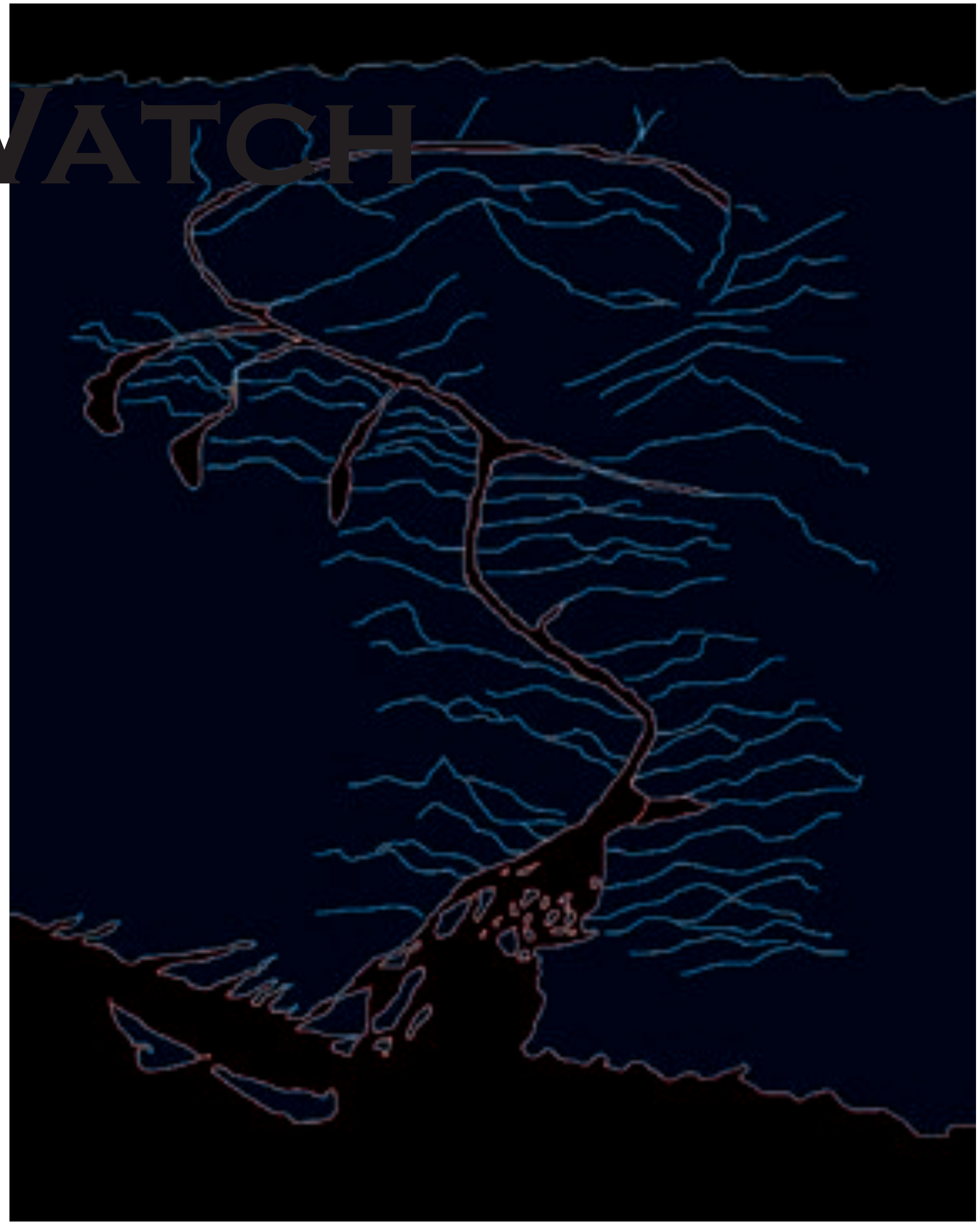
FishWatch



habitat and water quality monitoring in the Copper River watershed

Five Year Summary Report: 2002 - 2006

Copper River Watershed Project
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CRWP provides residents with a forum to consider and implement innovative approaches for achieving balance between a diverse economy and healthy ecosystems while maintaining our quality of life and our cultural heritage.

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Celebrating five years of FishWatch with Copper Basin Volunteers, June 2006

Introduction

Starting in fall, 2001, the Copper River Watershed Project began facilitating meetings of regional salmon fishery stakeholders. We had completed a few habitat restoration projects, the need for which had been brought to our attention by people like Paul Swartzbart, a Cordova commercial fisherman for 30 odd years.

What else was happening in our area that was going un-noticed, we wondered? What local knowledge -- of current conditions, and of changes from conditions of 20 to 30 years ago -- wasn't being captured in a systematic way?

A land ownership map of the Copper River watershed will show you two things: a sprawling river system with a dozen or so spawning tributaries that contribute to the Copper River's rich salmon fisheries, and a piece-meal map of what agencies manage the surrounding lands (private land owners such as the Chugach Alaska Corporation, the Ahtna Corporation, the Tatitlek Corporation, the Chitina Corporation and the Eyak Corporation, and the University of Alaska; the Bureau of Land Management, the Wrangell-St. Elias National Park and the Chugach National Forest; and the State of Alaska's Departments of Natural Resources, Fish and Game, and Transportation).

We saw a need to begin tapping our local "history keepers" for their knowledge. The FishWatch Planning Team, at its first meetings in August, 2001 (Glennallen) and September, 2001 (Cordova) agreed with the need to conduct some systematic habitat monitoring to establish a coordinated baseline of habitat conditions. The FishWatch Planning Team, made up of residents with varied backgrounds, bring years of combined expertise and local knowledge to the table. Planning Team members and our volunteers have been come our "eyes and ears" in the field, contributing their time and long local histories to the collective database of FishWatch.

Initially, the FishWatch Planning Team considered monitoring many of the typical water quality indicators, the usual "laundry list." But in spring 2002, after a long disucssion, the Planning Team altered the focus of monitoring indicators. Members of the Planning Team suggested that continual measurements of dissolved oxygen, temprature, and pH may not be as useful for early detection signs since the primary threats to fish habitat are created from human use. Monitoring the number of boats, number of user groups at popular areas, and bank habitat conditions would provide better information to warrant further studies than would monthly estimates of water quality. The FishWatch Planning Team recognized the need for a baseline condition to be established, and for nitrogen and phosphorous levels to be recorded in areas where residential develpment could compromise fish habitat. Ken Roberson suggested that by decreasing the time and energy required to monitor each site, we would be able to include more monitoring sites in the program.

Our "citizen science" water quality monitoring effort was launched, then, in the summer of 2002. With a training course on The Natural History of the Copper River Watershed offered at the Cordova campus of the PWS Community College, 25 volunteers were trained in Cordova and another 10 were trained in the Copper Basin. Each year trainings were held for new volunteers.

The monitoring data includes both water quality indicators and human use indicators. In later years of our FishWatch monitoring, we relied on the human use indicators to determine sampling times for hydrocarbon monitoring. On the following pages we've included the initial study questions drafted by the Planning Team to guide the monitoring, as well as a summary and analysis of the five years' worth of data collected by our dedicated volunteers.

We are very grateful for all of their contributions of time and effort!

FishWatch Goal

To maintain healthy salmon habitat that supports commercial, sport and subsistence fisheries, and to assure collaborative stewardship for water quality and wild salmon over the long term.

FishWatch Study Questions

- What are the baseline fish habitat conditions in selected streams and lakes in the Copper River watershed?
- What are the current use levels of boaters and fishers on selected streams and lakes in the Copper River watershed?
- What is the amount of increase of boat traffic and fishing effort on selected streams and lakes in the Copper River watershed over a multiple year time frame?
- What is the amount of increase of residential development around selected waterbodies in the region over a multiple year time frame?
- Are there sites that would benefit from restoration and further analysis?

FishWatch Accomplishments

- Over 40 volunteers trained from 2002 - 2006
- Water quality data collected at 20 sites
- Human use data collected at 10 monitoring sites
- The FishWatch Planning Team prioritized sub-watersheds that are in need of further study, and discussed options for a comprehensive watershed assessment
- The FishWatch Planning Team suggested and implemented a long-term temperature monitoring strategy (2005)
- Hydrocarbon sampling was initiated on waterbodies of concern (2005).
- 20 Water temperature loggers were purchased and first deployed (2006)

Selecting Sites to Monitor

To address these questions, the planning team developed criteria to select a representative sample of streams and lakes to monitor in the Copper River watershed. The sampling sites had to be important to anadromous fish habitat (spawning, rearing, or migration corridor), safely accessible to volunteers, and distributed throughout the watershed. Sites were chosen for both water quality monitoring and human use monitoring. The sampling schedule was determined by evaluating the intended use of the data and the availability of volunteers. Water quality samples were taken monthly, and human use observations were recorded weekly during the peak months of activity.

For the 2005 field season, FishWatch volunteers monitored water quality and human use at 30 sites throughout the watershed. Due to the increasing trends in temperature, the Planning Team suggested applying for funds for temperature data meters that can take continuos readings when anchored into the stream bottom. CRWP applied for, and recieved, grant money to deploy HOBO temperature meters in 2006.

HOBO temperature data logger sites (deployed 2006 and 2007)

Copper Basin:
Upper Willow Creek
Moose Creek
Tractor Creek
Lower Willow Creek
Gulkana River (3 sites)
Manker Creek
Sinona Creek
Squirrel Creek

Copper River delta:
Eyak Lake
Eyak River
Ibeck Creek
18 Mile (2 sites)
Alaganic Slough
Salmon Creek (25 mile)
Goose Meadows

Water Quality Monitoring Sites	Human Use Monitoring Sites
Alaganik Slough	Eyak River
Eccles Creek	Ibeck Creek
Eyak Lake (3 sites)	Scott River (9 Mile, CR Hwy.)
Eyak River	Airport Hole (11 Mile, CRH)
18 Mile Stream	Alaganik Slough
Ahtel Creek	18 Mile Stream
Fish Creek	22 Mile Boat Ramp (CRH)
Gulkana River	Paxson Lake
Kenny Lake	Gulkana River at Richardson Hwy. crossing
Little Tonsina	Gulkana River at Sourdough
Long Lake (two sites)	Klutina River
Paxson Lake	Little Tonsina
Rufus Creek	
Sinona Creek	
Squirrel Creek	
Tanada Creek	
Willow Creek	

Volunteers as the Eyes and Ears

CRWP Sponsored Trainings

The FishWatch program trained local residents to become stewards of the streams and lakes in their watershed. By sponsoring annual weekend workshops and a 2002 community college course, the Copper River Watershed Project has trained residents of all ages to become FishWatch monitors.

Volunteers were offered instruction on basic stream ecology concepts and the importance of spawning and rearing habitat to anadromous fish species. Volunteers were also taught how to use the water quality sampling and monitoring equipment and how to record their data. In spring 2001, twenty volunteers completed the required trainings. The courses were well attended by watershed residents including families, high school chemistry students, retirees, and fishermen.

For the 2005 field season, 30 volunteers contributed their time and efforts to collect water quality and human use data in the watershed. Many of these dedicated volunteers have been with the program for all four seasons, and a group of enthusiastic new volunteers joined FishWatch this year to help expand its efforts.

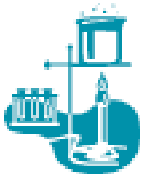
CRWP Partnerships

A primary component of the FishWatch project requires volunteers to observe the level of boat traffic and recreational use at designated water bodies in the watershed. Due to the extended time commitment and sometimes remote location required for this type of data collection, the planning team recommended that the CRWP partner with sport fish charter operators, BLM campground hosts, and rafting guides to serve as volunteers. Since their jobs require them to be at the popular use areas for extended and consistent time periods, their ability to observe human use and record FishWatch data became a more realistic expectation. In addition, landowners who reside near streams and lakes were able to consistently record the levels of activity in these areas.

