Pit 1 Fish Monitoring Report - 2006
Pit 1 Project
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This report presents the results of the third year of fish monitoring for the Pit 1 Project under the flow regimes stipulated by the license received November 18, 2003. Fish monitoring areas included Fall River Pond, the Fall River downstream of the pond (Lower Fall River), and the Pit River from the Pit River Weir downstream to the Highway 299 Bridge. The Pit River study area was divided into Big Eddy Pool, the Upper Canyon reach, Lower Canyon reach, and the reach downstream of the Pit 1 Powerhouse tailrace. In total, twenty stations were sampled during the 2006 fish monitoring effort. Sixteen of these stations were located throughout the Pit River, three stations were located in Fall River Pond, and one station was located in the Lower Fall River, below the pond.

As observed in previous pre- and post-license surveys for the Pit 1 Project, the Project-affected reaches continue to support a diverse mixture of native species, including rainbow trout, hardhead, Pit sculpin, Sacramento sucker (the primary fish prey species for bald eagles on the Pit River), and Sacramento pikeminnow as well as introduced species, primarily green sunfish, largemouth bass, and bluegill.

In 2006, thirteen fish species (eight native and five introduced) were found throughout the Pit River study reaches and five fish species (four native and one introduced) were found in the Fall River reaches. Largemouth bass continued to dominate the species composition overall in the Fall River reaches, followed by rainbow trout. In the Pit River, introduced species such as largemouth bass, green sunfish, and bluegill sustain dominance in the Big Eddy Pool. Only one native species, Sacramento sucker, was collected at Big Eddy. Largemouth bass and green sunfish catches declined in the Upper Canyon reach. In the Lower Canyon reach, the Sacramento pikeminnow catch was higher in 2006, but the tule perch and Pit sculpin catches were lower. Below the Pit 1 Powerhouse, there was also a decline in the catch of tule perch and Pit sculpin, despite an increase in sampling effort in that reach[1]. Three rough sculpin, a state-listed threatened species that primarily occurs in Fall River and Hat Creek, were collected below the powerhouse for the first time under the new flow regime.

Fish populations are likely still adjusting to the new flow regimes, and associated water quality and temperature, stipulated by the current license. Sampling will continue for the next two years to better determine actual changes in relative abundance of fishes in the reaches affected by the flow changes stipulated in the Pit 1 Project License.

[1] Shocking duration for the Lower Canyon sampling sites increased in 2006, compared to studies conducted in 2004 and 2005, however, total time spent sampling each individual station was similar between years. The increased shocking duration is potentially the result of differences in the composition of the field crew in 2006.

TABLE OF CONTENTS

Tables

Figures

1.0 INTRODUCTION

Pacific Gas and Electric Company's (PG&E) Pit 1 Project (FERC No. 2687) is located on the lower Fall River and middle Pit River in Shasta County, California (Figure 1). Water is diverted from the Fall River at the Pit 1 Forebay through a tunnel to the Pit 1 Powerhouse and subsequently into the Pit River several miles downstream of the natural confluence at Fall River Mills. As stipulated in the new license, a release of 150 cubic feet per second (cfs) is made from the Pit 1 Forebay through the Pit 1 Project (Project) bypass reaches from June 1 to October 31. A release of 50 cfs is required from November 16 to May 15, and a release of 75 cfs is required for the periods November 1 to November 15 and May 16 to May 31. The bypass reaches include a short section of the Lower Fall River and several miles of the Pit River. The new license also stipulates that a flow of 700 cfs or greater be maintained in the Pit River downstream of the powerhouse tailrace and that ramping rates associated with peaking operations follow specific guidelines. The fish populations of these Project-affected reaches are the subject of the Pit 1 fish monitoring effort. This report presents three years of data from a five year monitoring study, in addition to previous monitoring surveys.

The Pit River watershed supports a diverse fish population that includes native and introduced coldwater and warmwater species. Table 1 is a list of all reported species occurring in the Project vicinity. Some of these species are specifically adapted to lentic or lotic habitats and would not be expected to occur in all Project waters. Other species that are hard to sample because of specific behaviors or their use of deep or swift water habitats, may be more numerous or widespread than indicated in the following discussions.

2.0 STUDY APPROACH

Fish populations are being monitored in Project-affected waters, which include Fall River Pond, the Fall River downstream of the pond (Lower Fall River), and the Pit River from the Pit River Weir downstream to the Highway 299 Bridge (Figure 1). The Pit River reaches are divided into the Big Eddy Pool, the Upper Canyon, the Lower Canyon, and the section between the Pit 1 Powerhouse tailrace and the Highway 299 Bridge.

Twenty previously established sampling stations were sampled during the 2006 fish monitoring effort (Figure 1). Of these stations, 19 were established and sampled in 1991-1992 as part of the Pit 1 Project License Application FERC Project No. 2687 (PG&E 1993), and again in 2004 and 2005 as part of this five-year monitoring effort. The Lower Fall River fish sampling station between Fall River Pond and the Pit River confluence was added to the post-license monitoring plan in 2004. This section of Fall River was not sampled in 1991-1992, because flows at that time were restricted to seepage and occasional spills that created minimal habitat. All twenty stations have been sampled annually since 2004.

3.0 METHODS

Fish sampling was conducted on September 11-13, 2006. Sampling was conducted using a Smith-Root SR-18 electrofishing boat, Smith-Root Model 12 backpack electrofishing units, and a 15-foot inflatable cataraft outfitted with a Smith-Root Model 2.5 gas-powered generator and pulsating unit. As in 2004 and 2005, gillnets were not used with the cataraft electrofishing, contrary to the monitoring plan, because the potential increase in catch would not justify the increase in fish mortality associated with gill netting. Boat electrofishing was implemented in deep-water habitat areas (deep runs and pools) of the Pit River and Fall River Pond. Cataraft electrofishing was conducted in run, pocket water, and pool habitats of the Pit River that were too deep for backpack sampling and too inaccessible for launching the electrofishing boat. Riverine habitats less than 1 meter (~3.25 feet) deep were sampled with backpack electrofishing units. When practicable, two backpack electrofishing units were used simultaneously to maximize river sampling coverage.

Sampling stations were established throughout the study area to determine the relative abundance and distribution of fish in waters affected by Project Operations (Figure 1). Nine boat electrofishing stations, two cataraft stations, and five backpack electrofishing stations were located in representative habitats in the bypass reach from the Pit 1 Forebay to the Pit 1 Powerhouse to evaluate the effects of the release flows. Four backpack electrofishing stations were located downstream of the Pit 1 Powerhouse to determine the effects of higher minimum base flows and reduced daily flow fluctuations.

The 20 electrofishing stations were reoccupied based on landmarks, photo documentation, field maps, and station length. Boat and cataraft stations for previous sampling efforts ranged in length from 40 to approximately 200 meters. Backpack electrofishing stations ranged from approximately 30 to 95 meters.

All electrofishing stations were sampled in accordance to the Pit 1 fish sampling methods that were implemented in 1991-1992 (PG&E 1993). Prior to sampling, station limits were delineated to match the stations sampled in 1991-1992 and 2004-2005 to the extent possible. Although release flows were reduced from 150 cfs to 75 cfs for sampling the Upper and Lower Canyon stations in 2004-2006, flows

were still higher than those sampled in 1991-1992 (when release flows were approximately 30 cfs). Similarly, flows below the Pit 1 Powerhouse tailrace were maintained at approximately 500 cfs to facilitate sampling, but were still higher than the flows sampled in 1991-1992 (when flows were approximately 350 to 400 cfs during the surveys). Consequently, not all areas of the backpack electrofishing stations could be waded and sampled as was done in 1991-1992.

During sampling, all fish species were netted upon electrotaxis and placed in buckets or live wells to recover. At the end of each station, all fish were counted and identified to species. Fork length (FL) of each fish was recorded (in millimeters), weight was measured (in grams or volumetrically in milliliters), and irregularities in physical condition were noted. Trout were examined to determine whether they exhibited characteristics associated with being of hatchery origin (i.e., rounded, worn, or clipped fins). Following numeration and measurements, all fish were released into the same segment of river in which they were captured. Individual specimens that were indiscernible in the field were sacrificed and preserved for laboratory identification.

Air and water temperature (°C) were recorded at all stations. Photos were taken at several sites to document existing habitat conditions and station location. Depth measurements were not taken because of difficult wading conditions and because of the reduction of base flows for sampling.

Because of the flow, size, and complexity of the sampling stations, a qualitative sampling program was implemented. Although population estimates cannot be developed, a qualitative sampling program still enables the determination of relative abundance and spatial distribution of fish species. Also, because an attempt was made to keep station area and sampling effort consistent among years, information on total catch abundance (based on numbers of each species collected) can be obtained for each station.

Sampling at boat electrofishing stations generally progressed in an upstream direction, but sometimes varied with prevailing winds. As the boat approached the shore, sampling would begin approximately 3 to 4.5 meters (10 to 15 feet) from the wetted edge and continue until the shore was reached. This distance increased or decreased depending on the particular station's near-shore depth. A single pass was made at

each station utilizing two netters. All fish captured were placed in an onboard live well and were processed at the completion of each station.

Backpack electrofishing stations were sampled with one pass in an upstream direction. Because of the qualitative methodology, block nets were not used to isolate sampling stations. Due to swift flows and the deep channel profile at most backpack stations, it was only possible to sample one-third to two-thirds of the total channel area. With the exception of Station FR-1, all backpack stations were sampled with six-person crews; two people carrying backpack shockers were each accompanied by two netters. At Station FR-1, two people carried backpack shockers; each was accompanied by one netter. Fish collected during sampling were placed in buckets and were processed at the end of the station.

Because of the difficulty and limitations of sampling deep water in the Canyon area of the Project, an inflatable cataraft, outfitted with a Smith-Root electrofishing tote-barge, was used to sample two stations (PR-9 and PR-10). Due to the absence of road access into the middle reaches of the Canyon, the cataraft unit was transported by helicopter. The cataraft was operated with one oarsman and two netters, who controlled the electrical output with a foot pedal. All fish captured were placed in a live well for temporary holding. When the live well was full, the fish were transported to shore for processing while sampling continued.

4.0 RESULTS

Surveys prior to 2006 indicated that 27 species of fish and one hybrid (bluegill x green sunfish) had been observed in the Pit 1 Project vicinity. During the 2006 survey, 15 species were collected; 10 were native and 5 were introduced species (Table 1). In addition to these species, hybrid bluegill x green sunfish was collected in the Big Eddy section of the Pit River in 2006.

