EXXON VALDEZ Oil Spill Trustee Council

FY 01 Detailed Project Description

Improved salmon escapement enumeration using remote video and time-lapse recording technology

Project Number:	01366
Restoration Category:	Monitoring
Proposer:	ADF&G
Lead Trustee Agency:	ADF&G
Cooperating Agencies:	
Alaska SeaLife Center:	No
Duration:	3rd year, 3-year project
Cost FY 1999:	$ 53,473
Cost FY 2000:	$ 46.5 K
Cost FY 2001:	$ 12.4 K
Cost FY 2002:	$ 1.0 K*
Geographic Area:	Lower Cook Inlet
Injured Resource/Service:	salmon/commercial fishing

*Note: FY02 costs will only be incurred if $1000 page costs are not expended in FY01.

ABSTRACT

Salmon resources and services within the spill area, and particularly within Prince William Sound, were injured by the 1989 *Exxon Valdez* oil spill and have not yet fully recovered. To monitor the recovery of salmon stocks in the spill area and improve escapement information used to set spawning escapement goals, we propose to develop remote video and time-lapse recording technology for enumerating salmon escapement. Remote video has the potential to provide accurate, archivable documentation of salmon escapements well beyond the capacity of aerial survey indices, and well below the cost of weir and sonar projects. Videotapes can be retrieved and reviewed weekly to facilitate in-season management of commercial fisheries.

INTRODUCTION

Aerial survey has been used to monitor salmon escapement in clear streams throughout Alaska for over 35 years (Bevan 1961). This technique is favored for remote and marginally productive drainages which otherwise may go unassessed due to the high cost of intensive monitoring methods (e.g., weir, sonar) relative to the stream's modest escapement. However, aerial survey has several drawbacks. Observer experience, water clarity, stream morphology and habitat type, timing of survey flights, and stream residency are just a few factors shown to influence the accuracy and precision of aerial survey estimates of salmon escapement (see Bevan 1961, Evzerov 1981, Neilson and Geen 1981, Cousens et al. 1982, Shardlow et al. 1987, Perrin and Irvine 1990, Hill 1997, and Bue et al. 1998a). At best, aerial survey provides consistent indices of in-river escapement among years. It does not provide accurate, reliable estimates of spawner-abundance, particularly when in-river exploitation of salmon is high and observer efficiency and stream residency are not precisely known (Perrin and Irvine 1990, Bue et al. 1998a).

Accurate, reliable estimates of spawner abundance are required to monitor the recovery of damaged salmon resources, set appropriate spawning escapement goals for individual streams, and manage commercial fisheries in season. Because aerial survey cannot always provide this level of information and more accurate methods are prohibitively expensive for streams with marginal escapements, a niche exists that remote video technology may be able to fill. Fishery biologists have long considered the potential for photographic enumeration to eliminate the biases inherent to human derived aerial and tower counts of salmon escapement. In the late 1940's and early 1950's, researcher's experimented with aerial and tower based photography to count sockeye salmon in the Bristol Bay area (see Kelez 1947, Eicher 1953, and Mathisen 1962). While these early experiments showed promise, their feasibility was reduced by the state of technology of cameras and recording equipment from this era.

Many technological advancements have occurred since that time and recent video and time-lapse recording systems have proven effective for capturing remote images of adult (Hatch et. al 1994) and juvenile salmonids in controlled field situations (Irvine et. al 1991). In Chignik, Alaska, researchers are using underwater video equipment to facilitate enumeration of adult salmon passing a deep-water weir (Dave Owens, ADF&G Kodiak, personal communication). The Chignik system is powered by a gas generator and maintained by a field crew. In the Pacific Northwest, researchers are experimenting with stand-alone underwater video systems associated with partial weirs (P. Mundy, P. Mundy and Assoc., personal communication). An unmanned underwater system is not practical for most Alaskan streams because the camera would be vulnerable to inquisitive bears and other mammals. In FY99 we propose to develop an

unmanned video system that can be deployed above small streams, out of the reach of bears. The video system will document sockeye, pink, and coho salmon escapement into Delight Lake. Time-lapse images will be recorded onto a VCR powered by 12-volt batteries. Solar and hydropower generators will maintain the batteries. A weir will be operated concurrently to determine the accuracy of video counts. In FY00 we will evaluate the camera's performance counting pink and chum salmon escapement in a short, intertidal stream.

