# Habitat Selection, Behavioral Movement, and Fate of Adult Rainbow trout within the Kings River Downstream of Pine Flat Dam

*Summary Report*

**Kings River Fisheries Management Program**

Kings River Fisheries Management Program
June 2012

# Table of Contents

## Executive Summary

Construction of the Pine Flat Dam in eastern Fresno County was completed in 1954 by the United States Army Corps of Engineers (A.C.O.E.). The dam was built to control floodwaters, store irrigation water for local farmers, and surface water for nearby municipalities. The tailwater fishery was created downstream of the dam following its construction. California Department of Fish and Game (CDFG) stocking practices contributed to the development of the fishery into a prime rainbow trout *Oncorhynchus mykiss* fishery prized by many anglers.

In 1984, the Kings River Conservation District (KRCD) and the A.C.O.E. completed construction of the Jeff L. Taylor Power Plant, a 165-megawatt hydroelectric power plant located at the base of the Pine Flat Dam. Annual fish population surveys conducted as part of the Federal Energy Regulatory Commission license agreement indicated that the density of wild trout was greater than 400 trout per river mile in the early 1980's (KRCD, 1995). Since that time, the abundance of wild trout has steadily declined (KRCD, 2011). The most recent estimated abundance of wild trout was just 35 trout per mile (KRCD, 2012).

In 1991, a group of local fisherman and sportsman's groups filed a formal complaint against the KRCD, the Kings River Water Association (KRWA), and the CDFG with the State Water Resources Control Board for mismanaging the resources below the dam (Lower Kings River Committee, 1991). The complaint maintained that the minimum release of 50 cubic feet per second (cfs) was harming the fishery. As a result of the complaint, the King River Fisheries Management Program (KRFMP) was established in 1999 with the signing of the Framework Agreement by the CDFG, the KRWA, and the KRCD.

The goals of the KRFMP vary according to the particular management zone. In the Put and Take zone, the emphasis is an "All-year high yield trout fishery" while in the Catch and Release zone, the emphasis is on an "All-year premium-quality trout fishery" (KRFMP, 1999). In an effort to achieve these goals, the KRFMP has implemented a number of habitat enhancement projects and studies. Beginning in the fall of 2005, the KRFMP initiated a three year study of the rainbow trout habits within the tailwater fishery. This report summarizes the

research conducted by the KRFMP on the residence time, habitat selection, movement, and harvest of rainbow trout in the Kings River below Pine Flat Dam.

Each of the six reports is individually summarized in the following document however; the following list is a highlight of the most relevant findings from each analysis:

**Telemetry Equipment**

- Radio transmitters were selected over acoustic transmitters because they offered superior range, superior battery life, could function in water with low salinity, and did not require minimum depth.
- The model SRX-400 receivers were equipped with a DB-9 Serial Port that restricted data transfer rates and the limited memory capacity often resulted in lost data. Data download was required on a daily basis.
- The model SRX-600 offered greater memory capacity and a USB Port for data transfer. This eliminated data loss due to full memory banks.

**Transmitter Implant Surgeries**

- Overall post-surgery mortality rate was 7.6% (26 of 343).
- No significant difference was found in the mortality rates based on transmitter type (Active v. Dummy) or among size classes (small v. large).
- 259 trout were successfully released into the Kings River over the course of three years.
- Our control group experienced a 13% transmitter expulsion rate (8 of 60).

**Residence Time**

- Mean residence time range from 29 days to 142 days for the study group
- Mean residence time for small trout ranged from 15 days to 102 days.
- Mean residence time for large trout ranged from 44 days to 195 days.
- Residence time within the Catch and Release zone was significantly greater than the residence time within the Put and Take zone.
- Residence time also varied significantly by release location and timing.
- Large trout had a significantly longer median residence time than small trout.

**Habitat Selection**

- Habitat use varied from strong avoidance to strong preference depending on the habitat type, trout size-class, and flow.
- Boulder projects were avoided at low flow.

- Approximately half of the study population chose a single habitat type and location for the duration of their residency while the other half chose multiple habitat types and locations

**Movement**

- Our study population contained both sedentary and mobile trout.
- Distances travelled ranged from 0 meters to 30,195 meters in all directions.
- Movement was not significantly affected by trout size-class, water temperature, or flow.