Five fish species (four native and one introduced) were collected in the Fall River. Of these, four species (three native and one introduced) and one unidentified cyprinid were collected within Fall River Pond, while three species (two native and one introduced) were collected in the Lower Fall River downstream of Fall River Pond. One of the species collected in Fall River Pond, the bigeye marbled sculpin, is a California species of special concern.

Thirteen fish species (eight native and five introduced) and one hybrid were collected in the Pit River. Nine species (seven native and two introduced) were found below the powerhouse, and twelve species (seven native and five introduced) and one hybrid were found in the bypass reach above the powerhouse. Three rough sculpin were among the native fish collected below the powerhouse in 2006. The rough sculpin is found only in the Pit River watershed and is a state-listed threatened species (Moyle 2002). The hardhead, a California species of special concern, was collected throughout the Pit River below Big Eddy. The Sacramento perch, a California species of special concern native to California but introduced into the Pit River drainage (Moyle and Daniels 1982), was collected in the Lower Canyon in 2005 (one individual), but not in 2004 or 2006. Similarly, one Pit roach, which is also a California species of special concern, was collected in the Pit River below the Pit 1 Powerhouse in 2005, but Pit roach were not captured in 2004 or 2006.

Results are presented in terms of number collected (catch or total catch) and relative abundance (percent composition by species). Comparison of total catch among years assumes equal sampling effort annually

at each station[2]. Because the sampling is not rigorously quantitative, total catch of each species collected primarily provides supplemental information for evaluating changes in relative abundance. Table 2 presents the electroshocking duration at each site during the 2004-2006 surveys. At Sites PR-13 through PR-15 the shocking duration in 2006 was significantly higher than in previous years (Table 2). Although shocking duration increased in comparison to previous years, the time spent sampling at each sampling station was similar. Relative abundance at these stations is presumed to remain similar, despite the increase in shocking duration. Total catch results and relative species abundance for all stations in 2004, 2005, and 2006 for the Fall River and Pit River are presented in Table 3. Species composition (%) is graphically displayed in Figure 2. The catch results for each subsection sampled in the Fall River and Pit River are presented in Tables 4 and 5, respectively. Species relative abundance for each river subsection for 2006 is presented in Figures 3 through 10.

4.1 FALL RIVER

Five species were collected in the Fall River during 2006. Of the five, four were native species (rainbow trout, Sacramento pikeminnow, tui chub, and bigeye marbled sculpin) and one was an introduced species (largemouth bass) (Tables 1 and 3). Four species (three native and one introduced) were collected in Fall River Pond (Table 4, Figure 3), and three (two native and one introduced) were collected in the Lower Fall River (Table 4, Figure 4). Comparisons of species composition (percent abundance) in 2004, 2005, and 2006 are presented in Table 3 for the Fall River. Table 4 compares 2004, 2005, and 2006 catch data by subsection for the Fall River. Length-frequency distributions for largemouth bass and rainbow trout collected in the Fall River during 2006 are presented in Figure 11. Other species were not collected in sufficient numbers to create length-frequency distributions.

Three stations were sampled in Fall River Pond (FRP-1, FRP-2, and FRP-3) using the electrofishing boat (Figure 1). Of the four fish species collected in Fall River Pond (Figure 3), largemouth bass was by far

[2] An effort is made to maintain equal sampling effort; however, keeping sampling effort equal can be difficult with changes in sampling crew composition and the potential for changes in the physical structure of the sampling sites.

the most abundant (93%, n=80). Largemouth bass ranged in length from 58 mm to 381 mm (FL), with an average length of 140 mm. As observed in 2005, largemouth bass was the only centrarchid collected in Fall River Pond (Table 4). Rainbow trout was the second most abundant species (3.5%, n=3). The length range for rainbow trout collected in Fall River Pond was 290 mm to 410 mm (FL), with an average length of 330 mm. All rainbow trout specimens appeared to be wild fish (i.e., no hatchery stock characteristics) and appeared to be in excellent health. One Sacramento pikeminnow and one bigeye marbled sculpin were also collected in Fall River Pond. The pikeminnow was 183 mm (FL), while the marbled sculpin was 63 mm (FL). Tui chub, which was the second most abundant species (n=17) collected in Fall River Pond in 2004, was not collected in either 2005 or 2006 (Table 4).

One station (FR-1) was sampled with two backpack electrofishing units in the Lower Fall River, downstream of Fall River Pond (Figure 1). The total number of fish collected at this station in 2006 was lower than in previous years (Table 4). Rainbow trout was the most abundant species (57%, n=12) collected at this station (Figure 4). All rainbow trout specimens appeared to be wild fish (no hatchery stock characteristics) and appeared to be in excellent health. The length range of the rainbow trout collected was 97 mm to 170 mm (FL), with an average length of 137 mm. Largemouth bass was the second most abundant species collected (38%, n=8). In addition, one tule perch was collected at this station (FL=118 mm). Compared to 2005, largemouth bass relative abundance decreased in the Lower Fall River in 2006, while rainbow trout relative abundance increased (PG&E 2006).

4.2 PIT RIVER

Thirteen fish species (eight native and five introduced) and one hybrid were collected in the Pit River during the 2006 sampling event (Tables 1 and 3). The relative abundance of these species for the entire Pit River sample area (Stations PR-1 through PR-16) is illustrated in Figure 5. Nine species (seven native and two introduced) were found below the powerhouse; and twelve species (seven native and five introduced) and one hybrid (bluegill x green sunfish) were found above the powerhouse (Table 5). Comparisons of species composition for 2004, 2005, and 2006 are presented in Table 3 for the Pit River.

Table 5 compares 2004-2006 catch data by species and subsection for the Pit River. Length-frequency distributions for largemouth bass, Sacramento sucker, Sacramento pikeminnow, hardhead, Pit sculpin, tule perch, rainbow trout, and speckled dace are presented in Figure 12. Length-frequency distributions for other species collected in the Pit River were omitted because of insufficient numbers.

Because of the differences in habitat type, river morphology, and flow conditions within the Pit River study area, the results will be discussed in three major sections: Big Eddy Pool, the Canyon section between Big Eddy and the Pit 1 Powerhouse, and the reach below the Pit 1 Powerhouse (Figure 1). Due to significant groundwater accretion flows in the Canyon and the presence of a natural migration barrier (Pit River Falls), the Canyon section is further divided into the Upper Canyon and Lower Canyon sections.

Six stations (PR-1 to PR-6) were sampled by boat electrofishing in the Big Eddy pool reach (Figure 1). Six species and one hybrid (bluegill x green sunfish) were collected (Table 5). The six species included one native species (Sacramento sucker) and five introduced species (green sunfish, largemouth bass, bluegill, carp, and black crappie). Relative abundance of the species collected in the Big Eddy reach is illustrated in Figure 6. In addition, several unidentified centrarchid species were collected in the Big Eddy reach. These individuals were age 0+ juveniles and were unidentifiable in the field due to their small size (< 30 mm). Because they were not identified to species level, these individuals were included in the total number of fish collected, but will not be discussed relative to species composition. These fish were most likely bluegill, green sunfish, or hybrids, based on their appearance and the abundance of those species at Big Eddy. The most abundant species collected in Big Eddy was green sunfish (40%, n=53). Green sunfish ranged in length from 29 mm to 145 mm (FL), with an average length of 86 mm. Largemouth bass and bluegill were the next most abundant species collected, respectively. Largemouth bass comprised 27% (n=35) of the catch and ranged in length from 37 mm to 388 mm (FL), with an average length of 104 mm. Bluegill represented 22% (n=29) of the catch and ranged in length from 58 mm to 158 mm (FL), with an average length of 127 mm. Four carp, ranging from 425 mm to 625 mm

(FL), were collected in the Big Eddy pool reach. Two Sacramento suckers (378 mm and 424 mm FL), two bluegill x green sunfish hybrids (74 mm and 144 mm FL), and one black crappie (57 mm FL) were also collected in Big Eddy.

Changes in relative abundance were observed in Big Eddy among sampling years. Most notably, the relative abundance of largemouth bass increased between 2004 and 2005 and then decreased between 2005 and 2006 (PG&E 2006). Consequently, largemouth bass numbers in 2006 were similar to those collected in 2004. The number of green sunfish increased slightly from 2005 but was still less than the number collected in 2004 (Table 5). Bluegill numbers were slightly lower than in 2005, continuing a downward trend in number collected and relative abundance. As in 2005, a single black crappie was collected in Big Eddy in 2006.

In total, ten species were collected at six stations (PR-7 through PR-12) in the Canyon section of the Pit River (Table 5). The relative abundance of these species is illustrated in Figure 7. Two backpack stations and one cataraft station were located in both the Upper Canyon and Lower Canyon sections (Figure 1). Because the two Canyon sections differ in water quality and accretion flow and are separated by Pit River Falls, the following discussion presents results separately for the Upper Canyon and Lower Canyon sections.

Eight species were collected in the Upper Canyon section in 2006 (Table 5, Figure 8). Five of the species were native (Sacramento pikeminnow, hardhead, Sacramento sucker, Pit sculpin, and tule perch), and three were introduced (largemouth bass, green sunfish, and black crappie). The most dominant species in the Upper Canyon was largemouth bass, comprising 36% (n=34) of the species collected. Largemouth bass ranged in length from 55 mm to 134 mm (FL), with an average length of 81 mm. Tule perch was the second most abundant species collected (15%, n=14). Tule perch ranged in length from 85 mm to 102 mm (FL), with an average length of 93 mm. Sacramento sucker comprised 14% (n=13) of the species composition and ranged in length from 82 mm to 422 mm (FL). The average size of Sacramento sucker was 287 mm. Pit sculpin was the next most abundant species, contributing 13% (n=12) of the species

composition. Pit sculpin lengths ranged from 51 mm to 123 mm (FL), with an average of 166 mm. Green sunfish accounted for 12% (n=11) of the species composition in the Upper Canyon and ranged in length between 76 mm and 136 mm (FL), with an average of 101 mm. Eight hardhead were also collected in the Upper Canyon, accounting for 8% of the species composition. Lengths of hardhead ranged between 56 mm and 395 mm (FL), with an average length of 202 mm. Two black crappie (104 mm and 152 mm FL) were collected in the Upper Canyon, comprising 2% of the species composition. Additionally, one 180-mm Sacramento pikeminnow was collected in the Upper Canyon.

Numbers of each species collected were lower in the Upper Canyon than in previous years, with the exception of Sacramento sucker and tule perch (Table 5). Largemouth bass and pikeminnow relative abundance decreased substantially from 2005 to 2006, while tule perch and Sacramento sucker increased (PG&E 2006). Minor changes in relative abundance were observed among the other species.

