Rapids Data Collection, 2006

YRDFA Student Technician Project




Stan Zuray

December 2006

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Final Report to the Yukon River Drainage Fisheries Association

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Cover (clockwise from top left):

1. Students collecting whitefish genetics samples for DFO Canada, 2005.
2. Students travel to multiple fishers' subsistence camps for samples.
3. Weighing, measuring and getting genetic fin clips and scales for ADF&G.
4. Getting out the PCR sampling kit for ICH work for YRDFA.

Title: Rapids Data Collection, 2006, YRDFA Student Technician Project

Principal Investigator: 1. Stan Zuray, Project Manager, Box 172, Tanana, AK 99777, stanzuray@gmail.com, 907-366-7114

Management Regions: Yukon River Geographic Area

Information Type: Stock Trends and Status/Traditional Ecological Knowledge

Issue(s) Addressed: The sex, length, weight and disease data this project collects has been identified as priority data at many past and present Regional Advisory Council and Yukon River Drainage Fisheries Association meetings. This is combined with the need to involve and make more young people aware of fisheries work and issues relating to their subsistence lifestyles.

Study Cost: 2006 $5000

Study Duration: June 1- August 10, 2006

Key Words: data collection, education, fisheries research projects, fishwheels, management, traditional ecological knowledge, students, subsistence, communication,.

Project Data: *Description-* Data for this study consists of: 1. Data worksheets and graphs on Chinook sex, length, weight and disease condition (Ichthyophonus) for the complete season. 2. Fall chum arrival data worksheets related to visible fat content (flesh color). 3. Chinook scale samples taken for ADF&G 4. Chinook genetic fin clip samples taken for ADF&G. 5. PCR heart samples of Chinook hearts taken for YRDFA
Custodian(s) - Reports and student work data on numbers 1 through 3 above are kept by Stan Zuray of Tanana. Numbers 3 through 5 held by respective organizations.
Availability – data on 1 and 2 available upon request.

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Author

Stan Zuray has been a fisherman and trapper in the Tanana area since 1973. The last 11 years he has run fish wheels for a number of monitoring projects at the Rampart Rapids. He is one of the developers of the fish wheel video system currently in use on a number of Yukon River drainage fish wheels.

Sponsorship

This project is funded by a grant from Yukon River Drainage Fisheries Association, Anchorage, Alaska

Acknowledgments

Thanks to the Rapids Video Project for absorbing some significant costs related to project, and providing the computers for data collection.

Thanks to the local fishers and fish processor (Interior Alaska Fish Processors) who went out of their way to make sure the students had the samples they needed.

Thanks to the following persons and parents for donations involving transportation, data collection, camp materials, work with students, and coordinating logistics: Faith Peters, Linda Johnson, Charlie Campbell, Lester Erhart, Steve O'Brien, Mike Andon, Carrie Farr, Tobin Hugny-Farr.

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Introduction

Residents of the rural interior village of Tanana share a rich history of subsistence fishing. Most elders and many adults living in the village at present were raised at summer fish camps. Historically, large portions of the year's food was put up and small amounts of cash needed for other foods and supplies was made by putting up fish strips or drying fish for dog food for the dog teams that delivered mail. Tanana still has some fish camps that operate in a non-recreational manner. The people running these camps and those they provide fish to are very dependent on the fish that come up the river for their subsistence way of life.

A stated goal common to the Office of Subsistence Management (OSM) and the Yukon River Panel is that of capacity building. Also presently the fishery is faced with need for specific data on issues such as fish size and disease

The Tanana Conservation Outreach (TCO) fisheries/subsistence/data projects funded though OSM from 2001 to 2005, (Peters Zuray, K. 2004) and now the 2006 Yukon River Drainage Fisheries Association (YRDFA) data collection effort have generated much interest amongst local school age students to work on fisheries projects. The projects also teach cultural and practical values of the subsistence life choice by putting students in direct daily contact with full time subsistence fish camp persons.

The project gives many students a taste of being part of important biological studies through participating in data collection. Our hope is to help develop their interest in future fisheries work. The data is comprised of Chinook salmon sex, lengths, and weights during the Chinook season and visual inspection of changing flesh color and fat content in chum salmon. Whitefish species were also inspected for disease conditions. The data from these studies provide valuable information for subsistence management of Chinook, chum and migratory whitefish in the Yukon River.

The two main project studies were chosen because of their expressed importance to subsistence fishermen at multiple Regional Advisory Council meetings, the last 6 annual YRDFA board meetings and the fall 2004 YRDFA sponsored *Ichthyophonus* meeting. Concerns were expressed over the perceived lack of larger and female Chinook salmon making it into the upper Yukon. The need for accurate sex, length and weight data can help address this issue. Second, on an annual basis there is a controversy between management and fishermen over the appropriateness of counting fall chums using a fixed date (July 15th) to determine the arrival or start of the fall chum salmon run. The inability of management to identify when fall chum start entering the river (by even a few days) could mean closing subsistence fishing on some low run years. Large amounts of chum can enter the river in a matter of days and if management is off by a week or more, serious under-counting or over-counting can occur. This blending and testing of western science and local knowledge has produced a working method of determining fall chum run arrival that is inexpensive and more accurate than the current method used by management.

Background:

In the summer of 2000, members of the Tanana Tribal Council, superintendent and board members of the Tanana City School District and two classes of students made trips to the Rampart Rapids. There they viewed a Chinook video CPUE project (Zuray, S., 2000) and the USFWS Rapids fall chum tagging projects, (Underwood et al. 2000). As the saying goes, "a picture is worth a thousand words". It became quite clear that the amount that people got out of the visit was so much more than you could ever get from attending a meeting or lecture on fisheries research. Students were excited and wanted to ask relevant questions. For some students who had less opportunity to be on the river it was a unique experience. They were able to handle equipment and some actually helped in the operations of the projects. After discussions amongst fisheries biologist Tevis Underwood (USFWS Fairbanks Field Office) who ran the tagging project at that time, Stan Zuray of Tanana who runs the present video project (Zuray, S., 2004) and Kathleen Peters Zuray of the Tanana Tribal Council's Environmental Services Office it was felt that some organized effort to provide a forum for elders, management, children and fisheries biologist at the Rapids project site could be very positive. Tevis Underwood, Kathleen Zuray, and Stan Zuray offered to work with the children. Stan and Kathleen offered the use of their subsistence fish camp for lodging and the Tanana Conservation Outreach project was then proposed and approved.

In 2001 to 2003 the Tanana Conservation Outreach project (Peters Zuray, K., 2003) was able to work with a large number of students and smaller numbers of adults, counselors, and elders. During the course of the 2001-2003 projects it was possible to accomplish the original objectives and go further, giving students' opportunities to work with researchers such as Dr. Kocan and Paul Hershberger (*Ichthyophonus* study) and get a feel for scientific sampling and even receive small stipends for their efforts. Also because of donated personnel time and transportation by the Tanana Tribal Council and others in Tanana, costs were kept to a minimum and some students were paid for clearing brush for two tent frames and a campsite for the 2004 to 2005 project. OSM funding was lost in 2006 and the smaller YRDFA data collection project was conceived as a way of not losing continuity of the yearly data base which had been started.

In all years the project has operated without any administrative costs or costs associated with most of the equipment needed to run camp. In 2006 the use of only older students who had the ability to work independent of constant adult supervision was required. All technicians were required to have their own boat and motors and provide all their camp supplies and food. Principal investigator Stan Zuray donated all time involved in overseeing the project and writing the final report, etc.

Study Area

The project was conducted on the Yukon River 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. Both traditionally and today it is an area known for its abundance of a wide variety of fish species and one of the major fish camp areas for local residents.

Objectives

1. To collect sex, length, and weight and *Ichthyophonus* disease rate data on Chinook and data used to determine the arrival of the fall chum run using students who have training in these methods from prior years work.

2. Collect other data as needed. Presently requests have been made by ADF&G (scales and genetic samples) and YRDFA (Chinook heart samples for PCR Ichthyophonus exam). Dr. Richard Kocan has volunteered to do an Ichthyophonus lab confirmation on a small number of samples identified as positive, so these will be collected also.

3. Produce a written report and electronic worksheet record of data for future data analysis.

Methods

The 2006 fisheries data collection project was conducted at the Rampart Rapids, the same location as the previous 2001 to 2005 OSM projects. Unlike the prior years projects where 30 plus, young and old students from all over were given opportunities to work, the 2006 project required a lot of independence, equipment and start up funds from the individual student technicians (see pictures – Figure 1 and 2).

Technicians were mostly drawn from a group of older Tanana High School students who were selected as "YRDFA Team Leaders" in 2004. These were 8 students who excelled in data collection efforts and were asked to come back to work with younger students each week in 2004. Funding was provided by YRDFA for these 8 students to each work one extra week. In 2006 because of the lack of project funding for equipment, gas and supplies the students were also expected to supply their own boat and motor and gas. There were 4 "Team Leader" students who were able to get this together and work for the 2006 YRDFA project. Also there are 4 students that have advanced from years with the student data collection projects and went on to receive USFWS training and work for the USFWS Fall Chum Tagging Project. Two of these students were able to work for the 2006 YRDFA project. Also a small number of other older students worked smaller amounts of time.

Student Technicians (in alphabetical order)

* The below 3 students committed to supplying there own boats and motors prior to the season and were the projects main workers:

Colin Campbell - High school senior, 6 years with Rapids data collection projects, YRDFA Team Leader, was set to work on USFWS Rapids Tagging Project in 2006 when it ended unexpectedly.

Tsood Peters - High school junior, 6 years with Rapids data collection projects, YRDFA Team Leader, experienced boat driver and careful data collector.

Joseph Zuray - High school junior, 6 years with Rapids data collection projects, YRDFA Team Leader, USFWS volunteer in 2004, through 1 USFWS work training and 1 year with USFWS Rapids Tagging Project in 2005.

* The below students were able to work deals with above students for transportation or were able to borrow transportation inseason and work for project:

Ruby Campbell - High school sophomore, 6 years with Rapids data collection projects, YRDFA Team Leader, great attitude and data worksheet worker.

Esra Conrad - High school sophomore, 6 years with Rapids data collection projects, locally recognized as a born scientist.

Cy Conrad - High school freshman, 6 years with Rapids data collection projects, very strong, hard worker.
Ria Conrad - High school senior, 5 years with Rapids data collection projects, excellent data worksheet and computer worker.
Shawn Erhart - High school sophomore, 6 years with Rapids data collection projects, would have been a 2004 YRDFA Team Leader but program not available his week. Science minded student and serious worker.
Tobin Hugny-Farr - High school Grad, 6 years with Rapids data collection projects, YRDFA Team Leader, through USFWS work training and 1 year USFWS Rapids Tagging Project in 2005. Volunteered some time in 2006
Emil Hugny-Farr - High school Grad, 4 years with Rapids data collection projects, Volunteered some time in 2006. Energetic and willing worker.
Katlyn Zuray - High school senior, 6 years with Rapids data collection projects, through 2 USFWS work trainings and 2 years with USFWS Rapids Tagging Project in 2003, 2004.

Below is a general description of the data collection. It should be stressed that with having to work around subsistence schedules, commercial openings, variable weather, increased or decreased sampling opportunities, etc., that no two days were the same. This ability to adapt was an important aspect of real technician data collection and that was explained to students, on those occasions such as commercial openings, when they were asked to get up at 5 am and work long hours.

Each day the students assembled on the beach and any stored fish were worked up. Usually after a trip was made to another camp for additional samples. Data collection started at whatever time necessary to fit into local fishers' subsistence schedules and would often extend to getting data at other camps into the evening. This depended on the amount of subsistence fish activity going on at a camp. A large extended family and many friends using a camp during prime Chinook season and a lot of samples are available. Bad weather and early or late in the season and samples are hard to get. No fish are taken unless they go into the subsistence fishery or will be sold during commercial openings.

