

AK LEGISLATURE SPECIAL COMMITTEE FILES SCOMM 147 3190

From: Larry Johnson [akgift@yahoo.com]
To: Monday, March 05, 2007 9:36 PM
Louie Flora
Subject: HB 134

Good Evening Louie,

I hope Paul is successful in getting the issues separated in this bill.
I think That the Pebble mine project should stand or fall based on it's own merits, taking into account the best interest of the entire State.

Thanks,
Larry Johnson
Seward

Need Mail bonding?

Go to the Yahoo! Mail Q&A for great tips from Yahoo! Answers users.
<http://answers.yahoo.com/dir/?link=list&sid=396546091>

From: Scott Adams [showmethethefish@yahoo.com]
Sent: Thursday, February 15, 2007 10:49 PM
To: Rep. Paul Seaton
Subject: Pebble Mine & Halibut Limit

Hello To All That Represent the People Of Alaska,

I think that passing of a bill and making a special refuge in order to stop the process towards deciding whether or not to open the area to mining, is wrong. This would be a blow to the economy of the stagger Kenai Peninsula and the State of Alaska. I would think that the state could down size the area to where it would be backed by both sides. Most of our fine state is tied up in Federal or State lands, Parks and the likes! And our economy is mostly driven by one resource, it's time to change that and develop more jobs and build more infrastructures.

The halibut limit of one fish by emergency order by AK. F&G for June 15-30 & no crew fish should be rescinded. This will have a major economic effect on the Kenai Peninsula with booking for charters being canceled, as with hotels, B&B's, spending towards restaurants, fishing gear shop, etc will be down. The real problem is the by catch of 14+ million lbs. caught and throw back over the side, mostly dead, by the dragging industry.

I've seen it 1st hand, of what they can do, I've fished for over twenty years and have been on the receiving end of the draggers, telling us to move or lose your gear. Only to come back to the fish the ground weeks later on the location the dragger's dragged, to find nothing there! Their the real problem and the ones to blame.

Scott Adams

Need a quick answer? Get one in minutes from people who know.
Ask your question on www.answers.yahoo.com

*City of Egegik
P.O. Box 189
Egegik, AK 99579
Phone (907) 233-2400
Fax (907) 233-2231*

Position Statement of the Egegik City Council Regarding HB 134 and SB 67

The Egegik City Council held a regularly scheduled meeting on February 15, 2007 and at that meeting the council members unanimously agreed to the following position statement.

Egegik, as well as our region, depends on the commercial harvest of salmon as a major portion of our economic base. The downturn in the salmon prices over the last several years, along with smaller runs in some years, has resulted in an increasing hardship on local residents to pay the rising cost of fuel, utilities, groceries, etc.. The lower earnings and higher costs of living have forced many residents to leave their homes and move to the more urban areas to find jobs.

For the last three years we have barely met the State's requirement of a minimum of 10 students in our school in order to receive State funding for the school and to keep it open. The next year appears like it will be a significant challenge as well. Should the school close, Egegik would no longer be a desirable community for parents to raise their children and would very likely join other Bristol Bay Communities facing extinction in the largest salmon producing region in the world.

As we struggle to survive, and continue to reside in the place that has been our home for generations, we are looking for other means to maintain our style of life and to grow and thrive once again.

We see hope on the horizon with mining and gas exploration in our region as a major opportunity. We support responsible, ecologically sound, economic development for our region and believe that HB 134 and SB 67 are nothing more than a short sighted attempt to block this development. We, the undersigned members of the Egegik City Council, do hereby **strongly oppose** HB 134 and SB 67 and we object to using the good name of Governor Hammond to try and achieve this objective.

Not Available for Signing
Richard E. Deigh, Mayor

Myra J. Olsen, Deputy Mayor

Not Available for Signing
Gerald Alto, Council Member

Charles Abalama, Council Member

Darrel Bakk, Council Member

Kevin Deigh, Council Member

Henry Olsen, Council Member

February 28, 2007

The Honorable Paul Seaton
Chairman, Special Committee on Fisheries
Alaska State Legislature
State Capitol
Juneau, Alaska 99811

Dear Chairman Seaton:

SUBJECT: Testimony on HB 134

Mr. Chairman and Members of the Fisheries Committee – thank you for giving me the opportunity to testify on this legislation. My name is Gail Phillips. I am a former legislator and Speaker of the House. I am testifying on my own behalf and as the Vice Chairman of a private non-profit organization called "Truth About Pebble". My testimony will strongly oppose the passage of any version of this bill.

In fact, I think this bill should be renamed from "An act relating to conservation and protection of wild salmon production....." to a more honest assessment, which would be "the illegal takings of any and all future economic and resource development for the entire Bristol Bay region".

You have previously heard credible opposing testimony to this unprecedented and transparent withdrawal of over 22 million acres of mineral-productive lands in Southwest Alaska; lands that were specifically identified for mineral development when the State made its land selection.

I am not going to repeat the facts that have previously been presented to you in opposition of this bill; I am, however, going to focus my testimony on three major issues: (1) a blatantly onerous attempt to circumvent Alaska's legally-established permitting process; (2) the "takings" issue that will result in major lawsuits against the State of Alaska if these lands are withdrawn and restricted; and (3) the constitutional mandates regarding the development of our natural resources for the benefit of all Alaskans.

#1 – Circumvention of the State's Permitting Process

Alaska is one of the richest resource states in the Union, with many types and vast amounts of natural resources available for development. We have been diligent in our efforts to create comprehensive permitting policies that now insure the safe and profitable development of our resources. As you are all aware, laws pertaining to Alaska's permitting process are continually updated and refined as new technologies become available.

When I was the Speaker of the House, revising and updating our well-established permitting policies was a high priority. We did not do this in a vacuum – all of these policy refinements were accomplished in an open public process. The best scientific advice was applied, while conforming to State and Federal guidelines and the adamant direction of the people of Alaska to “DO THINGS RIGHT”.

As a result of Alaska’s on-going permitting process, and thanks to many of you for your efforts in this regard, we now have major resource development projects throughout the State that are the most environmentally safe in the Nation.

This blatant attempt to circumvent our permitting process, especially on lands that have been previously identified for mineral and resource development, is egregious and completely contrary to our State’s fairness doctrine.

#2 – The “Takings” Issue:

This bill would specifically stop all mineral development. Yet, at this time we all know that there is a mineral prospect in the area that has the potential to exceed \$200,000,000,000 (billion) in mined product. Geologic exploration and results show this prospect to be one of the largest in the world. If this bill should pass and the millions of acres withdrawn from future mineral development, “takings” lawsuits will be inevitable. We don’t have enough money in the State, including all the assets of our Permanent Fund, to cover the potential amounts of payments that will follow. This one issue alone could easily bankrupt the State of Alaska.

#3 – Constitutional Mandate to Develop our Resources:

Each of you, as I did when I served in the Legislature, took an oath of office to uphold the Constitution of our State. Article VIII – Natural Resources – of our Constitution is very clear about the policy of the State to encourage the development of its resources for maximum public use (Section 2) and that no exclusive right or special privilege of fishery shall be created or authorized in the natural waters of the State (Section 15) and that all laws and regulations governing the use or disposal of our natural resources shall apply equally to all persons (Section 17). I think that an attempt to approve any version of this onerous legislation will put each of you in direct conflict with your promise to uphold the constitution.

Again, I thank you for the opportunity to share my opinion on this legislation. I would be glad to answer any questions you may have.

Thank you.

Gail Phillips
1241 W. 27th, #736
Anchorage, Alaska 99503
277-4867

02/24/2007

The Honorable Paul Seaton
Alaska State House of Representatives
State Capitol Room 102
Juneau, Alaska 99801-1182

George Hornberger
P.O. Box 113
Iliamna, AK 99606-0113
hornberger@starband.net

Dear Representative Seaton,

I am writing in regard to the Pebble Mine prospect in the Iliamna area and also the massive game refuge and fish reserve that is being proposed for the same area. (HB 134 & SB 67)

I have spent the last 44 years of my life in Southwest Alaska between Naknek, Iliamna, Newhalen and Lake Clark.

Over the years I have made my living working for Alaska Dept. of Fish and Game, Fish and Wildlife Protection, trapping, commercial fishing, logging, cutting lumber, commercial flying (for the last 20 years) and several other occupations. I am the President of the Lake and Peninsula School Board and am a member of the Newhalen City Council.

I have chosen to live in the Iliamna / Newhalen area because I love the area and it is a wonderful place to raise children. Also my wife was born and raised here.

Having lived in this area for a good portion of my life, having raised a family here and having a very well rounded resume of work experience I believe gives me a unique and objective perspective in considering the Pebble Mine prospect.

There seems to be a major amount of controversy in Alaska these days over the Pebble Mine Prospect. I hope you noticed I called it a prospect and nothing else. It seems there are a lot of people who are turning Pebble into a mine and it is nowhere near that at this time. It is a prospect and nothing more.

Northern Dynasty spent 21 million dollars in 2006 on environmental studies. Since 2002 they have spent close to 50 million dollars just on environmental studies. These studies involve more than 50 independent consulting firms, with more than 500 people having worked on this project since 2004.

I would be surprised if anything in this great state has seen this amount of study since the Trans-Alaska Pipeline.

From the Pebble Mine Prospect to Iniskin Bay and the shores of lower Cook Inlet there is a no more intensely studied piece of real estate than this anywhere in Southwest Alaska and quite possibly the entire state. There isn't a bird, mouse, fish, plant, insect or body of water that hasn't been analyzed, categorized and scrutinized.

Northern Dynasty is employing some of the best mining and resource development scientists and consulting firms in the world, and close to 75 percent of the 33 to 36 firms are Alaskan.

Northern Dynasty has, as far as I am concerned has done a wonderful job of employing local people from all over the area. I have flown people from as far as Togiak, TwinHills, New Stuyahok, Dillingham, Koliganik, Ekwok, Aleknagik and all the villages in the Iliamna Lake area to work here in Iliamna for Northern Dynasty.

The prosperity that has come to this area from the mineral exploration is exciting and everyone is excited about things to come yet.

Now we have Bob Gillam and all his hired guns, Renewable Resources Coalition, Bristol Bay Alliance etc. all doing their level best to throw any and all barriers in the way of NDM to keep anything from ever happening here.

I wonder if somehow some of these people don't have ulterior motives in their haste to condemn Northern Dynasty and the Pebble Prospect.

Bob Gillam has his huge lodge at the end of Keys Point. He brings in all his big money clients to play on Lake Clark and the surrounding area. They have big jet boats, jet skis, and float planes. Bob has a huge dock that I think is an eyesore in the waters of Lake Clark. I might add that either HB134 or SB67 (Bob Gillam is supporting both) I can't remember which one, will forbid building a dock like Bob Gilliam's. Mr. Gillam is what I call a typical environmentalist. He built his cabin in the woods last year.

Brian Kraft of Bristol Bay Alliance. I know Brian personally. What is his motive? Brian has his huge lodge on the Kvichak River. He makes money bringing in high paying guests to go flying in his floatplanes (which are very noisy). They race jet boats up and down the rivers and streams (which tear up the salmon beds) When Brian is done for the summer he locks up his big fancy lodge and leaves.

I doubt if Mr. Kraft or Mr. Gillam has ever thought of doing an environmental study of what their jet boats do to the rivers, how much pollution they pump into our pristine waters. How much their noisy airplanes annoy the local people when we have to hear them take off at 6 in the morning to take their rich fishermen out to go fishing.

I really wonder why these people don't want any development in this area. Could it be because they don't want anyone else here in the way of their lodges? I don't believe they are only interested in environment. They don't even live here. All they do is come out here, take advantage of the local resources then leave. What have they invested in the local economy?

Northern Dynasty employs local people almost year around. I believe most of the people employed out here had only a month off between December and January. This is something that Bob Gillam, Brian Kraft, and the Renewable Resources Coalition do not do and I have not heard their plan (and I certainly hope they have one) for employing all the local people whom they would like to put on the unemployment roster.

We cannot continue to be entitlement villages forever. We have a project here that has the potential to bring industry and infrastructure to the Iliamna Lake area and beyond. People are working. This means they are not on welfare or unemployment.

To work for Northern Dynasty a person must pass a drug test. This means that anyone who is working is not doing drugs. This project is not only bringing prosperity to the people out here, it is also cleaning up the villages.

I have lived here for a long time. In the last few years I have seen local people go from wondering how they are going to pay for their winter heating fuel to being proud that they have a good job and can afford to not only pay for the fuel but afford to go to the State Fair too. This prosperity is not from Bob Gillam, the Bristol Bay Alliance or the Renewable Resources Coalition.

No one who lives and works here is willing to "give the farm" away to Northern Dynasty. We all recognize that there is a lot at stake here. We all eat salmon. We all hunt caribou and moose. We all live a subsistence lifestyle. We do want to give Northern Dynasty the chance to finish their exploration and start the permitting process.

The Pebble land was open for mineral exploration and if it is shut down now the State will be sending a loud message to all mineral exploration companies that it is not a friendly place for mineral exploration. This state was virtually founded on the backs of miners and the mining industry. Is this the kind of message we want to send out to the world?

Commercial fishing is not a way to make a year around living anymore and unfortunately a lot of people out here sold their permits so that makes NDM even more of an attractive employer.

I think it is interesting that a lot of the people who are heading up the opposition to Pebble are not from the Iliamna Lake area. They are from elsewhere and make their money elsewhere. We live here. We pay the incredible prices for fuel and gas. Stove oil is \$5.05 per gallon. Gasoline is \$5.34 per gallon. Electricity is 48 cents a KWH. If you want to build a house you can double the price you would pay in Anchorage because of airfreight prices.

I am not a politician, so perhaps I am not reading HB 64 and SB 167, as I should and understanding it, as I should. Perhaps there is something I am missing. What I don't think I am missing is the fact that they both stink and are designed to put Northern Dynasty out of business as far as Pebble is concerned.

If the Pebble Prospect is brought to production it has the potential to bring in affordable power and cheaper gas and oil. It has the potential to improve our schools and villages through taxes. It will

offer good jobs to local people, even more jobs than there are now. It will mean a road to the coast where we could have barge and ferry service.

I guess the point of this whole letter is that we have something happening here that is pulling this area out of the gutter and bringing jobs and hope to the local people from all over Southwest Alaska.

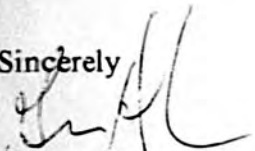
If the politicians, Bob Gilliam's, Renewable Resources Coalition people, Bristol Bay Alliance, etc can shut this down just because they don't like it, then I hope they have an alternate plan for this area that will continue to put people to work. If not, then they better bring their checkbooks when all the work is gone and people are on unemployment again.

I would like to end by stressing again that no one is in favor of just signing this whole project over to Northern Dynasty and telling them to have a good time with the land. We must make sure that all permitting follows the letter of the law. BUT if they can satisfy all the requirements and get all the permits then lets make Pebble a model for mines to follow.

