Rampart Rapids Summer Catch Per Unit Effort Video Monitoring, 2002

Using a Fishwheel on the Yukon River, Alaska

By Stan Zuray

December 2002

Annual Report to the U.S. Fish and Wildlife Service
Federal Office of Subsistence Management

Federal Subsistence Fishery Monitoring Program Report

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Fishery Information Services Division Project FIS 01- 197
Annual Report

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Cover: Two-basket fishwheel, equipped with netting sides, water generator, equipment enclosure, microwave transmitter and video chute.

Title: Rampart Rapids Summer Catch Per Unit Effort Video Monitoring, 2002

Study Number: FIS 01- 197

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Management Regions: Yukon River Geographic Area

Information Type: Stock Status and Trends

Issue(s) Addressed: Currently no other in-season project in Alaska provides assessment data on Canadian chinook salmon in the Yukon River above Pilot Station. Catch per unit effort (CPUE) data on chinook and the numerous other species counted at this site provides valuable run timing and abundance data useful to fishery managers.

Study Cost: 3 year project total 64,250.00

Study Duration: June 1, 2001 to August 1, 2003

Key Words: catch-per-unit-effort, stored video images, Yukon River, chinook salmon, Oncorhynchus tshawytscha, fishwheel, computer, microwave transmitter

Citation: Zuray, S., 2002. Rampart Rapids Summer Catch Per Unit Effort Video Monitoring, 2002 Using a Fishwheel on the Yukon River, Alaska. Federal Subsistence Fishery Monitoring Program Annual Project Report FIS 01- 197, U.S. Fish and Wildlife Service, Office of Subsistence Management, Fishery Information Services Division, Anchorage, Alaska.

Author

Stan Zuray has been a fisherman and trapper in the Tanana area since 1973. During the last seven years he has had a contract with the U. S. Fish and Wildlife Service Fisheries Resource Office in Fairbanks to run fishwheels for their chum salmon tagging project at the Rampart Rapids.

Sponsorship

This project is funded by a grant from the U.S. Fish and Wildlife Service, Federal Office of Subsistence Management, Federal Subsistence Fishery Monitoring Program.

U.S. Fish and Wildlife Service, Fisheries Resource Office continues to provide electronic and computer set up help and consultation in computer operation and statistics.

Tanana Tribal Council provides fax, copying and message services for the project.

Acknowledgments

Thanks to fisheries biologist Dave Daum (U. S. Fish and Wildlife Service Fisheries Resource Office, Fairbanks) who provided invaluable preseason computer support, in season help and assessment and post season analysis.

Thanks to fisheries biologist Tevis Underwood (U. S. Fish and Wildlife Service Fisheries Resource Office, Fairbanks) for his continued help and use of his “Rapids” camp facilities. Also for the help of his technical crew in camp breakdown work each year.

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Introduction

Monitoring of chinook salmon (Oncorhynchus tshawytscha) passage in the middle Yukon River began in 1999 at Rampart Rapids (Rapids: 730 miles upstream from the Yukon River mouth). Before this time, there were no U.S. run assessment projects for mainstem Yukon River chinook salmon above Pilot Station, 138 miles from the mouth. This unmonitored area covered over 1,000 miles. Numerous subsistence and commercial fishermen harvest salmon along this section of river. In 1999 daily subsistence fishwheel chinook salmon catch–per-unit-effort (CPUE) was supplied to the Alaska Department of Fish and Game by satellite phone from the Rapids. In 2000 and 2001, 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 continuous 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 fishwheel site since fishwheels came to the Yukon (around 1900). Traditionally, the particular bend in the river where the 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, fishwheels 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 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, fishwheels 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. The majority of these fishwheels 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 that 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 2001 (present) the site has been used to run fishwheels for the Rampart Rapids fall chum salmon tagging project (Underwood et al. 2000). During these six 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 also 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 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).

In 1999 the fishwheel operator at Rapids was supplied with a satellite phone from the U.S. Fish and Wildlife (USFWS), Fisheries Resources Office in Fairbanks and called in daily subsistence chinook salmon CPUE data to the Alaska Department of Fish and Game. 1n the fall of 1999 a development project was undertaken at this site to address the increasing concerns over live box held fish and come up with 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. In transferring this technology to a fishwheel 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 fishwheel 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 then 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 fishwheel was used having many features designed to reduce possible injury to fish. The USFWS, Fisheries Resource Office in Fairbanks 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 grants 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 video projects have been able to run both years without any down days or days when data were compromised. They provided data without any live box held fish being released back into the river.

In 2001and 2002 operation of the chinook video project took place funded by the USFWS Federal Office of Subsistence Management. The 2001 to 2003 Office of Subsistence Management project is a mating of the need for chinook run timing and assessment data and the use of video capture as a means of producing data in a way that is much less harmful to fish. This report will cover all the major developmental changes and major equipment used in the 2002 project, the field video taping procedures, and computer image capture methods. Data will be described, counts compared, and a comparison of the data provided. Aspects of the project that may help someone implement their own project and recommendations for further work are discussed that shed light on the practical aspects of making a video project work. A fall chum video project also ran in 2002, which was funded through the Restoration and Enhancement Fund and is reported under separate cover

Objectives

1. To obtain catch-per-unit-effort data on chinook and summer chum salmon, sheefish, broad, humpback whitefish and cisco spp. using the video collection system developed in fall of 1999 and improved upon in 2001.

2. To provide the U.S. Fish and Wildlife Service and the Alaska Department of Fish and Game with the above catch-per-unit-effort data via satellite phone on a daily basis.

3. To provide a yearly report on project operations and results

Study Area

The project was conducted on a fishwheel 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 it is an area known for its abundance of a wide variety of fish species. This condition exists because of the fast currents and steep banks that force fish to migrate through the area relatively concentrated and close to shore. (Figure 6)

Methods

Fishwheel

A two-basket fish wheel equipped with a video capture system was used to count salmon and other species from June 17 to July 31, 2002. Effort was taken so the site of the project was consistent from year to year. The fishwheel rotation speed, the 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 the fish as they were lifted clear of the water. Plastic 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 fishwheel 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 had been mounted on the fishwheel or set up back at camp. This included the surveillance camera, video tape recorder (VCR), portable monitor, laptop and desktop computers, and 2 generators.