The students are related to or friends of all the area fishermen and fish buyers and these persons go out of their way to help the students get their samples by coming by camp to coordinate sampling times or putting up flags etc. to signal sampling opportunities. Fishermen have also expressed that the help the students provide in handling the fish actually makes their job easier and they are more than happy to have them work with them. This support is a key to getting the large amount of samples we were able to obtain. No one camp could normally provide consistent sampling of the run throughout the full season.

Data entry, which was often a combination of that and a computer techniques class, took place whenever there was time. Often with only two students working at a time it was a full day just getting the samples and raw paper data.

Specific Chinook Sex, Weight, Girth and Length Data Collection Methods:

Chinook length, weight, girth and sex data were collected during the entire run in 2006 (Figures 3 – 6). Some late season data was of smaller sample size due to the lack of subsistence fishing because of the higher amount of Ichthyophonus disease found in those late season fish. In 2006, girth measures were added to the data collection effort. Fish were taken from a variety of subsistence fishermen in the Rapids area. Net-caught fish were not used because of their inability to catch jack and very large Chinook at rates at all similar to the Chinook population in the river. Sampling only took place out of well-known Chinook fish wheel sites as opposed to chum sites, which traditionally catch a high number of jacks. It is not known at present the extent or direction of the bias from using these fishwheels and no studies have been done on this.

As opposed to the *Ichthyophonus* sampling, no samples were allowed from catches if some fish were missing from a day's catch as in some were given away or already processed. This was the first questions students asked when arriving at someone's camp to sample and many days they would arrive back at main camp saying they couldn't sample because fishers had already cut a few of the fish. Chinook salmon were measured and the gender of each determined either by full dissection or a slit made in the belly into which a finger was inserted to feel for eggs or sperm sac. This second method was necessary because many of the Chinook are not advanced enough in spawning characteristics to determine sex with accuracy, yet it was necessary to keep the fish whole for freezing or transporting out of the area. Informal testing and talking to fishermen about this issue suggest that the data are very poor if taken with external viewing only, especially early in the run. Based on our measures, 1 out of every 5 large king cannot be sexed accurately by external characteristics even among long time fishermen (chum salmon however, can be accurately sexed externally).

Ichthyophonus Sampling:

Fish were taken from a variety of subsistence fishermen in the Rapids area and fish that were harvested with both net and fish wheel were sampled. As opposed to the male/female/size sampling, *Ichthyophonus* sampling was allowed even if some fish were missing from a days catch (in the event that some were given away or already processed). The heart, liver, and spleen, were looked at after being washing in water and afterwards the flesh was evaluated. A positive heart was defined as having 3 or more cysts. Other organs having cysts were recorded but alone could not make a positive assessment of *Ichthyophonus*. (Figures 2 and 7 – 10)

Each day all hearts from king sampled at other camps would be brought back to project manager (Stan Zuray) with the data containing the number positive for ICH. That number would be checked next to the number positive after project manager rechecked the hearts. This method did result in all the days' data from one tech being discarded as there was consistent missing of ICH hearts with this individual.

While a dissecting microscope was used to view examples of the disease tissue no program of sub sample culturing or microscopic procedure was undertaken in 2006 by the students. Dr Richard Kocan did however volunteer to do laboratory confirmation on 12 samples from the 2006 project that were labeled as positive for *Ichthyophonus* by the students. The positive results are in the results and discussion section (see Figures 7 - 10).

Another note on sampling technique: In 2005 Simon Jones (DFO Canada) and Joe Sullivan (YRDFA) came by the camp to give a presentation to local fish camp residents on *Ichthyophonus* and other diseases. They viewed our methods and stated that from what they could see the identification of fish positive for *Ichthyophonus* was proper (personnel communication).

Specific Chum Data Collection Methods:

The chum salmon study started up as the Chinook sampling was nearing its end. We started at an early date to insure that some of the sampling would take place before the fall run arrived even if it came early. Also this provided an opportunity to establish a baseline of summer chum flesh samples before the fall chum arrive. Chum salmon were examined for quality of flesh and traditional ecological knowledge was used to determine if the fish was a summer or fall chum salmon. As stated all this started before the fall chum run had established itself in order to document the change of the summer to fall chum run with the object being to establish a more accurate fall chum arrival date than management currently can provide in this section of the river.

Samples of chum, from catches being used for subsistence, were examined using the traditional methods of determining fall chums. While other factors were looked at while doing this traditional determination such as condition of the fishes' exterior color, tooth and jaw development and overall body robustness; the determining factor was the flesh color and its corresponding fat content (Figures 1, 11 and 12).

Each year while the summer chums are running significant color (red) in the flesh is only found in about 10% of the chums. While this is a subjective measurement, the increase in this percentage to 70 – 90% with significant color each year is dramatic and is seen by all fishermen. During this project the use of standard color charts by the students and other consistent sampling practices helped strengthen this traditional method.

In 2006 funding did not allow for the extensive sampling of the prior two years where large amounts of data was able to produce graphs clearly showing the arrival time and then the progressive decline in flesh condition as the fall season moves along. For the purpose of the objective to determine the true arrival day of the fall chum at Rapids the sampling effort was more than adequate however.

Stan Zuray, the project manager, was in charge of operations at the Rapids to insure that student and project needs were being met. Many of the fish samples came from his fish wheel. All of his time was donated as were the costs related to the project's use of all the generators and equipment he provided. The project operated with no administrative costs as it has since 2001.

In addition to the data that is required to continue the Chinook measures and Ichthyophonus baseline started years ago, each year there are requests by others for samples. This year ADF&G had need for Chinook scale and genetic fin clips and YRDFA requested Chinook heart samples for PCR study by Chris Stark. This was accomplished (see results section)

Results and Discussion

The student technicians did a commendable job working hard for a small stipend while showing their independence and resourcefulness in an environment that had little of the adult oversight of the prior years. 801 subsistence and commercial Chinook salmon were sampled for sex, weight, girth and length and 476 subsistence Chinook were sampled for *Ichthyophonus* disease in 2006. Approximately 1000 individual Chinook were handled in all by the students, as some of the sex/length/weight samples were not used for *Ichthyophonus* work.

For the chum flesh study we sampled 333 in 2006. Large samplings in 2004 and 2005 have provided the project with clear examples of the relationship of flesh color and summer versus fall chum runs through out the whole chum run. These were done when the project had larger funding dollars and it was good to do to show the pattern throughout the whole season. However the summer to fall change is not something that needs to be graphed so completely each year as it probably will not change its pattern year to year. The fall chum arrival date is however critical to good fall chum counts but that can be done each year with lesser effort of 300 to 400 samples in a shorter period of time.

Some preliminary data for the studies were released in season at each weekly YRDFA teleconference (depending on importance and time). More complete preliminary data and graphs were distributed in-season to state, federal and Canadian agency personnel by email on multiple occasions. Post season preliminary data were released during the YRDFA sponsored fish size meetings in Anchorage and a number of USFWS Regional Advisory Council meetings and State Advisory Council meetings.

The *Ichthyophonus* sampling work by the students shows the feasibility of advanced disease sample collection in this section of the river. The data collected as part of this project also point to a correlation between an increased incidence in *Ichthyophonus* and larger Chinook size. That is, the data seem to support the idea that the larger Chinook are the ones that develop the most disease (Figures 8 and 10). The question of larger, older Chinook dying from Ichthyophonus before making it to the spawning grounds is one that needs further research, especially since it is a distinct possibility (in addition to gear selectivity) for explaining the loss of the older age classes of Chinook salmon.

In 2006 Dr Kocan did a confirmation of student identified ICH positives at Rapids. The sampling was admittedly small but was something we wanted to do for years. The results:

2006 Examination of Histology Slides of Rapids Data Collection Project Samples, Dr Richard Kocan School of Aquatic & Fishery Sciences
University of Washington, Seattle, WA

I just finished examining the histology slides we made from the 12 Chinook samples you sent. We got both H&E and PAS stains to be certain that we didn't miss any positives. I examined 10 microscopic fields at 10X magnification and calculated the mean number of spores per 10X field for each fish. This gives the very minimum number of Ich positives, but in this case it didn't matter.

Results

1. Tissues from 12 fish examined (10 fields at 10X magnification)
2. 12/12 (100%) were positive for Ichthyophonus
3. 9 were heavily infected (5-20+ spores per 10X field)
4. 3 were lightly infected (< 1 spore per 10 X field)

Seven of the 9 heavily infected fish had a preponderance of large spores (>100 microns) indicating a "mature" or long standing infection. Two of the 9 had a preponderance of small spores, which suggests they have less mature infections or that they were more recently infected than those with the large spores.

Based on these results your evaluation of "clinical infections" in Chinook at the Rapids is essentially 100% correct. This is supported by our earlier studies where 98% of ALL clinical diagnoses were verified by culturing the same tissue.

Water temperatures taken at the Rapids are used to compare to the annual disease rates (Figure 13). Students work also shows the ability to obtain a large sample size without any added lethal sampling having to take place. By having capable students collecting the samples it reduces the overall cost of samples while benefiting the students in many ways. The project has chosen the above data collection projects because of the expressed need over the years for these types of baseline data projects. At numerous Federal Regional Advisory Council meetings, the last six annual YRDFA board meetings and the fall 2004 YRDFA sponsored *Ichthyophonus* meeting data needs related to the above were voiced often.

Flesh Study Discussion:

Accurate fall chum arrival dates are critical for management decisions about opening and closing the fishery. It is important that projects from the mouth of the river all the way into Canada have the best available fall chum arrival information. For a number of years the fall chum run has arrived at the Rapids at a date that did not correspond at all with the predetermined fall chum management arrival date at Pilot Station of July 19th (given the normal 18 - 20 day travel time between Pilot sonar and Rapids).

Each year management uses a date that was chosen many years ago as the date when they stop counting every chum entering the Yukon as a summer chum and start counting every chum as a fall chum. This is simple, archaic and lends itself to constant error as the fall run can actually enter the river anytime over the course of a three-week period. In the 6 years of the video project using a combination of traditional and modern data collection methods of determining arrival of the first large numbers of fall chum, they have arrived as early as July 25th and as late as August 4th with arrival dates as late as August 8TH and August 15TH being remembered by area fishermen in past history.

In this part of the Yukon as long as anyone can remember people have always had a simple way of recognizing this event: the fall chum arrived when they arrived. To explain: the summer chum run in this section of the river is relatively small in numbers and is made up of chum whose fat reserves are low (most are close to their spawning areas) and therefore their flesh color is very pale. All during the summer run people catch chum with pale flesh color in roughly 90% of their catch (see figures 9 and 10). These fish provide much less value for people and dogs as they dry up into something resembling stiff cardboard.

As anyone knows who has spent time right on summer chum spawning grounds a small percent of fish, even there will have nice red flesh, especially in the early part of the run. Each year you hear people on the main river calling these few nice fish fall chums. *This is not at all the event that we are talking about in this section of the river however, when we say the fall chums have arrived*.

What happens here is in a matter of 3-5 days (occasionally longer) after the summer run has been providing people with say consistent 10% (approximately) red flesh fish, the percent of red fleshed fish will rise progressively to a minimum 50% (as in 2004 and 2005) or more normally 75%, to as high as 90% on some years (depending on the amount of summer chum still running and mixed in). After this time summer chum continues to be mixed in, however before this time there are fall chum also in the population. For the purposes of an exact date the video project started calling the day the chum flesh passes the 50% point as the official fall chum start date for counting.

