Auburn Ravine Video Monitoring Project
2016/2017 Season Report

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Abstract

The California Department of Fish and Wildlife conducted a video monitoring survey in Auburn Ravine from October 2016 through April 2017 in collaboration with Nevada Irrigation District, the City of Lincoln, and Friends of Auburn Ravine. This was the pilot year of video monitoring, focusing on data relative to native adult anadromous fish species composition, enumeration, and temporal distribution in Auburn Ravine. Focal anadromous species were Central Valley fall-run Chinook salmon (*Oncorhynchus tshawytscha*) and California Central Valley steelhead trout (*O. mykiss*). The video monitoring system was a useful method for estimating numbers of adult salmon and steelhead during the migration season. A total of 2,147 hours of video was recorded and reviewed providing 306 focal species observations, and of these, 99.9 percent were salmon.

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1.0 Introduction

Long term species abundance is of particular concern in the California Central Valley (CV), where many native fish species are in substantial decline compared to historical abundances due to a multitude of anthropomorphic changes to the environment. No fish species in the CV are more emblematic than the several native forms of salmonids (*Salmonidae*) that occur in the CV, many currently listed and protected by the Federal Endangered Species Act (ESA) or California Endangered Species Act (CESA). A tributary to the CV, Auburn Ravine is known to provide habitat for many fish species including CV salmonids: the Central Valley fall-run Chinook salmon (*Oncorhynchus tshawytscha*) and the California Central Valley steelhead trout (*O. mykiss*). Stream dwelling rainbow trout (*O. mykiss*) belong to the California Central Valley steelhead trout Evolutionarily Significant Unit (ESU) and occur in ample numbers in Auburn Ravine (Navicky 2008). The Central Valley fall-run Chinook salmon (fall-run salmon) is listed by both the ESA and CESA as a species of special concern, while the California Central Valley steelhead trout (steelhead) is listed as endangered by the ESA. Auburn Ravine is defined as essential fish habitat for fall-run salmon and critical habitat for steelhead trout (NMFS 2005).

There has been a growing interest in the value of small streams and their utility in supporting in-river life stages of naturally producing salmonids and their contribution toward the recovery in the Central Valley (Maslin et. al, 1998 and Titus 2003, 2013). Information on salmonid spawner abundance is useful for documenting temporal population trends in Auburn Ravine specifically, but also provides opportunities for restoring and maintaining stream conditions, and to begin to develop a relationship of Auburn Ravine's contribution to the greater CV salmonid metapopulations (McEwan and Jackson 1996). Several studies have conveyed the utility of video equipment for gathering information on adult salmonid spawner migration timing (Hatch et al. 1994, Davies et al. 2007, McCormic et al. 2015) as well as emigration timing of juvenile and sub-adult salmonids (Irvine et al. 1991, Deacy et al. 2016). Video monitoring has much utility in that provides cost effective data, requires little materials, can be quickly installed, does not require state or federal sampling permits and electronically archived records that can be reviewed multiple times over any span of time. In addition, video monitoring stations are used to create passage and population estimates in other CV streams (Killam et al. 2016).

2.0 Goals and Objectives

The primary goal of the project in its first year was to find an easily accessible location in Auburn Ravine and install and utilize video equipment to document basin specific presence of CV fall-run Chinook salmon and CV steelhead trout occurrence.

The objectives of the Auburn Ravine Video Monitoring Project were to:

1. Install, operate and evaluate a video system to enumerate salmonid species;
2. Create a list of standard operating procedures for field staff and data gathering protocols for video reviewers;
3. Determine relative annual abundance of salmonids passing this monitoring location and describe spawner run timing;
4. Begin to evaluate temporal salmon status trends in Auburn Ravine with subsequent monitoring efforts.

3.0 Methods

The video monitoring station design and the equipment selected to be used by the Auburn Ravine Video Monitoring Project was replicated from methods described by Killam et al. 2016. Several Department staff from multiple offices located throughout northern California assisted with the video monitoring station concept design and construction. The site was approximately 400 meters (0.25 mile) downstream of Lincoln Boulevard (Old Highway 65) near the town of Lincoln, CA. The location was chosen primarily because studies conducted by the Department in the years of 2012, 2013 and 2014 reported salmon spawning occurring entirely above Lincoln Boulevard (Hoobler 2015). To reach these known spawning areas, a migrating adult salmonid would likely have to pass the video station location and therefore get counted.

3.1 Study Area

Auburn Ravine originates in the Sierra Nevada foothills at an elevation of 335 meters above sea level and is a tributary to the Sacramento River. The stream flows in a westerly direction for approximately 53 kilometers and is characterized as a low elevation stream. It receives natural input mostly in the form of rain, with little to no snow pack in most years. The headwaters of the stream begin near the town of Auburn, and the stream flows west through the cities of Ophir and Newcastle. In the lower portions of the watershed, the stream is confined between levees on its north and south banks to protect urban development around the town of Lincoln. All of these developed areas contribute urban runoff to the creek. Auburn Ravine also receives out-of-basin water transfers from the adjacent Bear, Yuba and American rivers for the purpose of consumptive water obligations. Waste water treatment plants in the towns of Auburn and Lincoln directly release treated water to the creek and contribute to flows. Water input and transfer has drastically changed Auburn Ravine's natural hydrograph, where flows in the lower portion of the watershed have become perennial rather than what was historically described as seasonal (Titus 2001).

The migration season for CV adult fall-run Chinook salmon is June through December, and July through March for CV steelhead trout (Yoshiyama et al. 1998). In the months of April through October, during the majority of CV adult fall-run Chinook salmon migration season and all of the CV adult steelhead trout migration, Auburn Ravine is used by water agencies to convey flows for consumptive use (Lawson & Mulloy 2012), and water delivery devices (flashboard dams) can entirely block adult passage (Jones & Stokes 2005). In low precipitation years, flows are typically not available to attract anadromous fish that occur in lower CV tributaries into Auburn Ravine unless consumptive use dissipates.

There is a diverse fish assemblage in Auburn Ravine; Department fish surveys from 2004 and 2005 identified 15 species, of which 7 were native varieties and the others nonnative (Navicky 2008). These surveys noted the dominant fish species in Auburn Ravine was *O. mykiss*, comprising approximately half of total observations, followed by Sacramento pikeminnow (*Ptychocheilus grandis*) and Sacramento sucker (*Catostomus occidentalis*).

Habitat in Auburn Ravine near the video monitoring station is similar to other CV low gradient streams. There is homogeneous canopy cover provided by riparian plants consisting mostly of interior live oak (*Quercus wislizenii*), western sycamore (*Plantanus racemosa*), white alder (*Alnus rhombifolia*), California black walnut (*Juglans californica*) and willow (*Salix sp.*). Stream side vegetation consists of small to medium shrubs, but no instream vegetation occurs near the sampling site. Upstream of the sampling site, there are numerous amounts of large and small coarse woody materials in the stream channel and along the stream banks. Stream gradient is less than one percent and stream substrate is composed of coarse grained soils, fine grained organic soils, and plant materials, with sand, gravel and cobble present but no natural boulders.