**Harvest**

- 59% of the harvested trout from our study population was classified as large.
- 41% of the harvested trout from our study population was classified as small.
- Average residence time for a trout harvested by an angler was 54 days.
- The majority of the trout harvested were caught from the Put and Take zone during periods when flows were less than 500cfs.

## References

Kings River Fisheries Management Program (KRFMP). 1999. Kings River Fisheries Management Program Framework Agreement. Unpublished.

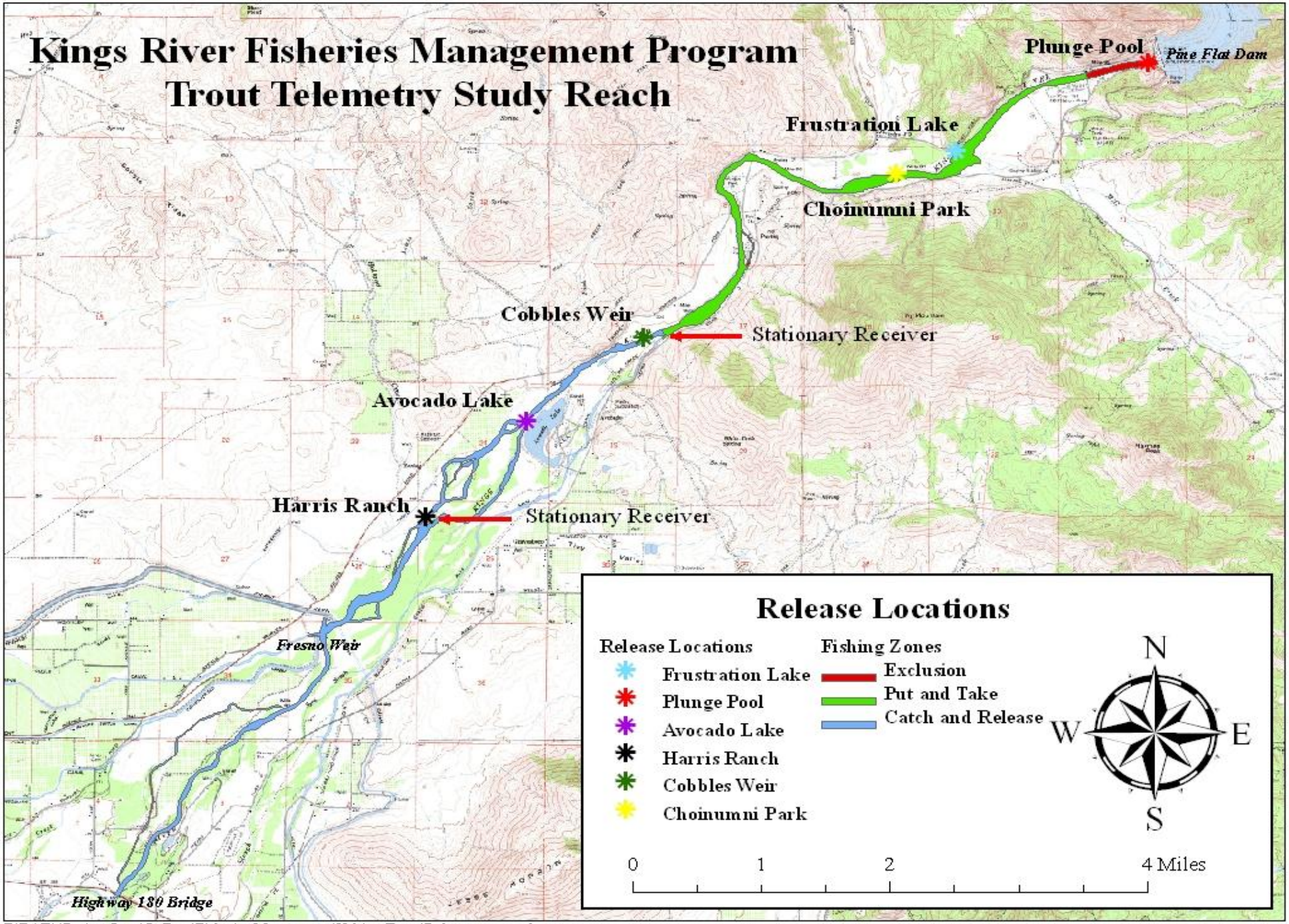
Kings River Conservation District (KRCD) – Environmental Division. 1995. Creel Survey of the Kings River Downstream of Pine Flat Dam (Fresno County, California) 1990 – 1995. Unpublished.