Student volunteers collecting and recording water quality data for FishWatch.

Part I.,

Water Quality Data



Water Temperature

Importance of the Indicator

Water Temperature is a key factor affecting the growth of and survival of anadromous fish species. For salmonids, temperature ranges of 4-18 C support healthy growth. Documenting seasonal temperature variability over time provides valuable reference data for potential climate change and human alteration.

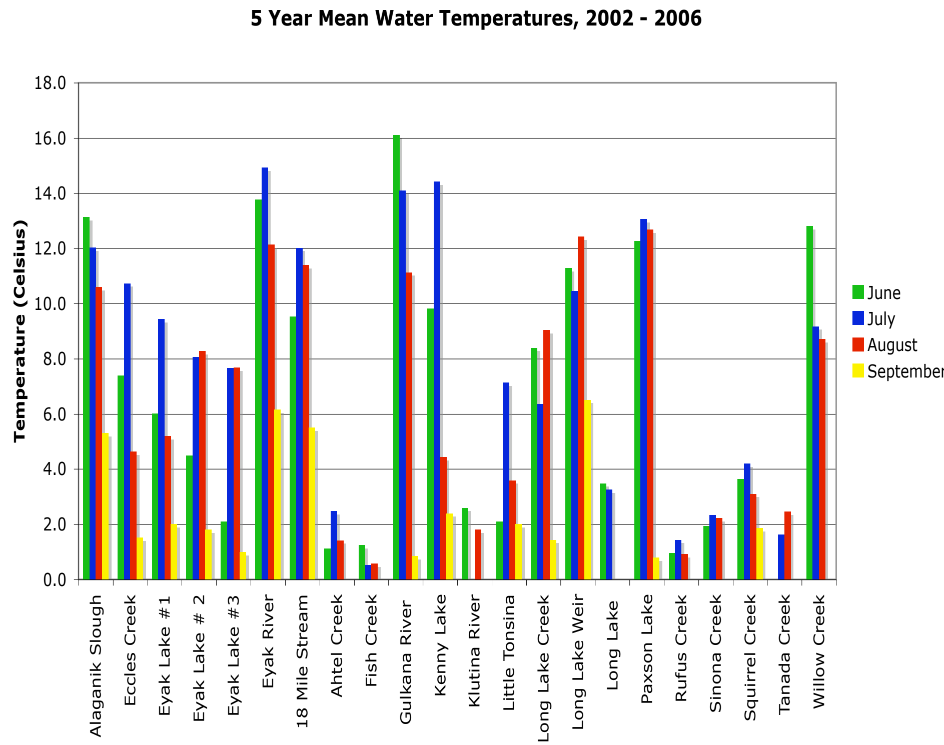
Monitoring Technique

FishWatch monitors collected water temperature data monthly at assigned sites by submerging National Institute of Standards and Measures approved temperature meters into the water body. Measurements were taken at the water's surface. Air temperatures were also collected at the monitoring sites along with water temperatures.

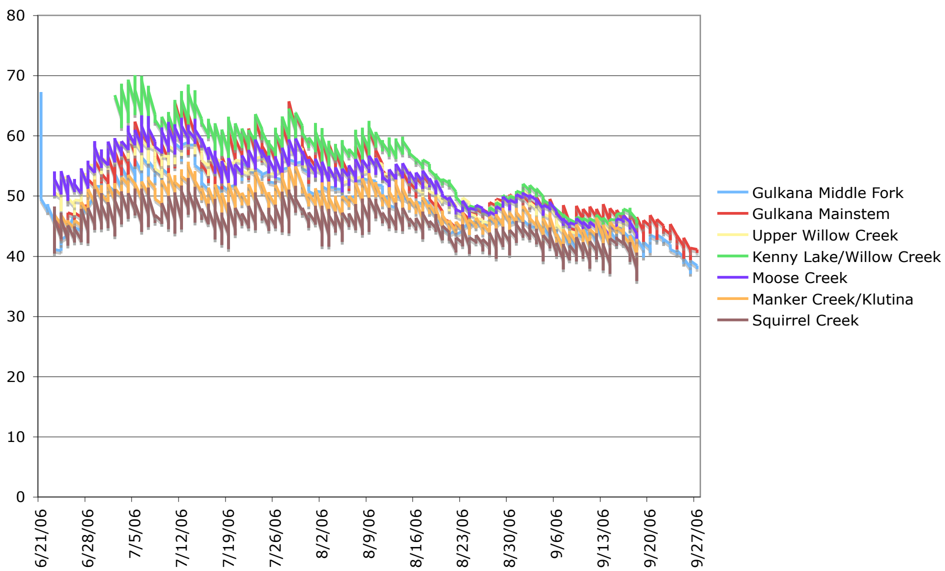
Story Behind the Stats

Collecting baseline water temperature data for the Copper Basin and on the Copper River Delta was an important initiative for FishWatch. As global warming and climate change become larger issues, CRWP wanted to establish baseline temperature for future comparison. Water temperature is also influential on other water quality indicators. For example, dissolved oxygen levels directly correlate with the temperature of the water. As water temperature increases, the ability of water to retain dissolved oxygen, important for fish, decreases.

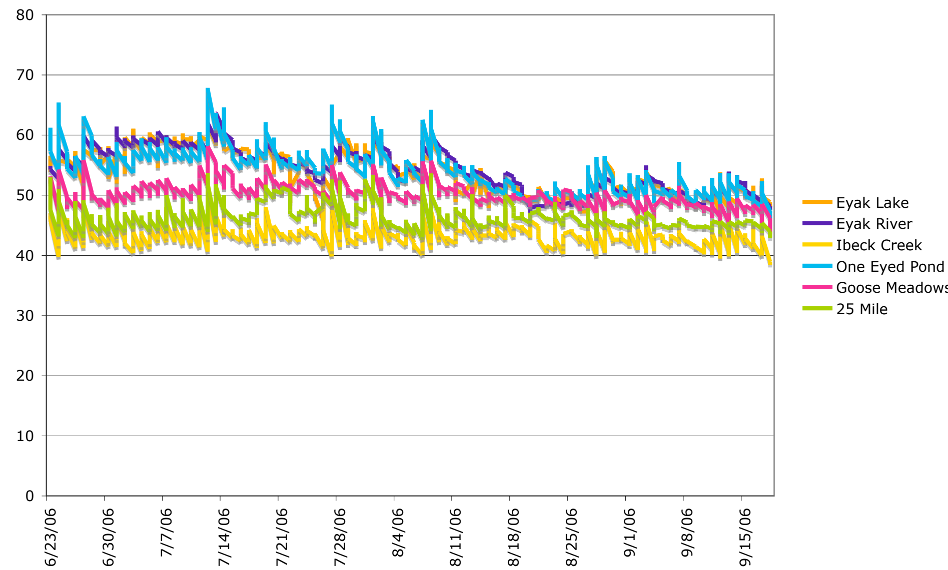
Water temperatures on the Gulkana River appear to be high compared to other waterbodies sampled because they tend to rise in early summer after the snow-melt run-off has drained through. Non-glacial, fresh water rivers like the Gulkana River are warmer than glacial rivers. Slow moving parts of the Gulkana River can heat up and stay warmer, especially if rainfall in a given summer is low and air temperatures are cool.



2006 HOBO Temperature Logger Readings in Copper Basin



2006 HOBO Logger Temperatures on Copper River Delta



Temperature Monitoring with Data Loggers

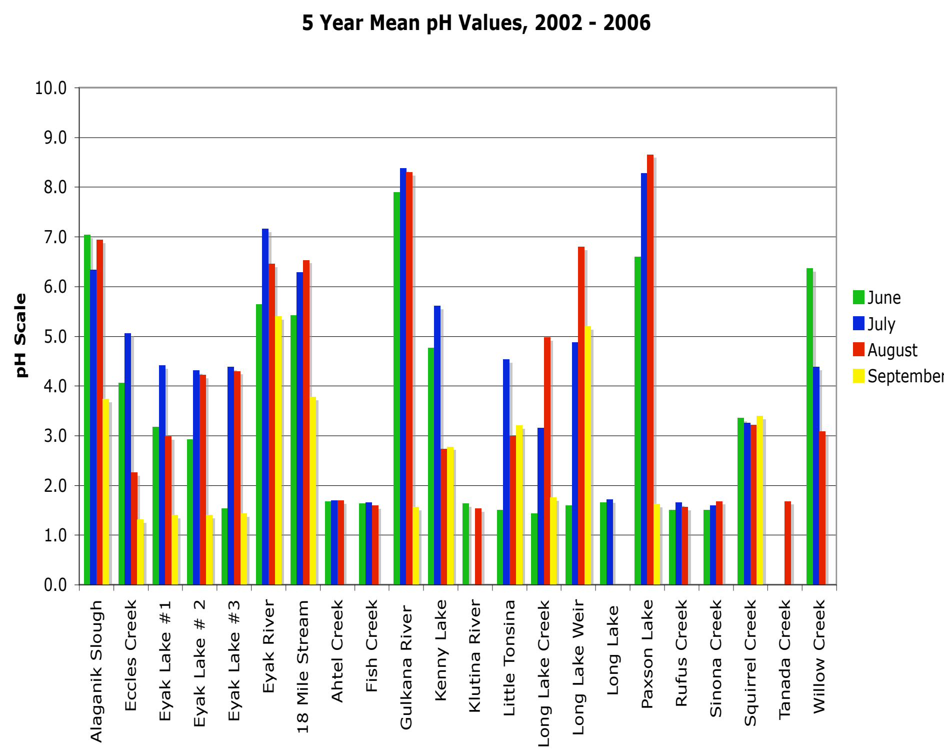
Monthly temperature readings by volunteers are useful, but subject to fluctuations and human variability. With assistance from the Norcross Wildlife Foundation, the CRWP was able to purchase twenty HOBO temperature loggers in 2006 and deploy them in waterbodies throughout the Copper River drainage. The loggers can be programmed to take readings at regular intervals. CRWP staff, volunteers and BLM staff then retrieved the loggers in fall, 2006 so that we could download the data.

Results are consistent with waterbody types. The basin's and the delta's fresh water, shallower waterbodies such as Eyak Lake, Eyak River, One-Eyed Pond, Kenny Lake and the Gulkana River registered warmer temperatures than our glacier-fed stream such as Manker Creek and the Klutina River, Squirrel Creek, and the Ibeck Creek.

pH

Importance of the Indicator

Water pH measures how acidic or basic the water is on a scale from 1-14. Water below pH 7 is acidic, and water above pH 7 is basic. The pH of the water affects fish egg production and survival, aquatic insect survival and emergence, and the toxicity of other pollutants.



Monitoring Techniques

FishWatch volunteers recorded pH levels by using the Waterproof pHep pH Testers. The pH tester was placed in the water body for several minutes while the monitor recorded the data. The equipment detects pH levels with an accuracy of 0.1, and is calibrated with buffer solutions to maintain consistency.

Story Behind the Stats

The Copper River delta streams and lakes are slightly more acidic than those in the Copper Basin. In the Copper River delta's wetland ecosystem, decomposition of organic matter produces naturally acidic by-products, such as tannic and humic acids. These are leached into water bodies by the heavy rainfall (160 inches per year) that the Copper River delta experiences. Acidity is increased by rain having a natural pH of 6.8. Copper Basin streams and lakes are charged by glacial runoff and often contain basic minerals such as calcium and magnesium in the glacial flour. FishWatch volunteers collected five years of pH data to create a baseline of information for future comparison.

