Rampart Rapids Full Season Video Monitoring 2004

Using a Fish Wheel on the Yukon River, Alaska

By Stan Zuray

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Final Report to the Yukon River Panel, Anchorage, Alaska

Rampart Rapids Full Season Video Monitoring – 2004

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Stan Zuray
Box 172
Tanana, Alaska
Tel: (907) 366-7114
Fax: (907) 366-7195
stanzuray@netscape.net

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Cover: Rapids two-basket fish wheel, equipped with netting sides, water generator, equipment enclosure, video camera, automated lighting, microwave transmitter and video chute.

Authors

Stan Zuray has been a fisherman and trapper in the Tanana area since 1973. During the last 9 years he has had a contract with the USFWS Field Office in Fairbanks to run fish wheels for their fall chum salmon tagging project 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 U.S. Fish and Wildlife Service through the Restoration and Enhancement Fund provided through the U.S. Salmon Treaty Negotiations.

The 2004 Rampart Rapids video project continues a close working relationship with the USFWS Field Office in Fairbanks. Dave Daum, a biologist with this office, has a partnership relationship with this project and his office will be providing yearly funding contributions for his in-season computer and assessment assistance and post-season analysis related to the video project data some of which is included in this report. He is also one of the developers of the fish wheel video system.

The Tanana Tribal Council provides fax, copying and message services for the project. They arrange all 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 main stem 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 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 data base that will increase in value as the project continues. A funding source has not been found however, that will finance this project over the long-term.

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.

Fishwheels are commonly used as a capture method for management and research activities in the Yukon River drainage. Specifically, fish wheels have provided catch-per-unit-effort (CPUE) data at various locations to fishery managers. Also, fishwheels are used to capture and hold fish for tagging studies. Most of these fish wheels use live boxes to store 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 (Underwood et al. in prep: Underwood, U.S. Fish and Wildlife Service, Fairbanks, personal communication: and Eiler, National Marine Fisheries Service, personal communication).

From 1996 to 2004 (present) the site has been used to run fishwheels for the Rampart Rapids fall chum salmon tagging project (Underwood et al. 2000). During these nine years the site fishwheel operated without any down days or days when data were compromised. In 1996, 1998 and 1999 a fall chum radio-tagging project was conducted from this site (J. Eiler, National Marine Fisheries Service, personal communication). 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 results (not yet published) showed a significant negative effect on fish held in the live box for 4 to 6 hour (Eiler, personal communications). A further indication of a possible problem with live boxes was a 1998 radio-tagging project done on sheefish showing excellent results from fish tagged and immediately released with no holding time in the live box (Brown, 2000). Although this study was not designed to look into livebox holding that all of the immediately released sheefish were detected in the known upriver spawning area later in the season added weight to the livebox mortality theory.

In 1999 the fishwheel 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 efficient and 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 contracts from the USFWS through 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, S., 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, S. 2002a and Zuray, S. 2002c)

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

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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 develop a method for adjusting raw catch data, which takes into account factors such as river discharge, water clarity, and fishwheel catch efficiency.
5. To use video measuring techniques to separate captured Chinook salmon into jack and mature age 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. Fishwheel sites have been established for many years in the area so no site conflicts are expected. The unique protection offered by the site, from wind, high water, and spring river drift allow fishwheels 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 2004. 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 preventing heavy current.

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 was 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 fishwheel 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 starts 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 Sunday.

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 2004 was July 27 (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 amount that may be 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 icing conditions are severe. Reasons for schedule are as follows:

1. 24 hours sampling would maximize the amount of data collection time and be in line with recommendations from the ADF&G for operation of the Rapids fall chum CPUE project.
2. The 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 2004, 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 silts and-or changing sites frequently, 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. These listed below should be kept as consistent as possible each year.

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 multiple beam (6), 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 fishwheel 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).

Video System

The video system used in 2004 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 was 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, lights 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 were 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 on the past limitations of the system. A camera was mounted directly to a laptop computer on the fish wheel. A new version of Salmonsoft software (funded by USFWS) that used electronic triggers to initiate capture of fish images as they slid down the fishwheel 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, (funded by USFWS) 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 in-season evaluation, and post-season assessment. In 2003 and 2004 a totally separate luminescence capture program was run one day a week for in-season assessment purposes. The results of each were compared as a means off 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 fishwheel 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 fishwheel (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 4 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 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. While 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, so any taper charge, 15 amps or larger should work.

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 purchased.

Lights: two 90-watt halogen 27^0 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.

Fishwheel 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 refocus 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 fishwheel 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 and 2004. 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 and 2004 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 2001-2004 produced noticeably better images than the similar model WV-CP464 used in 2000. This 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). This 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 fishwheel. 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. This 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 fishwheel 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 98 SE operating system, 20 GB hard drive, 256 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. The laptop is still running after 4 years.

Capture and video review software: Salmonsoft capture software Vcap 1.4.0 was used to capture fish images off the fishwheel. The software allowed use of a trigger switch to record fish images as they slide down the fishwheel 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 in 2003 and 2004 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 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. This system is still running fine.

Related Areas of Study

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 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.

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 1 m depth. Four measurements were taken daily at 6 h intervals and mean daily water temperature was calculated by averaging the four readings. These measurements were taken in 2003 and 2004 in an effort to provide more points of temperature data collection on the Yukon River and to explore possible effects on fish wheel efficiency that temperature variations might have (Table 1).

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. These daily readings were compared to historical data from 1996 – 2003. 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 should be 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 in that 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, it is hoped, may provide an effective model for more accurately describing run strength in the future.

Secchi Disk: A standard 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 and 2).

Results and Discussion

The primary objective of the project is to provide catch per unit effort data (Tables 3 through 6). The Chinook salmon numbers are presently the ones of most interest to ADF&G and USFWS (Figure 1). This data is only meaningful in as far as it relates accurately to actual Chinook salmon passing through the site area. That actual number is of course not available for comparison so other established Chinook salmon assessment and escapement projects on the river are looked at and compared for indications of project accuracy.

Before the Rampart-Rapids Summer catch per unit effort video monitoring project the Lower Yukon test net catches and Pilot Station Sonar passage estimates were the only 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 four years old so only years 2000-2004 are compared.

Year	24 hr. expanded Rapids cumulative	Lower River set net cumulative	Pilot Sonar estimates	Canadian Border estimates
2000	1708 Chinook	14.12	70,000	17,215
2001	5563 Chinook	15.23	141,816	55,400
2002	1667 Chinook	20.23	183,000	28,000
2003	1646 Chinook	26.98	254,000	58,000
2004	2854 Chinook	20.48	194,155*	48,500*

. * 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 jack 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 jack or mature salmon based on length (< 71 cm total length = jack). 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 jack and mature fish. The results were dramatic and show just how far off a run assessment can be if some jack 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 jacks and mature Chinook salmon are separated one sees a catch of mature Chinook salmon (> 71 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 mature fish (females) headed to the spawning grounds emerges (figure 2). In 2004 estimated jack salmon catch rates slightly increased from the 2003 level (from 21% jacks to 29% jacks) and did not show the large difference in jack populations of 2002 to 2003 runs.

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 jack separation technique and to continue work on developing a digital measuring method to accurately measure individual fish with the help of Dave Daum.

The video system proved to be very accurate at counting fish that were captured by a fishwheel. Many of the potential fish handling problems associated with fishwheel capture have been eliminated by the development of this method. The video capture system used in 2001-2004 had 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 fishwheel was a time saving of two hours for each 12 hours of data collected. The assessment figures (Table 7) 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.

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 fish (Figure 3 and 4). 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 2004 that 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.

The building and maintenance of the fish wheel chute door was greatly simplified in 2001and 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 to light could be triggered by gusting winds. Both these conditions were again dealt with in the 2004 season as chute height adjustments forced workable compromises to be arrived at.

The chute door dampening system never had a problem but did need to be readjusted anytime the chute door was reworked.

The magnetic switch experienced 1 failure in 2004 and was replaced (no failures in 2002 and 2003 and one failure in 2001).

Discharge levels are continuing to be explored for their effects on catch efficiency by the Rapids video project, Dave Daum, USFWS, and Bonnie Borba, ADF&G. Preliminary work by project leader Stan Zuray shows a strong linear correlation between discharge and efficiency in chum salmon when using the Rampart fall chum tagging project as a standard. In 2004 discharge adjusted fall chum data was sent in daily with the normal CPUE data to state and federal managers (Figure 4).

Daily chum numbers are adjusted, using a fishwheel efficiency model related to daily water discharge. This adjusted cumulative index, while still being worked on as a project objective, appears to be much more inline with other Yukon run assessment projects than the unadjusted CPUE.

The discharge model originally was not designed to adjust for the extreme lower discharges that existed during the fall of 2004 (Figure 5). Because of this design, the low fishwheel efficiency (% of Tagging Project Estimates caught by video project) from low water in 2004 has not been incorporated into the model. With this model design in mind the 2004 adjusted cumulative CPUE should be considered conservative and will probably end up higher when a more complete model is made this winter.

Daily mean water temperatures in 2004 varied from a high of 21 °C on June 26 to 3.8 °C on September 22 (Figure 6). Within a day, water temperatures varied by around 1 °C during the season. The lowest readings were between 0600 and 1200 each day. Water was warmer for 2004 except the month of September when it was slightly less.

Hourly catch rates for fall chum salmon were slightly diel, with the highest catches occurring between 1000 and 1900. Diel in 2004 was a bit stronger yet showed the same hourly pattern of occurrence as 2003 (Figure 9 and 10)). This same trend was also apparent in 2001 to 2003.

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 (Table 1 and 2).

The mechanical triggered video system developed during the 2001 to 2004 Rapids video project has been installed and tested on four fishwheels 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). 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 2004 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, Department of Fish and Game and the Office of Subsistence Management viewed the workings of the project each summer.

Aaron Poetter was the main contact person at the Department of Fish and Game for the daily reporting of data from the project.

The Tanana Tribal Council and the Tanana City School District have been running a USFWS Fishery Resource Monitoring Project called Tanana Fisheries Conservation Outreach from 2001 to 2003 (Peters Zuray, K. 2003). This project has brought multiple groups of elders and school children to the Rapids project site to view and work with the Rapids video project. The video project equipment and project leader directly aided student activities. For example students running their own Chinook salmon *Ichthyophonus* study with each shown how to set up and enter data into Excel spreadsheets using the video project computer, and a work program where students cleared campsites for a future youth research camp.

In 2004 Tanana Fisheries Conservation Outreach was run by Kathleen Peters Zuray of the Tanana Tribal Council Environmental Office and the video project helped support the running of a

sex, length, *Ichthyophonus* data collection study and a fall chum salmon arrival data study through loaned equipment and access to fish samples.

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.

This summer 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. Samples were taken and worked up at the Rapids video test fishwheel. 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 graciously took students with them on each of their sampling trips. This type of experience was invaluable to the students and hopefully this project will continue next year with the students being more involved.

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 inquires 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 the major source of development work in video technology and monitoring. Current discharge adjustments to CPUE and operating system work done in 2004 show improvements over prior methods.

Figures 7 and 8 in this report show some of this capacity development effort. The site of these projects can be seen in the map provided (figure 8).

Conclusions

1. CPUE data can be dependably generated by a fish wheel livebox 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 in as much as it is a reflection of what is actually happening in the river. To this end the Rapids video project began 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. In 2003 and 2004 USGS water discharge data for the Yukon River was looked at with the idea of incorporating it into the assessment of the CPUE data at the Rapids. The effects of high and low water and other factors on CPUE should be investigated further.
3. Proper assessments of test fish wheel projects and other fish projects will only be made if raw data and methods of project operations are available in the project reports. Without

these reporting requirements projects cannot be assessed for operational integrity and usefulness.

4. An Internet web site needs to be run and 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, provide information for Yukon River Drainage Fishermen's Association (YRDFA) representatives for weekly teleconferences, and to facilitate making more informed decisions. Aaron Poetter with ADF&G did a great job in this regard in 2004 with his e-mail updates during fall chum season and this should be continued during the full season.

Budget Summary

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

2004:

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 appear to be necessary.