Kings River Conservation District (KRCD). 2011. Lower Kings River annual trout and non-game fish population Survey: 2010 electrofishing results. Unpublished.

Kings River Conservation District (KRCD). 2012. Lower Kings River annual trout and non-game fish population Survey: 2010 electrofishing results. Unpublished.

## Study Area

The tailwater fishery created by the Pine Flat Dam is approximately 20km long. Two regulatory management zones and an "Exclusion" zone exist between the dam and the Highway 180 Bridge (Figure 1). The Exclusion zone is located between Pine Flat Dam and the Army Corps of Engineers (ACOE) Bridge and is approximately 0.8km long. Prior to the fall of 2001, public access was available in this section of the river. The Department of Homeland Security restricted access to this reach following the attacks on the World Trade Center on September 11, 2001. The Put and Take zone, located between the Army Corps of Engineers Bridge and the Cobbles Weir, is approximately 8km long, and the Catch and Release zone, located between Cobbles Weir and the Highway 180 Bridge, is approximately 11km long (Figure 1).




Z:\DATA\Project Specific Data\Fisheries Management\Habitat Types\Release map.mxd

**Figure 1: Tailwater fishery created by the Pine Flat Dam in eastern Fresno County. Two regulatory management zones and an Exclusion zone are present in the study reach of the Kings River; Exclusion (red), Put & Take (green), and Catch & Release (blue). The asterisks represent release locations used in this study.**

# Telemetry Equipment: Selection and performance of telemetry equipment used in the study of rainbow trout behavior in the Kings River below Pine Flat Dam

***Purpose:*** The Kings River Fisheries Monitoring Program (FMP) implemented a radio telemetry study in two phases. The first phase evaluated the techniques and equipment needed for a telemetry study of rainbow trout movements in the lower Kings River. This helped to establish protocols and the experimental design required for the second phase of the telemetry study designed to quantify movement patterns of rainbow trout and residency in response to angler pressure and varying instream flow and thermal conditions.

***Methods:*** We selected radio transmitters over acoustic transmitters because they offered superior range (up to ½ mile), superior battery life (initially 170 days for small tags and 685 days for large tags), could function in water with low salinity, and did not require a minimum depth.

Transmitters were selected for two size classes of trout equating to a catchable class (0.5 to 2.0 pounds), and a trophy class (> 2.0 pounds). The NTC-6-2 Nanotag Radio Fish Transmitters (small transmitters) were used for the catchable class and initially offered a battery life of 170 days. The MCFT-3A Microprocessor Coded Radio Fish Transmitters (large transmitters) were used for the trophy class and initially offered a battery life of 685 days. Over the course of the study, transmitter battery technology improved, offering longer battery life. The NTC-6-2 offered infrared activation, 5-sec burst rate, and weighed 16.0 grams. NTC-6-2 Dummy Transmitters and MCFT-3A Dummy Transmitters were used in the control fish. Dummy transmitters were similar in weight and size to the active transmitters but were not equipped with the transmitter technology.

Two stationary monitoring positions were established to monitor movement of study fish 24 hours per day. Stationary units were housed in an Environmental Enclosure to protect the equipment from the elements. An SRX-400 Datalogging Coded Series Receiver (later upgraded to the SRX-600) and an ASP-8 automatic antenna switchbox were located at each stationary

receiver location. Power was supplied by a 12 volt deep-cycle automotive battery. Solar panels were used to keep the batteries charged. Two Yagi antennas were positioned to monitor upstream and downstream of the stationary receiver location.

An SRX-600 radio receiver equipped with a GPS receiver was used for mobile tracking. A hand-held Yagi antenna offered directional relocation when tracking on foot and an omnidirectional whip antenna was used when tracking from a vehicle. Two Outcast Pac 800 Inflatable Pontoon Boats were used to float the entire study area in a single afternoon. An omnidirectional whip antenna was mounted to the boat frame and connected to a SRX-600 receiver. The receiver's GPS antenna was also mounted to the boat frame.