As a way of reducing subjective observation the video project and now this student data project have been using standard color charts at the cutting table since 2000. Observations and even percentages are also compared amongst fishermen in the area as have been long before this project. While this method is not perfect, as pointed out each year by management, it is currently the most accurate method used to determine the passage of the first significant numbers of fall chum heading into the upper Yukon and Canada. This changeover of summer to fall chum is clearly visible to all observers, trained or untrained, when the fall chums first arrive in this part of the river. This method would probably not work in areas closer to the river mouth as all upper Yukon summer chum probably have color there. For the purposes of helping to manage fishing in all sections of the river a date determined at the time the fall run arrives in this section of the river is not at all too late. In 2004 the date for arrival of fall chum was July 27th; and in 2003 it was July 30th. In 2002 the date was July 26th. These dates are only 8 days, 11 days, and 7 days respectively after Pilot Sonar started counting what they considered the first fall chum.

The project leaders and some of the older students have always been aware that this project can go away at any time. While support sometimes runs high for educating youth, and providing fisheries training, etc. these issues often get neglected when funding is tight. For these reasons we committed ourselves to using this camp as a means to provide as much meaningful and needed data as possible and being open and flexible to the future needs of researchers and managers. Funding is currently unsure for the 2007 season.

We hear the expressed need for basic disease and sex, length and weight data over and over at many of the meetings we attend. It is an issue that management and fishers will be dealing with and it’s a shame to see projects specifically designed to monitor this change be cut short at this time. Also this project has also been the only published source of *Ichthyophonus* disease rate information on the Yukon River since 2004. This basic monitoring is essential to keep track of any possible resistance buildup to the disease in the future and/or advance of the disease because of the present warming trends in river. Infection testing alone will not do this. While this disease may seem of little consequence to some in other parts of the river in this area it is the reason each year the subsistence Chinook fishery ends while there is still significant numbers of fish going by.

Declining Chinook Size issue: About fifteen years ago and prior, it was not at all uncommon for Tanana/Rapids fishers who fished the whole season to catch 50 pound Chinook salmon each year, and a 30-35 pound fish was not considered that large. Of note is the fact that at that time our local buyer would only buy 14 lb king and larger. Then it went to 12 lb and 10 and now, except for grayling size king we often sell any size. It is also important to note that all these salmon were harvested with the same size gear that fishers in this area have been using for years, thus there is no change in the methods. Finally, the sample size each year is equal to the total catch of numbers of camps over the whole season.

The weight tables (Table 2 and 3) in this report will be most understood by fishers, buyers and long term managers who have years of experience and/or knowledge of fish wheel use. It illustrates, using data, the alarmingly small size and lack of larger fish in the Chinook salmon fishery of this area that fishers have been noticing for many years now. Collection of weight data started in 2005, however our 2004 length and sex data indicate weights would have averaged similar or even less in 2004 had they been taken.

Note: “jacks” or more accurately small Chinook are less than 65.5 cm eye to tail

Table 1 **Some 2004 -2006 data collection project Chinook sampling comparisons.**

	2004	2005	2006
Chinook samples -	1113	927	737
Average weight - all -	n/a	11.4 lbs	11.9 lbs
Average length - all males -	67.1 cm	68.9 cm	69.0 cm
Total 30 + lbs.	n/a	7	6
Total 25 - 29.9 lbs.	n/a	14	16

Partnership and Capacity Development

As has always been the case during the past projects any assistance that the students could give to other projects or needs requests by federal or state management for other data than that which they are collecting was considered. Often these needs are not known far in advance but this project fully expects to be help in that way. As with getting samples from the area fishermen this can help both students and researchers.

Each year the student data collection project adds support or collects the samples for research activities by other individuals or agencies. These have included:

1. *Ichthyophonus* research by Dr. Kocan and Paul Herschberger in 2001 and 2002.
2. The contaminants in salmon study by Keith Mueller and Angela Matz with the Fish and Wildlife Service in 2001.
3. A 2003 bering cisco data and otolith sample effort for Randy Brown of the USFWS Fairbanks Field Office.
4. In 2004 a Bioelectrical Impedance Analysis project designed to investigate bio-energetic features (body fat, water retention, etc) in migrating salmon (Chinook and Chum) was conducted at Rapids working in conjunction with biologists from the Fairbanks Fish and Wildlife Field Office, Keith Cox (Doctoral student who designed this technique) from West Virginia University, Kyle Hartman (Professor) from West Virginia University, and Joe Margraff (Professor, Co-op leader) from the University of Alaska, Fairbanks. Testing in 2005 continued with fish out of the video fish wheel.
5. In 2005 with student from the TCO project, genetic samples and data from whitefish species were collected for biologists with the Department of Fisheries and Oceans Canada. This collection was spread over the season.
6. In 2006 the project collected Chinook scale and genetic fin clip sampling at Rapids for ADF&G.
7. 2006 Ichthyophonus heart samples for YRDFA’s PCR testing.

The cover and Figure 1 in this report show some of this capacity development effort. Almost all area fishermen, the Tanana and Huslia schools, Tanana Tribal Council members, a number of Fish and Wildlife Service personnel, almost all local and a few non local students, and the Yukon River Drainage Fisheries Association, have all had some part in making the project work over the years

Conclusions

It is clear that when presented with the right opportunity and people who care and provide supervision and training, young people can show a lot of enthusiasm and capacity for fisheries research work. This project did just that - we provided the opportunity and a supportive learning environment, and the youth excelled.

Another point is that local students have already formed relationships with area fishermen. They have knowledge of the areas traditional ways, and are developing and honing their river and outdoor skills. Because of this they are able to avoid many of the pitfalls and obstacles that outside researchers often experience. With proper supervision and support, this can translates into important, quality information collected with extremely significant cost savings.

Recommendations

The basic data collected on Chinook sex, length, weight and disease conditions, and fall chum run timing at this site needs to continue. This information is directly related to many important issues facing Yukon River fishers now and a solid consistent yearly data record of these conditions could be of significant value in evaluating any perceived changes in the future. Not continuing the effort will turn the present data base into yet another unusable data collection exercise and I feel be a loss to the fishery.

Budget Summary

Total Cost: $5,000 Project Dates: June 1- August 10, 2006

	FY 2006
a. Total Annual Budget	5000
b. Expenditures thru December	5000
c. Balance thru December	0
d. Anticipated Remaining Expenditures	0
e. Anticipated Final Balance	0

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Peters Zuray, K. 2002. Tanana Conservation Outreach, 2002, Federal Subsistence Fishery Monitoring Program Final Project Report FIS 01- 199, U.S. Fish and Wildlife Service, Office of Subsistence Management, Fishery Information Services Division, Anchorage, Alaska.

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Peters Zuray, K. 2004. Tanana Conservation Outreach, 2004, Federal Subsistence Fishery Monitoring Program Final Project Report FIS 04- 256, U.S. Fish and Wildlife Service, Office of Subsistence Management, Fishery Information Services Division, Anchorage, Alaska.

Zuray, S., 2006 Rampart Rapids Full Season Video Monitoring, 2006 -Using a Fish Wheel on the Yukon River, Alaska. Annual report to the Yukon River Panel, Anchorage, Alaska.

Underwood, T. J., S. P. Klosiewski, J. L. Melegari, and R. J. Brown. 2000 Estimated abundance of adult fall chum salmon in the middle Yukon River, Alaska, 1998-1999. U. S. Service, Fairbanks Fish and Wildlife Office, Alaska Fisheries Technical Report Number 57, Fairbanks, Alaska.

Underwood, T. J., and J.F. Bromaghin. 2003.Estimated abundance of adult fall chum salmon in the middle Yukon River, Alaska, 2000-2001. U. S. Service, Fairbanks Fish and Wildlife Office, Alaska Fisheries Technical Report Number 62, Fairbanks, Alaska.

Apodaca,C.K., T.J. Underwood, J.F. Bromaghin, and D.W. Daum. 2004. Estimated abundance of adult fall chum salmon in the middle Yukon River, Alaska 2003. U.S. Fish and Wildlife Service, Fairbanks Fish and Wildlife Field Office, Alaska Fisheries Technical Report Number 71, Fairbanks, Alaska

Figure 1

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

During the commercial openings students set up on fishers' boats to collect sex and length data. 5 am wakeups were the order on these days.

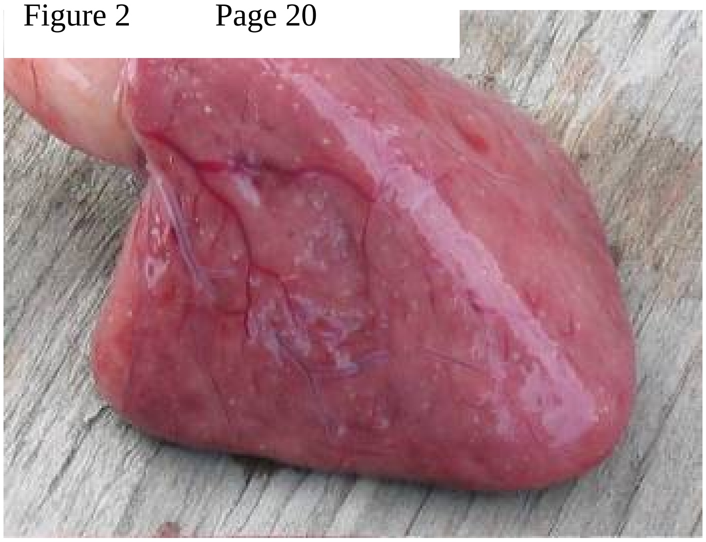
Flesh and exterior color common to Rapids summer chum. 90% are 3's and 4's on color chart before fall chum arrival time. This is # 4 pale

Students collected hundreds of sex, length, and weights. Assisted by Stan Zuray (project manager)

1 red: Flesh type found in high % only in the first bright chum section of fall run

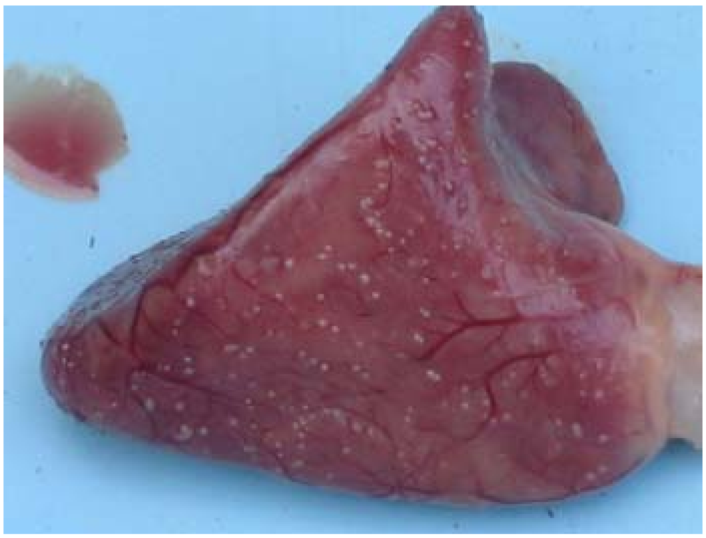
Whitefish genetic samples taken for DFO Canada. All season and each group participated.

Figure 2

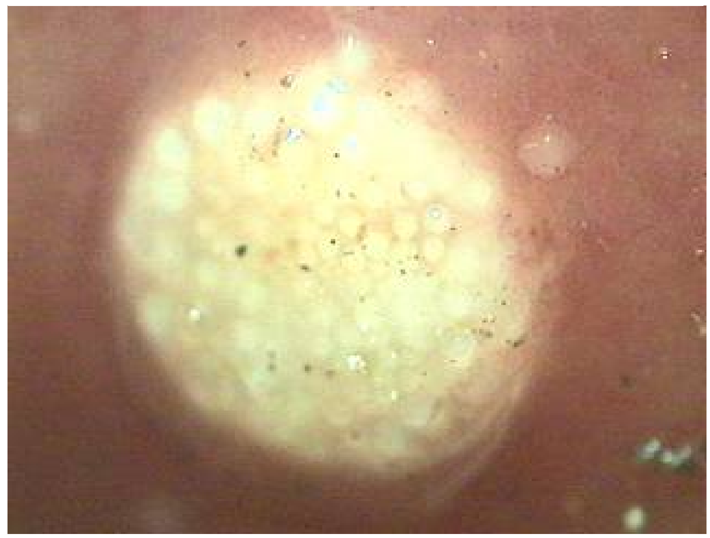


Ichthyophonus (ICH) spores in a Chinook heart. Note how they are imbedded in the meat (typical).