The advantages in selecting the video station location at Nevada Irrigation District's flow gaging station was the concrete weir required little modification to facilitate video equipment installation and it was already outfitted with an alternating current (AC) power source. The electronics running the stream flow gauge were housed in a streamside utility canister built from three foot diameter corrugated culvert pipe, which also acted as a housing for the video system (see Appendix for images). Stream flows were recorded throughout the sampling period, and flow records were later supplied for this report by Nevada Irrigation District. The standardized unit of measurement used to record flows at the gauge was cubic feet per second (cfs). The location also allowed for evaluation of the boulder type step-and-pool fishway constructed in 2011 immediately downstream of the monitoring station and its ability to facilitate fish passage.

3.2 Video Monitoring Materials

Three sheets of 1.27 centimeter (cm) thick vinyl "white plates" were set into 10.2 cm flat steel framing and attached to the bottom of the concrete weir using hammer bolts. The white plates and framing measured 1.5 meters (m) by 7.6 m and spanned the entire floor of the concrete weir. An overhead, 4.8 m high by 7.6 m wide, four by four inch square metal "A-frame" structure was constructed and mounted to the edges of the concrete weir walls. The A-frame spanned the creek channel perpendicularly, directly above the white plates. One "bullet" shaped, outdoor security camera was attached to middle of the A-frame and aimed downward toward the white vinyl plates. Two 90 watt outdoor flood lights were attached to the A-frame on either side of the security camera provided lighting for recording video at night. Outdoor floodlights were connected to a light sensor placed at the top of the A-frame. Lights would automatically turn on after 2 minutes in darkness and turn off after 2 minutes of light exposure. The square metal tubing of the A-frame protected 7.6 m of RG6 coaxial camera cable and light wiring that was fed to a metal pipe welded between the A-frame and the back of the utility canister.

Three bullet cameras were placed in water tight camera housings made from two inch PVC pipe, approximately eight inches in length and sealed at both ends with a clear lens in the front side for camera viewing and a coaxial port on the other side. These camera housings were then secured inside instream housings that were built to protect the cameras by withstanding variable stream discharge. The instream housings consisted of a heavy 20.3 cm by 30.5 cm railroad steel base and a 20.3 cm by 30.5 cm white plate angled over the top to streamline against flow. A 15.2 cm long by 1.27 cm diameter piece of steel rebar was welded to the railroad base in order to provide protection the camera's coaxial port joint. The three cameras inside their protective housings were attached and secured by heavy gage wire to the white plate. The cameras were spaced evenly on the upstream side of the white plate and positioned to view perpendicular to flow, with the two southern cameras pointed north, and the northern camera pointed south. The cameras were fed RG6 coaxial cable under the white plate through the base of the A-frame and back of the utility canister. Inside of the utility canister was a battery back-up power source, computer tower, computer monitor, 700 watt power inverter, and surge protector. Nevada Irrigation District's stream flow gauge equipment was also in the utility canister. The utility canister protected this electronic and monitoring equipment from inclement weather and was outfitted with a locking mechanism to prevent theft.

3.3 Station Maintenance

Nevada Irrigation District provided general maintenance of the area around the utility canister and for the stream flow gauge. Department staff video station maintenance occurred every Monday, Wednesday and Friday through the sampling season. Department staff typically needed to enter the stream to perform standard maintenance unless flows were too swift to safely do so. An onsite maintenance journal was stored in the utility canister so field staff could keep track of standard maintenance issues including the following: time and date of visit, cleaning white plates of algae and sediment, cleaning and repositioning of underwater camera housings, checking back-up battery status, checking video feed from all cameras, recording water height at the site and the initials of staff present during the site visit. A copy of the field sampling protocol containing trouble shooting instructions was stored on site in the utility canister (Appendix A).

Regular servicing mainly consisted of:

1. Sweeping the instream white plates of sand and silt and removing algae growth;
2. Removing woody material from within and around the concrete weir structure to protect underwater cameras and associated electrical cords;
3. Checking the status of overhead lighting and readjusting as needed;
4. Monitoring file sequence and ensuring video data was being recorded in a continuous fashion: 24 hours a day, 7 days a week, and in 5-minute intervals;
5. Monitoring external disc usage and swapping external discs as they became full of data and;
6. Providing hand written entries to the onsite maintenance journal.

3.4 Data Collection, Processing and Analysis

Digital video for each camera was gathered using the software titled "GeoVision" and stored as files on a three terabyte external hard drive. Video files from each camera were stored in five minute intervals, allowing up to 288 files in a 24-hour period for each of the four cameras. Each video file was named with the date and time the video was taken and stored on external discs in sequence. When an external hard disc was close to becoming full, it was swapped out for a blank external disc. External discs with video files were transported to an office location and back-up copies of video files were made on additional three terabyte external discs.

The back-up copies of video files were distributed to volunteers from Friends of Auburn Ravine to view and scan for fish. Observations made from the video files were recorded on a data sheet by reviewers, noting the date that fish passed through the monitoring area, time, approximate size of fish, and if possible, species and sex. Reviewers also noted the condition of imagery of the video files; indicating if the camera was recording normally, camera view was obstructed by turbidity or debris, or if there was equipment failure. Reviewers also evaluated water turbidity: easy-to-see conditions were recorded as "clear", intermediate turbidity conditions recorded as "murky", and heavy turbidity loads were recorded as "muddy". Finally, reviewers recorded the date video files were reviewed and the reviewer's name.

Fish were counted and identified using the one overhead camera and the three underwater cameras. The overhead view was used primarily to count fish, note direction of travel and location relative to the underwater cameras. The underwater cameras were used secondarily to confirm fish species, given that the fish was within range of the camera. If fish were not identifiable to species, they were noted as "unidentified fish" in the data sheets. Criteria for counting upstream movement was determined by salmonids swimming from the bottom of the screen, across the white plate, and continued swimming upstream out of the field of vision on the upstream side of the plates. The opposite was for downstream movement. Net upstream movement was determined by subtracting the total number of downstream movement from the total upstream movement.

Chinook salmon counts were recorded in one of two categories: as grilse being a one to two year old fish, or as adults being greater than two years old (Rutter 1904). The distinction of adults and grilse was made by size evaluation; if the salmon appeared to be less than 61 cm it was counted as grilse, or if greater than 61 cm it was counted as an adult. Steelhead trout were also recorded into two size categories, where trout appearing under 41 cm were counted as sub-adults, while trout over 41 cm were counted as adults. All motion clips of Chinook and steelhead were archived by a Friends of Auburn Ravine reviewer. The archive clips were then reviewed by a Department biologist for quality assurance and quality control (QA/QC). For these purposes, Department staff created a master spreadsheet in Microsoft Excel containing columns tracking date of fish observation, species, number, and size. All motion clips of salmonids collected during the sampling period were archived on a dedicated hard drive for future reference.

4.0 Results

System install and testing at the site occurred from 15 October to 25 October, 2016, video monitoring for fish fully initiated 26 October and the sampling period continued through 11 April, 2017 spanning 183 days. Department field staff visited the site 77 times to perform standard maintenance and cleaning of sampling equipment. A total of 2,147 hours of video was captured during the entire sampling period. This amount of video footage required 716 hours of review time by volunteers with Friends of Auburn Ravine to completely scan footage for fish. Species of fish positively identified through the sampling period included Chinook salmon, steelhead trout, Sacramento pikeminnow and Sacramento sucker.

During the entire monitoring effort, all four cameras were functional for 74 days (40%), some but not all cameras were functional for 79 days (43%) and the cameras were not functional for 30 days (16%). During the observed migration period however, all four cameras were functional for 68%, some but not all cameras were functional for 26% and the cameras were not functional for 6% of the time. Water clarity conditions throughout the entire season were categorized as clear 62%, murky 15% and muddy 23% of the time. Water clarity during the observed migration period were recorded as clear 84%, murky 10% and muddy 6% of the time.

