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RESTORATION PLANNING WORK GROUP
ECONOMICS WORKSHOP
August 5, 1992

Attendees:

Catherine Berg	USFWS	(907) 786-3520
John Strand	NOAA/NMFS	(907) 789-6601
Bob Loeffler	DEC	(907) 278-8012
Ray Thompson	USDA-FS	(907) 278-8012
Chris Swenson	ADF&G	(907) 278-8012
Sandy Rabinowitch	NPS/RPWG	(907) 257-2653
Jeff Hartman	ADF&G	(907) 465-4160
Tony Nakazawa	Community and Regional Affairs	(907) 269-4606
Lewis Queirolo	NOAA/NMFS	(206) 526-6364
Kathy Schildbach	Walcoff	(703) 684-5588
Barbara Iseah	Restoration Team	(907) 278-8012

The following documents were distributed:

Minutes of the November 7, 1991 Economics Workshop
May 26, 1992 Letter to Ken Rice from Dan McCollum
Option 11
Option 33A
Development of Economic Guidelines and Estimation of Net Social Benefits of Oil Spill Projects for NEPA and Trustee Council
August 3, 1992 Memo to RPWG from John Strand and Ray Thompson

John - Ray will lead the discussion. It is John's hope that the dialogue began in November can be continued. RPWG is at a critical juncture in the development of the Restoration Plan and needs some guidance on how to better integrate economics analyses into restoration planning. Other RPWG members were asked to express their expectations of this workshop.

Ray - a letter was sent on Monday to RPWG members with ideas for possible subjects for discussion. These subjects should be validated and prioritized for today's discussion. The following questions were provided to guide today's discussion:

1. Economic measurement of restoration options and issues - is it a monetary measure or a performance measure.
2. We need an interpretation of cost effectiveness and cost/benefit as it relates to option implementation. How can we define measures of cost effectiveness for implementation actions?
3. We are looking for suggestions for incorporating economic and social discussions into the Restoration Plan. More specifically, how do we project the economic implications of injury to services, and how is this important to restoration planning?

4. Will decisions be political and we'll only have to summarize economic information in a useful (to political decision making) way?
5. What are the real costs of private land acquisition, particularly where the current land owner is using, or plans to use, the land for income generation?
6. Are we settling an option's value to restoration based upon dollars and cents? If so, we need an economists. If not and we are settling this through political arguments, we need a political scientist.
7. How definitive do we need to be, and how many "parts" of the big picture do we need to show if we are estimating cost and benefits before we have a credible product? (parts may be employment, income, implementation costs, status of resource, level of recovery, physical attributes, etc.)

There is a strong need to focus on how economics would influence selection or accumulation of options within the Restoration Plan and eventually options for the EIS.

Tony - in terms of looking at economic impacts, is that optional for RPWG's plan?

Lou - in light of what was discussed in November, the fundamental decision on what role economics would play would be a legal call. He spoke with NOAA attorneys with specific reference to the degree to which the economic requirements of NEPA or mandates would apply to this process. None of them was willing to give a solid answer; however, independently, each advised that from a strategic stand point, it is imperative that this process operate with a functional equivalent standard to the NEPA rules because of litigation potential. The EIS will be dependent upon the foundation that RPWG lays.

Bob - the decision process needs to be explicit so that it can be followed and tracked.

Sandy - thinks that Lou's point has been covered in the framework document.

Lou - to be comprehensive you will have to treat what you can quantitatively and also to the best you can the qualitative implications; otherwise, you haven't provided the decisionmaker with the full scope.

Jeff - all economists would have you discuss errors and biases and list whether a consideration will bias upward or downward.

Ray - he heard definitions of what cost benefit looks like as follows:

Lou - Cost-benefit analysis purports to be a way of deciding

what society prefers. Where only one option can be chosen from a series of options, CBA should inform the decisionmaker as to which option is socially most preferred. Cost benefit is usually confined to public projects. Cost benefit is consistent with the assumption that social objectives can be defined in terms of individuals' preferences. CBA is a way of recording these preferences, either as they are revealed directly in the market, or, where no market exists, which gives the net benefit to society.

Jeff - The estimation of net social benefits would differ slightly from classical cost-benefit analysis in that additional emphasis is placed on the description of qualitative effects that may be difficult to quantify in cost-benefit analysis. To the extent possible, biases caused by these qualitative effects, are identified in any numerical results produced.

Sandy - if there are useful parts of the framework document for this definition, they should be used because the Trustees have signed off on it.

Ray - he didn't know how to define cost effectiveness, and we should discuss this meaning to come to a conclusion.

Jeff - to do anything meaningful in estimating the cost to alternatives, you can almost never be sure the benefits are equal for things like enhancement programs. It is not so difficult to understand cost effective analysis, but it is difficult to apply to restoration programs.

Lou - there seems to be two levels of cost effectiveness here, including undoing the spill as far as the public is concerned. If you know what the objective is and you have a suite of alternatives, you can choose the one which produces the outcome you want at least cost.

Bob - there are a suite of services all of which you would like to completely recover.

John - we have to assume for the purpose of the exercise that this will be achieved.

Ray - there is no beginning point or end point, and there is no count on the number of birds or animals affected. There are some perimeters, and we have to work in that direction.

Lou - why is this information not available?

Ray - we don't know where a species started before it was injured. Populations have been estimated to see what the original population was.

Sandy - in terms of service (recreation), the damage assessment information on injury has not been made available to this group.

Lou - this is a catch 22 situation for RPWG because you don't have the baseline data, so you don't know what to pay for.

Sandy - the Interior regulations define cost effective and cost effectiveness as when two or more activities provide a similar level of benefits and the least costly benefit will be selected.

Lou - someone will have to divine the underlying social utility function to determine what the public's best benefit is likely to be.

Tony - how would you treat something if you want to clean off rocks? Would you contract with the village or bring in someone else to achieve cost effectiveness?

Lou - the decisionmakers may determine what implications there are for economic growth in providing Native jobs. The net value to society may have to be explained.

Jeff - the number of fish could have different benefits in two locations of the state.

Ray - many of the decisions may be political. The concern is with the decisionmaking process, what is the value of economics in this and if there is a value, how should an economist be incorporated?

Sandy - he would reword Question #4 to delete political. The information should be understood by the public as well as the Trustee Council.

Bob - the use of the word political has a bad connotation and means back room influence. If we use economics to hide value judgements, it is not clear how decisions are being made. We should ask questions that illuminate the important value questions and provide the economics as a portion of that.

Jeff - if the public cannot understand information, economics can weed out some of the spurious arguments.

Tony - if he was in the public and some of the options were given to him, he would be comfortable because there would be some consistency in knowing something small with directional magnitude. As long as it is consistent, people would be comfortable with taking the information at face value.

Lou - the functional equivalent standards mandated in CERCLA and NEPA should be adhered to because it will be harder to challenge how the results were arrived at. The attorneys say you may or may not be bound to legally meet those, but you should attempt to

adhere to those approaches. A systematic way makes good common sense.

Ray - in the past the Forest Service has not had real implementable alternatives in the process. If we have real alternatives, we can measure with various degrees what really happened.

Jeff - this needs to be systematic using good economics.

Ray - what is good economics in building a programmatic Restoration Plan.

Sandy - whatever is done has to be equally rigorous, and you need to determine whether existing data will be used or new data created.

Jeff - there is time to set up systematic data.

Ray - a decision will be made by the Trustee Council based on the alternatives presented to them. RPWG is to find the measurement of the effects that the public can understand and be effective in describing the differences.

Jeff - multiple objectives was suggested as a synonym for political.

Tony - Sandy stated issues like who gets contracts would be handled in the annual work plan. Is there any way to discuss the distribution now? In terms of priority of who was impacted because of the spill, can this question be addressed?

Bob - the process can but this part of the process can't.

Lou - the Trustee Council will decide on a policy for distribution but it is not an objective for this group. It is a part of the multi-level planning. A decision cannot be made on benefit weighting such as rural jobs over all other jobs.

Sandy - the impacts of actions on a community should be discussed.

Bob - he would not quantify the negative.

Ray - part of Walcoff's task will be to take this process beyond what we describe. He envisions them taking the plan and the alternatives and describing what the differences are. Discussing the effects goes beyond this.

Sandy - the following definition of restoration in the MOA was given:

1. Restoration includes "restoration, rehabilitation, and/or acquisition of equivalent natural resources and the

services those resources provide to the baseline." 43 CFR 11.82

2. Restoration means any action which endeavors to "restore to their pre-spill condition any natural resource injured, lost, or destroyed as a result of the oil spill and the services provided by that resource or which substitutes for the injured, lost or destroyed resource and affected services. Restoration includes all phases of injury assessment, restoration, replacement and enhancement of natural resources, and acquisition of equivalent resources and services. (MOA paragraph II. K)

Ray - Is there closure on the political/economic interface? Jeff's suggestion for replacing political with multiple objectives could be incorporated.

Bob - a planning process is a process for the public to make political decisions.

Ray - Question #1 seems to fit in several of the discussions. How to measure performance to the goal of restoration should also be discussed.

Sandy - we need to give the economists a copy of the options notebook and ask them to look at each one and give us some feedback on what measurements, if any, can be applied. RPWG could gain from this what the economists think can be measured and evaluated. This will determine what is useful.

Jeff - The input requested would be how would economists go about evaluating the net effects of each project.

Bob - it might be useful to take a couple of examples and try this out. The socio-economic criteria needs a lot of work.

Ray - another element in formulating Question #1, is people see spending money out of the settlement in their favor and not very often do they mention restoring resources to original level. Restoration is the goal. We want to measure the options by performance irrespective of where the dollars go.

Sandy - each evaluation will throw some light on the ability of an option to help restoration. Economists should focus on economic performances. This process has a multi-level aspect.

Lou - he is not clear on what the end point is. At Exxon's economic workshop, a number of people seemed to suggest that it was the compensation of loss of human welfare that was at the heart of this. He is not sure which criteria is driving this exercise.

Ray - there is concern over whose pocket the dollars go into.

RPWG's job is to have an effective and efficient restoration program for the resources.

Sandy - the definition of proposed action from the framework document was discussed. He doesn't think there are enough measures for what was or would have been and doesn't know when we will be able to declare victory and go home. We are paid to put forth our best professional judgment.

Jeff - the physical scientist in NRDA wrongly defined injury. Economists approach damage from a completely different world.

Lou - the question boils down to who is the potentially responsible party.

Ray - the performance issue is a combination of scientific and socio-economic values.

Sandy - the definition of baseline from the regulations was discussed. His sense of knowing the baseline is that ultimately we will never know. It all comes back to best professional judgment. This is an area where damage assessment has failed because not much energy was put in.

Jeff - economist have to think about what would have taken place with or without analysis. Time changes the value of resource populations.

Meeting adjourned for lunch at 12:15.

Sandy - a question which was asked by Mike Barton is why is there consideration for buying Native land when it was just given back to them. Nobody would vote to condemn land; therefore, if any is acquired, it will be from a willing seller.

Bob - Barton seemed to be saying you would be taking GNP timber and putting it into another category.

Ray - Barton feels there are opportunities for discrete restoration opportunities through the wholesale process.

Lou - land is just another form of invested capital.

Jeff- the net social benefits need to be estimated.

Bob - he would estimate net social benefits by describing the effects in the different categories.

Jeff - in the anatomy of estimating the net social benefits, you list the benefits and cost. Some of those effects can be quantified.

Sandy - there is the basic assumption that land is wealth.

Jeff - in the sale of property, the market is reflecting people's perceptions in terms of one buyer and seller. Use of the land could be restricted. There are with and without policies for these restrictions. In land purchases, there are possible extranality effects.

Ray - another scenario is purchasing the right that someone may hold on the land.

Lou - mechanically, that can be valued. You can come up with a dollar value of what the market should dictate.

Ray - there is concern over purchasing land for disenfranchisement of the logger. The public feels land would be better cared for in public ownership than in private ownership. In the Restoration Plan, we have to ensure that people really understand if the plan includes an acquisition option.

Lou - this will be complicated if the calculus includes wilderness and dispersed recreation against the costs of scarce resources and if you ignore the benefits of the land you argued for.

Ray - an exercise was done looking at a couple of options and determining some of the economic implications.

Bob - the following process for creating alternatives was diagramed:

	<u>Science</u>	
Option 11 - Salmon enhancement	Potential to improve recovery	H
	Technical feasibility	H
	<u>Socio-economic</u>	
	Jobs/Income	+
	Quality of Life of Communities	
	Public Use	+
	Subsistence	+

Bob - logically, you are creating an alternative which takes these kinds of value judgements for improving the physical manipulation of the environment and creating a package of alternatives to take to the public. Packages give the public the ability to talk in concepts. Two places where economic evaluation is used in its broadest sense is having criteria which illuminates what the public cares about and in evaluating the alternative as a whole.

Sandy - two examples were given of options for "growing" more fish.
Jeff - with this example, an economist could estimate the net

social benefit but he will need to ask about the cost for carrying out the project and information that relates the output through time.

Jeff - an anatomy of cost benefit would list possible benefits and costs. A production and demand function are also needed. All these work to create a bio-economic model.

Bob - he would want to know the effect of the option on human uses.

Jeff - you would have to go through a more rigorous exercise to find this out. The analysis has to be carried out to get a feel for what the trade-offs are.

John - we do not have the data for this type of analysis.

Jeff - some of the things that are not worth carrying out cost benefit analysis on need to be filtered out. The scope of work needs to be narrowed down.

Sandy - the economists' experience and insight might help to educate RPWG on which options are cost effective. Everyone brings bits and pieces of knowledge that others don't have.

Jeff - he would start with the part of the analysis that would make or break the project.

John - would the approach outlined by Bob be useful?

Lou - some viable options will be thrown out that should be retained because selection was based on general intuition; if there had been time and expertise, you would have retained those options.

Bob - the public review process follows this process.

Ray - whatever the public cared about could be a lead alternative.

Sandy - every option could have a geographic component.

John - the data on geography is really soft.

Lou - as a non-site specific product with no detail on costs, Bob's diagram gives a sorting device for the different components of the social welfare option.

Jeff - before any points in Bob's diagram are cast in concrete, the terms have to be defined.

Lou - he suggested contacting a cultural anthropologist for discussion of the diminishing quality of life in local communities. The resource was injured and the public was damaged.

Ray - do we want to go through the field presence of management option 7b?

Sandy - we might benefit from reviewing the copies of the evaluation sheets.

Ray - Option 33a was distributed as an example for how the criteria was dealt with.

Lou - Explain the technical feasibility category.

Kathy - under the science criteria, technical feasibility means do we have the technology to proceed with this and under the socio-economic category, technical feasibility means would this be a success and would the public accept it.

Sandy - it might be most helpful to ask the economists to talk with us about cost effectiveness and the relationship of expected costs to expected benefits and anything we might add in.

Jeff - what does the no additional services injury category under the socio-economic criteria mean?

Sandy - it is similar to the no additional resource injury category under the science criteria.

Ray - a clear definition of cost effectiveness and cost benefit is needed.

Sandy - there are a couple of levels to consider these at.

Lou - he is treating this as a crude sorting device.

Sandy - this will give a relative feel to our collective judgment.

Lou - based on the cost effectiveness discussion, the definition is a homogenous benefit yielding improvement in the direction you want to go. At this first cut, every option is judged as to the direction it moves you in.

Sandy - cost effectiveness in education and the other options were reviewed for which might accomplish the goal from our bag of options.

Lou - this is not sorting on the same plane.

Sandy - RPWG accepted that education is a good thing to do and also that an increased field presence was a good thing for a variety of resources. These were compared to options that would yield the same results and were felt to be cost effective.

Lou - you may fall into a trap and assume that all options are the

same when they are not on the same scale. The options are not compared relative to each other.

Jeff - the database needs to be resorted. A field is needed to explicitly show which ones are compared.

Lou - the cost effectiveness category is meaningless for sorting. The relative cost to benefit relationship will be more useful.

Sandy - this criteria may not fit at this level of evaluation. Is there some place in the sorting process where this factor comes back in?

Lou - when you have homogenous output, then you can look at cost effectiveness.

Sandy - the process for writing the criteria summaries was discussed and he felt that we failed because we didn't have enough information to base the dollars and cents on.

Lou - the options are not specific enough to be definitive about the cost effectiveness issue.

Bob - he suggested assuming all options have a positive cost benefit ratio.

Lou - during damage assessment, fiscal scientist and economists disagreed on the importance of some elements in the impact assessment.

Ray - the murre project was suggested as an example of spending money and not knowing the benefits. There is a consensus that cost effectiveness is not appropriate at this level.

Sandy - if we move it out of the sphere of the plan, we are eliminating one of our criteria. We need to be clear about why we are moving it.

Jeff - obtaining economic models was suggested to make this process easier.

John - an RFP has been issued to request a consultant to help develop a more comprehensive monitoring program and give some ways to monitor the recovery of injured critters and damaged services.

Ray - are there any issues which need closure?

Sandy - economists should be integrated into much of the work evaluating the options so that the evaluation and the ultimate sorting and construction of alternative benefits from the economists' input. Ultimately, the economist could help write sections of the plan to explain this process.

Jeff - having a group of economists as an advisory group was suggested. He is not sure that agency people can pull out of what they are doing, but where the agencies are agreeable, it would be helpful. RPWG should get as much economic help as their resources can produce.

Sandy - is there money for funding economic help?

John - the money is with DEC. The same funds are being used for the RFP to obtain an editor.

Sandy - the Restoration Team has agreed that we need some help.

John - the money was available as of July 1.

Bob - the questions to answer in the next month are not primarily economic in character but how to group options into alternatives in a way that illuminates the values in which people make decisions.

Sandy - we have started to score criteria #4, and we would benefit significantly if we had some input from economists and would be a lot more on target with our score.

Bob - if we wanted something more intricate from the criteria, the level of expertise would go up.

Sandy - economists could see a lot of things that we are not thinking about.

Ray - most of the evaluation will run pretty much the same with a few which are very high or very low. We could obtain a second opinion very easily from personnel in agencies.

John - Jeff and Lou might be able to come back when these options have been fleshed out a little more.

Lou - there is a certain amount of frustration in not hearing from RPWG from November to August.

Jeff - if there is a specific set of tasks, economists could be contacted then.

Ray - appreciation was expressed for Lou and Jeff's time.

Sandy - Jeff and Lou were asked if in a couple of weeks, RPWG could send the options to them for review and any reactions.

Ray - where there is no consensus, the economists could give help on which direction to go.

Sandy - if he was a member of the public and wanted to blow away the plan, lack of economic input might be it.