Example of a blood vessel being restricted by ICH spores in a Chinook heart.



Chum heart showing both imbedded ICH and "surface white spots" (in 2005 identified as meta cercarial trematode which is a fluke)



Close up of an ICH spore multiplying into many. Taken with the dissecting microscope.

Sheefish heart with imbedded ICH. This fish had its intestines full of cysts also. Note orange eggs (?) on surface in middle of heart.

Humpback whitefish hearts positive for surface white spots. About 90% of humpback had these spots each year (meta cercarial trematode).

Figure3

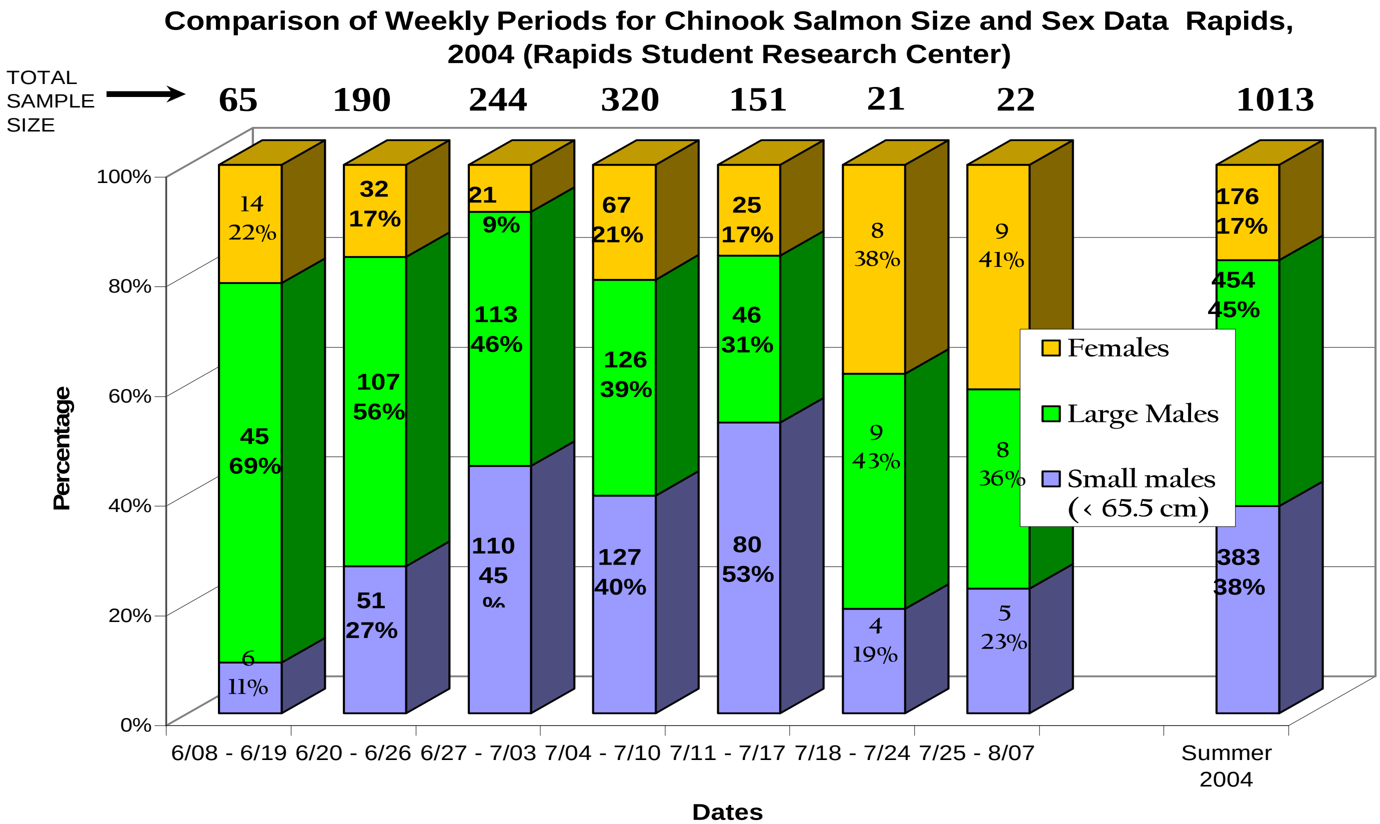


Figure 4

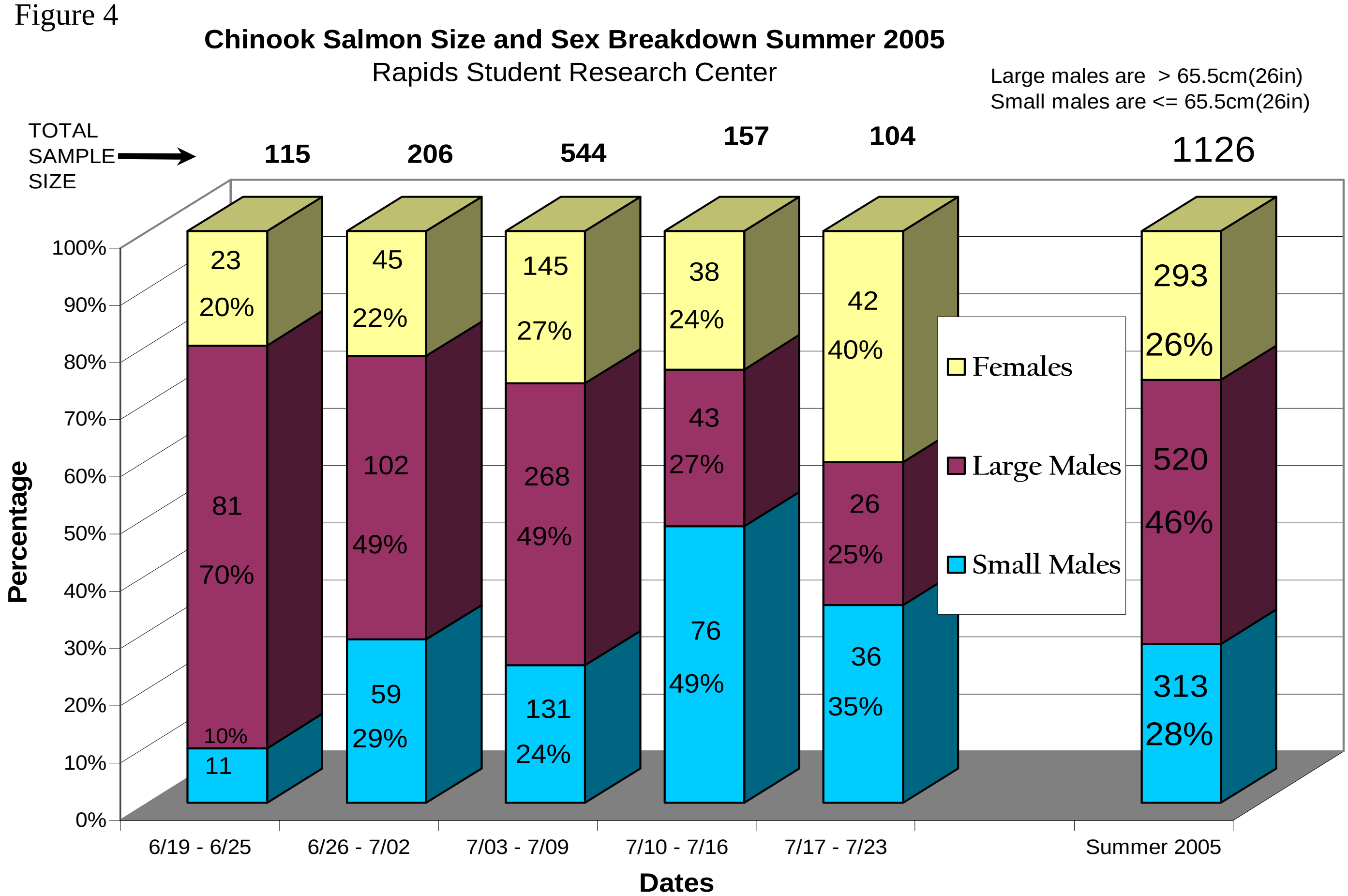