I cannot support SB67, which would create the Jay Hammond Wildlife Refuge. Even the name of this is designed to play with people's emotions.

I knew Gov. Jay Hammond personally. Bella Hammond was my teacher in second grade. I used to work for Gov. Hammond at Lake Clark. He was a great man and Bella is a fine person and I respect her as much as anyone I have ever respected. I agree that there could be better places for a mine. But this is what we have, the United States and Alaska need the mineral resources and Southwest Alaska has everything to gain if this is done properly and to the letter of the law.

Sincerely



George Hornberger

CC: All State Senators
All State Representatives
Senator Ted Stevens
Representative Don Young
Senator Lisa Murkowski
Lt. Governor Sean Parnell

From: Eddie Angasan [eddie@bristolbay.com]
Sent: Wednesday, February 28, 2007 6:29 PM
To: Rep. Paul Seaton
Subject: SB 67 & HB 134

Dear Representative Seaton ,

As a resident and a commercial salmon fisherman in the Bristol Bay region, I want to express my opposition to any plans to develop a fish refuge in the region (Senate Bill 67 and House Bill 134). We are already surrounded by enough refuges, reserves, State and National Parks.

Those of us who live here see the need to keep our options open to future economic development - whether it's the Pebble project, oil & gas development or any other economic opportunities that this fish refuge might preclude. We can no longer afford to be the play ground for the rich who come here to play or for the special interest groups that want to involve themselves in our lives. We can no longer allow them to dictate to us what is in our best interests.

There is no group more concerned about the protection of our fish and wildlife resources than those of us who live here. But we also know that Alaska has a system in place for ensuring environmental protection that has a proven track record.

Too often, policy makers can be convinced to rush to make a decision for the sake of satisfying political promises made to special interest groups or to the wealthy that made campaign contributions. I want to assure you that many of us that live in this region recognize the long-term impacts of pushing ahead with this fish refuge proposal at the expense of important future economic opportunities and that of our grand kids future to be able to provide for themselves. For those that want to stop development within our region of the state, what solutions do they have to provide economic diversity and security for us. The answer is nothing !!

The late Governor Hammond has passed on, don't bury our chances of economic diversity and security with him all because someone said that this is what he wanted. I heard him say many things but nothing about making a fish refuge in Bristol Bay. People are trying to romanticize and twist his words. He was all for economic development. Infact in the early 60's as our State Representative he was successful in getting a resolution passed in the State legislature to develop a road from the Bristol Bay Borough thru the Katmai National Park to a ferry terminal on the salt water side to promote economic development and to reduce the cost of living to the region. As shown here:

<http://www.nps.gov/archive/katm/adhi/adhi4a.htm>

We still need a road, railroad or a dirt path to Anchorage, Interior Railbelt or to a ferry terminal to promote economic opportunities and to reduce the cost of living to the region. Forgive me, but this is what the our State Legislature should be working on not trying to find

ways to stop economic development from occurring with in Bristol Bay. We still need ground transportation.

We live in a cash economy, we need more than just the ability to pick some berries and put some fish in the freezer. Please don't allow this legislation to be adopted, don't take away my grand kids opportunity to provide for themselves by having economic diversity and security with in Bristol Bay.

Take care and be safe,

Mark E. Angasan

FREE Emoticons for your email!

[Click Here!](#)





Alaska State Legislature

Please enter into the record my testimony to the HFSH
committee name
committee on HB 134, dated 02/28/07
bill/subject

I am opposed to the passage of House Bill 134, an Act which extends the 1972 Bristol Bay Fisheries Reserve to the river systems, ground water, aquifer and all drainage systems that connect to the surface water of Bristol Bay.

This Act, to take effect immediately, inappropriately usurps future energy development in an area that was specifically selected for its significant mineral potential, by literally turning off the tap.

This Act will make a blanket moratorium on nearly all future industrial, commercial or infrastructure development, including the proposed Pebble Mine project.

This Act denies those that live in the Lake and Peninsula Borough, an area with some of the highest unemployment rates in the State, opportunities to learn new skills and trades, gain improved medical care and increased educational opportunities.

What this Act does achieve is to add fuel to the fire that allows policy-making decisions be made based on emotional outbreak and knee-jerk reactions instead of from data and sound research found from the rigor of technical and environmental studies.

We must not be afraid to look for Alaska's future. To summarize, I would like to quote my good friend, David Gottstein, who noted the area that will be impacted by House Bill 134, has "too much potential to just reject out of hand. We all need to know the truth."

I respectfully request that House Bill 134 be rejected.

Signed: Sharon E. Anderson
Testifier

Representing (Optional)
PO Box 200187 9840 Hillside Dr, Anch, AK 99520
Address
(907) 272-2608
Phone No.

TESTIMONY ON HB 134

My name is Roger C. Burggraf and reside at 830 Sheep Creek Rd, Fairbanks, Alaska.

I have lived and worked in Alaska since 1953. I majored in Wildlife Management and Conservation in college and worked for the US Fish & Wildlife Service for 3 seasons in Alaska as a stream guard and Fisheries aide. I was working for the USFWS the last year fish traps were allowed to operate and monitored their activities. I saw how Alaskans interests were being exploited by outside interests.

I am opposed to HB 134. Putting another layer of bureaucratic red tape on management of the land would serve as another disincentive for the mining and mineral exploration industry. The State of Alaska will not be allowed to promote the responsible development of other high value resources on its land.

The land encompassed by the so-called proposed Bristol Bay Fisheries Reserve was originally selected by the State for its high mineral potential.

The Pebble project has the possibility of becoming a World Class mining operation, if permitted, and would provide millions of dollars in revenues to the State of Alaska. It would provide for thousands of high paying jobs for Alaskans (especially local people who live in an economically depressed area). Spin off benefits to local communities in the form of small businesses in support of the industry and growing communities would flourish. There is no base for that now.

Under the constitution of Alaska you as Legislators have an obligation to see to it that Alaskans get the maximum benefit from the lands it selected from the Federal Government. The passage of this bill would send a strong negative message to the mining industry ^{and other resource development industries doing business in Alaska} thereby discouraging many potential investors.

I see HB 134, ^{an Act relating to conservation + protection of wild salmon production in drainage areas} the Bristol Bay Fisheries Reserve, is nothing more than an effort to subvert the existing permitting process. The permitting process is thorough and time-tested to be state-of-the-art in determining whether a mine can be developed and operated in an environmentally sound manner. However, lodges in the area would be allowed to continue operations in their exclusive playground for the rich and influential and be undisturbed. This is very discriminatory.

The future of Alaska is dependent on the responsible development of our natural resources - petroleum, gas, minerals, timber and fisheries. All effort should be made to facilitate that development for the betterment of Alaskans in accordance with our Constitutional mandate: "It is the policy of the State to encourage the settlement of its land and the development of its resources by making them available for maximum use consistent with the public interest." A balanced approach is imperative for the benefit of all, not just a few influential special interest persons and groups at the expense of the general population.

Chairman Seaton and Committee members,

Thank you for the opportunity to speak to you concerning House Bill 134.

My name is Kevin Jensen and I was born, raised and currently reside in Pedro Bay, an Athabascan village on the northeast shore of Lake Iliamna.

I am opposed to HB 134 because I don't want to live in a refuge. I don't want to worry about whether or not my dragging a couple of trees in place over a stream so that I can hunt on the other side is going to earn me a fine or jail time. I don't want my heritage and cultural rights to subsist as my forefathers did to be stomped on by a group of people intent on using any and all means at their disposal to fight a process that has not even begun. With or without the mine, we as a tribal people manage our resources better than anyone who has attempted to do so, and this is an historical fact.

Our tribe is preparing to begin a waterfront project that we have been in need of for quite some time. We are also trying to finish our new landfill, which will require a bridge to reach the site. However, I have to ask myself whether or not these projects will ever reach fruition under this bill. Our children explore our lands on foot and by all terrain

vehicle, is this the use of these ATVs going to be a point of contention? If I read this bill right, then yes they will, and that's not something I can agree with.

To use our lands and waters as a fulcrum to leverage this body to pass laws that will forever change the way we live is just wrong. I want to live on our ancestral lands the way we always have, without "outside" entities changing our lives without so much as a by your leave. I don't believe this bill was created so much to protect our waters and fish as it was to shortsightedly tilt at a windmill that hasn't even been built.

I implore you to oppose HB 134, not just for my tribe, but for our descendants.

Thank you for your time.

A handwritten signature in black ink, appearing to read "Ken Jern". The signature is fluid and cursive, with a large loop at the end.

My name is Eva Nielsen-King And I am here representing myself as a commercial fisherman, a resident of South Naknek, and the South Naknek Village Council. I ask that these comments be entered into the record.

House bill 134 introduced by Rep. Edgmon and The Jay Hammond State Game Refuge Proposal By Senator Gary Stevens (both separate bills) are as restrictive as all National Parks and Wildlife Refuges in Bristol Bay. Currently the Bristol Bay region acre for acre is more impacted by National Parks and Wildlife refuges than any other region in Alaska. In fact the Bristol Bay region has the second largest state park in the United States.

Either of the two bills considered will in fact stop any development in our region. It is as anti-development as one could ever be. Village and Regional Corporations will not be able to develop and more importantly villages such as South Naknek will be choked from developing any needed infrastructure in the future. These bills, no matter how you read them, are a classic example of a taking by our government, of our rights and development potential. Remember you cannot restrict or take away our rights and privileges from village and regional corporations including our village communities without legal consideration. If you do, it is a taking and the State will find itself in court – without question.

We feel it is a sorry state of affairs when some politicians introduce legislation like this to pay off political debts to their donors and for special interest groups.

Where in the world is our Alaskan spirit? Anymore it seems it doesn't matter if you're a Democrat or a Republican – both parties are acting like the old Democrats, which is anti-development and anti-work. If you choke our village and region from development you better be prepared to provide a lot of welfare checks.

Indeed we are commercial fishermen. However, as resident fishermen are a minority.

For your information our village has lost two-thirds of our population and our village school is closed.

Because of our commercial fishing situation, a lack of catch coupled with low fish prices has forced many of our people to move to look for employment. Gone are the days where we as commercial fishermen can make a decent annual living from it. Our only hope is what Northern Dynasty is offering – with out diversifying our economic base more and more villagers will move out. We are wondering why our State government want to take this potential economic benefit away. If you are not going to permit any mining what exactly do you have that can replace investments by private enterprises? You say you are only applying better safeguards to protect our resources by this legislation. Current environmental protection laws and regulations have enough restrictions to protect the environment, although laws and regulations lack enforcement.

By the way, do salmon processing plants both shore based and off shore, including fishing boats get a free pass to pollute our waters? We know some fish companies oppose the Pebble Project because of “environmental issues”, however isn’t this the pot calling the kettle black?

The fishing industry has been polluting our country for about 100 years or so, and our waters – where is the state’s oversight? Why not come and dig some holes around current and old cannery sites. Come and take a look at our beaches after a fishing season. Why isn’t the State of Alaska concerned about these polluters?

Do some get “free passes” and others have to be as clean as the driven snow?

How about local employment? The fishing industry has had over 100 years to employ our people. How many have they provided year around jobs to (for resident and other Alaskans)?

Northern Dynasty has employed more of our people in the last couple of years than the fishing industry has in over a hundred years. There is something wrong with this picture. Can you give us and our region some needed support? Where are you when we need you?

We feel you don't actually care about better safeguards, but rather to stop development PERIOD. Why not be honest with us with your true intentions – that this is paying your political debts, providing for special interest groups; sport fishing lodge owners, sports outfitters, sports fishermen, etc. And killing any development opportunities – why not be honest?

Jay Hammond was a fine person. However, another refuge will not provide a viable living for us who live in villages. People from our village are a proud people who want benefits of a more diversified economy. Therefore, I am opposed to Senate Bill 67 which provides for the Hammond Game Refuge in the Bristol Bay Headwaters and House Bill 134 which expands the Bristol Bay Fisheries Reserve.

Ralph Angasan Sr.
Pres. APC

Honorable Members of the House of Representatives

I am here on behalf of Alaska Peninsula Corporation. APC owns about 400,000 acres of land in and around three of the major rivers that are the subject of HB 134. Our holdings include about 180,000 acres of land in the Iliamna Lake area, about 140,000 acres of land along the Naknek River, and about 90,000 acres of land adjacent to the Ugashik system, including Port Heiden. APC has over 600 shareholders with 5,000 years of history in those Bristol Bay drainages. We oppose HB 134.

We want our children's children to continue to live and work at home, in Bristol Bay. HB 134 would strip any economic or social reason for any of us to remain. It proposes, with no basis in science, no objective findings whatsoever, to create a virtual monopoly for the preexisting lodges and fish processors, and to foreclose any new industry, whether it be mining or oil development, or alternative power that is water-dependent.

Because the bill allows for only existing permits, it effectively blocks any future economic growth. Communities along the Nushigak would be prohibited from any extraordinary growth or needs for water or discharges because the bill freezes community needs at "existing and ordinary present and future needs." Naknek, King Salmon and South Naknek cannot grow. The exploration now occurring with 2 miles of the Naknek River for geothermal sources would likely come to a grinding halt.

HB 134 would fine my corporation up to \$ 1,000,000 a DAY if we filled in a bog. It would fine my few shareholders who could still eke out a living in their communities for riding their four wheelers over the bogs of our lands in the summer, for causing adverse affect—like tire tracks. But, with fish prices at 60 cents a pound, and fuel at over \$ 5.00 a gallon, and electricity at 40 cents a kilowatt hour, and no new opportunities, perhaps there won't be much 4 wheeler traffic. Bristol Bay is already in severe economic crisis. It is rapidly losing population. Increasing the pressure on us will only increase the outward migration and depression in the region.

HB 134 will increase outward migration. Because, under HB 134, there won't be any new economic opportunities. Only uses presently authorized, approved and permitted at the time of the bill. The few remaining salmon processors are covered. That is probably why fish processors donated to the campaign of the sponsor of HB 134. But maybe my great grandchildren do not want to gut fish in order to eke out a living.

Perhaps they can go to work at a silk-stocking fishing lodge for peanuts. That is perhaps why lodge owners donated to the sponsor of the bill. But lodge owners' responsibilities are only to their families, nor are their families struggling to make ends meet as the community they live in dwindles, its schools closed for lack of population.. I have over 600 shareholders' futures to worry about. And they can't all work for a few lodges, even if they wanted to.