Nine species were collected in the Lower Canyon in 2006 (Table 5, Figure 9). Seven were native species (rainbow trout, Sacramento sucker, hardhead, tule perch, Pit sculpin, Sacramento pikeminnow, and speckled dace), and two were introduced (largemouth bass and green sunfish). As in 2005, hardhead was the most abundant species collected (43%, n=106). They ranged in length from 35 mm to 406 mm (FL), with an average length of 93 mm. The majority of hardhead collected in the Lower Canyon were juveniles less than 150 mm in length. Sacramento sucker was the second most abundant species collected in the Lower Canyon section (19%, n=46). Suckers ranged in length from 46 mm to 485 mm (FL), with an average length of 238 mm. Approximately 50% of the individuals collected were adult fish (>295 mm). Pit sculpin was the next most abundant species (14%, n=35), ranging in length from 53 mm to 147 mm (FL), with an average length of 84 mm. Sacramento pikeminnow represented 13% (n=33) of the species composition in the Lower Canyon. All of the pikeminnow were fry or juveniles, ranging in length from 40 mm to 86 mm (FL), with an average length of 55 mm. Twelve speckled dace were collected, representing 5% of the species composition. Speckled dace lengths ranged from 42 mm to 60 mm (FL), with an average length of 52 mm. Six rainbow trout were collected, ranging in length from 84 mm to 348

mm (FL), with an average of 217 mm. These fish represented just over 2% of the species composition in the Lower Canyon. Largemouth bass represented 2% (n=5) of the species composition; all bass collected were young-of-the-year. Four adult tule perch were collected, representing less than 2% of the species composition. Tule perch lengths ranged from 91 mm to 99 mm (FL), with an average length of 94 mm. One green sunfish (115 mm FL) was collected in the Lower Canyon.

Several notable shifts in the relative abundance of fish species in the Lower Canyon were observed between 2005 and 2006. The catch and relative abundance of tule perch decreased considerably (from 30 in 2004, to 22 in 2005, to four in 2006), while the catch and relative abundance of Sacramento pikeminnow in the Lower Canyon increased considerably (from seven in 2004, to four in 2005, to 33 in 2006) (Table 5). Speckled dace numbers also increased, while Pit sculpin numbers were less than those in 2005. Three introduced species (carp, black crappie, and Sacramento perch) collected in 2005 were not collected during the 2006 effort. Slightly higher numbers of Sacramento sucker were collected in 2006 than in 2005. Catch totals for largemouth bass, green sunfish, hardhead, and rainbow trout remained generally consistent with 2005 results. Overall, total catch was similar between years (Table 5).

Nine fish species were collected at the four backpack electrofishing stations below the Pit 1 Powerhouse (Table 5, Figure 10). Of these species, seven were native (rainbow trout, Sacramento sucker, tule perch, Pit sculpin, rough sculpin, hardhead, and Sacramento pikeminnow) and two were introduced (green sunfish and largemouth bass). Hardhead (33%, n=151) and Pit sculpin (33%, n=149) were the most abundant species. Hardhead ranged in length from 28 mm to 96 mm (FL), with an average length of 41 mm. No adult hardhead were collected below the powerhouse. Pit sculpin ranged in length from 36 mm to 128 mm (FL), with an average length of 84 mm. Sacramento sucker (n=65) and rainbow trout (n=63) each represented 14% of the species composition below the powerhouse. Suckers ranged in length from 31 mm to 436 mm (FL), with an average length of 59 mm. Trout ranged in length from 57 mm to 201 mm (FL), with an average length of 105 mm. Approximately 70% of rainbow trout collected were young-of-the-year individuals (<110 mm). Sacramento pikeminnow accounted for 3% of the relative

abundance below the powerhouse (n=13). Pikeminnow lengths ranged from 43 mm to 200 mm (FL), averaging 94 mm. Nearly all of the pikeminnow collected were young-of-the-year. Tule perch was the next most abundant species (2%, n=10). The tule perch collected ranged in length from 70 mm to 100 mm (FL), with an average length of 88 mm. Three rough sculpin, comprising less than 1% of the species composition, were collected below the powerhouse. The rough sculpin were 35 mm, 38 mm, and 75 mm in length (FL). Two largemouth bass (86 mm and 100 mm FL) and one green sunfish (85 mm FL) were also collected below the powerhouse.

In general, numbers of native fish below the powerhouse were higher in 2006 than in 2004 and 2005. Hardhead total catch and relative abundance in 2006 was higher than in 2004 or 2005. In addition, Sacramento sucker and rainbow trout total catch increased over 2005 numbers. Although Sacramento pikeminnow total catch was less than 2005, it remained higher than 2004 numbers. The exception to the general increase in numbers was the decrease in Pit sculpin abundance. Total catch and relative abundance for Pit sculpin was lower in 2006 than in 2004 and 2005. Tule perch numbers were also lower in 2006 than in 2005, but similar to the 2004 total catch. No speckled dace were collected below the powerhouse in 2006, even though they were captured there in 2004 and 2005. Three rough sculpin were collected in 2006. Rough sculpin were not collected below the powerhouse in 2004 or 2005. Similarly, two largemouth bass were collected below the powerhouse in 2006; no largemouth bass were captured below the powerhouse during the 2004 or 2005 surveys (Table 5).

5.0 DISCUSSION

This report presents the results of three years of fish monitoring for the Pit 1 Project under the modified flow regimes. Fish populations may still be adjusting to the relatively new conditions in the Project-affected reaches of the Fall River and Pit River. Consequently, conclusive discussions of the results are premature and will be limited to comparisons with the 1991-1992 survey results under the previous license conditions (PG&E 1993) and results from the 2004-2005 surveys. As in previous years, the Project-affected reaches support a diverse community of native species, including rainbow trout, hardhead, Sacramento pikeminnow, Sacramento sucker (an important bald eagle prey species), and Pit sculpin. Additionally, the Project-affected reaches support several introduced species, primarily largemouth bass, green sunfish, and bluegill. The introduced species are dominant in deep, low-velocity riverine habitats, such as Fall River Pond and the Big Eddy section of the Pit River. The native species are more abundant in the higher velocity habitats that occur in the Canyon section of the bypass reach and downstream of the Pit 1 Powerhouse. Within those sections, rainbow trout in particular are found in the coldwater areas of the spring-fed Lower Canyon and between the powerhouse and the Highway 299 Bridge.

Changes in the relative abundance and distribution of fish from those found in the 2004-2005 surveys were observed in 2006, but may not reflect eventual population trends resulting from the modified flow regime. Some changes observed in 2005 continued, while other changes in fish community structure reversed or remained stable. The samples in the re-watered section of Lower Fall River below Fall River Pond were primarily composed of rainbow trout and largemouth bass in 2004, 2005, and 2006, but numbers were lower in 2006 than in previous years. One tui chub was collected in the Lower Fall River in 2006, compared to zero in 2005. In contrast, tui chub were the third most abundant species in the Lower Fall River in 2004. In 2005 and 2006, rainbow trout, Sacramento pikeminnow and bigeye marbled sculpin were collected in Fall River Pond. None of these species were collected in 2004. Fish found in the Lower Fall River may move or be displaced into this section from Fall River Pond or the Pit 1

Forebay during the three license-required flushing flows that are made from the Pit 1 Forebay every summer. Largemouth bass are relatively abundant in Fall River Pond just upstream, and rainbow trout are known to occur in Pit 1 Forebay, located immediately upstream of Fall River Pond (PG&E 1993). At this time, it is inconclusive whether the occurrence of these species indicates the presence of suitable habitat in the Lower Fall River to sustain the population or if their occurrence is a result of natural migration and/or displacement caused by the flushing flow events. Fish sampling occurred within four weeks following the last flushing flow event.

In 2006 there were decreases in largemouth bass numbers and relative abundance in Lower Fall River, Big Eddy Pool, and the Upper Canyon; areas where largemouth bass are typically the dominant species. In these river sections, largemouth bass numbers decreased to levels similar to those observed during 2004. Similar fluctuations in numbers of largemouth bass were noted during the 1991-1992 surveys as well. The exception to the decline in 2006 was at Fall River Pond, where the catch increased somewhat over levels observed in 2004 and 2005. The observed fluctuations in relative abundance and catch could be the result of several factors, including natural variation in year-class recruitment, predation by adult largemouth bass, and population cycling.

Green sunfish catch numbers and relative abundance continued to remain low relative to 2004 catch data. Both Green sunfish and largemouth bass are primarily found in the warm, slow-water habitats of Fall River Pond, Big Eddy, and the Upper Canyon. The continued reduction in catch numbers is interesting, because the green sunfish is known to be an extremely resilient, invasive species (Moyle 2002, Scott and Crossman 1973). The decrease in relative abundance and catch could be due to the factors mentioned above for largemouth bass, and/or a response to the higher base flows in the bypass reach. Although three years of data exist and a trend is apparent, the lack of prolonged monitoring precludes a more definitive causative conclusion.

Low capture numbers of native species in the Canyon sections during the 2004-2006 surveys makes interpretation of change difficult with only three years of data. That said, changes observed included an

increase in the catch of Sacramento pikeminnow and a decrease in the catch of tule perch in the Lower Canyon in 2006, compared to 2004 and 2005. Also, there was a decline in the catch of Pit sculpin in the Lower Canyon from 2004 to 2005 and from 2005 to 2006. Such changes should be followed over the next two monitoring years, particularly due to the higher summer water temperatures that occur in the Lower Canyon under the modified flow regime (PG&E 2006).

With the exception of Site PR-16, the shocking duration for the sites below the powerhouse was much higher in 2006 than in previous years (Table 2). Although shocking duration increased in comparison to previous years, the time spent at each sampling station was similar. Because of these factors it is difficult to assess the level of effort in 2006 in comparison to the surveys conducted in 2004 and 2005. Although this makes year-to-year comparisons more difficult, it is assumed that higher catch numbers would result from the increased shocking duration at these sites. Increased catches were observed for rainbow trout, hardhead, and Sacramento sucker at sites below the powerhouse. However, tule perch and Pit sculpin catches declined. Most notably was a substantial decline in the number of Pit sculpin in 2006, compared to 2004 and 2005 despite the increased shocking duration. The primary changes in the flow regime below the powerhouse were the reduction in the magnitude of daily flow fluctuations and a higher minimum flow (i.e., more permanently wetted streambed). A decline of Pit sculpin numbers could result from flow stabilization, if more stable flows favor the life histories of potential competitors or predators. The capture of three rough sculpin was unexpected, because this species is adapted to spring-fed systems with constant flow and stable substrate conditions. Rough sculpin are common in Fall River upstream of the Pit 1 Forebay, in Baum Lake and possibly lower Hat Creek, and in Sucker Springs Creek, a tributary to the Pit River below the Pit 1 Powerhouse. Rough sculpin could access the Pit River directly from Sucker Springs Creek or from the Fall River via the Project diversion. The new, more stable base flows in this section of the Pit River should be more favorable to rough sculpin, but it remains to be seen if they will become more numerous there, given the variable seasonal flows that occur.