Dissolved Oxygen

Importance of Indicator

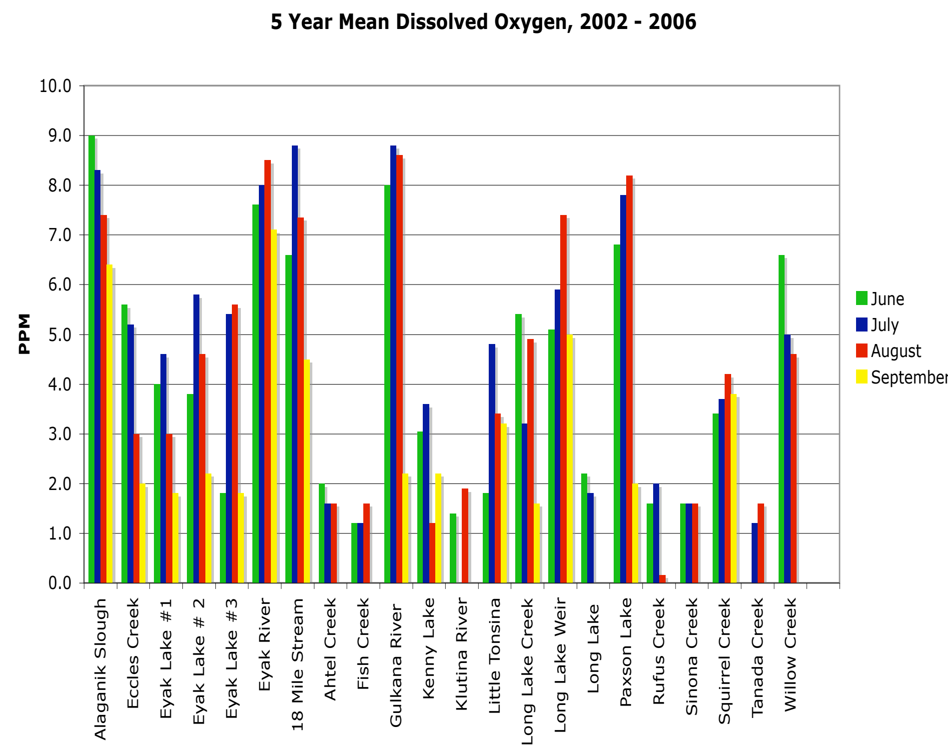
Dissolved oxygen (DO) refers to the amount of oxygen that is dissolved in the water at any given temperature. In waters supporting salmon, the minimum dissolved oxygen level required for productive spawning and rearing habitat is 6 parts per million (ppm). The primary sources for dissolved oxygen are photosynthetic activities of aquatic plants and aeration from moving water such as waves and currents. Demands on DO come from plant respiration and the decomposition of organic materials by bacteria and other microorganisms.

Monitoring Technique

FishWatch monitors collected dissolved oxygen readings monthly using the CHEMets testing kit. The sample is then compared to calibrated color charts to determine DO concentration.

Story Behind the Stats

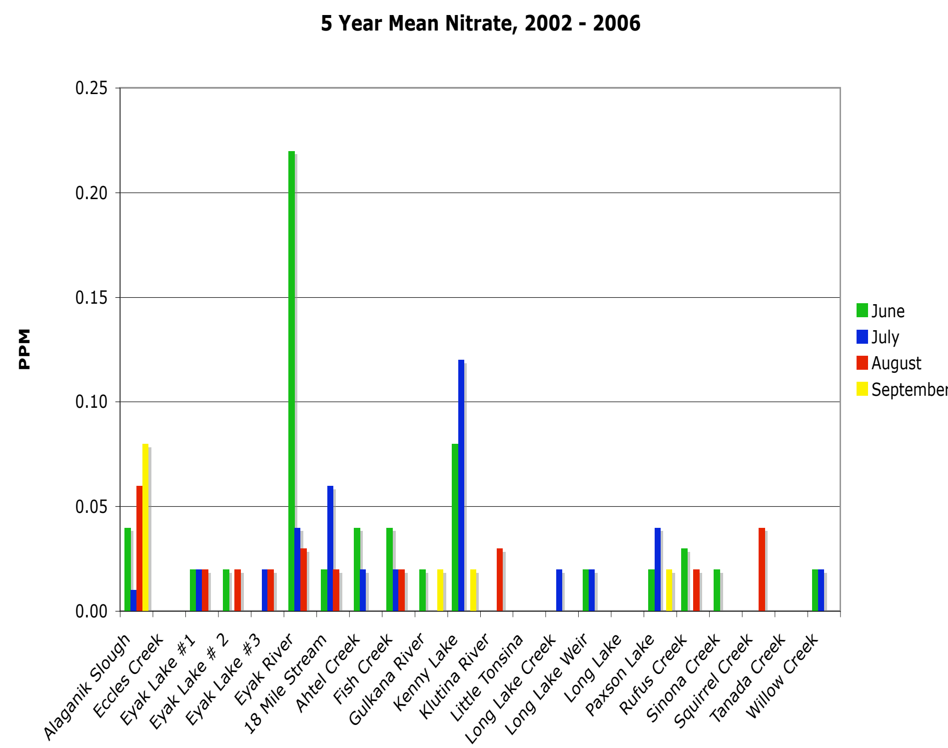
Dissolved oxygen and water temperature are directly linked. The greater the water temperature the less dissolved oxygen the water is capable of holding. Anadromous fish species require a minimum DO of 6 ppm for basic biological activities such as spawning and rearing. However 8-12 ppm of DO is the range for optimum health of anadromous fish species. The turbulent rivers and shallow lakes found in the Copper River watershed generally have healthy levels of dissolved oxygen. Several of the healthy stocks of salmon in the region were found to be in the water bodies with the highest recorded levels of DO. On the Copper River Delta high DO levels were found in Alaganik Slough, Eyak River and the 18 Mile Stream. In the Copper River Basin the Gulkana River, Paxson Lake, and Long Lake had the highest DO levels. These water bodies also correspond with important spawning and rearing grounds for salmon.



Nitrate Concentration

Importance of the Indicator

Nitrogen is a naturally occurring nutrient that stimulates the growth and development of plants. Nitrates are the most common form of nitrogen in aquatic environments. Nitrates in unnaturally high concentrations can stimulate excessive growth of aquatic plants and algal blooms. When algae and plants decompose, the process uses up large amount of dissolved oxygen. This process is called eutrophication. Low dissolved oxygen levels can be detrimental for anadromous fish populations. Nitrate pollution typically comes from leaking septic tanks, fertilizers, agricultural wastes and pet wastes.



Monitoring Technique

Volunteers used the CHEMets testing kit to determine nitrate concentrations. The kit supplies pre-measured ampoules, which when mixed with the water sample, produce a specific shade of pink. The sample's color is compared with a color chart to determine the nitrate concentration measured in parts per million (ppm).

Story Behind the Stats

Low nitrate levels were found at most of the sampling sites. Eyak River and Kenny Lake had the highest nitrate concentrations of sampled waters. These concentrations on Eyak River could be from large concentrations of trumpeter swans that winter in the open water. Both Kenny Lake and Eyak River do have residential development in the vicinity and there could be nitrate pollution stemming from septic systems.

Phosphate Concentration

Importance of the Indicator

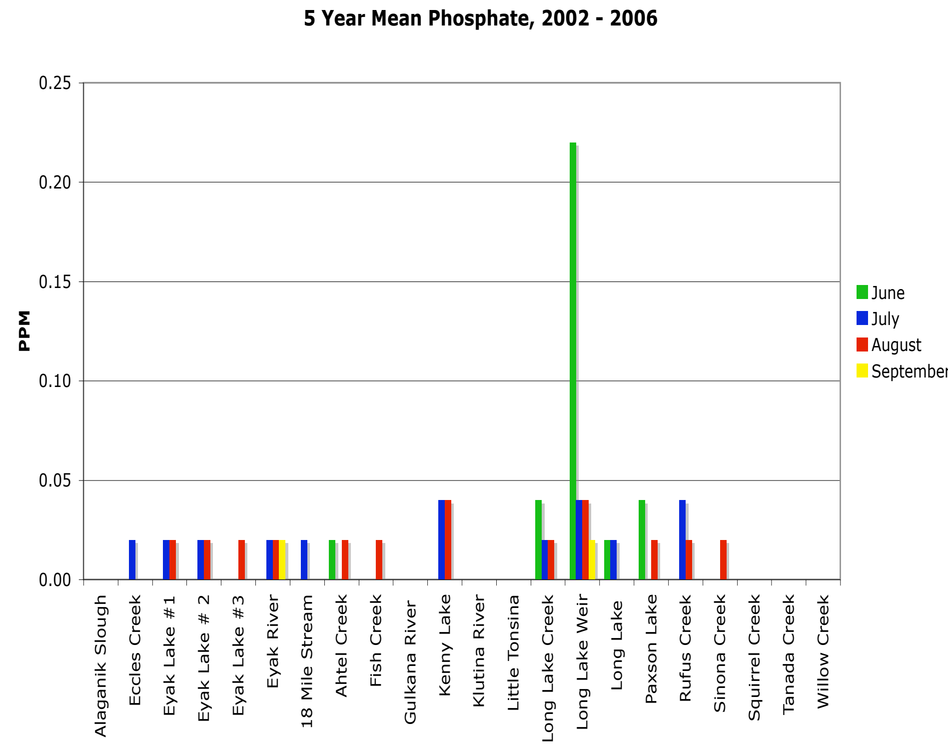
Phosphorus is an essential naturally occurring nutrient for plant and animal life. Phosphorus has no negative impact to the aquatic community in its elemental state, but when phosphates are found in excess eutrophication or nutrient pollution occurs. Eutrophication occurs when algae "blooms" or grows exponentially as a result of an addition of new nutrients to the water body. The rapid algae growth needs more oxygen and continues to reduce dissolved oxygen levels as the algae dies and decays. Less light is available for aquatic plants when algal blooms occur and plant death and decomposition further rob the water body of dissolved oxygen. This ultimately creates an environment in which fish cannot survive. While the water bodies of the Copper Basin and Copper River Delta are not in danger of eutrophication, phosphates are a typical and important water quality indicator studied.

Monitoring Technique

Volunteers used the CHEMets testing kit to determine phosphate concentrations. The kit supplies pre-measured ampoules which, when mixed with the water sample, produce a specific shade of blue. The sample's color is then compared with a color chart to determine the phosphate concentration measured in parts per million (ppm).

Story Behind the Stats

Long Lake exhibited the highest concentration of phosphates in the FishWatch five-year study. Long Lake's high levels of phosphate may be linked to the large returns of sockeye salmon that the lake experiences. The decomposing fish create a huge flux of nutrients to the system. The waters demonstrating low levels of phosphates probably exhibit natural releases of phosphate from seasonal turnover of lakes or the general mineral composition of the area. The level of phosphates are not alarming or detrimental to fish populations. FishWatch studied this indicator to determine whether phosphates were reducing oxygen levels within anadromous water due to eutrophication and to gather baseline data on phosphate presence.



Bio Assessment Data

Benthic Macroinvertebrate Survey

Importance of the Indicator

Aquatic insects need clean and healthy waters for survival. Their presence or absence from a water body serves as an excellent indicator of water quality. Aquatic insects can be used as tools to determine whether a water body is polluted because of their sensitivity to dissolved oxygen levels and turbidity. Aquatic insects are an important food source for juvenile salmon, and their presence indicates high quality rearing habitat.

Monitoring Technique

Volunteers were trained according to EPA Rapid Bio-assessment Protocols using a 300-micron D-frame dip net to collect five samples at each site. Macroinvertebrates were collected and placed into sorting trays to be identified using a field guide. The macroinvertebrates were then returned to the stream.