NEED FOR THE PROJECT

A. Statement of Problem

Salmon resources and services were injured by the 1989 *Exxon Valdez* oil spill. Accurate, reliable estimates of spawner abundance are required to monitor the recovery of damaged salmon resources, set appropriate spawning escapement goals for individual streams, and manage commercial fisheries in season. Aerial survey estimates of spawning escapement are often biased by conditions (e.g., observer experience/efficiency, timing of flights, etc.) that are difficult to account for, leading to imprecise indices of spawning escapement. Because accurate escapement monitoring is so important for salmon management and documenting the recovery of salmon resources and services, reliable, cost-effective techniques should be developed to improve escapement estimation where aerial survey is currently used.

B. Rationale/Link to Restoration

Salmon resources throughout the spill area, and particularly in Prince William Sound (Bue et al. 1996, Bue et al. 1998b) were damaged by the 1989 *Exxon Valdez* oil spill (EVOS) and have not fully recovered (1998 EVOS Trustee Council Status Report). This project has potential for improving long-term monitoring and management of salmon stocks within the spill area and statewide. Improved escapement monitoring will enable more effective evaluation of recovery efforts. It will also facilitate improved in-season management of fisheries, which will help restore injured sport and commercial fishing services.

C. Location

Development of this improved escapement monitoring technology will occur in Lower Cook Inlet (Southern Kenai Peninsula). However, project benefits could be realized throughout the

spill area and anywhere in Alaska where aerial survey is currently being used to monitor salmon escapement in small, clear streams.

COMMUNITY INVOLVEMENT AND TRADITIONAL ECOLOGICAL KNOWLEDGE

Although McCarty Fiord and much of the Kenai Peninsula's outer coast is contained within Kenai Fiords National Park (KFNP), Delight Lake and its outlet stream (Delight Creek) are owned by the Port Graham Corporation (PGC). Port Graham residents report a long history of using these salmon resources for commercial and subsistence purposes and are concerned for the area's continuing productivity. Although the remote video system could be evaluated elsewhere, a unique opportunity exists at Delight Lake to fulfill PGC and KFNP requests to provide improved monitoring of salmon escapement and production.

PROJECT DESIGN

A. Objectives

1. (FY99): Determine the accuracy and reliability of a remote video system for estimating sockeye salmon escapement in small streams, and
2. (FY00): Determine the accuracy and reliability of a remote video system for estimating pink and chum salmon escapement in tidally influenced streams where intertidal spawning occurs.

B. Methods

Not applicable- report writing only; no field or lab activities (closeout year).

C. Cooperating Agencies, Contracts, and other Agency Assistance

Not applicable

SHEDULE

A. Measurable Project Tasks for FY99

October-January:	Purchase video equipment and associated materials.
January-April:	Fabricate strongbox for video equipment; arrange logistics for field camps and weir installation.
June:	Deploy camp, weir, and video equipment.
June-August:	Operate weir camp, maintain camera equipment, review tapes.
September:	Evaluate camera's performance against weir counts.

B. Measurable Project Tasks for FY00

November:	Present first year results at AFS meeting in Kodiak.
January-April:	Present poster at Annual EVOS workshop; turn in EVOS Annual Report, DPD, and budget for FY01 activities.
Late June:	Deploy camp, weir, and video equipment.
July-August:	Operate weir camp, maintain camera equipment, review tapes.
September:	Evaluate camera's performance against weir counts

C. Measurable Project Tasks for FY01

November 2000:	[1]Present second year results at AFS meeting in Fairbanks.
January-April 2001:	Present poster at Annual EVOS workshop; turn in EVOS draft final report for review.
May-September 2001:	Complete any necessary revisions of EVOS final report. [2]Prepare and possibly submit manuscript for publication

[1]If analyses can be completed in time and it fits into the PI's schedule.