Bob - we should try to do something that highlights and shows the value and leave economic analysis to the experts.

Sandy - the economic implications should be shown.

Bob - the way the issues will be decided will be on issues the public holds dear. The public has some pretty straight forward value judgments.

John - we did not get blown out of the water on the framework.

Bob - RPWG will pick up most of the glitches and the agency review will pick up others. He is more comfortable with the review process picking things up as long as we don't try to do something too complex.

Sandy - Lou and Jeff were asked what RPWG needs.

Lou - if Bob's position were true, RPWG would not have needed them. If they made any contributions in November or today, then economists might bring a different way of looking at problems.

Jeff - he is trying to understand how this process will be linked with the NEPA process. If you don't think about economics up front, there will be a lot more work for the people working on the EIS. In the EIS, the public will say what are the economic effects. You might have statements of significant impacts on every project. He favors a little more involvement of economists and a little more rigorous approach. Economists would like to be given the time to do a good job.

Ray - at this level in working with options, RPWG doesn't see the 35 options at a project level. It won't get more specific until a proposed action is approved by the Trustee Council. Then it will be open to agencies to define project level activities. He is not sure that economists are needed at the current level.

Chris - to hit the ground running, the economists will have to be in the process for some time. There is a lot of ground work.

Jeff - to do rigorous work, project level information in a more focused planning effort is needed.

John - RPWG would like to be able to call on Jeff and Lou again when the logistics are worked out. There has to be some better level of interaction and participation. We are committed to doing something more but we don't know what at this stage. We need to work on this process. Lou and Jeff will be contacted with more details to get another reading on how RPWG will use this process. Appreciation was expressed for the input provided.

Ray - copies of the minutes will be provided to Jeff and Lou.

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RPWG ECONOMICS WORKSHOP
AUGUST 5, 1992

SIGN-IN SHEET

NAME	AGENCY/PHONE	
John Strand	NOAA/NMFS	(907) 789-6601
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Memorandum Date: August 03, 1992

To: Restoration Planning Working Group
From: John Strand and Ray Thompson
Subject: Economics and the Restoration Plan Workshop, 8/5/92

The Restoration Planning Working Group has a need to incorporate an accurate sense of economic implications to restoration planning, which will subsequently provide interagency direction within the Restoration Plan. This workshop will develop a common sense of direction as we pursue the Plan and its associated Environmental Impact Statement.

Location: Fourth floor RPWG Conference Room, Oil Spill Restoration Offices, Simpson Building, 645 G. Street, Anchorage, AK.

Time: 1000 AM

Jeff Hartman, ADF&G, Lewis Queirolo, NMFS, and Tony Nakazawa, UAF will be here to assist RPWG. Both Jeff and Lou will make brief presentations on incorporating economics into restoration planning.

The attached questions and comments are suggested to guide our workshop discussion. We will get a group consensus on priorities before beginning any detailed discussion. Hopefully this will help us manage our time.

enclosure

cc: Dave Gibbons

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Economics Discussion, RPWG, 08/03/92

QUESTIONS AND COMMENTS TO GUIDE OUR DISCUSSIONS:

1] ECONOMIC MEASUREMENT OF RESTORATION OPTIONS AND ISSUES - IS IT A MONETARY MEASURE OR A PERFORMANCE MEASURE?

2] WE NEED AN INTERPRETATION OF COST EFFECTIVENESS AND COST/BENEFIT AS IT RELATES TO OPTION IMPLEMENTATION. HOW CAN WE DEFINE MEASURES OF COST EFFECTIVENESS FOR IMPLEMENTATION ACTIONS?

3] WE ARE LOOKING FOR SUGGESTIONS FOR INCORPORATING ECONOMIC AND SOCIAL DISCUSSIONS INTO THE RESTORATION PLAN. MORE SPECIFICALLY, HOW DO WE PROJECT THE ECONOMIC IMPLICATIONS OF INJURY TO SERVICES, AND HOW IS THIS IMPORTANT TO RESTORATION PLANNING?

4] WILL DECISIONS BE POLITICAL AND WE'LL ONLY HAVE TO SUMMARIZE ECONOMIC INFORMATION IN A USEFUL(TO POLITICAL DECISION MAKING) WAY?

5] WHAT ARE THE REAL COSTS OF PRIVATE LAND ACQUISITION, PARTICULARLY WHERE THE CURRENT LAND OWNER IS USING, OR PLANS TO USE, THE LAND FOR INCOME GENERATION?

6] ARE WE SETTLING AN OPTION'S VALUE TO RESTORATION BASED UPON DOLLARS AND CENTS? IF SO WE NEED AND ECONOMIST. IF NOT AND WE ARE SETTLING THIS THROUGH POLITICAL ARGUMENTS, WE NEED A POLITICAL SCIENTIST.

7] HOW DEFINITIVE DO WE NEED TO BE, AND HOW MANY "PARTS" OF THE BIG PICTURE DO WE NEED TO SHOW IF WE ARE ESTIMATING COST AND BENEFITS BEFORE WE HAVE A CREDIBLE PRODUCT? (PARTS MAY BE EMPLOYMENT, INCOME, IMPLEMENTATION COSTS, STATUS OF RESOURCE, LEVEL OF RECOVERY, PHYSICAL ATTRIBUTES, ETC.)

Worksheet for determining High, Medium or Low ranking for each Option or Suboption

RESOURCE/SERVICE:	SCIENCE CRITERIA	HML /U
OPTION # / TITLE:	1. Potential to Improve Rate and Degree of Recovery	
COMMENT:	2. Technical Feasiblity	
	3. No Additional Resource Injury	
	4. Timing	
	5. Measureability of Results	
	RPWG Evaluation	

RESOURCE/SERVICE:	SOCIOECONOMIC CRITERIA	HML /U
OPTION # / TITLE:	1. Technical Feasiblity -Probability of Success -Political Realities	
	2. Human Health/Safety	
COMMENT:	3. Cost Effectiveness	
	4. Relationship of Expected Costs to Expected Benefits	
	5. No Additional Services Injury -Socio-economic -other indirect effects	
	6. Measureability of Results	
	RPWG Evaluation	

United States Department of Agriculture | Forest Service | Rocky Mountain Forest and Range Experiment Station | 240 West Prospect Fort Collins, CO 80526-2098

Reply to:

Date: May 26, 1992

Mr. Kenneth Rice
Chugach National Forest
645 G Street
Suite 402
Anchorage, AK 99501

Dear Mr. Rice:

George Peterson told me he talked with you regarding your involvement in a planning process for restoration of some oil damaged areas in Alaska. My understanding is that you are interested in the impact of government intervention on private lands to protect them during restoration, among other issues related to restoration of damaged areas. I believe George told you that I have been involved in some joint projects over the last few years with the Alaska Dept. of Fish and Game. We are currently at the stage of collecting data for those studies. Our emphasis has been on estimating the economic value and economic impact of wildlife resources in Alaska, but many of the issues are similar to those that would arise in considering restoration of areas subjected to environmental damage. Let me try to give you a feel for some kinds of effects that might be considered.

One area of effect that government intervention on private lands might have is on the flow of goods and services related to those private lands. If the lands were used for a given purpose that resulted in the production of a good or service (or contributed to the production of a good or service) that was exchanged in the marketplace, government intervention might affect that process resulting in a measurable economic impact, i.e., one would be able to measure the change in economic activity due to the government intervention. Product or resource availability, local employment, or income might be increased or decreased over some time horizon resulting in changes in the flow of goods and services in the local or regional economy. Such impacts could be either positive or negative, and could change over time. They might be negative (positive) initially, then change to positive (negative) as the restoration proceeds. Over a longer term, they could change more than once. Additionally, government intervention could speed or slow the pace with which the lands recover and regain productivity lost due to the oil spill or whatever environmental damage occurred. An initial loss of productivity followed by productivity gains due to restoration is something else that could, conceivably, be measured in an economic impact analysis. Changes in land or resource productivity could be measured in biological or other terms as well, and the effects of government intervention on those measures estimated over time.

Another area of effect of government intervention might be on nonmarket goods and services related to the private lands. Some goods and services--recreation is one of several examples--are not traded on markets in the same way that goods like shoes or timber are bought and sold. These nonmarket goods are real goods and people receive benefits from their use, even though they do not appear in readily identifiable market transactions. Their effect on economic well being is every bit as real and important as that of market goods. Their value is typically measured in terms of "consumer surplus." In the past, many policy makers and land managers have been skeptical of such measures of benefit. As

more understanding has been gained of what these measures mean, and what they might imply for resource management, economic development, and other issues, managers and policy makers (as well as the legal system) have begun to accept these measures as real benefits and policy relevant information. In addition to these nonmarket economic values, work has been progressing to identify and measure the effects that nonmarket goods and services have on related market goods and services, and thereby do have effects that can show up in market transactions and can be measured as economic impacts. In short, it is not enough to look only at the goods and services that appear directly in market transactions.

Besides these two areas of possible effects of government intervention that would relate primarily to economic efficiency in the production of market and nonmarket goods and services, one might consider distributional issues and issues of equity. Effects of government intervention fall on different groups of people and/or different communities within society. Intervention and other policies can sometimes be structured differently to promote or avoid some effects on specific groups. One might want to encourage some activity in a particular community and structure government intervention accordingly. Alternatively, one might want to shield a community from some adverse effect and structure the intervention to accomplish that. The point is that there are several sides of the issue to be looked at and considered while gathering information on the effects that government intervention, or any other policy, might have on a local area or on society in general.

Under separate cover I am sending a copy of Valuing Wildlife Resources in Alaska. Chapter 2 in that book is an overview that might help you to focus on the kinds of questions you need to ask and what information you need.

I would be glad to help you however I could. Whether that might be by helping you choose and set up a steering or advisory committee to help you identify and address relevant issues and to advise as you go, or by becoming directly involved and acting in a review/advisory capacity and doing some studies myself, or in some other way is an open question. As George may have told you, I have found it useful to put together an inter-agency Steering Committee for my own research project in Alaska to foster cooperation and support from the relevant management agencies. This helps steer the research toward issues that the agencies perceive to be relevant to them and contributes to the applicability of the research results.

I anticipate being in Anchorage sometime in September or October with virtual certainty, and at the moment it appears likely I will be taking a trip to Fairbanks in mid to late August during which I could stop in Anchorage. At either or both of those times, I would be glad to meet with you and discuss your planning process and how I might fit in, or just help you think about issues and questions to consider. I can be reached at the above address or via DG at S28A; my phone number is (303) 498-1877, FAX is (303) 498-1660.

Sincerely,

/s/ Dan McCollum

Daniel W. McCollum
Economist

RRWG
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DISCUSSION DRAFT

DEVELOPMENT OF ECONOMIC GUIDELINES AND ESTIMATION OF NET SOCIAL BENEFITS OF OIL SPILL PROJECTS FOR NEPA AND TRUSTEE COUNCIL

Cooperating Agencies: USDA (Forest Service), NOAA (Damage Assessment), NOAA (NMFS), and DOI (Office of Program Analysis), State of Alaska (Alaska Department of Fish and Game)

INTRODUCTION AND PURPOSE:

With several hundred million dollars in proposed projects and less than $100 million available in funding for oil spill year 1993, EVOS Trustees are faced with the difficult task of choosing between competing projects. Trustees are certain to receive a cross section of economic information from interest groups and potential principal investigators explaining how the value of lost services may be restored from the implementation of each project. While some of these economic arguments may be compelling and properly constructed many may be spurious and misleading. To complicate the selection process, the range of potential restoration actions are so diverse that it will be difficult to determine the benefits and costs of proposed projects without some type of common measure.

The NEPA process has been initiated for the oil spill restoration, and the resulting EIS is to be administered by the U.S. Forest Service. Economic analysis, and in particular cost-benefit analysis or the estimation of Net National Benefits is frequently a major component and product of NEPA. The regulations for the NEPA process, produced by the Council of Environmental Quality (CEQ) (see 40 CFR 1986) refer to identifying impacts on the environment in terms of the physical and social sciences as well as economics. While the CEQ guidelines for NEPA encourage project level economic analysis, the standards and guidelines remain flexible for different applications. The purpose of this project is first, to develop guidelines for economic analysis of projects for NEPA under the Restoration process for the Exxon Valdez Oil Spill. The emphasis would be on identifying appropriate standards for measuring economic effects of projects. These economic effects should be revealed by using accepted economic market and non-market methods rather than only relying on anecdotal economic information. The second purpose of this proposal is to provide economic analysis for some selected restoration projects. This would allow for the economic effects of restoration to be revealed to the Trustees and Public prior to choosing between alternative projects.

Project level economic analysis would focus on the projection of net social benefits. The estimation of net social benefits would differ slightly from classical cost-benefit analysis in that additional emphasis is placed on the description of qualitative effects that may be difficult to quantify in cost-benefit analysis. To the extent possible, biases caused by these qualitative effects, are identified in any numerical results produced.

THE PROPOSAL:

This proposal consists of three related work products. The first is the development of economic guidelines for evaluating restoration projects. The guidelines that would be appropriate for evaluation of restoration options would also be appropriate for the NEPA process. Either a small workshop, or some coordinating meetings would be sufficient to recommend guidelines for economic analysis of restoration projects. This would be the major task in oil spill year 93 and would not require large resources. The guidelines would be

sufficiently detailed to identify what type of economic studies are appropriate for evaluating restoration projects. They would be consistent with current Federal law and standards on the application of economics to public expenditures. The guidelines would act as a filter to spurious economic analysis. It would also be sufficiently flexible and general to allow for the use of the best appropriate methodologies to be applied.

The second product, would be dedicated to developing basic studies on how to value major categories of restoration projects for which we do not have adequate models in place now. Economists have some models available that may be acceptable for evaluating changes in consumer and producer surpluses related to recreational and commercial fisheries, but determining the opportunity costs of placing land and marine areas into more restrictive uses presents some valuation problems that may warrant further study. It is assumed that this would occur in the year following guideline development.

The third work product(s) would be project level studies of the Net Social Benefits, cost efficiency analysis (where appropriate) and employment impact assessment (where appropriate) of selected restoration projects. This would require a structure and staff (consulting or agency) for carrying the analysis.

HOW THE PROJECT IS CARRIED OUT:

Initially, the development of guidelines could be accomplished by forming a RESTORATION ECONOMIC STEERING COMMITTEE. Economists, who previously worked together on economic studies for damage assessment from Department of Interior, Department of Agriculture, National Oceanic Atmospheric Administration, and the State of Alaska would be the logical oversight or reviewers for this effort. While economic studies under the damage assessment may have only moderate use for evaluating restoration, a current knowledge of the studies will be helpful in providing guidance on the feasibility and costs of economic studies. Few private contractors have access to this information. Other staff may be included and significant portions of the second and third products could be contracted out.

BUDGET:

While a budget was required to respond to the Oil Spill Year 1993 request for Restoration Ideas, it was preliminary. The budget for this project would be developed by a steering committee of economists from the trustee agencies after further consultation with the Restoration Planning Work Group. The initial step of developing guidelines could range from $20,000 to $80,000 in Oil Spill Year 1993. More detailed budgets would be possible to construct on the second and third work products following further direction from RPWG.

PRINCIPAL INVESTIGATORS:

The following staff economists would oversee the development of the restoration economics program. Other staff economists from government may be substituted or added if desired.

Jeff Hartman
Economist
FRED Division
ADF&G
(907) 465-4160

Norman Meade
Chief Economist
Damage Assess. Analysis
NOAA
(301) 443-8865

George L. Peterson
Economist
RM F&R. Experiment Station
USDA Forest Service
(303) 498-1100

Richard Wahl
Economist
Program and Analysis
Department of Interior
Washington, DC
(202) 208-4916

RPWG H

Worksheet for determining High, Medium or Low ranking for each Option or Suboption 7/30/92

RESOURCE/SERVICE: ALL impact	SCIENCE CRITERIA	HML /U
OPTION # / TITLE: 33a programmatic programs for provision and distribution of up-dated information & education	1. Potential to Improve Rate and Degree of Recovery	M
COMMENT:	2. Technical Feasiblity	H
1. Exceptional value to Archaeological Resources Subsistence resources	3. No Additional Resource Injury	H
4. Duration is important as is monitoring of effectiveness to modify approach for increased benefit	4. Timing	H
	5. Measureability of Results	L
	RPWG Evaluation	H

RESOURCE/SERVICE: damages	SOCIOECONOMIC CRITERIA	HML /U
OPTION # / TITLE:	1. Technical Feasiblity -Probability of Success -Political Realities	H
	2. Human Health/Safety	H
COMMENT:	3. Cost Effectiveness	M/H
3. Dependent upon injured resource (intertidal) being focused. Law enforcement works in short term, education in the long term.	4. Relationship of Expected Costs to Expected Benefits	H/M
5. Sensitivity to Native Cultural values needed	5. No Additional Services Injury -Socio-economic -other indirect effects	H
	6. Measureability of Results	M
	RPWG Evaluation	H/M

Opt#11.003

Ken Chalk

OPTION 11: Improve or supplement stream and lake habitats for spawning and rearing of wild salmonids.

APPROACH CATEGORY: Manipulation of Resources

INJURED RESOURCES AND SERVICES: Pink and sockeye salmon

PROPOSED ACTION

Construct or implement stream and lake improvements for the spawning and rearing of wild salmonids.

SUMMARY

There are a variety of well-established techniques for improving or supplementing spawning and rearing habitats to restore and enhance the productivity of wild salmon populations. These include construction of spawning channels and fish passes, removal of barriers impeding access to spawning habitats, and addition of woody debris to provide cover and food for fish. A survey of the oil-spill impact area will be conducted to estimate the amount of oiled spawning habitat. This information will be used to scale the effort applied to improving or replacing spawning habitat. Unlike pink and chum salmon which swim to sea in their first year, young sockeye salmon grow in lakes for 1-3 years before emigrating to sea. Appropriate restoration and enhancement techniques for sockeye salmon are determined by the amount of spawning and rearing habitat in the lake system. If possible, these two habitat characteristics should be balanced. In lake systems with inadequate spawning habitat, spawning channels or fish passes may be appropriate to increase the amount of available spawning habitat. In lake systems with damaged rearing habitat, chemical fertilizers may be added to temporarily supplement the nutrients needed to sustain the prey on which fry feed. Once the run is restored, the decomposition of salmon carcasses provides a natural source of nutrients to sustain the food chain.

SUBOPTION A Supplement fry production using such methods as egg boxes and net pens for fry rearing.

TARGET RESOURCES AND SERVICES

Pink and sockeye salmon in Prince William Sound.