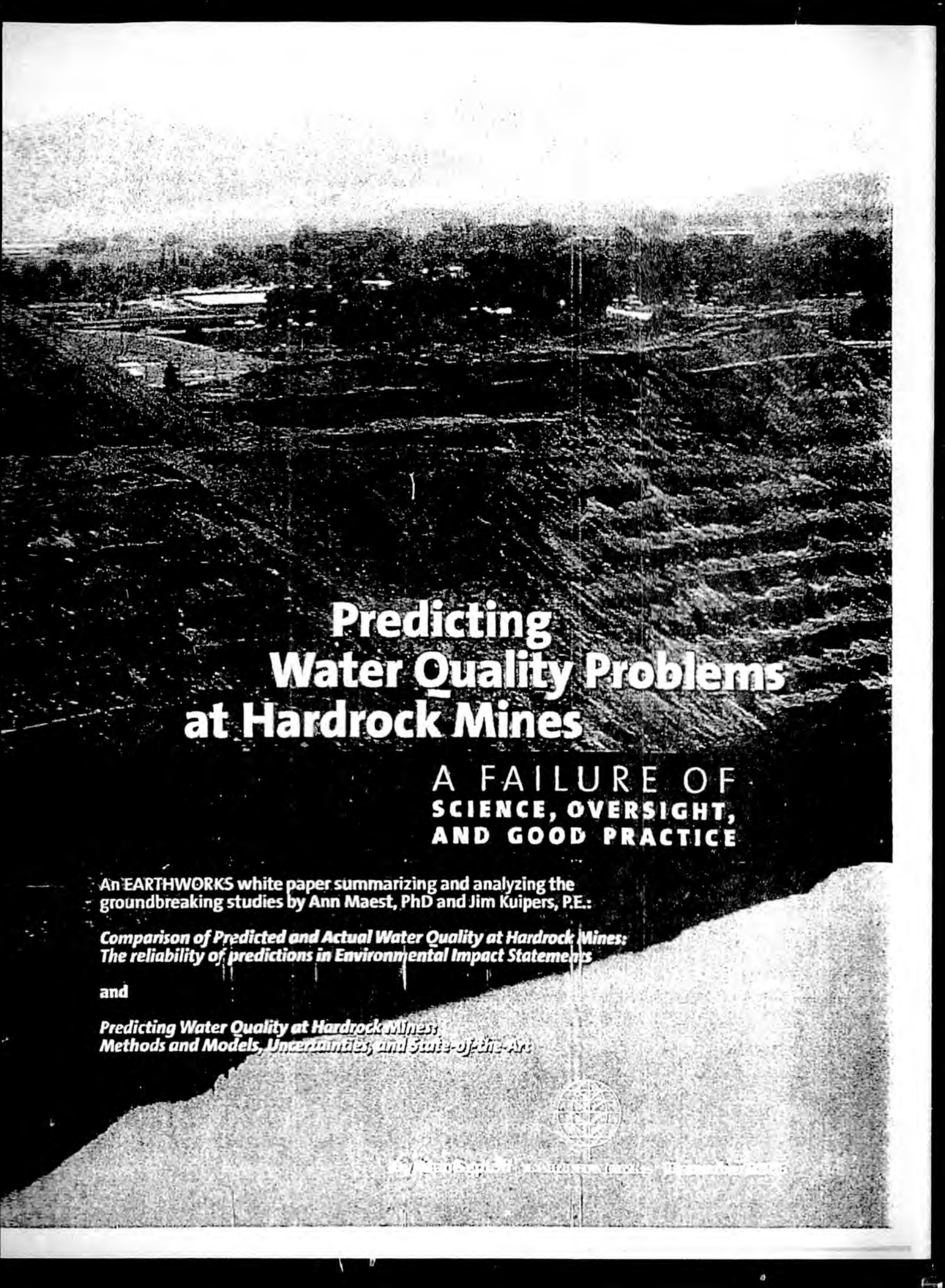
The sponsor of this bill is in the hands of the rich and powerful who want to convert Bristol Bay into their colony, and keep it there. Fish rich and people poor. That is not my vision, and it is not the vision of my people. We can preserve our salmon fishery and still diversify. Without HB 134.

HB 134, in fact, is not the vision of the Framers of the Alaska Constitution. The Framers guaranteed us the right of water appropriation, regardless of the watershed, and prohibited laws that divest us of the use of waters, our interests in the lands and the right to earn a living on our own.

HB 134 goes too far. Every stream, every bog, every aquifer, every swamp and lake that is in any way interrelated to or connected with the Nushigak, Ugashik, Egegik, Naknek or Kvichak Rivers is off limits under HB 134. Any use other than for drinking water is prohibited unless it is already permitted. What about the future?

The vision contained in HB 134 is the vision of the processors to pay 60 cents/lb for fish and send the profits to Japan. It is the vision of Anchorage and Seattle lodge owners and money managers to charge thousands of dollars a week for 16 weeks a summer for outsiders to stay at their lodges, and take it all home. Their vision is to fine some Native kid on a 4 wheeler who goes through a blueberry bog that is connected in some unknown way to the Kvichak, thousands of dollars a day in fines. Or to fine APC \$ 1,000,000 a day if it has the audacity to provide for a new industry. That is no vision of the future. That is colonialism, and colonialism should have ended in the 19th century. It is up to you to end it now.

Thank you.



Predicting Water Quality Problems at Hardrock Mines

A FAILURE OF SCIENCE, OVERSIGHT, AND GOOD PRACTICE

An EARTHWORKS white paper summarizing and analyzing the groundbreaking studies by Ann Maest, PhD and Jim Kuipers, P.E.:

*Comparison of Predicted and Actual Water Quality at Hardrock Mines:
The reliability of predictions in Environmental Impact Statements*

and

*Predicting Water Quality at Hardrock Mines:
Methods and Models, Uncertainties, and State-of-the-Art*



© 1997 Earthworks, Inc. All rights reserved. EARTHWORKS, INC. 10000 10th Avenue, Suite 100, Boulder, CO 80501

Introduction

A failure of science, oversight and good practice

This paper is a summary, written for the layperson, of the findings of a two-year research study on the accuracy of water quality predictions at hardrock mines. The study, conducted by Jim Kuipers and Ann Maest¹, brings to light a decades-long failure by government regulators, industry, and consultants to recognize and correct deficient procedures and methods for predicting contamination of water at hardrock mines.

Kuipers and Maest have discovered that, in practice, there is a failure to compare predictions made before the mines are permitted with the actual results. The predictive modeling results are not adjusted to account for real-life failures—this, despite the fact that at the vast majority of mines, problems were worse than predicted. Establishment of credibility in modeling requires that the predictions be tested, and then the models adjusted based on the results. This process appears broken when it comes to predicting the impact of mines on water quality for mine permits.

To permit mines, federal law² requires regulators to apply scientific approaches to predict the environmental impacts of the mine proposal—including surface water and groundwater quality impacts. The accuracy of these water quality predictions is of significant public concern. Mining's impacts on water quality may affect municipal, agricultural, and rural water supplies; important commercial, subsistence and sports fisheries; wildlife populations; tourism; and recreation. One of the reports from the study, *Comparison of Predicted and Actual Water Quality at Hardrock Mines (Comparison Report)*, asks a basic question that government regulators, industry officials and consultants should have asked long ago:

Do predicted water quality impacts match reality?

The answer, in short, is **no**. The *Comparison Report* reveals:

- 100 percent of mines predicted compliance with water quality standards before operations began (assuming pre-operations water quality was in compliance).
- 76 percent of mines studied in detail exceeded water quality standards due to mining activity.
- Mitigation³ measures predicted to prevent water quality exceedances⁴ failed at 64 percent of the mines studied in detail.

Along with more analysis of this question, the *Comparison Report* and the companion report on methods and models used to predict water quality (*Methods and Models Report*), also seek to answer the necessary follow-up questions:

- In cases where predicted water quality impacts fail to match reality, why do they fail?

- Do certain types of mines fail more often than others?
- What can be done to address current failures and prevent future failures?

The Kuipers-Maest reports were prepared for a professional audience. The purpose of this paper is to translate and summarize the main findings of their research (for the layperson and the interested public), and to offer common sense recommendations based on those findings with an eye toward protecting natural resources and public health.

The Context

Why this research was necessary

The Environmental and Public Costs of Faulty Predictions

The failure to accurately predict and manage water quality impacts can result in significant negative impacts on clean water and steep taxpayer liabilities for the costs of cleanup. Consider one often-cited example—the Summitville gold mine in Colorado. Water pollution at this mine has cost American taxpayers more than \$200 million in cleanup costs. The majority of that money has been spent mitigating acid drainage and cyanide releases that were not predicted during the permitting process. When pollution spilled from a containment pond, 18 miles of the Alamosa River were effectively killed—impacting not only the aquatic life in the river, but also the adjacent farms and ranches that relied upon the Alamosa for irrigation and livestock watering.

While it may be argued that Summitville is one of the worst-case examples, problems abound. According to the U.S. EPA's Abandoned Mine Land Team, the cost of mine cleanup at sites on the National Priorities List (i.e., Superfund sites, like Summitville) in the United States is \$20 billion—almost 3 times the EPA's FY 2007 budget request. Long term water treatment and management is often the single most significant cost associated with mine cleanup.

In fact, there is an increasing number of mine sites throughout the U.S. that will require water treatment in *perpetuity*. In the arid west, these types of long-term impacts place a tremendous burden on downstream communities who must deal with the consequences of failed predictions. For example, government regulators have determined that the Zortman Landusky mine, located near the Fort Belknap Reservation in Montana, will continue to generate acid mine drainage for thousands of years. As a result, the Fort Belknap Tribes are faced with a continual threat to important tribal water resources, and the state of Montana will be spending tens of millions in public funds for long-term water treatment.⁵

Do Predicted Water Quality Impacts Match Reality?

As indicated above, the answer is usually no — particularly when high risk mines, such as those with close proximity to water resources, are considered.

Sampled Mines

To arrive at this answer the authors initially reviewed 104 Environmental Impact Statements (EISs) and Environmental Assessments (EAs) for 71 major hardrock mines in the United States.⁷ The mines covered all important mineral sectors (gold, silver, copper, platinum group metals, molybdenum, lead, and zinc) and ten mining states (Alaska, Arizona, California, Idaho, Montana, New Mexico, Nevada, South Dakota, Utah, and Wisconsin).

A representative subset of 25 case study mines was then selected to evaluate the accuracy of the water quality predictions. Environmental impact reports for these mines were evaluated for predictions related to surface water, groundwater, and mine drainage quality during and after mining. These predictions were then compared with actual water quality conditions during and after mining.

Potential & Predicted Water Quality

The authors discovered a two-tiered system for water quality predictions, one-tier of which was based not on sound science, but on unsupported "good faith" projections.

The two tiers of "predictions" made about water quality in environmental assessments are referred to by the authors as "potential" and "predicted" water quality:

- **Potential** water quality is the expected water quality conditions in the absence of mitigation efforts by the operator.
- **Predicted** water quality takes the effect of mitigating measures into account. It is what mine operators forecast actual water quality will be during and after operations.

All the environmental reviews analyzed in the *Comparison Report* predict acceptable water quality after mitigation at mines where water quality standards were met before mining began. If this prediction were not made, the regulatory agency would not be able to approve the mine.

However, inadequate information was provided to demonstrate how the mitigation measures would actually prevent water quality impacts. Therefore, regulators were generally accepting the final water quality predictions on "faith."

Major Findings: Chronic Underestimates of Water Quality Problems

Prediction vs. Reality: Overall Water Quality Impacts to Ground and Surface Water

Of the 25 mines sampled:

- 76% of mines polluted groundwater or surface water severely enough to exceed water quality standards.
- 60% of mines polluted surface water severely enough to exceed water quality standards.
- At least 13 mines (52%) polluted groundwater severely enough to exceed water quality standards.

Predictions vs. Reality: the Failure of Mitigation

In the cases where water quality standards were exceeded, in some cases the mine proponent anticipated the potential for pollution and prepared mitigation strategies (e.g. a mine waste dump lined with plastic to prevent acid drainage leaching into groundwater). Predictions of the efficacy of mitigation were no more reliable than overall predictions of water quality:

- 73% of mines exceeded surface water quality standards despite predicting that mitigation would result in compliance. The other 4 mines didn't predict the need for mitigation.
- 77% of mines that exceeded groundwater quality standards predicted that mitigation would result in compliance. The other 3 mines didn't predict the need for mitigation.

Predictions vs. Reality: Mines near Water with Elevated Acid Drainage or Contaminant Leaching Potential are High Risk

Some mine projects are so high risk that water quality exceedances are a near certainty: those mines that are both near groundwater or surface water resources, and possess an elevated potential for acid drainage or contaminant leaching.

- 85% of the mines near surface water with elevated potential for acid drainage or contaminant leaching exceeded water quality standards
- 93% of the mines near groundwater with elevated potential for acid drainage or contaminant leaching exceeded water quality standards.
- Of the sites that did develop acid drainage, 89% predicted that they would not.

Water Quality Pollutants

Of the 19 mines that exceeded water quality standards, the pollutants that exceeded standards were as follows

- Toxic heavy metals such as lead, mercury, cadmium, copper, nickel or zinc exceeded standards at 63% of mines.

In order to ensure clean water and protect taxpayers from liability for cleanup costs it is important to understand the frequency and magnitude of failures in predicting water quality impacts. Consider that at most major mines, operators are required to post financial assurances prior to operating. This is the good news. These assurances are supposed to guarantee that, should the mine operator go bankrupt, the mine site will be reclaimed at no cost to the taxpayer. However, the bad news is that these financial assurances are based upon expected reclamation costs and expected reclamation costs are based in large part upon water quality predictions.

Previous research by Jim Kuipers demonstrates that taxpayers are potentially liable for up to \$20.4 billion⁶ in financial assurance shortfalls at existing mine sites (in addition to the \$20 billion for Superfund sites) – due in large part to inaccurate water quality predictions.

A Growing Problem

Without correction, the environmental and financial impacts of faulty predictions could grow. Recent increases in metals prices have triggered an increase in the number of new mines being proposed in the United States. According to the Bureau of Land Management, new mining claims filed in 2006 are on track to more than quadruple since metals prices began their precipitous rise in 2002.

In the United States alone there are approximately 180 large hardrock mines – in nearly all regions of the country – that are in various stages of permitting, development, operation or reclamation and closure. In order to better protect important water resources and reduce future economic liability, improvements must be made in the prediction and prevention of impacts to water quality at these sites. On the positive side, the increase in metals prices has resulted in fewer bankruptcies in the sector—and it is bankruptcies that trigger the use of reclamation bonds for mine site reclamation and water treatment. This may provide regulators and industry officials with a window of opportunity to solve the underlying problems with water quality prediction.

Unprecedented Research: the absence of previous studies and the data gap

When they began their research, the authors expected to incorporate data from some mines where government officials had already completed a comparison of predicted and actual water quality impacts. However, they were unable to find comparisons of water quality predictions and actual water quality impacts of mines.

The authors found that no single repository exists for the Environmental Impact Statements (EISs) currently mandated under federal law. EISs contain the water quality predictions analyzed in the study. In some cases, local

federal offices that processed the studies did not have copies of them. Furthermore, in many cases, the authors were forced to submit Freedom of Information Act requests and pay fees to obtain copies of these studies. Similarly, water quality from mines was inordinately difficult to obtain and in most cases required personal visits to agencies and long hours sorting through paper files.

