24 hours (1,441 min)	5	2.1
Total	**235**	**100.0**

Note:
Mean = 349.0; standard deviation = 379.7

Question 3: Fish Caught. Interviewers asked respondents to identify the number and size of fish they caught, by species, and the number of those fish they kept (harvested). When acceptable to the subject, interviewers measured the fish in the anglers' possession. In some cases anglers reported fish that they had caught and released while they were still on the water. Question 3 provided data on catch and harvest numbers and fish size.

Catch and Harvest Numbers

Table 5.1-17 summarizes catch and harvest results. Anglers surveyed in 2008 reported catching a total of 893 fish, of which 154 (17 percent) were kept and 739 (83 percent) were released. The catch included 543 smallmouth bass, accounting for 61 percent of the total catch reported, with 68 of these fish harvested. Triploid and conventional rainbow trout combined accounted for 156 fish caught (18 percent), with 68 of these fish harvested. Anglers reported catching 117 yellow perch, representing 13 percent of the catch.

Table 5.1-17. Catch and harvest reported by anglers during 2008 creel survey.

Species of Fish	Number Caught	Percent of Catch	Number Harvested
Triploid rainbow trout	47	5.3	26
Rainbow trout	109	12.2	42
Other trout	4	0.5	0
Smallmouth bass	543	60.8	68
Largemouth bass	12	1.3	1
Yellow perch	117	13.1	9
Other fish	61	6.8	8
Total	**893**	**100.0**	**154**

Note:
n = 235 respondents

Anglers reported catching 61 fish in the "Other" species category. By type, these included northern pike, peamouth, northern pikeminnow, sucker, sunfish, whitefish, lake trout (mackinaw) (*Salvelinus namaycush*), tench, and crappie. Just under half of the fish identified in this category were northern pikeminnow.

Fish Size Data

Angler responses for Question 3 regarding fish size were classified into four specific size ranges. In some cases, the size could not be determined from the response. Table 5.1-18 is a summary of the fish-size results. (Note that size data were not provided for approximately 19 percent of the total reported catch; the large majority of fish caught were released, and angler recall of the size for many of those fish was not strong.) For all fish in the aggregate, 43 percent (384 fish) of those reported were in the 10- to 18-inch size range. Nine percent of the fish caught were reported as over 18 inches in length, whereas 27 percent were less than 10 inches. The 10- to 18-inch class represented a majority of fish reported for all size species except for yellow perch, for which most of the catch was in the 6- to 9-inch range.

Table 5.1-18. Size range of fish caught, by species, during 2008 creel survey.

Species	Number of Fish by Size Range (in Inches)				
	Under 6	**6-9**	**10-18**	**Over 18**	**Size Undetermined**
Triploid rainbow trout	0	1	45	1	0
Rainbow trout	0	16	8	72	13
Other trout	0	0	4	0	0
Smallmouth bass	27	127	275	2	112
Largemouth bass	0	0	10	0	2
Yellow perch	19	39	2	0	57
Other species	6	5	40	7	3
Total	**52**	**188**	**384**	**82**	**187**

Note:
n = 245 respondents; "Size Undetermined" entries are fish that were unmeasured or fish sizes that did not fit into other categories.

Question 4: Means of Fishing. Question 4 addressed whether anglers fished from a boat or other watercraft, the shore, or both means, and asked respondents to identify the type of boat or watercraft they used. The majority of anglers surveyed in 2008 (56 percent) reported using a boat or other watercraft to fish during their visit, while 44 percent reported fishing from the shore or bank.

Anglers who reported fishing from a boat or other type of watercraft were asked to identify the type of craft they used with specific responses following. The survey sample provided 36 specific responses for this item, of which all but 4 appeared to reference some type of motorized boat. The actual responses are listed in Appendix 3b.

Question 5: Areas Fished. The survey form listed six different areas in or accessible from Boundary Reservoir, and interviewers asked anglers to identify all areas in which they had fished. "Other" was included as an option, and respondents selecting this answer were asked to name the location. Results for this question are summarized in Figure 5.1-9. The northernmost reach of Boundary Reservoir was indicated most frequently, with 39 percent of the sample indicating they fished in the Forebay area. Thirty-five percent of the respondents indicated they fished in the Canyon reach and 29 percent of respondents reported fishing from Metaline to Box Canyon. Four percent indicated they had fished in another area.

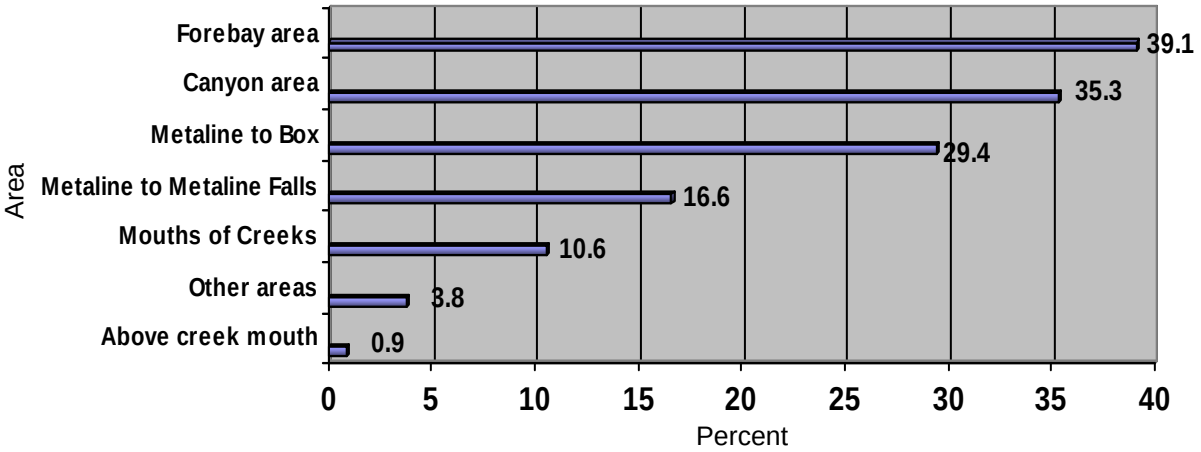


Figure 5.1-9. Areas fished by anglers in the 2008 creel survey (n = 235 respondents).

Anglers indicating they had fished in or above the mouth of a creek entering Boundary Reservoir, or selecting the "Other" response to Question 5, were asked to name those specific areas. The specific responses provided in these cases are listed in Appendix 3b. Slate Creek was by far the most common response (13 responses, out of 36 total) among anglers who reported fishing at the mouth of a creek. The nine respondents who selected the "Other" response identified 4 specific locations in Boundary Reservoir and another lake in the general area.

Question 6: Desired Catch. Anglers were asked to identify the species of fish they most wanted to catch, and were instructed to select only one of the responses listed. Forty-nine percent of the sample chose the smallmouth bass response. One respondent specifically identified largemouth bass as the desired catch. Forty-two percent of the respondents indicated they wanted to catch rainbow trout. Based on the error margin of approximately ± 6 percent, the true responses could range from 43 to 55 percent for smallmouth bass and from 36 to 48 percent for rainbow trout. Only 2 percent of the anglers stated they most wanted to catch other trout, 3 percent identified triploid rainbow trout, and 4 percent (9 anglers) selected the "Other species" response; these respondents identified pike, walleye, and cutthroat (a trout) as the desired catch. No anglers stated they were interested in catching yellow perch. One individual stated that he was interested in whatever fish were biting. Results for this question are summarized in Table 5.1-19.

Table 5.1-19. Fish species anglers most wanted to catch during 2008 creel survey.

Species	Frequency	Percent
Triploid rainbow trout	6	2.6
Rainbow trout	99	42.1
Other trout	5	2.1
Smallmouth bass	115	48.9
Largemouth bass	1	0.4
Yellow perch	0	0.0
Other species	9	3.8
Total	**235**	**100.0**

The species preferences indicated by the 2008 creel survey respondents differ considerably from comparable results from the 2007 recreational visitor and area resident surveys. The visitor survey sample indicated essentially equal preferences (approximately 25 percent each) for triploid rainbow trout, other trout, and smallmouth bass. The area resident respondents most commonly preferred triploid rainbow trout (65 percent) by a small margin over other trout (63 percent) and smallmouth bass (53 percent). (As noted previously, for both samples the response percentages among the three species can be considered the same because of the range of the applicable error margin.) The reason for the comparatively quite low preference (only 3 percent) for triploid rainbow trout among the 2008 creel survey sample is not known. It is possible the 2008 respondents were not making a distinction between triploid and conventional rainbow trout, although that did not appear to be the case in 2007. The tagged fish reward program focusing on triploid rainbow trout was active during both the 2007 and 2008 seasons, and should not have been a factor in respondents' preferences. Other plausible explanations for this difference have not been identified.

Question 7: First Visit. Anglers were asked if they had fished in Boundary Reservoir before the current visit. Approximately 77 percent of the sample stated they had fished in Boundary Reservoir before, with 23 percent indicating they were visiting the area for the first time.

Question 8: Angler Origin. Question 8 asked respondents to identify the ZIP code or postal code for their permanent residence. Table 5.1-20 summarizes the distribution of angler origins. Thirty-three percent of the anglers were from the local area, with Ione, Metaline, or Metaline Falls addresses. Anglers from the southern part of Pend Oreille County, primarily Newport and Cusick, accounted for 10 percent of the sample. Almost 29 percent of the respondents were from Spokane County, and 10 percent were from Stevens County. Washington locations outside of Pend Oreille, Stevens, and Spokane counties represented 6 percent of the respondents. Eleven anglers (just under 5 percent) were from Idaho, and 11 provided ZIP codes from other states, which included Alaska, California, Oregon, Maryland, Georgia, Oklahoma, Texas, and Hawaii. Only one angler reported being from Canada. Six responses were either stated or recorded incorrectly, as their location could not be determined.

Table 5.1-20. Origin of anglers interviewed at Boundary Reservoir during 2008 creel survey.

Location	Frequency	Percent[1]
Northern Pend Oreille (Ione, Metaline, and Metaline Falls)	78	33.2
Southern Pend Oreille	23	9.8
Spokane County	68	28.9
Stevens County	24	10.2
Other Washington counties	3	1.3
Bonner County, Idaho	10	4.3
Boundary County, Idaho	5	2.1
Kootenai County, Idaho	5	2.1
Other Idaho counties	1	0.4
Other states	11	4.7
British Columbia	1	0.4
Unknown/missing	6	2.6
Total	**235**	**100.0**

Note:
1 Percentage entries reflect rounding.

Question 9: Satisfaction with Fishing Opportunities. The final survey question asked anglers to rate their satisfaction with the fishing opportunities in Boundary Reservoir. The question defined a numerical scale ranging from 1 to 9, on which 1 represented "very poor" and 9 represented "excellent." The satisfaction responses from the 2008 season are summarized in Table 5.1-21. The most common rating (the mode) was a 5, "average," which was the response from 18 percent of the sample. The mean rating from this sample was 5.5, or slightly above average, and the median was 5. Twenty-one percent of the sample rated their satisfaction quite highly (ratings of 8 or 9), whereas 12 percent gave ratings at or near the low end of the scale.

Table 5.1-21. Angler satisfaction with fishing opportunities reported in 2008 creel survey.

Satisfaction Rating	Frequency	Percent	Mean	Median	Mode	SD
1-2	27	11.5	5.51	5	5	2.26
3-4	48	20.6				
5	42	17.9				
6-7	67	28.6				
8-9	50	21.4				
Total	**234**	**100.0**				

Note:
Scale ranged from 1 to 9, with 1 = very poor and 9 = excellent

Additional Comments

At the end of the survey, the interviewers asked respondents if they had any additional input or comments about how the fishery could be improved. The survey sample provided 232 distinct

thoughts among 196 recorded entries, some of which included multiple observations or suggestions. Given that there were 196 entries from the sample of 235 respondents, it is evident that the large majority of the respondents provided some type of input for this part of the survey. These comments addressed a wide range of topics. The most common type of comment (49 cases) simply contained incidental information about the respondent's visit, such as "Been here all weekend with the family, loves the place," and "Lives across from park, fishes here a lot." The specific comments are listed, generally in alphabetical order, in Appendix 3b. Table 5.1-22 summarizes the most common themes relating to management of the fishery or the reservoir, including access opportunities and facilities, among these comments.

Table 5.1-22. Additional comments from anglers interviewed at Boundary Reservoir during 2008 creel survey.

Comment Theme	Frequency	Percent[1]
Fishery management/enhancement	28	12.1
Boat launch/dock facilities	20	8.6
Shore fishing/river access	10	4.3
Quality of fishing	31	13.4
Water level management	31	13.4
Aquatic plants/weeds	3	1.3
Keep the place as it is	13	5.6
Other management needs	12	5.2
Positive general comments	31	13.4
Miscellaneous/personal/non-specific observations	49	21.1
Total	**232**	**--**

Note:
1 Percentages based on 232 distinct comments from 235 total respondents.

Twenty-eight (28) of these comments clearly related to management of the fishery, and most of these comments involved suggested fishery enhancement. Specific comments in this group included statements on the general need for more fish (7 cases), while some identified fish species that should be stocked or reduced. These included comments in favor of walleye (4 cases), trout (2), triploid rainbow trout (1), brook trout (1), bass (1), and pike (2). Comments requesting control or reduction of fish species addressed pike (2 comments), baitfish (1), triploid rainbow trout (1), northern pikeminnow (1), and predator/trash fish (1). Two comments addressed size and bag limits on fish. Although these comments indicate at least a moderate level of interest in the general subject of enhancing the recreational fishery (over 10 percent of the sample provided input of this nature), they do not suggest strong or obvious favor or disfavor for a particular species.

Most of the 20 comments relating to boat launch and/or docking facilities stated a desire for improvements to existing facilities or addition of new docks; 6 comments specifically requested facilities to tie up boats overnight. Among the comments classified as addressing the quality of the fishery, at least two-thirds were negative (the respondents thought the quality was poor) and at most one-third were positive. Most of the comments addressing management of the water

level in the reservoir were suggestions to maintain the water level, maintain a higher water level, or reduce water level fluctuations. Several of the comments in this category stated an effect of water level changes on fish or fishing, and at least 4 comments requested advance notifications of expected water conditions.

Two of the three comments involving aquatic plants indicated milfoil was an issue, whereas one comment suggested that aquatic plant life was absent because of reservoir fluctuations. The 12 comments classified as addressing other management needs were not directly related to the fishery or the reservoir. This group included suggestions to provide showers, clean rest rooms, electricity and water at campsites, and better swimming facilities, and to get rid of mosquitoes, remove tree stumps, and dredge silt at the mouth of Sullivan Creek.

5.1.2. Tagged Fish Reward Program

The tagged fish reward program was operated for the spring, summer, and fall seasons of 2007 and continued through November 2008. Tetra Tech established the toll-free phone line for the program on March 30, 2007. Posters were installed at access points and fliers were distributed to key community locations in the first week of April. The first tags submitted by anglers were received on approximately April 20, 2007. Tetra Tech continued to receive tags intermittently through early December 2007. During 2008, the first tag was received in February. Following no activity in March, there was a relatively steady volume of tag returns from April through August, with diminished activity from September through November.

5.1.2.1. Tag Return Summary

5.1.2.1.1. 2007 Returns

Table 5.1-23 summarizes the activity in the tagged fish reward program on a monthly basis during 2007. Appendix 4 provides a complete listing of the individual angler reports received during the season; Table A.4-1 includes information about reporting and catch dates, tag numbers, fish length, and catch locations. Through December 2007, anglers submitted 67 reports accounting for 130 tags. Most of the angler reports involved single tags, but a few included multiple tags. One angler submitted 11 tags in a single report, although the catch dates spanned a full month. Fully 70 percent of all tags returned for the year were received in May, June, and July 2007, with 30 or 31 tags returned in each month.

Table 5.1-23. 2007 tagged fish reward program activity summary, by month.

Month	Number of Reports/Anglers	Number of Tags
April	2	2
May [1]	21	30
June [2]	12	30
July	15	31
August	9	17
September	6	9
October	1	6
November	0	0
December	1	5
Season Total	**67**	**130**

Notes:
1 May total includes 14 tags from 12 Bassin' Assassin Derby anglers.
2 June total includes 7 tags from one angler in drop box.

5.1.2.1.2. 2008 Returns

Table 5.1-24 summarizes the activity in the tagged fish reward program on a monthly basis during 2008. Appendix 4 (Table A.4-2) provides a complete listing of the individual angler reports received during the second season. Through November 10, 2008, anglers submitted 52 reports accounting for 100 tags. Most of the angler reports again involved single tags, but 16 included multiple tags. One angler submitted 11 tags in a single report, although the catch dates spanned approximately 6 weeks. The number of tags returned by month varied from zero in March to 27 in April, with 51 percent of all tags received in May, June, and July 2008.

Table 5.1-24. 2008 tagged fish reward program activity summary, by month.

Month	Number of Reports/Anglers	Number of Tags
January	0	0
February	1	1
March	0	0
April	7	27
May	11	18
June	5	19
July	10	14
August	9	11
September	3	3
October	5	6
November	1	1
Season Total	**52**	**100**

5.1.2.2. Angler Information

5.1.2.2.1. 2007 Returns

Anglers returning tags to Tetra Tech reported their addresses so they could be mailed their tag rewards. Of the 67 tag reports received during the 2007 season, 36 (54 percent of the total) came from the nearby communities of Metaline, Metaline Falls, and Ione. There were 22 tag reports from anglers with Ione addresses, representing by far the largest single source of tag returns from any community. Anglers from other Pend Oreille County communities (Cusick, Usk, and Newport) accounted for another 9 tag reports, and 8 were from Spokane County addresses. The distribution of angler origins is summarized in Table 5.1-25.

Table 5.1-25. Distribution of angler origins for 2007 tag returns.

Location	Number of Reports
Ione	22
Metaline	9
Metaline Falls	5
Cusick	4
Usk	2
Newport	3
Spokane County	8
Other Northeast Washington	5
Other Eastern Washington	3
Western Washington	3
Idaho	2
British Columbia	1

5.1.2.2.2. 2008 Returns

Tag returns for 2008 showed a similar pattern, but with a more pronounced domination of local addresses among the tag reports. Of the 52 tag reports received during the 2008 season, 35 (67 percent of the total) came from the nearby communities of Metaline, Metaline Falls, and Ione. There were 19 tag reports from anglers with Metaline Falls addresses, representing the largest single source of tag returns from any community. In 2008 there were no tag reports from the Pend Oreille County communities of Cusick and Usk, and only 2 from Newport. Six tag reports (10 percent) were from Spokane County addresses, and 4 (8 percent) were from Idaho residents. The distribution of angler origins for 2008 is summarized in Table 5.1-26.

Table 5.1-26. Distribution of angler origins for 2008 tag returns.

Location	Number of Reports
Ione	11
Metaline	5
Metaline Falls	19
Cusick	0
Usk	0
Newport	2
Spokane County	6
Other Northeast Washington	1
Other Eastern Washington	1
Western Washington	3
Idaho	4
British Columbia	0
Total	**52**

5.1.2.3. Harvest-related Information

5.1.2.3.1. 2007 Returns

Triploid rainbow trout accounted for 124 of the 130 tags (95 percent) returned during 2007, with the remaining 6 tags from smallmouth bass. (As indicated in Section 4.3.1, 1,000 Floy-tagged triploid rainbow trout were released in Boundary Reservoir at the end of March 2007. The smallmouth bass reported by the reward program represent a harvest of 6 out of a total of 151 game fish [102 smallmouth bass] tagged and released in Boundary Reservoir during Study 9 fish distribution and abundance sampling.) Anglers reporting catches of tagged fish included information on fish length for 87 of the 130 tags returned. Four of those reports involved tags from smallmouth bass, of which two were reported as 10-inch fish and two as 11-inch fish. Fish length reported for 83 triploid rainbow trout ranged from 9 inches to 20 inches. The most common length reported for triploid rainbow trout was 13 inches, as indicated in 26 tag reports (31 percent of the total). Another 22 tags (26 percent) came from fish reported as 11 inches long. Fish reported as 15 inches or longer accounted for 11 tags (13 percent). The median fish length reported for triploid rainbow trout in this sample was just over 12 inches. The entries in Appendix 4 show that the tag returns from larger fish all occurred later in the season, and there was an evident pattern of generally increasing fish length as the season progressed. Table 5.1-27 summarizes the fish length data reported, on a monthly basis.

Table 5.1-27. 2007 tagged fish reward program fish length summary, by month.

Month[1]	Number of Tags	Tags with Length Reported	Size Range (inches)	Average Length (inches)
April	2	2	11	11
May	30	20	9–14	11.0
June	30	12	8.5–16	11.5
July	31	25	10–17	12.7
August	17	10	10–14	12.1
September	9	7	11–15	13.4
October	6	6	19–20	19.5
November	0	0	--	--
December	5	5	13	13
Season Total	**130**	**87**	**8.5 - 17**	**12.6**

Note:
1 Entries based on month report submitted, from running log during the season.

Anglers reported catch locations for 123 of the 130 tags returned (see Appendix 4) in 2007. Those location statements were interpreted to represent 27 different locations, virtually all of which referenced specific locations in Boundary Reservoir or its tributary streams (e.g., reports for eight tags mentioned simply "Boundary Reservoir"). Box Canyon Dam at the upper end of Boundary Reservoir was the most common location identified, associated with 20 of the tags (16 percent of the total). Boundary Dam (or sites in the immediate vicinity) was identified as the catch location for 12 tagged fish. Tributary creeks or creek mouths (Slate, Sweet, Lime, Sullivan, and Flume Creeks) accounted for 24 of the reported catch locations, and another 6 locations were identified as "near Slate Creek"). Locations downstream from Boundary Dam were reported for 3 tags, including 1 reported as "below Boundary Dam" (possibly in the tailrace area), 1 as Seven Mile Reservoir, and 1 from Lake Roosevelt (the Columbia River behind Grand Coulee Dam). Additional discussion of fish location is provided in Section 5.3.

The tag reports provided little information concerning fishing effort and whether anglers kept or released the tagged fish they caught. Twelve reports from 2007 representing 14 tagged fish indicated the amount of time spent fishing. Those reports indicated a total effort of 24.5 hours, or an average of approximately 1.8 hours per fish caught. In 19 of these reports the anglers indicated that they released the tagged fish, whereas in 7 cases they reported keeping the fish.

5.1.2.3.2. 2008 Returns

Triploid rainbow trout accounted for 90 of the 100 tags (90 percent) returned during 2008. The remaining 10 tags included 3 from smallmouth bass; 2 each from non-triploid rainbow trout, brown trout, and largemouth bass; and 1 from a northern pike. (Tagging efforts in 2008 included a release of 1,503 Floy-tagged triploid rainbow trout in Boundary Reservoir during the spring, plus 393 other fish that were caught, tagged, and released in Boundary Reservoir at various times during Study 9 fish distribution and abundance sampling. The latter activity during 2008 involved 218 smallmouth bass, 52 brown trout, 43 triploid rainbow trout, 11 wild or redband

rainbow trout, 14 largemouth bass, 21 walleye, 1 brook trout, 4 lake trout, 11 northern pike, and 18 burbot.)

Anglers reporting catches of tagged fish included information on fish length for 94 of the 100 tags returned. The 10 tag reports from fish other than triploid rainbow trout all included size data. These fish were generally in the 13- to 16-inch size range, although one brown trout was reported at 21 inches. Fish length reported for triploid rainbow trout ranged from 9 to 18 inches; one tag report involved a holdover triploid rainbow trout reported at 30 inches. The most common length reported for triploid rainbow trout was 10.5 inches, as indicated in 17 tag reports (24 percent of the triploid total). Fish from all species reported as 15 inches or longer accounted for 12 tags (15 percent). The median fish length reported for triploid rainbow trout in this sample was 12 inches. The entries in Appendix 4, Table A.4-2 show that most of the tag returns from larger fish occurred later in the season and, as in 2007, there was an evident pattern of generally increasing fish length as the season progressed. Table 5.1-28 summarizes the fish length data reported, on a monthly basis.

Table 5.1-28. 2008 tagged fish reward program fish length summary, by month.

Month[1]	Number of Tags	Tags with Length Reported	Size Range (inches)	Average Length (inches)
January	0	0		
February	1	1	17.3	17.3
March	0	0		
April	27	25	9-14.5	10.5
May	18	18	9–16	10.7
June	19	19	9–14	12.3
July	14	11	12–21	14.4
August	11	11	10–30	15.9
September	3	2	14-17	15.5
October	6	6	12-18	14.9
November	1	1	15.5	15.5
Season Total	**100**	**94**	**9-30**	**12.5**

Note:
1 Entries based on month report submitted, from running log during the season.

Anglers reported catch locations for 90 of the 100 tags returned (see Appendix 4, Table A.4-2) in 2008. Those location statements were interpreted to represent 18 different locations, virtually all of which referenced general or specific locations in Boundary Reservoir or its tributary streams. Box Canyon Dam at the upper end of Boundary Reservoir was the most common location identified, associated with 30 of the tags (33 percent of the total). Boundary Dam (or sites in the immediate vicinity) was identified as the catch location for 23 tagged fish. Areas near tributary creeks or creek mouths (Slate, Lime, and Everett creeks) accounted for 8 of the reported catch locations. Locations reported as “below Boundary Dam” or “north of Boundary Dam” (possibly in the tailrace area) accounted for 5 tags. Three tags were from fish caught in Lake Roosevelt

(the Columbia River behind Grand Coulee Dam). Additional discussion of fish location is provided in Section 5.3.

The tag reports provided limited information concerning fishing effort and whether anglers kept or released the tagged fish they caught. Thirty-two reports from 2008 representing 47 tagged fish indicated the amount of time spent fishing. Those reports indicated a total effort of 157 hours, or an average of approximately 3.3 hours per fish caught. (These data apply only to a specific sub-sample, and are not indicative of the CPUE for all tagged fish or all angling in general.) In 33 cases the anglers indicated that they released the tagged fish, whereas in 29 cases they reported keeping the fish (harvest/release information was not provided for 38 tagged fish caught).

5.1.2.4. Toll-free Phone Line Operation

The toll-free telephone line established for the tagged fish reward program during 2007 recorded 40 calls or voicemail messages. Virtually all of the calls were from anglers reporting catches of tagged fish who subsequently submitted tags by mail. The line was somewhat active during April and May, received few calls in June, and was most active in July, with 25 calls or messages during the month. The last activity on the line during 2007 was recorded on August 1. More than half of the calls were repeat calls from a previous caller, typically with new reports on tagged fish catches. The relatively low level of activity on the phone line is likely in response to the requirement that anglers still needed to submit their tags to confirm a catch and receive the reward, rather than confirm a catch just with a phone report.

During 2008 there were 28 voicemail messages left on the toll-free line from the beginning of the year through early November. All of these messages identified a tag number and provided catch information. April was the busiest month, with 9 messages, followed by 6 messages in August and 5 in July.

5.1.3. Angler Survey

Results for all of the angling-related questions in the Project-area visitor questionnaire and the area resident questionnaire are provided in Section 5.1.1.1. Results from the 2008 creel survey effort are addressed in Section 5.1.1.2.

5.1.4. Smallmouth Bass Derby Monitoring

5.1.4.1. 2007 Tournament

5.1.4.1.1. SCL Data Collection

SCL staff visited the SCL Forebay Recreation Area, Metaline Waterfront Park, and Campbell Park (Box Canyon Dam) boat launches during the May 5–6, 2007, Bassin' Assassin Derby (smallmouth bass derby) at Boundary Reservoir. Contacts with derby participants provided several types of information concerning fishing effort and success, anglers' opinions and perceptions, water and access conditions, and related considerations. Angler catches of tagged fish reported in these contacts were recorded.

SCL contacts during the 2007 derby included 12 anglers who had caught a total of 14 tagged fish. One of these fish was a smallmouth bass and the remaining 13 were triploid rainbow trout. The length of the fish caught was indicated for 6 of the tagged fish; length was reported as 11 inches for 5 fish and 12 inches for the sixth. Catch location was reported for 13 of the fish, with 8 caught in the Upper Reservoir Reach and 5 in the Canyon Reach. The most common catch location was near Box Canyon Resort (5 fish), followed by the old powerhouse below Metaline Falls (3 fish). Data on hours fished and whether fish were kept or released were not recorded from these contacts.

Additional data were collected from several anglers on their knowledge of fish-spawning areas, distribution of game species, and potential stranding and trapping areas, as part of the Study 7 Habitat Mapping component. The details of these queries are presented in the Study 7 Final Report (SCL 2009c).

5.1.4.1.2. Tournament Sponsor Data

Subsequent to the 2007 tournament, SCL obtained information that had been compiled by the tournament sponsor (Sargent 2008). The tournament records indicated that 143 anglers participated in the 2007 Bassin' Assassin Derby. The vast majority of the entrants originated from Pend Oreille County, including 67 (47 percent) from Metaline, Metaline Falls, and Ione, and nearby counties in northeastern Washington. Catch data for the event are summarized as follows:

- Tournament anglers submitted 118 smallmouth bass for weigh-in.
- Smallmouth bass submitted as tournament entries ranged from 11.5 inches to 20.5 inches in length, and 0.8 pound to 5.1 pounds in weight.
- The median length for the reported smallmouth bass catch was 15.1 inches, and the median weight was 2.2 pounds.
- Tournament anglers reported catching 244 fish of other species, including 167 rainbow trout (the catch reports did not differentiate between triploid and non-triploid rainbow trout), 53 largemouth bass, 13 brown trout, 6 walleye, and 5 lake trout.

5.1.4.2. 2008 Tournament

5.1.4.2.1. Survey Sampling

The 2008 Bassin' Assassin Tournament was held on May 3 and 4. The sampling season for the 2008 creel survey began on May 2, and survey crews actively sampled anglers at the Boundary Reservoir access points during the entire weekend of the tournament. The tournament was well attended, particularly on Sunday, May 4. Anecdotal reports noted at the time indicated at least 160 anglers participated in the 2008 event. Survey crews completed interviews with 53 anglers during the weekend, including 17 on Saturday, May 3 and 36 on Sunday, May 4. Virtually all of the respondents were participating in the tournament. Survey responses for the May 3–4 interviews were processed separately to provide details for this section of the report, and are summarized below for the respective survey questions.

Metaline Waterfront Park is the center of activity at the Bassin' Assassin tournament, as fish are weighed and entries are recorded at the nearby Western Star Bar and Grill, the tournament

sponsor. Consequently, a large majority of surveys from this weekend was collected at Metaline Waterfront Park (38 surveys, 72 percent of the total), while only 11 surveys (21 percent) were conducted at the SCL Forebay Recreation Area and 4 at other locations. Table 5.1-29 indicates the complete distribution of survey activity for the May 3-4 weekend. Results tabulated for the respective survey questions follow the table.

Table 5.1-29. Location for surveys completed during the 2008 Bassin' Assassin tournament.

Survey Location	Frequency	Percent
Forebay Recreation Area	11	20.8
Metaline Waterfront Park	38	71.7
Box Canyon Dam	2	3.8
USGS gaging station	2	3.8
Total	**53**	**100.0**

Note:
1 Percentage entries reflect rounding.

Group Size

Question 1 asked anglers how many people were fishing in their group. Among the 53 anglers interviewed during the 2008 Bassin' Assassin Tournament, the most common reply to the question about group size was from anglers fishing in pairs (20 respondents, or 38 percent of the sample). One angler reported being in a group of more than five people during the tournament. The median group size for this sub-sample was 2.3 people. Based on the sample size (53) and the median group size (2.3 people), this sample represents a total of 122 anglers active during the tournament weekend.

Activity Timing Responses

Anglers were asked in Question 2 to identify the approximate times they had started and ended fishing for the day. Sixty-four percent of the respondents indicated they had started fishing before 8:00 a.m., and 42 percent started between 5:00 and 7:00 a.m. The ending times ranged from late morning to late afternoon, with largest proportion coming off the water between 1:00 and 2:00 p.m. The closing time for official weigh-ins was 2:00 p.m. on Sunday, which no doubt influenced the ending time for many of the anglers interviewed during the tournament.

Activity durations for the anglers interviewed during the tournament were calculated from the start and end times reported. Durations ranged from 150 minutes (2.5 hours) to 870 minutes (14.5 hours). The largest fishing duration was reported by twenty-two (42 percent) visitors who indicated they had fished between 400 to 499 minutes.

Total fishing effort reported by the tournament sample was calculated by multiplying the fishing durations calculated from the Question 2 responses by the group size responses in Question 1. Results for this calculation are provided in Table 5.1-30. The resulting effort estimates per group ranged from 350 minutes (5.8 hours) to 2,940 minutes (49 hours), and the data from 30 percent

of the respondents represented 1,500 minutes (25 hours) or more for their groups. The mean estimated effort was 1,234.5 minutes (over 20.5 hours) per group, although the large standard deviation indicates a large variance in the angler effort during the tournament. The median effort duration was slightly more than 1,000 minutes (16.7 hours) per group. Multiplying this figure by the 53 respondents provides an estimated total effort by the sample population of approximately 885 hours of fishing activity over the tournament weekend.

Table 5.1-30. Fishing effort reported by anglers interviewed during the Bassin' Assassin 2008.

Angler Effort (Minutes)	Frequency	Percent
350-499	6	11.3
500-799	9	17.0
800-999	11	20.8
1,000-1,499	11	20.8
1,500 or more	16	30.2
Total	**53**	**100.0**

Notes:
Percentage entries reflect rounding.
Mean = 1,234.5; standard deviation = 637.0

Catch and Harvest Data

Question 3 asked respondents to identify the number and size of fish they caught, by species, and the number of those fish they kept (harvested). Because prizes for the Bassin' Assassin tournament are exclusively based on smallmouth bass entries, smallmouth bass was the dominant species caught during this weekend. All smallmouth bass catches entered for the tournament are released back into Boundary Reservoir, so the proportion of smallmouth bass that were harvested during the tournament is likely lower than would otherwise occur. The May 3–4, 2008, survey sample reported catching 182 smallmouth bass (representing an average of 3.4 smallmouth bass per group surveyed), none of which were harvested. Triploid rainbow trout was the second most common species, with a catch of 44 fish. Fish reported in the "other species" category included northern pike, peamouth, northern pikeminnow, sucker, whitefish, mackinaw (lake trout), and tench. Table 5.1-31 provides a summary of the catch and harvest data.

Table 5.1-31. Catch and harvest reported by anglers interviewed during the 2008 Bassin' Assassin tournament.

Species of Fish	Number Caught	Number Harvested
Triploid rainbow trout	44	3
Rainbow trout	14	0
Other trout	13	4
Smallmouth bass	182	0
Largemouth bass	1	0
Yellow perch	1	0
Other species	62	1
Total	**317**	**8**

Fishing Means and Locations

Question 4 addressed whether anglers fished from a boat or other watercraft, the shore or both means, and asked respondents to identify the type of boat or watercraft they used. Virtually all anglers (96 percent) interviewed during the 2008 tournament reported fishing from a boat, while only 4 percent fished from shore.

Question 5 on the survey form listed six different areas in or accessible from Boundary Reservoir, and interviewers asked anglers to identify all areas in which they had fished. "Other" was included as an option, and respondents selecting this answer were asked to name the location. Results for this question are summarized in Table 5.1-32. The upper (southern) reach of Boundary Reservoir received by far the greatest angler use during the tournament weekend, with 59 percent of the sample indicating they fished in the area above Metaline and 35 percent identifying the area between Metaline and Metaline Falls. Only 2 respondents (4 percent) reported fishing in the forebay section of the reservoir, and 10 (20 percent) fished in Canyon Reach.

Table 5.1-32. Areas fished by anglers interviewed during the 2008 Bassin' Assassin tournament.

Location Fished	No		Yes	
	Frequency	Percent	Frequency	Percent
Forebay area	49	96.1	2	3.9
Canyon area of Boundary Reservoir	41	77.4	10	19.6
Boundary Reservoir between Metaline and Metaline Falls	33	64.7	18	35.3
Boundary Reservoir between Metaline and Box Canyon	21	41.2	30	58.8
Mouths of Creeks entering Boundary Reservoir	46	90.2	5	9.8
Creeks (above creek mouth)	51	100.0	0	0.0
Other lakes/ponds/creeks	48	94.1	3	5.9

Angler Characteristics

The last four questions on the survey asked anglers about the fish they wanted to catch, whether they had fished in Boundary Reservoir previously, their home location, and their satisfaction with the fishing opportunities.

Desired Catch: When asked to identify the species of fish they most wanted to catch (Question 6), 98 percent of the anglers interviewed (52 out of 53 surveyed) during the tournament identified smallmouth bass as the desired species. One angler identified other trout as the desired catch, and likely was not aware of the tournament or was not entered.

First Visit: Question 7 asked anglers whether they had fished in Boundary Reservoir prior to the current visit. Ninety-four percent of the anglers interviewed during the 2008 Bassin' Assassin tournament indicated that they had fished in Boundary Reservoir previously.

Angler Origin: Question 8 asked respondents to provide their home ZIP or postal code. Approximately half of the anglers interviewed during the 2008 tournament were from northern Pend Oreille County (with Ione, Metaline, or Metaline Falls ZIP codes), and another 17 percent were from southern Pend Oreille County. Other origins represented by smaller numbers in this sample were Spokane County and Stevens County in Washington, northern Idaho, and Montana (one respondent).

Satisfaction with Fishing Opportunities: The final survey question asked anglers to rate their satisfaction with the fishing opportunities in Boundary Reservoir. The question defined a numerical scale ranging from 1 to 9, on which 1 represented "very poor" and 9 represented "excellent." The satisfaction responses from the 2008 tournament weekend are summarized in Table 5.1-33. The most common rating (the mode) was a 5, "average," which was the response from 23 percent of the sample. The mean rating from this sample was 6.25, while the median was 5.4, or slightly above average. Thirty-four percent of the sample rated their satisfaction quite highly (ratings of 8 or 9), while 8 percent gave ratings at or near the low end of the scale.

Table 5.1-33. Satisfaction with fishing opportunities reported by anglers during the 2008 Bassin' Assassin tournament.

Satisfaction Rating	Frequency	Percent
1-2	4	7.5
3-4	5	9.5
5	12	22.6
6-7	14	26.4
8-9	18	34.0
Total	**53**	**100.0**

Note:
Mean = 6.25; median = 5.4; mode = 5; standard deviation = 2.23

5.1.4.2.2. Tournament Sponsor Data

The tournament sponsor provided SCL with a summary of data about participants and fish harvest for the 2008 tournament (Sargent 2008). The tournament records indicated that 170 anglers participated in the 2008 Bassin' Assassin Derby. The vast majority of the entrants originated from Pend Oreille County, including 82 (48 percent) from Metaline, Metaline Falls, and Ione, and from nearby counties in northeastern Washington. Compared to the 2007 data, the 2008 tournament attracted somewhat more entrants from more distant locations, including 6 with Montana addresses, 5 from Idaho, and 1 from California. Catch data for the event are summarized as follows:

- Tournament anglers submitted 132 smallmouth bass for weigh-in, and reported catching an additional 1,150 smallmouth bass.
- Smallmouth bass submitted as tournament entries ranged from 12.8 to 21.8 inches in length, and 0.8 to 5.2 pounds in weight.
- The median length for the reported smallmouth bass catch was 15.2 inches, and the median weight was 1.8 pounds.
- Tournament anglers reported catching 294 fish of other species, including 160 rainbow trout, 103 largemouth bass, 9 northern pike, 9 lake trout, 6 brown trout, 4 walleye, and 3 cutthroat trout.
- Tournament anglers reported fishing a total of 1,670 hours during the tournament.

5.2. Triploid Rainbow Trout Biotelemetry

This section presents the results of the Triploid Rainbow Trout Biotelemetry component of Study 13.

5.2.1. Tag Implantation and Post-Release Monitoring Success

In total, 74 triploid rainbow trout were tagged (Table 5.2-1) with either a radio tag (50 fish) or CART tag (24 fish). Hatchery triploid rainbow trout were implanted with radio tags and released on March 30 and October 19, 2007, and carry-over triploid rainbow trout were implanted with CART or radio tags from May 25, 2007, through June 2008. Numerical tagging and release objectives were generally met with the exception of fall 2007 releases, when only 19 of 20 fish were tagged and released due to mortality of one of the tagged fish just prior to release. Also, only 35 of the goal of 40 carry-over triploid rainbow trout were tagged due to lack of capture of suitable size fish. Additionally, one of these carry-over triploid rainbow trout was inadvertently CART tagged and released in the Boundary Dam Tailrace. This tagging error did not adversely affect tagging goals in the Boundary Reservoir. With the exception of one fall 2007 release triploid rainbow trout, all tagged fish were healthy and vigorous at release.

Table 5.2-1. Estimated number of days at large for tagged triploid rainbow trout during telemetry monitoring from March 30, 2007 to October 3, 2008.

Triploid Rainbow Trout Category	Total Number Released with Tags	Average Days at Large	Minimum Days at Large	Maximum Days at Large
Triploid rainbow trout spring 2007	20	27	1	110
Triploid rainbow trout fall 2007	19	43	1	278
Triploid rainbow trout carry-over	35	93	0	394
Total or Average	**74**	**62**		

Telemetry data recorded during mobile tracking and at shore-based stations were used to determine the status of each fish based on the following criteria:

- Alive, consistent movement recorded
- Tag recovered from river, above high water mark
- Tag recovered from river, below high water mark
- Tag not recovered, stationary, above high water mark
- Tag not recovered, stationary, below high water mark
- Location unknown, no or very few valid detections
- Continual downstream movement
- Tag returned by angler

During mobile tracking, fish routinely found in the same location or that were tracked to a position above the high water mark were designated as either suspect or as dead. Tagged fish were also deemed suspect if data from the shore-based stations indicated that the fish moved continuously downstream immediately after release. Furthermore, the health of a tagged fish was also suspect if the tags were not detected or very rarely detected after release. Absolute confirmation of mortality was confirmed by either tag recovery or if the tag was turned in by an angler. When plots of suspect movement data were reviewed and interpreted, minor changes in location due to difference between the actual position of the tag, when located by mobile tracking, and when detected at an adjacent shore-based station, were not considered as valid movement.

The most conclusive evidence of mortality for a fish was the recovery of the tag. For example, in 2007, following a search of the shoreline during a period of low reservoir level in late August, two radio tags (Fish[2] 79 and 80), deployed in the spring 2007 triploid rainbow trout releases, were recovered from below the high water mark immediately downstream of the Box Canyon Dam tailrace region. A third radio tag (Fish 81) deployed at the same time was tracked to a localized area of riprap downstream of Box Canyon Dam tailrace, but could not be recovered.

[2]The designations of "Fish", "code", and "tag code" are equivalent terms used throughout this report. The specific designation is used in the context of the information being presented (e.g., text, tabular data, or graphics).

In the Canyon Reach, two CART tags (Fish 34 and 61) were recovered at, or slightly above, the high water mark downstream of Slate Creek. Fish 34 was associated with fish remains and other evidence that suggested avian predation or scavenging. A single radio tag (Fish 95) was located well above the high water mark in the vicinity of Slate Creek, possibly in an eagle or osprey nest. In the Forebay Reach, another radio tag (Fish 96) also was located above the high water mark and likely in a bird nest.

Other tagged fish were classified as either dead or suspect based on the lack of movement from essentially the exact same location over several mobile tracking sessions. Fish that were alive but with high fidelity to a specific location were identified by occasional small movements detected during mobile tracking. Tags were also classified as dead or suspect if only a minimal (i.e., less than 10) number of detections had been recorded since release or if the signals recorded were sporadic and intermittent.

Only three CART-tagged triploid rainbow trout were detected with the mobile acoustic receiver. When detected, depth data indicated that these fish remained deep in the water column and at a constant depth. Because their locations were only deep and there was no detectable movement (which is not normal triploid rainbow trout behavior) these fish were considered to be dead.

The estimated numbers of days at large during which valid detections were recorded for all triploid rainbow trout released are presented in Figure 5.2-1. Most of the fish were only at large for a few months. Overall, the lowest average days at large were recorded for spring release 2007 fish (average = 27 days), followed by the fall release 2007 fish (average = 42 days), while the highest average days at large were recorded for carry-over triploid trout (average = 93 days) (Table 5.2-1).

The relatively short number of days at large of the hatchery-raised triploid rainbow trout was not entirely unexpected. High water temperatures (i.e., greater than 22°C) combined with predation (including angling) were assumed to be the primary cause of mortality of both spring 2007 release fish and carry-over triploid rainbow trout tagged and released prior to October 2007. With temperatures, the reported critical thermal maxima for rainbow trout under most conditions is between 24 and 26ºC (Bidgood 1980). Maximum growth of rainbow trout occurs at 17.2ºC, above which metabolic stress can occur and result in reduced feeding and growth (Hokanson et al. 1977, as cited by Selong et al. 2001). Very low water temperatures and severe winter conditions in 2007/2008 may have resulted in increased mortality of the fall 2007 released fish. Generally, under most conditions, carry-over fish (i.e., fish than have already adapted and survived more than one year) were expected to have the highest chance of survival, and the telemetry data supported this expectation. The reported critical thermal minima for rainbow trout is between 1 to 2ºC at which temperature metabolic activity decreases and feeding and digestion typically stop. At these temperatures or lower, the ability of the fish to regulate ions may be impaired and higher rates of mortality may occur (Finstad et al. 1988; Belkovskiy et al. 1991, as cited in Molony 2001).

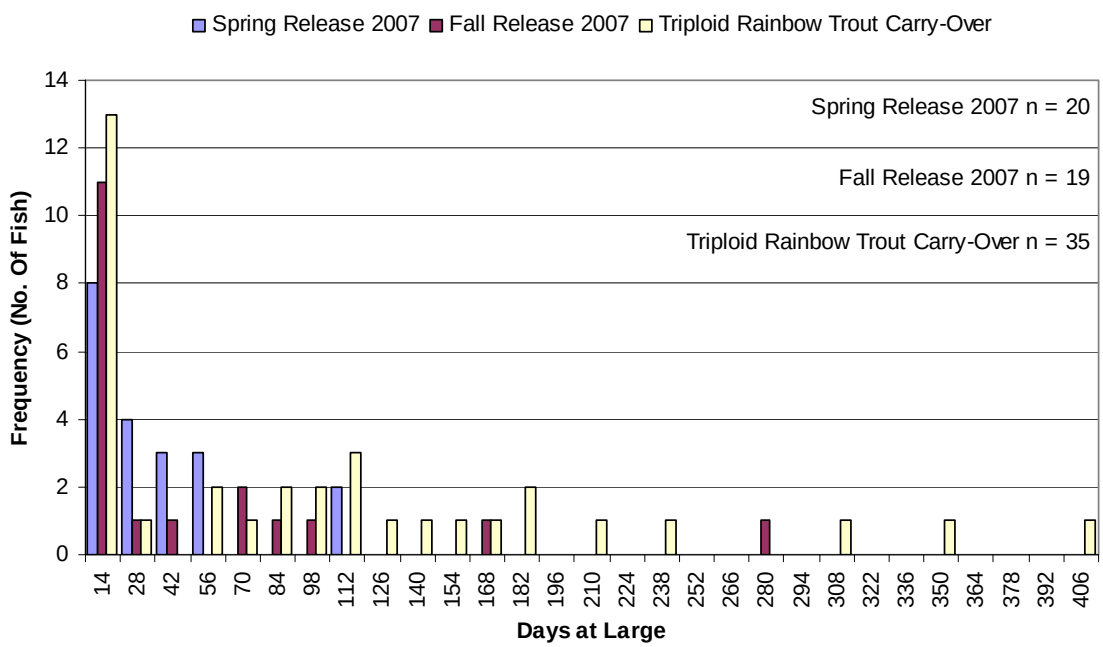


Figure 5.2-1. Estimated number of days at large during which valid detections were recorded for triploid rainbow trout released in spring and fall 2007, and for carry-over triploid rainbow trout tagged in 2007 and 2008.

Longer periods of detection have been recorded during studies of rainbow trout in other areas (e.g., RL&L [2000] investigations on Brilliant Reservoir on the Kootenay River in British Columbia where 22 of 29 fish provided valid detection for 1 year). The fish in these other studies, however, were from established native rainbow trout populations and were likely exposed to substantially lower angling pressure, lower predation, and more suitable water temperatures. For all fish tagged for the Project studies, an estimate of the total number of days at large when each fish was alive and surgical tag implantation records are provided in Appendix 5, Tables A.5-1 and A.5-2, respectively.

5.2.2. Triploid Rainbow Trout Movement and Distribution Data Correlation with Environmental Variables

Due to the low survival of the tagged triploid rainbow trout, statistical correlations of fish movement in relation to environmental variables could not be conducted. Movements of spring and fall 2007 hatchery-released fish and carry-over triploid rainbow trout were plotted in relation to reservoir water temperature, discharge, and water level elevation. These figures are presented in Appendices 6, 7, and 8, for spring 2007, fall 2007, and carry-over releases, respectively. An estimate of the number of days each fish was considered alive and after which it was considered dead or suspect is provided in Appendix 5, Table A.5-1.

Fish movement was examined in relation to variation in representative environmental conditions (e.g., water level elevation, total river discharge) for the Project reaches (Upper Reservoir,

Canyon, Forebay, or Tailrace). Data from a particular reach were selected for the comparisons based on the initial release location and the location of the primary residence of the fish.

Movement data for fish located upstream of Metaline Falls were compared with smoothed Box Canyon Dam total discharge and water level elevations recorded at the USGS gage station 1.2 miles downstream of Box Canyon Dam. Movement data from fish downstream of Metaline Falls were compared to estimated Boundary Dam inflows and water elevation data as measured in the Forebay Reach. Movement data for the spring 2007 release fish were also compared to the inverse reservoir residence time in days (e.g., 2 days residence time = 0.5 inverse residence time), which served as an analog of reservoir water velocity and was calculated based on the discharge storage curve, Forebay Reach elevations, and total Boundary Dam outflows. A review of the data analysis in the Study 13 Interim Report (SCL 2008) suggested that residence time and total discharge were similar environmental variables and provided the same information. Therefore, to simplify presentation and interpretation of the movement data, residence time was not used as a variable in the analysis of fall 2007 release or carry-over triploid rainbow trout in 2008. Movement data of fish in the Tailrace of Boundary Dam were compared to reservoir water temperature, total Boundary Dam discharge, total spill, and Boundary Tailrace elevation. A summary of the range of environmental parameters against which fish movement was compared is provided in the Study 9 Final Report (SCL 2009a).

Triploid rainbow trout positions determined during mobile tracking were plotted on a Geographic Information System (GIS) aerial photograph and color coded by the season (i.e., spring summer, fall, winter) in which they were detected (see Appendix 9). This included all triploid rainbow trout released over the length of the study. The movements and distributions observed were likely related to local and regional environmental conditions in the Project area, as well as behavioral characteristics of these fish. The plots indicated that triploid rainbow trout were primarily located near the release location. However, some individuals dispersed widely, including passage through the dam into the Boundary Dam Tailrace and Seven Mile Reservoir. Concentrations of tagged fish were apparent in the spring near the Box Canyon tailrace and to a lesser extent in the Forebay Reach. By summer, the fish were more dispersed over the study area, with many appearing in the Tailrace Reach. Less distribution data were available for the fall of 2007 compared to spring or summer, but fish were generally present in all areas, with limited use of the Canyon Reach, and also, again, showing concentrations in the Forebay Reach. Winter distribution was similar to fall, but detections were affected by the fewer number of surveys that could be conducted in the Canyon Reach due to access difficulties.

5.2.2.1. Spring 2007 Release Movement

The general movement of the spring 2007 release triploid rainbow trout was highly variable, based on whether they were released in the Box Canyon Dam tailrace or in the Forebay Reach. All radio-tagged spring 2007 release triploid rainbow trout were assumed to be dead by fall 2007 and substantial amounts of movement were not exhibited by most of the fish after August 2007. A consistent pattern of movement in response to changes in other environmental parameters was not evident among any fish from either release location.

5.2.2.1.1. Box Canyon Tailrace Releases

Five of the 10 fish released in the Box Canyon tailrace on March 30, 2007 (Fish 76, 77, 78, 83, and 84) moved downstream immediately after release (Appendix 6, Figures A.6-1, -2, -3, -8, and -9). Telemetry data recorded at shore-based stations indicated that Fish 78 maintained its position upstream of Sweet Creek until April 21, 2007, after which it moved continuously downstream and into the Forebay Reach on May 11. Fish 78 (Figure A.6-3) after 43 days at large was then entrained through the Boundary Dam powerplant or spillway on May 12 at approximately 0330 hours and was last detected at the Red Bird Creek station in Canada on May 15.

Fish 77 and 83 moved downstream and were detected primarily in the Canyon Reach immediately downstream of Metaline Falls (Appendix 6, Figures A.6-2 and A.6-8). Fish 77 generally remained downstream of Metaline Falls; it was also briefly but consistently detected downstream at Slate Creek on May 25, 2007, after which the fish returned upstream to Metaline Falls. After water temperatures increased to above 20ºC (mid-July), the telemetry data suggest Fish 77 actively sought thermal refugia and was repeatedly detected at the mouth of Flume Creek during several sessions of mobile tracking. After July 17, this fish remained stationary and the health of the fish was considered suspect. Fish 83 exhibited a movement pattern similar to Fish 77 and maintained a position immediately downstream of Metaline Falls in the Canyon Reach until May 1, 2007. After May 1, Fish 83 moved farther downstream to a position just out of range of the Metaline Falls station, after which the fish remained stationary and was only detected sporadically during mobile tracking. During peak reservoir water temperatures later in the summer, Fish 83 remained stationary and was not associated with any known areas of thermal refugia. Based on this lack of movement in response to high water temperature, all tracking data obtained for this fish after May 1 were considered suspect.

Fish 76 moved downstream after release and was detected consistently near Sweet Creek for approximately 16 days and then moved downstream to Pocahontas Creek where it was briefly detected on May 2 (Appendix 6, Figure A.6-1). This movement downstream by Fish 76 appeared to correspond to an increase in total river discharge and velocity.

Fish 84 also moved downstream from the Box Canyon Dam tailrace and was consistently detected near Pocahontas Creek until April 25 and downstream of Metaline Falls until May 16, after which the fish was no longer detected (Appendix 6, Figure A.6-9).

Four of the 10 radio-tagged fish (Fish 79, 80, 81, and 82) released in the Box Canyon Dam tailrace remained in the general tailrace area or moved slightly downstream. During mobile tracking and as early as April 26, Fish 79, 80, and 81 were tracked to generally the same locations where their tags were eventually found and it was assumed these fish died relatively soon after release because of the lack of subsequent detectable movement. Of these, Fish 79 and 80 died after release (within about 15 days after release; see Appendix 5, Table A.5-1) and the tags were later recovered from the exposed river bed during low reservoir levels on September 11 (Appendix 6, Figures A.6-4 and A.6-5). Fish 81 also died or lost its tag (likely within 15 days of release; see Appendix 5, Table A.5-1), probably during high flow (Appendix 6, Figure A.6-6). At lower flow levels, Fish 81 was tracked to a location out of the water within the riprap bank immediately downstream of the Box Canyon Dam tailrace launch; the tag could not be

recovered. All telemetry data recorded for this fish after April 13, 2007, were considered suspect. Due to the increase in signal strength when tags are in the air (i.e., not submerged), signals from tag 81 were continuously detected by the receiver in the Box Canyon tailrace and interfered with reception of other tags in the area.

Fish 82 was detected consistently in the Box Canyon Dam tailrace until July 14 and then moved rapidly downstream to Sweet Creek (Appendix 7, Figure A.7-7). This fish was detected at Sweet Creek and then at Pocahontas Creek until July 16, after which the fish was no longer detected.

Fish 85 was not detected after release. The reasons for the non-detection are unknown, but could be due to a number of possibilities such as tag failure.

In summary, from the March 30, 2007, release at the Box Canyon tailrace, three fish died shortly after release (Fish 79, 80, and 81), two fish remained in the Upper Reservoir Reach (Fish 76 and 82), one fish remained in the Upper Reservoir Reach then moved to the Canyon Reach (Fish 84), two fish moved to the Canyon Reach and died near Flume Creek (Fish 77 and 83), one fish was entrained past Boundary Dam and detected at Red Bird Creek (Fish 78), and one fish was not detected after release (Fish 85). The movements exhibited by fish that were considered alive were interpreted as post-release behavior during which the fish attempted to find suitable habitat in a new environment that met basic survival requirements. Tag implantation related stress likely also had some effect on movement behavior up to two weeks after release.

5.2.2.1.2. Boundary Dam Forebay Releases

Ten fish were released in the Forebay Reach on March 30, 2007. Of these, two fish (Fish 88 and 89) were entrained through the Project powerplant or spillway and were detected in the Tailrace Reach. Fish 88 was likely entrained near noon on April 18 (19 days at large), after which time the fish moved immediately downstream and was last detected at the international border on April 18 at approximately 1339 hours (Appendix 6, Figure A.6-11). The health of the fish after entrainment could not be determined. Fish 89 was entrained on March 30 at approximately 2130 hours (one day at large), after which this fish was consistently detected during mobile tracking of the Tailrace Reach in the same location immediately downstream of the powerhouse discharge on the left downstream bank. Telemetry data obtained from Fish 89 after entrainment indicated the health of this fish was considered dead (Appendix 6, Figure A.6-12).

At least four tagged fish (Fish 87, 94, 95, and 96) were likely captured or scavenged by birds soon after release, with all but one likely dead within 8 days of release (see Appendix 6, Figures A.6-10 and A.6-17 through A.6-19; also Appendix 5, Table A.5-1). Fish 87, 95, and 96 were deposited somewhere on shore within range of shore-based receivers, possibly in a nest or on a cliff ledge, where they were continuously detected and recorded by the receivers in the Forebay Reach and at Slate Creek. As with Fish 81 (released at Box Canyon), signals from these tags occasionally interfered with signals from other tags in the area and made mobile tracking in the Forebay Reach and vicinity of Slate Creek more difficult. Telemetry data recorded after March 30 for Fish 87 and 94 were considered suspect; data recorded for Fish 95 and 96 after April 6 and May 12, respectively, were considered suspect.

Fish 90 remained in the Forebay Reach after release and was detected by the three receiver stations at the Forebay Reach, canyon opening, and at Pewee Falls until April 6. It was not detected again until it was sporadically detected in the Forebay Reach from June 6 to July 13 when it was last detected (Appendix 6, Figure A.6-13). The reservoir water temperature at the time of last detection was approximately 23ºC. The health of this fish was considered suspect after March 30.

Fish 91 was consistently detected in the Forebay Reach until May 8, after which time the fish was no longer detected (Appendix 6, Figure A.6-14). Fish 92 and 93 were detected consistently in the Forebay Reach until April 1, after which they moved upstream. Fish 92 was last detected near Slate Creek on April 26 (Appendix 6, Figure A.6-15), but telemetry data for this fish was considered suspect after April 1. Fish 93 was detected sporadically at upstream locations after April 1; however, these upstream detections were assumed to be false signals from other electronic interference (Appendix 6, Figure A.6-16). All data after March 31 for Fish 93 were considered suspect.

Due to the low number of fish detections indicative of live fish versus the high proportion classed as dead and suspect, correlation of movement data with environmental changes was not possible. Qualitatively, the data suggest that as reservoir temperature increased, the spring 2007 release triploid rainbow trout moved into cold-water refugia. Examples include Fish 77 and possibly Fish 82. However, these fish were later confirmed to have died and it is uncertain whether these fish actively moved into these areas while alive, or drifted into these areas when dead or moribund.

In summary, of the 10 radio-tagged fish released March 30, 2007, in the Forebay Reach, 6 fish likely died shortly after release (Fish 87, 90, 92, 93, 94, and 95). During the brief period when these fish were alive, movements were generally confined to the Forebay Reach. Upstream movements detected for Fish 92, 93, and 95 were possibly due to scavenging by birds. Once tag 95 was deposited onshore near Slate Creek, detection of tags 92 and 93 near Slate Creek may have also incorrectly decoded signals from tag 95. Two fish (Fish 91 and 96) resided in the Forebay Reach until early May. Two fish were entrained past Boundary Dam (Fish 88 and 89); the health of these fish before and after entrainment was suspect. Similar to the fish released in the Box Canyon tailrace, the movement exhibited by fish considered to be alive was interpreted as post-release behavior during which the fish attempted to find suitable habitat in a new environment. Tag implantation–related stress likely also had some effect on movement behavior up to two weeks after release.

5.2.2.2. Fall 2007 Release Movement

During fall 2007, 10 triploid rainbow trout were radio-tagged and released in the Box Canyon tailrace, while 9 triploid rainbow trout were released in the Forebay Reach. The survival of the fall 2007 radio-tagged triploid rainbow trout was low and most fish likely died soon after release. An estimate of the date after which the health of each fish was considered suspect is provided in Appendix 5, Table A.5-1. During the tag implantation, a general observation was made that the fall 2007 triploid rainbow trout were small and in very poor condition in overall vigor and muscle tone. For example, the muscle tissue in the abdominal area was of such low quality that suturing to obtain an even closure of the incision was difficult.

5.2.2.2.1. Box Canyon Tailrace Releases

The Box Canyon fish exhibited two movement patterns when released: either they remained relatively stationary in the Box Canyon Dam tailrace area, or they drifted downstream and remained stationary at a new downstream location, usually in shallow backwater areas. Fish that remained stationary in the tailrace were routinely located at the same position in the river (Fish 136, 142, and 149; Appendix 7, Figures A.7-3, -9, and -16). Both Fish 136 and 149 were considered suspect almost immediately after release. Fish 136 was located onshore and was continuously detected by the Box Canyon tailrace receiver station to the exclusion of other legitimate tagged fish that did not transmit as frequently or as strongly as Fish 136. Small localized movements by Fish 142 were detected during mobile tracking. These movements were limited to the Box Canyon tailrace. After January 11, 2008, the health of this fish was considered suspect.

Fish that drifted downstream after release in the Box Canyon tailrace were eventually assumed dead based on their lack of movement at their new downstream location (Fish 133, 137, 139, 144, 145, 147, and 150; Appendix 7, Figures A.7-1, -4, -6, -11, -12, -14, and -17, respectively). Generally, all of the fish remained stationary with little evidence of sustained upstream movement and were considered suspect either immediately after release or by the following mobile tracking session. Some movement was detected associated with Fish 147, but the relatively small movements detected were likely related to small positional inaccuracies inherent with mobile tracking.

In summary, nearly all (8 of 10) of the fish released in the Box Canyon tailrace were considered suspect within two weeks after release. Seven fish drifted downstream immediately after release where they remained stationary (Fish 133, 137, 139, 144, 145, 147, and 150). One fish (Fish 136) remained in the Box Canyon tailrace and was considered suspect immediately after release; a second (Fish 147) exhibited some movement, but was eventually considered suspect.

5.2.2.2.2. Boundary Dam Forebay Releases

Fall 2007 radio-tagged triploid rainbow trout released in the Boundary Dam forebay did not appear to survive any better than fish released in the Box Canyon tailrace. Fish released in the Forebay Reach also exhibited two movement patterns: fish either remained in the Forebay Reach or they were eventually entrained through the Boundary Dam powerplant or spillway. Fish that remained in the Forebay Reach either eventually disappeared or the tags were located onshore after being continually detected by one or more receiver stations (Fish 135, 141, 146 and 148; Appendix 7, Figures A.7-2, -8, -13, and -15). Fish 135 and 148 likely died within days after release, but Fish 141 and 146 were considered alive until December 25 and 21, 2007, respectively; these fish remained in the forebay where they were detected at all three stations at different times. Generally, these two fish were found near the canyon opening near PRM 18.

Four fish were entrained after release in the Forebay Reach (Fish 140, 143, 151, and 152; Appendix 7, Figures A.7-7, -10, -18, and -19, respectively; see Section 5.3.6). With the exception of Fish 152, relatively little data were recorded for these fish while in the Forebay Reach.

Whether these fish were alive or dead at the time of entrainment could not be determined. However, following entrainment, only downstream movement or no movement was recorded for these fish. Fish 152 was detected in the Forebay Reach from October 19, 2007, until March 24, 2008. During this time, the fish appeared to use different areas of the reservoir at different times (the gap in the data set in February was due to failure of the forebay station). Fish 152 was entrained on March 24, 2008, at approximately 1529 hours, after which the fish was consistently detected in the Tailrace until August 27; the tag for Fish 152 was later retrieved from the shore downstream of Boundary Dam during a low water period on September 16.

Fish 138 was released in the Forebay Reach and was considered alive, based on consistent evidence of upstream movement (Appendix 7, Figure A.7-5). This fish moved upstream and was detected first at Slate Creek on November 22, 2007, and then at the station below Metaline Falls until November 29, when it returned downstream and remained in the Forebay Reach for the winter. After a long period of only a few detections, the fish then was consistently detected on July 22, 2008, in the forebay.

In summary, only one fish (Fish 138) exhibited substantial upstream movement after release. Three fish (Fish 141, 146, and 152) remained alive in the Forebay Reach for more than 60 days and were detected at different locations in the Boundary Reservoir. Four fish released in the Forebay Reach were entrained through Boundary Dam (Fish 140, 143, 151, and 152).

5.2.2.3. Triploid Rainbow Trout Carry-Over Movement

Movement of carry-over triploid rainbow trout was recorded from May 2007 to September 2008. Carry-over triploid rainbow trout implanted with CART tags demonstrated two general types of movement behavior after tag implantation. The first type of movement behavior involved the fish generally remaining for a period of time in the same area where they were captured (as part of electrofishing for Study 9). The second type was a relatively rapid downstream movement almost immediately after tagging. An estimate of the date after which the health of each fish was considered suspect is provided in Appendix 5, Table A.5-1.

Prior to October 2007, 16 carry-over triploid rainbow trout were implanted with CART tags. Of these, 5 moved downstream from the release location and the other 11 remained at or near the release location. The movement of those that remained near their release location is summarized below:

- Fish 34 was tagged on June 22 and released near Slate Creek (Appendix 8, Figure A.8-7). After release, the fish died or was killed and the tag was recovered by the field crew on the shore downstream of Slate Creek on September 25.
- Fish 37 was tagged on June 20 and released in the Forebay Reach (Appendix 8, Figure A.8-9). Temperature and depth data from the CART tag recorded on July 31 suggested that the fish was likely dead based on constant depth readings of approximately 7 meters (23 feet) and an ambient water temperature of almost 25ºC.
- Fish 40 was tagged on May 25 and generally remained in the Forebay Reach, with occasional upstream movement into the Canyon as far upstream as Slate Creek (Appendix 8, Figure A.8-11). Mobile tracking indicated that Fish 40 used the cold-water refugia at the base of Pewee Falls during the period of peak reservoir water

temperatures in late July. After August 6, Fish 40 moved rapidly upstream and resided nearshore between the Metaline boat launch and Pocahontas Creek. Positional and depth data from the CART tag indicated that the fish was continually at the surface; therefore, after August 20, 2007, the health of Fish 40 was considered suspect. The reason why this fish moved upstream in the reservoir when water temperatures were in excess of 22°C was not readily apparent. Telemetry data suggest that this fish did not use Slate or Sullivan creeks as a thermal refuge while moving upstream.

- Fish 49 was tagged on July 28 near Sweet Creek and was generally detected in the same area near its release location over multiple mobile tracking sessions; the health of Fish 49 was suspect (Appendix 8, Figure A.8-15).
- Fish 55 was tagged on June 13 near Sweet Creek and remained in the immediate area and was consistently detected for most of the summer (Appendix 8, Figure A.8-17). Sensor data from this fish were also recorded during intensive monitoring of a westslope cutthroat trout on August 3. After August 10, the fish was no longer detected.
- Fish 62 was tagged and released near Sullivan Creek on July 28. This fish was later detected in the Forebay Reach in mid-November and then below Metaline Falls in late July 2008; the inconsistent detections and the absence of detections at intermediate stations between these two locations suggest that this movement may have been suspect (Appendix 8, Figure A.8-19).
- Fish 35 was released in the Forebay Reach on June 22 and was rarely detected after release. The limited data recorded were not plotted. The health of the fish was considered suspect.
- Fish 38 was released in the Forebay Reach on June 20 and was rarely detected after release (Appendix 8, Figure A.8-34). The health of the fish was considered suspect.
- Fish 33 was tagged and released near Flume Creek on August 30 and was not detected after release. The health of the fish was considered suspect. The fish was then detected in the Boundary Dam forebay in early October 2007, in the Box Canyon Dam tailrace by mid-October, and then again in the forebay from November 2007 to March 2008, after which the fish was detected near Metaline Falls in June and July 2008. The inconsistent detections, the lack of detection at intermediate stations, and the lack of detections of this fish during mobile tracking suggest that all of these detections may be suspect (Appendix 8, Figure A.8-6).
- Fish 11 was tagged in mid-September and released in the Forebay Reach. This fish was initially considered alive based on continual detections, but the tag was eventually recovered from the shore in the forebay (Appendix 8, Figure A.8-1).
- Fish 39 was also tagged in mid-September and released near Sweet Creek. This fish moved downstream near the Metaline boat launch, then returned upstream and was consistently detected near Pocahontas Creek until late November 2007. In December the fish moved downstream near PRM 28 where it was only detected by mobile tracking. The lack of movement after December 2007 suggested that this fish was dead (Appendix 8, Figure A.8-10).

The following 5 of 16 CART-tagged carry-over triploid rainbow trout moved rapidly downstream after release and were considered dead:

- Fish 36 was tagged and released near Slate Creek on June 22 where it was consistently detected until June 24. The fish was detected by mobile tracking on July 4 in the Forebay Reach where it maintained a constant depth of 24.1 meters (79 feet) (Appendix 8, Figure A.8-8).
- Fish 61 was tagged and released on July 28 near Sweet Creek. The fish moved or was transported rapidly downstream to Slate Creek by August 1, after which the fish was either captured or scavenged by an osprey or eagle and the tag deposited on the shore downstream of Slate Creek (Appendix 8, Figure A.8-18). This tag was recovered by field crews on September 25 near the same location where tag 34 was recovered.
- Fish 70 was tagged and released on July 27 in the Box Canyon Dam tailrace (Appendix 8, Figure A.8-21). Based on very few records, this fish moved continuously downstream and was last detected at depth with the acoustic receiver upstream of Slate Creek on July 31, 2007.
- Fish 28 was tagged and released in the Box Canyon Dam tailrace on June 13 (Appendix 8, Figure A.8-3). Once tagged, the fish moved rapidly downstream and held at Slate Creek from June 20 to July 2. The fish was next detected August 14 downstream of Everett Island, and subsequently it moved into the Forebay Reach where it remained until September 26. Although not plotted on Figure A.8-3 (Appendix 8), subsequent telemetry data suggested that this fish was entrained through Boundary Dam on October 26 at 1620 hours, and then moved downstream and was detected in the Salmo River at the BC Hydro telemetry station on October 26 at 1642 hours until October 28. However, this fish was also concurrently detected at approximately the same time at the Red Bird Creek station, with concurrent intermittent detections at the Tailrace Reach and international border stations. These concurrent detections at multiple stations suggested that the fish was captured or scavenged by an avian predator and moved to a location somewhere downstream in range of both the Red Bird Creek and BC Hydro Salmo River stations.
- Fish 31 was tagged and released in the Tailrace Reach on June 17, moved downstream after release, and was detected once (i.e., a one-event detection – not plotted) at the Red Bird Creek station on July 26 (Appendix 8, Figure A.8-4). CART tag releases of triploid rainbow trout into the Tailrace Reach were not in the study plan so this release was inadvertent. Fish 31 was detected in the Salmo River at the BC Hydro monitoring station on October 3 and was continually detected at this station until December 8, 2007.

Similar to the spring 2007 release triploid rainbow trout and with few exceptions, essentially all of the CART-tagged triploid rainbow trout tagged prior to October 2007 were considered dead within approximately 6 months or less after release and few detections indicative of movement were available to quantitatively assess patterns of movement in response to changes in discharge and reservoir level fluctuations. However, during the period when some of the fish were alive during summer 2007, the positional data recorded provided some insight into fish movement in response to high reservoir water temperatures. At least two fish, Fish 40 and 55, were relocated near or within cold-water refugia located at the base of Pewee Falls and the delta of Sweet Creek,

respectively, during high reservoir temperatures (e.g., greater than 22°C) in July and August 2007. This use of thermal refugia was also confirmed by visual observation of large numbers of externally tagged and non-tagged triploid rainbow trout aggregating near the identified thermal refugia located at the mouths of Boundary Reservoir tributaries, primarily Flume, Slate, and Sweet creeks (see Study 9 [SCL 2009a]). No obvious non-tributary use of thermal refugia was noted by any other CART tag data from triploid rainbow trout.

In the Tailrace Reach, apparent tributary use by two triploid rainbow trout (Fish 28 and 31) was detected at the Salmo River station operated by BC Hydro. Fish 28 was either entrained at Boundary Dam and/or likely captured by an avian predator on October 26 after 135 days at large. Fish 31 was released in the Tailrace Reach and detected at the Red Bird Creek station on July 26 after 39 days at large and at the Salmo station on October 3 after 108 days at large. Through the winter, however, this fish remained stationary for an extended period (i.e., 3 months) and a BC Hydro consultant conducting a telemetry monitoring study in this area eventually considered this fish to be dead, based on a lack of movement.

Carry-over triploid rainbow trout tagged after October 2007 appeared to have had a higher survival rate than those tagged earlier. This higher survival rate was attributed, in part, to tagging the fish when water temperatures were relatively cool (e.g., generally less than 10°C). In total, 20 carry-over triploid rainbow trout were implanted with tags. Nine received CART tags (Fish 12, 32, 44, 47, 48, 53, 57, 64, and 74) and 11 were implanted with radio tags (Fish 119, 120, 122, 126, 127, 128, 132, 162, 164, 170, and 171). Following are summaries of the movements of these fish:

- Fish 47, 53, 64, 119, 122, 126, 128, 170, and 171 all moved large distances downstream from the Upper Reservoir Reach into either the Canyon or Forebay reaches (Appendix 8, Figures A.8-13, -16, -20, -23, -25, -26, -28, -32, and -33). The timing of most of this movement coincided with the onset of the spring freshet in 2008.
- Fish 47, 53, 119, 126, 128, and 170 also exhibited upstream movements and held at a specific locations for extended periods of time during their overall downstream movements.
- Seven fish were eventually entrained through the Boundary Dam (Fish 32, 47, 53, 64, 122, 126, and 171). Only Fish 47 and 126 exhibited upstream movement after entrainment, which suggested that they were still alive. One mortality, Fish 64, was confirmed when the tag was recovered from the shore, but it not known whether the fish was alive or dead prior to entrainment. Fish 47 was recorded in the Salmo River where it moved upstream into the river. Fish 32 was also entrained in February. This fish maintained a position in the canyon section downstream of the Boundary Dam tailrace but upstream of Red Bird Creek until the end of the study (Appendix 8, Figure A.8-5).
- Fish 48 (Appendix 8, Figure A.8-14) remained relatively stationary in the Box Canyon tailrace through mid-winter and then moved downstream to near Sullivan Creek before last being detected near Metaline Launch in July 2008.
- Fish 132 near Pocahontas Creek (Appendix 8, Figure A.8-29) remained essentially stationary near Pocahontas Creek, but was detected moving upstream for a brief period into the Box Canyon tailrace before returning to an area near Pocahontas

Creek where it remained stationary. This fish likely would have been considered dead until it was recaptured alive in June 2008 during electrofishing sampling. However, after this capture session, the fish continued to remain stationary and its tag was later detected on shore. Consequently, data after June 6, 2008, were considered suspect.

Fish that remained generally stationary but were considered alive included Fish 12, which was consistently located in the Boundary Dam forebay area (Appendix 8, Figure A.8-2), and Fish 74 and 164, which were located in the Box Canyon Dam tailrace (Appendix 8, Figures A.8-22 and -31).

The remaining triploid rainbow trout (Fish 44, 62, 74, 120, 127, and 162) were considered dead or suspect shortly after release (Appendix 5, Table A.5-1). This designation was made based on relocating the fish on several occasions during mobile tracking to the exact same location or if the fish was rarely detected (Appendix 8, Figures A.8-12, -19, -24, -27, and -30). Due to inconsistent detection, both the release location and general movement pattern exhibited by Fish 74 were considered suspect (Appendix 8, Figures A.8-22).

In summary, 11 of 16 carry-over triploid rainbow trout tagged prior to October 2007 remained at or near the release location for a week or more after release, while 5 of the fish moved downstream from the release location almost immediately after release. Of the 11 fish that were initially stationary, only Fish 33 and 40 exhibited movement greater than one mile; however, an obvious relation between the movement and an environmental variable was not apparent. The health of these fish was considered suspect and Fish 11 and 34 were eventually recovered on shore. Of the 4 reservoir fish that moved downstream after tagging, one fish (Fish 28) was either entrained through the dam or was scavenged by a bird and moved downstream. The tag from another fish (tag 61) was recovered from shore. Fish 31, which was inadvertently released in the tailrace, was later located in the Salmo River.

Of the 9 CART-tagged and 11 radio-tagged carry-over triploid rainbow trout released after September 2007, 9 (Fish 47, 53, 64, 119, 122, 126, 128, 170, and 171) moved large distances downstream from the Upper Reservoir Reach into either the Canyon or Forebay reaches. This movement generally corresponded to the onset of the spring freshet. However, these fish were also detected holding for extended periods of time within range of shore-based receiver stations during the general downstream movement. The ability of the fish to hold position at these locations suggested that these fish were alive during these periods, as opposed to moribund or dead and drifting with the current. Five fish exhibited less movement and remained in the general area where they were released (Fish 12, 48, 74, 132, and 164); these fish were considered to be alive for at period of time. Four of the other 6 fish remained stationary after a short period of movement initially after release (Fish 44, 74, 120, and 127), while 2 were sporadically detected (Fish 62 and 162). In total, 7 of 35 tagged carry-over fish were eventually entrained through the Boundary Dam (Fish 32, 47, 53, 64, 122, 126, and 171) and only Fish 47 and 126 exhibited upstream movement after entrainment. Fish 32 was also considered alive.

5.3. Triploid Rainbow Trout Management

5.3.1. External Tagging

Three groups of externally tagged triploid rainbow trout were released in spring 2007 (n = 1,000), fall 2007 (n = 1,000), and spring 2008 (n = 1,503), respectively. These tagged fish were part of about 4,200 triploid rainbow trout released in each of these three periods into Boundary Reservoir. Approximately half of the fish were released at the boat ramp at the Forebay Recreation Area and the other half from the boat ramp at Campbell Park in the Box Canyon Dam tailrace. Based on available length data, both the spring 2007 and 2008 releases were, on average, larger and appeared healthier than the fall 2007 releases (Figure 5.3-1). The spring 2007 and 2008 releases had an average total length of 266 mm and 272 mm; the fall 2007 fish were smaller with an average total length of 244 mm. During surgical tag implantation, surgeons noted that the body wall tissue of the tagged fish was fairly spongy, low density, and difficult to suture. During handling and external tagging, it was also noted that these fish were initially lethargic after transport, but eventually became more vigorous after a few hours once placed in the holding pens.