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 prior to the arrival of the 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 were being monitored from ADF&G's Pilot Station Sonar Project. On June 17th, 8 chinook salmon were caught in the Rapids test fishwheel and the project officially started.

The schedule for running the wheel 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 fishwheel is not advisable. This was clearly the case in 2000 and 2001. In 2002 drift was much less.
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 2000, 2001 and 2002, the town trip was not needed every week and a count would be taken for that Sunday.

Project Specifications

This is a new section added this year. The object is to provide specifications on fishwheel components and operation so future year's CPUE results can be as comparable as possible. Changes in some specifications could easily make these comparisons meaningless. Because of shifting silts and-or changing sites frequently, some projects are not able to collect data consistently from one year to the next. The Rapids has a hard rock bottom and the same site can be used each year. The project specifics 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 fishwheel 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 appears to be especially true of fall chum salmon, which prefer a very consistent depth range to run at.
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 2001 consisted of a color CCD camera mounted above the fish wheel chute and directly connected to a laptop computer through a video capture card. After the fish wheel captures fish, they travel down a chute, are video recorded, and then reenter the river. A time-lapse VCR is linked to the system for continuous video recording backup. Twelve-volt batteries power the whole system. During daytime operation, a water-wheel generator charges the batteries. At night, lights necessitate the use of a small generator.

This system differed substantially from what was used in 1999 and 2000. In these years 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) that extracted 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, USFWS, Fairbanks Fishery Resources Office, developed a new system that eliminated the past limitations of the system. A camera was mounted directly to a laptop computer on the fishwheel. Then a new re-designed version of Salmonsoft software (funded by USFWS) was run that used electronic triggers to initiate capture of fish images as they slide 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 limitations of using time-lapse tapes were 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 were constructed and set up to house the equipment in camp. The same system was deployed in 2002. Here is a list of daily video procedures followed at the fishwheel:

Start up

Arrival at the fishwheel - make sure wheel is adjusted for running (the most complicated part).

Switch on power to water generator and lower into water. Turn on fishwheel.

Open electronics cabinet, turn on DC power from batteries, and turn on VCR and laptop.

Check laptop 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 recording VCR tape. Turn on computer capture program.

Shut down

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

Remove VCR tape and turn off VCR.

Transfer data file from hard drive to portable microdrive and shut down computer.

Turn off main DC power switch.

Lift water generator out of water and turn off DC current to water generator.
Turn off fishwheel 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. Then avi files were viewed through a Windows media player and hand-tallied. This method was un-adjustable as to scroll speed of viewing video and all numbers of fish by species and sample times had to be entered into the data base by hand.

In 2001, an electronic tally system was developed that would 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, USFWS, 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, which calculated 24-hour CPUE by day. These daily counts and CPUE calculations were then called into ADF&G using a satellite phone. Usually within a couple hours after retrieval of the data from the fishwheel, the call could be made to the fishery manager. 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. The project in 2002 used this tally system throughout the season

Assessment of New Capture Program

As a final assessment, segments of original VCR tapes were viewed and compared to the corresponding video capture files generated from the magnetic switch video system. The original VCR tapes contain all fish that pass through the chute, so assessing how many fish, if any, were missed by the program was a fairly straightforward process although rather tedious and boring. Selection of assessment samples was two-part. 1. Each Tuesday throughout the season was selected (in 2000 each Monday was selected). 2. The first six hours or the first 50 fish each Tuesday were selected to review (based on workload in reviewing that much material).

The process was as follows:

1. The VCR tape for a particular day was put in the VCR and played into a computer software program called Win TV 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 monitors screen the AVI file made by the fishwheel laptop/switch program was opened using Salmonsoft review program or the Windows 98 default video viewer found in Windows Explorer.

3. Both viewing samples were set at the beginning of the assessment sample period. The regular VCR controls on the VCR and remote were used for viewing the VCR tape and the computer mouse and keyboard forward and reverse features were used for viewing the AVI file from this point on.

4. The AVI file was advanced to the first fish, stopped and the time stamp noted.

5. The VCR tape was then run forward until a fish appeared and then was paused.

6. If all went well the VCR frame fish and the AVI file fish should be the same and have corresponding times. What was looked for was a fish that was on the VCR tape and not in the AVI file. If one were found that would signify a miss by the laptop/switch program.

7. Each fish reviewed on the VCR tape was counted on a multiple tally denominator.

8. Misses are recorded in the project workbook in case further study is needed to see why the error occurred. Most of the time the reason was apparent.

9. The AVI file was advanced to the next fish frame and the process repeated itself.

10. After an assessment selection went through this process the AVI file was then opened in Salmonsoft review program and the AVI file counted and compared to the VCR tally figure. These figures are seen in Table 2**.**

In the 2000 video project selections of the VCR tapes were viewed and fish on them counted. That number was then compared to the number of fish on a corresponding AVI file. The process described above and used in 2001-2002 was much more time consuming per fish viewed but produced better information about the precise reasons for counting errors.

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 run in the daytime hours (no lights needed), the camera, laptop, and VCR were able to run without a supplemental generator and keep a full charge at 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 like a durable, continuous use piece of equipment.

Honda 1000 watt generator (EU1000I): With the color video camera running at higher shutter speeds, it required about 180 watts of light at night 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 also boosted gas economy to 10 hours per filling. 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 also wired into the generator so that the generator would shut off whenever you 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 fishwheel spar pole to the equipment enclosure. Because the project was run in daytime it was used infrequently. Depending on site or project it could be the main fishwheel power source however.

Honda 2500-watt generator (EB2500): This generator was used at camp to run the desktop computer.

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. Also this kind of reserve allowed the water generator to not have to run the 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. As the charger will run constant at 8 amps at night with lights on, any taper charge, 15 amps or larger should be fine.

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.

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.

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 USFWS biologist 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 which was the preferred color background for photographic reasons.

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. Bouncing of the 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 that was 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 that have to be synchronized. This dampening system was necessary because of the 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.

