

# **Rampart Rapids Full Season Video Monitoring 2005**



## **Using a Fish Wheel on the Yukon River, Alaska**

**By Stan Zuray**

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Rampart Rapids Full Season Video Monitoring 2005

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Cover (clockwise): 1. Rapids south bank video fish wheel 2. Rapids canyon and Rock Island (center) from hilltop. 3. Video monitoring equipment modifications on fish wheel. 4. Broad whitefish, sheefish, coho and chum salmon, and humpback whitefish.

## **Author**

Stan Zuray has been a fisherman and trapper in the Tanana area since 1973. The last 10 years he has run fish wheels for a number of monitoring projects at the Rampart Rapids. He is one of the developers of the fish wheel video system currently in use on a number of Yukon River drainage fish wheels.

## **Sponsorship**

This project was funded by a grant from the US/Canada Restoration and Enhancement Fund.

The 2005 Rampart Rapids video project continues a close working relationship with the USFWS Field Office in Fairbanks. They provided a biologist with this office, who has a partnership relationship with this project and this office provides yearly funding contributions for in season computer and assessment assistance and postseason analysis related to the video project data some of which is included in this report.

The Tanana Tribal Council provides fax, copying and message services for the project. They also arrange travel for students who work with the video project.

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## Introduction

Monitoring of Chinook salmon (*Oncorhynchus tshawytscha*) passage in the middle Yukon River began in 1999 at Rampart Rapids (Rapids: 730 miles upstream from the Yukon River mouth). Before this time, there were no U.S. run assessment projects for mainstem Yukon River Chinook salmon above Pilot Station, 138 miles from the mouth. This unmonitored area covered over 1,000 miles. Numerous subsistence and commercial fishermen harvest salmon along this section of river. In 1999 daily subsistence fish wheel Chinook salmon catch-per-unit-effort (CPUE) was supplied to the Alaska Department of Fish and Game (ADF&G) by satellite phone from the Rapids. From 2000 to 2004, daily catch rates of Chinook and chum salmon (*O. keta*), sheefish (*Stenodus leucichthys*), humpback whitefish (*Coregonus pidschian*), broad whitefish (*C. nasus*), and cisco spp (*C. laurettae* and *C. sardinella*) were reported. Future data on Chinook salmon and the numerous other fish species (many important subsistence resources) caught at Rapids will help build a long-term population trend database that will increase in value as the project continues. The Restoration and Enhancement Fund has been the major source of funding for this project.

The project site at the Rapids has probably been a subsistence fish wheel site since fish wheels came to the Yukon (around 1900). Traditionally, the particular bend in the river where this site is located has always been well known for its ability to consistently produce good catches of fish, Chinook as well as chum salmon, whether the water was high or low. Because of the unique currents in the Rapids, fish wheels are capable of being run there even during the spring drift that happens at the same time as the Chinook salmon run. Traditionally, people would travel to the Rapids area to spend their summers because of these qualities. Even today it is one of the most densely populated active fish camp areas on the Yukon River.

Fish wheels are commonly used as a capture method for management and research activities in the Yukon River drainage. Specifically, fish wheels have provided CPUE data at various locations to fishery managers. Also, fish wheels are used to capture and hold fish for tagging studies. Most of these fish wheels continue to use live boxes to hold fish until the researchers or contractors process and release the fish. Crowding and holding times greater than four hours are common and a growing body of data suggests delayed mortality and reduced traveling rates are associated with holding, crowding, and/or repeated re-capture (Bromaghin and Underwood 2003, 2004; Bromaghin et al. 2004; Underwood et al. 2004).

From 1996 to 2005 (present) the site has been used to run fish wheels for the Rampart Rapids fall chum salmon tagging project (Apodaca et al. 2004). During these ten years the site fish wheel operated without any down days or days when data were compromised. In 1997, 1998 and 1999 a fall chum radio-tagging project was conducted by the National Marine Fisheries Service at this site. During the first year of operation the radio tag project became aware of a possible problem with live box held chum salmon. This problem was studied in 1998 and 1999 and project results (not yet published) showed a significant negative effect on fish held in the live box for 4 to 6 hour (J. Eiler, National Marine Fisheries Service, personal communication).

In 1999, the fish wheel operator at Rapids was supplied with a satellite phone from the USFWS, Fisheries Resources Office in Fairbanks and called in daily subsistence Chinook salmon CPUE data to the ADF&G. In the fall of 1999, a development project was undertaken at this site to address the increasing concerns over live box held fish and devise an alternative method of monitoring catch using video (Zuray and Underwood 1999). Video technology, as an alternative to live boxes, avoids all of the handling and live box crowding issues by eliminating the use of live boxes altogether. Video systems have been used in counting

windows at dams in the Columbia River basin for several years (Hatch et al. 1998). These systems have proved to be efficiently able to provide accurate counts. They have however been designed for use in developed areas where standard power is available and environmental variables are easily controlled. To transfer this technology to a fish wheel on the Yukon River, it was necessary to deal with many problems that did not exist in prior applications of this technology. A video capture system was developed that had low DC power requirements. The system used an analog CCD camera, mounted above the fish wheel chute. As fish slide down the fish wheel chute, they were recorded to a time-lapse VCR in 12-hour recording mode. The fish images were then extracted from the VCR tape and digitized using Salmonsoft video capture software. Fish were tallied by species and CPUE data were generated (see the methods section of Zuray and Underwood 1999 for a detailed description of the video methods). Also, a specially built fish wheel was used that had many features designed to reduce possible injury to fish. The USFWS Fairbanks Field Office was directly involved in the development and support of the Rapids CPUE video project in 1999.

In 2000, a Chinook and fall chum salmon CPUE video project was funded at the Rapids site by the Restoration and Enhancement Fund (Zuray 2000a and Zuray 2000b). Also, catches of sheefish, humpback whitefish, broad whitefish and cisco spp. were monitored. The Chinook and fall chum salmon video projects were run both years without any live box held fish released back into the river and were the first projects of this kind ever run.

From 2001 to 2003 the USFWS Office of Subsistence Management funded operation of the Chinook salmon video project (Zuray 2003). The 2001 to 2003 Office of Subsistence Management project was a mating of the need for run timing and assessment data and the use of video capture as a means of producing data in a way much less harmful to fish. Restoration and Enhancement Fund monies continued to fund fall chum salmon video projects in 2001 and 2002 (Zuray 2002a and Zuray 2002c)

In 2004 and 2005 the Restoration and Enhancement Fund funded the Chinook and fall chum salmon full season video project at the Rapids. As requested by the Yukon River Panel this project provided monitoring of the whole season for all species present.

## Objectives

1. To provide daily fish wheel/video catch-per-unit-effort (CPUE) data on Chinook, summer chum, and fall chum salmon.
2. To provide daily fish wheel/video CPUE data on migratory whitefish.
3. To continue improving fish-friendly fish wheel capture techniques.
4. To use and continue improving present methods for adjusting raw catch data, which takes into account factors such as river discharge and fish wheel catch efficiency.
5. To continue using video measuring techniques to separate captured Chinook salmon into small and large size categories.

## Study Area

The project was conducted on a fish wheel 40 miles upriver from the village of Tanana at an area locally known as “The Rapids”, a narrow canyon 1176 km (730 miles) from the mouth of the Yukon River. Traditionally and at the present time this area is known for its abundance and variety of fish species. This condition exists because of the currents and steep banks that force fish to migrate through the area relatively concentrated and close to shore. Fish wheel sites have been established for many years in the area so no site conflicts occurred. The unique protection offered by the site, from wind, high water, and spring river drift allow fish wheels to run there with little or no down time.

## Methods

### *Fish Wheel*

A two-basket fish wheel equipped with a video capture system was used to count salmon and other species in 2005. Effort was taken so the operation of the project was consistent from year to year. The fish wheel rotation speed, baskets dip depth, distance from the basket to river bottom, and length of the lead fence were kept similar between years. Sonar readings were used to improve the consistent positioning of the wheel relative to the migrating fish. Basket width was 10 feet and dip was kept around 13 feet. Nylon seine netting was installed on the sides of the baskets to minimize injury to fish as they were lifted clear of the water. Plastic covered mesh was placed on the bed or sliding portion of the baskets for “fish friendly” operation. Underwater holding boxes that were used for subsistence by the operator and as a means of catching fish for research activities that the project supported were eight feet long, four feet deep and two and one half feet wide. Two and one half inch holes were drilled throughout the live box to allow a continuous flow of water while reducing current inside box.

The fish wheel was put in the water during the first week of June and assembled in running order within a week. The water generator and associated electronics gear were mounted on the wheel. By mid-June all of the electronic gear to be used in the video project was mounted on the fish wheel or set up back at camp. This included the surveillance camera, video tape recorder (VCR), portable monitor, laptop and desktop computers, two generators, the data transmitter and receiver. Secchi disk readings related to fish wheel efficiency testing are started at this time,

The first Chinook salmon arrive as early as mid June or as late as the first week of July. Because of the large amount of subsistence gear in the river at the Rapids before arrival of



Chinook salmon and the applicants own participation in this fishery, monitoring the arrival of the first fish is always easy. Nets were in the water at the Rapids in early June and reports monitored from ADF&G's Pilot Station Sonar Project. Within a day or so of the first reported fish caught anywhere in this section of river the Rapids test wheel started counting. Collection of sheefish, broad, humpback and cisco whitefish data started at this time also (Figures 11 – 14).

The schedule for running the wheel during Chinook season was 12 hours per day, 6 days per week (excluding Sundays). This schedule was originally worked out in a discussion with Keith Shultz of the Department of Fish and Game in 2000. The reasons for this schedule are as follows:

1. Because of the high amount of drift in the river at this time of year, continuous nighttime (unattended) running of the fish wheel is not advisable. This was clearly the case in years such as 2000 and 2001.
2. Twelve hours running time would reduce the amount of Chinook salmon processed by the wheel yet still provide the data needed.
3. The logistics of one person running a site, 40-miles from the nearest town, necessitate one day a week being used for a supply trip to Tanana. In all years the town trip was not needed every week and a count would be taken for that day.

During the fall season some changes take place in the running of the project. The date this project used for the official fall chum salmon arrival in 2005 was July 31 (TEK Fall Chum Arrival Date). Traditional ecological knowledge derived from elders in this area is used to determine arrival time. This date is different than the set date used each year by Federal and State managers. The arrival of fall chum salmon is determined by viewing the flesh of the fish as they are cut in the subsistence fishery. Each day the percent of salmon having bright red color in the flesh is recorded. When the percentage reaches 50% it is considered that the fall chum run is solidly underway. This method of thinking is prevalent in the subsistence fishery of this area and is used in place of a set date.

Start up date for the fall project is August 1 unless significant numbers of fall chum salmon are detected earlier. The proposed schedule for running is 24 hours per day (minus time needed for normal maintenance, data transfer, etc. each day). Project runs 6 days per week (see below). Project shut down coincides with the declining numbers of the last fall chum pulse (Sept. 15 – Sept 25) or if icing conditions are severe. Reasons for schedule are as follows:

1. Twenty four hours sampling would maximize the amount of data collection time and be in line with recommendations from ADF&G for operation of the Rapids fall chum CPUE project.
2. Logistics of one person running a site 40 miles from the nearest town necessitate one day a week being needed for a supply trip to Tanana and occasional equipment repairs or changes. As demonstrated during the Chinook and fall chum salmon projects from 2000 to 2005, data are collected on these off days when trips or repairs are not needed.

### *Project Specifications*

This section provides specifications on fish wheel components and operation so future year's CPUE results can be as comparable as possible. Changes in some of these could easily make these comparisons meaningless. Because of shifting silt deposits and unstable banks sites change frequently and some projects are not able to collect data consistently using these

specifications from one year to the next. The Rapids has a hard rock bottom and the same site can be used each year. The specifications listed below should be kept as consistent as possible each year and notes made any year that was not possible.

Project Specifications:

1. Basket dip (amount of basket in water when vertical) is 13 feet (12 ½ to 13 ½).
2. Width of basket (outside to outside) is 10 feet.
3. Lead fence length is 20 feet.
4. Wheel is two-basket design with a basket side height on the lead facing side of 5 feet
5. A six beam down looking sonar is used in season to slightly adjust fish wheel location, keeping the concentration of migrating salmon centered in line with the inside logs of the fish wheel raft. The size of the fish wheel was made to fit this specific spot. After many years of using the sonar in conjunction with this size fish wheel, the wheel seems to normally center itself over the concentration of passing fish when these operational specifications are followed. This assumption appears to be especially true of fall chum salmon, which prefer to run at a very consistent depth range.
6. Wheel baskets are always run between one and 1.5 feet off bottom (hitting the rocky bottom can be disastrous).
7. Basket rotation speed is approximately one to 1.5 turns per minute. This slow speed is part of the fish friendly operation and is controlled by sets of easily removable paddleboards. Desired rotation is described as “just a little faster than stalled”.

*Video System*

The video system used in 2005 consisted of a color CCD camera mounted above the fish wheel chute and directly connected to a wireless microwave transmitter mounted on the back of the fish wheel and aimed back toward the camp site. At camp the wireless receiver is connected to a laptop computer through a video capture card. After the fish wheel captured the fish, they were video recorded as they traveled down a chute, and then re-entered the river. A time-lapse VCR and second computer were linked to the system for assessment work and video recording backup. Twelve-volt batteries powered the system at the fish wheel. During daytime operation, a water-wheel generator charged the batteries. In fall at night, floodlights necessitated the use of a small generator. This system differed substantially from what was used in the development year of 1999 and the first full project year of 2000. In 1999 and 2000 the camera was attached directly to the time-lapse VCR using 12-hour recording mode. These tapes were taken back to camp and run through a capture program (Salmonsoft Vcap 1.07) to extract the video frames that contained fish into digital avi format files. This process took two hours per 12-hour tape. The software program pulled the fish images out of the VCR tape with a “luminescence trigger” that used the change in pixel brightness between the background and the passing fish image. The system worked fairly well as long as any sources of strong shadow and light was eliminated from the viewing area. The major limitations of this method were: 1) the frame rate was limited to 5 frames per sec, 2) camera positioning was limited by the background (no shadows), 3) the system could only be run for 12 hour periods, and 4) VCR tapes would take an additional two hours of processing before digital files could be counted for fish.

In 2001, Dave Daum, developed a new system that improved past limitations of the system (Daum 2005). A camera was mounted directly to a laptop computer on the fish wheel. The computer had a new version of Salmonsoft software (funded by USFWS) that used electronic triggers to initiate capture of fish images as they slid down the fish wheel chute. A lightweight door was installed at the bottom of the chute with a magnetic switch attached.

When a fish exiting the chute opened the door, a signal was sent to the computer. Frame rate and numbers of frames captured before and after the triggering event were controlled by software so the limitation of using time-lapse tapes was eliminated. Since the time-lapse VCR was still linked to the camera, any failure of the magnetic switch would be “backed up” on tape. Every day, the video data was downloaded off the computer using a 1GB IBM, micro-drive and brought back to camp. A plywood shack and wood stove was constructed and set up to house the equipment in camp. Here is a list of daily video procedures followed at the fish wheel (this gives a general idea only as these procedures change over the season):

#### *Start up*

- Turn on camp laptop, microwave receiver, and start software capture program.
- Arrival at the fish wheel - make sure wheel is adjusted for running (the most complicated part).
- Switch on power to water generator and lower into water. Turn on fish wheel.
- Open electronics cabinet, turn on DC power from batteries, and turn on camera and microwave transmitter.
- Check portable monitor to make sure camera is on, in focus and positioned (rarely changes).
- Wipe window clean on camera case (splash marks) and clean chute background (for nice pictures).
- Start official counting by manually tripping capture system while holding a start sign in camera view.

#### *Shut down*

(12 hours later: at least one trip was made to wheel mid-day and often more when drift was heavy).

- Manually trip capture system while holding a stop sign in camera view.
- Lift water generator out of water and turn off DC current to water generator.
- Turn off fish wheel and lift baskets up to protect from nighttime drift.

#### *Fish Counting*

In 1999 and 2000 time-lapse VCR 12-hour tapes were brought back to camp and run through Salmonsoft’s “luminescence” program to digitize the fish images to electronic video format (avi). This process took two hours. Avi files were viewed through a Windows media player and hand-tallied. We were unable to adjust scroll speed while viewing video and all numbers of fish by species and sample times had to be entered into the database by hand.

In 2001, an electronic tally system was developed to facilitate rapid counting and calculating of CPUE data by fish species. This new video counting system, Salmonsoft capture review program, allowed tallying of individual fish species using a computer keyboard. Images could be reviewed at user-defined speeds and played forward or reverse for review. Dave Daum did considerable Beta testing of the software, so a finished product would be available for the beginning of the 2001 season. After fish were tallied on the computer, numbers and times were entered into an Excel spreadsheet to calculate 24-hour CPUE by day. These daily counts and CPUE calculations were called into ADF&G using a satellite phone usually within a couple hours after retrieval of the data from the fish wheel. All avi files and Excel spreadsheets were backed up on compact discs daily. VCR tapes were collected daily as backup, but were not processed daily. The primary purpose of the tape recordings was to provide data in case of a failure in the laptop/switch system, data for inseason evaluation, and

postseason assessment. In 2003 to 2005 a totally separate luminescence capture program was run one day a week for inseason assessment purposes. The results of each were compared as a means of detecting problems. We decided to drop the daily backup using VCR tapes because lack of system failures warranted less backup effort.

### *Assessment of Capture Program*

As a video capture system assessment, segments of separate luminescence program counts were viewed and compared to the corresponding video capture files generated from the magnetic switch video system. The luminescence program counts contain fish that pass through the chute captured in an entirely different manner than the trigger method, so assessing how many fish, if any, were missed by the trigger method was a fairly straightforward process although rather tedious and boring. Selection of assessment samples was two-part. 1. A day was selected based mostly on weather, which would optimize the luminescence programs operation. 2. The first six hours or the first 50 fish was selected to review (based on workload in reviewing that much material).

The process was as follows:

1. The luminescence program AVI file for a particular day was played into a computer software program called Salmonsoft review that simply opened up a window on the monitor for viewing. This window was moved onto one half of the monitor screen.
2. On the other half of the screen the AVI file made by the fish wheel laptop/switch program was opened using Salmonsoft review program
3. Both viewing samples were set at the beginning of the assessment sample period. The regular program controls, the computer mouse and keyboard forward and reverse features were used for viewing the AVI file from this point on.
4. The trigger AVI file was advanced to the first fish, stopped and the time stamp noted.
5. The luminescence program AVI was run forward until a fish appeared and paused.
6. If all went well the trigger AVI fish and the luminescence program AVI fish should be the same and have corresponding times. The operator looked for a fish on one frame and not the other. This situation would signify a miss by the laptop/switch program or the luminescence program.
7. Each fish reviewed was counted on a tally sheet.
8. Misses are recorded on the tally sheets in case further study is needed to see why the error occurred, however most of the time the reason was apparent.
9. The AVI file was advanced to the next fish and the process then repeated.

### *Power Equipment*

Aquair UW propeller driven water generator: This generator had very little output for the water speed encountered at the fish wheel (approx. 6-8 ft/sec.). It could only produce 1-2 amps. Because the project was sometimes run in only the daytime hours (no lights needed), the camera, laptop, and VCR were able to run without a supplemental generator and keep a full charge on the batteries. Its use is recommended only after carefully assessing the water current at each site, power needs of the project, cost (\$2000.00) and work of setting up. On a positive note it seems to be a durable, continuous use piece of equipment and lasted 5 years and had only shaft seals replaced once.

Honda 1000 watt generator (EU1000I): The color video camera running at higher shutter speeds required about 180 watts of light at night (fall time only) to produce a nice picture. This plus other equipment (camera, VCR, and inverter) came to under 300 watts,

which this generator easily handled, on a lower RPM setting that this generator was equipped with. This efficiency boosted gas economy to 10 hours per .61 gallons. An extended gas supply was run into the generator's carburetor for more use without refueling. When not in use the extended gas supply was lowered to a level below the generator to avoid possible problems associated with a leaking carburetor needle valve. Another method was also used where the fuel supply was run into the generator fuel pump. It required more dismantling of the generator but the fuel supply could then be kept at a level lower than the generator. Although not necessary a timer switch was wired into the generator so the generator would shut off whenever desired. The generator was light and ran on the shore in a converted doghouse with an open front and a 6" square hole in the back for the exhaust to blow out. A 100' extension cord ran from shore along the fish wheel spar pole to the equipment enclosure. A number of generators have had to be replaced over the years (about 1 per year) and overall they don't seem to hold up to the long run times the project requires.