Flow rate was an important consideration for field staff who needed to enter the stream for maintenance, where flows greater than approximately 40 cfs were learned to be too dangerous to get in the water. Nevada Irrigation District provided stream flow data at the end of the sampling season. Flows ranged from 7.7 cfs to greater than 200 cfs. Flow data was capped at 200 cfs due to equipment limitations. There were some gaps in flow data, but flows did not exceed gauge limitations during the observed migration period. Events where flow exceeded the stream gauge capability occurred four times, from the dates of 8 January to 13 January, 18 January to 24 January, 3 February to 12 February and 17 February to 23 February, 2017, for a total of 30 days.

4.1 Fall Chinook Salmon

A total of 303 Chinook salmon was counted passing upstream of the monitoring location comprised of 193 (57%) adults and 110 (43%) grilse. Observed adult migration occurred for 72 days, where the first Chinook salmon was recorded on 27 October and the last was recorded on 29 December, 2016 (Figure 1). Because the entire body image of every salmon was not entirely clear between all of the camera angles, no attempt to identify adipose fin status (clipped versus not clipped) was made and therefore not included in the analysis.

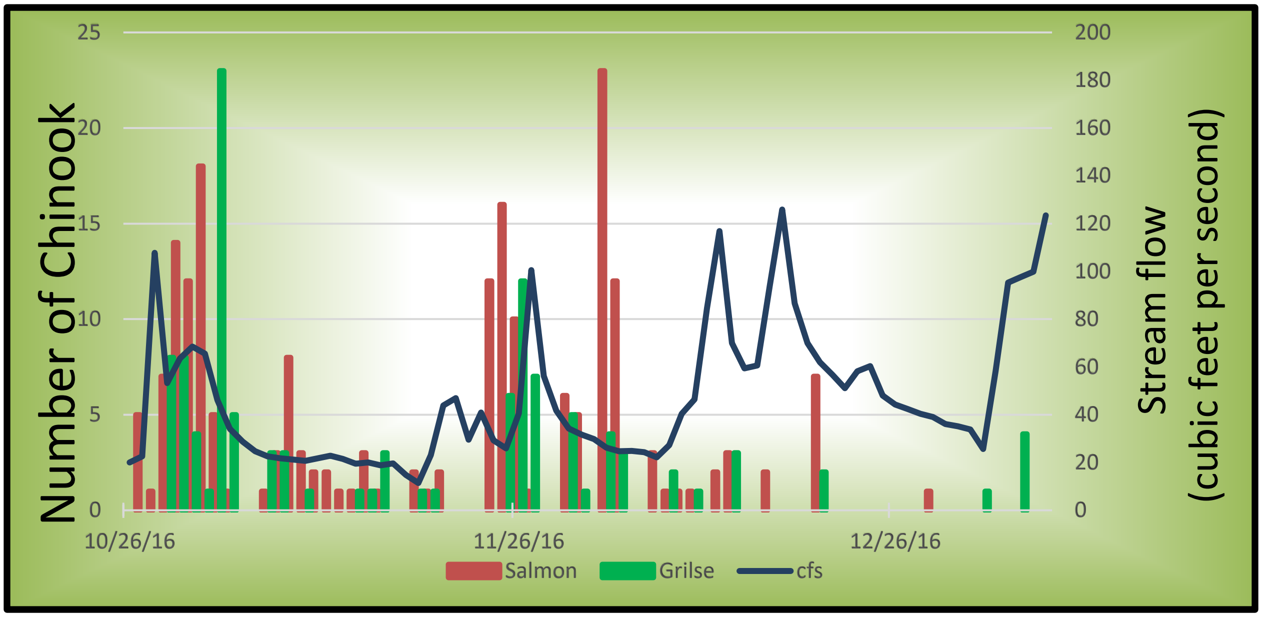

Figure 1. Chinook salmon passage occurred from 27 October to 29 December, 2016. During this time, stream flow rate ranged from 7.7 cfs to 125 cfs. Any missing flow data was extrapolated from adjacent data records.

4.2 Steelhead Trout

During the sampling period there were 21 sub-adult (less than 41 centimeters) and no adult (greater than 41 centimeters) steelhead observations. These fish were observed from 29 November through 13 December, 2016. Net downstream movement of steelhead was three individuals based on 12 (57%) moving downstream and 9 (43%) moving upstream. Because the entire body image of every steelhead was not entirely clear between the camera angles, no adipose fin status (clipped versus not clipped) recordings were made and therefore not included in the results.

5.0 Discussion

During this pilot season, the earliest date that video monitoring could be initiated was 26 October, 2016. The monitoring station was not set up in time to reflect historical run timing of adult fall-run Chinook salmon and steelhead trout, which can start as early as mid-summer as described in historical references (Yoshiyama et al. 1998). Flows in Auburn Ravine ranged between 7.7 cfs and 10.7 cfs in early October and were not conducive for upstream passage. In mid-October considerable precipitation fell within the Auburn Ravine watershed and flows increased to 63.2 cfs resulting in improved upstream passage potential. This increase in passage potential in Auburn Ravine occurred immediately prior to video monitoring initiation. The first spawners of the season were observed on the 27 October, numbering five fall-run individuals. Considering known historical run timing of focal species typically occurs prior to video monitoring initiation and that several records of passage occurred only one day after equipment initiation, an unknown number of spawners may have passed the video station site prior to initiation and were not counted.

One of the wettest years in California's history occurred during the winter and spring of 2016/2017 and monitoring efforts, inclusive. Flows at the station varied substantially; ranging from 7.7 cfs to greater than 200 cfs. It is unknown how much flows exceeded 200 cfs because of flow gauge limitations, however, these record flows occurred after the last upstream migrants were observed on 5 January, where the first of three flow events over 200cfs occurred on 8 January. Due to record flows coinciding with what appeared to be the tail-end of the observed migration, some spawners, though likely few in number, may have altogether circumvented the video station during bank-to-bank flow conditions and were not observed by the project.

Habitat in Auburn Ravine is suitable for salmon spawning, particularly just upstream of the video station as documented by the Department in adult redd and escapement surveys. However, habitat below the video station is similar to habitat above as documented in Department habitat and flow studies and is suitable enough for salmonid spawning and redd construction. Species in the *Oncorhynchus* genera have evolved in stream systems with variable conditions and are known to be advantageous spawners (Bjornn and Reiser 1991), where if stream discharge, water temperature, water depth, nearby cover and substrate type are suitable, successful spawning may occur; all of these factors can vary year-to-year with varying amounts of precipitation and fluctuating stream flows. Considering the high variation of habitat created by record flows this season, some salmon, however speculative, may have held and spawned downstream of the video station and in this case, were not observed in video station data.