Fishwheel Construction

It is counterproductive to install a video system only to have fish injured by the fishwheel unnecessarily. The fishwheel 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 is lined with high-density plastic webbing instead of wire. All entrance and exit doors are lined with closed-cell foam. Easily removable paddleboards of different sizes allow much control of the fishwheel 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.

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 produced noticeably better images than the similar model WV-CP464 used in 2000.

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).

Monitor: 3"X5" color LCD wired to the 12 volt system and the VCR provided a picture of the camera's view for focusing, zooming, positioning and camera parameter settings. 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.

Video Recorders: Video cameras were connected to a 12 volt DC video recorder (Panasonic AG-1070dc) with 12 and 24-hour time-lapse capability. The video recorder was placed in a waterproof Pelican case and wires ran to the outside via waterproof connectors. The video recorder stored images on the videotape at a rate of approximately 5 frames per second on the 12 hour setting and it had a date and time stamp feature that was used at all times. A matching, second video recorder was used to play images into the video capture card/computer. These VCRs have factory-cleaning recommendations of every 60 hours. Conditions at the wheel are very clean and dry and new tapes are used for each recording but use is sometimes pushed well beyond the 60 hours. VCR's are sent in for cleaning, adjustment and parts replacement after every season. This model of VCR is no longer manufactured.

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 1000 Mhz Pentium III processor, 384 MB of SDRAM memory, Windows 98 SE operating system, Recordable/Rewriteable 12x/8x/32x CDRW, analog PCI video capture card, and a PC card reader installed. The PC card reader was used to download the video files from the IBM micro-drive. All files were backed up on compact disk.

Laptop: The laptop was connected directly to a camera on the fishwheel 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 was enclosed in a waterproof case.

Capture and video review software: Salmonsoft capture software Vcap 1.3.3 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 1.3.4. 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. This 5.8 Mhz microwave transmitter and receiver were used to experiment with sending the video signal from the fishwheel 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 perfectly in 2002 and plans are underway to install a complete system on the fishwheel in 2003 thereby eliminating the need for having the laptop capture system on the fishwheel. All video capture would be done back at camp. This would reduce power requirements at the fishwheel, reducing amp/hr usage from approx.3.4 to around .5 amp/hr. The USFWS loaned the wireless system used in 2002. Hopefully, additional funding can be acquired to purchase a system dedicated to this project.

Results and Discussion

The primary objective of the project is to provide catch per unit effort data. The chinook salmon numbers are presently the ones of most interest to the Alaska Department of Fish and Game and USFWS. This data is only meaningful in as far as it relates accurately to the actual chinook passing through the site area. That actual number is of course not available for comparison so other established chinook assessment and escapement projects on the river are looked at and compared for indications of project accuracy.

Below the project is compared to three major chinook, Yukon River drainage projects. The project is only three years old so only years 2000-2003 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	20.22	183,000	28,000

. * Some 2002 figures are preliminary numbers at this time

Some general comments on the above:

1. In 2002 Rapids video data pointed to a considerable decrease in chinook escapement over 2001. The only other project above to show a decrease in chinook escapement for 2002 was the Canadian border tag estimates.
2. Considering the three-year period, Rapids video shows no similarity to the Lower Yukon set net figures.
3. Considering the three-year period, Rapids video shows only little similarity with Pilot Sonar (the increased run strength between 2000 and 2001)

A CPUE project should also be able to track pulses of fish as they move through the site area. Figure 3 is a graph comparing the day-to-day intensity of the Rapids chinook numbers with that of the Lower Yukon chinook set net test fishery numbers.

Prior to 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 assessment projects before the fish reached the Canadian border. Data provided at the Rapids video project provides fisheries managers with another view with which it 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 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. (Figure 6 – map)

The project and video system operated for 44 days. Data were recorded for 4 of the 6 scheduled days off (Sunday) in 2002.The new video system again proved to be very accurate at counting fish that were captured by a fishwheel. Many of the potential fish handling problems associated with fish fishwheel capture have been eliminated by the development of this method. The video capture system used in 2001-2002 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. Originally there was concern about operating a laptop on the fishwheel because of the wet environment. The amount of computer work needed on the wheel was very small and the enclosure kept the system dry. As was noted in 2001 when observing the condition of the equipment used at the fishwheel, the laptop computer in 2002 stayed much cleaner and less prone to environmental damage than the desktop computer and VCRs back at camp that worked in much dustier conditions.

Finding the best software program settings that controlled 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 that captured more frames than was necessary would mean larger than needed file sizes and more time spent reviewing video files. Settings that captured not 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 fishwheel captures of multiple fish when the run was the strongest. Software settings are influenced by the goals of each project. The summer video project is primarily used at present to provide CPUE data, with fish needing to be identified by species. If the project were 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 also 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 we easily accessible and controlled by the keyboard. These features became more important as the numbers of fish counted in a day increased. In 2002 a separate fall project counted 2003 chums on Sept. 6. 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 problem free in 2002. The laptop computer experienced occasional lockups during file transfer if files were large and the capture program was running in the background. The computer interface experienced none of the troubles noted in the 2001 report.

The building and maintenance of the fishwheel chute door was greatly simplified in 2001and 2002. Construction techniques still require attention, as 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 that was to light could be triggered by gusting winds. Both these conditions were again dealt with in the 2002 season as a new chute was constructed and a workable compromise was 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 no failures in 2002 (one failure in 2001).

Consultations and Capacity Development

The Chinook 2002 video project continues a close working relationship with the USFWS office in Fairbanks. Dave Daum with the USFWS Fairbanks office has made four trips this season to help with operations of the video CPUE project and assist in assessing those operations. Rapids video projects in 1999 through 2002 have also served as a center for research into fish friendly video development and low fish impact fishwheel improvements by the project manager and the Fairbanks Fish and Wildlife Office. This work continued in 2002. As in prior 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 this summer.