***Results:*** Only one of the 280 activated transmitters failed after activation. This was consistent with the 0.3% tag failure rate the Lotek Company estimated based on customer reports. Some issues were experienced with the SRX-400 receivers that resulted in the loss of data. The issues stemmed from the limited memory capacity and DB-9 Serial Port that restricted data transfer rates. The SRX-400s were eventually upgraded to the SRX-600 which eliminated the memory capacity and data transfer rate issues.

Over the 36 month study period (October 2005 – October 2008), a total of 10,207,656 data points were collected by stationary receivers. Scientific Aides tracking on foot collected an additional 4,358 data points. Lastly, 944 general location data points were collected while float tracking.

***Conclusion:*** Changes were made to the data collection techniques to improve data collection efficiency and reliability. Replacing the SRX-400 receivers with SRX-600 receivers at each of the stationary sites eliminated data loss due to limited memory capacity. The SRX-600 performed well under various climatic conditions including hot summer days and cold, rainy, winter days, though weather proofing was required. The SRX-600 receivers were not available in a waterproof format at the time of this study. They have since been improved by the manufacturer to include waterproofing.

At the onset of tracking by boat, the receivers were mounted in the saddle bags, which offered no submersion protection. The receivers were later mounted in Pelican™ waterproof cases that were

mounted to each pontoon boat to provide some measure of protection for the receivers. The cases were modified by installing BNC and SMA bulk-head fittings. This allowed both the omnidirectional antenna and the GPS antenna to be connected to the receiver while maintaining the waterproof qualities of the case.

Transmitters used in this study were programmed with a 5-sec burst rate. Signal overlap was common when transmitters were within close proximity of each other. This often caused false detections or error codes unless IDs were filtered. The ID filter feature, standard on the SRX receivers, allowed for the effective relocation of study fish along the river corridor. Overall, the equipment performed well. We encountered very few equipment related problems and those that were encountered were quickly corrected so as not to hinder the project.

***Project Report:*** Kings River Fisheries Management Program. 2009. Telemetry Equipment: Selection and performance of telemetry equipment used in the Study of rainbow trout behavior in the Kings River below Pine Flat Dam.

# Transmitter Implant Surgeries: Analysis of the transmitter implant procedure used in the study of rainbow trout behavior in the Kings River below Pine Flat Dam

***Purpose:*** The purpose of this report was to summarize the effectiveness of the radio transmitter implant surgeries performed as part of the trout tracking study conducted on the Kings River between October 2005 and July 2008.

***Methods:*** Rainbow trout were anesthetized using methods similar to those described by Anderson et al (1997). Trout were placed in an anesthetic bath until a lack of response to touch was achieved. Weight (g), and fork length (mm) were recorded. Trout were then placed in a "V" shaped trough, ventral side up. The gills were aerated using a maintenance solution fed from elevated buckets through 1/4 inch plastic tubing. An incision was made posterior to the pelvic girdle, anterior to the vent, and ventral to the lateral line along the right side of the body. A large bore IV needle and catheter were passed through the body wall in a rearward direction. The IV needle was removed leaving the catheter in place. The transmitter antenna was passed through the catheter prior to insertion of the transmitter. The catheter was removed and the incision was sutured closed.

Trout were then placed in a recovery bath of fresh water until able to swim unassisted. They were then released into a holding tank for post-surgery observation. After a minimum of two weeks holding time, the study trout were released into the river for observation. This occurred seven times throughout the course of the study.

***Results:*** 343 implant surgeries were performed (279 active transmitters, 64 dummy transmitters). 2% died from acute complications brought on by the surgery. 8.3% (5 of 60) of the control group died within the 21-day post-surgery observation period. 5.1% of the study group (14 of 276) died within the 21 day observation period. No significant difference in mortality rate was found among size-classes or transmitter types.

A transmitter expulsion rate of 13% was observed in the control group. This was similar to findings in other studies.

***Conclusion:*** The overall mortality rate for trout having undergone the transmitter implant surgery procedure was 7.6%. While zero mortality was preferred, the observed mortality rate was acceptable to the KRFMP. Expulsion rates were similar to those observed in other studies. The KRFMP considers the transmitter implant procedure a success.

***Project Report:*** Kings River Fisheries Management Program. 2009. Transmitter Implant Surgeries: Analysis of the transmitter implant procedure used in the study of rainbow trout behavior in the Kings River Below Pine Flat Dam.