There were no adult steelhead identified this season, yet there were 21 sub-adult trout observations occurring over a twelve day period, from 29 November to 13 December. Net trout movement was observed to be downstream, where there were 12 downstream records and nine upstream counts. All California hatcheries producing steelhead mark all juveniles by removing the adipose fin prior to release. Video images of trout did not provide enough information to confidently detect adipose fin status, so the trout observed during sampling were of unknown origin, either; hatchery produced, naturally produced within basin, or naturally produced outside of basin. Stream dwelling resident trout of all ages are known to redistribute during river discharge events (Mellina et al. 2005) for a variety of reasons including population density, available foraging resources, age and environmental conditions such as available cover, flow and temperature (Northcote 1992). Juvenile steelhead from the CV may emigrate from streams to the ocean at a variety of size classes and at one, two or three years of age (McEwan 2001). Numerous studies have shown that steelhead emigration is triggered by discharge events (Kemp et. al 2005, Giorgi et. al. 1997). Considering these polymorphic life strategies of the species, it is unknown if the trout observed in video data were steelhead migrating to or from the ocean or stream resident trout redistributing naturally within Auburn Ravine.

It is possible that some fish passage was not recorded due to equipment performance based on environmental conditions. Increased flows can mobilize large woody material that can damage equipment and can cover underwater cameras with localized sediment accumulation. Video equipment was partially functional for 26% and not functional for 6% of the observed migration period. Also, increased amounts of suspended sediments (turbidity) due to increased stream discharge may affect video performance and fish viewing. Water clarity during the observed migration period was recorded as murky 10% and muddy 6% of the time. Because increases in discharge facilitate adult migrant upstream passage as well as create environmental conditions that are favorable for downstream migrants, these periods of time are critical when evaluating total passage estimates and may have influenced the totals.

Another evaluation to consider are those fish that passed and were recorded by the video station, but did not spawn. Some fish may have been counted but were removed from the system due to human poaching or terrestrial animal predators, both subjects being difficult to quantify. Another similar consideration is prespawn mortality, where salmon die after migration but before spawning. There are several mechanisms that drive prespawn mortality and it can be highly variable year-to-year in low elevation CV tributaries. Neither poaching, predation nor prespawn mortality would be discernable in video data only. Without formal adult escapement surveys or redd counts occurring to cross-reference with video data, it is difficult to determine whether the total numbers of spawners observed in video data truly reflect numbers of spawners occurring.

Information collected by the 2016-2017 Auburn Ravine Video Monitoring Project in its pilot year of studies provides relative abundance and seasonal run timing indication for listed salmonids migrating past the video monitoring location. The fish counts gathered this season are considered partial, as they were obtained from the operation of a single video array in its first year of use. During the first year, there were periods of time some cameras were not functioning, equipment needed to be repaired and troubleshooting techniques developed. These may be common issues for any such fishery monitoring program, however much was learned by the program in the pilot year. Future efforts should focus on refining techniques and developing strategies that ensure equipment protection while deployed.

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7.0 Appendices

2016-2017 Protocols for

Auburn Ravine Video Monitoring

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Background

Video monitoring provides a non-invasive method for gathering information on salmon migration in streams. Fish passage monitoring in Auburn Ravine above Lincoln gaging station in Lincoln, CA will be conducted using overhead and underwater video monitoring. The goals of the Lincoln video monitoring are to estimate abundance of fall-run Chinook salmon above Nevada Irrigation District's (NID) Lincoln gaging station on Auburn Ravine. The dataset can be used to generate abundance estimates, help evaluate restoration actions, and examine trends in fish usage in Auburn Ravine.

Video monitoring also can help establish temporal distribution of adult Chinook salmon migration, size structure, and examine annual and multi-year trends in Chinook salmon immigration timing, size class, and abundance in Auburn Ravine. The video monitoring data in conjunction with water temperature and flow data can help to evaluate potential relationships between water temperatures and flows with the timing of adult salmonid immigration.

Survey Location

The Auburn Ravine video monitoring station is located in the city of Lincoln adjacent to the Nevada Irrigation District (NID) gaging station, on river mile 14.5 of Auburn Ravine (Figure 1).

Figure 1. Auburn Ravine and the NID Lincoln Gauging Station near the city of Lincoln.

Directions to Auburn Ravine from Region 2:

- Turn left on Nimbus Road
- Turn left on Gold Country Blvd.
- Turn left on Hazel Ave.
- Turn left on E. Roseville Parkway
- Turn right on Galleria Blvd.
- Move over to the far left hand lane and merge onto CA-65 N toward Marysville
- Take exit 315 onto Ferrari Rancho Road
- Turn right onto Ferrari Ranch Road
- Turn left on Green Ravine Dr.
- Turn right into the second entrance of Southbridge Cir. (North side)
- Turn left on Mossdale Ct.
- At the end of Mossdale Ct. will be three locked yellow posts that block off vehicle access to the walkway leading to the green can. Unlock the middle post with the key from the City of Lincoln and drive down the walkway. The green can is on the right hand side of the walkway.

Video Monitoring Specifications

The video monitoring station consists of three components:

- Underwater plastic white plates and three underwater cameras,
- A metal A frame that sits directly above the white plate, and houses two flood lights and an overhead camera, and
- A green can that houses a computer and monitor, external hard drive, power inverter and battery backup.

Power for the video system is supplied by DC current from a near-by power pole, and is run underground from the power pole to the gaging station. Please note that the green can also contains an analog gage, belonging to NID that measures stage height of the creek. The analog gage is supplied by an additional underground DC current. The box and the gage should not be moved as this may cause inaccurate readings of stage height.

Survey Period

The four cameras are capable of recording video footage 24 hours/day for monitoring fish migration in Auburn Ravine. The video system is anticipated to be run from October to mid April.

Sampling Frequency

Recorded passage data will be downloaded once a week every Friday and saved to a 3 terabyte external hard drive by CDFW staff. These files will be taken back to the CDFW office and subsequently uploaded onto another hard drive for back-up purposes. Once the files are backed-up, the original external hard drive can be distributed to volunteers from Friends of Auburn Ravine. Mr. Jim Haufler is the main contact for Friends of Auburn Ravine (Cell #: 916-801-3669). From there, Jim will distribute the footage amongst multiple 1 terabyte hard drives, each containing 2-3 days' worth of footage from the original hard drive. Volunteers from Friends of Auburn Ravine will receive one hard drive each from which to review footage.

After volunteers have reviewed the footage, 1 terabyte hard drives will be returned to Jim Haufler, cleared and reused for subsequent week's footage.

Monitoring Protocols and Procedures

The lead biologist is responsible for supervising CDFW staff, carrying out logistics with operating the video monitoring system, data management needs, coordinating efforts with Friends of Auburn Ravine and NID, and preparing an annual report of the video monitoring findings.

Data Collection and Sampling Techniques

All fish passage events are recorded by the video monitoring system. Data collected from the video will be viewed by volunteers to identify and enumerate: (1) fish species passing by the underwater white plate; (2) observe if Chinook salmon have an adipose fin; and (3) identify non-fish passage events (mammals, reptiles, etc.). All positively identified and unknown fish recorded on the video passing the Lincoln gaging station will be recorded on a data sheet (Appendix B) noting the date, time, approximate size, and if possible, species and sex of fish that pass through the monitoring area. Size of fish will be estimated using an object on the white plate with known dimensions. If fish are not identifiable to species, they will be noted as "unidentified fish" in the data sheets. Once the observations from the video are recorded on a data sheet, the data sheets will be transferred to CDFW staff for QA/QC purposes.

Weir and Video Equipment Maintenance

CDFW staff will be responsible for cleaning and maintenance of the video monitoring station. These duties will include: cleaning of the white plate and underwater cameras, cleaning and adjusting the underwater and overhead cameras and lights when necessary, and maintenance of the electronic components in the green can. Visits to the site will occur three days a week for maintenance purposes, with one of the three days being used to switch out hard drives.