Bill Busher 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 FY 2001-2003 Fishery Resource Monitoring Project called Tanana Fisheries Conservation Outreach. This project has brought multiple groups of elders and school children to the Rapids project site to view and work with the chinook 2002 video project and speak with fisheries biologists with the fall chum tagging project. The Rapids video project equipment and manager directly aided student activities. These included students running their own chinook Ichthyophonus study with each shown how to set up and enter data into Excel spreadsheets using the video computer and a work program where students were paid to clear a campsite for tent frame housing and a future youth research camp.

Dr. Kocan used the Rapids video project during most of the chinook season for samples for his Ichthyophonus study. Dr. Kocan was able to work directly with students in the outreach project. Stan Zuray and Kathleen Zuray of the Tanana Native Council Environmental Office took care of student scheduling and making sure Dr. Kocan had fresh helpers each day. Students putting in the required hours each day received payment for their work from Dr. Kocan.

All the major equipment purchased for the functioning of the 2002 chinook project is presently being used in a similar fall chum salmon video project, at this site, funded by Fish and Wildlife Service, Restoration and Enhancement money.

Conclusions

1. CPUE data can be dependably generated by a fishwheel livebox alternative such as a video capture system.
2. CPUE data at Rapids project site showed a decrease in run strength from 2001 to 2002 similar to the U.S. Canadian border test wheels.

Recommendations

Work on the recommendations made in 2001 for future improvements to the video system continue and new recommendations include:

1. CPUE data is only valuable in as much as it is a reflection of what's actually happening in the river. To this end the Rapids video project has begun a list of project components that may influence CPUE data (see Project Specifications on page 11). Annual specifications for these components should be included in future project reports to aid in data collection and interpretation.
2. In 2003 USGS water level data for the Yukon River will be 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 on CPUE should be investigated.
3. An aspect of the video system is still being worked on by USFWS and Salmonsoft.

The video review/tally program is being linked into Excel spreadsheets. When the operator finishes with a video file tally the software will automatically write fish species numbers and sample times into the spreadsheet. Daily CPUE will be automatically calculated and daily updates to graphs will be entered. Since temporal data is embedded into each video frame, calculations of sample times can be accomplished automatically. This improved tally/spreadsheet interface should be available for the 2003 season.

4. Proper assessments of test fishwheel projects as well as other fish projects will only be made if raw data and methods of project operations are available in the form of reports. Without reporting requirements projects cannot be assessed for operational integrity and usefulness.

5. An internet web site needs to be run and kept 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. To this end, discussion has been initiated within YRDFA with considerations being given to running a web site that provides timely in-season information.

Budget Summary

Total Cost: 64,250 (3 year project) Project Dates: June 1 to August 1, 2001-2003

2001 - 36,150
2002 - 14,050
2003 - 14,050

	FY 2002
a. Total Annual Budget	14,050
b. Expenditures Thru December	14,050
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. All major equipment should be available for the 2002 season.

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Zuray, S., 2001b. Rampart-Rapids Fall Catch-Per-Unit-Effort Video Monitoring – 2001 using a Fishwheel on the Yukon River, Alaska. A final report to the Yukon River Panel, Anchorage, Alaska.

Figure 1. 2000 to 2002 Rapids Chinook CPUE Compared

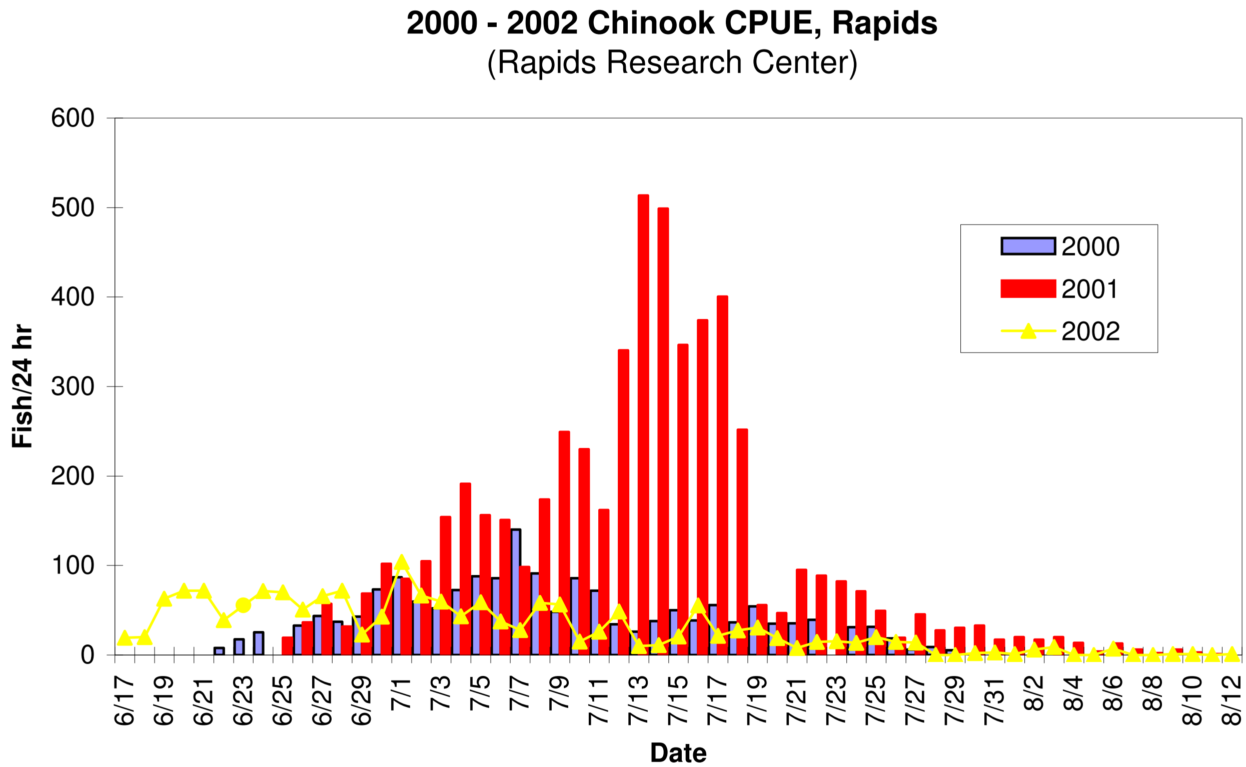


Figure 2, Canadian DFO graph showing relative strengths of 2000 to2002 chinook runs