Taken together, the absence of previously published research and the difficulty in gathering information is evidence of a data gap that surprised the authors and may help explain the previous lack of a comprehensive study of this nature.

It is important to note that the predictions data were available – no matter how difficult to obtain – only because the National Environmental Policy Act (NEPA) requires it. Without NEPA, this study would have been impossible to conduct.

A Tool for Many Audiences

While the research focuses on the underlying scientific and engineering processes that form the basis of water quality predictions, its recommendations are intended for use by many audiences to increase the effectiveness of future mine water quality predictions – directly and indirectly:

- This study should be useful to the scientific and engineering communities for suggesting ways to better characterize risks to water quality and to better apply mitigation methods to minimize or prevent potential impacts.
- The regulatory community can look to these reports, especially *Methods and Models*, for recommendations on how to fundamentally improve the permitting process to ensure a more accurate analysis of potential mining impacts. The inherent uncertainty in water quality predictions and mitigation failures should be conservatively viewed in order to ensure mine permitting decisions that are more protective of human health and the environment. The integrity of the mine permitting process is dependent on the use of accurate methods and models.
- This report can be utilized by the mining industry to improve current practices and more accurately predict consequences and ameliorate potential effects.
- It can be utilized by the insurance and investment industry as a tool to better understand the potential risks and costs associated with mining, and as a basis to reassess risks at current mines.
- And finally, it can be utilized by the interested public to more effectively advocate for water quality protections in the permitting process and to advocate in the public arena for legislative and regulatory changes that better protect water resources.

- Arsenic and sulfate exceeded standards at 58% of mines.
- Cyanide exceeded standards at 53% of mines.

Why Do Predictions Fail?

In order to evaluate water quality impacts during the permitting process, government regulators rely on water quality predictions created by hydrologists and geochemists and mining engineers using computer models and other types of field or laboratory studies. Those predictions are only as good as the science upon which the models/tools are based, and the site characterization information supplied to those models. So when water quality predictions fail to predict water quality for mining operations, they fail for two general reasons:

1. the science of mine water quality prediction is imperfect
2. the science of mine water quality prediction is imperfectly applied at mine sites

The Imperfect Science of Mine Water Quality Prediction

The complexity of pollutants' interaction and movement in groundwater and surface water systems at mines is difficult to recreate in a model. This is addressed in detail in the companion report by Maest & Kuipers titled *Predicting Water Quality at Hardrock Mines: Methods and Models, Uncertainties, and State-of-the-Art*.

According to *Methods and Models*, factors that complicate the prediction of water quality at mine sites range in scale from small to large. On a small scale, for example, it is not well known how minerals react in complex systems. On a large scale, geology, climate, methods of mining and mineral processing, and mine waste management approaches vary among and within mine operations. These large scale variations limit the degree to which information from one site can be applied to another.

Also, extrapolation from the laboratory to the mine must address complicating factors such as environmental conditions, water and gas transport, differences in particle size, and how these variables affect drainage quality over periods of decades or centuries. However, there is virtually no available field information describing the effect of these variables over extended periods of time. The lack of this field information introduces significant additional uncertainty into predictions.

Just as weather cannot be accurately predicted beyond a certain point because weather models and their inputs are not perfect, the transport of pollutants through complex geological and hydrological systems over the longer term, which can range from five years to tens of thousands of years is similarly difficult to predict.

One of the study's most significant findings, however, is where the practice of predicting weather and the practice of predicting water quality at mining operations part ways. Weather models are consistently reevaluated based on a comparison of predictions with actual weather conditions that occur subsequently.

Not so with the models used for predicting water quality at mining operations. The very fact that the study is unprecedented shows that *professionals who predict mine water quality do not revisit their predictions, and neither do the regulators responsible for ensuring the accuracy of those predictions*. The models used for the predictions cannot be improved if their failures and successes are not evaluated. Where predictions of water quality at mining sites are concerned, the scientific process is broken.

Imperfect Science, Imperfectly Applied

A mine water quality prediction model can only reach its potential at any individual mine site if that site is correctly characterized (in terms of its hydrology and geochemistry) to the extent possible. According to Maest and Kuipers, that potential is not being reached.

There are two types of characterization failures described in the *Comparison Report*: hydrologic (related to water flow at a mine site) and geochemical (the chemistry, geology and mineralogy of the materials/minerals that comprise the mine site).

The *Comparison Report* documents that six of the 25 case study mines were inadequately characterized hydrologically, and that eleven of the case study sites were inadequately characterized geochemically.

Another example of "imperfect science, imperfectly applied" is the bias of mine water quality predictions made by consultants hired by the prospective mine operator. This problem is implied by the number of site characterization failures, and by the failure to check the results of past mine water quality predictions.

Regulatory agencies, both federal and state, allow the mining company to select and directly pay consultants to predict mine water quality impacts, and to review and comment on (or even reject) those predictions, prior to release to the agency. It is an understatement to say that consultants heavily influence mine water quality predictions.

Unfortunately, given the client/customer relationship between prospective mine operators and their consultants, consultants are rewarded for having favorable predictions. On the other hand a prediction of poor water quality will usually delay a permit, which increases the permitting costs. While exceptions exist, consultants that predict poor water quality often are not rehired. This perverse incentive is contrary to the spirit of unbiased science, and contrary to the public interest.

Preventing Future Failures (and Addressing Current Failures)

Recommendations

Both the *Comparisons* and the *Methods and Models Reports* reveal that the prediction of future mine water quality is an uncertain business. And given the difficulty in modeling natural systems, even if all the recommendations included here and in the Kuipers-Maest research are implemented, mine water quality prediction will always be an uncertain business. However, there is considerable room for improvement.

Just as weather prediction has improved over time, so can mine water quality prediction — if regulators and professionals in the sector learn from past predictions and improve characterization efforts.

With that in mind, the following recommendations are intended to help improve mine water quality predictions today and in the future.

Addressing the Consequences of the Existing Prediction Process

Assess existing mines. If the results of the *Comparison Report* are extrapolated to all operating major mines, water quality standards would be exceeded at roughly 75% of all mines in the United States. Regulators should, in a public process, canvass all permitted mines to:

- determine which mines are exceeding water quality standards,
- evaluate how surrounding communities and the environment are being affected, and what cleanup steps are necessary,
- revisit the original predictions, and
- reassess the adequacy of the financial assurances provided by mine operators to guarantee mine cleanup and long-term water treatment.

Incorporate uncertainty into permitting process. Regulators should take a suitably precautionary approach to the mine permitting process, and require that mine design, mitigation and financial assurance calculations prepare for reasonable worst-case rather than best-case scenarios.

Better screen high-risk mines. Regulators must demonstrate concrete improvement in the accuracy of mine water quality predictions and mitigation efforts. For example, additional regulatory scrutiny should be given to the highest risk proposals such as those mines near water resources and with elevated acid drainage or contaminant leaching potential. In cases where the risks are too high, regulators should not permit mines. It should be noted

that this recommendation is supported by the *Comparison Report* which demonstrates that 93 % of such mines near groundwater, and 85% near surface water, exceeded water quality standards.

Some major mining companies are realizing that the life-cycle costs need to be clearly evaluated, including the costs of *perpetual maintenance and water treatment after mine closure*. While some leaders in the industry are using life-cycle cost estimates, this is still not a uniform industry standard, and regulators ultimately must make the determination for many mine proposals.

Inform the public about the uncertainty of water quality prediction. As part of the mine permitting process, regulators should inform the public of the history of the accuracy of mine water quality predictions so they can better determine the risk involved in a mine proposal.

Improving Future Mine Water Quality Predictions

Ease access to predictions and results. Information regarding pre-mining, mining and post-mining water quality should be publicly available online, along with the associated mine water quality predictions made during the permitting process. This will facilitate a more informed mine permit process for regulators and the public.

Review original predictions as water quality develops during mining. Mine operations should be regularly assessed to determine if they are departing from mine water quality predictions. This will allow regulators and mine operators to take early action when mine water quality begins to depart from the predicted.

Consult past predictions at other mines. When permitting a mine, regulators should be required to seek similar mines, or similar aspects of different mines, and determine what predictions were made and what water quality actually occurred. These mine analogs should be publicly disclosed.

Require improved characterization of mine sites. This recommendation is covered in much greater detail in the *Methods and Models Report*. In summary, regulators should require better information about the mine site — before, during and after operations.

Require more research on the effectiveness of mine water quality mitigation. The *Comparison Report* found that where predictions of good mine water quality were predicated upon the mine operator using mitigation strategies, mine water quality usually exceeded water quality standards. More research is needed to determine how and why these mitigation efforts fail, and how to improve them.

Change the procedure for selecting consultants to avoid the present conflict of interests. Agencies should independently select and pay the consultants to conduct the

studies. This will limit the ability of a mining proponent to influence the outcome of the predictions. The mine proponent can comment on the study, similar to public interest organizations, but they should not be able to exert sufficient influence to bias the outcome.

Increase government expertise. Many state and federal agencies are not sufficiently funded to employ staff with the technical expertise to provide appropriate analysis and oversight of the mine permitting process. Increased funding should be incorporated into agency budgets to ensure that technical expertise is available for permit review.

Endnotes

1. Jim Kuipers, PE, is a mining engineer with Kuipers & Associates in Butte, Montana, and Ann Maest, PhD, is an environmental geochemist with Buka Environmental in Boulder, Colorado.
2. The National Environmental Policy Act requires a science-based review of mine proposals when federally-owned land is affected, or when a federal permit is required (e.g. the Clean Water Act requires a permit when a mine discharges into waters of the United States). Many states have similar laws, based on NEPA, that apply to mine proposals even when federal land is not involved.
3. Mitigation is the effort by a mine operator to prevent or reduce pollution. For example, some mine waste (e.g., tailings impoundments) is underlain by thick plastic to prevent contaminants from moving into nearby water resources.
4. In this paper, an "exceedance" is the presence of a pollutant in concentrations higher than a water quality standard. This is different from a water quality "violation," which is a breach in the terms of a water quality permit. A water quality permit, although based on standards, may allow exceedances under some conditions. A mine operator is legally liable for a water quality violation.
5. Mitchell, Larry D., a staff paper prepared for the Environmental Quality Council, "Zortman and Landusky Mines: HJ 43 Water Quality Impacts, October 2004.
6. Kuipers, J, 2003, Putting a Price on Pollution: Financial Assurance for Mine Reclamation and Closure. This report was funded by Mineral Policy Center.
7. Many mines have multiple EISs or EIAs for different eras of mining.

Revised Final Report

**Economics of Wild Salmon Watersheds:
Bristol Bay, Alaska**

February 2007

For:
Trout Unlimited, Alaska

by:
John Duffield and David Patterson
Department of Mathematical Sciences
The University of Montana
Missoula, MT 59812

Chris Neher
Bioeconomics, Inc.
315 South 4th Street East
Missoula, MT 59801

Acknowledgements

We would like to acknowledge the generous assistance of Alaska Department of Fish and Game staff in developing the sample frame for the angler survey. Bill Romberg helped provide us with angler use data for our study area and facilitated our contact with other staff. Gretchen Jennings, and Kathrin Sundet provided us with a random sample of anglers by vendor location for each of several license sale time periods, and provided total license sale data. Brian Kraft of Alaska Sportsman's Lodge helped develop our lodge sample frame and provided a client sample frame as well. Several faculty and staff at the Institute of Social and Economic Research (ISER) of the University of Alaska Anchorage assisted in particular study tasks. Gunnar Knapp at ISER provided data and guidance in our analysis of the commercial fish sector. Lexi Hill at ISER assembled data on the non-consumptive wildlife sector. Scott Goldsmith at ISER calculated the economic significance of the wild salmon ecosystem expenditures as well as the total regional employment. We are indebted to Jim Fall for providing us with the results of the Alaska Division of Subsistence's most recent household surveys. Jim Sylvester and John Baldridge helped develop the web-based angler survey instrument, and implemented the survey for us at the Bureau of Business and Economic Research at the University of Montana. Finally, we are very appreciative of the many lodge owners and Alaska anglers who took the time to respond to our angler survey.

Table of Contents

Acknowledgements.....	2
Table of Contents.....	3
List of Tables.....	5
List of Figures.....	7
Executive Summary.....	9
1.0 Introduction.....	21
1.1 Study Objectives.....	21
1.2 Definition of Study Area.....	21
1.3 Focus of Study-Economic Uses.....	24
2.0 Methods.....	28
2.1 Sample Design Methods.....	28
2.2 Net Economic Value Analysis Methods.....	28
2.3 Regional Economic Modeling Methods.....	29
3.0 Data Collection.....	30
3.1 Survey and Sampling Design.....	31
3.1.1 Structure of Bristol Bay Angler Survey.....	32
3.1.2 Bristol Bay Angler Survey Sample Allocation Design.....	33
4.0 Survey Response Rates and Weighting.....	38
4.1 Results of Survey Incentive Experiment.....	38
4.2 Sample Population and Non-response Weighting.....	39
5.0 Bristol Bay Sport Fishing.....	41
5.1 Fishing Experience and Attitudes for Alaska Resident and Non-resident Anglers.....	42
5.2 Bristol Bay Area Trip Characteristics and Angler Attitudes.....	43
5.3 Bristol Bay Angler Expenditures and Trip Value.....	48
5.3.1 Aggregate Direct Sport fishing Expenditures in Bristol Bay.....	50
5.3.2 Estimation of Net Willingness to Pay for Bristol Bay Fishing Trips.....	52
5.4 Package Fishing Trip Characteristics.....	55
5.4.1 Estimated Explanatory Model of Sportfishing Package Expenditures.....	57
5.5 Bristol Bay Development Issues and Resource Values.....	58
5.6 Bristol Bay Angler Survey Demographic Characteristics.....	61
5.7 Results of Mail Survey of Bristol Bay Remote Lodge Clients.....	62
5.7.1 Bristol Bay Conservation Trust Fund Contribution Responses.....	64
6.0 Commercial Fisheries.....	66
6.1 Introduction.....	66
6.2 Overview of the Bristol Bay Fishery.....	66
7.0 Subsistence Harvest.....	84
8.0 Sport Hunting.....	89
9.0 Wildlife Viewing / Tourism.....	91
10.0 Economic Significance.....	92
10.1 Summary.....	92
10.2 Regional Economic Overview.....	93
10.3 Commercial Fisheries.....	97

10.4	Recreation: Total.....	98
10.5	Recreation: Sport Fishing	101
10.6	Recreation: Sport Hunting	102
10.7	Recreation: Wildlife Viewing and Other Passive Uses	103
10.8	Subsistence.....	104
11.0	Net Economic Values	106
11.1	Commercial Fisheries	106
11.2	Subsistence Harvest.....	107
11.3	Sport Fishing Net Economic Value	108
11.4	Sport Hunting Net Economic Value	109
11.5	Wildlife Viewing and Tourism Net Economic Value.....	110
11.6	Existence Value	110
11.7	Total Net Economic Value and Present Value and Inter-temporal Issues.....	111
	References.....	112
	Attachment A: Angler Survey Instrument	115