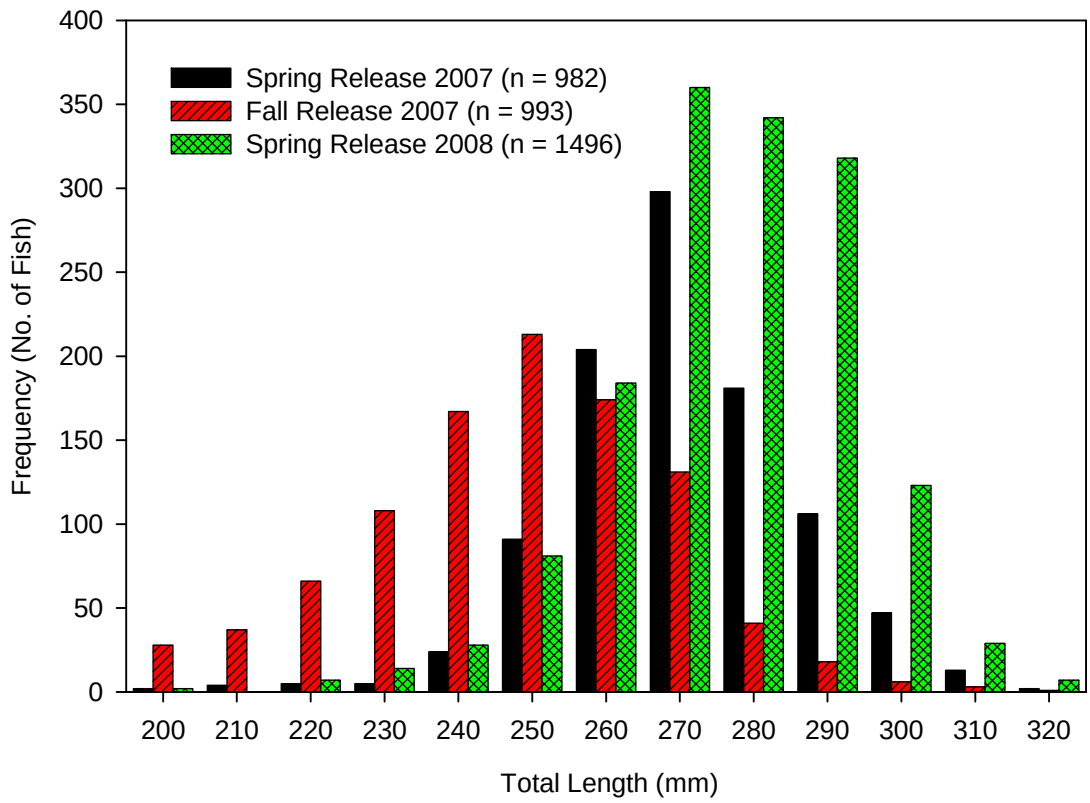


Figure 5.3-1. Length frequency of externally tagged triploid rainbow trout released in spring 2007 (March 29 and 20), fall 2007 (October 18 and 19), and in spring 2008 (April 3 and 4).

Note: The lengths were not recorded for all externally tagged fish.

Information from angler returns of external tags and the capture of tagged fish during the passive and active part of Study 9 provided both an approximate capture location and a length measurement of the fish at the time of capture. Corresponding PRM locations were estimated for the capture location of each fish based on angler descriptions and a map location of the capture sample site provided in the Study 9 Final Report (SCL 2009a).

Measurements of total length were provided by both anglers and the Study 9 fish capture program. The measurements provided by anglers were likely subject to more measurement error than the data provided by the fish capture program because total length data provided by the anglers were more dependent on whether the lobes of the caudal fin were compressed along the midline when the measurements were recorded. Typically, fork length is the standard length measurement for salmonids. Fork length measurements generally tend to be more consistent and are less likely to change in the event the caudal fin lobes of the fish are damaged. Consequently, fork length was recorded for each of the externally tagged triploid rainbow trout at release. Based on a visual assessment of the fish, the caudal fins of the hatchery fish were not deeply forked and measurements between fork and total length likely were not substantially different. A sub-sample of 180 fish from the spring 2008 release was also measured for total length. Based on these data, a conversion value was calculated to provide an estimate of the initial total length of triploid releases for comparison with fish length recorded during Study 9 and reported by anglers. This conversion was also used to plot values in Figure 5.3-1.

5.3.2. External Tag Recovery from Study 9 Efforts: Triploid Rainbow Trout Movement, Distribution, and Tag Loss Estimates

During Study 9 fish capture efforts from March 30, 2007, to September 4, 2008, 132 (3.8 percent) of the 3,503 triploid rainbow trout externally tagged and released during all three releases (i.e., spring and fall 2007, spring 2008) were recaptured at least once (Table 5.3-1). Of the 136 total recaptured fish, 4 were recaptured twice (22, 25, 26, and 105 days apart, respectively). One fish was last recaptured 9 miles upstream of the initial release site. Another fish was last recaptured 8.7 miles downstream of the initial release site. The remaining two fish were recaptured within 1 mile of their initial release site.

Table 5.3-1. Capture frequency of T-bar anchor tagged triploid rainbow trout released in spring 2007, fall 2007, and spring 2008 during active and passive sampling for Study 9.

	Number Recaptured (% Recaptured)			
Release Locations	**Spring Release 2007 (n = 1,000)**	**Fall Release 2007 (n = 1,000)**	**Spring Release 2008 (n = 1,503)**	**All Releases (n = 3,503)**
Boundary Forebay Reach	23 (4.6%)	29 (5.8%)	19 (2.5%)	73 (4.2%)
Box Canyon Dam Tailrace	20 (4.0%)	26 (5.2%)	15 (2.0%)	63 (3.6%)
Single Recaptures	**43 (4.3%)**	**55 (5.5%)**	**34 (2.3%)**	**132 (3.8%)**
Double Recaptures	**1**	**3**	**0**	**4**
All Recaptures (n)	**44**	**58**	**34**	**136**

Inspection of the catch data indicated that more fish were initially captured at the release locations; over time, the number of tags recovered at these locations declined. Movement upstream into the Canyon and Upper Reservoir reaches by fish released in the Forebay Reach was recorded, as was downstream movement by fish released in the tailrace of Box Canyon Dam (Table 5.3-2).

Table 5.3-2. Mean dispersal distance, standard deviation, and minimum and maximum values of hatchery triploid rainbow trout, based on Study 9 external tag recapture data, by release session and release location at the Boundary Forebay Reach and Box Canyon Dam tailrace.

Release Location	n[1]	Net Movement (miles)				Tailrace Reach External Tag Recaptures
		Mean	Std Dev	Min	Max	
Spring Release 2007						
Boundary Forebay Reach	24	2.1	3.2	0	9	4
Box Canyon Dam Tailrace	20	2.4	1.8	0.5	7.5	0
Release Total	**44**	**2.2**	**2**	**0**	**9**	**4**
Fall Release 2007						
Boundary Forebay Reach	30	3.1	3.9	0	12.7	1
Box Canyon Dam Tailrace	28	2.8	4.2	0.5	17.2	0
Release Total	**58**	3.0	4.1	0	17.2	**1**
Spring Release 2008						
Boundary Forebay Reach	19	1.9	3.2	0	9.7	9
Box Canyon Dam Tailrace	15	3.9	5	0.9	17.8	1
Release Total	**34**	**2.8**	**4.1**	**0**	**17.8**	**10**
Overall Total	**136**					**15**

Note:
1 All external tag recaptures including Tailrace Reach recaptures based on Study 9 recapture efforts. Angler returns are discussed in Section 5.3.3. Only fish with designated distances are included.

Based on the capture locations, the catch distribution indicated that fish released at both the Box Canyon Dam tailrace and in the Forebay Reach release areas dispersed in both downstream and upstream directions, respectively (Figure 5.3-2) with similar distances among release sessions and release locations. In spring 2008, downstream dispersal from the Box Canyon tailrace release location was, on average, slightly high than upstream movement from the Boundary Forebay Reach release site. This difference was likely due to higher flows in 2008.

In total, 15 external tags or 11 percent of total tag recaptures were from fish entrained through Boundary Dam and recaptured in the Tailrace Reach (Table 5.3-2). Entrainment of triploid rainbow trout from the Forebay Reach release site (n = 14, or 90 percent of tailrace captured tags) were much more common than from the Box Canyon Dam tailrace site (n = 1, or less than 7 percent of tailrace captured tags). Most entrained fish were from the Forebay Reach in 2008 (9 of 15 fish). By release group, 4, 1, and 9 of the spring 2007, fall 2007, and spring 2008 releases, respectively, were captured in the Tailrace Reach. Greater entrainment appears associated with high flows during spring and early summer. Out of the 9 spring 2008 fish that were released on

April 3 in the Forebay Reach and later recaptured in the Tailrace, 1 fish was captured in late April, 4 in mid-July, 3 in early September, and 1 in mid-September. The single fish released in the Box Canyon tailrace on April 4, 2008, was recaptured in the Boundary Tailrace on May 15.

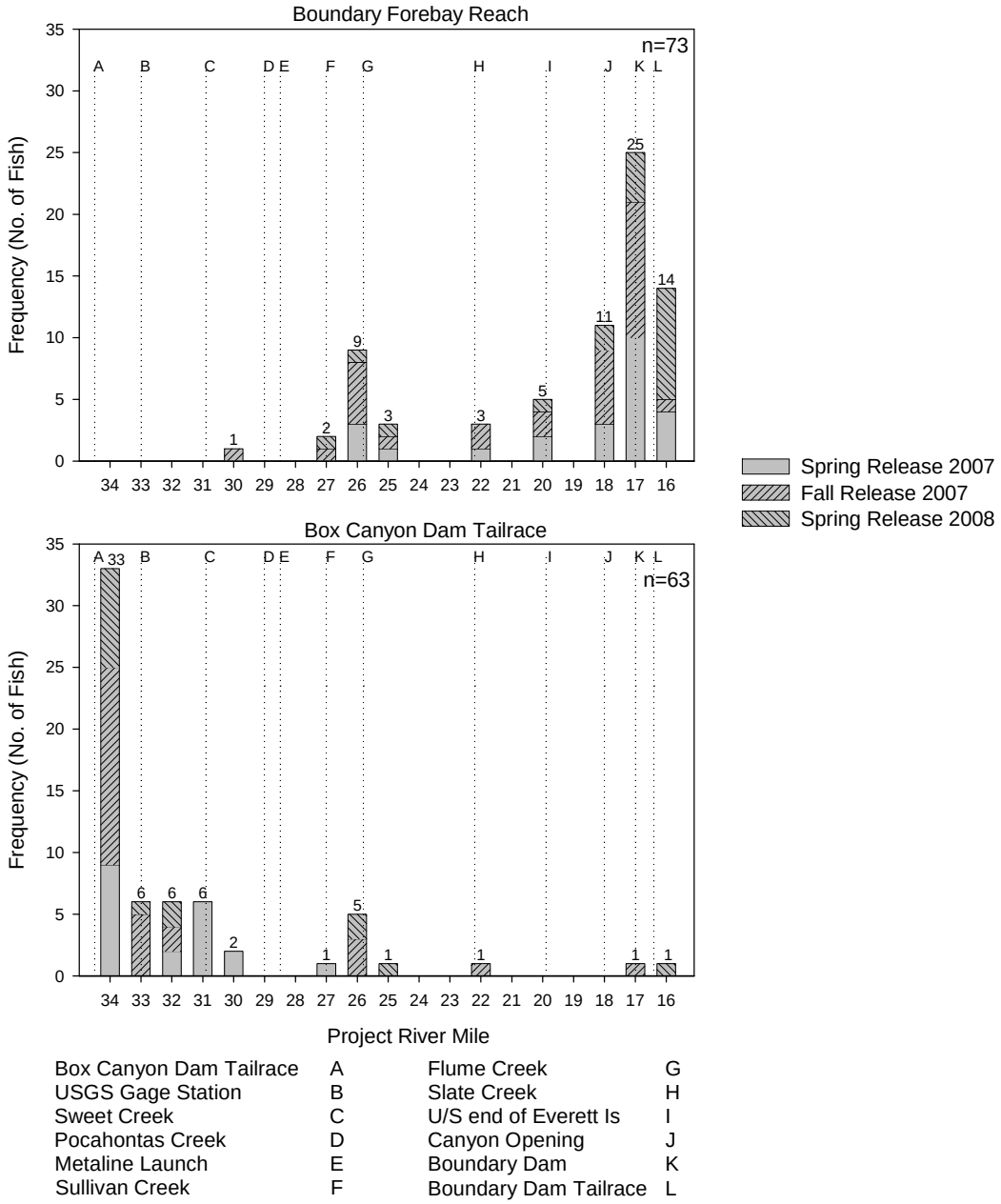


Figure 5.3-2. First capture locations during Study 9 of externally tagged spring 2007, fall 2007, and spring 2008 triploid rainbow trout releases in relation to release location in the Forebay Reach at PRM 17.3 and in the Box Canyon Dam tailrace at PRM 34.5 as of September 18, 2008.

Even though the exact dates of entrainment for externally tagged fish are unknown, the fish captured in mid-May, July, and early September were probably entrained during high flows. In spring 2007, the 4 fish entrained from the Boundary Forebay Reach included 2 fish entrained in late April and 2 in late June; fish captured in June were likely entrained during higher flows. Entrained tags accounted for approximately 9 percent and 29 percent of total external tags recovered from the spring 2007 and 2008 spring releases, respectively. The lowest estimated entrainment rate (2 percent) was associated with the fall 2007 release.

Because fish capture efforts in the Tailrace Reach were limited to monthly sampling between Boundary Dam and the international border, the number of external tags recovered likely represents a minimum estimate of the triploid rainbow trout entrainment rate. Substantially more Tailrace fish could have been recovered if systematic sampling had also been conducted in Seven Mile Reservoir.

Seven fish, in addition to the 132 tagged fish recaptured during the study period (Table 5.3-1) were identified as triploid rainbow trout with tag wounds at the base of the dorsal fin. Assuming this proportion applied to all tagged fish, tag loss rates were potentially about 5 percent.

5.3.3. Angler Tag Returns: Triploid Rainbow Trout Movement and Distribution Data

A total of 219 external anchor tags (from Boundary Reservoir catches only) were returned by anglers between March 30, 2007, and October 24, 2008, of which 131, 11, and 77 tags were spring 2007, fall 2007, and spring 2008 released triploid rainbow trout, respectively (Table 5.3-3). Compared to the spring 2007 and spring 2008 releases, relatively few of the fall 2007 released fish were captured by anglers. This lower capture efficiency may have been due to a longer time interval between when the fish were released and when anglers had an opportunity to capture the fish. During this period, the fish could have either moved out of the reservoir or had their numbers depleted through mortality, especially during winter conditions when foraging conditions were likely limited.

Table 5.3-3. Capture frequency of T-bar anchor tagged triploid rainbow trout released in spring 2007, fall 2007, and spring 2008 as reported by anglers between March 30, 2007, and October 24, 2008 (captures in Boundary Reservoir only).

Release Location	Capture Frequency (%Recaptured)			
	Spring Release 2007 (n = 1,000)	**Fall Release 2007 (n = 1,000)**	**Spring Release 2008 (n = 1,503)**	**All Releases (n = 3,503)**
Boundary Forebay Reach	39 (7.8%)	5 (1.0%)	38 (5.0%)	82 (4.7%)
Box Canyon Dam Tailrace	92 (18.5%)	6 (1.2%)	39 (5.3%)	137 (7.9%)
Total capture (n)	**131 (13.1%)**	**11 (1.1%)**	**77 (5.1%)**	**219 (6.3%)**

Note:
1 Only tags returned with angler-designated capture months are shown.

The locations of the released fish captured by anglers, for which a location and date of capture were provided (193 out of 219 fish), were plotted relative to PRM (Figure 5.3-3). Fish released at both the Box Canyon Dam tailrace and Boundary Forebay Reach release locations eventually dispersed throughout the reservoir (Table 5.3-4). However, similar to the recapture data collected from Study 9, the greatest numbers of triploid rainbow trout were captured near their respective release locations in the Forebay Reach (24 percent of total captures) and the Box Canyon Dam tailrace (33 percent of total captures).

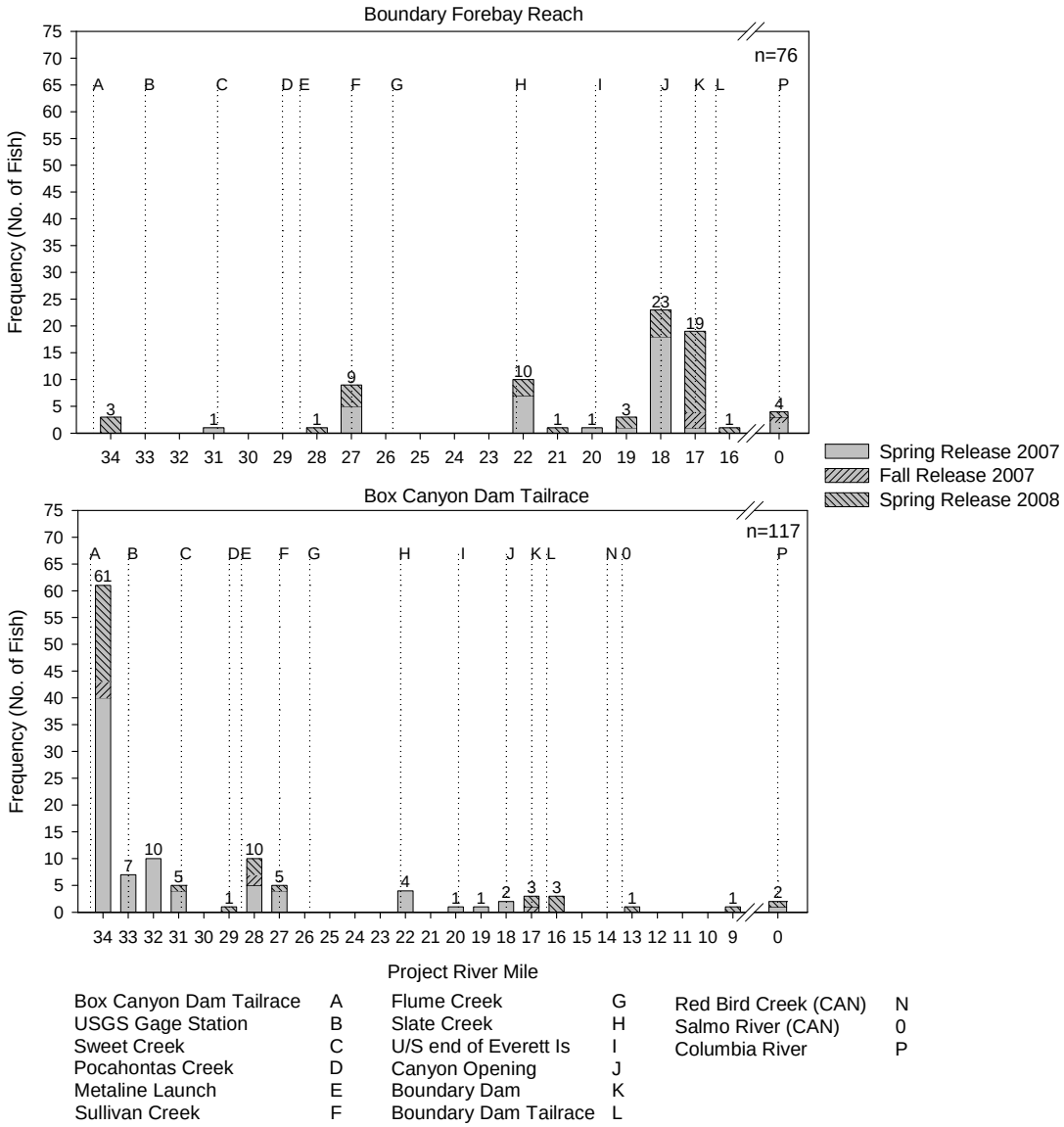


Figure 5.3-3. Angler tag return catch location data of externally tagged spring 2007, fall 2007, and spring 2008 triploid rainbow trout releases as reported by anglers from March 30, 2007, to October 24, 2008, indicating downstream capture location of triploid rainbow trout released in the Forebay Reach at PRM 17.3 and the Box Canyon Dam tailrace at PRM 34.5.

Other locations where anglers captured numerous fish included the section of river between the USGS gage and Sweet Creek (PRM 33.1 to 30.9; 12 percent of total captures), and areas near Sullivan Creek (PRM 27; 13 percent of total captures) and Slate Creek (PRM 22; 8 percent of total captures). Triploid rainbow trout were also captured by anglers in the Tailrace Reach (PRM 16.7; 2 percent of total captures), in the Salmo River (PRM 13.4; <1 percent of total captures), and at Seven Mile Reservoir (PRM 9; <1 percent of total captures); at least six externally tagged triploid rainbow trout (3 percent of total captures) were captured in the Columbia River or Lake Roosevelt. These latter individuals moved a considerable distance downstream from their release locations and through several dams. For example, one of the Columbia River fish was captured near Grand Coulee Dam, approximately 160 miles downstream. Another fish was captured near the confluence of the Spokane River with Lake Roosevelt, which is approximately 130 miles from its release location in the Forebay Reach (see Table 5.3-4).

Table 5.3-4. Mean dispersal distance and associated confidence intervals of spring 2007, fall 2007, and spring 2008 release triploid rainbow trout released in the Forebay Reach and Box Canyon Dam tailrace based on angler tag return data.

Release Location/Period		Net Movement (miles)				Tailrace Tag Recaptures/ (Columbia River Recaptures)	Combined Tailrace and Columbia River Total
	n[1]	Mean	Std Dev	Min	Max		
Spring Release 2007							
Forebay Reach	34	3.1	3.8	0	13.6	0 (2)	2
Box Canyon Dam Tailrace	78	3.2	4.3	0.5	17	0 (1)	1
Total or Average	**112**	**3.2**	**4.2**	**0**	**17**	**0 (3)**	**3**
Fall Release 2007							
Forebay Reach	3	0.2	0	0.2	0.2	0 (1)	1
Box Canyon Dam Tailrace	6	5.2	6.5	0.5	17.2	0	0
Total or Average	**9**	**3.5**	**5.7**	**0.2**	**17.2**	**0 (1)**	**1**
Spring Release 2008							
Forebay Reach	35	3.7	3.8	0	16.7	1 (1)	2
Box Canyon Dam Tailrace	31	5.8	7.9	0.5	25.5	5 (1)	6
Total or Average	**66**	4.7	6.6	**0**	**25.5**	**6 (2)**	**8**

Note:
1 The six fish captured in Columbia River are not included in net movement calculations. Only fish with designated distances are included.

In total, 156 (71 percent) of the 219 tags recovered from triploid rainbow trout and returned by anglers were reportedly caught in the Boundary Reservoir (Table 5.3-5). All fish were caught in spring and early summer. After release of the spring 2007 triploid rainbow trout, most fish were captured from April to July 2007, with fewer fish caught in August 2007. Relatively few of the fall 2007 release fish were caught by anglers, and those were captured in late spring 2008.

Table 5.3-5. Summary of externally tagged rainbow triploid trout recaptured by anglers between March 30, 2007, and October 24, 2008.

Month/Year of Capture	Number of Externally Tagged Triploid Captured by Release Group[1]			
	Spring Release 2007	Fall Release 2007	Spring Release 2008	Total
Apr-07	12	0	0	**12**
May-07	28	0	0	**28**
Jun-07	17	0	0	**17**
Jul-07	28	0	0	**28**
Aug-07	11	0	0	**11**
Apr-08	0	1	16	**17**
May-08	0	4	19	**23**
Jun-08	0	1	8	**9**
Jul-08	1	1	2	**4**
Aug-08	0	0	7	**7**
Grand Total	**97**	**7**	**52**	**156**

Note:
1 Only tags returned with angler designated capture months are shown.

Of the spring 2008 release group, most (67 percent) were captured in the spring (through May 2008) with the remainder captured in the summer. Overall, anglers reported catching few triploid rainbow trout during the summer, particular in late summer, when angling intensity by local area residents was reported to be highest (Table 5.1-7). This apparent reduction in the availability of triploid rainbow trout for anglers in late summer may be due either to removal of the triploid rainbow trout from the reservoir through harvest, entrainment, predation, natural mortality, or reduced catchability during the warm-water period. Water temperature and discharge likely influenced the rate of triploid rainbow trout loss from the reservoir. A higher estimated entrainment rate of spring 2008 released fish relative to the other releases was recorded, in that 9 percent (6 of 66 tags) of the tags were recovered from entrained fish caught by anglers in the areas between Boundary Dam and the Pend Oreille River–Columbia River confluence. These are considered to be low estimates (see Section 5.3.6).

Anglers were able to catch tagged triploid rainbow trout from both spring 2007 and 2008 releases in the month of August, whereas fish capture efforts during Study 9 did not. This suggests that anglers were able to target and catch fish at locations used by triploid rainbow trout in the summer (likely temperature refugia at stream mouths), which were not sampled during Study 9. The spring 2007 and 2008 releases that were captured in August provided some support that at least a proportion of the triploid rainbow trout remained in the reservoir and were available to anglers.

5.3.4. Triploid Rainbow Trout Growth Rates

Growth rates of the released triploid rainbow trout were estimated using data obtained from 130 of the 136 externally tagged fish recaptured during Study 9. Six fish were not included due to unsuitable length measurements. In both 2007 and 2008, systematic collection during Study 9

fish capture efforts on a monthly basis allowed continual monitoring of the change in length and weight of externally tagged triploid rainbow trout. Instead of total length, the change in weight or estimated weight was selected for analysis as the more accurate estimator of growth for fish across all size classes, but particularly for large fish (i.e., changes in weight increase roughly by the cube [power of three] relative to length. Consequently, this change would be more detectable in a large fish than would a simple increase in length). The daily percent change between capture weight and an estimated release weight was used as a measure of change in growth rate. A trend line (linear regression) of short-term (i.e., over the period of recapture of tagged fish) change of the growth rate is presented in Figure 5.3-4. In the absence of weight data (5 of 130 fish), estimates of weight were calculated using a log-based length to weight regression (see equation below) based on data collected at the time of initial stocking of the triploid rainbow trout.

$$\text{LogW} = \text{Log a} + \text{bLog(L)};$$

Where:

W = weight (g)
L = total length (mm)
a = regression intercept
b = regression slope

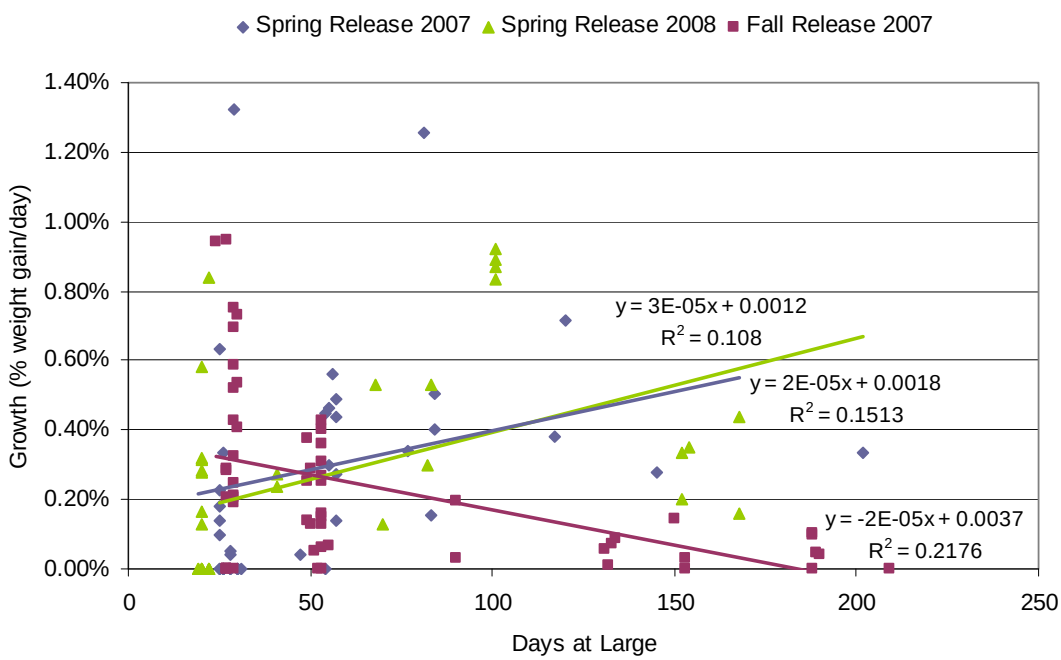


Figure 5.3-4. Percent weight gain per day, relative to initial release weight, of externally tagged hatchery triploid rainbow trout, released in spring 2007, fall 2007, and spring 2008, based on Study 9 recapture data between April 24, 2007, and September 18, 2008.

Average growth rates per day among the three release groups were similar, in part, because a large proportion of the growth rates used in calculating the average were from fish captured within 60 days of each release (Table 5.3-6). The results indicated that growth rates of the fall 2007 release fish in the first 60 days were higher than expected given the lower fall water temperatures.

Table 5.3-6. Average percent growth rate per day by weight, relative to initial release weight, of spring 2007, fall 2007, and spring 2008 release triploid rainbow trout in Boundary Reservoir based on Study 9 recaptures.

Release Session	n[1]	Mean No. of Days	Growth Rate per Day by Weight (%)[2]			
			Mean	Std Dev	Min	Max
Spring Release 2007	41	61	0.26	0.31	0.00	1.32
Fall Release 2007	57	69	0.23	0.24	0.00	0.94
Spring Release 2008	32	60	0.31	0.30	0.00	0.92
All Sessions	130	64	0.26	0.28	0.00	1.32

Notes:
1 Length data from 6 fish were either not recorded or considered erroneous and not used. One outlier from the spring 2007 release captured after 391 days at large was also not used in the analysis. Data indicating negative growth were set at equal zero growth per day.
2 Table is based on measured or calculated increase in weight between day of release and capture as recorded during Study 9 for fish captured between April 24, 2007, and September 18, 2008. Growth rate was calculated based on difference in weight at capture and release divided by days at large and was plotted as a percent of initial release weight.

Although the recapture rate of Floy-tagged triploid rainbow trout recorded during Study 9 was low (i.e., 136 out of 3,503 tags or 3.9 percent), a sufficient number of tags were recovered from each of the spring release groups to indicate that the majority of growth likely occurs in the spring or early summer of each year, followed by a second slower growth period in the fall. Triploid rainbow trout from both (2007 and 2008) spring releases grew relatively rapidly in late spring and early summer as water temperatures increased. General inspection of the data suggested differences in the timing of peak growth between 2007 and 2008 (Figure 5.3-4), which was likely influenced by the substantial difference between the 2007 and 2008 flow years, both in terms of total discharge and thermal regime. Flows in 2007 were generally much lower and temperatures were higher and occurred earlier than in 2008.

The lines shown in Figure 5.3-4 are intended to show the general trend of the data over the periods of data collection. They should not be implied as an indication of significant changes in growth rate over the monitoring periods, because the data were too limited to make this determination and the slope is highly dependent on when fish were recaptured. Inspection of the data indicates the period of rapid spring growth in 2007 appeared to start earlier, with evidence of moderate growth first recorded in May 2007 (about 30 to 60 days after release). In 2008, this period of rapid growth may have began slightly later and extended into late June and early July (about 70 to 100 days after release), although insufficient data were collected in May and June to accurately assess a difference.

Growth during the summer was not readily assessed due to the low number of recaptures in August and September. The few fish captured in September 2008 from the spring 2008 release had not grown substantially more than fish captured in early summer. High reservoir water temperatures (approaching 25°C), possibly combined with reduced feeding opportunities, likely resulted in reduced growth in late summer 2007.

Fish released in fall 2007 appeared to undergo an initial period of growth in the first month after release, but the growth rates appeared to decrease by the second month after release and steadily declined thereafter through the remainder of the winter (Figure 5.3-4). Reduced growth was not unexpected during the winter. The fall 2007 release fish captured in spring 2008 were of similar size to fall 2007 fish captured within 60 days after initial release. The low overwinter growth of fall-released fish was also identified based on similar length frequencies distribution between fall 2006 releases captured in March 2007 and the length frequency distribution of spring 2007 releases (see Section 5.3.6). Although the fall 2007 releases did not grow substantially over the winter, a larger number of fall 2007 releases were captured after 90 or more days (n = 15) compared to spring 2007 releases (n = 5) or the spring 2008 releases (n = 9). This suggests that a moderate proportion of the fall releases may have survived the winter.

Due to the uncertainty about how anglers measured the fish they caught, growth estimates based on angler-provided length data were assumed to be less accurate than data from Study 9. In addition, out of 219 tags returned by anglers, a capture date and length estimate were only provided for 129 tags on which a comparison of growth rates was conducted based on percent growth rate per day by weight (Figure 5.3-5). Because no weight data were provided by the anglers, all fish weights were calculated through the same length weight regression value used for Study 9 fish. Based on angler tag returns, higher average growth rates were recorded for spring 2007 and 2008 releases compared to the fall 2007 release. However, this difference was due in part to the low number of fall 2007 angler tag returns compared to the other releases (Table 5.3-7). Based on the fall 2007 tag returns, assessment of growth rate for the fall 2007 fish over the winter was not possible because all but one fish was captured by anglers in May and June 2008 (Figure 5.3-5). The increase in weight recorded for these fish likely occurred in late fall 2007, but also in early spring 2008. Consequently, an expected reduced growth in the winter could not be measured. The resulting figure shows the increasing growth rate in spring 2008, which agrees with the increasing growth rate patterns of spring-released fish.

Growth patterns based on angler catch reports for the two spring releases were similar to that of fish captured during Study 9 efforts except that the average magnitude of growth differed, which is likely a result of reporting methods. Overall, very few fall 2007 release fish were caught by anglers, so no reasonable trends in growth could be discerned.

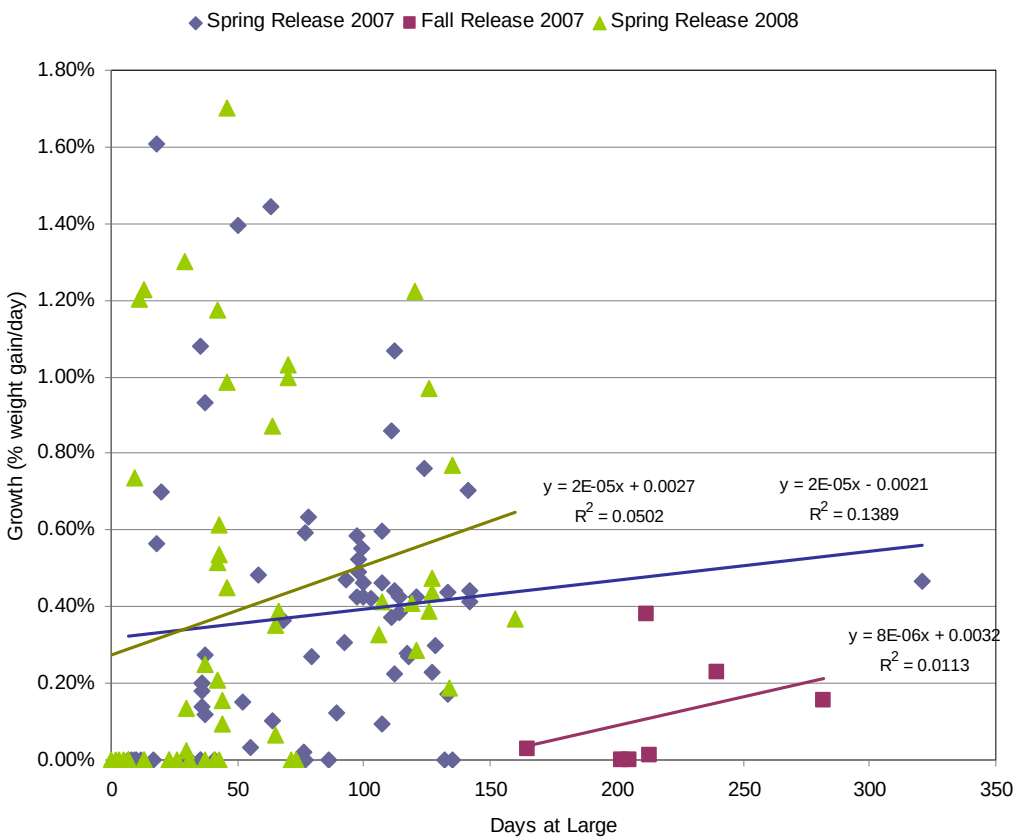


Figure 5.3-5. Percent weight gain per day, relative to initial release weight, of externally tagged hatchery triploid rainbow trout, released in spring 2007, fall 2007, and spring 2008, as reported by anglers between April 24, 2007, and October 24, 2008.

Table 5.3-7. Average percent change in weight per day of spring 2007, fall 2007, and spring 2008 release triploid rainbow trout in Boundary Reservoir, tailrace, and downstream reaches based on angler tag return data reported between April 24, 2007, and October 24, 2008.

Release Session	n	Mean # of Days[1]	Percent Growth Rate per Day by Weight (%)[2]			
			Mean	Std Dev	Min	Max
Spring 2007 Release	69	80	0.38%	0.36%	0.00%	1.61%
Fall 2007 Release	7	217	0.11%	0.15%	0.00%	0.38%
Spring 2008 Release	53	54	0.40%	0.45%	0.00%	1.70%
All Sessions	129	77	0.37%	0.40%	0.00%	1.70%

Notes:

1 Length data from 3 fish were considered erroneous and were not used. Length data that indicated negative growth were assumed to equal zero (i.e., no increase from initial release length).

2 Table is based on calculated increase in weight between day of release and capture provide by anglers for fish captured between April 24, 2007, and October 24, 2008. Growth rate was calculated based on difference in weight at capture and release divided by days at large and was plotted as a percent of initial release weight.

In summary, both Study 9 and angler capture data indicated the general patterns of growth of triploid rainbow trout released in the spring and fall. In general, the spring 2007 releases had a more rapid growth rate in the spring and a declining growth rate in the fall. In contrast, the spring 2008 fish, which experienced higher flows and lower spring/summer water temperatures, showed slightly later growth periods that peaked in the summer later than in 2007. The reason for this difference may have been that the higher water temperatures (e.g., maximum of 25°C) in 2007 inhibited growth. In early 2008, high water may have made it difficult to access optimum feeding habitat and delayed growth into summer. However, the growth rate for spring 2008 released fish also declined in the fall. Fall 2007 released fish showed the highest growth in early to late fall, but apparently no new growth in the winter. This was not indicated by the angler survey data for fall released fish, as none were captured in the winter. However, the angler survey did indicate increased growth in the spring of 2008 of fall released fish, similar in relative change to the spring released fish. Study 9 data indicated that overall average growth rates between spring and fall released fish were similar, although the timing of growth was different.

5.3.5. Habitat Use Data Summary for Planted and Carry-over Triploid Rainbow Trout

Attributes of habitat used by triploid rainbow trout were recorded during both the biotelemetry component and the fish capture component of Study 9. The available amount of habitat data recorded was averaged over each month to identify any large-scale seasonal changes or trends in habitat use by triploid rainbow trout. Overall, the amount of habitat data associated with the spring 2007 release triploid rainbow trout was low. Consequently, strong conclusions regarding triploid rainbow trout habitat use in the Boundary Reservoir were not possible (Table 5.3-8).

Differences in seasonal use by planted triploid rainbow trout and carry-over triploid rainbow trout of water temperature, water depth, distance from shore, and water velocity were evident. Also, more use of high water velocity areas and warm water temperatures sites was recorded in the spring and summer than fall and winter. Surface water velocities (measured at a depth of 6 feet [about 1.8 m]) at assigned fish locations tended to be in excess of 1 foot per second (fps). Total river depth associated with fish location was highly variable and likely not representative of actual fish position in the water column.

When carry-over triploid rainbow trout were compared to recently planted spring and fall releases in terms of association with deep versus shallow water areas, the recently planted fish were generally found in shallower water areas compared to carry-overs. This suggests that recently planted fish likely retain their surface-oriented hatchery behavior for a period time after release before learning to use deeper water areas. However, few newly planted fish had field measurements, so this observation is not clearly distinct.

Table 5.3-8. Average monthly habitat use data recorded at locations of radio-tagged a) carry-overs and b) spring and fall 2007 release triploid rainbow trout identified during mobile telemetry tracking from April 2007 to September 2008 in the Boundary Reservoir.

Month	Water Temp. Reservoir (°C)[1]		Distance to Bank (ft.)		Water Depth (ft.)		Surface Velocity (fps)	
	Mean (SD)	n[2]	Mean (SD)	n	Mean (SD)	n	Mean (SD)	n
Carry-overs								
June 2007	15.8 (0.8)	4	182.1 (112.1)	4	77.7 (84.0)	4	0.3 (0.1)	3
July 2007	20.8 (3.0)	3	65.6 (N/A)	1	20.3 (N/A)	1	0.2 (N/A)	1
August 2007	20.9 (N/A)	1	(N/A)[3]	(N/A)[3]	(N/A)[3]	(N/A)[3]	(N/A)[3]	(N/A)[3]
Summer 2007	***18.3 (3.2)***	***8***	***158.8 (110.2)***	***5***	***66.2 (77.1)***	***5***	***0.3 (0.1)***	***4***
October 2007	12.3 (0.1)	2	(N/A)[3]	(N/A)[3]	14.8 (N/A)	1	(N/A)[3]	(N/A)[3]
November 2007	7.1 (1.0)	8	75.5 (51.4)	5	12.7 (2.2)	5	0.4 (0.5)	3
Fall 2007	***8.1 (2.4)***	***10***	***75.4 51.4)***	***5***	***13.1 (2.1)***	***6***	***0.4 (0.5)***	***3***
December 2007	0.8 (0)	2	(N/A)[3]	(N/A)[3]	(N/A)[3]	(N/A)[3]	(N/A)[3]	(N/A)[3]
February 2008	2.2 (0.1)	2	82.0 (N/A)	1	15.3 (N/A)	1	(N/A)[3]	(N/A)[3]
Winter 2007/ 2008	***1.4 (0.6)***	***6***	***93.0 (34.1)***	***3***	***16.1 (0.9)***	***3***	***(N/A)[3]***	***(N/A)[3]***
March 2008	4.6 (0.3)	6	78.1 (50.3)	5	47.7 (65.9)	5	0.2 (N/A)	1
April 2008	6.9 (0.7)	18	96.8 (116.8)	16	15.6 (20.1)	12	3.8 (N/A)	1
May 2008	10.6 (1.0)	18	116.5 (136.1)	14	40.2 (39.9)	16	(N/A)3	(N/A)3
Spring 2008	***8.1 (2.4)***	***42***	***102.0 (116.5)***	***35***	***32.4 (40.0)***	***33***	***2.0 (2.5)***	***2***
June 2008	12.4 (1.3)	16	79.8 (85.0)	16	49.4 (64.6)	13	(N/A)3	(N/A)3
July 2008	20.4 (0.8)	11	71.5 (62.3)	10	69.2 (67.0)	10	(N/A)3	(N/A)3
August 2008	20.9 (0.7)	6	78.7 (59.3)	6	29.3 (37.7)	6	(N/A)3	(N/A)3
Summer 2008	***16.6 (4.3)***	***33***	***77.0 (72.2)***	***32***	***52.1 (60.8)***	***29***	***(N/A)3***	***(N/A)3***
September 2008	17.5 (0)	4	143.5 (113.1)	4	45.7 (52.5)	4	(N/A)3	(N/A)3
Fall 2008	***17.5 (0)***	***4***	***143.5 (113.1)***	***4***	***45.7 (52.5)***	***4***	***(N/A)3***	***(N/A)3***
Spring and Fall Releases 2007								
May 2007	10.7 (1.5)	4	56.6 (52.9)	4	18.5 (9.4)	4	0.3 (0.1)	3
Spring 2007	***10.7 (1.5)***	***4***	***56.6 (52.9)***	***4***	***18.5 (9.4)***	***4***	***0.3 (0.1)***	***3***
June 2007	17.0 (N/A)	1	16.4 (N/A)	1	(N/A)[3]	(N/A)[3]	(N/A)[3]	(N/A)[3]
July 2007	18.8 (N/A)	1	75.5 (N/A)	1	23.9 (N/A)	1	0.6 (N/A)	1
Summer 2007	***17.9 (1.3)***	***2***	***45.9 (41.8)***	***2***	***23.9 (N/A)***	***1***	***0.6 (N/A)***	***1***
November 2007	7.1 (1.3)	2	131.2 (0)	2	14.1 (1.3)	2	0.7 (N/A)	1
Fall 2007	***7.1 (1.3)***	***2***	***131.2 (0)***	***2***	***14.1 (1.3)***	***2***	***0.7 (N/A)***	***1***
February 2008	2.1 (N/A)	1	164.0 (N/A)	1	206.7 (N/A)	1	(N/A)[3]	(N/A)[3]
Winter 2008	***2.1 (N/A)***	***1***	***164.0 (N/A)***	***1***	***206.7 (N/A)***	***1***	***(N/A)[3]***	***(N/A)[3]***

Notes:
1 Reservoir water temperatures were recorded manually in the main channel during mobile tracking.
2 Data recorded from multiple fish and/or the same fish at multiple locations over one or more tracking sessions.
3 Either one data point or no data.
fps – feet per second SD – standard deviation
N/A – not applicable

Habitat use data and temperature and depth data recorded from CART-tagged triploids were also of limited value in determining habitat associations (Table 5.3-9). Average surface water velocities associated with CART-tagged fish ranged between 0.6 fps in July and 2.0 fps in September. Total depths in the river associated with fish positions, as measured with the boat depth sounder, were highly variable; CART tag depth data confirmed that fish were generally in the middle to upper portion of the water column (most less than 12 feet deep [about 3.7 m]) and were seldom found at the maximum depths reported by the boat depth sounder.

Table 5.3-9. Average monthly habitat use data recorded at locations of CART-tagged triploid rainbow trout identified during mobile tracking from June 2007 to August 2008 in Boundary Reservoir.

Month	Reservoir Water Temperature (°C)[1]		Average Fish Temperature (ºC)		Distance to Bank (ft.)		Water Depth (ft.)		Average Fish[2] Depth (ft.)	
	Mean (SD)	n[3]	Mean (SD)	n	Mean (SD)	n	Mean (SD)	n	Mean (SD)	n
June 2007	15.8 (0.8)	4	15.5 (1.3)	4	182.0 (112.0)	4	77.7 (84.0)	4	5.8 (1.7)	4
July 2007	19.0 (0.3)	3	19.3 (0.9)	3	65.6 (N/A)	1	20.3 (N/A)	1	11.0 (4.6)	3
August 2007	22.7 (2.5)	2	20.9 (0.4)	2	(N/A)[4]	(N/A)[4]	(N/A)[4]	(N/A)[4]	6.7 (3.0)	2
Summer 2007	***18.4 (3.0)***	***9***	***18.0 (2.6)***	***9***	***158.8 (110.1)***	***5***	***66.2 (77.1)***	***5***	***7.8 (3.7)***	***9***
September 2007	16.9 (N/A)	1	16.4 (N/A)	1	(N/A)[4]	(N/A)[4]	(N/A)[4]	(N/A)[4]	2.9 (N/A)	1
October 2007	12.3 (N/A)	1	11.6 (N/A)	1	(N/A)[34]	(N/A)[3]	(N/A)[3]	(N/A)[3]	2.3 (N/A)	1
November 2007	6.0 (0)	2	6.0 (0)	2	32.8 (N/A)	1	9.0 (N/A)	1	5.8 (1.6)	2
Fall 2007	***10.3 (5.3)***	***4***	***10.0 (5.0)***	***4***	***32.8 (N/A)***	***1***	***9.0 (N/A)***	***1***	***4.2 (2.1)***	***4***
December 2007	0.8 (0)	2	1.2 (N/A)	1	(N/A)[4]	(N/A)[4]	(N/A)[4]	(N/A)[4]	11.0 (2.4)	2
February 2008	2.2 (0.1)	2	2.3 (0.4)	2	82.0 (N/A)	1	15.3 (N/A)	1	9.2 (6.5)	2
Winter 2007/2008	***1.5 (0.8)***	***4***	***1.9 (0.7)***	***3***	***82.0 (N/A)***	***1***	***15.3 (N/A)***	***1***	***10.1 (4.1)***	***4***
April 2008	7.2 (0.2)	5	6.2 (0.4)	5	186.3 (185.6)	5	11.8 (5.8)	4	7.3 (1.6)	5
Spring 2008	***9.1 (2.1)***	***10***	***7.1 (1.8)***	***7***	***162.1 (163.9)***	***7***	***13.1 (7.3)***	***6***	***7.4 (5.2)***	***10***
May 2008	11.0 (1.0)	5	9.4 (1.9)	2	101.7 (120.6)	2	15.7 (12.0)	2	7.4 (7.7)	5
June 2008	11.2 (0)	2	10.8 (0)	2	23.0 (0)	2	14.0 (3.9)	2	4.0 (2.4)	2
Summer 2008	***11.2 (0)***	***2***	***10.8 (0)***	***2***	***23.0 (0)***	***2***	***14.0 (3.9)***	***2***	***4.0 (2.4)***	***2***

Notes:
1 Reservoir water temperatures at the surface were recorded manually in the main channel during mobile tracking.
2 Velocity not reported because limited data were recorded

Table 5.3-9, continued…

3 Data recorded from multiple fish and/or the same fish at multiple locations over one or more tracking sessions.
4 Either one data point or no data.
CART – combined acoustic and radio transmitter.
SD – standard deviation.

Average water temperature at assigned fish positions tended to be slightly lower (less than 1°C) than the surface reservoir temperature in July. In August, substantial differences between fish temperature and reservoir temperatures were not apparent because all data were recorded when water temperatures were lower (e.g., less than 24ºC) and fish use of cold-water refugia was reduced or possibly intermittent. Lack of a distinct thermocline in the reservoir also limited available cooler water regions for fish to use. Triploid rainbow trout carry-overs were found at slightly deeper depths during the winter than in other seasons.

Habitat data recorded during HSC data collection as part of the Study 9 electrofishing program provided the majority of habitat use data for triploid rainbow trout from March 2007 through February 2008. Electrofishing becomes increasingly inefficient at depths greater than 8 feet (about 2.4 m). Consequently, depth utilization data from electrofishing are biased towards shallower depths (usually less than 8 feet [about 1.8 m]).

Habitat data were recorded during this period in all months except June, November, and January (Table 5.3-10). With the exception of March, in all other months in which data were collected, triploid rainbow trout were found near the shore in average water depths of less than 6 feet. Triploid rainbow trout were associated with an average water depth of approximately 12 feet in March. In all months but May and October, water velocities were, on average, less that 1 fps; an average water velocity of 1.6 fps was recorded in May and 1.0 fps in October for near surface (0.2 foot depth) measurements.

Table 5.3-10. Triploid rainbow trout habitat use data recorded during the HSC data collection portion of Study 9 electrofishing program from March 2007 to February 2008 (excluding June, November, and January) in the Boundary Reservoir and Tailrace Reach.

Sample Period	Water Depth (ft.)		Velocity (fps) 0.2 depth		Velocity (fps) 0.6 depth		Velocity (fps) 0.8 depth		Water Temperature (ºC)	
	Mean (SD)	n	Mean (SD)	n	Mean (SD)	N	Mean (SD)	n	Mean (SD)	N
Mar	11.6 (3.4)	5	0.3 (0.2)	5	0.1 (0.1)	5	0.2 (0.1)	5	6.0 (0.0)	5
Apr	4.8 (2.7)	40	0.9 (0.7)	21	0.6 (0.6)	19	0.9 (1.0)	21	10.4 (0.4)	40
May	5.6 (3.5)	24	1.6 (0.8)	12	0.3 (0.3)	13	1.4 (0.6)	12	13.8 (0.7)	24
Jul	3.0 (N/A)[1]	1	N/A[1]	0	0.1 (N/A)[1]	1	N/A[1]	0	23.4 (N/A)[1]	1
Aug	4.4 (2.8)	11	0.1(0.1)	9	0.3 (0.2)	3	0.1 (0.1)	9	21.1 (1.3)	11
Sep	4.6 (N/A)[1]	1	0.0 (N/A)[1]	1	N/A[1]	0	0.0 (N/A)[1]	1	14.7 (N/A)[1]	1
Oct	5.4 (0.9)	3	1.0 (1.0)	3	N/A[1]	0	1.0 (1.1)	3	11.0 (0.0)	3
Dec	2.5 (0.5)	4	N/A[1]	0	0.4 (0.5)	4	N/A[1]	0	0.4 (0.2)	4
Feb	1.4 (1.1)	4	0.0 (0.0)	2	0.0 (N/A)[1]	1	0.0 (0.0)	4	1.8 (0.2)	4

Notes:
1 Either one data point or no data.
fps – feet per second.
N/A – not applicable
SD – standard deviation.

Triploid rainbow trout were associated with a wide variety of substrate and habitat cover type and demonstrated no clear seasonal association for these habitat parameters. Possible exceptions for substrate (Table 5.3-11) were a high affinity for large gravel in July and for large cobble in September. Similarly, for cover type (Table 5.3-12), there was a high affinity for woody cover in March and boulder/large cobble in September. It should be noted that the habitat data collected during fish sampling was limited to that found in the nearshore shallow water (usually less than 8 feet) region because of the sampling limitations of electrofishing in deeper water. Data were not collected after February 2008, as per agreement with the RPs (see Section 4.2.5).

Table 5.3-11. Triploid rainbow trout substrate associations for carry-overs (a) and spring and fall releases (b) from 2007, recorded during the Study 9 fish capture program from March 2007 to September 2008 (excluding June, November, and January) in the Boundary Reservoir and Tailrace Reach.

Month	Dominate Substrate Type (Number/Percent)									n
	Silt, Clay, Organic	Sand	Small Gravel[1]	Med. Gravel[2]	Large Gravel[3]	Small Cobble[4]	Large Cobble[5]	Boulder[6]	Bedrock	
Carry-overs										
June 2007	0	0	0	0	0	0	0	0	0	0
July 2007	0	0	0	0	1(50)	0	0	0	1(50)	2
Summer 2007	***0***	***0***	***0***	***0***	***1(50)***	***0***	***0***	***0***	***1(50)***	***2***
October 2007	0	0	0	0	0	0	0	0	0	0
November 2007	1	0	0	0	2	0	2	0	0	5
Fall 2007	***1(20)***	***0***	***0***	***0***	***2(40)***	***0***	***2(40)***	***0***	***0***	***5***
February 2008	0	0	0	0	0	1	0	0	0	1
Winter 2008						***1(100)***	***0***	***0***	***0***	***1***
March 2008	1(20)	1(20)	0	0	0	0	1(20)	1(20)	1(20)	5
April 2008	1(9)	1(9)	1(9)	3(27)	2(18)	3(270	0	0	0	11
May 2008	0	1(10)	0	3(30)	0	2(20)	0	0	4(40)	10
Spring 2008	***2(8)***	***3(12)***	***1(4)***	***6(23)***	***2(12)***	***5(19)***	***1(4)***	***1(4)***	***5(19)***	***26***
June 2008	3(60)	0	0	0	0	0	0	0	2(40)	5
July 2008	0	2(20)	0	1(10)	0	1(10)	0	0	6(60)	10
August 2008	0	0	0	1(17)	0	0	1(17)	3(50)	1(17)	6
Summer 2008	***3(14)***	***2(10)***	***0***	***2(10)***	***0***	***1(5)***	***1(5)***	***3(14)***	***9(43)***	***21***
September 2008	0	0	0	0	1(33)	0	1(33)	0	1(33)	3
Fall 2008	***0***	***0***	***0***	***0***	***1(33)***	***0***	***1(33)***	***0***	***1(33)***	***3***
Spring and Fall Release 2007										
May 2007	0	0	0	0	0	0	0	0	0	0
Spring 2007	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
June 2007	0	0	0	0	0	0	0	0	0	0
July 2007	0	0	0	0	0	0	0	0	1(100)	1
Summer 2007	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1(100)**	**1**
November 2007	0	0	0	0	1(50)	0	1(50)	0	0	2
Fall 2007	**0**	**0**	**0**	**0**	**1(50)**	**0**	**1(50)**	**0**	**0**	**2**
February 2008	0	0	0	0	0	0	0	1(100)	0	1
Winter 2008	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1(100)**	**0**	**1**

Notes:
1 0.25–1.25 cm
2 1.25–3.75 cm
3 3.75–7.5 cm
4 7.5–15 cm
5 15–30 cm
6 >30 cm

Table 5.3-12. Triploid rainbow trout habitat cover associations recorded during the Study 9 fish capture program from March 2007 to February 2008 (excluding June, November, and January) in the Boundary Reservoir and Tailrace Reach.

	Dominant Cover Type (Number and Percent of Fish)										
Mon-Yr	**Under-cut Bank**	**Over-hanging Vegetation (within 1m of surface)**	**Root Wads**	**Log Jams**	**Indivi-dual Logs**	**Aquatic Vegeta-tion**	**Short (<1ft) terres-trial grass**	**Vegetation beyond the bank-full waters edge**	**Boulder, Large Cobble**	**None**	**n**
Oct. 2007	0	0	0	0	0	1(100)	0	0	0	0	1
Nov. 2007	0	0	0	0	0	0	0	0	0	0	0
Fall 2007	***0***	***0***	***0***	***0***	***0***	***1(100)***	***0***	***0***	***0***	***0***	***1***
Feb. 2008	0	0	0	0	0	0	0	0	0	0	0
Winter 2008	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***
March 2008	0	0	0	0	0	0	0	0	1(100)	0	1
April 2008	0	0	0	0	1(33)	0	0	0	0	2(67)	3
May 2008	0	0	0	1(8)	1(8)	0	0	2(17)	0	8(67)	12
Spring 2008	***0***	***0***	***0***	***1(6)***	***2(13)***	***0***	***0***	***2(13)***	***1(1)***	***10 (63)***	***16***
June 2008	1(11)	2(22)	0	0	0	0	1(11)	0	1(11)	4(44)	9
July 2008	0	0	0	0	0	0	0	0	0	0	0
August 2008	0	0	0	0	0	0	0	0	4(100)	0	4
Summer 2008	***1(8)***	***2(15)***	***0***	***0***	***0***	***0***	***1(8)***	***0***	***5(38)***	***4(31)***	***13***
Sept. 2008	0	0	1(33)	0	0	0	0	0	2(66)	0	3
Fall 2008	***0***	***0***	***1(33)***	***0***	***0***	***0***	***0***	***0***	***2(66)***	***0***	***3***

5.3.6. Triploid Rainbow Trout Loss

Triploid rainbow trout are potentially lost from the Boundary Reservoir through sport fishing, natural mortality (e.g., disease and predation), and entrainment through either the Boundary Dam powerplant or spillway. To evaluate triploid rainbow trout loss, the length-frequency of March 2007 captures of carry-over triploid rainbow trout was compared with fish from the spring 2007 release (Figure 5.3-6). This comparison indicated that two separate groups of triploid rainbow trout were already present in the reservoir, prior to the spring 2007 release. Based on past triploid rainbow trout release data (Table 1.3-1), the larger fish were likely the fall 2005/spring 2006 (and older) releases and the smaller group from the fall 2006 release (Figure 5.3-6).

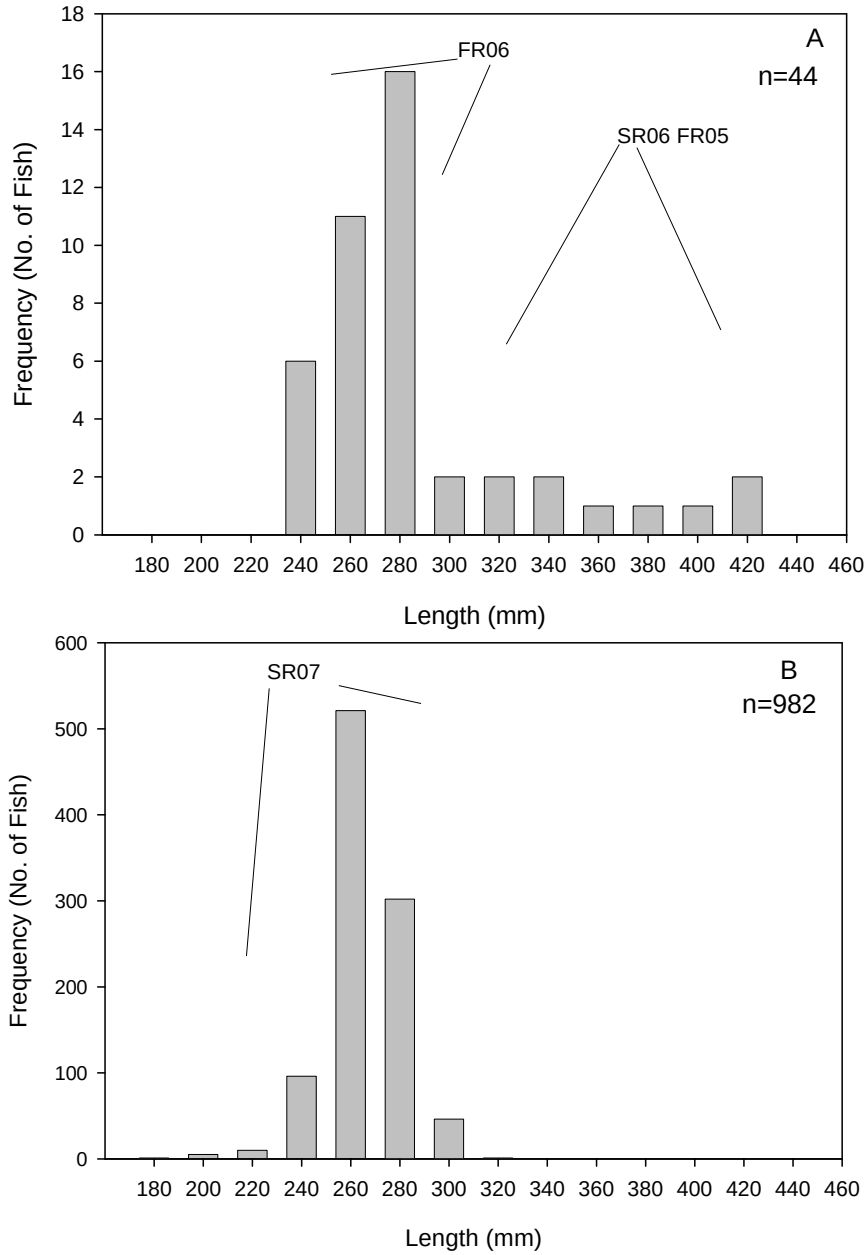


Figure 5.3-6. Length frequency distribution of all triploid rainbow trout captured between February 25 and March 13, prior to release of spring 2007 triploid rainbow trout on March 29 and 30 (A) compared to the length frequency distribution spring 2007 (SR07) release (B).

Note: Spring release (SR) and fall release (FR) for 2006 and the fall release in 2005 are identified.

Although based on a small sample size, the length distribution of the fish captured in March 2007 suggested that the fall 2006 release did not grow significantly over the winter. Length data from fall 2007 releases also suggested that there was only slight initial growth in the fall (average

about 10 mm), but little or no growth through the winter. Furthermore, when the length frequency of fall 2006 and spring 2007 releases were compared, they overlapped and could not be separated. This overlap suggests that each fall triploid rainbow trout release and the following spring triploid rainbow trout release were effectively a single release group from a size perspective. Fish less than 310 mm in fork length were likely released in fall 2006 (see Figure 5.3-6).

The total number of triploid rainbow trout released in spring 2006/fall 2005 was 9,000, compared to 4,300 fish released in fall 2006 (Table 1.3-1). Based on the length frequency data in Figure 5.3-6, only a small number of the triploid rainbow trout survived through the summer and carry over to the following spring.

Based on captures from the Boundary Reservoir, tag recaptures from the spring 2007 plantings indicated very low yearly survival of stocked triploid rainbow trout. Of 97 tags turned in by anglers, only 1 tag (about 1 percent) turned in from the 2008 capture was from the spring 2007 release (Table 5.3-5). Study 9 results were very similar with only 1 of 43 tags (2 percent) from the spring 2007 release captured in 2008. Overall, this suggests that the loss of stocked triploid rainbow trout from Boundary Reservoir from spring to spring is high. Additional anecdotal information from anglers about the degree of potential losses of triploid rainbow trout from the reservoir also suggests that survival of planted fish may be low. Specifically, in May 2001, approximately 1,000 external tags were deployed out of 2,100 fish released. During a weekend bass derby in May 2003, a $50 reward was offered for every external tag returned; however, no tags were returned (McGregor 2007).

As discussed earlier, one of the major losses of fish from the Boundary Reservoir is through entrainment. The number of external tags recovered downstream of Boundary Dam by anglers and during Study 9 fish capture efforts (27 out of 329 tags, or 8 percent from known locations) was low (Table 5.3-13); however, Study 9 sampling efforts, angling efforts, and angler reporting rates of tags are likely lower in this area compared to areas within the Boundary Reservoir because of limited access and dispersion of fish out of the sampling area. This would result in an underestimate of triploid rainbow trout entrainment from this data. Out of the 27 tagged fish entrained, 19 (70 percent) of the fish were released in the Forebay Reach. Of these, at least 9 were suspected to have been entrained during high flows. Overall, when considering all releases and release sites, the highest number of entrained tags (n = 18) were recovered during 2008, a high flow year. Even though more tags were released in spring 2008 than other periods, the rate of capture downstream of Boundary Dam is still about double the recapture rate for the spring 2007 releases, and six times that of the fall 2007 releases.

Table 5.3-13. Combined total of triploid rainbow trout entrained based on externally tagged fish from Study 9 recapture efforts and angler tag returns.

Release Locations	Number Entrained [1]			
	Spring Release 2007	**Fall Release 2007**	**Spring Release 2008**	**All Releases**
	(n = 1,000)	**(n = 1,000)**	**(n = 1,503)**	**(n = 3,503)**
Boundary Forebay Reach	6	2	11	19
Box Canyon Dam Tailrace	1	0	7	8
Total Entrained (n)	**7**	**2**	**18**	**27**

Note:
1 Includes combined totals of external tags from Study 9 recaptures and angler returns (see Tables 5.3-2 and 5.3-4).

Another estimate of triploid rainbow trout loss from the reservoir was determined from the entrainment rates of radio- and CART-tagged fish (Table 5.3-14). In total, 15 (20 percent) of the 74 triploid rainbow trout equipped with transmitters and released in the reservoir were entrained (Fish 28, 32, 47, 53, 64, 78, 88, 89, 122, 126, 140, 143, 151, 152, and 171). However, subsequent data obtained for one of these fish (Fish 28) suggested that the tag was moved downstream by an avian predator, either by scavenging the fish from the Forebay Reach or scavenging the fish from the Tailrace Reach after entrainment. Out of these fish, with the exception of two fish that demonstrated initial upstream movement (Fish 47 and 126), researchers were unable to determine if the entrained fish were alive and actively swimming at the time of entrainment. In addition, even though the tags of two entrained triploid rainbow trout (Fish 64 and 152) were recovered from the shore in the tailrace, the cause of mortality could not be determined.

Out of the 15 entrained radio or CART tagged fish, about half (7) of the entrained tags came from the Forebay releases, but the other half were mostly from near the Box Canyon tailrace or the Upper Reservoir Reach. Most of the Upper Reservoir Reach radio-tagged fish were entrained during high flows in 2008. This suggests that in a high flow year, a fish anywhere within the reservoir has an increased chance of entrainment, and that high flow may be an important factor affecting triploid rainbow trout entrainment rates.

Table 5.3-14. Entrainment dates of radio- and CART-tagged triploid rainbow trout in relation to release date, release location, and Boundary Dam discharge and spill.

Tag Number	Release Group or Carry-Over	Date and Time of Entrainment	Release Date	Days in Reservoir	Release Location (PRM) [1]	Boundary Dam[2]	
						Total Discharge (cfs)	Spill (cfs)
89	Spring 2007	3/30/2007 21:34	3/30/2007	1	17.3	42,322	2,302
88	Spring 2007	4/18/2007 12:17	3/30/2007	20	17.3	43,319	0
78	Spring 2007	5/12/2007 3:41	3/30/2007	43	34.2	28,761	0
151	Fall 2007	10/22/2007 14:10	10/19/2007	4	17.3	25,923	0
140	Fall 2007	10/25/2007 12:41	10/19/2007	7	17.3	21,643	0
28	Carry-over	10/26/2007 16:20	6/13/2007	136	34.3	17,340	0
32	Carry-over	3/1/2008 23:02	10/17/2007	137	17.3	9,377	0
152	Fall 2007	3/24/2008 15:29	10/19/2007	158	17.3	25,846	11,882
143	Fall 2007	3/27/2008 18:51	10/19/2007	161	17.3	13,157	0
122	Carry-over	5/26/2008 6:24	4/16/2008	40	25.8	87,114	39,714
64	Carry-over	6/7/2008 20:12	2/29/2008	100	33.6	89,469	53,900
171	Carry-over	6/14/2008 21:48	4/16/2008	60	25.6	86,719	36,593
47	Carry-over	6/16/2008 22:22	2/29/2008	109	30.4	88,742	40,011
126	Carry-over	6/20/2008 15:28	4/15/2008	67	33.8	69,469	26,060
53	Carry-over	7/14/2008 0:13	10/20/2007	268	34	40,232	0

Note:
1 PRM 17.3 involves Forebay Reach releases; others are in the Upper Reservoir Reach.
2 Average hourly discharge and spill at the time of entrainment.
cfs – cubic feet per second
PRM – Project river mile

In summary, the telemetry data, combined with external tag recoveries from downstream of Boundary Dam and the capture and observation of moderate numbers of untagged triploid rainbow trout in the Boundary Tailrace Reach (see Study 9 [SCL 2009a]), suggest that entrainment results in a substantial loss of planted triploid rainbow trout from the Boundary Reservoir. Based on the number of tags recovered, combined with evidence that at least some triploid rainbow trout are entrained relatively soon after release, it is possible that 20 to 30 percent or more of all triploid rainbow trout are entrained within 3 to 4 months after release. Spring freshet flow and spill conditions, as seen in 2008, may accelerate the entrainment process.

Another potentially significant source of triploid rainbow trout loss is predation, with both piscivorous fish and birds as the primary predators. Anecdotal evidence of piscivorous fish predation has been provided by anglers, usually during removal and inspection of the stomach and hindgut of a fish caught while angling. In one such case, an external tag originally affixed to a triploid rainbow trout was returned by an angler who recovered it from the gut of a northern pikeminnow. With the presence of northern pike in addition to the other known piscivorous fish species within the reservoir (e.g., smallmouth bass), fish predators may consume a relatively large proportion of each group of triploid rainbow trout released.

Avian predation on surface-oriented triploid rainbow trout may also be another source of loss. In addition to ospreys and eagles, inland cormorants were identified as a major avian predator in the area. Up to 30 cormorants were observed occupying a roost near the highway bridge crossing at Metaline Falls. Coincidentally, this is the exact location where a considerable number of radio tags have been located and have tended to accumulate. Mobile telemetry tracking confirmed that these tags do not move and the fish they were implanted in are likely dead. Given the association of this site with cormorants, there is a high probability that at least a portion of these tags were in fish killed and eaten by a cormorant.

Finally, angler captures of triploid rainbow trout, the actual purpose for the triploid release program, likely were responsible for more removal of triploid rainbow trout than the tag returns suggest. One study (Denson et al. 2002) reported that only 50 percent of captured tags in similar studies were returned, suggesting that even with the reward program many captured tags were never returned. A lack of reporting was likely suggested by anecdotal information from tributary deltas. For example, fish use of tributary deltas as temperature refugia during the summer was known by anglers. During intensive tracking in 2007, anglers fishing near the Sweet Creek delta informed field staff that a large portion of their catch the previous week was triploid rainbow trout and several external tags were collected. If this report is accurate, the tags from fish caught in the Sweet Creek delta were not turned in by the anglers for the tag reward because only five tag rewards were claimed for tagged fish that were reported as captured at Sweet Creek.

5.3.6.1. Triploid Rainbow Trout and Native Salmonid Habitat Use Comparison

Comparison of habitat use between triploid rainbow trout and native salmonids was not possible due to low numbers of native salmonids tagged and the high mortality rate of radio- and CART-tagged triploid rainbow trout. Use of cold-water refugia by triploid rainbow trout was observed visually and through telemetry tracking of tagged triploid rainbow trout to cold water refugia during periods of high reservoir temperatures. External tags recovered by anglers and from fish recaptured during Study 9 also suggested use of cold-water refugia by triploid rainbow trout.

During intensive tracking of a native cutthroat trout on August 3, 2007, near the mouth of Sweet Creek, CART tag sensor data from a triploid rainbow trout (Fish 55) in the same vicinity were recorded. Depth and temperature recorded were compared with changes in reservoir temperature and elevation over time. At the time, Boundary Reservoir water temperatures were in excess of 24°C, well above a reported rainbow trout thermal optimum of 17.2°C (Hokanson et al. 1977, as cited by Selong et al. 2001), and approached the reported critical thermal maxima for rainbow trout under most conditions of between 24 and 26ºC (Bidgood 1980). During monitoring, Fish 55 remained at shallow depths between 2 feet (about 0.6 m) and 5 feet (about 1.5 m) and at water temperature between 14 and 20ºC (Figure 5.3-7). The lowest temperature recorded where the fish was located and shallow depth corresponded to the lowest reservoir elevation (~1,988 feet NAVD 88 [~1,984 feet NGVD 29[3]]) recorded during the monitoring session. This behavior was

[3] SCL is in the process of converting all Project information from an older elevation datum (National Geodetic Vertical Datum of 1929 [NGVD 29]) to a more recent elevation datum (North American Vertical Datum of 1988 [NAVD 88]). As such, elevations are provided relative to both data throughout this document. The conversion factor between the old and new data is approximately 4 feet (e.g., the crest of the dam is 2,000 feet NGVD 29 and 2,004 feet NAVD 88).

similar for the native cutthroat trout tracked on the same date at the mouth of Sweet Creek. The cutthroat trout had similar changes in depth and range of temperature use, remaining mostly between 4 and 7 feet deep, and 15 to 22°C (SCL 2009a). Other evidence of cold-water refugia use by trout at this time was the observation of what appeared to be about 130 triploid rainbow trout in the cold-water plume of Sweet Creek during summer 2007.

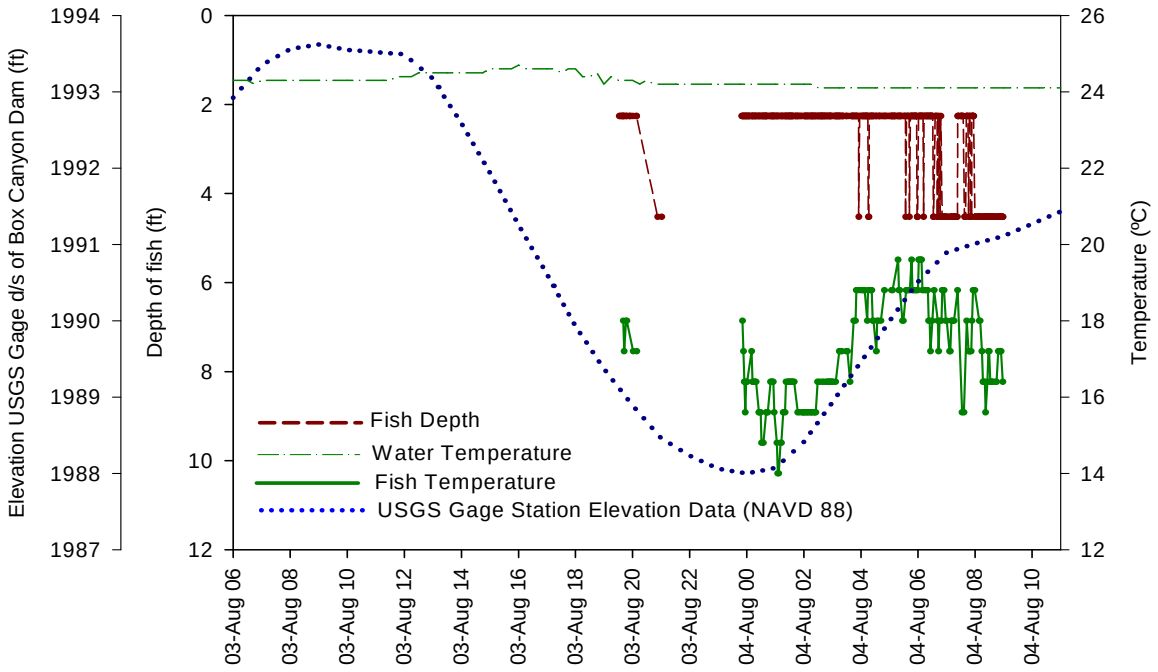


Figure 5.3-7. Depth and temperature CART sensor data recorded during intensive tracking of Fish 55 near Sweet Creek on August 3, 2007.

Note: Elevation datum is feet NAVD 88.

During 2008, which was a much cooler temperature summer than 2007, no documented use by CART-tagged triploid rainbow trout was measured with the fixed acoustic receivers at Sweet, Sullivan, or Slate Creeks. Some native tagged salmonids were documented at some of these tributaries, but their presence did not appear to be completely related to the use of the regions as thermal refugia (SCL 2009a).

Overall, while very few native salmonids were observed in thermal refugia in 2007 or 2008, the available data suggest that, at certain times, these are areas where native trout would likely be found. There is obvious overlap of this habitat use during very warm periods, based on both the available data and the known thermal requirements of both native salmonids and triploid rainbow trout. During the warmest summer periods, these thermal refugia would be very small regions of the reservoir and native salmonids and stocked triploid rainbow trout would likely be in close

proximity in these areas (see Study 8, Sediment Transport and Boundary Reservoir Tributary Delta Habitats Final Report [SCL 2009d] for physical characterization of thermal refugia).

5.3.7. Triploid Rainbow Trout Issues and Management Options

As discussed earlier in this report, the Study 13 field studies in 2007 and 2008 led to the following key conclusions, which are pertinent to management of triploid rainbow trout in the Project vicinity:

- Triploid rainbow trout are an important component to the current recreational fishing opportunities in Boundary Reservoir and often targeted by anglers. Based on the results of this study, this is a favorable program for anglers at this location.

- Although there are too few native salmonids using Boundary Reservoir to produce meaningful quantitative assessments of their interactions with triploid rainbow trout, biotelemetry and visual observations suggest an overlap in their use of thermal refugia near the mouth of tributaries to the reservoir during the warm summer period.

- Spring-to-spring carry-over rates for catchable-size triploid rainbow trout releases are relatively low, based on length-frequency mode analyses, but they are not abnormal for this type of fish stocking.

- Triploid rainbow trout have been entrained through the Boundary Dam powerplant and possibly its spillways during high flow years, based on radio telemetry, tag returns by anglers, and Study 9 recoveries of triploid rainbow trout in the Tailrace Reach combined with evidence that triploid rainbow trout were not stocked directly into Seven Mile Reservoir or its tributaries (FISS 2008).

- Entrainment of triploid rainbow trout appears to be much higher, maybe 2 to 3 times higher, during high flow years than low flow years, based on tag recaptures both from Study 9 and angler returns of fish downstream of Boundary Dam.

- During the winter, sustained periods of daily average water temperature in Boundary Reservoir of less than 1°C have been recorded. Rainbow trout have a critical thermal minima of between 1 to 2ºC at which metabolic activity decreases and feeding and digestion typically stop. At these temperatures or lower, the ability of the fish to regulate ions may be impaired and higher rates of mortality may occur (Finstad et al. 1988; Belkovskiy et al. 1991, as cited in Molony 2001). A critical thermal minima would likely apply most to planted fish released in the fall and during their first year overwintering in the reservoir.