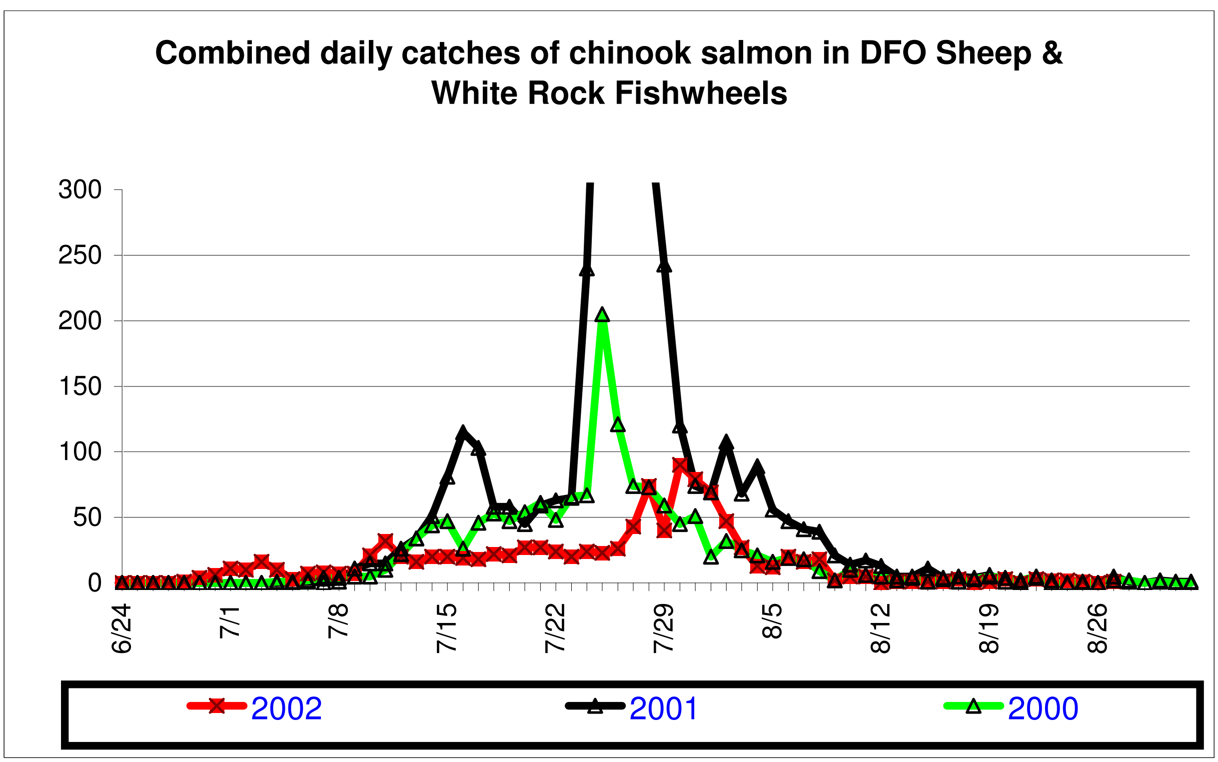


Figure 3, Rapids Video and Lower Yukon Set Net CPUE and Run Timing Compared

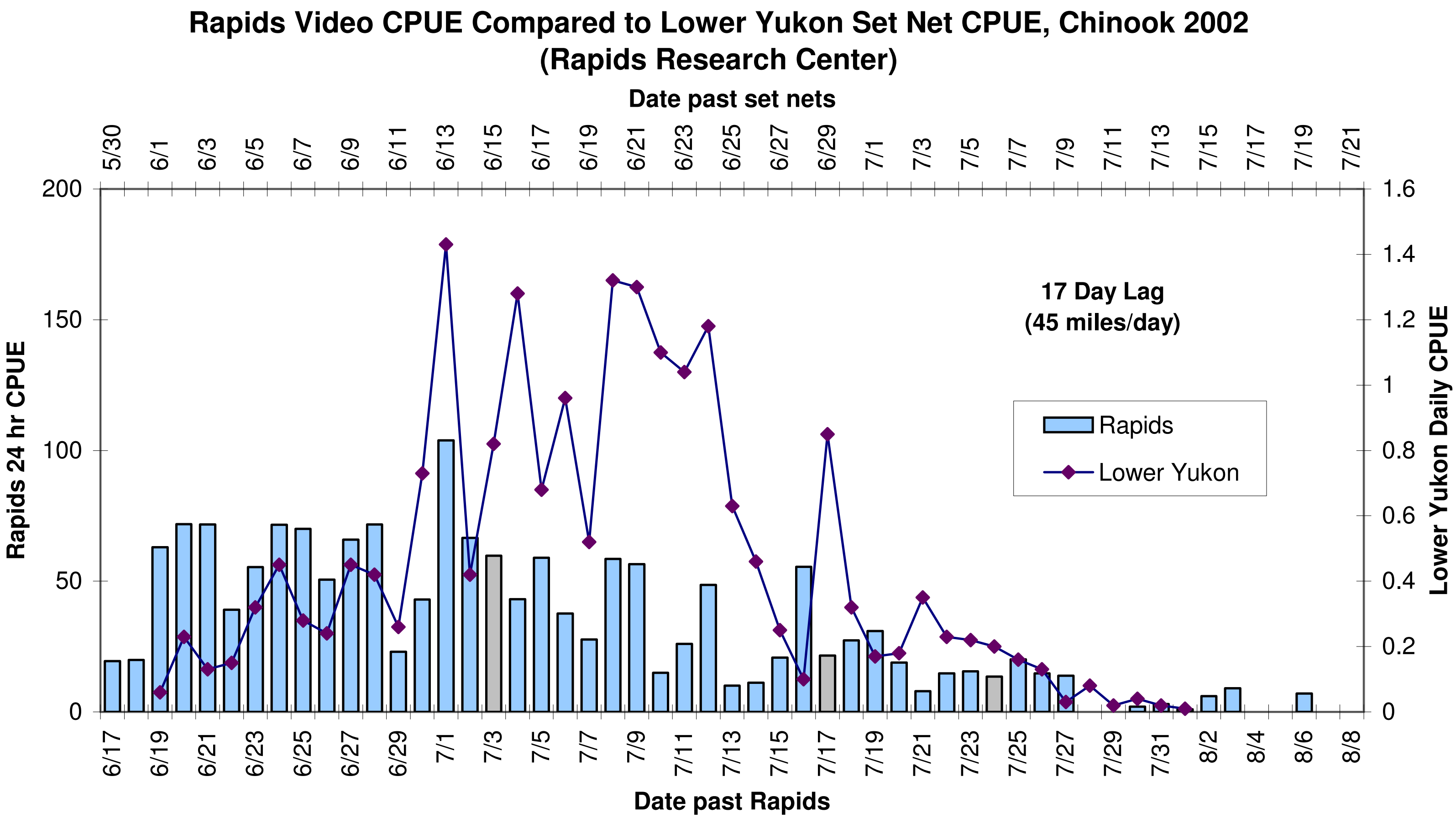


Figure 4

Video capture system on wheel

Computer shack - microwave reciever

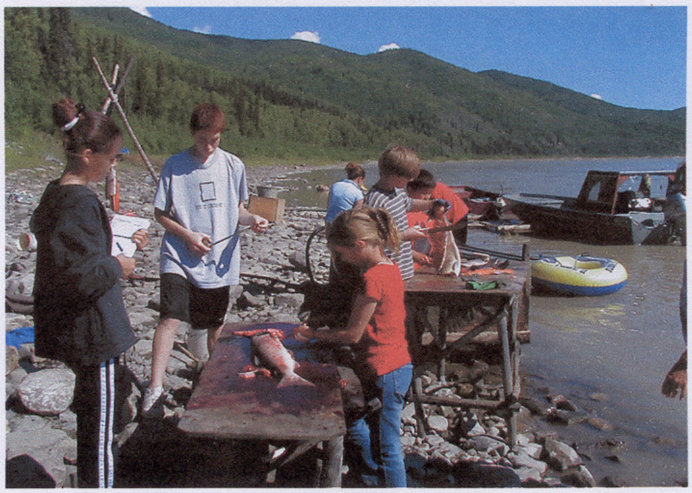
Microwave transmitter on wheel

USFWS tag crew and students

Students aiding in ICH research

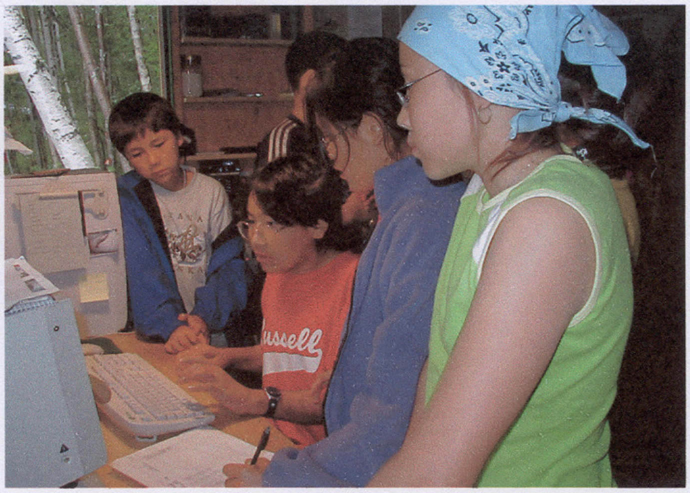
Tanana Conservation Outreach

Students do own ICH study



Data for students computer worksheets

Elders and student talk at Rapids video



Students take turns entering their data

One fish after another till done

One of two student research tents

Table 1. 2002 Video Short Summary-Rapids

Start Day	No.	Counting Date	Start Date/Time	End Date/Time	Run Time (hr)	King	Chum	Shee-fish	Broad WF	Hump back	Cisco WF	Comments	King per hr	King / 24 hr	Chum per hr	Chum / 24 hr
Mon	1	6/17/02	6/17/02 14:07	6/18/02 0:00	9.88	8	0	0	0	0	22	Johnson 3x	0.81	19.43	0.00	0.00
Tue	2	6/18/02	6/18/02 9:21	6/18/02 21:23	12.03	10	0	0	1	0	29	all same as 17th	0.83	19.94	0.00	0.00
Wed	3	6/19/02	6/19/02 9:12	6/19/02 21:23	12.18	32	0	0	0	0	19	all up	2.63	63.04	0.00	0.00
Thu	4	6/20/02	6/20/02 8:18	6/20/02 20:59	12.68	38	0	0	0	0	19	all slowed up	3.00	71.91	0.00	0.00
Fri	5	6/21/02	6/21/02 8:16	6/21/02 21:59	13.72	41	1	0	0	0	45		2.99	71.74	0.07	1.75
Sat	6	6/22/02	6/22/02 9:03	6/22/02 23:10	14.12	23	8	0	0	1	55	all down-nets to	1.63	39.10	0.57	13.60
Sun		6/23/02	1/0/00 0:00	1/0/00 0:00	0.00	0	0	0	0	0	0					
Mon	7	6/24/02	6/24/02 9:29	6/24/02 21:33	12.07	36	1	0	0	0	49		2.98	71.60	0.08	1.99
Tue	8	6/25/02	6/25/02 9:15	6/25/02 21:35	12.33	36	2	1	0	0	32	all down	2.92	70.05	0.16	3.89
Wed	9	6/26/02	6/26/02 9:42	6/26/02 22:02	12.33	26	0	0	0	0	50	all still down	2.11	50.59	0.00	0.00
Thu	10	6/27/02	6/27/02 9:11	6/27/02 22:17	13.10	36	3	0	0	0	32		2.75	65.95	0.23	5.50
Fri	11	6/28/02	6/28/02 11:17	6/28/02 23:59	12.70	38	1	0	0	0	23	moved VCR to tranmit system, late start	2.99	71.81	0.08	1.89