DESCRIPTION

This restoration technique includes construction of egg boxes adjacent to damaged wild stock spawning streams or nearby streams. Artificial spawning techniques will be used to fertilize eggs taken from wild salmon. Fertilized eggs will be placed in the egg boxes. Fry will outmigrate from the boxes on their own in the spring.

This restoration technique also includes rearing fry in net pens and releasing fry when conditions in the natural environment are favorable for survival. In addition, a representative group of fry may be coded-wire tagged to evaluate the success of the program and reduce exploitation of damaged stocks in the fishery. Recoveries of coded-wire tagged fish when they return as adults will provide the information fishery managers need to direct exploitation away from damaged stocks.

- increase egg-to-fry survival by a factor of 5 to 8 in egg boxes.
- double the fry-to-adult survival of fish reared in net pens.
- accelerate the pace of recovery to pre-spill conditions by increasing the number of returning spawners.
- mitigate for reduced runs of pink and sockeye salmon expected over the next several years.
- offset any persistent injuries sustained by fish stocks.
- reduce exploitation of damaged stocks in the fisheries.

IMPLEMENTATION ACTIONS

- construct streamside egg boxes where appropriate.
- conduct remote egg takes and incubate eggs in boxes to increase survival.
- capture outmigrant fry and rear in net pens to increase survival.
- coded-wire tag a representative group of outmigrant fry to evaluate project success.
- recover coded-wire tagged fish to provide the information fishery managers need to reduce exploitation of damaged stocks.

NEPA compliance. These types of programs are generally categorically excluded from NEPA requirements.

Additional/new legislative or regulatory actions. None necessary.

MEANS TO EVALUATE SUCCESS

Surveys of users within the oil-spill area could be conducted. Because this option attempts to change use patterns to low-impact habits, it will be very difficult to measure. It may not be cost-effective.

REPRESENTATIVE COSTS

The interpretive plan which the Chugach National Forest is proposing is expected to cost $50,000 over a two year program for development.

A private consultant firm (Inside/Outside) said they typically take 3-4 days to develop a draft conceptual plan, at a cost between $2,000 and $3,000 (John Hanna 512-327-3438).

Brochures: $2,500 for first 1000 tri-folds, $150.00 for additional thousand. Estimated costs ranged from $3,000 to nearly $4,000 for first 1000, 8.5 X 5.5" brochures with additional printings between $300-600 dollars.
Posters: $1000 for first 1000
Training costs: $1000/pers
Salary (new hires): $40,000/yr (probably less)
Office supplies: 2,000/yr

Total Costs:

ADDITIONAL INFORMATION NEEDED

Information on ideal low-impact uses is needed to effectively implement this option. Specific areas and times in which birds and mammals are especially vulnerable to human disturbance are needed ~~to~~ for developing brochures etc...

CITATIONS

7B

SUBOPTION B **Increase the field presence of management agencies within the affected area.** to provide protection for resources recovering

TARGET RESOURCES AND SERVICES

Common and thick-billed murres, harlequin ducks, sea otters, harbor seals and killer whales.

DESCRIPTION

There are many parks, refuges and forests scattered throughout the oil-spill area. Because of the remote locations and the distances between sensitive areas, managing agencies are limited in their ability to provide extensive field presence. Increased staff capability and frequencies of patrols would ensure greater compliance to existing Federal and State laws which currently provide protection to resources recovering from the oil-spill. In addition, increased field presence by the managing agencies will allow for greater education opportunities which were discussed in Suboption A.

IMPLEMENTATION ACTIONS

Hire and train additional staff to monitor activities at sensitive areas (including fish, wildlife, recreation and archaeological sites) and to provide information to the commercial and recreational users of the areas.

Develop monitoring program to document the success of these activities.

TIME NEEDED TO IMPLEMENT

Hire and train personnel could take 6-9 months.

Acquire/purchase necessary equipment and supplies could take several months depending on the purchase (i.e. boat vs. office supplies)

MEANS TO IMPROVE RECOVERY

There are several studies which document the effects of human disturbance on the reproductive success of birds and marine mammals (citesome). Increased field presence by the agencies would help ensure that disturbance is minimized. In addition, illegal activities such as harassment of marine mammals, vandalism at recreation or archaeological sites, etc... would also be reduced. Reduced disturbance would result in increased reproductive success of fish and wildlife and would prevent further injury to other

resources. Vandalism and looting of archaeological sites has increased dramatically since the oil spill. Since these sites are non-renewable in the sense of biological populations, it is especially important to prevent further damage.

PROTECTION AND MANAGEMENT UNDER EXISTING LAWS

The Marine Mammal Protection Act of 1972 prohibits any activity of vessels and aircraft which intentionally or negligently disturb or molest a marine mammal (50 CFR 216.3).

The Migratory Bird Treaty Act and the Bald Eagle Protection Act protects birds.

Archaeological sites and artifacts are protected under federal law by the Archaeological Resources Protection Act of 1971, 16 USC 470, and under state law by the Alaska Historic Preservation Act, Alaska Statute 41.35.010. Both state and federal agencies which manage land within the oil spill area have professional archaeologists who coordinate agency work to limit impacts on sites.

RELATIONSHIPS WITH EXISTING/PLANNED USES OR MANAGEMENT

The National Park Service has patrol boats in many of their parks. Most other land management agencies do not conduct regular patrols.

TECHNICAL FEASIBILITY

Increased field presence by the Trustee agencies is certainly feasible. Personnel trained in law enforcement and knowledgeable about the species, services and regulations would be able to ensure greater compliance to laws.

POTENTIAL TO IMPROVE RECOVERY OR ENHANCE THE RESOURCE/SERVICE

An increased field presence of the Trustee agencies near sensitive wildlife areas would encourage greater compliance to State and Federal laws designed to protect wildlife from disturbance and harassment and other resources such as archaeological sites from vandalism. Reduced disturbance could increase the overall productivity of injured species.

Incidences of vandalism, wildlife harassment, or illegal harvesting are reported each year by the various agencies. For example, vandalism has occurred at 19 of 35 archaeological sites studies so far and it is suspected to have occurred at an additional 16 sites. Agencies do not have sufficient funding and staffing capabilities to send more personnel into the field.

INDIRECT EFFECTS

The indirect environmental effects could include increased populations of non-targeted species as well as populations injured by the oil-spill.

The increased field presence would also lessen the disturbance or vandalism of restoration project sites designed to enhance the recovery of fish and wildlife populations.

Indirect socio-economic effects would include a long-term gain in viewing opportunities for tourists as the wildlife approach their pre-spill population levels. Fishing opportunities should increase as the populations recover.

There are always risks to human health and safety when extended field work is required. However, these risks can and will be greatly reduced through proper training and equipment.

RELATIONSHIP TO OTHER EVOS RESPONSE/RESTORATION ACTIONS

Many of the other options and suboptions consider regulatory changes which would be much more effective with additional law enforcement capabilities. For example: Option 4, Suboption C may establish permanent buffer zones around sensitive areas, if that suboption is implemented it will be important to have adequate law enforcement capabilities.

OTHER OPTIONS THAT COULD ACHIEVE THIS SAME OBJECTIVE

This is the only option that considers providing increased field-presence to protect all injured resources. Option 1 is focused on archaeological sites, Option 4 is related to marine bird and mammal concentration areas.

LEGAL CONSIDERATIONS

Consistency with the settlement. This suboption is consistent with the terms of the settlement aimed at restoring natural resources injured by the oil spill.

Agencies with management/regulatory responsibilities. Depending on the specific sites involved the land management agency (e.g. DNR, NPS, USFS or USFWS), the agency responsible for the target species (USFWS or ADF&G), and the Department of Water (?) would need to be involved.

Permits required. No permits would need to be obtain to implement any action in this suboption (verify).

NEPA compliance. These activities are generally categorically excluded from NEPA review.

Additional/new legislative or regulatory actions. None necessary.

MEANS TO EVALUATE SUCCESS

Field personnel will be able to gage the success of this option by the number and types of contacts they have with users in the oil-spill area.

REPRESENTATIVE COSTS

There are 8 different Federal and State parks, refuges and forests in the spill affected area. Assume we support 1 FTE/year for each, at the lower level funding for law enforcement personnel (Technician level).

Salary: $40,000/year/agency ($320,000 total)
Boat maintenence: $1,500/boat/year = $12,000
Fuel: $50,000 (from 1991 law enforcement proposal)
Field supplies: 7,000
TOTAL: $390,000

[NOTE: A 1991 proposal for cultural resource protection asked for a $200,000 per annum budget. The following costs were described:

6 seasonal GS-5s for 8 pp	43,000
Equipment	7,000
Aircraft and Boats	100,000
Fuel	50,000

If Law Enforcement Training has to be provided the cost increases by $12,000 per person trained (for Federal Training).

ADDITIONAL INFORMATION NEEDS

Develop an interagency conservation law enforcement cadre to effect presence.

Worksheet for determining High, Medium or Low ranking for each Option or Suboption

RESOURCE/SERVICE: Commercial Fisheries	**SCIENCE CRITERIA**	HML /U
OPTION #11/ TITLE: Improve or Supplement Stream & Lake Habitat	1. Potential to Improve Rate and Degree of Recovery	H
COMMENT:	2. Technical Feasiblity	H
	3. No Additional Resource Injury	M/H
All other factors notwithstanding	4. Timing	H
	5. Measureability of Results	M
	RPWG Evaluation	H

RESOURCE/SERVICE:	**SOCIOECONOMIC CRITERIA**	HML /U
OPTION #11 / TITLE:	1. Technical Feasiblity -Probability of Success -Political Realities	H
	2. Human Health/Safety	H
COMMENT:	3. Cost Effectiveness	H
	4. Relationship of Expected Costs to Expected Benefits	H
	5. No Additional Services Injury -Socio-economic -other indirect effects	H
	6. Measureability of Results	M
	RPWG Evaluation	H

RPWG
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"CONFIDENTIAL LITIGATION SENSITIVE ATTORNEY WORK PRODUCT"

RPWG Meeting
Economics Workshop
November 7, 1991

Attendees:

Susan MacMullin	EPA	(202) 260-6412
Jeff Hartman	ADF&G	(907) 465-4160
Mike Mills	ADF&G	(907) 267-2369
Lewis Queirolo	NOAA/NMFS	(206) 526-6364
George Peterson	USDA/FS	(303) 498-1885, 1886
Sandy Rabinowitch	DOI/RPWG	(907) 257-2653
John Strand	NMFS/RPWG	(907) 789-6601
Art Weiner	ADNR/RPWG	(907) 278-8012
Ken Rice	USFS/RPWG	(907) 278-8012
Mark Brodersen	ADEC	(907) 465-2610
Gardner Brown	Univ. of WA	(206) 523-7915
Alex Swiderski	AG's Office	(907) 269-5274
Peg Kehrer	OSIAR/ADF&G	(907) 465-4125
Stan Senner	ADF&G	(907) 278-8012
Regina Sleater	DOI	(907) 271-4131
Barbara Iseah	CACI/RPWG	(907) 278-8012

Meeting began at 9:15

Stan - gave an overview of restoration planning; stated that Alex would speak on legal aspect of economic analysis; this is an initial scoping meeting; restoration group needs to get a better understanding of economic point of view; a secondary purpose is that we have three proposals put forth by the Department of Fish and Game to carry out economic restoration studies; need to evaluate those proposals; no members of federal economics team have seen the proposals; copies are being prepared; will give time to scan them; don't need to do a detailed critique but see if they fit with the emerging program; the Restoration Work Group consists of seven agencies which have worked together since January 1990 as a planning team and have identified a wide array of restoration options and concepts; are now evaluating individual ideas; focus of our efforts was doing this in the context of litigation and ultimately would have prepared a damage claim; basic job is still to identify options and formulate a restoration plan which involves public participation; past public involvement had been kept to a minimum prior to the settlement; the charge in the settlement is still to restore, replace, acquire resources and enhance

Stan diagramed the following as a sequence to look at different restoration options:

Injury - resource
service

Regulate - human uses
species and habitat manipulations

Direct- replacement
equivalent resources

Habitat protection

Actions should be scientifically credible, objective for making decisions, and ecologically-oriented; all these are attributes of what we are trying to put in place; public participation is also important; there are political and social components to consider; economics comes in here; we need to have NRDA economic dimensions incorporated in post settlement; in addition to all these attributes, it has to be a common sense program for staff in trenches and the public; it has to be cost efficient

Sandy - there is the need for application at the project level; there may be impacts on the economics of the community

Alex - talked about the regulations (NRDA) in the settlement; how they interplay and how he perceives them applying to the settlement and the economics portion of them; would like to see the role of economists in the regs; regs will provide significant guidance on how to proceed with restoration; the settlement consists of a number of documents:

1. Settlement Agreement - says two governments must abide by the MOA
2. Memo of Agreement - is really the document that tells us how to proceed with restoration

MOA defines restoration slightly different from the regulations; MOA allows for enhancement of resources and services in addition to other things that can be done

Applicability of DOI regulations:

A. The MOA (settlement) provides that the governments do not elect to be bound by the DOI regulations

B. The definition of restoration in the MOA differs from that in the DOI regulations:

    1. Restoration includes "restoration, rehabilitation, and/or acquisition of equivalent natural resources and the services those resources provide to the baseline." 43 CFR 11.82

    2. Restoration means any action which endeavors to "restore to their pre-spill condition any natural resource injured, lost, or destroyed as a result of the Oil

Spill and the services provided by that resource or which substitutes for the injured, lost or destroyed resource and affected services. Restoration includes all phases of injury assessment, restoration, replacement, and enhancement of natural resources, and acquisition of equivalent resources and services. (MOA paragraph II. K)

C. Portions of the regulations have been disapproved by the D.C. Circuit Court of Appeals in Ohio v. DOI. Those portions have been redrafted and circulated for comment. The comments are currently being reviewed.

The proposed portion of the regs deal with valuation; the section on valuations may be useful to RPWG and economists in determining how to address the services component of restoration; cost benefit analysis is a very large component; another aspect of the Ohio case is the grossly disproportionate test; how that applies is that the court opinion suggests that it be applied to the cost benefit analysis in determining which restoration option would be selected; the Trustees should look to technical feasibility project, natural recovery period, acquisition of equivalent land; there are ten factors; Interior has proposed that they would apply the gross disproportionate test.

The proposed regs are (1) not going to apply a hard and fast rule; trustees will have discretion and (2) there should still be application of gross disproportionate test but specifically they are an initial set of comments and do not intend that the Trustees will be bound to the 3 to 1 analysis; the Trustees have a little more discretion than perceived from the opinion but should be able to justify deviating;

The proposed regulations provide for the development of a "Restoration and Compensation Determination Plan." The trustees must develop a reasonable number of restoration alternatives, the purpose of which is to:

a. Return the injured natural resource to its baseline condition.

b. Return the level of services provided to the public by the natural resource to its baseline level.

1. Services means "the physical and biological functions performed by the resources including the human uses of those functions. These services are the result of the physical, chemical, or biological quality of the resource." 43 CFR 11.14.

c. Baseline means the condition or conditions that would have existed at the assessment area had the discharge

not occurred.

Comment - from the literature, exercise of GDT and restoration costs and burden operates from the assumption that someone takes an action that results in damage and another party is trying to predict what the liability will be for that action; GDT argument would seem to make sense; Exxon already knows what their liability is, so why would the gross disproportionate test enter into this

Alex - have this finite pot of money for the next ten years; we should pick the one that is most cost efficient; there have been things in the press with suggestions of marine parks; a more serious and viable one is a marine research institute; some of the things may affect the size of the pot of money spent on hands-on restoration

Comment - who would intervene and say a marine sanctuary is not a viable option?

Alex - environmentalists, fishermen, Native corporations, Exxon, ...each other; would not be surprised to see Exxon take a somewhat critical role in the restoration process

Comment - regarding payments

Alex - there is a provision for the reopener clause for damage that was not foreseeable; there is a provision for reopening claims for upward of 100 million dollars; the other part is that the restoration process will become public within 90 days of settlement; has not figured out how public participation will be accomplished

Susan - may be sued; need to establish we are doing it with correct analysis

Stan - have a public trust and will need a record

Alex - Trustees have a fiduciary obligation

Mark - public and courts have a handle in making sure the trustees maintain public trust; GDT may be used to shoot down some options

Alex - MOA says we are not bound by regs

Stan - in proposed DOI revisions, it boils down to cost benefit and cost effectiveness (the least cost alternative that delivers the desired results); a little ambiguity when referring to alternative (a suite of projects)

Sandy - are bound by public opinion

Susan - do we have to do grossly disproportionate?

Comment - may not even be relevant

Alex - addresses inadvertent or accidental discharge

Comment - disproportionate rule benefits the spiller

Ken - the parallel is back to the EIS process where you have a reasonable set of options; have used the red face test in proposing projects; need some bounds for what suite of alternatives that we put forth

Comment - regarding GDT, does the law describe cost as social cost?

Alex - don't know

Stan - does GDT involve a valuation of the damaged or undamaged resource?

Alex - value resource and service; don't know how you would separate them

Comment - can't understand why you would want to consume more value than you produce, is it because of political restraints?

Art - enhancement constraints may force us into this; an example would be recreation enhancement opportunities

Mark - another example is a unique salt marsh that would cost a lot to fix; in terms of value to ecosystem, may be more important than value in dollars and cents

Alex - in the preamble to the proposed regs in terms of cost benefit:

> the trustee should consider the relationship of the expected costs of an alternative to the benefits from the implementation of that alternative, both in terms of the recovery of the resource and the benefits to the public that would result. This consideration is not intended to be a straight cost/benefit analysis. The trustee should weigh circumstances unique to each assessment against the expected alternative costs. Such circumstances might include seasonal conditions, e.g., long winters resulting in a short field sampling season requiring extra personnel, overtime, and high travel costs. All relevant consideration that might affect the weighing of costs and benefits should be taken into account by the trustee on a case-by-case basis. The trustee will document this consideration within the Restoration and Compensation Determination Plan that is subject to

public review and comment.

Stan - least cost is being addressed in restoration options

Comment - is that compounding injury in some sense?