- During the summer, daily average water of Boundary Reservoir can approach 25°C and maintain a continuous high daily average water temperature in excess of 23°C for up to 30 days (i.e., in 2007). Based on seven-day temperature tolerance experiments, the ultimate upper incipient lethal temperature (UUILT) of 25.6ºC (Hokanson et al.

1977) and 26.2ºC Kaya (1978) were estimated for rainbow trout (as cited by Selong et al. 2001). Studies have reported critical thermal maxima for rainbow trout under most conditions of between 24 and 26ºC (Bidgood 1980). Maximum growth of rainbow trout occurs at 17.2ºC, above which metabolic stress can occur and result in reduced feeding and growth (Hokanson et al. 1977, as cited by Selong et al. 2001).

- Thermal refugia in the reservoir have higher densities of triploid rainbow trout and likely have most salmonids using them during the period of thermal maximums (generally late summer). It is not known if the higher densities of fish in these areas for a short time of the year result in any density-dependent effects on growth or survival or increased fishing pressure on other salmonid species.

- Based on reward tags submitted, return to anglers from the releases was likely greater than 13 percent for 2007 spring releases, about 1 percent for fall 2007 releases, and about 5 percent for spring 2008 releases. The overall average of all releases was 3.9 percent. This level of return to anglers is generally higher than returns for another very similar rainbow trout stocking program on Lake Roosevelt on the Columbia River (McLellan et al. 2008). The authors found that, over a 13-year tag and return study period, return rates from two of the reservoir release locations averaged 1.3 and 2.4 percent, with specific returns by year ranging from 0.1 to 4.7 percent. They also found little effect in rate of return with or without rewards for tag returns.

- Growth rates of fall release triploid rainbow trout exhibit growth during the fall but demonstrate little growth over the winter. Spring release triploid rainbow trout grew rapidly in late spring and early summer. Although very few tagged triploid rainbow trout were captured during the fall, the existing data suggest the growth of spring release triploid rainbow trout is reduced in late summer likely due to thermal stress.

- Fish growth in the system appears to be relatively low. When compared to two reservoirs in Idaho, Boundary Reservoir triploid rainbow trout have less than half of the growth (based on weight gain) for similar sized fish (Teuscher and Dillon 2003).

- Anglers caught the greatest number of triploid rainbow trout at the locations where they were released, and their catch of triploid rainbow trout increased in July 2007 near Sweet Creek, Sullivan Creek, Slate Creek, and Pewee Falls.

- Triploid rainbow trout released in the Box Canyon tailrace tend to become more widely distributed in the Boundary Reservoir and have a higher harvest rate than triploid rainbow trout released in the Forebay Reach, based upon angler returns of tags; however, this varies between years.

- Both visiting and resident anglers slightly prefer catching triploid rainbow trout over other species, based on recreational creel and angler surveys conducted in 2007.

Triploid rainbow trout management practices and risks were assessed through a literature review and interviews with WDFW staff, including the state-wide triploid rainbow trout program manager. The findings are discussed in Appendix 1.

As with other fisheries, management of a triploid rainbow trout fishery depends on the target balance point selected between angler satisfaction and the potential for adverse effects to native fish. Therefore, the objectives of any future management plan need to be considered and developed through consultation with the resource agencies, tribal interests, and the general public. Following are possible objectives for a management plan:

- Increase angler harvest of triploid rainbow trout. This is the objective for the existing program. Release of catchable-size triploid rainbow trout can provide a direct input to angler opportunities to harvest fish. The actual releases would depend on optimizing locations, timing, and size at release; notifications to the public; and compliance with state and federal fishing and fish release regulations. For example, results from this study indicate various use patterns in the Boundary Reservoir such as visitors typically utilizing the forebay whereas local residents utilize the Box Canyon tailrace area.

- Minimize potential impacts to protected species and native salmonids. As discussed elsewhere in this report, releases of triploid rainbow trout could affect protected species such as bull trout or native salmonids such as cutthroat or whitefish through competition for food sources, overlap of habitat, possible transmission of disease, or other factors. Although current population levels for protected species and native salmonids are low in the Project area, future management plans for these species would need to be considered and integrated into a triploid rainbow trout management plan and its objectives.

  A wide variety of measures could be used to minimize the potential impacts. For example, discontinuing the stocking of triploid rainbow trout (discussed below) would remove the potential impacts to other species. Another option could be to substitute triploid rainbow trout plants with hatchery cutthroat trout produced from a local native stock, if such a hatchery source were available or could be developed. In addition, adjustments in angling regulations could be used, if needed, to provide additional protections for protected species or native salmonids (with or without introduction of triploid rainbow trout). Such regulations could include closures around thermal refugia ("bubble fisheries") at tributary mouths during warmer summer months to protect species congregating at these locations, use of angling restrictions (e.g., single barbless hooks, no bait, fly fishing only, and partial closures such as no fishing on specific days of the week), or other restrictions.

- Minimize the loss of stocked fish in the Boundary Reservoir. The results reported in this study indicate that the timing and location of release can affect movements of triploid rainbow trout and potential angler success. For example, returns appear to be higher from releases near the Box Canyon tailrace than at the Boundary Forebay. However, this was only apparent for the spring 2007 releases. Also, higher flow

years such as observed in 2008 may increase movement of triploid rainbow trout downstream from the reservoir, therefore making fewer triploid rainbow trout available to Boundary Reservoir anglers. Returns from fall 2007 were substantially lower than both of the spring releases regardless of release site, suggesting fall releases should be conducted earlier in the year, curtailed, or halted. Stocking distribution between the Boundary forebay and Box Canyon tailrace could potentially be adaptively managed depending upon anticipated flow levels. Releases at the Metaline boat ramp could also be considered.

Other objectives might be considered, such as possible development of a "trophy" fishery for larger triploid rainbow trout that have been reared in the hatchery for a longer period, active or targeted fisheries to reduce potential competition or predation from other introduced species such as northern pike or native species such as northern pikeminnow, or other measures to increase protected species or native salmonids while maintaining the triploid rainbow trout fishery. All of these would need to be explored through an interactive process and through adaptive management that considers management factors that might affect the implementation of future triploid rainbow trout releases. Ultimate implementation of future management measures would most likely need to be on a cooperative basis including SCL and appropriate resource managers.

Table 5.3-15 displays the anticipated effects that varying management factors would have on angler catch number and size, entrainment through Boundary Dam, congregation of triploid rainbow trout with native salmonids, introgression (hybridization) with native fish, and disease.

The management factors considered in this analysis are the triploid rainbow trout mix (male to female ratio) stock, triploid rainbow trout stocking rate, location and season of stocking, and the size of triploid rainbow trout stocked. The effects of many of these factors depend on one another; therefore, it is important to consider these interactions when selecting a management option(s) to be pursued.

The anticipated effects of four triploid rainbow trout management options are discussed below in comparison to the existing triploid rainbow trout management program, including discussion of the interaction between the management factors.

Table 5.3-15. Effects of triploid rainbow trout management options in comparison to existing management.

Category	Catch No.	Catch Size	Entrainment	Congregate with Natives	Potential Introgression	Disease Potential
Triploid mix						
Solely "female" [1]	○ (○)	↑ (○)	○ (○)	↓ (○)	⊙ (○)	⊙ (○)
Mixed "male" and "female" [1]	○ (○)	○ (↓)	○ (○)	○ (↑)	○ (⊙)	○ (⊙)
Stocking rate						
None	⬇	⬇	⬇	⬇	↓	↓
Same	○	○	○	○	○	○
Much higher	⬆	↻	⬆	⬆	↑	⊙
Stocking location						
Box Canyon Tailrace and Forebay	○	○	○	○	○	○
Box Canyon Tailrace and Metaline Boat Ramp	↑	↻	↓	↑	⊙	⊙
Solely Box Canyon Tailrace	⬆	↻	⬇	↑	⊙	⊙
Solely Forebay	⬇	↻	⬆	↓	⊙	⊙
Stocking time						
Spring	○	○	○	○	○	○
After high flows [2]	⬇/↑	⬇	⬇	⬆	↑	⊙
Fall preference [3]	⬇	⬇	⬆	⬇	↓	⊙
Stocking size						
Trophy Size (~3 pounds)	↻	⬆	↓	⊙	⊙	○
Catchable	○	○	○	○	○	○
Fingerlings	?	⬇	⬆	?	↓	⊙

Notes:
High ⬆⬇, Low to Moderate ↑↓, Negligible ⊙, None ○, Depends on other factors ↻

1 Because stocking solely "female" triploid rainbow trout is not required but has been the practice, effects compared to stocking a mix of "male" and "female" triploid rainbow trout are followed in "()"s by effects compared to stocking solely "female" triploid rainbow trout.

2 Symbol before "/" is for prior to the end of the high flow season and the symbol after is for after the high flows.

3 This option places greater emphasis on stocking triploid rainbow trout in the fall than in the spring, and recognizes that fall stocking has occurred in the past with the goal of providing larger fish in anglers' spring catches.

5.3.7.1. No Stocking

Terminating the triploid rainbow trout stocking program likely would substantially reduce the success and potentially the satisfaction of anglers at both the Box Canyon tailrace and the Boundary Reservoir forebay. However, it would reduce the concentration of salmonids in cold-water refugia in very warm-water years and associated density-dependent stress on native salmonids due to the presence of the triploid rainbow trout. In the absence of triploid rainbow trout, reduced targeted salmonid angling effort would be expected at the location of cold-water

refugia, although native salmonids still could potentially be caught during angling directed at other species such as bass. However, this management strategy could result in increasing fishing pressure on native fish including trout, particularly in cold-water refugia during the summertime. Although overall salmonid catch rates (e.g., CPUE) would likely decline, which might lead to lower angler effort, the proportion of those fish captured that were native salmonids (i.e., ratio of native salmonids to triploid rainbow trout) and the total harvest of native salmonids could both potentially increase.

5.3.7.2. Stocking Solely "Female" Triploid Rainbow Trout

Switching to a management strategy that requires stocking the same number of "female" triploid rainbow trout as under the existing triploid rainbow trout management program would have little effect on either native fish or the fishery. Due to availability, solely female triploid rainbow trout have been stocked even though this is not a requirement of the existing triploid rainbow trout management program. However, should mixed (i.e., combination of "male" and "female") triploid rainbow trout become available, they could be used under the existing program. This could lead to a small reduction in the size of post-spawning-aged triploid rainbow trout caught by anglers along with a low to moderate increase in the potential for congregation of triploid rainbow trout with native trout during the spawning season as a result of the secondary spawning behavior of "male" triploid rainbow trout.

Based upon analysis of length frequency data, few triploid rainbow trout in Boundary Reservoir live long enough to achieve the growth advantage that results from the reduction in gonad development and reproductive activity. The effects of stocking solely female triploid rainbow trout and other factors are negligible. The stocking of females only would potentially introduce competition to protected species and native salmonids, particularly at thermal refugia areas near tributary mouths during the warmer months of the year (i.e., late summer when fish may seek thermal refugia).

5.3.7.3. Stocking Catchable Triploid Rainbow Trout After High Flows

The river/reservoir reach between Box Canyon and Boundary dams has historically been stocked with triploid rainbow trout in March–May and October–November periods (Table 5.3-13). The spring triploid rainbow trout releases occur before the end of the typical high-flow period (April–June), and occasionally before high-flows have begun. Although delaying the stocking of triploid rainbow trout until after the high-flow period would eliminate the possibility of anglers catching them during the spring, there is evidence that at least some, and perhaps a substantial number, of the catchable triploid rainbow trout stocked by SCL under the current triploid rainbow trout management program are entrained through Boundary Dam (either over the spillway or through the powerplant).

The high springtime inflows combined with the Project's run-of-river operations result in high velocities in the Boundary Reservoir, and likely contribute to entrainment at Boundary Dam (see Study 9 Final Report [SCL 2009a]). At outflows of more than the powerplant's hydraulic capacity (i.e., 55,000 cfs), water is released through the dam's spillway(s) increasing the pathways for entrainment to occur, and velocities through the reservoir are even higher than at non-spill outflow levels. Therefore, stocking triploid rainbow trout after the high-flow period

would be expected to reduce entrainment at the dam and thereby increase the number of triploid rainbow trout that remain in the reservoir.

Growth of triploid rainbow trout released after high flows would be reduced as these fish would not benefit from the increase in nutrient and food availability due to turn-over of upstream lakes and reservoir and bed scour during high flows. In early spring, invertebrates as well spring hatch young-of-the-year fish likely provide an important food source for triploid rainbow trout. Water temperatures during spring and early summer are also optimal for growth, where the higher water temperatures later in the summer are not. Overall, late release triploid rainbow trout would likely be of smaller size and less desirable to anglers as a sport fish.

Reduction of entrainment would increase the number of triploid rainbow trout remaining in the reservoir and likely using cold-water refugia with native salmonids during critically warm periods as well as increase the number of triploid rainbow trout caught by anglers. The 2007–2008 study results indicate that more entrainment likely occurs during years when considerable spill occurs at Boundary Dam and the water travel time is relatively short. A study of the effects of Lake Roosevelt operations on angler return of stocked trout (McLellan et al. 2008) shows that reservoir retention time and drawdown level significantly affect angler catches. The authors of the Lake Roosevelt study suggest that annual adjustments to trout release strategies could maximize trout harvest potential. Given the apparent higher entrainment rates for the extreme high flow year, stocking catchable triploid rainbow trout after high flows in years that are expected to have considerable spill, but not lower flow years, may maximize angler trout catches. However, this would require additional coordination with the hatchery supplying the triploid rainbow trout, and may have added costs or not be realistic because of constraints on hatchery production.

The magnitude of the effects described above for stocking catchable triploid rainbow trout after high flows would depend on the stocking rate and location. Much higher stocking rates and/or releasing triploid rainbow trout much closer to cold-water refugia than under the existing management program may result in substantially more triploid rainbow trout congregating in cold-water refugia. The effects that stocking solely female triploid rainbow trout would have on this option likely would be negligible. Effects of stocking fingerlings in the fall are discussed separately below.

5.3.7.4. Solely Stocking Fingerlings in the Fall

Research indicates that stocking triploid rainbow trout fingerlings in Idaho lakes and reservoirs has mixed results on survival and suggests mixed results on catchable-sized fish to anglers in the following year. Female triploid rainbow trout fingerlings stocked in two productive but relatively small reservoirs located in southeast Idaho (Daniels and Treasureton reservoirs)[4] had significantly higher relative survival rates than diploids (Teuscher and Dillon 2003). However, preliminary results suggest that triploid rainbow trout may not survive as well as diploids in high mountain lakes, which are less productive (Kozfkay et al. 2006). The characteristics of these reservoirs and high mountain lakes are considerably different than Boundary Reservoir, making

[4] Daniels Reservoir is less than 1.5 miles long and has a surface area of 376 acres. Treasureton Reservoir is less than 1 mile long and has a surface area of 143 acres.

it difficult to draw direct parallels. As described in earlier sections of this report, high velocities occur in Boundary Reservoir, particularly during the April through June peak flow period. Solely stocking fingerlings in the fall likely would result in greater losses to entrainment at Boundary Dam during the high-flow season, particularly in extremely high flow years. Results of the 2007/2008 field studies indicate that the springtime size of triploid rainbow trout is virtually the same for triploid rainbow trout released the previous fall and springtime releases. Therefore, stocking fingerling-sized triploid rainbow trout only in the fall would likely result in fingerling-sized triploid rainbow trout the following spring.

Other factors also might limit any benefit from stocking fingerling triploid rainbow trout. For example, piscivorous fish including bass, northern pike, and northern pikeminnow may consume many of the stocked fingerlings and thereby substantially limit any improvements in angler catches. In addition, solely stocking fingerling triploid rainbow trout would limit the ability for anglers to harvest large trout, and likely would increase foraging competition with native salmonids. Furthermore, the level of survival of fingerling-sized triploid rainbow trout over the winter, even if they were to avoid entrainment, is uncertain in Boundary Reservoir, which is considered a relatively unproductive water body (see Study 5, Water Quality Constituent and Productivity Monitoring Final Report [SCL 2009e]).

The effects of solely stocking fingerlings in the fall likely would depend on the stocking location and stocking rate. Fingerlings stocked in the lower reservoir probably would be more likely to become entrained through Boundary Dam and no longer available to the Boundary Reservoir fishery. Although high stocking rates would result in increased numbers of entrained triploid rainbow trout, it also would result in an increased number of triploid rainbow trout being retained in the reservoir, which likely would increase angler catch, if they were to survive to a catchable size. If the number of triploid rainbow trout in the reservoir remains elevated during the critically warm period, increasing the stocking rate also could increase congregation with native salmonids during critically warm periods. The effects of the triploid rainbow trout mix (i.e., ratio of “females” to “males”) are expected to be negligible.

6 CONCLUSIONS

6.1. Recreational Creel and Angler Surveys

6.1.1. 2007 Survey Program

The visitor survey and the area resident survey conducted in 2007 as part of the program for Study 21 provided a substantial volume of information related to fishing in the study area. Questions incorporated in these survey instruments addressed both creel survey and angler survey objectives identified for Study 13. The visitor survey provided samples ranging from approximately 150 to 227 respondents (out of a total survey population of approximately 600) who indicated they participated in fishing during their visit to the Boundary Reservoir Area and responded to at least some of the survey questions related to fishing and boating. Although the total population for the area resident survey was similar in size, many of these respondents reported they did not use the Boundary Reservoir Area for recreation, and approximately 150 responded to the fishing and boating questions. The sample size for each survey was sufficiently

large that the results can reasonably be applied to the general visitor and area resident populations. The survey responses provide information about fishing activity and success that can be used (with appropriate qualification) to develop estimates of fishing effort and catch rates. The survey responses also include useful information about the means used for fishing (i.e., from a boat or the shore), access facilities anglers use for launching boats, species preference, and satisfaction with the fishing opportunities.

Highlights from the results tabulated for the completed visitor and area resident surveys that pertain to the recreational fishery study can be summarized as follows:

- **Fishing Locations:** The visitor respondents showed a greater tendency to fish the northern reaches of Boundary Reservoir, whereas area residents were comparatively more oriented to the southern parts of the reservoir. Forty percent of visitors reported fishing in the Forebay Reach, compared to 27 percent for area residents. By contrast, 23 percent of visitors reported fishing between Metaline and Box Canyon, whereas 50 percent of area residents fished that area (the most frequent location indicated by residents). Area residents also showed a strong tendency to fish water bodies other than Boundary Reservoir, particularly Sullivan Lake, Mill Pond, and Box Canyon Reservoir.

- **Preferred Fish Species:** Species preference among visitors was evenly divided between triploid rainbow trout, other trout, and smallmouth bass. Although high percentages of area residents also selected those species, residents indicated a slightly greater tendency to fish for triploid rainbow trout (65 percent) and other trout (63 percent), versus 53 percent for smallmouth bass and 39 percent for largemouth bass. As noted previously, for both samples the response percentages among the three species can be considered the same because of the range of the applicable error margin. Consequently, with respect to angler preferences that would provide insight to potential recreational fishery enhancement considerations, the two 2007 survey samples do not yield inferences about a particular species that Boundary Reservoir anglers favor.

- **Fishing Satisfaction:** Approximately 62 percent of the visitors responding to this question assigned ratings of above average (6 or higher on the 9-point scale) to their satisfaction with the fishing opportunities, whereas 57 percent of area residents reported above-average satisfaction. Eight percent of residents rated their satisfaction as excellent, compared to 17 percent of visitors. For both samples, the most common response was a rating of 5, or average.

- **Boat Launch Adequacy:** Area residents appear to be less satisfied with the conditions at the local boat launches than are visitors. Approximately 68 percent of the resident respondents to this question reported that the boat launch they used adequately met their needs, whereas 32 percent indicated that it did not. In comparison, only 9 percent of the visitor sample indicated the launch they used did not meet their needs.

- **Water Conditions:** Among visitors, nearly 70 percent of the sample reported no problems with water conditions and 7 percent reported minor problems. By contrast, approximately 44 percent of the area resident sample reported they had not encountered problems with the water conditions while boating on Boundary Reservoir and 36 percent indicated water conditions had caused them minor problems. Nearly 15 percent of the area resident sample selected one of the responses characterizing problems with water conditions as major, compared to 3 percent for the visitor sample. Several expected or plausible factors could contribute to the area resident respondents being less satisfied with boat launch conditions and reporting a greater degree of problems with water conditions. A key factor is likely to be that area residents typically have longer boating experience on Boundary Reservoir (a large majority had been boating on the reservoir for 6 years or more) and use the reservoir more frequently for boating (e.g., median use of 5 days per year in the summer). That greater level of use is likely to result in a greater probability of encountering problems. In addition, many area residents tend to boat on the reservoir during at least three seasons of the year whereas visitors are most likely to be present in the summer, and SCL operates the reservoir with a narrower range of water level fluctuations from Memorial Day through Labor Day. The area resident responses also indicated a greater tendency to use the launch at Metaline compared to the visitor respondents, and the Metaline launch was the most common location for adverse comments about boat launch adequacy and associated problems with water conditions.

- **Desired Recreation Improvements:** Approximately 30 percent of the visitor survey sample and 31 percent of the area resident sample indicated they would like to see various types of recreation resource improvements. The most common topics among these comments from both sample populations were related to developed recreation facilities such as boat launches (improved boat ramps and/or docks), restrooms, and campsites. Small numbers of comments from each sample (five visitors and four area residents) addressed desires for enhanced fishing opportunities, and a few comments indicated milfoil was an issue.

6.1.2. 2008 Creel Survey

Creel survey work was conducted during 2008 as a separate field activity, because the broader recreation survey effort conducted for Study 21 was not repeated in 2008. Survey crews completed interviews with 235 anglers during the May 5–October 4 creel survey season (excluding surveys completed during the annual smallmouth bass tournament, which are reported separately). The sample size of 235 completed questionnaires was large enough to allow researchers to make inferences about the overall angler population within approximately a 6 percent margin of error at the 95 percent confidence level. Therefore, the creel survey database represents a sufficient sample size to allow application of results from the sample to the overall angler population.

Key findings from the results tabulated for the 2008 creel survey can be summarized as follows:

- **Angler Effort:** Total fishing effort reported by the creel survey sample was calculated by multiplying the fishing durations calculated from the Question 2 responses by the group size responses in Question 1. The mean estimated effort was 349 minutes (5.8 hours) per group, although the large standard deviation (379.7) indicates a large variance in the effort per group during the season. The median effort duration is approximately 240 minutes (6 hours) per group. Multiplying this figure by the 235 respondents provides an estimated total effort by the sample population of approximately 940 hours of fishing activity over the season.

- **Catch and Harvest Data:** Anglers surveyed in 2008 reported catching a total of 893 fish, of which 154 (17 percent) were kept and 739 (83 percent) were released. The catch included 543 smallmouth bass, accounting for 61 percent of the total catch reported, with 68 of these fish harvested. Triploid and conventional rainbow trout combined accounted for 156 fish caught (18 percent), with 68 of these fish harvested. Anglers reported catching 117 yellow perch, representing 13 percent of the catch. Nearly half of all fish caught were in the 10- to 18-inch size class.

- **Fishing Locations:** Respondents identified the northernmost reach of Boundary Reservoir as the most frequent fishing location, with 39 percent of the sample indicating they fished in the forebay area. Thirty-five percent of the respondents indicated they fished in the Canyon Reach and 29 percent of respondents reported fishing from Metaline to Box Canyon. Four percent indicated they had fished in another area.

- **Preferred Fish Species:** Forty-nine percent of the creel survey sample identified smallmouth bass as the species they most wanted to catch. Forty-two percent of the respondents indicated they wanted to catch rainbow trout, and 3 percent identified triploid rainbow trout as the desired species. (These responses differ considerably from comparable results from the 2007 recreational visitor and area resident surveys, which indicated relatively small, statistically insignificant differences in preferences among triploid rainbow trout, other trout and smallmouth bass. As discussed in Section 5.1.1.2, the reason for the comparatively quite low preference for triploid rainbow trout among the 2008 creel survey sample is not known.) Again, with respect to angler preferences relative to potential recreational fishery enhancement considerations, the 2008 creel survey sample does not yield strong inferences about a particular species that Boundary Reservoir anglers favor.

- **Satisfaction with Fishing Opportunities:** When asked to rate their satisfaction with the fishing opportunities in Boundary Reservoir on a numerical scale ranging from 1 to 9, (with 1 representing "very poor" and 9 "excellent"), the most common rating (the mode) was a 5, "average," which was the response from 18 percent of the sample. Half of the sample rated their satisfaction as above average (ratings of 6 or higher), and the other 50 percent assigned ratings of average (5) or below. Twenty-

one percent of the sample rated their satisfaction quite highly (ratings of 8 or 9), whereas 12 percent gave ratings at or near the low end of the scale. Based on the clearly average satisfaction with the fishing experience among the 2008 creel survey sample, it can reasonably be inferred that these anglers would be in favor of enhancing the recreational fishery.

- **Improving the Fishery:** The 2008 survey sample provided 232 distinct thoughts among 196 recorded entries when asked if they had any additional input concerning how the fishery could be improved. Over 80 percent of the sample provided some form of input in response to this part of the survey. These comments addressed a wide range of topics, and the most common type of comment (49 cases) simply contained incidental information about the respondent's visit. Twenty-eight (28) of these comments clearly related to management of the fishery. Specific comments in this group included statements on the general need for more fish (7 cases), and approximately 17 comments identified fish species that should either be stocked or reduced. Although these comments indicate at least a moderate level of interest in the general subject of enhancing the recreational fishery (over 10 percent of the sample provided input of this nature), they do not suggest strong or obvious favor or disfavor for a particular species. Most of the 20 comments relating to boat launch and/or docking facilities stated a desire for improvements to existing facilities or addition of new docks. Among the 31 comments classified as addressing the quality of the fishery, at least two-thirds were negative (the respondents thought the quality was poor) and at most one-third were positive. Most of the 31 comments addressing management of the water level in the reservoir were suggestions to maintain the water level, maintain a higher water level, reduce water level fluctuations, and/or provide advance notifications of expected water conditions. Only 3 comments addressed aquatic plants, with 2 indicating milfoil was an issue and 1 comment suggesting that aquatic plant life was absent because of reservoir fluctuations.

6.1.3. Tagged Fish Reward Program

The tagged fish reward program was operated from March 29, 2007, through November 2008. A toll-free phone line for the program was established in March 2007; posters were installed at access points and fliers distributed to key community locations in the first week of April. The first tags submitted by anglers were received in April 2007, and tags were received intermittently through the end of the program. Key results from this program are summarized as follows:

- During 2007, anglers submitted 67 reports accounting for 130 total tags. Corresponding figures for 2008 were 52 reports and 100 total tags. It is not known how many tagged fish were caught but not reported.

- May, June, and July were generally the busiest months for the tag returns. Fully 70 percent of all tags returned in 2007 were received in May, June, and July of that year, with 30 or 31 tags returned in each month. In 2008, 51 percent of all tags for the year were received during those months, although the highest single-month total was 27 tags in April.

- Participation in the tag reward program was dominated by residents of the local northern Pend Oreille County area. For 2007, 54 percent of all tag reports came from the nearby communities of Metaline, Metaline Falls, and Ione, with 22 tag reports from Ione representing by far the largest single source of returns from any community. Those three communities accounted for 67 percent of all tags returned in 2008, with more tags from Metaline Falls than the other local communities. Southern Pend Oreille County and Spokane County accounted for substantial portions of the tag returns in each year.

- Anglers reported the catch location for more than 90 percent of the tags returned. The specific location most commonly identified in both 2007 and 2008 was Box Canyon Dam (i.e., the tailrace, associated with 20 tags in 2007 and 30 tags in 2008). Boundary Dam or specific sites in the immediate vicinity (e.g., the Forebay Reach) represented the second most common catch location, followed by several tributary creeks or creek mouths. Among the latter group, Slate Creek appeared to be the most frequent catch location.

- Triploid rainbow trout accounted for 95 percent of the tagged fish reported in 2007 and 90 percent of the 2008 total. Length data reported for fish caught in 2007 ranged from 8.5 inches to 17 inches and averaged 12.6 inches for the year. Comparable data for 2008 were a range of 9 to 30 inches and an average of 12.5 inches. In both years the average length for fish reported in the latter months of the year was noticeably larger than reports from the spring and early summer.

6.1.4. Smallmouth Bass Derby Monitoring

SCL staff monitored activity at the SCL Forebay Recreation Area, Metaline Waterfront Park, and Campbell Park (Box Canyon Dam) boat launches during the May 5–6, 2007, Bassin' Assassin Derby (smallmouth bass derby) at Boundary Reservoir, and contacted derby participants for several types of information (reported in section 5.1.4).

The 2008 Bassin' Assassin Tournament was held on May 3 and 4. The sampling season for the 2008 creel survey began on May 2, and survey crews actively sampled anglers at the Boundary Reservoir access points during the entire weekend of the tournament. Survey crews completed interviews with 53 anglers during the weekend. Highlights from these survey responses are summarized as follows:

- Activity durations ranged from 2.5 hours to 14.5 hours. Total angler effort for the sample population was calculated at 885 hours.
- The sample population reported catching 182 smallmouth bass during the tournament, along with 135 fish of other species.
- Fishing activity was concentrated on the upper reaches of Boundary Reservoir, with 59 percent of the respondents indicating they fished in the area above Metaline and 35 percent identifying the area between Metaline and Metaline Falls.

- Approximately half of the anglers interviewed provided home ZIP codes from northern Pend Oreille County (Ione, Metaline and Metaline Falls), and another 17 percent were from southern Pend Oreille County.
- The mean and median fishing satisfaction ratings from this sample were slightly above average.

The tournament sponsor provided SCL with a summary of data about participants and fish harvest for both the 2007 and 2008 tournaments (Sargent 2008). The tournament records indicated that 170 anglers participated in the 2008 Bassin' Assassin Derby, an increase from a total of 143 in 2007. The vast majority of the entrants in both years originated from Pend Oreille County (including about half from Metaline, Metaline Falls, and Ione) and nearby counties in northeastern Washington. Tournament anglers submitted 132 smallmouth bass for weigh-in in 2008, and 118 smallmouth bass in 2007. Fish submitted as tournament entries ranged from about 12 inches to 22 inches in length (with a median of 15 inches), and 0.8 pound to just over 5 pounds in weight (median of about 2 pounds). Tournament anglers reported catching 294 fish of other species in 2008, and 244 fish of other species in 2007.

The monitoring data and the information provided by the tournament sponsor indicate the Bassin' Assassin Derby is a popular and highly visible event that appears to be growing in participation. The concentrated angling activity during the tournament weekend accounts for a substantial proportion of total activity during the recreation season.

6.2. Biotelemetry

Assessment of larger fish movement patterns in response to temporal changes in environmental parameters was not possible due to the high mortality rate of radio- and CART-tagged fish. Overall, specific movement in response to changes in environmental parameters was only recorded during intensive tracking for a single CART-tagged carry-over triploid rainbow trout (Fish 55) that was in the vicinity of Sweet Creek during the monitoring of a westslope cutthroat trout in the same area on August 3, 2007.

To a lesser extent, a few radio-tagged spring 2007 release triploid rainbow trout exhibited movement in response to high reservoir water temperatures; they apparently moved into areas assumed to be cold-water refugia (e.g., Fish 77 and 40). Use of cold-water refugia by triploid rainbow trout was also visually confirmed during intensive tracking on August 3, where aggregations of triploid rainbow trout (~130 individuals), including a few with external tags, were observed within the scoured outflow channel of Sweet Creek.

Telemetry data provided some insights for obtaining an estimate of triploid rainbow trout entrainment through the Boundary Dam powerplant or spillways based on the proportion of entrained telemetry tags to the total deployed in Boundary Reservoir. In total, 10 radio-tagged fish and 5 CART-tagged fish were entrained. This was about 20 percent of the 74 total tags deployed in the reservoir (one CART- tagged fish was inadvertently released directly into the Tailrace in the spring of 2007). Telemetry data recorded in the Forebay and Tailrace reaches were able to determine the exact day and time each fish was entrained (see Section 5.3.6; Table 5.3-14). Of the 15 entrained radio- or CART-tagged fish, about half (7) came from Forebay

Reach releases and the rest (8) were mainly from the Upper Reservoir Reach. Most of the Upper Reservoir Reach fish were entrained in 2008 during high flows. Additionally, 5 out of 8 carry-over triploid rainbow trout were entrained during spill events, which suggests that spill may increase the chance of entrainment. This also suggests that in a high flow year, a fish anywhere within the Boundary Reservoir has an increased chance of entrainment.

The high mortality rate of tagged triploid rainbow trout was likely due to several factors. The following conditions and environmental factors may have contributed to the mortality of radio- and CART-tagged triploid rainbow trout:

- Stress during transport from the hatchery combined with stress from tag implantation
- Poor condition of triploid rainbow trout
- Predisposition of triploid rainbow trout to capture by anglers
- Predisposition of triploid rainbow trout, in general, to predation by avian, terrestrial, and aquatic fish predators, and increased risk of predation from tagging stress
- Thermal stress during high reservoir water temperatures

Possible procedural techniques that may have contributed to high mortality of radio- and CART-tagged triploid rainbow trout were:

- Excessive handling, transport and prolonged hold time in live-wells after tag implantation to release of fish near a capture location
- Capturing fish by electrofishing at water temperatures higher than 18ºC.

High survival rates of tagged carry-over triploid rainbow trout were recorded for fish tagged after September 2007 when water temperatures were 10°C or less. Although the fall 2007 release fish were smaller and appeared in poorer condition than other triploid rainbow trout releases, cooler fall water temperatures during release, followed by colder winter temperatures, may have resulted in a slightly higher survival of the fall 2007 release fish compared to the spring 2007 release fish that were subject to higher water temperature in summer 2007. However, there was generally poor survival of radio-tagged hatchery fish that were tagged shortly after transport from the hatchery. If future radio tagging of triploid rainbow trout from hatcheries is conducted, an approach to reduce mortality that should be considered is to tag the fish at the hatchery and hold them for an extended period before release to the reservoir.

6.3. External Tag Recapture and Angler Tag Returns

The number of external tags recaptured during the Study 9 fish capture program (3.9 percent recapture rate) was slightly lower than the number of angler tag returns (6.3 percent return rate) for all tags released. Angler tag return and external tag recapture data during Study 9 suggested that triploid rainbow trout released in both the Forebay Reach and the Box Canyon tailrace tended to remain near their release sites. However, dispersal to other portions of the reservoir by fish released at both locations also was confirmed.

The spring 2008 release external tag entrainment data appear to support the telemetry data regarding entrainment during higher flows because about 67 percent (18 of 27 tags) of the Floy tags recaptured downstream of Boundary Dam were from 2008 releases, which was a very high spring flow year (see Section 5.3.6). Floy tag data also indicated that releases in the Forebay

Reach are most likely to be entrained (i.e., 19 of 27 or about 70 percent of all tags captured below Boundary Dam were from Forebay Reach releases [Table 5.3-13]).

Growth rates estimated from recapture and angler return data based on comparison of fork length at release and at capture suggested that fish released at Box Canyon Dam grew at approximately the same rate as fish released in the Forebay Reach. Preliminary length frequency data from fish captured in Boundary Reservoir in March 2007 indicated that the fall 2006 release triploid rainbow trout did not grow substantially over the winter and that these fish could not be distinguished from spring 2007 release triploid rainbow trout, based on length. Based on the recapture of Floy-tagged fall 2007 release fish captured from late fall 2007 to early spring 2008 during Study 9 fish capture efforts, moderate growth of triploids was evident in the fall within 2 months after release. Reduced growth of fall release fish over the winter was also identified. Spring triploid rainbow trout releases experienced the most growth, which occurred in late spring and early summer. High water temperatures during the summer, especially in August, appeared to result in reduced growth. Overall growth rates in the reservoir are likely low relative to some other regions and possibly less than half that described by Teuscher et al. (2003).

Loss (e.g., natural mortality, harvest, predation, and emigration) of triploid rainbow trout from the reservoir was examined, based on the length frequency data from spring sampling prior to the spring 2007 release and tag recaptures from Study 9 and angler returns. The analysis suggested relatively small percentages of the fall and spring releases survived through to the following autumn, which is consistent with other studies of triploid rainbow trout catchable fish survival (Havens et al. 1995). Based on tag returns, annual survival (spring to spring) may be as low as 1 or 2 percent.

Habitat use comparisons between triploid rainbow trout and native salmonids could not be conducted due to the low numbers of native fish tagged (as part of the Biotelemetry component of Study 9, a total of 13 cutthroat trout and 40 mountain whitefish were tagged, including those released in the Tailrace Reach [SCL 2009a]). Additional tagging and data collection in 2008 did not provide a better indication of niche overlap between the triploid rainbow trout and native species. However, based on the known thermal requirements of both native salmonids and triploid rainbow trout, the available data indicates that thermal refugia are used by both groups. The small size and limited number of known thermal refugia, during the warmest periods in the Boundary Reservoir suggest these groups of salmonids are likely to be in close proximity to each other during their use of refugia.

6.4. Triploid Rainbow Trout Management Options

Potential alternative triploid rainbow trout management options could include altering the timing of stocking, stocking location, size at stocking, and stocking level (e.g., eliminate fall stockings, eliminate or reduce Boundary forebay stocking levels, or increase overall stocking levels). Changes in the current strategy could potentially be evaluated for changes in survival, growth, and harvest rates.

Given the low number of fish currently being stocked, the stocking rates would likely need to be increased substantially to affect growth or survival. One exception to this would be if impacts occur because of competition with native salmonids for space or food in cold-water refugia.

Such competition would be very difficult to model or predict and would likely require empirical data from alternative stocking rates before evidence of density-dependent effects could be obtained.

Benefits or risks of changes in the existing triploid rainbow trout program will most likely be evaluated through adaptive management approaches that evaluate the results of making adjustments to the stocking program. Another option could be to substitute triploid rainbow trout plants with hatchery cutthroat trout produced from a local native stock, if such a hatchery source were available or could be developed.

7 VARIANCES FROM FERC-APPROVED STUDY PLAN AND PROPOSED MODIFICATIONS

7.1. Variances

There were no significant variances in the executed study plan from the RSP (SCL 2007). Small sample sizes because of lack of available native fish precluded comparisons of triploid rainbow trout with native species, particularly salmonids. Small adjustments were made to the telemetry program to accommodate logistical issues as described in the methodology.

The one proposed variance to the study plan relating to the recreational fishery study is presented below. This variance was approved by RPs at a meeting with on March 25 through 27, 2008 and by FERC per its July 9, 2008, Study Plan Determination letter (Robinson 2008):

- Survival of triploid rainbow trout radio-tagged during fall 2007 was evaluated over the winter of 2007/2008. Because of poor survival, additional radio-tagging of triploid rainbow trout planned for the spring of 2008 was reconsidered and discussed with the RPs and it was agreed that such tagging would not be conducted. Therefore, the radio-tagging of spring 2008 triploid rainbow trout releases was eliminated, and these tags were made available for potential re-allocation to additional tagging of carry-over triploid rainbow trout. (See Section 4.2 concerning poor overwinter survival.)

7.2. Study Modifications

The following recommended modifications were intended to refine sampling efforts for 2008. These recommendations were not considered variances from the FERC-approved study plan.

The recommended modification to the recreational and angler survey was as follows:

- Do not conduct the angler survey portion of the creel and angler survey in 2007. A very high rate of return of the angler survey forms occurred during 2007 from both on-site visitors and residents. This information supplied good confidence that the desires and use information of anglers and other recreational users were well quantified. Therefore, another year of detailed angler survey questions would not substantially change overall assessment of use and desires for the Project area concerning angling-related activities. (This was implemented.)

Several of the recommendations suggested in the Study 9 Final Report (SCL 2009a) also likely benefited the biotelemetry aspects of the triploid rainbow trout biotelemetry monitoring program. Recommendations for the 2008 triploid rainbow trout biotelemetry and external tagging work were as follows:

- Implant CART tags in triploid rainbow trout at water temperature no greater than 15 to 16ºC. Review tagging and handling procedures to identify factors that may increase mortality. (This was implemented.)
- Conduct a dedicated fish capture session using local anglers for carry-over triploid rainbow trout and tag them during optimal environmental conditions. Fish captured should be operated on immediately and released within 1 hour after recovery. Tagged fish should not be held in live wells for sustained periods while the boat is moving. (This was implemented.)
- Deploy more external tags (750 in each of the forebay and Box Canyon tailrace groups) in the spring 2008 release. (This was implemented.)
- Record both fork length and total length of spring 2008 release and all triploid rainbow trout captured under Study 9. (This was implemented for the spring 2008 release but not for the triploid trout captured under Study 9; only total length was measured in 2008 for Study 9 efforts).
- Habitat use data (collected by electrofishing under Study 9) to support model development in Study 7 would not be collected after February 2008. (The RPs agreed to this recommendation; see Section 4.2.5).

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Appendix 1: Triploid Management Issues and Options Information

Triploid Rainbow Trout Management Issues and Options Information

During the past 20 years, the production and stocking of fish that cannot hybridize with native fish has become a focus in many areas. This has led to hatchery production of triploid fish, which possess an extra set of chromosomes (three instead of two) and are sterile. Results of a survey conducted in 2005 indicate that eight states (Alaska, California, Idaho, Montana, Nevada, Oregon, Utah, and Washington) in the western United States had ongoing hatchery trout sterilization programs (Kozfkay et al. 2006).

Triploid rainbow trout typically have 90 chromosomes instead of the standard 60 chromosomes, which diploids have (Thorgaard and Gall 1979). Although triploid rainbow trout are essentially sterile, they have partially developed sexual organs and are commonly referred to as male and female triploid rainbow trout. Male triploid rainbow trout have an XXY sex chromosome complement and female triploid rainbow trout have an XXX sex chromosome complement. These characteristics can be determined through microscopic observance of stained white blood cell cultures or body tissues. Production of solely female triploid rainbow trout requires an additional step and their eyed eggs cost about twice as much as mixed-sex diploid rainbow trout (Kozfkay et al. 2006).

Stocking triploid rainbow trout has risks and benefits. The following discussion addresses the major management concerns of triploid rainbow trout being introduced into surface waters.

Disease

Introduction and transfers of fish involve risks as well as benefits. Codes of practice with a logical framework for thorough evaluation of proposed introductions and transfers have been developed; a widely known example was developed by ICES (International Council for the Exploration of the Sea) and EIFAC (European Inland Fisheries Advisory Commission) as detailed in Turner (1988). Given crowded hatchery conditions and their history as sources of disease transmission and the possibility for reduced fitness (including reduced immunity) where natural selection is not in force, codes of practices should apply for the introduction and transfer of hatchery fish to natural waters.

In cooperation with the Northwest Indian Fisheries Commission, WDFW developed The Salmonid Disease Control Policy of Fisheries Co-Managers of Washington State (NWIFC and WDFW 1998), which is ostensibly used to guide fish health decisions including hatchery practices and transfers of fish, eggs, water, or carcasses in the state of Washington. It is to be implemented by WDFW as well as tribal and private entities. Fish stocking at the Project should be subject to these standards. However, John Kerwin, WDFW's Hatcheries Division Manager, said WDFW no longer conducts fish health inspections at private suppliers' facilities, and that fish health is the responsibility of the individual suppliers (Kerwin 2007).

Whirling disease in salmonids is caused by the protozoan *Myxosoma cerebralis*, and it is propagated through an intermediate host, a tubifex worm. The intermediate host can be transmitted to other water bodies via bird or other animal feces. Mr. Kerwin stated that whirling disease has never been observed in a private farm or public hatchery in Washington State. He

said a wild fish health survey conducted in 2001 and 2002 found evidence of whirling disease in streams in northeast Washington, possibly including tributaries to the Pend Oreille River, and more generally in headwater streams in the Colville National Forest. Mr. Kerwin said he had no idea of the origin of the disease in those waters (Kerwin 2007).

Mr. Kerwin mentioned that whirling disease was found in 2004 in a private hatchery in suburban Portland, Oregon. The facility reared rainbow trout in earthen ponds, and was partially closed by the Oregon Department of Fish and Wildlife after the whirling disease was discovered. Four sites in Washington State that received fish from the private Oregon hatchery were sampled, and Mr. Kerwin said he did not recollect finding any evidence of the disease in those sites. He said most of the sites were farm ponds, providing a "dead end" effect for disease transmission, and the likelihood of disease transmission was further reduced because most fish did not survive through the summer. Mr. Kerwin acknowledged that the disease could be transmitted to other areas via bird or other animal feces (Kerwin 2007).

Mr. Kerwin said whirling disease was also observed in the early 1990s in the Grande Ronde River (southeastern Washington), a tributary to the Snake River, and may have originated further upstream in the Snake River valley, possibly in a state or federal hatchery or in one of the private trout farms in Idaho. He also mentioned whirling disease had been found in one Chinook salmon that returned to the Priest River hatchery, and speculated that fish may have originated in Idaho. Mr. Kerwin said an unidentified *Myxobolus* organism (same genus as the causative agent of whirling disease) was found in the Entiat River system, but its species was not *cerebralis*, the same as whirling disease, and that infected fish exhibited a pathology, but not similar to whirling disease (Kerwin 2007). It is very possible that disease outbreaks are not more prevalent because of the very specific nature of the intermediate host for the pathogen (Marnell 1986). Jim Uehara, WDFW's triploid rainbow trout stocking program manager, said that he is not aware of any incidence of triploid rainbow trout causing disease in a natural setting (Uehara 2008), which suggests that the disease control policies are working.

Given the presence of bass (*Micropterus spp.*) at the Boundary Reservoir, it is also worth noting here that larvae from the bass tapeworm (*Proteocephalus ambloplites*), a cestode, have been found in wild salmonids that were in waters shared with introduced black bass (Becker and Brunson 1968). The principal intermediate host for this cestode is *Cyclops bicuspidatis*, a prey item for salmonids (Antipa 1974).

Genetic Effects

Genetic impacts on native salmonid populations are the primary reason triploid rainbow trout are more frequently used for planting in support of local sport fisheries (Kozfkay et al. 2006). Genetic effects of stocking can have at least three forms: interspecific and intraspecific introgression, and indirect effects on a native population's genetic integrity through disease, ecological imbalance, and changed community structure.

Good conservation practices generally seek to maintain the widest range of a species' adaptations. With geographically isolated sub-populations, these adaptations can be very local in nature and likely reflect an evolved response to the selective pressures of that area's

environmental conditions. Cutthroat trout in particular have many subspecies with much genetic, morphological, and ecological variation (Allendorf and Leary 1988).

Interspecific introgression—hybridization between species—can produce offspring with reduced fitness. Leary et al. (1985) found that hybrids between rainbow trout and three different subspecies of cutthroat trout had decreased developmental stability. Allendorf and Leary (1986) produced experimental hybrids between rainbow trout and westslope cutthroat trout to test for differences in growth rate; hybrids had slower growth rates than parental taxa under hatchery conditions. Martin et al. (1985) found evidence of introgression from rainbow trout in 7 of 39 cutthroat trout populations in Utah, and introgressed populations of Paiute and coastal cutthroat trout with rainbow trout were described by Busack and Gall (1981) and Campton and Utter (1985). Evidence of hybridization and introgression between introduced rainbow trout and Yellowstone cutthroat trout was also detected by Allendorf and Leary (1986).

Where species introduced are the same as native species, but from a different stock, intraspecific introgression can occur, altering the native species' genome and adaptations to local conditions, including subtle behavioral and physiological traits (Coates 1998; Hindar et al. 1991). For example, much of the genetic variation within the westslope cutthroat trout subspecies occurs in relatively few local populations; preserving genetic variation requires preserving as many local populations as possible (Allendorf and Leary 1988).

Allendorf and Leary (1988) identify the greatest danger to the conservation of cutthroat trout as introgressive hybridization among subspecies and with rainbow trout. The States of Idaho, Montana, Oregon, and Washington have adopted policies focused either on the cessation of stocking non-native trout in westslope cutthroat trout waters, or the use of sterile triploid rainbow trout in hatchery supported fisheries that are adjacent or connected to waters supporting westslope cutthroat trout (Campbell 2003).

Because the fish stocked at the Project are triploid rainbow trout, the risk of genetic introgression is minimized. Dillon (1988) evaluated the effects of heat-shock temperature, time after fertilization at which heat shocks began, and duration of heat shocks, and reported that all of these factors significantly affected rainbow trout triploidy induction rates and survival to feeding rates. However, hatchery production of rainbow trout triploid rainbow trout tend to have induction rates of 96-100 percent (Dillon 1988; IDFG 2007; Kozfkay et al. 2006; Wagner 2001), and Uehara reported that WDFW's triploidy induction rate has consistently been 98-100 percent (Uehara 2008). Uehara also noted that WDFW requires triploid vendors to supply proof of triploidy (Uehara, WDFW, personal communication, September 17, 2008). Kozfkay et al. (2006) reported that they believe that the hybridization potential of a stocked group of triploid rainbow trout is reduced by an amount directly equal to its induction rate.

Although triploidy results in sterile fish, both male and female gonads develop to some extent. Research has shown that even though triploid males cannot successfully reproduce, they still have spawning behavior, migrating to spawning grounds and competing with other males for females (Thorgaard and Gall 1979). Stocking only female triploid rainbow trout in put-and-take fisheries is one possible solution to avoid this displacement of native males as this strategy has

been implemented in fisheries in Alaska where there is the potential for interaction with native stocks (Havens et al. 1995).

Ecological Impacts and Changes to Community Structure

Apart from possible impacts associated with genetic introgression and introduction of disease detailed above, hatchery-reared fish can have impacts to ecology and community structure. Significant predation by introduced brown trout on resident fish has been observed on other salmonids (Taylor et al. 1984) as well as non-game fish (Moyle and Marciochi 1975; Garman and Nielsen 1982). Sholes and Hallock (1979) reported that stocked yearling Chinook salmon (*O. tshawytscha*) consumed up to 15 times as many stocked Chinook salmon fry in the Feather River, California.

Bachman (1984), Petrosky (1984), and Petrosky and Bjorrn (1985) studied the effects of hatchery trout on wild populations, and found that energy-conserving behaviors determined the results of competition between hatchery and wild fish. Bachman (1984) found that wild fish tended to prevail as they were better able to conserve energy for extended periods. Petrosky (1984) observed competition between hatchery and wild trout, but more often for positioning to feed than for individual acts of feeding. This positioning established size-dominated hierarchies, and suggested that the inefficient foraging behavior learned by hatchery trout—scrambling periodically, rather than feeding methodically to conserve energy—put them at a competitive disadvantage.

Relatively little research has been done comparing growth and survival of wild fish after hatchery fish introductions, or results were compromised by lack of control or other experimental design flaws. Petrosky (1984) reported no significant impacts on growth or survival of wild trout in Idaho streams from introduced hatchery rainbow trout, even at very high stocking rates. Reisenbichler and McIntyre (1977) mated Deschutes River (Oregon) steelhead to test for growth and survival. Crosses were hatchery with hatchery, hatchery with wild, and wild with wild. The pure wild fish had the highest survival in the natural stream environment, and the hatchery/wild cross tended to have higher growth rates in the same environment. The pure hatchery fish had the highest growth and survival rate but only when reared in the hatchery ponds. Vincent (1975, 1985) conducted very long-term monitoring of wild rainbow and brown trout populations in the Madison River (Montana) and concluded that both numbers and biomass of wild trout increased substantially after stocking was discontinued, though the study results were somewhat compromised by environmental changes (increased in-stream flows) close to the time when stocking ceased.

Competition could result in displacement of the less well-adapted species, or in extreme cases, complete replacement. Looking specifically at effects of hatchery-reared fish on wild fish, some research has demonstrated encroachment of brown trout populations on wild brook trout, and rainbow trout on native brook trout populations (Marnell 1986).

Studies of growth rates and survival rates had differing results for reservoirs and high mountain lakes in Idaho (Kozfkay et al. 2006). Female triploid rainbow trout fingerlings stocked in two productive reservoirs (Treasureton and Daniel reservoirs) had significantly higher relative

survival rates than diploids (Teuscher and Dillon 2003). In contrast, preliminary results suggest that triploid rainbow trout may not survive as well as diploids in high mountain lakes, which are less productive.

Triploid Rainbow Trout Stocking Rates

Optimum stocking rates for both triploid and diploid rainbow trout as fingerlings have been explored experimentally by the state of Alaska (Havens and Sonnichsen 1992). The study was limited to natural lakes without an outlet capable of passing fish. Stocking rates of fry at 50, 100, 200, 400, 800 and 1,000 fish per surface acre of the lake resulted in annual survivals of 37 percent, 35 percent, 30 percent, 11 percent, 10 percent, and 15 percent, respectively. Growth rates based on size at recapture indicated a similar trend. Based on this study and economic analysis, policies were adopted that limit stocking of rainbow trout to 100 fish per surface acre in lightly fished lakes and 200 fish per surface acre in heavily fished lakes.

Catchable sized fish (>200 mm or about 8 inches) are typically stocked in Alaska at rates of 50 to 300 fish per acre and are generally not stocked in lakes where competition with natural stocks is a potential. If there is any potential for interbreeding, only triploid rainbow trout females are stocked. Comparative studies suggest growth rates and survival are less for triploid rainbow trout when compared with diploids, but the numbers are still sufficient to justify the stocking program. Catchable programs were confined to systems that were having very high use with harvests occurring rapidly with high public access (Havens et al. 1995).

WDFW uses triploid rainbow trout to avoid genetic introgression. The stocking rates that WDFW uses for triploid rainbow trout are not standardized across the state, but instead vary depending on the goals for the fishery along with stocking of other fish (Whalen 2008). Evaluation of reported stocking rates for catchable (averaging 1½ pound) triploid rainbow trout range from 0.4 to 300 trout per acre for lakes in Regions 1-3 (Eastern, North Central and South Central Washington) in 2001-2003 (WDFW 2001a, 2002a, 2003a). However, only five of these stocked lakes are larger than 500 acres, and annual stocking rates for these larger lakes fell within a range of 0.4 to 3.5 trout per acre. Review of corresponding hatchery trout fry stocking plans (WDFW 2001b, 2002b, 2003b) indicate that none of these larger lakes were stocked with fry during the spring of 2001–2003 or fall of 2000–2002. However, WDFW (2002b, 2003b) reported that in 2001 and 2002, Banks Lake, a 26,880 acre reservoir created just south of Grand Coulee Dam as part of the Bureau of Reclamation's Columbia Basin Project, was stocked annually with 93,032 to 100,000 triploid rainbow trout fry, which is an average annual stocking rate of 3.6 trout fry per acre.

WDFW stocked catchable rainbow trout in March–May (WDFW 2001b, 2002b, 2003b). Evaluation of other triploid rainbow trout stocking programs indicates that between 1995 and 2004 catchable-sized triploid rainbow trout were released into Lake Roosevelt between late April and late June (McLellan et al. 2008). It is not clear whether WDFW stocked the triploid rainbow trout fry in Banks Lake during the spring or fall (WDFW 2002b, 2003b). Triploid rainbow trout fry have been stocked in portions of Lake Roosevelt in June, mid-August, and November (Peone 2008; Combs 2003). Triploid rainbow trout fingerlings have been released in Lake Roosevelt in mid- to late September (Coombs 2003).

The average annual stocking rates for catchable-size triploid rainbow trout in Boundary Reservoir (average of ~4.5 trout/acre)[5] is a little higher than other large lakes east of the cascades in Washington, although it is far below standard practices used in other jurisdictions. The only likely time that densities may be an adverse factor for the overall fishery in Boundary Reservoir is when fish aggregate in cold water refugia during the summer months. This concentration of fish may limit growth during this period of time because of intra-specific competition but is likely to have little impact on overall survival. The high degree of aggregation likely contributes to the success rate of anglers. Consequently, angling is likely to have a much larger effect on survival in thermal refugia than intra- or interspecific competition.

Because of the very low density of salmonids in Boundary Reservoir, competition for space during these warm periods is likely the only time of the year when triploid rainbow trout may significantly compete for resources with native salmonids. The low number of native salmonids encountered preclude meaningful quantitative assessment of any of the effects other than as indicated from very limited telemetry data, which indicates that triploid rainbow trout and native salmonids likely occupy the same habitat during the warmest part of the year.

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Appendix 2: Project-Area Visitor Questionnaire

Seattle City Light

SURVEY

of Recreation Visitors to the

Boundary Reservoir Area

Northern Pend Oreille County, Washington

Site Name _____

Date _____

Introduction to Boundary Visitor Survey

Dear Visitor,

Seattle City Light (SCL) operates Boundary Dam and Reservoir and provides several recreation sites in the area. SCL is conducting a survey to learn about your opinions and experiences concerning recreation in the Boundary Reservoir Area and nearby areas in northern Pend Oreille County.

By completing this survey you will help SCL and other resource managers maintain and improve the recreation opportunities available at Boundary Reservoir. Your participation in the survey is completely voluntary and your answers will be kept in strict confidence. We estimate that it may take up to 15 minutes to complete.

To show our gratitude, all visitors completing a questionnaire will be entered into a prize drawing to occur at the end of the study. A pool of 10 people who complete the survey will be selected at random to receive cash prizes ranging from $20 to $150. There is a space at the end of the questionnaire for you to provide contact information so that we may notify you if you are selected for a cash prize. Your name and contact information will not be provided to a third party and will be destroyed after the drawing.

We encourage you to take time now to complete the questionnaire and hand it back to one of our crew members. If you complete your survey after we have left, please place it in one of the labeled drop boxes provided at the Vista House, the Boundary Dam Visitors' Gallery, the campground or the boat ramp at the Forebay Recreation Area, the boat ramp at Metaline Waterfront Park, the campground below Box Canyon Dam (Campbell Park), or at Sweet Creek Falls Rest Area. If you cannot complete the questionnaire during your visit, please place it in the stamped, self-addressed envelope provided and send it to us by mail within the next week.

Most of the questions ask you about your current visit to the Boundary Reservoir Area as opposed to visits that you have made in the past.

If you have any questions regarding this survey, please contact me at

509-446-3083 or **lonnie.johnson@seattle.gov**

or Michele Lynn, SCL's Recreation Resources Coordinator, at

206-386-4578 or **michele.lynn@seattle.gov**.

Thank you for your cooperation with this important recreation study!

Sincerely,

Lonnie Johnson

Boundary Powerhouse Supervisor

Information on Your Visit

1. Is this your first visit to the Boundary Reservoir Area? *(Please see map for extent of area. Circle one.)*

1 No → Skip to Question 3

2 Yes

2. Do you think that you would visit the Boundary Reservoir Area again? *(Circle one.)*

1 No

2 Yes

3 I'm not sure

3. How many people, including yourself, are in your group for this visit? *(Your group is all the people you arrived with and/or planned to meet here.)*

#_____ People #_____Males #_____Females

4. On this visit to the Boundary Reservoir Area, are you staying overnight? *(Circle one.)*

1 No, just passing through on the way to somewhere else → Skip to Question 6

2 No, just here today for a total of _____ hours *(Write number of hours.)* → Skip to Question 6

3 Yes, staying overnight for a total of _____ nights *(Write number of nights.)*

5. Where are you staying overnight? *(Circle all that apply if you are staying more than one night.)*

1 Campground at Boundary Dam (Forebay Area) in a tent _____ or in an RV/camper _____ *(Check one)*

2 Campground at Box Canyon Dam (Campbell Park) in a tent ____ or in an RV/camper ____ *(Check one)*

3 U.S. Forest Service campground *(Please name.)* _____

4 Privately-operated campground *(Please name.)* _____

5 Hotel, motel, resort or bed & breakfast *(Please name the town.)* _____

6 Private home of family or friends

7 Other *(Please describe.)* _____

6. What is the ZIP code or postal code at your primary residence? *(where you live on a permanent basis)*

ZIP/Postal Code _____

Recreation Activities

7. Please indicate which of the following activities you plan to do or have done <u>during this visit</u> to the Boundary Reservoir Area. *(Circle all that apply.)*

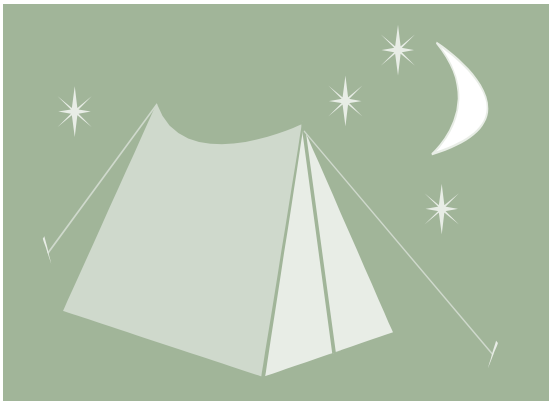
1 Fishing
2 Swimming
3 Picnicking
4 Motor boating for pleasure
5 Water skiing
6 Canoeing/kayaking
7 Personal watercraft (jet ski)
8 Viewing scenery/sight seeing
9 Viewing/visiting the dam(s)
10 Traveling State Route 31 North Pend Oreille Scenic Byway
11 Day hiking/nature trails
12 Walking/jogging
13 Bicycling
14 Photography
15 Nature study (bird/wildlife watching, flowers/rocks)
16 Collecting edible fruits, berries, mushrooms
17 Car/tent/RV camping (developed facilities, services, people present)
18 Car/tent/RV camping on back roads (secluded, no services, fewer amenities)
19 Boat-in camping along river shoreline
20 Socializing
21 Spending time alone
22 Off-roading (dirt bike, ATV, 4X4)
23 Hunting
24 Attend a special event/festival
25 Other (Please specify.)_____

8. Which <u>one</u> of the activities that you circled in the list above was <u>your primary recreation activity for this visit</u> to the Boundary Reservoir Area? *(Your primary recreation activity is the one that you spent the most time doing. Please write the number from the list on the previous page.)*

I spent most of my time doing activity # _____ during this visit.

9. Overall, how would you <u>rate the quality of your recreation experience</u> for this visit to the Boundary Reservoir Area? *(Circle one number on the scale.)*

1	2	3	4	5	6	7	8	9
Very Poor				Average				Excellent



IMPORTANT - PLEASE READ

The Fishing Section is only for visitors who are fishing on this visit to the Boundary Reservoir Area. If you did not circle fishing in Question 7 and your party does not plan to fish on this visit, pelase skip to Question 16 (on page 7).

10. How much time did/will <u>you and others in your party</u> spend fishing on this visit to the Boundary Reservoir Area? *(Please write the number.)*

Number of people fishing _____

Number of days fished _____

Average/typical number of hours fished per day _____

11. How did you go fishing during this visit to the Boundary Reservoir Area? *(Circle all that apply.)*

1 Boat/watercraft *(Please specify type.)*_____

2 Shore/bank

3 Both

4 Other means *(Please specify.)* _____

12. In what area(s) did/will you fish during this visit to the Boundary Reservoir Area? *(See map to identify areas. Circle all that apply.)*

1 Forebay area of Boundary Reservoir (Boundary Dam to north end of canyon)

2 Canyon area of Boundary Reservoir

3 Boundary Reservoir between Metaline and Metaline Falls

4 Boundary Reservoir between Metaline and Box Canyon

5 Mouth of creek(s) entering Boundary Reservoir *(Please specify.)* _____

6 Creek(s) entering Boundary Reservoir (above creek mouth) *(Please specify.)* _____

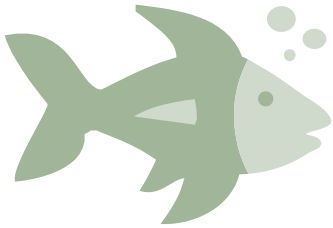
7 Other creek/stream in the area *(Please name.)*_____

8 Box Canyon Reservoir

9 Sullivan Lake

10 Mill Pond

11 Other lake/pond *(Please name.)* _____



Fishing

13. While fishing in the Boundary Reservoir Area, what species of fish do you want to catch? *(Circle all that apply.)*

1 Triploid rainbow trout

2 Other trout

3 Smallmouth bass

4 Largemouth bass

5 Other species *(Please identify.)* _____

14. Please tell us about the fish you and your party caught during this visit to the Boundary Reservoir Area. *(Please write your responses in the blanks.)*

Type of Fish	Number Caught	Size Range (inches)
Triploid rainbow trout	_____	_____
Other trout	_____	_____
Smallmouth bass	_____	_____
Largemouth bass	_____	_____
Other: _____	_____	_____
Other: _____	_____	_____

15. Overall, how would you rate your satisfaction with the fishing opportunities at Boundary Reservoir? *(Circle one number on the scale.)*

1	2	3	4	5	6	7	8	9
Very Poor				Average				Excellent

16. Did you operate or ride in a boat or other watercraft on Boundary Reservoir during this visit? *(Circle one.)*

1 No ➡ Skip to Question 19

2 Yes

17. Which boat launch did you use during this visit to the Boundary Reservoir Area? *(See map. Circle all that apply.)*

1 Launch at Boundary Dam (Forebay Area)

2 Metaline Waterfront Park launch

3 Launch below Box Canyon Dam (Campbell Park)

4 Private boat launch *(Please specify.)*_____

5 Launched directly from shore with no boat launch *(Specify.)* _____ ➡ Skip to Question 19

6 I'm not sure

18. Did the boat launch or launches that you circled in Question 17 adequately meet your needs for this visit to the Boundary Reservoir Area? *(Circle one.)*

1 Yes

2 No *(Describe below any boat launch problems you encountered.)*

19. Whether you used a boat or not, did the water conditions of the reservoir/river cause any problems for you during this visit to the Boundary Reservoir Area? *(For example, rising or falling water levels, fast currents, or rapids. Circle one.)*

1 I did not use or access the reservoir/river or its shoreline on this visit

2 No problems

3 Minor problems

4 Major problems, but this <u>would not</u> keep me from returning in the future

5 Major problems that <u>would</u> keep me from returning in the future

6 I'm not sure

(Please describe any problems with water conditions you encountered.)

Recreation Facilities and Service

20. Different people look for different recreation facilities and opportunities. Some of the items listed below may be found at the Boundary Reservoir Area and others may not be available. Thinking about your recreation needs, please rate how <u>important</u> it is to you to have each of these items available when you recreate. Then, rate your <u>satisfaction</u> with each item at the Boundary Reservoir Area. *(Circle one number for IMPORTANCE on the left and one number for SATISFACTION on the right. If something is not at all important to you or does not apply, you may circle NA.)*

	IMPORTANCE					SATISFACTION					
	Not at all Important				Extremely Important	Not at all Satisfied				Extremely Satisfied	Does Not App;y
Tent campsites	1	2	3	4	5	1	2	3	4	5	NA
RV campsites	1	2	3	4	5	1	2	3	4	5	NA
RV hookups/utilities	1	2	3	4	5	1	2	3	4	5	NA
Campsite fees	1	2	3	4	5	1	2	3	4	5	NA
Parking area	1	2	3	4	5	1	2	3	4	5	NA
Road access to recreation areas	1	2	3	4	5	1	2	3	4	5	NA
Access for the disabled	1	2	3	4	5	1	2	3	4	5	NA
Drinking water	1	2	3	4	5	1	2	3	4	5	NA
Flush toilets	1	2	3	4	5	1	2	3	4	5	NA
Vault/portable toilets	1	2	3	4	5	1	2	3	4	5	NA
Trash containers/collection	1	2	3	4	5	1	2	3	4	5	NA
Picnic sites	1	2	3	4	5	1	2	3	4	5	NA
Swimming/beach access	1	2	3	4	5	1	2	3	4	5	NA
Historic sites/information	1	2	3	4	5	1	2	3	4	5	NA
Scenic views/viewpoints	1	2	3	4	5	1	2	3	4	5	NA
Wildlife viewing/nature trails	1	2	3	4	5	1	2	3	4	5	NA
Interpretive/education programs	1	2	3	4	5	1	2	3	4	5	NA
Hiking trails	1	2	3	4	5	1	2	3	4	5	NA
Boat ramps	1	2	3	4	5	1	2	3	4	5	NA
Boat docks	1	2	3	4	5	1	2	3	4	5	NA
Boating safety information	1	2	3	4	5	1	2	3	4	5	NA
Navigation hazard marking	1	2	3	4	5	1	2	3	4	5	NA
River/shore access for fishing	1	2	3	4	5	1	2	3	4	5	NA
Fishing opportunities	1	2	3	4	5	1	2	3	4	5	NA
Hunting opportunities	1	2	3	4	5	1	2	3	4	5	NA
Boat-in campsites	1	2	3	4	5	1	2	3	4	5	NA
Canoe/kayak access facilities	1	2	3	4	5	1	2	3	4	5	NA
Other: _____	1	2	3	4	5	1	2	3	4	5	NA
Other: _____	1	2	3	4	5	1	2	3	4	5	NA

21. Based on your experiences during <u>this visit</u>, are there any improvements to the existing recreation opportunities at the Boundary Reservoir Area that you think are needed? *(These could be recreation ACTIVITIES that you would like to do here that are not currently available, or specific recreation FACILITIES that are not currently available or that do not adequately meet your needs. These should be activities or facilities THAT YOU WOULD USE YOURSELF if they were present. Circle one.)*

1 No, I am satisfied with the recreation activities/facilities currently available here

2 I'm not sure

3 Yes, I would like other recreation activities/facilities at this destination *(Please list.)*

Your Primary Destination

22. For this visit, what specific sites <u>in the Boundary Reservoir Area</u> do you intend to visit or have you already visited? *(See map. Circle all that apply.)*

1 Vista House
2 Boundary Dam Visitors' Gallery
3 Picnic area below Boundary Dam (Tailrace Area)
4 Campground at Boundary Dam (Forebay Area)
5 On the water in a boat/other watercraft
6 Crescent Lake
7 Metaline Waterfront Park
8 Campground below Box Canyon Dam (Campbell Park)
9 Sweet Creek Falls Rest Area/Trail
10 Small boat-in campsite or day use site on the reservoir/river
11 Other *(Specify)* _____

_____

23. Which one of the places that you circled in the list above was your primary destination for this visit to the Boundary Reservoir Area? *(Your primary destination is the site where you spent the most time during this visit. Please write the number from the above list.)*

I spent most of my time at site # _____ during this visit.

24. Please indicate whether or how much you felt crowded on this visit to your primary destination listed in Question 23. *(Circle one number on the scale.)*

1	2	3	4	5	6	7	8	9
Not at all Crowded				Moderately Crowded				Extremely Crowded

25. During this visit to the destination you listed in Question 23, did you experience any problems or conflicts with other visitors or their behaviors that detracted from your enjoyment of being there? *(Circle one.)*

1 No

2 Yes *(Please describe what occurred.)*

26. Based on your experiences during this visit at the destination you listed in Question 23, do you intend to adjust your recreation plans to avoid the presence or behaviors of other visitors at this site in the future? *(Circle one.)*

1 No → Skip to Question 28

2 Yes

27. How do you intend to adjust your recreation plans? *(Circle all that apply.)*

1 Move my activity to a different site in the Boundary Reservoir Area

2 Go to a different site in the region outside the Boundary Reservoir Area

3 Visit this same site earlier or later in the year to avoid busier times of year

4 Visit this same site on weekdays instead of weekends or holidays

5 Visit this same site at a different time of day to avoid busier times of day

6 Other *(Please specify.)* _____

28. For this visit, did you find the facilities at your primary destination that you listed in Question 23 to be adequately maintained? *(Circle one.)*

1 Yes

2 No *(Describe any maintenance needs you thought were not currently met.)*

Past Visits

29. How many times have you visited the Boundary Reservoir Area within the past 12 months? *(Write the number. Do not include this visit.)*

#_____ Visits in the past 12 months If this is your first visit → Skip to Question 32

30. About how many years have you been visiting the Boundary Reservoir Area? *(Write the number.)*

#_____ Years

31. In what seasons of the year do you visit the Boundary Reservoir Area? *(Circle all that apply.)*

Spring Summer Fall Winter

32. What do you particularly like about visiting the Boundary Reservoir Area or what is it that attracted you to come here? *(Circle all that apply.)*

1 The scenery/I like the views
2 It's close to home/easy to get to
3 It's a good place for fishing
4 It's a good place to go boating/recreate on the water
5 I like the small/low-key camping areas
6 I like the cost/it's affordable
7 It's quiet/peaceful
8 It's a good place to explore/I wanted to see a new area
9 Other reason *(Please specify.)* _____
_____
_____

33. Which other lakes or rivers in the region do you frequently visit for recreation? *(Please name up to three.)*

Lake/river _____ State/Province _____
Lake/river _____ State/Province _____
Lake/river _____ State/Province _____

34. Which other places or features in the region do you intend to visit or have you already visited during <u>this visit</u> to the Boundary Reservoir Area? *(Circle all that apply.)*

1 North Pend Oreille Scenic Byway (State Route 31)
2 Selkirk International Loop
3 British Columbia, Canada
4 Northern Idaho
5 Spokane, Washington
6 Colville, Washington
7 Newport, Washington
8 Little Pend Oreille National Wildlife Refuge
9 Colville National Forest
10 Little Pend Oreille Lakes
11 Sullivan Lake/Mill Pond area
12 Salmo-Priest Wilderness
13 Box Canyon Reservoir
14 Columbia River/Lake Roosevelt
15 Gardner Caves/Crawford State Park
16 Other places *(Please specify.)* _____
_____
_____

35. Overall, please rate the visual quality of the scenery at the Boundary Reservoir Area. *(Circle one number on the scale.)*

1	2	3	4	5	6	7	8	9
Very poor				Average				Excellent

36. During this visit to the Boundary Reservoir Area, have you seen any facilities or structures associated with the Boundary Hydroelectric Project? *(E.g., the dam itself, maintenance buildings, utility lines and towers near the dam, SCL recreation facilities, etc. Circle one.)*

1 No → Skip to Question 39

2 I'm not sure

3 Yes

37. Where were you when you saw these facilities? *(See map. Circle all that apply.)*

1 Vista House

2 Picnic area below Boundary Dam (Tailrace Area)

3 Campground at Boundary Dam (Forebay Area)

4 On the water/river (Boundary Reservoir surface)

5 Roads near reservoir

6 Other *(Please specify.)*_____

38. How did seeing these facilities affect your enjoyment of the scenery at the Boundary Reservoir Area on this visit? *(Circle one.)*

1 These facilities greatly enhanced my overall enjoyment of the scenery here.

2 These facilities slightly enhanced my overall enjoyment of the scenery here.

3 These facilities had no effect on my overall enjoyment of the scenery here.

4 These facilities slightly detracted from my overall enjoyment of the scenery here.

5 These facilities greatly detracted from my overall enjoyment of the scenery here.

(Please explain your response.)

Trip Expenses

39. Please estimate the total amount of money that you spent or will spend in Pend Oreille County for this visit to Boundary Reservoir Area for the following types of purchases. *(Please write the approximate amounts in U.S. dollars that you paid for yourself, for others in your group, and any portion of your shared expenses.)*

Someone else paid my expenses *(Circle one.)*

1 No 2 Yes → Skip to Question 40

	Amount Spent
Hotels, motels, bed & breakfast, other lodging	$_____
Camping/RV hookup fees	$_____
Eating/drinking establishments	$_____
Grocery/food and beverage purchases	$_____
Gasoline, oil, other auto supplies and services	$_____
Rentals of boats or recreation vehicles (including fuel/oil)	$_____
Hunting/fishing supplies (bait/tackle, ammunition)	$_____
Shopping/souvenirs	$_____
Recreational services (e.g., excursions, guided tours)	$ _____
Other expenses *(Please specify.)* _____	$ _____

About You and Your Party

40. Are you? *(Circle one.)*

Male Female

41. What is your age? *(Check one.)*

_____under 16 _____16-19 _____20-29 _____30-39 _____40-49 _____50-59 _____60-69 _____70 and up

42. What are the ages of the other people in your group? *(Please write the number of people for each.)*

#_____under 16 _____16-19 _____20-29 _____30-39 _____40-49 _____50-59 _____60-69 _____70 and up

Seattle City Light would like to thank you for your time. You have helped us to learn more about the people who visit and recreate at the Boundary Reservoir Area. We welcome any additional input or comments from you about how we can improve the management of the Boundary Reservoir Area. *(Please feel free to write any additional comments below.)*

Thank you for participating in this important study!