List of Tables

Table 1. Bristol Bay Area Communities, Populations, and Subsistence Harvest.....	11
Table 2. Bristol Bay and Alaska Commercial Fishery Permits, Harvest, and Gross Earnings, 2002	14
Table 3. Summary of Regional Economic Expenditures Based on Wild Salmon Ecosystem Services (Million 2005 \$).....	16
Table 4. Total Estimated Recreational Direct Spending in Alaska Attributable to Bristol Bay Wild Salmon Ecosystems, 2005	16
Table 5. Total Full Time Equivalent (FTE) Employment in Alaska Dependent on Bristol Bay Wild Salmon Ecosystems, 2005	17
Table 6. Structure of the Bristol Bay Economy, 2004.....	18
Table 7. Total Alaska Payroll Associated with Use of Bristol Bay Wild Salmon Ecosystems, 2005 (Million 2005 dollars)	19
Table 8. Summary of Bristol Bay Wild Salmon Ecosystem Services, Net Economic Value per Year (Million 2005 \$).....	20
Table 9. Demographic and Socioeconomic Characteristics of the Bristol Bay Region ...	22
Table 10. Bristol Bay Area Communities and Populations	22
Table 11: Types of Ecosystem Services	26
Table 12: Bristol Bay Surveys: Sample Frame and Design.....	30
Table 13: Bristol Bay Angler Survey and Sample Design	31
Table 14. 2005 Actual ADF&G Sportfish License Sales	33
Table 15. Distribution of Sample of License Holders Drawn from ADF&G License Pool	34
Table 16. Ratio of Sportfishing License Sample Sizes to Population Sizes	35
Table 17. Distribution of all Survey Responses to Internet Survey.....	36
Table 18. Distribution of Survey Responses with Information on a Bristol Bay Fishing Trip.....	36
Table 19. Distribution of Survey Responses with Information on a Kenai Area Fishing Trip.....	37
Table 20: Bristol Bay Survey Response Rates	38
Table 21. Comparison of Response Rates between those Respondents Receiving an Incentive Payment, and those receiving No Incentive.....	39
Table 22. Nonresponse weighting results, by population strata	40
Table 23: Bristol Bay Angler Experience and Preferences	42
Table 24: Bristol Bay Angler Ratings of Importance of Selected Angling and Area Attributes.....	43
Table 25. Bristol Bay Angler Distribution across Trip Types, by Residency	44
Table 26: Bristol Bay Angler Trip Characteristics.	45
Table 27: Bristol Bay Angler Survey, Targeted Species and Associated Trip Characteristics.....	45
Table 28. Bristol Bay Angler Survey, Targeted Species and Associated Trip Characteristics : Remote Lodge Sub-sample	46
Table 29: Bristol Bay Angler Rating of Selected Attributes of Fishing Trip	46

Table 30. Angler Rating of Selected Attributes of Fishing Trip: Selected Subsamples..	47
Table 31: Bristol Bay Angler Rating of Angler Crowding on Trip.....	48
Table 32. Comparison of Reported Average Trip Spending across Populations and Area	49
Table 33. Nonresident trips to Bristol Bay waters, mean expenditure per trip estimates by trip type.....	49
Table 34: Distribution of Trip Expenditures across Spending Categories, by Residency and Area	50
Table 35. Estimated 2005 Bristol Bay area angler trips, by Angler Residency.....	51
Table 36. Estimated Aggregate Spending Associated with Sportfishing in the Bristol Bay Region.....	51
Table 37. Bristol Bay Sportfishing: Aggregate in and out of Region and State Spending.....	52
Table 38. Responses to Current Trip Net Economic Value Question	53
Table 39: Estimated Mean Willingness to Pay for Anglers' Recent Trip to Bristol Bay	54
Table 40. Multivariate explanatory model of willingness to pay for nonresident Bristol Bay fishing trips.....	55
Table 41. Explanatory model of reported sportfishing package trip prices: nonresident Bristol Bay anglers.....	58
Table 42. Comparison of responses to Bristol Bay road development policy questions: Bristol Bay angler residents, non-residents, and non-resident lodge clients	61
Table 43: Socioeconomic Characteristics of Bristol Bay Anglers, by Residency.....	61
Table 44. Bristol Bay Angler Household Income Levels, by Residency	62
Table 45. Comparison of Lodge Mail and Lodge Internet Sample Responses for Selected Survey Questions	63
Table 46. Comparison of Drainages/waters Fished: Internet vs. Mail Lodge Client Samples.....	64
Table 47. Bristol Bay and Alaska Commercial Fishery Permits, Harvest, and Gross Earnings (2002).....	68
Table 48. Bristol Bay Salmon Harvest and Ex Vessel Value	68
Table 49. Time Series Average Annual Ex Vessel Prices for Bristol Bay Salmon: Real and Nominal.....	71
Table 50. 2004 and 2005 Bristol Bay Harvest and Earnings.....	72
Table 51. 1999-2003 Bristol Bay Drift Gillnet Earnings, Costs, and Net Returns.....	73
Table 52. Bristol Bay Region Fishing Permits and Crew Members, 2005.....	74
Table 53. Distribution of Commercial Fishing Permit Holders by Residency and 2005 Harvest and Earnings	75
Table 54. Comparison of 1995 and 2004 Permit Ownership.....	76
Table 55. Time Series, Bristol Bay Drift Gillnet Basic Information Table.....	77
Table 56. Time Series, Bristol Bay Set Gillnet Basic Information Table.....	78
Table 57. Commercial Salmon Processors and Buyers Operating in Bristol Bay, 2004.	79
Table 58. Changes in Estimated End-markets for United States Sockeye Salmon (Source: Knapp 2004).....	81
Table 59. 2005 Bristol Bay Salmon Fishery Processing and Gross Earnings	81
Table 60. Comparison of Bristol Bay Harvest and Processing Total Earnings (2005) ...	82
Table 61. 2003-2005 Total Bristol Bay Fishery Salmon Production Value, by End-product Type	82

Table 62. ADF&G Division of Subsistence Average Per Capita Subsistence Harvest for Bristol Bay Communities.....	85
Table 63. Historical Subsistence Harvest for Bristol Bay, Alaska. (Knapp et al. 2004) .	86
Table 64. Bristol Bay Subsistence Salmon Harvests by Location, 2003. (Knapp et al. 2004).....	87
Table 65. Estimated Total Annual Bristol Bay Area Subsistence-Related Expenditures	88
Table 66. ADF&G Reported Big Game Hunting in Bristol Bay and Alaska Peninsula Game Management Units	89
Table 67. Estimated annual big game hunting expenditures for Bristol Bay region	89
Table 68. Economic Significance of Bristol Bay Ecosystems.....	92
Table 69. Employment in the Bristol Bay Region, 2004.....	94
Table 70. Federal Spending in the Bristol Bay Region 2004 (\$000).....	94
Table 71. Residence of Workers in the Bristol Bay Region, 2002.....	96
Table 72. Personal Income in the Bristol Bay Region, 2004 (000\$).....	97
Table 73. Economic Significance of Commercial Fishing—Harvest and Processing	98
Table 74. Recreational Trips and Expenditures in the Bristol Bay Region, 2005	99
Table 75. Economic Significance of All Recreational Trips	101
Table 76. Economic Significance of Sport Fishing	102
Table 77. Economic Significance of Sport Hunting	103
Table 78. Economic Significance of Passive Use Visits	104
Table 79. Economic Significance of Subsistence	105
Table 80. Current Bristol Bay Salmon Fishing Permit Numbers and sale prices, 2005.	106
Table 81. Estimated Net Economic Annual Value of Bristol Bay Area Subsistence Harvest.....	108
Table 82. Estimated Willingness to Pay for Sportfishing Fishing in the Bristol Bay Region.....	109
Table 83. Estimated annual big game hunting net economic value for Bristol Bay region	109
Table 84: Summary of Bristol Bay Ecosystem Services, Net Economic Value per Year (Million 2005 \$).....	111

List of Figures

Figure 1. Map of Bristol Bay Study Area.....	10
Figure 2. Bristol Bay Area Location and Major Communities.....	12
Figure 3. Bristol Bay Area Commercial Salmon Fishery Management Districts.....	13
Figure 4. Bristol Bay Area Location and Major Communities.....	23
Figure 5. Map of Bristol Bay Study Area.....	24
Figure 6. Flows of Ecosystem Services (Adapted from NRC 2005).....	26
Figure 7. Comparison of Resident and Nonresident Bristol Bay Angler Trip Types.....	44
Figure 8. Bristol Bay and Kenai angler rating of selected fishing trip attributes.	47
Figure 9. Distribution of Trip Length, Bristol Bay Package Fishing Trips	56
Figure 10. Bristol Bay Package Fishing Trips, Services Provided	57

Figure 11. Bristol Bay Angler Responses to Impact of Bristol Bay Road Access on Sportfishing.....	59
Figure 12. Bristol Bay Angler Support and Opposition to Bristol Bay Road Access	60
Figure 13. Bristol Bay Area Commercial Salmon Fishery Management Districts (ADFG 2005)	67
Figure 14. Time Series of Bristol Bay Salmon Harvest, pounds (Source: Knapp 2004).	69
Figure 15. Time Series of Bristol Bay Salmon Harvest, Number of Fish (Source: Knapp 2004).	70
Figure 16. Time Series, Ex Vessel Price of Bristol Bay Sockeye Salmon (Source: Knapp 2004).	70
Figure 17. Time Series, Real and Nominal Ex Vessel Value. (Source: Knapp 2004).	72
Figure 18. Time Series, Bristol Bay Sockeye Salmon Harvest and Production. (Source: Knapp 2004).	80
Figure 19. Time Series, Frozen and Canned Production of Bristol Bay Sockeye Salmon (Source: Knapp 2004).	83
Figure 20. Time Series, Average Prices of Bristol Bay Sockeye Salmon. (Source: Knapp 2004).	83
Figure 21. Distribution of Bristol Bay Subsistence Harvest.....	84

Executive Summary

This report provides estimates of the economic values associated with sustainable use of wild salmon ecosystem resources, primarily fisheries and wildlife, of the major watersheds of the Bristol Bay, Alaska region. Both regional economic significance and social benefit-cost accounting frameworks are utilized. This study reviews and summarizes existing economic research on the key sectors in this area and reports findings based on original survey data on expenditures, net benefits, attitudes, and motivations of the angler population.

The major components of the total value of the Bristol Bay area watersheds include subsistence use, commercial fishing, sportfishing and other recreation, and the preservation values (or indirect values) held by users and the U.S. resident population. The overall objectives of this proposed work are to estimate the share of the total regional economy (expenditures, income and jobs) that is dependent on these essentially pristine wild salmon ecosystems, and to provide a preliminary but relatively comprehensive estimate of the total economic value (from a benefit-cost perspective) that could be at risk from extractive resource development in the region.

The rivers that flow into the Bristol Bay comprise some of the last great wild salmon ecosystems in North America (Figure 1). The Kvichak River system supports the world's largest run of sockeye salmon. While these are primarily sockeye systems, all five species of Pacific salmon are abundant, and the rich salmon-based ecology also supports many other species, including Alaska brown bears and healthy populations of rainbow trout. The Naknek, Nushagak, Kvichak, Igushik, Egegik, Ugashik, and Togiak watersheds are all relatively pristine with very few roads or extractive resource development. Additionally, these watersheds include several very large and pristine lakes, including Lake Iliamna and Lake Becherof. Lake Iliamna is one of only two lakes in the world that supports a resident population of freshwater seals (the other is Lake Baikal in Russia). The existing mainstays of the economy in this region are all wilderness-compatible and sustainable in the long run: subsistence use, commercial fishing, and wilderness sportfishing. The commercial fishing is largely in the salt water outside of the rivers themselves and is closely managed for sustainability. The subsistence, sportfish and other recreation sectors are relatively low impact (primarily personal use and catch and release fishing, respectively). Additionally, there are nationally-important public lands in the headwaters, including Lake Clark National Park and Preserve, Katmai National Park and Preserve, Togiak National Wildlife Refuge, and Wood-Tikchick State Park (the largest state park in the U.S.).

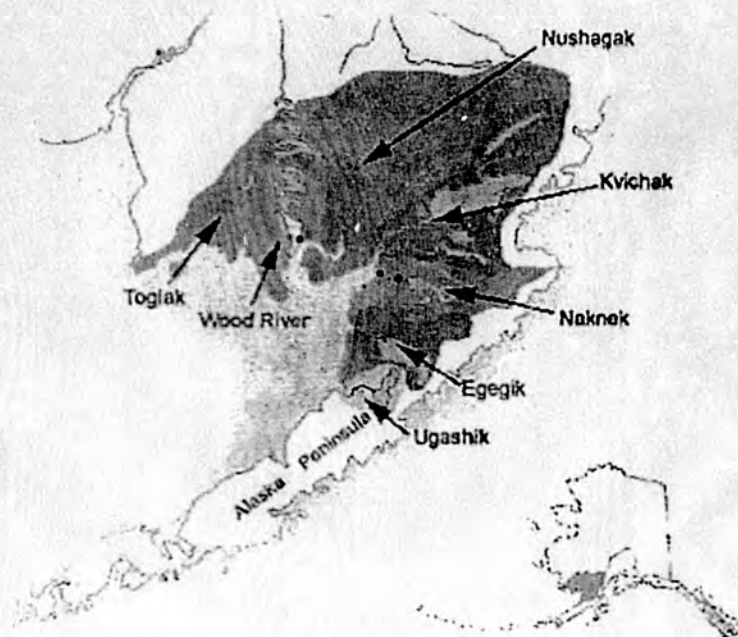


Figure 1. Map of Bristol Bay Study Area

A complete economic analysis would be conducted in several phases. The current study focuses on: 1) an overview of values based on existing data and previous studies, 2) original data collection focused on the sportfish sector, including angler surveys, and 3) estimation of both the regional economic significance (focusing on jobs and income) of these ecosystems using an existing regional economic model, as well as total value in a social benefit-cost framework. The objective is to provide a preliminary but relatively comprehensive estimate of the range of fishery-related values in this region (Figure 1).

This summary provides a brief characterization of each of the major sectors, followed by the primary economic findings.