Story Behind the Stats

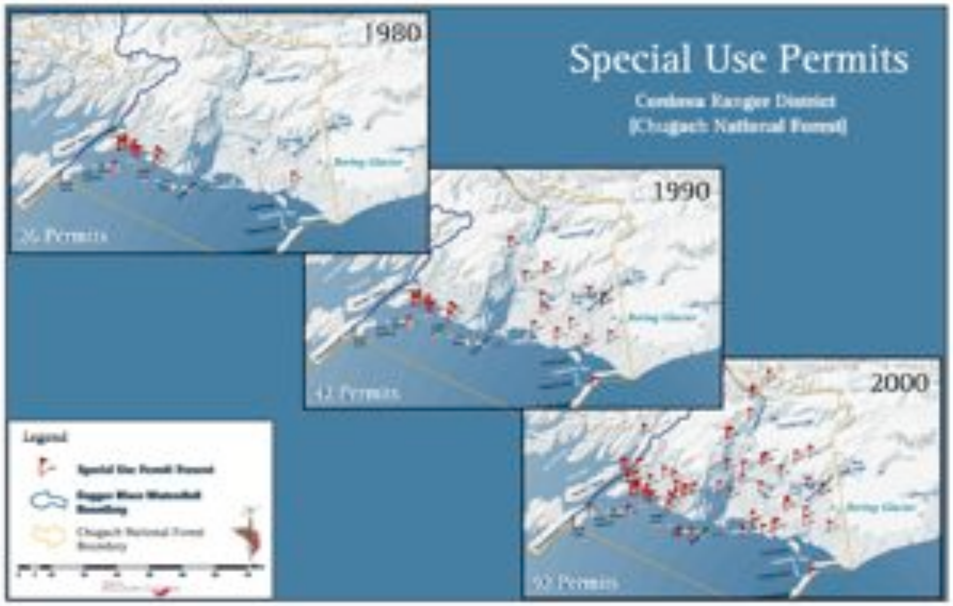
Aquatic mites, snails, and worms were most prevalent in the FishWatch sampling. These species are suited towards a wide range of habitats. Caddisflies, stoneflies, and mayflies require clear, cold, and highly oxygenated water. They are typically used as indicator species of stream health. Their presence usually indicates good water quality. The research done on macroinvertebrate populations in the Copper River watershed provides good baseline data. If an absence of these species is found in future studies, it may be an indicator that water quality has deteriorated.

FishWatch volunteers Mark Vail of McCarthy, Trae Lohse of Long Lake, Becky Clausen, CRWP, and others look for macroinvertebrates collected with a kick net (2003).

Human Use Data

When the Copper River Watershed Project's FishWatch Planning Team met in 2001 to design a fish habitat monitoring project for one of Alaska's most productive watersheds, they knew that underwater data were not the only important indicator. The study design must also monitor what's happening on top of the water. So the resource managers and local residents who created FishWatch supplemented the goals of collecting chemical, physical, and biological data with another important goal: monitoring levels of human use. In this way they hoped to detect early signs of salmon habitat degradation caused by concentrated boating and fishing in certain areas.

Although remarks like "There sure are a lot more people fishing in my favorite streams these days" had been heard around the watershed for years, there was no hard data to back up the perception of increased human use. The FishWatch Planning Team wanted to collect baseline data on human use to serve as a benchmark against which to monitor changes for years to come.



Special Use Permits (for commercial operators) issued by the Chugach National Forest for the Copper River delta, 1980 - 2000.

Our volunteer pool consisted of approximately 15 people who already had a job, task, or hobby that required them to frequently be on a river segment that was part of our study. Our recruits included two campground hosts, a U.S. Geological Survey gaging station technician, two rafting guides, a fishing guide, and a sportfish charter boat operator. Most everyone we approached readily agreed to fill out a simple form asking for their daily observations on number of boats, type of boat, whether boats were motorized or nonmotorized, and number of fisheres. Many offered encouraging comments like "Someone needs to keep track of how many new people are coming here each year."

In Cordova, we formed a rotating pool of volunteers that would take turns driving a certain stretch on the Copper River Highway during peak use weekends and recording the number of vehicles parked at popular fishing holes. . . [w]e gained valuable information on human use at peak time periods (i.e., during waking hours, especially on the weekends) and were able to detect general trends over time.

State and federal agencies have incorporated aspects of our data into their own human use studies. For example, Chugach National Forest aerial flight patterns are correlated with where the CRWP has recorded peak vehicle use throughout the silver salmon season. We have agreements with the Bureau of Land Management, the U.S. Forest Service, and Alaska Department of Fish and Game to exchange human use data, and we compile data from all these sources into comprehensive reports of human use in our region.

Our program has used the human use data to prioritize subwatersheds for more concentrated and focused human use surveys as well as for possible restoration or remediation efforts.

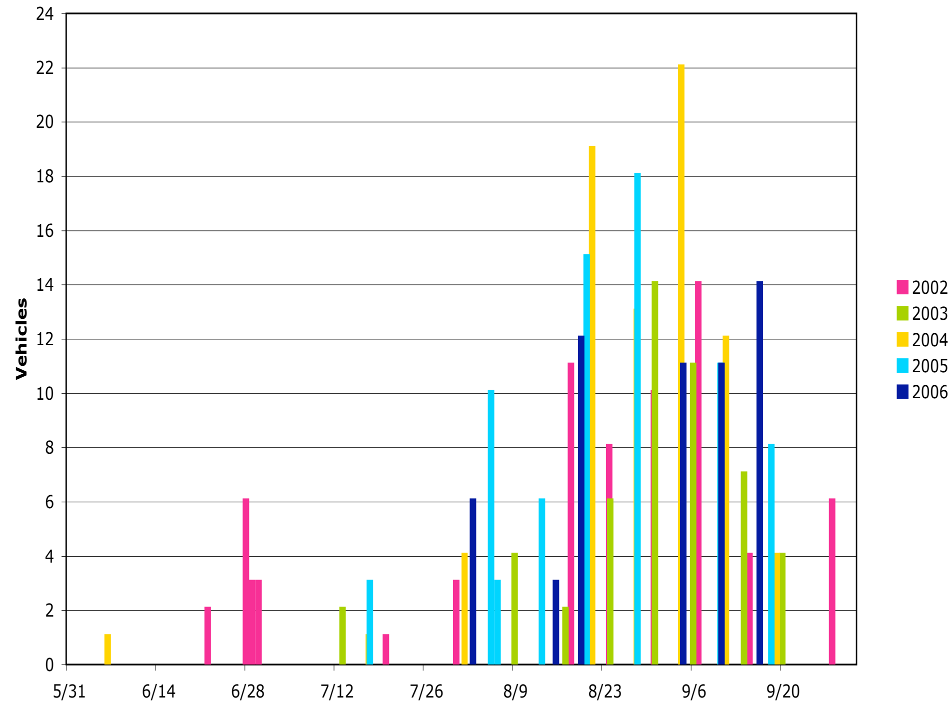
Excerpted from *"Monitoring Human Use in a Remote Alaskan Watershed,"* by Becky Clausen, CRWP FishWatch Coordinator, in The Volunteer Monitor, Vol. 18, No. 2, Fall 2006.

Human Use Data
Copper River Delta

The Copper River Delta human use data were collected to establish a baseline for recreational use. The increasing popularity of sport fishing for coho salmon was also motivation to determine current levels of use and to monitor increases in usage. The U.S. Forest Service Cordova Ranger District collected data on sport fishing on the Copper River delta from 2002 - 2006. This has given FishWatch comparative data on the human use findings. FishWatch data confirms that peak use is during coho salmon sport fishing season and that use is increasing.

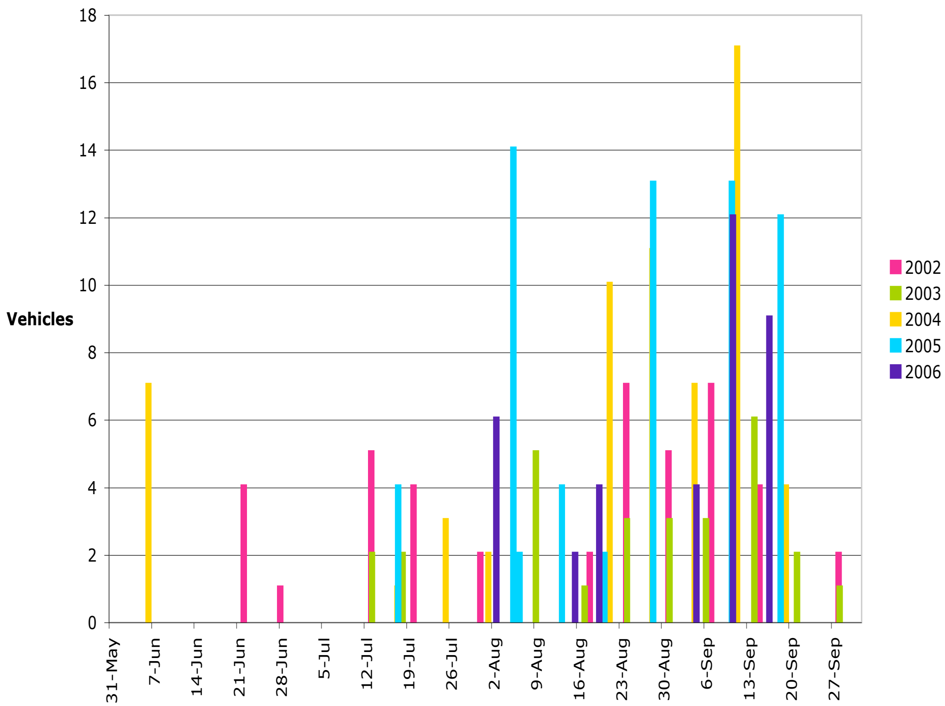
Copper River Delta. Photo by Pat and Rosemarie Keough, 1995.

Eyak River

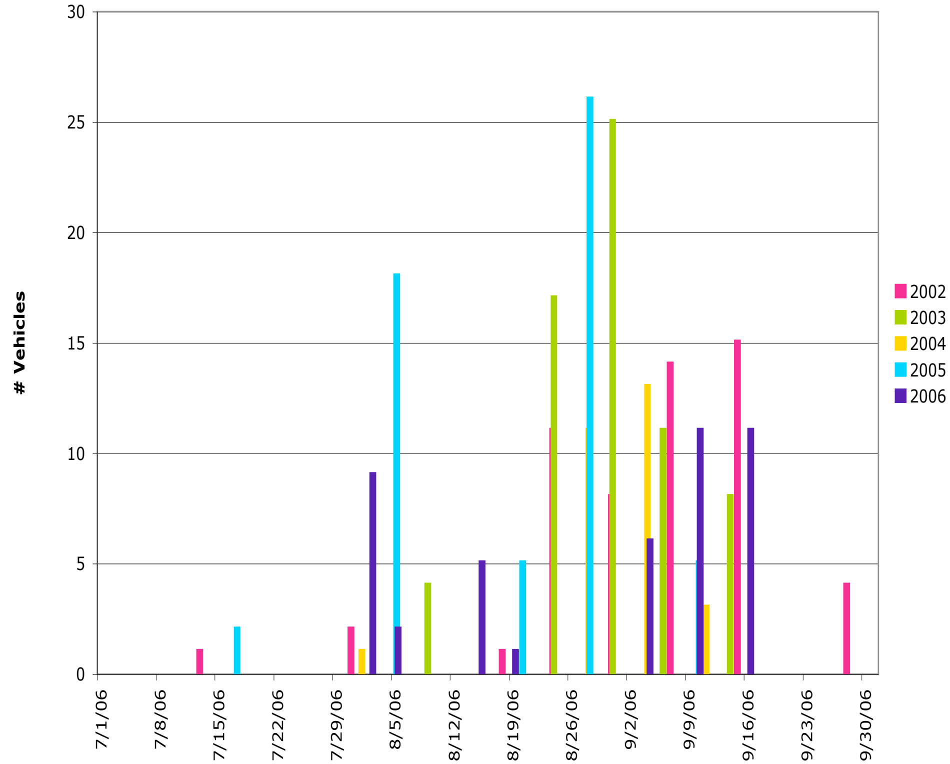


Eyak River is the migration corridor for sockeye and coho salmon into Eyak Lake and its tributaries. Eyak Lake has been dubbed Cordova's "Million Dollar Lake" for the value of its salmon returns: ADF&G estimates that between $ .9 and $1.5 million are generated *annually* in ex-vessel seafood sales by the lake's sockeye and coho salmon (ADF&G Annual Finfish Management Reports, 1994 - 2003). The U.S. Forest Service operates a recreation site and boat launch that provides access for sport fishermen. Eyak River has become increasingly popular for sport fishermen and guiding outfits during the coho salmon run.