Please remember to provide your contact information so that we may enter your name in a drawing for a cash prize. *(Fully completed questionnaires will be considered for a cash prize. We will detach your contact information from your answers and will not share it with a third party.)*

Name _____

Address _____

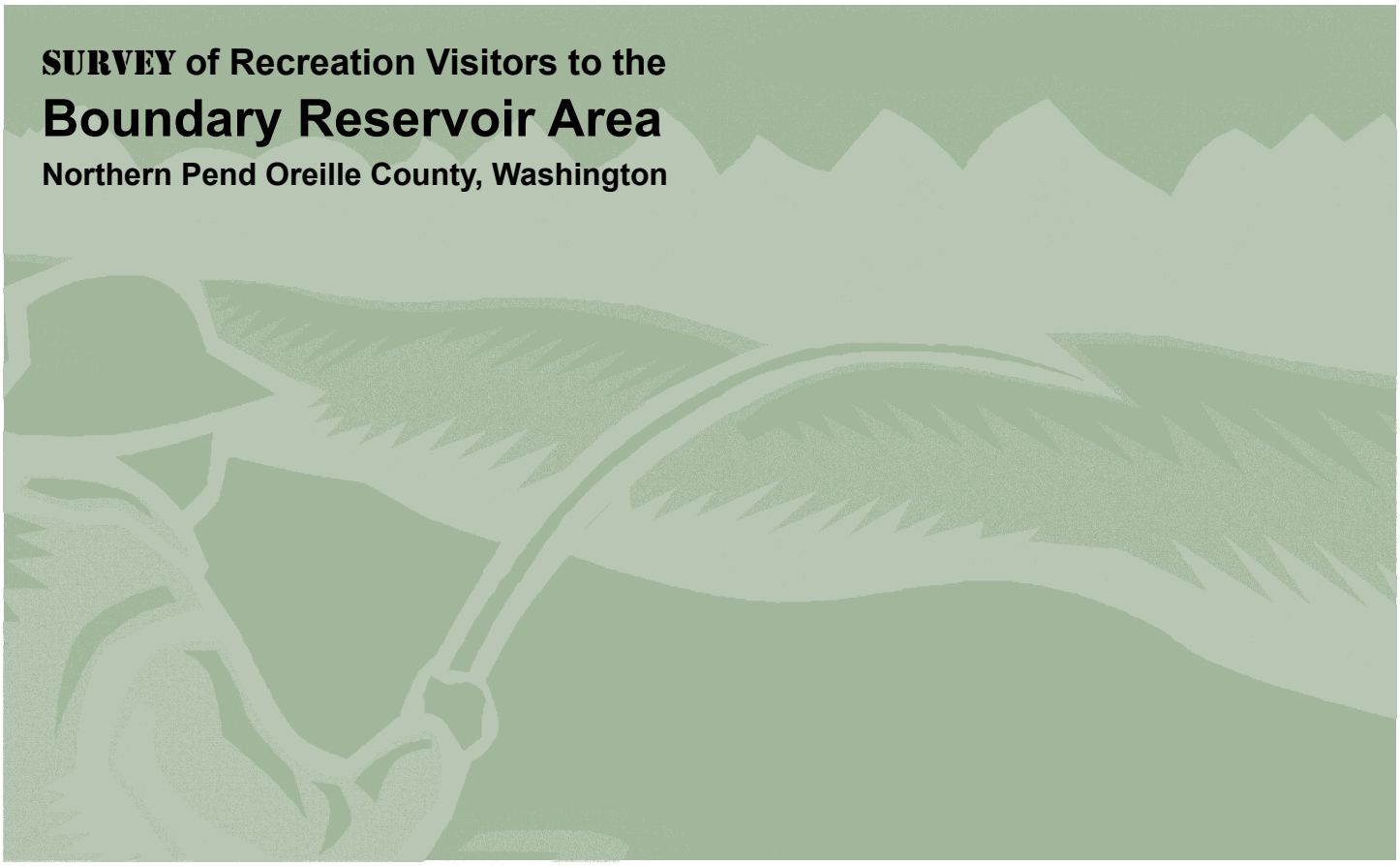
_____

Telephone # _____

SURVEY of Recreation Visitors to the

Boundary Reservoir Area

Northern Pend Oreille County, Washington



P.O. Box 604
Ione, WA 99139

Appendix 3: 2008 Creel Survey Documentation

Appendix 3a. Boundary Reservoir 2008 Creel Survey Form

Appendix 3b. Verbatim Responses to Creel Survey Questions

Appendix 3a. Boundary Reservoir 2008 Creel Survey Form

Boundary Reservoir
2008 Creel Survey

Site Name _____
Date _____/_____/ ***2008***
Surveyor _____

1. Including yourself, how many people are fishing with you today? # _____ People

2. We would like to know how much time your party spent fishing today.

Approximately what time did you start fishing? _____

Approximately what time did you end fishing? _____

[Make post-interview entry for fishing duration, in minutes.] _____ minutes

3. Please tell us about the fish you and your party caught during this visit to Boundary Reservoir. *[Enter number of fish caught by type of fish.]* **Would you mind if I measure your fish? If you would rather I did not, that's OK.** *[Please write responses in the blanks; be specific on sizes. If they allow you to measure their fish, record species and total length for each fish harvested.]*

Type of Fish	Number Caught	Sizes (inches)	# Number Harvested
Triploid rainbow trout			
Other trout			
Bass			
Yellow perch			
Other: _____			

4. How did you go fishing during this visit to Boundary Reservoir? (Circle one.)

1 Boat/watercraft (Please specify type of boat or watercraft**)**

_____

2 Shore/bank

3 Both

5. In what area(s) did you fish during this visit to Boundary Reservoir?

*[Show map to identify areas. Circle **all** that apply.]*

1 Forebay area of Boundary Reservoir (Boundary Dam to north end of canyon)

2 Canyon area of Boundary Reservoir

3 Boundary Reservoir between Metaline and Metaline Falls

4 Boundary Reservoir between Metaline and Box Canyon

5 Mouth of creek(s) entering Boundary Reservoir (Please specify) _____

6 Creek(s) entering Boundary Reservoir (above creek mouth) (Please specify) _____

7 Other (Please name) _____

6. While fishing in Boundary Reservoir on this visit, what species of fish did you most want to catch? *[Circle only **one**.]*

1 Triploid rainbow trout

2 Other trout

3 Bass (smallmouth and/or largemouth bass)

4 Yellow perch

5 Other species **(Please identify)** _____

7. Have you fished in Boundary Reservoir before this visit? *[Circle one.]*

1 No

2 Yes

8. What is the ZIP code or postal code where you live on a permanent basis? _____

9. Overall, how would you rate your satisfaction with the fishing opportunities in Boundary Reservoir? *[Circle one number on the scale.]*

1	2	3	4	5	6	7	8	9
Very poor				Average				Excellent

CONCLUSION: ***Seattle City Light thanks you for your time. You have helped us to learn more about the fishing opportunities at Boundary Reservoir. Do you have any additional input or comments about how the fishery can be improved?*** [Please record any additional comments below.]

_____

_____

_____

Thank you for participating in this important study!

Appendix 3b. Verbatim Responses to Creel Survey Questions

Verbatim Responses to Creel Survey Questions

Several questions in the 2008 creel survey included "Other" as a possible response, and/or provided space for respondents to enter open-ended responses to a question. In most cases, the space for open-ended responses was intended to allow respondents to explain or identify those additional responses that did not fit a pre-defined category. Appendix 3b documents the open-ended responses that were provided for the respective items on the questionnaire, as they were stated by the respondents (i.e., verbatim). Entries in these tables reflect possible misspelling in the responses and limitations on the ability to read or interpret some of the responses.

Question 4: Means of fishing. When anglers reported fishing from a boat or other type of watercraft, the interviewer attempted to document the type of craft the respondent used. The specific responses are listed below in Table A.3b-1. Almost all of the 71 responses appear to describe a motorized craft of some type. Two anglers reported they fished from a kayak, and one from an inflatable pontoon boat. Boats with outboard motors represent the majority of the motorized watercraft. Many of the responses identified the size of the boat, and ranged from 10 feet to 22 feet in length.
7.

Table A.3b-1. Responses for specific type of watercraft used by anglers.

10' Outboard (2)
11' Fiberglass
12' Outboard
14' Outboard
16' Outboard
17' Seaswirl
18' Ranger
18' Smokercraft
19' Inboard
19' Searay
20' Outboard
22' Outboard
22' Raider
22' Smokercraft
25hp Outboard 16' Hewes Craft
Bass boat
Bayliner 18ft
Bayliner outboard
Canoe
Canoe with outboard
Crestliner outboard 10'
Inboard
Individual inflatable pontoon boat
Kayak
Motorized 14ft Starcraft

Table A.3b-1, continued…

Open 14'
Open outboard
Outboard
Outboard 14ft Starcraft
Outboard Smokercraft
Pontoon
Sea kayak
Small outboard
Smokercraft outboard
Starcraft inboard
Starcraft outboard
Zodiac

Question 5: Areas fished. Question 5 asked anglers to identify areas fished during their visit to Boundary Reservoir. The question included six pre-specified responses identifying localized areas and "Other" as a possible seventh response. Anglers indicating they had fished in or above a creek mouth during their visit to Boundary Reservoir or selecting the "Other" response were asked to name these specific areas. The specific responses are listed in Table A.3b-2. Anglers reported fishing at the mouths of seven creeks entering Boundary Reservoir, with Slate Creek the most common response (14 responses, out of 29 total). Only two respondents indicated they fished above the mouth of a creek. One of the respondents who selected the "Other" response identified a water body (Meadow Lake) that is not in the Boundary Reservoir area.

Table A.3b-2. Responses naming areas anglers fished in 2008 at Boundary Reservoir.

Location	**Frequency**
Creeks entering Boundary Reservoir	
Flume	4
Lime Creek	4
Pewee Falls	2
Slate Creek	13
Sullivan Creek	1
Sweet Creek	1
Above creek mouth	
Dead Man's Eddy	1
Flume Creek	1
Other lakes/ponds/streams	
Box Canyon boat launch	1
Dead Man's Eddy	1
Everett Island	3
Meadow Lake	1
Pewee Falls	3

Additional Comments

At the end of the survey, the interviewers asked respondents if they had any additional input or comments about how the fishery could be improved. The specific comments are listed, generally in alphabetical order, in Table A.3b-3.

Table A.3b-3. Additional comments from anglers reported in the 2008 creel survey.

Ten-year-old with no real opinions at this time; here with family for weekend
First time bank fishing, usually goes out in boat
Three local boys have fished often but like fishing in boats better
Add walleye to the reservoir
Agrees boat launch needs extensive improvements; knows plans are underway, hopes they get approved this year and that they include dock and jetty.
Arrived Friday night, here for weekend with a number of others.
Area has always been fine
Beautiful area, just learning how to fish
Been fishing from shore of and on all summer, hasn't caught many fish, thinks there are less fish now than in previous years
Been fishing here for years; leave things the way they are
Been here all weekend with family, loves the place
Been here camping since Thursday afternoon. Three hours reported with the Rainbows from Friday's efforts
Been here many times before, loves the area. Fishing was poor/unsatisfactory this time. Doesn't want to see any changes to area; if improvements were made more people would come in and ruin the place.
Better access for shore fishing
Better access for shore fishing; dock at boat launch; control pike population
Better access for shore fishing; maybe some nature trails for hiking
Better access to river
Better docking facilities
Better docking moorage for campers
Better fishing in morning; this place is better than other places in Idaho he goes to.
Better than any place else; poor shore fishing opportunities, though.
Border Patrol family picnic. Love the area, just having fun with kids, not serious about fishing
Camping here with adult male relatives, others in party out fishing in boat did not return before end of shift
Camping in park, been here all weekend
Camping up river for the past 2 days, is reporting abandoned camping equipment at BLM site near the "Z" looks like it has been there for a couple of weeks, tent is collapsed, water on supplies
Camps on the river a lot, says road to campsite needs a lot of work
Can't think of anything
Can't think of anything. Really enjoyed area with kids but want electricity/water at campsites
Caught 2 bass from shore while launching boat; left with 2 other anglers in boat; this party and 2 other fishing parties were still out on the water
Comes 3 or 4 times per, year loves the place, hopes it stays quiet and clean
Control bait fish population
Couldn't fish, water level too low, better notification of level would have been helpful

Table A.3b-3, continued…

Dad lives here, loves the area; maybe keep pike out if they are harmful to other species
(area) Definitely improved over last 20 years
Didn’t catch anything, not too pleased today
Didn't like shore fishing
Do all Triploid have fins cut? More fish would be nice
Don't draw the water down so often or so deep; not good for fish
Don't over promote the area, keep it un-crowded
Dredge silt from mouth of Sullivan Creek
Encourage slot limits for smallmouth bass, have anglers keep the smaller fish they catch
Extend boat launch ramp for lower water
Family camping with kids fishing; put in showers (cold water ok) build a protected area for swimming with a dock platform
First time fishing here
Fish every Friday, been in area since December 2007
Fished at Box Canyon before, always happy when fishing
Fishes here almost every day, says he’s been averaging 1-2 pike per day but slow today; hasn’t seen any bass in a while, is worried that raising and lowering the water level has killed off this year’s spawn of fish
Fishes most every day
Fishing from shore is too difficult. Part of larger group of POTC employees participating in an informal derby $5 per man for the biggest fish. Other guys were fishing Sat/Sun on different parts of the river.
Fishing getting better
Fishing has been poor due to high water. Adding a dock to Metaline Park would be nice
Fishing is always a good day here
Fishing is fine
Fishing slow this year, it was better in years past
Fix boat ramp, install dock
Fix the dock
Get rid of mosquitoes
Going to Yokum Lake, as I only saw one fish on the fish finder. Really need handicapped parking for boaters.
Happy the way things are
Has been coming here for 35 years, loves it
Has been here camping since Thurs.; maintain water level
Having a good time, love the area. Fishing is lousy with rain and cold murky water, haven't caught any fish
Heading down towards Box Canyon to try there
Here with extended family for long weekend
Ideal area but fishing not very good
Information on how to fish?
Ione native, loves this area. Does not think college kids and widows from Seattle should be managing the forests and natural resources. Lots of opinions on other issues as well.
Just getting started, no opinions yet, see him after weekend
Just passing the time, enjoys the area, here with a large group all weekend
Just taking the kids out for a drive, will try some other areas
Keep campgrounds family oriented, stock more triploid rainbow trout, rope off area for kids to swim in

Table A.3b-3, continued…

Keep the water level up
Keep things the way they are, stock walleye
Keep water level up
Keep water level up
Keep water level up, dock at Metaline Park would be nice
Kids fishing from dock while family is here camping
Kids on dock unhappy fish aren't biting
Leave area undeveloped; views are spectacular
Like to see more trout
Liked the area but didn't get a bite, here with granddad from Idaho 84088
Likes everything
Likes it as it is
Likes the area, still fishing when we left
Likes the camping but is disappointed in the fishing, no suggestions on how to improve
Likes the campground, doesn't like water level fluctuations, would like to be able to dock a boat overnight, will be here all weekend with friends
Lives across from park, fishes here a lot
Lives across from the park, loves the river but thinks SCL could maintain the level better
Loves the area
Love the area, not pleased with wet weather, cold, murky water lack of fish
Love the scenery, no opinion on fishing
Loves the area, but too much debris in the water this time; fantastic scenery
Loves the area, camping in woods outside of park, water too murky for good fishing
Loves the area even if the fish aren't biting
Loves the area, wouldn't change a thing
Loves the place
Loves the place (Cusick resident)
Loves the place, even in the rain
Loves the place, mainly camping here with friends
Loves the scenery, no suggestions on improving fishing
Lower the water level
Maintain higher water level, fishing has gotten a lot worse in past few years
Maintain higher water level; never seen river so murky
Maintain higher water level,, put in a place to moor boats at night for campers
Maintain level better; add pike
Maintain the remote campsites; better here camping every year
Maintain water level
Maintain water level, give advance warning of conditions
Maintain water level higher
Maintain water level; mainly here touring with kids, fished very little
Moorage for campers
Mostly here for the scenery

Table A.3b-3, continued…

Moving to south end of reservoir, will finish this evening, stated that the water was too cold to fish
Murky water not good for fishing but will be here often this summer
Murky water, too cold and wet and windy, likes the area though, just a bad day today
Need to have consideration on fish habitat when lowering water
Nice weather/area, where are the fish?
No aquatic plant life very strange? Few small birds? 6' plus tidal flux? Some shore fishing time is included in this survey
No comments
No comments, left survey in box when they returned from camping
No complaints things are fine here, too windy today and water too high
No firewood at remote campsite
No luck fishing from shore
No luck today, comes here a lot
No opinion
No opinion, camping here, reported on 9/18
No opinion on fishing, not really into this sport
No suggestions
No suggestions; just having a good time, like the area
No suggestions; loves the place, maybe some provision to keep boats in water overnight
No suggestions; might be too hot to catch fish?
Not much action today, no opinion as to why
Not really interested in fishing, thinks the area is great
Nothing to add, answered survey 50 times already he says
Notify public what water level is or what it is going to be
Not having much luck fishing from shore; likes the campground, though
Off-duty SCL employee and friend
Poor fishing, need more fish; need better notification when SCL is lowering river
Poor fishing today, don't know why
Put in a boat dock
Put a dock in at Metaline Park
Put in dock, repair boat launch
Put in showers in campground
Put in slips for boats for overnight, install showers
Raining; improve boat launch and boat trailer parking areas
Rate the campground an 8; fishing not so good, stock more fish, been here all weekend, didn't do much fishing
Really here for the kayaking
Really nice weather
Redpath, water conditions level/flow makes it harder to fish
Redpath, water is warming up getting better
Reduce number of squawfish fingerlings
Reported on 7/18 his party was fishing on 7/16 he was just starting to fish at 14:30; on 7/18 says he loves the places wouldn't make any changes

Table A.3b-3, continued…

Reporting on previous afternoon's efforts. Water is murky, wind is too cold, disappointed in experience here mainly due to weather.
Safer route to shore fishing access; great camping here, kids love the swimming area
Same guy as 246
Same guys from previous day still think leave things the way they are
SCL employee
SCL has done a great job with the area, lousy weather today, though
Shore access is limited; hasn't been paid for tags sent in, likes fishing but not pleased with how SCL is managing fish on the river
Same guys back for the afternoon
Started out for bass, didn't catch any, trying next for trout, thinks water may still be too cold
Staying in Cusick. Add hot water showers to campsite, better control predator/trash fish to improve game fishing
Stock more bass
Stock more brook trout, stock more pike
Stock more fish
Stock more fish after high water runoff so fish stay in reservoir
Stock more fish, improve access for shore fishing
Stock more fish; water is still too murky
Stock more fish; water level fluctuation makes fishing difficult
Stock more trout
Stop spray painting markers, defacing pristine area
Take out tree stumps, stock more fish
Temporarily living in Spokane, attending school; likes the area, not too happy no fish
Thank you
They have been camping here for awhile; stock more fish above Box Canyon to improve Ione fishing
Thinks bass fishing is fine, but the trout aren't doing very well.
Thinks there are less fish than in previous years
Too much milfoil, takes the lures
Too rainy today. SCL could improve access for shore fishing
Too windy to fish today
Tried all kinds of bait with no luck, thinks shore fishing is not very good
Very active on the river today. fish jumping all over
Visiting friends (Border Patrol) from Ione, very nice area, don't make any changes
Water is too high, area needs dock at boat launch, says 90% of residents will support that
Water level too low, can’t launch; SCL should give better notice (reported 9/6)
Water is too high; too many weeds, improve weed control lower on the river
Water level too low; have concerns about how many smallmouth bass you can catch a day (10), afraid bass could be fished out with that many a day, would like to see it back to 5 a day.
Water running fast
Water still too cold; fished off dock last year, will be here for a couple of days, will fish some more
Water too murky, don't draw the water so much; love the campground area
Well kept secret, keep as is, had a lovely time
Worse this year than last year, though fishing from shore; maintain level better

Table A.3b-3, continued…

Would like to catch more fish; they always release their catch
Would like to see a better boat launch
Would like to see water going down at night not during the day, can't fish
Would rather fish for walleye

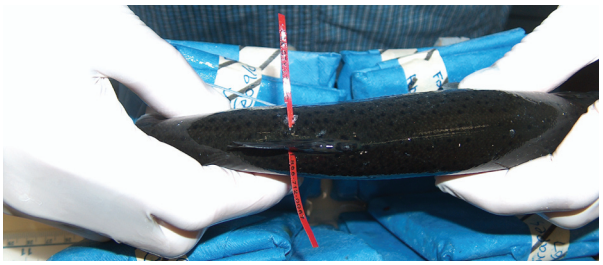
Appendix 4: Tagged Fish Reward Program Documentation

ATTENTION ANGLERS

REWARD

for Reporting Catch of 2007 Yellow Floy-Tagged Fish

Seattle City Light is studying the movements of hatchery - raised, triploid rainbow trout that are stocked each year in Boundary Reservoir in an effort to improve the fishery. Will you please help? We are asking you to do the following things:



- **Please RELEASE any fish you catch that have a RED, DOUBLE-STRAND STREAMER TAG. These tags indicate fish that have radio transmitters to track their movement; and**
- **Please REPORT any fish you catch with a SINGLE-STRAND YELLOW TAG (Floy tag; see photo) and RETURN THE TAG to us. For reporting, please provide the number on the tag, your contact information (name, address, phone number), the harvest date, specific harvest location, and approximate length of the fish.**
- **Put yellow Floy tags in envelopes provided at key Boundary Reservoir locations, and then place in drop boxes at these locations, or mail to us at the address below.**

You can contact us via the toll-free hotline number:

1-866-712-0067

Harvest reports AND TAGS can be mailed to this address:

Tetra Tech EC, Inc.
19803 North Creek Parkway
Bothell, WA 98011
Attn: SCL Boundary Reservoir
Tagged Fish Reward Program

We will send a $10 reward to each angler who reports a yellow-tagged catch and confirms the report by returning the tag. In addition, all anglers with a confirmed catch report will be entered into the next reward drawing after their catch, with a chance to win a cash prize of up to $100. Drawings will be held on June 1, September 1, and December 1. Winners will be notified by mail following each drawing. Please understand that we need your contact information and the tag to confirm the catch and send your reward.

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Table A.4-1. 2007 return log for tagged fish reward program tag returns.

Entry #	Mail Date	Sender Address	Tag #	Catch Date	Kept or Released	Hours Fished	Fish Length (Inches)	Catch Location
1	4/9/2007	PO Box 307, Metaline WA 99152	70662	4/6/07	R		11	1/4 mi. north of Slate Creek
2	4/17/2007	PO Box 307, Metaline WA 99152	70297	4/16/07	R		11	1/4 mi. north of Slate Creek
April Tot		**2 reports**	**2 tags**					
3	5/2/2007	P.O. Box 551, Ione, WA 99139	70574	4/29/07	K	2	11	Box Canyon Dam boat launch
4	5/3/07?	24409 Entwhistle Road East, Buckley, WA 98321	70519	4/16/07	R	2	10	Box Canyon Dam
			70504	4/17/07	R	1	11	Box Canyon Dam
5	5/3/2007	P.O. Box 771, Ione, WA 99139	70407	4/18/07			11	Everett Creek Island
			70154				11	1/4 mi. north of Slate Creek
			70319				11	1/4 mi. north of Slate Creek
			70451				11	1/4 mi. north of Slate Creek
6	5/3/2007	23031 LeClerc Rd. N, Ione, WA 99139	70583	5/4/07	R	4	9	Box Canyon Dam
			70871	5/4/07	R	1	9	Metaline
7	5/10/2007	P.O. Box 88, Usk, WA 99180	70105	5/7/07				Boundary Reservoir
			70415	5/7/07				Boundary Reservoir
8	5/15/2007	3361-B Thompson Road, Valley, WA 99181	70349	5/9/07	K	2	10	Boundary Dam
9	5/22/2007	2318 E Boone Ave, Spokane, WA 99202	70043	5/20/07	K	1	11	Boundary Dam
10	5/24/2007	P.O. Box 121, Ione, WA 99139	70986	5/24/07			10	Box Canyon Dam
11	5/24/2007	P.O. Box 760, Ione, WA 99139	70892	5/4/07			13	North of Box Canyon Dam
			70609	5/19/07			14	North of Box Canyon Dam
May Tot		**9 reports**	**16 tags**					
Bass Derby								
12	NA	P.O. Box 1166, Newport, WA 99156	70088	Derby wkd			11	Near powerhouse below Falls
13	NA	P.O. Box 203, Ione, WA 99139	70638	Derby wkd			11	Near Box Canyon Resort
14	NA	P.O. Box 652, Ione, WA 99139	70929	Derby wkd			11	In front of Box Canyon Resort
15	NA	P.O. Box 396, Metaline Falls, WA 99153	70344	Derby wkd			11	Just north of Slate Creek
16	NA	2326 Highway 25 North, Evans, WA 99126	70390	Derby wkd				

Table A.4-1, continued…

Entry #	Mail Date	Sender Address	Tag #	Catch Date	Kept or Released	Hours Fished	Fish Length (Inches)	Catch Location
17	NA	2643 Onion Creek Rd #28, Northport, WA 99157	74007	Derby wkd			SM bass	1 mile north of Tech Cominco mine
18	NA	P.O. Box 256, Cusick, WA 99119	70338	Derby wkd			12	Near powerhouse below Falls
19	NA	P.O. Box 64, Cusick, WA 99119	70756	Derby wkd				Near powerhouse below Falls
20	NA	P.O. Box 792, Newport, WA 99156	70961	Derby wkd				Near eagles' nest
			70976	Derby wkd				Near Box Canyon Resort
21	NA	P.O. Box 185, Metaline, WA 99152	70942	Derby wkd			11	Near old eagles' nest
22	NA	P.O. Box 121, Ione, WA 99139	70739	Derby wkd				Near back eddy downstream of high school
23	NA	P.O. Box 146, Ione, WA 99139	70676	Derby wkd				Near Box Canyon Resort
			70664	Derby wkd				Near Box Canyon Resort
Derby Tot		**12 reports**	**14 tags**					
Drop Box								
6/14/2007								
24	NA	P.O. Box 204, Metaline, WA 99152	70130	4/1-15/07				Boundary Dam
			70616	4/1-15/07				Boundary Reservoir
			70702	4/1-15/07				Boundary Reservoir
			70759	4/1-15/07				Boundary Reservoir
			70913	4/1-15/07				Boundary Reservoir
			70947	4/1-15/07				Boundary Reservoir
			70996	4/1-15/07				Boundary Reservoir
DB Tot		**1 report**	**7 tags**					
25	6/4/2007	P.O. Box 681, Ione, WA 99139	70027	5/26/07			11	Dock at Forebay Rec Area
26	6/7/2007	PO Box 533, Metaline Falls, WA 99153	70421	6/5/07			12	Above old mining powerhouse below Falls
27	6/12/2007	905 Celia Crescent, Trail, B.C. V1R 1B7	74564	5/30/07			11	2 miles above Seven Mile Dam
28	6/13/2007	P.O. Box 178, Ione, WA 99139	70944	5/10/07				Box Canyon boat ramp
			70639	5/10/07				Box Canyon boat ramp
			70577	5/10/07				Box Canyon boat ramp

Table A.4-1, continued…

Entry #	Mail Date	Sender Address	Tag #	Catch Date	Kept or Released	Hours Fished	Fish Length (Inches)	Catch Location
28 (cont'd)			70678	5/17/07				Box Canyon boat ramp
			70999	5/17/07				Box Canyon boat ramp
			70660	6/1/07				Stream gage below Box Canyon
			70979	6/1/07				Stream gage below Box Canyon
			70792	6/10/07				Stream gage below Box Canyon
			70933	6/10/07				Stream gage below Box Canyon
			70703	6/10/07				Stream gage below Box Canyon
			70627	6/10/07				Stream gage below Box Canyon
29	6/14/2007	205 8th Ave., Ione, WA 99139	70260	6/13/07			11	North side of boat dock
30	6/18/2007	261 Gregory Drive, Cheney, WA 99004-1102	70216	6/14/2007	K		8.5	Boundary Dam
31	6/18/2007	P.O. Box 324, Blanchard, ID 83804	70037	6/15/2007	K	1	13	Boundary Dam
			70893	6/15/07	K	1	12	Boundary Dam
32	6/22/07?	220 Lone Willow Lane, Ellensburg, WA 98926	70207	6/16/07			12	Near Pewee Falls
33	6/25/2007	P.O. Box 132, Cusick, WA 99119	70989	6/1/07	K	3	16	Boundary Dam
34	6/26/2007	211 Fir Drive, Cusick, WA 99119	70246	6/23/07			9	Mouth of Slate Creek
35	6/27/07?	P.O. Box 307, Metaline, WA 99152	70938	6/27/07	R		11	Sweet Creek area
			74003	6/27/07	R		SMB-11	Sweet Creek area
June Tot		**11 reports**	**23 tags**					
Running Total		**35 reports**	**62 tags**					
36	7/9/2007	PO Box 607, Ione WA 99139	70386	6/29/07			11.5	Lime Creek
37	7/9/2007	181 Highline Road, Metaline Falls, WA 99153	74585	7/7/07			SMB-10	Below Boundary Dam
38	7/13/2007	PO Box 307, Metaline WA 99152	74006	7/10/07			SMB-10	Below Box Canyon
39	7/16/2007	PO Box 185, Metaline WA 99152	70614	7/1/07			13	In front of Box Canyon Motel
40	7/18/2007	PO Box 771, Ione, WA 99139	70958	5/5/07			11	North of Metaline near High School

Table A.4-1, continued…

Entry #	Mail Date	Sender Address	Tag #	Catch Date	Kept or Released	Hours Fished	Fish Length (Inches)	Catch Location
41	7/19/2007	P.O. Box 681, Ione, WA 99139	70593	7/15/07			11	Mouth of Sweet Creek
			70709	7/15/07			11	Mouth of Sweet Creek
			70813	7/15/07			13	Mouth of Sweet Creek
42	7/21/2007	P.O. Box 652, Ione, WA 99139	70965	7/19/07			13	Eagles Nest Viewpoint
			70882	7/19/07			15	Eagles Nest Viewpoint
			70551	7/20/07			13	Eagles Nest Viewpoint
			70557	7/20/07			14	Eagles Nest Viewpoint
43	7/24/2007	PO Box 221, Ione, WA 99139	70628	7/20/07				below Eagles' Nest Look Out
44	7/24/2007	PO Box 221, Ione, WA 99139	70636					below Eagles' Nest Look Out
			74097					below Eagles' Nest Look Out
45	7/25/2007	PO Box 145, Ione, WA 99139	70982	7/5/07	R		13	Just below Box Canyon Dam
			70599	7/5/07	R		13	Just below Box Canyon Dam
			70611	7/6/07	R		13	Just below Box Canyon Dam
			70780	7/6/07	R		13	Just below Box Canyon Dam
			70728	7/8/07	R		13	Just below Box Canyon Dam
			70579	7/8/07	R		13	Just below Box Canyon Dam
46	7/25/2007	235 W. Cleveland Ave., Spokane, WA 99205	70307	7/6/07	R		13	Boundary Dam, 100 yds from silver barrels
47	7/26/2007	23613 57th Ave SE, Woodinville, WA 98072	70924	7/10/07				
			70966	7/10/07				
48	8/1/2007	PO Box 354, Metaline Falls, WA 99153	70781					Metaline Falls Park
		413 Pend Oreille Blvd.						
49	8/1/2007	2318 E. Boone Ave., Spokane, WA 99202-3712	70311				14	Boundary Reservoir Dam
			70418				17	Boundary Reservoir Dam
50	8/3/2007	PO Box 14, Metaline, WA 99152	70564	7/11/07			12	Sullivan Creek mouth
			70041	7/21/07			12.5	Sullivan Creek mouth
			70213	7/21/07			13	Sullivan Creek mouth
			70086	7/24/07			12	Pewee Falls
July Tot		**15 reports**	**31 tags**					

Table A.4-1, continued…

Entry #	Mail Date	Sender Address	Tag #	Catch Date	Kept or Released	Hours Fished	Fish Length (Inches)	Catch Location
Running Total		**50 reports**	**93 tags**					
51	8/6/2007	5307 Prufer Rd., Deer Park, WA 99006	70927	8/5/07			12.5	1/4 mile below Box Canyon Dam
52	8/10/2007	PO Box 673, Deer Park, WA 99006-0673	70095				13	East shore at Boundary Dam
53	8/13/2007	716 W. King Ave., Chewelah, WA 99109	70303					
54	8/14/2007	PO Box 369, Metaline Falls, WA 99153	70552	7/26/07			13	Mouth of Sullivan Creek
			70559	8/1/07			14	Mouth of Sullivan Creek
55	8/17/2007	23031 LeClerc Road N., Ione, WA 99139	70600	7/3/07	R	2		Metaline
			70837	7/3/07	R	2		Metaline
56	8/22/2007	PO Box 185, Metaline, WA 99152	70620	8/12/07			10.5	Metaline Park
57	8/22/2007	PO Box 915, Ione, WA 99139	70324	8/3/07			12	East bank, betw. log boom & survey mon.
			70225	8/9/07			12	Pewee Falls
			70139	8/9/07			12	Pewee Falls
			70788	8/9/07			10	Slate Creek
			70894	8/9/07			12	Slate Creek
58	8/13/2007	PO Box 383, Usk, WA 99180	70263	8/3/07				Pewee Falls
			70730					
59	8/30/2007	266 East 2nd Avenue, Colville, WA 99114	70538					
			70831					
Aug Tot		**9 reports**	**17 tags**					
Running Total		**59 reports**	**110 tags**					
60	9/10/2007	PO Box 346, Chattaroy, WA 99003	70440	8/18/07			15	Slate Creek
			70617	8/18/07			15	Slate Creek
61	8/18/2007	PO Box 85, Wilbur, WA 99185	70374	8/18/07			14	L. Roosevelt confluence w/ Spokane R.

Table A.4-1, continued…

Entry #	Mail Date	Sender Address	Tag #	Catch Date	Kept or Released	Hours Fished	Fish Length (Inches)	Catch Location
62	9/20/2007	476 Sandhagen Road, Port Angeles, WA 98363	70683					Near stream gage below Box Canyon
			70791					Near stream gage below Box Canyon
63	9/21/2007	23031 LeClerc Road, Ione, WA 99139	70904		R	4.5	13	Box Canyon Dam
			70908		R		13	Box Canyon Dam
64	9/25/2007	PO Box 1233, Newport, WA 99156	70066	7/28/07			13	Mouth of Sweet Creek
65	9/10/2007	PO Box 346, Chattaroy, WA 99003	70545	6/2/07			11	Lime Creek
Sep Tot		**6 reports**	**9 tags**					
Running Total		**65 reports**	**119 tags**					
66	10/9/2007	PO Box 21, Davenport, WA 99122	70951	7/13/07			20	Mouth of Lime Creek
			70392	7/21/07			19	Flume Creek
			70458	8/18/07			19	Lime Creek
			70188	8/4/07			19	Flume Creek
			70322	8/4/07			20	Flume Creek
			70543	8/18/07			20	Lime Creek
Oct Tot		**1 report**	**6 tags**					
Running Total		**66 reports**	**125 tags**					
Nov Tot		**0 reports**	**0 tags**					
Running Total		**66 reports**	**125 tags**					
67	12/8/2007	658 Clagstone Road, Spirit Lake, ID 83869	70206	8/13/2007			13	Boundary Dam/Pewee Falls/Launch
			70211	8/13/2007			13	Boundary Dam/Pewee Falls/Launch

Table A.4-1, continued…

Entry #	Mail Date	Sender Address	Tag #	Catch Date	Kept or Released	Hours Fished	Fish Length (Inches)	Catch Location
67 (cont'd)			70284	8/13/2007			13	Boundary Dam/Pewee Falls/Launch
			70414	8/14/2007			13	Boundary Dam/Pewee Falls/Launch
			70441	8/14/2007			13	Boundary Dam/Pewee Falls/Launch
Dec Tot		**1 report**	**5 tags**					
Running Total		**67 reports**	**130 tags**					

Notes:
Entries cover tags returned through December 14, 2007.
Highlighted tag numbers are from smallmouth bass; the rest are triploid rainbow trout.

Table A.4-2. 2008 return log for tagged fish reward program.

Entry #	Mail Date	Sender Address	Tag #	Catch Date	Kept or Released	Hours Fished	Fish Length (Inches)	Catch Location
1	2/15/2008	4924 N. Cannon, Spokane, WA 99205	70329	2/13/08			17.3	Lk. Roosevelt, 17 mi. above Gr. Coulee
Feb Total		**1 report**	**1 tag**					
Mar Total		**0 reports**	**0 tags**					
2	4/7/2008	Box 56 Metaline Falls, WA 99153	72031					
3	4/14/2008	PO Box 5, Ione, WA 99139	71516	4/1/08	R		10.5	Box Canyon boat launch
			72835		R		10.5	Box Canyon boat launch
			72895	4/3/08	R		10.0	Box Canyon boat launch
			73105	4/4/08	R		10.5	Box Canyon boat launch
			73304		R		10.5	Box Canyon boat launch
			73392	4/6/08	R		10.5	Box Canyon boat launch
			73394		R		10.5	Box Canyon boat launch
			73436	4/9/08	R		10.5	Box Canyon boat launch
4	4/14/2008	PO Box 5, Ione, WA 99139	70594	4/6/07	R		10.5	Box Canyon boat launch
			70637		R		10.5	Box Canyon boat launch
			70650	4/7/07	R		10.5	Box Canyon boat launch
			70701		R		10.5	Box Canyon boat launch
			70729	4/8/07	R		11.0	Cable crossing (gaging station)
			70768	4/9/07	R		9.5	Box Canyon boat launch
			70773		R		9.5	Box Canyon boat launch
			70889	4/11/07	R		10.0	Box Canyon boat launch
			71425	3/30/08	R		11.0	Boundary dam Reservoir
			71676	5/11/07	R		9.0	Box Canyon boat launch
			71754	5/8/07	R		9.0	Box Canyon boat launch

Table A.4-2, continued…

Entry #	Mail Date	Sender Address	Tag #	Catch Date	Kept or Released	Hours Fished	Fish Length (Inches)	Catch Location
5	4/14/2008	PO Box 502, Metaline Falls, WA 99153	70796				14.5	
			72811	3/26/08			12.0	
			73011	4/9/08				(Cut out of belly of pikeminnow
6	4/14/2008	PO Box 465, Metaline Falls, WA 99153	72962	4/13/08			11.5	Metaline Park boat ramp
7	4/22/2008	20309 135th Ave NE, Graham, WA 98338	72428	4/3/08			12.0	Forebay Rec Area campground
8	4/29/2008	PO Box 533, Metaline Falls, WA 99153	72072	4/10/08			9.0	300 yds. North of Metaline Falls Bridge
			72505				10.0	300 yds. North of Metaline Falls Bridge
April Total		**7 reports**	**27 tags**					
9	5/5/2008	PO Box 464, Metaline Falls, WA 99153	72322	5/4/08	R	4	14.0	Above Falls - MF bridge
10	5/5/2008	PO Box 774, Ione, WA 99139	73232	5/3/08	R	13.5	13.0	Box Canyon
			74808	5/3/08	R		13 RB	Box Canyon
11	5/5/2008	PO Box 642, Ione, WA 99139	72584	4/29/08	R	11	10.0	North of Pewee Falls
12	5/12/2008	PO Box 771, Ione, WA 99139	72392	4/16/08			10.5	1/2 mile north of Slate Creek
			72254	4/16/08			10.5	1/2 mile north of Slate Creek
			74701	5/3/08			16 RB	High school area
			73034	5/4/08			10.5	Box Canyon
			72739	5/4/08			10.5	Box Canyon
			72512	5/10/08			10.5	Everett Creek area
			72475	5/10/08			10.5	Everett Creek area
13	5/14/2008	PO Box 182, Metaline Falls WA 99153	73124	4/27/08	K	2	9.0	1/4 mile below Box Canyon Dam
14	5/14/2008	PO Box 85, Metaline Falls, WA 99153	74713	5/8/08	R	1.5	10.5 SMB	1/4 mile below Boundary Dam
		(reported 6 total fish, 10-14 inches, in 1.5 hours)						

Table A.4-2, continued…

Entry #	Mail Date	Sender Address	Tag #	Catch Date	Kept or Released	Hours Fished	Fish Length (Inches)	Catch Location
15	5/14/2008	PO Box 182, Metaline Falls WA 99153	73022	4/27/08	K	2	9.0	1/4 mile below Box Canyon Dam
16	5/16/2008	123 E. Crown, Spokane, WA 99207	72301	5/15/08	R	3	12.0	East end of dam
17	5/16/2008	123 E. Crown, Spokane, WA 99207	72379	5/14/08	R	2	10.0	Pewee Falls
18	5/16/2008	123 E. Crown, Spokane, WA 99207	72370	5/16/08	R	3	12.0	Boat landing
19	5/21/2008	1891 LeClerc Rd. S, Newport, WA 99156	72513	5/16/08	R	4	12.0	In front of dam
May Total		**11 reports**	**18 tags**					
20	6/12/2008	PO Box 261, Spirit Lake, ID 83869	72660	5/17/08	K	3	12.0	mouth of Boundary Dam
			71354	5/17/08	K	3	13.0	mouth of Boundary Dam
			71481	5/18/08	K	4	11.0	mouth of Boundary Dam
			72309	5/19/08	K	3	13.0	mouth of Boundary Dam
21	6/12/2008	PO Box 1165, Spirit Lake, ID 83869	72163	5/15/08	K	2.5	11.0	mouth of Boundary Dam
			72086	5/15/08	K	2.5	13.0	mouth of Boundary Dam
			72753	5/16/08	K	2	11.0	mouth of Boundary Dam
			73348	5/18/08	K	3	12.0	mouth of Boundary Dam
			72238	5/19/08	K	4	14.0	mouth of Boundary Dam
22	6/16/2008	PO Box 221, Ione, WA 99139	72988	6/13/08			14.0	Box Canyon Dam
			72826	6/13/08			14.0	Box Canyon Dam
			72179	5/19/08	K	3	11.0	mouth of Boundary Dam
23	6/23/2008	PO Box 261, Spirit Lake, ID 83869	72664	6/7/08	K	3	11.0	mouth of Boundary Dam
			73156	6/8/08	K	4	13.0	mouth of Boundary Dam
			72741	6/13/08	K	2	12.0	mouth of Boundary Dam

Table A.4-2, continued…

Entry #	Mail Date	Sender Address	Tag #	Catch Date	Kept or Released	Hours Fished	Fish Length (Inches)	Catch Location
24	6/23/2008	PO Box 1165, Spirit Lake, ID 83869	72604	6/6/08	K	3	13.0	mouth of Boundary Dam
			72678	6/8/08	K	5	12.0	mouth of Boundary Dam
			71499	6/14/08	K	2	13.0	mouth of Boundary Dam
			72328	6/15/08	K	3	11.0	mouth of Boundary Dam
June Total		**5 reports**	**19 tags**					
25	7/14/2008	PO Box 143, Ione, WA 99139	74652	7/13/08	K	3	16 LMB	East side across from Metaline Park
26	7/18/2008	PO Box 344, Metaline, WA 99152	74661	7/17/08	R	2	14 SMB	Metaline Falls bridge
27	7/19/2008	5208 N. Drury Rd., Otis Orchards, WA 99027	72258	7/18/08	K	10	12.0	Boundary Dam
28	7/21/2008	PO Box 307, Metaline, WA 99139	73220	7/3-12/08	R		14	Box Canyon Dam
			72943	7/3-12/08	R		14	Box Canyon Dam
			74503	7/3-12/08	R		16 GB	Box Canyon Dam
29	7/22/2008	PO Box 354, Metaline Falls, WA 99153	71768				12.0	Metaline Park
30	7/28/2008	PO Box 502, Metaline Falls, WA 99153	72828	4/28/08			12.0	
			74882	5/3/08			21 GB	
31	7/29/2008	1875 NE Old Belfair Hwy, Belfair WA 98528	71672	7/27/08	K	2	12.0	Campground
32	7/30/2008	PO Box 533, Metaline Falls, WA 99153	70580	7/18/08				200 yards south of Lime Ck, E side of river
33	7/31/2008	PO Box 56, Metaline Falls, WA 99153	72928					
			73408					
34	7/31/2008	PO Box 433, Ione, WA 99139	74612	7/29/08	R	6	15 LMB	Behind the high school
July Total		**10 reports**	**14 tags**					

Table A.4-2, continued…

Entry #	Mail Date	Sender Address	Tag #	Catch Date	Kept or Released	Hours Fished	Fish Length (Inches)	Catch Location
35	7/31/2008	PO Box 975, Ione, WA 99139	72740	7/31/08	R	0.75	14.0	Box Canyon Dam
36	8/11/2008	PO Box 464, Metaline Falls, WA 99153	73415	8/8/08	K	4	18.0	0.5 M above M.F. Bridge
37	8/14/2008	PO Box 307, Metaline, WA 99152	74937		R	4	16 SMB	~0.5 below Box Canyon Dam
38	8/14/2008	PO Box 500/406 1/2 Hough, Ione, WA 99139	72827	5/4/08	K	1.5	10.0	Boat Launch - Box Canyon Dam
39	8/15/2008	303 N. Main /PO Box 307, Metaline, WA 99152	74022		R	4	15 NP	Below Selkirk School
			73435		R	4	30.0	Below Selkirk School
40	8/18/2008	PO Box 396, Metaline Falls, WA 99153	72349	8/15/08	K	4	13.0	Near rope swing, 1 M? N. of Slate Creek
41	8/19/2008	Box 341, Metaline Falls, WA 99153	72623	8/2/08			12.0	Below Boundary dam, near Border
42	8/20/2008	1718 E. Lincoln Rd, #G244, Spokane, Wa 99217	72260	8/1/08	R	6	17.0	1 M. upstream of Boundary Dam
43	8/26/2008	PO Box 262, Metaline Falls, WA 99153	72217	8/8/08			15.0	N. of Boundary Dam Res
			72432	8/8/08			15.0	N. of Boundary Dam Res
Aug Total		**9 reports**	**11 tags**					
44	9/16/2008	PO Box 533, Metaline Falls, WA 99153	72666	8/11/08	K			Below SR 31 bridge at MF
45	9/17/2008	1708 Gala Way, Ellensburg, WA 98926	73391				14.0	Spring Canyon, Lake Roosevelt
46	9/29/2008	191 Hillcrest Lane, Newport, WA 99156	72340	8/16/08	K	5	17.0	1/2 way between dams, south of PeeWee
Sep Total		**3 reports**	**3 tags**					
47	10/6/2008	PO Box 130, Metaline Falls, WA 99153	73044				12.0	Down bank from Pend Oreille Blvd.
48	10/21/2008	PO Box 305 Metaline, WA 99152	72840	10/18/08	K	1	14.5	Boundary Dam boat launch area

Table A.4-2, continued…

Entry #	Mail Date	Sender Address	Tag #	Catch Date	Kept or Released	Hours Fished	Fish Length (Inches)	Catch Location
49	10/22/2008	PO Box 594, Colville, WA 99114	73418	9/28/08	K	3+	18.0	
50	10/23/2008	PO Box 771, Ione, WA 99139	72171	8/28/08	R	1	14.5	Everett Creek area
			72213	8/28/08		1	14.5	Everett Creek area
51	10/29/2008	PO Box 533, Metaline Falls, WA 99153	72635	10/23/08			16.0	Near Falls, above old powerhouse
Oct Total		**5 reports**	**6 tags**					
52	11/5/2008	11913 58th Place SE, Snohomish, WA	72859	10/23/2008			15.5	Willow basin at Lk. Roosevelt
Nov Total		**1 report**	**1 tag**					
Running Total		**52 reports**	**100 tags**					

Notes:
Highlighted tag entries are for species other than triploid rainbow trout.
Species abbreviations:
- RB – rainbow trout
- GB – German brown trout
- LMB – largemouth bass
- SMB – smallmouth bass
- NP – northern pike

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Appendix 5: Tag Status, Implantation Information, and CART Tag Physical Data Record

Table A.5-1. Deployed radio and CART tags and status of the tag (whether the fish is alive, dead, or suspected to be dead) as determined through mobile telemetry tracking and review of telemetry data recorded at the shore-based station during biotelemetry monitoring, April 2007 to September 2008.

Release Information							Approximate Time and Location of Last Valid Non-Suspect Detection		Condition Status and Fate of Fish			
Species	**Tag Class**	**Radio Tag Code**	**Acoustic Tag Code**	**Release Site Reach**	**Release Date**	**Release PRM**	**Date Time**	**PRM**	**Status[2]**	**Evidence Code[1]**	**Date After Which Fish Health was Suspect**	**Days at Large**
rainbow trout (triploid spring07)	Radio	76		upper reservoir	30-Mar-07	34.2	2-May-07 14:00	29.6	Dead	5	2-May-07	34
	Radio	77		upper reservoir	30-Mar-07	34.2	17-Jul-07 14:50	25.9	Dead	4	17-Jul-07	110
	Radio	78		upper reservoir	30-Mar-07	34.2	15-May-07 16:26	14	Suspect	6	15-May-07	47
	Radio	79		upper reservoir	30-Mar-07	34.2	13-Apr-07 23:54	34.1	Dead	2	13-Apr-07	15
	Radio	80		upper reservoir	30-Mar-07	34.2	13-Apr-07 13:04	33.1	Dead	2	13-Apr-07	15
	Radio	81		upper reservoir	30-Mar-07	34.2	13-Apr-07 23:54	34.1	Dead	4	13-Apr-07	15
	Radio	82		upper reservoir	30-Mar-07	34.2	16-Jul-07 02:52	30.9	Dead	5	16-Jul-07	108
	Radio	83		upper reservoir	30-Mar-07	34.2	1-May-07 22:21	26.6	Dead	6	1-May-07	33
	Radio	84		upper reservoir	30-Mar-07	34.2	16-May-07 10:07	26.6	Dead	6	16-May-07	47
	Radio	85		upper reservoir	30-Mar-07	34.2	31-Mar-07 00:00	34.1	Dead	5	30-Mar-07	1
	Radio	87		forebay	30-Mar-07	17.3	30-Mar-07 23:17	17	Dead	3	30-Mar-07	1
	Radio	88		forebay	30-Mar-07	17.3	18-Apr-07 13:36	16	Dead	5	18-Apr-07	20

Table A.5-1, continued…

Release Information							Approximate Time and Location of Last Valid Non-Suspect Detection		Condition Status and Fate of Fish			
Species	**Tag Class**	**Radio Tag Code**	**Acoustic Tag Code**	**Release Site Reach**	**Release Date**	**Release PRM**	**Date Time**	**PRM**	**Status[2]**	**Evidence Code[1]**	**Date After Which Fish Health was Suspect**	**Days at Large**
rainbow trout (triploid spring07) (cont'd)	Radio	89		forebay	30-Mar-07	17.3	30-Mar-07 23:58	16	Dead	4	30-Mar-07	1
	Radio	90		forebay	30-Mar-07	17.3	30-Mar-07 23:35	17	Dead	5	30-Mar-07	1
	Radio	91		forebay	30-Mar-07	17.3	8-May-07 17:45	17	Dead	5	8-May-07	40
	Radio	92		forebay	30-Mar-07	17.3	1-Apr-07 08:26	17	Dead	5	1-Apr-07	2
	Radio	93		forebay	30-Mar-07	17.3	31-Mar-07 23:52	17	Dead	5	31-Mar-07	2
	Radio	94		forebay	30-Mar-07	17.3	30-Mar-07 20:57	16	Dead	5	30-Mar-07	1
	Radio	95		forebay	30-Mar-07	17.3	6-Apr-07 14:05	17	Dead	3	6-Apr-07	8
	Radio	96		forebay	30-Mar-07	17.3	12-May-07 23:57	17.9	Dead	3	12-May-07	44
rainbow trout (triploid fall07)	Radio	133		upper reservoir	19-Oct-07	34.2	20-Oct-07 19:52	29.6	Suspect	5	20-Oct-07	2
	Radio	135		forebay	19-Oct-07	17.3	21-Oct-07 11:04	17.9	Suspect	5	21-Oct-07	2
	Radio	136		upper reservoir	19-Oct-07	34.2	19-Oct-07 23:27	34.1	Dead	3	19-Oct-07	1
	Radio	137		upper reservoir	19-Oct-07	34.2	22-Oct-07 05:33	26.9	Suspect	4	22-Oct-07	3
	Radio	138		forebay	19-Oct-07	17.3	22-Jul-08 20:53	17	Alive	0		278
	Radio	139		upper reservoir	19-Oct-07	34.2	7-Nov-07 12:43	30.2	Suspect	5	7-Nov-07	20

Table A.5-1, continued…

Release Information							Approximate Time and Location of Last Valid Non-Suspect Detection		Condition Status and Fate of Fish			
Species	**Tag Class**	**Radio Tag Code**	**Acoustic Tag Code**	**Release Site Reach**	**Release Date**	**Release PRM**	**Date Time**	**PRM**	**Status[2]**	**Evidence Code[1]**	**Date After Which Fish Health was Suspect**	**Days at Large**
rainbow trout (triploid fall07) (cont'd)	Radio	140		forebay	19-Oct-07	17.3	20-Oct-07 23:28	17	Suspect	5	20-Oct-07	2
	Radio	141		forebay	19-Oct-07	17.3	25-Dec-07 23:23	17	Suspect	5	25-Dec-07	68
	Radio	142		upper reservoir	19-Oct-07	34.2	11-Jan-08 13:34	34.1	Suspect	5	11-Jan-08	85
	Radio	143		forebay	19-Oct-07	17.3	6-Jan-08 04:40	17.9	Suspect	5	6-Jan-08	79
	Radio	144		upper reservoir	19-Oct-07	34.2	26-Oct-07 20:15	29.6	Dead	5	26-Oct-07	8
	Radio	145		upper reservoir	19-Oct-07	34.2	24-Oct-07 09:03	26.9	Suspect	5	24-Oct-07	5
	Radio	146		forebay	19-Oct-07	17.3	21-Dec-07 23:41	17	Suspect	5	21-Dec-07	64
	Radio	147		upper reservoir	19-Oct-07	34.2	21-Nov-07 15:39	31.6	Suspect	5	21-Nov-07	34
	Radio	148		forebay	19-Oct-07	17.3	20-Oct-07 23:58	18	Suspect	3	20-Oct-07	2
	Radio	149		upper reservoir	19-Oct-07	34.2	20-Oct-07 23:31	34.1	Suspect	5	20-Oct-07	2
	Radio	150		upper reservoir	19-Oct-07	34.2	20-Oct-07 04:28	29.6	Suspect	4	20-Oct-07	1
	Radio	151		forebay	19-Oct-07	17.3	20-Oct-07 23:31	17	Suspect	5	20-Oct-07	2
	Radio	152		forebay	19-Oct-07	17.3	24-Mar-08 15:29	16.5	Dead	2	24-Mar-08	158

Table A.5-1, continued…

Release Information							Approximate Time and Location of Last Valid Non-Suspect Detection		Condition Status and Fate of Fish			
Species	**Tag Class**	**Radio Tag Code**	**Acoustic Tag Code**	**Release Site Reach**	**Release Date**	**Release PRM**	**Date Time**	**PRM**	**Status[2]**	**Evidence Code[1]**	**Date After Which Fish Health was Suspect**	**Days at Large**
rainbow trout (triploid carry-over) (cont'd)	CART	11	800	forebay	22-Sep-07	17.7	27-Sep-07 22:41	17	Dead	2	27-Sep-07	6
	CART	12	900	forebay	17-Oct-07	17.3	7-Jun-08 04:10	17	Alive	0		234
	CART	28	2500	upper reservoir	13-Jun-07	34.3	26-Oct-07 23:57	14	Dead	5	26-Oct-07	136
	CART	31	2800	tailrace	17-Jun-07	16.5	15-Jul-08 03:03	16.5	Alive	0		394
	CART	32	2900	forebay	17-Oct-07	17.3	29-Sep-08 07:23	14	Alive	0		348
	CART	33	3000	canyon	30-Aug-07	25.2	22-Mar-08 18:33	17	Suspect	5	22-Mar-08	206
	CART	34	3100	canyon	22-Jun-07	22.2	22-Jun-07 23:51	22.1	Dead	1	22-Jun-07	1
	CART	35	3200	forebay	22-Jun-07	17.9	22-Jun-07 23:57	17.9	Suspect	4	22-Jun-07	1
	CART	36	3300	canyon	22-Jun-07	22.2	4-Jul-07 17:05	18.3	Dead	4	4-Jul-07	13
	CART	37	3400	forebay	20-Jun-07	17.9	17-Jul-07 16:15	17.9	Dead	4	17-Jul-07	28
	CART	38	3500	forebay	20-Jun-07	17.9	21-Jun-07 02:49	17.9	Dead	4	21-Jul-07	1
	CART	39	3600	upper reservoir	21-Sep-07	30.9	13-Dec-07 11:15	28	Suspect	4	13-Dec-07	83
	CART	40	3700	forebay	25-May-07	17.3	20-Aug-07 23:53	26.9	Suspect	4	20-Aug-07	88

Table A.5-1, continued…

Release Information							Approximate Time and Location of Last Valid Non-Suspect Detection		Condition Status and Fate of Fish			
Species	**Tag Class**	**Radio Tag Code**	**Acoustic Tag Code**	**Release Site Reach**	**Release Date**	**Release PRM**	**Date Time**	**PRM**	**Status[2]**	**Evidence Code[1]**	**Date After Which Fish Health was Suspect**	**Days at Large**
rainbow trout (triploid carry-over) (cont'd)	CART	44	4100	upper reservoir	20-Oct-07	34	2-Feb-08 01:19	29.6	Dead	4	2-Feb-08	105
	CART	47	4400	upper reservoir	29-Feb-08	30.4	27-Jun-08 15:19	13.3	Alive	0		120
	CART	48	4500	upper reservoir	20-Oct-07	34	26-Jan-08 21:35	29.6	Suspect	6	26-Jan-08	99
	CART	49	4600	upper reservoir	28-Jul-07	30.9	28-Jul-07 14:44	30.9	Dead	4	28-Jul-07	1
	CART	53	5000	upper reservoir	20-Oct-07	34	11-Aug-08 07:12	16.5	Alive	0		296
	CART	55	5200	upper reservoir	13-Jun-07	30.9	12-Aug-07 04:34	30.9	Dead	5	12-Aug-07	60
	CART	61	5800	upper reservoir	28-Jul-07	30.9	28-Jul-07 23:55	29.6	Dead	2	28-Jul-07	1
	CART	62	5900	upper reservoir	28-Jul-07	27	28-Jul-07 23:55	26.9	Suspect	5	28-Jul-07	1
	CART	64	6100	upper reservoir	29-Feb-08	33.6	7-Jun-08 23:58	16.5	Dead	2	7-Jun-08	100
	CART	70	6700	upper reservoir	27-Jul-07	33.6	28-Jul-07 00:00	30.9	Dead	6	28-Jul-07	1
	CART	74	7100	upper reservoir	29-Feb-08	30.4	29-Feb-08 00:00	34.1	Dead	5	29-Feb-08	0
	Radio	119		upper reservoir	16-Apr-08	31.8	3-Oct-08 13:43	17	Alive	0		171
	Radio	120		upper reservoir	16-Apr-08	30.1	25-Apr-08 23:51	28	Dead	4	25-Apr-08	10

Table A.5-1, continued…

Release Information							Approximate Time and Location of Last Valid Non-Suspect Detection		Condition Status and Fate of Fish			
Species	**Tag Class**	**Radio Tag Code**	**Acoustic Tag Code**	**Release Site Reach**	**Release Date**	**Release PRM**	**Date Time**	**PRM**	**Status[2]**	**Evidence Code[1]**	**Date After Which Fish Health was Suspect**	**Days at Large**
rainbow trout (triploid carry-over) (cont'd)	Radio	122		canyon	16-Apr-08	25.8	30-May-08 19:19	16	Alive	0		45
	Radio	126		upper reservoir	15-Apr-08	33.8	1-Oct-08 09:21	16.5	Alive	0		169
	Radio	127		upper reservoir	25-Apr-08	28.8	26-Apr-08 23:24	26.6	Suspect	5	26-Apr-08	2
	Radio	128		upper reservoir	19-Apr-08	34.1	15-Jul-08 16:27	19.9	Dead	7	27-Jul-08	88
	Radio	132		upper reservoir	16-Apr-08	29.8	6-Jun-08 02:00	29.2	Dead	4	6-Jun-08	51
	Radio	162		upper reservoir	25-Apr-08	31.6	26-Apr-08 10:28	30.9	Suspect	5	26-Apr-08	1
	Radio	164		upper reservoir	19-Apr-08	34.1	7-Jul-08 04:49	34.1	Alive	0		79
	Radio	170		canyon	17-Apr-08	23	17-Sep-08 12:41	19	Alive	0		154
	Radio	171		canyon	16-Apr-08	25.6	1-Oct-08 09:21	16.5	Alive	0		168

Notes:

1 **Evidence code** **Evidence description**

Evidence code	Evidence description
0	alive, movement recorded
1	tag recovered from river, above high water mark
2	tag recovered from river, below high water mark
3	tag not recovered, stationary, above high water mark
4	tag not recovered, stationary, below high water mark
5	location unknown, no or very few valid detections
6	continual downstream movement
7	tag returned by angler

2 Status designation as of September 2008:

Alive—A tagged fish that demonstrates active movement independent of river discharge and detected as either upstream movement between shore-based stations or localized movement detected during mobile telemetry tracking. When in range of only a single shore-based station, variations in signal detection and strength than did not correlated with reservoir fluctuation were used a confirmation of the "alive" status, but this method was less reliable. Fish designated as alive and provided extend periods of valid data maintained their designation as alive unless evidence suggested a change in status.

Table A.5-1, continued…

Suspect—A tagged fish either rarely detect or not exhibiting normal movement behavior. Typically, fish that were located to the exact location over three or more separate mobile tracking sessions were considered suspect, but this method was occasionally prone to over estimate the number of suspect fish, especially in winter when fish tended to remain stationary. Fish in atypical habitat (e.g., rainbow trout in weed bed) were also considered suspect.
Dead—A tagged fish was designated dead if the fish remained stationary for a greatly extended period (several months), or was rarely detected initially after release and then not detected after that. More definitvely, tags located above the high water mark or, of course, recovered from shore or return by anglers were considered dead.

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Table A.5-2. Tag implantation, surgery, and release information of triploid rainbow trout tagged as part of 2007/2008 biotelemetry monitoring.

Sample Number	Capture Site Reach	Capture Site	PRM Capture	Water Temp (ºC)	Triploid Rainbow Trout Type	Fork Length (mm)	Total Length (mm)	Weight (g)	Date of Surgery	Surgeon Initials	Radio tag tested Y/N	Tag Class	Tag Type	Radio Tag Frequency (MHz)	Radio Tag Code	Acoustic Tag Code	Streamer Tag No.	Tag Color	Fish Rel with tags (Y/N)	Release Date	Release Time	Release Location	Release Site Reach	PRM Release	Comments / External Condition
1				5.4	Spring 2007		265	166	29-Mar-07	BC	y	Radio	NTC-6-2	151.4	76		2	red	y	30-Mar-07	9:28	Box Canyon TR	upper reservoir	34.2	42ºF
2				5.4	Spring 2007		274	198	29-Mar-07	BC	y	Radio	NTC-6-2	151.4	77		3	red	y	30-Mar-07	9:28	Box Canyon TR	upper reservoir	34.2	
3				5.4	Spring 2007		268	164	29-Mar-07	EC	y	Radio	NTC-6-2	151.4	78		4	red	y	30-Mar-07	9:28	Box Canyon TR	upper reservoir	34.2	
4				5.4	Spring 2007		289	182	29-Mar-07	EC	y	Radio	NTC-6-2	151.4	79		6	red	y	30-Mar-07	9:28	Box Canyon TR	upper reservoir	34.2	
5				5.4	Spring 2007		265	164	29-Mar-07	RN	y	Radio	NTC-6-2	151.4	80		7	red	y	30-Mar-07	9:28	Box Canyon TR	upper reservoir	34.2	
6				5.4	Spring 2007		270	170	29-Mar-07	RM	y	Radio	NTC-6-2	151.4	81		8	red	y	30-Mar-07	9:28	Box Canyon TR	upper reservoir	34.2	
7				5.4	Spring 2007		272	184	29-Mar-07	TL	y	Radio	NTC-6-2	151.4	82		9	red	y	30-Mar-07	9:28	Box Canyon TR	upper reservoir	34.2	
8				5.4	Spring 2007		239	144	29-Mar-07	TL	y	Radio	NTC-6-2	151.4	83		10	red	y	30-Mar-07	9:28	Box Canyon TR	upper reservoir	34.2	
9				5.4	Spring 2007		265	174	29-Mar-07	DF	y	Radio	NTC-6-2	151.4	84		11	red	y	30-Mar-07	9:28	Box Canyon TR	upper reservoir	34.2	
10				5.4	Spring 2007		232	122	29-Mar-07	BC	y	Radio	NTC-6-2	151.4	85		12	red	y	30-Mar-07	9:28	Box Canyon TR	upper reservoir	34.2	
11				5.4	Spring 2007		265	158	29-Mar-07	DF	y	Radio	NTC-6-2	151.4	87		14	red	y	30-Mar-07	12:23	Boundary FB	forebay	17.3	7.1ºC
12				5.4	Spring 2007		288	210	29-Mar-07	BC	y	Radio	NTC-6-2	151.4	88		15	red	y	30-Mar-07	12:23	Boundary FB	forebay	17.3	
13				5.4	Spring 2007		282	206	29-Mar-07	EC	y	Radio	NTC-6-2	151.4	89		16	red	y	30-Mar-07	12:23	Boundary FB	forebay	17.3	
14				5.4	Spring 2007		265	164	29-Mar-07	RM	y	Radio	NTC-6-2	151.4	90		19	red	y	30-Mar-07	12:23	Boundary FB	forebay	17.3	
15				5.4	Spring 2007		268	190	29-Mar-07	EC	y	Radio	NTC-6-2	151.4	91		18	red	y	30-Mar-07	12:23	Boundary FB	forebay	17.3	
16				5.4	Spring 2007		268	172	29-Mar-07	EC	y	Radio	NTC-6-2	151.4	92		20	red	y	30-Mar-07	12:23	Boundary FB	forebay	17.3	
17				5.4	Spring 2007		256	150	29-Mar-07	RM	y	Radio	NTC-6-2	151.4	93		21	red	y	30-Mar-07	12:23	Boundary FB	forebay	17.3	

Table A.5-2, continued…

Sample Number	Capture Site Reach	Capture Site	PRM Capture	Water Temp (ºC)	Triploid Rainbow Trout Type	Fork Length (mm)	Total Length (mm)	Weight (g)	Date of Surgery	Surgeon Initials	Radio tag tested Y/N	Tag Class	Tag Type	Radio Tag Frequency (MHz)	Radio Tag Code	Acoustic Tag Code	Streamer Tag No.	Tag Color	Fish Rel with tags (Y/N)	Release Date	Release Time	Release Location	Release Site Reach	PRM Release	Comments / External Condition
18				5.4	Spring 2007		267	174	29-Mar-07	TL	y	Radio	NTC-6-2	151.4	94		22	red	y	30-Mar-07	12:23	Boundary FB	forebay	17.3	
19				5.4	Spring 2007		263	182	29-Mar-07	RM	y	Radio	NTC-6-2	151.4	95		23	red	y	30-Mar-07	12:23	Boundary FB	forebay	17.3	
20				5.4	Spring 2007		282	224	29-Mar-07	TL	y	Radio	NTC-6-2	151.4	96		25	red	y	30-Mar-07	12:23	Boundary FB	forebay	17.3	
21				11.6	Fall 2007	279		287	18-Oct-07	LH	y	Radio	NTC-6-2	151.4	133		90	red	y	19-Oct-07	12:30	BXTR	upper reservoir	34.2	Health at release, 10 Fish transferred to BXTR, 11.6 C water temp
23				11.6	Fall 2007	260		195	18-Oct-07	LH	y	Radio	NTC-6-2	151.4	134		91	red	n						not healthy, scarificed and tag removed
25				11.6	Fall 2007	266		191	18-Oct-07	PG	y	Radio	NTC-6-2	151.4	135		92	red	y	19-Oct-07	9:00	BDFB	forebay	17.3	Healthy at release, Only 7 fish in pen after remove of BXTR fish
27				11.6	Fall 2007	297		294	18-Oct-07	PG	y	Radio	NTC-6-2	151.4	136		93	red	y	19-Oct-07	12:30	BXTR	upper reservoir	34.2	Healthy at release
29				11.6	Fall 2007	260		237	18-Oct-07	PG	y	Radio	NTC-6-2	151.4	137		94	red	y	19-Oct-07	12:30	BXTR	upper reservoir	34.2	Healthy at release
31				11.6	Fall 2007	295		335	18-Oct-07	PG	y	Radio	NTC-6-2	151.4	138		95	red	y	19-Oct-07	9:00	BDFB	forebay	17.3	Healthy at release
33				11.6	Fall 2007	270		227	18-Oct-07	PG	y	Radio	NTC-6-2	151.4	139		96	red	y	19-Oct-07	12:30	BXTR	upper reservoir	34.2	Healthy at release
24				11.6	Fall 2007	270		228	18-Oct-07	LH	y	Radio	NTC-6-2	151.4	140		124	red	y	19-Oct-07	9:00	BDFB	forebay	17.3	Healthy at release
26				11.6	Fall 2007	278		273	18-Oct-07	LH	y	Radio	NTC-6-2	151.4	141		125	red	y	19-Oct-07	9:00	BDFB	forebay	17.3	Healthy at release
28				11.6	Fall 2007	264		242	18-Oct-07	LH	y	Radio	NTC-6-2	151.4	142		126	red	y	19-Oct-07	12:30	BXTR	upper reservoir	34.2	Healthy at release
30				11.6	Fall 2007	275		235	18-Oct-07	LH	y	Radio	NTC-6-2	151.4	143		127	red	y	19-Oct-07	9:00	BDFB	forebay	17.3	Healthy at release
32				11.6	Fall 2007	288		282	18-Oct-07	LH	y	Radio	NTC-6-2	151.4	144		128	red	y	19-Oct-07	12:30	BXTR	upper reservoir	34.2	Health at release, Bleeding from cannula exit wound
34				11.6	Fall 2007	263		237	18-Oct-07	LH	y	Radio	NTC-6-2	151.4	145		129	red	y	19-Oct-07	12:30	BXTR	upper reservoir	34.2	Healthy at release
35				11.6	Fall 2007	270		258	18-Oct-07	LH	y	Radio	NTC-6-2	151.4	146		130	red	y	19-Oct-07	9:00	BDFB	forebay	17.3	Healthy at release
36				11.6	Fall 2007	280		256	18-Oct-07	PG	y	Radio	NTC-6-2	151.4	147		131	red	y	19-Oct-07	12:30	BXTR	upper reservoir	34.2	Healthy at release
37				11.6	Fall 2007	276		280	18-Oct-07	PG	y	Radio	NTC-6-2	151.4	148		132	red	y	19-Oct-07	9:00	BDFB	forebay	17.3	Healthy at release
38				11.6	Fall 2007	243		298	18-Oct-07	PG	y	Radio	NTC-6-2	151.4	149		133	red	y	19-Oct-07	12:30	BXTR	upper reservoir	34.2	Healthy at release, Enlarged cloaca

Table A.5-2, continued…

Sample Number	Capture Site Reach	Capture Site	PRM Capture	Water Temp (ºC)	Triploid Rainbow Trout Type	Fork Length (mm)	Total Length (mm)	Weight (g)	Date of Surgery	Surgeon Initials	Radio tag tested Y/N	Tag Class	Tag Type	Radio Tag Frequency (MHz)	Radio Tag Code	Acoustic Tag Code	Streamer Tag No.	Tag Color	Fish Rel with tags (Y/N)	Release Date	Release Time	Release Location	Release Site Reach	PRM Release	Comments / External Condition
39				11.6	Fall 2007	278		299	18-Oct-07	PG	y	Radio	NTC-6-2	151.4	150		134	red	y	19-Oct-07	12:30	BXTR	upper reservoir	34.2	Healthy at release
40				11.6	Fall 2007	290		327	18-Oct-07	PG	y	Radio	NTC-6-2	151.4	151		135	red	y	19-Oct-07	9:00	BDFB	forebay	17.3	Healthy at release
22				11.6	Fall 2007	270		243	18-Oct-07	PG	y	Radio	NTC-6-2	151.4	152		136	red	y	19-Oct-07	9:00	BDFB	forebay	17.3	Healthy at release
91127	forebay	F1E	17.7	17.8	Carry-over	452		937	21-Sep-07	RM	y	CART	CH-TP11-18	151.4	11	800			y	22-Sep-07	8:00	F2E	forebay	17.7	
91132	forebay	F1E	17.3	12	Carry-over	364	367	469	16-Oct-07	TL	y	CART	CH-TP11-18	151.4	12	900	97	red	y	17-Oct-07	9:30	F1E	forebay	17.3	
91103	upper reservoir	below Box Canyon Dam	34.3	8.1	Carry-over	316		406	13-Jun-07	RM	y	CART	CH-TP11-18	151.4	28	2500	58	red	y	13-Jun-07	23:46	below Box Canyon	upper reservoir	34.3	T309-524
91102	tailrace	Tailrace	16.5	14.1	Carry-over	376	381	541	17-Jun-07	RM	y	CART	CH-TP11-18	151.4	31	2800	66	red	y	17-Jun-07	4:50	Tailrace	tailrace	16.5	released with cart tagT309-527
91131	forebay	F1E	17.3	12	Carry-over	450	455	803	16-Oct-07	TL	y	CART	CH-TP11-18	151.4	32	2900	98	red	y	17-Oct-07	9:30	F1E	forebay	17.3	maxillary deformity, old hook wound
91122	canyon	C3E	25.2	20.6	Carry-over	386		598	30-Aug-07	EC	y	CART	CH-TP11-18	151.4	33	3000	120	red	y	30-Aug-07	23:30	C3E,lower cell	canyon	25.2	Fish captured near the outfall of small tributary where water temperature was recorded at 19.5 C; fish held for approximately 6 hours at the outflow of the stream prior to surgery; fish released healthy as soon as it recovered from surgery
91112	tailrace	Tailrace	16.5	15.5	Carry-over	417	440	797	22-Jun-07	RM	y	CART	CH-TP11-18	151.4	34	3100	80	red	y	22-Jun-07	18:00	Slate Cr delta	canyon	22.2	transferred above Boundary dam
91111	tailrace	Tailrace	16.5	15.5	Carry-over	377	390	570	22-Jun-07	RM	y	CART	CH-TP11-18	151.4	35	3200	76	red	y	22-Jun-07	17:45	Peewee Cr	forebay	17.9	transferred above Boundary dam
91110	tailrace	Tailrace	16.5	15.5	Carry-over	359	372	458	22-Jun-07	RM	y	CART	CH-TP11-18	151.4	36	3300	73	red	y	22-Jun-07	18:00	Slate Cr delta	canyon	22.2	transferred above Boundary dam
91106	forebay	Peewee Cr delta	17.9	15.7	Carry-over	338	346	475	20-Jun-07	RM	y	CART	CH-TP11-18	151.4	37	3400	67	red	y	20-Jun-07	18:55	Peewee Cr	forebay	17.9	346mm total length
91107	forebay	Peewee Cr delta	17.9	15.7	Carry-over	350	361	538	20-Jun-07	RM	y	CART	CH-TP11-18	151.4	38	3500	68	red	y	20-Jun-07	18:55	Peewee Cr	forebay	17.9	361mm total length
91126	upper reservoir	UR5E	30.9	16.7	Carry-over	415	420	590	20-Sep-07	RM	y	CART	CH-TP11-18	151.4	39	3600	150	red	y	21-Sep-07	15:50	UR5E	upper reservoir	30.9	
91101	forebay	F2E	17.3	14	Carry-over	427	450	962	25-May-07	TL	y	CART	CH-TP11-18	151.4	40	3700	50	red	y	25-May-07	3:00	Forebay, near boat launch	forebay	17.3	triploid carryover

Table A.5-2, continued…

Sample Number	Capture Site Reach	Capture Site	PRM Capture	Water Temp (ºC)	Triploid Rainbow Trout Type	Fork Length (mm)	Total Length (mm)	Weight (g)	Date of Surgery	Surgeon Initials	Radio tag tested Y/N	Tag Class	Tag Type	Radio Tag Frequency (MHz)	Radio Tag Code	Acoustic Tag Code	Streamer Tag No.	Tag Color	Fish Rel with tags (Y/N)	Release Date	Release Time	Release Location	Release Site Reach	PRM Release	Comments / External Condition
91134	upper reservoir	UR1E	33.6	11	Carry-over	352	367	456	19-Oct-07	TL	y	CART	CH-TP11-18	151.4	44	4100	140	red	y	20-Oct-07	8:00	gaging station below Box Canyon Dam	upper reservoir	34	released healthy
91173	upper reservoir	UR7E	30.4	1.2	Carry-over	387	407	805	28-Feb-08	RM	Y	CART	CH-TP11-18	151.4	47	4400	182	red	y	29-Feb-08	14:30	UR7E, upper cell	upper reservoir	30.4	released healthy
91136	upper reservoir	UR1E	33.6	11	Carry-over	351	374	459	19-Oct-07	TL	y	CART	CH-TP11-18	151.4	48	4500	139	red	y	20-Oct-07	8:00	gaging station below Box Canyon Dam	upper reservoir	34	released healthy
91117	upper reservoir	UR5	30.9	22.7	Carry-over	349	364	468	28-Jul-07	RM	y	CART	CH-TP11-18	151.4	49	4600			y	28-Jul-07	8:20	UR5	upper reservoir	30.9	Captured at the Sweet Creek delta; fish held holding sock in 16.5 C water at Sweet Creek prior to surgery for approximately 3 hours; fish released in tributary mouth where cool water was mixing with reservoir approximately 30 minutes after surgery; temperature of reservoir at time of release was 22.7; fish released healthy
91135	upper reservoir	UR1E	33.6	11	Carry-over	360	375	444	19-Oct-07	TL	y	CART	CH-TP11-18	151.4	53	5000	138	red	y	20-Oct-07	8:00	gaging station below Box Canyon Dam	upper reservoir	34	released healthy
91104	upper reservoir	Sweet Cr delta	30.9	8.1	Carry-over	392	415	668	13-Jun-07	RM	y	CART	CH-TP11-18	151.4	55	5200	62	red	y	13-Jun-07	23:50	Sweet Cr	upper reservoir	30.9	T309-552
91118	upper reservoir	UR5	30.9	22.7	Carry-over	397	415	663	28-Jul-07	RM	y	CART	CH-TP11-18	151.4	61	5800			y	28-Jul-07	8:20	UR5	upper reservoir	30.9	Captured at the Sweet Creek delta; fish held holding sock in 16.5 C water at Sweet Creek prior to surgery for approximately 3 hours; fish released in tributary mouth where cool water was mixing with reservoir approximately 30 minutes after surgery; temperature of reservoir at time of release was 22.7; fish released healthy
91120	upper reservoir	UR9	27	25	Carry-over	450	472	1009	28-Jul-07	RM	y	CART	CH-TP11-18	151.4	62	5900			y	28-Jul-07	8:20	UR9	upper reservoir	27	Captured near Sullivan Creek; fish held in 18 C water in Sullivan Creek prior to surgery for approximately 2 hours and post surgery for approximately 2 hours; fish released in tributary mouth where cool water was mixing with reservoir; temperature of reservoir at time of release was 25; fish released healthy

Table A.5-2, continued…

Sample Number	Capture Site Reach	Capture Site	PRM Capture	Water Temp (ºC)	Triploid Rainbow Trout Type	Fork Length (mm)	Total Length (mm)	Weight (g)	Date of Surgery	Surgeon Initials	Radio tag tested Y/N	Tag Class	Tag Type	Radio Tag Frequency (MHz)	Radio Tag Code	Acoustic Tag Code	Streamer Tag No.	Tag Color	Fish Rel with tags (Y/N)	Release Date	Release Time	Release Location	Release Site Reach	PRM Release	Comments / External Condition
91175	upper reservoir	UR1E	33.6	1.2	Carry-over	351	371	487	28-Feb-08	RM	Y	CART	CH-TP11-18	151.4	64	6100	181	red	y	29-Feb-08	14:30	UR1E, near USGS gaging tower	upper reservoir	33.6	released healthy
91116	upper reservoir	UR1	33.6	25	Carry-over	342	358	500	27-Jul-07	RM	y	CART	CH-TP11-18	151.4	70	6700			y	27-Jul-07	14:20	UR1	upper reservoir	33.6	Captured in UR1E transect late evening; transported and held in Sweet Creek at 16.5 C water prior to surgery for approximately 2 hours and post surgery for approximately 7 hours; fish transported back to UR1E for release where water temperature was 24 C at time of release; fish released healthy
91113	tailrace	Tailrace	16.5	15.5	Carry-over	371	391	569	22-Jun-07	RM	y	CART	CH-TP11-18	151.4	72	6900	83	red	n						sacrificed,tag removed
91119	upper reservoir	UR9		15.5	Carry-over	455	472	1113	28-Jul-07	RM	y	CART	CH-TP11-18	151.4	72	6900			n						Captured near Sullivan Creek; fish held in 18 C water in Sullivan Creek prior to surgery for approximately 2 hours and post surgery for approximately 2 hours; died in holding sock
91174	upper reservoir	UR7E	30.4	1.2	Carry-over	371	391	497	28-Feb-08	RM	Y	CART	CH-TP11-18	151.4	74	7100	184	red	y	29-Feb-08	14:30	UR1E, near USGS gaging tower	upper reservoir	30.4	released healthy
408042	upper reservoir		33.8	6.8	Carry-over	355	367	518	16-Apr-08	PG	Y	Radio	NTC-6-2	151.4	119				y	16-Apr-08	1:08		upper reservoir	31.8	
408002	upper reservoir		30.1	6.8	Carry-over	396	416	761	16-Apr-08	LH	Y	Radio	NTC-6-2	151.4	120				y	16-Apr-08	5:17		upper reservoir	30.1	took long time to recover
408003	canyon		26.5	7.2	Carry-over	360	372	532	16-Apr-08	DS	Y	Radio	NTC-6-2	151.4	122				y	16-Apr-08	22:26		canyon	25.8	
408001	upper reservoir		34	6.8	Carry-over	358	380	601	15-Apr-08	LH	Y	Radio	NTC-6-2	151.4	126		300	red	y	15-Apr-08	2:42		upper reservoir	33.8	photo10, 11 good health, normal behaviour, swam away quickly
91177	upper reservoir	UR8E		5.8	Carry-over	362	382	564	25-Apr-08	EC	Y	Radio	NTC-6-2	151.4	127		254	red	y	25-Apr-08	19:32	UR8E	upper reservoir	28.8	released healthy
408056	upper reservoir		34	6.4	Carry-over	381	402	562	19-Apr-08	PG	Y	Radio	NTC-6-2	151.4	128				y	19-Apr-08	0:51		upper reservoir	34.1	photo 164- 6450, released healthy
408043	upper reservoir		30.2	6.8	Carry-over	359	367	518	16-Apr-08	PG	Y	Radio	NTC-6-2	151.4	132				y	16-Apr-08	4:20		upper reservoir	29.8	photo 7 & 8
91178	upper reservoir	UR1E	33.6	5.8	Carry-over	334	351	394	25-Apr-08	EC	Y	Radio	NTC-6-2	151.4	162		253	red	y	25-Apr-08	19:26	mouth of Sand Creek	upper reservoir	31.6	released healthy
408057	upper reservoir		34	6.4	Carry-over	380	498	566	19-Apr-08	PG	Y	Radio	NTC-6-2	151.4	164				y	19-Apr-08	1:00		upper reservoir	34.1	photo 164- 6451, released healthy

Table A.5-2, continued…

Sample Number	Capture Site Reach	Capture Site	PRM Capture	Water Temp (ºC)	Triploid Rainbow Trout Type	Fork Length (mm)	Total Length (mm)	Weight (g)	Date of Surgery	Surgeon Initials	Radio tag tested Y/N	Tag Class	Tag Type	Radio Tag Frequency (MHz)	Radio Tag Code	Acoustic Tag Code	Streamer Tag No.	Tag Color	Fish Rel with tags (Y/N)	Release Date	Release Time	Release Location	Release Site Reach	PRM Release	Comments / External Condition
408045	canyon		24	6.8	Carry-over	360	371	528	17-Apr-08	PG	Y	Radio	NTC-6-2	151.4	170				y	17-Apr-08	0:47		canyon	23	photo 10, 11 ,12
408044	canyon		26.8	6.8	Carry-over	376	389	556	16-Apr-08	PG	Y	Radio	NTC-6-2	151.4	171				y	16-Apr-08	22:30		canyon	25.6	photo 9, fish lively at release

Appendix 6: Spring 2007 Release Radio Tracking Figures

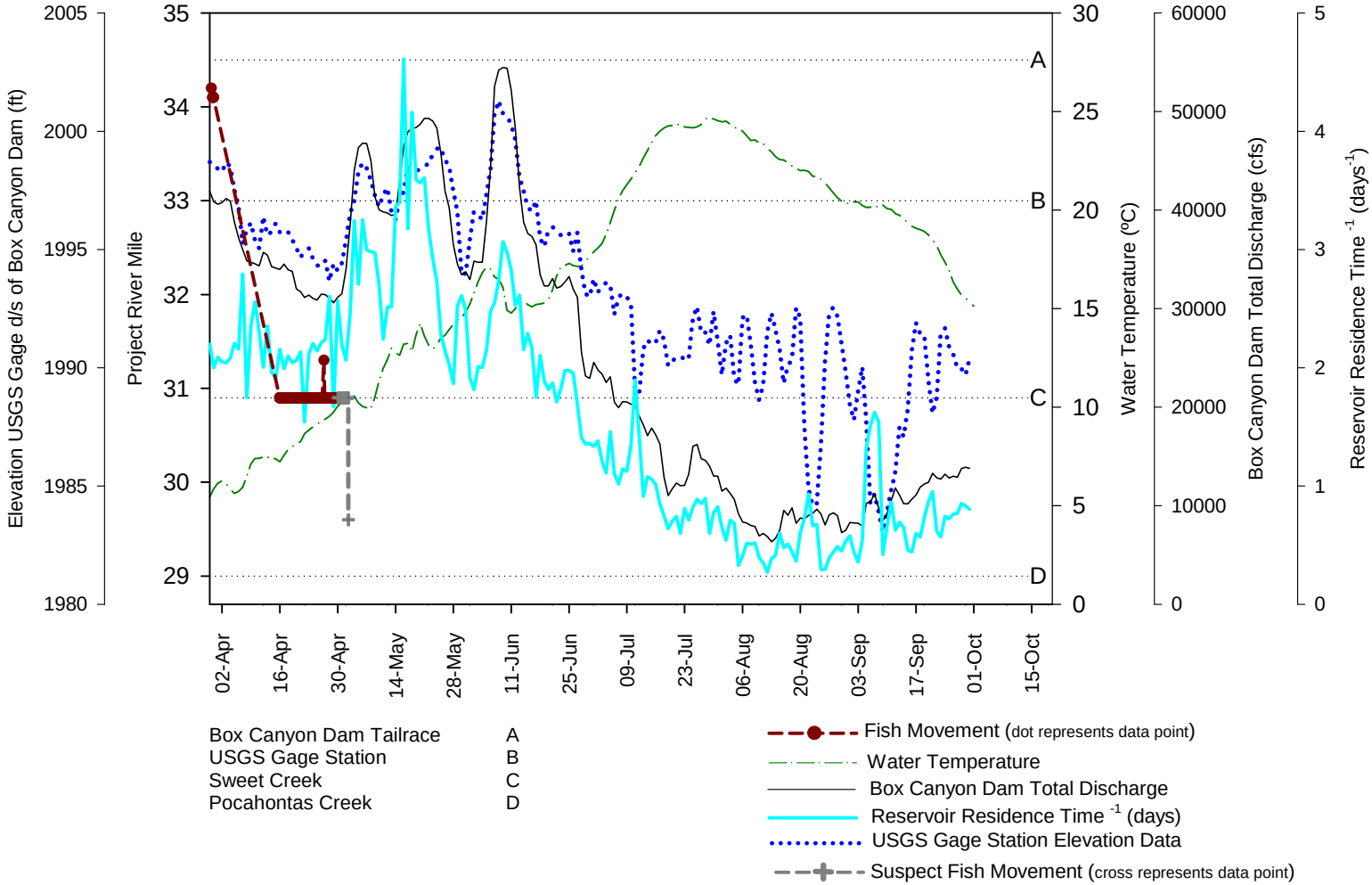

Figure A.6-1. Movement data of a radio-tagged (Fish 76) triploid rainbow trout spring release 2007 (*Oncorhynchus mykiss*) in the Upper Reservoir Reach (March 30, 2007, to May 2, 2007) in relation to daily average water temperature, daily average total discharge from Box Canyon Dam, inverse reservoir residence time (reservoir velocity), and daily average water level elevation as measured at the USGS auxiliary gage station 1.2 miles downstream of Box Canyon Dam.