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Figure 1, 2000 to 2004 Rapids Chinook CPUE Compared

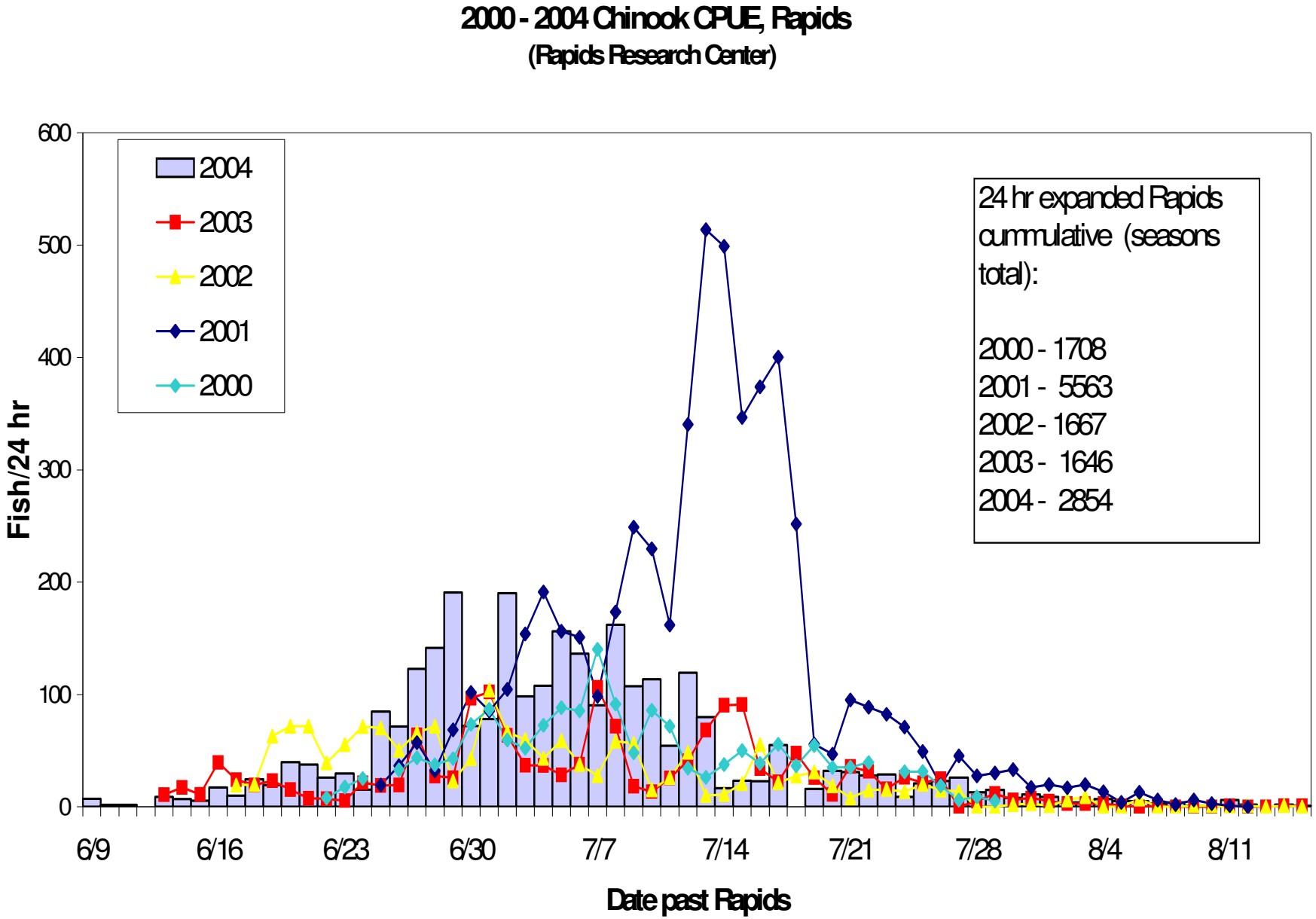

Figure 2

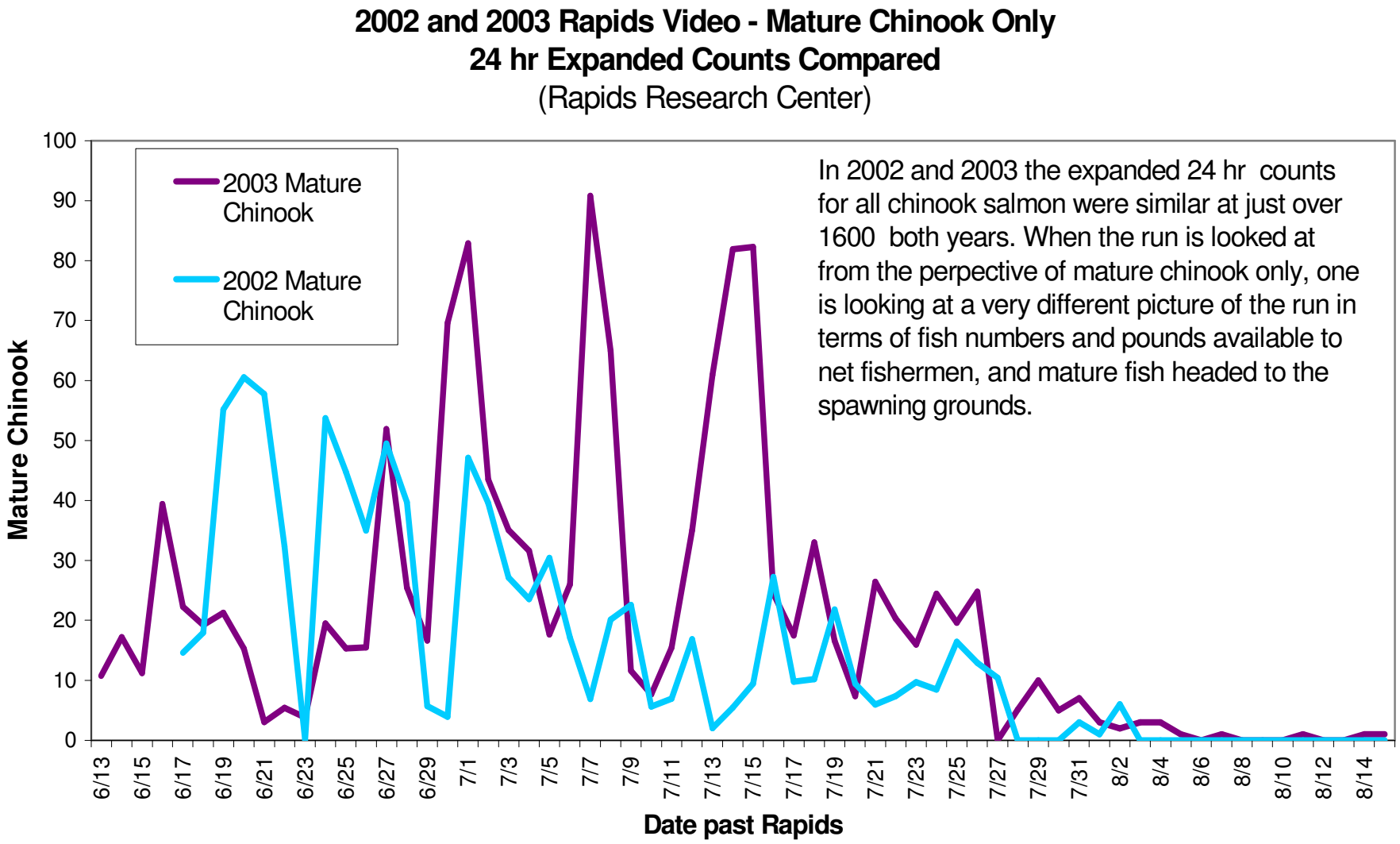
2002 and 2003 Rapids Video - Mature Chinook Only
24 hr Expanded Counts Compared
(Rapids Research Center)
2003 Mature Chinook
2002 Mature Chinook
In 2002 and 2003 the expanded 24 hr counts for all chinook salmon were similar at just over 1600 both years. When the run is looked at from the perpective of mature chinook only, one is looking at a very different picture of the run in terms of fish numbers and pounds available to net fishermen, and mature fish headed to the spawning grounds.
Mature Chinook
0
10
20
30
40
50
60
70
80
90
100
6/13
6/15
6/17
6/19
6/21
6/23
6/25
6/27
6/29
7/1
7/3
7/5
7/7
7/9
7/11
7/13
7/15
7/17
7/19
7/21
7/23
7/25
7/27
7/29
7/31
8/2
8/4
8/6
8/8
8/10
8/12
8/14
Date past Rapids

Figure 3,

2000 - 2004 Fall Chum Unadjusted CPUE, Rapids Video (Rapids Research Center)

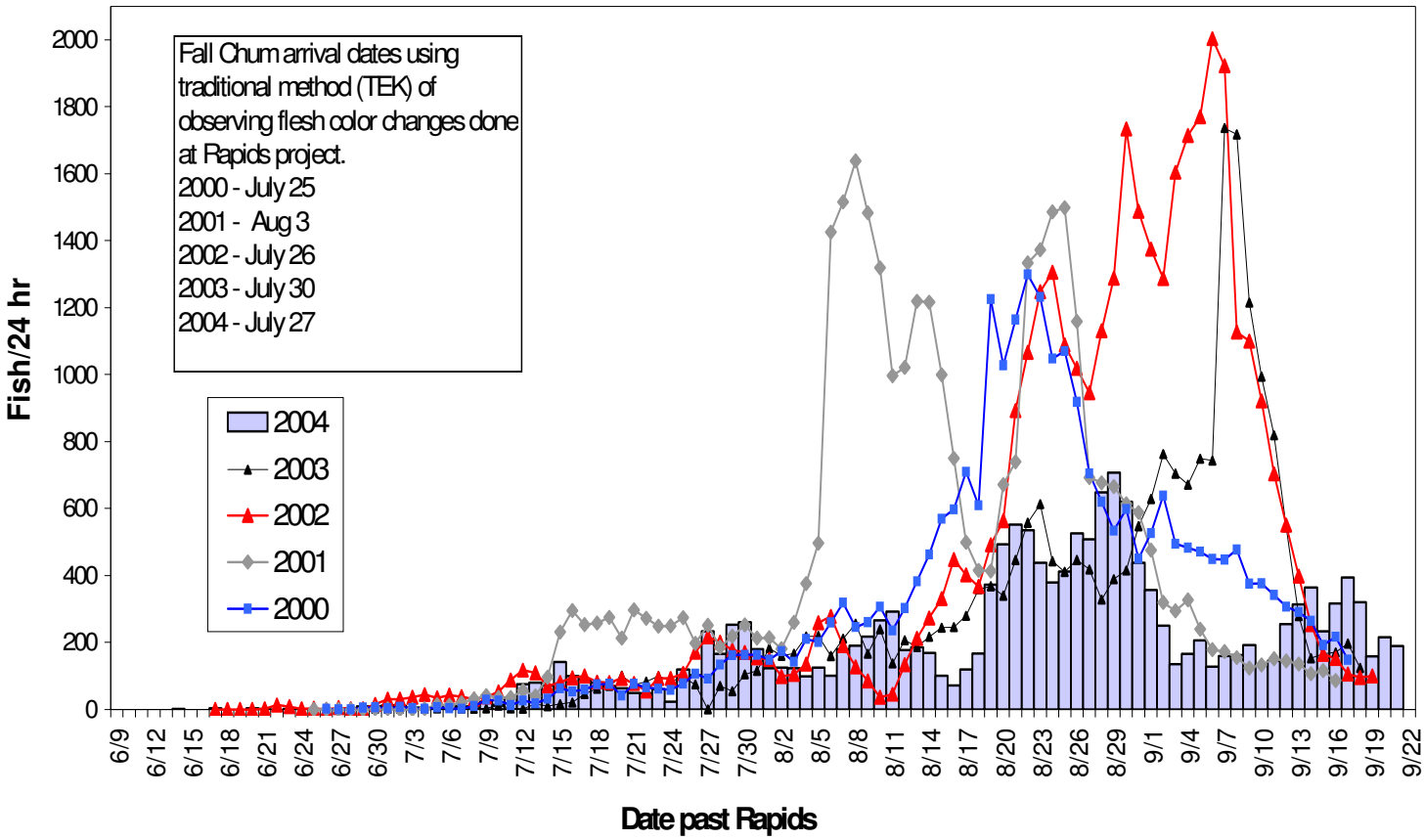

Figure 4,

1996 to 2004 Rapids Video CPUE Adjusted using ZRMC Discharge Adjustment, Fall Chum (Rapids Research Center)