[2]The PI will attempt to complete the manuscript before the end of FY01, but submittal and page costs may get deferred to FY02.

D. Project Milestones and Endpoints

September 1999	Objective 1:	Determine video system's accuracy and reliability by comparing video counts against weir counts.
September 2000	Objective 2:	Determine feasibility of using remote video to count pink and chum salmon escapement in tidally influenced streams.

September 2001 Obj. 1-2: Complete project final report.

E. Completion Date

All project objectives will have been met by the end of FY00 and the project will close out in FY01. If remote video proves to be a reliable and cost-effective method for improving upon aerial survey estimates of spawning escapement, ADF&G may use normal agency funding to replace aerial surveys with video, where suitable. The ADF&G may also pursue development of microwave technology to transmit digital images directly to field stations, and image-recognition software to facilitate auto-enumeration.

PUBLICATIONS AND REPORTS

Internal (ADF&G) and external (EVOS Trustee Council, Chief Scientist, etc.) peer review of project documents (DPD, Annual and Final Reports) will occur throughout the project's duration. In April FYO1, we will submit our Project Final Report. The PI also may choose to submit a manuscript for publication at that time, as partial fulfillment of his final reporting requirements to the EVOS TC. If a manuscript cannot be completed by April FY01, the PI plans to submit one for publication in FY02. Our intention is to submit an article entitled "Reliability and performance of a remote video system for monitoring salmon escapement in Alaska", most likely to Transactions of the American Fisheries Society or the North American Journal of Fisheries Management. Page costs have been requested in our FY01 budget, but these costs may get deferred to FY02 if the manuscript is not published by September 2001.

PROFESSIONAL CONFERENCES

Travel funds have been requested to attend the EVOS annual workshop in Anchorage, where we plan to present a poster. If analyses can be completed in time, FY00 results may be presented at the 2000 Annual Meeting of the Alaska Chapter of the American Fisheries Society, held in Fairbanks in November. If the PI's schedule does not allow this, that portion of the requested travel funds will not be spent.

NORMAL AGENCY MANAGEMENT

Along with monitoring the recovery of injured resources, the proposed project will improve the department's ability to assess and manage salmon resources within the spill area and elsewhere in Alaska. The department has few resources with which to develop new technology; without the Trustee Council's financial support, this project will not be funded in the near future. A unique opportunity exists for the EVOS Trustee Council to add to their legacy by supporting ADF&G's development of a new salmon counting technique that is likely to improve salmon management throughout Alaska.

COORDINATION AND INTEGRATION OF RESTORATION EFFORT

The PI has presented our FY99 results at two professional meetings, including one with scientists from other disciplines (EVOS Workshop). Our intention was to advertise remote video's potential for improving restoration and monitoring efforts of fish and wildlife resources. Partly through attendance at these meetings, we have maintained an active dialogue with other professionals interested in remote video applications (e.g., Arthur Kettle, USFWS, Barren Islands seabirds; Mike O'Meara, Pratt Museum, seabirds; Kathy Frost, ADF&G, PWS harbor seals, and Daniel Zatz, SeeMore Wildlife, Chiswell Island sea lions). Following the successful completion of this evaluation study, the PI may solicit professionals in other disciplines to submit a joint proposal to include remote video technology in the GEM Program.

EXPLANATION OF CHANGES IN CONTINUING PROJECTS

Does not apply.