Monitoring of Project-affected fish populations will continue over the next two years. The preliminary trends discussed above will be followed, and the analysis of the water quality and temperature monitoring results will be incorporated into interpretation of the effects of the modified flow regimes on native and introduced fish populations. In particular, potential changes in the populations of Sacramento sucker, the primary fish prey for resident bald eagles on the Pit River, will be tracked.

6.0 REFERENCES

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Tables

Table 1
Common Name, Taxonomic Name, and Status of Fish Species Reported from the Pit 1 Project Vicinity (X indicates collection in 2006).

Common Species Name	Taxonomic Name	Native or Introduced	Species Sampling Code	Fall River	Pit River
Trout	**Salmonidae**				
Rainbow Trout	*Oncorhynchus mykiss*	Native	RT	X	X
Eastern Brook Trout	*Salvelinus fontinalis*	Introduced	BRK		
Brown Trout	*Salmo trutta*	Introduced	BRN		
Minnow	**Cyprinidae**				
Sacramento Pikeminnow	*Ptychocheilus grandis*	Native	PM	X	X
Hardhead	*Mylopharodon conocephalis*	Native[1]	HH		X
Pit Roach	*Lavinia symmetricus mitrulus*	Native[1]	PR		
Speckled Dace	*Rhinichthys osculus*	Native	SD		X
Tui Chub	*Gila bicolor*	Native	TC	X	
Common Carp	*Cyprinus carpio*	Introduced	CARP		X
Golden Shiner	*Notemigonus crysoleucas*	Introduced	GSH		
Sucker	**Catostomidae**				
Sacramento Sucker	*Catostomus occidentalis*	Native	SKR		X
Surf Perch	**Embiotocidae**				
Tule Perch	*Hysterocarpus traski*	Native	TP		X
Sculpin	**Cottidae**				
Pit Sculpin	*Cottus pitensis*	Native	PSCP		X
Bigeye Marbled Sculpin	*C. klamathensis macrops*	Native[1]	MSCP	X	
Rough Sculpin	*C. asperrimus*	Native[2]	RSCP		X
Lamprey	**Petromyzontidae**				
Pit-Klamath Brook Lamprey	*Lampetra lethophaga*	Native	PKL		
Live Bearers	**Poecilidae**				
Mosquitofish	*Gambusia affinis*	Introduced	MF		
Catfish	**Ictaluridae**				
Channel Catfish	*Ictalurus punctatus*	Introduced	CC		
Black Bullhead	*I. melas*	Introduced	BBH		
Brown Bullhead	*I. nebulosus*	Introduced	BRBH		

Table 1 (Continued)
Common Name, Taxonomic Name, and Status of Fish Species Reported from the Pit 1 Project Vicinity (X indicates collection in 2006).

Sunfish/Bass	Centrarchidae				
Bluegill	*Lepomis machrochirus*	Introduced	BG		X
Green Sunfish	*L. cyanellus*	Introduced	GS		X
Sacramento Perch	*Archoplites interruptus*	Native[1,3]	SP		
White Crappie	*Pomoxis annularis*	Introduced	WC		
Black Crappie	*P. nigromaculatus*	Introduced	BC		X
Largemouth Bass	*Micropterus salmoides*	Introduced	LMB	X	X
Smallmouth Bass	*M. dolomieui*	Introduced	SMB		
	Total Species		**15**	**5**	**13**
	Total Native Species		**10**	**4**	**8**
	Total Introduced Species		**5**	**1**	**5**

[1] California Species of Special Concern
[2] State-listed threatened
[3] Species native to California but introduced in Project vicinity

Table 2
Comparison of Electrofishing Effort during the 2004, 2005, 2006 Surveys.

	Pit 1 Electrofishing Duration (Seconds)			
Station	**2004**	**2005**	**2006**	**Average**
FRP-1	191	247	254	231
FRP-2	145	165	187	166
FRP-3	205	140	156	167
Fall River Pond Total	**541**	**552**	**597**	**564**
FR-1	2188	2616	2614	2473
Fall River Total	**2729**	**3168**	**3211**	**3037**
PR-1	214	238	155	202
PR-2	170	279	148	199
PR-3	170	180	220	190
PR-4	150	150	175	158
PR-5	190	224	295	236
PR-6	171	227	238	212
Big Eddy Total	**1065**	**1298**	**1231**	**1197**
PR-7	891	1304	1769	1321
PR-8	930	628	975	844
PR-9	1009	1210	---[1]	1110[1]
Upper Canyon Total	**2830**	**3142**	**2744**[1]	**2905**[1]
PR-10	705	855	---[1]	780[1]
PR-11	734	954	1174	954
PR-12	1571	2378	2303	2084
Lower Canyon Total	**3010**	**4178**	**3477**[1,2]	**3555**[1]
PR-13	1588	1877	5542	3002
PR-14	1696	1947	3181	2275
PR-15	1733	1659	3148	2180
PR-16	1529	1148	1092	1256
Below PH Total	**6546**	**6631**	**12963**	**8713**
Pit River Total	**13451**	**15249**	**20451**[1]	**16370**[1]
Total Effort	**16180**	**18426**	**23626**[1]	**19411**[1]

[1] Timer was not working in 2006 for Stations PR-9 and PR-10. These stations are not included in totals.
[2] Shocking duration for the Lower Canyon sampling sites increased in 2006, compared to studies conducted in 2004 and 2005, however, total time spent sampling each individual sample site was similar between years. The increased shocking duration is potentially the result of differences in the composition of the field crew in 2006.

Table 3
Total Catch Results by Species for 2004, 2005, and 2006 for the Fall River and Pit River.

	Pit River Total			Fall River Total			Total Catch			% Composition		
Species	**2004**	**2005**	**2006**	**2004**	**2005**	**2006**	**2004**	**2005**	**2006**	**2004**	**2005**	**2006**
Rainbow Trout	47	54	69	21	30	15	68	84	84	6.2	7.0	8.1
Sacramento Pikeminnow	30	29	47	-	1	1	30	30	48	2.7	2.5	4.6
Hardhead	156	190	265	-	-	-	156	190	265	14.1	15.8	25.5
Pit Roach	-	1	-	-	-	-	-	1	-	-	0.1	-
Speckled Dace	12	11	12	-	-	-	12	11	12	1.1	0.9	1.2
Tui Chub	-	-	-	31	-	1	31	-	1	2.8	-	0.1
Common Carp	10	5	4	-	-	-	10	5	4	0.9	0.4	0.4
Golden Shiner	1	-	-	-	-	-	1	-	-	0.1	-	-
Sacramento Sucker	104	80	126	-	1	-	104	81	126	9.4	6.7	12.1
Tule Perch	43	60	28	-	-	-	43	60	28	3.9	5.0	2.7
Pit Sculpin	282	340	196	-	-	-	282	340	196	25.6	28.2	18.9
Bigeye Marbled Sculpin	1	-	-	1	2	1	2	2	1	0.2	0.2	0.1
Rough Sculpin	-	-	3	1	-	-	1	-	3	0.1	-	0.3
Mosquitofish	-	1	-	-	-	-	-	1	-	-	0.1	-
Brown Bullhead	-	-	-	-	1	-	-	1	-	-	0.1	-
Bluegill	45	35	29	5	-	-	50	35	29	4.5	2.9	2.8
Green Sunfish	116	60	66	8	2	-	124	62	66	11.2	5.1	6.4
Bluegill x Green Sunfish	5	9	2	-	-	-	5	9	2	0.5	0.7	0.2
Sacramento Perch	-	1	-	-	-	-	-	1	-	-	0.1	-
Black Crappie	4	7	3	7	-	-	11	7	3	1.0	0.6	0.3
Largemouth Bass	87	150	76	86	102	88	173	252	164	15.7	20.9	15.8
Unidentified Centrarchid	-	34	5	-	-	-	-	34	5	-	2.8	0.5
Unidentified Cyprinid	-	-	-	-	-	1	-	-	1	-	-	0.1
Totals	**943**	**1067**	**931**	**160**	**139**	**107**	**1103**	**1206**	**1038**	**100**	**100**	**100**

Table 4
Catch Data by Species, Location, and Year for the Fall River.

	Fall River Pond			Lower Fall River			Fall River Total		
Species	**2004**	**2005**	**2006**	**2004**	**2005**	**2006**	**2004**	**2005**	**2006**
Rainbow Trout	-	5	3	21	25	12	21	30	15
Sacramento Pikeminnow	-	-	1	-	1	-	-	1	1
Hardhead	-	-	-	-	-	-	-	-	-
Pit Roach	-	-	-	-	-	-	-	-	-
Speckled Dace	-	-	-	-	-	-	-	-	-
Tui Chub	17	-	-	14	-	1	31	-	1
Common Carp	-	-	-	-	-	-	-	-	-
Golden Shiner	-	-	-	-	-	-	-	-	-
Sacramento Sucker	-	-	-	-	1	-	-	1	-
Tule Perch	-	-	-	-	-	-	-	-	-
Pit Sculpin	-	-	-	-	-	-	-	-	-
Bigeye Marbled Sculpin	-	-	1	1	2	-	1	2	1
Rough Sculpin	-	-	-	1	-	-	1	-	-
Mosquitofish	-	-	-	-	-	-	-	-	-
Brown Bullhead	-	1	-	-	-	-	-	1	-
Bluegill	5	-	-	-	-	-	5	-	-
Green Sunfish	7	-	-	1	2	-	8	2	-
Bluegill x Green Sunfish	-	-	-	-	-	-	-	-	-
Sacramento Perch	-	-	-	-	-	-	-	-	-
Black Crappie	7	-	-	-	-	-	7	-	-
Largemouth Bass	70	73	80	16	29	8	86	102	88
Unidentified Centrarchid	-	-	-	-	-	-	-	-	-
Unidentified Cyprinid	-	-	1	-	-	-	-	-	1
Totals	**106**	**79**	**86**	**54**	**60**	**21**	**160**	**139**	**107**

Table 5
Catch Data by Species, Location, and Year for the Pit River.