Honda 2500-watt generator (EB2500): used at camp to run the desktop computer. It ran all the camp equipment easily and was very quiet.

Batteries: four 6-volt deep cycle batteries supplied the stored 12-volt DC power. Although fewer batteries could be used, a generator shut down could necessitate the use of this much reserve power to keep the video running. The reserve allowed for minimal use of the water generator on days when drift was especially bad. The batteries all sat neatly in an inexpensive waterproof plastic tote in the bottom of the equipment enclosure.

Battery charger: a 10/30/50 amp (Schumacher SE-1250), taper charge, automobile type, charger was used. The charger will run constant at 8 amps at night with lights on. In 2006 plans are to go to a charge controller specifically made for constant use (the auto type chargers are not designed for continuous use).

Inverter for light: an inexpensive 150-watt modified sine wave inverter worked well and drew minimum watts. A 300 watt modified sine wave inverter was used also and had the advantage of a power off switch. These inverters are replaced each year because of durability problems. Spares were always on hand.

Lights: two 90-watt halogen 27<sup>0</sup> beam GE floodlights. One was run off an inverter from the DC batteries in case the gas generator system ever shut down. The other light ran directly off the generator in case the DC inverter system failed. Each light had an adjustable light sensor wired in and was quite workable with each light coming on independent of the other as darkness progressed. During a generator, light, or inverter failure, one light could produce a dark yet fully countable video. I found these to last the length of time stated by the manufacturer so I started writing installation dates on each light and changing them before they would fail.

### *Fish Wheel Chute*

On wheels equipped with live boxes a "chute" is used to pass the fish from the wheel baskets over the raft logs and into the live box. Wheel sites do exist that do not require vertical adjustments to the axle; this site however required adjustment in times of lower water. The chute, therefore, had to be adjustable in that it must go up and down to match up to the changing level of the baskets or fish injuries increase from fish dropping rather than sliding into the chute. This means the camera, enclosed sides of the chute and the chute must be one

unit to eliminate refocuses of camera, especially in bad weather, in times when the wheel axle/baskets are needed to be raised. The chute enclosure in 2000 was the source of some of the greatest trials and tribulations (Zuray, S. 2000). In 2001 the laptop/switch method developed, with the help of Dave Daum, eliminated the need for all the sunlight and wind blocking structures of the fish wheel chute. The bottom (viewing area) of the chute was lined with white UHMW 3/16" thick plastic. It was easily cleaned and stayed white, the preferred color background for the video images.

#### *Chute Door/ Magnetic Switch*

A door made of 1/4-inch plywood covered with 3/8-inch thick closed cell foam was constructed to fit over the exit area of the camera chute. The magnet that activated the trigger switch was mounted on the door. The switch itself was mounted in a stationary position adjacent to the magnet. When the door moved outward approximately three inches the magnetic field around the switch weakened sufficiently to close the switch. This sent an electrical current to a serial interface that in turn communicated the switch event with the computer. The door was hinged on top with fish exiting out the bottom. The operation of the door had to be light enough so that even small whitefish could open it, and at the same time, it had to close positively without bouncing when large fish passed. A bouncing door could cause the switch to open again after a fish had passed, resulting in empty frames captured. A 2-foot wooden rod was attached to the top of the door and acted as a counter-balance. The rod was attached by a length of nylon cord that passed through a pulley to a weight suspended in an "ABS" plastic pipe filled with a water/anti-freeze mixture for all weather use. The weight was made of a plastic pill bottle filled with the solution and some lead shot. The action of the weight, dampened by its movement through the liquid, caused the door to slow down just before it reached the closed position, providing bounce-free operation. This system, developed on site, worked very well but required considerable trial and error to install correctly. The length of the handle, the height of the pulley, and the amount of shot used for weight are factors to be synchronized. This dampening system was necessary because of vast differences in the way a 1/2-pound cisco and a 50-pound Chinook salmon went through a hinged door. A buzzer was installed in-line with the switch to provide an audible indicator that the switch was working. In 2003 a simple wind counterbalance was installed at the top of the 2' wooden rod on the chute door that removed much of the false door openings cause by heavy wind.

#### *Fish Wheel Construction*

It is counterproductive to install a video system only to have fish injured by the fish wheel unnecessarily. The fish wheel used was specially built to try to eliminate injuries. Basket sides have seine webbing and no braces creating a sort of trampoline in the critical areas. The basket bed was lined with 1 1/2" x 1 1/2" high-density plastic webbing in 2001 and 2002 and 1" x 1" vinyl coated wire in 2003 to 2005. All entrance and exit doors are lined with closed-cell foam. Easily removable paddleboards of different sizes allow much control of the fish wheel rotation speed. Rotation needs to be consistent with no prolonged hesitations but should not be so fast as to lift the fish high before it has a chance to migrate towards the basket chutes. In 2003 to 2005 basket chutes were completely lined with durable 5/16" closed cell foam that was contact cemented to the chute boards. This produced dramatic results in the reduction and for all practical purposes the elimination of bloody gills in Chinook.

#### *Electronics*

Panasonic color 1/3" format CCTV camera: (model WV-CP474 with 480 lines

horizontal). This camera has many user selectable features including shutter speed that was critical for providing quality images. The camera has 12-volt DC power input and standard BNC video connectors for video output. Numerous lenses are available. The lens selected is described below. This camera used in 2001-2005 produced noticeably better images than the similar model WV-CP464 used in 2000 and is still running fine.

Lens: by Computar, vari-focus model TG3Z271FCS, 2.7-8mm,F1.0 TV lens, color camera. A nice piece of equipment new in 2002, improved the pictures that made the system work. The color, zoom and focus capabilities of this camera were essential features. The camera mounts and waterproof case were under \$1000. A waterproof camera housing was necessary and we kept a good amount of silica gel in it at all times to absorb any water vapor trapped inside the case (Pelco Surveillance Camera Housing) and is still running fine.

Monitor: a 3"X5" color LCD monitor wired to the 12 volt system and the VCR provided a picture of the camera's view for focusing, zooming, and positioning and camera parameter settings at the fish wheel. All of these of course needed to be done on the wheel. It was supplied with 6-ft long wires and could be put right next to the camera during these adjustments for easy viewing and is still running fine.

Video Recorders: these are presently used mostly for our backup system. Video cameras are connected to a 12 volt DC video recorder (Panasonic AG-1070dc) with 12 and 24-hour time-lapse capability. The video recorder is placed in a waterproof Pelican case and wires ran to the outside via waterproof connectors. The video recorder stores images on the videotape at a rate of approximately 5 frames per second on the 12 hour setting and it has a date and time stamp feature that is used at all times. A matching, second video recorder at camp is available to play images into the video capture card/computer for final luminescence capture. These VCRs have factory-cleaning recommendations of every 60 hours. This model of VCR is no longer manufactured. These are still running fine and kept available for instant installation in the event of a trigger system failure.

Desktop Computer: a desktop computer was used in camp to download video files from the fish wheel video system, review and tally fish, capture fish from VCR tapes, and organize data in spreadsheets and graphs. The computer had 3.20 GHz Pentium 4 processor, 1024 MB 400 MHz of DDR SDRAM memory, Windows XP operating system, Recordable/Rewriteable DVD RW/ R/CD-RW, analog PCI video capture card, and multiple card reader installed. The card reader was used to download the video files from the IBM micro-drive. All files were backed up on compact disk. This computer is new in 2004 and capable of the video work required by this system.

Laptop: connected directly to a camera on the fish wheel though a USB analog capture card. The laptop was a Panasonic Toughbook CF-48. It was the only laptop found that was capable of running on straight 12-volt current. The laptop had a Pentium III 700 Mhz processor, Windows XP operating system, 20 GB hard drive, 500 MB of SDRAM, and an 8 MB video card. An IBM 1 GB micro-drive was used to move video files from the laptop to the camp's desktop computer.

Capture and video review software: Salmonsoft capture software Vcap 1.4.0 was used to capture fish images off the fish wheel. The software allowed use of a trigger switch to record

fish images as they slide down the fish wheel chute. In camp, video files (AVI format) were reviewed and tallied using Salmonsoft viewing software Vcap Rev 1.4.0. This software could view video files, play files forward and reverse using user controlled scroll speeds, and tally fish with user defined keyboard keys.

Wireless Video Communications System: Model CS-300 made by Premier Wireless Inc. In 2002 this 5.8 Mhz microwave transmitter and receiver were used to experiment with sending the video signal from the fish wheel to camp 1/2 mile away. The objective was to run the system for the entire fall season along side the existing video capture system to see how it performed in various environmental conditions, i.e., wind, rain, and fog. The system performed flawlessly in 2002 and the complete system was installed and ran on the fish wheel from 2003 to 2005 thereby eliminating the need for having the laptop capture system on the fish wheel. All video capture was done back at camp. This reduced power requirements at the fish wheel, reducing amp/hr usage from approx. 3.4 to around .5 amp/hr. The USFWS Fairbanks Field Office loaned the project the wireless system used in 2002 and 2003. Along with the advantages realized in normal use of this wireless system, the ability to run multiple capture systems, both luminescence and magnetic trigger initiated ones, for experimentation purposes, has been greatly enhanced. Having multiple unproven systems on the fish wheel would be difficult in many regards. With wireless this experimentation can be done at camp. In the 2004 season we ran 2 trigger systems with different operating systems and one luminescence system for assessment. The wireless video system made this much simpler and is still running fine.

#### *Project Related Areas of Study*

*Flesh color and fall chum arrival.* The summer chum run in this section of the river is relatively small in numbers and is made up of chum whose fat reserves are low (most are close to their spawning areas) and therefore their flesh color is very pale in roughly 90% of the population. These chums are of much lesser value for people and dogs. With the arrival of the fall chum in late July and early August a distinct and unmistakable change takes place. What happens is in a matter of 3-5 days (occasionally longer) after the summer run has been providing people with say consistent 10% red flesh fish, the percent of red fleshed fish will rise progressively to 50 - 75% or as high as 90% (mostly depending on the amount of summer chum still running and mixing in). The “official” start date for the video project begins when the red flesh color passes the 50% point. This method has supplied Rapids video project with the most accurate date to start counting fall chum each year since 2000. Presently no other method including genetic analysis has replaced it although this project has supported genetic proposals to do so.

*Fish wheel efficiency model.* Daily mean water discharge readings from the Yukon River, near the Haul Road Bridge, were used to monitor the changes in river volume at the Rapids after adjusting for time differences. The discharge site is maintained and the data distributed by USGS. Since very little addition to the Yukon River’s water volume occurs between the Haul Road Bridge and the Rapids, the USGS site is a useful tool for estimating river volume at the Rapids. The existence of an historical database adds to the site’s utility. The Rapids site is fortunate because discharge levels directly affect current speed at the fish wheel in a linear fashion. The correlation between discharge/water speed and fish wheel catch efficiency, seems to have provided an effective model for more accurately describing run strength at the Rapids site.



Why discharge adjustment is able to work at the project site is because from the lowest water (fall 2004) to the highest water, there is never a time when the current does not speed up if the water goes up or slow down if the water goes down. This is not the case with most fish wheel sites such as my Rapids north Tagging wheel or the other Rapids subsistence wheels. The discharge and water speed at the video site do have a linear correlation or relationship (took current readings during the 2004 season). The video fish wheel is 1 of 2 wheels providing fish for the USFWS Rampart Rapids Tagging project and after 9 years of Tagging Project data it is clear the efficiency of the fish wheel increases in fast water and decreases in slow water (again linear). Traditional Ecological Knowledge also suggests fish move to the bank (near the wheels) in fast water and spread out in slow. By using daily efficiency data (% the video CPUE wheel catches of the Tagging Project) plus manipulations using escapement data a formula was made that produces adjusted CPUE estimates that more accurately reflects fish passage. The discharge formula continues to be improved on each year as more data is produced and analyzed.

*Water temperature.* An Onset StowAway TidbiT© water temperature data logger was installed at the fish wheel for the duration of the fishing season. The logger was installed on the fish wheel lead at about 3 m depth. Measurements were taken daily at 1 h intervals and mean daily water temperature was calculated by averaging the hourly readings. These measurements were taken from 2003 to 2005 in an effort to provide more points of temperature data collection on the Yukon River, to explore possible effects on fish wheel efficiency that temperature variations might have and to have temperature correlation data for the *Ichthyophonus* disease studies at the Rapids.

*Diel catch patterns.* These patterns are not at present available for Chinook because of the lack of large enough numbers of captured Chinook salmon, large amount of days containing hours with 0 Chinook captured and 12 hour project run time. While the existing data has been looked at with interest, the project is unable to present any statistically valid diel patterns at this time. The project's equipment and time does support this type of effort on the fall chum salmon run which typically starts during the latter part of the project. Seasonal mean hourly catch rates were calculated from days with 24 h of continuous data for fall chum salmon. First, hourly catch rates (fish/h) were calculated for all hours in each day. These hourly catch rates were expressed as proportions (%) of the daily catch so high catch days did not bias results. Then mean catch rates (%) by hour were calculated for the season. Only days with catches of over 100 fish were used to minimize using hours with no fish captured. This is another part of the work being done to explore movements of fish as it relates to the operations of the video project in an attempt to make the project more consistent and accurate.

*Water turbidity.* A standard Secchi disk was used to take daily readings on water clarity changes at the Rapids starting in 2003. This was done in a shaded area about 10' away from shore. Two readings were taken each day). Water clarity is known to affect fish capture and this is another area being explored for its effect on catch efficiency at the Rapids fish wheel (Table 1).

## Results and Discussion

The primary objective of the project is to collect CPUE data in a consistent manner year to year (Tables 2 through 5). The Chinook (Figures 1 and 2) and chum salmon numbers are presently the ones of most interest to ADF&G, USFWS and the Department of Fisheries and Oceans Canada. This data is only meaningful in as far as it relates accurately to actual salmon passing through the site area. That actual number is of course not available for comparison so other established Chinook and chum salmon assessment and escapement projects on the river are looked at and compared for indications of project accuracy.

*Chinook salmon.* Before the Rampart Rapids video monitoring project the Lower Yukon test net catches and Pilot Station Sonar passage estimates were the only inseason Chinook salmon assessment projects before the fish reached the Canadian border. Data provided at the Rapids video project provides fisheries managers with another view to help confirm or reassess estimates made in the lower river. This second look takes place after a large amount of subsistence harvest has taken place and the Tanana River component of the Chinook salmon run has branched off. Chinook salmon passing through the Rapids (40 miles above the confluence of the Tanana and Yukon rivers) are largely Canadian bound and accurate assessment of those numbers are of great importance in meeting U.S. border passage obligations.

Below, the project is compared to three major Chinook salmon, Yukon River drainage projects. The project is only six years old so only years 2000-2005 are compared.

Year	24 hr. expanded Rapids cumulative		Lower River set net cumulative	Pilot Sonar estimates	Canadian Border estimates
	<u>All</u>	<u>Large</u>			
2000	1708		14.12	70,112	16,995
2001	5563		15.23	137,453	54,029
2002	1667	911	20.23	183,505	43,359
2003	1646	1351	27.06	253,774	58,082
2004	2854	2000	20.48	188,874	48,500
2005	2061	1485	17.8	143,997	45,000

Some figures are preliminary at this time

Some comments on the above numbers:

One area of note is the similarity in overall Chinook salmon numbers in 2002 and 2003 for the Rapids project. This drew our attention because the overall number was the one most used in the past to measure run strength and the project operator did not feel the 2002 and 2003 runs were similar in strength at all. The runs were also not viewed as similar in strength by any of the subsistence fishermen in the Tanana and Rapids area fish camps, which numbered about fifteen. This accelerated an ongoing investigation into just how extreme the abundance or absence of small Chinook salmon in a population can affect the projects assessment of run strength.

Starting in 2003, length measurement marks in the video chute have allowed classification of Chinook salmon into small or large salmon based on length (< 70 cm total length = small). Though not as accurate as manual measurements, the marked chute provides a way to differentiate between two size-classes of fish. Separating the Chinook salmon run into these two components was believed to give a better picture of the run when comparing its catch

to other assessment projects. Because the video chute in 2002 had the same marks as the 2003 chute, the 2002 Chinook salmon video avi files were recounted separating the small and large fish. The results were dramatic and show just how far off a run assessment can be if some small separation technique is not employed. For example, the total number of Chinook salmon captured at Rampart Rapids video project was just over 1,600 fish in both 2002 and 2003, but when the small and large Chinook salmon are separated one sees a catch of large Chinook salmon (= or > 70 cm total length) in 2003 that is 67% higher than 2002. When the run is looked at from this perspective a very different picture in terms of fish numbers and pounds available to Chinook net fishermen, pounds available to wheel fishermen, and large fish (females) headed to the spawning grounds emerges (Figures 3 and 4).

Thus, by having the ability to separate the Chinook salmon run into the two size components, the result is a better understanding of the run characteristics and true strength. Future project plans are to develop a reporting method that includes the accuracies of the separation technique and to continue work on developing a digital measuring method to accurately measure individual fish with the help of Dave Daum (USFWS).

*Chum salmon.* Chum projects available for comparison are much more numerous with some of these using relatively accurate weirs and small stream sonar. A comparison technique used by USFWS for looking at upper Yukon chum salmon passage above the Tanana River involves adding together escapement projects, harvest, and border passage to see how that figure compares with in season monitoring projects. This project uses that method to evaluate its yearly discharge adjusted index or estimated passage of chum salmon at the Rapids site. Estimates for years 1996 to 2005 show a relatively close comparison using the projects discharge adjusted formula (Figures 5 and 6).

The 2005 fall chum run was estimated by Yukon River managers to be the highest in 30 years with a run estimate at the mouth of 1.8 million. Catch rates at the Rapids site exceeded 4000 one day in the video wheel with an estimated passage of almost 100,000 chum that day. Total season chum that were video counted was 78,628. The total estimated Rapids passage index produced by the discharge formula (ZRMC2) for fall chum was 1,459,167. When using the ADF&G fall chum start date the corresponding Rapids passage index number is 1,357,208.

*Diel catch patterns.* Hourly catch rates for fall chum salmon were slightly diel, with the highest catches occurring between 800 and 2000. Diel in 2005 was a bit stronger yet showed the same hourly pattern of occurrence as past years (Figures 7 through 9).

*Flesh color and fall chum arrival.* In 2005 video project supported efforts by the student data collection project determined a fall chum arrival date of July 31. Somewhat like 2004, the line between summer and fall chum was clouded by the fact the summer run was still peaking as the first major pulse of the “bright” fall chum showed up. This caused fall chum arrival day flesh rates to not rise as high as they are capable of (Figures 10 and 11).

*Fish wheel efficiency model.* Discharge levels are continuing to be explored, the last few years, for their effects on catch efficiency by the Rapids video project, Dave Daum, USFWS, and Bonnie Borba, ADF&G. Work by project leader Stan Zuray continues to show a strong linear correlation between discharge and fish wheel efficiency with chum salmon (Figures 12 through 16). In 2004 and 2005 discharge adjusted fall chum data was sent in daily with the normal CPUE data to state and federal managers (Table 2 and 3).

Daily chum numbers are adjusted, using a fish wheel efficiency model related to daily water discharge. This adjusted passage index continues to be worked on as a project objective with formula upgrades each season being made. The results appear to be much more inline with other Yukon run assessment projects than the unadjusted CPUE (Figure 13).

*Water temperature.* Daily mean water temperatures in 2005 varied from a high of 19 °C on July 20 to 8.23 °C on September 24. Within a day, water temperatures varied by around 1 °C during the season. The lowest readings were between 0600 and 1200 each day. Relative to 2003 and 2004 the 2005 temperatures ran a little cooler during the Chinook season, about average after that and quite warmer by project end in late September (Figure 17, Table 1).