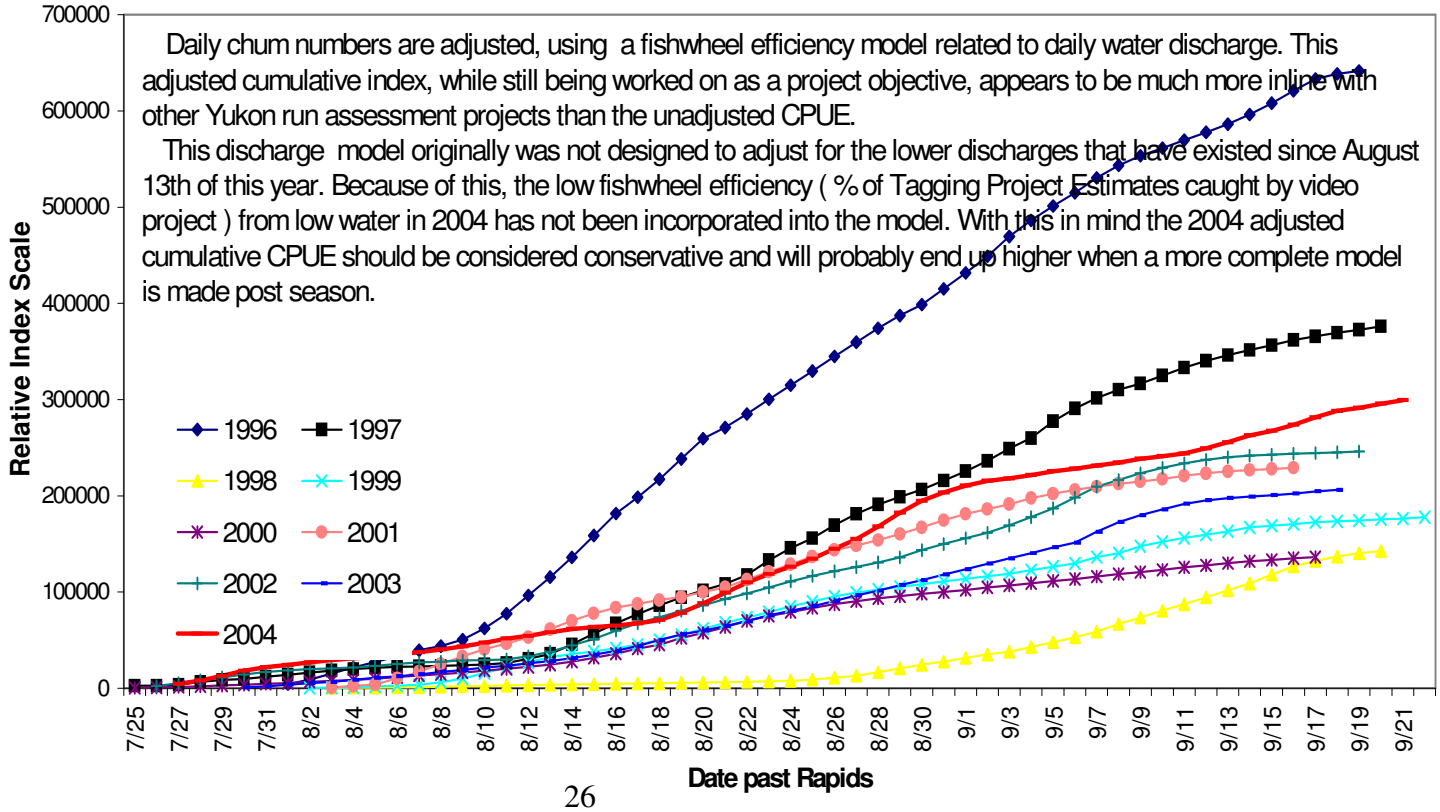

Figure 5

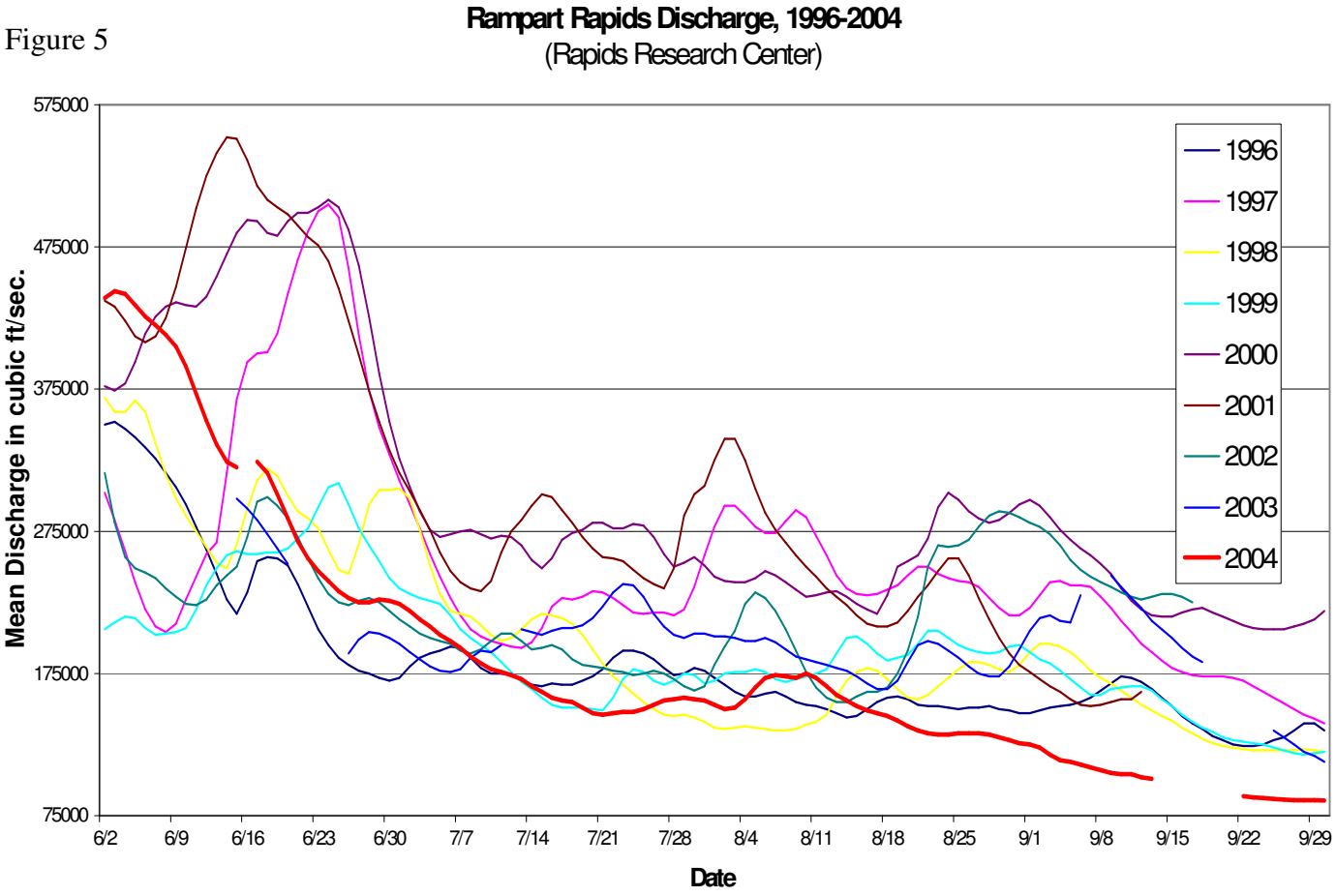

Figure 6

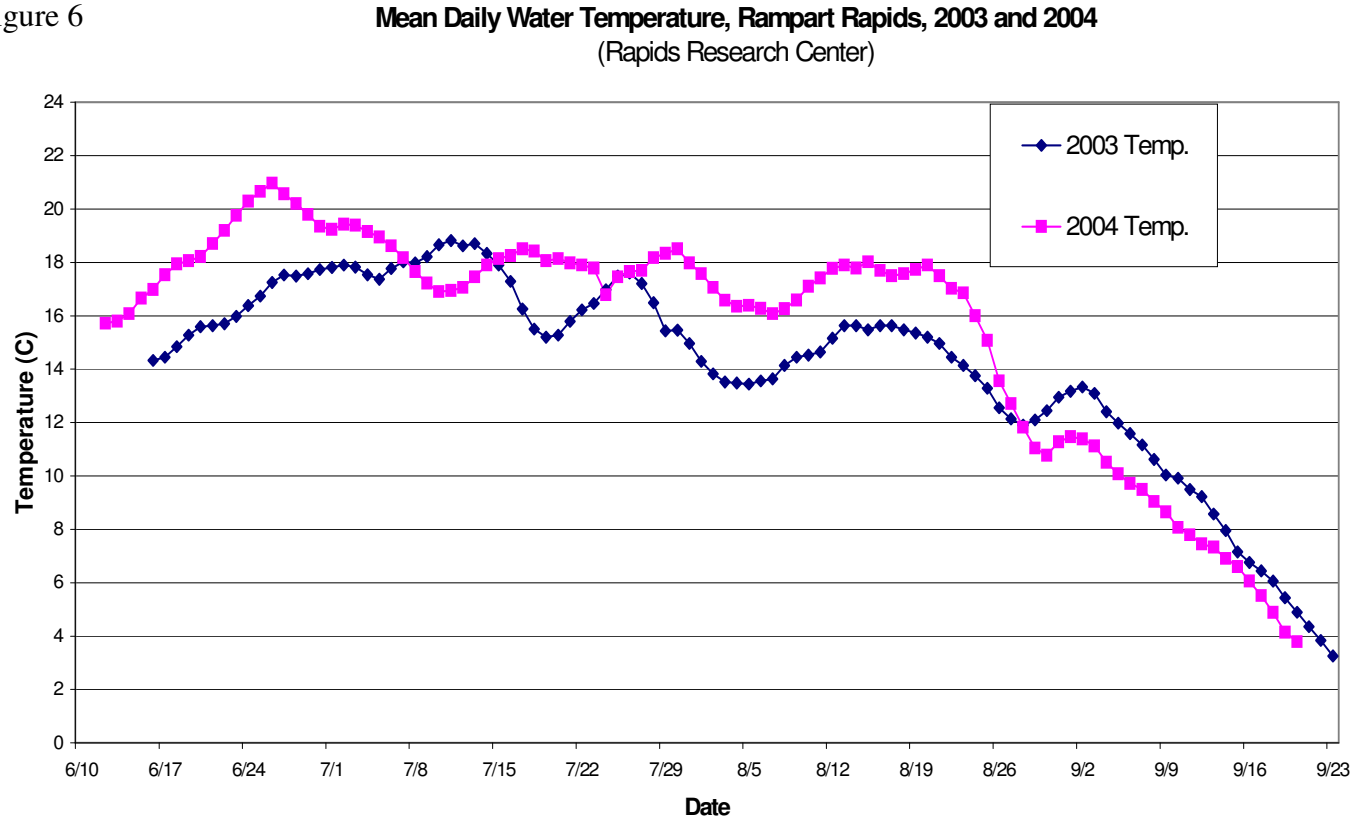

Figure 7

Rapids video fishwheel in spring Chinook season. Lead fence in foreground.

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.

Broad whitefish, sheefish, coho and chum salmon, and humpback whitefish (picture), plus Chinook salmon and cisco whitefish get counted.

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

Rapids video shack with microwave dish for receiving video for computer fish counting.

Figure 8

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

Jason (USFWS tagging project) working a shift with a local hire and a 2-week student volunteer. Rapids video is directly involved with this outreach effort.

Keith + Kyle (West Virginia Univ.), Joe (Univ. of Alaska), and Chrissy + Jason (USFWS tagging) get samples at the video wheel during Chinook season for a bioelectrical impedance analysis project.

Showing students the Rapids video equipment.

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

Figure 9. Diel catch patterns of 2003 fall chum

Mean (± 2SE) hourly frequency of fall chum salmon caught at the Rapids test wheel, Yukon River, 2003. 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.