Figure 5

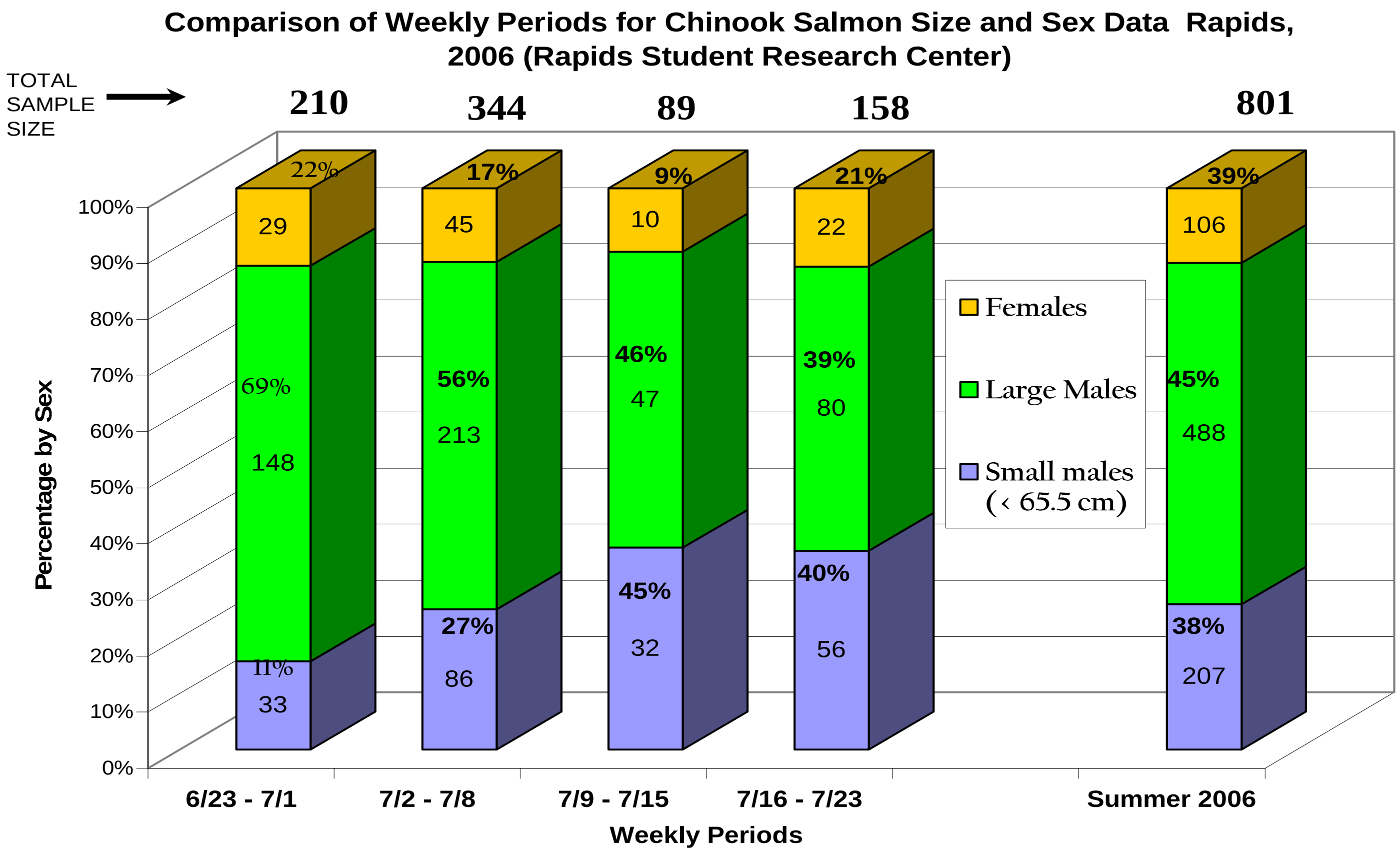


Figure 6

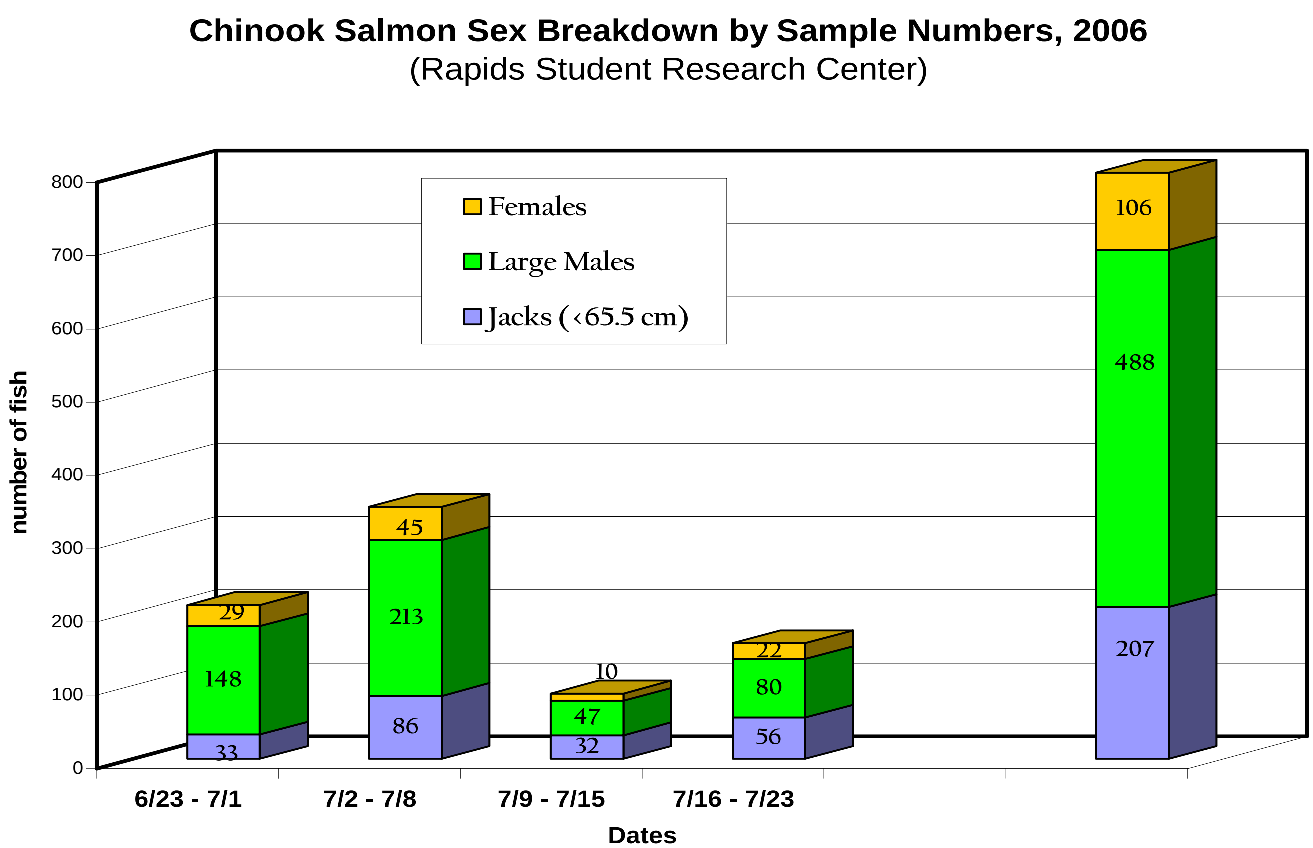


Figure 7

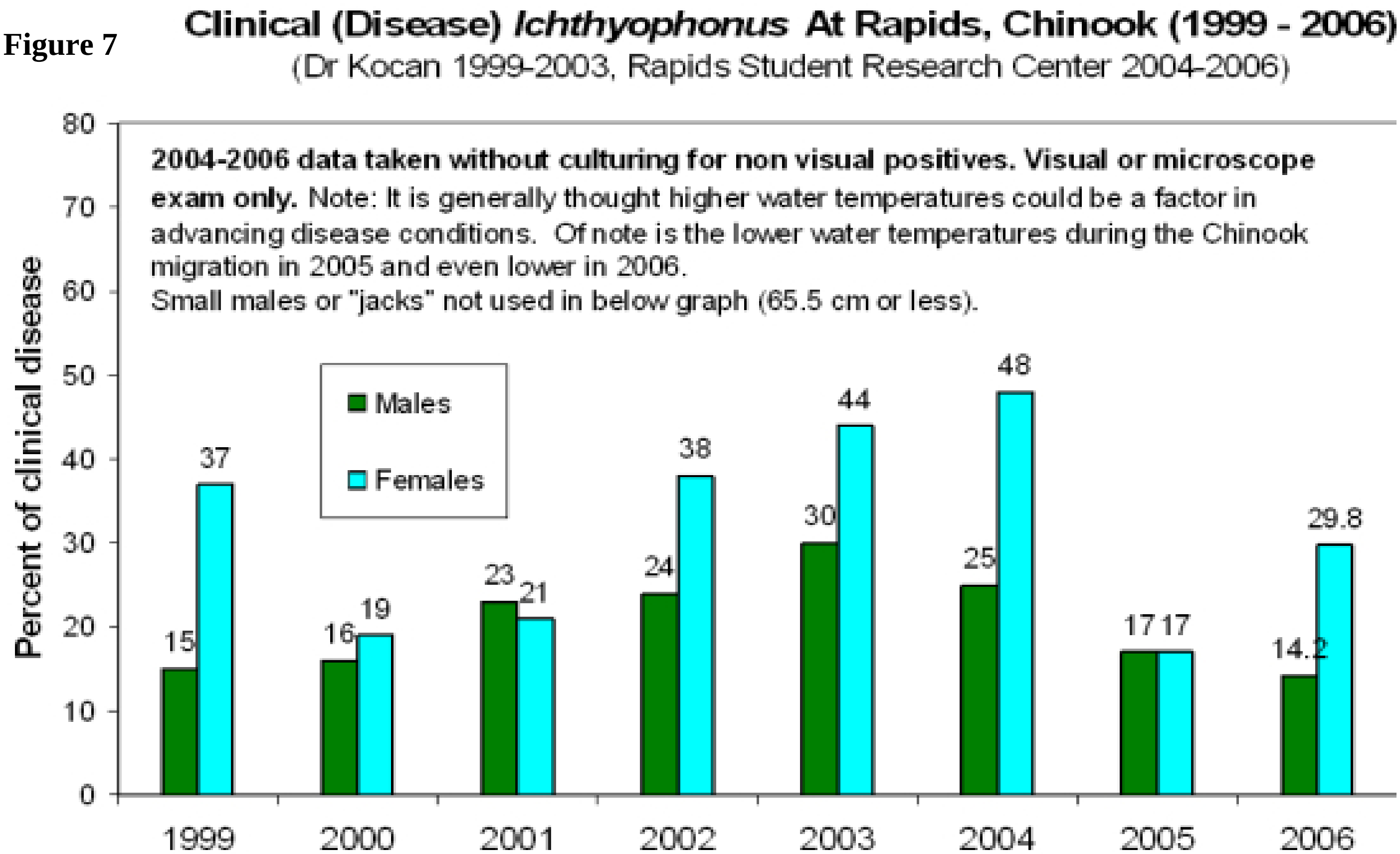


Figure 8

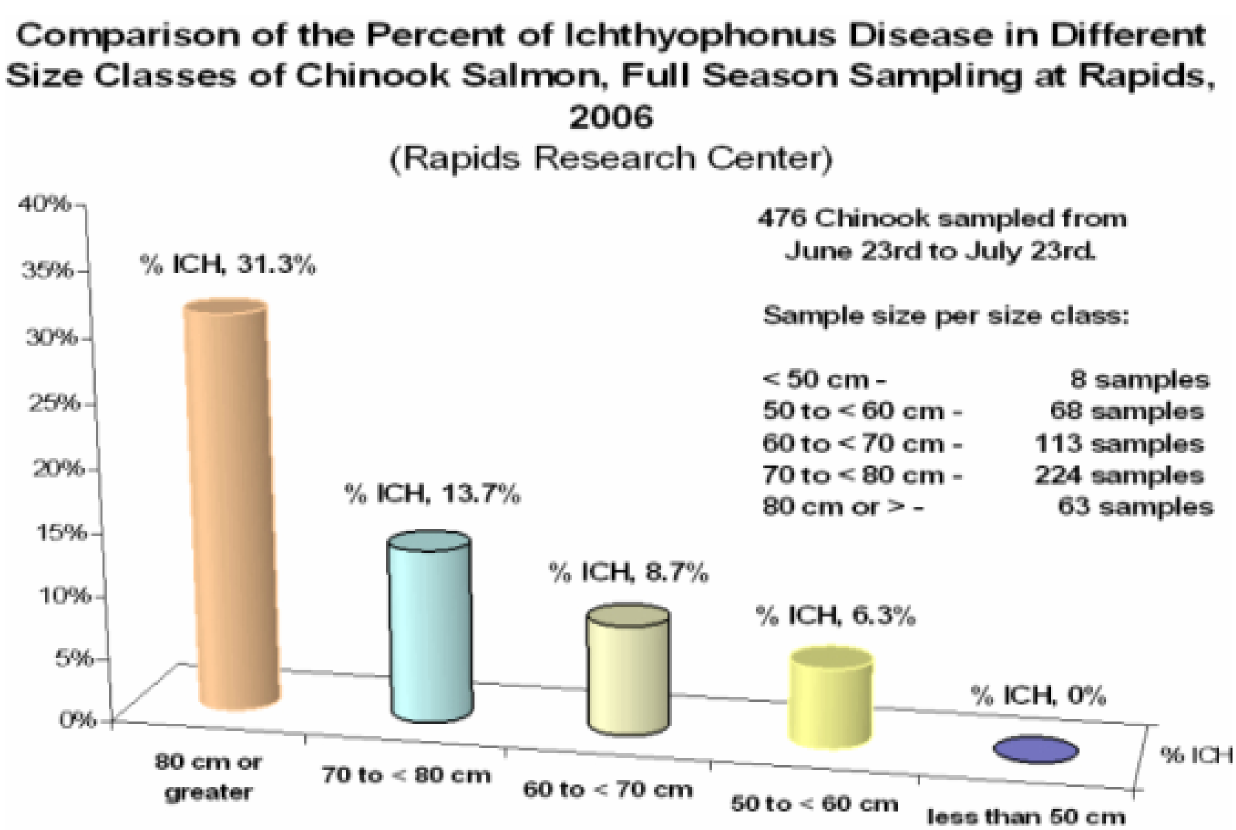
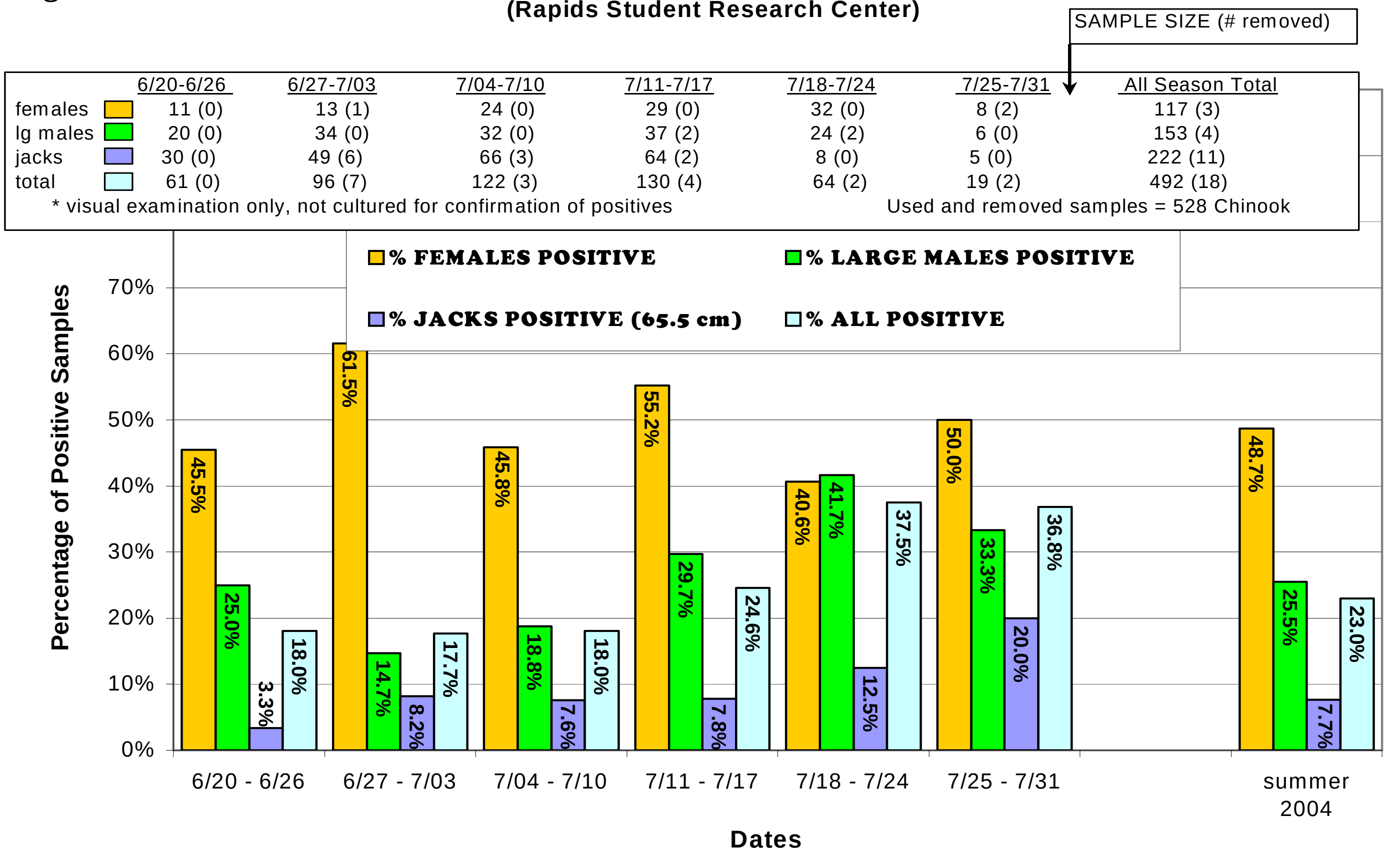


Figure 9

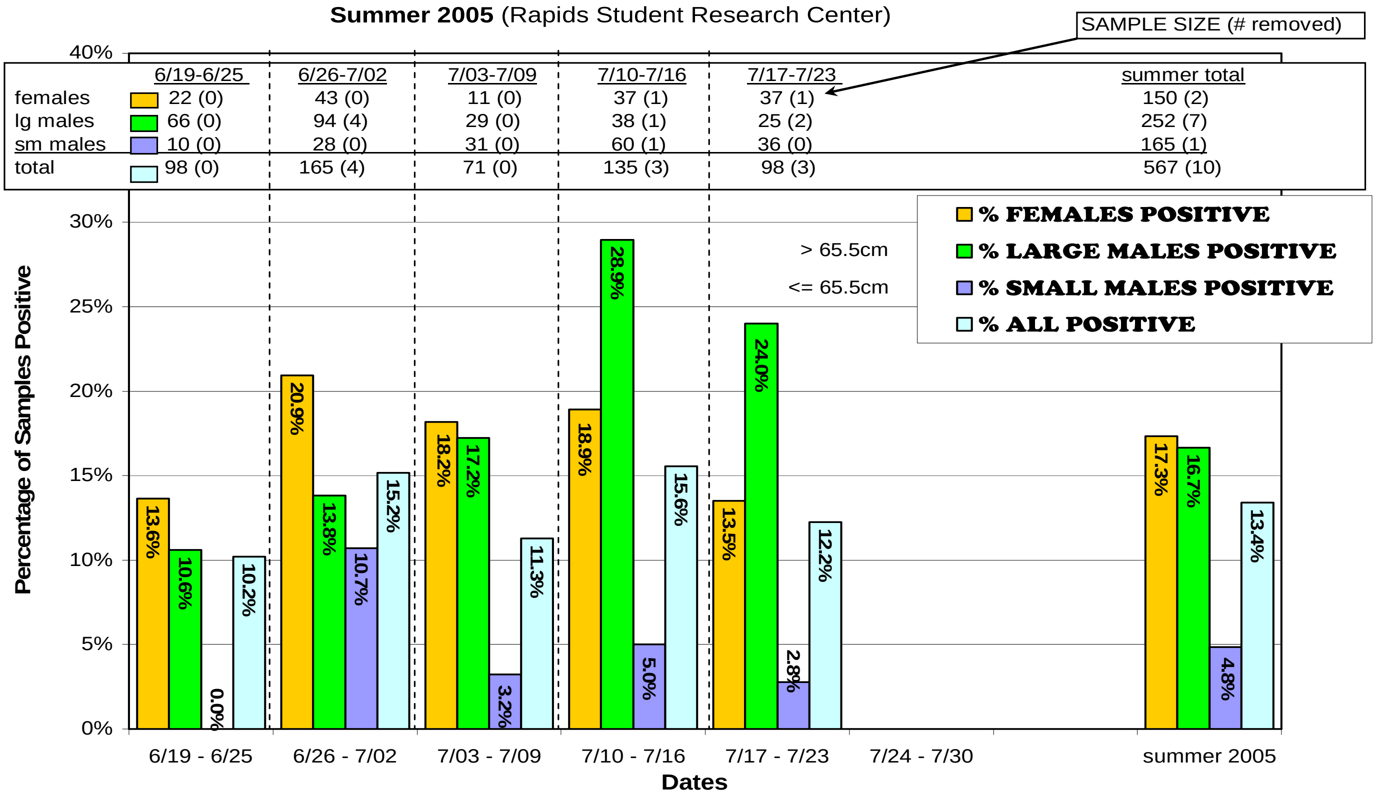
Percentage of Ichthyophonus in Chinook Salmon, 2004
(Rapids Student Research Center)



	6/20-6/26	6/27-7/03	7/04-7/10	7/11-7/17	7/18-7/24	7/25-7/31	All Season Total
females	11 (0)	13 (1)	24 (0)	29 (0)	32 (0)	8 (2)	117 (3)
lg males	20 (0)	34 (0)	32 (0)	37 (2)	24 (2)	6 (0)	153 (4)
jacks	30 (0)	49 (6)	66 (3)	64 (2)	8 (0)	5 (0)	222 (11)
total	61 (0)	96 (7)	122 (3)	130 (4)	64 (2)	19 (2)	492 (18)