	Big Eddy			Upper Canyon			Lower Canyon			Below Pit 1 PH			Pit River Total		
Species	**2004**	**2005**	**2006**	**2004**	**2005**	**2006**	**2004**	**2005**	**2006**	**2004**	**2005**	**2006**	**2004**	**2005**	**2006**
Rainbow Trout	-	-	-	-	-	-	5	4	6	42	50	63	47	54	69
Sacramento Pikeminnow	-	-	-	19	10	1	7	4	33	4	15	13	30	29	47
Hardhead	-	-	-	19	12	8	111	108	106	26	70	151	156	190	265
Pit Roach	-	-	-	-	-	-	-	-	-		1	-	-	1	-
Speckled Dace	-	-	-	-	-	-	2	5	12	10	6	-	12	11	12
Tui Chub	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Common Carp	9	1	4	1	-	-	-	4	-	-	-	-	10	5	4
Golden Shiner	-	-	-	1	-	-	-	-	-	-	-	-	1	-	-
Sacramento Sucker	1	2	2	12	8	13	75	42	46	16	28	65	104	80	126
Tule Perch	-	-	-	3	5	14	30	22	4	10	33	10	43	60	28
Pit Sculpin	-	-	-	5	16	12	51	44	35	226	280	149	282	340	196
Bigeye Marbled Sculpin	-	-	-	-	-	-	-	-	-	1	-	-	1	-	-
Rough Sculpin	-	-	-	-	-	-	-	-	-	-	-	3	-	-	3
Mosquitofish	-	-	-	-	1	-	-	-	-	-	-	-	-	1	-
Brown Bullhead	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bluegill	44	35	29	1	-	-	-	-	-	-	-	-	45	35	29
Green Sunfish	72	42	53	42	15	11	1	2	1	1	1	1	116	60	66
Bluegill x Green Sunfish	2	9	2	3	-	-	-	-	-	-	-	-	5	9	2
Sacramento Perch	-	-	-	-	-	-	-	1	-	-	-	-	-	1	-
Black Crappie	-	1	1	4	4	2	-	2	-	-	-	-	4	7	3
Largemouth Bass	26	65	35	59	78	34	2	7	5	-	-	2	87	150	76
Unidentified Centrarchid	-	34	5	-	-	-	-	-	-	-	-	-	-	34	5
Unidentified Cyprinid	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Totals	**154**	**189**	**131**	**169**	**149**	**95**	**284**	**245**	**248**	**336**	**484**	**457**	**943**	**1067**	**931**

Figures

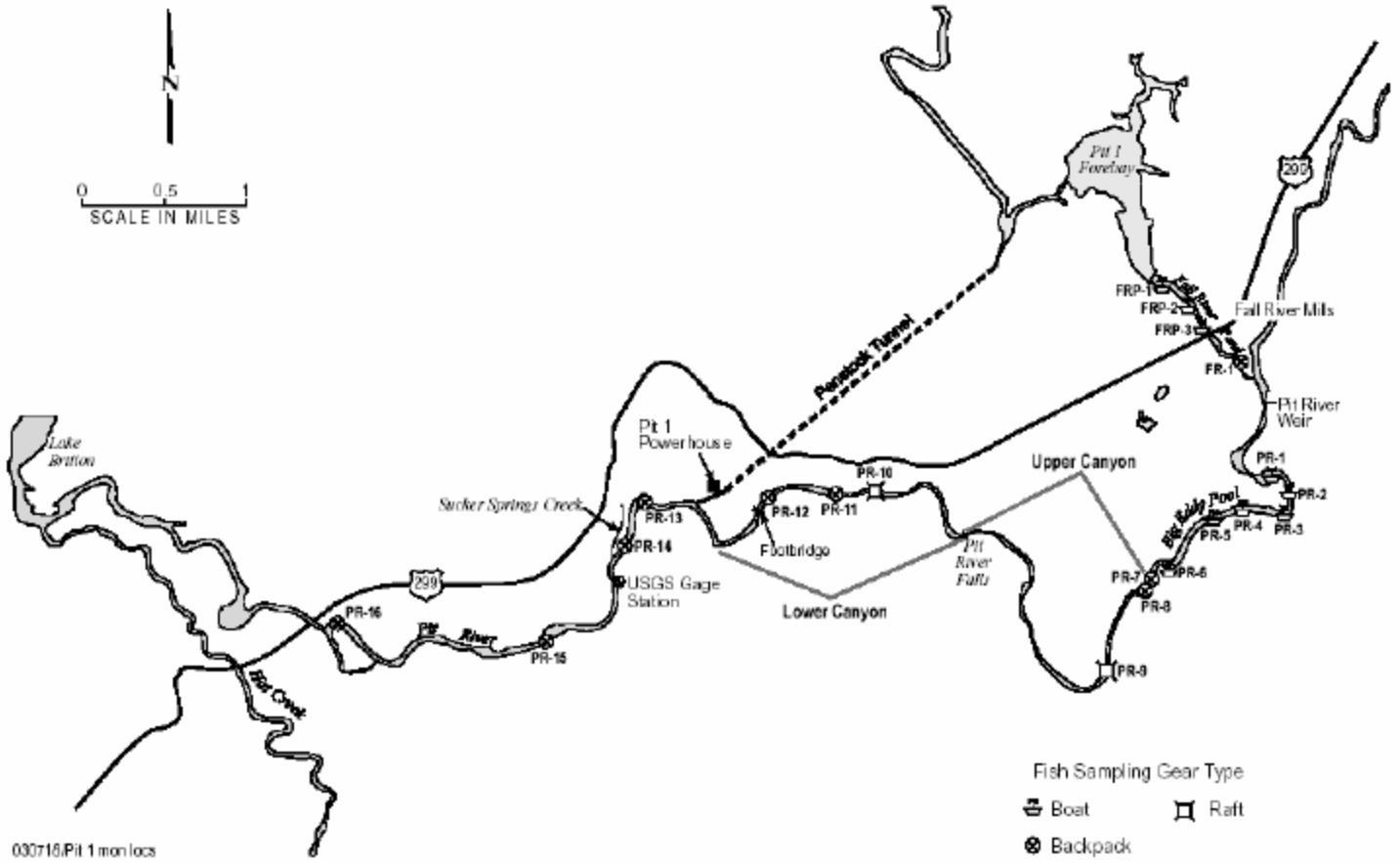

Figure 1. Pit 1 Project fish monitoring station locations.

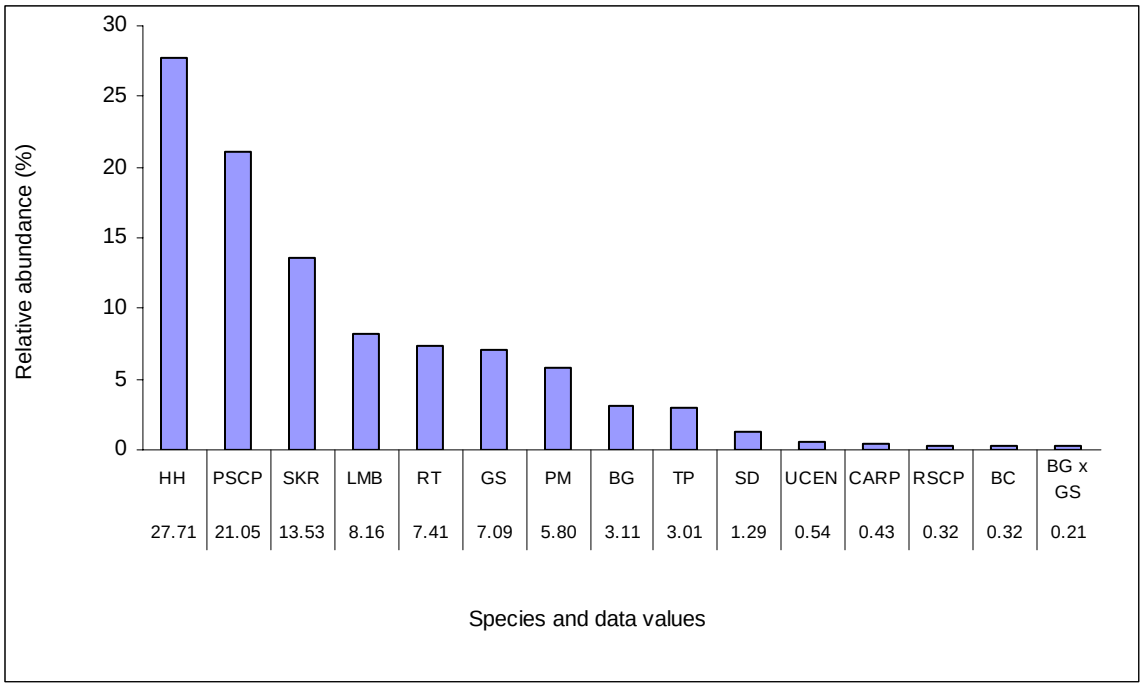

Figure 2 Relative abundance (%) of all fish species collected in the Pit River and Fall River (September 2006).

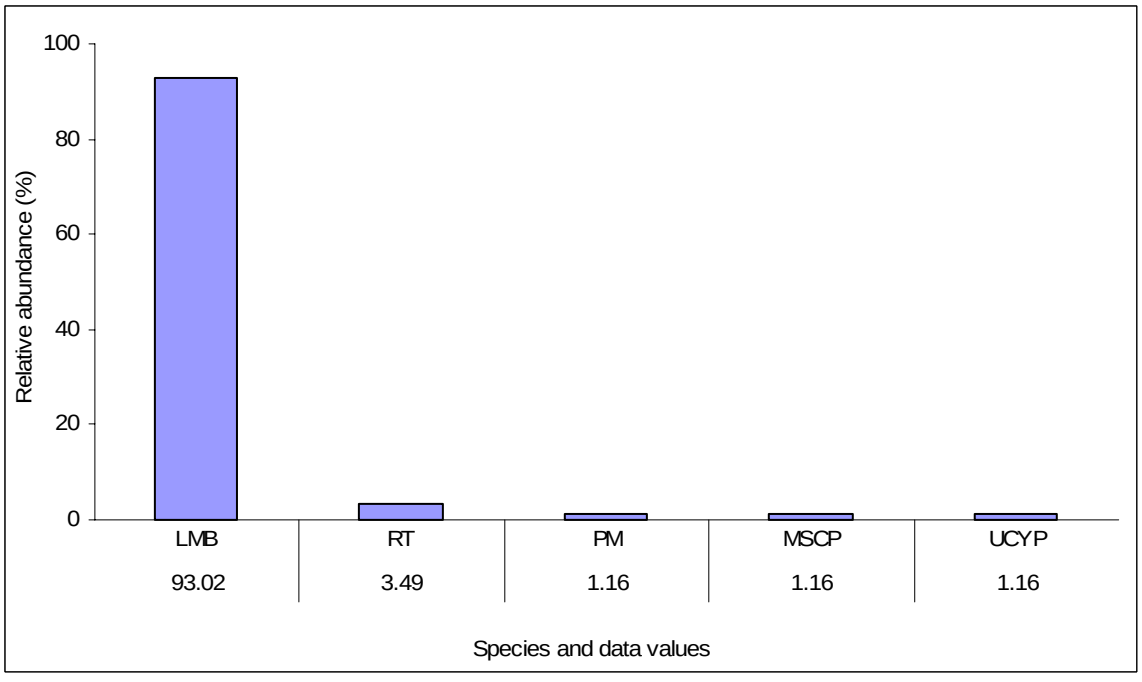

Figure 3 Relative abundance (%) of all fish species collected in Fall River Pond (FRP-1 through FRP-3; September 2006).