## References

Anderson, W. Gary, R.S. McKinley, and M. Colavecchia. 1997. The use of Clove Oil as an anesthetic for Rainbow trout and its effects on swimming performance. North American journal of Fisheries Management 17:301-307.

# Residence Time of Rainbow Trout: The effects of management zones, release location, release timing, and size-class on the residency of rainbow trout within the Kings River downstream of the Pine Flat Dam.

***Purpose:*** The purpose of this study was to determine the effects of the two river zones, release location, release timing, and size-class on the duration of residency of rainbow trout in the Kings River below Pine Flat Dam.

***Methods:*** Groups of approximately 40 trout (20 small, 20 large) were released at locations stratified across two regulatory management zones. Releases corresponded with seasonal changes in stream flow conditions. A total of seven releases were made over three years. The final disposition of the study trout was categorized into one of five categories; Caught Out, Recovered Transmitter, Missing Transmitter, Survived Beyond Life of Transmitter, or Dead (with carcass). Total residence time was used for descriptive statistics however, the first 170 days of residence was statistically analyzed. This was the amount of time that the small transmitter batteries were guaranteed for.

***Results:*** The mean residence time varied by groups and ranged from 29 days to 142 days. For small trout, residence time ranged from 15 days to 102 days while the mean residence time for large trout ranged from 44 days to 195 days. The maximum residence time was 325 days for small trout and 438 days for large trout.

At 30 days, approximately 30% of the study population had been removed from the river. At 90 days, approximately 58% of the study population had been removed, and at 180 days approximately 84% of the population had been removed. Only 16% survived beyond six months and only 3% survived beyond one year.

Management zone had a significant effect on residence time as did size-class. Trout survived longer in the Catch and Release zone than in the Put and Take zone. Large trout survived longer within each management zone. Release location also had a significant effect on trout residency as did release timing.

***Conclusion:*** Despite finding significant differences in survival rates among river zones, release locations, release timing, and size-classes, residence time is still relatively low. While differences in median residence times among management zones were statistically significant yet small (9 days), differences among 3rd quartiles were more likely to be biologically significant (40 days) with residence time in the Catch and Release zone greater than that in the Put and Take zone. Trout released at the Harris Ranch site (Catch and Release zone) persisted significantly longer than trout released elsewhere. Residence time also varied significantly among release groups. In general, trout survived longer when released immediately before or during a high flow period.

***Project Report:*** Kings River Fisheries Management Program. 2011. Residence Time of Rainbow Trout: The effects of management zones, release location, release timing, and size-class on the residency of rainbow trout within the Kings River downstream of the Pine Flat Dam.

## Habitat Selection: The effects of flow and size-class on habitat use by rainbow trout within the Kings River downstream of the Pine Flat Dam.

***Purpose:*** The purpose of this study was to quantify the proportion of available habitat at various flow rates, determine the proportion of use of the available habitat, the effects of flow on the proportion of habitat use, and the effects of size-class on the proportion of use of the available habitat.

***Methods:*** For the purposes of this study, three flow regimes were chosen. The 100 - 249 cubic feet per second (cfs) representing minimum flows, 250 - 999cfs representing low-level demand flows, and 1,000cfs or greater representing irrigation demand flows. Habitat availability and utilization by rainbow trout was assessed for each of these flow ranges. Polygons of the wetted width of the Kings River were drawn for each of the management zones (Put & Take, Catch & Release) using ESRI® ArcMap™ 9.3 software. This process was repeated for each of the three stated flow regimes. Hi-resolution aerial photographs of the Kings River at each of the chosen discharge rates were used to delineate habitat types and to determine total surface area of available habitat. Habitat use and site fidelity were calculated for each of these discharge rates. Total wetted surface area in hectares was quantified. Habitat types within each management zone were delineated and the habitat polygons were used to determine total available habitat by type as a percentage of the total wetted area.

Habitat types were categorized as pool, riffle, run, boulder project, Weir (including the skirt and rip rap), and side channels. Relocation data corresponding with each of the three flow regimes was overlaid on the habitat maps to determine habitat usage. Relocations within specific habitat types were enumerated and usage was calculated as percent of total observations. Site fidelity was calculated for each size-class and flow regime as well. Site fidelity was exhibited if a study fish selected for a single habitat type and location (i.e. pool 1) for the duration of its residency within the river. To account for transition zones, a distance of 10 meters was set as the minimum travel distance for selection of an alternate habitat type.