*Water turbidity.* Secchi Disk readings responded to rises in river levels and early in the season the normal melting of glacial streams from high temperature days. Colder temperatures of advancing fall weather, lowering of the water level and subsequent clearing of the river are seen in the data too.

*Video system components.* The video system proved to be very accurate at counting fish that were captured by a fish wheel. Many of the potential fish handling problems associated with fish wheel capture have been eliminated by the development of this method. The video capture system used in 2005 has many improvements over the system used in 2000. Being able to have the laptop computer and capture software eliminate empty frames and store frames containing fish in real time on the fish wheel was a time saving of two hours for each 12 hours of data collected. The assessment figures (Table 6) show the consistent video capturing of the medium and large fish species. Small cisco whitefish continue to be a challenge, however even the cisco assessment figures show a 98% capture success rate in 2004 and 95% in 2005.

Finding the best software program settings to control the amount of frames captured before and after the magnetic switch was tripped was a matter of trial and error during the test period prior to the official start date. A setting to capture more frames than was necessary would mean larger than needed file sizes and more time spent reviewing video files. Settings that did not capture enough frames caused some fish to be missed either because they were not recorded at all or there were so few frames in the video file that human error came into play during the review process. Some adjustments to these settings were made in season usually associated with fish wheel captures of multiple fish when the run was the strongest. Software settings are influenced by the goals of each project. The video project is primarily used at present to provide CPUE data, with fish needing to be identified by species. If the project was attempting to sex chum salmon the number of frames collected might need to be increased. In applying this technology to a recapture wheel in a spaghetti tagging study one might also want to increase the numbers of frames collected so tagged and untagged fish could be identified consistently. Because of the improved review program being able to speed up or slow down the review process, more frames captured for each fish does not substantially slow down the overall counting process. The increase in file size this may cause is of small consequence considering the storage capacity of the laptop hard drive, micro drive transfer disk and final storage on CD-R disks.

A good review program is important for accurate and timely counting of captured fish. Improvements made to the program in 2001 allowed the user to adjust the speed at which the frames were reviewed. The tally for each species was made with a single click of the computer mouse instead of a mechanical counter and hand tallied on a paper form. Reverse, stop and forward controls were easily accessible and controlled by the keyboard. These features became

more important as the numbers of fish counted in a day increased. For example some years daily chum catches can approach 2000-4000 fish. At high numbers such as these every refinement becomes meaningful, not just to speed up the process but also to reduce operator error.

Operation of the laptop computer, interface, electronic components, software program, VCR, and camera all worked well enough in 2005 there was no day data could not be collected. Running longer into the evening or using our backup luminescence video capture system solved the few problems threatening a loss of a day's data. The laptop computer experienced occasional lockups during file transfer if files were large and the capture program was running in the background. On September 9 about 11 hours of data was corrupted because of multitasking the capture computer for testing purposes. This should not have been done and a lesson was learnt the hard way. A half-day of good data was collected however.

The building and maintenance of the fish wheel chute door was greatly simplified in 2001 and 2002. Construction techniques still require attention; because its operation is critical to the proper triggering of the laptop capture system. A door that was too heavy would not allow tiny cisco whitefish through properly and a door too light could be triggered by gusting winds. Both these conditions were again dealt with in the 2005 season as chute height adjustments forced workable compromises to be arrived at. The chute door dampening system never had a problem. The magnetic switch experienced 1 failure in 2005 and was replaced (no failures in 2002 and 2003 and one failure in 2001 and 2004).

Figures 18 and 19 show some of our project operation pictures.

*Video system testing.* The mechanical triggered video system developed during the 2001 to 2004 Rapids video projects has been installed and tested on four fish wheels operated in the Yukon River drainage. Two wheels were used for monitoring daily catch during the summer and fall season and two wheels were used for counting tagged and untagged salmon for mark-recapture experiments. As of spring of 2004 the video system operated for over 14,000 hours and recorded over 262,000 fish images. Salmon species (Chinook, chum, and coho salmon) were the most common species captured (235,962), followed by Bering and least Cisco (14,746), and sheefish (7,145) (see Figures 20 through 23 for 2005 whitefish data). Data were collected on total operation time, number of fish captured by species, and type and number of system failures. Throughout the testing period, comparisons were made between fish counted from the switch-triggered video files to: 1) fish collected in the fish wheel live boxes, or 2) fish recorded on time-lapse videotape. A video review program, Salmonsoft Fish Review, was used to tally fish by species from the digitized video files. Live box captured and time-lapse recorded fish were tallied by hand. Digitized and time-lapse recordings were synchronized and each frame was time-stamped so similar time segments could be compared.

During the multi year testing period, comparisons between numbers of fish recorded from the triggered video system were similar to fish recorded on time-lapse videotape and fish captured in fish wheel live boxes. A total of 357 hours of fish wheel capture were recorded on videotape and 1794 hours from live boxes. Compared to time-lapse recordings, the video system missed 34 of 3,462 fish (1%) that passed down the video chute. Of the 34 missed fish, 22 were small cisco species that passed under the exit door without triggering the switch and 12 salmon were missed because the software capture settings for frames captured before the trigger event needed to be increased to allow for multiple fish captures i.e., more than one fish sliding down the chute at once. Subsequent adjustments to the door and software capture settings eliminated undercounting by the video system. Compared to live box capture, the triggered video system recorded 660 additional fish, i.e., of the 19,499 fish recorded using the

switch program, 18,839 were counted in the live box. Fish jumping out of the live box before counting began and data recording errors explained the difference

## **Partnerships and Capacity Development**

The Rapids video project continued a close working relationship with the USFWS office in Fairbanks. Dave Daum has made trips each season to help with operations of the video CPUE project and assist in assessing those operations. Rapids video projects in 1999 through 2005 have also served as a center for research into fish friendly video development, low fish impact fish wheel improvements, and run assessment improvements related to diel catch patterns, and water discharge and clarity effects on catch efficiency, by the project manager and the Fairbanks Fish and Wildlife Field Office.

All years the projects doors were always open to the public and any agency personnel. A number of persons from the Fish and Wildlife Service and Department of Fish and Game view the workings of the project each summer.

Laurie Stack was the main contact person at the Department of Fish and Game for the daily reporting of data from the 2005 project.

In response to a number of persons requesting the project's data I started a list of persons to be emailed daily. While the project is in a partnership relationship with the USFWS its operation and results are not reported daily by them when they report their projects and same with ADF&G reporting. Hence the project in the past has mostly relied on YRDFA teleconferences and individual emailing to report data to the public. The list has been a good success and names were constantly added all summer long as I received requests for it. Presently the daily updates are sent out to 22 persons and include a lot of the graphs and tables seen in this report updated as I get information from other projects. Also there are short text reports on area subsistence and commercial activity. Anyone wanting on the list, email me they want on.

The Tanana Tribal Council and the Tanana City School District ran a USFWS Fishery Resource Monitoring Project called Tanana Conservation Outreach (TCO) from 2001 to 2003 (Peters Zuray, K. 2003). In 2004 and 2005 Tanana Conservation Outreach was run by Kathleen Peters Zuray of the Tanana Tribal Council Environmental Office. This project has brought multiple groups of 6 through 12 grade school children to the Rapids project site to work with the Rapids video project. Presently (2004-2005) this project collects full season sex, length, weight and disease information on over 1000 subsistence caught Chinook and flesh color and disease information on over 1000 chum in the Rapids area. This information is described as very important at many of the USFWS regional council meetings, YRDFA meetings, and state advisory council meetings that have taken place each year.

Each year the video project supports a number of research activities such as *Ichthyophonus* research by Dr. Kocan and Paul Herschberger in 2001 and 2002, the contaminants in salmon study by Keith Mueller and Angela Matz with the Fish and Wildlife Service in 2001, a 2003 bering cisco data and otolith sample effort for Randy Brown of the USFWS Fairbanks Field Office, and whitefish radio telemetry by Bill Carter of the USFWS Fairbanks Field Office in 2002 and 2003.

In 2004 a Bioelectrical Impedance Analysis project designed to investigate bio-energetic features (body fat, water retention, etc) in migrating salmon (Chinook and Chum) was conducted at Rapids working in conjunction with biologists from the Fairbanks Fish and Wildlife Field Office, Keith Cox (Doctoral student who designed this technique) from West Virginia University, Kyle Hartman (Professor) from West Virginia University, and Joe Margraff (Professor, Co-op

leader) from the University of Alaska, Fairbanks. Testing in 2005 continued with fish out of the video fish wheel.

In 2005 with student from the TCO project, genetic samples and data from whitefish species were collected for biologists with the Department of Fisheries and Oceans Canada. This collection was spread over the season.

The video system developed at the Rapids project has been transferred to and currently operates on the Tanana River 5A test fish wheel (Fliris, B. 2000), Rampart fall chum tag recapture fish wheel (USFWS) and the Nenana test fish wheel (ADF&G) Numerous other inquiries have been made from other river systems and the technology has been adjusted to operate at weirs and counting towers.

Rapids video project continues to be a major source of development work in video technology and fish wheel monitoring methods.

Figures 18 and 19 in this report show some of this capacity development effort. The site of these projects can be seen in the map provided (Figure 24).

## **Conclusions**

1. CPUE data can be dependably generated by a fish wheel live box alternative such as a video capture system.
2. Workable and often inexpensive improvements to a fish wheels construction and operation can dramatically reduce injury to sampled fish.

## **Recommendations**

1. CPUE data is only valuable if it is a reflection of what is actually happening in the river. To this end the Rapids video project maintains a list of project components that may influence CPUE data (see Project Specifications on page 9). Future projects at this site should incorporate these specifications to aid in more accurate data collection and interpretation.
2. From 2003 to 2005 USGS water discharge data for the Yukon River was used for the adjustment of the CPUE data at the Rapids. Based on positive results and improved project usefulness the effects of high and low water and other factors on CPUE should be investigated further.
3. Each year this project provides local fishermen with run timing and run strength information verbally and through bulletin board postings in Tanana. It is often quite difficult to consistently find the data necessary to keep all Yukon River project updates current. We have State, Federal and private projects (such as this one) all with different mechanisms and success for getting the data to the public. I would like to see an Internet web site updated with the daily numbers and information from all projects on the Yukon River. Project managers, fishermen, and concerned persons need to have the data in a timely manner to assess their own projects, know when fish pulses are arriving, and provide information to Yukon River Drainage Fishermen's Association (YRDFFA) representatives for weekly teleconferences. I have been recommending this for many years now and would be grateful to see some agency or private project take this on.

## **Budget Summary**

Total Cost: 32,000 (1 year project)    Project Dates: June 1 to September 25, 2005:

a. Total Annual Budget	32,000
b. Expenditures Thru December	32,000
c. Balance Thru December	0
d. Anticipated Remaining Expenditures	0
e. Anticipated Final Balance	0

Additional information: No alterations to the budget were necessary.



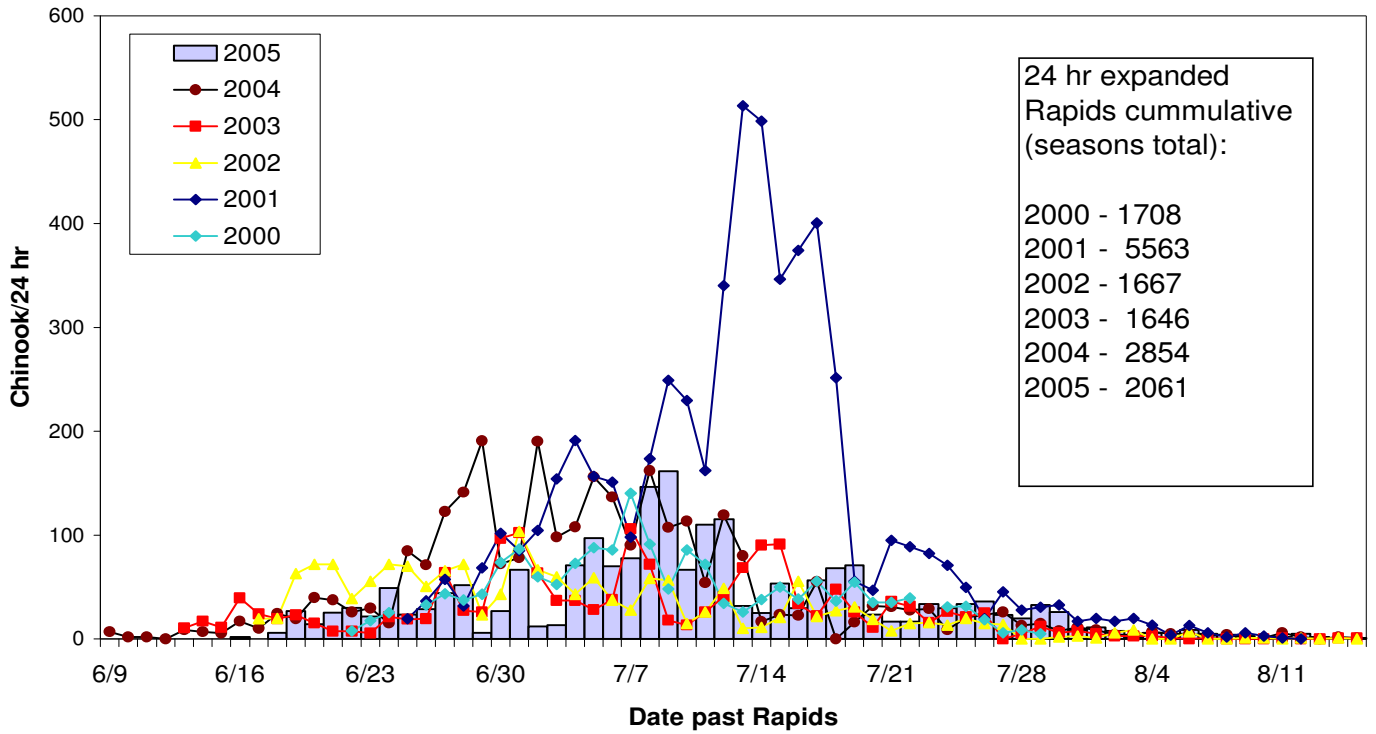
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Figure 1