PROPOSED PRINCIPAL INVESTIGATOR

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PRINCIPAL INVESTIGATOR

Edward O. Otis, Asst. Area Research Biologist for Lower Cook Inlet, Alaska Department of Fish and Game, Commercial Fisheries Division (CF), 3298 Douglas Place, Homer, AK 99603. ***Education***: Master of Science, Fisheries Science, University of Arizona, 1994. Bachelor's of Science, Environmental Science, University of New Hampshire, 1988. ***Professional Experience:*** April 1996-present: Asst. Area Research Biologist for Lower Cook Inlet, Alaska Department of Fish and Game, CFMD, Homer, AK. Supervised by William R. Bechtol. Responsible for assessment and forecasting of Kamishak Bay herring stock; directs salmon and herring catch/escapement-sampling programs; forecasts Lower Cook Inlet salmon returns. April 1994-March 1996: Fishery Biologist, Kenai Fishery Resources Office, U.S. Fish and Wildlife Service, Kenai, AK. Supervised by Gary Sonnevil. Project leader for Andreafsky River (Yukon) adult salmon enumeration project: constructed and deployed resistance board/floating weir to count adult salmon; project leader for Kenai River rainbow trout radio-telemetry project: surgically implanted radio transmitters and tracked fish using mobile receivers and remote data loggers. June 1991-March 1994: Graduate Research Asst., Univ. of Arizona, Dept. of Renewable Natural Resources, Tucson, AZ. Supervised by Dr. O. Eugene Maughan. Designed and implemented field studies to assess the composition, abundance, and distribution of fishes in streams tributary to the Colorado River in Grand Canyon. Designed and implemented field study to inventory aquatic habitat available to stream fishes in Grand Canyon. August 1987-June 1991 (intermittent): Field biologist/technician, Kenai Fishery Resources Office, U.S. Fish and Wildlife Service, Kenai, AK. Supervised by Gary Sonnevil. Project Leader or team member on various field projects including: assessing adult salmon returns using weirs (Uganik R, Kodiak); developing new approaches to aging dolly varden and lake trout otoliths; enumerating emergent salmon fry (Tustumena Lake); investigating steelhead distribution and angler effort (Cold Bay); investigating run-timing and migration rates of chinook salmon (Kuskokwim River); and inventorying salmon spawning habitat (Ayakulik R., Kodiak).

Selected Publications:

Weiss, S.J., ***E.O. Otis***, and O.E. Maughan. 1998. Spawning ecology of flannelmouth sucker *Catostomus latipinnis* (Catostomidae) in two small tributaries of the lower Colorado River. Environmental Biology of Fishes.

Otis, E.O. and W.R. Bechtol. 1997. Forecast of the Kamishak herring stock in 1997. Alaska Dept. of Fish and Game, Regional Information Report No. 2A97-03.

Otis, E.O. 1997. Lower Cook Inlet pink salmon forecast for 1997. Alaska Department of Fish and Game Regional Information Report No. 2A97-09.

Otis, E.O., W.R. Bechtol, and W.A. Bucher. 1998. Coping with a challenging stock assessment situation: the Kamishak Bay sac-roe herring fishery. In Proceedings of the International Stock Assessment Symposium, 1997 Lowell Wakefield Conference (*in press*).

Otis, E.O., W.R. Bechtol, and W.A. Bucher. 1998. Abundance, age, sex, and size statistics for sockeye salmon in Lower Cook Inlet, 1995. Alaska Department of Fish and Game Regional Information Report No. 2A98-07.

Otis, E.O., and M.S. Dickson. 1999. Abundance, age, sex, and size statistics for sockeye, chum, and pink salmon in Lower Cook Inlet, 1996. Alaska Department of Fish and Game Regional Information Report No. 2A99-09.

OTHER KEY PERSONNEL

Project Manager: Mark Dickson, Fish and Wildlife Technician IV. Mr. Dickson has been employed as a fish culturist and fish and wildlife technician with the Alaska Department of Fish and Game for the past 20 seasons. He has considerable experience managing salmon escapement related field projects, including: the *EVOS* Trustee Council funded Delight and Desire Lakes project (97254) and currently, the Port Dick Creek Restoration project (97139A2).