The Bristol Bay economy is a mixed cash-subsistence economy. The primary features of these socio-economic systems include use of a relatively large number of wild resources (on the order of 70 to 80 specific resources in this area), a community-wide seasonal round of activities based on the availability of wild resources, a domestic mode of production (households and close kin), frequent and large scale noncommercial distribution and exchange of wild resources, traditional systems of land use and occupancy based on customary use by kin groups and communities, and a mixed economy relying on cash and subsistence activities (Wolfe and Ellanna, 1983; Wolfe et al. 1984). The heart of this cash-subsistence economy is the resident population of 7,611 individuals (in the year 2000) located in 25 communities (Table 1) spread across this primarily un-roaded area (Figure 2). Archeological evidence indicates that Bristol Bay has been continuously inhabited by humans at least since the end of the last major glacial period about 10,000 years ago. Three primary indigenous cultures are represented here:

Aleuts, Yupik Eskimos, and the Dena'ina Athapaskan Indians. The share of the population that is Alaska Native is relatively high at 70 percent, compared to Alaska as a whole, with 16 percent.

Table 1. Bristol Bay Area Communities, Populations, and Subsistence Harvest

Bristol Bay Area Community /year of harvest data	Population (2000 census)	Per Capita Harvest	Total Annual Harvest	% Native Population
Aleknagik 1989	221	379	54,079	81.9%
Clark's Point 1989	75	363	20,325	90.7%
Dillingham 1984	2,466	242	494,486	52.6%
Egegik 1984	116	384	37,450	57.8%
Ekwok 1987	130	797	85,260	91.5%
Igiugig 1992	53	725	33,915	71.7%
Iliamna 2004	102	508	51,816	50.0%
King Salmon 1983	442	220	81,261	29.0%
Kokhanok 1992	174	1,013	175,639	86.8%
Koliganek 1987	182	830	154,705	87.4%
Levelock 1992	122	884	97,677	89.3%
Manokotak 1985	399	384	118,337	94.7%
Naknek 1983	678	188	72,110	45.3%
New Stuyahok 1987	471	700	247,494	92.8%
Newhalen 2004	160	692	110,720	85.0%
Nondalton 2004	221	358	79,118	89.1%
Pedro Bay 2004	50	306	15,300	40.0%
Pilot Point 1987	100	384	24,783	86.0%
Port Alsworth 2004	104	133	13,832	4.8%
Port Heiden 1987	119	408	41,985	65.6%
South Naknek 1992	137	297	39,893	83.9%
Ugashik 1987	11	814	8,144	72.7%
Togiak City	809	--	--	86.3%
Portage Creek	36	--	--	86.1%
Twin Hills	69	--	--	84.1%
Total communities	7,447	--	--	--
Unincorporated areas	164	--	--	--
Total (interpolated to include unincorporated areas)	7,611	315	2,397,970	69.6%

Sources: US Census Bureau (2000 census statistics), and ADF&G Division of Subsistence Community Profile Data Base. & Fall et al. 2006. Note: % native indicates those who classify themselves as Native only.

Wild renewable resources are important to the people of this region and many residents rely on wild fish, game and plants for food and other products for subsistence use. Total harvest for these 25 communities is on the order of 2.4 million pounds based largely on surveys undertaken in the late 1980's and early 1990's, as summarized in the Alaska Division of Subsistence community profile data base. A new round of surveys is now underway to update this data. Estimates for the 2004 study year (Fall et al. 2006) for five communities (Newhalen, Nondalton, Iliamna, Pedro Bay, and Port Alsworth) are included in the data presented in Table 1. Per capita harvests averaged about 315 pounds. Primary resources used include salmon, other freshwater fish, caribou, and moose. Subsistence use continues to be very important for communities of this region, based on

these recent surveys, and participation in subsistence activity, including harvesting, processing, giving and receiving is quite high. Compared to other regions of Alaska, the Bristol Bay area has some characteristic features, including the great time depth of its cultural traditions, its high reliance on fish and game, the domination of the region's market economy by the commercial salmon fishery, and the extensive land areas used by the region's population for fishing, hunting, trapping and gathering. (Wright, Morris, and Schroeder, 1985).



Figure 2. Bristol Bay Area Location and Major Communities

The primary private source of cash employment for participants in Bristol Bay's mixed cash-subsistence economy is the commercial salmon fishery. The compressed timing of this fishery's harvesting activity makes it a good fit with subsistence in the overall Bristol Bay cash-subsistence economy. Many commercial fishing permit holders and crew members, as well as some employees in the processing sector, are residents of Bristol Bay's dominantly-native Alaskan villages. In 2004, there were 952 resident commercial fishing permit holders in the Bristol Bay study area, as well as 920 crew members. This is a significant share of the area's total adult population. An ADF&G summary of subsistence activity in Bristol Bay (Wright, Morris, and Schroeder 1985) noted that as of the mid-1980's traditional patterns of hunting, fishing, and gathering activities had for the most part been retained, along with accommodations to participate in the commercial fishery and other cash-generating activities. In the abstract to this 1985 paper, the authors

characterize the commercial salmon fishery as "a preferred source of cash income because of its many similarities to traditional hunting and fishing, and because it is a short, intense venture that causes little disruption in the traditional round of seasonal activities while offering the potential for earning sufficient income for an entire year." Commercial fishing is a form of self employment requiring many of the same skills, and allowing nearly the same freedom of choice as traditional subsistence hunting and fishing. (Wright, Morris, Schroeder 1985; p. 89).

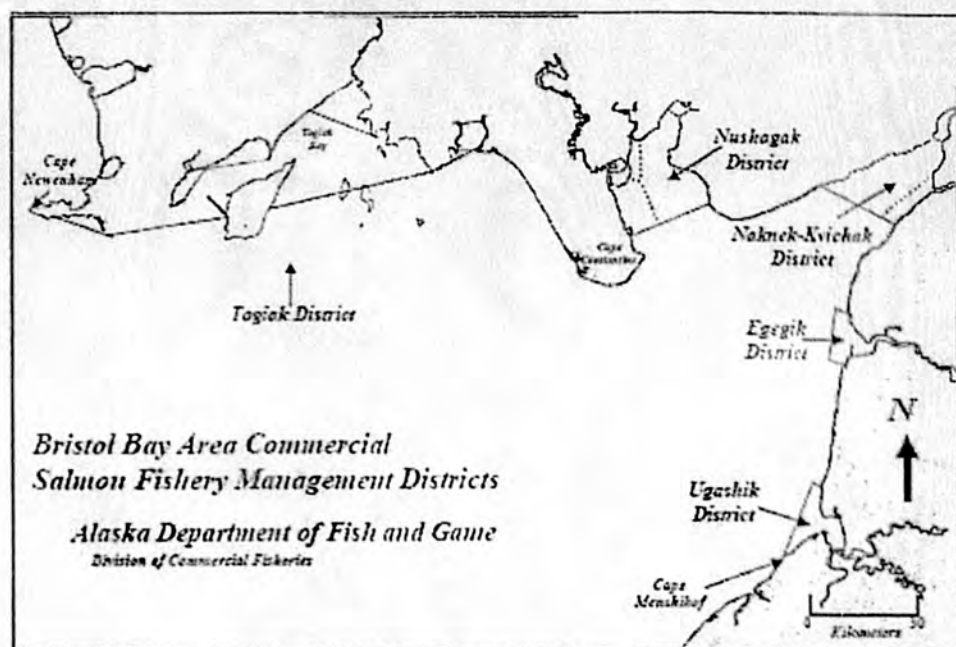


Figure 3. Bristol Bay Area Commercial Salmon Fishery Management Districts

The Bristol Bay commercial fisheries management area encompasses all coastal and inland waters east of a line from Cape Menikof to Cape Newenham (Figure 3). This area includes eight major river systems: Naknek, Kvichak, Egegik, Ugashik, Wood, Nushagak, Igushik and Togiak. Collectively these rivers support the largest commercial sockeye salmon fishery in the world (ADF&G, 2005). This is an interesting and unique fishery, both because of its scale and significance to the local economy, but also because it is one of the very few major commercial fisheries in the world that has been managed on a sustainable basis.

The five species of pacific salmon found in Bristol Bay are the focus of the major commercial fisheries. Sockeye salmon is the primary species harvested both in terms of pounds of fish and value. Annual commercial catches between 1984 and 2003 averaged nearly 24 million sockeye salmon, 69,000 chinook, 971,000 chum, 133,000 coho, and 593,000 (even year only) pink salmon (ADF&G, 2005). Prices for sockeye salmon are typically higher than for other salmon species, making the Bristol Bay fishery the most

valuable of Alaska's salmon fisheries (CFEC, 2004). Nearly one-third of all earnings from Alaska salmon fishing come from the Bristol Bay fishery (Table 2). This is also the largest Alaska fishery in terms of the number of permit holders. In 2004, there were 1,857 potentially active entry permits in the drift gillnet fishery and 992 in the set gillnet fishery (CFEC, 2004).

Table 2. Bristol Bay and Alaska Commercial Fishery Permits, Harvest, and Gross Earnings, 2002

Sector	# permit holders	# permits	Pounds	Gross earnings
Bristol Bay Salmon	2,850	2,276	165,582,203	\$94,571,755
Drift gillnet	1,862	1,447	135,549,944	\$77,243,936
Set gillnet	988	829	30,032,259	\$17,327,819
All Alaska Salmon	10,594	7,508	872,577,336	\$293,147,368
All Alaska Fisheries	14,318	13,463	3,842,853,863	\$990,099,365

Source: Derived from ADFG (2005)

The fishery is organized into five major districts (Figure 3) including Togiak, Nushagak, Naknek-Kvichak, Egegik, and Ugashik. Management is focused on discrete stocks with harvests directed at terminal areas at the mouths of the major river systems (ADF&G, 2005). The stocks are managed to achieve an escapement goal based on maximum sustained yield. The returning salmon are closely monitored and counted and the openings are adjusted on a daily basis to achieve desired escapement. Having the fisheries near the mouths of the rivers controls the harvest on each stock, which is a good strategy for protection of the discrete stocks and their genetic resources. The trade-off is that the fishery is more congested and less orderly, and the harvest is necessarily more of a short pulse fishery, with most activity in June and early July. This has implications for the economic value of the fish harvest, both through effects on the timing of supply, but also on the quality of the fish. Most fish are canned or frozen, rather than sold fresh. The fishery is quite cyclical in terms of run size and potential harvest. For example, harvests were as low as only several million fish in the early 1970's, but exceeded 45 million fish in the early 1990's. Prices have also varied quite dramatically historically. In real terms (constant 2005 dollars) prices peaked at \$3.15 per pound in 1989 and reached a recent historical low of about \$0.40 a pound in 2002. Prices are currently low because of competition with farmed salmon and other factors. For the period 1985 to 2005, total production value for processors averaged about \$288 million, with a low of \$95 million in 2002. Total production value in 2005 was \$225 million. According to the Commercial Fish Entry Commission (2004) the total salmon return to Bristol Bay is strongly influenced by sockeye returns to the Kvichak River, which is historically the largest salmon resource in the region, and perhaps the largest in the world. The sockeye return to the Kvichak is highly variable, and exhibits a pattern of oscillating cycles. In recent years the Kvichak sockeye return has been weaker, and the river has been classified as a "stock of management concern" by the Alaska Department of Fish and Game and the Alaska Board of Fisheries.

Next to commercial fishing and processing, recreational angling is the most important private economic sector in the Bristol Bay region. The 2005 Bristol Bay Angler Survey, which was undertaken for purposes of this report, confirmed that the fresh water rivers, streams, and lakes of the region are a recreational resource equal or superior in quality to other world renowned fisheries.

In their survey responses Bristol Bay anglers consistently emphasized the importance of Bristol Bay's un-crowded, remote, wild setting in their decisions to fish the area. Additionally, a significant proportion of respondents to the survey specifically traveled to the region to fish the world-class rainbow fisheries. These findings indicate that Bristol Bay sport fishing is a relatively unique market segment, paralleling the findings of Romberg (1999) that angler motivation and characteristics vary significantly across Alaska sport fisheries.

Recreational fishing use of the Bristol Bay region is roughly divided between 65% trips to the area by Alaska residents and 35% trips by nonresidents. These nonresidents (approximately 13,000 trips in 2005 (personal communication, ADF&G, 2006)) account for the large majority of total recreational fishing spending in the region. It is estimated that in 2005 approximately \$48 million was spent in Alaska by nonresidents specifically for the purpose of fishing in the Bristol Bay region. In total, it is estimated that \$61 million was spent in Alaska in 2005 on Bristol Bay fishing trips.

While sport fishing within the Bristol Bay region comprises the largest share of recreational use and associated visitor expenditures, several thousand trips to the region each year are also made for the primary purpose of sport hunting and wildlife viewing.

Table 3 through 8 detail the summary results of the analysis of economic values. Table 3 shows estimated direct expenditures in Alaska related to harvest or use of Bristol Bay area renewable resources. Total estimated direct expenditures (that drive the basic sector of the economy) were estimated to be \$324 million in 2005. The largest component is commercial fishing harvesting and processing. These estimates were obtained from the Alaska Department of Revenue and the Commercial Fishing Entry Commission. The range shown of low and high estimates reflects the cyclical nature of this sector, and is based on a 95 percent confidence interval for total earnings in this sector between 1985 and 2005. The next most significant component is sportfishing at \$61 million in 2005. This estimate is derived from original survey data as described below, and a 95 percent confidence interval for this 2005 estimate is relatively imprecisely estimated at zero to \$123.2 (this broad range reflects the statistical uncertainty within a number of estimated parameters used to estimate spending, including average spending per angler and average number of trips per year per angler). Sport hunting and wildlife viewing / tourism are less important economically. The wildlife viewing and tourism estimates are approximate, and reflect a small share of the visitation at Katmai National Park. Most of the visitation at Katmai is expected to be picked up in the sportfishing use estimates and is excluded here to avoid double-counting.

Table 3. Summary of Regional Economic Expenditures Based on Wild Salmon Ecosystem Services (Million 2005 \$)

Ecosystem Service	Estimated direct expenditures / sales per year	Low estimate	High estimate
Commercial fish wholesale value	\$226.0	\$226.0	\$346.0
Sport fisheries	\$61.2	0	\$123.2
Sport hunting	\$12.4	\$12.4	\$12.4
Wildlife viewing / tourism	\$17.1	\$17.1	\$17.1
Subsistence harvest expenditures	\$7.2	\$7.2	\$7.2
Total direct annual economic impact	\$323.90	\$262.70	\$505.90

Table 4 provides additional detail on recreation expenditures, including number of trips and spending by residence of the participants. A large share of sportfish expenditures, and hence of total recreation expenditures, is by nonresident anglers (\$48 of \$61 million). This reflects the high quality of this fishery, in that it is able to attract participants from a considerable distance in the lower 48 states as well as foreign countries.