Stan - that is tricky because if we take an action, we want to minimize cost

Comment - who pays the cost and who receives the benefits; need to keep our ledgers straight

Comment - don't need to get into who the individual bearers are

Mark - seems we are somewhat vulnerable at this point

Alex - that's why we wanted to settle with the fishermen

Comments - there are all types of legal complexities; these are good questions for the future

Stan - need to hear some thoughts from the economists on what is cost effective; what basic elements do we need in our program

Comment - need to define what you mean by cost and also what is the goal

Stan - our goal is recovery; to the short hand would be pre-spill conditions such as composition, abundance, and a healthy system with functional integrity as prior to spill; settlement is very explicit about pre-spill condition and allows us to enhance

Susan - regarding cost benefit, aren't there certain categories of cost to look at

Comment - There are engineering cost and land acquisition cost; have to go to the political arena to choose among options

Alex - suggest we begin with task of making ecosystem whole; if trustees ask us to deviate, we can deal with those questions as they arise

Stan - when talking about alternatives, one could have alternatives consisting of suites of action that have different emphasis; need to package this in way that the public will get a handle on the range of strategies; may have several different packages; Art prepared a restoration plan decision diagram; it gives a good sequence for making decisions

Comments - is this a time sequence?

Stan - conceptually it is not a time sequence

Art - run options through decision tree

Stan - it is a series of decisions made in sequence but not spread out over ten years

10 minute break

Stan - the RPWG is working on a process by which we are identifying the relevant habitats; showing which ones are on public and private land and ultimately enabling us to make recommendations to the trustees; need to translate from the conceptual down to the specific which will enable us to get down to cost

Jeff - had an opportunity to see some projects generated by biologist for fisheries and can't see where benefit side is equal; if cost effective analysis is to be a meaningful exercise, you have to make sure two projects have identical benefits

Comment - RPWG has to bring economists some very precise information about the physical attributes, status of resource, level of recovery and rate at which that recovery will occur for them to tell RPWG about the cost benefit; will be hard for economists to do much in a quantitative way otherwise

Mark - that would be requesting a level of understanding of the ecosystem that we don't possess

Comment - can't definitively determine cost benefit unless very precise about benefit scheme

Art - if we decrease the recovery time, is that a benefit?

Comment - would have to see an explicit example

John - are getting some information from a contract dealing with estimating

Art - Alternatives are no action, management action and direct intervention action

Comment - can tell us difference in cost and productivity; one in dollars and one physical units; have trick ways of computing

Ken - putting in a net present value

Comment - the problem in reality is that the political decision will be made; all they can do is summarize the information in a useful way

Comment - the one advantage is that the goal is defined to pre-spill equilibrium; can determine relative performance of options

Comment - are you talking only about direct cost of obtaining the alternative?

Art - there are also benefits that might accrue

Comment - see if you can assign economic values; how much money and how much credibility do you want to assign to the methods?

Alex - NEPA does not apply but can be used to make decisions as a methodology for determining endpoints

Comments - may not be able to quantify to the last duck, but theory tells us about the estimates surrounding each

Alex - regarding applicability of NEPA regulations, can only speak from the state side

Stan - anything that can be construed as a federal action or using federal money will have NEPA come into play

Ken - may have to do site specific analysis

Stan - a good deal of money might get eaten up in NEPA compliance

Mark - would like to get a summary of where we are in terms of cost effectiveness; what can we do to make an administrative record to show that we have considered this

Stan - if someone were assigned to provide an economic view to the RPWG, what types of steps do we need to be going through?

Comment - have to be sure everyone is talking about the same questions; economist are infamous for answering the wrong questions; have to have the concepts nailed down

Art - need to use an example we are faced with such as Harlequin Duck

Comment - important to date your expenditures

Art - what about costs of land?

Comment - management and monitoring are costs economist need to know about

Stan - it's not the purchase of land that improves productivity but rather it prevents further degradation of the environment in which the duck is nesting

Comment - what are things that will go away as a result of purchase of land?

Stan - when cost is incurred and when the benefits are realized should be noted; maintenance operating cost and at what intervals are also information we desire to have; another is planning and compliance cost;

Stan diagramed the following for project costs:

Internal Project Costs

Planning/compliance
Construction/acquisition
when incurred
when benefit realized (rate of benefit accrual)
maintenance
  -interval
administrative/fixed

Benefit
service restored
when realized
  -rate of accrual

External Project Costs

Costs	**Benefit**
lost use	services restored
-technical spill overs	-joint products
	-additional benefits

Community/Regional Impact

who gains?
who loses?
how much?

Art - would we need to provide a no action scenario?

Comment - yes

Comment - some of these lost uses are lost property, and others are de facto losses that are not recognized under the law

Comment - you can't collect what you never owned

Comment - be careful of double counting

Stan - do we need to look at economic impacts?

Art - would be politically impossible not to

Comment - we don't have the data to give us a stable model

Sandy - would rather be criticized for what we have done than what we have not done

Art - we should be able to quantify losses to fishermen

Comment - in the absence of evidence to the contrary, each option has the same repercussion effect

Stan - is there potentially a non-trivial effect?

Art - who determines what is trivial?

Mark - the Trustees

Comment - there may be multiple objectives; economics deals with efficiency and equity; economic impact assessment only explains to the best of your ability

Comment - input/output is a loaded term and should be substituted with community/regional impact

Comment - in a cost benefit analysis, it is appropriate to list your errors and biases

Comment - can't begin to do any analysis until the mapping out is done

Break for lunch at 12:15

Stan - work group needs to huddle together to make good use of time this afternoon with economist; will meet at 12:45

Stan - work group met and tried to frame a few more questions for the economists; here are a few things we need to know more about:

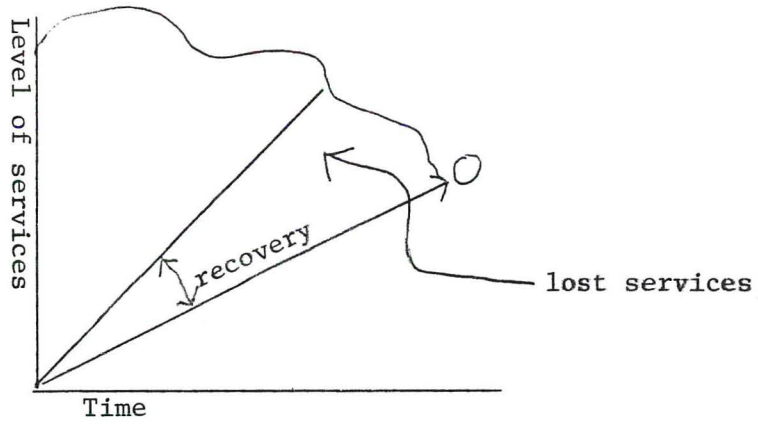
1. Is framework appropriate
2. Methods - where do we go to get some insight to establish a program
3. Level or rigorousness needed to satisfy Trustees
4. What kind of staff capability is required (staff economist)

we tried to articulate the goals; need to have valuations of resources and injuries to make judgments

Comment - it is not a monetary measure but a performance measure

Mark - we are expending money we recovered for lost use and returning it in the form of enhancement; we are compensating the people through enhancement beyond pre-spill

Art diagramed the following:



Art - whole system will come back to this dynamic equilibrium even if left alone

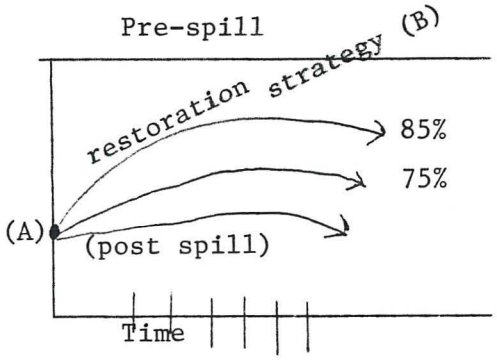
Comment - is that a good thing to do?

Stan - why do you call this enhancement and not restoration?

Comment - should look at what do we gain per dollar

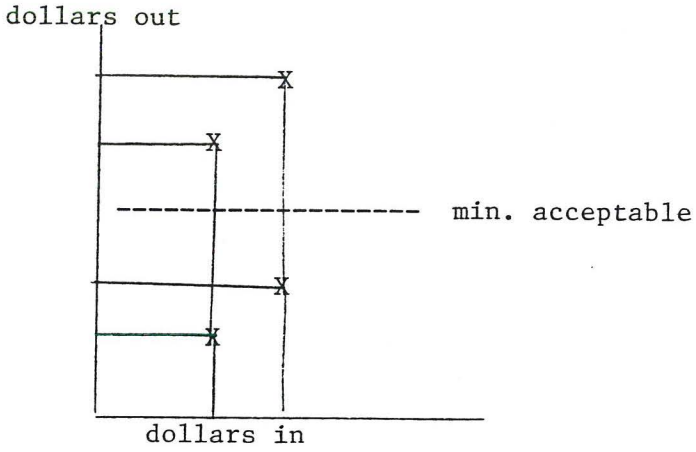
Stan - in order to calculate benefit, we still need a valuation in dollars and cents

Another diagram was drawn by an economist from work of Dennis King, Wetland Creation and Restoration: An Integrated Framework for Evaluating Costs, Expected Results and Compensation Ratios, Chesapeake Biological Laboratory Center for Environmental and Estuarine Studies, University of Maryland System, Solomons, MD 20688-0038 (301) 326-4281, prepared for Kenneth Adler, Office of Policy Planning and Evaluation, U.S. Environmental Protection Agency, April 1991. A copy was obtained from Industrial Economics Incorporated, 2067 Massachusetts Avenue, Cambridge, Massachusetts 02140



Another economist diagramed whether margin of cost is worth the margin of gain:

MEASURES OF EFFECTIVENESS



Comment - bristles at the notion that you have to use scientist and analyst to sell these things

Comment - some of us think the cleanup added to the damage; what is the alternative best use of this money that would produce more benefit?

Stan - that is what the equivalent resource option is

Comment - do benefits have to be in Alaska?

Stan - yes; what capabilities does it require to do basic cost benefit analysis? does technical team need to have a couple of economist? do we need them now or after we have a conceptual plan?

Comment - probably should have had one a year and a half ago when the RPWG began working; need someone advising which may short circuit problems

Art - what kind of person do we need (background)?

Comment - need someone who can relate to non-economist and with natural resource experience

Stan - is it necessary to have an economics team?

Comment - you have a pile of money and at some point will have to make some hard allocations; at this point you will need an economist, especially when considering benefits

Stan - cost estimation is not something that is an issue for an

economists

Comment - need an economist to compute costs; minimum protocols need to be established

Stan - would you need a committee to meet to hammer out protocols?

Comment - yes; may get a few people together to draw up a proposal

Stan - does Fish and Game do cost estimation the same way?

Comment - have to make sure they are expressed in the form of marginal costs

Stan - have to have a way to calculate basic cost

Mark - not comfortable that we have identified a way to keep the economic analysis cost down and make it defensible; need to reach closure on what level of economic analysis is needed

Susan - maybe if agencies have a standard method of doing cost analysis, it might help to look at it

Comment - not aware of anything agency-specific for cost analysis

Susan - EPA does

Art - gave the classes of restorable options

Comment - what are the five most important?

Art - we selected the most defensible ones

Stan diagramed the following species for restitution:

Sea Otter
Dolly Varden/Cutthroat
Harlequin Duck
Common Murre

Stan - there are no competing alternatives for Sea Otters, Harlequin Duck, or Common Murre; can only maintain the environment in which they live; need to look for things that benefit multiple resources

Comment - if you need to do it on political grounds, you need a political scientist; what is the nature of the form to resolve disputes

Alex - even Trustees can't make decisions completely in a vacuum;

decisions must be defended

Break at 2:15

Ken - need to look at the three proposals for economic studies this year; see how they fit into restoration program

Comments by Jeff Hartman

Comment - (overview of proposed projects) - developed a demonstration project to show how cost benefit analysis could be used; damage assessment would probably concentrate on consumer surplus; should be more concentration on the supply function and the industry cost function; put together proposal for project study #1 for commercial fisheries restoration; two economist would be John Boyce and Matt Berman for this project; would get them access to confidential fish files; funds are in the budget but want advice as to whether to carry out studies

Comment - why did you decide to ignore consumer surplus?

Comment - this is not an import/export model

Art - would management differential be shown in this model?

Comment - could ask managers to provide us with that

Sandy - is it correct to consider this a desk study?

Comment - yes; data already here

Sandy - how long would it take you?

Comment - a year to get the model developed

Comment - what is the kind of precision that is going to be used to make decisions on restoration allocation; do we contemplate doing studies that will provide estimates like this for all the restoration projects? is this kind of fine tuning necessary?

Stan - there are different answers to that questions; fisheries, land acquisition and economic implication, and recreation are three areas most likely to need economic studies beyond the routine

Mark - how can we do something most cheaply that will be defensible? what is the level?

Art - does model deal with management actions?

Comment - it would be capable of estimating management issues

Art - why isn't it being done as part of regular management budget?

Comment - been trying to convince Fish and Game to do this for half a decade

John - would hate to see a decision made regarding enhancing pink salmon without a cost benefit analysis; need the kind of data the model will give us

Comment - take best estimates you can find; how much can you improve estimates of archaeological studies? doesn't know how to spend the money

Susan - do you have to justify economically?

Comment - not required to by law

Art - is the money already allocated for fisheries

Stan - money allocated for restoration is subject to NRDA approval
Alex - to avoid the appearance of an agency getting its own work done with restoration money, work group should take a look at this kind of question in a broader prospective and make the decision that these should be done as pilot projects

Sandy - appropriate context is to hold next year's program

Stan - difficulty is the projects have been on the table for six months; should be on a faster track

Comment - could you be more precise on the nature and how cost function will be estimated?

Comment - recommends having a conference call with John Boyce

Stan - looking for some indication that conceptually these are worth looking further at; should hear other two proposals and have some discussion on them

Comment - (proposal regarding Dolly Varden/Cutthroat project) - this proposes to use some models and information that was developed for management purposes by the Dept. of Fish and Game about cost and benefits associated with management actions and regulatory proposals; began in Cook Inlet on problems with King Salmon and then the next important question came up in Southeastern; probably won't get to PWS before restoration begins; history - had input/output models for impact estimates and developed some discrete choice models for benefit analysis; committed to a voluntary experimental approach; made more sophisticated models that have computer based models that give changes in benefits;

going out and evaluating stocks in non-oiled areas to see if they are up to supporting displaced resources; might take some management action to move sport fishing from oiled areas to other areas; values on discrete choice models tend to be very small; have an annual survey in which usage is measured all over the state; all of this was directed at assessing benefits

Ken - focus is on dolly varden and cutthroat?

Comment - yes, but the direction kept changing

Ken - what if we wanted to look at all recreation fishing?

Comment - they would do that; would refine models so they could do that

Comment - economists love to make assumptions; model is incredible but is the cost worth it; what are you willing to pay for the extra precision?

Stan - can anyone talk about Scott Goldsmith's project?

Comment - the most accurate way to describe what Scott wants to do is conduct a survey on household consumption data and try to refine some impact models he is already operating; suggestion to do economic impact assessment and relate it to fisheries in the oil spill affected areas

Art - unfair to have someone to explain someone else's project

Susan - how do these two fit together?

Comment - describe employment and personal income changes in subregions in the state

Comment - if you decide to estimate economic impacts, then these are the kinds of things you would want to do; only small parts of big picture

Comment - if you decide to do these things, it is best to go with an available mode

Ken - need to bring this to some kind of closure; could we ask our peer reviewers to take these back and maybe get on conference call with PI and then later get on conference call with RPWG before making a final decision? do we want this level of analysis?

Alex - seems appropriate

Susan - could we get technical reviews so we can figure out how we want to extrapolate this to the larger picture?

Stan - not sure we should hold them hostage to our not having identified the other elements we need; we have money to do these on hand

Mark - just because we want additional information, does not mean we want this level of detail

Peg - are you setting up an expectation?

Mark - what level of information is needed; if we don't need it for other studies, we don't need it for these

Alex - is there a need to do some level of investigation?
Comment - would want to know are there other proposals out there that could do the same thing for better or for less

Comment - felt the whole assessment process cost 8 or 10 times what it should have; wondering about other opportunities out there

Comment - strategy does not accomplish returning ecosystem as a whole to pre-spill conditions; someone will have to integrate all component parts from models; need to redefine the goal; one definition is not consistent with how you are strategically attacking it

Stan - no simple answer, have to use the hand dealt us; damage assessments were charismatic species-driven; have tried to operate on a couple of different levels; one is on a species-specific action that can restore or enhance; we need to look at individual species opportunities for restoration and need to look at habitat level approach that benefits multiple species

Comment - hard to integrate without a little background context

Stan - believe there are beds of mussels that are sinks for oil and are prey for a variety of predators; several species are experiencing long-term decline; may be something we can do to restore prey base

Art - the action taken was a response action; an attempt to work on the entire ecological system

Comment - seems you are starting at the upper end; could fertilize and plant

Stan - invested money in Fucus for a while

Ken - what do we want to do with the three studies?

Susan - would appreciate a technical review

Ken - would be hard to review the third one

Comment - would encourage review with the authors

Stan - could we arrange a conference call? we could organize it; would you be willing to chat with individuals? recognizing we have not resolved some of the larger issues

Alex - Gardner's services are rather expensive

Stan - what are we looking at 3 or 4 hours?

Gardner - is not worth it?

Stan - learned some things; RPWG has a lot more thinking to do

George - when calling his office, extension 1886 rings into his office, 1885 disappears

Comment - Ben Chambers sends his regards; is in NOAA restoration office in Washington on November 20th for a meeting

Meeting adjourned at 4:00.

"CONFIDENTIAL LITIGATION
SENSITIVE ATTORNEY WORK
PRODUCT"

Restoration Planning Work Group

"Economics and Restoration Planning"

7 November 1991
Simpson Building, Anchorage
09:00 h

Agenda

Introduction

0900-0930 Status of restoration planning and meeting objectives - Stan Senner

What are the rules?

0930-1000 Legal guidance on economic analyses/criteria - Alex Swiderski

1000-1015 Break

Implementing the Settlement

1015-1200 Identifying economic analyses needed to implement the settlement - all

Specific needs and issues:
-valuing the damaged resources
-cost estimation
-cost-benefit analysis
-economic effects of restoration strategies
-consistency in methodologies

1200-1300 Lunch

What Resources are Needed?

1300-1400 Identifying the resources and expertise needed to carry out economic analyses - Mark Brodersen

1400-1415 Break

Current Proposals for Economic Analyses

1415-1530 Discussion of the concepts in the three ADF&G proposals - Ken Rice

1530-1630 Wrap-up and summary - Stan Senner

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S U M M A R Y

Title: Regional Economic Impact Assessment for Commercial Fisheries Restoration

Lead Agency: University of Alaska - Anchorage
Institute for Social and Economic Research

Principle Investigator: Scott Goldsmith

(The principle investigator was on vacation and could not be reached to provide a project description. This short description was derived from previous submissions.)