**Table 1: - Comparison of available habitat types by flow within the Kings River below Pine Flat Dam.**

**Proportion of Available Habitat**

| Flow | Pool | Run | Riffle | Boulder Project | Glide | Weir | Side Channel |
|---|---|---|---|---|---|---|---|
| **100 - 249** | 16.0% | 20.5% | 5.2% | 17.5% | 36.1% | 0.2% | 4.5% |
| **250 - 999** | 13.6% | 37.3% | 4.9% | 8.6% | 30.1% | 0.2% | 5.3% |
| **> 1,000** | 11.9% | 47.3% | 0.8% | 8.8% | 22.9% | 0.1% | 8.2% |

**Results:** The proportion of habitat varied with each flow regime (Table 1). In the 100cfs – 249cfs range, trout exhibited a strong preference for riffles and weirs and a strong avoidance of boulder projects and side channels. Use varied within the two management zones and size classes as well. In the 250cfs – 999cfs range, trout exhibited a strong avoidance of side channels and weirs. In the 1,000cfs and greater range, trout exhibited a strong preference for weirs and a moderate preference for riffles and glides. They also exhibited a moderate avoidance of runs and a strong avoidance of side channels.

Sixty-two percent (23) of the thirty-seven trout tracked (20 small, 17 large) at low flow exhibited site fidelity. Among those, thirteen were small trout and ten were large trout representing 65% and 59% of their respective populations. Fifty-two percent (50) of the ninety-six trout (40 small, 56 large) chose only a single habitat site at intermediate flow. Twenty-five of those were small trout and 25 were large trout representing 63% and 45% of their respective populations. Lastly, fifty percent (68) of the one hundred and thirty-nine trout (64 small, 72 large) tracked at high flow exhibited site fidelity. Thirty-five of those were small trout and 31 were large trout representing 55% and 43% of their respective populations.

***Conclusion:*** Pool habitat decreased by 4% as flow increased to the average summer flows. Conversely, run habitat increased by over 27% under the same conditions. In general, use of pool habitat was proportional to its availability across all flows. Boulder projects constructed by the KRFMP were strongly avoided at low flow but used in proportion to their availability at the intermediate and high flow levels.

Approximately half of our study population was sedentary, exhibiting site fidelity, while the other half was mobile, choosing multiple habitat types and locations.

***Project Report:*** Kings River Fisheries Management Program. 2011. Habitat Selection: the effects of flow and size-class on habitat use by rainbow trout within the Kings River downstream of the Pine Flat Dam.

# Movement of Resident Rainbow Trout: Movement in response to temperature, flow, management zone, and weirs in the Kings River below Pine Flat Dam.

***Purpose:*** The purpose of this study was to determine the effects of size-class, flow, water temperature, and management zone on movement of rainbow trout within the tailwater fishery.

***Methods:*** Groups of approximately 40 trout (20 small, 20 large) implanted with radio transmitters were released at locations stratified across two regulatory management zones. Releases corresponded with seasonal changes in stream flow conditions. A total of seven releases were made over three years. Trout were relocated approximately twice in each seven day period. Once located, a bearing was recorded along the transect perpendicular to the trout's position. Upstream and downstream bearings were recorded when possible. Location of the seasonal observer was automatically recorded via the GPS receiver integrated in the radio receiver. These data were used to determine the exact location of the trout within the river using a trigonometric function.

A point location map was produced using ESRI® ArcMap™ 9.3 software by placing the layer of point observations over a scaled base map as a feature class. The attribute table was referenced to identify and isolate individual trout and the (ArcMap) measuring tool was used to measure the distance in meters moved between points. The first measurement taken for each trout was the distance moved away from its stocking point, with each successive movement measured independently. Movements less than 10 meters up or down stream were considered negligible and were excluded from the statistical data. The dates, distances and direction (Longitudinal: upstream/downstream or Lateral: instream/outstream) moved for each individual fish were retrieved from the table and documented accordingly. By isolating the individual locations of study trout we were also able to identify which trout crossed upstream over weirs and on which dates.

***Results:*** Trout often swam in both up and downstream directions with many changing position laterally within the river. The mean upstream distance moved was 291 meters and the mean downstream distance moved was 360 meters. Total distance travelled ranged from 0 meters to

30,195 meters. Only 69% of the study group moved 10 meters or more from the release point. The mean dispersal time for movement greater than 10 meters from release point was 10 days. Water temperature, size-class, flow, and management zone did not have a significant effect on the movement of trout within the tailwater fishery.