Table 4. Total Estimated Recreational Direct Spending in Alaska Attributable to Bristol Bay Wild Salmon Ecosystems, 2005

Sector	Alaska Residents			Nonresidents	Total
	Local residents	Non-local residents	Total Alaska		
(A) TRIPS					
Sport fishing	19,488	4,450	23,938	12,966	60,842
Sport hunting	-	1,538	1,538	2,310	3,848
Wildlife viewing / tourism	-	1,000	1,000	9,000	10,000
Total	19,488	6,988	26,476	24,276	50,752
(B) SPENDING					
Sport fishing	\$6,606,432	\$6,397,747	\$13,004,179	\$48,207,588	\$61,211,767
Sport hunting	-	\$2,214,720	\$2,214,720	\$10,870,860	\$13,085,580
Wildlife viewing / tourism	-	\$970,010	\$970,010	\$16,168,280	\$17,138,290
Total	\$6,606,432	\$9,582,477.00	\$16,188,909	\$75,246,728.00	\$91,435,637.00

Table 5 summarizes the full time equivalent employment associated with the sectors of the Bristol Bay economy that are dependent on wild salmon ecosystems. A total of 5,540 full time equivalent jobs are supported, with an estimated 1,598 of these held by local residents of Bristol Bay, 1,829 by non-local Alaskans (for a total of 3,430 Alaska jobs) and 2,110 by nonresidents. Three-fourths of these jobs are in the commercial fish sector (4,239) and about one-fourth in recreation. A small number of jobs (49) are also shown for subsistence, based on expenditures made by subsistence participants for supplies and

equipment to support subsistence activity. However, this perspective on subsistence is somewhat misleading, as it is only from the cash side of the mixed cash-subsistence economy. The level of full-time equivalent subsistence jobs was estimated for a similar sized population of Bristol Bay residents by Goldsmith et al. (1998) at 762 jobs. This is based on the approximation that the average Alaska Native (3,048 in Goldsmith's population) participates in subsistence activities a total of three months a year, and that non-natives participate not at all. Unfortunately there is not much evidence to support or refute this estimate, but it does indicate the possible significance of subsistence employment from a broader perspective than that of just the cash economy as shown in Table 5.

Table 5. Total Full Time Equivalent (FTE) Employment in Alaska Dependent on Bristol Bay Wild Salmon Ecosystems, 2005

Sector	Alaska Residents			Nonresidents	Total FTE jobs
	Local residents	Non-local residents	Total Alaska		
Commercial fishing	689	667	1,357	1,172	2,529
Commercial processing	465	449	914	796	1,710
Sport fishing	288	435	723	123	846
Sport hunting	60	105	165	2	167
Wildlife viewing / tourism	82	139	222	17	239
Subsistence	14	34	49	0	49
Total FTE jobs	1598	1829	3,430	2,110	5,540

A related perspective is that angler effort in the sport fishery is on the order of 100,000 angler days (for example, 106,000 in the year 2000), mostly in the June-September period. From the theoretical economic "household production" perspective of anglers utilizing capital and labor resources to produce themselves a good outdoor experience, this is the equivalent of about 400 full time equivalent jobs. An interesting feature of the sportfish sector, and one that limits its economic impact relative to the commercial fishery, is that there is essentially no (or only a very limited) processing sector in this dominantly catch and release fishery.

The overall structure of the Bristol Bay economy is shown in Table 6. This estimate was derived by starting from the official employment data reported by the U.S. Bureau of Economic Analysis and the Alaska Department of Labor. These sources miss some of the wage and salary employment in the region as well as non local resident proprietors (self employed). Revised employment data developed for this study shows that the annual average employment in the Bristol Bay economy was 7,691 jobs in 2004. The private sector basic employment in this economy is currently almost totally dependent on Bristol Bay's wild salmon ecosystems with mining contributing a small amount. The only other basic driver is government employment (here including hospitals and other non profit enterprises which are publicly funded). As a share of all basic employment, the salmon ecosystem-dependent sectors account for 64 percent of all the basic employment that drives this cash economy. A good share of the non-basic employment is also derived

through induced and indirect effects (multiplier effect) from the ecosystem sectors as well. Furthermore, although government is here considered a BASIC sector activity because it brings money into the local economy, in the absence of the salmon ecosystem, regional population would surely be smaller and the government presence would also shrink.

Table 6. Structure of the Bristol Bay Economy, 2004

	ANNUAL AVERAGE	SUMMER (July)	WINTER (January)	SWING (Jan- July)
JOBS BY PLACE OF WORK	7,691	16,631	3,640	12,991
BASIC	6,251	15,028	2,304	12,724
Fish Harvesting	2,552	7,657	0	7,657
Fish Processing	1,150	4,193	200	3,993
Recreation	311	933	0	933
Government / Health	2,098	1,795	2,104	(309)
Mining	150	450	0	450
NON-BASIC	1,440	1,603	1,336	267
Construction	64	80	56	24
Trade/Transport/Leisure	642	765	580	185
Finance	127	118	116	2
Other Wage and Salary	180	213	157	56
Other Proprietors	427	427	427	0
JOBS BY PLACE OF RESIDENCE				
Local Resident	4,233	5,741	3,640	2,101
All Non Local	3,458	10,890	0	10,890

Table 6 also shows the extreme seasonal nature of this economy. From a winter low of 3,640 jobs, employment climbs by almost 13 thousand jobs to a total of 16,631 in summer. Since the total resident population (including children and the elderly) is only about 7,600 a large share of the seasonal increase must be filled by non local residents. The most seasonally stable component of the economy is government, which actually declines by about 300 jobs in summer, reflecting the academic year schedules of teachers. The winter employment pattern reveals the bare bones of the local cash economy, absent almost all of the cash employment jobs associated with fishing and recreation, except for about 200 jobs in commercial fish processing.

Subsistence users are not the only hunter-gatherers in this economy. Essentially the entire private economy is "following the game" (or, in this case, the fish), with many commercial fishers, processors, sport anglers, sport hunters and wildlife viewers coming from elsewhere in Alaska or the lower 48 to be part of this unique economy at the time that fish and game are available.

The estimated payroll associated with the salmon ecosystem-dependent jobs is shown in Table 7. The total is \$161 million in 2005, including \$46.8 million to Bristol Bay residents and a total of \$103.4 million to all Alaska residents.

Table 7. Total Alaska Payroll Associated with Use of Bristol Bay Wild Salmon Ecosystems, 2005 (Million 2005 dollars)

Payroll paid to:	Commercial fishing	Sport Fishing	Hunting	Other Recreation	Subsistence	Total
Local residents	\$34.554	\$8.180	\$1.536	\$2.015	\$0.525	\$46.810
Non-local residents	\$33.242	\$14.491	\$3.392	\$4.235	\$1.183	\$56.543
All Alaska Residents	\$67.796	\$22.671	\$4.929	\$6.250	\$1.707	\$103.353
Non Residents	\$52.694	\$4.303	\$0.087	\$0.597	\$0	\$57.681
TOTAL	\$120.490	\$26.974	\$5.016	\$6.847	\$1.707	\$161.034

The preceding discussion has focused on a regional economic accounting framework. Table 8 introduces the net economic value measures for evaluation of the renewable Bristol Bay resources. Commercial salmon fishery net economic values are derived by annualizing permit values, which are exchanged in an open market and reported by the Commercial Fish Entry Commission. These are on the order of \$51,200 for a drift gillnet permit in 2005 in total, but have been as high as \$200,000 as recently as 1993. Subsistence harvests are valued based on the willingness-to-pay revealed through tradeoffs of income and harvest in choice of residence location (Duffield 1997).

The sportfish net economic value is based on original data collected for purposes of this study, as reported below. These estimates are consistent with values from the extensive economic literature on the value of sportfishing trips. Sport hunting and wildlife viewing values are based on studies conducted about fifteen years ago in Alaska, and which need to be updated. Direct use values total from \$104 million to \$179 million.

A major unknown is the total value for existence and bequest (also called passive use values). Goldsmith et al. (1998) estimated the existence and bequest value for the federal wildlife refuges in Bristol Bay at \$2.3 to \$4.6 billion per year (1997 dollars). There is considerable uncertainty in these estimates, as indicated by the large range of values. Goldsmith's estimates for the federal wildlife refuges are based on the economics literature concerning what resident household populations in various areas (Alberta, Colorado) (Adamowicz et al. 1991; Walsh et al. 1984; Walsh et al. 1985) are willing to pay to protect substantial tracts of wilderness. Similar literature related to rare and endangered fisheries, including salmon, could also be appealed to here. It is possible that from a national perspective the Bristol Bay wild salmon ecosystems and the associated economic and cultural uses are sufficiently unique and important to be valued as highly as wilderness in other regions of the U.S. Goldsmith et al.'s (1998) estimates assume that a significant share of U.S. households (91 million such households) would be willing to pay on the order of \$25 to \$50 per year to protect the natural environment of the Bristol Bay federal wildlife refuges. The number of these households is based on a willingness to pay study (the specific methodology used was contingent valuation) conducted by the State of Alaska Trustees in the Exxon Valdez oil spill case (Carson et al. 1992). The

findings of this study were the basis for the \$1 billion settlement between the State and Exxon in this case. These methods are somewhat controversial among economists, but when certain guidelines are followed, such studies are recommended for use in natural resource damage regulations (for example, see Ward and Duffield 1992). They have also been upheld in court (Ohio v. United States Department of Interior, 880 F.2d 432-474 (D.C. Cir.1989)) and specifically endorsed by a NOAA-appointed blue ribbon panel (led by several Nobel laureates in economics) (Arrow et al. 1993).

Goldsmith's estimates for just the federal refuges may be indicative of the range of passive use values for the unprotected portions of the study area. However, there are several caveats to this interpretation. First, Goldsmith et al. estimates are not based on any actual surveys to calculate the contingent value specific to the resource at issue in Bristol Bay. Rather, they are based on inferences from other studies (benefits transfer method). Second, these other studies date from the 1980's and early 1990's and the implications of new literature and methods have not been examined. Additionally, the assumptions used to make the benefits transfer for the wildlife refuges may not be appropriate for the Bristol Bay study area. This is an area for future research.

Table 8. Summary of Bristol Bay Wild Salmon Ecosystem Services, Net Economic Value per Year (Million 2005 \$)

Ecosystem Service	Low estimate	High estimate
Commercial salmon fishery	\$9.4	\$18.8
Sport fishing	\$13.5	\$13.5
Sport hunting	\$1.8	\$1.8
Wildlife viewing / tourism	\$1.8	\$1.8
Subsistence harvest	\$77.8	\$143.1
Total Direct Use Value	\$104.30	\$179.00
Existence and Bequest Value	Not estimated	Not estimated

The estimates in Table 8 are for annual net economic values. Since these are values for renewable resource services that in principle should be available in perpetuity, it is of interest to also consider their present value (e.g. total discounted value of their use into the foreseeable future). Recent literature (EPA 2000; Weitzman 2001) provides some guidance on the use of social discount rates for long term (intergenerational) economic comparisons. A rate as low as 0.5% has been recommended by EPA (2000). Weitzman, based on an extensive survey of members of the American Economic Association, suggests a declining rate schedule, which may be on the order of 4 percent (real) in the near term and declining to near zero in the long term. He suggests a constant rate of 1.75% as an equivalent to his rate schedule. Applying this parameter to the net economic values shown in Table 8 results in a net present value of \$6.0 billion to \$10.2 billion for just the direct uses.

1.0 Introduction

This report provides information on the importance of wild fisheries and the natural environment in the Bristol Bay region to the economies of the Bristol Bay region, the State of Alaska and the U.S. as a whole.

1.1 Study Objectives

This report provides estimates of the economic values associated with sustainable use of wild salmon ecosystem resources, primarily fisheries and wildlife, of the major watersheds of the Bristol Bay, Alaska region. Both regional economic significance and social benefit-cost accounting frameworks are utilized. This study reviews and summarizes existing economic research on the key sectors in this area and reports on original survey data on expenditures, net benefits, attitudes and motivations of the angler population.

The major components of the total value of the Bristol Bay area wild salmon ecosystems include subsistence use, commercial fishing and processing, sportfishing, and the preservation values (or indirect values) held by users and the U.S. resident population. The overall objectives of this work are to estimate the share of the total regional economy (expenditures, income and jobs) that is dependent on these essentially pristine wild salmon ecosystems, and to provide a preliminary but relatively comprehensive estimate of the total economic value (from a benefit-cost perspective) associated with the ecosystem.

1.2 Definition of Study Area

The Bristol Bay region is located in southwestern Alaska. The area is very sparsely populated and the large majority of its population is comprised of Alaskan Natives (Table 9). The region, which includes Bristol Bay Borough, the Dillingham Census Area, and a large portion of Lake and Peninsula Borough contains a relatively small number of communities, the largest of which are shown in Figure 4. Although median household income varies among census areas within the region, outside of the relatively small Bristol Bay Borough, income is somewhat lower than for the state of Alaska as a whole. As noted, Alaskan Natives make up over two-thirds of the total population within the region as compared to approximately 16% for the entire state (Table 9)

Table 9. Demographic and Socioeconomic Characteristics of the Bristol Bay Region

<i>Area</i>	<i>Population 2004</i>	<i>Percent Alaska native</i>	<i>Percent 18 or over</i>	<i>Number of households</i>	<i>Median household income 1999</i>
Bristol Bay Borough	1,103	43.7%	68.7%	490	\$ 52,167
Dillingham Census Area	4,924	70.1%	61.9%	2,341	\$ 43,079
Lake & Peninsula Borough	1,584	73.5%	62.2%	588	\$ 36,442
Total Bristol Bay Region	7,611	67.0%	62.9%	3,419	\$ 43,015
State of Alaska	655,435	15.6%	69.6%	221,600	\$ 51,571

Source: US Census Quickfacts. Quickfacts.census.gov**Table 10. Bristol Bay Area Communities and Populations**

<i>Bristol Bay Area Community</i>	<i>Population (2000 census)</i>	<i>% Native Population</i>
Aleknagik	221	81.9%
Clark's Point	75	90.7%
Dillingham	2,466	52.6%
Egegik	116	57.8%
Ekwok	130	91.5%
Igiugig	53	71.7%
Iliamna	102	50.0%
King Salmon	442	29.0%
Kokhanok	174	86.8%
Koliganek	182	87.4%
Levelock	122	89.3%
Manokotak	399	94.7%
Naknek	678	45.3%
New Stuyahok	471	92.8%
Newhalen	160	85.0%
Nondalton	221	89.1%
Pedro Bay	50	40.0%
Pilot Point	100	86.0%
Port Alsworth	104	4.8%
Port Heiden	119	65.6%
South Naknek	137	83.9%
Ugashik	11	72.7%
Togiak City	809	86.3%
Portage Creek	36	86.1%
Twin Hills	69	84.1%



Figure 4. Bristol Bay Area Location and Major Communities

This study focuses on the economic contributions of the Bristol Bay ecosystem. The rivers that flow into the Bristol Bay comprise some of the last great wild salmon ecosystems in North America (Figure 5). All five species of Pacific salmon are abundant, and the rich salmon-based ecology also supports many other species, including healthy populations of rainbow trout. The Naknek, Nushagak-Mulchatna, and Kvichak-Lake Iliamna watersheds are relatively pristine with very little roading or extractive resource development. The existing mainstays of the economy in this region are all wilderness-compatible and sustainable in the long run: subsistence use, commercial fishing, and wilderness sportfishing. The commercial fishing is largely in the salt water outside of the rivers themselves and is closely managed for sustainability. The subsistence and sportfish sectors are relatively low impact (primarily personal use and catch and release fishing, respectively). Additionally, there are important public lands in the headwaters, including Lake Clark National Park and Preserve, Katmai National Park and Preserve, and Togiak National Wildlife Refuge.