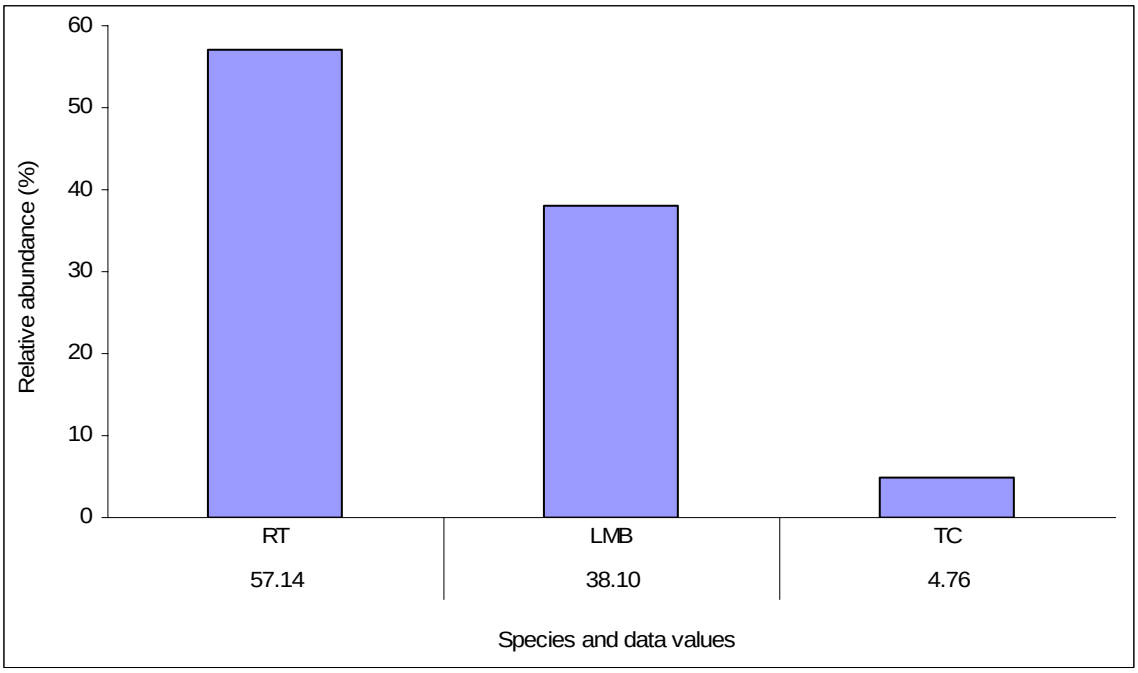

Figure 4 Relative abundance (%) of all fish species collected in Lower Fall River (FR-1), downstream of Fall River Pond.

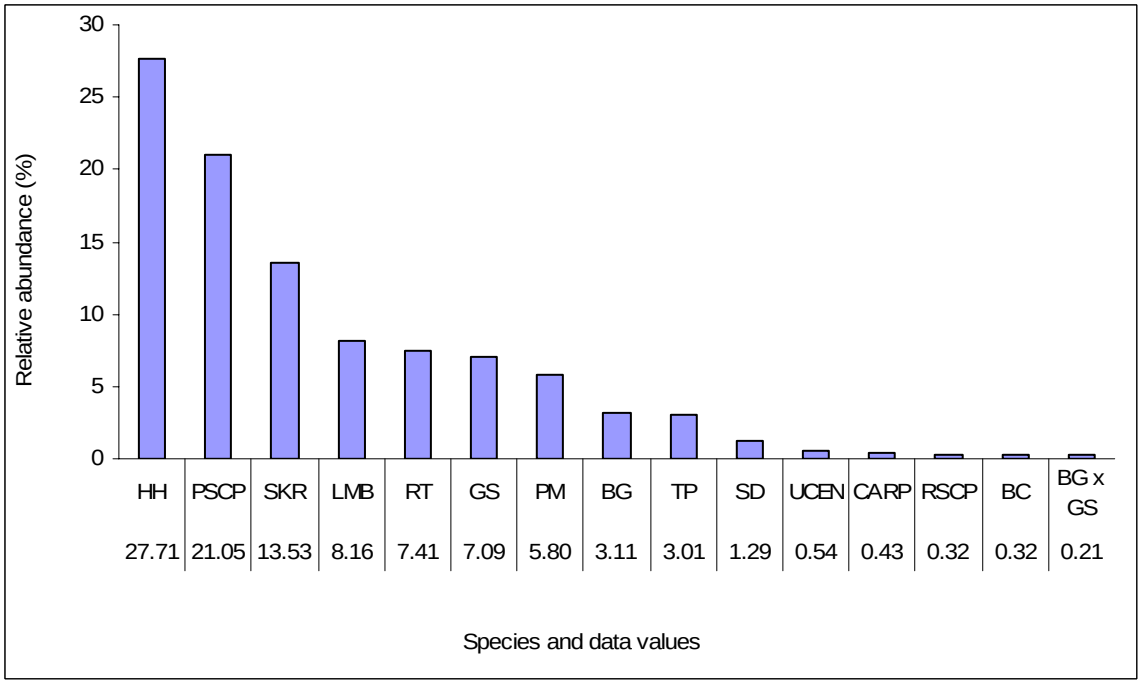

Figure 5 Relative abundance (%) of all fish species collected in the Pit River (PR-1 through PR-16).

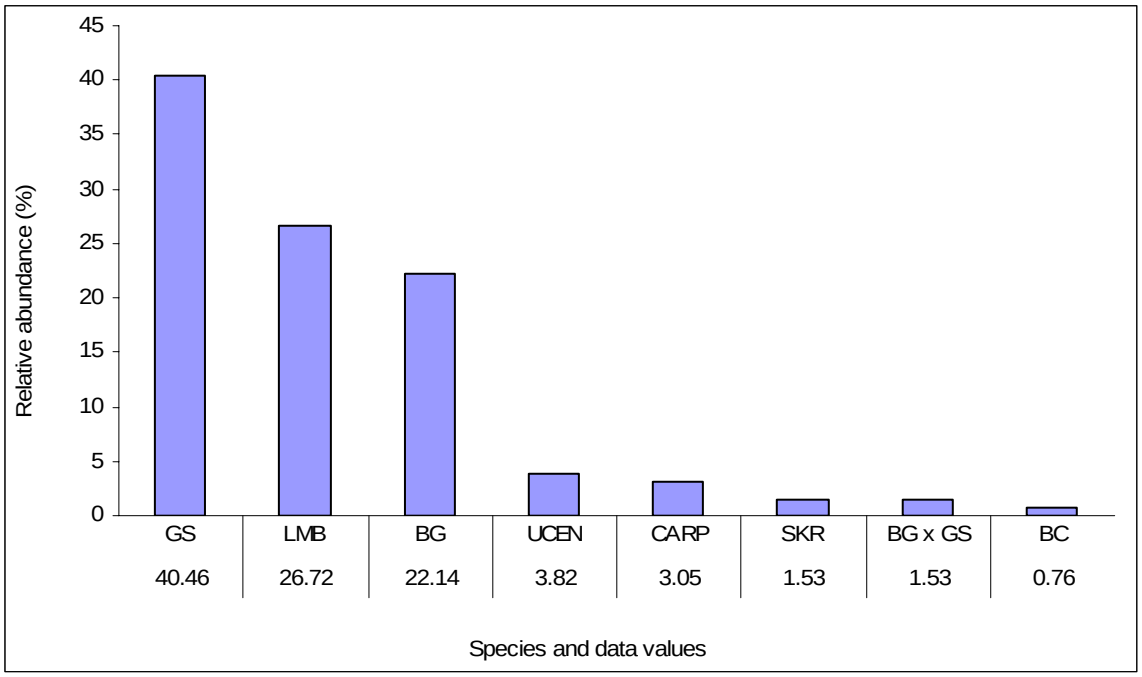

Figure 6 Relative abundance (%) of all fish species collected in the Big Eddy section of the Pit River (PR-1 through PR-6).

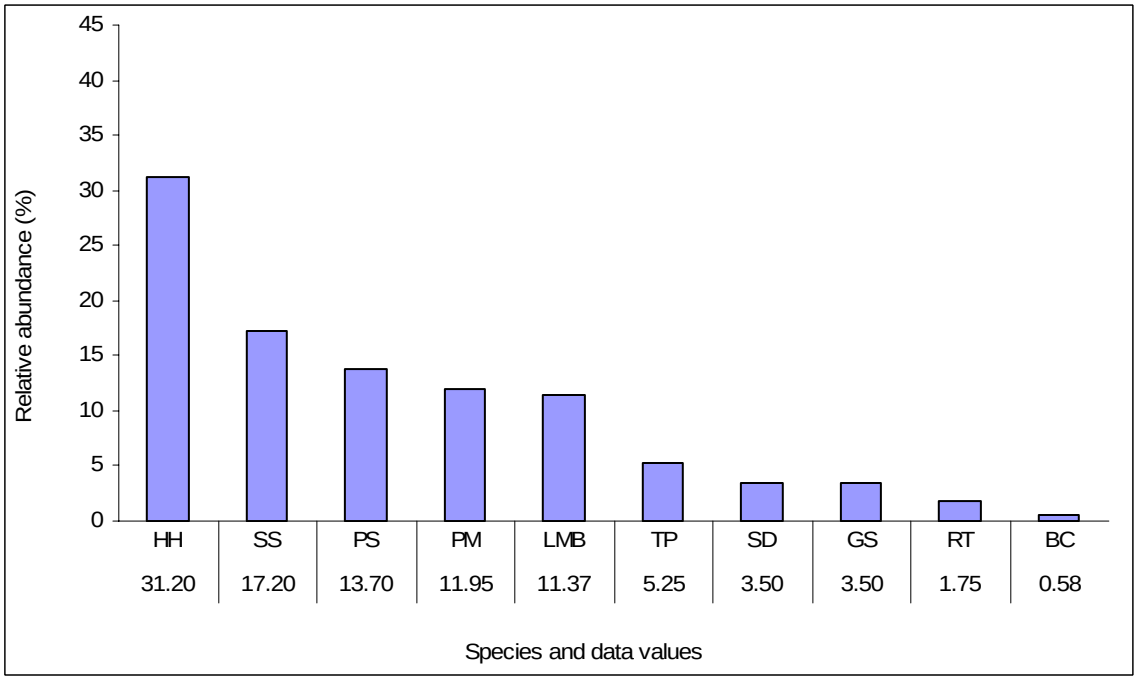

Figure 7 Relative abundance (%) of all fish collected in the Canyon section of the Pit River (PR-7 through PR-12).