Site visits will require one to two field staff per visit. Field staff will determine if flow is low enough to safely enter the water for cleaning the equipment. Under safe flow conditions, field staff should begin by cleaning the white plates, underwater cameras and cables of all algae, sediment and debris using a long handled scrub brush. Care should be taken while cleaning around the underwater cables, as disturbing the cable may cause momentary loss of video. Underwater camera lenses should be cleaned by hand or with a soft sponge or rag (Cleaning camera lenses with the scrub brush may not sufficiently clean off algae).

Computer and Data Download

Maintenance of the electronic components inside the green can will require checking the video monitoring system to ensure it was recording and saving footage properly between the time of the last visit and the current visit. To check the video monitoring system, open the green box and turn the computer monitor on to inspect a portion of the previously recorded footage, both from the daytime and night, to ensure the lights, cameras, computer and hard drive are in good working order (Please see Appendix A for instructions on how to view previously recorded footage).

On Friday of each week, all data saved onto the external hard drive must be downloaded onto another external hard drive (Please see Appendix A for instructions on how to change hard drives and set up video monitoring/recording). After the computer, external hard drive, lights and cameras have been inspected, leave the computer on and Geovision software running, but turn off the monitor. This will reduce the risk of a power failure at the green can.

In the event that there is a failure of the cameras or computer system, please refer to the instructions outlined in Appendix A. Some failures, such as missing footage, may be a result of a save location for the footage not being chosen. An unexpected shutdown of the computer may also occur, in which case the computer will reboot back to the login screen. Login information can be found on the front of the tower. Once the computer is logged in to, the Geovision software should begin the auto startup sequence and reboot itself. For further trouble shooting, contact Shig Kubo (209) 352-1604.

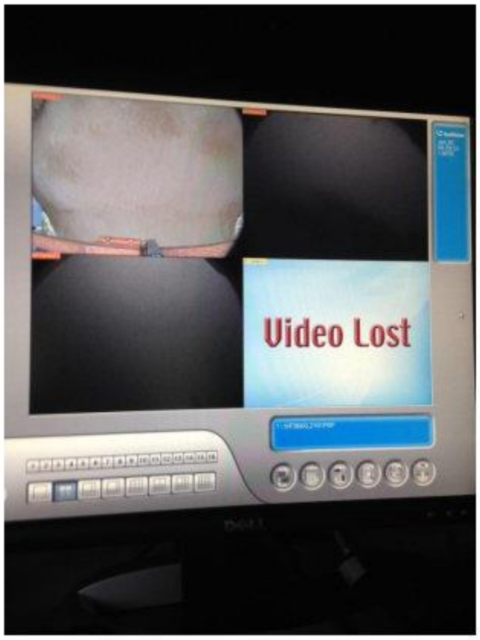
Maintenance Log

Details of each visit will be recorded on daily site check data sheets (Appendix B) and will include the following information:

- Time and date of visit
- Initials of staff present
- Does the video have good picture (Yes or no)
- Was the hard drive switched out (Yes or no)
- Were the white plates, underwater and overhead cameras cleaned (Yes or no)
- Was the battery back-up and the lights checked (Yes or no)
- Water height on staff gauge
- Additional comments/observations

Appendix A. Geovision software user's guide

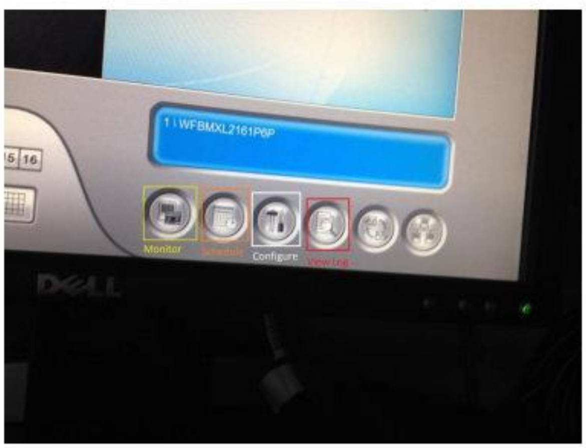
Setting up video monitoring/save location

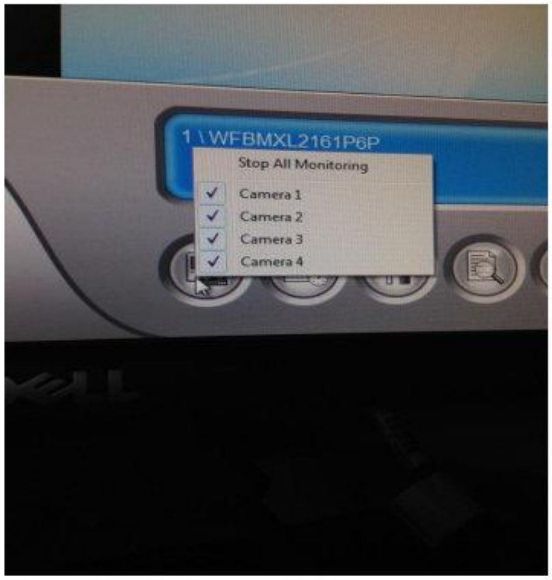


The following describes how to set up monitoring and select a folder in an external hard drive for the video footage to be saved to from Geovison.

Pictured left is the home screen for the Geovision software, showing the real time footage of the cameras that are connected to the computer.

Pictured on the bottom left is a picture of the different options for the software controls, highlighted and labeled.





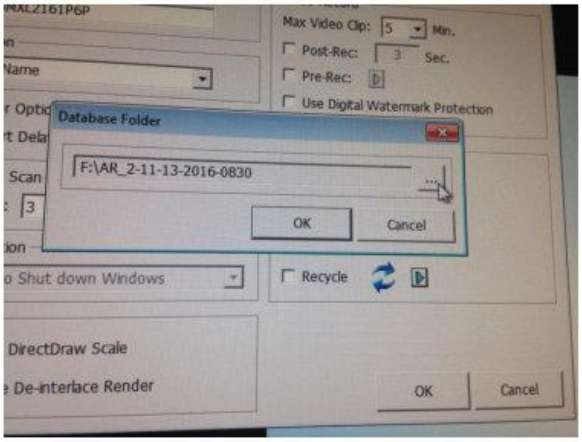
Before video is saved to an external hard drive, a new folder will need to be created in the external hard drive, labeled in the following format: "AR_MM_DD_YYYY-00:00".

Once a new folder has been created in the external hard drive, open the Geovision program and click on the "monitor" tab and select "stop all monitoring". This will stop footage from being recorded, but the cameras will remain on and show real time footage.

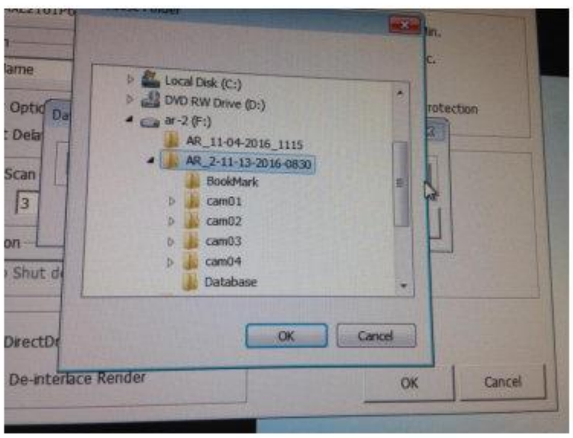
Once "stop all monitoring" has been selected, the boxes in the upper left had corner of each camera screen will turn yellow, indicating that footage from that camera is no longer being recorded.