The Bristol Bay area includes the political designations of Bristol Bay Borough, the Dillingham census area, and most of Lake and Peninsula Borough. The largest town in the area is Dillingham. In 2004 the Dillingham census area had an estimated population of 4,294 (US Census, Quick Facts).

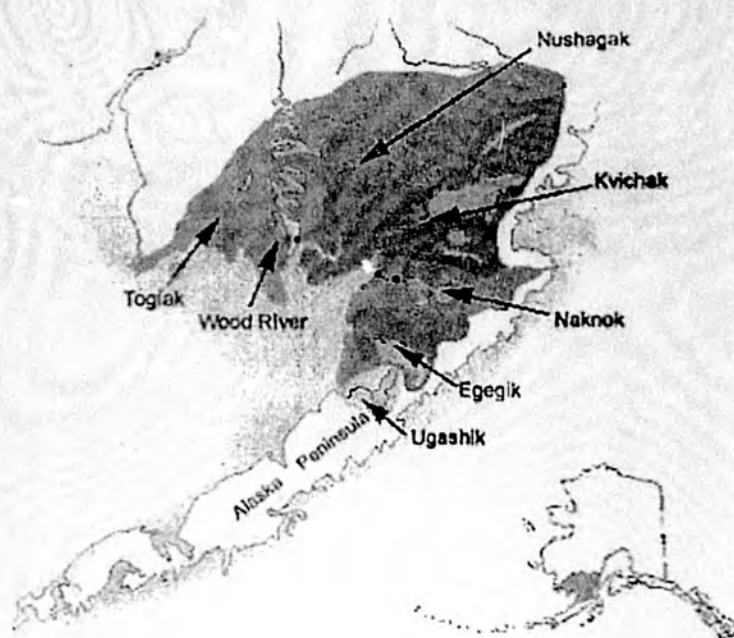


Figure 5. Map of Bristol Bay Study Area

1.3 Focus of Study-Economic Uses

The current research focuses on the ecosystem services provided by the Bristol Bay Region. These services are broad and substantial and include, but are not limited to commercial, aesthetic, recreational, cultural, natural history, wildlife and bird life, and ecosystem services.

A primary dichotomy of economic values is the division of values into those that are, or can be traded within existing economic markets, and those for which no developed market exists. Examples of resource services specific to the Bristol Bay region that are traded in markets are commercial fish harvests and guided fishing trips. While a number of services provided by the Bristol Bay natural resources can be classified as market services (with associated market-derived values), there are many services provided by this area that are classified as non-market services. These non-market resource services include noncommercial fishing, wildlife watching, subsistence harvests, protection of cultural sites, and aesthetic services.

A second dichotomy of resource services and associated values is that of direct use and passive use services and values. The most obvious type, direct use services, relates to direct onsite uses. The second type of resource services are so-called passive use services. These services have values that derive from a given resource and are not dependent on direct on-site use. Several of the possible motives for passive use values were first described by Weisbrod (1964) and Krutilla (1967), and include existence and bequest values. Existence values can derive from merely knowing that a given natural environment or population exists in a viable condition. For example, if there were a proposal to significantly alter the Bristol Bay natural ecosystem, many individuals could experience a real loss, even though they may have no expectation of ever personally visiting the area.

While use services may or may not have associated developed markets for them, passive use services are exclusively non-market services.

When passive use and use values are estimated together, the estimate is referred to as total valuation. This concept was first introduced by Randall and Stoll (1983) and has been further developed by Hoehn and Randall (1989).

The National Research Council in their 2005 publication, "Valuing Ecosystem Services: Toward Better Environmental Decision Making" provided an outline of ecosystem services. Table 11 provides an application of the NRC outline to Bristol Bay resources, and details examples of the ecosystem services, both use and passive use, that are produced by natural resources such as those found in the Bristol Bay region. Additionally, Figure 6 diagrams the flow of ecosystem services.

Table 11: Types of Ecosystem Services

<i>Use Values</i>		<i>Nonuse Values</i>
Direct	Indirect	Existence and Bequest Values
Commercial and recreational fishing	Nutrient retention and cycling	Cultural heritage
Aquaculture	Flood control	Resources for future generations
Transportation	Storm protection	Existence of charismatic species
Wild resources	Habitat function	Existence of wild places
Potable water	Shoreline and river bank stabilization	
Recreation		
Genetic material		
Scientific and educational opportunities		

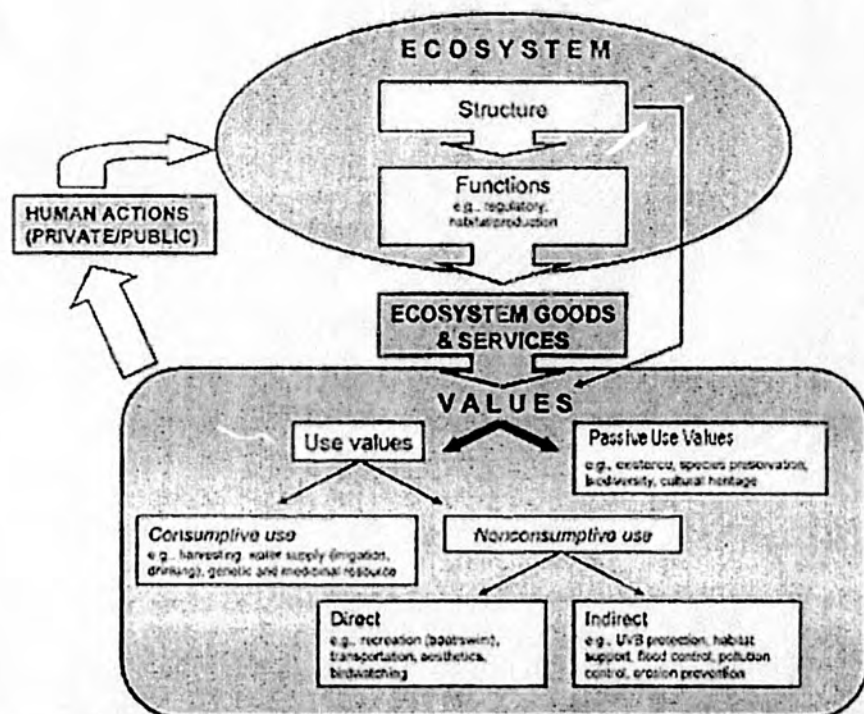


Figure 6. Flows of Ecosystem Services (Adapted from NRC 2005)

A comprehensive economic evaluation of these Bristol Bay wild salmon ecosystems needs to include two accounting frameworks. One is regional economics or economic significance, focused on identifying cash expenditures that drive income and job levels in the regional economy. The other is a net economic value framework that includes all potential costs and benefits from a broader social (usually national) perspective. The latter necessarily includes nonmarket and indirect benefits, such as the benefits anglers derive from their recreational activity, over and above their actual expenditure. Both perspectives are important for policy discussions and generally both accounting frameworks are utilized in evaluating public decisions, for example through the NEPA process (such as environmental impact statements) or in informing public opinion.

2.0 Methods

This section provides information on the statistical methods and modeling procedures utilized in the following analysis.

2.1 Sample Design Methods

The sample for the 2005 Alaska sportfish angler internet survey (and random mail survey) was designed as a random sample of a large share of Alaska Department of Fish and Game 2005 fishing license sales in South-central Alaska. The pool of possible license holders was sampled through a stratified random sample design to increase the probability of sampling freshwater anglers who had fished Bristol Bay streams or lakes in 2005. Respondents were weighted appropriately in analysis to reflect the actual distribution of license sales among the subset of South-central Alaska license vendors that were sampled.

In addition to population weighting, survey responses were also weighted to correct for potential non-response bias using methods developed by Kanninan, Chapman and Hanemann (1992).

The survey procedure followed a standard Dillman (2000) survey methodology using initial contact and repeat follow-ups. Further detail is presented below in Section 4. An example of the angler survey instrument is included as Attachment A.

All analysis and data manipulation was completed using SAS statistical software, and Microsoft Excel.

2.2 Net Economic Value Analysis Methods

The estimation of willingness to pay models described below (see Table 33) was derived using a maximum likelihood interval approach (Welsh and Poe 1998). Respondents were asked to choose the highest amount he or she was willing to pay from a list of possible amounts. It was inferred that the respondent's true willingness to pay was some amount located in the interval between the amount the respondent chose and the next highest amount presented. Let X_{il} be the maximum amount that the i th person would be willing to pay and X_{ih} be the lowest presented amount that person would not pay.

Given this, WTP must lie in the interval $[X_{il}, X_{ih}]$. If $F(X_i; \beta)$ is the statistical distribution function for WTP _{i} , with parameter vector β then the probability that WTP _{i}

lies between two given payment bid amounts is $F(X_{il}; \beta) - F(X_{il}; \beta)$ and the associated log-likelihood function is:

$$\ln(L) = \sum_{i=1}^n \ln [F(X_{il}; \beta) - F(X_{il}; \beta)]$$

The SAS statistical procedure LIFEREG was used to estimate the parametric model of willingness to pay based on the underlying payment card responses.

2.3 Regional Economic Modeling Methods

Calculations of the economic significance of the various uses of the Bristol Bay ecosystem were carried out using the ISER regional Input-Output Model (Goldsmith, 2000). This model has been specifically designed and constructed using Alaska data to calculate the employment, wage, value added, and sales effects on Alaska regional economies from different activities including commercial fishing, recreational spending, and household spending.

Dollars spent in the Bristol Bay region and elsewhere in Alaska by the commercial fishing sector, by recreational visitors, or by subsistence users are input into the model, and the indirect and induced effects of those expenditures are calculated. The indirect effect is the increase in jobs and wages that results from local businesses supplying goods and services to the commercial fishing businesses, visitors, or subsistence hunters. The induced effect is the increase in jobs and wages from consumer purchases by households working for these various businesses. The sum of these effects provides a measure of the importance of these activities to the economy of the region.

The model incorporates a number of structural features that account for unusual characteristics of the regional economies of Alaska. In particular it tracks the residence of workers in different industries and "leakages" of expenditures. Large shares of the workers in both the commercial fishing and recreation industries move into the Bristol Bay region during the summer but live either in other parts of Alaska or outside the state. The model divides the economic effect of the worker payroll between their place of work and their place of residence. Much of the spending by businesses and households in the Bristol Bay region occurs in other parts of Alaska or outside the state. The model tracks where this spending "hits the street" and its impact on jobs and wages is calculated at that location.

3.0 Data Collection

A major emphasis of this study was to update in part the previous data collection efforts that provide information on recreational angling in the Bristol Bay region (Ackley 1988, Romberg 1999). To this end, the current study designed and implemented a suite of surveys in the region. The three populations surveyed included licensed anglers, destination fishing lodge owners within Bristol Bay, and Bristol Bay fishing lodge clients.

Section 4 of this report details the design and implementation of the Bristol Bay angler survey. The main objectives of the survey were to measure angler expenditures, preferences and attitudes, net economic values, and demographic characteristics. The Bristol Bay angler survey was designed to collect a stratified random sample of anglers that would support extrapolation of the survey results to a good share of the population of licensed anglers in south central Alaska. The primary population sampled was anglers who had purchased a 2005 Alaska Sportfishing license. Table 12 shows the populations surveyed, and data collected. The primary survey sample used for analysis was the sample of 2,400 licensed anglers. These anglers were asked questions relating to their fishing trips, expenditures, opinions, and preferences.

A second sample of Bristol Bay fishing lodge owners was asked detailed questions regarding their lodge operations as well as financial information on payroll and other business expenditures.

Finally, a third population, a sample of Bristol Bay fishing lodge clients, was also contacted and surveyed on their fishing trips, expenditures, opinions, and preferences.

Table 12: Bristol Bay Surveys: Sample Frame and Design

<i>Population</i>	<i>Source/sample size</i>	<i>Data Collected</i>
Licensed Alaska Anglers	Alaska F&G License database – 2,400 anglers	Trip information Opinions and preferences Expenditures Net economic value estimates Preservation value estimates
Destination fishing lodge owners	Listing of major lodges in Bristol Bay – 45 Lodges	Services provided Rates and occupancy Business expenditure patterns
Bristol Bay Lodge clients	Lodge client information supplied by cooperating lodges (330 lodge clients)	Same as for licensed Alaska anglers

3.1 Survey and Sampling Design

The design of the 2005 Bristol Bay angler and lodge owners surveys followed the Dillman total design survey method (Dillman 2000). Table 13 details the methods employed in surveying the anglers and lodge owners.

Table 13: Bristol Bay Angler Survey and Sample Design

<i>Population</i>	<i>Subpopulation/ wave</i>	<i>Number of contacts</i>	<i>Survey method</i>	<i>Monetary incentive</i>
Licensed Alaska Anglers	Jan – July licenses	4 mail	Internet	932 of 1,400 (66%)
	Aug – Sept licenses	4 mail	Internet	1,000 of 1,000 (100%)
	Jan – July licenses	4 mail	Mail	none
Bristol Bay Lodge Owners	One sample of 46 lodges	2 mail 2 email	Mail	none
Bristol Bay Clients	One sample of 330 lodge clients	4 mail	Mail	none

A stratified sample of licensed anglers was drawn from a pool of 2005 Alaska sport-fishing licenses sold by four different groups of vendor locations in south-central Alaska: Bristol Bay, Anchorage, Matanuska/Susitna, and Kenai. The sampling was designed to increase the probability of sampling anglers who had fished in Bristol Bay in 2005, yet at the same time sampling the primary possible south-central Alaska license vendor locations for anglers likely to fish in Bristol Bay.

This sample was drawn in two stages. First a sample of 1,400 license-holders was drawn from the January-July license base. Because there is a lag in the development of the computer-based data base of license sales, a sample was drawn from this first pool of licenses as soon as available from Alaska Department of Fish and Game, in order to minimize potential recall bias. A second sample of 1,000 license holders from the license sale pool for August 1 to September 30 was drawn and surveyed subsequently. The stratified sampling design required that the survey results be weighted to reflect the entire license pool from which they were drawn.

The angler samples received four mail contacts asking potential respondents to participate in the 2005 Bristol Bay Angler Survey and directing them to a survey website at the University of Montana, Bureau of Business and Economic Research. Respondents were provided with unique passwords, giving them access to their survey. The mailings sent to potential respondents included: 1) initial contact letter, 2) reminder postcard, 3) 2nd reminder letter, and 4) 3rd reminder letter. To increase response rates and to test the