Figure 10

Percentage of Ichthyophonus Disease in Chinook (King) Salmon
Summer 2005 (Rapids Student Research Center)



	6/19-6/25	6/26-7/02	7/03-7/09	7/10-7/16	7/17-7/23	summer total
females	22 (0)	43 (0)	11 (0)	37 (1)	37 (1)	150 (2)
lg males	66 (0)	94 (4)	29 (0)	38 (1)	25 (2)	252 (7)
sm males	10 (0)	28 (0)	31 (0)	60 (1)	36 (0)	165 (1)
total	98 (0)	165 (4)	71 (0)	135 (3)	98 (3)	567 (10)

Figure 11

Percentage of Chum that are Red Fleshed, 2004

1 or 2 on color chart (Rapids Student Research Center)

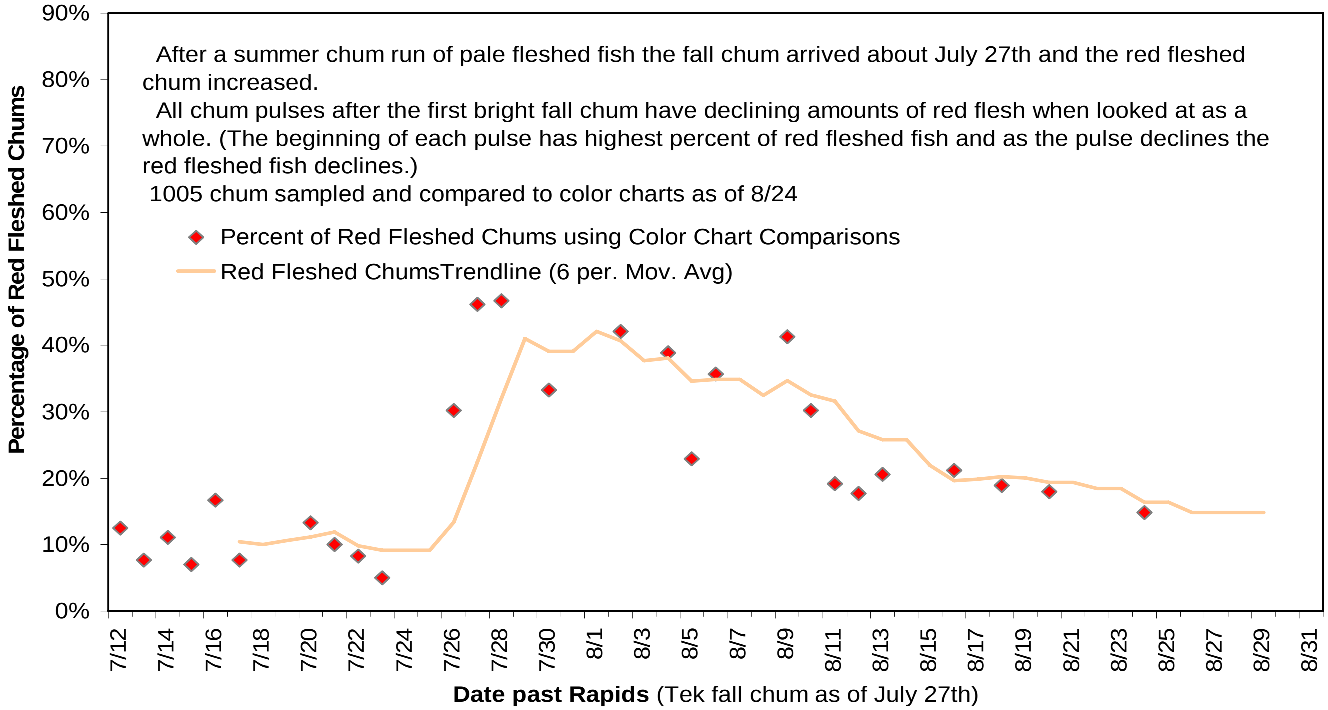


Figure 12

Percentage of Chum that are Red Fleshed, 2005

1 or 2 on color chart (Rapids Student Research Center)