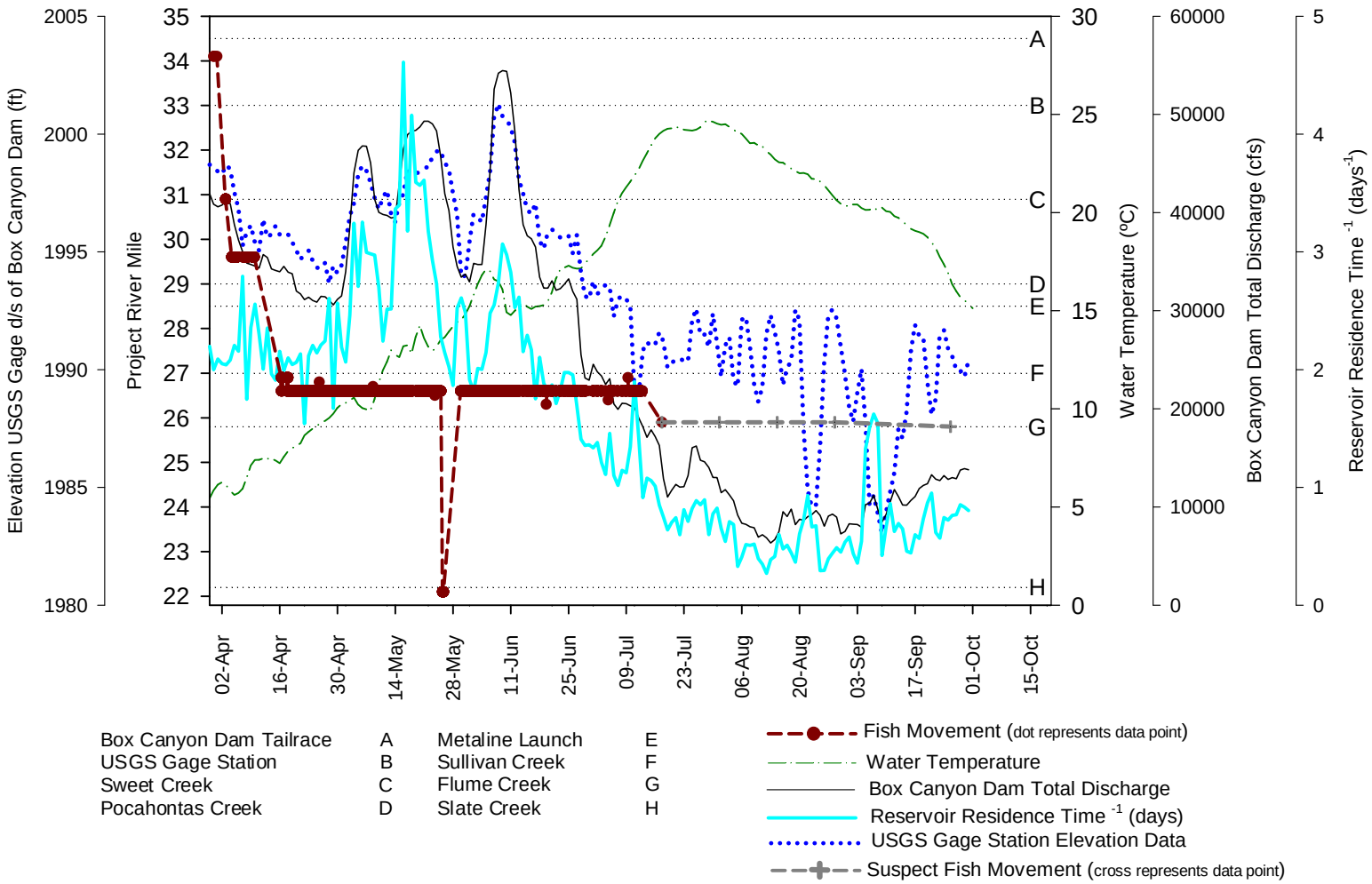

Figure A.6-2. Movement data of a radio-tagged (Fish 77) triploid rainbow trout spring release 2007 (*Oncorhynchus mykiss*) in the Upper Reservoir and Canyon reaches (March 31, 2007, to September 25, 2007) in relation to daily average water temperature, daily average total discharge from Box Canyon Dam, inverse reservoir residence time (reservoir velocity), and daily average water level elevation as measured at the USGS auxiliary gage station 1.2 miles downstream of Box Canyon Dam.

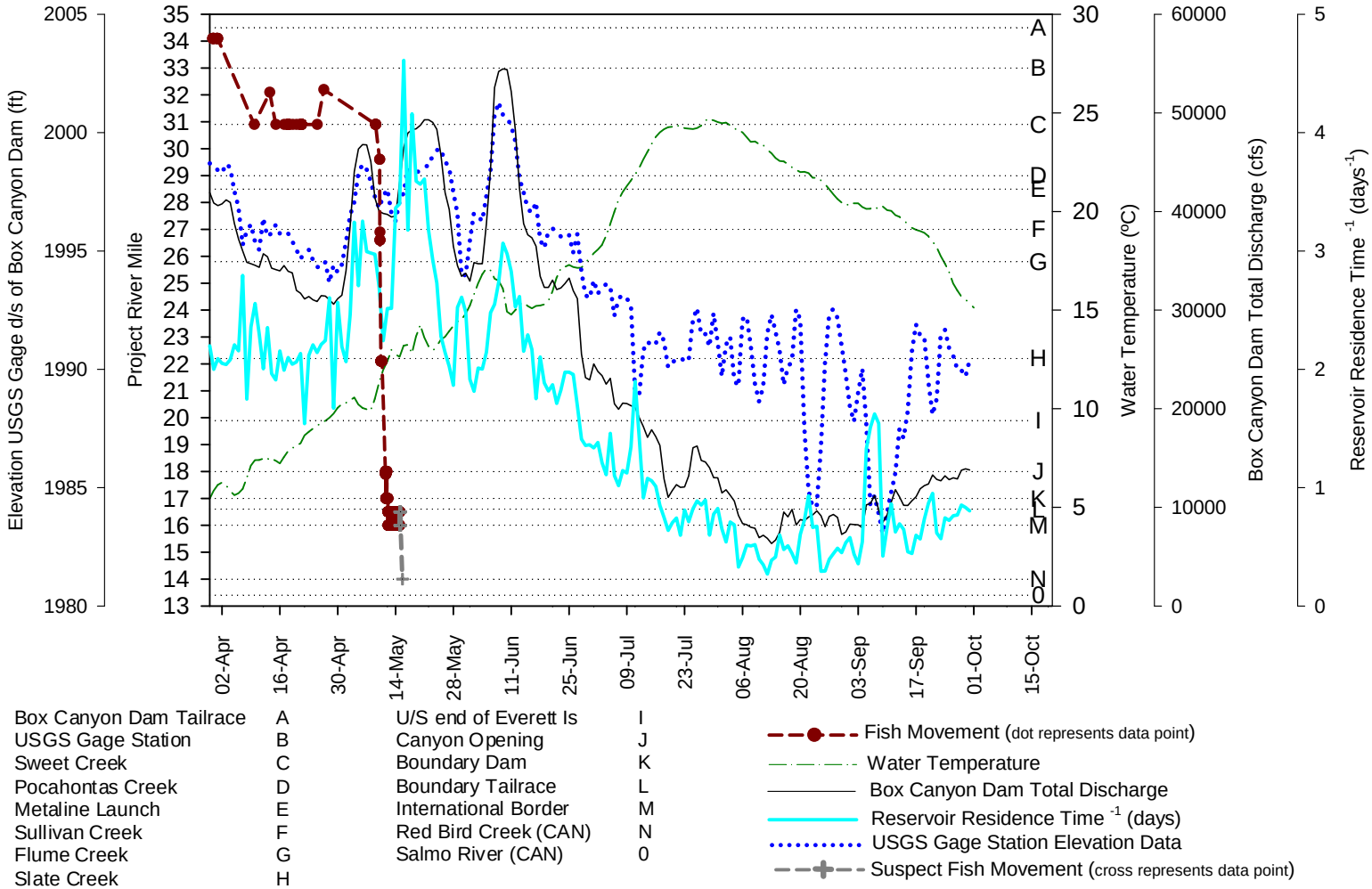

Figure A.6-3. Movement data of a radio-tagged (Fish 78) triploid rainbow trout spring release 2007 (*Oncorhynchus mykiss*) in the Upper Reservoir, Canyon, Forebay, and Tailrace reaches (March 30, 2007, to May 15 2007) in relation to daily average water temperature, daily average total discharge from Box Canyon Dam, inverse reservoir residence time (reservoir velocity), and daily average water level elevation as measured at the USGS auxiliary gage station 1.2 miles downstream of Box Canyon Dam.

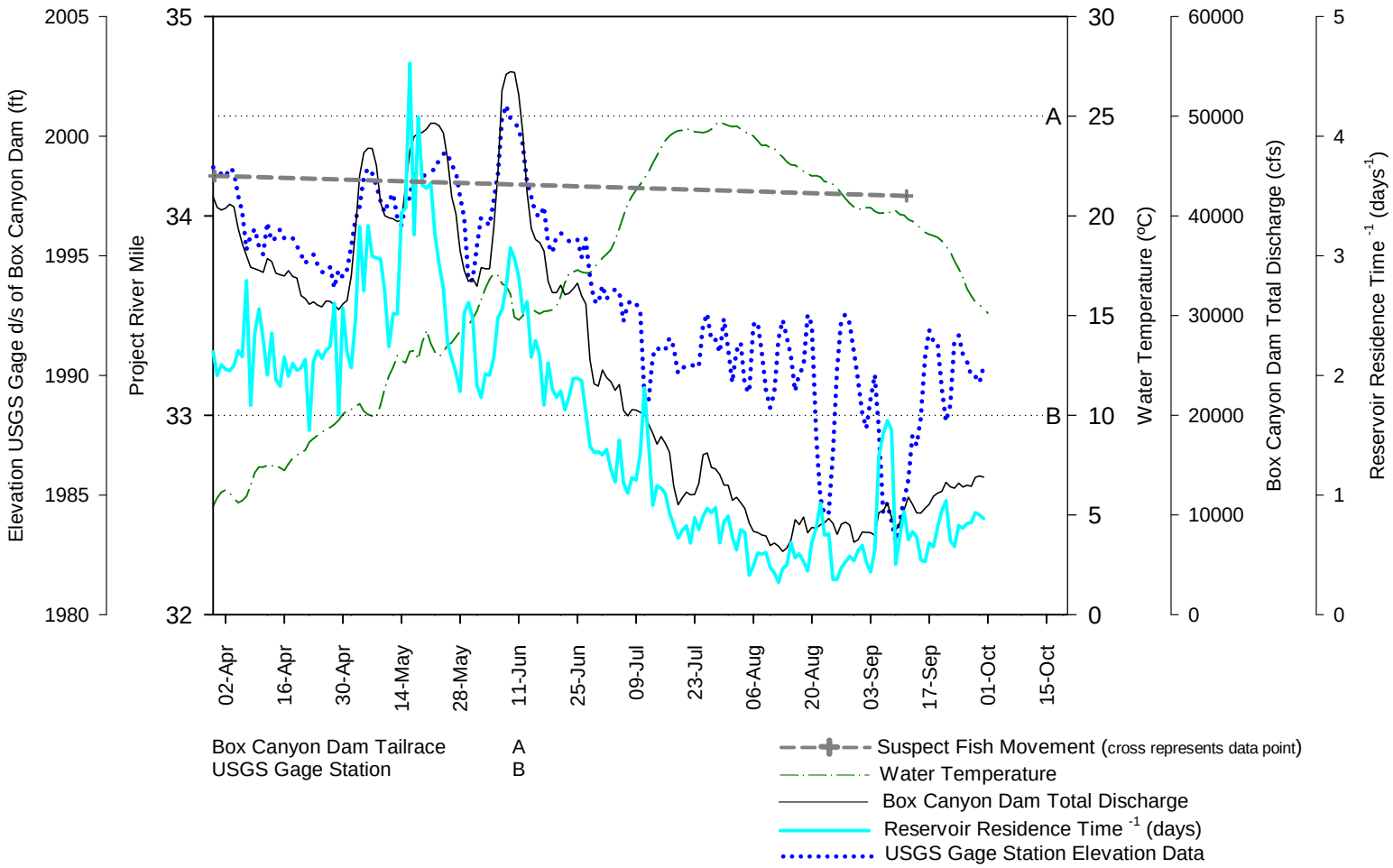

Figure A.6-4. Movement data of a radio-tagged (Fish 79) triploid rainbow trout spring release 2007 (*Oncorhynchus mykiss*) in the Upper Reservoir Reach (March 30 to September 11, 2007) in relation to daily average water temperature, daily average total discharge from Box Canyon Dam, inverse reservoir residence time (reservoir velocity), and daily average water level elevation as measured at the USGS auxiliary gage station 1.2 miles downstream of Box Canyon Dam.

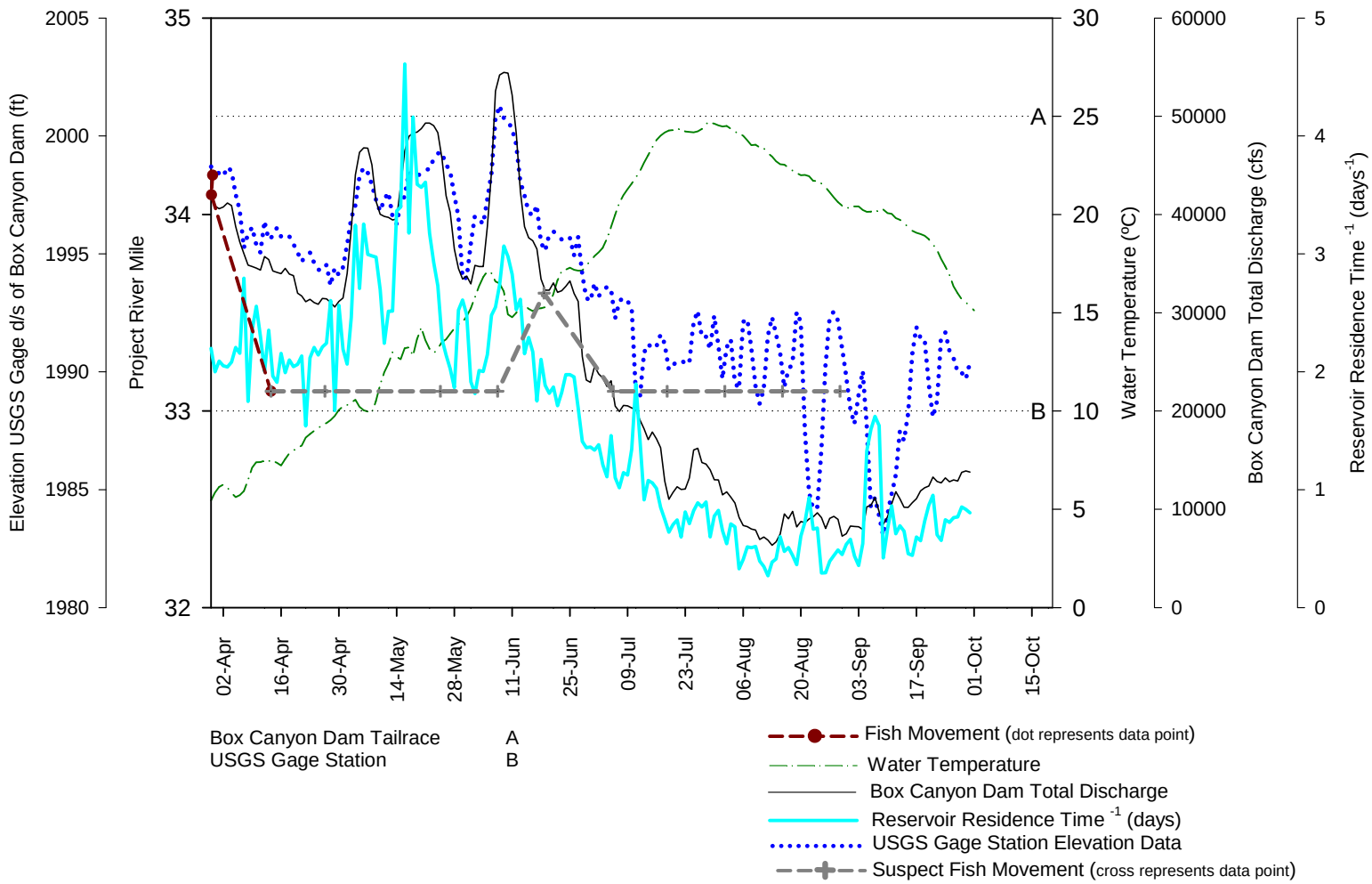

Figure A.6-5. Movement data of a radio-tagged (Fish 80) triploid rainbow trout spring release 2007 (*Oncorhynchus mykiss*) in the Upper Reservoir Reach (March 30, 2007, to September 11, 2007) in relation to daily average water temperature, daily average total discharge from Box Canyon Dam, inverse reservoir residence time (reservoir velocity), and daily average water level elevation as measured at the USGS auxiliary gage station 1.2 miles downstream of Box Canyon Dam.

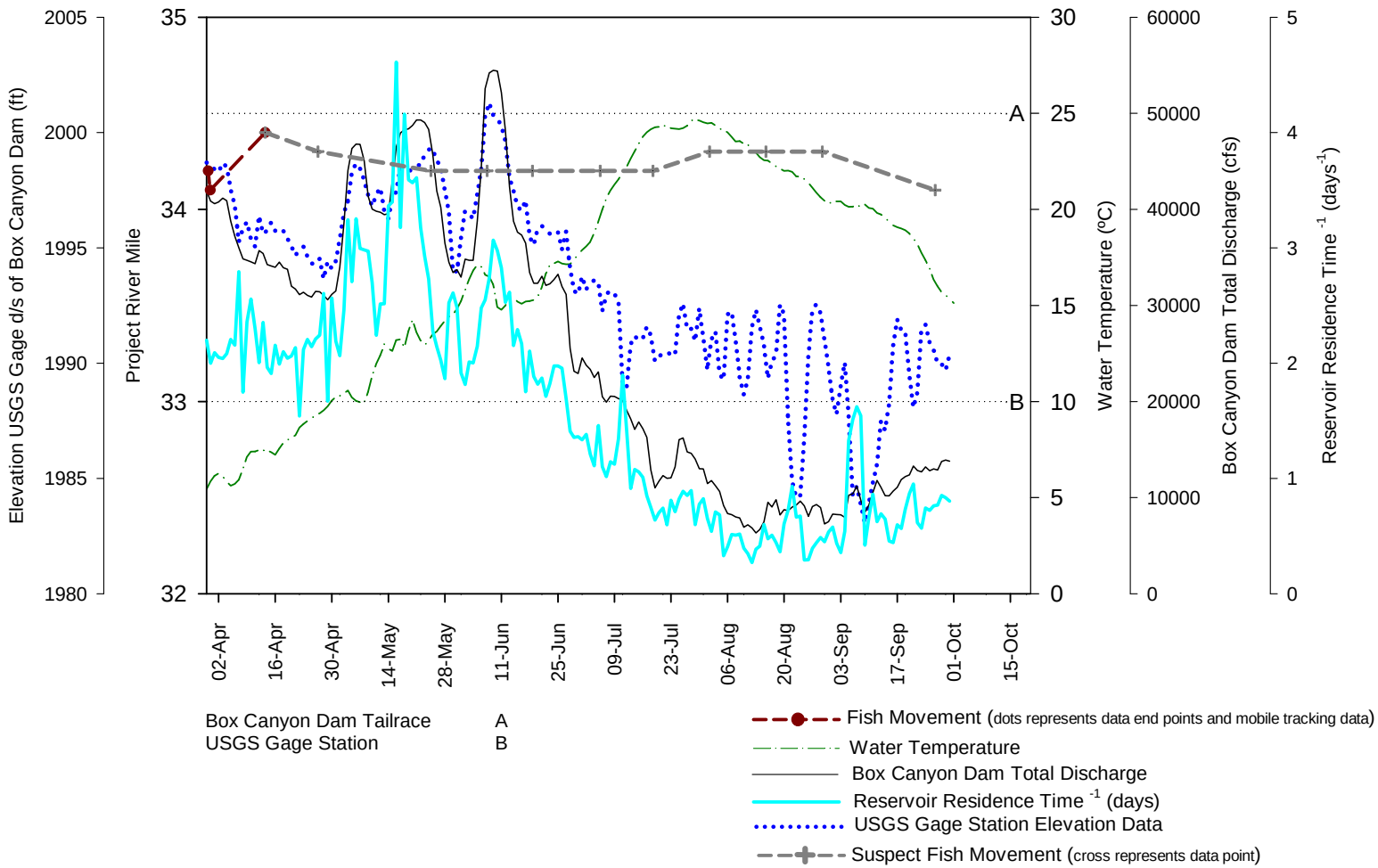

Figure A.6-6. Movement data of a radio-tagged (Fish 81) triploid rainbow trout spring release 2007 (*Oncorhynchus mykiss*) in the Upper Reservoir Reach (March 30, 2007, to September 26, 2007) in relation to daily average water temperature, daily average total discharge from Box Canyon Dam, inverse reservoir residence time (reservoir velocity), and daily average water level elevation as measured at the USGS auxiliary gage station 1.2 miles downstream of Box Canyon Dam.

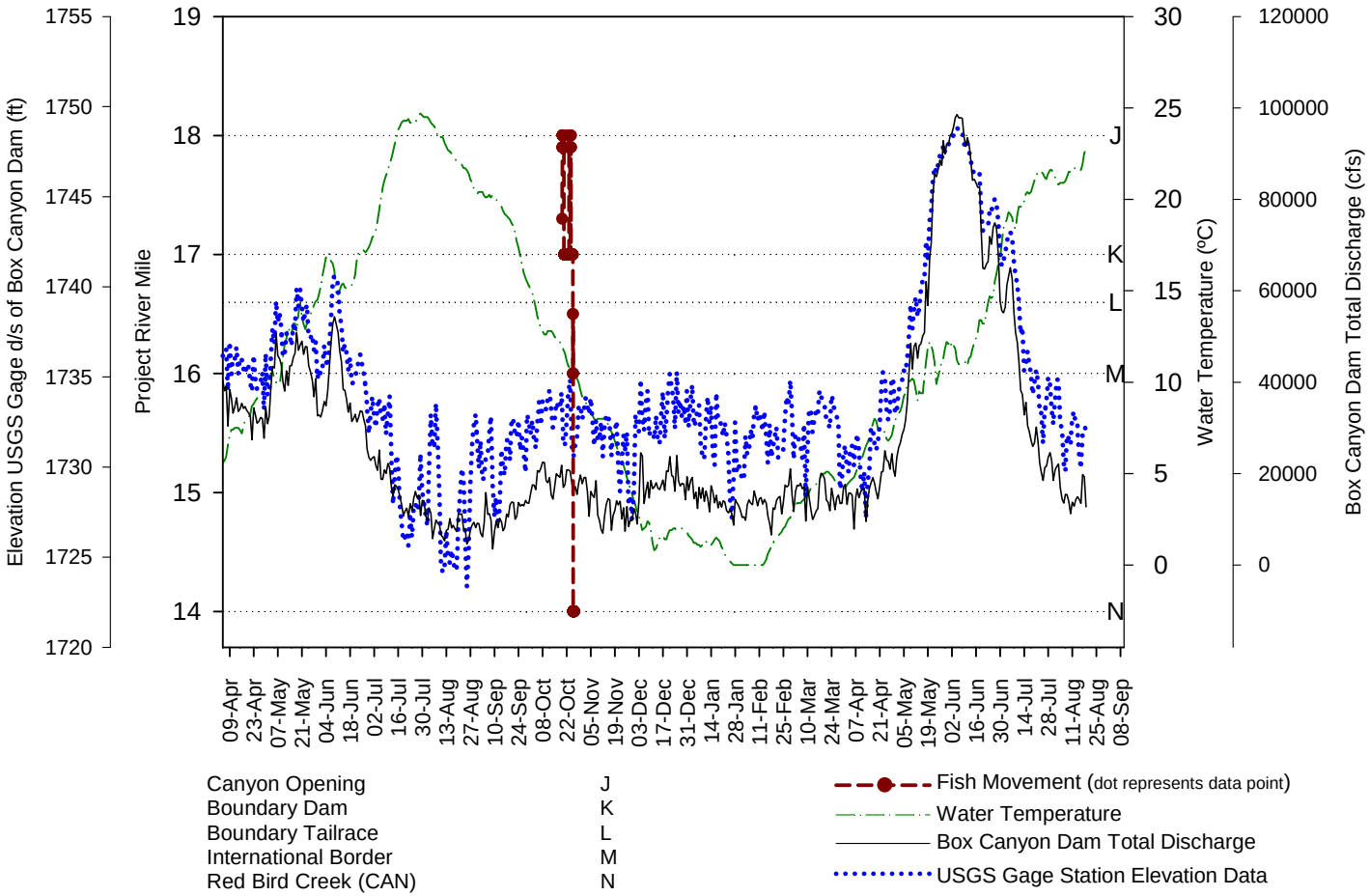

Figure A.6-7. Movement data of a radio-tagged (Fish 140) triploid rainbow trout fall release 2007 (*Oncorhynchus mykiss*) in the Boundary Tailrace (October 19, 2007, to December 20, 2007) in relation to daily average water temperature, daily average total Boundary discharge, and daily average water level elevation as measured at Boundary Tailrace.

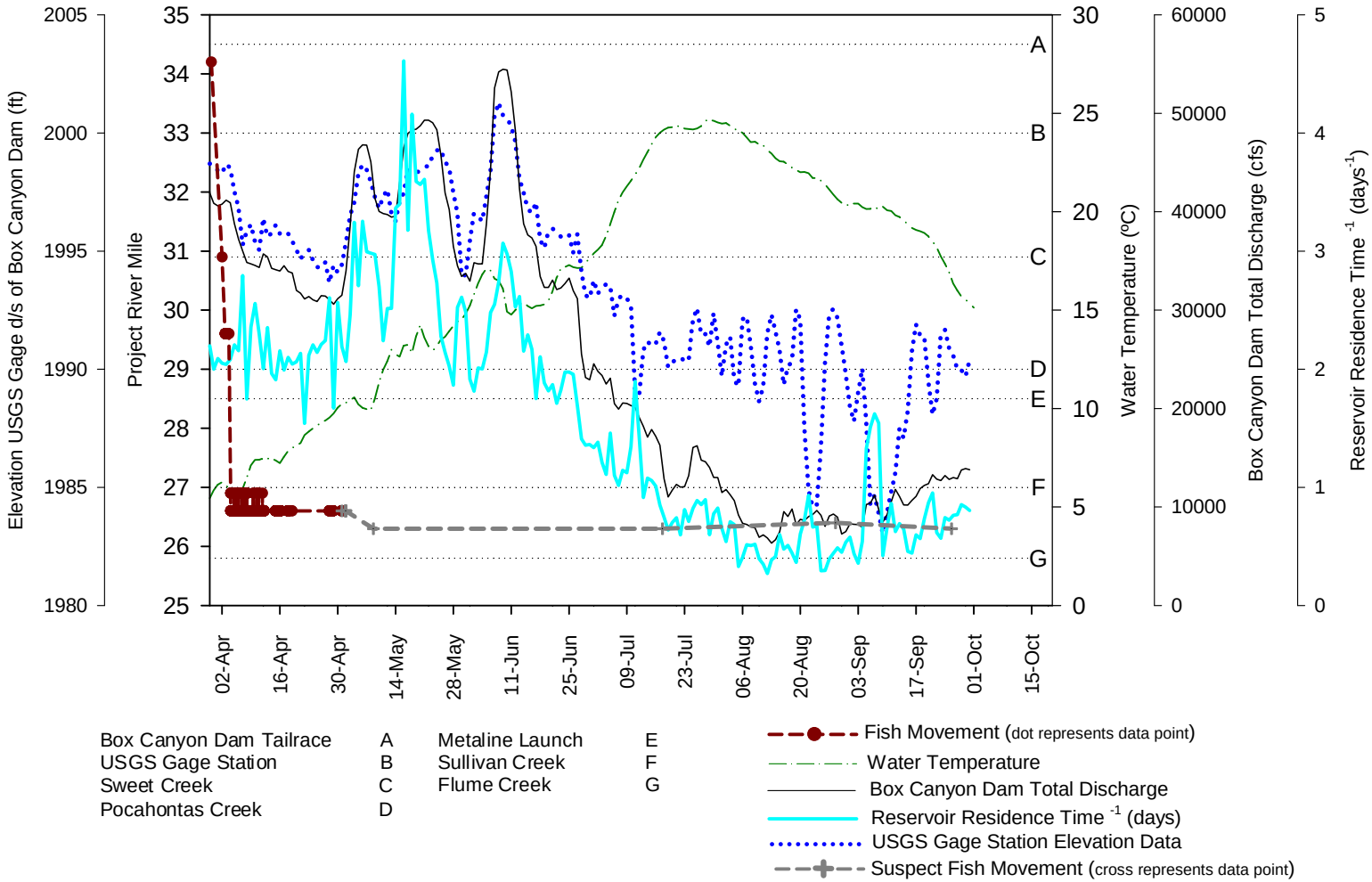

Figure A.6-8. Movement data of a radio-tagged (Fish 83) triploid rainbow trout spring release 2007 (*Oncorhynchus mykiss*) in the Upper Reservoir and Canyon reaches (March 30, 2007, to September 25, 2007) in relation to daily average water temperature, daily average total discharge from Box Canyon Dam, inverse reservoir residence time (reservoir velocity), and daily average water level elevation as measured at the USGS auxiliary gage station 1.2 miles downstream of Box Canyon Dam.

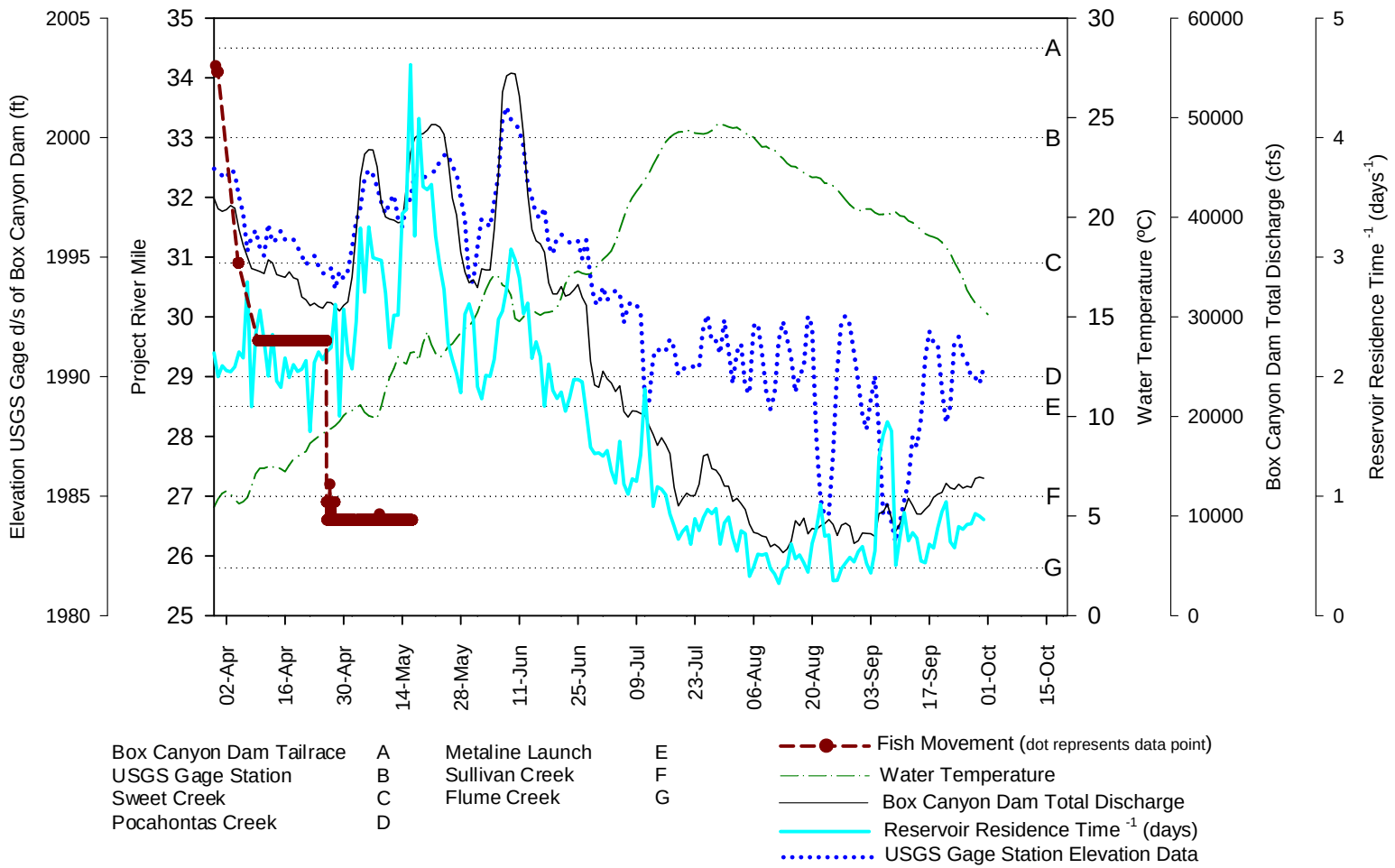

Figure A.6-9. Movement data of a radio-tagged (Fish 84) triploid rainbow trout spring release 2007 (*Oncorhynchus mykiss*) in the Upper Reservoir and Canyon reaches (March 30, 2007, to May 16, 2007) in relation to daily average water temperature, daily average total discharge from Box Canyon Dam, inverse reservoir residence time (reservoir velocity), and daily average water level elevation as measured at the USGS auxiliary gage station 1.2 miles downstream of Box Canyon Dam.

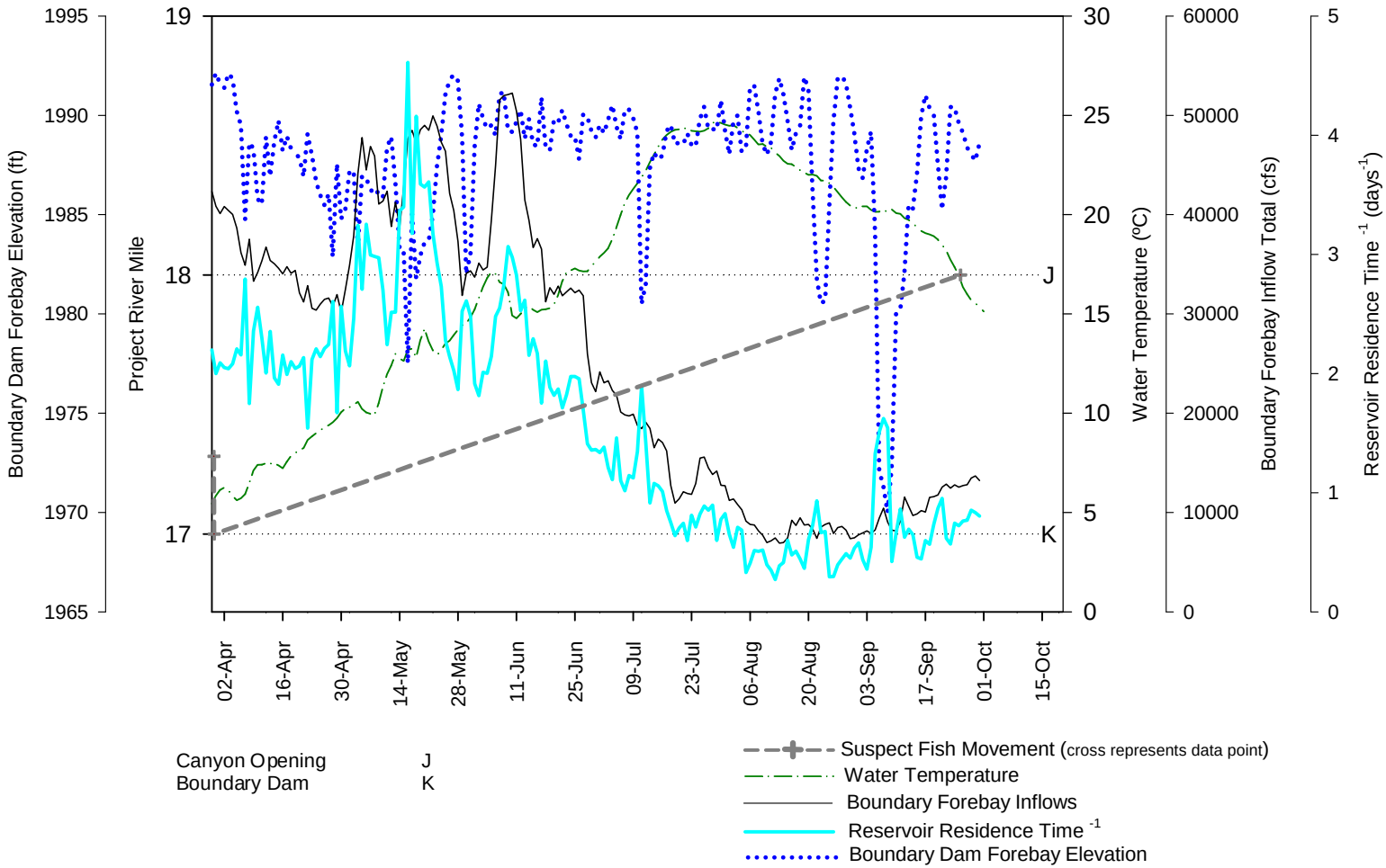

Figure A.6-10. Movement data of a radio-tagged (Fish 87) triploid rainbow trout spring release 2007 (*Oncorhynchus mykiss*) in the Forebay Reach (March 30, 2007, to September 25, 2007) in relation to daily average water temperature, daily average total Boundary forebay inflows, inverse reservoir residence time (reservoir velocity), and daily average water level elevation as measured at Boundary forebay.

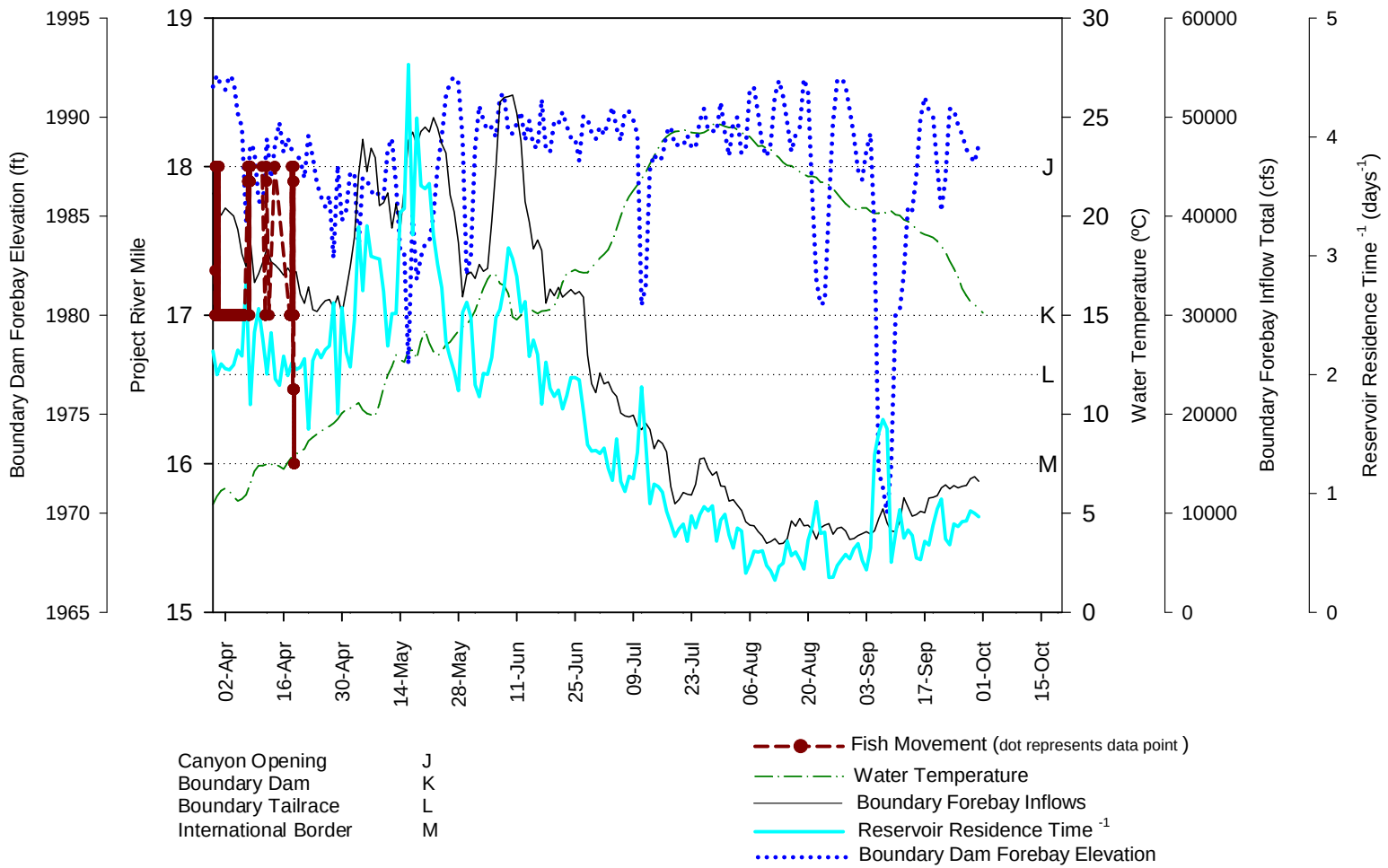

Figure A.6-11. Movement data of a radio-tagged (Fish 88) triploid rainbow trout spring release 2007 (*Oncorhynchus mykiss*) in the Forebay and Tailrace reaches (March 30, 2007, to April 18, 2007) in relation to daily average water temperature, daily average total Boundary forebay inflows, inverse reservoir residence time (reservoir velocity), and daily average water level elevation as measured at Boundary forebay.

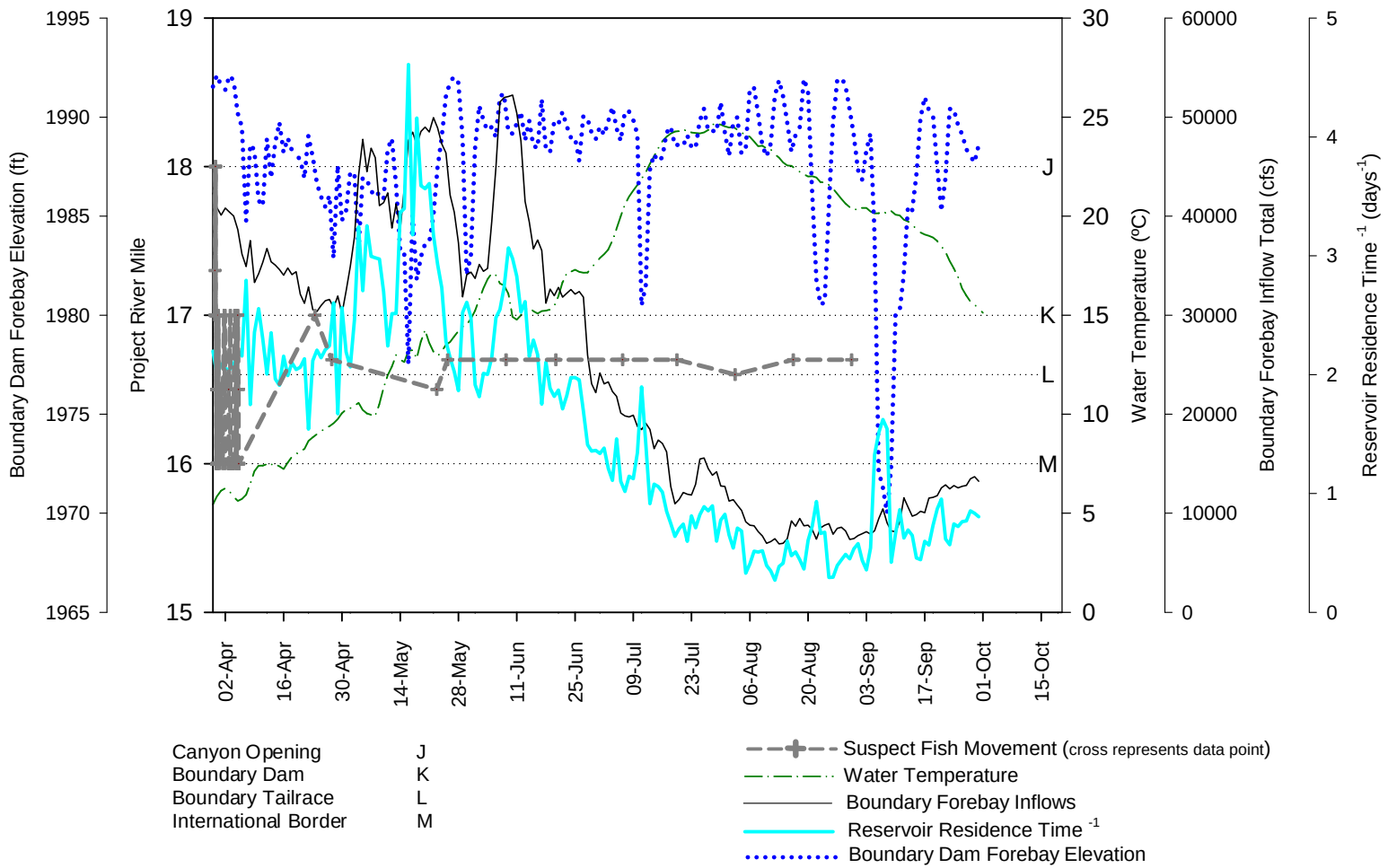

Figure A.6-12. Movement data of a radio-tagged (Fish 89) triploid rainbow trout spring release 2007 (*Oncorhynchus mykiss*) in the Forebay and Tailrace reaches (March 30, 2007 to August 30, 2007) in relation to daily average water temperature, daily average total Boundary forebay inflows, inverse reservoir residence time (reservoir velocity), and daily average water level elevation as measured at Boundary forebay.

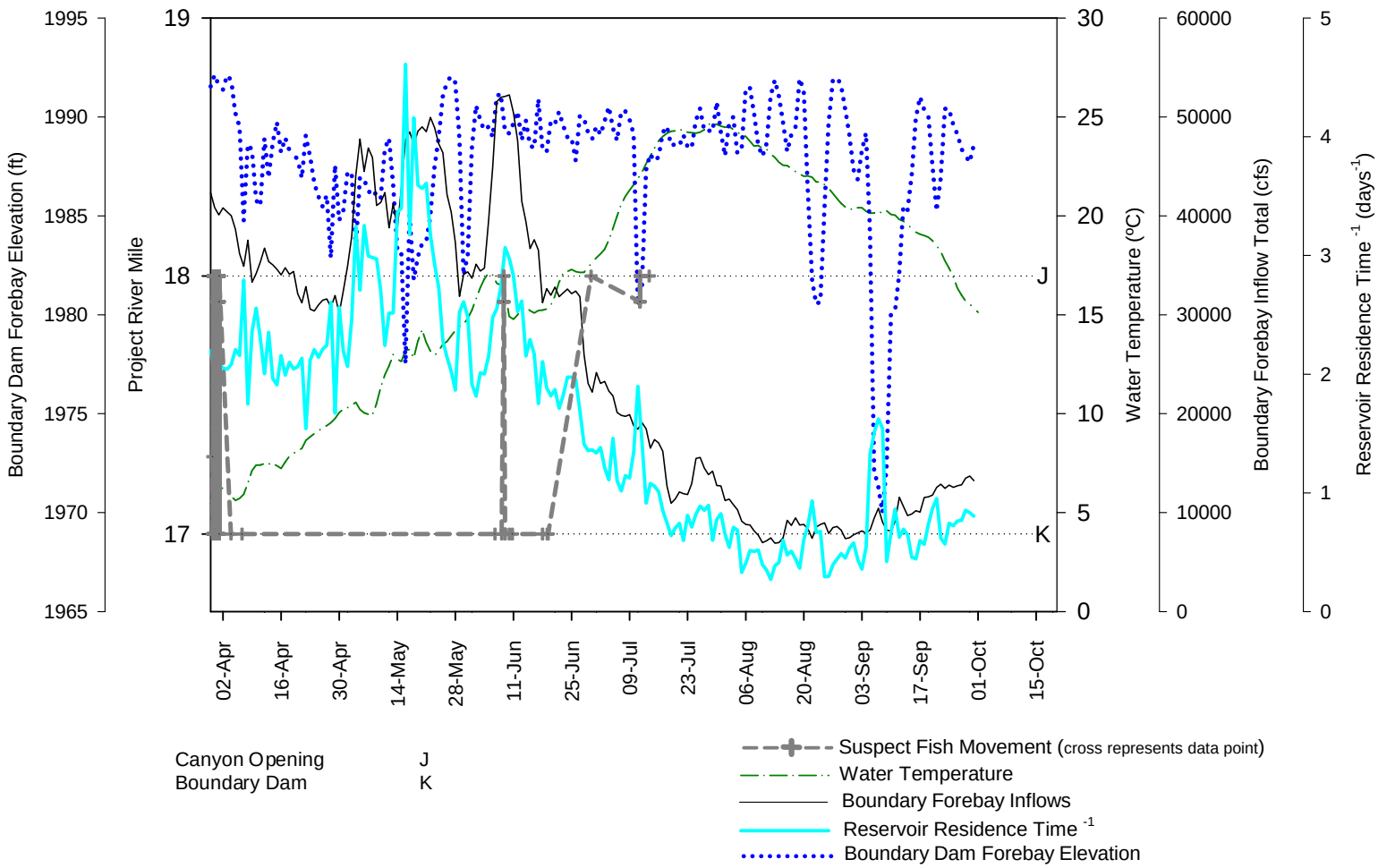

Figure A.6-13. Movement data of a radio-tagged (Fish 90) triploid rainbow trout spring release 2007 (*Oncorhynchus mykiss*) in the Forebay Reach (March 30, 2007, to July 13, 2007) in relation to daily average water temperature, daily average total Boundary forebay inflows, inverse reservoir residence time (reservoir velocity), and daily average water level elevation as measured at Boundary forebay.

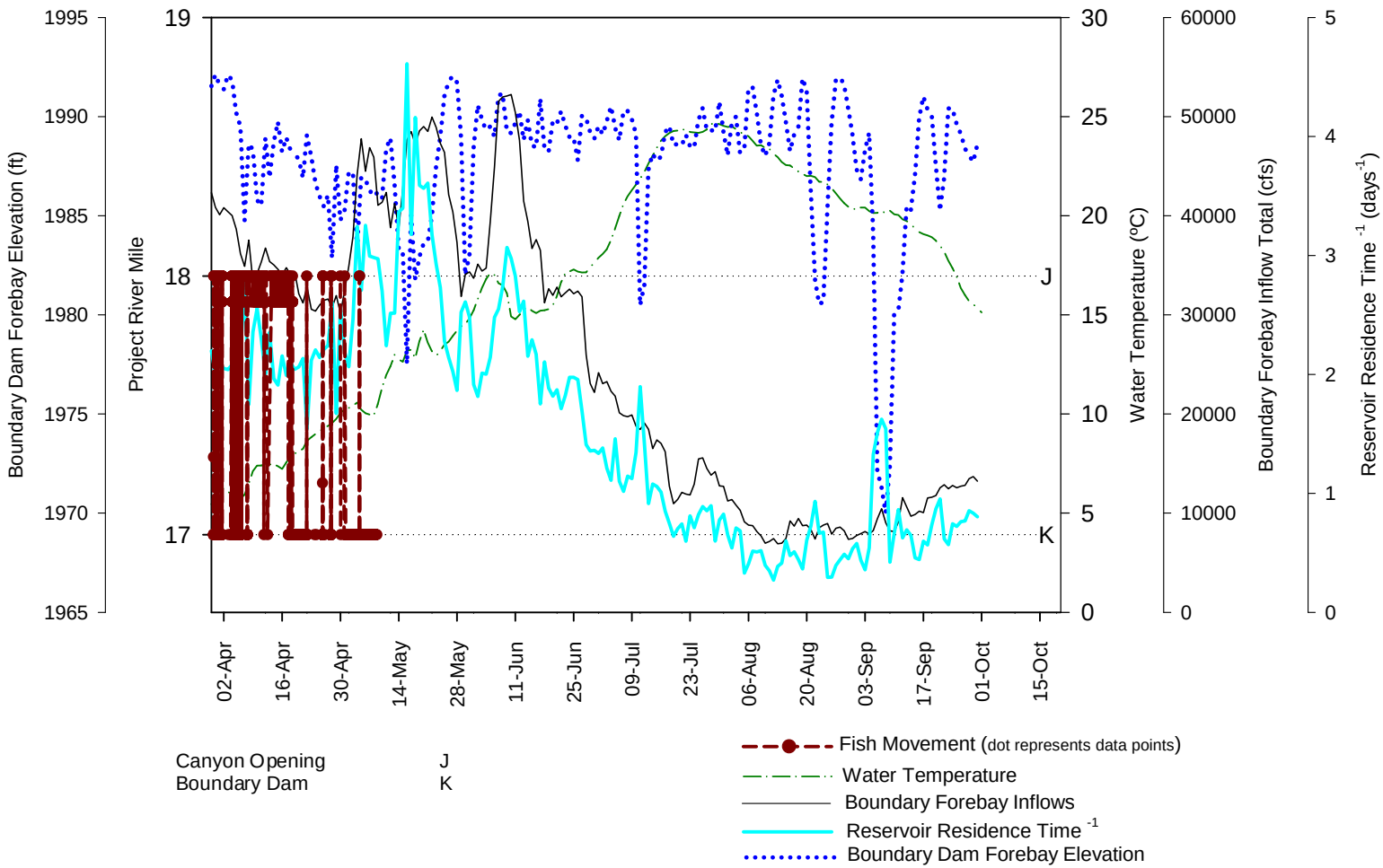

Figure A.6-14. Movement data of a radio-tagged (Fish 91) triploid rainbow trout spring release 2007 (*Oncorhynchus mykiss*) in the Forebay Reach (March 30, 2007, to May 08, 2007) in relation to daily average water temperature, daily average total Boundary forebay inflows, inverse reservoir residence time (reservoir velocity), and daily average water level elevation as measured at Boundary forebay.

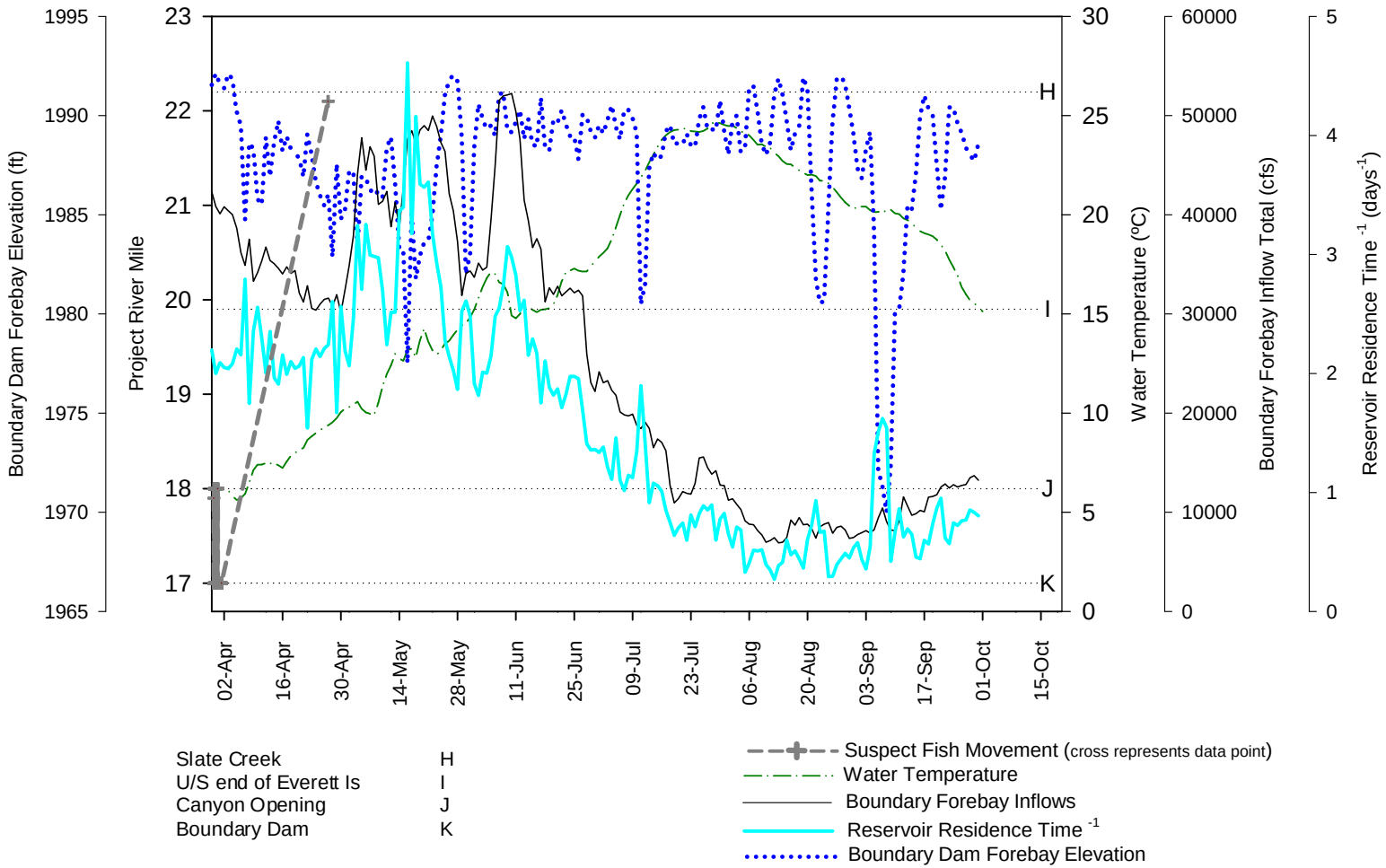

Figure A.6-15. Movement data of a radio-tagged (Fish 92) triploid rainbow trout spring release 2007 (*Oncorhynchus mykiss*) in the Forebay Reach (March 30, 2007, to April 25, 2007) in relation to daily average water temperature, daily average total Boundary forebay inflows, inverse reservoir residence time (reservoir velocity), and daily average water level elevation as measured at Boundary forebay.

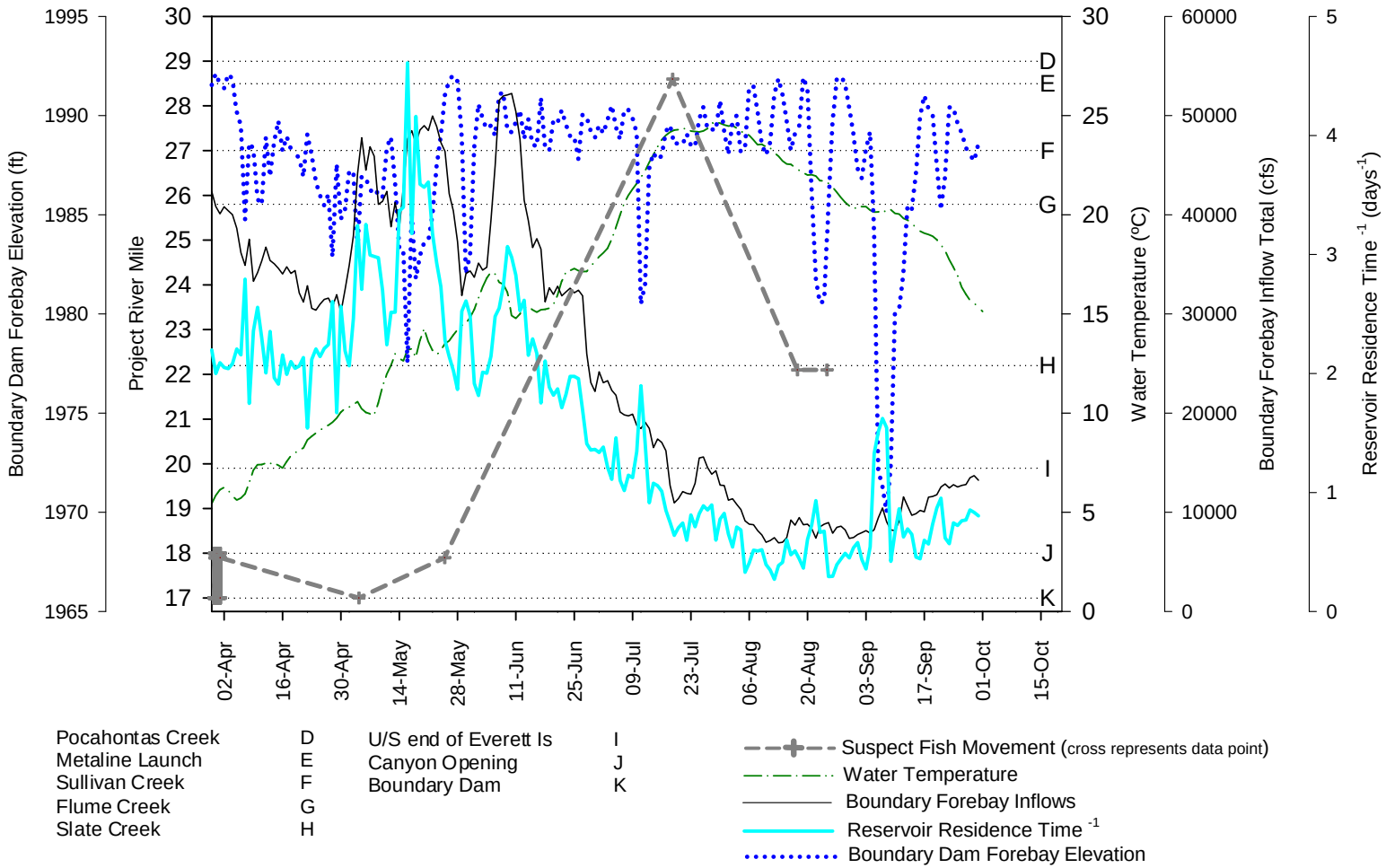

Figure A.6-16. Movement data of a radio-tagged (Fish 93) triploid rainbow trout spring release 2007 (*Oncorhynchus mykiss*) in the Forebay Reach (March 30, 2007, to August 24, 2007) in relation to daily average water temperature, daily average total Boundary forebay inflows, inverse reservoir residence time (reservoir velocity), and daily average water level elevation as measured at Boundary forebay.

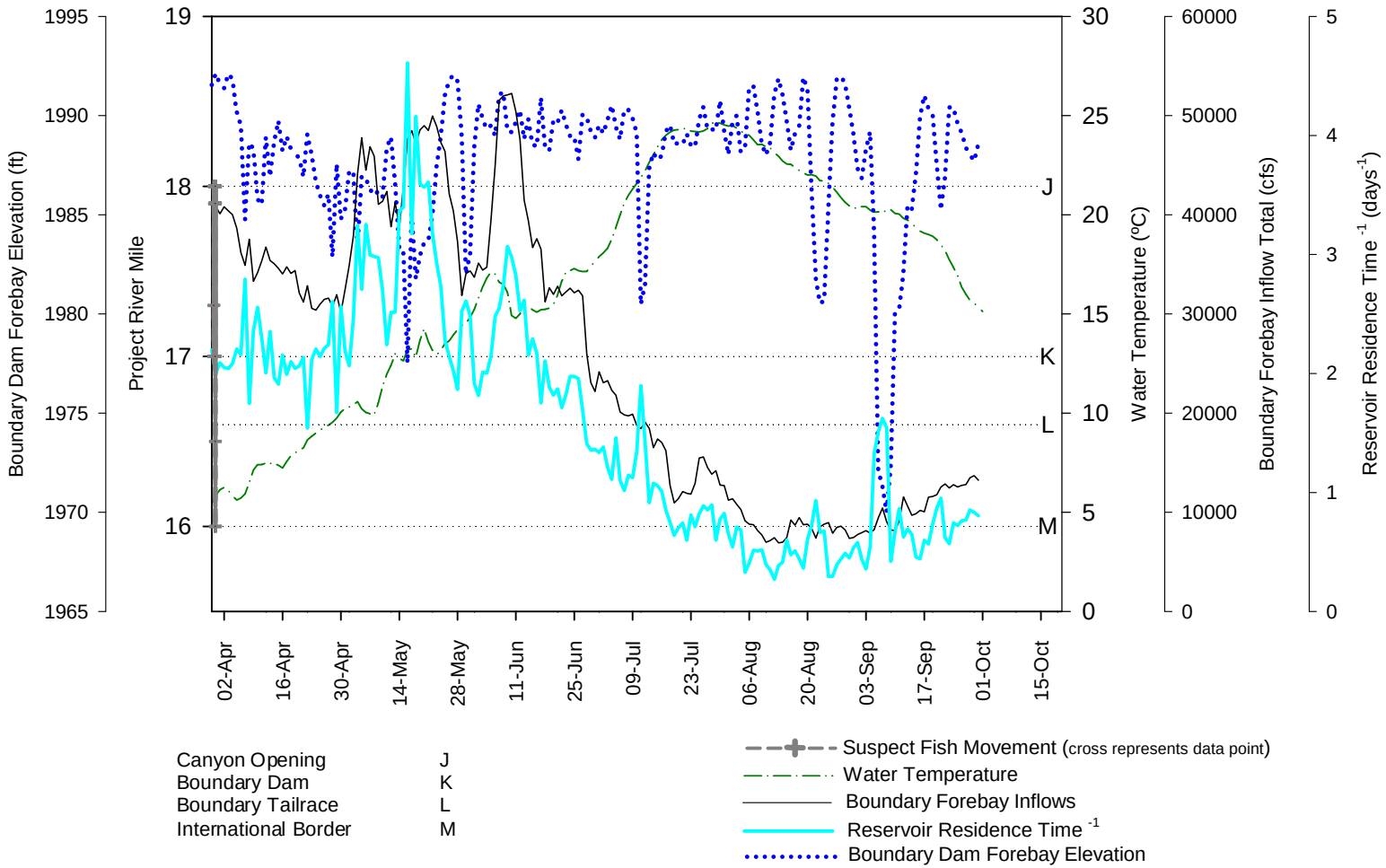

Figure A.6-17. Movement data of a radio-tagged (Fish 94) triploid rainbow trout spring release 2007 (*Oncorhynchus mykiss*) in the Forebay and Tailrace reaches (March 30, 2007) in relation to daily average water temperature, daily average total Boundary forebay inflows, inverse reservoir residence time (reservoir velocity), and daily average water level elevation as measured at Boundary forebay.

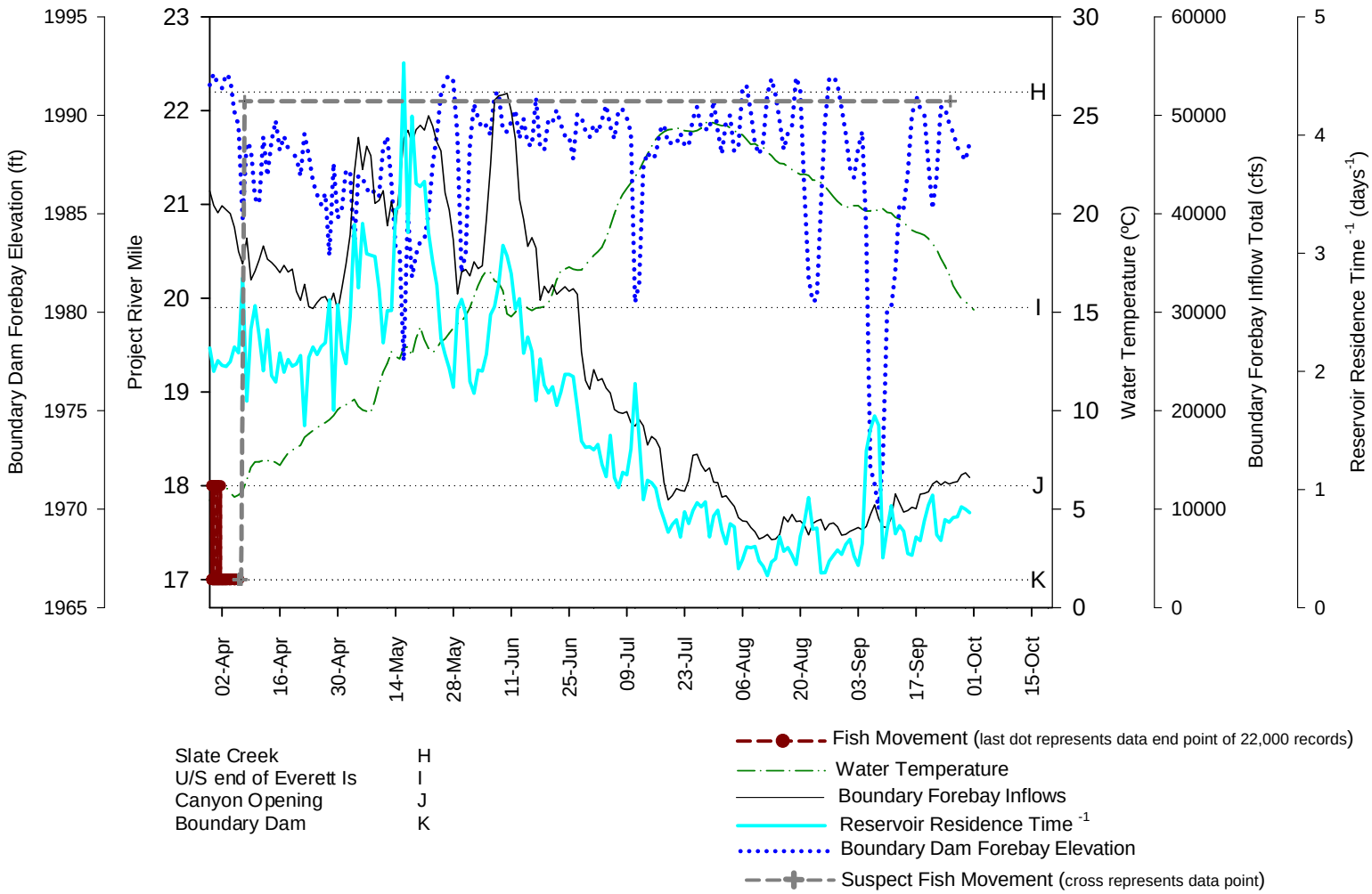

Figure A.6-18. Movement data of a radio-tagged (Fish 95) triploid rainbow trout spring release 2007 (*Oncorhynchus mykiss*) in the Forebay Reach (March 30, 2007, to September 25, 2007) in relation to daily average water temperature, daily average total Boundary forebay inflows, inverse reservoir residence time (reservoir velocity), and daily average water level elevation as measured at Boundary forebay.