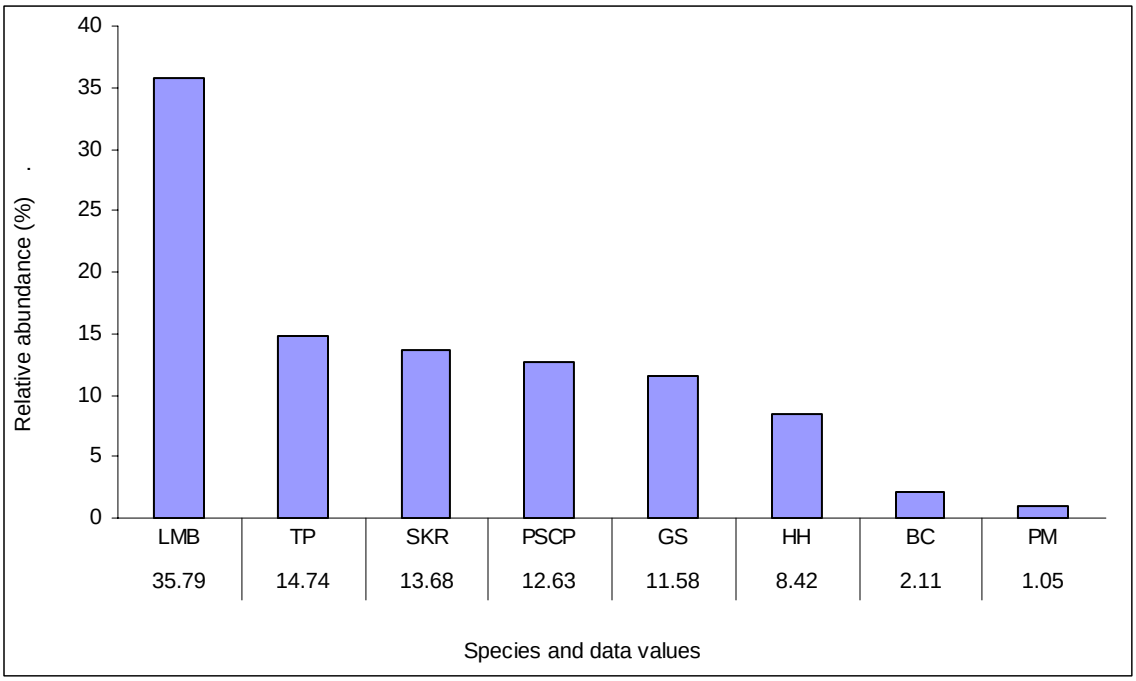

Figure 8 Relative abundance (%) of all fish species collected in the Upper Canyon section of the Pit River (PR-7 through PR-9).

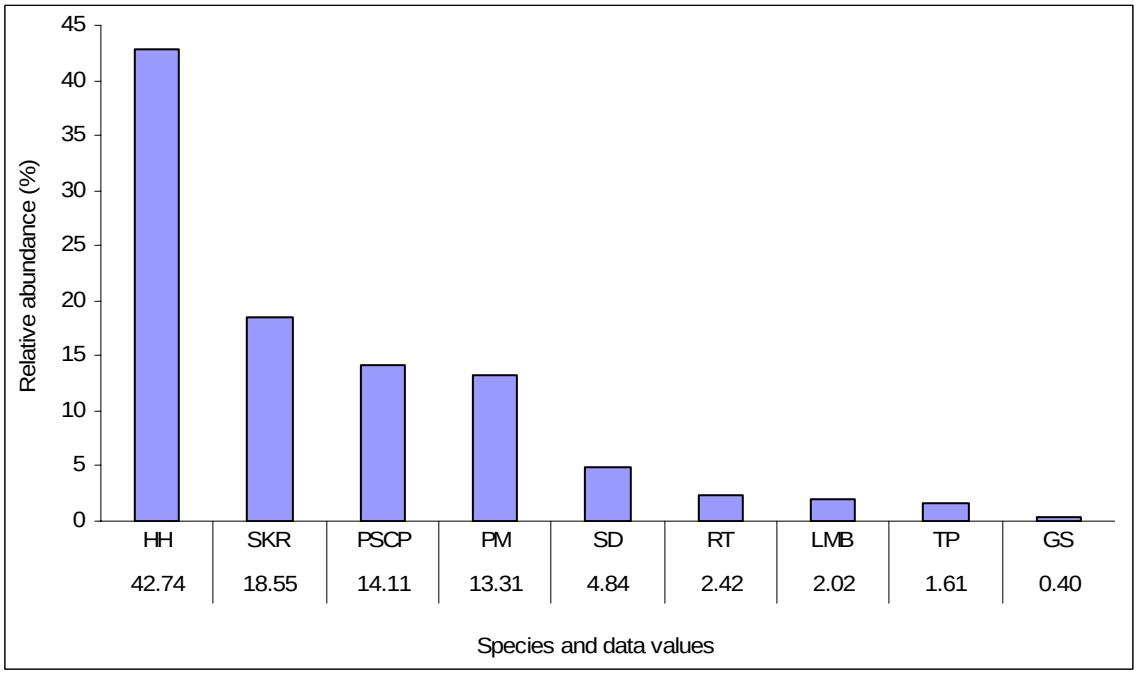

Figure 9 Relative abundance (%) of all fish species collected in the Lower Canyon section of the Pit River (PR-10 through PR-12).

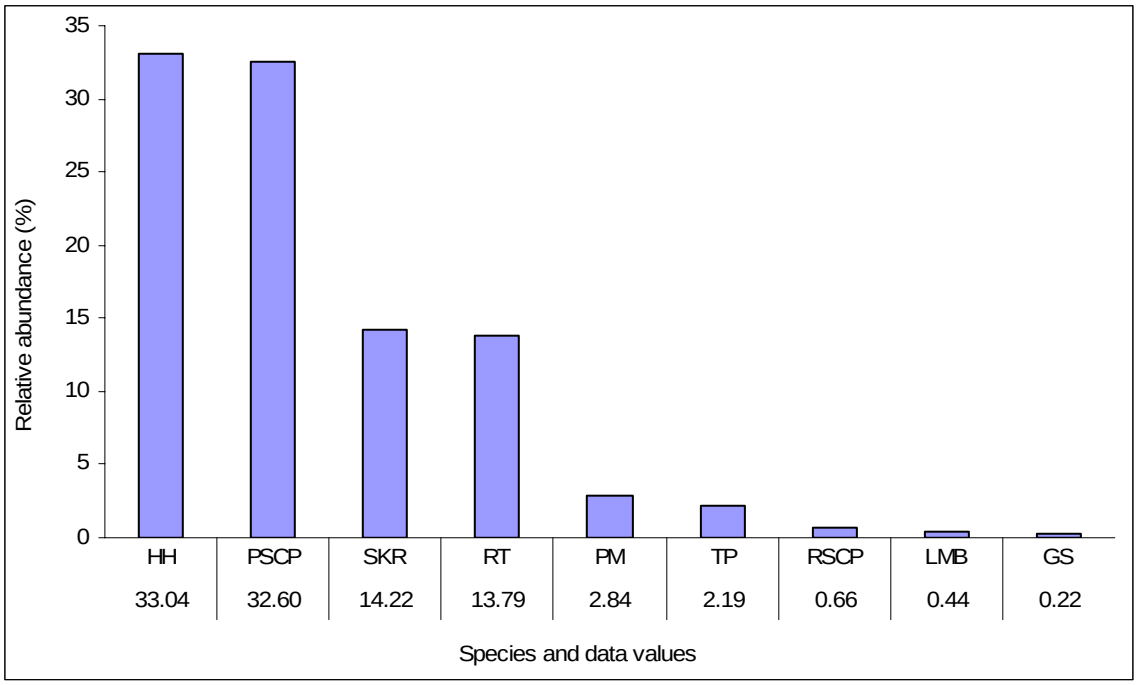

Figure 10 Relative abundance (%) of all fish species collected below the Pit 1 Powerhouse (PR-13 through PR-16).