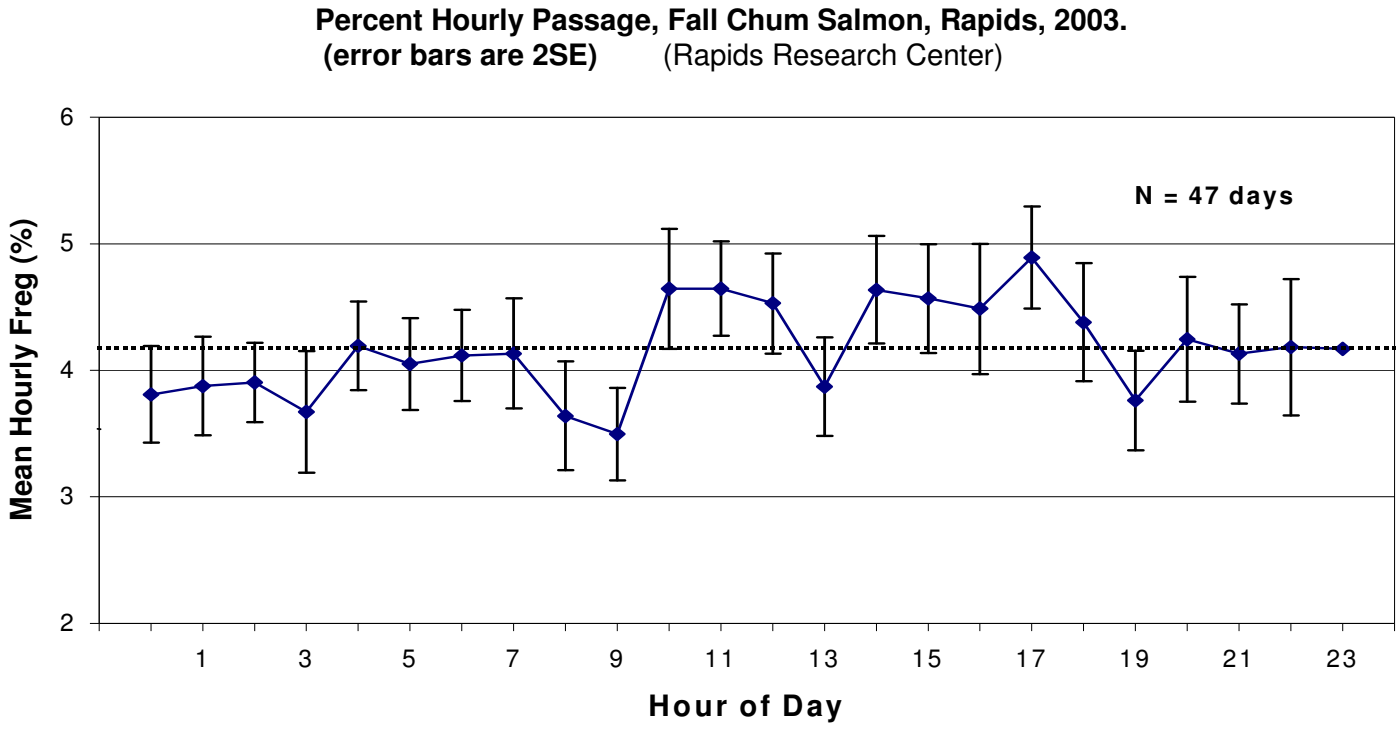

Figure 10

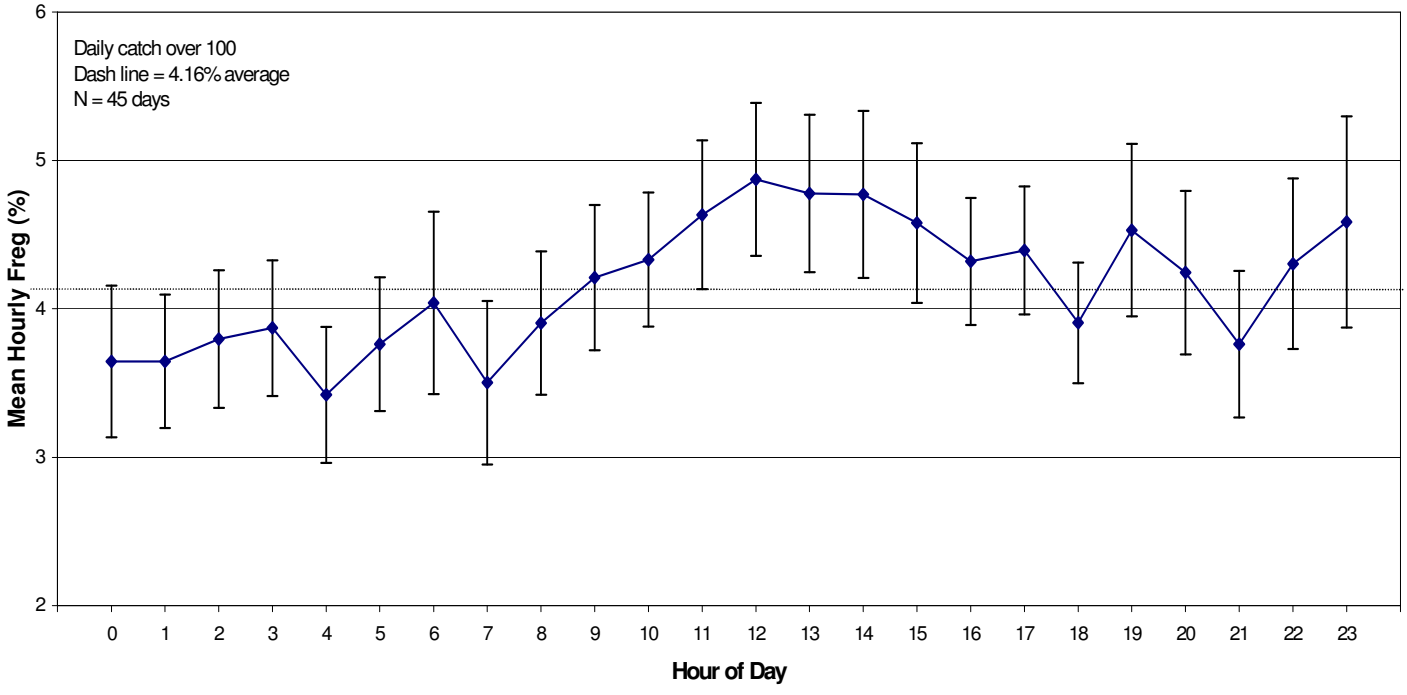

Figure 11

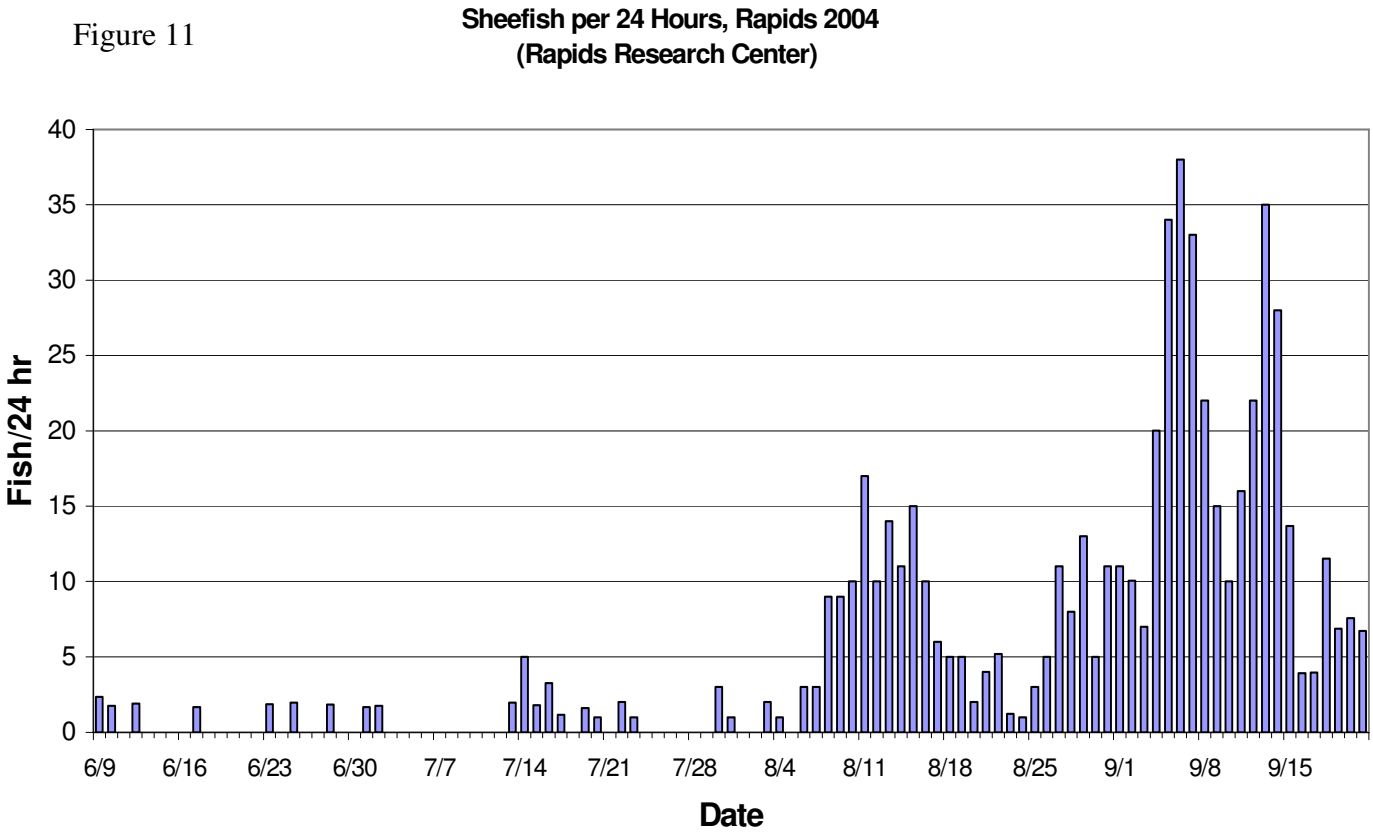

Figure 12

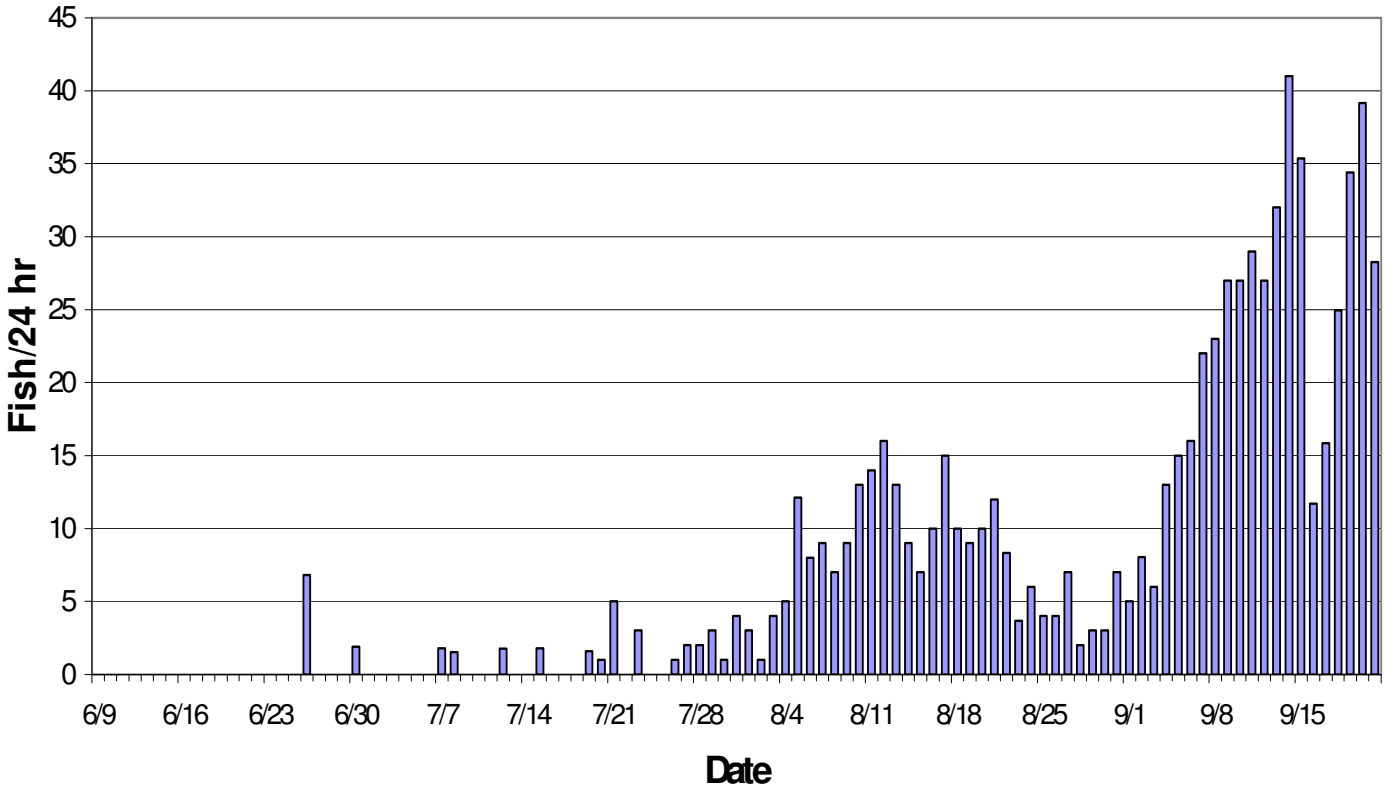

Figure 13

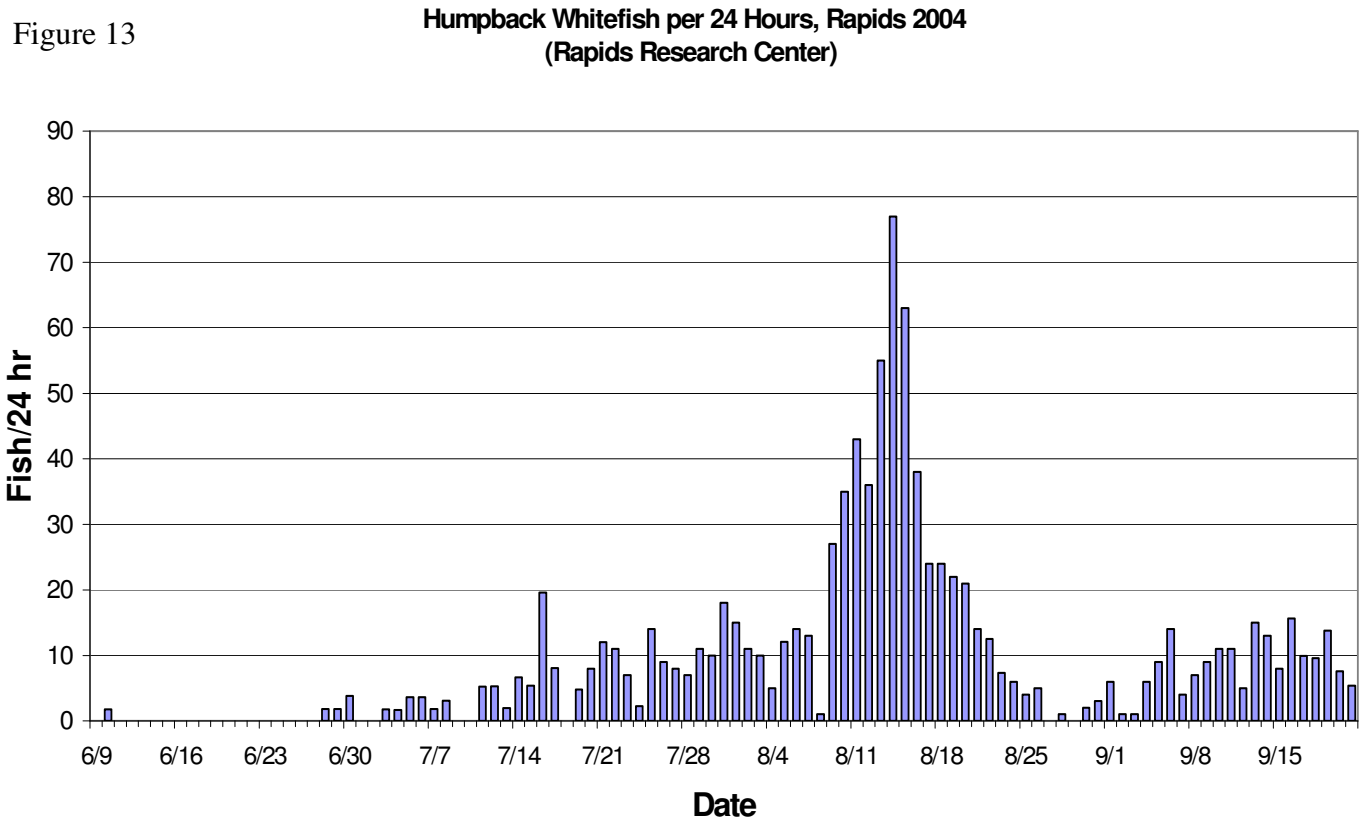

Figure 14

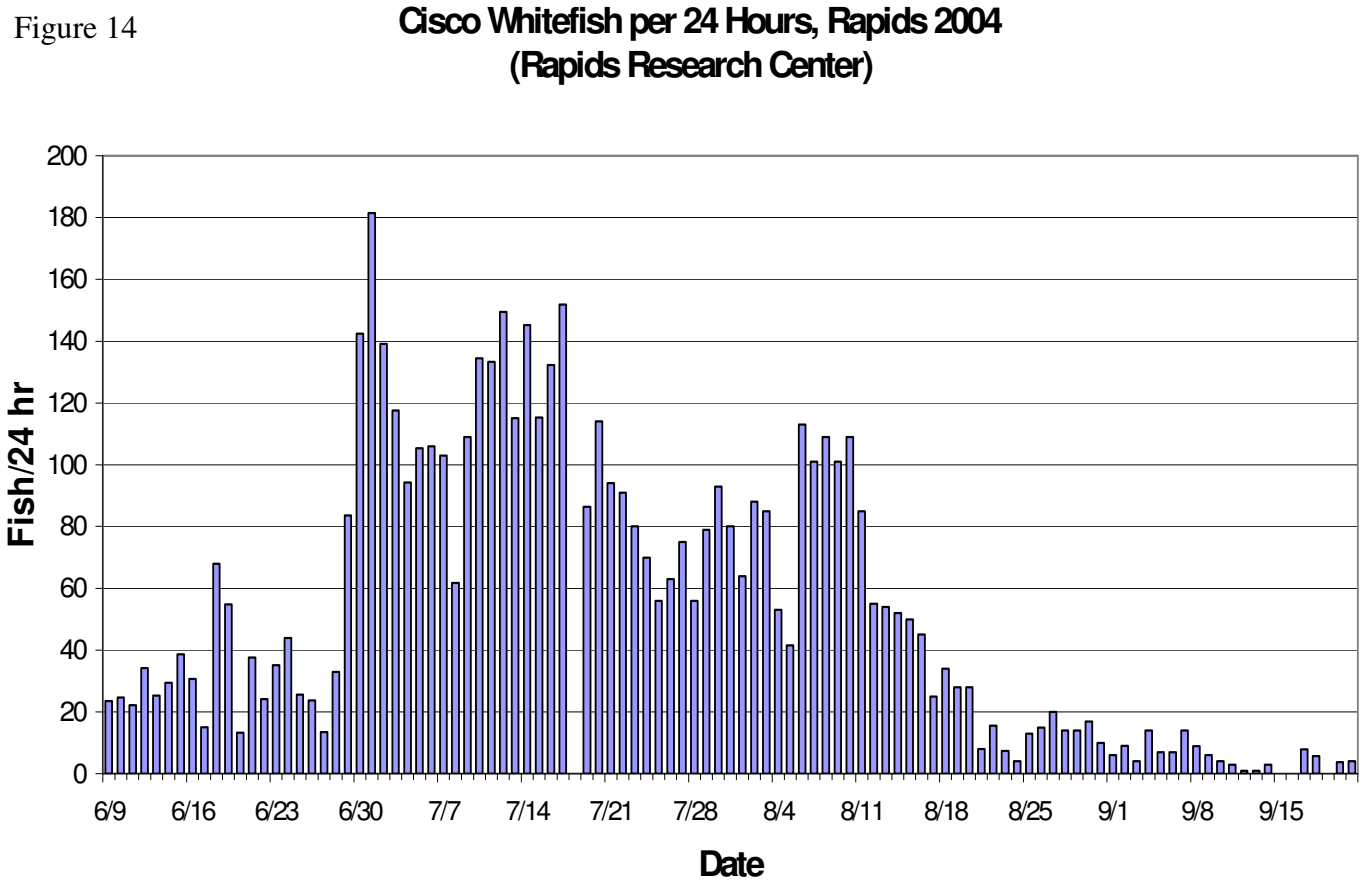

Figure 15. Site map

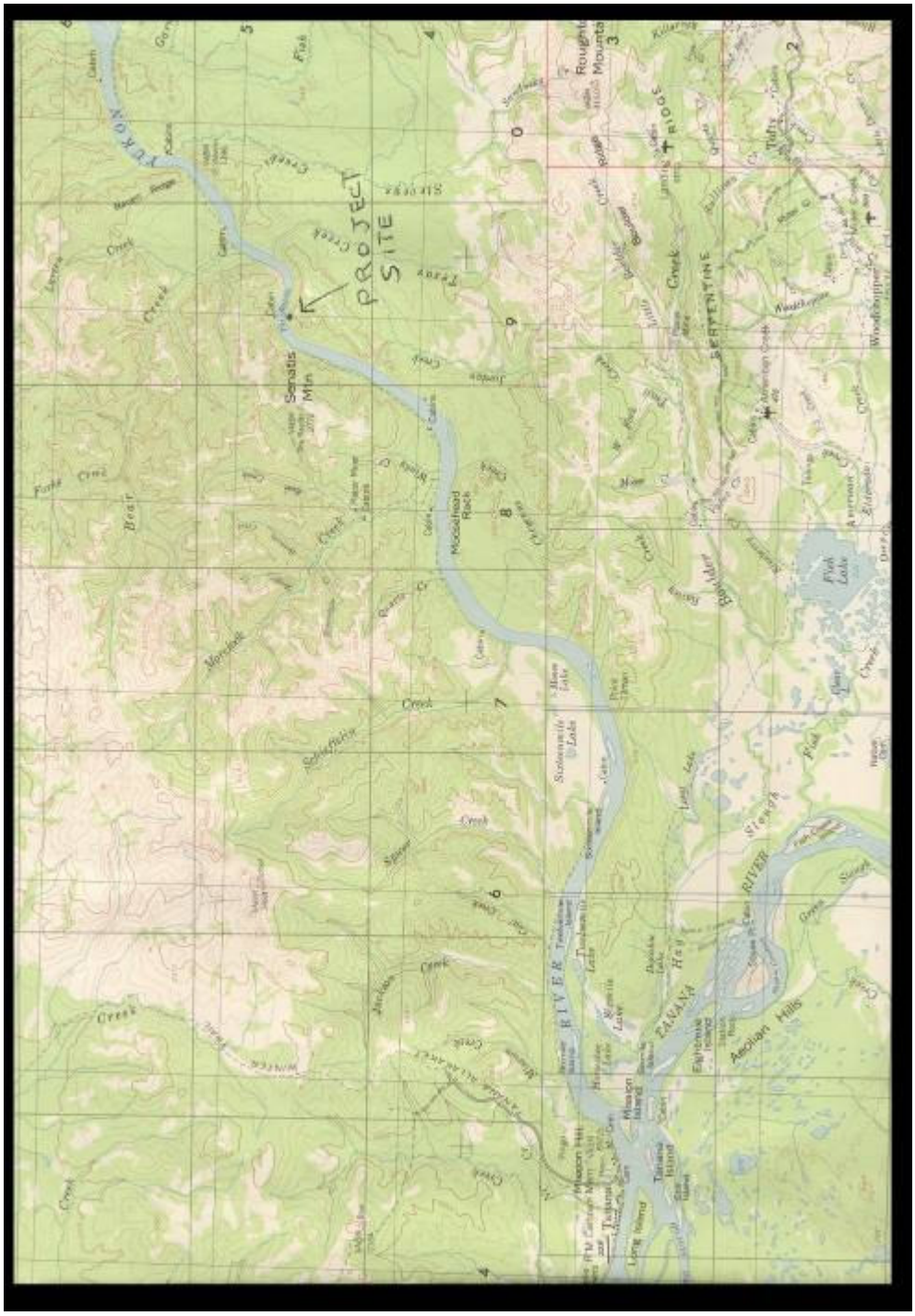

Table 1

2003 - 2004 Secchi Disk, Water Temp., and Fishwheel Water Speed Readings- Rampart Rapids										
	Secchi			Fishwheel			Secchi			Fishwheel
Reading	Disk (cm)		Water	Water		Reading	Disk (cm)		Water	Water
Date	2 readings		Temp. C	Speed (mph)		Date	2 readings		Temp. C	Speed (mph)
6/5/03						6/5/04				
6/6/03						6/6/04				
6/7/03						6/7/04				
6/8/03						6/8/04				
6/9/03						6/9/04				
6/10/03						6/10/04	13	13		
6/11/03						6/11/04	14	14		
6/12/03						6/12/04	13	13	15.72	
6/13/03						6/13/04	15	15	15.80	
6/14/03						6/14/04	15	15	16.07	
6/15/03						6/15/04			16.66	
6/16/03	15	16	14.33			6/16/04	15	15	16.98	
6/17/03	16	16	14.45			6/17/04	11	11	17.54	
6/18/03	17	17	14.84			6/18/04			17.94	
6/19/03			15.28			6/19/04	9	10	18.06	
6/20/03	16	17	15.59			6/20/04	10	10	18.22	
6/21/03			15.63			6/21/04	15	15	18.71	
6/22/03	16	16	15.71			6/22/04	16	16	19.19	
6/23/03	15	15	15.98			6/23/04	16	16	19.76	
6/24/03	15	16	16.38			6/24/04	16	16	20.29	
6/25/03	15	15	16.74			6/25/04	16	16	20.65	
6/26/03	14	15	17.25			6/26/04	14	14	20.98	
6/27/03	13	13	17.53			6/27/04	11	11	20.57	
6/28/03	13	13	17.49			6/28/04	9	9	20.20	
6/29/03	13	13	17.57			6/29/04	9	8	19.80	
6/30/03	14	14	17.74			6/30/04	8	8	19.35	
7/1/03	14	14	17.82			7/1/04	6	6	19.23	
7/2/03	14	14	17.90			7/2/04	6	5	19.43	
7/3/03	14	13	17.82			7/3/04	6	6	19.39	
7/4/03			17.53			7/4/04	5	5	19.15	
7/5/03			17.37			7/5/04	5	5	18.95	
7/6/03	13	13	17.77			7/6/04	5	5	18.62	
7/7/03	12	12	18.02			7/7/04	5	5	18.18	
7/8/03			17.98			7/8/04	5	5	17.66	3.62
7/9/03	11	11	18.22			7/9/04	4	5	17.22	3.54
7/10/03	11	12	18.66			7/10/04	5	5	16.90	3.64
7/11/03			18.82			7/11/04	5	5	16.94	3.55
7/12/03	12	10	18.62			7/12/04	5	5	17.06	3.78
7/13/03	11	11	18.70			7/13/04	5	5	17.46	3.55
7/14/03			18.34			7/14/04			17.90	3.85
7/15/03	10	11	17.90			7/15/04	5	5	18.14	3.52
7/16/03	10	11	17.29			7/16/04	4	4	18.26	3.48
7/17/03	11	11	16.26			7/17/04	5	5	18.50	3.14
7/18/03	10	10	15.51			7/18/04	5	5	18.42	
7/19/03	10	10	15.20			7/19/04	5	5	18.06	3.15
7/20/03			15.28			7/20/04	5	5	18.14	3.49
7/21/03	9	10	15.79			7/21/04	5	5	17.98	3.67
7/22/03	9	9	16.22			7/22/04	6	6	17.90	3.22
7/23/03	9	9	16.46			7/23/04	7	6	17.78	3.38
7/24/03	10	9	16.97			7/24/04	7	7	16.78	
7/25/03			17.49			7/25/04	6	6	17.46	3.56
7/26/03	9	9	17.61			7/26/04	5	5	17.66	
7/27/03	9	8	17.22			7/27/04	5	5	17.70	3.67
7/28/03	9	8	16.50			7/28/04	5	4	18.18	3.44
7/29/03	7	7	15.43			7/29/04	5	4	18.34	3.46
7/30/03	5	6	15.47			7/30/04	5	5	18.50	3.23
7/31/03			14.96			7/31/04			17.98	3.10
8/1/03	6	6	14.29			8/1/04	6	6	17.58	3.50
8/2/03	6	6	13.83			8/2/04	7	7	17.06	3.38

Table 2

2002 - 2004 Secchi Disk, Water Temp and Fishwheel Water Speed Readings- Rampart Rapids (Continued)										
	Secchi			Fishwheel			Secchi			Fishwheel
Reading	Disk (cm)		Water	Water		Reading	Disk (cm)		Water	Water
Date	2 readings		Temp. C	Speed (mph)		Date	2 readings		Temp. C	Speed (mph)
8/3/03	6	6	13.52			8/3/04	7	7	16.58	3.22
8/4/03	6	5	13.48			8/4/04	6	6	16.35	
8/5/03	6	7	13.44			8/5/04	5	5	16.39	3.49
8/6/03	7	7	13.56			8/6/04	5	5	16.27	3.58
8/7/03	8	7	13.64			8/7/04	5	5	16.07	3.36
8/8/03			14.14			8/8/04	6	6	16.27	