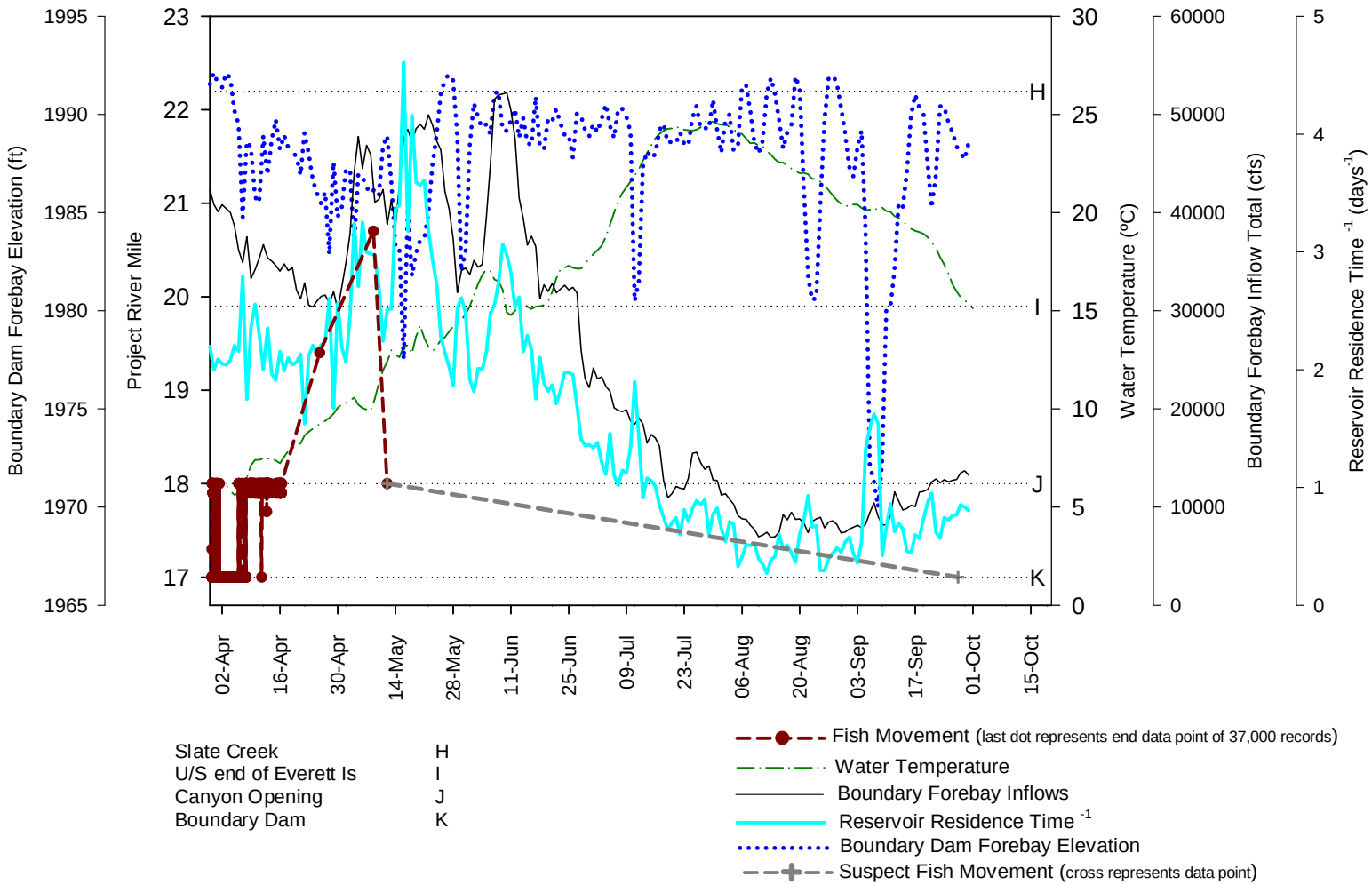

Figure A.6-19. Movement data of a radio-tagged (Fish 96) triploid rainbow trout spring release 2007 (*Oncorhynchus mykiss*) in the Forebay Reach (March 30 to September 27, 2007) in relation to daily average water temperature, daily average total Boundary forebay inflows, inverse reservoir residence time (reservoir velocity), and daily average water level elevation as measured at Boundary forebay. Fish was likely killed on May 12, after which Fish 96 was detected continuously by receivers in the forebay.

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Appendix 7: Fall 2007 Release Radio Tracking Figures

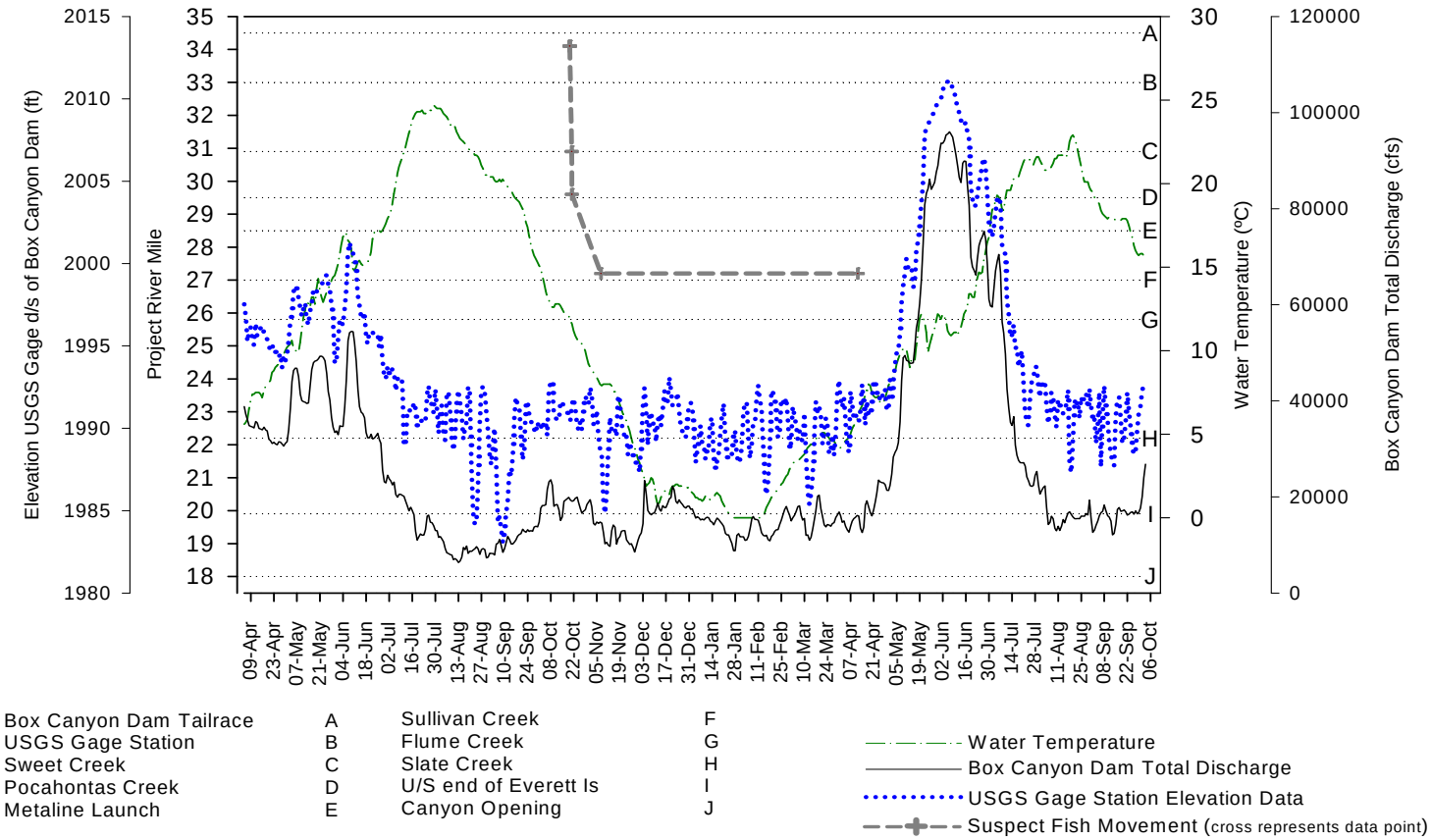

Figure A.7-1. Movement data of a radio-tagged (Fish 133) triploid rainbow trout fall release 2007 (*Oncorhynchus mykiss*) in the Boundary Reservoir (October 19, 2007, to April 11, 2008) in relation to daily average water temperature, daily average total discharge from Box Canyon Dam, and daily average water level elevation as measured at the USGS auxiliary gage station 1.2 miles downstream of Box Canyon Dam.

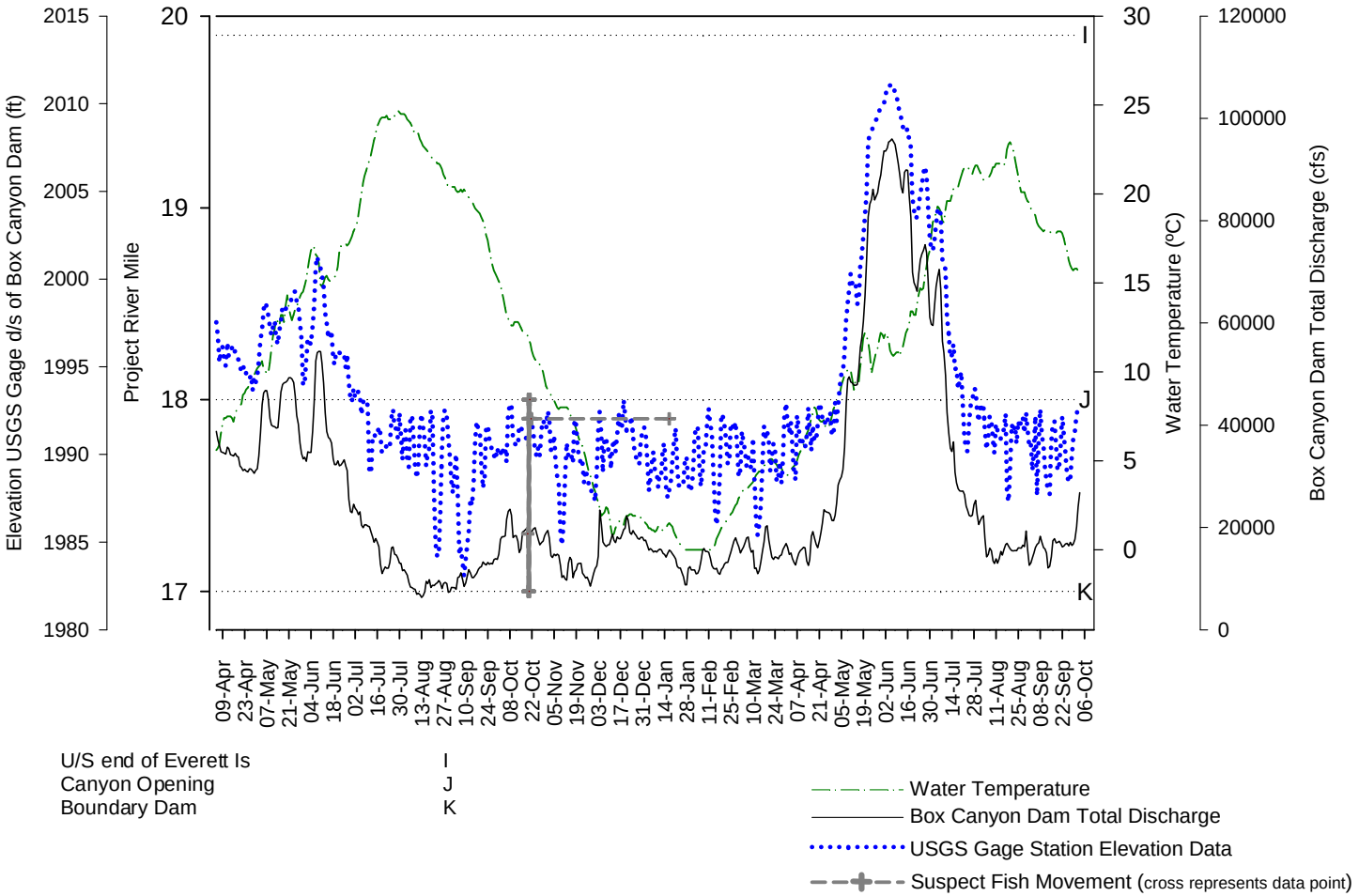

Figure A.7-2. Movement data of a radio-tagged (Fish 135) triploid rainbow trout fall release 2007 (*Oncorhynchus mykiss*) in the Boundary Reservoir (October 19, 2007, to January 16, 2008) in relation to daily average water temperature, daily average total discharge from Box Canyon Dam, and daily average water level elevation as measured at the USGS auxiliary gage station 1.2 miles downstream of Box Canyon Dam.

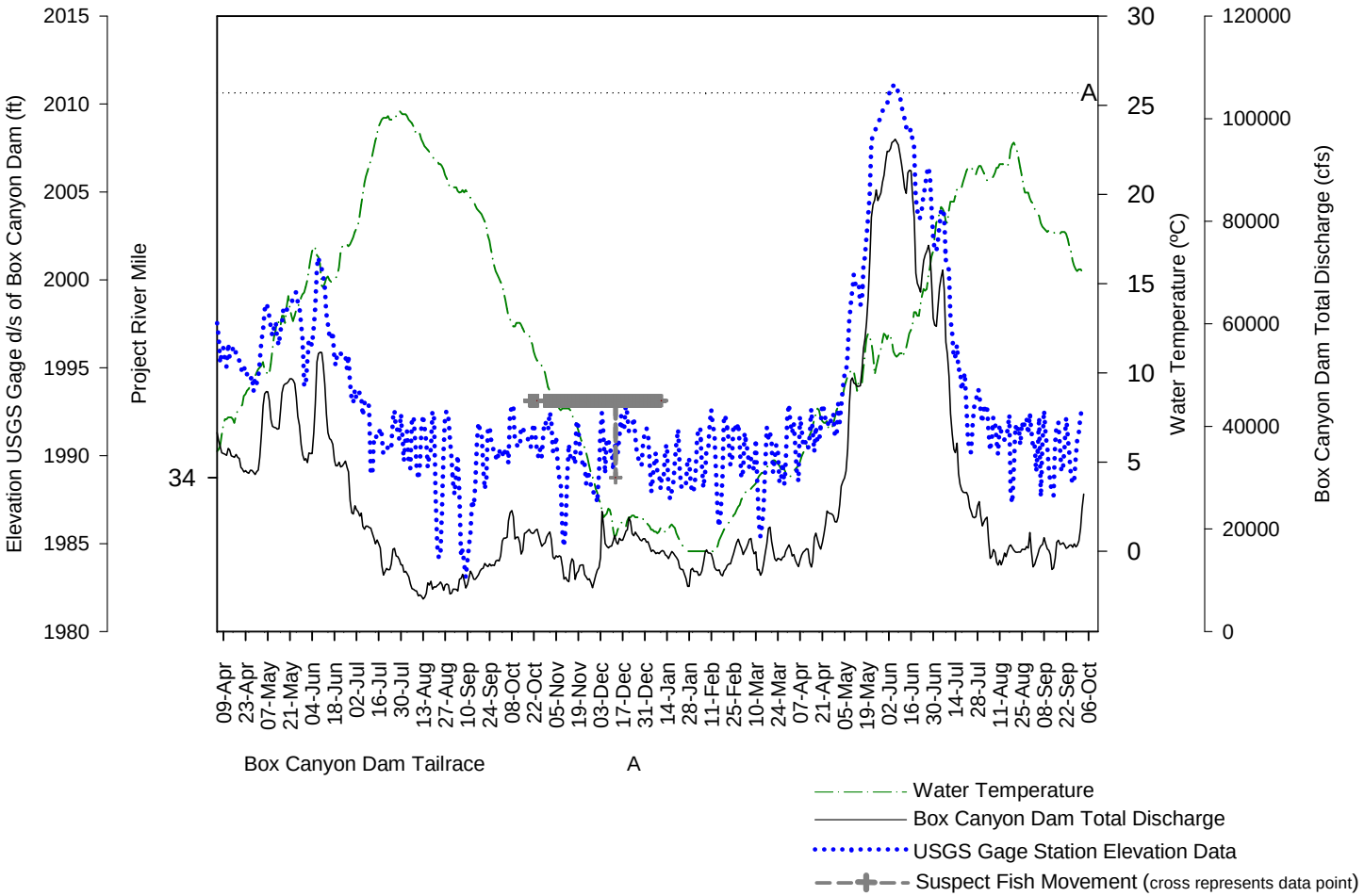

Figure A.7-3. Movement data of a radio-tagged (Fish 136) triploid rainbow trout fall release 2007 (*Oncorhynchus mykiss*) in the Boundary Reservoir (October 19, 2007, to January 10, 2008) in relation to daily average water temperature, daily average total discharge from Box Canyon Dam, and daily average water level elevation as measured at the USGS auxiliary gage station 1.2 miles downstream of Box Canyon Dam.

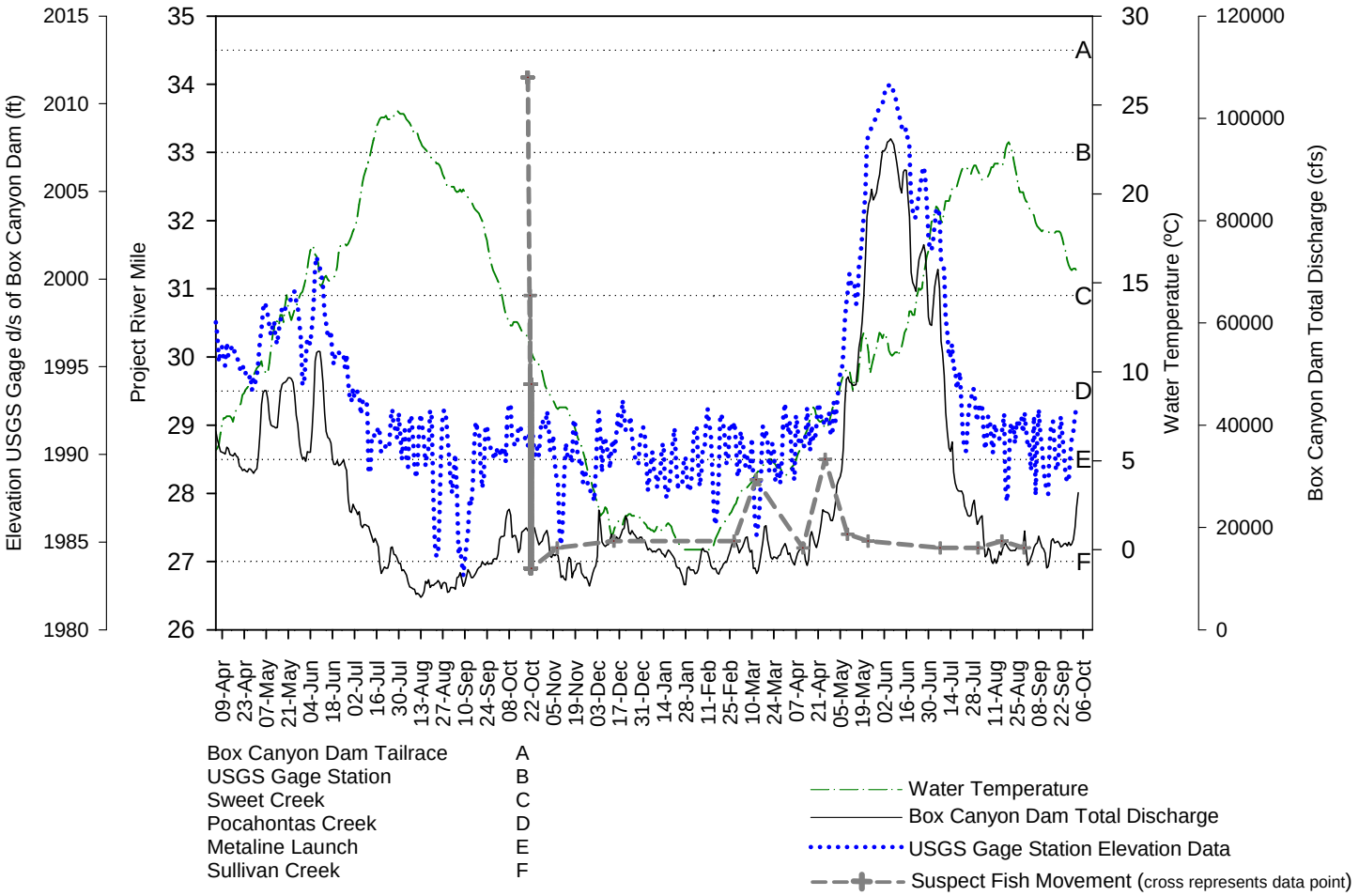

Figure A.7-4. Movement data of a radio-tagged (Fish 137) triploid rainbow trout fall release 2007 (*Oncorhynchus mykiss*) in the Boundary Reservoir (October 19, 2007, to August 29, 2008) in relation to daily average water temperature, daily average total discharge from Box Canyon Dam, and daily average water level elevation as measured at the USGS auxiliary gage station 1.2 miles downstream of Box Canyon Dam.

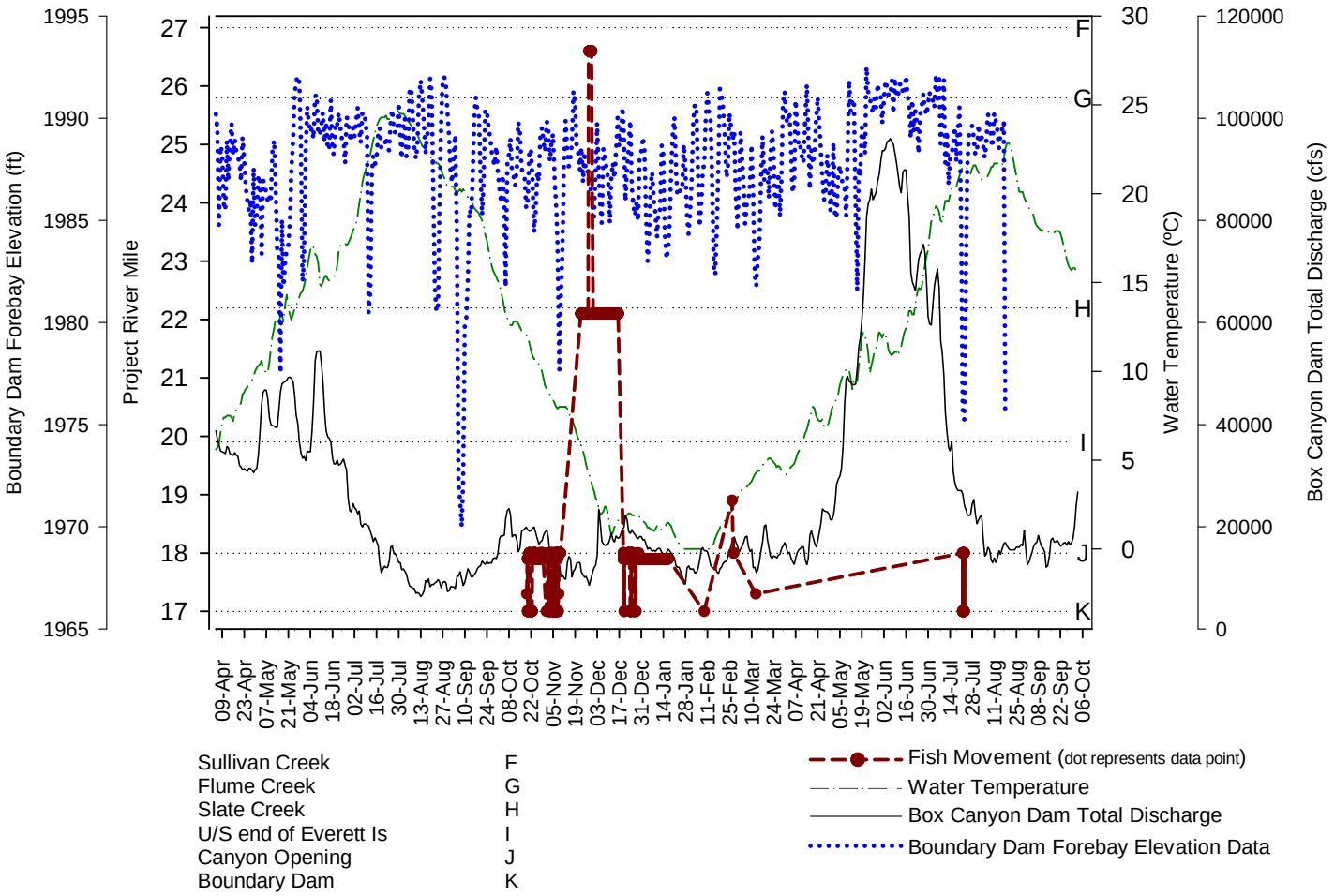

Figure A.7-5. Movement data of a radio-tagged (Fish 138) triploid rainbow trout fall release 2007 (*Oncorhynchus mykiss*) in the Boundary Reservoir (October 19, 2007, to July 22, 2008) in relation to daily average water temperature, daily average total discharge from Box Canyon Dam, and daily average water level elevation as measured at the Boundary Dam Forebay.

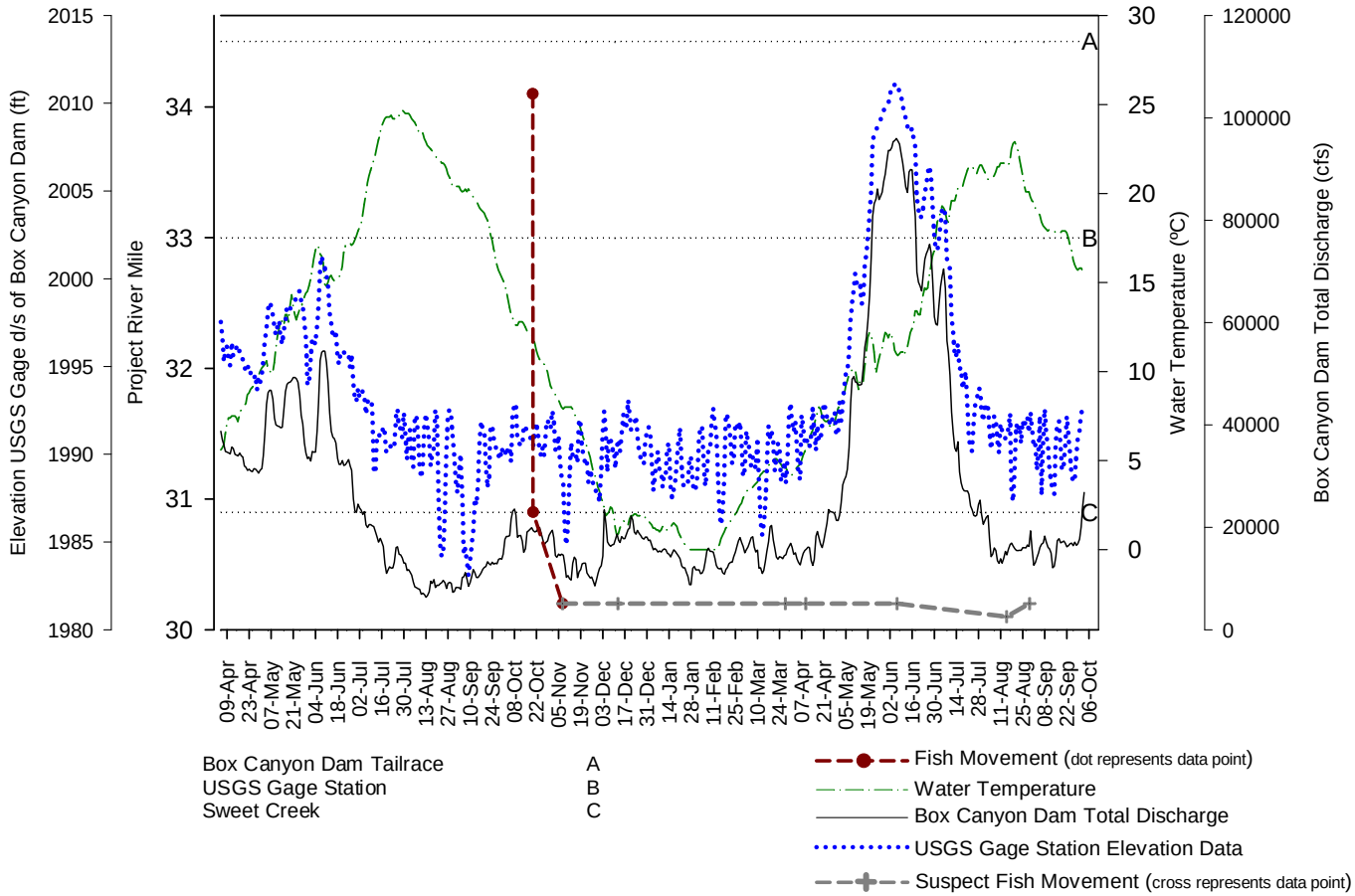

Figure A.7-6. Movement data of a radio-tagged (Fish 139) triploid rainbow trout fall release 2007 (*Oncorhynchus mykiss*) in the Boundary Reservoir (October 19, 2007, to August 29, 2008) in relation to daily average water temperature, daily average total discharge from Box Canyon Dam, and daily average water level elevation as measured at the USGS auxiliary gage station 1.2 miles downstream of Box Canyon Dam.

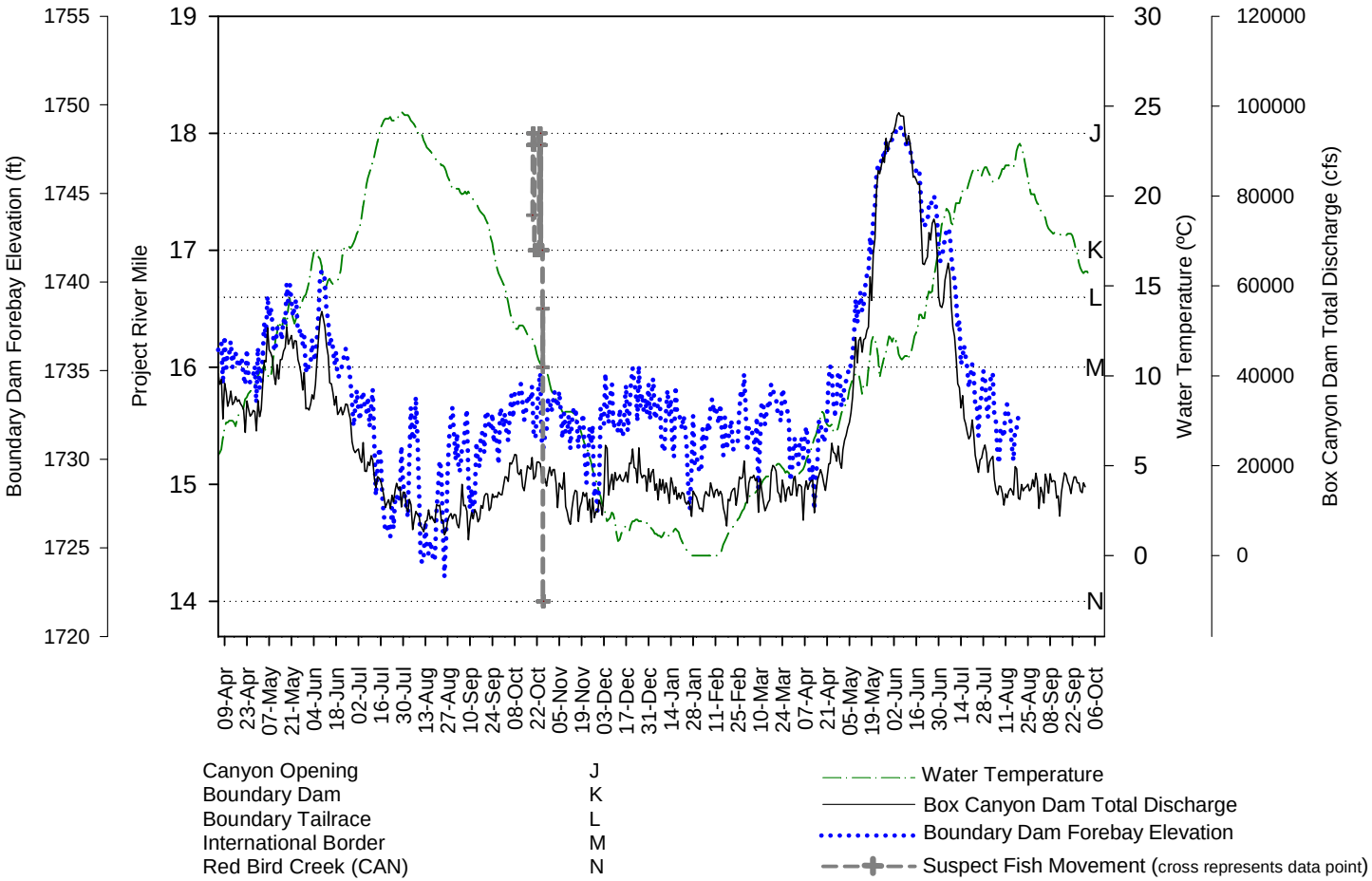

Figure A.7-7. Movement data of a radio-tagged (Fish 140) triploid rainbow trout fall release 2007 (*Oncorhynchus mykiss*) in the Boundary Tailrace (October 19 to December 20, 2007) in relation to daily average water temperature, daily average total Boundary discharge, and daily average water level elevation as measured at Boundary Dam Forebay.

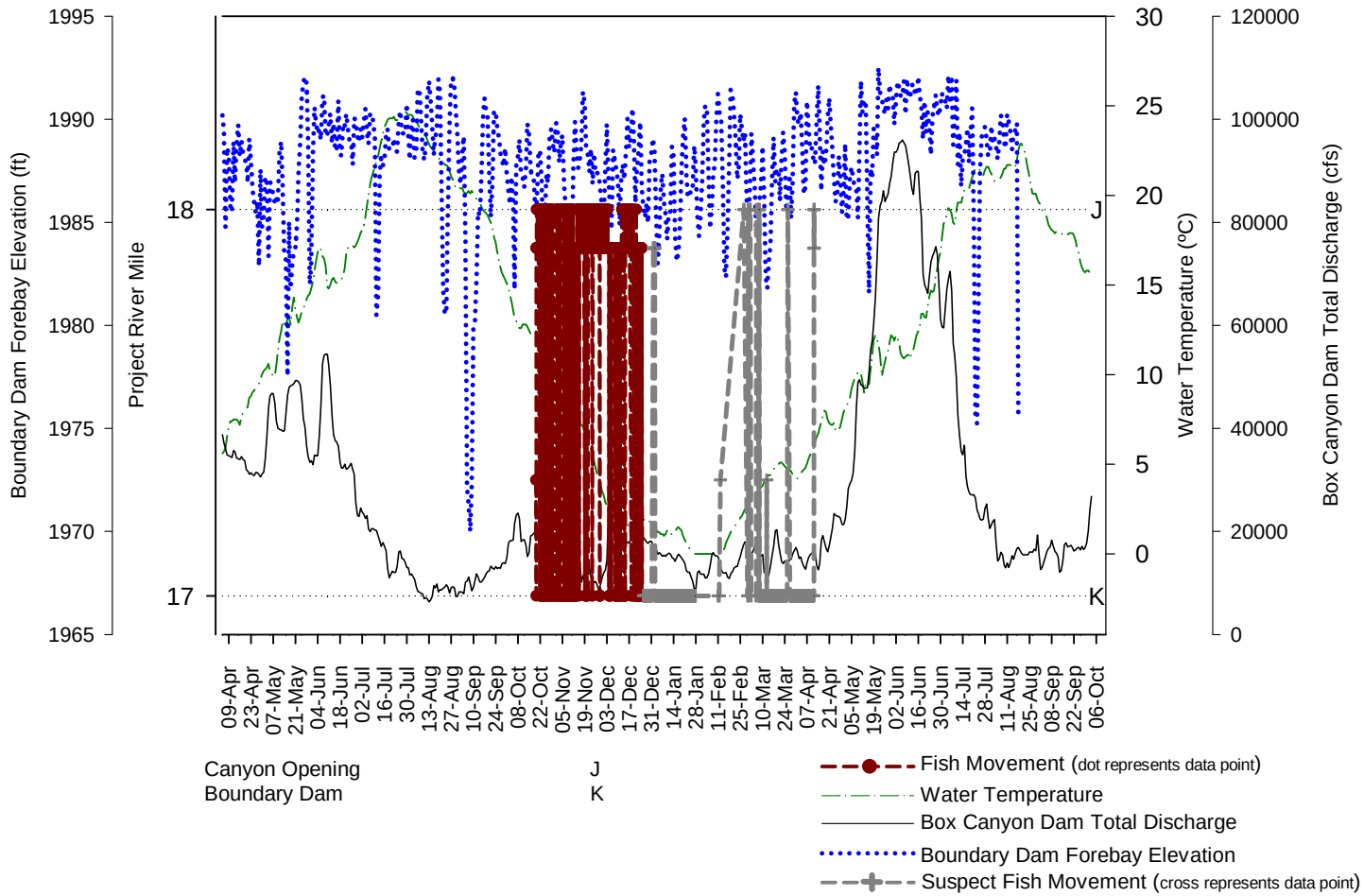

Figure A.7-8. Movement data of a radio-tagged (Fish 141) triploid rainbow trout fall release 2007 (*Oncorhynchus mykiss*) in the Boundary Reservoir (October 19, 2007, to April 11, 2008) in relation to daily average water temperature, daily average total discharge from Box Canyon Dam, and daily average water level elevation as measured at the Boundary Dam forebay.

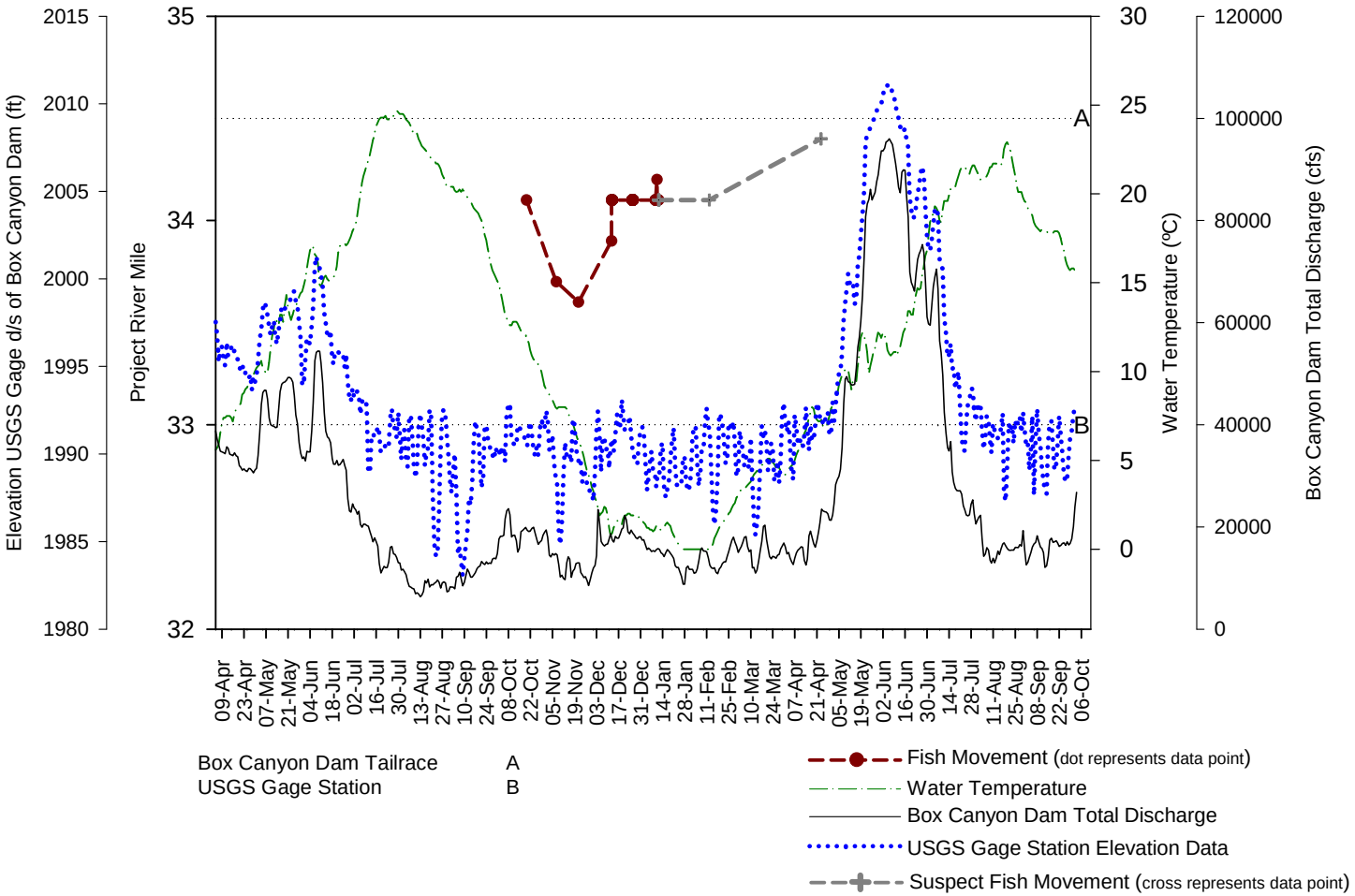

Figure A.7-9. Movement data of a radio-tagged (Fish 142) triploid rainbow trout fall release 2007 (*Oncorhynchus mykiss*) in the Boundary Reservoir (October 19, 2007, to April 23, 2008) in relation to daily average water temperature, daily average total discharge from Box Canyon Dam, and daily average water level elevation as measured at the USGS auxiliary gage station 1.2 miles downstream of Box Canyon Dam.

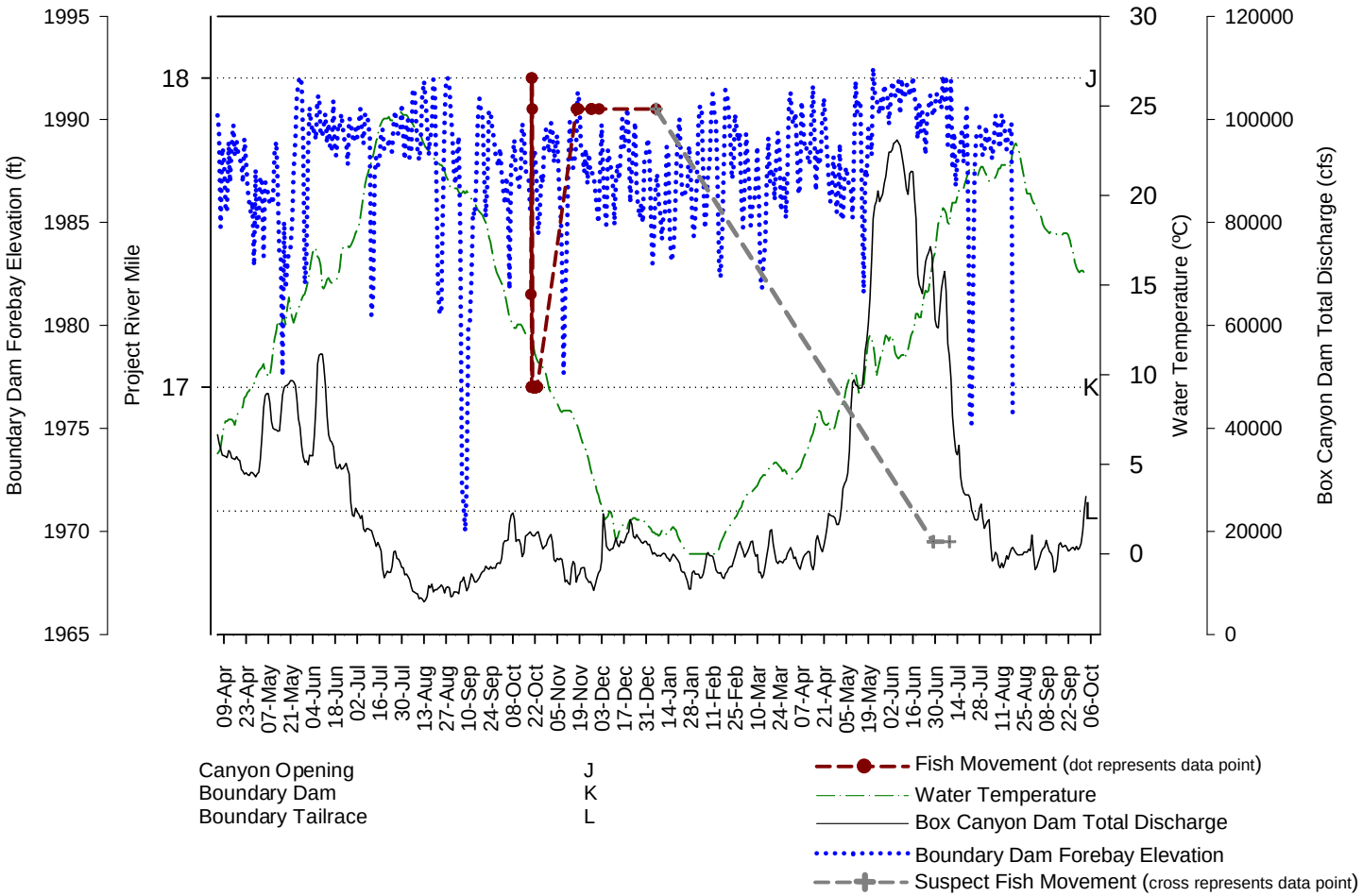

Figure A.7-10. Movement data of a radio-tagged (Fish 143) triploid rainbow trout fall release 2007 (*Oncorhynchus mykiss*) in the Boundary Reservoir (October 19, 2007, to July 9, 2008) in relation to daily average water temperature, daily average total discharge from Box Canyon Dam, and daily average water level elevation as measured at the Boundary Dam forebay.

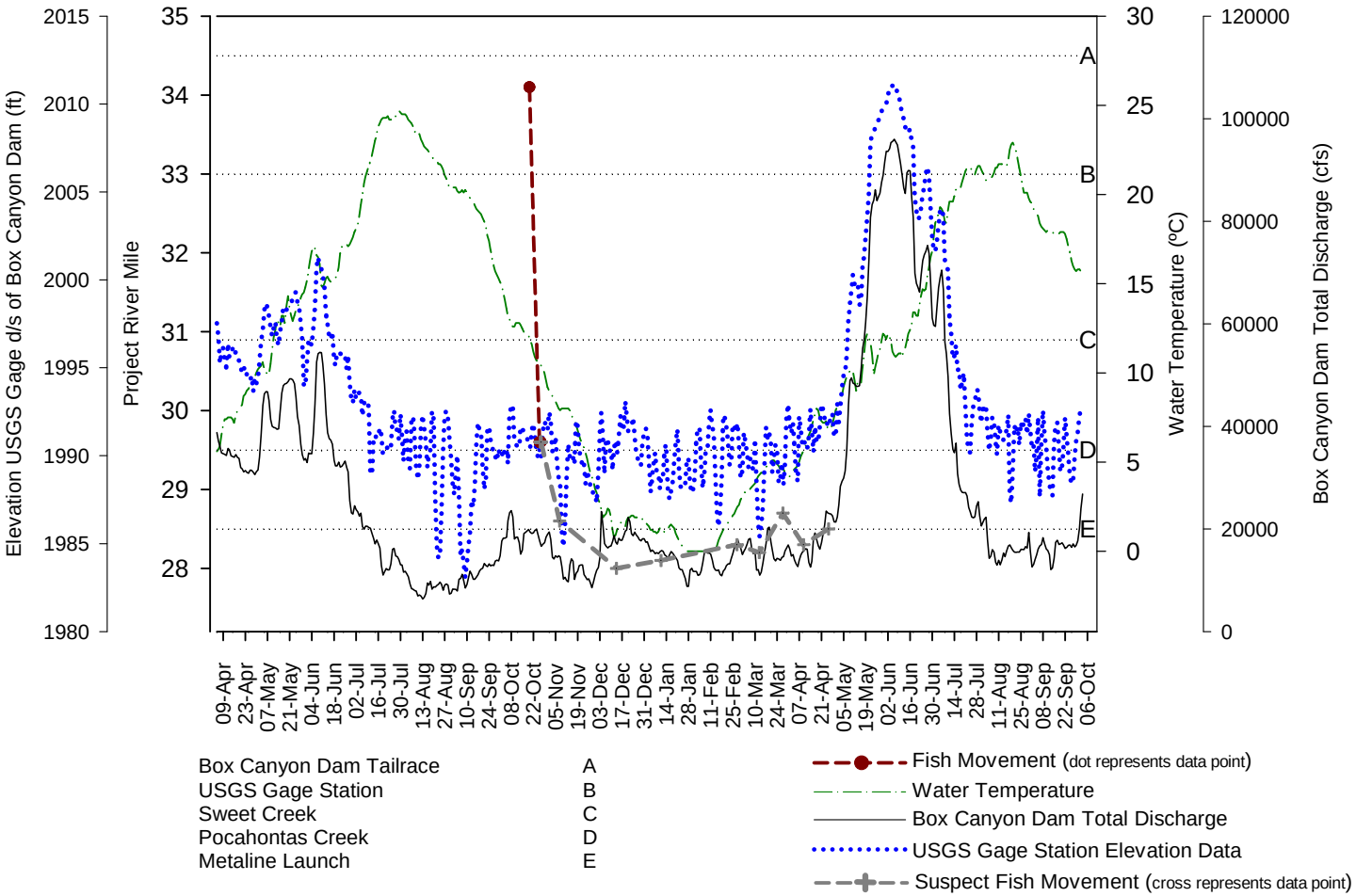

Figure A.7-11. Movement data of a radio-tagged (Fish 144) triploid rainbow trout fall release 2007 (*Oncorhynchus mykiss*) in the Boundary Reservoir (October 19, 2007, to April 25, 2008) in relation to daily average water temperature, daily average total discharge from Box Canyon Dam, and daily average water level elevation as measured at the USGS auxiliary gage station 1.2 miles downstream of Box Canyon Dam.

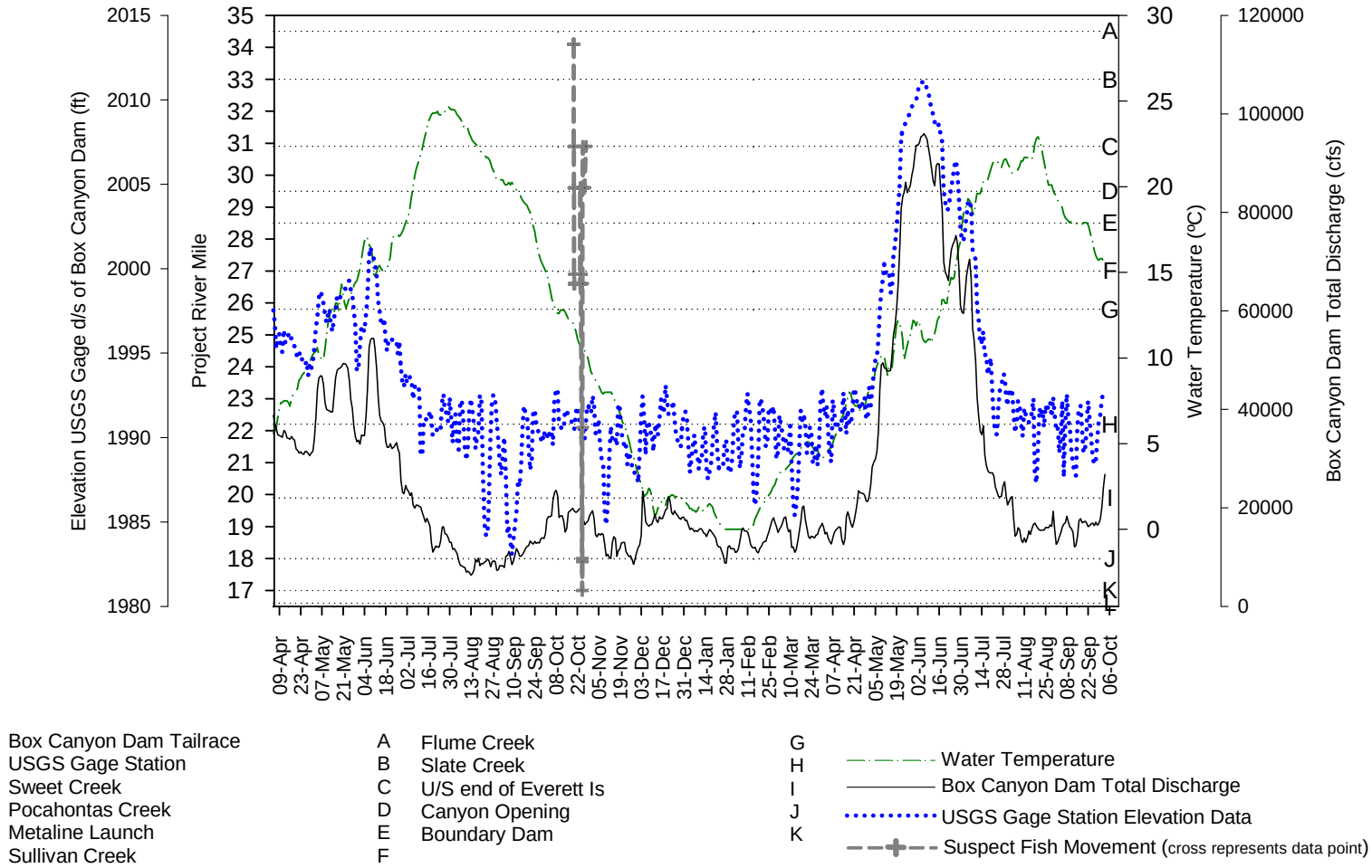

Figure A.7-12. Movement data of a radio-tagged (Fish 145) triploid rainbow trout fall release 2007 (*Oncorhynchus mykiss*) in the Boundary Reservoir (October 19 to October 27, 2007) in relation to daily average water temperature, daily average total discharge from Box Canyon Dam, and daily average water level elevation as measured at the USGS auxiliary gage station 1.2 miles downstream of Box Canyon Dam.

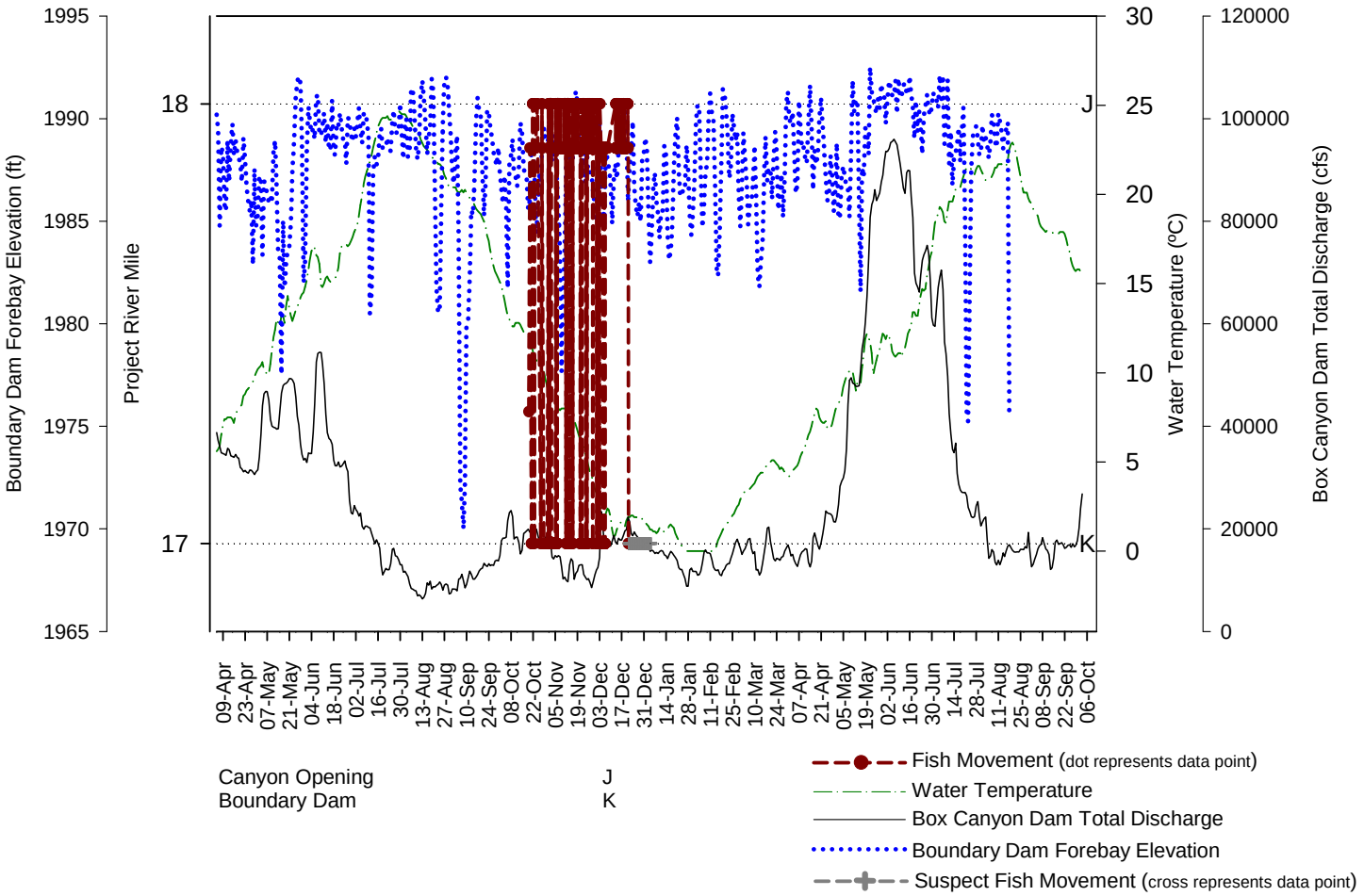

Figure A.7-13. Movement data of a radio-tagged (Fish 146) triploid rainbow trout fall release 2007 (*Oncorhynchus mykiss*) in the Boundary Reservoir (October 19, 2007, to January 4, 2008) in relation to daily average water temperature, daily average total discharge from Box Canyon Dam, and daily average water level elevation as measured at the Boundary Dam forebay.

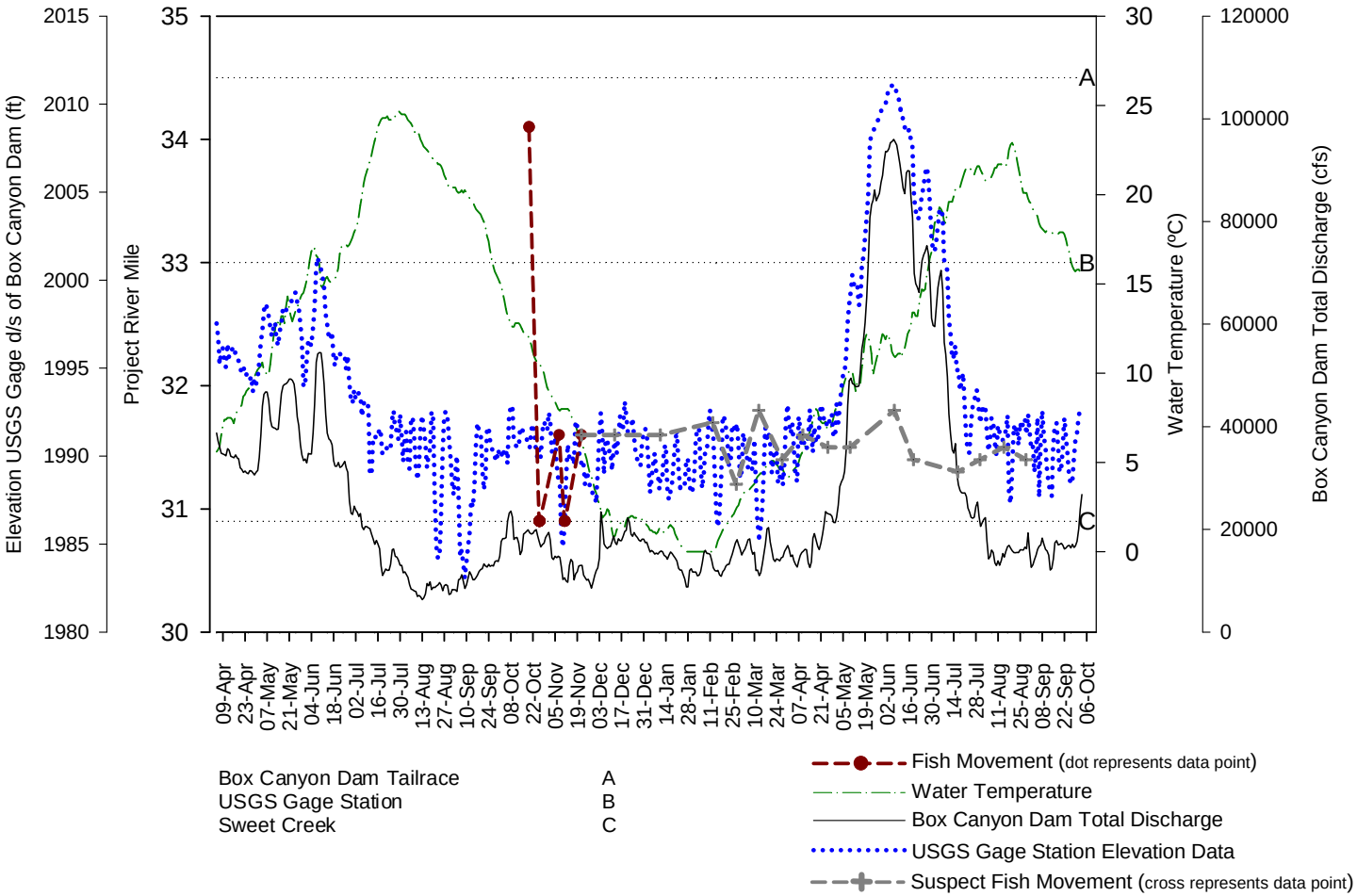

Figure A.7-14. Movement data of a radio-tagged (Fish 147) triploid rainbow trout fall release 2007 (*Oncorhynchus mykiss*) in the Boundary Reservoir (October 19, 2007, to August 28, 2008) in relation to daily average water temperature, daily average total discharge from Box Canyon Dam, and daily average water level elevation as measured at the USGS auxiliary gage station 1.2 miles downstream of Box Canyon Dam.

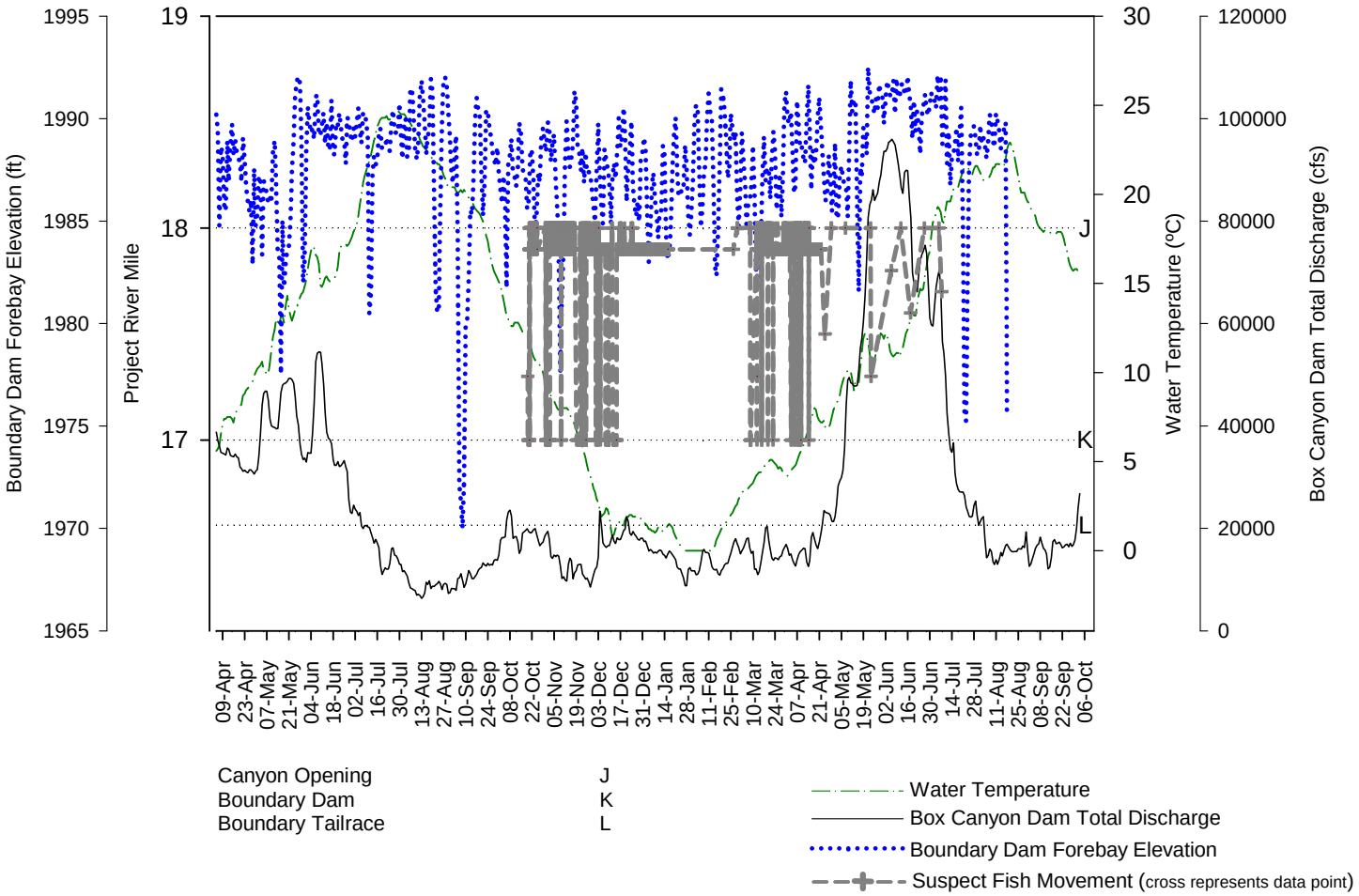

Figure A.7-15. Movement data of a radio-tagged (Fish 148) triploid rainbow trout fall release 2007 (*Oncorhynchus mykiss*) in the Boundary Reservoir (October 19, 2007, to August 28, 2008) in relation to daily average water temperature, daily average total discharge from Box Canyon Dam, and daily average water level elevation as measured at the Boundary Dam forebay.

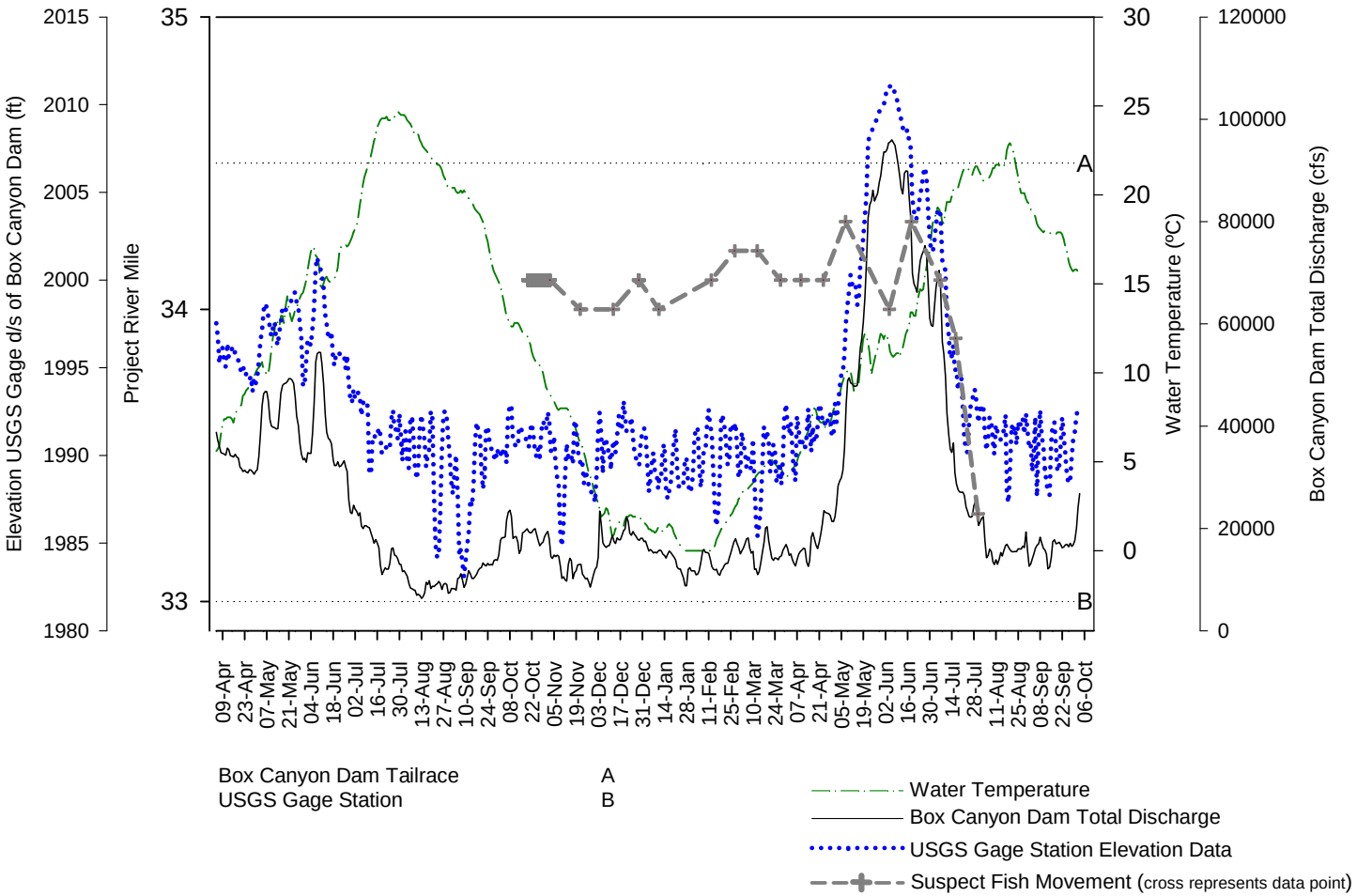

Figure A.7-16. Movement data of a radio-tagged (Fish 149) triploid rainbow trout fall release 2007 (*Oncorhynchus mykiss*) in the Boundary Reservoir (October 19, 2007, to July 30, 2008) in relation to daily average water temperature, daily average total discharge from Box Canyon Dam, and daily average water level elevation as measured at the USGS auxiliary gage station 1.2 miles downstream of Box Canyon Dam.

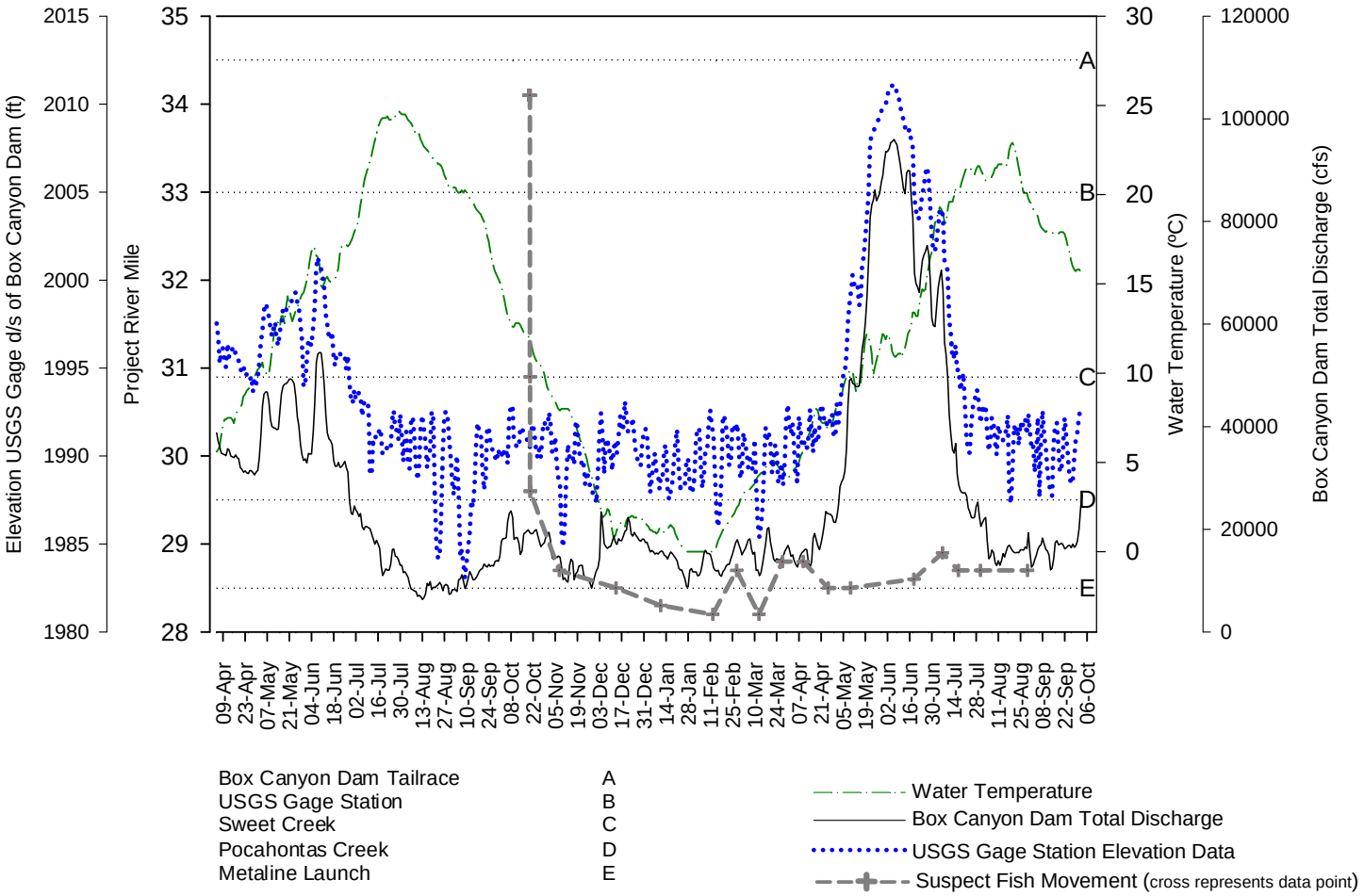

Figure A.7-17. Movement data of a radio-tagged (Fish 150) triploid rainbow trout fall release 2007 (*Oncorhynchus mykiss*) in the Boundary Reservoir (October 19, 2007, to August 29, 2008) in relation to daily average water temperature, daily average total discharge from Box Canyon Dam, and daily average water level elevation as measured at the USGS auxiliary gage station 1.2 miles downstream of Box Canyon Dam.

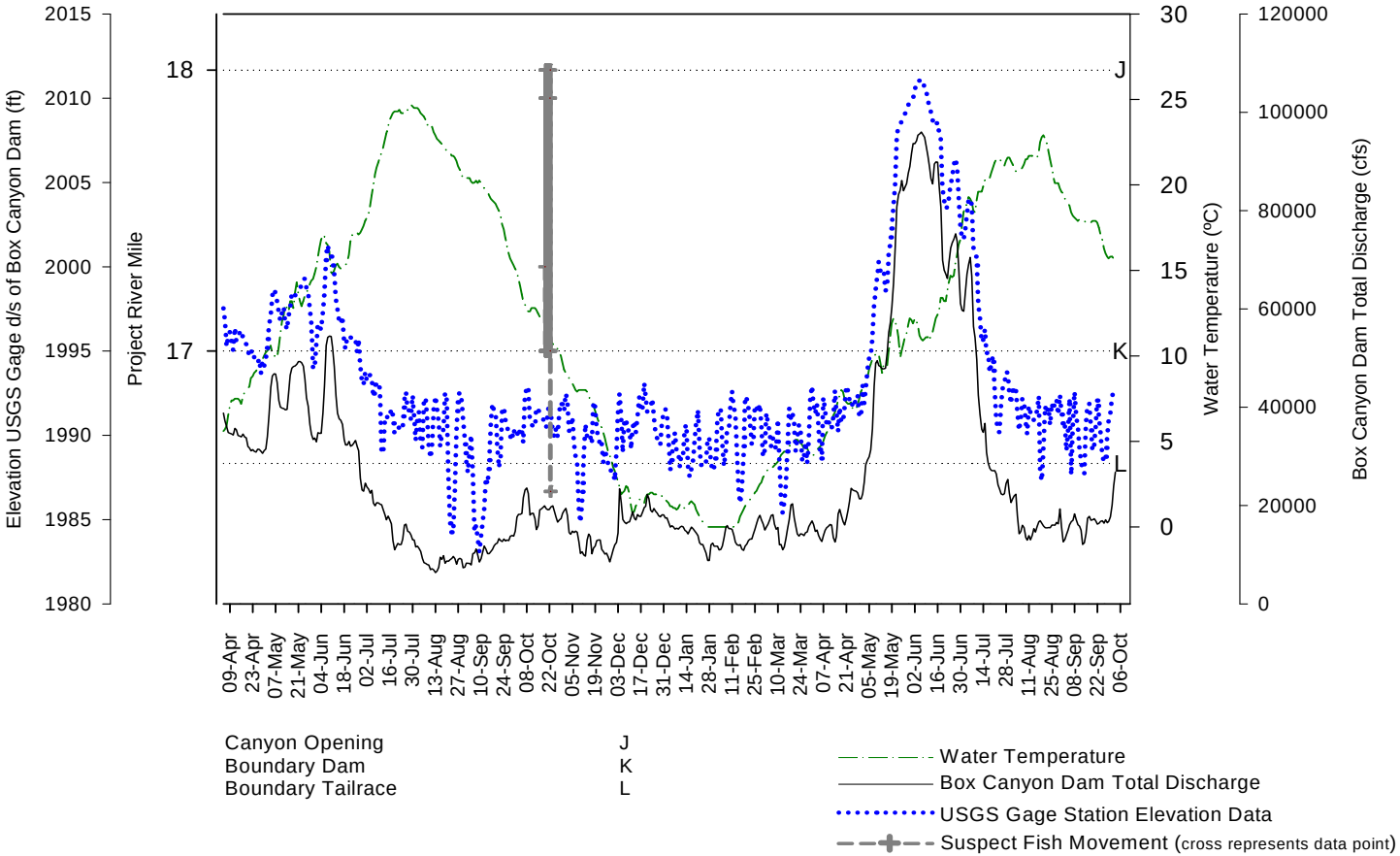

Figure A.7-18. Movement data of a radio-tagged (Fish 151) triploid rainbow trout fall release 2007 (*Oncorhynchus mykiss*) in the Boundary Reservoir (October 19 to October 22, 2007) in relation to daily average water temperature, daily average total discharge from Box Canyon Dam, and daily average water level elevation as measured at the USGS auxiliary gage station 1.2 miles downstream of Box Canyon Dam.