Click on the "configure" tab > "system configure" > "general setting"

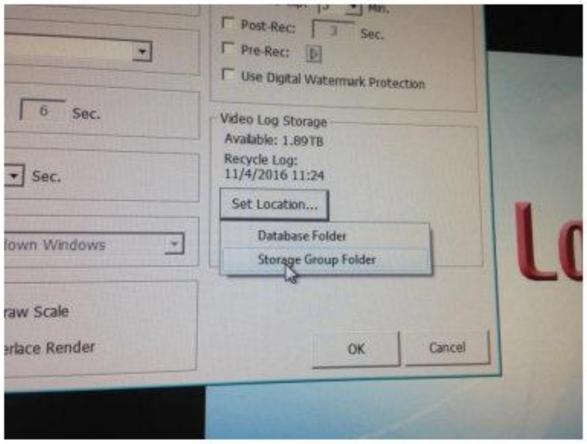
In the "general setting" window, click on "set location" and select "database folder". This will allow the user to select where the database for the recorded footage will be saved to. The "set location" tab will not be highlighted unless all monitoring has been stopped.



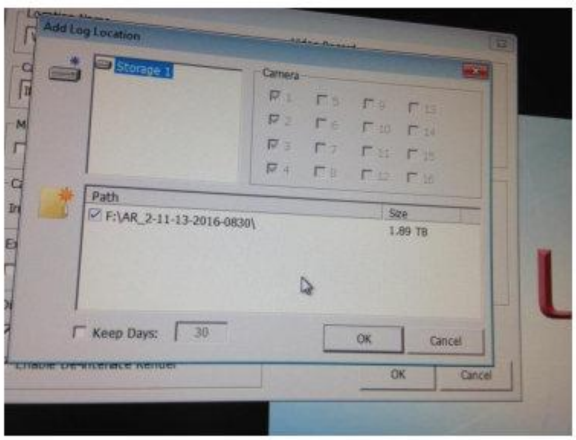
In the "database folder" window, click on the button next to the file name shown in the window.



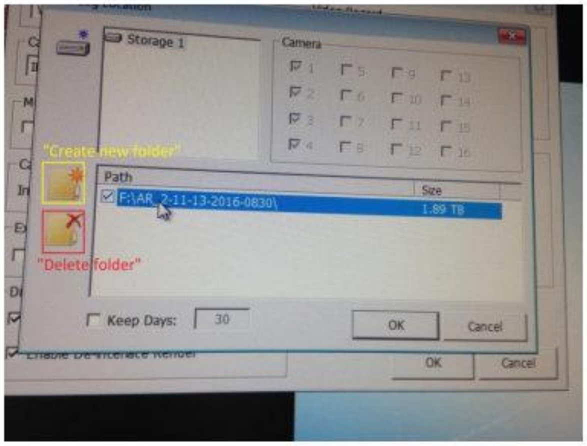
Another window will be prompted, listing options for locations to save the database folder to. Select the recently created file in the external hard drive. This will be the same folder that will be saved to in subsequent steps.



Once the save location for the database folder has been selected, go back to the "general setting" window, click "set location" and select "storage group folder".



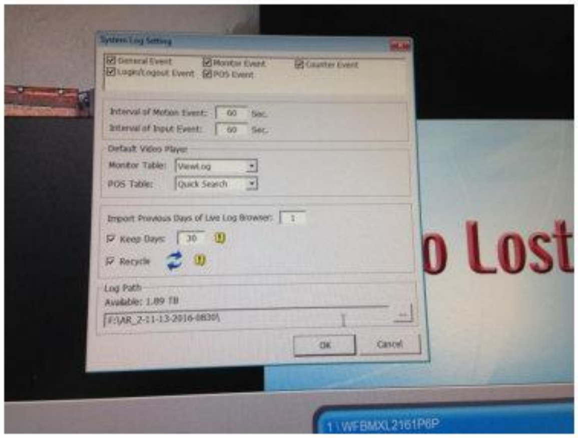
The window pictured to the left will appear. If a folder was not previously selected to save to, the column in the bottom box of the window labeled "path" will be blank. If a folder had been previously selected, a folder name should be present in the "path" column.



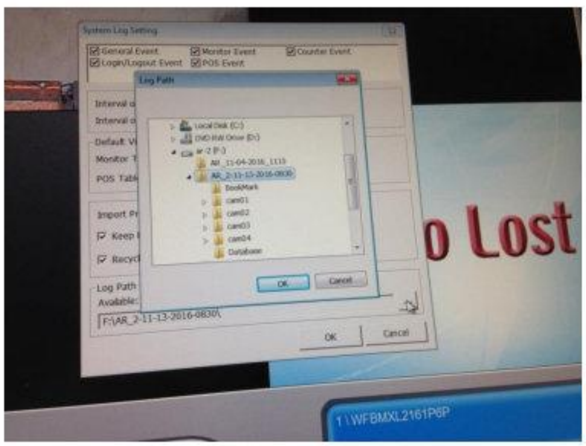
If a previously selected folder is present in the column, click on the folder name. Afterwards, the "delete folder" icon should appear next to the box as pictured to the left. Once this icon appears, click on it to remove it from the previously chosen folder.

After the old folder has been deleted, select a new save location by clicking on the "create new folder icon", which should be present above the "delete folder" icon. Another window will appear where you can select a save location. Select the aforementioned folder in the external hard drive.

After a save location has been selected in the general settings, select a save location for the system log settings by using the following: "configure tab" > "system configure" > "system log setting".



In the "system log setting" window, you can select a save location by clicking on the tab in the bottom right corner of the window. If a folder was previously selected, a file name should appear in the box at the bottom of the screen next to the tab.



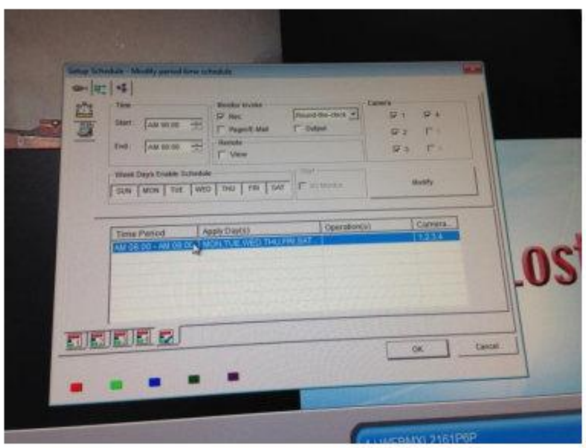
Once the window pictured to the left appears, select the same folder as mentioned in previous steps.

The cameras need to be set to monitor and record 24/7. A schedule in the software needs to be set for the cameras to record when so desired. If the schedule is not set for monitoring 24/7 due to equipment malfunction/failure, or if monitoring is started for the first time after a prolonged period of inactivity, the schedule needs to be changed or adjusted using the following steps:

Click on the "schedule" tab and select "schedule edit". In the "schedule edit" window, there are three main tabs labeled with different icons. Select the tab with the camera icon.

Within that tab, there will be two additional sub tabs with different icon labels. Select the tab with the clock icon.