8/9/03	8	9	14.45			8/9/04	6	6	16.59	3.61
8/10/03	10	11	14.53			8/10/04	6	6	17.10	3.53
8/11/03	12	10	14.65			8/11/04	5	5	17.42	3.63
8/12/03	12	12	15.16			8/12/04	5	5	17.78	
8/13/03	12	13	15.63			8/13/04	6	6	17.90	3.35
8/14/03			15.63			8/14/04	6	6	17.78	3.66
8/15/03	11	11	15.47			8/15/04			18.02	3.34
8/16/03	11	10	15.63			8/16/04	6	5	17.70	3.16
8/17/03	11	11	15.63			8/17/04	6	6	17.50	3.00
8/18/03	12	12	15.47			8/18/04	7	7	17.58	3.38
8/19/03	11	11	15.35			8/19/04	7	7	17.74	3.22
8/20/03	10	10	15.20			8/20/04	7	7	17.90	2.13
8/21/03			14.96			8/21/04	6	6	17.50	
8/22/03	10	10	14.45			8/22/04	5	5	17.02	2.98
8/23/03	10	10	14.14			8/23/04	5	5	16.86	3.21
8/24/03	11	11	13.75			8/24/04	5	5	16.00	2.34
8/25/03	12	12	13.29			8/25/04			15.08	2.18
8/26/03	12	12	12.56			8/26/04	5	5	13.56	1.97
8/27/03			12.14			8/27/04	5	5	12.71	2.15
8/28/03	12	13	11.90			8/28/04	6	6	11.83	
8/29/03	13	13	12.10			8/29/04	6	6	11.05	2.31
8/30/03	15	15	12.44			8/30/04	6	6	10.78	1.85
8/31/03	19	19	12.94			8/31/04	5	5	11.28	2.19
9/1/03	20	20	13.17			9/1/04	5	5	11.47	
9/2/03	19	20	13.33			9/2/04	5	5	11.39	2.61
9/3/03	22	22	13.10			9/3/04	5	5	11.12	
9/4/03			12.40			9/4/04	4	4	10.51	1.54
9/5/03	23	23	11.98			9/5/04	4	4	10.08	2.37
9/6/03	18	18	11.59			9/6/04	5	4	9.73	1.34
9/7/03	16	15	11.16			9/7/04	6	6	9.50	2.14
9/8/03	22	22	10.62			9/8/04	7	7	9.04	2.33
9/9/03	16	25	10.04			9/9/04	10	10	8.65	2.52
9/10/03	27	27	9.92			9/10/04	10	10	8.07	2.15
9/11/03	30	30	9.50			9/11/04	12	11	7.80	2.47
9/12/03			9.23			9/12/04	12	12	7.45	
9/13/03	31	31	8.57			9/13/04	13	13	7.33	2.31
9/14/03	31	31	7.96			9/14/04	14	14	6.91	2.06
9/15/03			7.15			9/15/04	14	14	6.60	2.15
9/16/03	26	26	6.76			9/16/04	15	15	6.06	
9/17/03			6.45			9/17/04	16	16	5.51	
9/18/03			6.06			9/18/04			4.89	1.54
9/19/03			5.44			9/19/04	18	18	4.15	1.77
9/20/03			4.90			9/20/04	22	22	3.79	
9/21/03			4.35			9/21/04	24	24		
9/22/03			3.84			9/22/04				
9/23/03			3.26			9/23/04				

Table 3

			2004 Video Short Summary-Rapids											
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
				1961	1723	70 cm	15176	560	676	899	4160	TOTALS	2854	16509
Wed	6/9/04	13:48:37	23:59:59	10.19	3	0.0%	0	1	0	0	10	1 king in 4:45 min on 8th - 20 lbs, dip is 1' off specs	7.07	0.00
Thu	6/10/04	9:21:33	22:59:09	13.63	1	0.0%	0	1	0	1	14	Basket dip on specs, Obrian net 3 king	1.76	0.00
Fri	6/11/04	9:00:00	22:01:05	13.02	1	0.0%	0	0	0	0	12	Obrian net down	1.84	0.00
Sat	6/12/04	9:04:00	21:42:13	12.64	0	0.0%	0	1	0	0	18	Obrian net still down	0.00	0.00
Sun	6/13/04	8:47:18	22:05:26	13.30	5	0.0%	0	0	0	0	14	Nets up also	9.02	0.00
Mon	6/14/04	8:52:04	22:44:27	13.87	4	0.0%	1	0	0	0	17		6.92	1.73
Tue	6/15/04	9:27:31	22:30:00	13.04	3	0.0%	0	0	0	0	21	nets still low	5.52	0.00
Wed	6/16/04	9:38:56	22:09:18	12.51	9	0.0%	0	0	0	0	16		17.27	0.00
Thu	6/17/04	8:58:49	23:21:04	14.37	6	0.0%	2	1	0	0	9	System assessments past 3 days	10.02	3.34
Fri	6/18/04	12:19:57	23:59:59	11.67	12	16.7%	0	0	0	0	33	1st rock of rockisland showed up	24.68	0.00
Sat	6/19/04	8:12:14	21:46:18	13.57	11	9.1%	0	0	0	0	31	Nets not up same as wheel, Dave left	19.46	0.00
Sun	6/20/04	8:24:18	22:54:31	14.50	24	4.2%	2	0	0	0	8	water to low at upper eddie for meaningful counts	39.71	3.31
Mon	6/21/04	6:00:00	21:10:05	12.77	20	10.0%	1	0	0	0	20	windy	37.59	1.88
Tue	6/22/04	9:19:40	22:15:20	12.93	14	7.1%	0	0	0	0	13	Larsen's slow, Obrian wheel starts, 1st student group	25.99	0.00
Wed	6/23/04	8:43:23	21:41:57	12.98	16	18.8%	1	1	0	0	19	Steve wheel small king also on new pulse	29.59	1.85
Thu	6/24/04	9:07:11	21:40:06	12.55	8	12.5%	0	0	0	0	23		15.30	0.00