LITERATURE CITED

Bevan, Donald E. 1961. Variability in aerial counts of spawning salmon. Journal of the Fisheries Research Board of Canada 18(3):337-348.

Bucher, W.A., and L.F. Hammarstrom. 1997. 1996 Lower Cook Inlet annual finfish management report. Alaska Department of Fish and Game, Commercial Fisheries Management and Development Division, Anchorage.

Bue, B. G., S. Sharr, S.D. Moffitt, and A. Craig. 1996. Effects of the Exxon Valdez oil spill on pink salmon embryos and preemergent fry. Pages 619-627 *in* Rice et al. (1996).

Bue, B.G., S.M. Fried, S. Sharr, D.G. Sharp, J. Wilcock, and H.J. Geiger. 1998a. Estimating salmon escapement using area-under-the-curve, aerial observer efficiency, and stream-life estimates: the Prince William Sound pink salmon example. North Pacific Anadromous Fisheries Commission Bulletin 1:240-250.

Bue, B. G., S. Sharr, and J.E. Seeb. 1998b. Evidence of damage to pink salmon populations inhabiting Prince William Sound, Alaska, two generations after the *Exxon Valdez* oil spill. Transactions of the American Fisheries Society 127:35-43.

Cousens, N.B.F., G.A. Thomas, D.G. Swann, and M.C. Healey. 1982. A review of salmon escapement techniques. Canadian Technical Report of Fisheries and Aquatic Sciences 1108:129 pp.

Dickson, M., W. Bucher, and G. Coble. 1999. Tributary restoration and development project: Port Dick Creek, Lower Cook Inlet, Alaska, Exxon Valdez oil spill restoration project 1998 annual report (Restoration Project 98139-A2), Alaska Department of Fish and Game, Homer, Alaska.

Edmundson, J., M. Dickson, and W. Bucher. 1998. Limnology and fishery investigations concerning sockeye salmon production in Delight and Desire lakes, EVOS Restoration Project 97254 Final Report submitted by the Alaska Department of Fish and Game, Division of Commercial Fisheries Management and Development.

Eicher, G.J. 1953. Aerial methods of assessing red salmon populations in western Alaska. Journal of Wildlife Management 17(4):521-527.

Evzerov, A.V. 1981. An evaluation of the errors occurring in salmon census by aerial survey. Canadian Translations of Fisheries and Aquatic Sciences 4714:1-5. Translated from Salmonidae of the Far East, 1975 CVI:82-84.

Hatch, Douglas R., M. Schwartzberg, and P.R. Mundy. 1994. Estimation of pacific salmon escapement with a time-lapse video recording technique. North American Journal of Fisheries Management 4:626-635.

Hatch, D.R., J.K. Fryer, M. Schwartzberg, D.R. Pederson, and A. Wand. 1998. A computerized editing system for video monitoring of fish passage. North American Journal of Fisheries Management 18: 694-699.

Hill, R.A. 1997. Optimizing aerial survey count frequency for the area-under-the-curve method of estimating escapement. North American Journal of Fisheries Management 17:461-466.

Irvine, J.R., B.R. Ward, P.A. Teti, and N.B.F. Cousens. 1991. Evaluation of a method to count and measure live salmonids in the field with a video camera and computer. North American Journal of Fisheries Management 11:20-26.

Kelez, G.B. 1947. Measurement of salmon spawning by means of aerial photography. Pacific Fisherman 45:46-51.

Mathisen, O.A. 1962. Photographic enumeration of red salmon escapement. Pages 349-372 in Koo, T.S.Y (ed.) Studies of Alaska Red Salmon. Univ. of Wash. Publ. In Fish. New Ser. 1: 449 pp.