**2000 - 2005 Chinook CPUE, Rapids  
(Rapids Research Center)**



**Rapids Video CPUE Compared to Lower Yukon Set Net CPUE  
Chinook 2005 (Rapids Research Center)**

Figure 2

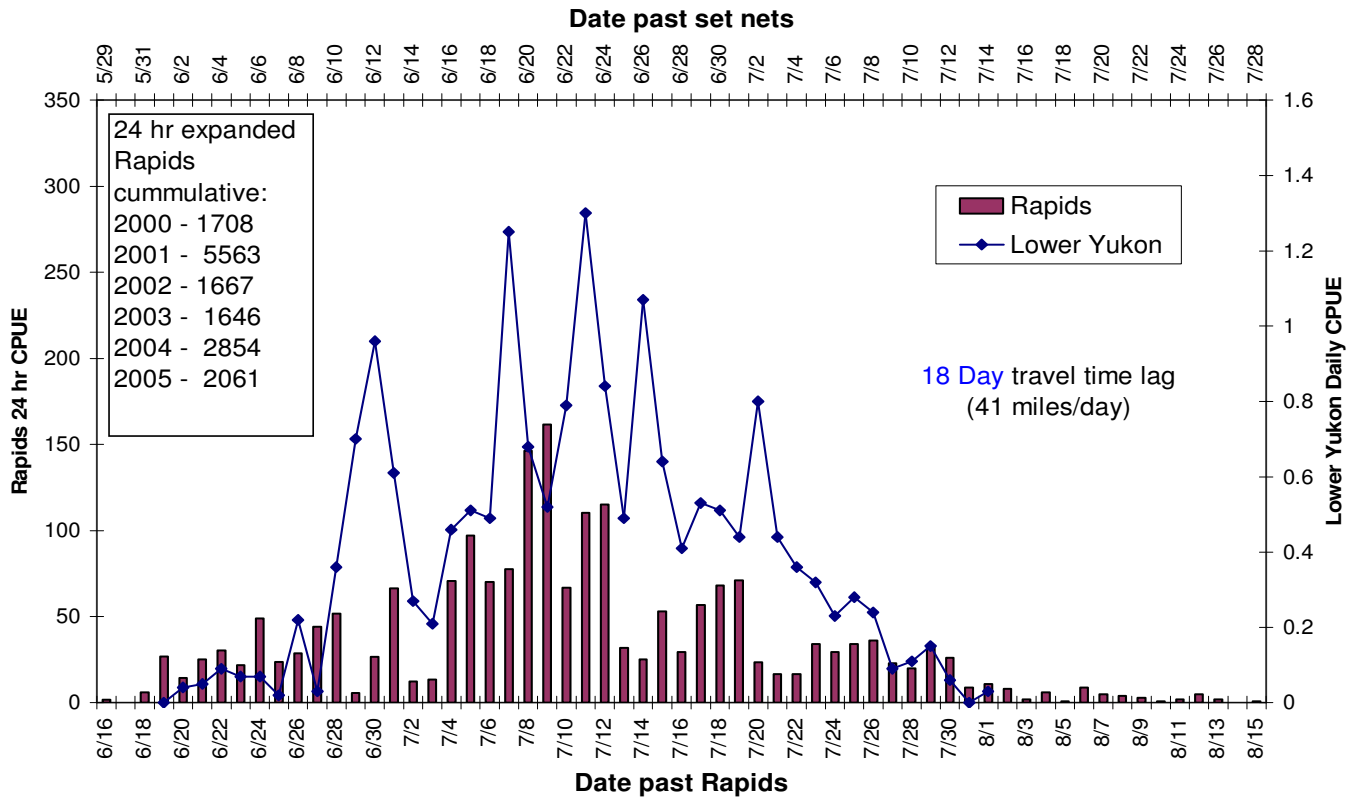


Figure 3

**2002 to 2005 Large Chinook Cumulative CPUE Compared to All Chinook Cumulative CPUE (Rapids Research Center)**

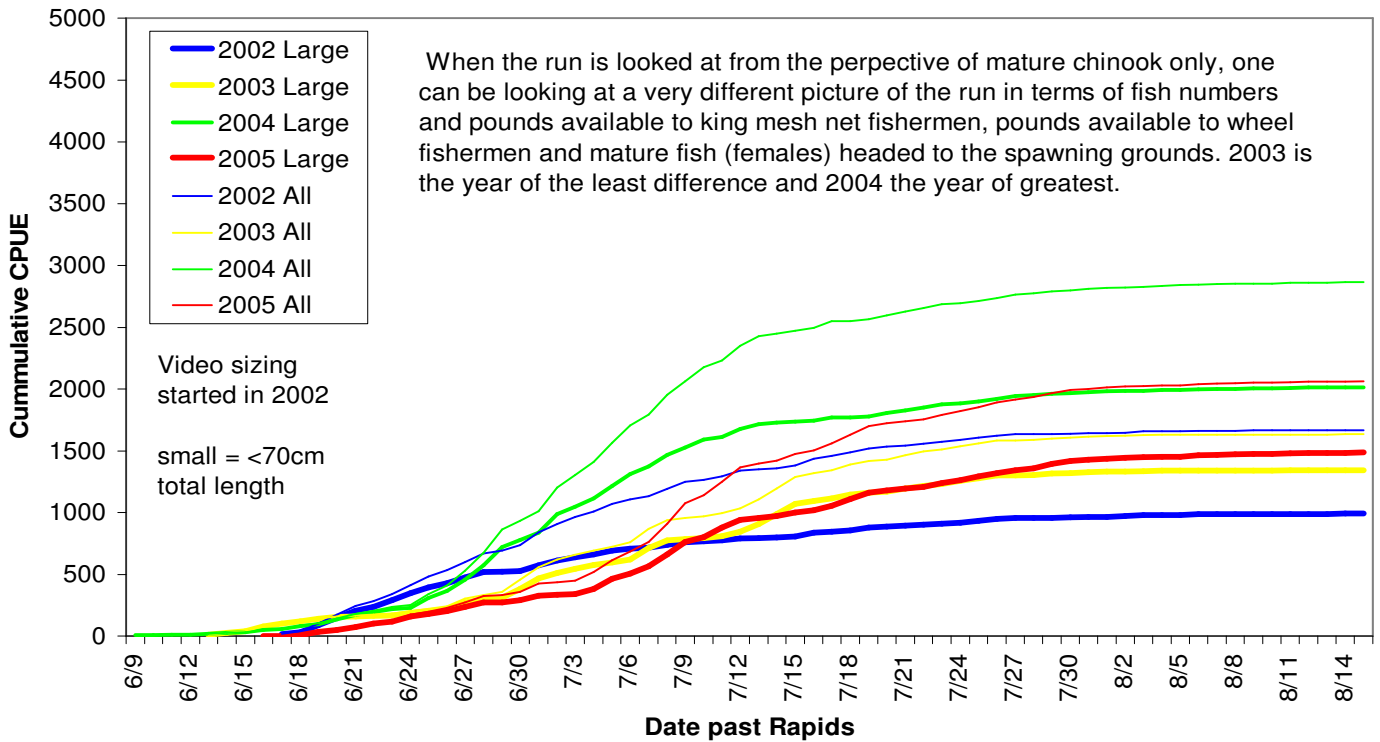


Figure 4

**2002 and 2003 Large Chinook Only - 24 hr Expanded Counts Rapids Video Fishwheel, (Rapids Research Center)**

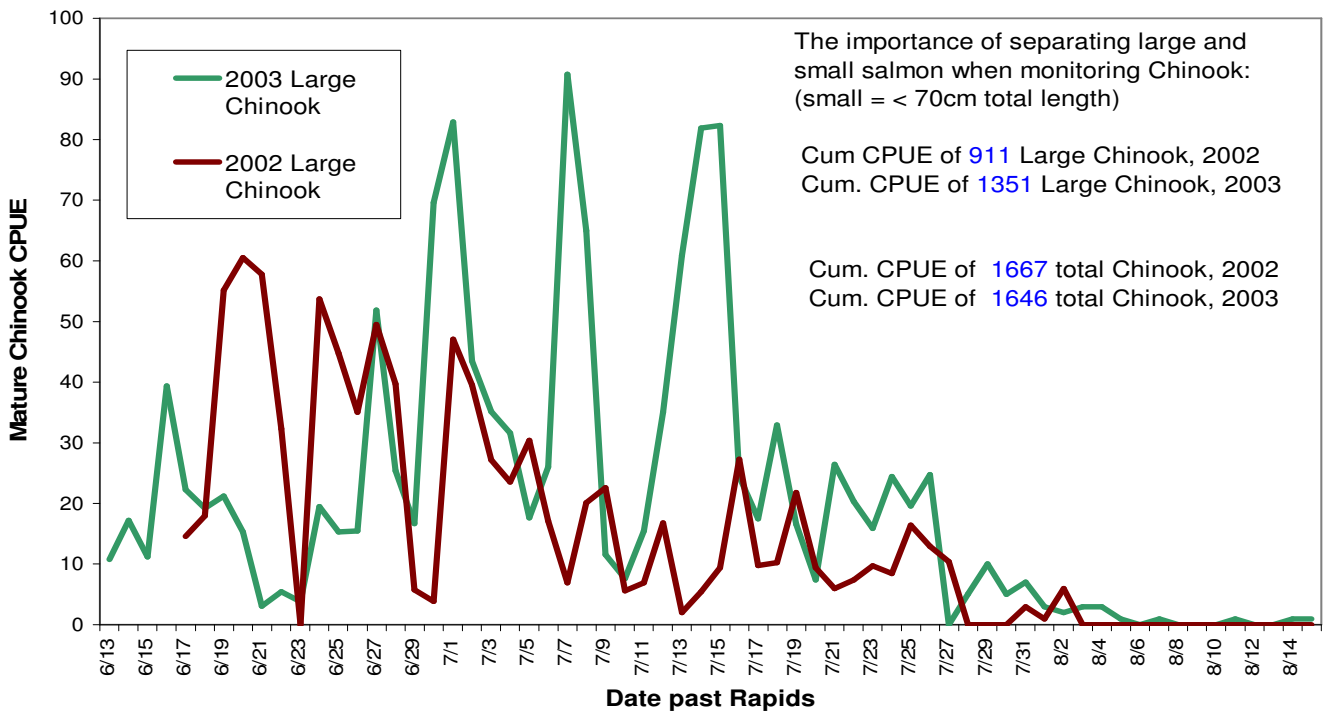


Figure 5

**Rapids Video Discharge Adjusted Index and Pilot Station Sonar Compared, 2005**  
**Chum (Rapids Research Center)**

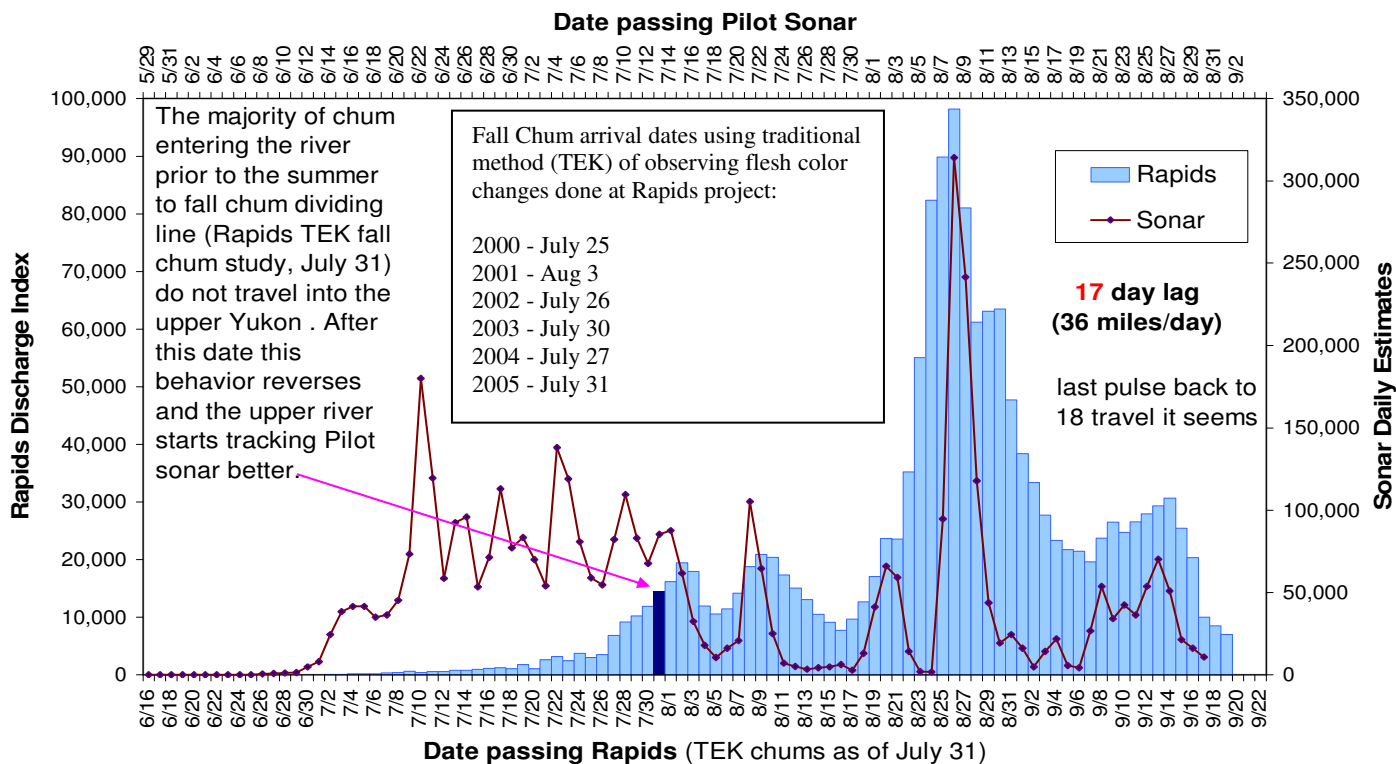
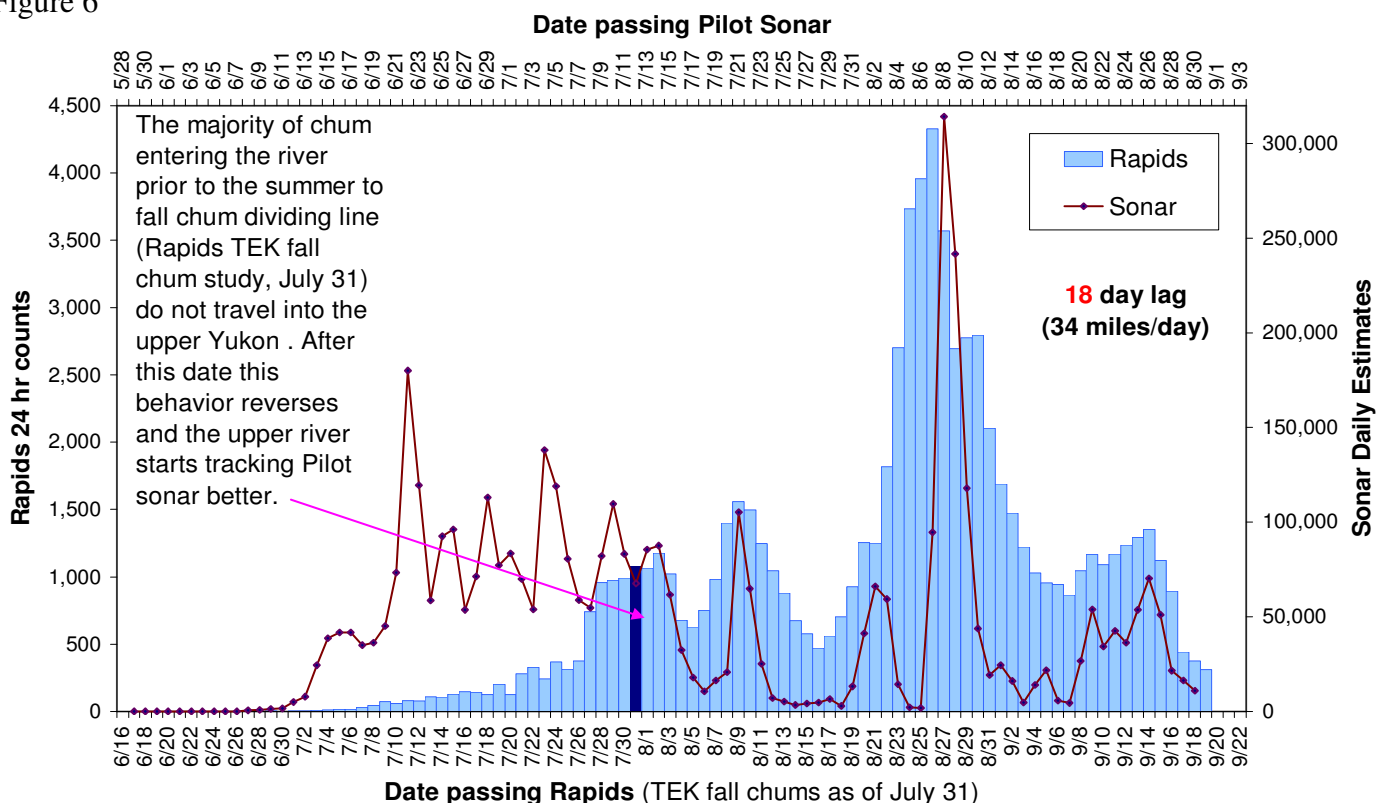


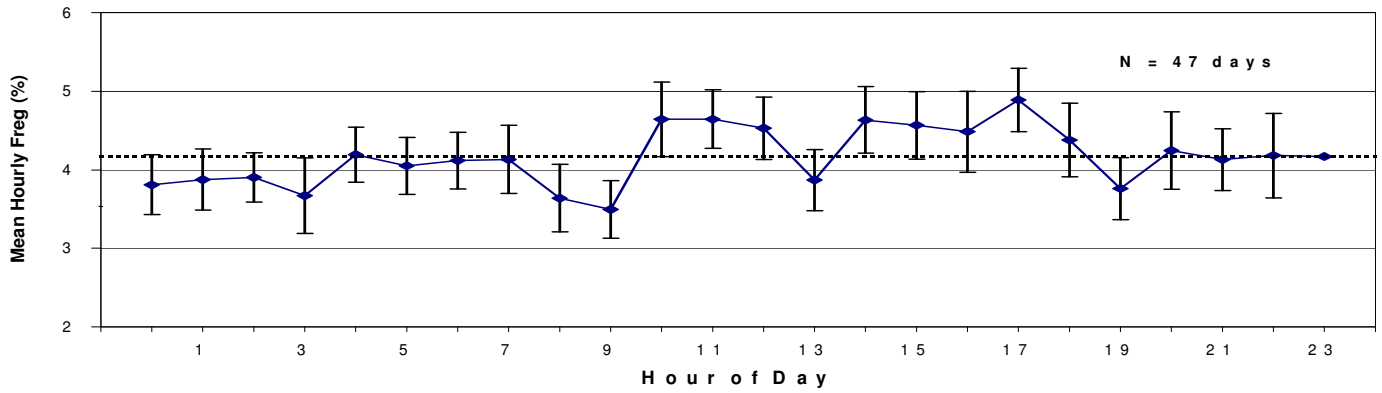
Figure 6

**Rapids Video (Unadjusted for Discharge) and Pilot Station Sonar Compared, 2005**  
**Chum, (Rapids Research Center)**



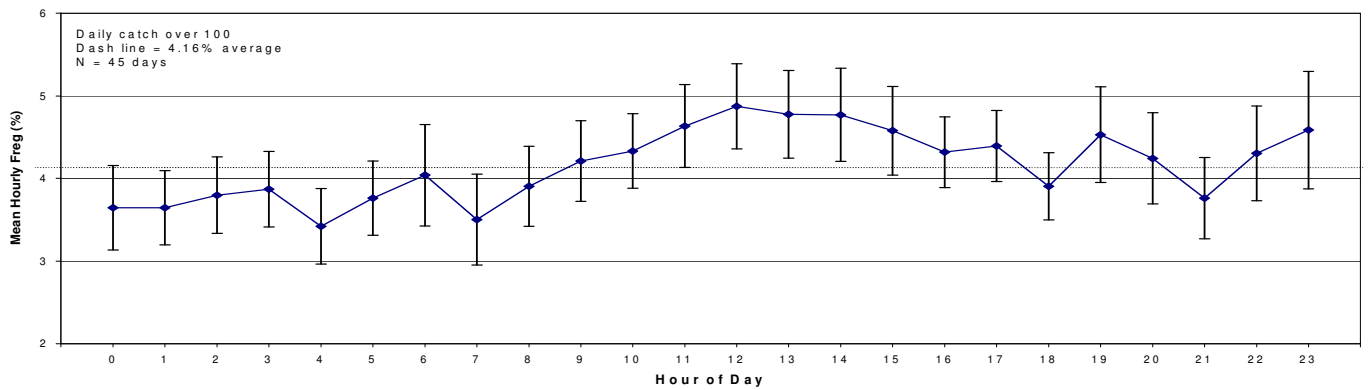
**Figure 7.** Diel catch patterns of 2003-2005 fall chum (Thanks to Dave Daum, USFWS)

Mean ( $\pm 2SE$ ) hourly frequency of fall chum salmon caught at the Rapids test wheel, Yukon River. Dashed line represents the average hourly catch (4.16%). Data include only days with 24 h of continuous records and a daily capture of over 100 fish.