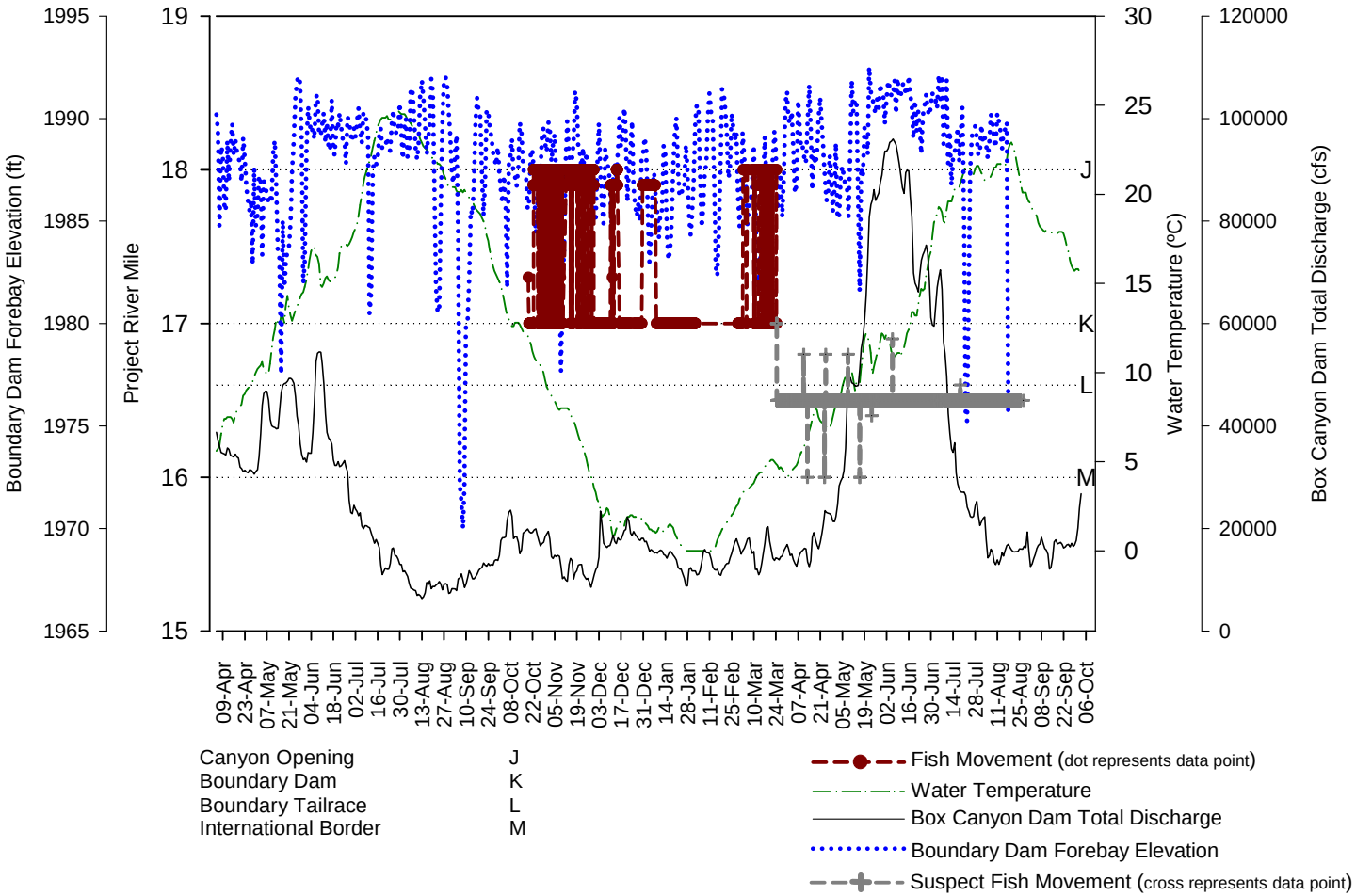

Figure A.7-19. Movement data of a radio-tagged (Fish 152) triploid rainbow trout fall release 2007 (*Oncorhynchus mykiss*) in the Boundary Reservoir (October 19, 2007, to August 27, 2008) in relation to daily average water temperature, daily average total discharge from Box Canyon Dam, and daily average water level elevation as measured at the Boundary Dam forebay.

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Appendix 8: Carry-Over 2007/2008 Release Radio Tracking Figures

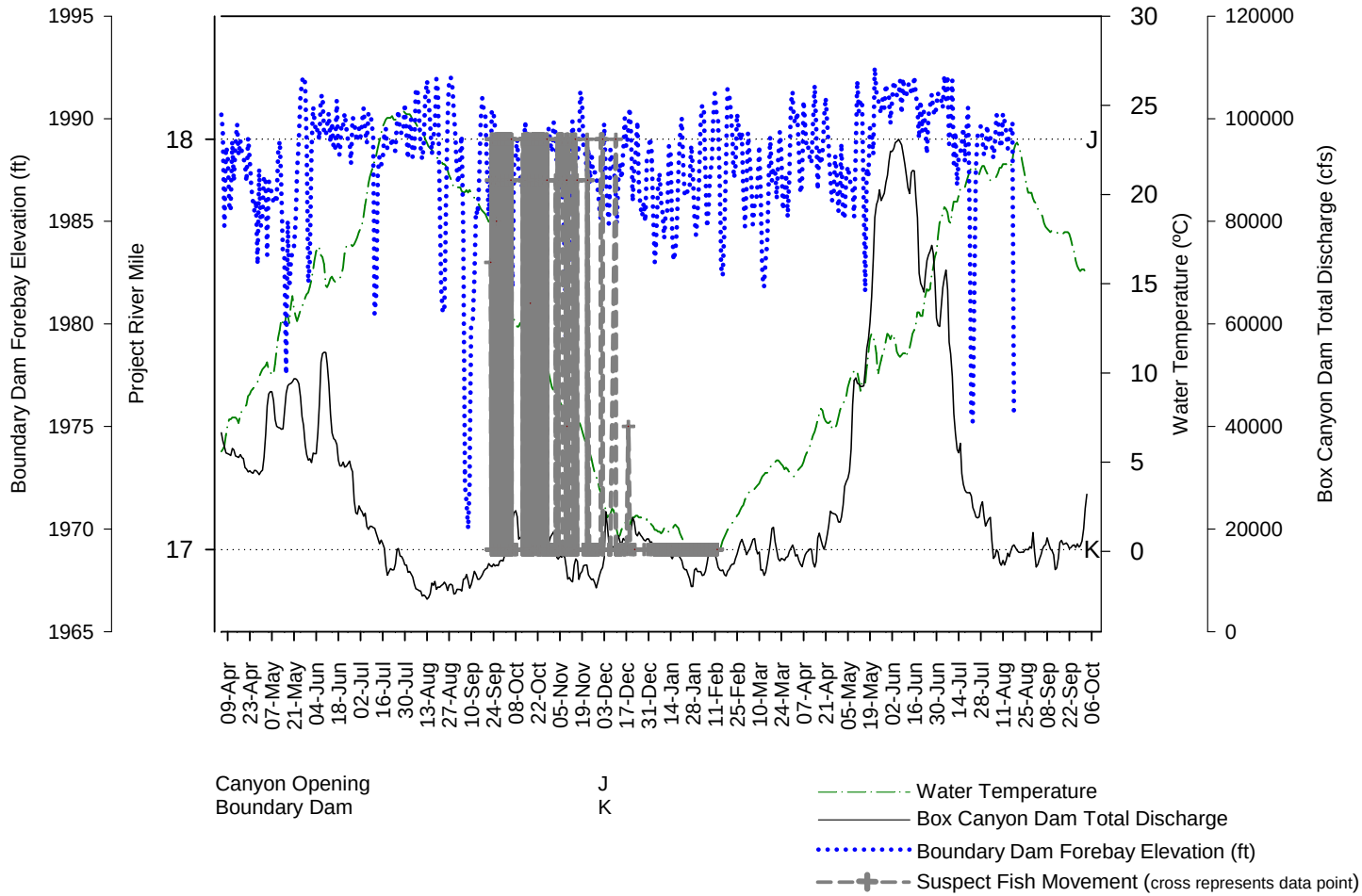

Figure A.8-1. Movement data of a radio-tagged (Fish 11) triploid rainbow trout carry-over (*Oncorhynchus mykiss*) in the Boundary Reservoir (September 22, 2007, to February 12, 2008) in relation to daily average water temperature, daily average total discharge from Box Canyon Dam, and daily average water level elevation as measured at the Boundary Dam forebay. Tag eventually found on shore.

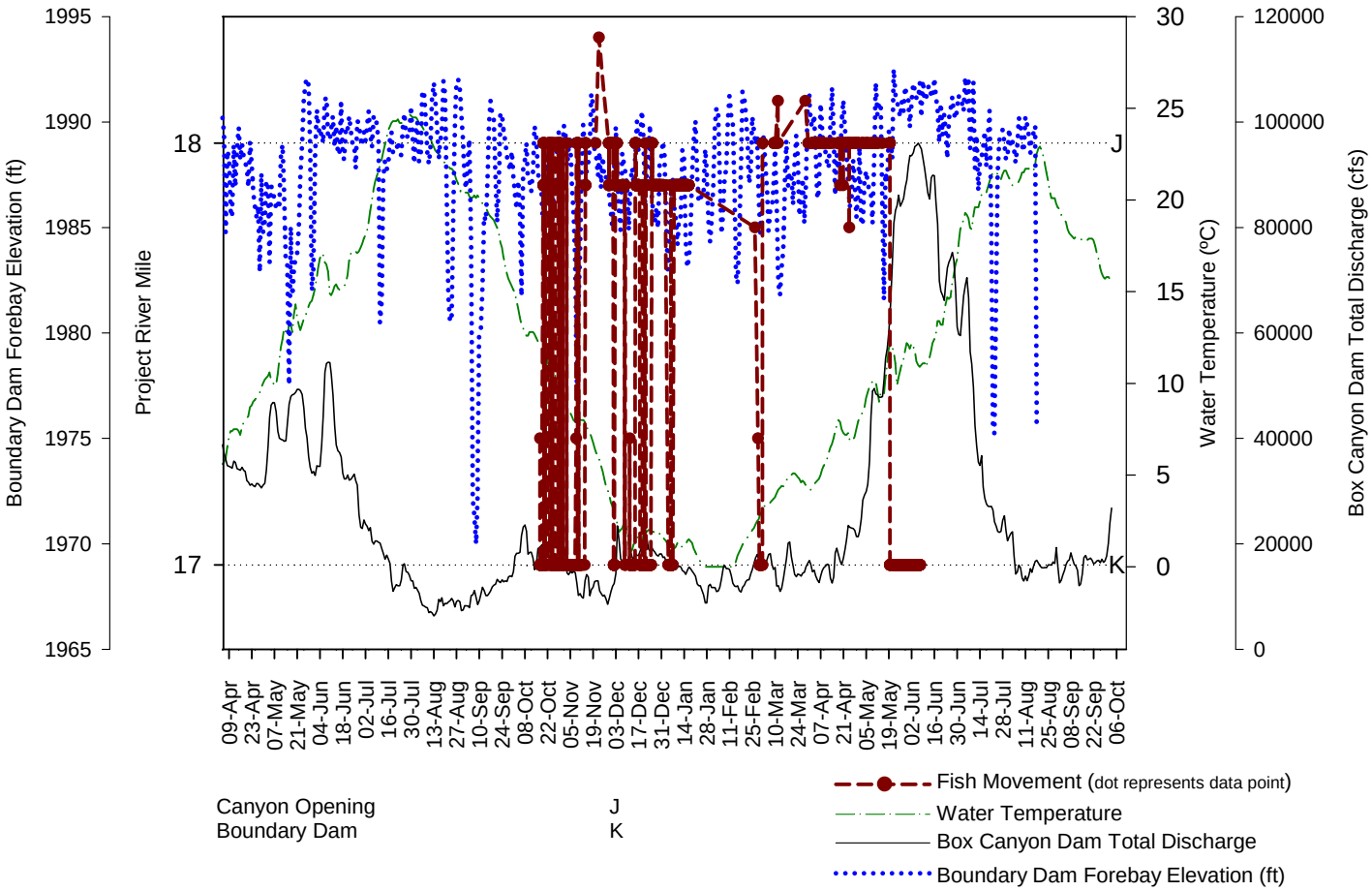

Figure A.8-2. Movement data of a radio-tagged (Fish 12) triploid rainbow trout carry-over (*Oncorhynchus mykiss*) in the Boundary Reservoir (October 17, 2007, to June 7, 2008) in relation to daily average water temperature, daily average total discharge from Box Canyon Dam, and daily average water level elevation as measured at the Boundary Dam forebay.

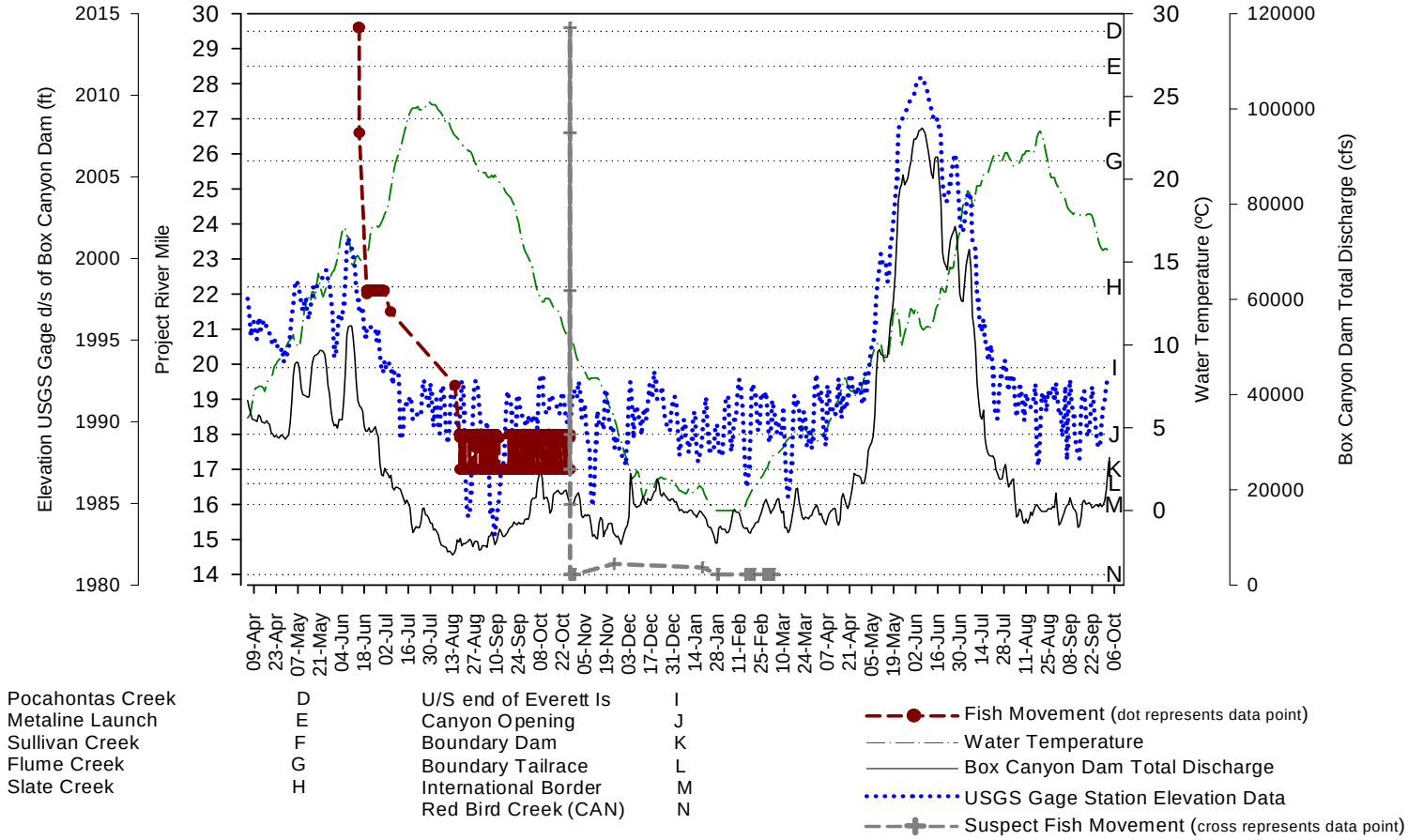

Figure A.8-3. Movement data of a radio-tagged (Fish 28) triploid rainbow trout carry-over (*Oncorhynchus mykiss*) in the Boundary Reservoir and Tailrace (June 14, 2007, to March 3, 2008) in relation to daily average water temperature, daily average total discharge from Box Canyon Dam, and daily average water level elevation as measured at the USGS auxiliary gage station 1.2 miles downstream of Box Canyon Dam.

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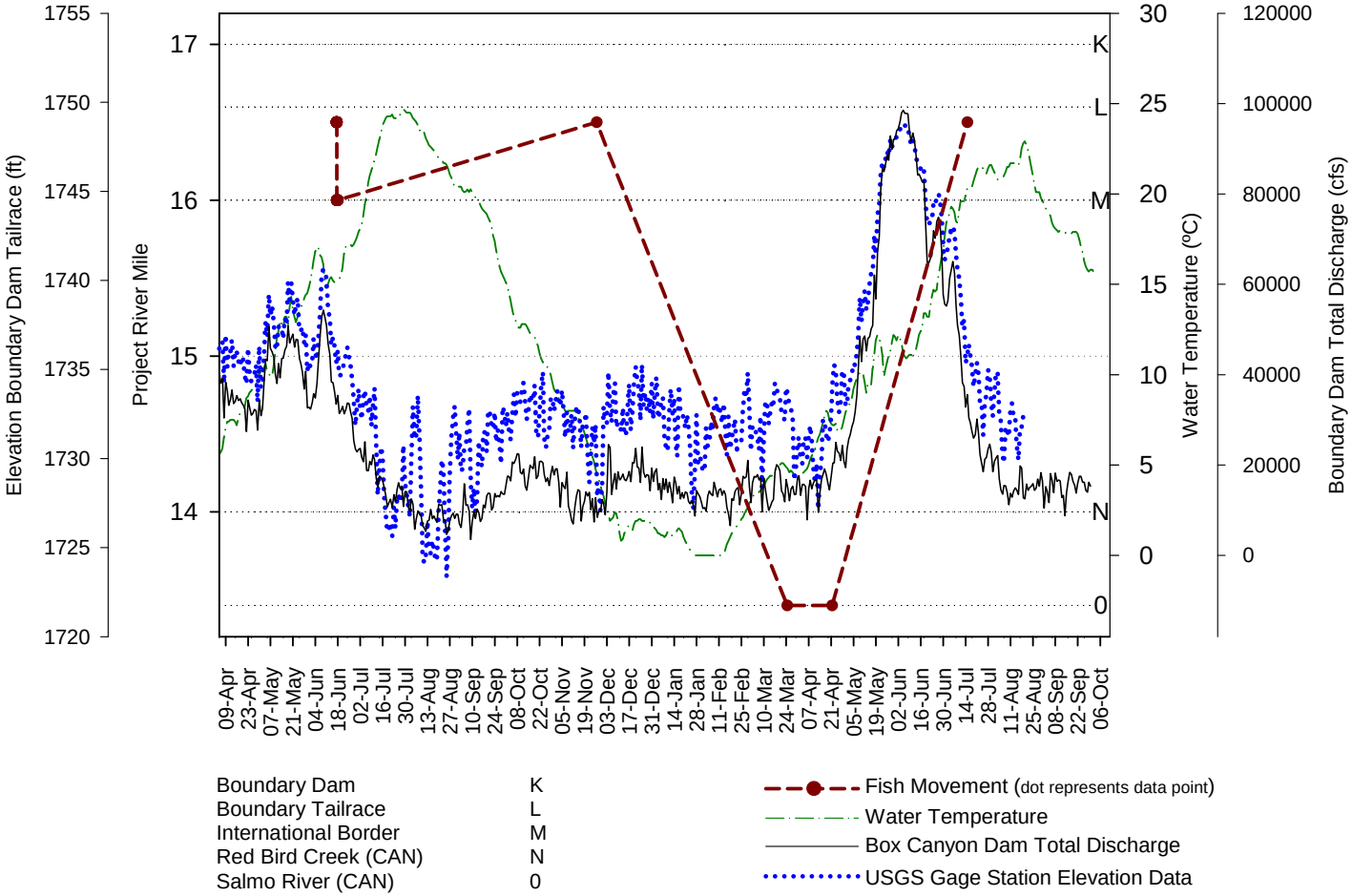

Figure A.8-4. Movement data of a radio-tagged (Fish 31) triploid rainbow trout carry-over (*Oncorhynchus mykiss*) in the Boundary Reservoir and Tailrace (June 17, 2007, to July 15, 2008) in relation to daily average water temperature, daily average total Boundary, and daily average water level elevation as measured at Boundary Tailrace.

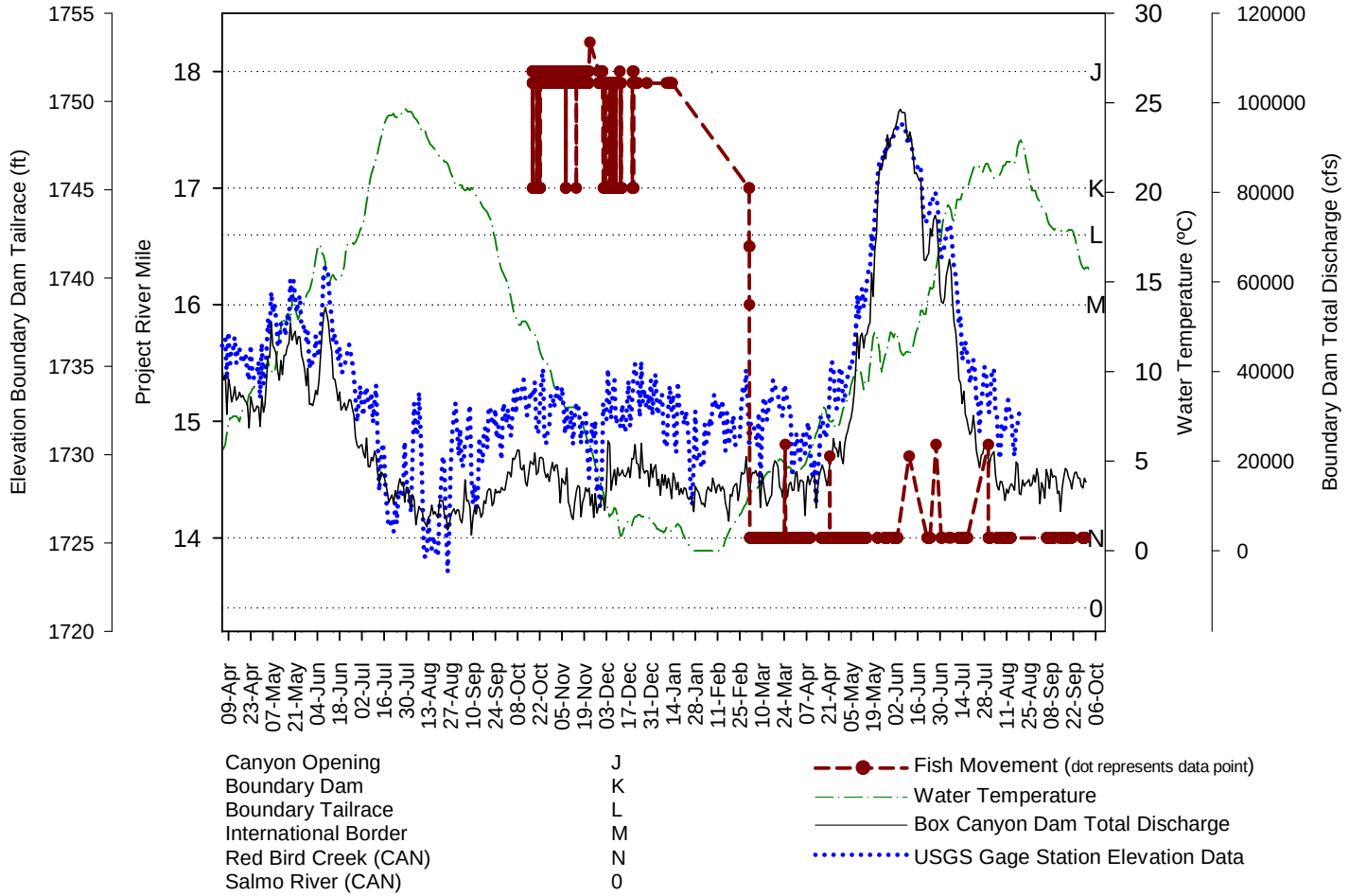

Figure A.8-5. Movement data of a radio-tagged (Fish 32) triploid rainbow trout carry-over (*Oncorhynchus mykiss*) in the Boundary Reservoir and Tailrace (October 17, 2007, to August 13, 2008) in relation to daily average water temperature, daily average total Boundary, and daily average water level elevation as measured at Boundary Tailrace.

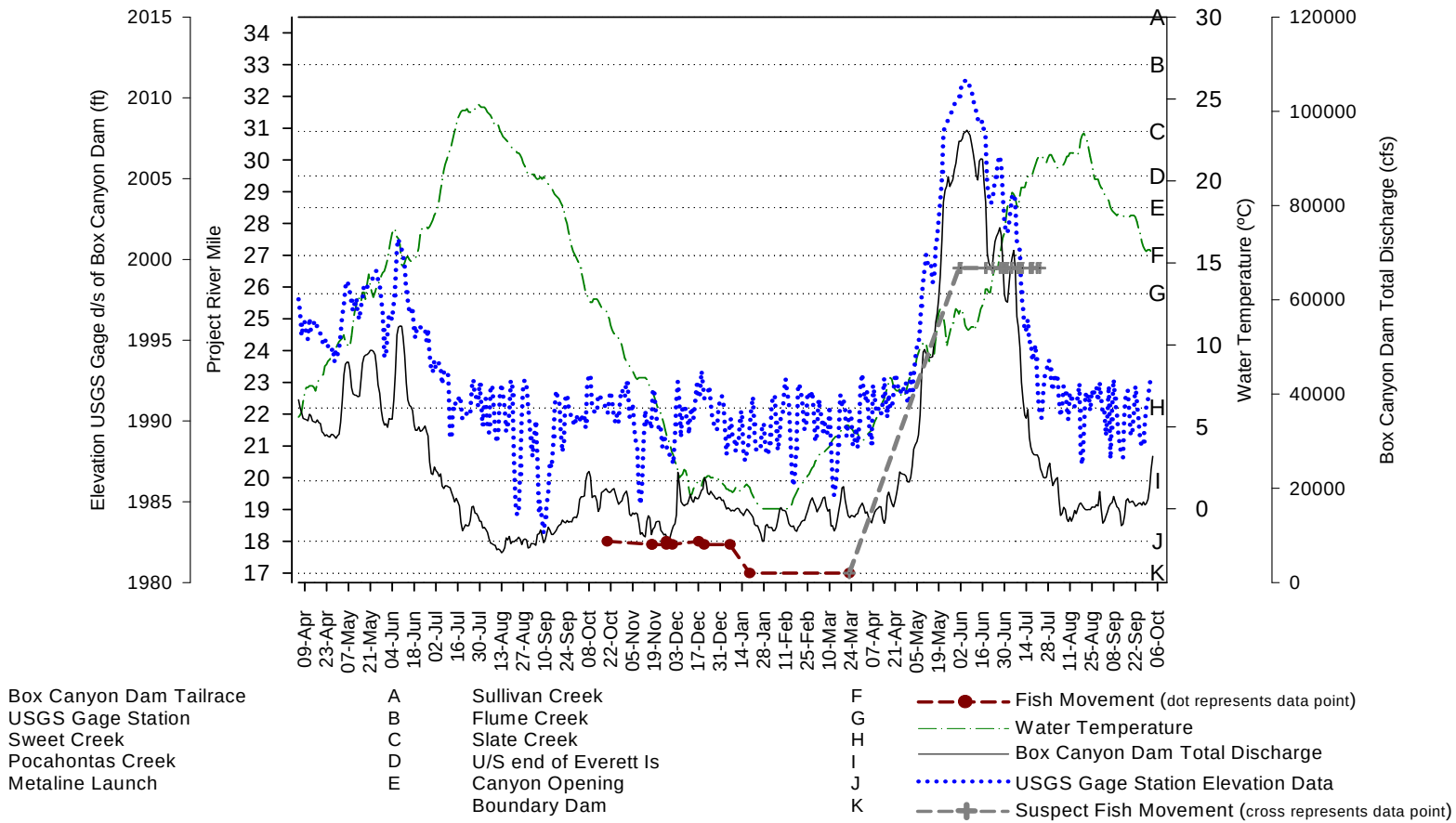

Figure A.8-6. Movement data of a radio-tagged (Fish 33) triploid rainbow trout carry-over (*Oncorhynchus mykiss*) in the Boundary Reservoir (October 19, 2007, to July 22, 2008) in relation to daily average water temperature, daily average total discharge from Box Canyon Dam, and daily average water level elevation as measured at the USGS auxiliary gage station 1.2 miles downstream of Box Canyon Dam.

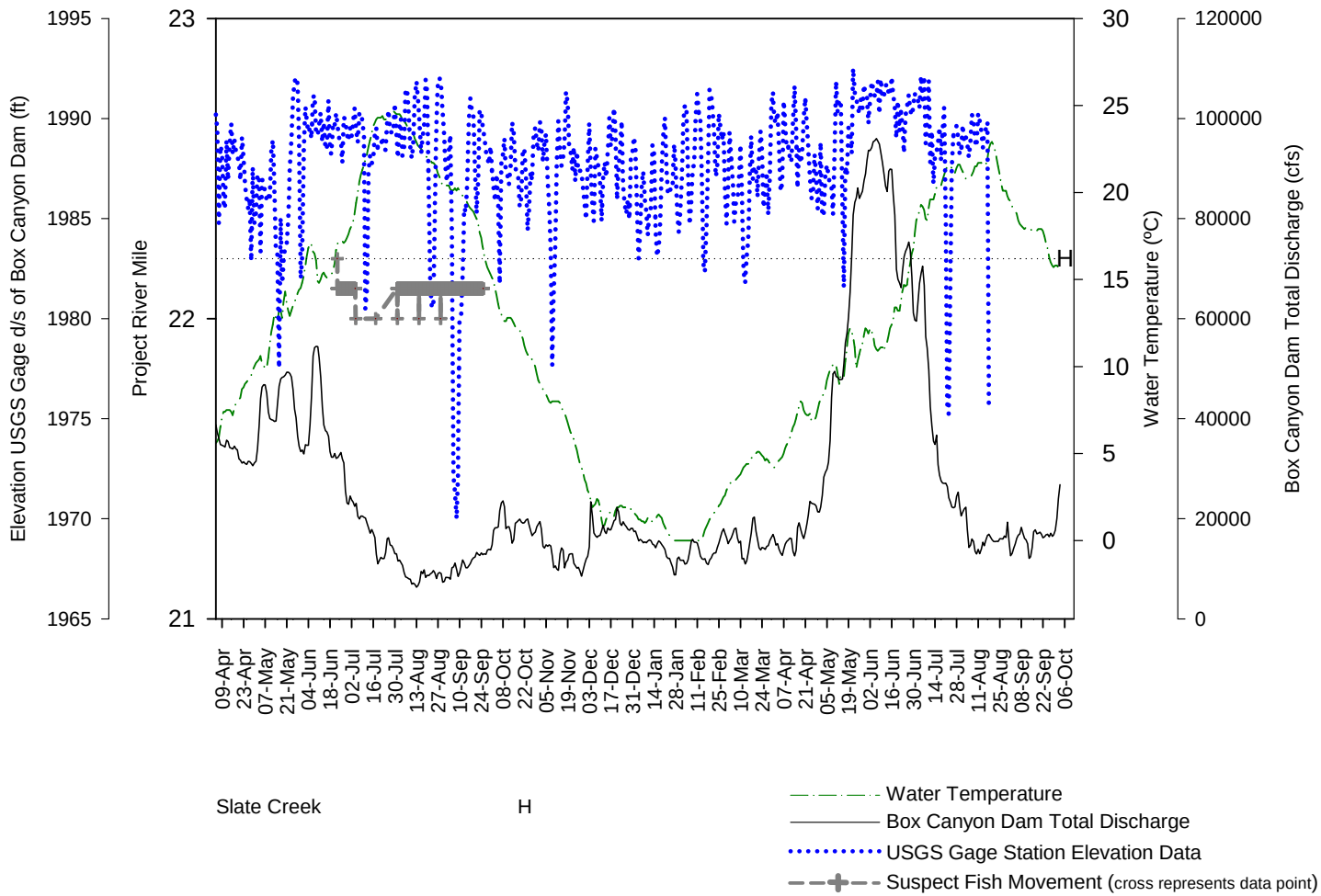

Figure A.8-7. Movement data of a radio-tagged (Fish 34) triploid rainbow trout carry-over (*Oncorhynchus mykiss*) in the Boundary Reservoir (June 22, 2007, to September 25, 2008) in relation to daily average water temperature, daily average total discharge from Box Canyon Dam, and daily average water level elevation as measured at the Boundary Dam forebay.

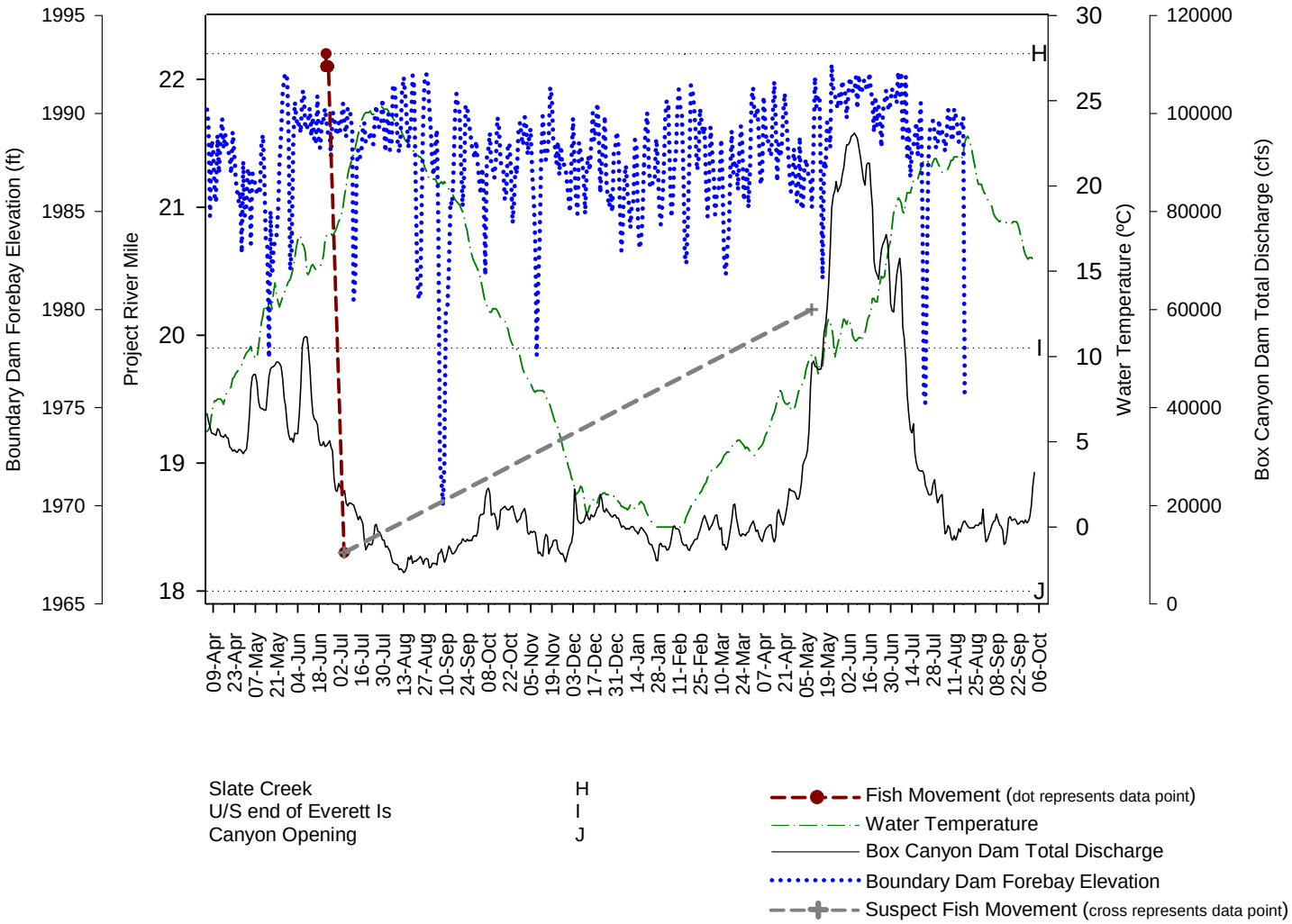

Figure A.8-8. Movement data of a radio-tagged (Fish 36) triploid rainbow trout carry-over (*Oncorhynchus mykiss*) in the Boundary Reservoir (June 22, 2007, to May 08, 2008) in relation to daily average water temperature, daily average total discharge from Box Canyon Dam, and daily average water level elevation as measured at the Boundary Dam forebay.

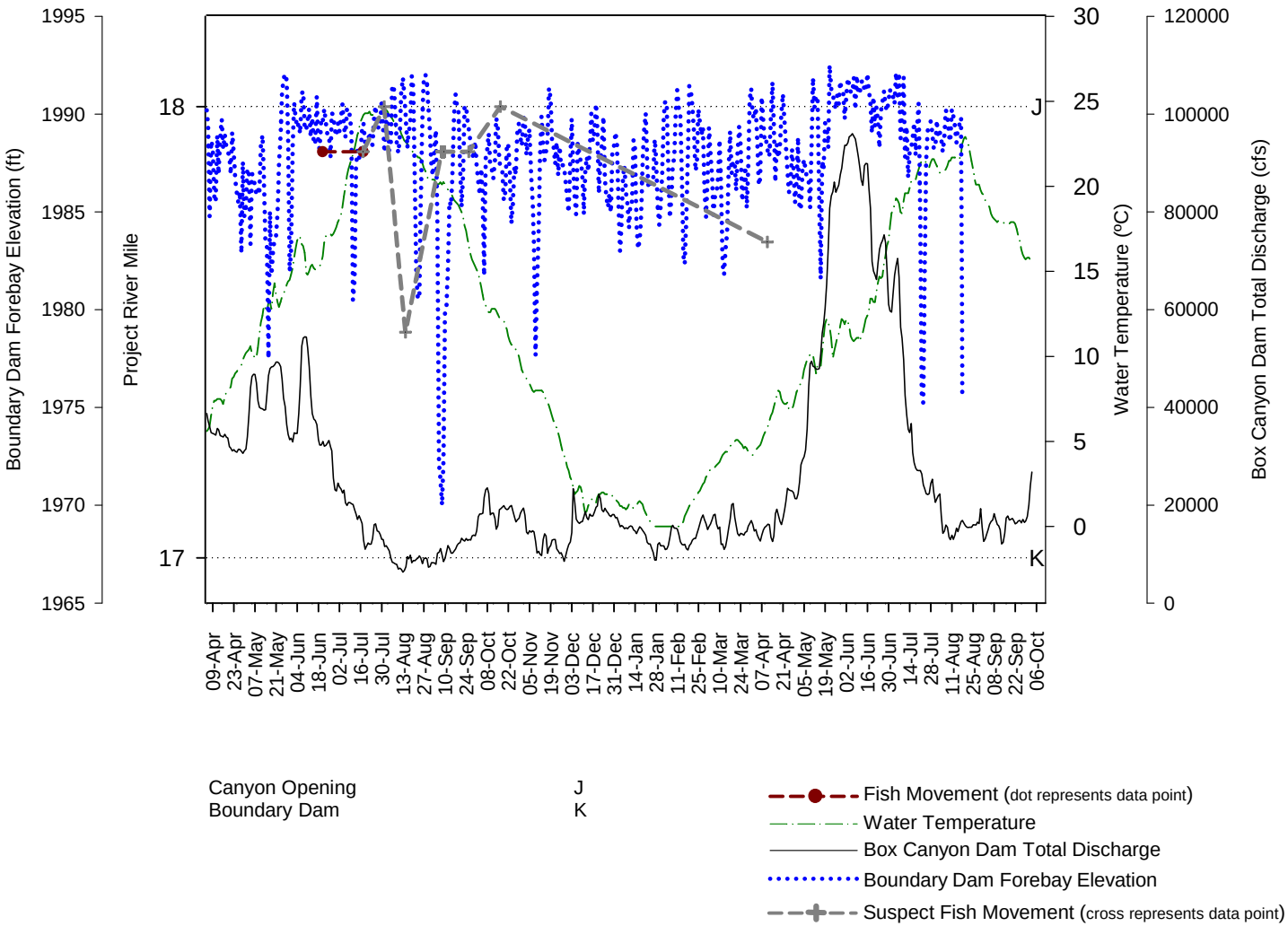

Figure A.8-9. Movement data of a radio-tagged (Fish 37) triploid rainbow trout carry-over (*Oncorhynchus mykiss*) in the Boundary Reservoir (June 20, 2007, to April 10, 2008) in relation to daily average water temperature, daily average total discharge from Box Canyon Dam, and daily average water level elevation as measured at the Boundary Dam forebay.

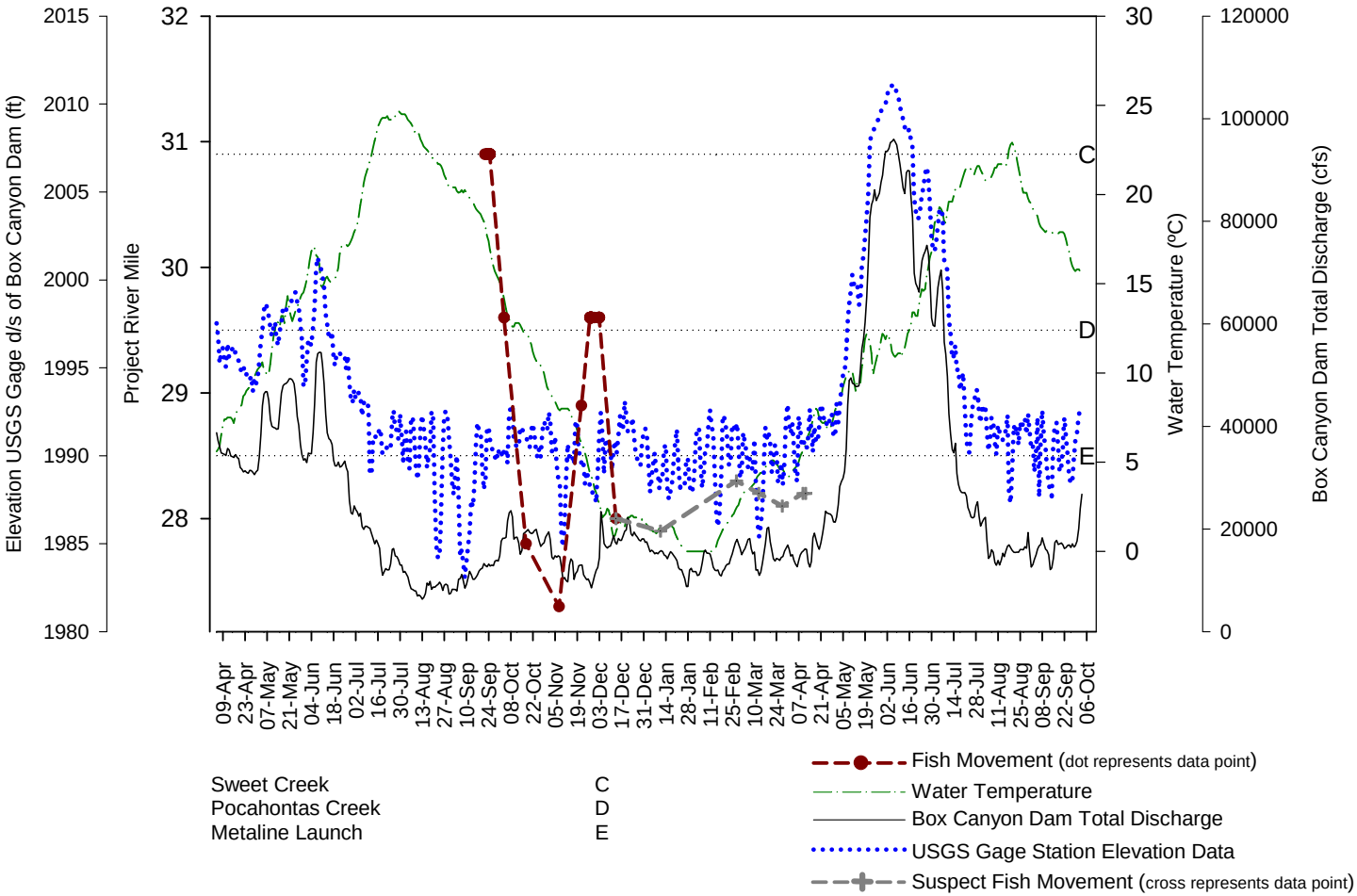

Figure A.8-10. Movement data of a radio-tagged (Fish 39) triploid rainbow trout carry-over (*Oncorhynchus mykiss*) in the Boundary Reservoir (September 21, 2007, to April 11, 2008) in relation to daily average water temperature, daily average total discharge from Box Canyon Dam, and daily average water level elevation as measured at the USGS auxiliary gage station 1.2 miles downstream of Box Canyon Dam.

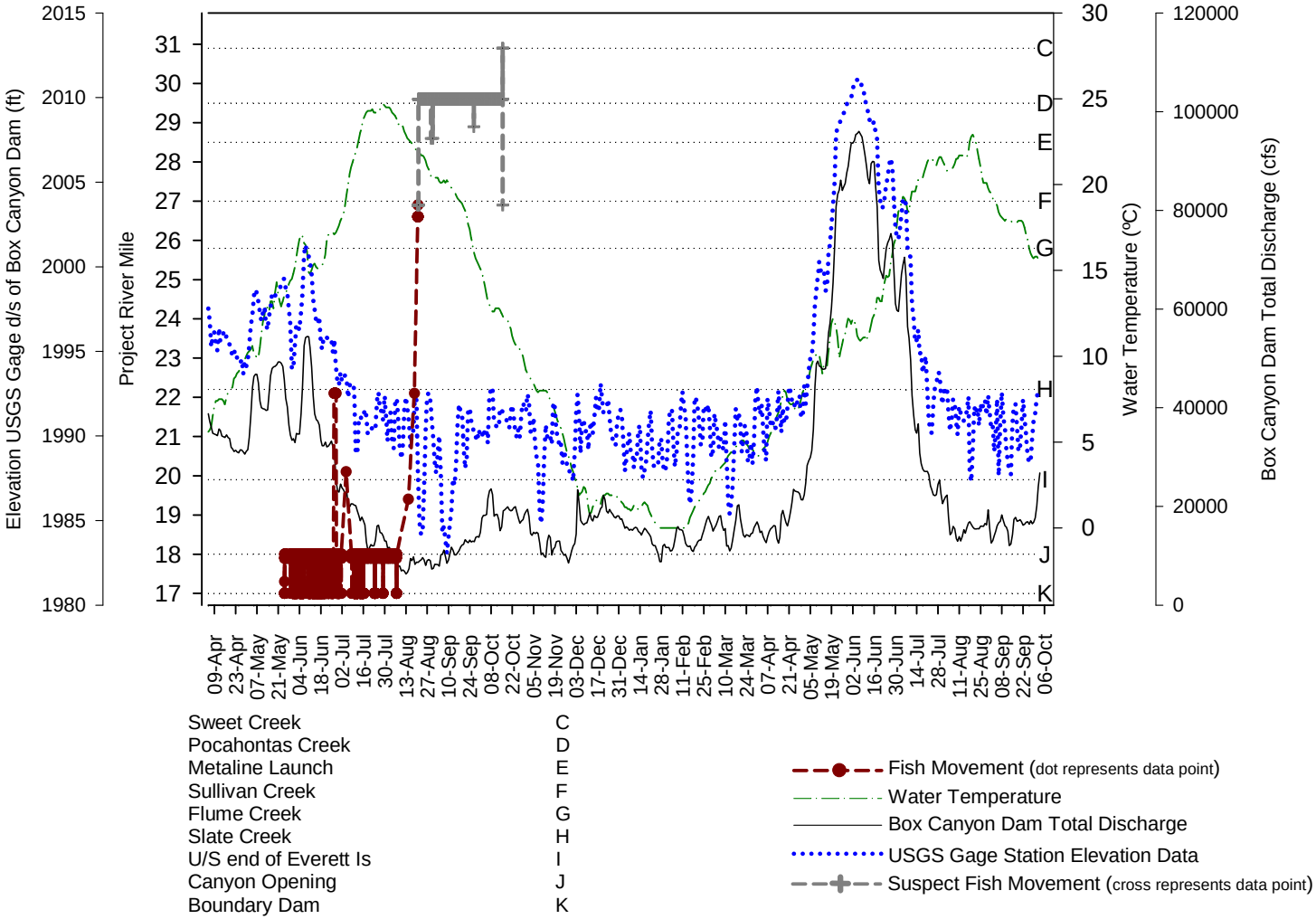

Figure A.8-11. Movement data of a radio-tagged (Fish 40) triploid rainbow trout carry-over (*Oncorhynchus mykiss*) in the Boundary Reservoir (May 25, 2007, to October 15, 2007) in relation to daily average water temperature, daily average total discharge from Box Canyon Dam, and daily average water level elevation as measured at the USGS auxiliary gage station 1.2 miles downstream of Box Canyon Dam.

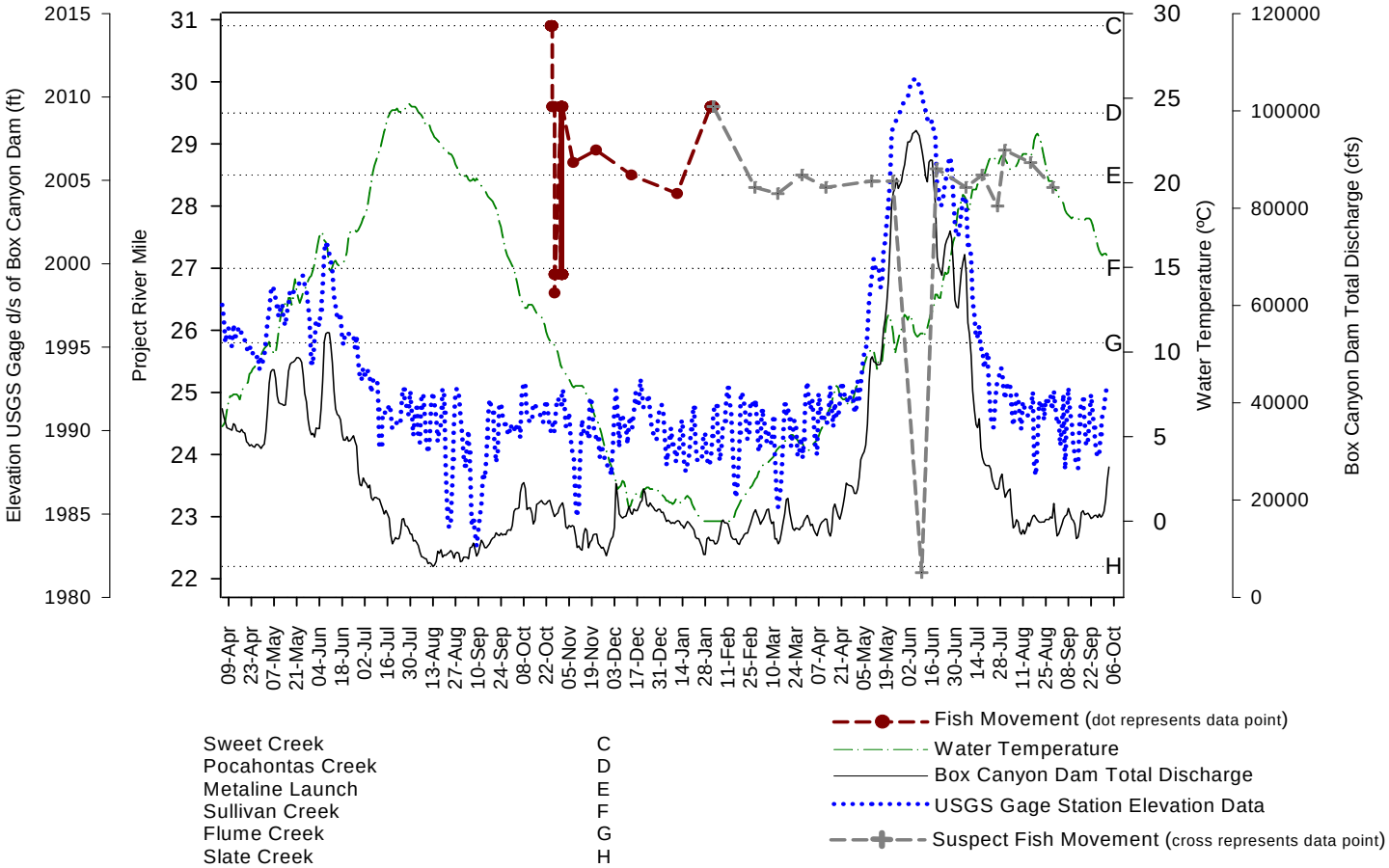

Figure A.8-12. Movement data of a radio-tagged (Fish 44) triploid rainbow trout carry-over (*Oncorhynchus mykiss*) in the Boundary Reservoir (October 24, 2007, to August 29, 2008) in relation to daily average water temperature, daily average total discharge from Box Canyon Dam, and daily average water level elevation as measured at the USGS auxiliary gage station 1.2 miles downstream of Box Canyon Dam.

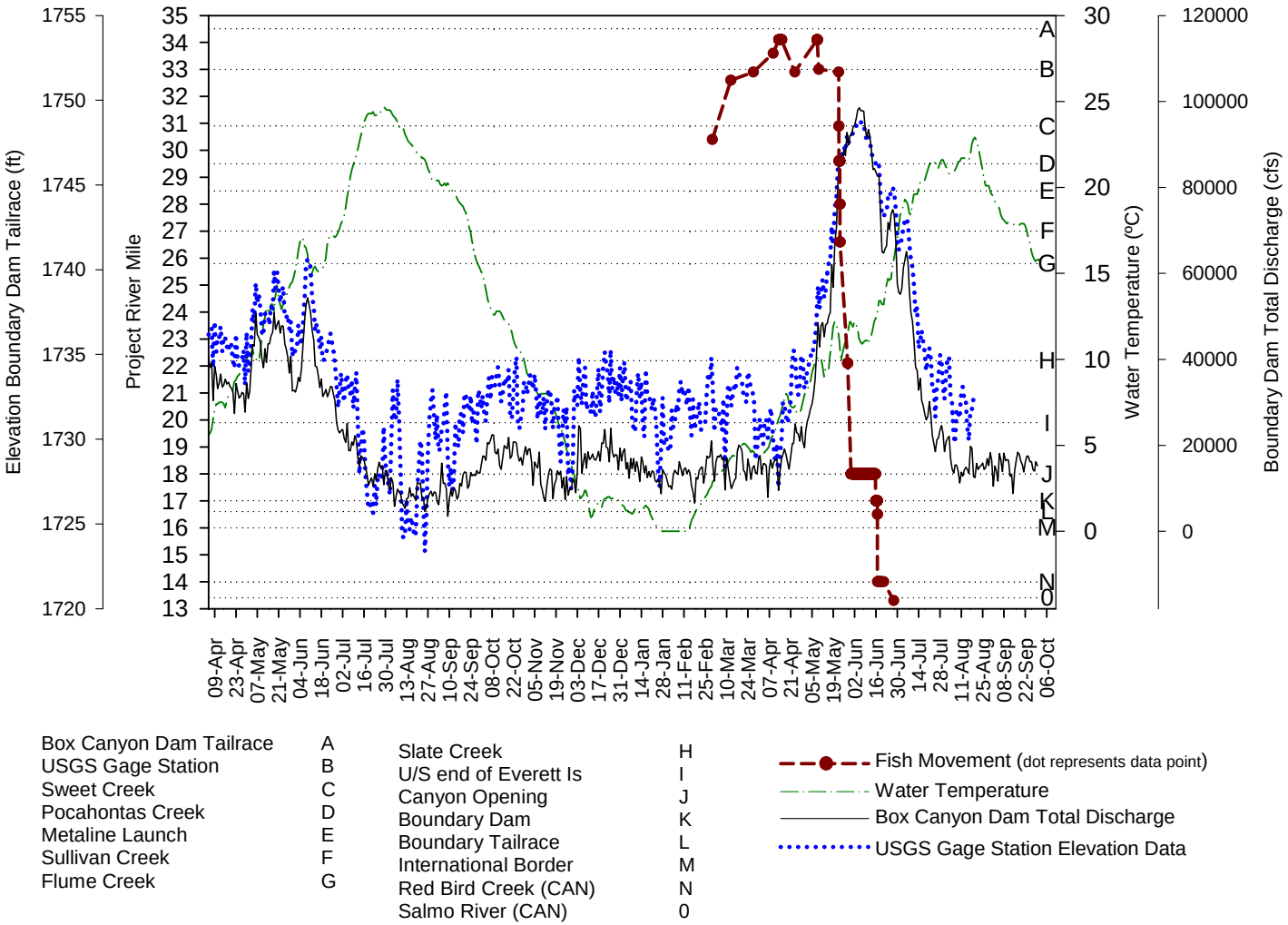

Figure A.8-13. Movement data of a radio-tagged (Fish 47) triploid rainbow trout carry-over (*Oncorhynchus mykiss*) in the Boundary Reservoir and Tailrace (February 29, 2008 to June 27, 2008) in relation to daily average water temperature, daily average total Boundary, and daily average water level elevation as measured at Boundary Tailrace.

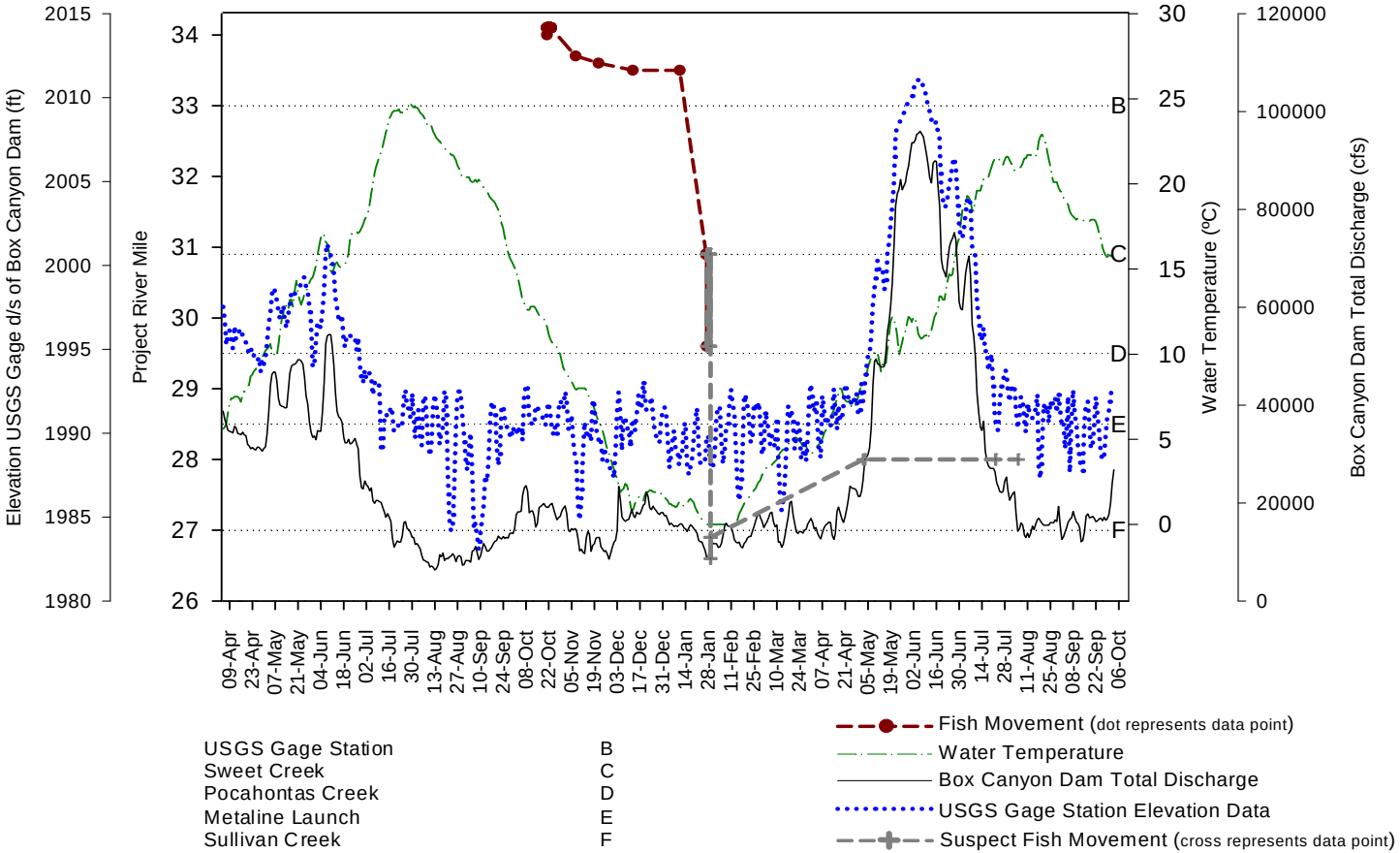

Figure A.8-14. Movement data of a radio-tagged (Fish 48) triploid rainbow trout carry-over (*Oncorhynchus mykiss*) in the Boundary Reservoir (October 20, 2007, to August 05, 2008) in relation to daily average water temperature, daily average total discharge from Box Canyon Dam, and daily average water level elevation as measured at the USGS auxiliary gage station 1.2 miles downstream of Box Canyon Dam.

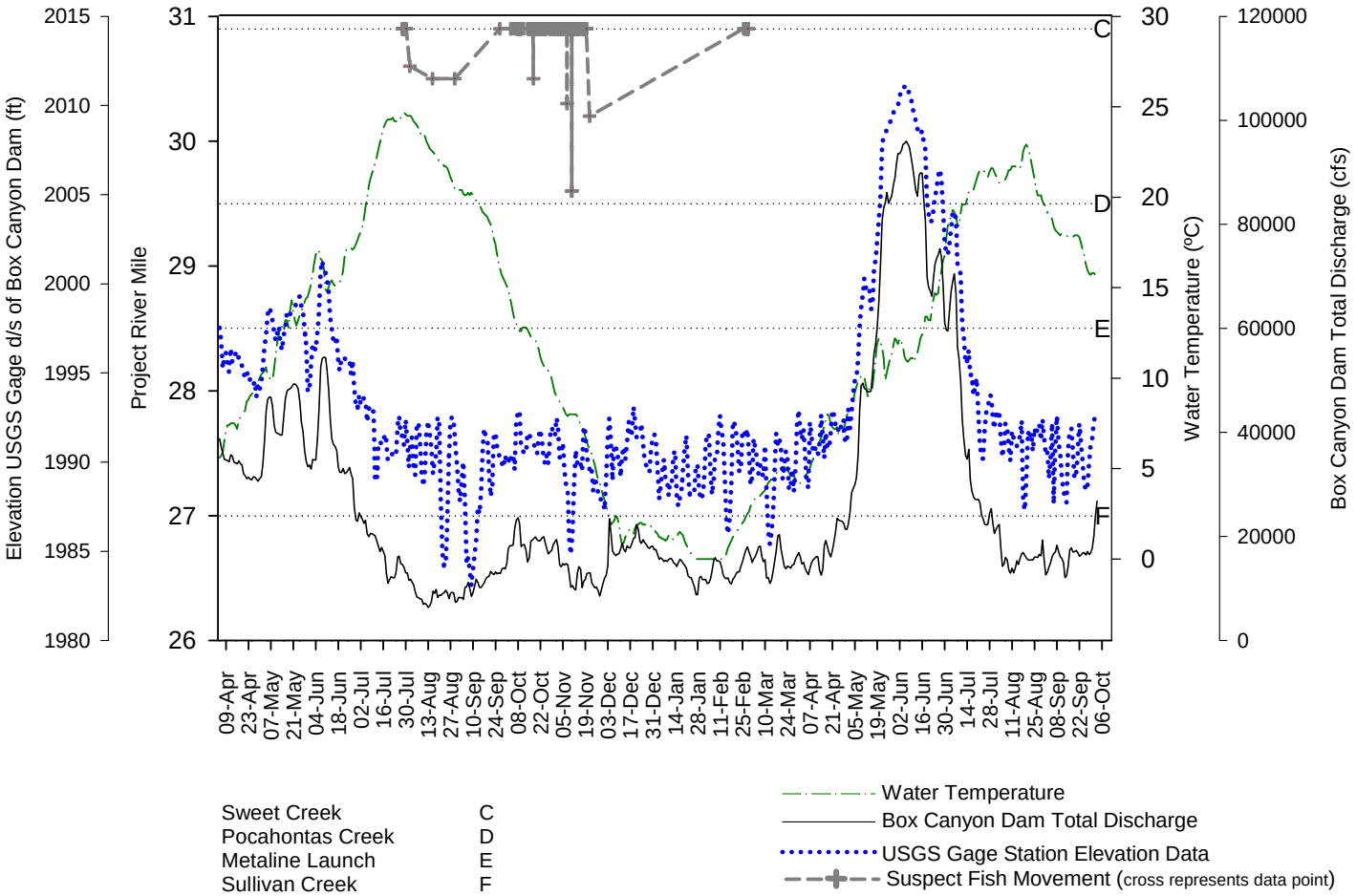

Figure A.8-15. Movement data of a radio-tagged (Fish 49) triploid rainbow trout carry-over (*Oncorhynchus mykiss*) in the Boundary Reservoir (July 28, 2007, to February 28, 2008) in relation to daily average water temperature, daily average total discharge from Box Canyon Dam, and daily average water level elevation as measured at the USGS auxiliary gage station 1.2 miles downstream of Box Canyon Dam.

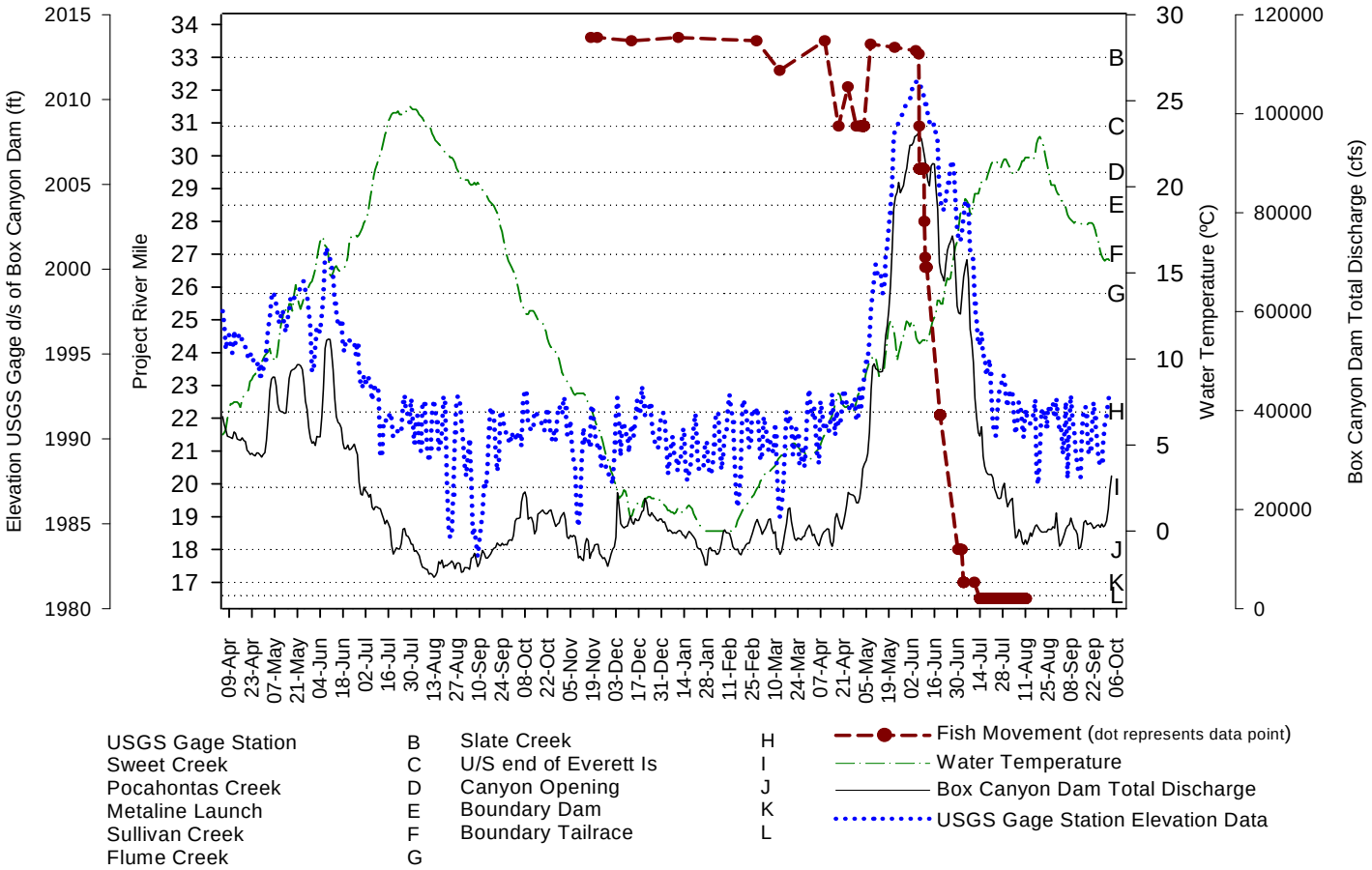

Figure A.8-16. Movement data of a radio-tagged (Fish 53) triploid rainbow trout carry-over (*Oncorhynchus mykiss*) in the Boundary Reservoir (November 17, 2007, to August 11, 2008) in relation to daily average water temperature, daily average total discharge from Box Canyon Dam, and daily average water level elevation as measured at the USGS auxiliary gage station 1.2 miles downstream of Box Canyon Dam.

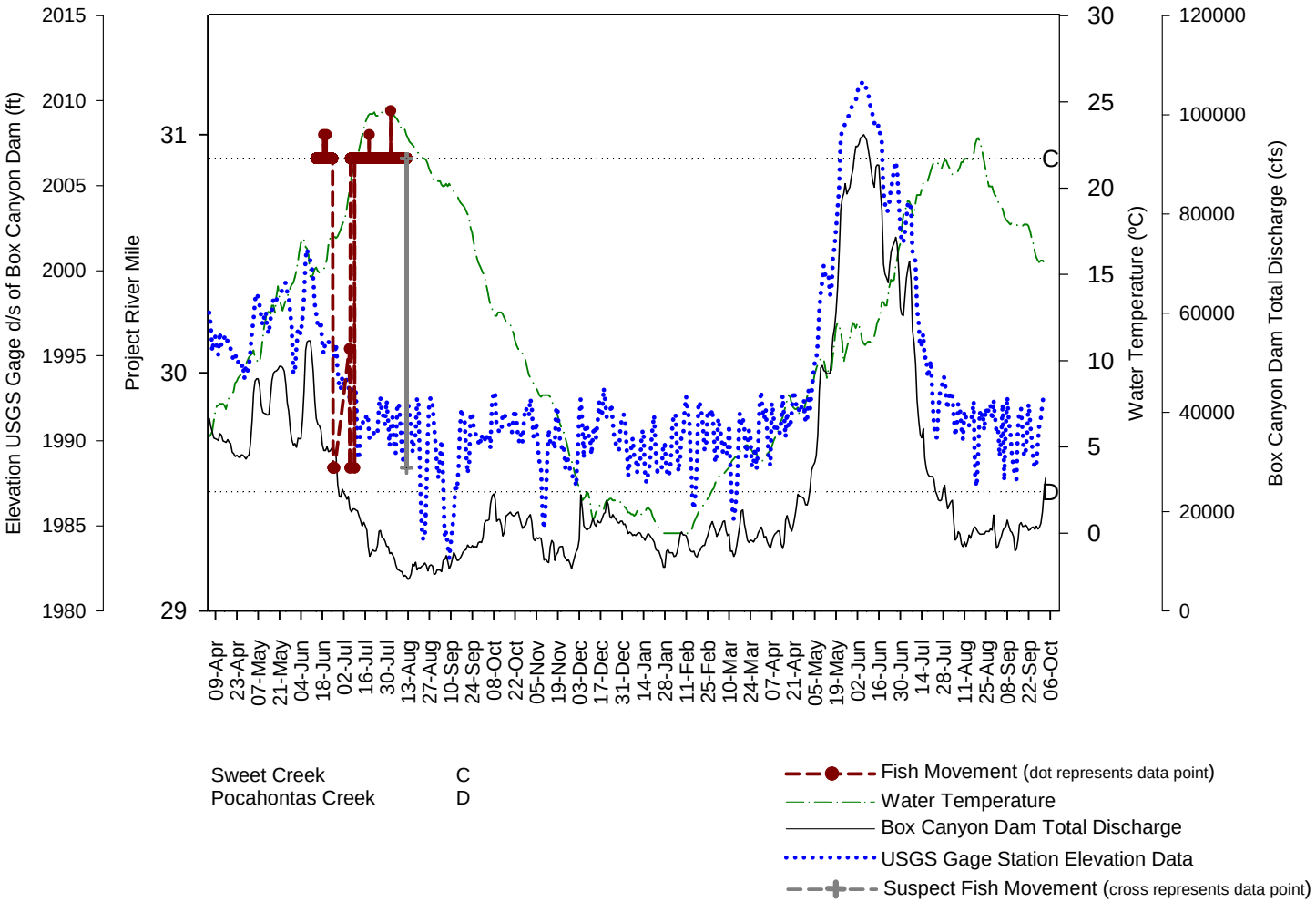

Figure A.8-17. Movement data of a radio-tagged (Fish 55) triploid rainbow trout carry-over (*Oncorhynchus mykiss*) in the Boundary Reservoir (June 13, 2007, to August 12, 2007) in relation to daily average water temperature, daily average total discharge from Box Canyon Dam, and daily average water level elevation as measured at the USGS auxiliary gage station 1.2 miles downstream of Box Canyon Dam.

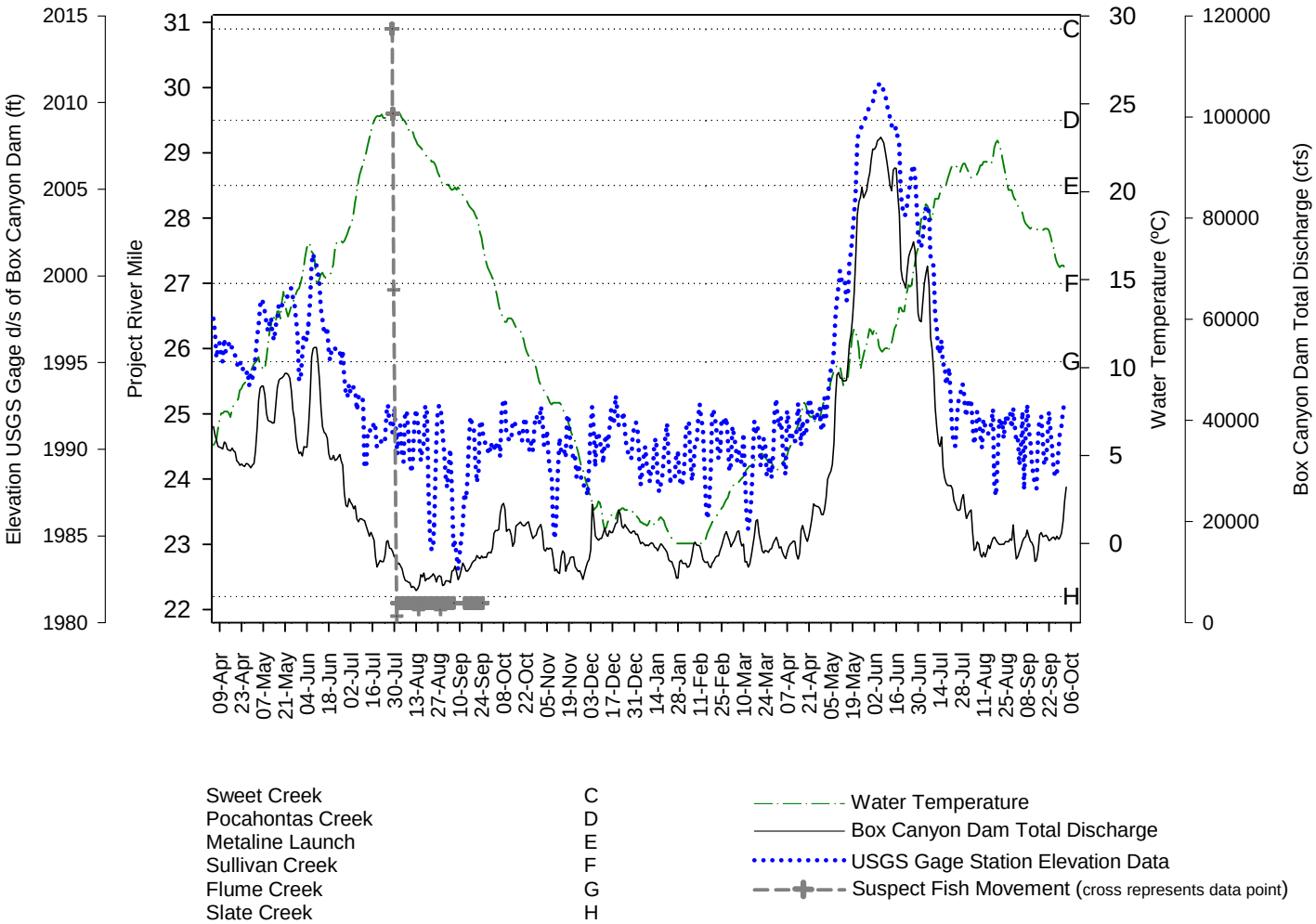

Figure A.8-18. Movement data of a radio-tagged (Fish 61) triploid rainbow trout carry-over (*Oncorhynchus mykiss*) in the Boundary Reservoir (July 27, 2007, to September 24, 2007) in relation to daily average water temperature, daily average total discharge from Box Canyon Dam, and daily average water level elevation as measured at the USGS auxiliary gage station 1.2 miles downstream of Box Canyon Dam.

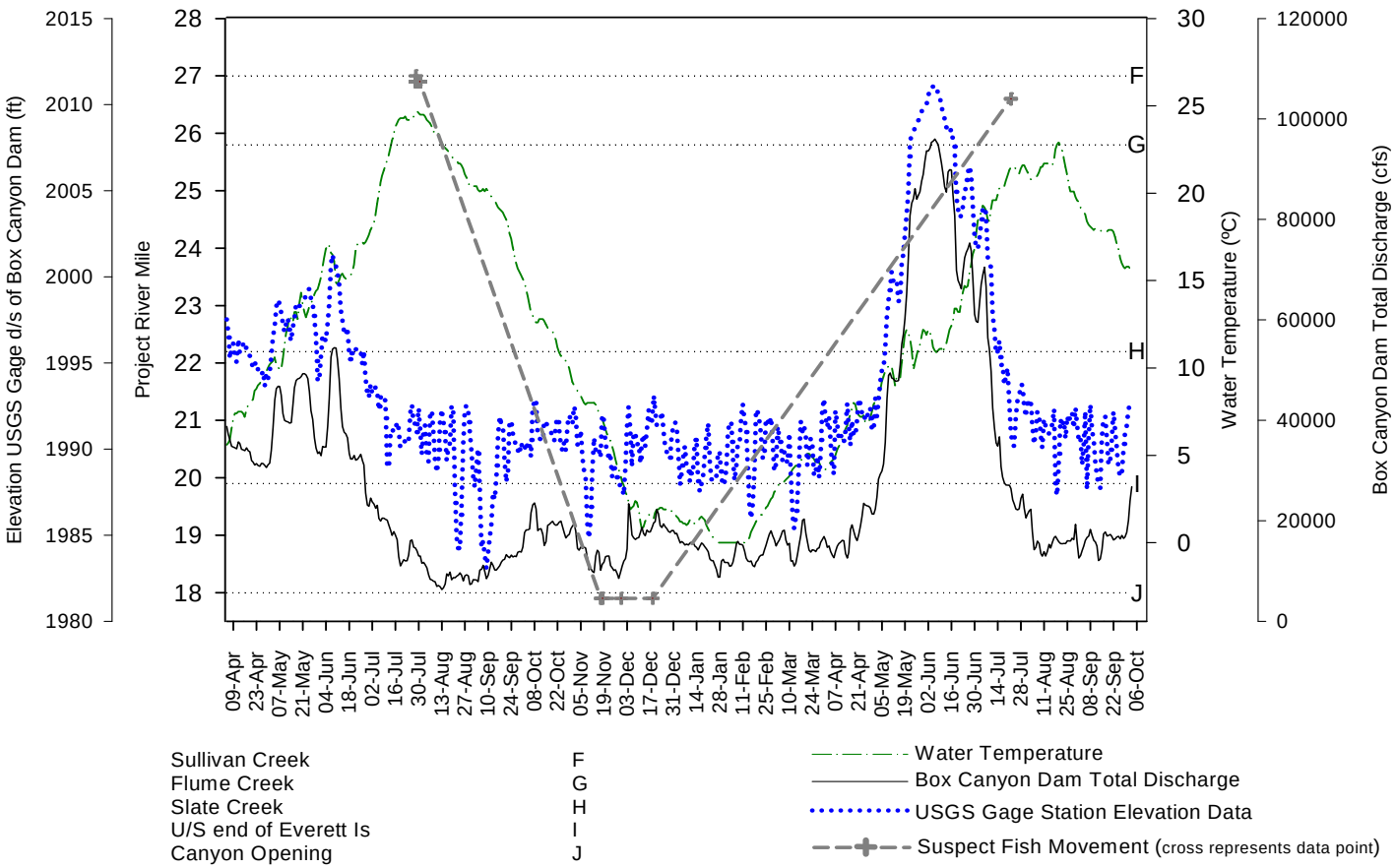

Figure A.8-19. Movement data of a radio-tagged (Fish 62) triploid rainbow trout carry-over (*Oncorhynchus mykiss*) in the Boundary Reservoir (July 28, 2007, to July 22, 2008) in relation to daily average water temperature, daily average total discharge from Box Canyon Dam, and daily average water level elevation as measured at the USGS auxiliary gage station 1.2 miles downstream of Box Canyon Dam.