Sat	12	6/29/02	6/29/02 9:44	6/29/02 22:16	12.53	12	1	0	0	0	25	all wheels, nets down- tiny kings, jacks	0.96	22.98	0.08	1.91
Sun	13	6/30/02	6/30/02 11:43	6/30/02 17:52	6.15	11	4	1	0	0	23	9.5lb average for 23 kings, 2 fem., 4 Ich	1.79	42.93	0.65	15.61
Mon	14	7/1/02	7/1/02 9:35	7/1/02 21:49	12.23	53	16	2	1	0	37	new fish- larger	4.33	103.98	1.31	31.39
Tue	15	7/2/02	7/2/02 8:37	7/2/02 21:58	13.35	37	17	0	0	1	22	low catch all wheels, new but still small	2.77	66.52	1.27	30.56
Wed	16	7/3/02	7/3/02 8:58	7/3/02 22:13	13.25	33	20	1	0	0	30	all down more, small	2.49	59.77	1.51	36.23
Thu	17	7/4/02	7/4/02 8:52	7/4/02 21:06	12.23	22	23	1	0	0	9	all wheels down more,couple of 20lb-ders	1.80	43.16	1.88	45.12
Fri	18	7/5/02	7/5/02 9:03	7/5/02 21:40	12.62	31	18	1	0	1	11	red kings, end of pulse, commercial	2.46	58.97	1.43	34.24
Sat	19	7/6/02	7/6/02 8:16	7/6/02 22:18	14.03	22	25	0	0	3	23	4 20-30lb kings at night subsistence run	1.57	37.62	1.78	42.76
Sun	20	7/7/02	7/7/02 8:18	7/7/02 22:09	13.85	16	22	1	0	0	20	down	1.16	27.73	1.59	38.12
Mon	21	7/8/02	7/8/02 8:50	7/8/02 21:58	13.13	32	17	3	1	1	12	new fresh fish and up	2.44	58.48	1.29	31.07
Tue	22	7/9/02	7/8/02 9:15	7/8/02 22:00	12.75	30	20	2	0	2	20	more red fish	2.35	56.47	1.57	37.65
Wed	23	7/10/02	7/9/02 9:22	7/9/02 22:10	12.80	8	28	1	0	3	24	all gear down in Rapids	0.63	15.00	2.19	52.50
Thu	24	7/11/02	7/10/02 8:34	7/10/02 22:23	13.82	15	51	0	0	2	14	nets and wheels all poor	1.09	26.06	3.69	88.59
Fri	25	7/12/02	7/11/02 8:39	7/11/02 21:28	12.82	26	63	0	0	3	15	small, many pale kings	2.03	48.69	4.92	117.97
Sat	26	7/13/02	7/13/02 9:49	7/13/02 21:42	11.88	5	54	1	1	2	10	Johnson 0 in3 hr, hole rock net 1 overnight,	0.42	10.10	4.54	109.06
Sun	27	7/14/02	7/14/02 9:53	7/14/02 23:00	13.12	6	38	1	1	1	11	seems like end of run, mostly jacks	0.46	10.98	2.90	69.53
Mon	28	7/15/02	7/15/02 9:10	7/15/02 21:53	12.72	11	43	0	0	2	9	no fish Ich project ends	0.87	20.76	3.38	81.15