Introduction:

The overall goal of this research is to develop the economic impact tools needed to assess the regional and inter-regional economic impact of restoration projects. Specific objectives include:

- collecting data on the purchasing behavior of key commercial fishing and sport fishing sectors.

- using this data in an economic impact framework to assess impacts on regional employment, gross revenue, income multipliers and state tax receipts under various assumptions about the ability of different sectors to respond.

- collecting data on household consumption patterns, goods and services purchased and place of purchase.

- identifying which regions, sectors and types of businesses are most likely to be able to benefit from enhanced fishing opportunities.

Methods:

The Department of Fish and Game has a preliminary version of an economic impact model, developed by the Institute of Social and Economic Research, for evaluating the effects of increments in harvest for major statewide fisheries. This model is based on a spreadsheet analysis of secondary data showing the percent of harvest costs accruing to labor and other factors of production. It projects personal income and full time equivalent employment. This model needs further disaggregation to make it more useful for determining the indirect impacts that may occur in the local economy due to changes in a number of commercial species which may result from restoration activities.

Data on firm and household purchasing behavior will be collected via direct survey of permit holders and crew. Primary data will be sought only if it is believed it will have a significant influence on the output of the model and that the true data values are different from those available from secondary sources.

Regional Economic Impact Assessment for Fisheries Restoration (Project 3.)

DRAFT WORKPLAN (Partial)

III. PROJECT DESCRIPTION

III.a. Concept

Restoration implementation projects will impact the regional economies in South Central Alaska in several ways. The manpower and other resources directly devoted to the projects will have a short term economic effect. The permanent changes in the stock of seafood in the Sound resulting from the restoration projects will have a long term economic effect. Other temporary or permanent changes in the natural or human environments of the Sound resulting from the restoration projects will create other short term or long term economic impacts.

The regional economic impact of these projects is popularly known as the "multiplier effect". It is a measure of how an initial infusion of money into a region is multiplied through the economy by the subsequent economic transactions which it engenders.

For example, the construction and operation of a fish hatchery brings new money into the community within which it is located. Workers are temporarily employed in construction jobs. When construction is completed workers get permanent jobs operating the hatchery and fish harvesting and processing activity may also increase. These activities generate additional jobs within the community in two ways. First some of the inputs to the construction and operation of the hatchery as well as the harvesting and processing of the fish, such as fuel or gravel, are provided by local businesses which expand operations when the hatchery enters the region. Economists call this the "indirect" economic effect of the hatchery. Second the workers at the hatchery and processing plants and the fishermen spend some of their wages and other income in the community. This stimulates activity for those local businesses that provide goods and services to households. Economists call this the "induced" economic effect of the hatchery. The total economic impact of the hatchery on the community includes not only the new jobs created at the hatchery itself but also the "indirect" and "induced" employment created by the expansion of other businesses within the community.

Measuring the economic impacts associated with the restoration implementation projects is a useful policy analysis exercise. The impacted communities and individuals usually view increases in jobs and income from such projects as economic benefits even if, in a classical economic benefit-cost analysis, they are not. Consequently, policy makers need to be aware of the changes in economic activity which result from government projects which influence the economy.

(8) $k(n_{i,t}) = \kappa + \eta n_{i,t} + \varphi T_{i,t} + v_{5,i,t}$

where, again, the intercept plus the coefficient on the $n_{i,t}$ term will represent the opportunity cost of the most efficient fishermen, and the η parameter will represent the incremental cost of adding another fisherman to the fishery. One check on the logical consistency of the model will be in examining the location of the entry and exiting cost functions relative to one another. The entry cost equation should lie above the exiting cost equation everywhere.

The Equilibrium Conditions

Two types of equilibrium may occur in the fishery. In the event that fishermen are observed entering the fishery (in net), the equilibrium will be characterized by equating expected revenues with the entry cost,

(9) $E(z_{i,t}|z_{i,t-1}, y_{i,t-1}, n_{i,t-1}, m_{i,t-1}, s_{i,t-1}) = k(n_{i,t})$.

The "reduced form" equation corresponding to this equilibrium is

(10) $n_{i,t} = (\kappa/\gamma) + (-1/\gamma)z_{i,t-1} + (-1/\gamma)z_{i,t-1} + (\beta/\gamma)n_{i,t-1} + (\alpha/\gamma)(m_{i,t-1} - s_{i,t-1} - y_{i,t-1}) + (\varphi/\gamma)T_{i,t} + e_{1,i,t}$

where $\gamma = \beta - \eta$, and the error term is $e_{1,i,t} = (1/\gamma)(v_{3,i,t} - v_{5,i,t})$. It is this equation that will be estimated when entry is observed to occur. A similar equation will exist when exiting is observed to occur. When exiting occurs, the equilibrium is given by equating expected revenues with the variable opportunity cost function,

(11) $E(z_{i,t}|z_{i,t-1}, y_{i,t-1}, n_{i,t-1}, m_{i,t-1}, s_{i,t-1}) = c(n_{i,t})$.

The "reduced form" equation corresponding to this equilibrium is

(12) $n_{i,t} = (\phi/\delta) + (-1/\delta)z_{i,t-1} + (-1/\delta)z_{i,t-1} + (\beta/\delta)n_{i,t-1} + (\alpha/\delta)(m_{i,t-1} - s_{i,t-1} - y_{i,t-1}) + (\sigma/\delta)q_{i,t} + e_{2,i,t}$

where $\delta = \beta - \omega$, and the error term is $e_{1,i,t} = (1/\gamma)(v_{3,i,t} - v_{5,i,t})$. It is this equation that will be estimated when exiting is observed to occur.

The model to be estimated will thus "switch" between equations (10) and (12), depending upon which equilibrium is in effect. The parameters of the model are to be estimated using maximum likelihood (MLE) techniques taking into account the non-linearity of the parameters.

The Disequilibrium Conditions

There are four disequilibrium conditions that are also possible. One set of cases occurs at the two "corner solutions" corresponding to $n_{i,t}$ equal to zero (all people have exited the fishery because expected revenues are below the opportunity cost of even the most efficient fisherman) and $n_{i,t}$ equal to the number of permit holders (all possible entrants have entered the fishery because expected revenues are in excess of the least efficient fisherman's opportunity cost of entering). A third case occurs when the fishery is closed by management officials even though expected revenues exceed the opportunity cost of at least some fishermen. The fourth case occurs when it is profitable for all fishermen who are in the district to remain in the district, but it is not profitable for additional fishermen to enter.

If any of the disequilibrium conditions holds, the error terms $e_{1,i,t}$ and $e_{2,i,t}$ will no longer have expected values of zero. To ignore this would violate the properties assumed to hold for the MLE estimator of the paramters. To deal with this problem, a two-step procedure suggested by Heckman[1] will be used. This procedure will be described for the case where the fishery is closed by management authorities even though it remains profitable to fish for some fishermen. In this case, the number of fishermen observed to be in the fishery the day following the closing is zero. However, the equilibrium condition (11) is replaced by the condition that

(13) $E(z_{i,t}|z_{i,t-1}, y_{i,t-1}, n_{i,t-1}, m_{i,t-1}, s_{i,t-1}) > c(1)$.

In terms of equation (12), we have $n_{i,t}$ observed to be zero. Given the conditions in the fishery, there exists an $n^*_{i,t} > 0$ for which (12) would be satisfied with equality. Unfortunately, this value is not observed. So we have

(14) $n^*_{i,t} = 0$ when $n^*_{i,t} > 0$, and the district is closed, and
$n^*_{i,t} = n_{i,t}$ when $n^*_{i,t} > 0$, and the district is open.

Let an indicator variable, $I^*_{i,t} = 1$ when the district is closed, and $I^*_{i,t} = 0$ when it is open. What we want to obtain is an estimate of the expected value of the error term $e_{2,i,t}$ conditional upon the indicator variable being equal to one. We are not trying to explain the indicator variable, only to use it as a conditioning device.

(15) $E(n_{i,t}|I^*_{i,t} = 1) = (\phi/\delta) + (-1/\delta)z_{i,t-1} + (-1/\delta)z_{i,t-1} + (\beta/\delta)n_{i,t-1} + (\alpha/\delta)(m_{i,t-1} - s_{i,t-1} - y_{i,t-1}) + (\sigma/\delta)q_{i,t}$
$+ E(e_{2,i,t}|I^*_{i,t} = 1)$

The expectation of the error term (also known as the hazzard function) is zero when the indicator variable equals zero. To estimate the hazzard function value, we may set up a probit equation, where the right hand side is the right hand side of (12), and the dependent variable is the indicator variable. The probit estimation procedure is known to have the property that the likelihood function is globally concave in the parameters, so parameter estimates are econometrically consistent. In this case, the parameters may be estimated in their reduced form, linear-in-parameters form since all they are being used for is to obtain an estimate of the expected value of the error term given that the inequality in (13) holds. The expectation of the error term is derived in Maddala (p. 222). This value is substituted into (15) with an expectation of zero when $I^*_{i,t} = 0$, and the right-hand-side of (15) is used to estimate (12) using ordinary least squares.

This methodology is described in more detail in Chapter 8 of Maddala (1983) for the present circumstances and for cases differing from the present example. The other disequilibrium conditions will be handled in a similar fashion. The final estimating equation would then be a dummy variable model switching between (10) and (12), appending the appropriate hazzard functions as an extra explanatory variable. The coefficient for the hazzard function variable turns out to be the variance estimator for the model.

The Sequential Choice Model

The sequential choice model is based on work on probabalistic choice used by psychologists and economists to explain behavior under conditions that depend upon what the state of the economic system in which the fisherman operates is and upon previous decisions by the fisherman. These models assume that the random factors influencing responses at various stages are independent (Maddala, p. 51). In it's simplest formulation, the model may be expressed as follows:

The probability that an action (to enter, exit, or to remain in the area) is taken by an fisherman in district i, on day t,depends upon the state of the system. The state of the system is a function of variables specific to the individual, such as where that individual is fishing, how long he has been there, and his own history of participation, as well as variables which are specific to the area, but general to the individuals. This would include things such as the number of fishermen in the area in the previous period, the CPUE in that area, the species mix, and the like. The individual would make an observable choice in each period.

The sequential choice model can be translated into effort supply curves by including a variable on the expected revenues (ie., a dollar variable) in the set of explanatory variables. This is the methodology used in discrete choice contingent valuation method models used in recreation demand.[2] The idea is to estimate the probability that an fisherman will enter or remain in a fishing district given the expected revenues associated with taking this action. The supply curve for effort is then obtained by obtaining the expected number of fishermen at each given price, where "price" is the estimate of the expected revenues in the area.

This method is much simpler to estimate than is the simultaneous equations model used in the structrual equation model. In addition, it has the benefit of using a probit equation, which is extremely robust in its estimation properties since the underlying likelihood function is globally concave in the parameters of the model.

The Estimating Equation

The estimation equation has as its dependent variable an indicator variable $I_{i,t}$, where = 1 if the fisherman choses to enter or remain in area i given the status of that area on day t, and is zero otherwise. The entry cost function may be differentiated from the exiting cost function by a dummy variable $s_{i,t-1}$ which designates the status of the fisherman in the previous day. For example, if the fisherman is in area i on day $t-1$, then $s_{i,t-1}$ =1, and is zero otherwise. The idea is that the fisherman will enter if and only if the expected revenues exceed the fisherman's "reservation cost". This reservation cost, of course, is the opportunity cost of entering the fishery. Similarly, the opportunity cost of remaining in the fishery will act as the reservation cost in determining whether or not a fisherman will exit the fishery. The individual characteristics variables are used to describe how these reservation costs differ across individuals. The estimating equation would be of the following form:

$$(16) \qquad I_{i,t} = s_{i,t-1}(\pi_1 + \pi_2 x^e_{i,t} + \pi_3 n_{i,t} + \pi_4 y_{i,t}) + (1-s_{i,t-1})(\pi_4 + \pi_5 x^e_{i,t} + \pi_6 n_{i,t} + \pi_7 z_{i,t}) + v_{i,t}$$

where $x^e_{i,t}$ is the measure of the expected value of the biomass, and is obtained by estimating (6), $n_{i,t}$ is the number of participants in the area, $y_{i,t}$ is a set of variables describing the vessel characteristics, policy variables (species mix, etc.) and $z_{i,t}$ is a set of variables describing the vessel characteristics, policy variables (including the length of the season), and $v_{i,t}$ is the unobserved random disturbance. The dummy variable $s_{i,t-1}$ switches the regression equation back and forth between the enty cost and the exiting cost part of the regression.

The idea is that the dependent variable will be equal to 1 (the fisherman either enters the area or remains in the area) when the right-hand-side of the equation exceeds the relevant opportunity cost. The number of participants variable is included to account for crowding externalities. The coefficient on the expected stock variable is interpreted as the change in the probability of entering (or remaining in) the fishery as the expected revenues increase. In each case, the sign of this coefficient is expected to be positve. The other variables are included in the regression as shift parameters on the supply function. At the individual level, these will include things such as historical effort rates and the number of days in the fishery (in the case of exiting). At the policy level, these will include variables such as the species mix (and thus the average expected price) and the length of the opening remaining (in the case of entry).

SUMMARY AND DISCUSSION

Two models have been developed in this paper. The structural equations model explicitly specifies opportunity cost of entering or remaining in the fishery. The equations to be estimated are derived explicitly from this relationship. The sequential choice model depends upon the notion that the actions of the agents reveal their reservation costs. By using a measure of expected revenues as the price variable, the reservation costs are obtained implicitly.

Each model depends very heavily upon the expected revenues estimate. In the structural equations model, the function is explicitly defined, however, actual estimates of the expected revenues are not derived. This is because these values are equated with the unobservable reservation costs in the derivation of the estimating equation. In the sequential choice model, this value is explicitly estimated using the model underlying equation (6). This is in contrast to the travel cost method proposed by Dr. Berman, which uses distance travelled as a proxy for costs. The relative merits of the two models will probably lie in the ability of the expected revenues function to accurately predict the expected revenues faced by fishermen.

In addition, both sets of models make use of a dummy variable switching regression econometric technique and each model incorporates explicitly censored and truncated regression problems associated with the econometric disturbances. Both models will have to deal with the "corner solutions" as well as with the occurences where exiting occurs because the season closes.

The data requirements for each model are identical: a historical trip ticket data set is required to obtain estimates of timing of runs as well as historical participation records of individuals; opening and closing dates for the year selected as the base year (preferrably 1988 or 1990); and vessel characteristics data.

The policy variables that may be considered are the stock variables associated with species mix and size and timing of the runs, as well as variables affecting a differential use of capital such as changing the length of openings and closings. Each model is capable of generating estimates of opportunity costs that are independent of some of the area characteristics. For example, characteristics which affect how strong is the crowding externality can be accounted for explicitly in the regression analysis (the β parameter in the production function (1)), thus rendering the cost equation estimates independent of these characteristics. Other factors, such as distance from a major port can also be directly accounted for in the intercept paramters of the entry cost function (ie., allowing κ in equation (8) to differ across areas).

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[1]Heckman, J. (1976) "The Common Structure of Statistical Models of Truncation, Sample Selection and Limited Dependent Variables and a Simple Estimator for Such Models." *Annals of Economic and Social Measurement* 5:475-92. See also the discussion in Chapter 8 of G.S. Maddala (1983) *Limited-Dependent and Qualitative Variables in Econometrics*, Cambridge University Press.

[2]For a survey, see Kenneth E. McConnell, "The Economics of Outdoor Recreation", Chapter 15, pp. 677-722, in *Handbook of Natural Resource and Energy Economics*, Volume II, edited by A.V. Kneese and J.L. Sweeney, Elsevier Science Publishers, 1985.

SUMMARY AND DISCUSSION

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INSTITUTE OF SOCIAL AND
ECONOMIC RESEARCH

August 8, 1991

Memorandum

To: Jeff Hartman

From: Matt Berman

Subject: Fishing Cost Model

Post-it™ brand fax transmittal memo 7671	# of pages ▸
To Jeff Hartman	From M. Berman
Co. ADFAG	Co. UAA ISER
Dept FRED	Phone # 786-7716
Fax # 465-4168	Fax # 786-7739

Attached is a technical description of the model I am proposing to estimate for estimating the effects of enhancement projects on benefits and costs to fish harvesters. I have outlined two versions of the model. The first, more complete version is the one I would like to use for the restoration study. The second approach can be estimated more quickly and easily for a larger number of fisheries. I propose to use that method as the fallback position for the legislative hatchery study.

I would be interested in your comments and questions as soon as possible. I plan to be out of the office next week, but should be back on the 20th.

A Model of Fishing Cost and Participation

The proposed model of fishing cost and participation utilizes information about the choice of when and where to fish, given the available alternatives, to estimate expected profit and cost functions for Alaska salmon fisheries. Two versions of the basic model are outlined here. The first version -- the choice model -- is theoretically the most complete and utilizes the most information about the behavior of individual fishing permit owners. Using this method can produce more accurate estimates of net benefits, but more data are required, and problems may potentially arise with estimation of the model parameters for some fisheries. The second version -- the number of trips model -- follows the same line of reasoning but summarizes some of the information contained in the choice model. The latter model therefore requires less data and is easier to estimate, but is likely to produce less accurate results.

Choice model

Let Y_i represent the profit which would be earned if the fisher chose to fish in area i. Then

$$(1) \qquad Y_i = p_i q_i - C(q_i, w, x_i) + u_i,$$

where p_i represents the price vector of the individual's catch q_i, the cost function, C, depends on the harvest, a vector of factor prices, w, and a vector of characteristics of the district, x_i, and u_i is a random term representing unobserved variables and forecasting and optimization mistakes of fishers. If we assume that expected catch rates are a function of the total stock in area i, Q_i, that is:

$$q_i = f(Q_i),$$

then

$$(2) \qquad Y_i = V_i(p_i, Q_i, w, x_i) + u_i,$$

where V_i represents expected profits, given by

$$(3) \qquad Y_i = p_i f(Q_i) - C[f(Q_i), w, x_i] + u_i.$$

The area referenced by the subscript i can represent a statistical area or any level of aggregation of statistical areas. The size of the area used as the unit of analysis should be large enough so that most if not all the harvest recorded on an individual fish ticket comes from one area, yet small enough to observe different boats harvesting fish from the same opening in different areas. For now, we will assume that the area represents a district.