Fri	6/25/04	7:00:00	23:59:59	12.16	43	11.6%	0	1	0	0	13	Wheel hit bottom-broke and log hit wheel-fun day	84.87	0.00
Sat	6/26/04	9:41:03	23:47:43	14.11	42	19.0%	0	0	4	0	14	Obrian 7 per hr and smaller	71.43	0.00
Sun	6/27/04	10:31:40	23:01:44	12.50	64	25.0%	0	0	0	0	7	Glacer water here, redder kings now	122.87	0.00
Mon	6/28/04	9:04:52	22:09:08	13.07	77	16.9%	2	1	0	1	18	river full of burnt matter	141.38	3.67
Tue	6/29/04	9:17:47	22:30:00	13.20	105	22.9%	5	0	0	1	46	redder and more bad flesh-lots of small mature kings	190.86	9.09
Wed	6/30/04	9:16:16	21:54:35	12.64	38	21.1%	5	0	1	2	75	end of pulse fish but okay	72.16	9.49
Thu	7/1/04	8:39:07	23:04:23	14.42	47	25.5%	7	1	0	0	109	Cambell 7/hr for short time,	78.22	11.65
Fri	7/2/04	9:04:10	22:42:19	13.64	108	19.4%	6	1	0	0	79	1st commercial, Obrian and Cambell 3x Zuray	190.09	10.56
Sat	7/3/04	9:43:08	23:23:41	13.68	56	41.1%	3	0	0	1	67	2nd com, all about 3x Zuray	98.28	5.26
Sun	7/4/04	8:45:07	23:00:00	14.25	64	37.5%	3	0	0	1	56	subsist closure	107.80	5.05
Mon	7/5/04	9:47:03	23:00:04	13.22	86	36.0%	3	0	0	2	58	subsist closure, 1st wheel paddles all season put on	156.16	5.45
Tue	7/6/04	9:38:04	23:00:00	13.37	76	30.3%	6	0	0	2	59	3rd Com open, Larger kings-everyone,	136.47	10.77
Wed	7/7/04	9:22:55	22:40:08	13.29	50	30.0%	5	0	1	1	57		90.31	9.03
Thu	7/8/04	8:21:00	23:54:24	15.56	105	42.9%	6	0	1	2	40	Lots of jacks, ICH building up, new speed method	161.99	9.26
Fri	7/9/04	9:26:30	23:18:58	13.87	62	45.2%	13	0	0	0	63	quiting soon because of ICH	107.25	22.49
Sat	7/10/04	9:20:29	22:00:58	12.67	60	41.7%	7	0	0	0	71	0	113.61	13.25
Sun	7/11/04	8:08:14	21:49:09	13.68	31	61.3%	20	0	0	3	76	Obrain wheel quit-to many chum	54.38	35.08
Mon	7/12/04	9:20:57	23:00:00	13.65	68	45.6%	43	0	1	3	85	12.5% red flesh chums, 4 of 7 large chin had ICH flesh	119.55	75.60
Tue	7/13/04	9:38:40	21:56:32	12.30	41	48.8%	41	1	0	1	59	7.7% red,	80.01	80.01
Wed	7/14/04	8:35:32	22:58:36	14.38	10	30.0%	43	3	0	4	87	11.1% red	16.68	71.74
Thu	7/15/04	8:00:00	21:19:37	13.33	13	69.2%	79	1	1	3	64	7% red, summer chum run only	23.41	142.27
Fri	7/16/04	8:39:43	23:21:51	14.70	14	71.4%	61	2	0	12	81	16.7 red ,	22.85	99.58
Sat	7/17/04	0:00:00	20:51:41	20.86	48	50.0%	78	1	0	7	132	7.7% red, most quit cause of king ICH and pale	55.22	89.74
Sun	7/18/04	0:00:00	0:00:00	0.00	0	0.0%	0	0	0	0	0		0.00	0.00
Mon	7/19/04	8:59:45	23:59:59	15.00	10	40.0%	44	1	1	3	54	Lights set up for night video	16.00	70.38
Tue	7/20/04	0:00:00	23:59:59	24.00	32	25.0%	64	1	1	8	114	13.3% red, 24 hr counts, no fall chum run, all slow	32.00	64.00
Wed	7/21/04	0:00:00	23:59:59	24.00	31	29.0%	49	0	5	12	94	10% red, Obrian pulled wheel,	31.00	49.00
Thu	7/22/04	0:00:00	23:59:59	24.00	28	14.3%	48	2	0	11	91	8.3% red,	28.00	48.00
Fri	7/23/04	0:00:00	23:59:59	24.00	29	17.2%	60	1	3	7	80	5% red, Still summer chums	29.00	60.00
Sat	7/24/04	0:00:00	10:38:53	10.65	4	0.0%	10	0	0	1	31	Mnook creek flooded-wheel hit bad-off	9.02	22.54
Sun	7/25/04	17:08:29	23:59:59	6.86	6	16.7%	34	0	0	4	16		21.00	118.98
Mon	7/26/04	0:00:00	23:59:59	24.00	23	21.7%	103	0	1	9	63	30.2% red flesh, Tagging started	23.00	103.00
Tue	7/27/04	0:00:00	23:59:59	24.00	11	18.2%	166	0	2	8	75	46.2% red,TEK Fall Start	11.00	166.00
Wed	7/28/04	0:00:00	23:59:59	24.00	12	16.7%	147	0	2	7	56	46.7% red	12.00	147.00
Thu	7/29/04	0:00:00	23:59:59	24.00	15	33.3%	253	0	3	11	79	0	15.00	253.00
Fri	7/30/04	0:00:00	23:59:59	24.00	8	50.0%	261	3	1	10	93	33.3% red	8.00	261.00
Sat	7/31/04	0:00:00	23:59:59	24.00	11	18.2%	180	1	4	18	80		11.00	180.00