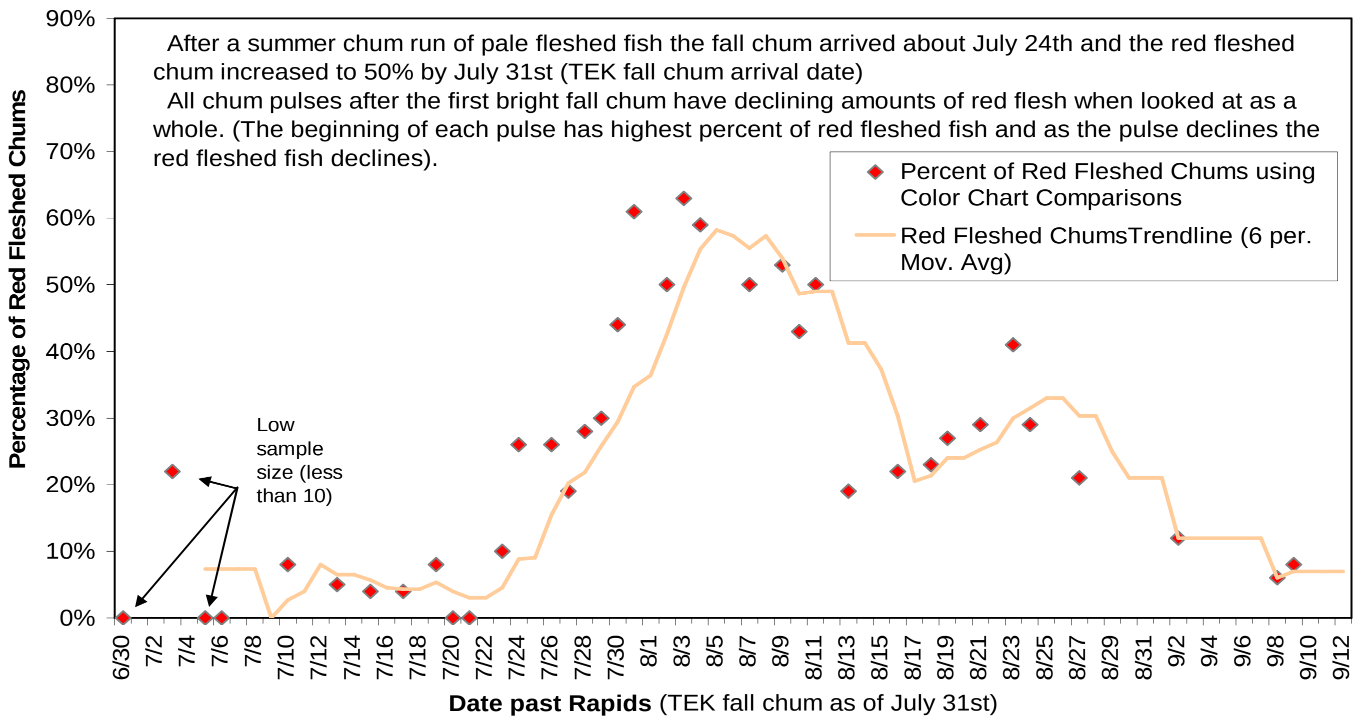


Figure 13

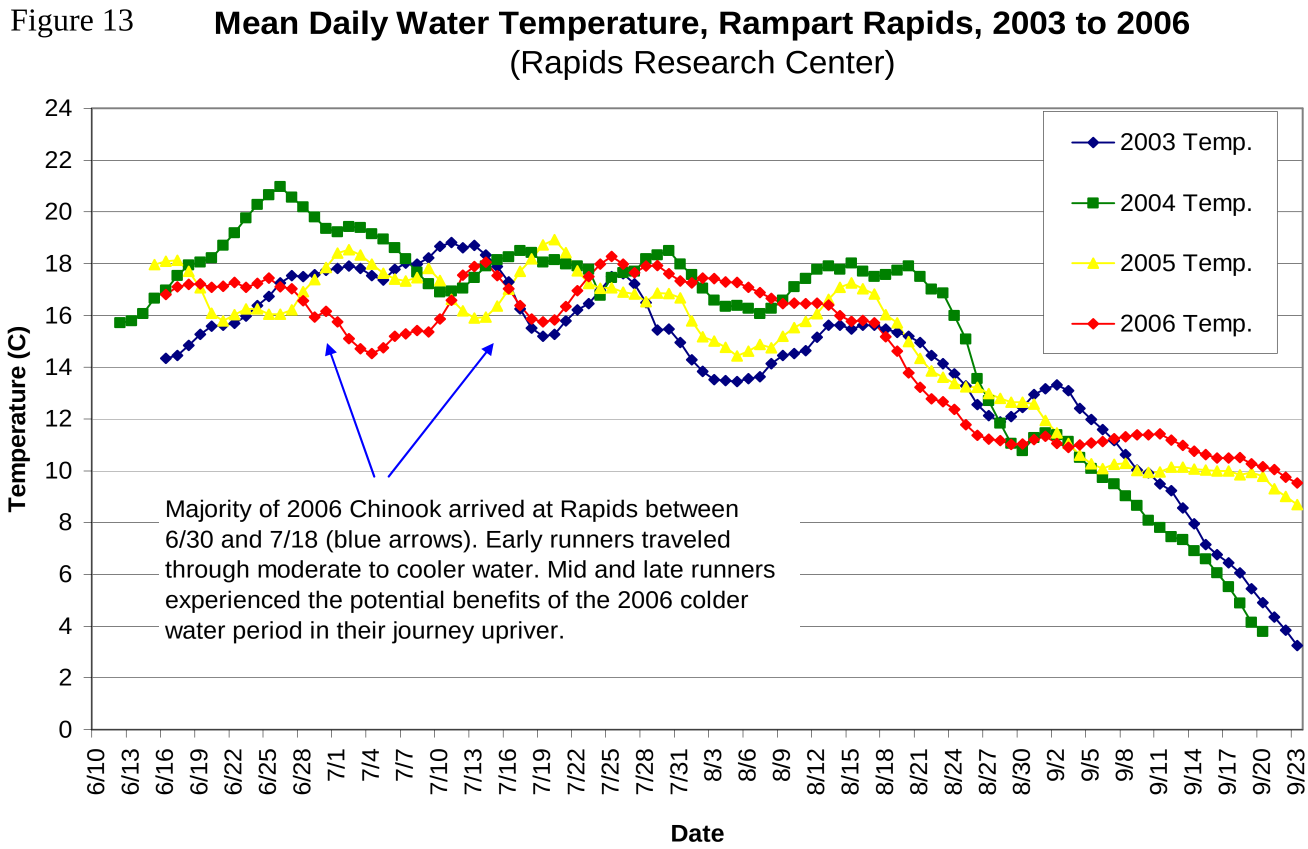

Mean Daily Water Temperature, Rampart Rapids, 2003 to 2006
(Rapids Research Center)
Temperature (C)
Date
2003 Temp.
2004 Temp.
2005 Temp.
2006 Temp.
Majority of 2006 Chinook arrived at Rapids between 6/30 and 7/18 (blue arrows). Early runners traveled through moderate to cooler water. Mid and late runners experienced the potential benefits of the 2006 colder water period in their journey upriver.
0
2
4
6
8
10
12
14
16
18
20
22
24
6/10
6/13
6/16
6/19
6/22
6/25
6/28
7/1
7/4
7/7
7/10
7/13
7/16
7/19
7/22
7/25
7/28
7/31
8/3
8/6
8/9
8/12
8/15
8/18
8/21
8/24
8/27
8/30
9/2
9/5
9/8
9/11
9/14
9/17
9/20
9/23

Table 2

All Chinook Weights Taken in 2006, YRDFA Data Collection Project at Rapids

Chinook were weighed and the gender of each determined by full dissection or a slit made in the belly. No samples are allowed from catches if some fish were missing from a day's catch as in some were given away or already processed. Includes Some Commercial Catch Weights, , Chinook Fish Wheel Sites Only
737 Chinook - 11.9 lb ave. weight - 70.9 cm (27.5 in.) ave. length