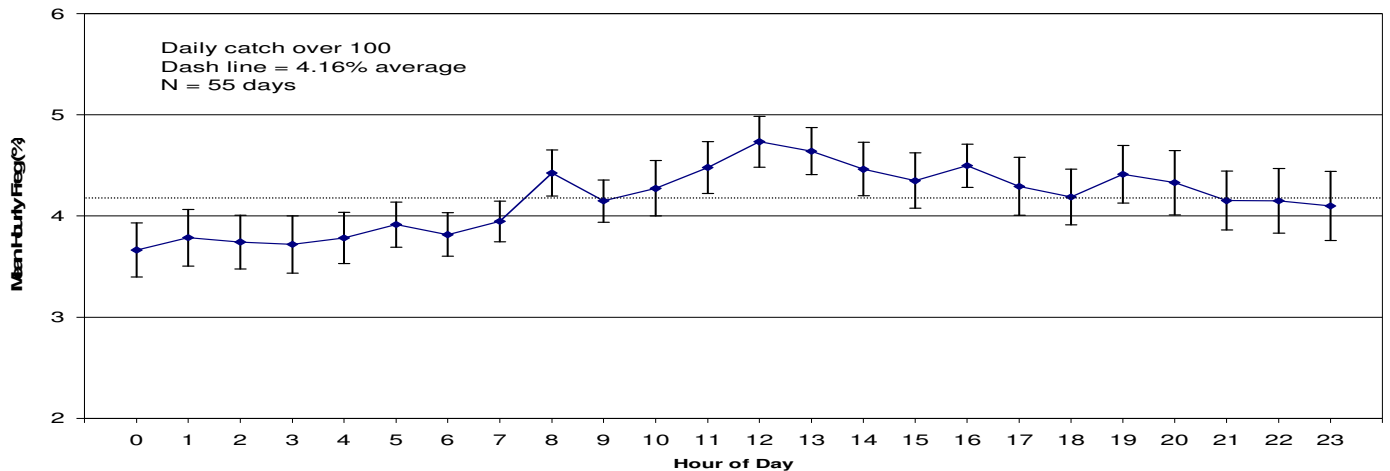
**Figure 8**

**Percent Hourly Passage, Fall Chum Salmon, Rapids, 2004.**  
(error bars are 2SE) (Rapids Research Center)



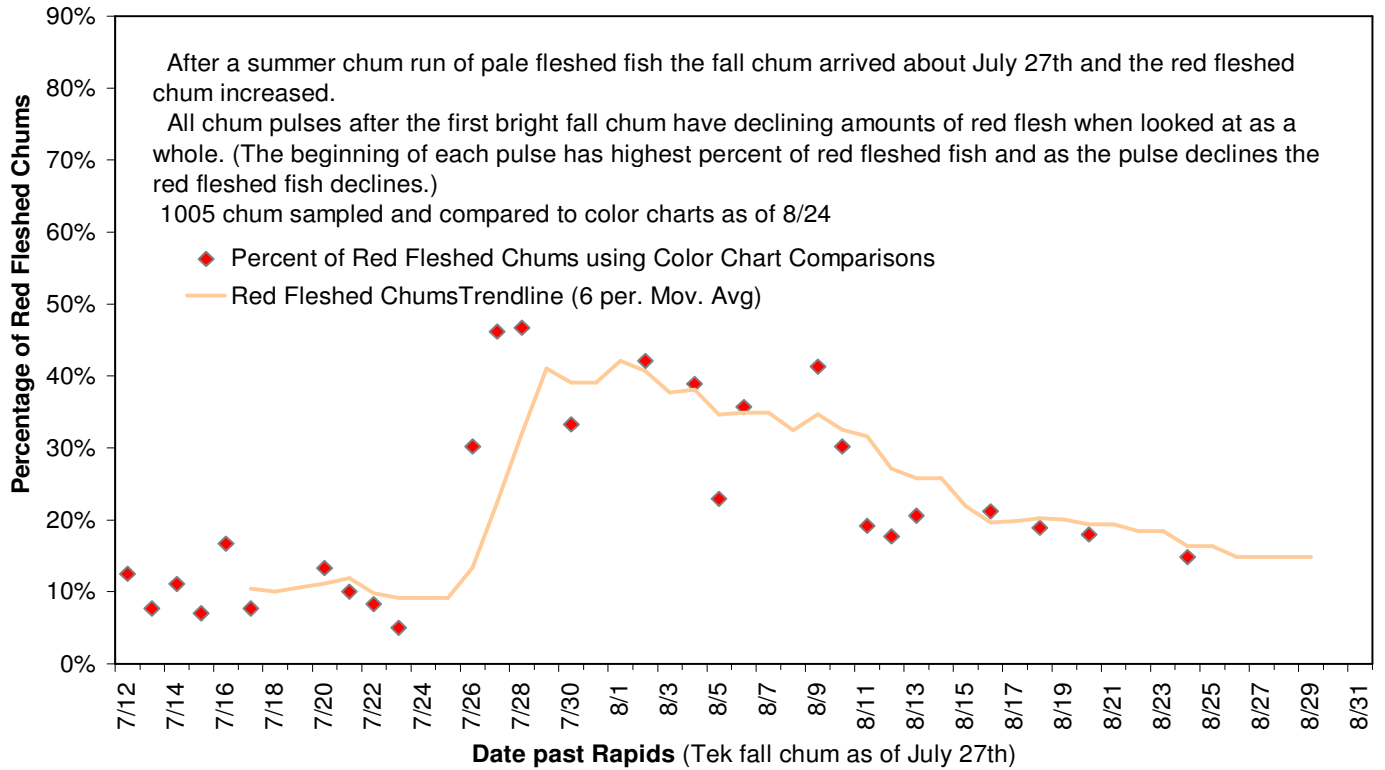
**Figure 9**

**Percent Hourly Passage, Fall Chum Salmon, Rapids, 2005.** (error bars are 2SE)



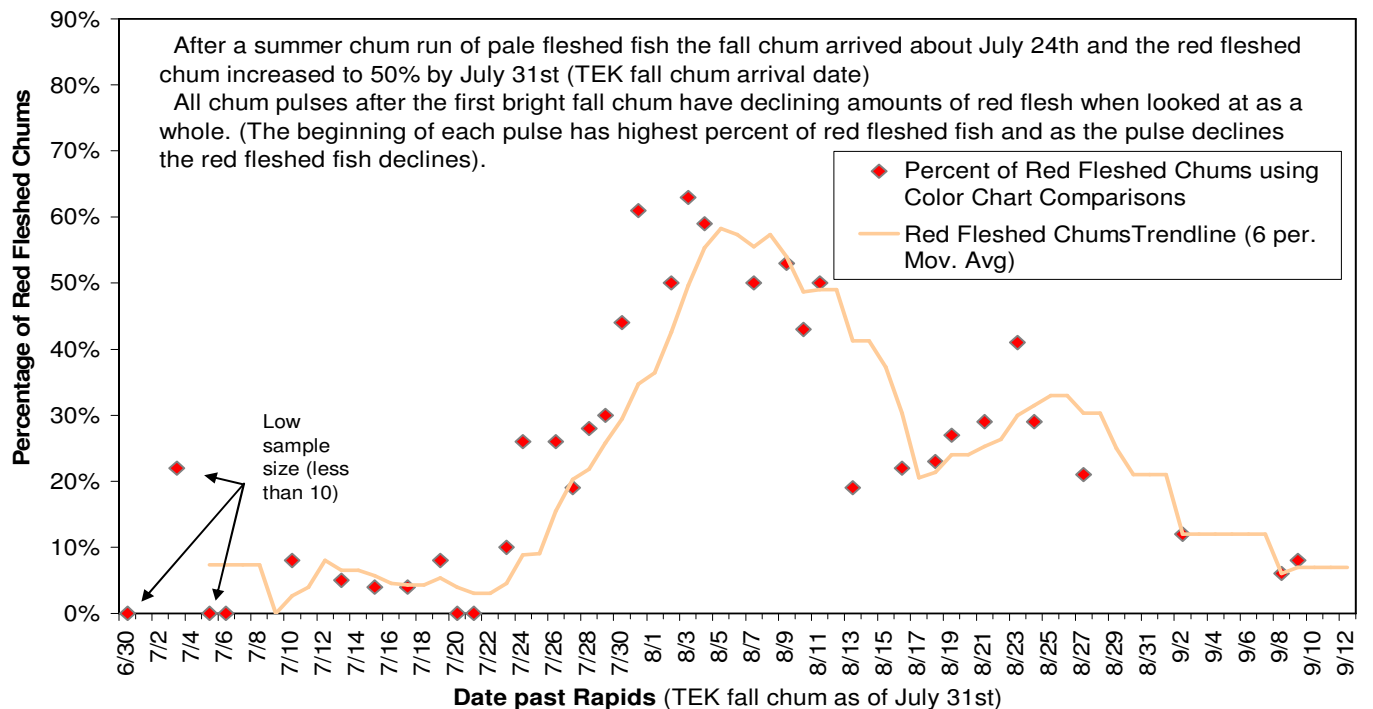
**Figure 10**

**Percentage of Chum that are Red Fleshed, 2004**  
 1 or 2 on color chart (Rapids Student Research Center)



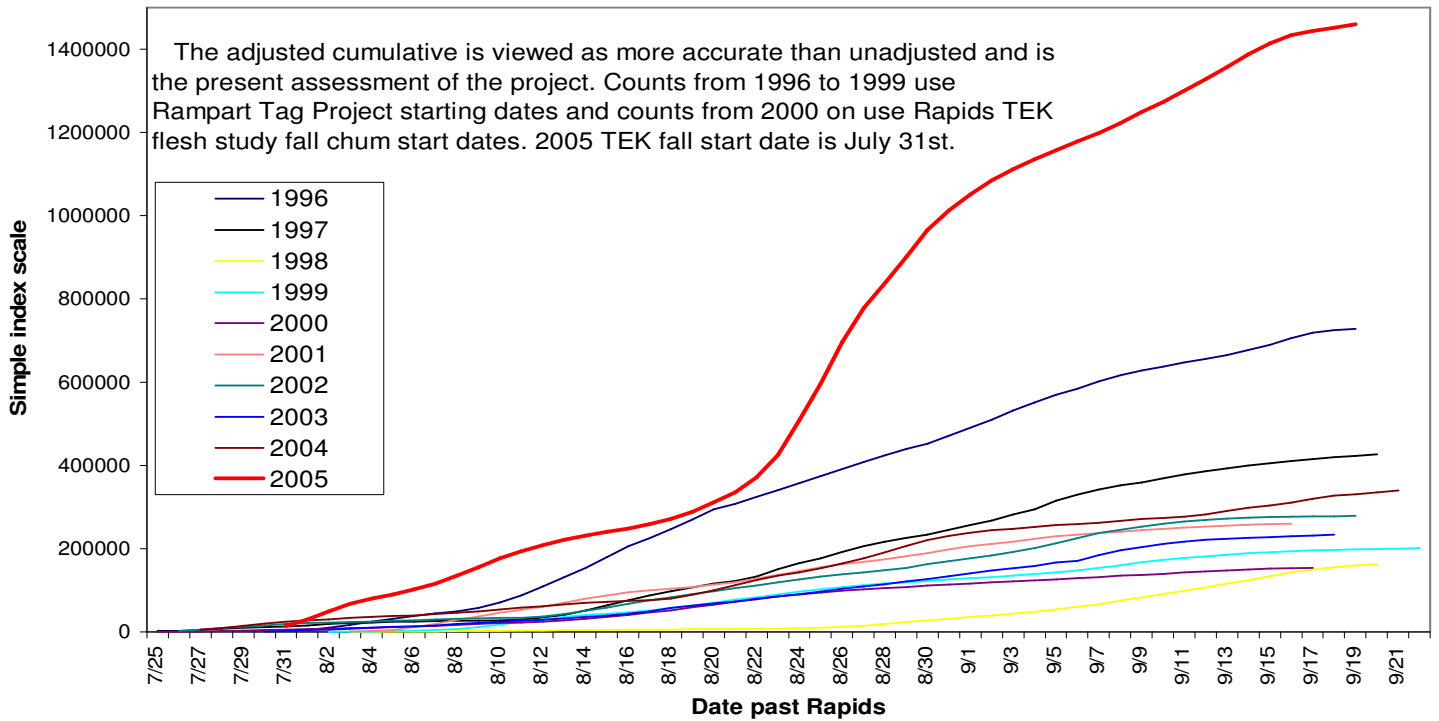
**Figure 11**

**Percentage of Chum that are Red Fleshed, 2005**  
 1 or 2 on color chart (Rapids Student Research Center)



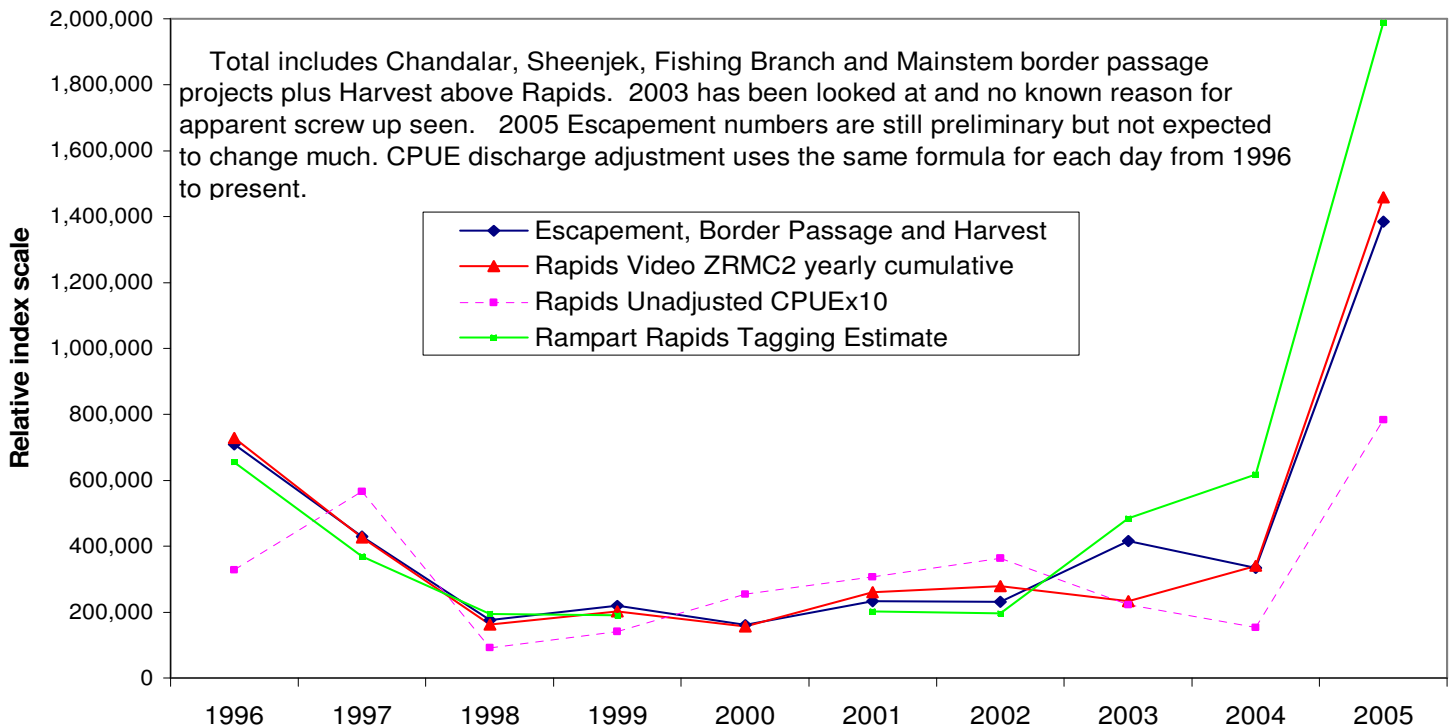
**1996 to 2005 Rapids Video Fall Chum CPUE Adjusted  
Using ZRMC Discharge Formula  
(Rapids Research Center)**

**Figure 12**



**Figure 13**

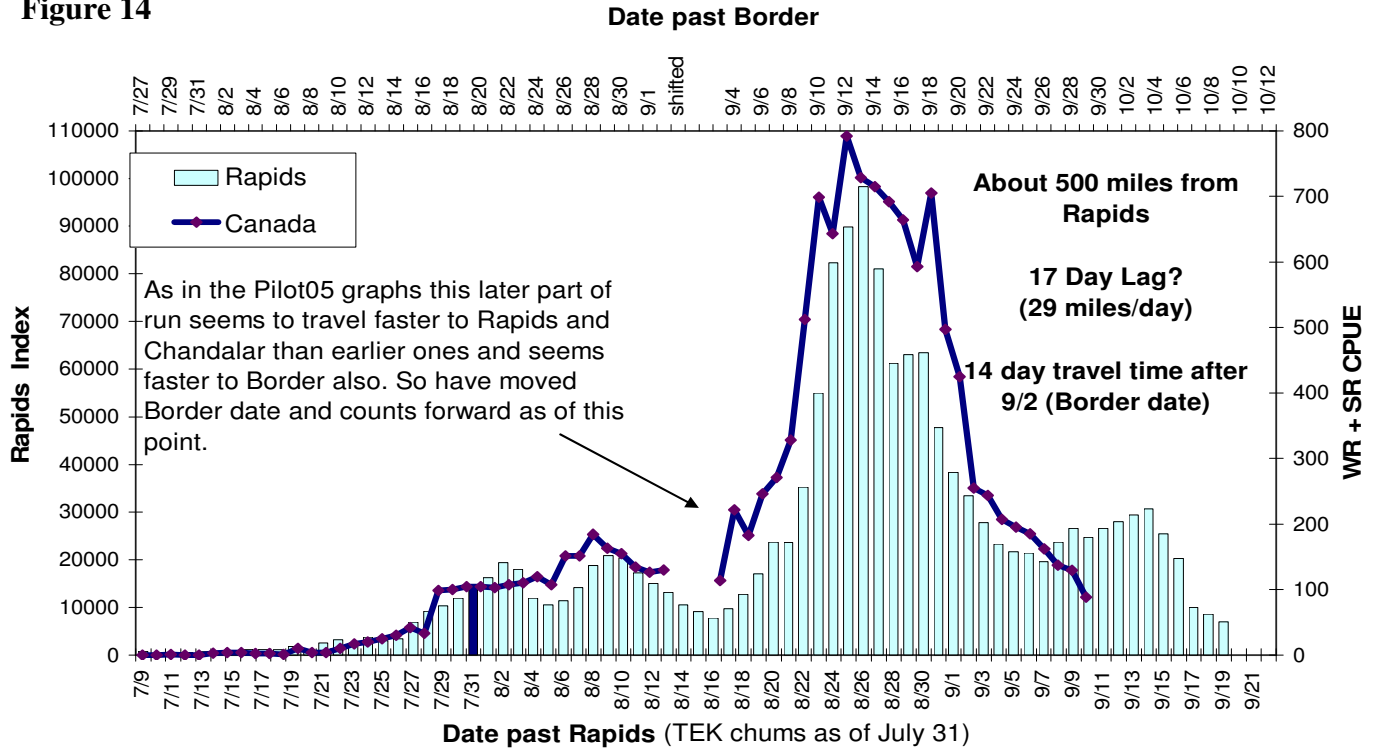
**1996 to 2005 Upper Yukon Fall Chum Escapement Projects, Border Passage and Harvest Combined and Compared to Rapids Video, Discharge Adjusted CPUE (ZRMC2) and Rampart Rapids Tagging Estimate (Rapids Research Center)**





**Rapids Video Discharge Adjusted Index Compared to Combined Canadian Border Testwheel CPUE, Chum 2005 (Rapids Research Center)**

**Figure 14**



**Chandalar Sonar Counts and Discharge Adjusted Rapids Video Count Index Compared, 2005 Fall Chum, (Rapids Research Center)**