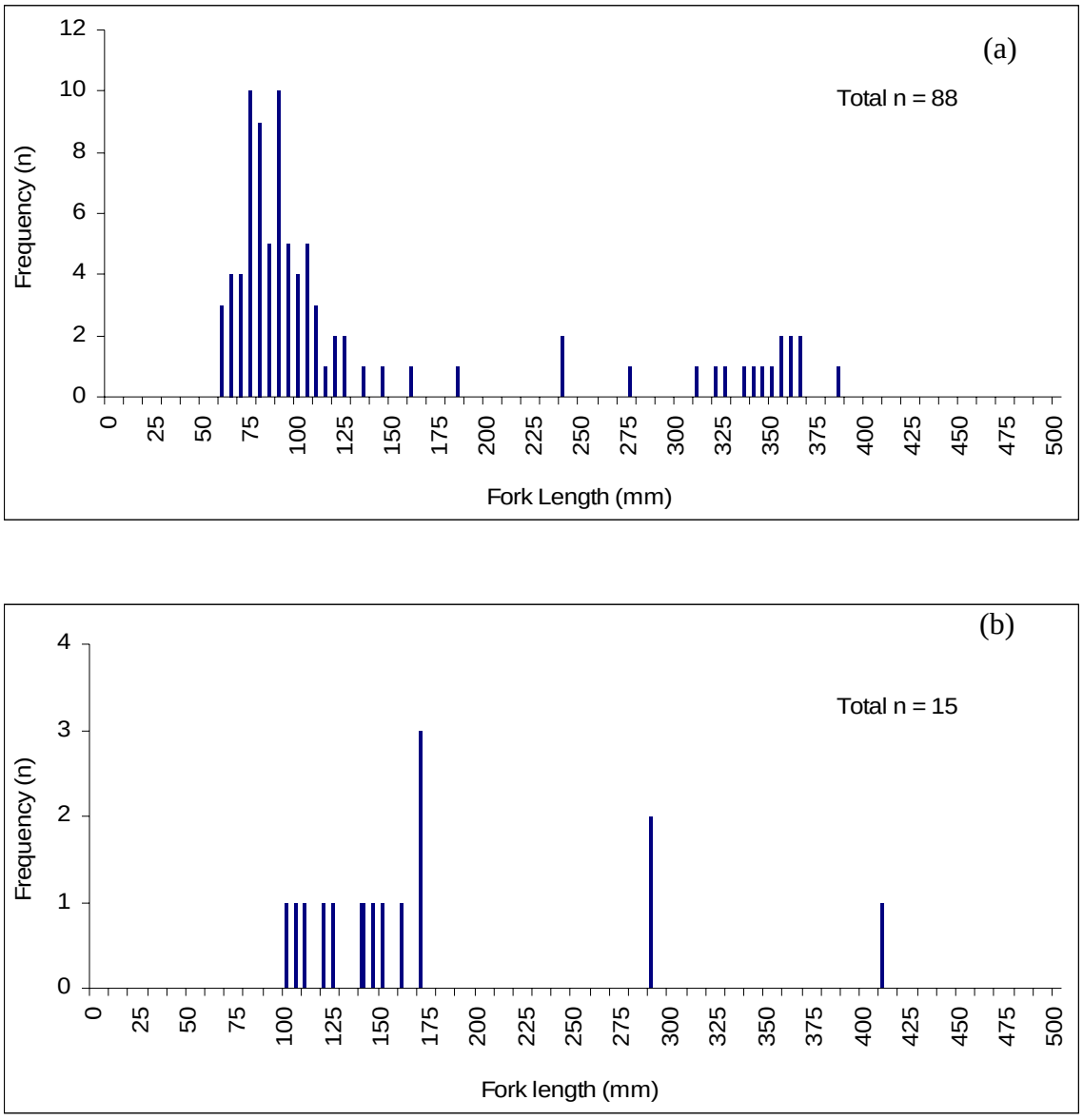

Figure 11 Length-frequency distributions for (a) largemouth bass and (b) rainbow trout collected and measured in the Fall River Stations FRP-1 through FRP-3 and FR-1 during September 2006.

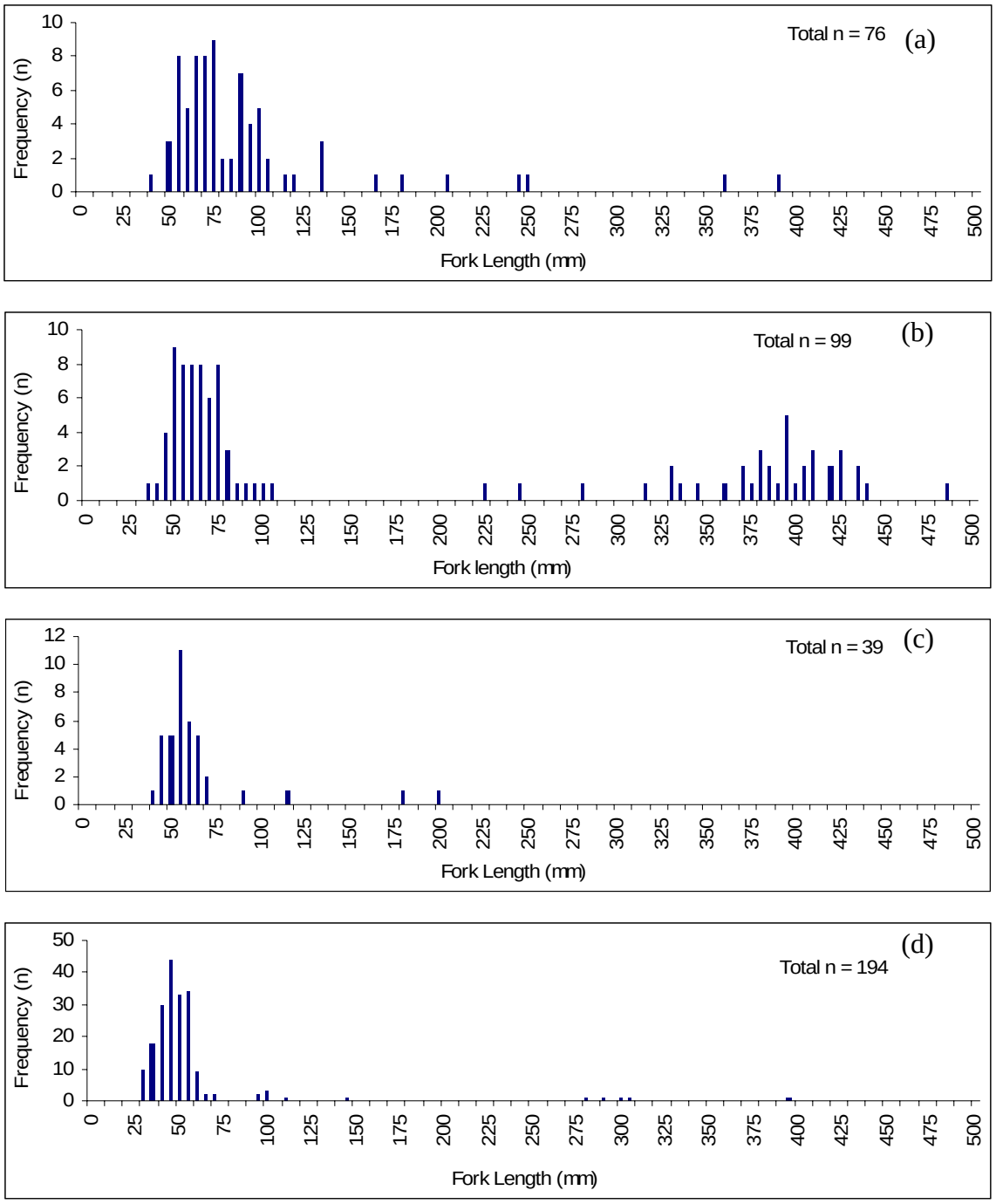

Figure 12 Length-frequency distributions for (a) largemouth bass, (b) Sacramento sucker, (c) Sacramento pikeminnow, (d) hardhead, (e) Pit sculpin, (f) tule perch, (g) rainbow trout, and (h) speckled dace collected and measured in the Pit River at Stations PR 1 through PR 16 during September 2006.

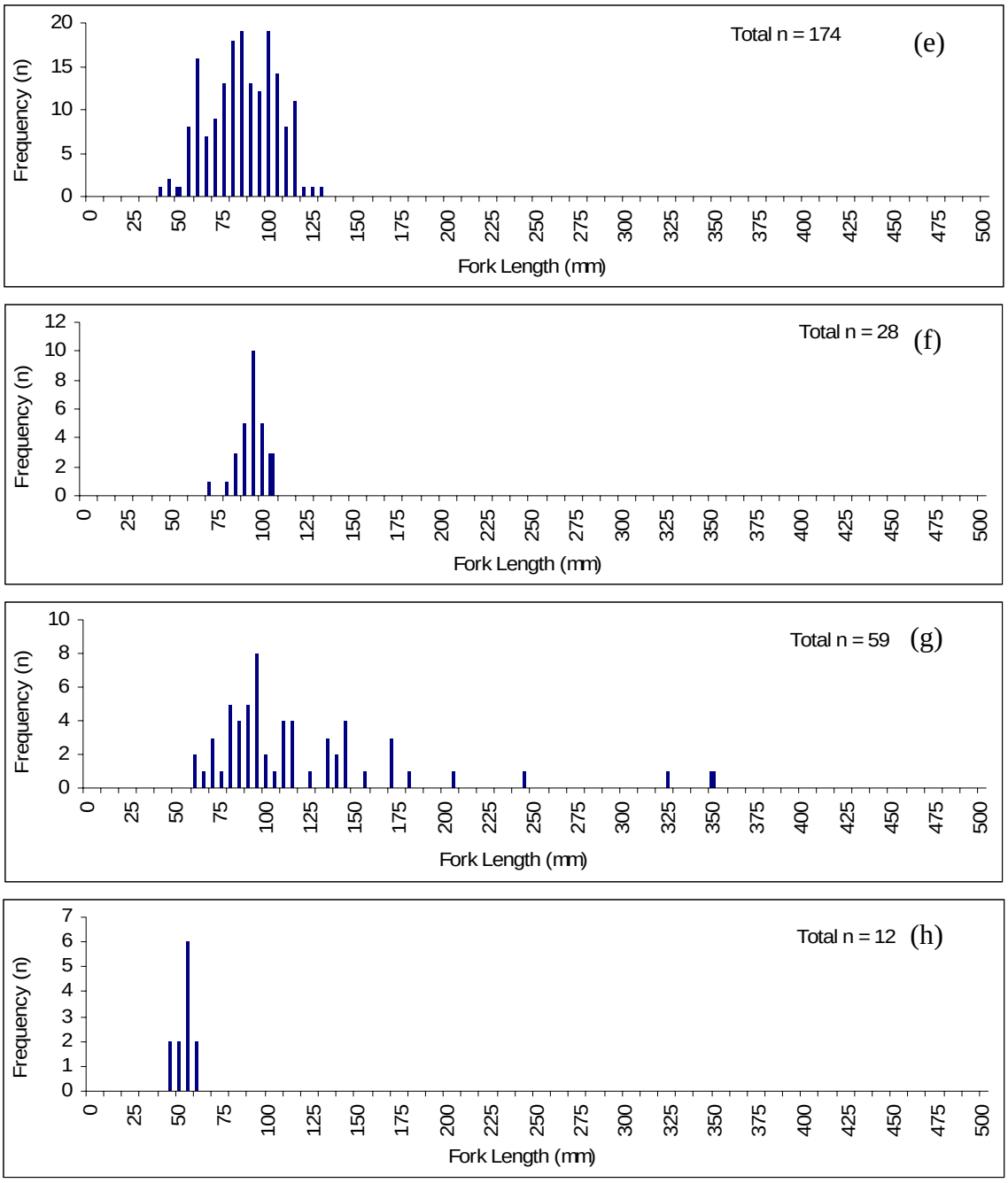

Figure 12 (continued) Length-frequency distributions for (a) largemouth bass, (b) Sacramento sucker, (c) Sacramento pikeminnow, (d) hardhead, (e) Pit sculpin, (f) tule perch, (g) rainbow trout, and (h) speckled dace collected and measured in the Pit River at Stations PR 1 through PR 16 during September 2006.