Unfortunately, Y_i cannot be observed. Instead, fishers are observed to choose one district in which to fish.[1] One can represent this choice as follows:

$H_i = 1$ if $Y_i = \max(Y_1, Y_2, \ldots, Y_D)$

$H_i = 0$ otherwise,

where D represents the number of districts open for fishing (open to the fisher) at any given time. If the error terms, u_i, are independent and identically distributed with the type 1 extreme value distribution (see Maddala, 1983), then

(4) $\quad \text{Prob}(H_i = 1 | Q_i, w, x_i) = \exp(V_i)/\Sigma_j \exp(V_j), \quad (j = 1, \ldots, D)$

where the expression $\exp(V)$ denotes e^V. The vector, w, of prices of inputs typically does not change over districts in a fishery, but they might vary over time and across regions of the state. Elements of w might include fuel prices, prices of food and provisions, and the opportunity cost of labor (wage rate in alternative occupations).

Each one of the N individuals who holds a permit and can potentially enter this fishery may have a different expected profit function, $V_i(Q_i, w, x_i)$, from fishing a particular district, i. One could, however, rewrite equation (2) so that profits are a general function of characteristics of the site and of each individual participant as follows:

(5) $\quad Y_i^n = V_i(p_i, Q_i, w, x_i^n) + r_i z^n + u_i^n,$

where z^n is a vector of characteristics specific to fisher n which do not vary among the various sites but whose effect on expected profits might differ across sites (for example, vessel characteristics). The site characteristics vector x_i^n may also possibly differ by individual (for example, distance from home port).

Equation (4) may now be rewritten as

(6) $\quad \text{Prob}(H_i^n = 1) = \exp(V_i + r_i z^n)/\Sigma_j \exp(V_j + r_j z^n), \quad (j = 1, \ldots, D)$

In order to estimate equation (6), one must choose a functional form for V. With w constant across observations, a simple form might be

(7) $\quad V_i = \alpha + \delta(p_i + \beta)Q_i + \phi x_i^n$

This specification for V_i^n turns equation (6) into a standard multinomial logit, whose coefficients may readily be estimated with maximum likelihood techniques (Maddala, 1983). More complex functional forms for $f(Q)$ and $C(q, w, x)$ would imply different versions of equation (6) which might more realistically model the fishery but would be somewhat more difficult to estimate.

A second-level problem would be to incorporate the possibility of choosing to participate in other fisheries (not just other districts), or to not fish at all during an opening. This would transform the model into a

nested multinomial logit model. Following McFadden (1982), define the "inclusive value" for the kth fishery, I_k^n as

$$I_k^n = \log[\Sigma_j \exp(V_{jk} + r_{jk}z^n)], \quad (j = 1, \ldots, D_k)$$

where there are D_k open districts in the kth fishery. If the choice to fish in district i is now conditioned on participating somewhere in the opening, equation (6) may be rewritten as

$$\text{Prob}(H_{i|k}^n = 1 | J_k^n = 1) = \exp(V_{ik}^n + r_{ik}z^n)/\exp(I_k^n)$$

where J_k^n represents the choice of participating in the kth fishery. If there are S available alternative fisheries for the nth individual, the probability of participating in the kth fishery may be written as

$$(8) \qquad \text{Prob}(J_k^n = 1) = \exp(V_k^n + r_k z^n + I_k^n)/\Sigma_j \exp(V_j + r_j z^n + I_j^n),$$

$$(j = 1, \ldots, S)$$

Equation (8) represents the choice problem for individuals who have permits for several fisheries which may have overlapping openings. The only choices which need to be modeled are for those fisheries in which individuals have the option to participate (e.g., they own permits).[3] In equation (8), V_k^n represents the profit function for the most profitable district in fishery k. Explanatory variables included in that equation will be those which vary among fisheries -- for example, prices of fish, wage rates, distance from home port -- and factors such as vessel characteristics which might make some individuals to be more likely than others to participate in a particular fishery in which they have an option -- e.g., a permit and an opening -- to participate.

The multinomial logit equations (6) and (8) carry the implied assumption of "independence of irrelevant alternatives." This assumption means in essence that if a change affecting one of the alternatives does not affect the relative probabilities of choosing the other alternatives. For example, the model implies that an enhancement project which increases the stock of fish in district A will increase the probability that fishers choose to fish in district A and decrease the probabilities that districts B and C are chosen. But the *relative* probability of choosing B over C would not change. We have no reason to believe that this assumption is invalid for the Alaska salmon fishery. Methods are available to test and correct for this problem (Maddala, 1983).

Estimating equation (6) for those individuals participating in various openings for an individual fishery yields estimates of the expected profit an individual would earn from fishing in each district as well as a probability of fishing in that district, given the expected size of the stock, characteristics of districts, and characteristics of the individual. The parameters estimated from equation (6) also estimate the inclusive value, I_k^n. One can then estimte equation (8) in order to estimate the probabilities and expected profit from participating in alternative fisheries. If all individuals holding permits for the kth fishery participate in all openings

over a season, then the probability J_i is always equal to 1, and equation (8) cannot be estimated. The overall expected earnings -- the earnings estimated for each alternative multiplied by the probability of choosing that alternative -- estimates the producers surplus of the fishery. If the available stock of fish changes for an opening in a district, the equations produce another estimate of the producers surplus, based in part on higher profits for vessels already fishing in that district and in part on vessels switching into that district from other districts, and possibly in part on higher participation rates in the fishery as a whole.

In addition, the estimated coefficients on distance, stock of fish, and vessel characteristics measure the incremental profit an individual fisher expects to earn from a marginal change in these factors. These estimates trace out profit and cost functions for an individual participating in the fishery. However, an analysis of benefits and costs for the entire fishery must address the effect on changing location of fishing effort and changing participation rates.

Number of landings model

The number of landings model assumes the same underlying decision structure as the choice model enumerated above. The choice model examines the choice of whether or not to participate in an opening, given other options, and the choice of where to fish, given the decision to participate. Instead of looking at each choice separately, the number of trips model aggregates the choices of where to fish into observations on the number of landings from a district. As such, it proposes to estimate expected profit functions in a way which is closely analogous to the way demand curves are estimated for outdoor recreation using the travel-cost method (see Huppert 1983).

Let N_k represent the demand for trips to the ith site in the kth fishery during a particular opening. We assume that this demand, and the number of observed landings, is a function of the expected profit which could be earned by fishing in that district, i.e.,

$$N_k = g(Y_{k1}, \ldots, Y_{ki}, \ldots, Y_{km}) + v_k,$$

where the Y_{ki}'s represent expected earnings from fishing in alternative districts open in fishery k and v_k is a stochastic error term.

If one assumes that the function g is linear, the equation for the number of landings for a given fishery becomes (dopping the suscript k for clarity):

$$(9) \qquad N_k = \mu_0 + \mu_1 Y_1 + \ldots + \mu_i Y_i + \ldots + \mu_D Y_D + v_i,$$

For estimating equation (9), Y_{ki} is given by equation (5), and V_k is given by equation (7). It is also possible to include expected profits from fisheries in addition to the kth fisheries if these are able to draw at least some fishers away from an some openings in fishery k. Realistically, only a few alternatives can be included in equation (9) due to practical

problems with construction of the data series and obvious multicollinearity among the explanatory variables.

Variation in the number of landings will be explained by factors which influence the profitability of fishing in one district relative to another, including size and value of stocks, vessel characteristics, and characteristics of alternative districts. Two alternative ways of aggregating the number of landings are possible. One is to observe the total number of landings made from a district by all vessels for each opening during the season. The other is to observe the number of landings made by each vessel for all openings over the season. For the first method, variations in landings are explained primarily by variations in the sizes of stocks from one opening to the next. This method offers no opportunity to identify how characteristics of vessels and permittees affect costs and profits.

For the second method, differences in landings are explained by variations in the average sizes of stocks in different districts over the entire season. This latter method allows one to examine how individual and vessel characteristics influence revenues and costs. Some hybrid of the two methods could be constructed, however, by observing the average number of landings made in each opening by individuals with the same value for a particular characteristic such as a given home port or vessel size. The choice of which method to use will depend on the pattern of stock variability for the individual fishery. If the relative sizes of stocks harvested in different districts varies dramatically from one opening to the next, the first method may yield better results, despite its inability to utilize fully the information about differing characteristics of individual fishers.

Expected profits are derived from estimates of equation (9) by solving the equation for Y_i as a function of the number of trips, N_i, and the expected profits in other districts. A change in the stock of fish in district i will elicit a change in the number of landings in that district and possibly in other districts as well. Consequently, in order to estimate producers surplus from a change in the stock, one solves the system of equations for Y_i for the various districts as a function of the exogenous variables: prices, total stock, characteristics of the sites, and characteristics of individuals. This reduced form equation represents the expected profit earned by the typical boat fishing in the district, given the values of the explanatory variables. One evaluates this reduced form equation directly -- that is, estimates the change in expected profit as a function of the change in the stock -- in order to measure the change in producers surplus for the typical fisher. The change in expected profit times the number of permittees then estimates the change in net economic benefits to the fishery.

Notes

1. If a landing includes harvest from more than one district, we assume that the area with the largest harvest is the target destination.

2. Individuals may also work as crew members on various fisheries. One option open to all fishers is not to fish at all. These options will be explicitly included in estimating equation (8).

Changes in employment, wages, and personal income are the variables most commonly used to measure these regional economic impacts. In addition to these measures state and local government fiscal variables as well as demographic variables are sometimes included in descriptions of economic impacts.

An important component of any analysis of this type is the distribution of the impacts, both regionally and across types of people. Some of the benefits of job or income creation associated with a project may "leak" out of the community either because non-residents are employed or because purchases by residents are made outside the community. Generally smaller and less stable communities will be able to retain less of the economic impacts generated by projects.

An accurate and defensible economic impact measure requires an accurate economic impact model. A number of economic impact models already exist for Alaska and for its regions but none has the structure necessary to calculate the impact of a restoration project, or for more general use in the calculation of the impacts of seafood harvesting and processing activities and policy alternatives.

There are a number of reasons for this all of which relate to the absence of good information on the most important relationships determining the size and composition of the economic impact. Numerous theoretical studies of economic impact have shown that the most important determinants of the size of the impact (the size of the economic multiplier) are the size of the direct effect and the average "leakage" of purchasing power outside the regional economy from subsequent spending of households and businesses.

First, although there have been a number of surveys and studies of the composition of inputs of seafood harvesters and processors, there is still little useful information for developing a profile of purchases for a typical fishing boat for a particular type of catch for a particular location. Accurate information on the proportions of gross receipts which is profit to the owner, crew share, variable cost, fixed cost, etc. is the most important for estimating the economic impact of a change in harvest or fishing effort.

Second, there is little information on the residency of workers in fish harvesting and fish processing jobs. This information is necessary to determine the size of the most important element of "leakage" of purchasing power out of the regional economy and into other regions.

Third, there is little information on the composition or variation in purchasing patterns of different types of households and workers in small Alaskan communities. Non residents spend less in the community than residents, but residents of smaller communities also spend less in the community than residents of larger places. The proportion of household income spent within the community is the other important element which determines the "leakage" of purchasing power out of the community and into other regions.

The models of economic impact currently available do not adequately treat these

relationships. The standard input-output models (which have a number of other well known shortcomings) used in impact analysis generally devote little attention to these important relationships. The approach developed by ISER for the economic impact model of the salmon hatcheries (SALMOD) identified these important relationships, but lack of adequate funding prevented a complete treatment of the identification of model parameter values.

III.b. Description **(VERY INCOMPLETE)**

Estimation of the economic impacts on small maritime communities of restoration projects which change the long run supply of seafood resources and alter the physical environment in other ways requires an economic model which describes the economic structure of the region. This project would construct and apply such a model.

The proposed model is what is called in the regional economics literature an "extended input-output model". Such a model uses a conventional input-output model (essentially a matrix of coefficients describing the transactions among businesses within the economy) as a starting point and augments it in one or more ways depending upon the structure of the economy and the analyses to be conducted.

The augmentation of the model for the study of small maritime regions would primarily be in the expansion of detail in the "final demand" part of the model. Data would be collected to allow the differential purchasing patterns of businesses and households to be identified and incorporated into the model. Two important areas where these differential purchasing patterns occur are between resident and non-resident workers, and between resident and non-resident businesses. As indicated above non-resident workers are less likely to spend their income within the local economy and to the extent they take their income out of the region the economic multiplier in the region is reduced. The same is true for non-resident businesses that operate in the region for a short period of time.

Model construction and augmentation will rely first upon existing publicly available models and data. The results of other economic restoration studies may provide useful information, particularly on the cost structure of seafood production. Past modeling efforts and evaluations have shown however that existing models and data are incomplete in the identification and estimation of many of the most important parameters defining the structure of the regional economy. These parameters will be identified early in the process of model development and a survey will be conducted to obtain the missing pieces of information.

III.c. Products

Three products will result from this work.

(1) A set of economic impact analyses of selected restoration projects.

(2) An comprehensive economic impact model for use in analyses of both the

seafood industry and small maritime communities.

(3) A report on the structure of economic activity in small maritime communities in Alaska with particular emphasis on the role of the maritime resources on their economies.

IV. SCHEDULES AND PLANNING

The model would be developed during FY 1992. Applications would be done as the parameters of the restoration projects became available.

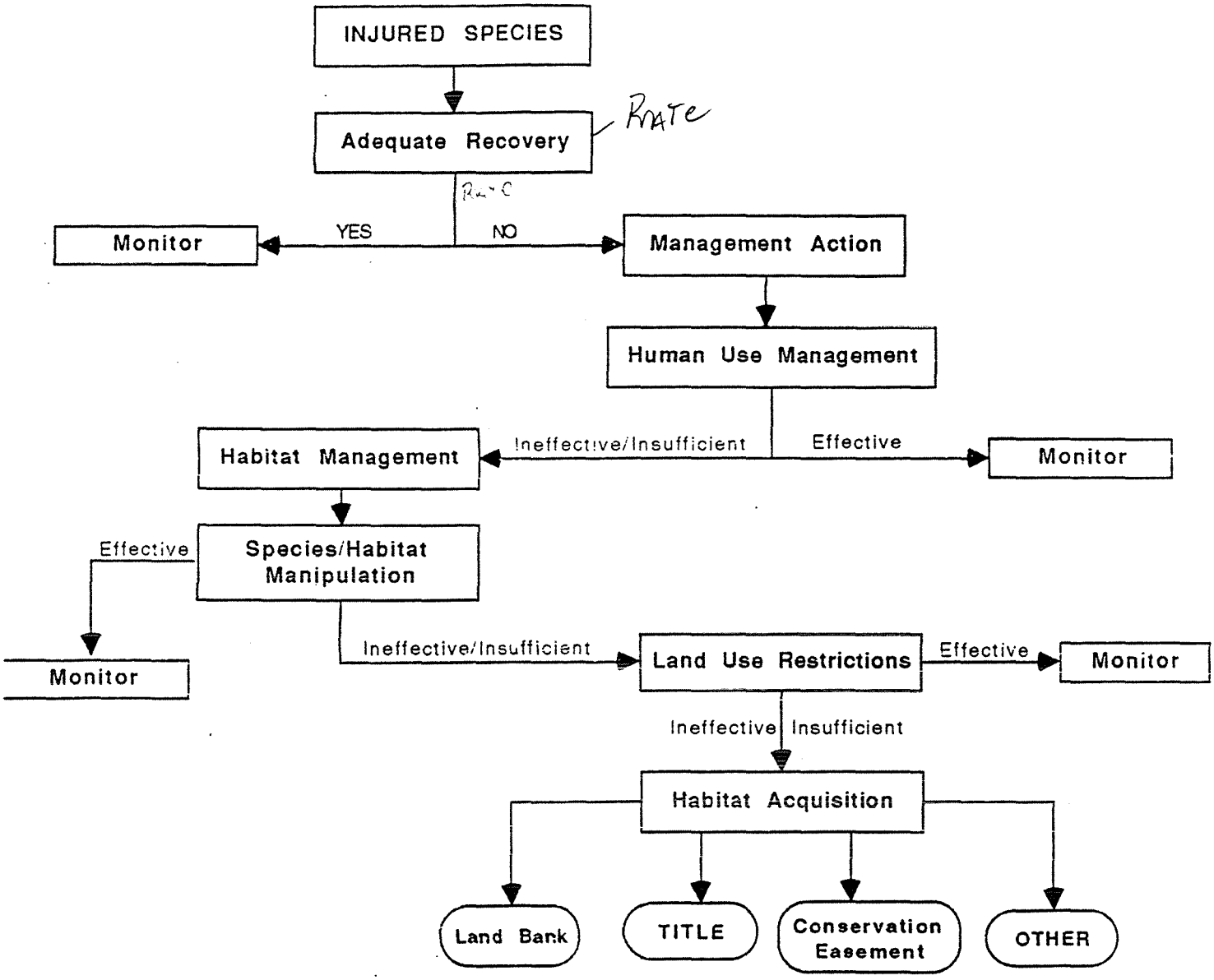
VI. BUDGET

$100,000.

VIII. PERSONNEL QUALIFICATIONS

Oliver Scott Goldsmith, Professor of Economics at the Institute of Social and Economic Research, University of Alaska Anchorage, will be the Principal Investigator.

RESTORATION PLAN DECISION DIAGRAM



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MEMORANDUM **STATE OF ALASKA**

TO: Peg Kehrer
Graduate Intern
OSIAR Division

DATE: October 22, 1991

FILE NO: VI.500.075.100

TELEPHONE NO: 267-2369

THRU:

SUBJECT: Economic Study Work Plan

FROM: Mike Mills, Chief
Research and Technical Services
Division of Sport Fish
Department of Fish and Game

Enclosed is a revised detailed work plan for the fiscal year 92 portion of the *Recreational Fishing Economic Impacts and Benefits* study. It is the first phase of what must be a multi-year project since the principal restoration science project it will value, Study 7, *Restoration of Dolly Varden and Cutthroat Trout Populations in Prince William Sound*, is a multi-year project from which management strategies will develop in later years.

The enclosed work plan schedule is optimistic. Delays caused by the economic study proposal review procedures may jeopardize completion during fiscal year 92 of all aspects of the *Recreational Fishing Economic Impacts and Benefits* study. It may prove necessary to encumber funds for use in fiscal year 93 to complete model refinement and baseline estimation.

Enclosures

RECREATIONAL FISHING ECONOMIC IMPACTS AND BENEFITS

ID Number:

Project Leader: Mike Mills

Lead Agency: Alaska Department of Fish and Game, Division of Sport Fish

Proposal Cost: $81,200

Project Dates: 15 November 1991 through 30 June 1992

Location: Anchorage, Alaska

INTRODUCTION

During fiscal year 1992, the Alaska Department of Fish and Game, Division of Sport Fish, Research and Technical Services, will conduct a study to develop computer models from existing software for use in estimating the economic impacts and benefits of restoration projects affecting recreational fishing in the area impacted by the Exxon Valdez oil spill.