Table 4

2004 Video Short Summary-Rapids - continued

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
Sun	8/1/04	0:00:00	23:59:59	24.00	9	22.2%	123	0	3	15	64		9.00	123.00
Mon	8/2/04	0:00:00	23:59:59	24.00	4	25.0%	125	0	1	11	88	42% red	4.00	125.00
Tue	8/3/04	0:00:00	23:59:59	24.00	4	50.0%	123	2	4	10	85	0	4.00	123.00
Wed	8/4/04	0:00:00	23:59:59	24.00	7	28.6%	98	1	5	5	53	38% red	7.00	98.00
Thu	8/5/04	10:07:25	23:59:59	13.88	3	66.7%	79	0	7	7	24	Fish getting darker	5.19	136.64
Fri	8/6/04	0:00:00	23:59:59	24.00	5	20.0%	101	3	8	14	113		5.00	101.00
Sat	8/7/04	0:00:00	23:59:59	24.00	3	0.0%	180	3	9	13	101	new fish, big males, darker	3.00	180.00
Sun	8/8/04	0:00:00	23:59:59	24.00	4	50.0%	190	9	7	1	109		4.00	190.00
Mon	8/9/04	0:00:00	23:59:59	24.00	1	0.0%	218	9	9	27	101		1.00	218.00
Tue	8/10/04	0:00:00	23:59:59	24.00	1	0.0%	266	10	13	35	109		1.00	266.00
Wed	8/11/04	0:00:00	23:59:59	24.00	6	16.7%	292	17	14	43	85		6.00	292.00
Thu	8/12/04	0:00:00	23:59:59	24.00	2	0.0%	178	10	16	36	55	10 sheefish pos. ICH	2.00	178.00
Fri	8/13/04	0:00:00	23:59:59	24.00	0	0.0%	186	14	13	55	54	Geoff left	0.00	186.00
Sat	8/14/04	0:00:00	23:59:59	24.00	2	0.0%	169	11	9	77	52		2.00	169.00
Sun	8/15/04	0:00:00	23:59:59	24.00	1	0.0%	101	15	7	63	50		1.00	101.00
Mon	8/16/04	0:00:00	23:59:59	24.00	2	0.0%	72	10	10	38	45		2.00	72.00
Tue	8/17/04	0:00:00	23:59:59	24.00	0	0.0%	83	6	15	24	25	Nice big chum	0.00	83.00
Wed	8/18/04	0:00:00	23:59:59	24.00	0	0.0%	167	5	10	24	34		0.00	167.00
Thu	8/19/04	0:00:00	23:59:59	24.00	0	0.0%	373	5	9	22	28		0.00	373.00
Fri	8/20/04	0:00:00	23:59:59	24.00	0	0.0%	493	2	10	21	28	2 small paddles and small tarp on wheel	0.00	493.01
Sat	8/21/04	0:00:00	23:59:59	24.00	0	0.0%	552	4	12	14	8	Can't see wheel-smoke	0.00	552.01
Sun	8/22/04	0:00:00	23:59:59	23.09	1	0.0%	515	5	8	12	15	Log in wheel basket, lost approx. 1 hour	1.04	535.30
Mon	8/23/04	0:00:00	23:59:59	19.61	0	0.0%	358	1	3	6	6	Battery/light failure-lost about 4 hours	0.00	438.14
Tue	8/24/04	0:00:00	23:59:59	24.00	1	0.0%	379	1	6	6	4		1.00	379.00
Wed	8/25/04	0:00:00	23:59:59	24.00	0	0.0%	412	3	4	4	13		0.00	412.00
Thu	8/26/04	0:00:00	23:59:59	24.00	0	0.0%	526	5	4	5	15		0.00	526.01
Fri	8/27/04	0:00:00	23:59:59	24.00	0	0.0%	508	11	7	0	20		0.00	508.01
Sat	8/28/04	0:00:00	23:59:59	24.00	0	0.0%	649	8	2	1	14		0.00	649.01
Sun	8/29/04	0:00:00	23:59:59	24.00	0	0.0%	707	13	3	0	14		0.00	707.01
Mon	8/30/04	0:00:00	23:59:59	24.00	0	0.0%	620	5	3	2	17		0.00	620.01
Tue	8/31/04	0:00:00	23:59:59	24.00	0	0.0%	438	11	7	3	10	Raised up 6" beyond specs	0.00	438.01
Wed	9/1/04	0:00:00	23:59:59	24.00	0	0.0%	357	11	5	6	6		0.00	357.00
Thu	9/2/04	0:00:00	23:52:57	23.88	0	0.0%	249	10	8	1	9		0.00	250.23
Fri	9/3/04	0:00:00	23:59:59	24.00	0	0.0%	135	7	6	1	4	Raised up 1' beyond specs, ice	0.00	135.00
Sat	9/4/04	0:00:00	23:59:59	24.00	0	0.0%	166	20	13	6	14	Full gang of paddles now, plus small tarps on baskets	0.00	166.00
Sun	9/5/04	0:00:00	23:59:59	24.00	0	0.0%	206	34	15	9	7	Rock in front of wheel showing, ice on wheel	0.00	206.00
Mon	9/6/04	0:00:00	23:59:59	24.00	0	0.0%	128	38	16	14	7	wheel hitting bottom in morning, ice, 1 1/2' above specs	0.00	128.00
Tue	9/7/04	0:00:00	23:59:59	24.00	0	0.0%	159	33	22	4	14	More paddles, 2' above specs	0.00	159.00
Wed	9/8/04	0:00:00	23:59:59	24.00	0	0.0%	162	22	23	7	9	More paddles and basket tarps, 4'x8' of paddles now	0.00	162.00
Thu	9/9/04	0:00:00	23:59:59	24.00	0	0.0%	192	15	27	9	6	YRDFA Mike here, start crib raft	0.00	192.00
Fri	9/10/04	0:00:00	23:59:59	24.00	0	0.0%	134	10	27	11	4	Dave doing assessments	0.00	134.00
Sat	9/11/04	0:00:00	23:59:59	24.00	0	0.0%	146	16	29	11	3	2 1/2' above specs	0.00	146.00
Sun	9/12/04	0:00:00	23:59:59	24.00	0	0.0%	255	22	27	5	1	wheel heavy with ice at night	0.00	255.00
Mon	9/13/04	0:00:00	23:59:59	24.00	1	0.0%	313	35	32	15	1	added spar extension and pushed out more	1.00	313.00
Tue	9/14/04	0:00:00	23:59:59	24.00	0	0.0%	364	28	41	13	3	Campbell wheel been same as always 2-3x	0.00	364.00
Wed	9/15/04	0:00:00	21:01:45	21.03	1	0.0%	204	12	31	7	0	ice never left wheel in day	1.14	232.82
Thu	9/16/04	7:52:23	20:10:00	12.29	0	0.0%	162	2	6	8	0	ice never left wheel in day, 3' above specs	0.00	316.26
Fri	9/17/04	7:48:29	20:25:00	12.11	0	0.0%	199	2	8	5	4	chipped ice-raft sinking, 3 1/2' above specs, crib town	0.00	394.38
Sat	9/18/04	8:00:00	20:30:00	12.50	0	0.0%	167	6	13	5	3	crib in town, above freezing so run at night	0.00	320.64
Sun	9/19/04	20:30:43	23:59:59	3.49	0	0.0%	23	1	5	2	0	another tarp , pushed out all way on extension	0.00	158.27
Mon	9/20/04	0:00:00	23:59:59	19.00	0	0.0%	171	6	31	6	3	wheel turning good but close to bottom	0.00	216.00
Tue	9/21/04	0:00:00	17:50:00	17.83	0	0.0%	141	5	21	4	3	We're going home	0.00	189.76
0	1/0/00	0:00:00	0:00:00	0.00	0	0.0%	0	0	0	0	0	0	0.00	0.00