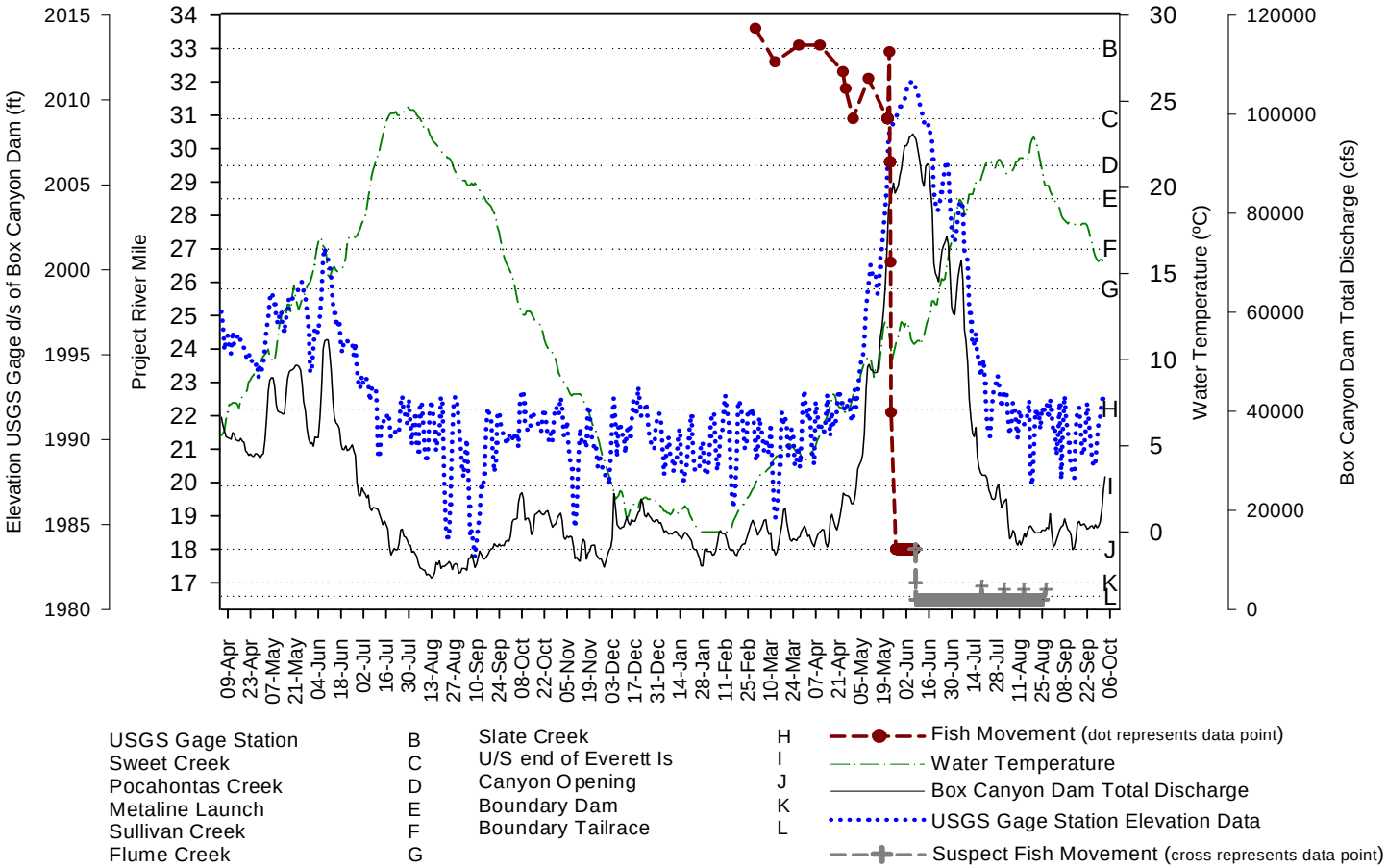

Figure A.8-20. Movement data of a radio-tagged (Fish 64) triploid rainbow trout carry-over (*Oncorhynchus mykiss*) in the Boundary Reservoir (February 29, 2008 to August 27, 2008) in relation to daily average water temperature, daily average total discharge from Box Canyon Dam, and daily average water level elevation as measured at the USGS auxiliary gage station 1.2 miles downstream of Box Canyon Dam.

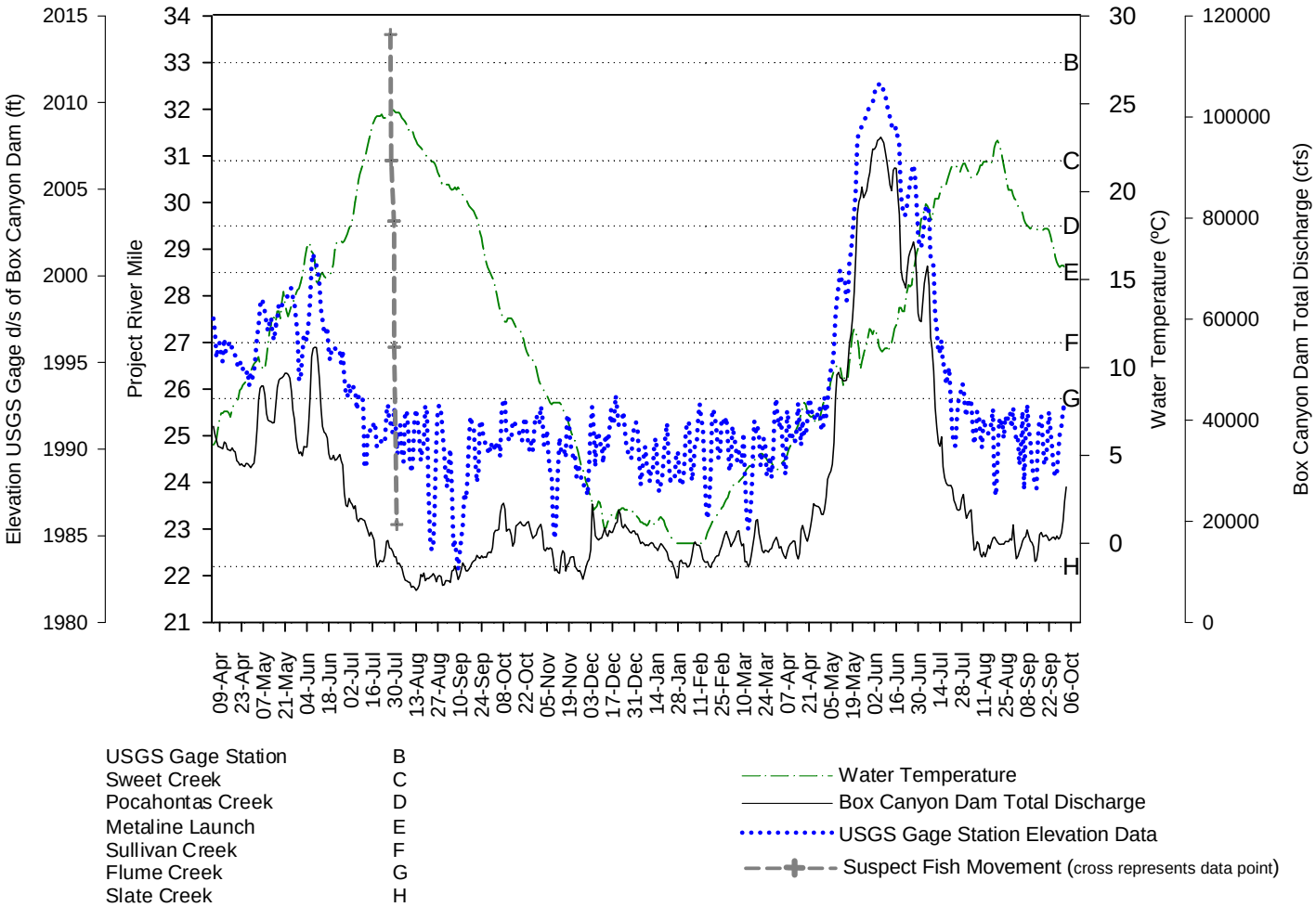

Figure A.8-21. Movement data of a radio-tagged (Fish 70) triploid rainbow trout carry-over (*Oncorhynchus mykiss*) in the Boundary Reservoir (July 27, 2007, to July 28, 2007) in relation to daily average water temperature, daily average total discharge from Box Canyon Dam, and daily average water level elevation as measured at the USGS auxiliary gage station 1.2 miles downstream of Box Canyon Dam.

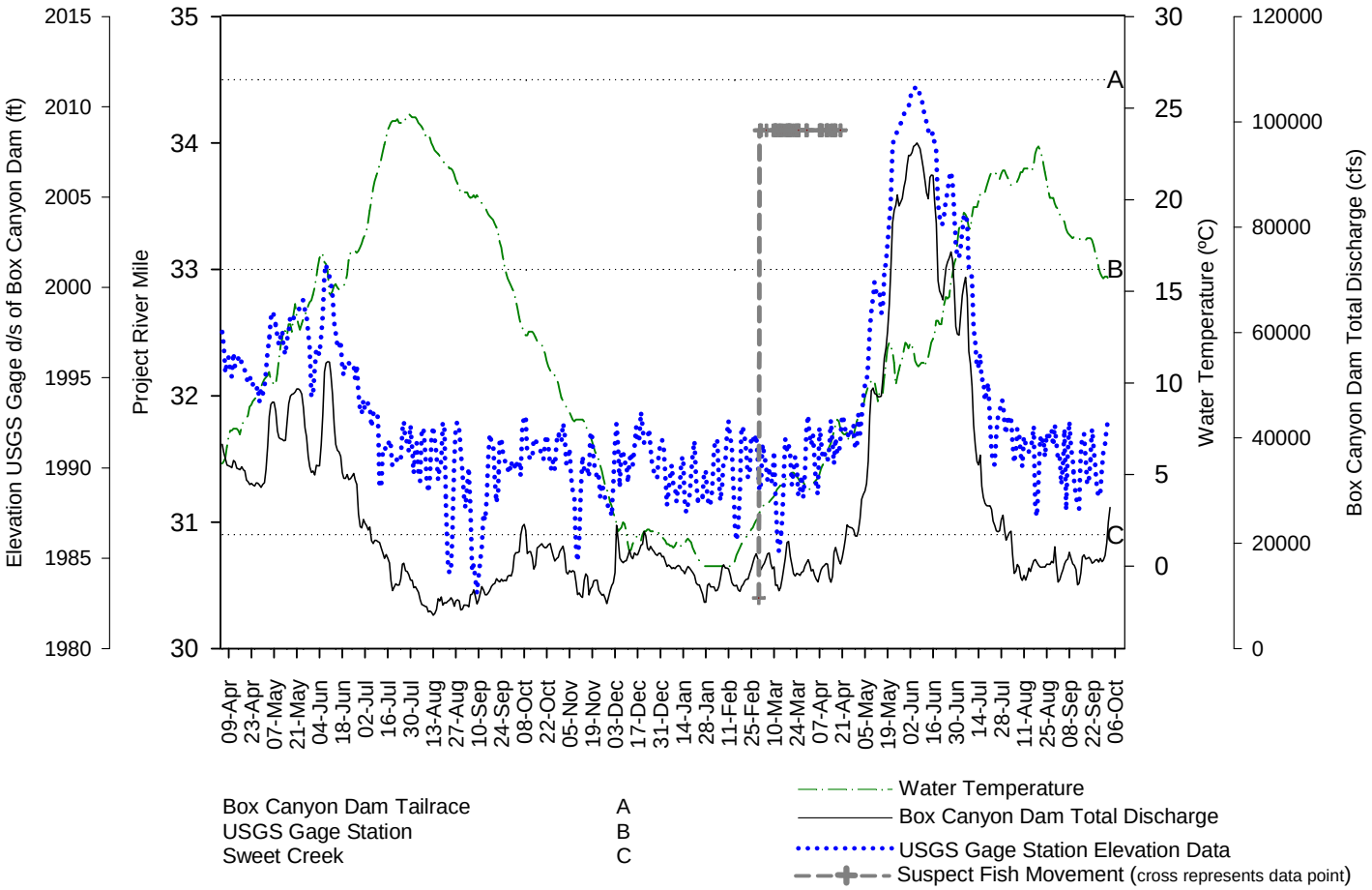

Figure A.8-22. Movement data of a radio-tagged (Fish 74) triploid rainbow trout carry-over (*Oncorhynchus mykiss*) in the Boundary Reservoir (February 29, 2008 to April 19, 2008) in relation to daily average water temperature, daily average total discharge from Box Canyon Dam, and daily average water level elevation as measured at the USGS auxiliary gage station 1.2 miles downstream of Box Canyon Dam.

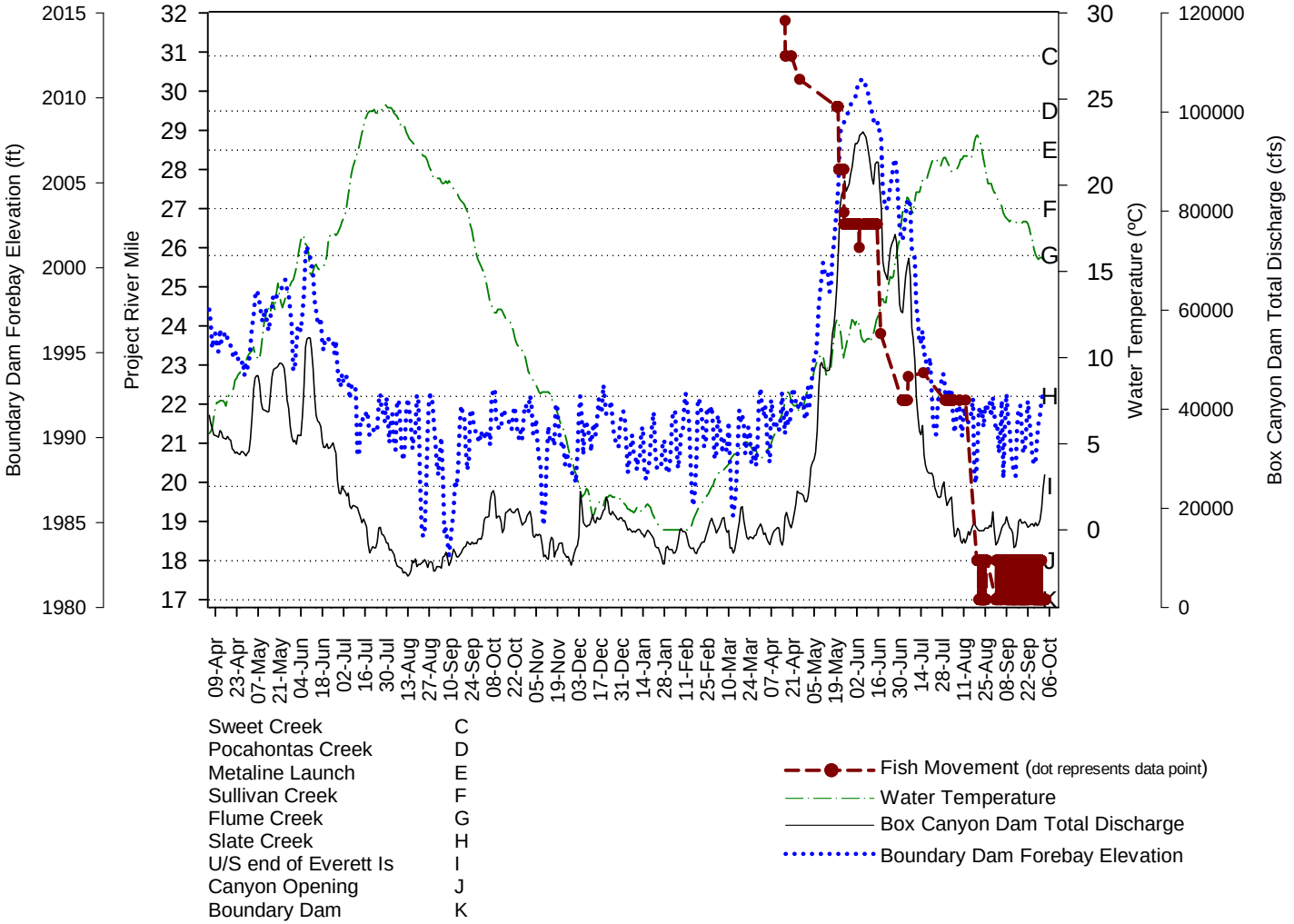

Figure A.8-23. Movement data of a radio-tagged (Fish 119) triploid rainbow trout carry-over (*Oncorhynchus mykiss*) in the Boundary Reservoir (April 16, 2008 to August 26, 2008) in relation to daily average water temperature, daily average total discharge from Box Canyon Dam, and daily average water level elevation as measured at the Boundary Dam forebay.

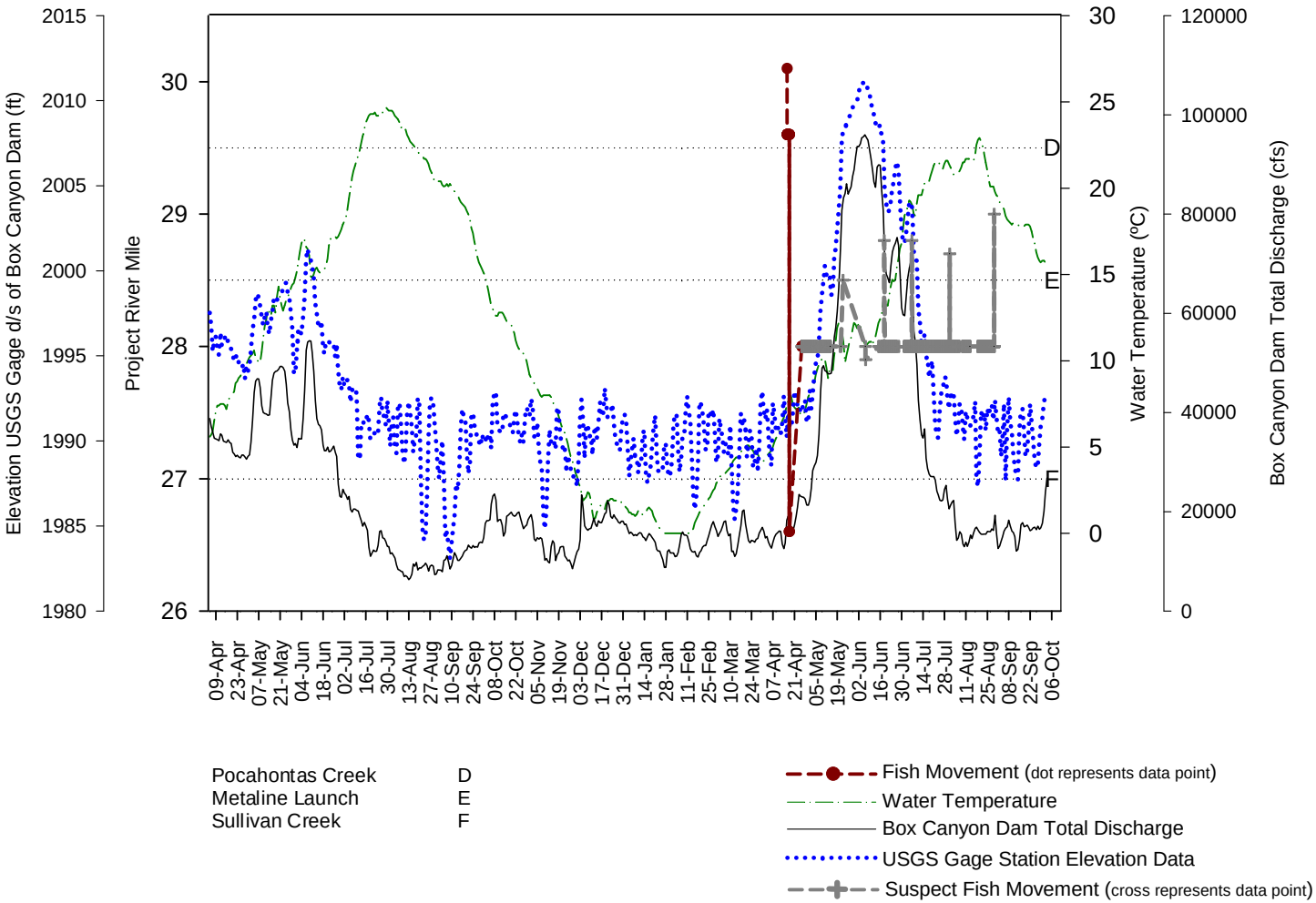

Figure A.8-24. Movement data of a radio-tagged (Fish 120) triploid rainbow trout carry-over (*Oncorhynchus mykiss*) in the Boundary Reservoir (April 16, 2008 to August 29, 2008) in relation to daily average water temperature, daily average total discharge from Box Canyon Dam, and daily average water level elevation as measured at the USGS auxiliary gage station 1.2 miles downstream of Box Canyon Dam.

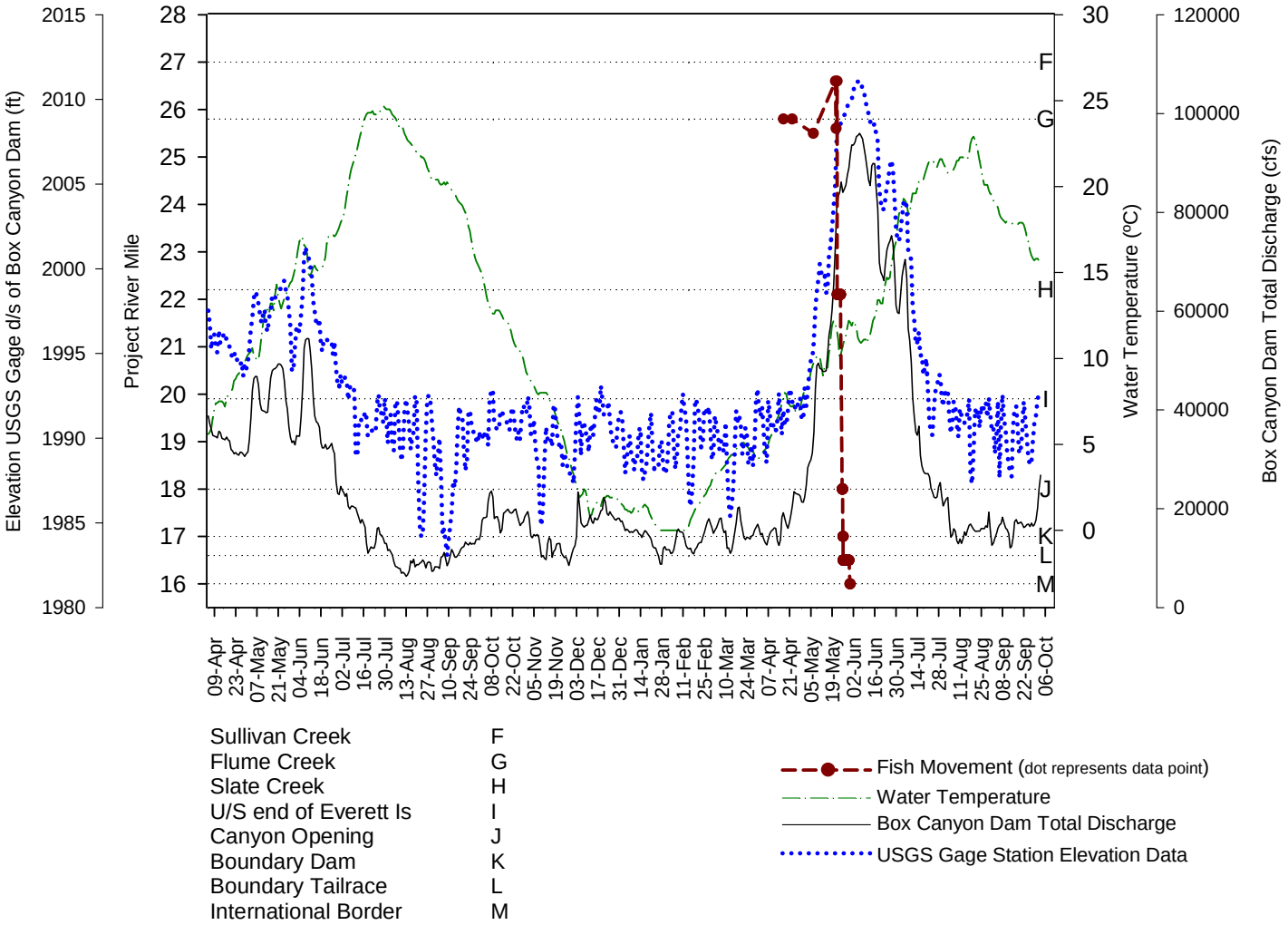

Figure A.8-25. Movement data of a radio-tagged (Fish 122) triploid rainbow trout carry-over (*Oncorhynchus mykiss*) in the Boundary Reservoir and Tailrace (April 16, 2008 to June 16, 2008) in relation to daily average water temperature, daily average total discharge from Box Canyon Dam, and daily average water level elevation as measured at the USGS auxiliary gage station 1.2 miles downstream of Box Canyon Dam.

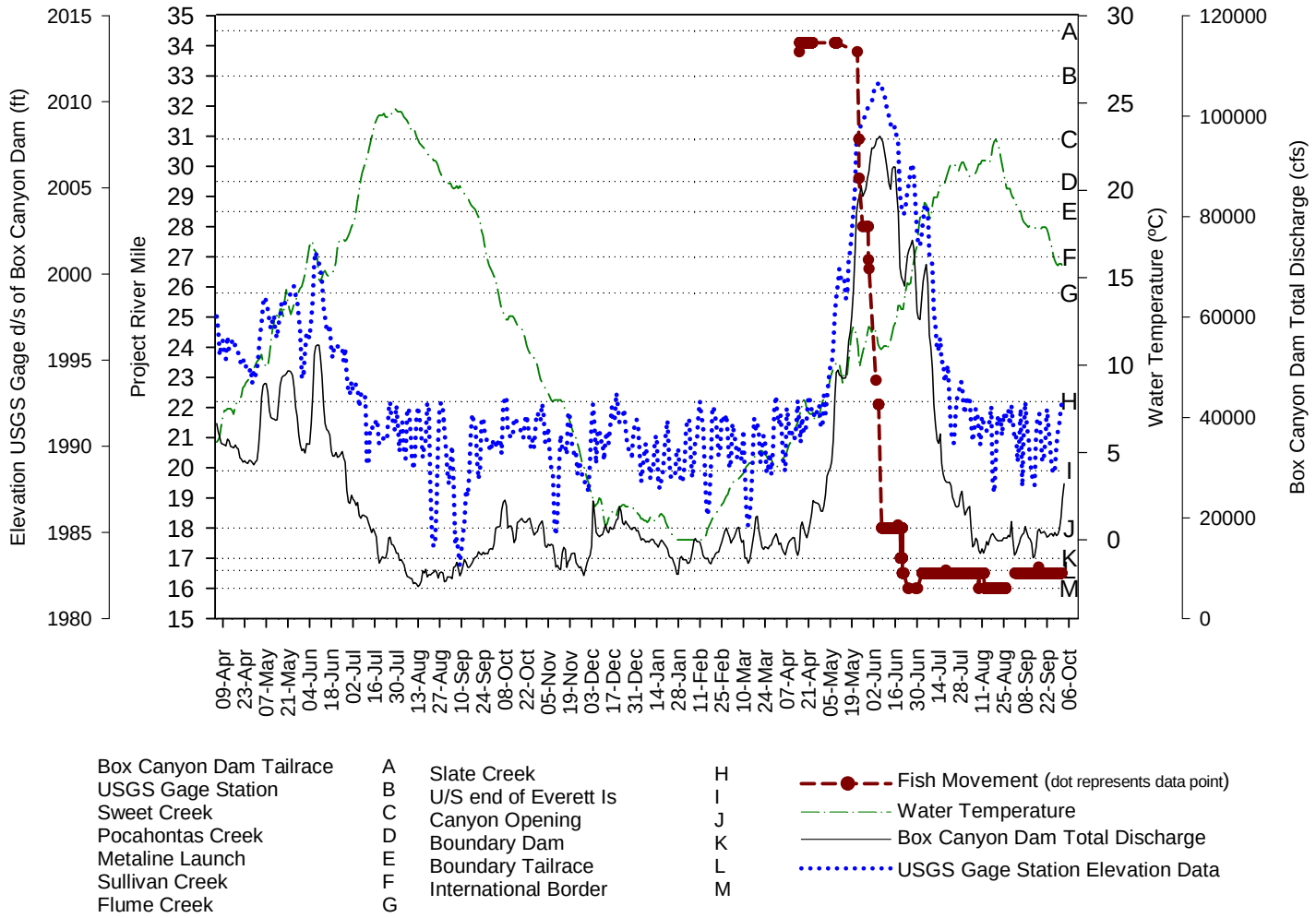

Figure A.8-26. Movement data of a radio-tagged (Fish 126) triploid rainbow trout carry-over (*Oncorhynchus mykiss*) in the Boundary Reservoir (April 15, 2008 to August 26, 2008) in relation to daily average water temperature, daily average total discharge from Box Canyon Dam, and daily average water level elevation as measured at the USGS auxiliary gage station 1.2 miles downstream of Box Canyon Dam.

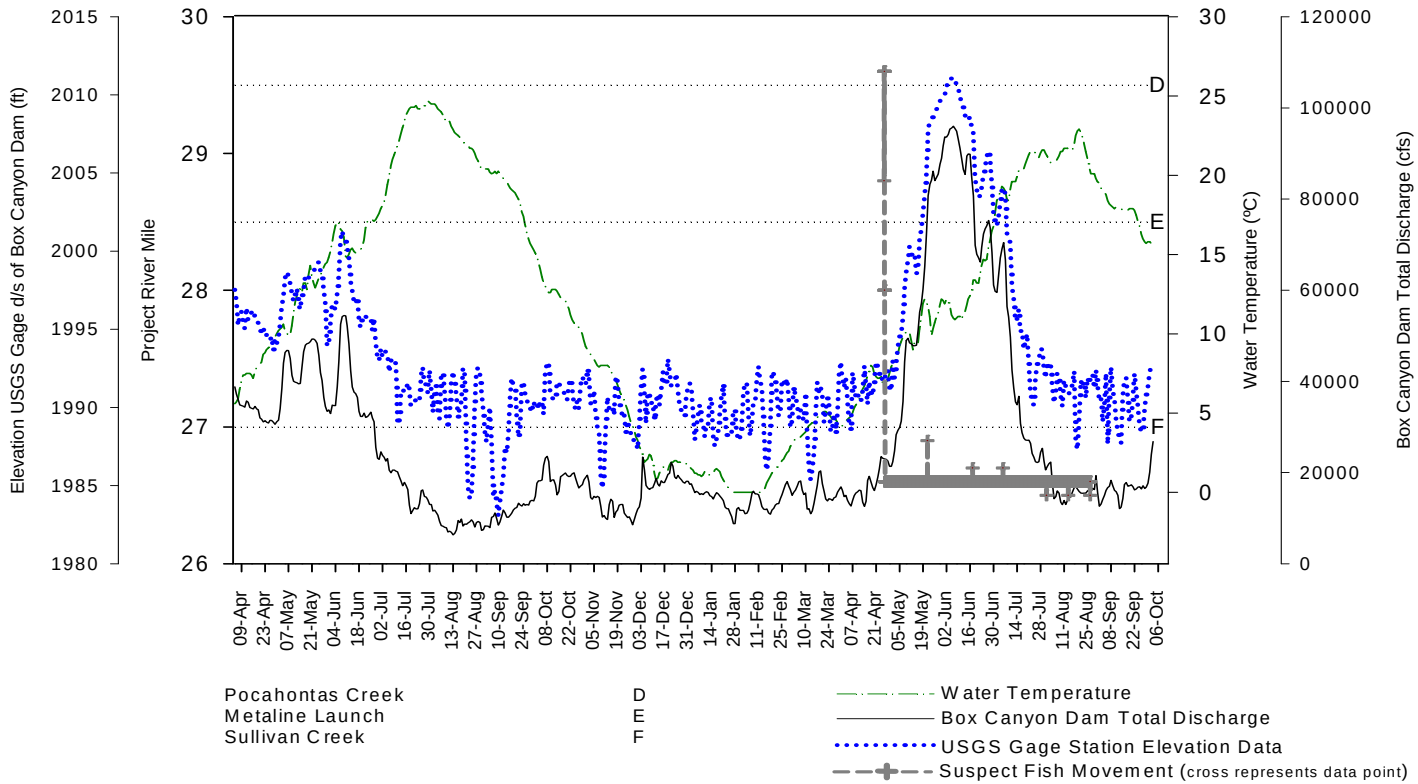

Figure A.8-27. Movement data of a radio-tagged (Fish 127) triploid rainbow trout carry-over (*Oncorhynchus mykiss*) in the Boundary Reservoir (April 25, 2008, to August 26, 2008) in relation to daily average water temperature, daily average total discharge from Box Canyon Dam, and daily average water level elevation as measured at the USGS auxiliary gage station 1.2 miles downstream of Box Canyon Dam.

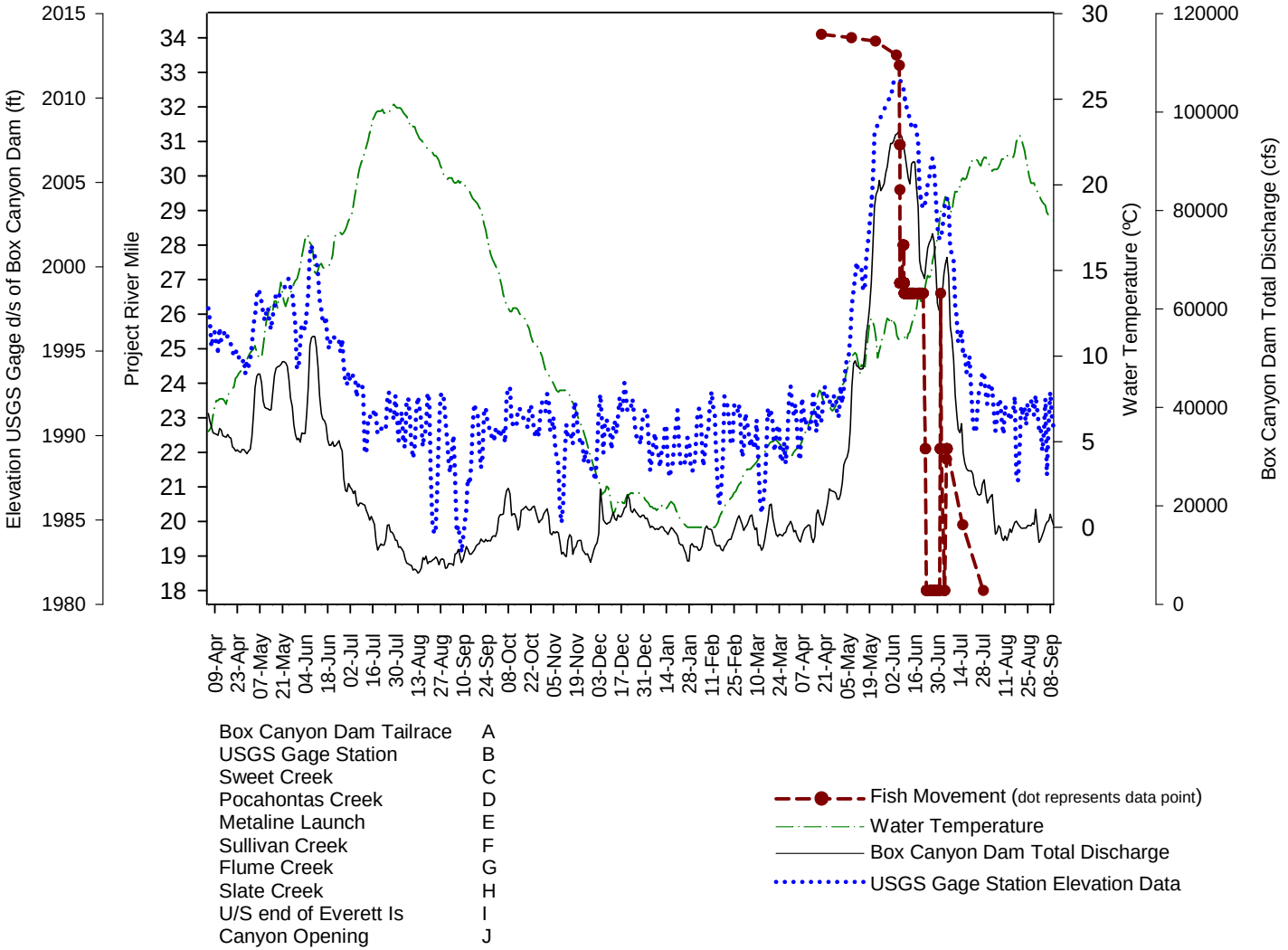

Figure A.8-28. Movement data of a radio-tagged (Fish 128) triploid rainbow trout carry-over (*Oncorhynchus mykiss*) in the Boundary Reservoir (April 19, 2008, to July 28, 2008) in relation to daily average water temperature, daily average total discharge from Box Canyon Dam, and daily average water level elevation as measured at the USGS auxiliary gage station 1.2 miles downstream of Box Canyon Dam.

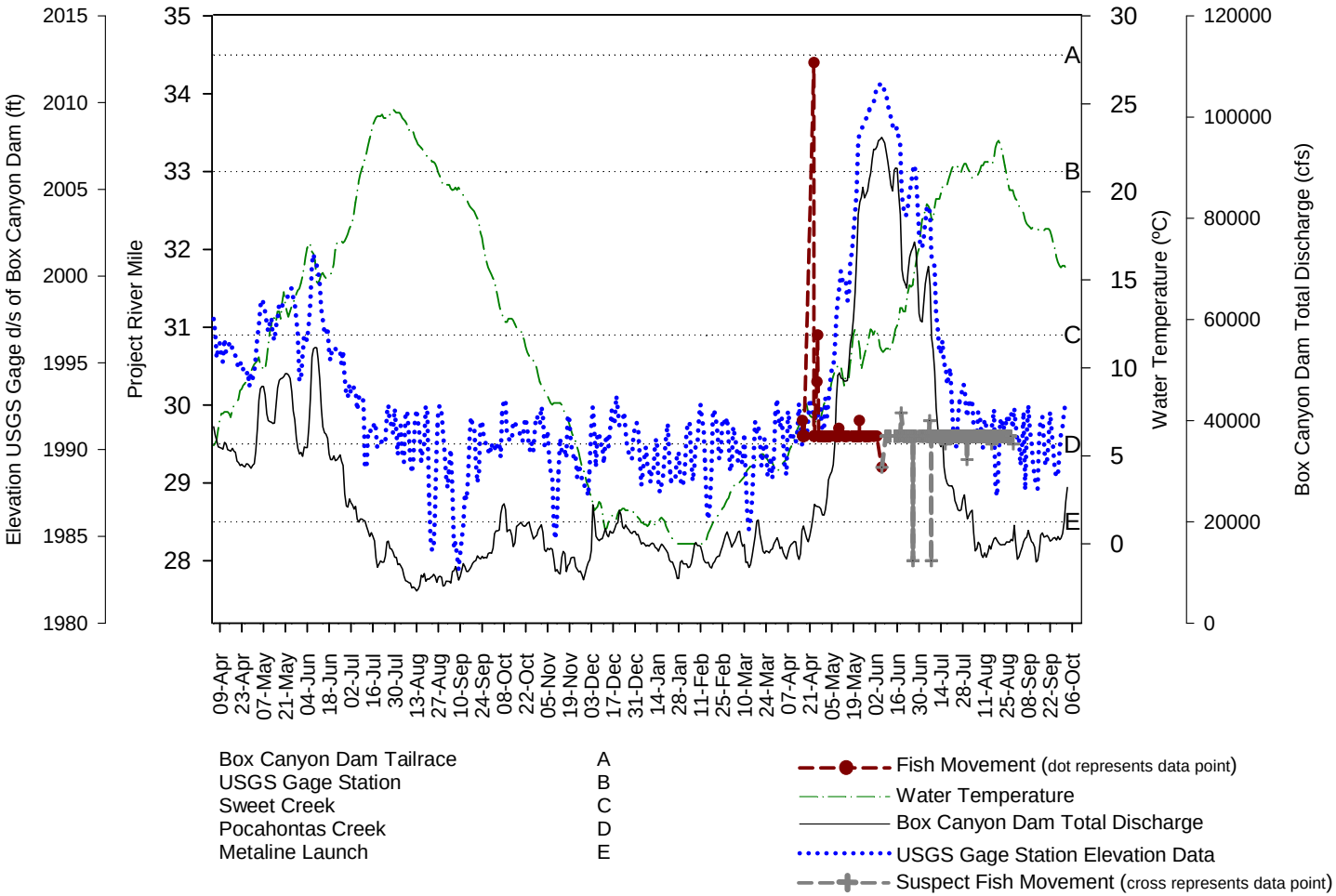

Figure A.8-29. Movement data of a radio-tagged (Fish 132) triploid rainbow trout carry-over (*Oncorhynchus mykiss*) in the Boundary Reservoir (April 16, 2008, to August 29, 2008) in relation to daily average water temperature, daily average total discharge from Box Canyon Dam, and daily average water level elevation as measured at the USGS auxiliary gage station 1.2 miles downstream of Box Canyon Dam.

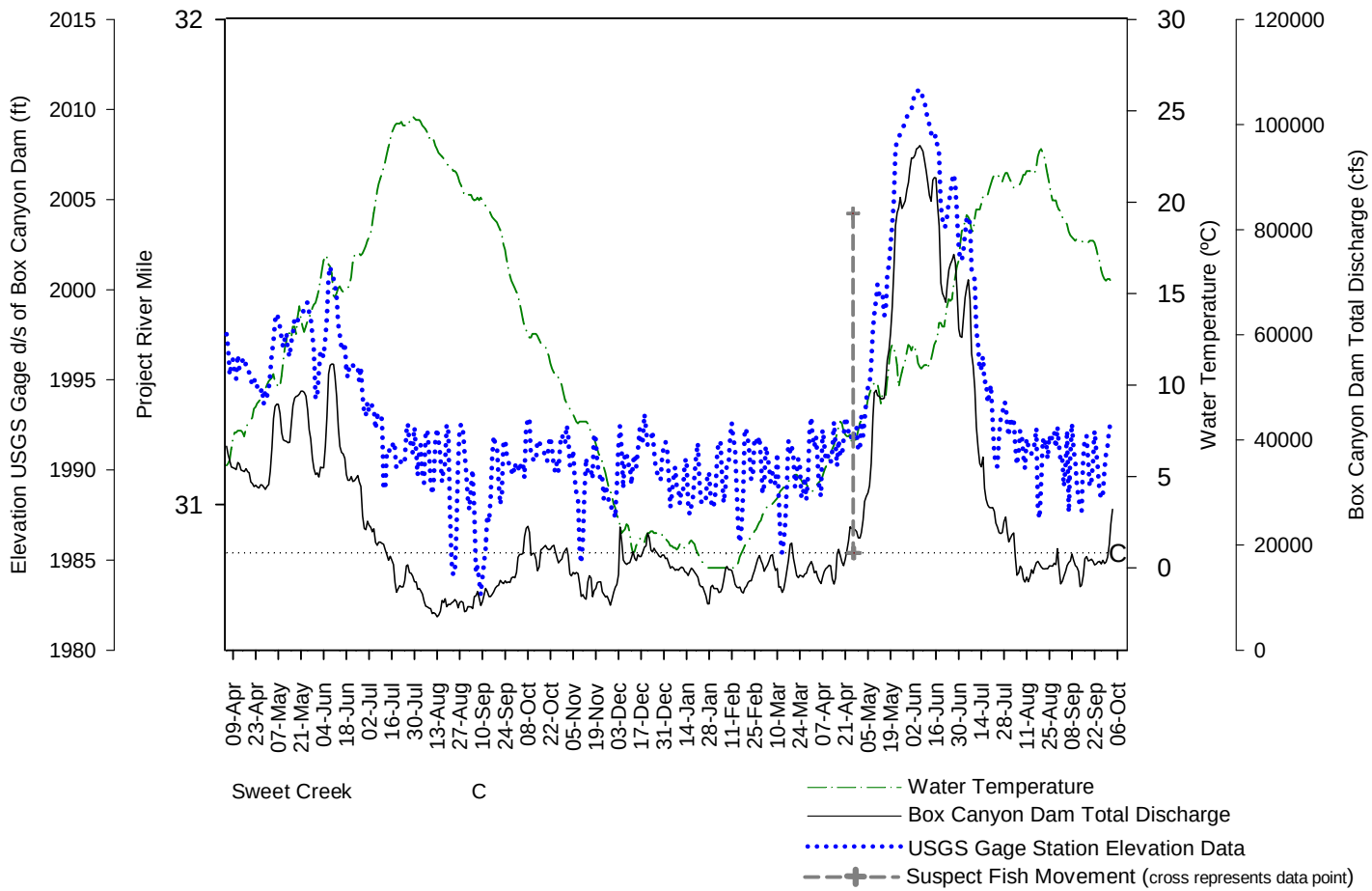

Figure A.8-30. Movement data of a radio-tagged (Fish 162) triploid rainbow trout carry-over (*Oncorhynchus mykiss*) in the Boundary Reservoir (April 25 to April 26, 2008) in relation to daily average water temperature, daily average total discharge from Box Canyon Dam, and daily average water level elevation as measured at the USGS auxiliary gage station 1.2 miles downstream of Box Canyon Dam.

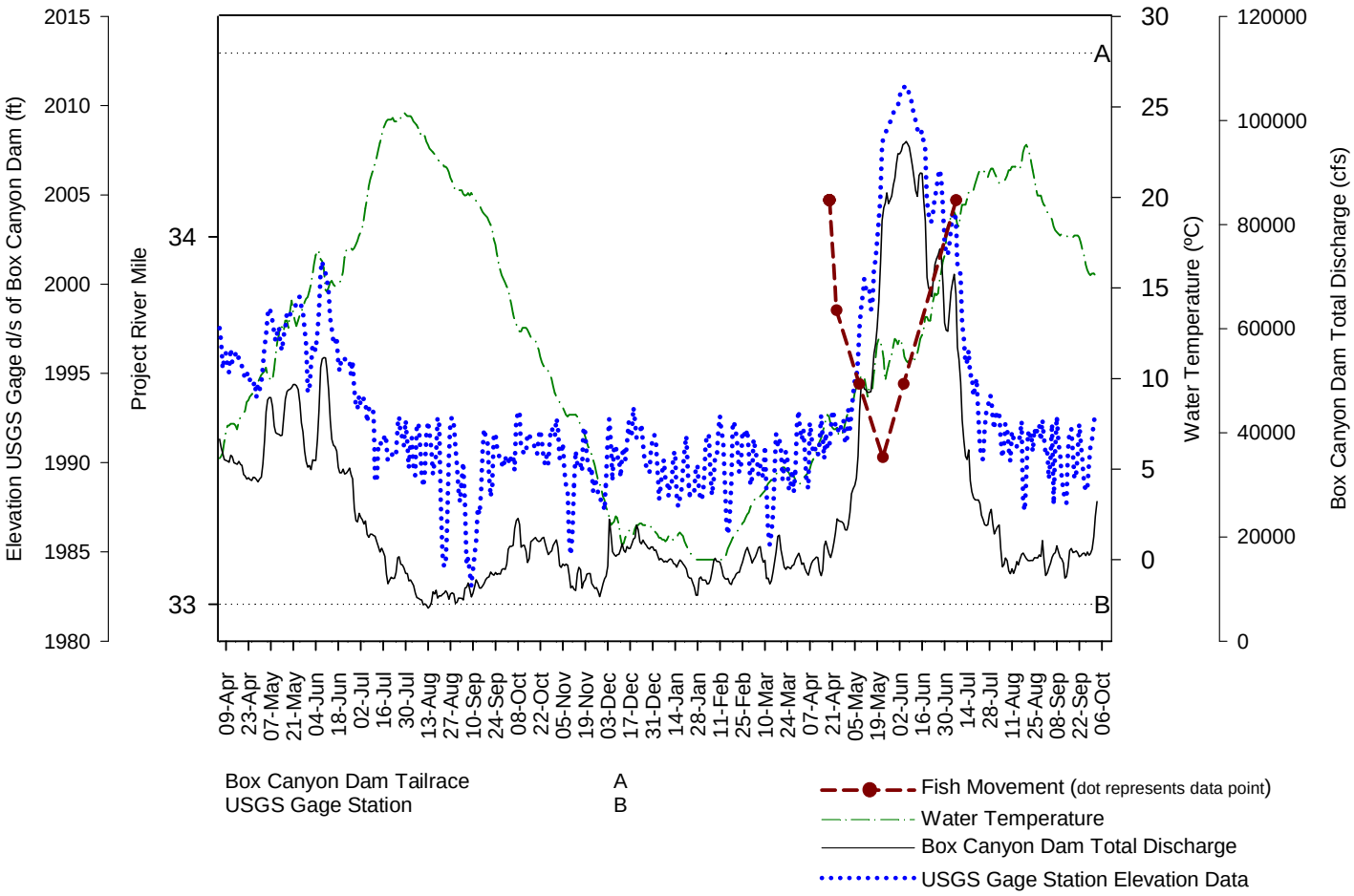

Figure A.8-31. Movement data of a radio-tagged (Fish 164) triploid rainbow trout carry-over (*Oncorhynchus mykiss*) in the Boundary Reservoir (April 19, 2008, to July 07, 2008) in relation to daily average water temperature, daily average total discharge from Box Canyon Dam, and daily average water level elevation as measured at the USGS auxiliary gage station 1.2 miles downstream of Box Canyon Dam.

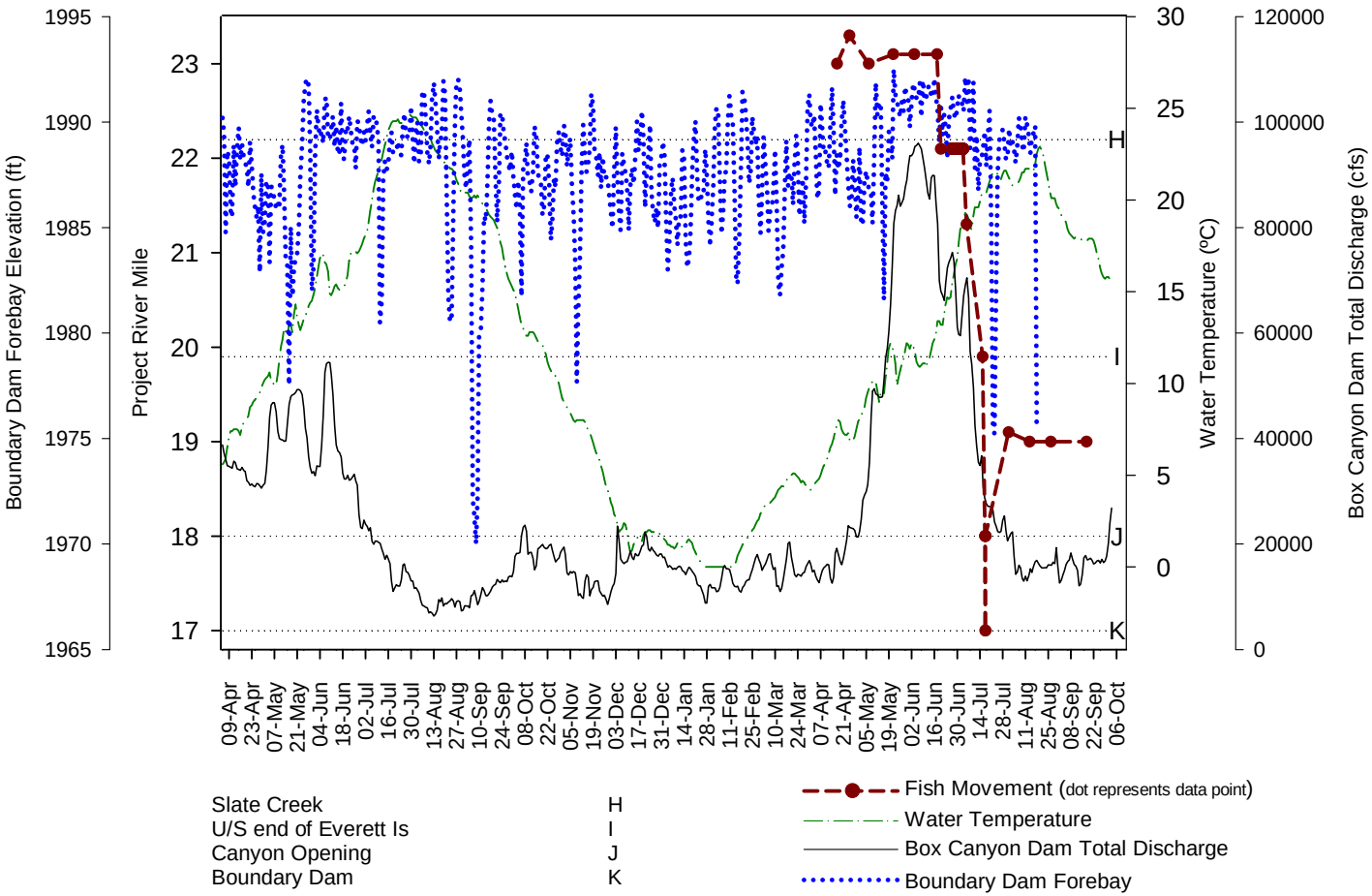

Figure A.8-32. Movement data of a radio-tagged (Fish 170) triploid rainbow trout carry-over (*Oncorhynchus mykiss*) in the Boundary Reservoir (April 17, 2008, to August 26, 2008) in relation to daily average water temperature, daily average total discharge from Box Canyon Dam, and daily average water level elevation as measured at the Boundary Dam forebay.

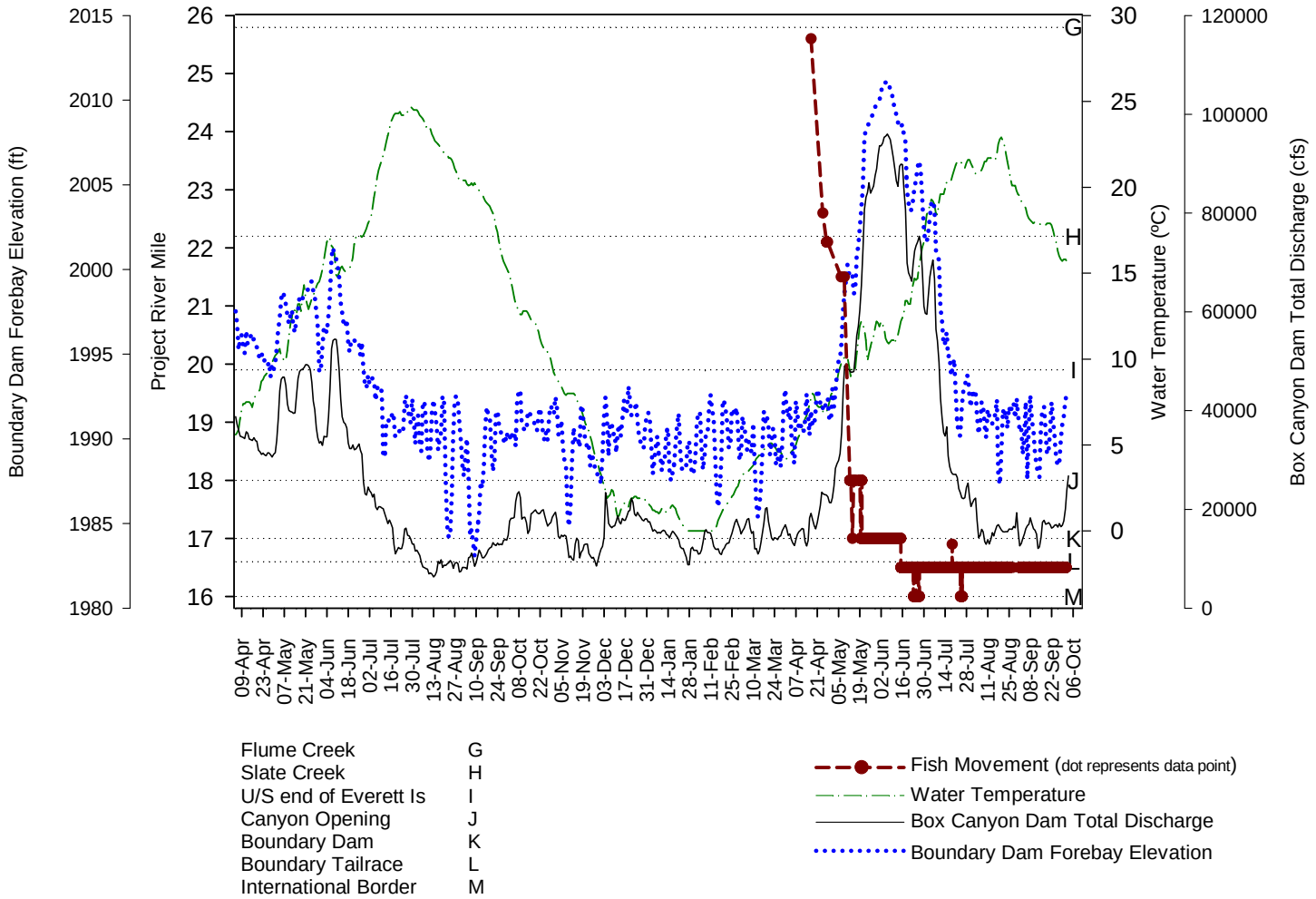

Figure A.8-33. Movement data of a radio-tagged (Fish 171) triploid rainbow trout carry-over (*Oncorhynchus mykiss*) in the Boundary Reservoir (April 16, 2008, to August 27, 2008) in relation to daily average water temperature, daily average total discharge from Box Canyon Dam, and daily average water level elevation as measured at the Boundary Dam forebay.

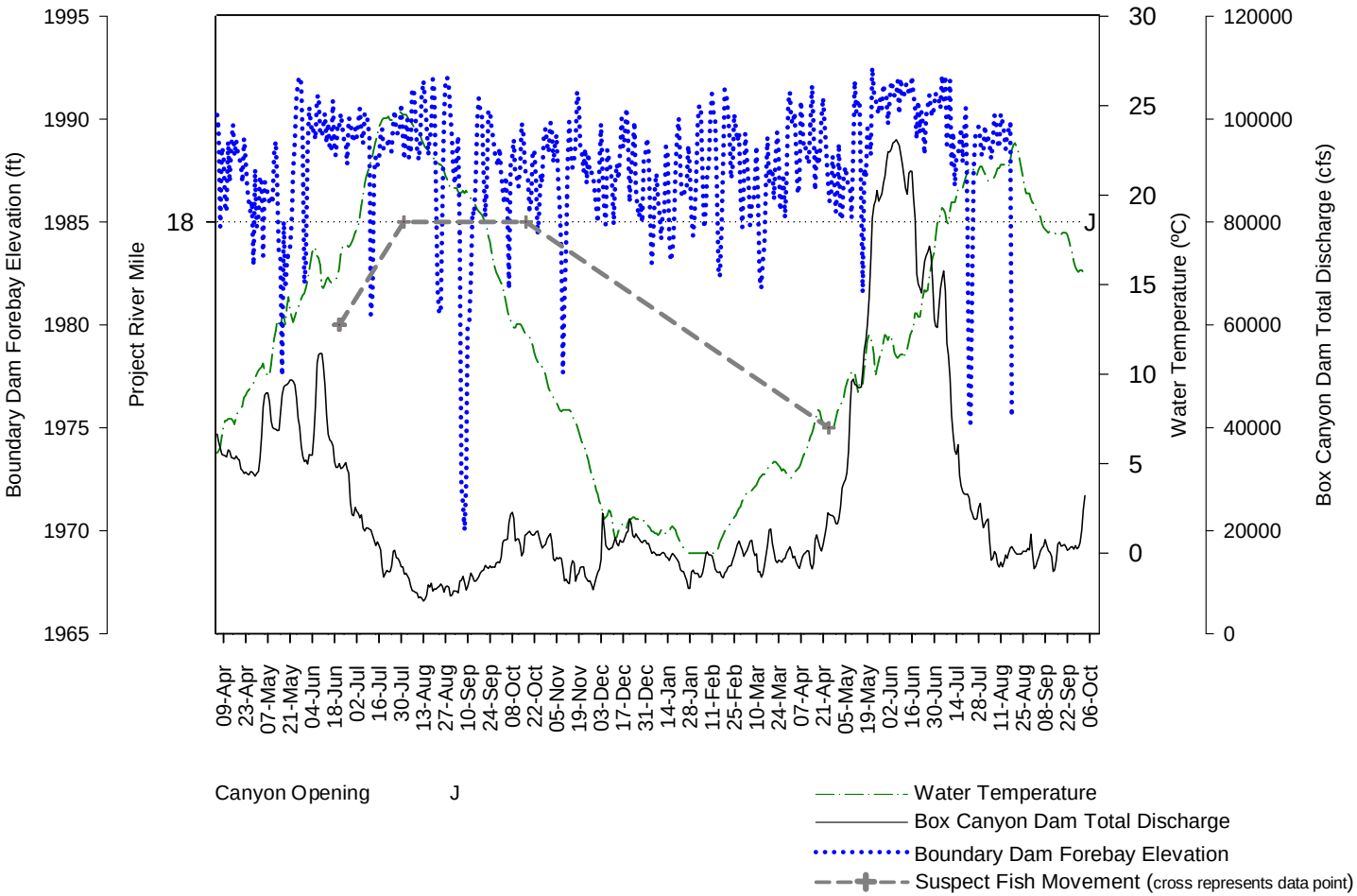

Figure A.8-34. Movement data of a CART-tagged (Fish 38) triploid rainbow trout carry-over (*Oncorhynchus mykiss*) in the Boundary Reservoir (June 20, 2007, to April 24, 2008) in relation to daily average water temperature, daily average total discharge from Box Canyon Dam, and daily average water level elevation as measured at the Boundary Dam forebay.

Appendix 9: Active Tracking Location Figures of Triploid Rainbow Trout by Season

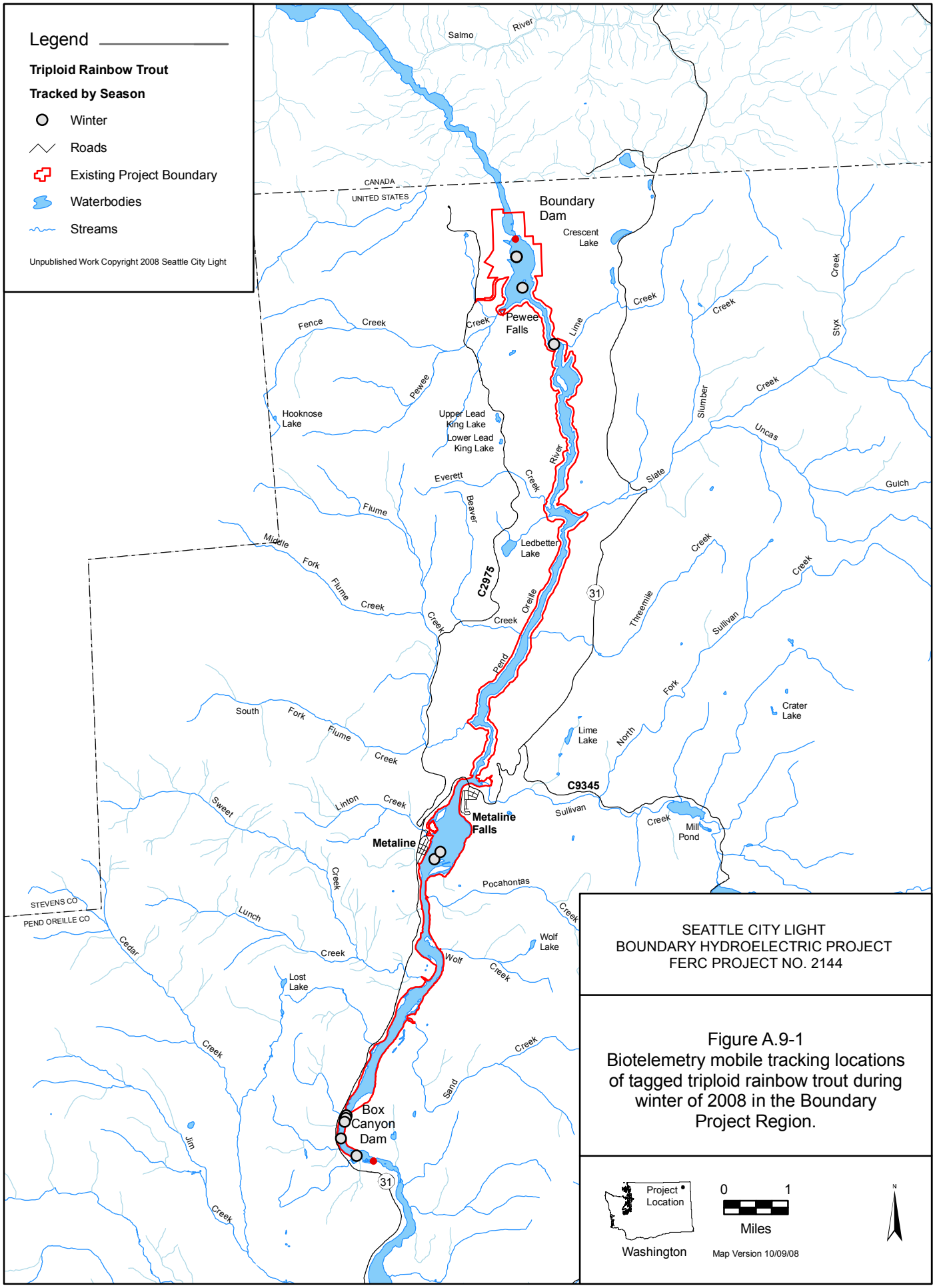

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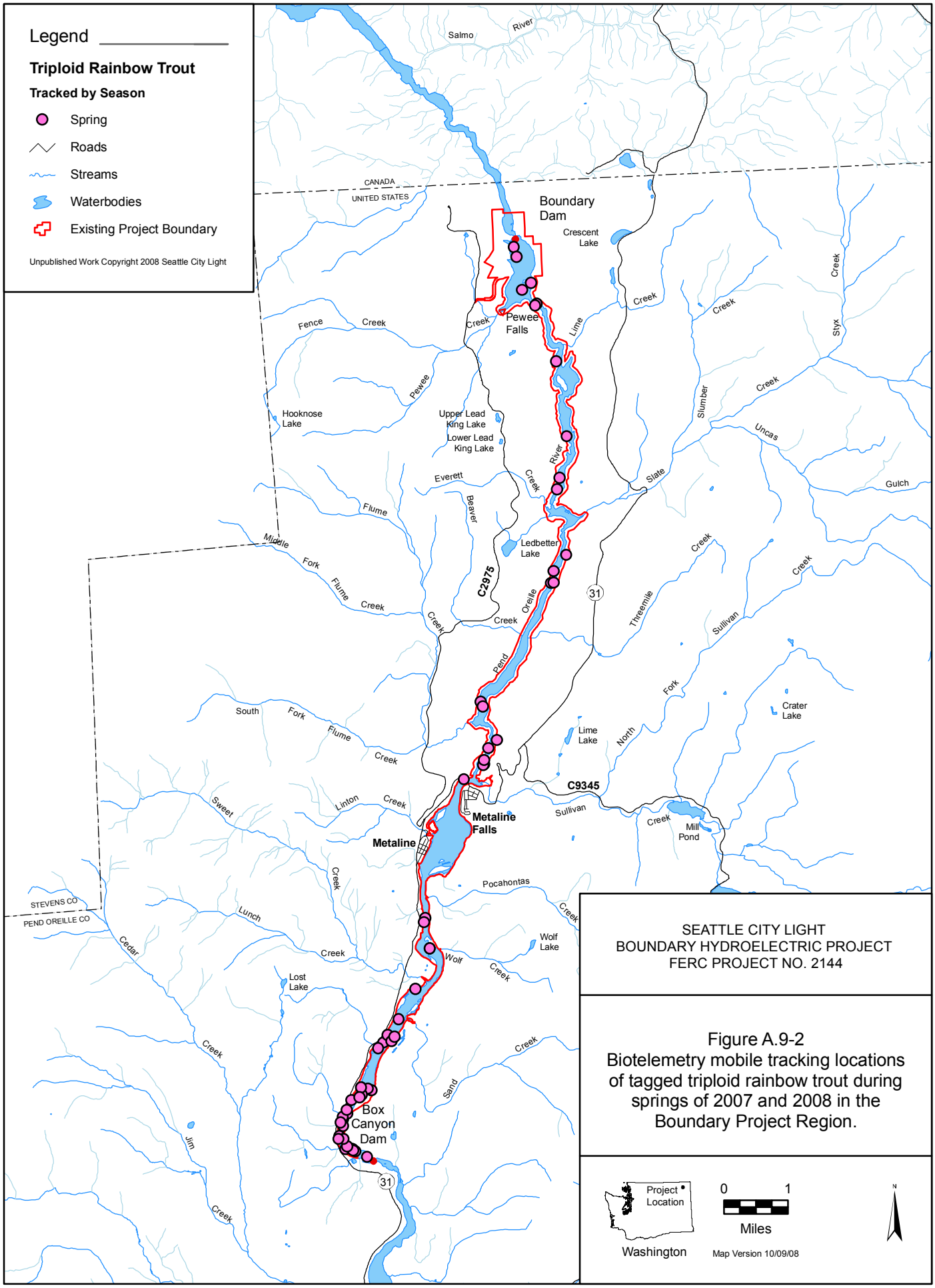
Figure A.9-1
Biotelemetry mobile tracking locations of tagged triploid rainbow trout during winter of 2008 in the Boundary Project Region.



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FERC PROJECT NO. 2144

Figure A.9-2
Biotelemetry mobile tracking locations of tagged triploid rainbow trout during springs of 2007 and 2008 in the Boundary Project Region.

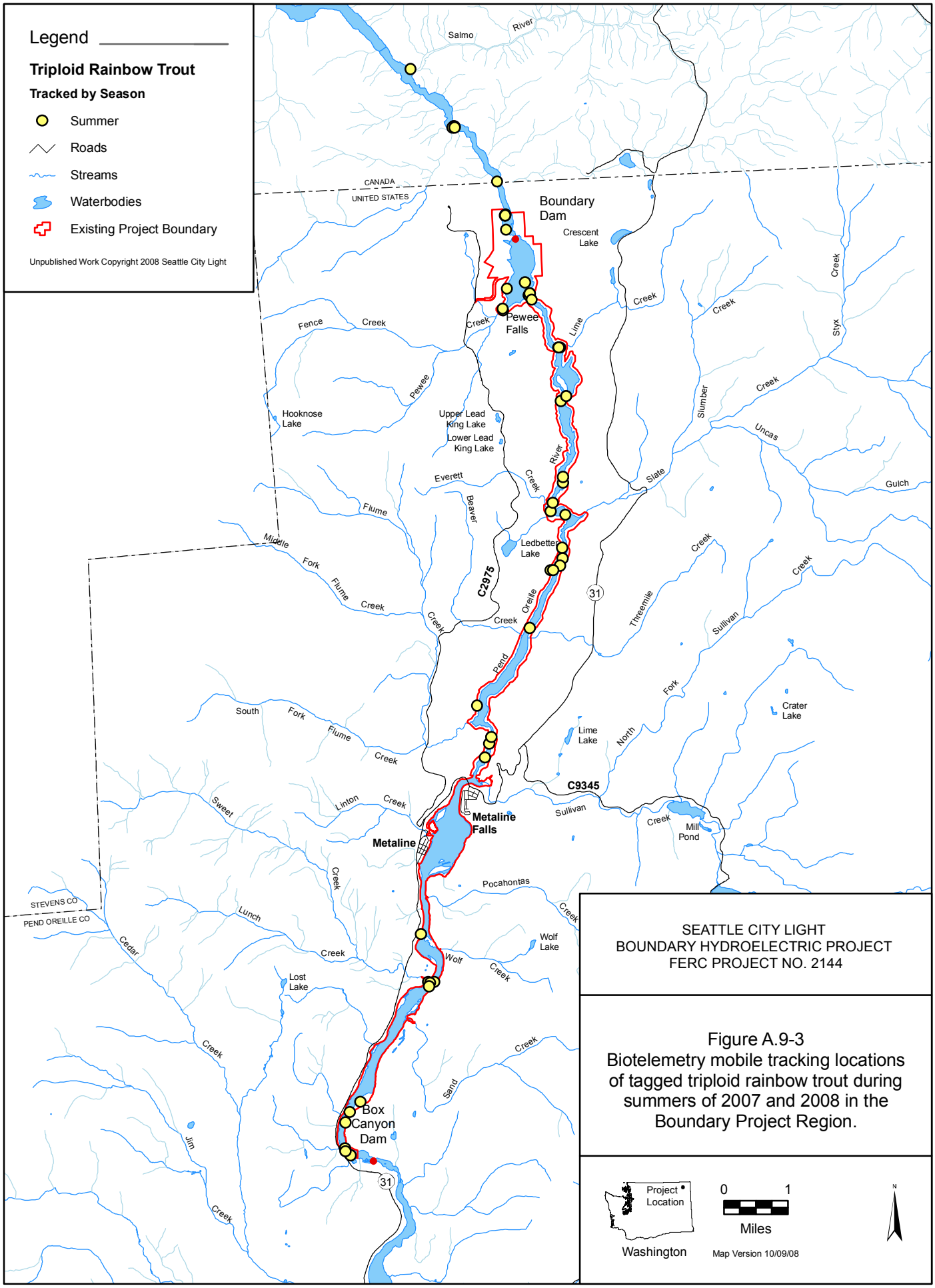

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Figure A.9-3
Biotelemetry mobile tracking locations of tagged triploid rainbow trout during summers of 2007 and 2008 in the Boundary Project Region.

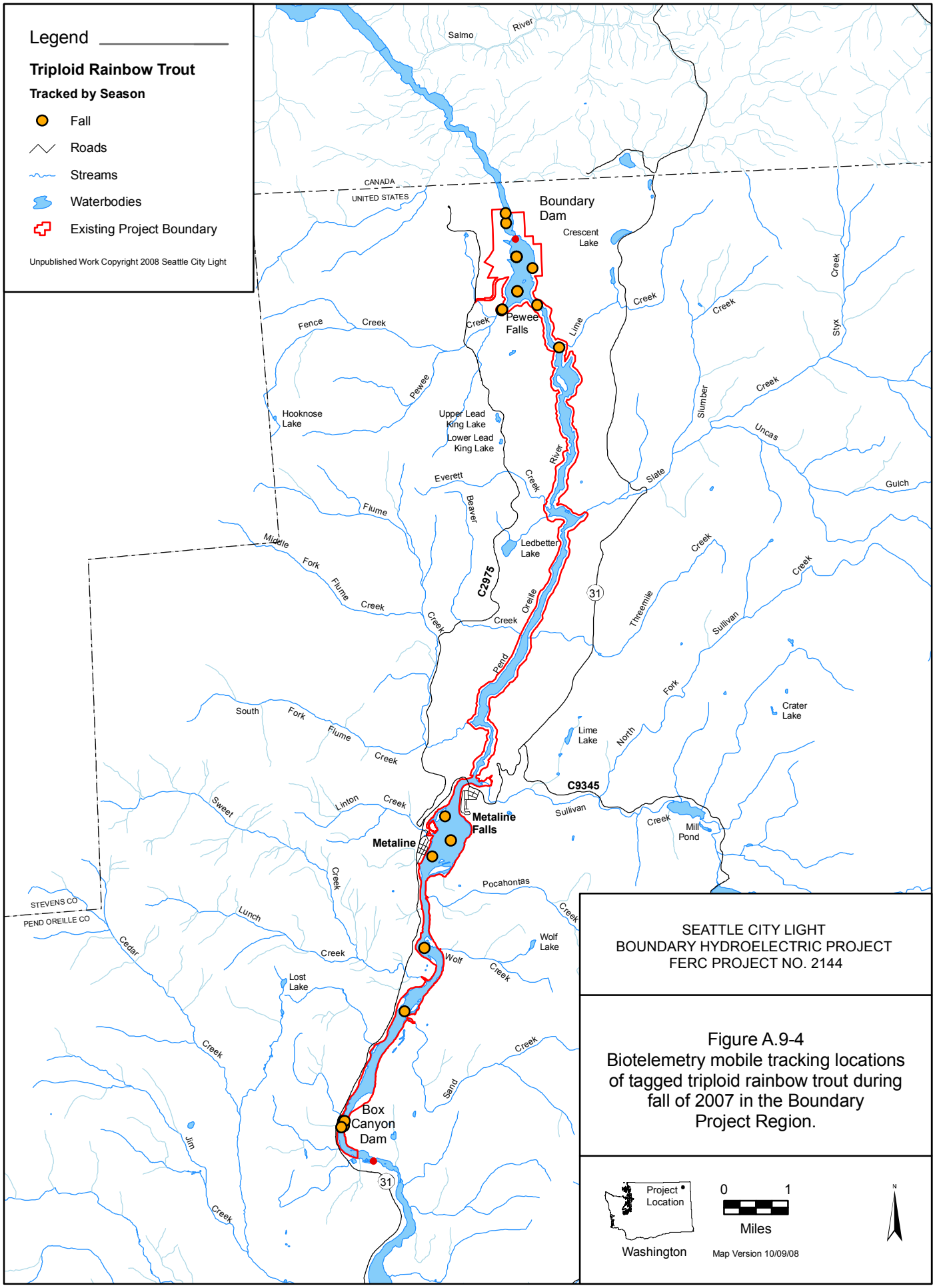

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Figure A.9-4
Biotelemetry mobile tracking locations of tagged triploid rainbow trout during fall of 2007 in the Boundary Project Region.