Tue	29	7/16/02	7/16/02 8:44	7/16/02 20:51	12.12	28	48	0	1	2	10	fresh kings but few	2.31	55.46	3.96	95.08
Wed	30	7/17/02	7/17/02 9:03	7/17/02 21:19	12.27	11	51	1	1	3	14	fewer kings and redder (subsistence)	0.90	21.52	4.16	99.78
Thu	31	7/18/02	7/18/02 9:07	7/18/02 21:24	12.28	14	42	0	1	3	8	half nice kings	1.14	27.35	3.42	82.06
Fri	32	7/19/02	7/19/02 10:18	7/19/02 23:30	13.20	17	44	1	0	3	6	larger kings again	1.29	30.91	3.33	80.00
Sat	33	7/20/02	7/20/02 8:34	7/20/02 21:16	12.70	10	49	0	1	5	15	all gear getting larger, better but not numbers	0.79	18.90	3.86	92.60
Sun	34	7/21/02	7/21/02 10:24	7/21/02 22:30	12.10	4	39	0	0	4	38	Cambell down-rock island down	0.33	7.93	3.22	77.36
Mon	35	7/22/02	7/22/02 8:30	7/22/02 21:30	13.00	8	30	1	0	4	47	20% red flesh chums	0.62	14.77	2.31	55.38
Tue	36	7/23/02	7/23/02 9:34	7/23/02 21:55	12.35	8	48	0	0	2	37		0.65	15.55	3.89	93.28
Wed	37	7/24/02	7/24/02 8:15	7/24/02 22:25	14.17	8	55	0	1	8	21	35% red flesh chums - large kings	0.56	13.55	3.88	93.18
Thu	38	7/25/02	7/25/02 8:48	7/25/02 21:57	13.15	11	59	1	1	7	36	45% red flesh chums - kings all poor meat	0.84	20.08	4.49	107.68
Fri	39	7/26/02	7/26/02 9:32	7/26/02 22:32	13.00	8	93	0	3	10	12	**TEK bright fall chums officially here**	0.62	14.77	7.15	171.69
Sat	40	7/27/02	7/27/02 9:09	7/27/02 23:00	13.85	8	125	1	2	10	40	All wheels (4) up + bright fish	0.58	13.87	9.03	216.68
Sun		7/28/02	1/0/00 0:00	1/0/00 0:00	0.00	0	0	0	0	0	0					
Mon	41	7/29/02	7/29/02 9:31	7/29/02 21:42	12.18	0	102	0	4	8	52	Fall chum tagging started	0.00	0.00	8.37	200.93
Tue	42	7/30/02	7/30/02 8:13	7/30/02 21:12	12.98	0	96	0	0	13	52	set up video lights (24 hr)	0.00	0.00	7.39	177.46
Wed	43	7/31/02	7/31/02 0:00	8/1/02 0:00	24.00	3	154	1	0	17	115	fall chums getting darker- main pulse?	0.13	3.00	6.42	154.00
Thu	44	8/1/02	8/1/02 0:00	8/2/02 0:00	24.00	1	149	0	4	19	139	nice chums but main brights have passed	0.04	1.00	6.21	149.00
Fri	45	8/2/02	8/2/02 0:00	8/3/02 0:00	24.00	6	98	3	3	33	172	solidly into fall run now	0.25	6.00	4.08	98.00