Under the clock tab, there are several sections with different schedule settings to be aware of.



Under the "time" section, you can select a start and end time for the cameras to be monitoring. Set both the start and stop time for 08:00 am. This will tell the software to record for 24 hours per day.

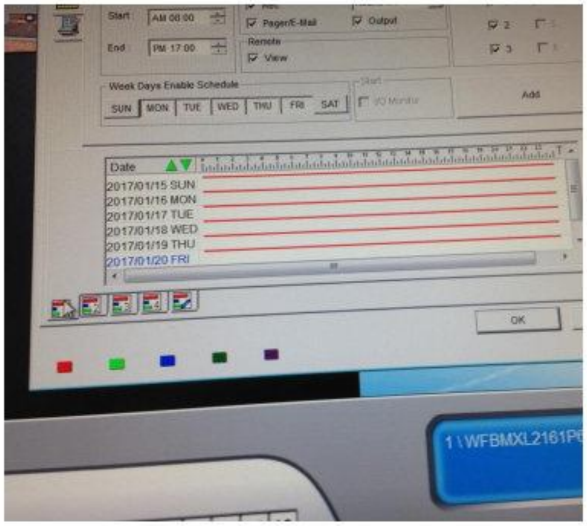
In the "monitor invoke" section, check the "rec" box and select the "round-the-clock" option in the associated drop down menu. The other boxes should remain blank.

In the camera section, check the boxes for cameras 1-4 or for all cameras that are connected at the time.

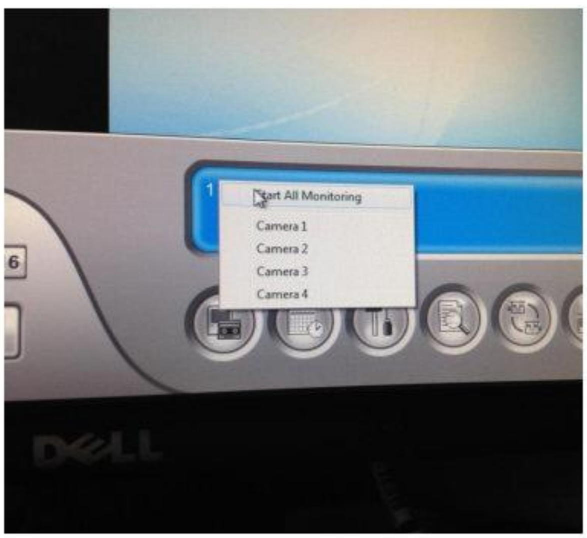
Under the "week days enable schedule", select all 7 days.

Once all of these settings have been changed, click on "modify". The selected settings should appear in the spreadsheet at the bottom of the window.

***NOTE:** The recording schedule should only need to be checked and not modified during a routine hard drive change, unless there was a power/equipment failure that reset the schedule.

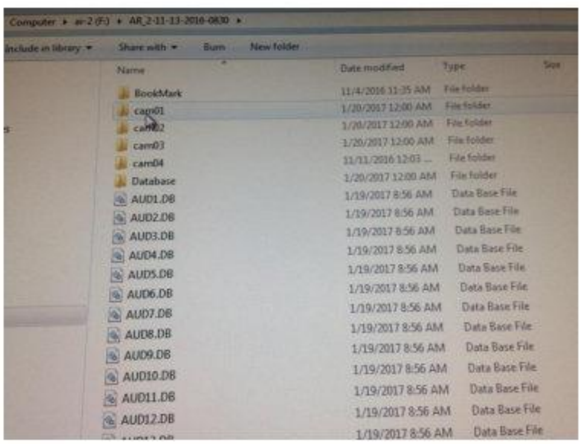


In order to double check that each individual camera is recording on the desired schedule, click on the tabs located at the bottom of the spreadsheet in the schedule edit window. The schedule for each camera should be shown in a spreadsheet as pictured to the left. The red lines next to the days of the week indicate how long the camera records on each of those days. Each day for each camera should show a red line going through the entire day.



After the folder for footage to save to has been selected, and the recording schedule set and confirmed, click on the "monitor" tab and select "start all monitoring".

Once "start all monitoring" has been selected, the boxes next to each camera name in that menu should be checked, and the boxes in the upper left hand corners of the camera screens should turn orange. This should indicate that the footage is currently being recorded.

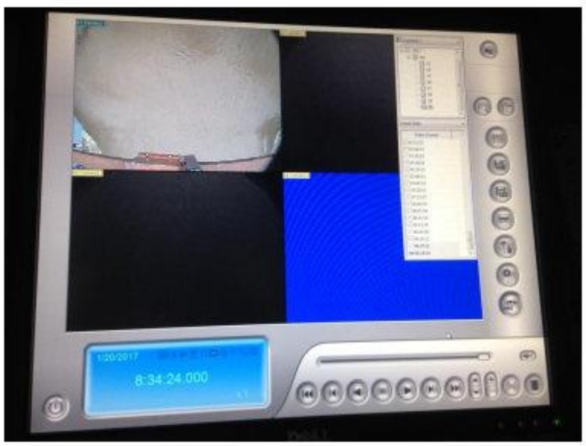


After the newly created folder in the hard drive has been selected as the save location for the video files, it will be auto-populated with several folders, as well as audio and video files. Each camera should have its own folder, labeled as "cam##", where the video files will be saved and organized by day. The videos will be saved as AVI files, each being 5 minutes long.

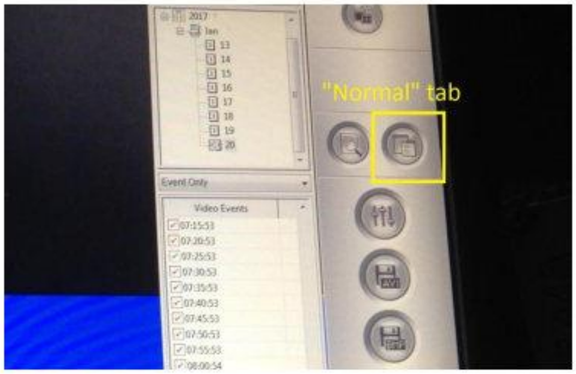
To ensure that the cameras and lights were functioning properly and the footage was properly stored to the external hard drive, open the folders for each camera to check that all days the current hard drive was plugged in for are present. Also check for gaps in the recordings. If there are missing days or individual 5 minute events, make a note of it in the comments of the daily site visit sheet.

Viewing previously recorded footage in Geovision

To view previously recorded footage in Geovision, click on the "view log" tab and select "video/audio log".



The View log software will open in a separate window, showing screens for each camera as well as controls at the bottom of the window that can be used to toggle through recorded video footage, and tabs on the right hand side of the screen.



The window on the right hand side of the camera screens, pictured left, will be open and is used to select previously recorded video files to play back. This window can be toggled open or close by clicking on the "normal" tab. To view each individual file, select the year, month, and day in the upper section of the box. Once a day has been selected, a list of files labeled with time stamps will appear in the lower section (pictured left). Select one of the files labeled with a timestamp to play back.