Three of the five weirs were confirmed to be passable by trout during the study. Twenty-one trout were documented crossing weirs in an upstream direction at least once during the study. No trout were document crossing Fresno or Gould weirs in an upstream direction.

***Conclusion:*** In analyzing the significance of the tested variables we have found that mature rainbow trout are not being forced from the study area by increased seasonal flow. This study failed to isolate a significant causation for trout movement however, the null hypotheses that flow, water temperature, size-class, and management zones are having no significant impact on trout movement within the tailwater fishery has been confirmed.

***Project Report:*** Kings River Fisheries Management Program. 2012. Movement of Resident Rainbow Trout: Movement in response to temperature, flow, management zone, and weirs in the Kings River below Pine Flat Dam.

# Harvest of Rainbow Trout: The effects of time, flow, size-class, planting location, and management zone on trout harvest in the Kings River below Pine Flat Dam.

***Purpose:*** The purpose of this study was to determine the duration the effects of flow, size-class, planting location, and management zone on trout harvest rates. We also examined reasons why anglers may neglect to report catching radio-tagged trout.

***Methods:*** Two hundred and fifty-nine rainbow trout were implanted with radio transmitters and released into the Kings River for study. Each transmitter was marked with a notice of a $25 reward program for returning the transmitter to the Kings River Conservation District office. In addition, signs were placed in public access areas to make anglers aware of the study. Anglers who returned transmitter tags were asked to fill out a short form which solicited their name, date, angling location and the trout's tag number. This data was used in conjunction with telemetry data to determine the residence time of each trout caught during the study.

***Results:*** Of the 259 trout tagged and released into the Kings River, 27% (69) were harvested by anglers. The mean residence time for harvested trout was 54 days. When trout were released in the Catch and Release zone, mean residence time was 83 days. Mean residence time decreased to 49 days when trout were released in the Put and Take zone (Table 1).

Most of the harvest (51%) occurred when flows were below 500 cubic feet per second. A large

**Table 1: - Residence time of harvested rainbow trout (*Irrigation Demand)**

| | | | Residence Time of Harvested Trout (Days) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Small | | | Large | | | Total | | |
| Release | ID* | % Harvest | Min | Max | Mean | Min | Max | Mean | Min | Max | Mean |
| 1 | ENID | 26% | N/A | N/A | N/A | 13 | 178 | 60 | 13 | 178 | 60 |
| 2 | LNID | 18% | 97 | 325 | 167 | 5 | 156 | 81 | 5 | 325 | 412 |
| 3 | ID | 14% | 39 | 52 | 46 | 33 | 252 | 141 | 33 | 252 | 103 |
| 4 | ENID | 34% | 1 | 105 | 42 | 24 | 164 | 85 | 1 | 164 | 68 |
| 5 | LNID | 33% | 1 | 13 | 4 | 3 | 45 | 21 | 1 | 45 | 11 |
| 6 | ID | 32% | 5 | 45 | 23 | 7 | 40 | 22 | 5 | 45 | 22 |
| 7 | LNID | 30% | 1 | 51 | 11 | 14 | 191 | 55 | 1 | 191 | 35 |

| Management Zone | Min | Max | Mean | Min | Max | Mean | Min | Max | Mean |
|---|---|---|---|---|---|---|---|---|---|
| Put & Take | 0 | 325 | 37 | 3 | 252 | 61 | 0 | 325 | 49 |
| Catch & Release | 105 | 181 | 143 | 13 | 164 | 63 | 13 | 181 | 83 |

number of transmitters (82) were classified as missing. Their final disposition is unknown. If these were to have been harvested and not reported, the overall harvest rate would have been 58%.

***Conclusion:*** Trout, particularly large trout, planted in highly accessible areas during low flows are the most likely to be harvested. Due to the return of transmitters from trout harvested from the Catch and Release zone, we can confirm that poaching contributes to the number of trout regularly harvested from the tailwater fishery.

***Project Report:*** Kings River Fisheries Management Program. 2012. Harvest of Rainbow Trout: The effects of time, flow, size-class, planting location, and management zone on trout harvest in the Kings River below Pine Flat Dam.