**Figure 15**

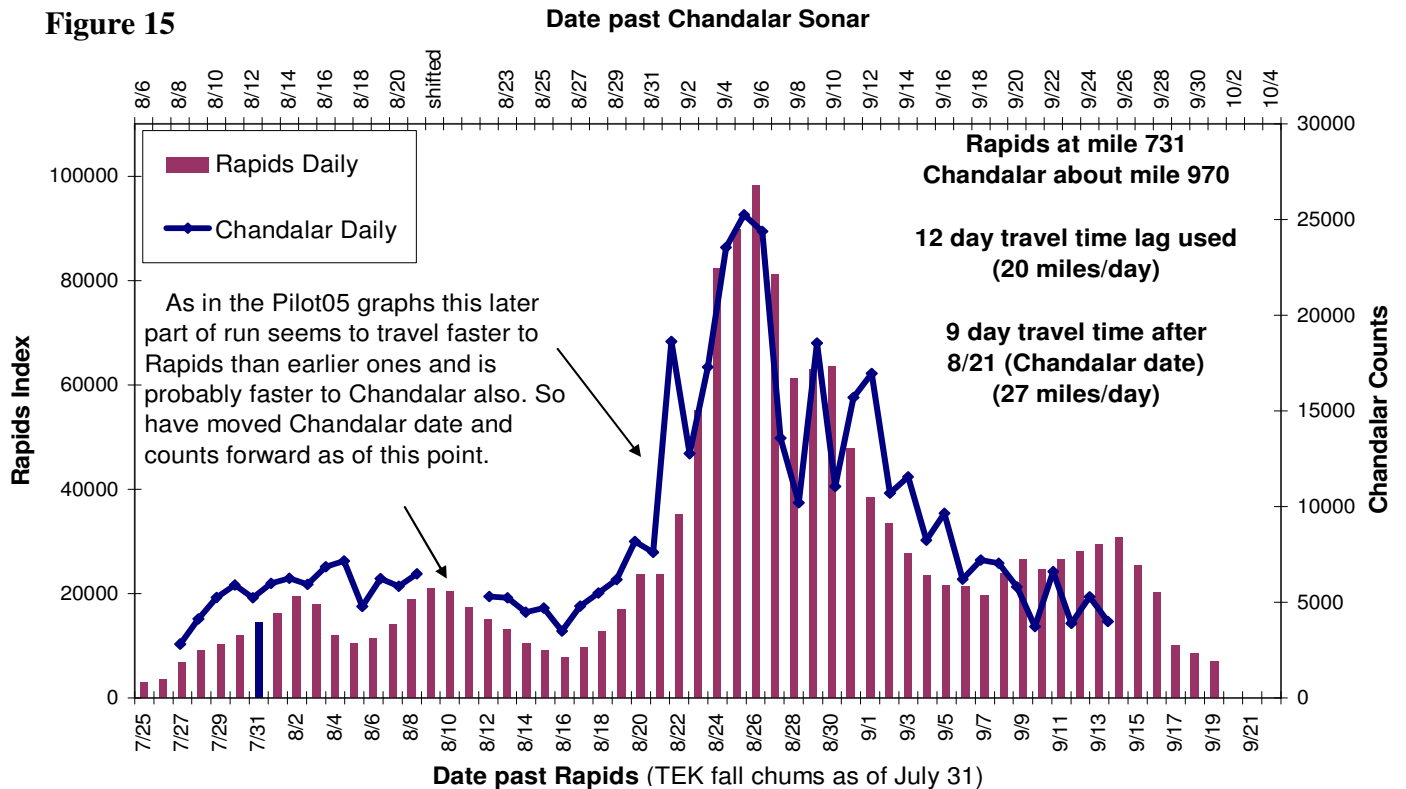


Figure 16

### Rampart Rapids Discharge, 1996-2005 (Rapids Research Center)

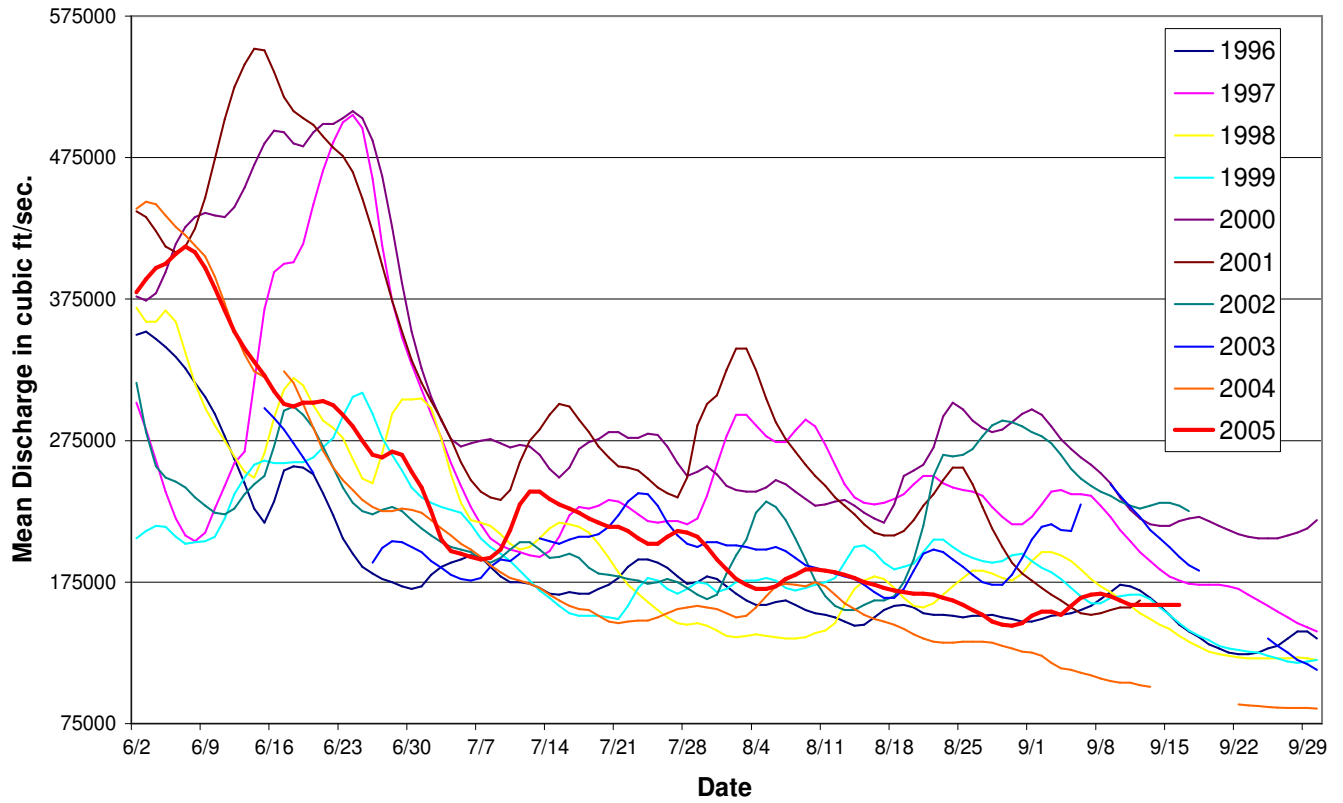
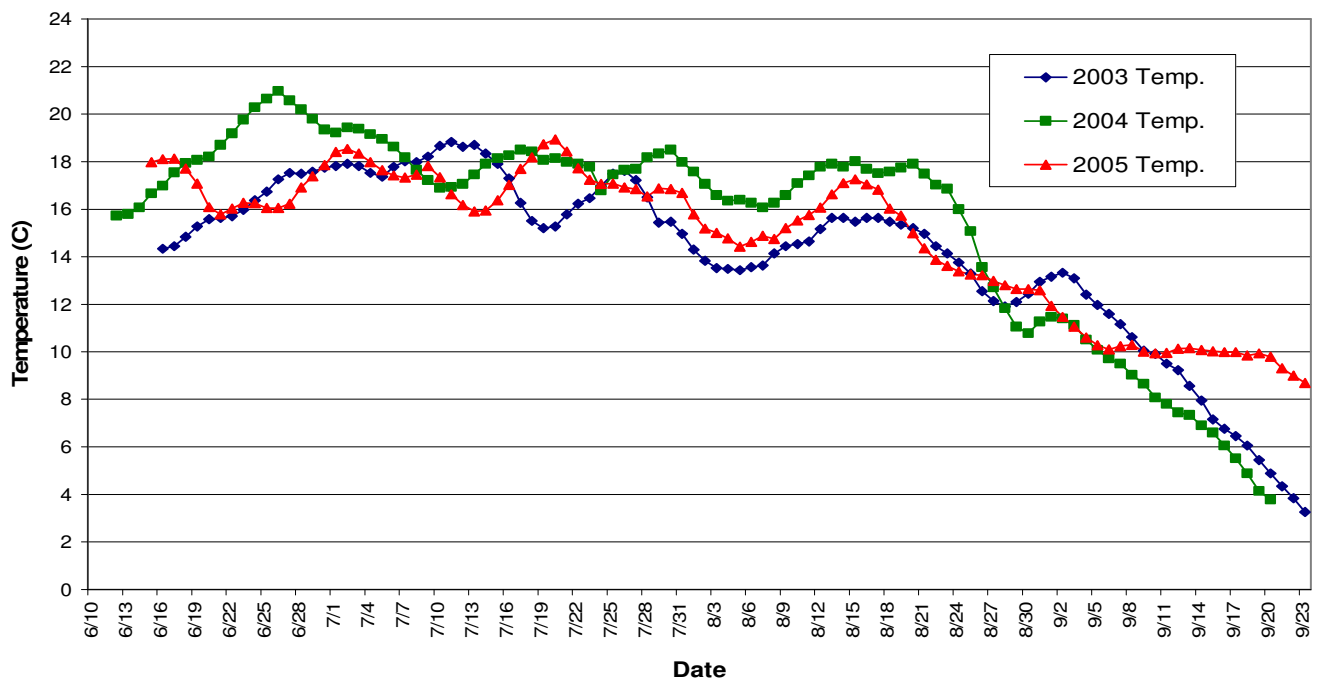


Figure 17

### Mean Daily Water Temperature, Rampart Rapids, 2003 to 2005 (Rapids Research Center)



**Figure 18**



Rapids south bank video fish wheel



One of approx. 10 frames taken of these chum coming down the video chute at night.



Tagging project workers and students in training listen to YRDFA teleconference at Rapids Research Center shack.



Computer microscope viewing of ICH and surface white spots inside video shack.



Strategic placement of closed cell foam padding reduces injury dramatically to the fish.



2 chums, 1 month dry, illustrate difference in oil content of the pale and red flesh chum used to determine fall chum arrival at Rapids.

Figure 19



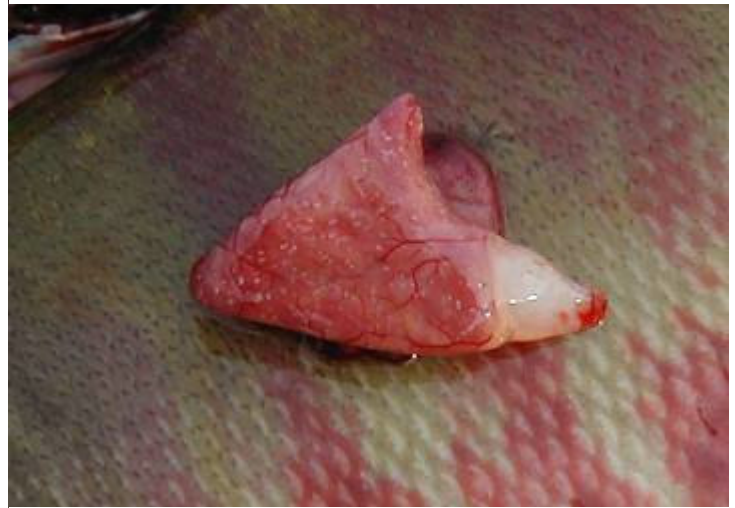
Tanana Conservation Outreach techs get to run video fish counting software at Rapids.



2 past students of TCO camp tagging full time for USFWS in 2005. Rapids video is directly involved with this outreach effort.



Video project oversaw student whitefish genetic data collection for Canadian biologists (DFO)



Surface white spots (often mistaken as ICH) on most whitefish, identified as meta cercarial trematode (a fluke and harmless to humans and the fish)



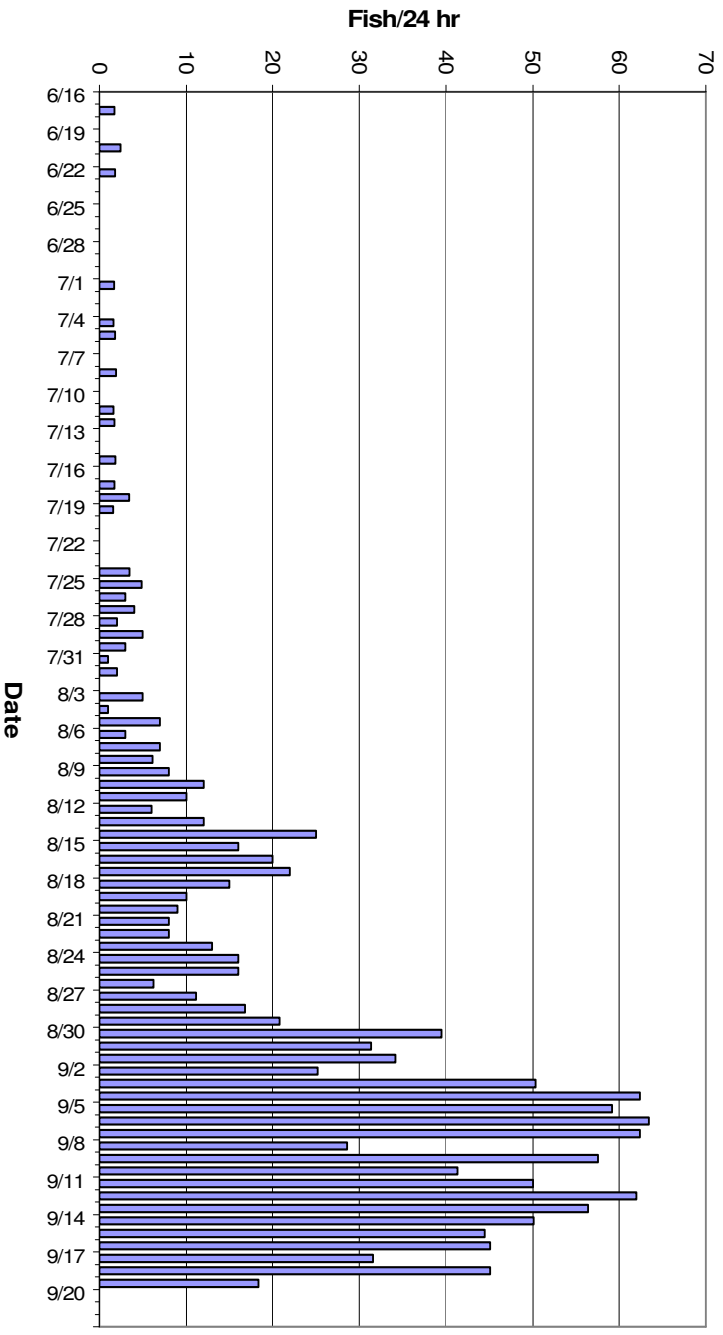
Showing students the Rapids video equipment.



During commercial openings boats arrive at the video camp and the students get lots of data.