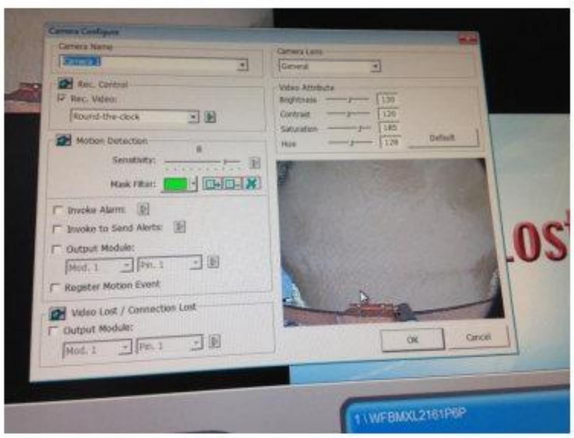
Use the controls at the bottom of the screen to toggle through the footage. The footage can be sped up or slowed down using the controls highlighted in the picture.

After the footage has been reviewed and the user is ready to exit, close the window by clicking on the power button icon on the bottom left hand corner of the window and select exit.

Camera configuration through Geovision

After installing cameras or reconnecting them, use the following steps to configure the software in order for the cameras to function properly.

Click on the configure tab > system configure > camera configure.

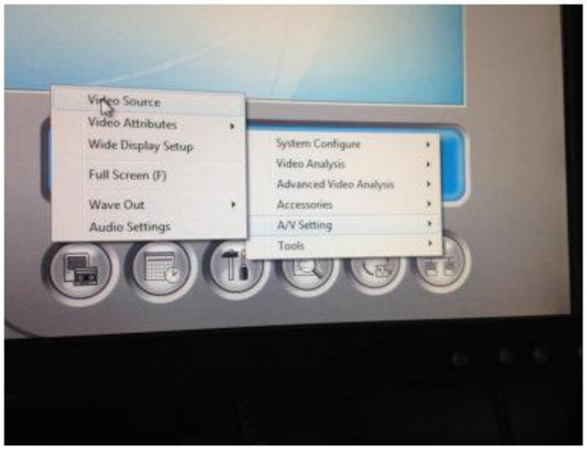


In the camera configure window, select which camera to configure in the upper left hand drop down menu.

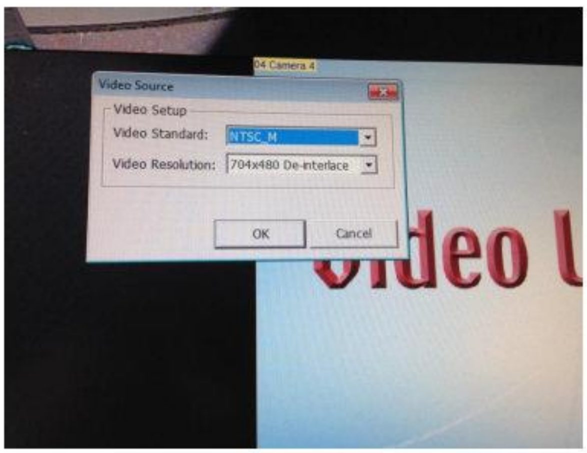
In the drop down menu under the rec. control section, check the "rec. video" box and select "round-the-clock" in the drop down.

Under the "camera lens" setting, "general" should be selected in the drop down menu.

All other settings should be left blank.



Click on the "configure" tab > "A/V setting" > "video source"



In the video source window under the video standard drop down menu, select "NTSC_M".

Under "video resolution", select the highest resolution setting in the menu.

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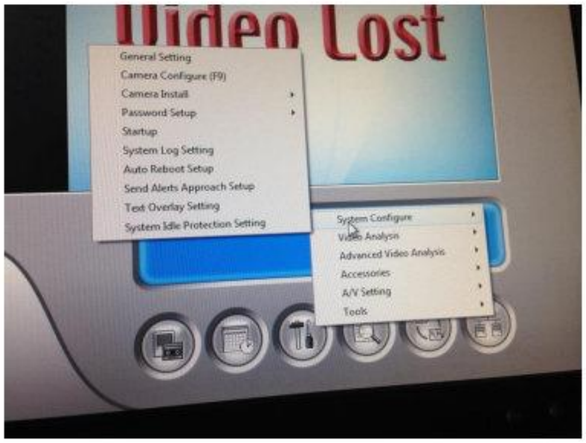
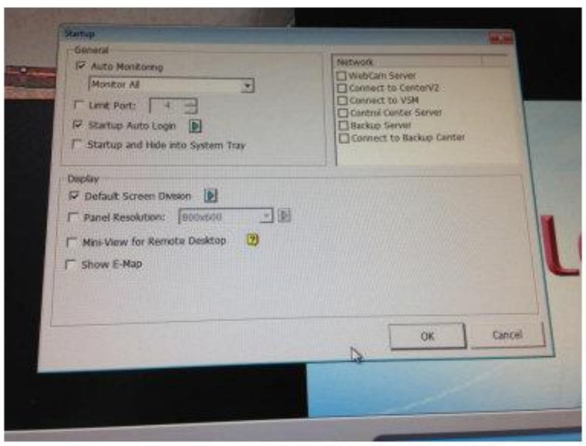
Auto startup after unexpected shutdown



In the event of an unexpected shut down or power failure of the computer, the Geovision software can be configured so that after power is restored, or the computer is rebooted, Geovision will continue monitoring.

To configure Geovision to automatically restart after an unexpected shutdown/power failure, use the following steps: "configure tab" > "system configure" > "Startup".



In the "startup window", under the "general" section, check the "auto monitoring" box and the "startup auto login" box, and select "monitor all" in the following drop down menu.

Under the "display" section, the only box checked should be the "default screen division" box.

Appendix B. Data sheets

AUBURN RAVINE VIDEO STATION: DISK & MAINTENANCE LOG

PLEASE FILL OUT THE FOLOWING LOG FOR EACH VISIT

If you have problems contact Mike Healey at CDFW (916-358-4334 W, or 916-747-1756 C), or Shig Kubo at CDFW (209-352-1604 C).

DATE	DAY	TIME OF VISIT	YOUR INITIALS	Does TV HAVE Good Picture?	Change Disk? Disk # in	CLEAN white plates?	Clean UW Cameras?	Clean Top Cam ?	Battery Check Light Check	Water Height on Gauge?	DOES STATION NEED ATTENTION? ANY COMMENTS?
10/25/16	Tuesday										
10/26/16	Wednesday										
10/27/16	Thursday										
10/28/16	Friday										
10/29/16	Saturday										
10/30/16	Sunday										
10/31/16	Monday										

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FISH PASSAGE DATA AT THE AUBURN RAVINE VIDEO STATION

Date Video was recorded:	MM	DD	YYYY		Date scanning and counting completed:	MM	DD	YYYY

Name of person who did the scanning & counting:

View: blank = video normal, 1 = turbid, 2 = equip. failure

	Time		Salmon > 24" SALMON #UP	#DN	Jack Sal < 24" JACKS #UP	#DN	Steelhead > 16" STEELHEAD #UP	#DN	Trout < 16" TROUT #UP	#DN	View (See code)	COMMENTS:
Midnight	0:00	0:29										
	0:30	0:59										
	1:00	1:29										
	1:30	1:59										
	2:00	2:29										
	2:30	2:59										
	3:00	3:29										
	3:30	3:59										
	4:00	4:29										
	4:30	4:59										
	5:00	5:29										
	5:30	5:59										
AM	6:00	6:29										
	6:30	6:59										
	7:00	7:29										
	7:30	7:59										
	8:00	8:29										
	8:30	8:59										
	9:00	9:29										
	9:30	9:59										
	10:00	10:29										

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