Large males (=>65.5 cm eye-tail)										Females		Small males ("Jacks")			
5.8	9.3	10.0	10.8	11.5	12.1	12.7	13.6	15.0	16.3	10.2	18.5	3.0	5.0	6.1	7.5
6.3	9.3	10.0	10.9	11.5	12.1	12.7	13.6	15.0	16.5	10.8	18.5	3.0	5.0	6.1	7.5
7.2	9.4	10.1	10.9	11.5	12.2	12.8	13.6	15.0	16.5	11.1	18.6	3.0	5.0	6.1	7.5
7.3	9.4	10.1	10.9	11.5	12.2	12.8	13.6	15.0	16.7	11.7	18.9	3.1	5.1	6.2	7.5
7.4	9.4	10.1	10.9	11.5	12.2	12.9	13.7	15.0	16.7	12.2	19.1	3.1	5.1	6.2	7.5
7.5	9.5	10.1	10.9	11.5	12.2	12.9	13.7	15.0	16.9	12.2	19.4	3.2	5.1	6.2	7.5
7.6	9.5	10.1	11.0	11.6	12.2	12.9	13.8	15.0	17.0	12.4	19.4	3.2	5.1	6.3	7.5
7.8	9.5	10.1	11.0	11.6	12.2	12.9	13.8	15.0	17.0	12.5	19.5	3.3	5.1	6.3	7.5
7.8	9.6	10.1	11.0	11.6	12.2	13.0	13.9	15.0	17.0	12.9	19.6	3.3	5.2	6.3	7.5
8.0	9.6	10.1	11.0	11.6	12.2	13.0	13.9	15.1	17.0	12.9	19.7	3.5	5.2	6.4	7.5
8.0	9.6	10.1	11.0	11.6	12.2	13.0	13.9	15.1	17.1	13.4	19.8	3.5	5.3	6.4	7.5
8.0	9.6	10.2	11.0	11.7	12.3	13.0	13.9	15.1	17.3	13.5	19.9	3.7	5.3	6.5	7.5
8.0	9.6	10.2	11.0	11.7	12.3	13.0	13.9	15.2	17.3	13.5	19.9	3.8	5.3	6.5	7.7
8.1	9.6	10.2	11.0	11.7	12.3	13.0	14.0	15.3	17.5	13.5	20.2	3.8	5.4	6.5	7.7
8.1	9.7	10.2	11.1	11.7	12.3	13.0	14.0	15.3	17.6	13.6	20.7	3.8	5.5	6.6	7.8
8.1	9.7	10.3	11.1	11.7	12.3	13.0	14.0	15.3	18.1	13.7	20.8	3.9	5.5	6.6	7.8
8.2	9.7	10.3	11.1	11.7	12.3	13.0	14.0	15.3	18.2	14.0	20.9	3.9	5.5	6.7	7.8
8.3	9.7	10.3	11.1	11.7	12.3	13.0	14.0	15.4	18.5	14.0	21.0	4.0	5.5	6.7	7.8
8.4	9.8	10.3	11.2	11.8	12.3	13.0	14.0	15.4	18.5	14.1	21.1	4.0	5.5	6.7	7.9
8.5	9.8	10.4	11.2	11.8	12.4	13.0	14.1	15.4	18.6	14.3	21.2	4.0	5.5	6.8	7.9
8.5	9.8	10.4	11.2	11.8	12.4	13.0	14.1	15.4	19.3	14.4	21.5	4.0	5.5	6.8	8.0
8.5	9.8	10.4	11.2	11.8	12.4	13.0	14.2	15.5	19.9	14.5	21.6	4.0	5.6	6.9	8.0
8.5	9.8	10.4	11.2	11.8	12.4	13.1	14.3	15.5	19.9	14.5	21.9	4.1	5.6	7.0	8.0
8.6	9.8	10.5	11.2	11.8	12.4	13.1	14.3	15.5	20.0	14.9	21.9	4.2	5.6	7.0	8.0
8.6	9.9	10.5	11.2	11.8	12.5	13.1	14.4	15.5	20.2	15.0	22.5	4.2	5.7	7.0	8.0
8.7	9.9	10.5	11.2	11.8	12.5	13.1	14.4	15.5	20.4	15.2	22.5	4.3	5.8	7.0	8.0
8.8	9.9	10.5	11.3	11.9	12.5	13.2	14.4	15.6	20.5	15.2	22.9	4.3	5.8	7.0	8.1
8.9	9.9	10.5	11.3	11.9	12.5	13.2	14.4	15.6	21.1	15.2	23.5	4.5	5.8	7.0	8.1
8.9	9.9	10.5	11.3	11.9	12.5	13.2	14.5	15.7	21.9	15.2	23.7	4.5	5.8	7.0	8.2
8.9	9.9	10.5	11.3	12.0	12.5	13.3	14.5	15.7	22.4	15.8	24.2	4.5	5.8	7.0	8.2
8.9	9.9	10.6	11.3	12.0	12.5	13.3	14.5	15.7	22.8	15.8	24.5	4.6	5.8	7.0	8.3
9.0	9.9	10.6	11.3	12.0	12.5	13.3	14.5	15.8	23.0	16.1	24.9	4.6	5.9	7.0	8.5
9.0	9.9	10.6	11.4	12.0	12.5	13.3	14.5	15.8	23.4	16.1	25.1	4.7	5.9	7.0	8.5
9.0	10.0	10.6	11.4	12.0	12.5	13.3	14.5	15.8	23.5	16.1	25.3	4.7	5.9	7.1	8.5
9.0	10.0	10.7	11.4	12.0	12.5	13.3	14.6	15.9	24.5	16.1	25.5	4.8	5.9	7.1	8.6
9.0	10.0	10.7	11.4	12.0	12.5	13.3	14.7	16.0	25.7	16.3	25.6	4.8	5.9	7.1	8.6
9.0	10.0	10.7	11.4	12.0	12.5	13.4	14.7	16.0	26.5	16.5	26.0	4.8	6.0	7.1	8.6
9.0	10.0	10.8	11.4	12.0	12.5	13.4	14.7	16.0	26.9	16.5	27.0	4.8	6.0	7.2	8.8
9.0	10.0	10.8	11.4	12.0	12.6	13.4	14.7	16.0	28.0	16.8	27.0	4.9	6.0	7.2	8.8
9.0	10.0	10.8	11.4	12.1	12.6	13.5	14.8	16.0	31.3	16.9	27.5	4.9	6.0	7.2	8.9
9.0	10.0	10.8	11.4	12.1	12.7	13.5	14.8	16.1	33.5	17.1	28.5	4.9	6.0	7.2	9.0
9.1	10.0	10.8	11.4	12.1	12.7	13.5	14.8	16.1	35.8	17.3	28.5	4.9	6.0	7.3	9.0
9.1	10.0	10.8	11.4	12.1	12.7	13.5	14.8	16.2		17.4	29.5	5.0	6.0	7.3	9.1
9.2	10.0	10.8	11.4	12.1	12.7	13.5	14.9	16.2		17.4	29.5	5.0	6.0	7.3	9.5
9.2	10.0	10.8	11.4	12.1	12.7	13.5	14.9	16.3		17.5	30.0	5.0	6.1	7.4	9.6
9.3	10.0	10.8	11.5	12.1	12.7	13.6	15.0	16.3		17.6	32.0	5.0	6.1	7.4	9.7
										18.2	49.5	5.0		7.4	10.5

Table 3

Table of all Chinook Weights Taken in 2005. Chinook Fish Wheel Sites Only																			
Includes Interior AK Prosessors Commercial Catch at Rapids																			
Weights only for : Large Males										Females					"Jacks"				
5	9.5	10.5	11	12	12.8	13.8	14.5	16	19	10	14	16	18.5	21.7	1.9	4.5	5.7	6.2	7.4
6.1	9.5	10.5	11.2	12	12.8	13.8	14.5	16	19	10	14	16	18.5	21.8	2	4.5	5.8	6.3	7.5
6.5	9.5	10.5	11.3	12	12.8	13.9	14.5	16	19.2	10.4	14	16.1	18.5	21.8	2	4.5	5.8	6.3	7.5
7.3	9.5	10.5	11.3	12	12.8	13.9	14.6	16	19.2	10.8	14	16.1	18.5	22	2	5	5.8	6.3	7.5
7.7	9.5	10.5	11.3	12	12.9	14	14.6	16.1	19.5	10.8	14	16.1	18.5	22	2	5	5.8	6.4	7.5
7.8	9.5	10.5	11.3	12	12.9	14	14.6	16.1	19.5	10.8	14.1	16.2	18.5	22.2	2	5	5.8	6.5	7.5
8	9.6	10.5	11.3	12	12.9	14	14.7	16.2	19.6	10.9	14.1	16.2	18.5	22.5	2	5	5.9	6.5	7.5
8	9.6	10.5	11.4	12	13	14	14.7	16.5	19.6	11	14.3	16.3	18.5	22.5	2	5	6	6.5	7.5
8	9.6	10.5	11.4	12	13	14	14.8	16.5	19.9	11	14.3	16.3	18.6	22.7	2	5	6	6.5	7.5
8	9.6	10.5	11.4	12.1	13	14	14.9	16.5	20	11.3	14.3	16.3	18.6	22.8	2	5	6	6.5	7.5
8	9.6	10.5	11.4	12.1	13	14	15	16.5	20	11.3	14.4	16.5	19	22.9	2	5	6	6.5	7.5
8.3	9.7	10.5	11.4	12.2	13	14	15	16.5	20.1	11.3	14.5	16.5	19	23.1	2	5	6	6.5	7.6
8.4	9.8	10.5	11.4	12.2	13	14	15	16.5	20.7	11.5	14.5	16.5	19	23.5	2	5	6	6.5	7.6
8.5	9.8	10.5	11.5	12.2	13	14	15	16.8	21	11.5	14.5	16.5	19	24.3	2	5	6	6.5	7.6
8.5	9.9	10.5	11.5	12.2	13	14	15	16.9	21.5	11.8	14.5	16.5	19.2	24.5	2.5	5	6	6.5	7.9
8.5	10	10.6	11.5	12.3	13	14	15	16.9	21.5	11.8	14.5	16.6	19.2	24.5	3	5	6	6.5	7.9
8.6	10	10.6	11.5	12.3	13	14	15	17	22	12	14.5	16.7	19.4	25.2	3	5	6	6.5	8
8.6	10	10.6	11.5	12.3	13	14	15	17	22	12	14.5	16.9	19.4	25.4	3	5	6	6.5	8
8.8	10	10.6	11.5	12.3	13	14	15	17	22.3	12.2	14.6	17	19.5	25.5	3	5	6	6.5	8
8.8	10	10.6	11.5	12.4	13	14	15	17	23	12.2	14.6	17	19.5	27.5	3	5	6	6.5	8
8.9	10	10.7	11.5	12.4	13.1	14	15	17	23	12.2	14.7	17	19.6	28.4	3	5	6	6.5	8
9	10	10.8	11.5	12.4	13.1	14	15	17	23	12.5	14.7	17	19.7	29.5	3.5	5	6	6.6	8
9	10	10.8	11.5	12.4	13.2	14	15	17	23	12.5	14.8	17	19.7	29.8	3.5	5	6	6.7	8
9	10	10.9	11.5	12.5	13.2	14	15	17	23	12.5	14.8	17	19.8	34	3.8	5	6	6.7	8
9	10	10.9	11.5	12.5	13.2	14	15	17.2	23.5	12.5	14.9	17	20		4	5	6	6.7	8
9	10	11	11.6	12.5	13.2	14	15.1	17.2	24	12.5	14.9	17	20		4	5	6	6.9	8
9	10	11	11.7	12.5	13.3	14	15.2	17.2	24	12.5	15	17	20		4	5.3	6	7	8
9	10	11	11.7	12.5	13.3	14.1	15.3	17.2	24	12.7	15	17.1	20		4	5.4	6	7	8
9	10	11	11.7	12.5	13.3	14.1	15.3	17.4	24.5	12.7	15	17.1	20		4	5.5	6	7	8
9	10	11	11.7	12.5	13.4	14.2	15.3	17.5	24.5	13	15	17.2	20		4	5.5	6	7	8
9.1	10	11	11.7	12.5	13.5	14.2	15.5	17.5	25	13	15.3	17.2	20		4	5.5	6	7	8
9.1	10	11	11.7	12.5	13.5	14.3	15.5	17.5	25	13	15.4	17.3	20.5		4	5.5	6	7	8.1
9.1	10	11	11.8	12.5	13.5	14.4	15.5	17.5	26.1	13	15.5	17.3	20.5		4	5.5	6	7	8.3
9.1	10	11	11.8	12.5	13.5	14.4	15.5	17.5	26.2	13.1	15.5	17.4	20.5		4	5.5	6	7	8.4
9.2	10.1	11	11.8	12.5	13.5	14.4	15.5	17.5	26.5	13.3	15.5	17.5	20.5		4	5.5	6	7	8.5
9.2	10.1	11	11.8	12.5	13.5	14.4	15.5	17.5	26.5	13.4	15.5	17.5	20.8		4	5.5	6	7	8.5
9.2	10.1	11	11.8	12.5	13.5	14.5	15.6	17.5	28.4	13.5	15.5	17.6	20.8		4.4	5.5	6	7	8.5
9.2	10.1	11	11.9	12.5	13.5	14.5	15.7	17.9	30	13.5	15.5	17.6	20.9		4.4	5.5	6	7	8.6
9.3	10.3	11	11.9	12.5	13.5	14.5	15.7	18	30.5	13.6	15.5	17.7	21		4.5	5.5	6	7	8.8
9.3	10.3	11	11.9	12.5	13.5	14.5	15.8	18	33	13.6	15.6	17.8	21		4.5	5.5	6	7.1	8.8
9.3	10.4	11	11.9	12.5	13.5	14.5	15.9	18	34	13.7	15.8	17.9	21		4.5	5.5	6	7.1	9
9.3	10.4	11	12	12.6	13.5	14.5	15.9	18	34.2	13.7	15.8	18	21		4.5	5.5	6	7.2	9
9.3	10.4	11	12	12.6	13.5	14.5	15.9	18.3	35	13.8	16	18	21		4.5	5.5	6	7.2	9
9.4	10.4	11	12	12.6	13.5	14.5	16	18.4		13.9	16	18	21		4.5	5.5	6	7.2	11
9.5	10.4	11	12	12.7	13.6	14.5	16	18.5		13.9	16	18	21.3		4.5	5.6	6	7.3	
9.5	10.4	11	12	12.7	13.6	14.5	16	18.5		14	16	18	21.5		4.5	5.7	6.1	7.3	
9.5	10.4	11	12	12.7	13.7	14.5	16	18.8		14	16	18.3	21.5		4.5	5.7	6.1	7.4	
9.5	10.5	11	12	12.7	13.7	14.5	16	18.8		14	16	18.3	21.5		4.5	5.7	6.2	7.4	

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Suggestions to print report - Print each of the below in separate print jobs:

1. Print pages 1, 19 and 20 in best quality and single sided.
2. Print pages 2 – 18 in regular quality and double sided.
3. Print pages 21 – 29 in regular quality and double sided.