PROJECT DESCRIPTION

The information derived from this study would be used to estimate the economic impacts and benefits associated with restoration projects affecting sport fishing, in particular, study 7, *Restoration of Dolly Varden and Cutthroat Trout Populations in Prince William Sound*[1]. In this first phase of a multi-year study, economic impact and benefit models will be developed, data collected, and baseline information produced. In future years, as management strategies are implemented to promote fishing opportunities for Dolly Varden and cutthroat trout at non-oiled sites in Prince William Sound, the models will be used to estimate the employment impacts in oil spill affected areas of Alaska, the distribution of revenues between geographic areas, and net benefits to anglers.

Existing software would be modified and updated. The Southcentral Alaska sport fishing economic study[2] developed a series of separate programs, models, and spreadsheets to estimate impacts and benefits of sport fishing. Input-output methodology was used to estimate total economic impacts associated with Southcentral Alaska sport fishing in terms of sales, employment, and income. The demand for sport fishing by Alaska residents was analyzed using a nested generalized logit model. Hanemann[3] shows how estimates of net willingness to pay (the dollar amount over and above actual expenditures) for sport fishing opportunities can be derived from fitted logit models. Nonresident angler demand for Southcentral Alaska sport fishing opportunities was modeled using the travel cost method and a contingent valuation survey. The Southeast Alaska sport fishing economic study[4] carried model development a step further by producing an integrated modeling system to simultaneously measure impacts and benefits.

Using the Southcentral components supplemented by available data and new data from a small mail survey concentrated on the oil spill impact area missed in the previous Southcentral survey, a system similar to the Southeast system will be developed for the oil spill impact area and will be used to analyze sport fishing restoration projects.

---

[1]Study 7 will identify non-oiled streams with Dolly Varden and cutthroat trout and estimate stock sizes. This information will enable fisheries managers to redirect sport fishing effort to non-oiled streams, thereby enabling fish stocks in oiled streams to recover.

[2]Jones and Stokes Associates, Inc. 1987. Southcentral Alaska Sport Fishing Economic Study. Sacramento, CA. Prepared for the Alaska Department of Fish and Game, Sport Fish Division, Anchorage, AK.

[3]Hanemann, W.M. 1985. Applied welfare analysis with discrete choice models. Working Paper. University of California, Department of Agricultural and Resource Economics, Berkeley, CA,

[4]Jones and Stokes Associates, Inc. In prep. Southeast Alaska Sport Fishing Economic Study. Sacramento, CA. Prepared for the Alaska Department of Fish and Game, Anchorage, AK.

The sampling frame for the mail survey will be the respondents to the division's annual sport fish harvest survey who indicate that they sport fished in the oil spill impact area. The economic mail survey will concentrate on respondents who live in the oil spill impact area communities of Prince William Sound and Kodiak Island, but will also contact anglers who reside in other locations. The survey data will reveal individual angler choices concerning use of specific fisheries. By observing such choices, it should be possible to use estimated demand equations in conjunction with theoretical models to generate baseline willingness to pay measures. As fisheries management strategies are implemented in the future that affect the oil spill impact area, angler choices can be observed, and net benefits and impacts can be estimated.

The project will be based in Anchorage. The need for technical assistance with model development and survey design will be met through contractual agreement(s). Survey typesetting, graphic art work, and printing will also be contracted. Implementation of the survey, programming, and data processing will be performed by the lead agency personnel.

SCHEDULE AND PLANNING

Assuming a project implementation date of November 15, 1991, model development and baseline estimates will be completed during fiscal year 92.

This project will use new and historic data collected by the division's annual sport harvest survey. Data collection for the 1991 sport fishing season will occur during the October 1991 through March 1992 period.

A supplemental survey will concentrate on anglers who reside in the spill impact area. A small sample of respondents to the annual sport fish harvest survey will be contacted to gather information needed to run the computer models. Survey design and printing will be completed by December 1991. Data collection will be completed by March 1992. Data will be entered, edited, and synthesized by April 1992.

A contract will be established for development of the modeling system from existing components by February 1992. Computer model development will be completed by May 1992. Model refinement and estimation of baseline impacts and benefits should be completed by June 1992.

Project Schedule

Complete supplemental survey design and printing: December 1991

Establish modeling system contract: February 1992

Complete supplemental survey data collection: March 1992
Complete supplemental survey data synthesis: April 1992

Complete modeling system development: May 1992
Complete baseline estimation: June 1992

Project personnel

Mike Mills, Chief of Research and Technical Services. Responsible for project management, contract administration, and reporting.

Allen Howe, Fishery Biologist. Responsible for coordination of survey design, typesetting, graphic art work, and implementation.

Wolfgang Kurtz, Analyst Programmer. Responsible for development of software to enter, edit, and process survey data.

Katheryn Kush, Data Processing Clerk. Responsible for survey receipt and data entry.

Alaska Specialized Education and Training Services (ASETS). Responsible for survey instrument typesetting, printing, and mailing.

Contractor (to be determined). Responsible for model development and survey instrument design.

FY 92 BUDGET REQUEST

Project: Recreational Fishing Economic Impacts and Benefits	Project Leader: Mike Mills
Project No.:	Location: Anchorage Phone: 267-2369

LINE ITEM	AMOUNT 7/1/91-2/28/92	3/1/92-6/30/92	7/1/91-6/30/92
71000	15.4	22.7	38.1
72000	0.0	0.0	0.0
73000	27.1	16.0	43.1
74000	0.0	0.0	0.0
75000	0.0	0.0	0.0
TOTAL	42.5	38.7	81.2

COMMENTS:

The above breakdown assumes a project implementation date of November 15, 1991.

FY 92 BUDGET REQUEST

71000 PERSONAL SERVICES						
PCN/NP/NEW	RANGE/STEP	CLASSIFICATION	NO. MONTHS	LOCATION	INCUMBENT	SUPERVISOR
4052	22K	Fisheries Scientist	1.0	Anchorage	Mills	Netsch
4119	18F	Fishery Biologist	1.0	Anchorage	Howe	Mills
4267	17A	Analyst Programmer	5.0	Anchorage	Kurtz	Fidler
4268	9B	Data Processing Clerk	1.0	Anchorage	Kush	Fidler

72000 TRAVEL	AMOUNT
	0.0

73000 CONTRACTUAL	DESCRIPTION	AMOUNT
PROFESSIONAL SERVICES	ECONOMIC MODEL DEVELOPMENT AND TESTING	30.0
PROFESSIONAL SERVICES	SURVEY INSTRUMENT DESIGN	5.0
NONPROFESSIONAL SERVCS.	SURVEY TYPESETTING, LAYOUT	2.6
NONPROFESSIONAL SERVCS.	SURVEY PRINTING AND MAILING PREPARATION	1.5
POSTAGE	SURVEY MAILING AND RETURN POSTAGE	4.0

74000 SUPPLIES	DESCRIPTION	AMOUNT
		0.0

75000 EQUIPMENT	DESCRIPTION	AMOUNT
		0.0

FY 92 BUDGET REQUEST

71000 PERSONAL SERVICES --- FOR 7/1/91-2/28/92

PCN/NP/NEW	RANGE/STEP	CLASSIFICATION	NO. MONTHS	LOCATION	INCUMBENT	SUPERVISOR
4052	22K	Fisheries Scientist	0.5	Anchorage	Mills	Netsch
4119	18F	Fishery Biologist	0.5	Anchorage	Howe	Mills
4267	17A	Analyst Programmer	2.0	Anchorage	Kurtz	Fidler
4268	9B	Data Processing Clerk	0.0	Anchorage	Kush	Fidler

PERSONNEL QUALIFICATIONS

Project Leader

Mike Mills is Chief of Research and Technical Services for the Sport Fish Division of the Alaska Department of Fish and Game. He has been employed by the department since 1974. He holds a B.A. from the University of Colorado and a M.S. from the University of Washington. He directed the first studies on economics of sport fishing in Alaska; has consulted on, designed, and analyzed data from economic studies; has made presentations on economics to economists and natural resource professionals, the legislature, and the public; has served on economics committees; and was involved in planning of economic damage assessment studies for the Exxon Valdez oil spill.

Other Project Personnel

Allen Howe, Fishery Biologist III, Alaska Department of Fish and Game, Sport Fish Division, Research and Technical Services.

Wolfgang Kurtz, Analyst Programmer III, Alaska Department of Fish and Game, Sport Fish Division, Research and Technical Services.

Katheryn Kush, Data Processing Clerk II, Alaska Department of Fish and Game, Sport Fish Division, Research and Technical Services.

MEMORANDUM

STATE OF ALASKA
Department of Fish and Game

TO: Jerome Montague
Director
Oil Spill Impact Assessment
and Restoration Division
Juneau

DATE: September 23, 1991

FILE NO:

THRU:

TELEPHONE NO: 465-4160

SUBJECT: Restoration Economic Study#1

FROM: Jeff Hartman
Economist
Division of FRED
Department of Fish and Game

Thank you for the opportunity to submit a detailed work plan for Economic Study #1 (ES #1). This plan was requested by Peg Kehrer in her memo of July 25, 1991. The name of ES #1 is Cost-Benefit Analysis of Salmon Restoration Projects.

In this study plan, Dr. Berman, Dr. Boyce, and I have addressed additional coordinating issues between other ADF&G divisions. We have also adjusted the cost of the study to reflect Mike Dean's suggestion that the full cost of the project should be reflected in the budget. I had previously intended to donate my time at no cost to OSIAR. I am including one month of salary, and travel funds for one project coordinating trip, for Boyce and Berman in this proposal, as well as some funding for data manipulation for the Division of Commercial Fisheries.

Stan Senner raised some very good questions about how ES #1 would measure "the economic impacts of modifying our management practices and harvest levels to protect wild stocks in oiled streams." Also: "How might such actions as time and area closures to protect wild stocks affect the hatchery based-fishery? Do either of the salmon projects as proposed address this question."

The answer to these questions are: yes... the work outlined in ES #1 is the only way that Dr. Boyce, Berman, and I know of to empirically estimate the relationship between the costs and benefits[1] of area

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[1] *Stan used the term "economic impacts" in his question. I think that he is referring to benefits and costs that as they are defined in welfare economics. The term "impacts" in economics generally refers to employment and income data produced by economic impact models, such as an input-output model.*

time openings and closings in the salmon fishery. In fact, historical area/time openings and closings for salmon (available by district in area management reports) are key pieces of data in ES #1. The cost model is structured to explain how altered openings and closings would change short run fishing patterns and in turn, how the costs of the fishing fleet would increase or decrease, in the short run and long run. Additionally, the demand model would be used to compute the change in revenue to the fishing fleet of reduced catches from the hatchery stock and possibly future increased catches from the wild stocks. Of course the biologists would have to provide information on population feedbacks from the short run reduction in exploitation of wild stocks, long run changes in population size of wild stocks, change in the harvests of enhanced stocks, and changes in the cost of evaluation, management and monitoring.

Boyce, Berman and I would be happy to provide a detailed discussion of how the modeling and simulations would allow for this restoration option to be evaluated. A discussion in a meeting setting with the three principal investigators of ES #1, and staff from OSIAR and RPWG would be the most efficient way to present a primer on how this modeling would be applied to restoration policy questions. I would also be happy to attend a meeting with you, Mike and Stan to explain how this study would work and discuss how economics can be integrated with the restoration studies to evaluate costs in relation to the benefits.

Stan has also indicated that the RPWG has other economic needs and listed that some of those needs included "nuts and bolts things like costs estimation, not sophisticated models." I would like to point out, however, that the sport fish economic modeling project proposed will be using the discrete choice models from the South Central study, which is one of the most sophisticated non-market models that exists in resource economics today. A CRAY super-computer was required to calibrate the models. I think that the sportfish project should be carried out, and would produce some useful analysis that would be as helpful to fishery managers as ES #1. My point is that sophisticated models are sometimes required to make precise and reliable economic projections that can withstand scrutiny.

As you can see from the attachments, (appendix 1 and 2) that detail the equations and methods for this ES #1, John Boyce, Matt Berman and I have already invested a great deal of effort in satisfying the information requests for this proposed study. The coordination of the project and finalizing the RSA's will require a face to face meeting with Boyce, Berman, Schelle (of CFEC) and me in Juneau. Some, travel funding assistance with this step would be helpful. Approximately $ 1,400.00 should be sufficient for the first meeting which I would like to schedule within a week.

Matt Berman pointed out to me that the Reimbursable Services Agreement is the legally binding document that is conventionally used for ISER and UAF studies on economics. It would be better for the University, if The Detailed Work Plan was an attachment to an RSA, which would eventually be signed by the Chancellor of each campus.

I believe that ES #1 will assist in evaluating costs and benefits of immediate salmon restoration studies and implementation projects identified in the second Federal Register notice. This study will also assist in identifying costs and benefits of salmon restoration that the RPWG may wish to carry out in the future. Finally, ES #1 will provide valuable insights on commercial fishing costs that the Alaska State Board of Fish, and the State Legislature would find useful in unraveling the current crisis that salmon fisheries are in now. Finally, ES #1 does not duplicate or overlap with any economic studies

related to the AG offices Litigation on the EVOS.

If you have comments or questions please contact me.

cc:
Jeff Koenings
Robert Burkett
Johnny Holland

TITLE: Cost-Benefit Analysis of Salmon Restoration Projects.

Project I.D. Number:
Name of Project Leader(s):

Matt Berman P.h. D., John Boyce P.h. D., Jeff Hartman

Lead Agencies:

Alaska Department of Fish and Game, F.R.E.D. Division
University of Alaska, Fairbanks, School of Management
University of Alaska, Institute of Social and Economic Research, Anchorage

Cooperating Agencies:

Alaska Department of Fish and Game, Division of Comm. Fish.
Commercial fishery Entry Commission

Cost of Proposal (for Each agency):

Alaska Department of Fish and Game: $10,650 (project management, data preparation, RSA development, and study product review).

University of Alaska, Fairbanks: $20,000 (model development, testing, simulations, reporting)

University of Alaska, ISER: $20,000 (model development, testing, simulations, reporting)

Commercial Fishery Entry Commission $3,000 (acquisition of fish ticket file data and reports)

University of Alaska, Fairbanks and/or ISER, $15,000 (combining of demand and cost model into computer software, simulation of 15 or more restoration cases, reporting of results in formal report).

Total $68,650

Dates of Project Implementation:
To begin on October 1, 1991 and to be completed on June 30, 1992.

Location of Project Implementation:
Analysis will be carried out at Anchorage, Fairbanks, and Juneau AK.

Signature of Financial officer(s):
To be completed in RSA process.

Note: The legally binding document with UAF and UAA will be a Reimbursable Services Agreement.

II. INTRODUCTION

The purpose of Economic Study #1 (ES #1) Cost-Benefit Analysis of Salmon Restoration Projects. is to assist in the restoration of the economic benefits provided by the salmon resources affected in the EVOS, and to increase the value of those resources to the fishing industry and to society of the investments in restoration. More specifically, ES #1 is designed to evaluate "the relationship of the expected costs of the proposed actions to the expected benefits" of salmon restoration, in a manner that is consistent with the guidelines of welfare economics and economic criteria in NRDA.

The primary product of the study would be development of computer software in SAS, and the simulation of net benefits for specific salmon restoration projects identified by the Restoration Planning Work Group (RPWG). The software, and all associated reports and data would, be the property of OSIAR. Simulation results displaying the benefits and costs of specific restoration projects would be made by June 30, 1991. The data manipulation, econometric modeling, software development, model simulations, and report writing would occur through a cooperative effort between the University of Alaska, Anchorage, and the University of Alaska, Fairbanks, the Alaska Department of Fish and Game, and the Commercial Fishery Entry Commission.

III. DESCRIPTION OF PROJECT

Evidence of injury and damage to salmon has been revealed through the NRDA (damage assessment) studies under the Clean Water Act. While the most telling evidence is for pink salmon and chum salmon in Prince William Sound, other studies are expected to reveal population level damages for other species in regions where hydrocarbons have been observed, or where fisheries were subject to emergency closure as a result of the spill. Fishery managers and restoration planners are proposing several studies and implementation projects for the restoration commercial salmon fisheries as identified in the Federal Register Notice #2.

These restoration projects include:

Restoration Implementation Study #3 Salmonid Stocks and Habitat Restoration (Principal Investigator, Mark Willette), Restoration Study #4 Protection of Strategic Fish and Wildlife Habitats and Recreation Sites (with respect to the impacts on the value of the commercial salmon fishery), #8 Coded-Wire Tagging of Pink Salmon, Restoration Study #9 Prince William Sound Pink Salmon Escapement Enumeration.

Restoration economics study #1 is designed to provide software for estimation of net benefits specifically of Implementation Study #3 and #4, and probably Restoration Studies #8 and #9.

This study is also designed to estimate the benefits and costs of other restoration actions that may be proposed in the future, including but not restricted to, changes in area/time openings and closings of some fisheries, adjustments gear restraints, investments in coded wire tagging, scale pattern analysis, enforcement, escapement monitoring, or any other management investment that can be related to an increment in short run or long run abundance in salmon fishing districts. Additionally, ES #1 would allow for the estimation of commercial fishing benefits and costs of protecting selected critical salmon

habitat through changes in land status or land acquisition, rehabilitating affected salmon stocks through application of intensive or extensive wild stock rehabiltiation techniques, or relying on natural recovery.

The **objective** of this study will be to develop all necessary economic software for a cost-benefit analysis of Restoration studies that alter (1) abundance of salmon in districts, by species and time, (2) changes in area/time openings and closings, and (3) some types of gear restraints, and fleet rationalization. ES #1 will also be designed to carry out an immediate evaluation of Implementation Restoration study 3. The analysis in ES #1 will include the formulation and testing of a model that will project short run and long run fishing costs, development of software from reduced form equations to use in CBA simulations of restoration project outcomes, and combining of the cost functions with other existing salmon demand models to estimate the Net Benefits of a sample of selected restoration projects for the purpose of estimating the Net Present Value of the alternatives.

Classical cost-benefit analysis (CBA) will be applied to evaluate the net economic benefits and tradeoffs between these proposed restoration activities. Estimates of the net economic benefits (as measured by the producer surplus) for proposed salmon restoration will depend on how the changes in salmon stock size, management actions and market prices will affect fishing behavior and marginal costs of producers and government.