Alaganik Slough



Ibeck Creek



Alaganik Slough is a major migration route for Copper River delta sockeye and coho salmon returning to McKinley Lake. Two recreation sites on the slough, each with a boat launch, are managed by the U.S. Forest Service to provide access for sport fishermen to launch boats and for fishing on shore. Highest visitation coincides with the coho salmon run.

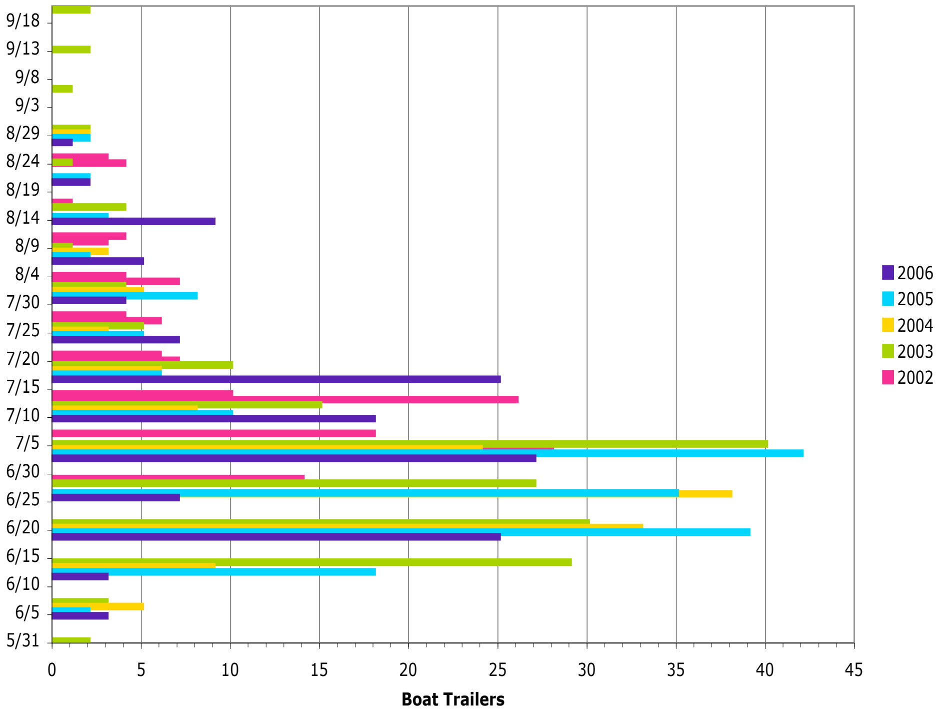
FishWatch data demonstrate the popularity of sport fishing for coho salmon in early fall on Ibeck Creek. Ibeck Creek is one of the increasingly popular sites for sport fishing on the Copper River Delta. No parking or fishing facilities exist at this site. Fishermen park within the DOT right of way on the Copper River Highway or on the dike road.

Gulkana River

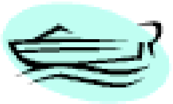
The Gulkana River is a popular recreational area and provides critical spawning and rearing habitat for chinook and sockeye salmon. The Gulkana is the leading salmon tributary to the Copper River. The Sourdough Campground and Richardson Highway crossing were sites chosen for human use observations. Data showed that peak use occurred around the Fourth of July weekend. High visitor use in June coincides with the Chinook salmon run. FishWatch wanted to record baseline data of visitor users on the Gulkana River. FishWatch was also interested in monitoring increasing human use and impact on the Gulkana River.

Rafting the Gulkana River is a popular form of recreation. The Trans- Alaska Pipeline crosses the Gulkana River. Photo courtesy of BLM.

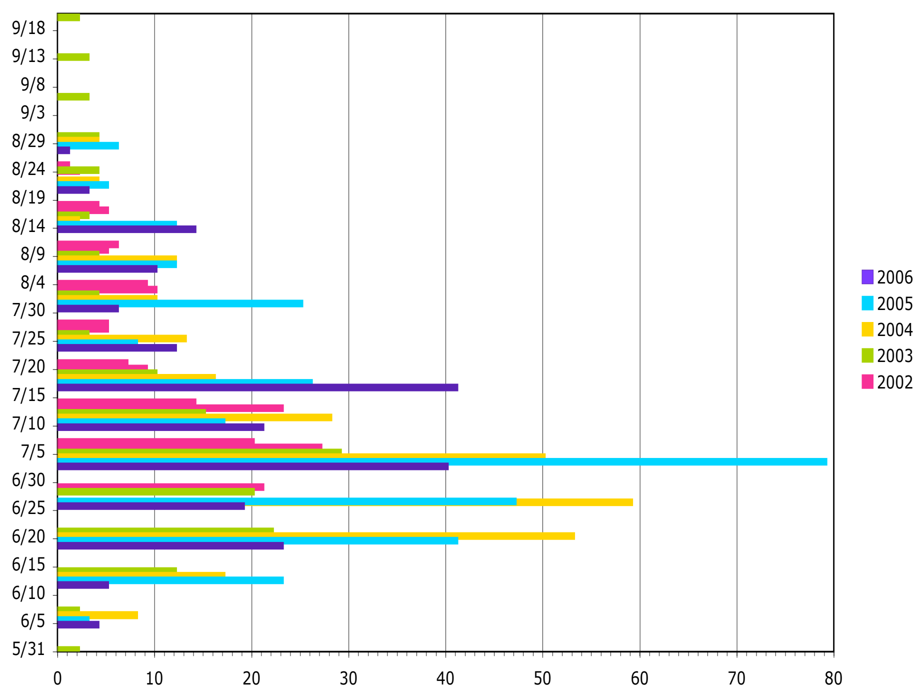
Boat Trailers, Sourdough Campground



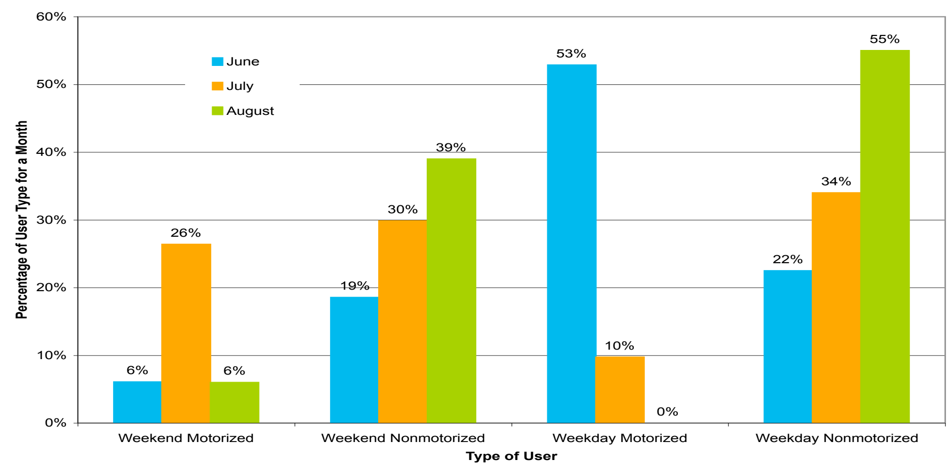
The heaviest use on the Gulkana coincides with the height of the king salmon run in mid June to the middle of July. Recreation and fishing activity peaks consistently on the July 4th weekend each year.



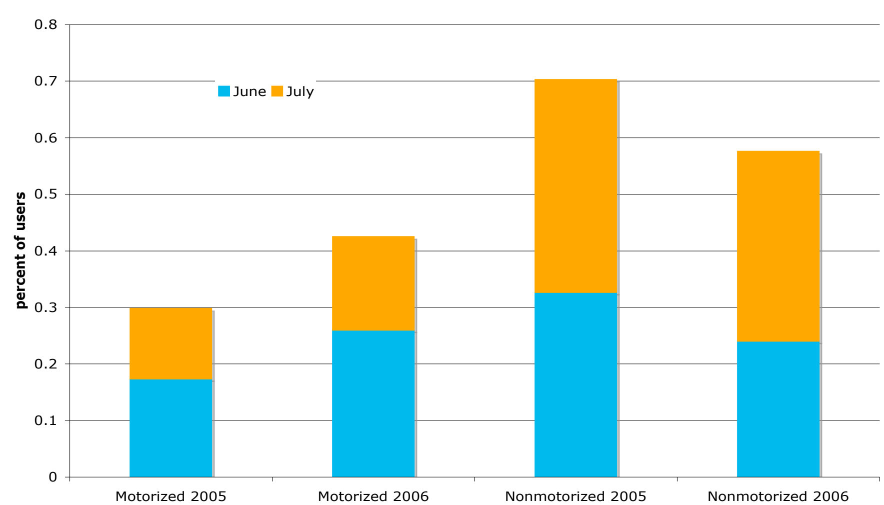
Vehicle Observations, Sourdough Campground



Gulkana 2006 - Weekend vs. Weekday User Type



2005 and 2006 Comparison of Motorized and Nonmotorized Use



The Bureau of Land Management collects watercraft and user data from a fish counting tower on the Gulkana River in the Scenic and Wild River Corridor. The 2006 observations are shown above.

Hydrocarbon Sampling

FishWatch was interested in determining the presence of hydrocarbons in **Eyak Lake, Eyak River, and the Gulkana River**. These sites were of interest because of increasing human use from sport fishing and their importance for salmon. Samples were collected so that a baseline of hydrocarbon pollutants could be recorded. Eyak Lake and Eyak River were selected because of their importance to spawning sockeye and coho salmon. The Gulkana River was chosen for its importance to salmon and because the river is the source of drinking water for the Gulkana Village.

Hydrocarbon pollutants are especially dangerous to developing juvenile salmon and incubating eggs. These sites were chosen because of their important rearing and spawning habitat for Copper River watershed salmon. The hydrocarbons pollutants that were sampled for were benzene, toluene, ethylbenzene, and xylene (BTEX) and polycyclic aromatic hydrocarbons (PAHs). This group of volatile organic compounds (VOCs) is found in petroleum hydrocarbons, such as gasoline, and other common environmental contaminants. VOCs have low water solubility, which allow them to be detected through monitoring efforts.

CRWP started the monitoring using the grab sample method. A grab sample is a method of sampling that requires taking a sample of water from the water column. It is a “snap shot” of any pollutants that may be present in the water body. Grab samples are easy to collect however they may miss hydrocarbon pollutants depending on the time of day, user activity, volume of water, etc.

The other sampling method was a passive sampler, which recorded the presence or absence of PAHs (polycyclic aromatic hydrocarbons). A polyethylene membrane devices (PEMDs) was the device used. A “puck” was submerged in the water in various sampling spots on Eyak Lake and Eyak River. The samplers have a metal housing the size of a hockey puck and contain an internal ribbon of a material that absorbs traces of hydrocarbons, mimicking teh bio-accumulation process of aquatic organisms. The PAH puck records data on a polyethylene strip. Any present PAH hydrocarbons and their concentrations within the water column in the 30-day sampling period are recorded. The pucks were sent to the Auke Bay Lab in Juneau Alaska to be analyzed after the 30-day monitoring period.