Figure 6

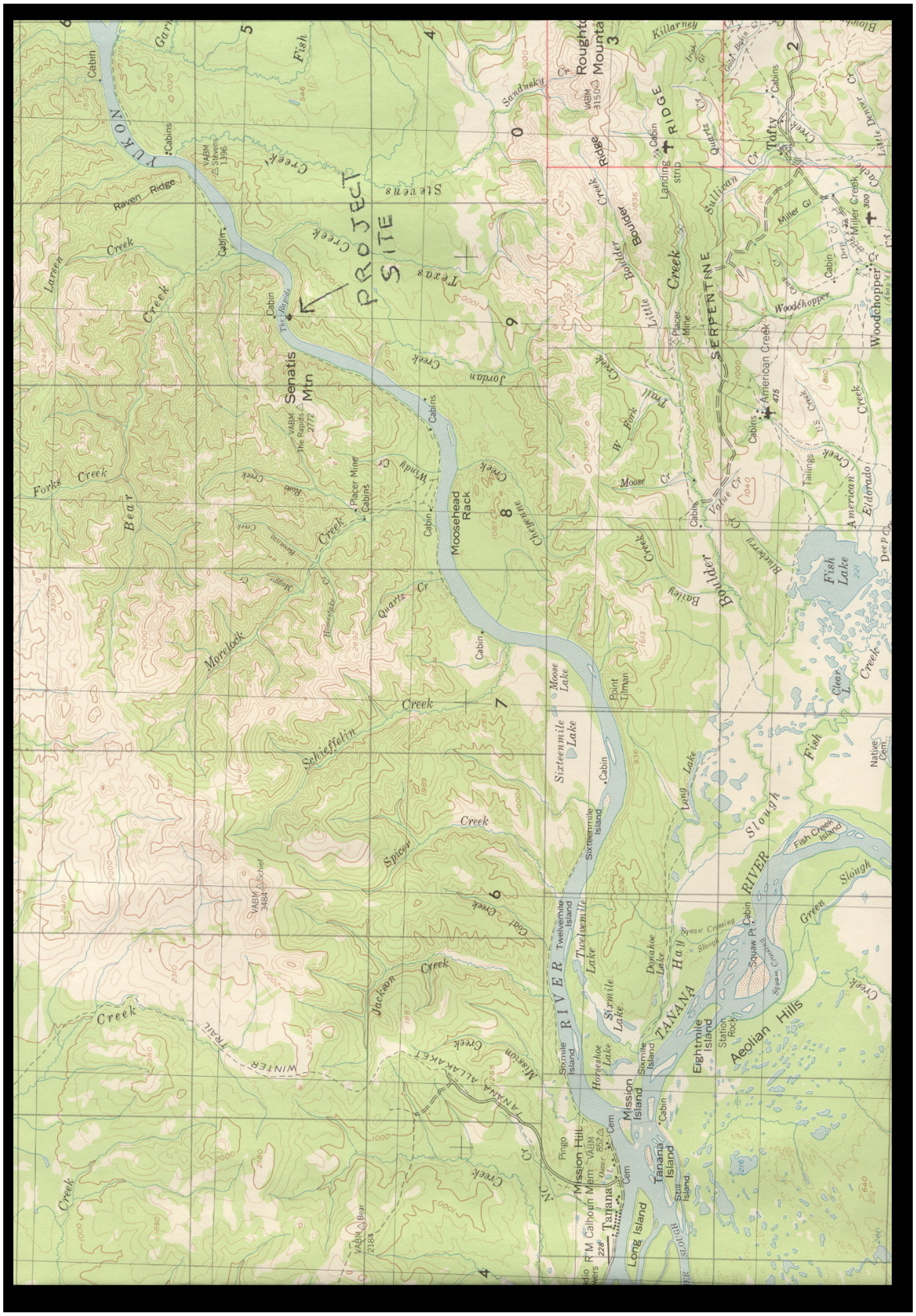

PROJECT SITE
Senatis Mtn
Moosehead Rack
Sixteenmile Lake
Moose Lake
Fish Lake
Aeolian Hills
Eightmile Island
Mission Island
Tanana Island
Long Island
Mission Hill
Tanana
Tofty
Woodchopper
American Creek
SERPENTINE
Boulder
Schieffelin
Morelock
Spicer
Jordan
Texas
Stevens
Raven Ridge
Larsen
Bear
Forks Creek
WINTER TRAIL
TANANA ALLAKAKET
Twelvemile Lake
Sixmile Lake
Horseshoe Lake
Donohoe Lake
Hay Slough
Green Slough
Fish Creek Island
Squaw Pt
Placer Mine

Table 2. Final assessment figures for video system

Table 2. Chinook 2002 Final Assessment

Fish found on original VCR tapes but missed by video capture system are noted below as missed.
Fish found on original VCR tapes and counted by video capture system are noted below as capture.
Six hours or the first 50 fish of each week are used for the assessment sample.

Tape No.	Date	Sample Time	Fish Assessed	Chum Captured	King Captured	Sheefish Captured	Broad Whitefish Captured	Humpback Whitefish Captured	Cisco Whitefish Captured	Other Captured	Missed (reason)
6	6/22	7hrs 35min	60	8	14	0	0	1	37	0	0
10	6/27	10hrs 38min	56	3	24	0	0	0	28	0	1 (cisco)
18	7/5	12hrs 7min	63	17	32	1	0	1	12	0	0
25	7/12	6hrs 56min	61	38	14	0	0	1	7	0	1 (cisco)
31	7/18	8hrs 31min	53	34	10	0	0	2	7	0	0
38	7/25	5hrs 12min	52	31	3	0	0	2	16	0	0

Disclaimer

Non-Discrimination Statement