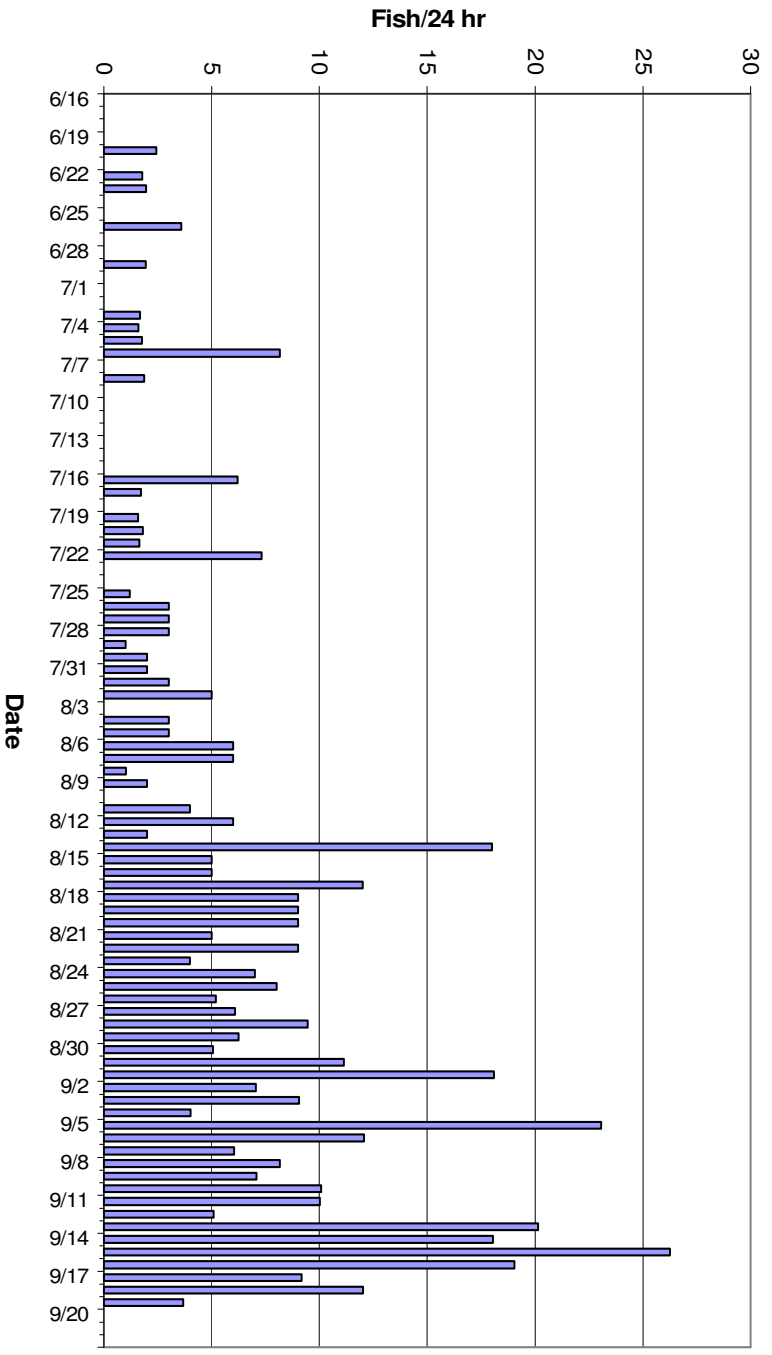
**Figure 20**

**Sheefish per 24 Hours (Video), 2005**  
(Rapids Research Center)



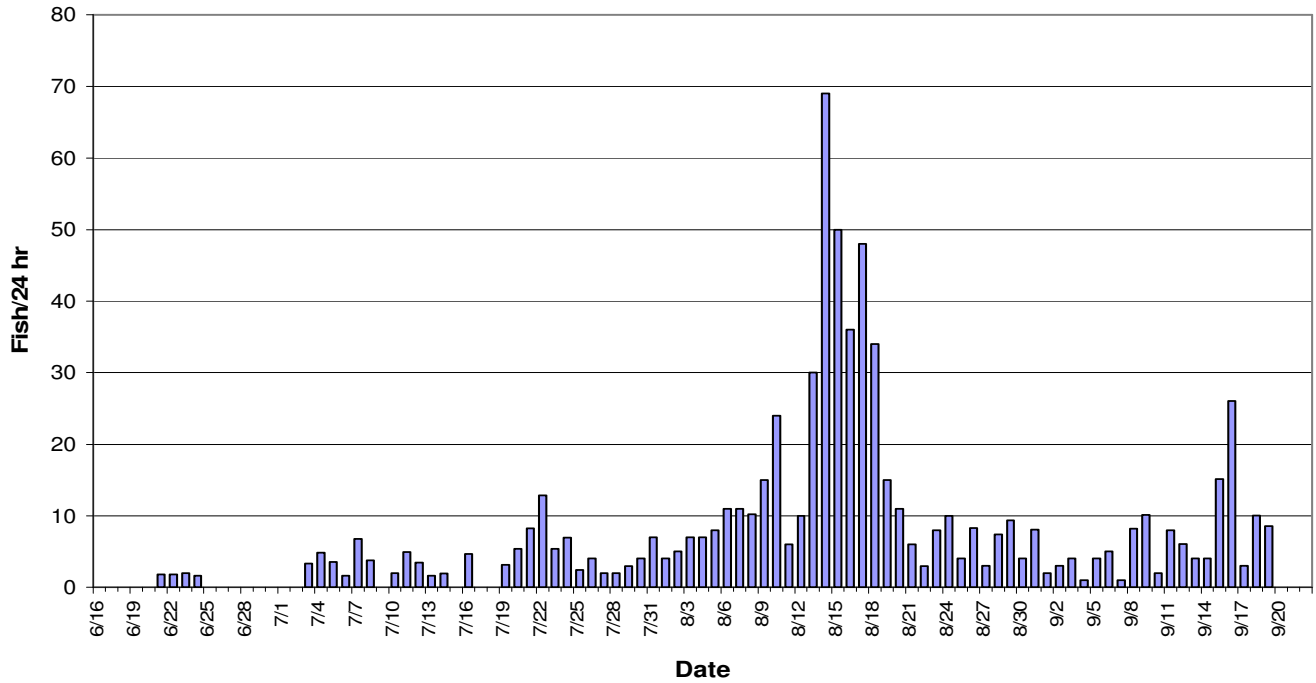
**Figure 21**

**Broad Whitefish per 24 Hours (Video), 2005**  
(Rapids Research Center)



**Figure 22**

**Humpback Whitefish per 24 Hours (Video), 2005**  
(Rapids Research Center)



**Figure 23**

**Cisco per 24 Hours (Video), 2005**  
(Rapids Research Center)

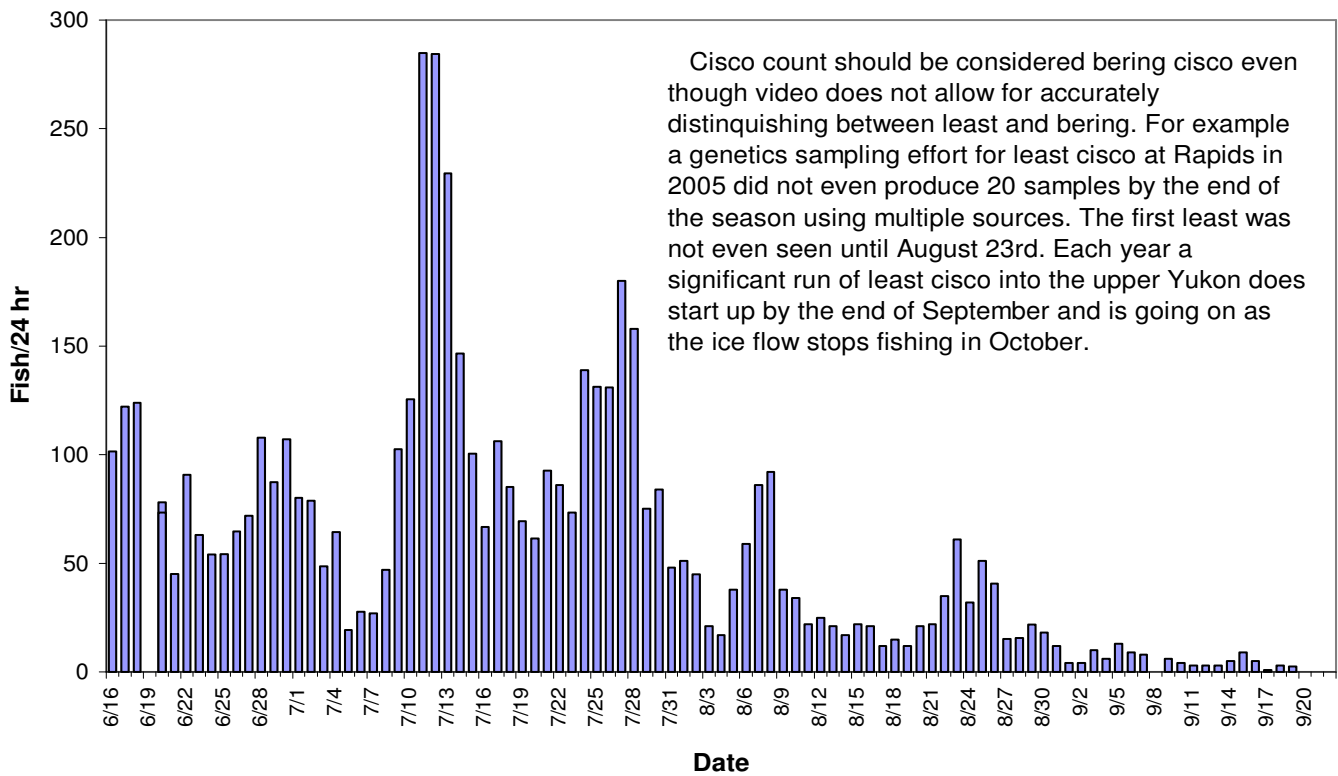
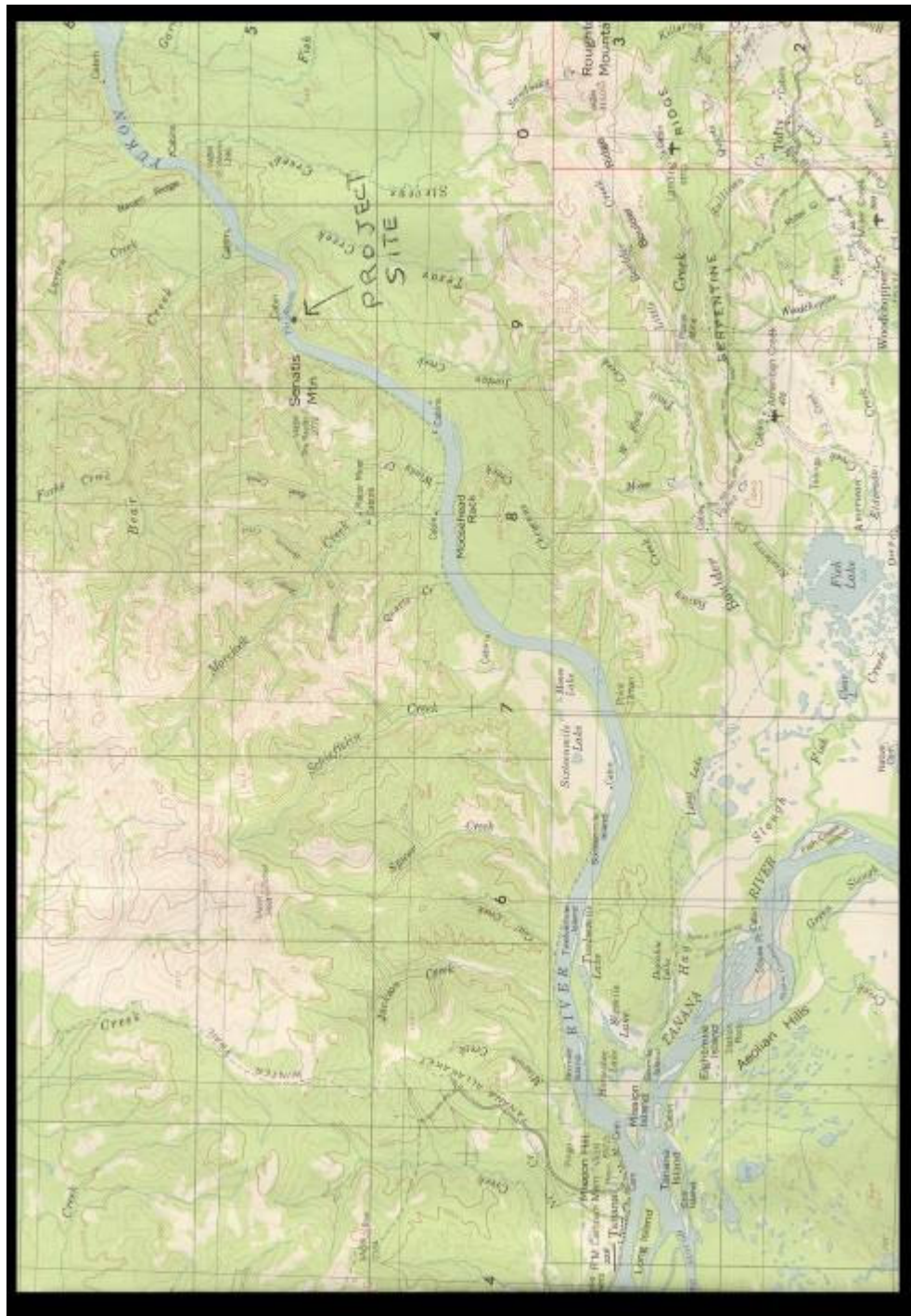


Figure 24. Site map



**Table 1**

2005 Date	Seechi		Water Temp. C	2005 Date	Seechi		Water Temp. C
	Disk (cm)	2 readings			Disk (cm)	2 readings	
6/15/05			18.0	8/5/05	11	11	14.4
6/16/05			18.1	8/6/05	11	10	14.6
6/17/05			18.1	8/7/05	11	11	14.9
6/18/05	13	13	17.7	8/8/05	11	11	14.8
6/19/05	14	13	17.1	8/9/05	10	10	15.2
6/20/05	12	12	16.1	8/10/05	10	10	15.5
6/21/05	12	12	15.8	8/11/05	12	12	15.8
6/22/05	11	11	16.0	8/12/05	13	13	16.1
6/23/05	11	10	16.3	8/13/05	14	14	16.6
6/24/05	9	9	16.3	8/14/05	15	14	17.1
6/25/05	9	9	16.1	8/15/05	14	14	17.3
6/26/05	8	8	16.1	8/16/05	14	14	17.0
6/27/05	9	8	16.2	8/17/05	15	15	16.8
6/28/05	8	8	16.9	8/18/05	15	15	16.0
6/29/05	7	8	17.4	8/19/05	13	14	15.7
6/30/05	8	8	17.8	8/20/05	11	11	15.0
7/1/05	10	10	18.4	8/21/05	10	10	14.3
7/2/05	13	12	18.5	8/22/05	9	9	13.9
7/3/05	14	14	18.3	8/23/05	9	9	13.6
7/4/05	14	14	18.0	8/24/05	8	8	13.4
7/5/05	13	13	17.6	8/25/05	7	8	13.3
7/6/05	11	11	17.4	8/26/05	8	8	13.2
7/7/05	10	10	17.3	8/27/05	7	7	13.0
7/8/05	8	8	17.5	8/28/05	7	7	12.8
7/9/05	7	6	17.8	8/29/05	7	7	12.6
7/10/05	6	6	17.3	8/30/05	8	8	12.6
7/11/05	6	6	16.6	8/31/05	8	8	12.6
7/12/05	7	7	16.2	9/1/05	9	9	11.9
7/13/05	8	7	15.9	9/2/05	9	9	11.5
7/14/05	9	9	15.9	9/3/05	10	10	11.1
7/15/05	11	11	16.4	9/4/05	10	10	10.6
7/16/05	12	12	17.0	9/5/05	10	10	10.3
7/17/05	11	12	17.7	9/6/05	10	10	10.1
7/18/05	10	9	18.2	9/7/05	11	11	10.3
7/19/05	8	8	18.7	9/8/05	12	12	10.3
7/20/05	7	7	18.9	9/9/05	13	14	10.0
7/21/05	7	7	18.4	9/10/05	14	14	9.9
7/22/05	7	7	17.7	9/11/05	16	16	10.0
7/23/05	7	7	17.2	9/12/05	18	18	10.1
7/24/05	7	7	17.1	9/13/05	25	25	10.1
7/25/05	8	8	17.1	9/14/05	27	26	10.1
7/26/05	9	9	16.9	9/15/05	29	29	10.0
7/27/05	9	9	16.8	9/16/05	30	30	10.0
7/28/05	11	10	16.5	9/17/05	30	30	10.0
7/29/05	10	10	16.9	9/18/05	28	28	9.8
7/30/05	10	10	16.8	9/19/05			9.9
7/31/05	11	10	16.7	9/20/05			9.8
8/1/05	10	10	15.8	9/21/05			9.3
8/2/05	10	10	15.2	9/22/05			9.0
8/3/05	10	10	15.0	9/23/05			8.7
8/4/05	11	11	14.8	9/24/05			8.3



Table 2

2005 Video Short Summary-Rapids													Discharge		
Start Day	Counting Date	Start Time	End Time	Run Time (hr)	King Salmon	Percent Jack	Chum Salmon	Shee-fish	Broad WF	Hump back	Cisco WF	Comments	King / 24 hr	Chum / 24 hr	Adjusted Chum Daily
				1870.62	1286	70 cm	76182	1282	447	677	3966	TOTALS	2066	78628	1528261
Thu	6/16/05	10:15:00	23:16:16	13.02	1	0.00%	0	0	0	0	55	Rampart 1 king on 14th, 3 wheels 2 nets Rapids 1 king	1.84	0	0
Fri	6/17/05	8:26:46	22:23:59	13.95	0	0.00%	0	1	0	0	71	most wheels and nets catching king now-low #'s	0.00	0	0
Sat	6/18/05	8:46:20	20:47:11	12.01	3	0.00%	0	0	0	0	62	Obrien 8 king on 17th	5.99	0	0
Mon	6/20/05	0:26:35	10:16:22	9.83	11	0.00%	0	1	1	0	32	Cambell 2x, Obrien 4x, (not scheduled project run)	26.86	0	0
Mon	6/20/05	10:16:33	23:41:12	13.41	8	0.00%	0	0	0	0	41	Clay eddie 9 overnight, Cambell 17 in 12 hr.	14.32	0	0
Tue	6/21/05	8:00:00	23:29:59	13.28	14	7.14%	0	0	0	1	25	reworked exit door, time not used for count	25.30	0	0
Wed	6/22/05	8:00:00	21:28:34	13.48	17	5.88%	0	1	1	1	51	Obrien 5 king per hour,Cambell 2/hr, Ich hearts 17%	30.28	0	0
Thu	6/23/05	9:48:30	21:58:51	12.17	11	27.27%	0	0	1	1	32	smaller fish now	21.69	0	0
Fri	6/24/05	9:03:49	23:45:00	14.69	30	13.33%	0	0	0	1	33	nice fish, new pulse	49.02	0	0
Sat	6/25/05	8:50:33	23:00:00	14.16	14	14.29%	0	0	0	0	32	very little visable ICH lately,	23.73	0	0
Sun	6/26/05	8:30:00	21:52:22	13.37	16	18.75%	0	0	2	0	36	0	28.72	0	0
Mon	6/27/05	8:30:00	23:10:36	14.68	27	22.22%	1	0	0	0	44	1st Chum in Rapids	44.15	2	9
Tue	6/28/05	9:57:00	21:57:54	12.02	26	34.62%	0	0	0	0	54	Steve 2nd chum	51.94	0	0
Wed	6/29/05	9:23:42	21:45:28	12.36	3	66.67%	1	0	1	0	45	Cambell way down also, Obrien no run	5.82	2	13
Thu	6/30/05	8:30:39	21:58:00	13.46	15	26.67%	0	0	0	0	60	Cam, OB, NC, Hug, Hyslop all down today	26.75	0	0
Fri	7/1/05	9:14:57	23:19:51	14.08	39	48.72%	2	1	0	0	47	3 wheels, 2 nets asked, all up good + smaller	66.47	3	31
Sat	7/2/05	9:38:54	23:22:01	13.72	7	42.86%	3	0	0	0	45	last half day low # of king	12.25	5	58
Sun	7/3/05	9:08:06	23:30:00	14.37	8	62.50%	5	0	1	2	29	OB, Cam, down and small-closure now	13.37	8	94
Mon	7/4/05	8:00:00	22:54:27	14.91	44	38.64%	7	1	1	3	40	closure so nobody else running to see good fish	70.84	11	131
Tue	7/5/05	9:37:19	23:13:50	13.61	55	16.36%	9	1	1	2	11	big day but # went low for all wheels at 6pm com. open	97.00	16	190
Wed	7/6/05	8:01:31	22:44:35	14.72	43	37.21%	8	0	5	1	17	Com. #s better than last night same time-3 wheels	70.12	13	154
Thu	7/7/05	8:00:00	22:12:24	14.21	46	26.09%	18	0	0	4	16	Chums hitting all wheels, nice looking kings	77.71	30	334
Fri	7/8/05	9:47:38	22:34:22	12.78	78	33.33%	23	1	1	2	25	water up little, chums running 8% red flesh	146.49	43	392
Sat	7/9/05	8:44:28	23:00:00	14.26	96	38.54%	43	0	0	0	61	water up little, commercial 6 pm	161.58	72	657
Sun	7/10/05	6:00:00	18:15:00	12.25	34	41.18%	30	0	0	1	64	shifted hours early for "day off" wheel work	66.61	59	441
Mon	7/11/05	9:02:00	23:36:25	14.57	67	29.85%	48	1	0	3	173	Big bering cisco pulse - closure now	110.34	79	542
Tue	7/12/05	8:15:00	22:00:48	13.76	66	43.94%	44	1	0	2	163	10% red flesh chums	115.09	77	531
Wed	7/13/05	8:51:35	23:55:41	15.07	20	60.00%	69	0	0	1	144	All wheels way down (king) during day	31.85	110	795
Thu	7/14/05	9:24:40	21:50:55	12.44	13	38.46%	54	0	0	1	76	All gear few king and poor quality	25.09	104	783
Fri	7/15/05	6:00:00	23:59:00	13.12	29	48.28%	70	1	0	0	55	Still slow for all, wheel work mid day-hours shifted	53.05	128	990
Sat	7/16/05	8:30:00	23:58:00	15.47	19	31.58%	94	0	4	3	43	All gear slow, few king and poor quality	29.48	146	1162
Sun	7/17/05	8:15:00	22:15:00	14.00	33	36.36%	83	1	1	0	62	a few better king today	56.57	142	1182
Mon	7/18/05	9:01:51	23:07:19	14.09	40	22.50%	72	2	0	0	50	Joe Sullivan and Simon Jones workshop today	68.13	123	1063
Tue	7/19/05	8:30:00	23:41:58	15.20	45	26.67%	127	1	1	2	44	some nicer king, still low ICH for this late	71.06	201	1778
Wed	7/20/05	8:30:00	21:46:46	13.28	13	15.38%	68	0	1	3	34	Cambell wheel + Obrien net down also	23.49	123	1090
Thu	7/21/05	8:02:24	22:32:23	14.50	10	20.00%	169	0	1	5	56	Obrien wheel 30 chum/hr short run	16.55	280	2567
Fri	7/22/05	8:57:21	22:04:09	13.11	9	11.11%	179	0	4	7	47	That's it for king for almost everyone	16.47	328	3193
Sat	7/23/05	8:00:00	21:25:05	13.42	19	10.53%	134	0	0	3	41	water steady on Yukon, chum red flesh low	33.98	240	2458
Sun	7/24/05	8:00:00	21:48:58	13.82	17	17.65%	212	2	0	4	80	10% red flesh chum, Campbell ran 30/hr chum	29.53	368	3777
Mon	7/25/05	4:15:00	23:59:59	19.75	28	10.71%	258	4	1	2	108	26% red, Going to 24hr counts for fall chum season	34.03	314	3018
Tue	7/26/05	0:00:00	23:59:59	24.00	36	27.78%	377	3	3	4	131	27% red, looks brighter, - fall run? We'll see	36.00	377	3460
Wed	7/27/05	0:00:00	23:59:59	24.00	23	4.35%	739	4	3	2	180	First pulse of Fall Chum but still #'s of summers also	23.00	739	6863
Thu	7/28/05	0:00:00	23:59:59	24.00	20	5.00%	957	2	3	2	158	28% red, Tagging Start -over 400 tagged	20.00	957	9214
Fri	7/29/05	0:00:00	23:59:59	24.00	33	0.00%	974	5	1	3	75	30% red, least cisco, Cambell-Erhart say 25% falls	33.00	974	10257
Sat	7/30/05	0:00:00	23:59:59	24.00	26	3.85%	991	3	2	4	84	#REF!	26.00	991	11868
Sun	7/31/05	0:00:00	23:59:59	24.00	9	0.00%	1078	1	2	7	48	61% red, TEK FALL CHUM START	9.00	1078	14451