Neilson, J.D. and G.H. Geen. 1981. Enumeration of spawning salmon from spawner residence time and aerial counts. Transactions of the American Fisheries Society 110:554-556.

Perrin, C.J. and J.R. Irvine. 1990. A review of survey life estimates as they apply to the area-under-the-curve method for estimating the spawning escapement of Pacific salmon. Canadian Technical Report of Fisheries and Aquatic Sciences No. 1733. 49 pp.

Shardlow, T., R. Hilborn, and D. Lightly. 1987. Components analysis of instream escapement methods for Pacific salmon (Oncorhynchus spp.). Canadian Journal of Fisheries and Aquatic Sciences 44:1031-1037.

2001 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 2000 - September 30, 2001

Budget Category:	Authorized FY 2000	Proposed FY 2001
Personnel	$28,000.0	$6,900.0
Travel	$1,500.0	$2,220.0
Contractual	$4,370.0	$1,100.0
Commodities	$1,825.0	$0.0
Equipment	$6,500.0	$0.0
Subtotal	$42,195.0	$10,220.0
General Administration	$4,300.0	$1,069.5
Project Total	$46,495.0	$11,289.5
Full-time Equivalents (FTE)	0.5	0.1
Other Resources		

LONG RANGE FUNDING REQUIREMENTS

			Estimated FY 2002		

Dollar amounts are shown in thousands of dollars.

Comments:

See accompanying cover letter re: publication page costs.

FY01

Prepared:

Project Number: 01366
Project Title: Using Remote Video and Time Lapse Recording...
Agency: Alaska Department of Fish and Game

2001 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 2000 - September 30, 2001

Personnel Costs:		GS/Range/ Step	Months Budgeted	Monthly Costs	Overtime	
Name	Position Description					
Mark Dickson (or equivelant)	Fish and Wildlife Technician IV Assistance in preparing the final report and manuscript for publication	13J	1.5	4600.0		
	Subtotal		1.5	4600.0	0.0	
					Personnel Total	

Travel Costs:	Ticket Price	Round Trips	Total Days	Daily Per Diem	
Description					
Annual EVOS Restoration Workshop					
Homer-Anchorage and return (for Ted Otis and Mark Dickson).	180.0	2	6	42.0	
Lodging			3	130.0	
Annual Alaska Chapter AFS Meeting in Fairbanks					
Homer-Fairbanks and return (for Project PI)	500.0	1			
Food per diem- 1 person for 3.5 days			4	42.0	
Lodging- 1 person for 3 nights			3	150.0	
Registration Fee					
				Travel Total	

FY01

Prepared:

Project Number: 01366
Project Title: Using Remote Video and Time Lapse Recording...
Agency: Alaska Department of Fish and Game

2001 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 2000 - September 30, 2001

Contractual Costs:	
Description	
We are removing our FY01 request for publication page costs because we cannot guarantee we would meet the TC's requirement that the manuscript is published in FY01. However, we do intend to publish a manuscript entitled "Reliability and performance of a remote video escapement recorder (RVER) for monitoring salmon escapement in Alaska" in the North American Journal of Fisheries Management in FY02. Note: see accompanying cover letter. Photo developing and digitizing, graphic art design, poster costs, etc.	
When a non-trustee organization is used, the form 4A is required. **Contractual Total**	
Commodities Costs:	
Description	
Commodities Total	

FY01

Prepared:

Project Number: 01366
Project Title: Using Remote Video and Time Lapse Recording...
Agency: Alaska Department of Fish and Game

2001 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 2000 - September 30, 2001

New Equipment Purchases:	Number of Units	Unit Price	
Description			
Those purchases associated with replacement equipment should be indicated by placement of an R.		**New Equipment Total**	

Existing Equipment Usage:	Number of Units	
Description		
Personal computers	2	

FY01

Prepared:

Project Number: 01366
Project Title: Using Remote Video and Time Lapse Recording...
Agency: Alaska Department of Fish and Game