This cost/benefit analysis for will consist of five components: (1) Restoration project production function and production assumptions (provided by biologists) (2) population-growth model for the restoration of the wild stock that is linked to fishing exploitation (provided by biologists), (3) a demand model, (4) a fishing-cost model, and (5) a software package that combines components 2 and 3 in a CBA system that is capable of estimating the net present value of various projects. A key component of this study is the development of a model for determining the marginal costs of catching the restored salmon population. Fishing costs are the largest single social cost in most of the world's regulated fisheries. Long run fishing costs in Alaska's salmon fishery probably dwarf the social costs of managing fisheries, yet fishing costs are the least understood component of producer costs affecting the value of Alaska's salmon fisheries.

To conduct a cost-benefit analysis fishing costs, must be determined in the short run and the long run. In the short run, a restoration action may encourage salmon fishermen to direct more fishing effort (a function of gear, boat size, horse power, crew size, etc.) into a specific statistical area and away from another statistical area (or alternative fishing opportunity). With the existing restraints on salmon fishing in place, these short-run increases in marginal costs may be smaller than potential short-run rents from the project. In the long run, fishermen can be expected to increase fishing effort even if new vessels are not allowed to enter the fishery. Currently, economists can only provide informed guesses of the magnitude of short run and long run fishing costs in Alaska's salmon fishery. These issues can only be emperically answered by examining the vessel-level data that are contained in fish ticket and license operators' files.

Methods:

-Restoration Production Assumptions and population level effects.

Dr. Mark Willette will project the operating and construction costs of candidate restoration alternatives identified in Restoration Implementation study project #3. He will also develop projections of the change in the catch by district and month between the starting year of the alternative and for 30 years into the future. The projections for each candidate restoration alternative will be forwarded to James Brady of the Division of Commercial Fisheries, who will compute any increases or decreases in the costs of managing fisheries that might result from the project. In the absence of a formal management cost estimate from the Division of Commercial Fisheries, it will be assumed that the average costs of management in a region will be equal to the marginal cost for this enhancement project[2].

Other restoration studies, or projects will need to generate similar projections of catch and public costs to evaluate the associated social costs and benefits.

-Demand Model for Salmon Fisheries

The demand model created by Dr. John Boyce, called: A Comparison of Demand Models for Alaska Salmon will be used for projecting prices and price responsiveness for all projects. An unrelated economic study currently funded by the Alaska State Legislature may provide an improved set of demand models to use for Alaska salmon. The University contractors will agree upon a set of the best demand models that are available at the time to apply to each fishing region and species.

-Cost Model for Salmon Fisheries

Economic theory suggests that fishermen's behavior will be driven by their desire to earn economic profits. This means that fishermen will participate in fisheries that they perceive as being the best alternative available to them. The cost to them of remaining in that fishery will depend upon what it costs them to fish, relative to their earnings in that fishery, and what they are giving up by not fishing in some other area. These costs can be inferred from entry/exit decisions (such as switching from one fishery to another). Fishing entry/exit decisions, and thus fishing costs will also be affected by the abundance of fish in a fishery. A restoration project may alter these decisions and costs, and in turn, the fishing costs of restoration projects can be explained through entry\exit behavior. Finally, a profitability model of various fisheries can be combined with a fishing cost model derived from entry\exit information to determine the net benefits of restoration activities. A more detailed description of the equations for both approaches are attached in Appendix 1 and 2.

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[2] *Average management costs are the mean annual ADF&G regional management budget for salmon divided by the mean annual lbs. of salmon harvested in the region.*

-Data available for fishing cost model:

The purpose of this cost modeling component is to calculate the marginal cost of fishing, using inferential techniques from data in the Commercial Fishery Entry Commission fish ticket files and vessel license operators' files. Fish ticket files provide harvest information by statistical area and species for each operator. The license file reveals how many fisheries the operator participates in and includes detailed information of vessel characteristics. It may be necessary to access data from several fisheries in order to develop a structural model form that predicts fishing behavior. These data bases are confidential and modeling exercises, as well as published simulations, must be designed around these constraints.

-Fishing Cost Model form and testing:

Two methods have been used to estimate the critical values of expected revenues necessary for fishermen to remain in the fishery or to enter a fishery. The first of these was used by Boyce (1990). It involves constructing the theoretical supply curves for the industry and using the equilibrium conditions that the number of fishermen that enter an area or switch into an area will be such that no single fisherman can profit by changing the decision, given the way in which the rest of the fishermen have acted. This method aggregates across fishermen and deals with the problem of heterogeneous fishermen only looking at the shape of the supply curve. The main advantage of this method is that it allows for a simple formulation of the expectations of revenues held by fishermen. The expected revenues are postulated to be a function of the number of fishermen and the size of the biomass. A different equation is specified for the biomass where it grows as the run of salmon reaches its peak and then declines afterwards. Thus, escapement data is also necessary for this analysis.

The second method utilizes specific data from each vessel and estimates the probability that a discrete action will occur (stay in the fishery, exit the fishery, or switch to an alternative location) based on what is known about the fisherman's opportunity set. This technique, which is borrowed from the recreational demand literature, has the advantage of not hiding any information in the aggregation process. That is, variations in fishermen based on historical patterns, capital characteristics, and the available set of permits can be used to estimate the actions of the individual fishermen. The disadvantages are that this method requires analyzing much larger data sets and that it also requires that the cost functions then be constructed by aggregating based on the probabilities of each decision by each agent.

The determination of which method to use is a decision that has to be made by the researchers after a preliminary analysis of the data is constructed.

This project will have 9 major steps:

1. Identifying relevant fisheries based on the regions and districts of probable restoration projects.
2. Obtaining the relevant fish ticket and vessel license file data from CFEC
3. Summarizing portions of the fish ticket file and license/vessel file in the form of reports that are usable and consistent with confidentiality regulations;
4. Merging the vessel and fish ticket files.

5.Formulation of the structural model and testing;
6.Development of software from reduced form equations to use in CBA simulations of restoration project outcomes;
7. Combining software of demand model and cost models in SAS so that NPV of projects can be projected.
8. Application of CBA using the demand models and cost models to estimate the Net Benefits of a sample of selected restoration projects, for the purpose of estimating the Net Present Value of the alternatives.
9. Documentation of models in a report, and instructions for using software.

IV. SCHEDULES AND PLANNING

As soon as funding is made available, John Boyce, Matt Berman, Jeff Hartman, and Kurt Schelle will meet in Juneau to determine our combined data needs and what CFEC's role will be. This schedule would have to be altered if additional review steps were imposed.

Major activities and target dates (assuming the project begins in October 15, 1991, would be:

1. Scoping meeting to coordinate CFEC data collection and manipulation: Sept 27.
2. RSA Written, reviewed and signed by both University Campuses: October 15, 1991.
3. Obtain data from fish ticket and vessel license files and match by SSN: Nov 15.
4. Compile data on seasoning openings and area closures: November 30.
5. Form specific data sets for estimation: December 31.
6. Estimate cost function with various approaches as described: April 30.
7. Select the cost model methods that work best for a given fishery, and appropriate demand model from available studies: May 15th.
8. Mark Willette to provide projections of project costs from data gathered on Implementation Restoration Study #3: May 1, 1991.
9. Mark Willette to provide projections of additional management costs that would result from the proposed projects, after review by Division of Commercial Fisheries, May 15, 1991.
10. Combine model software on salmon Demand (Boyce 1990) or (next best substitute) with cost. model, in SAS simulation framework capable of estimating a NPV for relevant time horizon: May 30th.
11. Run simulations on candidate restoration projects. June 15th.
12. Write report (one section from John Boyce, one section from Matt Berman, and one from Jeff Hartman: June 30.

V. NEPA/PERMIT STATUS

Not Applicable

VI. BUDGET

Alaska Department of Fish and Game: $10,650 (project management, data preparation, RSA development, contract development, and study product review).

Includes $6,250 for one month salary for Economist II FRED Division, $3,000 for 3 weeks AP I, C (programmer) in the Division of Commercial Fisheries, $1,400 for 1 project coordination meeting with Boyce and Berman.

University of Alaska, Fairbanks: $20,000 (model development, testing, simulations, reporting)

University of Alaska, ISER: $20,000 (model development, testing, simulations, reporting)

Commercial Fishery Entry Commission $3,000 (acquisition of fish ticket file data and reports)

University of Alaska, Fairbanks and FRED Division and/or ISER and FRED Division, $15,000 (combining of demand and cost model into computer software, simulation of up to 15 restoration cases, reporting of results in formal report).

Includes $5,000 for creating simulation software by University of Alaska Fairbanks, or University of Anchorage, ISER through RSA. Also up to $10,000 for immediate simulation of up to 15 projects (assumed to be approximately $650 each) and reporting results of simulations in a report. Number of simulations and the simulation costs may be less than this, depending on how many need to be completed in FY 92.

Total $68,650

VII. MONITORING PROGRAM

Not Applicable

VIII. PERSONNEL QUALIFICATIONS

13 pages of detailed resumes are available for:

Matthew D. Berman
Associate Professor of Economics, Institute of Social and Economic Research
School of Business and Public Affairs
University of Alaska Anchorage
3211 Providence Drive
Anchorage Alaska 99508

John R. Boyce
Associate Professor of Economics, Department of Economics
School of Management
University of Alaska
Fairbanks, Alaska 997750-1070

Jeff Hartman
Economist

Alaska Department of Fish and Game
F.R.E.D. Division
P.O. Box 3-2000
Juneau, AK 99824

Two Methods of Estimation of Effort Supply in a Commercial Salmon Fishery

John Boyce
University of Alaska Fairbanks

Introduction

Cost-benefit analysis for issues relating to altering species mixes, affecting timing of runs, changing the length of season openings, or reducing the variance in run sizes across years all have in common a need for knowing the costs incurred by fishermen. For example, if species mixes are altered, say by an increase in the numbers of low valued hatcheries raised species relative the numbers of higher valued wild stocks in a particular area, this affects the returns to fishermen in that area. If the returns were to decrease as a result of the increase in the ratio of hatchery raised fish, it is likely that some fishermen will no longer find it profitable to continue fishing in that area. Thus the question becomes how many fishermen will alter their behavior due to the change? To answer this question, one needs to have an estimate of the opportunity costs of fishermen. All fishermen do not have the same costs of fishing. Some will be very sensitive to changes in the returns to a particular area, others will not. This sensitivity to changes is a reflection of the implicit opportunity costs of the individual fishermen.

This paper develops two models which utilize existing data from fish ticket, emergency order openings and closings, and the vessel characteristics files that are designed to estimate effort supply curves. Each model makes use of observed data on participation in fisheries within a particular season. The first model is a "structural equations" model that makes use of the economic equilibrium conditions that describe participation or effort supply decisions. This model assumes that fishermen continue to enter a fishery as long as the expected revenues exceed the costs of doing so, and that fishermen exit a fishery when they are no longer able to cover their costs. It utilizes a simultaneous equations method equating the expected revenues with the costs of participating for the last fisherman participating. This model *aggregates* over individual fishermen, making the assumption that the first to enter are those with the lowest opportunity costs, and that the first to exit are those with the highest opportunity costs.

The second model is an individual "sequential choice" model. It assumes that the decisions made individuals are based on some characteristics observable to the econometrician, and upon some that are not observable. The decisions are assumed to be driven by the same criteria, whether expected revenues exceed the opportunity costs of the decision maker, as in the structural equations model. However, the data is not aggregated over individuals, but rather looks at the actions of each individual. Following the nature of the sequential polychotomous choice models, the actions of the individual are assumed to be stochastic events for which the econometrician is attempting to predict the probability of an action (such as entering a fishery, remaining in a fishery, or exiting from one) given characteristics about the individual and the fishery.

The structural equations model has the advantage of explictly specifying cost and expected revenue functions and then using equilibrium conditions to obtain estimating equations. However, this model has the disadvantage of hiding some of the variation in the data by the aggregation process, and of estimating a solution to a simultaneous set of equations, which is often not very robust. The sequential choice model makes use of all of the data (rather than some summary statisitics describing the data), but does not have an explicit estimation of a set of parameters which describe the opportunity costs of fishermen.

Each model requires access to the exact same data set: both require historical catch and effort data from the trip tickets file, and both require vessel characteristics data as well as knowledge of opening and closing dates in different areas. The structural equations model is *a priori* preferred as a model because it explicitly obtains parameter estimates of opportunity cost functions. However, the sequential choice model, which will give less explicit results, is much more likely to produce an estimate of opportunity costs than is the structural equations model. As the data requirements for each model is the same, and as each model will require construction of the same sets of expectations variables, each model will be estimated. Selection of a final model will depend upon the ability of each model to predict participation rates in the fishery.

The Structural Equations Model

This is a very brief summary of the structural equation model for entry and exiting in a fishery. It is based upon the author's 1990 Ph.D. dissertation, with modificarions for the data availability with respect to Alaskan fisheries.

The model consists of four basic equations: 1) a prodnction function equation, 2) an equation of motion for the biomass, 3) and exiting cost equation, and 4) and entry cost equation. In addition, there are several expectations equations plus a set of equilibrium identiries. These equations are developed below.

The main assumptions of the model are as follows. 1) there exists a crowding externality so that as the number of fishermen in a disnict increases, all else held constant, the CPUE declines; 2) fishermen are homogeneous in their productive capabilities, but differ in terms of the perceived opportunity costs of fishing; 3) fishermen will exit an area if expected revennes are less than the opportunity costs of remaining in the fishery; and 4) fishermen will enter an area as long as it is perceived that expected revennes will exceed the costs of entering and participating in the fishery.

The Production Function

The production function equation assumes that the catch in district i on day t is linear in the biomass $x_{i,t}$ and quadratic in the number of fishermen on the grounds, $n_{i,t}$. The equation is:

$$(1) \qquad y_{i,t} = (\alpha x_{i,t} + \beta n_{i,t}) n_{i,t} + u_{i,t}$$

where $y_{i,t}$ is the total catch in area i on day t, and $u_{i,t}$ is a random disturbance. The parameter α is interpreted as the average (per fishermen) marginal product of an additional unit of the biomass. The parameter β is interpreted as the "crowding externality" parameter. This parameter may vary across areas due to physical characteristics of the area. The production function may be rewritten in terms of the individual fisherman,

$$(2) \qquad z_{i,t} = y_{i,t}/n_{i,t} = \alpha x_{i,t} + \beta n_{i,t} + u_{i,t}/n_{i,t},$$

$$(2') \qquad z_{i,t} = \alpha x_{i,t} + \beta n_{i,t} + v_{1,i,t}$$

where $z_{i,t}$ represents the catch per unit effort (CPUE), and $v_{1,i,t}$ represents the heteroskedastic disnubance term. The value of the catch per unit effort is obtained by multiplying (2') by the average price per pound of fish, weighted by the species composition of the run. This price will be discussed below in the section on expected revennes.

The Biomass Equation of Motion

The biomass is assumed to flow through the area on it's spawning migration. The equation of motion for the biomass is denoted:

$$(3) \qquad x_{i,t} = x_{i,t-1} + m_{i,t-1} - s_{i,t-1} - y_{i,t-1} + v_{2,i,t},$$

where $x_{i,t-1}$ is the biomass remaining in the area from the previous period, $m_{i,t-1}$ is the biomass migration into the area in the previous time period, $s_{i,t-1}$ is the biomass escapement in the previous time period, and $v_{2,i,t}$ is an unobserved random disturbance term. Only escapement is observable to the econometrician. Migration

Retransmission of last 5 pgs. Jeff Hartman

into the area is unobserved, but can be assumed to depend upon the time since the run began. The magration data can be obtained by averaging over the history of the runs, taking into account things such as the periodicity of certain species as well as the species mix. The error term then accounts for annual differences in the average migration, implying that errors in a particular run are likely to be positively correlated with the error in the previous day.

The Expected Revenues Functions

The expected stocks in time $t-1$, $x_{i,t-1}$, can be derived by inverting the production function, lagged one period, ie.,

(4) $$E(x_{i,t-1}|z_{i,t-1},y_{i,t-1},n_{i,t-1}) = (1/\alpha)z_{i,t-1} - (\beta/\alpha)n_{i,t-1}.$$

Assuming that the historical average is a good indicator of the in-migration, and that escapement and total catch are known to all fishermen, the expected biomass in time t is then

(5) $$E(x_{i,t}|z_{i,t-1},y_{i,t-1},n_{i,t-1},m_{i,t-1},s_{i,t-1}) = E(x_{i,t-1}|z_{i,t-1},y_{i,t-1},n_{i,t-1}) + m_{i,t-1} - s_{i,t-1} - y_{i,t-1}$$

(5') $$= (1/\alpha)z_{i,t-1} - (\beta/\alpha)n_{i,t-1} + m_{i,t-1} - s_{i,t-1} - y_{i,t-1},$$

where the distrubance term disappears due to having an expected value of zero. The expected revenues to an individual of participating in the fishery are then obtained by substituting from (5') into the production function (2'), yielding

(6) $$E(z_{i,t}|z_{i,t-1},y_{i,t-1},n_{i,t-1},m_{i,t-1},s_{i,t-1}) = z_{i,t-1} - \beta n_{i,t-1} + \alpha(m_{i,t-1} - s_{i,t-1} - y_{i,t-1}) + \beta n_{i,t} + v_{3,i,t},$$

where the error term is included to denote the econometric error in estimating the expected revenue function. Expected revenues are derived by multiplying each variable on the right hand side of (6) by the species weighted average price.

The Cost Functions

There are two cost functions to be considered. The first is a variable cost function. It is assumed that fishermen have different costs of fishing and that fishermen with higher opportunity costs are the ones who will be first to exit. The variable cost function is given by the following,

(7) $$c(n_{i,t}) = \phi + \omega n_{i,t} + \sigma q_{i,t} + v_{4,i,t},$$

where $\phi+\omega$ equals the opportunity cost of the most efficient vessel, ω is the incremental cost associated with adding an additional vessel, σ is a vector of parameters relating costs to summary vessel characteristics of the active fleet, $q_{i,t}$, which may include data such as average horsepower, average number of days on the grounds, and other data compiled from the vessel data file and the historical fish tickets file (these variables will be selected by including data which explains the observed disturbances from a model not including that data). The unexplained disturbances are contained in the error term $v_{4,i,t}$.

The entry cost function will be similar to the exiting cost function, but will attempt to capture the costs associated with travelling to a particular area. As the costs have to be recouped over the entire opening, the length of the remaining opening will be used as a shifter in the entry cost function. This function will be estimated by a linear approximation,