Grab sampling was done in 2004 and 2005 for the sites on Eyak Lake, Eyak River, and the Gulkana River during peak human use time for sport fishing. Grab sampling was also done in 2006 on the Gulkana River in a collaborative effort with the Gulkana Village Council. The grab samples were sent to Analytica Labs to be analyzed. Xlylene and other hydrocarbons were detected in the Gulkana River in July, 2006 and June, 2007, though not in levels that exceed State water quality standards.

The PAH passive samples were taken in fall, 2005 and spring, 2006 in Eyak Lake. Three 30-day periods of sampling were conducted in five locations around Eyak Lake. The results from the Auke Bay laboratory found that the sampling sites near Nirvana Park (storm drain discharge site) and the former site of the Cordova Electric Co-Operative diesel generated power plant exhibited detectable levels of polycyclic aromatic hydrocarbons (PAHs). The highest concentrations were found in the fall sampling period when the largest amount of rainfall occurs. The hydrocarbons detected appeared to be a result of uncombusted fuels and spills, and from street runoff. The other grab samples and passive samplers did not detect the presence of hydrocarbons.

With FY 2008 DEC funding, the CRWP will be conducting a public education campaign on the harmful effects of storm water and what measures can be taken to mitigate storm water pollution in fish-bearing waters.

Hydrocarbon Pollutant Sources

Aerial view of spilled fuel oil entering Eyak River after severe flood in October 2006.

Street water run-off and sediments enter Eyak Lake through unfiltered culverts and from heavy precipitation events carrying gravel used in winter for road traction. Uncombusted fuel, leaking fluids from vehicles, and spills account for detectable levels of PAHs in Eyak Lake. This culvert site near Nirvana Park, Cordova, AK was also used as a snow dump during the 2006 - 2007 winter (photo taken in March, 2007).

Alaska Clean Water Actions (ACWA) Nomination

The Alaska Department of Environmental Conservation (DEC) accepts nominations for impaired water bodies annually. This process allows water bodies with impaired water quality to receive project money to allow for restoration and cleanup efforts.

Based on our volunteers' work and our working understanding of the area, CRWP nominated Eyak River, the Gulkana River, and the Klutina River to Alaska DEC in this process to better understand the impacts human use is having on these rivers and to allow for stewardship and further habitat actions. Waterbodies judged to be impaired or in need of protection may become eligible for funding through the Alaska Department of Environmental Conservation's Non-point Source Pollution grant program.

Eyak Lake and Eyak River

Eyak Lake and Eyak River were nominated for the ACWA ranking by CRWP because of increasing human use and impact on the river.

The Eyak system is an extremely productive salmon fishery. CRWP has dubbed Eyak Lake "Cordova's Million Dollar Lake". Alaska Department of Fish and game estimated that Eyak Lake and Eyak River produce over 1 million dollars in ex-vessel sales for the local salmon fishery. Eyak River is a major travel corridor for spawning sockeye and coho not only into Eyak Lake but other river systems on the Copper River Delta.

Eyak Lake is also a backup water supply for the City of Cordova. Residents of the six-mile subdivision rely on pure groundwater from a pristine water table for drinking water.

CRWP is concerned with the future impact of sport fishing during the coho salmon run. One of the main concerns is the increasing level of hydrocarbons in the water due to motorized use, primarily from jet boats. With the aftermath of the fall 2006 flooding CRWP is also concerned with proper fuel storage and containment.

Collecting water quality data on Eyak River

Gulkana River

The Gulkana River is a keystone in the Copper River salmon fishery. Its run of sockeye and king salmon are vital for a healthy commercial fishery and for subsistence and sport fishing. These runs of salmon are also critical to the other wildlife in the region.

CRWP is concerned with increasing human use and impact on the river and salmon stocks. Currently recreational use and sport fishing has been monitored however no limitations have been imposed to date. Fishing from shore and camping along the river has also impacted shoreline habitat and riparian zones.

Threats to the Gulkana River range from a potential breach in the Trans-Alaska Pipeline System (TAPS) to increasing sport fishing pressure on fish stocks.

The Gulkana River borders Gulkana Village and flows through much land owned by the Village. The residents of Gulkana Village use the Gulkana River for both domestic and subsistence purposes. Gulkana Village withdraws for domestic use an average of 6,400 gallons of water per day from a shallow, fifteen foot well directly influenced by the Gulkana River. This river also attracts significant usage from surrounding communities and tourists. These visitors use the river for sport fishing, long-term camping, and boating activities. Fish are cleaned at teh river and the carcasses are lfet on teh riverbanks and in the water. Numerous types of boats are launched in teh area including jet boats, airboats, and other watercraft. RVs, pickups, cars, and ATVs are driven and parked on the river banks. The heaviest usage area is directly upriver of the Village, a distance of approximately 200 yards. Residents of the village are concerned that the heavy usage of the river contaminates their primary water supply and decreases fish populations necessary for subsistence.

Excerpt frm "Water Resources Management Planning and Development," Gulkana Village Council, 2004.

Klutina River

The Klutina is a major spawning and rearing water body for salmon. It is a critical river supporting the Copper River commercial fishery and supports local subsistence and sport fishing. The Klutina has immense value as a fishery for commercial, subsistence, and recreational uses of salmon. It also has intrinsic value for its wilderness character.

The TAPS crosses the Klutina River as well. TAPS is buried where it crosses the Klutina River, though the crossing is only 1.5 miles upstream of the confluence with the Copper River. Response and containment options will be limited in this fast-flowing, cold river, especially if a spill event occurs in winter weather.

Sport fishing on the Klutina River. Photo by Mark Henspeter.

Part II.
A Habitat Conditions Index for the Copper River Watershed

With a system for collecting water quality and human use data in place, the FishWatch Planning Team began to think about the next step: how could the stakeholders better understand the quality of habitat conditions in the region? Because no systematic approach yet exists for assessing the watershed's salmon habitat conditions, we began to wrestle with creating one.

Advisors suggested starting with a tier approach to sorting out the watershed's sub-basins. With help from Ecotrust's GIS department, we created the map on page 27 showing the region's sub-basins. By listing all the threats and challenges that FishWatch Planning Team members were concerned about and identifying which challenges were present in which sub-basins, we were able to more clearly prioritize our habitat concerns. The matrix of habitat concerns (created in 2004, shown at right) became our guide, and the Gulkana River drainage our next area of focus. At the fall, 2005 FishWatch Planning Team meetings, participants focused on the first steps of initiating a comprehensive habitat assessment. Stillwater Sciences, Watershed and Riverine Sciences, was invited to give a presentation on potential modelling techniques that could be used to identify where fish habitat indicators are most threatened by future human use.

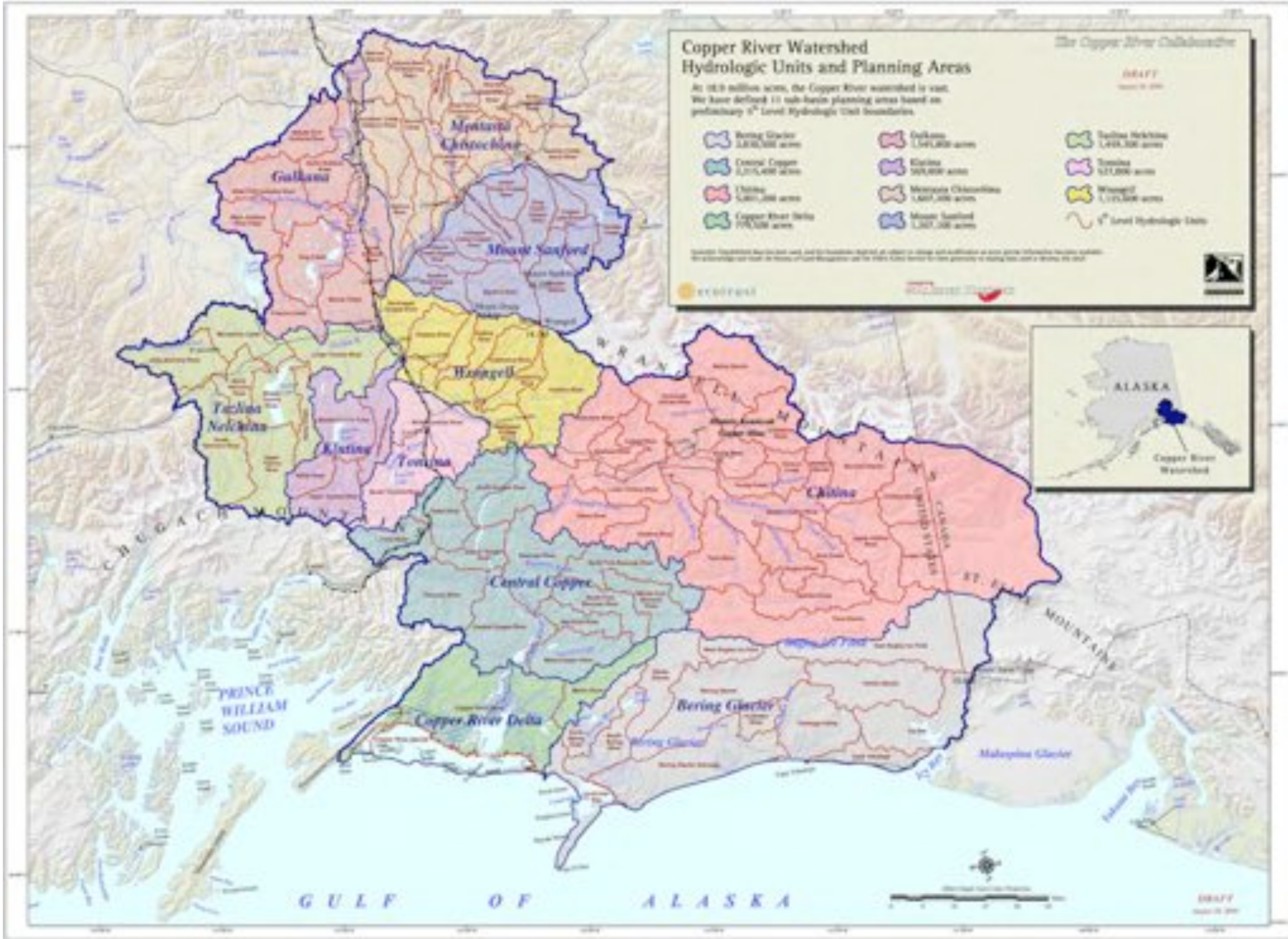
More recently, other publications have also pointed to the Gulkana River as facing heavy human use pressure. Changes to the Burean of Land Mangement's Gulkana National Wild River Management Plan (August, 2006) reflect rapidly increasing recreation use along the river. A survey of federal and state agencies by the Institute for Social and Economic Research concluded that within the Copper River watershed, salmon habitat in the Gulkana River drainage is the "most threatened" (ISER/UAA, Feb. 2007).