Table 3

2005 Video Short Summary-Rapids														King	Chum	Discharge
Start Day	Counting Date	Start Time	End Time	Run Time (hr)	King Salmon	Percent Jack	Chum Salmon	Shee-fish	Broad WF	Hump back	Cisco WF	Comments	King / 24 hr	Chum / 24 hr	Adjusted Chum Daily	
				1870.62	1286	70 cm	76182	1282	447	677	3966	TOTALS	2066	78628	1528261	
Mon	8/1/05	0:00:00	23:59:59	24.00	11	9.09%	1065	2	3	4	51	44% red, Morelock Creek many chum	11.00	1065	16213	
Tue	8/2/05	0:00:00	23:59:59	24.00	8	12.50%	1176	0	5	5	45	50% red, getting cutting people chum	8.00	1176	19407	
Wed	8/3/05	0:00:00	23:59:59	24.00	2	0.00%	1021	5	0	7	21	63% red, fall chum getting darker, bright run over	2.00	1021	17982	
Thu	8/4/05	0:00:00	23:59:59	24.00	6	0.00%	677	1	3	7	17	59% red, darker chum outside more-backside of pulse?	6.00	677	11923	
Fri	8/5/05	0:00:00	23:59:59	24.00	1	0.00%	625	7	3	8	38	Erhart family says cutting lots of people chum	1.00	625	10535	
Sat	8/6/05	0:00:00	23:59:59	24.00	9	0.00%	752	3	6	11	59	chum darker, still good red flesh on many	9.00	752	11448	
Sun	8/7/05	0:00:00	23:59:59	24.00	5	0.00%	981	7	6	11	86	50% red, new pulse nicer fish outside, cisco run	5.00	981	14114	
Mon	8/8/05	0:00:00	23:59:59	23.47	4	0.00%	1369	6	1	10	90	Bioelec. Project here(Joe, Kyle), time out wheel repairs	4.09	1400	18766	
Tue	8/9/05	0:00:00	23:59:59	24.00	3	0.00%	1560	8	2	15	38	53% red, Big sheefish hitting and chums everywhere	3.00	1560	20913	
Wed	8/10/05	0:00:00	23:59:59	24.00	1	0.00%	1496	12	0	24	34	43% red, Most Humpback by 2x this year,	1.00	1496	20403	
Thu	8/11/05	0:00:00	23:59:59	24.00	2	0.00%	1247	10	4	6	22	50% red, severe smoke, bioelec/flesh color test	2.00	1247	17307	
Fri	8/12/05	0:00:00	23:59:59	24.00	5	0.00%	1045	6	6	10	25	much darker chum outside (backside of pulse)	5.00	1045	15035	
Sat	8/13/05	0:00:00	23:59:59	24.00	2	0.00%	879	12	2	30	21	19% red, chum slowing, Humpback and Sheefish up	2.00	879	13127	
Sun	8/14/05	0:00:00	23:59:59	24.00	0	0.00%	673	25	18	69	17	whitefish increasing again	0.00	673	10448	
Mon	8/15/05	0:00:00	23:59:59	24.00	1	0.00%	576	16	5	50	22	Water about average, smoke less	1.00	576	9122	
Tue	8/16/05	0:00:00	23:59:59	24.00	1	0.00%	469	20	5	36	21	22% red, Worst smoke yet-no see wheel or lights	1.00	469	7740	
Wed	8/17/05	0:00:00	23:59:59	24.00	1	0.00%	561	22	12	48	12	worst smoke yet, next pulse front runners showing up	1.00	561	9664	
Thu	8/18/05	0:00:00	23:59:59	24.00	0	0.00%	705	15	9	34	15	23% red, Campbell up also-nicer fish on outside	0.00	705	12701	
Fri	8/19/05	0:00:00	23:59:59	24.00	0	0.00%	924	10	9	15	12	27% red, Cutting dog before quality decreases more	0.00	924	17037	
Sat	8/20/05	0:00:00	23:59:59	24.00	0	0.00%	1254	9	9	11	21	4 camps cutting dry dog food	0.00	1254	23678	
Sun	8/21/05	0:00:00	23:59:59	24.00	1	0.00%	1250	8	5	6	22	29% red, Cambell 2-3x as normal - short run	1.00	1250	23602	
Mon	8/22/05	0:00:00	23:59:59	24.00	1	0.00%	1819	8	9	3	35	chum jumping in the river and hit one with boat	1.00	1819	35192	
Tue	8/23/05	0:00:00	23:59:59	24.00	0	0.00%	2703	13	4	8	61	41% red, Cambell 220 in 50min.-10 in first basket	0.00	2703	55003	
Wed	8/24/05	0:00:00	23:59:59	24.00	1	0.00%	3734	16	7	10	32	29% red, RECORD CPUe+8 chum in one-south	1.00	3734	82383	
Thu	8/25/05	0:00:00	23:59:59	24.00	0	0.00%	3956	16	8	4	51	Record again, but rise has slowed	0.00	3956	89802	
Fri	8/26/05	0:02:27	23:59:59	23.08	0	0.00%	4162	6	5	8	39	Record again, and had a 235 per hour near days end	0.00	4328	98243	
Sat	8/27/05	0:06:49	23:59:59	23.63	0	0.00%	3516	11	6	3	15	21% red, Down a bit and chum real dark now	0.00	3571	81063	
Sun	8/28/05	0:03:56	23:59:59	22.86	0	0.00%	2569	16	9	7	15	Small log hit wheel - 45 min to repair	0.00	2697	61224	
Mon	8/29/05	0:00:00	23:59:59	23.07	0	0.00%	2670	20	6	9	21	Did long system check after all the fish	0.00	2778	63052	
Tue	8/30/05	0:03:28	23:59:59	23.73	0	0.00%	2764	39	5	4	18	water steady but kinda low, wheel bottom flattening out	0.00	2795	63457	
Wed	8/31/05	0:03:33	23:59:59	23.74	0	0.00%	2079	31	11	8	12	water steady, chum finally going down again	0.00	2102	47710	
Thu	9/1/05	0:00:00	23:59:59	23.89	0	0.00%	1683	34	18	2	4	broads increasing, dry fish to town	0.00	1691	38380	
Fri	9/2/05	0:00:00	23:59:59	23.83	0	0.00%	1460	25	7	3	4	12% red, little fishing going on except daily dog pots.	0.00	1470	33378	
Sat	9/3/05	0:00:00	23:59:59	23.84	0	0.00%	1214	50	9	4	10	work on new ultrasonic video trigger,	0.00	1222	27743	
Sun	9/4/05	0:00:00	23:59:59	23.86	0	0.00%	1023	62	4	1	6	sheefish up, many hurt and fungus chum-back of pulse	0.00	1029	23358	
Mon	9/5/05	0:03:55	23:59:59	23.93	0	0.00%	952	59	23	4	13	Biggest broad day, Dave Daum here+sonic work	0.00	955	21670	
Tue	9/6/05	0:00:00	23:59:59	23.86	0	0.00%	939	63	12	5	9	Sonic work going great, Biggest shee day this year	0.00	945	21440	
Wed	9/7/05	0:00:00	23:59:59	23.86	0	0.00%	858	62	6	1	8	Water up a little, Ultra sonic evaluation starts	0.00	863	19591	
Thu	9/8/05	12:15:00	23:59:59	11.75	0	0.00%	512	14	4	4	0	6% red, 1/2 day file corrupted- viewing while capturing?	0.00	1046	23740	
Fri	9/9/05	0:00:00	23:59:59	23.78	0	0.00%	1157	57	7	10	6	8% red, Water rising for 5 days now, a few wheelkillers	0.00	1168	26507	
Sat	9/10/05	0:00:00	23:59:59	23.83	0	0.00%	1080	41	10	2	4	water up, cribbing chum- Cambell 100 per hour	0.00	1088	24691	
Sun	9/11/05	0:00:00	23:59:59	23.99	0	0.00%	1169	50	10	8	3	water crested, 1 least cisco, crib done-1400	0.00	1169	26547	
Mon	9/12/05	0:00:00	23:59:59	23.62	0	0.00%	1214	61	5	6	3	water 1" down, 1 least in 1400 fish-Campbell wheel	0.00	1234	28001	
Tue	9/13/05	0:00:00	23:59:59	23.82	0	0.00%	1285	56	20	4	3	water down a little again,	0.00	1295	29390	
Wed	9/14/05	0:00:00	23:59:59	23.94	0	0.00%	1348	50	18	4	5	Erhart says still many chum, drying a problem	0.00	1351	30676	
Thu	9/15/05	0:00:00	23:59:59	23.77	0	0.00%	1111	44	26	15	9	North wheel slowed down also,	0.00	1122	25464	
Fri	9/16/05	0:00:00	23:59:59	23.95	0	0.00%	892	45	19	26	5	North wheel down also, Water steady	0.00	894	20291	
Sat	9/17/05	0:00:00	23:59:59	23.59	0	0.00%	433	31	9	3	1	North wheel down also, Water steady	0.00	441	10000	
Sun	9/18/05	0:00:00	23:59:59	23.95	0	0.00%	376	45	12	10	3	Tagging stopped - video stop tomorrow	0.00	377	8553	
Mon	9/19/05	0:00:00	19:36:30	19.61	0	0.00%	252	15	3	7	2	End	0.00	308	7002	

**Table 4**

**2005 All Video CPUE Summary - Rampart Rapids**

Start Day	Day No.	Counting Date	King per hr	King per 24 hr	Chum per hr	Chum per 24 hr	Sheefish per hr	Sheefish per 24 hr	Broad per hr	Broad per 24 hr	Humpback per hr	Humpback per 24 hr	Cisco per hr	Cisco per 24 hr
Thu	1	6/16	0.1	1.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.2	101.4
Fri	2	6/17	0.0	0.0	0.0	0.0	0.1	1.7	0.0	0.0	0.0	0.0	5.1	122.1
Sat	3	6/18	0.2	6.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.2	123.9
Mon	night	6/20	1.1	26.9	0.0	0.0	0.1	2.4	0.1	2.4	0.0	0.0	3.3	78.1
Mon	4	6/20	0.6	14.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.1	73.4
Tue	5	6/21	1.1	25.3	0.0	0.0	0.0	0.0	0.0	0.0	0.1	1.8	1.9	45.2
Wed	6	6/22	1.3	30.3	0.0	0.0	0.1	1.8	0.1	1.8	0.1	1.8	3.8	90.8
Thu	7	6/23	0.9	21.7	0.0	0.0	0.0	0.0	0.1	2.0	0.1	2.0	2.6	63.1
Fri	8	6/24	2.0	49.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	1.6	2.2	53.9
Sat	9	6/25	1.0	23.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.3	54.2
Sun	10	6/26	1.2	28.7	0.0	0.0	0.0	0.0	0.1	3.6	0.0	0.0	2.7	64.6
Mon	11	6/27	1.8	44.2	0.1	1.6	0.0	0.0	0.0	0.0	0.0	0.0	3.0	72.0
Tue	12	6/28	2.2	51.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.5	107.9
Wed	13	6/29	0.2	5.8	0.1	1.9	0.0	0.0	0.1	1.9	0.0	0.0	3.6	87.4
Thu	14	6/30	1.1	26.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.5	107.0
Fri	15	7/1	2.8	66.5	0.1	3.4	0.1	1.7	0.0	0.0	0.0	0.0	3.3	80.1
Sat	16	7/2	0.5	12.2	0.2	5.2	0.0	0.0	0.0	0.0	0.0	0.0	3.3	78.7
Sun	17	7/3	0.6	13.4	0.3	8.4	0.0	0.0	0.1	1.7	0.1	3.3	2.0	48.5
Mon	18	7/4	3.0	70.8	0.5	11.3	0.1	1.6	0.1	1.6	0.2	4.8	2.7	64.4
Tue	19	7/5	4.0	97.0	0.7	15.9	0.1	1.8	0.1	1.8	0.1	3.5	0.8	19.4
Wed	20	7/6	2.9	70.1	0.5	13.0	0.0	0.0	0.3	8.2	0.1	1.6	1.2	27.7
Thu	21	7/7	3.2	77.7	1.3	30.4	0.0	0.0	0.0	0.0	0.3	6.8	1.1	27.0
Fri	22	7/8	6.1	146.5	1.8	43.2	0.1	1.9	0.1	1.9	0.2	3.8	2.0	47.0
Sat	23	7/9	6.7	161.6	3.0	72.4	0.0	0.0	0.0	0.0	0.0	0.0	4.3	102.7
Sun	24	7/10	2.8	66.6	2.4	58.8	0.0	0.0	0.0	0.0	0.1	2.0	5.2	125.4
Mon	25	7/11	4.6	110.3	3.3	79.0	0.1	1.6	0.0	0.0	0.2	4.9	11.9	284.9
Tue	26	7/12	4.8	115.1	3.2	76.7	0.1	1.7	0.0	0.0	0.1	3.5	11.8	284.2
Wed	27	7/13	1.3	31.9	4.6	109.9	0.0	0.0	0.0	0.0	0.1	1.6	9.6	229.4
Thu	28	7/14	1.0	25.1	4.3	104.2	0.0	0.0	0.0	0.0	0.1	1.9	6.1	146.7
Fri	29	7/15	2.2	53.0	5.3	128.0	0.1	1.8	0.0	0.0	0.0	0.0	4.2	100.6
Sat	30	7/16	1.2	29.5	6.1	145.9	0.0	0.0	0.3	6.2	0.2	4.7	2.8	66.7
Sun	31	7/17	2.4	56.6	5.9	142.3	0.1	1.7	0.1	1.7	0.0	0.0	4.4	106.3
Mon	32	7/18	2.8	68.1	5.1	122.6	0.1	3.4	0.0	0.0	0.0	0.0	3.5	85.2
Tue	33	7/19	3.0	71.1	8.4	200.5	0.1	1.6	0.1	1.6	0.1	3.2	2.9	69.5
Wed	34	7/20	1.0	23.5	5.1	122.9	0.0	0.0	0.1	1.8	0.2	5.4	2.6	61.4
Thu	35	7/21	0.7	16.6	11.7	279.7	0.0	0.0	0.1	1.7	0.3	8.3	3.9	92.7
Fri	36	7/22	0.7	16.5	13.7	327.6	0.0	0.0	0.3	7.3	0.5	12.8	3.6	86.0
Sat	37	7/23	1.4	34.0	10.0	239.7	0.0	0.0	0.0	0.0	0.2	5.4	3.1	73.3
Sun	38	7/24	1.2	29.5	15.3	368.3	0.1	3.5	0.0	0.0	0.3	6.9	5.8	139.0
Mon	39	7/25	1.4	34.0	13.1	313.5	0.2	4.9	0.1	1.2	0.1	2.4	5.5	131.2
Tue	40	7/26	1.5	36.0	15.7	377.0	0.1	3.0	0.1	3.0	0.2	4.0	5.5	131.0
Wed	41	7/27	1.0	23.0	30.8	739.0	0.2	4.0	0.1	3.0	0.1	2.0	7.5	180.0
Thu	42	7/28	0.8	20.0	39.9	957.0	0.1	2.0	0.1	3.0	0.1	2.0	6.6	158.0
Fri	43	7/29	1.4	33.0	40.6	974.0	0.2	5.0	0.0	1.0	0.1	3.0	3.1	75.0
Sat	44	7/30	1.1	26.0	41.3	991.0	0.1	3.0	0.1	2.0	0.2	4.0	3.5	84.0
Sun	45	7/31	0.4	9.0	44.9	1078.0	0.0	1.0	0.1	2.0	0.3	7.0	2.0	48.0

**Table 5**

**2005 All Video CPUE Summary - Rampart Rapids (Continued)**

Start Day	Day No.	Counting Date	King per hr	King per 24 hr	Chum per hr	Chum per 24 hr	Sheefish per hr	Sheefish per 24 hr	Broad per hr	Broad per 24 hr	Humpback per hr	Humpback per 24 hr	Cisco per hr	Cisco per 24 hr
Mon	46	8/1	0.5	11.0	44.4	1065.0	0.1	2.0	0.1	3.0	0.2	4.0	2.1	51.0
Tue	47	8/2	0.3	8.0	49.0	1176.0	0.0	0.0	0.2	5.0	0.2	5.0	1.9	45.0
Wed	48	8/3	0.1	2.0	42.5	1021.0	0.2	5.0	0.0	0.0	0.3	7.0	0.9	21.0
Thu	49	8/4	0.3	6.0	28.2	677.0	0.0	1.0	0.1	3.0	0.3	7.0	0.7	17.0
Fri	50	8/5	0.0	1.0	26.0	625.0	0.3	7.0	0.1	3.0	0.3	8.0	1.6	38.0
Sat	51	8/6	0.4	9.0	31.3	752.0	0.1	3.0	0.3	6.0	0.5	11.0	2.5	59.0
Sun	52	8/7	0.2	5.0	40.9	981.0	0.3	7.0	0.3	6.0	0.5	11.0	3.6	86.0
Mon	53	8/8	0.2	4.1	58.3	1399.9	0.3	6.1	0.0	1.0	0.4	10.2	3.8	92.0
Tue	54	8/9	0.1	3.0	65.0	1560.0	0.3	8.0	0.1	2.0	0.6	15.0	1.6	38.0
Wed	55	8/10	0.0	1.0	62.3	1496.0	0.5	12.0	0.0	0.0	1.0	24.0	1.4	34.0
Thu	56	8/11	0.1	2.0	52.0	1247.0	0.4	10.0	0.2	4.0	0.3	6.0	0.9	22.0
Fri	57	8/12	0.2	5.0	43.5	1045.0	0.3	6.0	0.3	6.0	0.4	10.0	1.0	25.0
Sat	58	8/13	0.1	2.0	36.6	879.0	0.5	12.0	0.1	2.0	1.3	30.0	0.9	21.0
Sun	59	8/14	0.0	0.0	28.0	673.0	1.0	25.0	0.8	18.0	2.9	69.0	0.7	17.0
Mon	60	8/15	0.0	1.0	24.0	576.0	0.7	16.0	0.2	5.0	2.1	50.0	0.9	22.0
Tue	61	8/16	0.0	1.0	19.5	469.0	0.8	20.0	0.2	5.0	1.5	36.0	0.9	21.0
Wed	62	8/17	0.0	1.0	23.4	561.0	0.9	22.0	0.5	12.0	2.0	48.0	0.5	12.0
Thu	63	8/18	0.0	0.0	29.4	705.0	0.6	15.0	0.4	9.0	1.4	34.0	0.6	15.0
Fri	64	8/19	0.0	0.0	38.5	924.0	0.4	10.0	0.4	9.0	0.6	15.0	0.5	12.0
Sat	65	8/20	0.0	0.0	52.3	1254.0	0.4	9.0	0.4	9.0	0.5	11.0	0.9	21.0
Sun	66	8/21	0.0	1.0	52.1	1250.0	0.3	8.0	0.2	5.0	0.3	6.0	0.9	22.0
Mon	67	8/22	0.0	1.0	75.8	1819.0	0.3	8.0	0.4	9.0	0.1	3.0	1.5	35.0
Tue	68	8/23	0.0	0.0	112.6	2703.0	0.5	13.0	0.2	4.0	0.3	8.0	2.5	61.0
Wed	69	8/24	0.0	1.0	155.6	3734.0	0.7	16.0	0.3	7.0	0.4	10.0	1.3	32.0
Thu	70	8/25	0.0	0.0	164.8	3956.0	0.7	16.0	0.3	8.0	0.2	4.0	2.1	51.0
Fri	71	8/26	0.0	0.0	180.3	4327.9	0.3	6.2	0.2	5.2	0.3	8.3	1.7	40.6
Sat	72	8/27	0.0	0.0	148.8	3571.1	0.5	11.2	0.3	6.1	0.1	3.0	0.6	15.2
Sun	73	8/28	0.0	0.0	112.4	2697.1	0.7	16.8	0.4	9.4	0.3	7.3	0.7	15.7
Mon	74	8/29	0.0	0.0	115.7	2777.6	0.9	20.8	0.3	6.2	0.4	9.4	0.9	21.8
Tue	75	8/30	0.0	0.0	116.5	2795.4	1.6	39.4	0.2	5.1	0.2	4.0	0.8	18.2
Wed	76	8/31	0.0	0.0	87.6	2101.8	1.3	31.3	0.5	11.1	0.3	8.1	0.5	12.1
Thu	77	9/1	0.0	0.0	70.4	1690.7	1.4	34.2	0.8	18.1	0.1	2.0	0.2	4.0
Fri	78	9/2	0.0	0.0	61.3	1470.4	1.0	25.2	0.3	7.0	0.1	3.0	0.2	4.0
Sat	79	9/3	0.0	0.0	50.9	1222.1	2.1	50.3	0.4	9.1	0.2	4.0	0.4	10.1
Sun	80	9/4	0.0	0.0	42.9	1029.0	2.6	62.4	0.2	4.0	0.0	1.0	0.3	6.0
Mon	81	9/5	0.0	0.0	39.8	954.6	2.5	59.2	1.0	23.1	0.2	4.0	0.5	13.0
Tue	82	9/6	0.0	0.0	39.4	944.5	2.6	63.4	0.5	12.1	0.2	5.0	0.4	9.1
Wed	83	9/7	0.0	0.0	36.0	863.0	2.6	62.4	0.3	6.0	0.0	1.0	0.3	8.0
Thu	84	9/8	0.0	0.0	43.6	1045.8	1.2	28.6	0.3	8.2	0.3	8.2	0.0	0.0
Fri	85	9/9	0.0	0.0	48.7	1167.7	2.4	57.5	0.3	7.1	0.4	10.1	0.3	6.1
Sat	86	9/10	0.0	0.0	45.3	1087.7	1.7	41.3	0.4	10.1	0.1	2.0	0.2	4.0
Sun	87	9/11	0.0	0.0	48.7	1169.5	2.1	50.0	0.4	10.0	0.3	8.0	0.1	3.0
Mon	88	9/12	0.0	0.0	51.4	1233.5	2.6	62.0	0.2	5.1	0.3	6.1	0.1	3.0
Tue	89	9/13	0.0	0.0	53.9	1294.7	2.4	56.4	0.8	20.2	0.2	4.0	0.1	3.0
Wed	90	9/14	0.0	0.0	56.3	1351.4	2.1	50.1	0.8	18.0	0.2	4.0	0.2	5.0
Thu	91	9/15	0.0	0.0	46.7	1121.8	1.9	44.4	1.1	26.3	0.6	15.1	0.4	9.1
Fri	92	9/16	0.0	0.0	37.2	893.9	1.9	45.1	0.8	19.0	1.1	26.1	0.2	5.0
Sat	93	9/17	0.0	0.0	18.4	440.5	1.3	31.5	0.4	9.2	0.1	3.1	0.0	1.0
Sun	94	9/18	0.0	0.0	15.7	376.8	1.9	45.1	0.5	12.0	0.4	10.0	0.1	3.0
Mon	95	9/19	0.0	0.0	12.9	308.4	0.8	18.4	0.2	3.7	0.4	8.6	0.1	2.4

**Table 6**

**All Season 2005 Final Assessment of Video Capture System**

Fish found on Luminescence capture AVI but missed by video trigger capture system are noted below as missed.

Fish found on Luminescence capture AVI and counted by video trigger capture system are noted below as captured.

Fish found on Luminescence capture AVI are considered as fish assessed.

Minimum of six hours or the first 50 fish of each assessment day are used for the assessment samples.

Assessments coincide with times suitable to luminescence capture (cloudy) and available time.

No.	Date	Fish assessed	Large	Large	small	small	Missed (reason)
			fish assessed	fish captured	Cisco assessed	Cisco captured	
4	6/20	24	5	5	19	17	2 (cisco)
12	6/28	35	17	17	18	17	1 (cisco)
21	7/7	38	32	32	6	6	0
30	7/16	73	52	52	21	21	0
48	7/28	61	52	52	9	9	0
54	8/9	77	75	75	2	2	0
62	8/17	107	103	103	4	4	0
68	8/23	70	56	56	14	12	2 (cisco)
76	8/31	66	65	65	1	1	0
85	9/9	55	55	55	0	0	0

## **Disclaimer**

The mention of trade names of all commercial products in this report does not constitute endorsement or recommendation for use by the federal government.

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