Table 5

2004 All Video CPUE - Rampart Rapids

Start	Day	Counting	King	King	Chum	Chum	Sheefish	Sheefish	Broad	Broad	Humpback	Humpback	Cisco	Cisco
Day	No.	Date	per hr	per 24 hr	per hr	per 24 hr	per hr	per 24 hr	per hr	per 24 hr	per hr	per 24 hr	per hr	per 24 hr
Wed	1	6/9/04	0.29	7.07	0.00	0.00	0.10	2.36	0.00	0.00	0.00	0.00	0.98	23.55
Thu	2	6/10/04	0.07	1.76	0.00	0.00	0.07	1.76	0.00	0.00	0.07	1.76	1.03	24.66
Fri	3	6/11/04	0.08	1.84	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.92	22.12
Sat	4	6/12/04	0.00	0.00	0.00	0.00	0.08	1.90	0.00	0.00	0.00	0.00	1.42	34.19
Sun	5	6/13/04	0.38	9.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.05	25.26
Mon	6	6/14/04	0.29	6.92	0.07	1.73	0.00	0.00	0.00	0.00	0.00	0.00	1.23	29.41
Tue	7	6/15/04	0.23	5.52	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.61	38.65
Wed	8	6/16/04	0.72	17.27	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.28	30.70
Thu	9	6/17/04	0.42	10.02	0.14	3.34	0.07	1.67	0.00	0.00	0.00	0.00	0.63	15.03
Fri	10	6/18/04	1.03	24.68	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.83	67.88
Sat	11	6/19/04	0.81	19.46	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.28	54.84
Sun	12	6/20/04	1.65	39.71	0.14	3.31	0.00	0.00	0.00	0.00	0.00	0.00	0.55	13.24
Mon	13	6/21/04	1.57	37.59	0.08	1.88	0.00	0.00	0.00	0.00	0.00	0.00	1.57	37.59
Tue	14	6/22/04	1.08	25.99	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.01	24.13
Wed	15	6/23/04	1.23	29.59	0.08	1.85	0.08	1.85	0.00	0.00	0.00	0.00	1.46	35.14
Thu	16	6/24/04	0.64	15.30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.83	43.99
Fri	17	6/25/04	3.54	84.87	0.00	0.00	0.08	1.97	0.00	0.00	0.00	0.00	1.07	25.66
Sat	18	6/26/04	2.98	71.43	0.00	0.00	0.00	0.00	0.28	6.80	0.00	0.00	0.99	23.81
Sun	19	6/27/04	5.12	122.87	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.56	13.44
Mon	20	6/28/04	5.89	141.38	0.15	3.67	0.08	1.84	0.00	0.00	0.08	1.84	1.38	33.05
Tue	21	6/29/04	7.95	190.86	0.38	9.09	0.00	0.00	0.00	0.00	0.08	1.82	3.48	83.61
Wed	22	6/30/04	3.01	72.16	0.40	9.49	0.00	0.00	0.08	1.90	0.16	3.80	5.93	142.42
Thu	23	7/1/04	3.26	78.22	0.49	11.65	0.07	1.66	0.00	0.00	0.00	0.00	7.56	181.40
Fri	24	7/2/04	7.92	190.09	0.44	10.56	0.07	1.76	0.00	0.00	0.00	0.00	5.79	139.05
Sat	25	7/3/04	4.09	98.28	0.22	5.26	0.00	0.00	0.00	0.00	0.07	1.75	4.90	117.58
Sun	26	7/4/04	4.49	107.80	0.21	5.05	0.00	0.00	0.00	0.00	0.07	1.68	3.93	94.33
Mon	27	7/5/04	6.51	156.16	0.23	5.45	0.00	0.00	0.00	0.00	0.15	3.63	4.39	105.32
Tue	28	7/6/04	5.69	136.47	0.45	10.77	0.00	0.00	0.00	0.00	0.15	3.59	4.41	105.94
Wed	29	7/7/04	3.76	90.31	0.38	9.03	0.00	0.00	0.08	1.81	0.08	1.81	4.29	102.96
Thu	30	7/8/04	6.75	161.99	0.39	9.26	0.00	0.00	0.06	1.54	0.13	3.09	2.57	61.71
Fri	31	7/9/04	4.47	107.25	0.94	22.49	0.00	0.00	0.00	0.00	0.00	0.00	4.54	108.98
Sat	32	7/10/04	4.73	113.61	0.55	13.25	0.00	0.00	0.00	0.00	0.00	0.00	5.60	134.44
Sun	33	7/11/04	2.27	54.38	1.46	35.08	0.00	0.00	0.00	0.00	0.22	5.26	5.55	133.31
Mon	34	7/12/04	4.98	119.55	3.15	75.60	0.00	0.00	0.07	1.76	0.22	5.27	6.23	149.44
Tue	35	7/13/04	3.33	80.01	3.33	80.01	0.08	1.95	0.00	0.00	0.08	1.95	4.80	115.14
Wed	36	7/14/04	0.70	16.68	2.99	71.74	0.21	5.01	0.00	0.00	0.28	6.67	6.05	145.16
Thu	37	7/15/04	0.98	23.41	5.93	142.27	0.08	1.80	0.08	1.80	0.23	5.40	4.80	115.26
Fri	38	7/16/04	0.95	22.85	4.15	99.58	0.14	3.26	0.00	0.00	0.82	19.59	5.51	132.22
Sat	39	7/17/04	2.30	55.22	3.74	89.74	0.05	1.15	0.00	0.00	0.34	8.05	6.33	151.86
Sun		7/18/04												
Mon	40	7/19/04	0.67	16.00	2.93	70.38	0.07	1.60	0.07	1.60	0.20	4.80	3.60	86.38
Tue	41	7/20/04	1.33	32.00	2.67	64.00	0.04	1.00	0.04	1.00	0.33	8.00	4.75	114.00
Wed	42	7/21/04	1.29	31.00	2.04	49.00	0.00	0.00	0.21	5.00	0.50	12.00	3.92	94.00
Thu	43	7/22/04	1.17	28.00	2.00	48.00	0.08	2.00	0.00	0.00	0.46	11.00	3.79	91.00
Fri	44	7/23/04	1.21	29.00	2.50	60.00	0.04	1.00	0.13	3.00	0.29	7.00	3.33	80.00
Sat	45	7/24/04	0.38	9.02	0.94	22.54	0.00	0.00	0.00	0.00	0.09	2.25	2.91	69.87
Sun	46	7/25/04	0.87	21.00	4.96	118.98	0.00	0.00	0.00	0.00	0.58	14.00	2.33	55.99
Mon	47	7/26/04	0.96	23.00	4.29	103.00	0.00	0.00	0.04	1.00	0.38	9.00	2.63	63.00
Tue	48	7/27/04	0.46	11.00	6.92	166.00	0.00	0.00	0.08	2.00	0.33	8.00	3.13	75.00
Wed	49	7/28/04	0.50	12.00	6.13	147.00	0.00	0.00	0.08	2.00	0.29	7.00	2.33	56.00
Thu	50	7/29/04	0.63	15.00	10.54	253.00	0.00	0.00	0.13	3.00	0.46	11.00	3.29	79.00
Fri	51	7/30/04	0.33	8.00	10.88	261.00	0.13	3.00	0.04	1.00	0.42	10.00	3.88	93.00
Sat	52	7/31/04	0.46	11.00	7.50	180.00	0.04	1.00	0.17	4.00	0.75	18.00	3.33	80.00
Sun	53	8/1/04	0.38	9.00	5.13	123.00	0.00	0.00	0.13	3.00	0.63	15.00	2.67	64.00
Mon	54	8/2/04	0.17	4.00	5.21	125.00	0.00	0.00	0.04	1.00	0.46	11.00	3.67	88.00

Table 6

(continued) 2004 All Video CPUE - 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
Tue	55	8/3/04	0.17	4.00	5.13	123.00	0.08	2.00	0.17	4.00	0.42	10.00	3.54	85.00
Wed	56	8/4/04	0.29	7.00	4.08	98.00	0.04	1.00	0.21	5.00	0.21	5.00	2.21	53.00
Thu	57	8/5/04	0.22	5.19	5.69	136.64	0.00	0.00	0.50	12.11	0.50	12.11	1.73	41.51
Fri	58	8/6/04	0.21	5.00	4.21	101.00	0.13	3.00	0.33	8.00	0.58	14.00	4.71	113.00
Sat	59	8/7/04	0.13	3.00	7.50	180.00	0.13	3.00	0.38	9.00	0.54	13.00	4.21	101.00
Sun	60	8/8/04	0.17	4.00	7.92	190.00	0.38	9.00	0.29	7.00	0.04	1.00	4.54	109.00
Mon	61	8/9/04	0.04	1.00	9.08	218.00	0.38	9.00	0.38	9.00	1.13	27.00	4.21	101.00
Tue	62	8/10/04	0.04	1.00	11.08	266.00	0.42	10.00	0.54	13.00	1.46	35.00	4.54	109.00
Wed	63	8/11/04	0.25	6.00	12.17	292.00	0.71	17.00	0.58	14.00	1.79	43.00	3.54	85.00
Thu	64	8/12/04	0.08	2.00	7.42	178.00	0.42	10.00	0.67	16.00	1.50	36.00	2.29	55.00
Fri	65	8/13/04	0.00	0.00	7.75	186.00	0.58	14.00	0.54	13.00	2.29	55.00	2.25	54.00
Sat	66	8/14/04	0.08	2.00	7.04	169.00	0.46	11.00	0.38	9.00	3.21	77.00	2.17	52.00
Sun	67	8/15/04	0.04	1.00	4.21	101.00	0.63	15.00	0.29	7.00	2.63	63.00	2.08	50.00
Mon	68	8/16/04	0.08	2.00	3.00	72.00	0.42	10.00	0.42	10.00	1.58	38.00	1.88	45.00
Tue	69	8/17/04	0.00	0.00	3.46	83.00	0.25	6.00	0.63	15.00	1.00	24.00	1.04	25.00
Wed	70	8/18/04	0.00	0.00	6.96	167.00	0.21	5.00	0.42	10.00	1.00	24.00	1.42	34.00
Thu	71	8/19/04	0.00	0.00	15.54	373.00	0.21	5.00	0.38	9.00	0.92	22.00	1.17	28.00
Fri	72	8/20/04	0.00	0.00	20.54	493.01	0.08	2.00	0.42	10.00	0.88	21.00	1.17	28.00
Sat	73	8/21/04	0.00	0.00	23.00	552.01	0.17	4.00	0.50	12.00	0.58	14.00	0.33	8.00
Sun	74	8/22/04	0.04	1.04	22.30	535.30	0.22	5.20	0.35	8.32	0.52	12.47	0.65	15.59
Mon	75	8/23/04	0.00	0.00	18.26	438.14	0.05	1.22	0.15	3.67	0.31	7.34	0.31	7.34
Tue	76	8/24/04	0.04	1.00	15.79	379.00	0.04	1.00	0.25	6.00	0.25	6.00	0.17	4.00
Wed	77	8/25/04	0.00	0.00	17.17	412.00	0.13	3.00	0.17	4.00	0.17	4.00	0.54	13.00
Thu	78	8/26/04	0.00	0.00	21.92	526.01	0.21	5.00	0.17	4.00	0.21	5.00	0.63	15.00
Fri	79	8/27/04	0.00	0.00	21.17	508.01	0.46	11.00	0.29	7.00	0.00	0.00	0.83	20.00
Sat	80	8/28/04	0.00	0.00	27.04	649.01	0.33	8.00	0.08	2.00	0.04	1.00	0.58	14.00
Sun	81	8/29/04	0.00	0.00	29.46	707.01	0.54	13.00	0.13	3.00	0.00	0.00	0.58	14.00
Mon	82	8/30/04	0.00	0.00	25.83	620.01	0.21	5.00	0.13	3.00	0.08	2.00	0.71	17.00
Tue	83	8/31/04	0.00	0.00	18.25	438.01	0.46	11.00	0.29	7.00	0.13	3.00	0.42	10.00
Wed	84	9/1/04	0.00	0.00	14.88	357.00	0.46	11.00	0.21	5.00	0.25	6.00	0.25	6.00
Thu	85	9/2/04	0.00	0.00	10.43	250.23	0.42	10.05	0.33	8.04	0.04	1.00	0.38	9.04
Fri	86	9/3/04	0.00	0.00	5.63	135.00	0.29	7.00	0.25	6.00	0.04	1.00	0.17	4.00
Sat	87	9/4/04	0.00	0.00	6.92	166.00	0.83	20.00	0.54	13.00	0.25	6.00	0.58	14.00
Sun	88	9/5/04	0.00	0.00	8.58	206.00	1.42	34.00	0.63	15.00	0.38	9.00	0.29	7.00
Mon	89	9/6/04	0.00	0.00	5.33	128.00	1.58	38.00	0.67	16.00	0.58	14.00	0.29	7.00
Tue	90	9/7/04	0.00	0.00	6.63	159.00	1.38	33.00	0.92	22.00	0.17	4.00	0.58	14.00
Wed	91	9/8/04	0.00	0.00	6.75	162.00	0.92	22.00	0.96	23.00	0.29	7.00	0.38	9.00
Thu	92	9/9/04	0.00	0.00	8.00	192.00	0.63	15.00	1.13	27.00	0.38	9.00	0.25	6.00
Fri	93	9/10/04	0.00	0.00	5.58	134.00	0.42	10.00	1.13	27.00	0.46	11.00	0.17	4.00
Sat	94	9/11/04	0.00	0.00	6.08	146.00	0.67	16.00	1.21	29.00	0.46	11.00	0.13	3.00
Sun	95	9/12/04	0.00	0.00	10.63	255.00	0.92	22.00	1.13	27.00	0.21	5.00	0.04	1.00
Mon	96	9/13/04	0.04	1.00	13.04	313.00	1.46	35.00	1.33	32.00	0.63	15.00	0.04	1.00
Tue	97	9/14/04	0.00	0.00	15.17	364.00	1.17	28.00	1.71	41.00	0.54	13.00	0.13	3.00
Wed	98	9/15/04	0.05	1.14	9.70	232.82	0.57	13.70	1.47	35.38	0.33	7.99	0.00	0.00
Thu	99	9/16/04	0.00	0.00	13.18	316.26	0.16	3.90	0.49	11.71	0.65	15.62	0.00	0.00
Fri	100	9/17/04	0.00	0.00	16.43	394.38	0.17	3.96	0.66	15.85	0.41	9.91	0.33	7.93
Sat	101	9/18/04	0.00	0.00	13.36	320.64	0.48	11.52	1.04	24.96	0.40	9.60	0.24	5.76
Sun	102	9/19/04	0.00	0.00	6.59	158.27	0.29	6.88	1.43	34.41	0.57	13.76	0.00	0.00
Mon	103	9/20/04	0.00	0.00	9.00	216.00	0.32	7.58	1.63	39.16	0.32	7.58	0.16	3.79
Tue	104	9/21/04	0.00	0.00	7.91	189.76	0.28	6.73	1.18	28.26	0.22	5.38	0.17	4.04

Table 7

All Season 2004 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.

Approximately six hours or the first 50 fish of each week are used for the assessment samples.

No.	Date	Fish assessed	Large fish assessed	Large fish captured	small Cisco assessed	small Cisco captured	Missed (reason)
15	6/23	32	17	17	15	15	0
19	6/27	45	41	40	4	4	1 software/seconds missing
22	6/30	35	10	10	25	25	0
31	7/9	45	32	32	13	13	0
38	7/16	54	27	27	27	27	0
47	7/26	60	44	43	16	15	1 (cisco), 1seconds miss (chum)
61	8/9	56	40	40	16	16	0
71	8/19	54	53	53	3	2	1 (cisco)
81	8/29	57	56	56	1	1	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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U.S. Department of the Interior
Office for Equal Opportunity
1849 C. Street, NW
Washington, D.C. 20240