Fish Habitat Concerns Prioritized by Sub-Basin*

Sub-basins	(1.) Trails near streams	(2.) Trans-Alaska Pipeline	(3.) Land development	(4.) Hardened stream sites	(5.) Mineral development	(6.) Highway (re)construction	(7.) Industrial dump sites	(8.) Failed culverts	(9.) Forestry Sales	(10.) Snow machines/fuel spill
Gulkana	✖	✖	✖	✖	✖	✖		✖		✖
Tazlina/Nelchina	✖	✖	✖		✖	✖	✖	✖	✖	
Klutina	✖	✖		✖				✖	✖	
Central Copper		✖	✖		✖			?		
Chitina			✖	✖		✖	✖	✖		✖
Mentasta/ Chistochina	✖				✖	✖	✖	✖		✖
Tonsina (same impacts as Central Copper but diluted)										
Wrangell								✖		
Mt. Sanford										

Sub-basins	(1.) Overuse of spawning populations	(2.) Increased human use - fast ferry	(3.) ATV use	(4.) Oil development	(5.) Residential development	(6.) Motorized use on Eyak	(7.) Timber harvest	(8.) Foot traffic	(9.) Easements
Copper River Delta	✖	✖	✖		✖	✖	✖	✖	✖
Bering Glacier				✖					

* Fish habitat concerns were summarized from FishWatch Planning Team meetings held in Spring 2004. FishWatch Planning Team members then ranked each concern from 1 (highest concern) to 10 (lowest concern).


Copper River Watershed
Hydrologic Units and Planning Areas
Gulkana
Mentasta Chistochina
Mount Sanford
Wrangell
Tazlina Nelchina
Klutina
Tonsina
Chitina
Central Copper
Copper River Delta
Bering Glacier
PRINCE WILLIAM SOUND
GULF OF ALASKA
ALASKA
CHUGACH MOUNTAINS
WRANGELL MOUNTAINS
ST. ELIAS MOUNTAINS
Malaspina Glacier

Modeling Salmon Habitat

The Copper River watershed FishWatch Planning Team is confronting the same issue as the Alaska Department of Fish & Game on the state level. How can researchers trying to understand salmon habitat distribution and characteristics cover Alaska's vast stream channel networks in a cost effective manner? Alaska's fisheries are carefully managed for harvest and allocation, but comprehensive evaluation of the status and trends of habitat conditions are lacking for the State's major river systems. An April, 2006 workshop organized by The Nature Conservancy focused on this critical issue: "The threat of increased development coupled with the constraints of difficult logistics and the limited knowledge on the distribution of salmon habitat have heightened the need to predict the distribution of salmon in Alaska's unsurveyed freshwaters in a timely and efficient method" (Baker, *Workshop on Predicting Salmon Habitat in Alaska*, June 2007).

With assistance from The Charlotte Martin Foundation, the CRWP was able to contract with Stillwater Sciences for field work in September, 2006. ADF&G Fishery Biologist Steve Moffitt recommended that they start with looking at the Tonsina River drainage, for two reasons: the sub-basin is relatively undisturbed and can thus serve as a referenece for other areas, and the river hosts three species of salmon, chinook, sockeye, and cohos. Stillwater Sciences staff spent ten days in the field collecting hydrologic, fish distribution, and channel morphology data, then returned to their office to run these data through their model parameters. A summary of their approach follows, along with two resulting figures from their final report. The close match in figure A9 of ADF&G radio telemetry data with Stillwater's predicted Chinook spawning stream reaches illustrates that such a model "can efficiently predict geomorphic and biological constraints on the distribution of suitable spawning and rearing habitat, and provide rapid guidance for where focused investigations or monitoring of key habitats should occur." (Stillwater Sciences, March 2007).

Copper River Watershed Salmon Habitat Monitoring Plan Development:

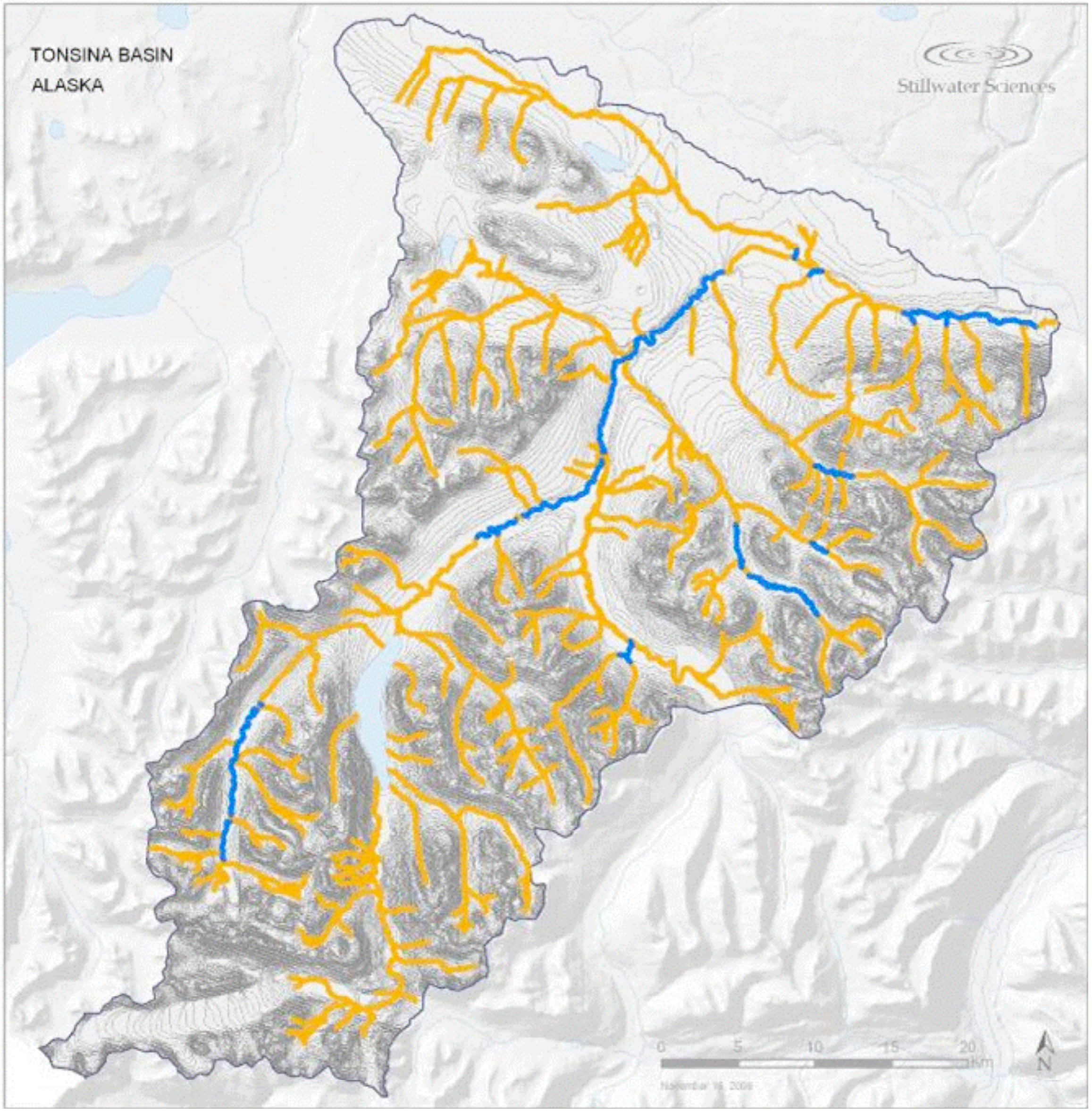
Results from Tonsina River Basin Field Reconnaissance

Project Background. The long term goal of this habitat assessment is to develop a monitoring plan to detect and characterize future risks to the health of salmon populations in the Copper River watershed, primarily as a result of land-use or climate changes. Due to the large size of the Copper River watershed (66,360 square km [26,500 mi2]), a simple census of all streams accessible to anadromous salmonids is not practical. Nor would this approach be desirable, because it would not provide the analytical tools or framework to predict future conditions across the watershed. However, with a comprehensive understanding of habitat conditions, habitat-forming processes, and salmon use, the consequences of impending changes on the spatial distribution and productivity of salmon can be anticipated.

The immediate goal of the Tonsina River reconnaissance was to apply a variety of tools that can rapidly characterize the nature and spatial extent of salmonid habitats within the basin. Those tools included analyses of remote sensing information, predicitve inferences about channel characteristics, and field visits to corroborate inferences and calibrate models with directly sampled fish and channel data.

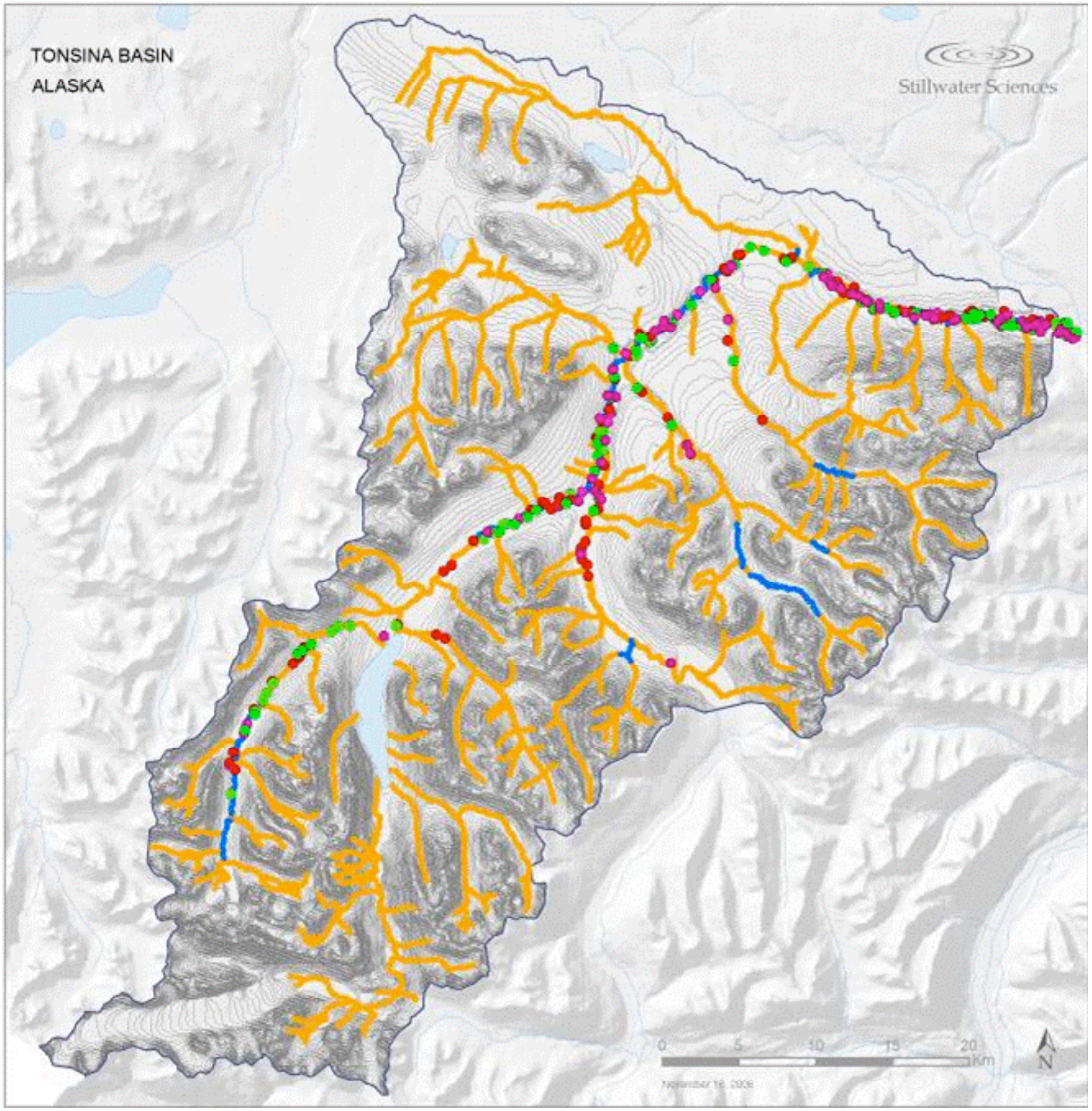
Our specific objectives in this study were to: (1.) develop a geologic overview of channel patterns, channel morphology, and local channel conditions in the Tonsina River basin; and (2.) collect data that would help develop conceptual models of factors that control the abundances of different salmon species (e.g., exploring the potential limits of habitat suitability for particular life stages). These objectives were specific to the Tonsina River basin, but they demonstrate that our field- and GIS-based approach of identifying suitable spawning and rearing reaches, using Chinook salmon as a model species, should be applicable across the entire Copper River watershed.

Stillwater Sciences, March, 2007



Final distribution of inferred Chinook spawning habitat (blue). These reaches, located in upper Greyling Creek, portions of the Tonsina River below Tonsina Lake, and reaches within Dust Creek, Bernard Creek, and Little Tonsina River, represent approximately seven percent of the entire channel network.

Figure excerpt from *Copper River Watershed Salmon Habitat Monitoring Plan Development: Results from Tonsina River Basin Field Reconnaissance* by Stillwater Sciences, March 2007.



Distribution of last-recorded location of 300 adult Chinook salmon, radio tagged over a five-year period (data from Saveriede 2005).

Figure excerpt from *Copper River Watershed Salmon Habitat Monitoring Plan Development: Results from Tonsina River Basin Field Reconnaissance* by Stillwater Sciences, March 2007.

APPENDIX I

Copper River Fish Habitat Review

An Index of Historical Fish Habitat Data in the Copper River Watershed; October, 2002

Summary

In fall 2001, the Copper River Watershed Project embarked on a planning process to develop a volunteer-based, fish habitat monitoring project for the Copper River drainage. To begin this endeavor, the Copper River Watershed Project conducted a literature search to identify previous fish habitat data collected in our region. We found that much of the historical data was irretrievable or long discontinued, and what data was accessible was scattered. The Copper River Watershed Project realized the need for a well-organized compilation of the historical data in this drainage to be used by agencies, landowners, community organizations, and tribal councils. We have addressed this need by indexing the fish habitat data we gathered, including water quality, geomorphology, and biologic distribution studies, that were published by agencies and independent researchers.

In general, the historical studies focus primarily on fish distribution throughout the watershed. This is most likely due to the importance of salmon escapements to the commercial and subsistence fisheries in this region. Water quality data is available for the Copper River Delta, however there are significant data gaps for streams and tributaries in the upper watershed. Macroinvertebrate data is perhaps the least prevalent, and we hope to supplement this knowledge with our volunteers' bioassessment data. We also hope to bolster the data on human use trends at popular fishing and recreating areas in the watershed.

Note: several studies of salmon run timing and distribution on Copper River tributaries were conducted by Ken Roberson, ADF&G Fisheries Biologist, between 19XX - 19XX and are believed to be located in the ADF&G archives. We have been unable to locate them to date.

Anadromous Fish Distribution

Alaska Department of Fish and Game. 1990. An atlas to the catalog of waters important for the spawning, rearing, or migration of anadromous fish. Southcentral Region, Resource Management, Region II.
This comprehensive report documents which species of anadromous fish are found in streams and lakes of the Copper River watershed. It also visually depicts which stream reaches are used for anadromous migration, spawning, and rearing. The report is continually being updated. The public can access the atlas at ADF&G offices in Cordova and Glennallen.

Alaska Department of Fish and Game. 1992, Fish habitat survey of proposed Copper River Highway Corridors. Southcentral Region, Habitat and Restoration Division, Region II.
In this report, ADF&G habitat biologists conducted field surveys to document and map fish bearing waters along previously unsurveyed portions of the three proposed Copper River Highway routes. Surveys were conducted on the Copper River (Million Dollar Bridge to Tiekel River), the Tasnuna River drainage, and the Tiekel River drainage in the summer of 1992.

Cliff Collins. 2001. Long Lake weir count from 1974 through 2001.
Cliff Collins, a long time resident of Long Lake, has maintained a weir every summer since 1974, documenting the number of sockeye salmon returning to this productive lake every year. Mr. Collins' data can be obtained from ADF&G's Cordova office.

United States Forest Service. 1991. The Copper River Delta Pulse Study: An Interdisciplinary Survey of the Aquatic Habitats. Pacific Northwest

Research Station, General Technical Report PNW-GTR-282.
One chapter of this interdisciplinary report includes a section titled "Anadromous Fish Habitat: Distribution of Juvenile Salmonids". A scientific team sampled juvenile salmonid populations in all major habitat types of the Copper River Delta using fyke nets, minnow traps, and snorkel counts. Their results are found on page 30-33 of this report.

Aquatic Macroinvertebrate Distribution

United States Forest Service. 1991. The Copper River Delta Pulse Study: An Interdisciplinary Survey of the Aquatic Habitats. Pacific Northwest Research Station, General Technical Report PNW-GTR-282.
Limited data exists regarding the type and distribution of aquatic macroinvertebrates in the Copper River watershed. In this interdisciplinary report, a scientific team collected sixteen benthic samples from representative aquatic habitats throughout the Copper River Delta to obtain a qualitative sample of the taxa in each habitat. Crustacea and Chironomidea were the most abundant, with their specific findings located on pages 26-29 of this report.

Water Quality

Alaska Department of Environmental Conservation. 1992. Eyak Lake Water Quality Monitoring: A report of field work conducted from July 1991 through May 1992. Monitoring and Laboratory Operations.
ADEC conducted this study to determine whether Eyak Lake's water quality is impaired as stated in the Alaska Water Quality Assessment 1990, the Clean Water Act 305(b) report to EPA. ADEC tested 7 sites on Eyak Lake for pH, temperature, dissolved oxygen, conductivity, alkalinity, total residual chlorine, hardness, fecal coliform, PCB analysis, volatile organic compounds, metals, nitrates, and dissolved and suspended solids. Their initial conclusion stated the lake was impaired by lead contamination, however the validity of the testing method was later questioned.

Alaska Department of Environmental Conservation. 1992-1993. Alaska WaterWatch data collected on Eyak Lake.
Volunteers collected water quality data on Eyak Lake for two years under the ADEC's WaterWatch program specifications. The water was tested for temperature, pH, dissolved oxygen, conductivity, turbidity, and nitrates. Iris O'Brien, staff member of the Native Village of Eyak, has compiled results from volunteer data sheets.

Native Village of Eyak and HDR Contractors. 2001. Eyak Lake Waterbody Assessment. Final Report Draft.
The Native Village of Eyak contracted with HDR to perform water quality tests on Eyak Lake. Lab work was conducted to determine levels of hydrocarbons, heavy metals, and coliform.

Alaska Department of Natural Resources. 1992. Copper River Highway Environmental Impact Studies: Water Quality of Surface Waters. Division of Water, Alaska Hydrologic Survey.
The Alaska Division of Water collected water quality data in July, September, and October 1992 on the Uranatina River, Tiekel River, Cleave Creek, Tasnuna River, and Nels Miller Slough to provide information for the EIS on the proposed Copper River Highway. Waters were tested for metals, temperature, turbidity, pH, specific conductance, dissolved oxygen, and fecal coliform.

Gulkana Fish Hatchery. On-going. Zooplankton and water quality data for Crosswind Lake. Gary Martinek, Prince William Sound Aquaculture Corporation.
Crosswind Lake provides necessary spawning are rearing habitat for the Gulkana Hatchery's sockeye salmon. The Gulkana Hatchery conducts

monthly zooplankton toes in the lake to determine water quality standards. Gary Martinek manages the Gulkana Hatchery, and the data are available through him.

Gulkana Fish Hatchery. On-going. Daily water quality monitoring for Gulkana River. Gary Martinek, Prince William Sound Aquaculture Corporation.
Gulkana Hatchery staff to determine the water quality for juvenile sockeye salmon records daily readings of temperature, pH, and dissolved oxygen. These parameters are important indicators for the survival of the juvenile salmon raised in the hatchery, and can be obtained by contacting the Gulkana Hatchery.

United States Forest Service. 1991. The Copper River Delta Pulse Study: An Interdisciplinary Survey of the Aquatic Habitats. Pacific Northwest Research Station, General Technical Report PNW-GTR-282.
A comprehensive survey was made of the distribution and concentration of dissolved chemical constituents in aquatic habitats of the Copper River Delta in July 1987. The overall objective was to identify nutrients and associated inorganic and organic chemical conditions that influence or reflect the productivity of aquatic habitats in the delta. The details of this report are revealed on pages 14-23.

United States Geologic Survey. 1985. Water Resources of the Copper River Basin, Alaska. Emery, et al. USGS Hydrologic Investigations Atlas HA-686.
Water quality samples have been periodically collected in the region by the USGS from 1949 to the present. Data has been collected form two sites on the Copper River, the Tiekel River, two sites on the Tsina River, Stuart Creek, Boulder Creek, and O'Brien Creek. Parameters monitored include metals, dissolved oxygen, fecal coliform, turbidity, temperature and discharge. A summary of this data can be found in Appendix C of the Alaska Department of Natural Resources Copper River Highway EIS (1992).

Geomorphology

United States Forest Service. 1991. The Copper River Delta Pulse Study: An Interdisciplinary Survey of the Aquatic Habitats. Pacific Northwest Research Station, General Technical Report PNW-GTR-282.
The survey of the Copper River Delta includes (1) morphology and distribution of sloughs and ponds, (2) particle-size analysis of sediments in channels, and (3) morphology of channels. All three directly influence the distribution of wildlife and fish habitats across the delta. Detailed results are reported on pages 6-13.

United States Geologic Survey. 1997. Geomorphology of the Lower Copper River, Alaska. U.S. Geological Survey Professional Paper 1581.
With the goal of obtaining a better understanding of the alluvial system of the lower Copper River, the Alaska Department of Transportation and Public Facilities and the U. S. Geologic Survey entered into a cooperative water-resources agreement in April 1991. This report describes the geomorphology of the lower Copper River form the early 1900's to 1995. The scope of this report includes the following: (1) documentation of past geomorphic changes; (2) evaluation of the process or processes that caused these changes and (3) an assessment of the future changes.

Human Use

Gulkana River 1999 On-River User Survey. Bureau of Land Management, Glennallen Field Office.
The Bureau of Land Management contracted Three Rivers Research and the Colorado State University to determine the number of people using the Gulkana's Wild and Scenic area, as well as the type of users. Preliminary

FishWatch Water Quality and Human Use Monitoring Program
Contributing Funders

Alaska Fund for the Future, 2001, $ 7,000

Alaska Department of Environmental Conservation: 2001, $11,200; 2002, $15,000; 2004, $30,000; 2005, $33,292; 2006, $50,000

U.S. Fish & Wildlife Service Coastal Program, 2002, $14,000

The George and Jane Mifflin Memorial Fund, 2002, $10,000 and 2004, $5,000

The Titcomb Foundation, 2003, $5,000

Patagonia, 2005, $5,000 for habitat modeling efforts

Ecotrust, 2004, $6,000, and GIS cartography, 2002 - 2006

The Mountaineers Foundation, 2006, $3,000 for habitat modeling efforts

Norcross Wildlife Foundaton, $5,000 for Hydrolab monitoring probes (2004) and $2,700 for temperature loggers (2006)

The Charlotte Martin Foundation, $25,000 for habitat model development, 2006

The Copper River Watershed Project thanks these supporters who contributed their resources for the benefit of asking important questions about the conditions of salmon spawning, rearing and migratory habitat in the Copper River region. Without their support, we could not have held critical roundtable meetings that brought together the resource managers and residents with deep historic knowledge about fisheries and fish habitat. We were also able to purchase, and continue to enjoy the use of, monitoring equipment that collects data shared with all agencies in the watershed.