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GEM PROPOSAL SUMMARY PAGE

(To be filled in by proposer)

Project Title:	Management Applications: Improving Preseason Forecasts of Kenai River Sockeye Salmon Runs through Salmon Smolt Monitoring – Technology Development
Project Period:	FY 05-FY 07
Proposer(s):	T. Mark Willette, Alaska Dept. of Fish and Game, 43961 Kalifornsky Beach Rd, Ste B, Soldotna, Alaska 99669-8367. (907)262-9368 ph, (907)262-4709 fax, mark_willette@fishgame.state.ak.us. J.A. Edmundson, Alaska Dept. of Fish and Game, 333 Raspberry Rd., Anchorage, Alaska (907) 267-2123 ph, (907) 267-2442 fax, jim_edmundson@fishgame.state.ak.us
Study Location:	Cook Inlet

Abstract: This project will develop and implement a smolt-monitoring program for Kenai River sockeye salmon as a tool for managing one of the largest and most accessible salmon stocks in Upper Cook Inlet. Sockeye salmon smolt population estimates will be used to develop preseason forecasts of run size for this stock. The Alaska Board of Fisheries has specified that the Kenai River sockeye salmon run will be managed based upon preseason and inseason forecasts of run strength, and inriver escapement goals for this system vary as a function of these forecasts. This management structure causes relative uses of the resource by recreational, personal use, and commercial fishers to be strongly dependent on the accuracy of forecasts. The project will use two independent methods to estimate the population size of sockeye salmon smolt emigrating from the Kenai River watershed. GEM funding is requested to support estimation of smolt population size using mark-recapture methods. ADF&G funding will support estimation of smolt population size using side-looking sonar. During the first two years of the project, we will evaluate the accuracy and precision of our estimates and identify the methodology that provides the best estimate at the lowest cost. In the third year, we will implement this new method to estimate smolt population size. The project will also provide samples to other investigators studying the role of marine-derived nutrients in watersheds.

Funding:	EVOS Funding Requested:	FY 05	$ 51.3	
		FY 06	$ 48.5	
		FY 07	$ 49.6	TOTAL: $ 149.4
	Non-EVOS Funds to be Used:	FY 05	$ 205.4	
		FY 06	$ 205.4	
		FY 07	$ 205.4	TOTAL: $ 616.2

Date:	April 15, 2004

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GEM RESEARCH PLAN

I. NEED FOR THE PROJECT

A. Statement of Problem

The Kenai River watershed supports the largest recreational and commercial sockeye salmon fisheries in upper Cook Inlet (UCI). Sockeye salmon runs to the Kenai River have been highly variable ranging from 0.6 to 8.6 million over the past 28 years. During this same period, the value of the commercial harvest in the inlet has ranged from less than $10 million to nearly $120 million. The value of recreational fisheries has been more difficult to determine, but it has been substantial.

The Kenai River late-run sockeye salmon management plan has largely governed management of recreational and commercial salmon fisheries in UCI. The plan specifies that the Kenai River sockeye salmon run will be managed based upon preseason and inseason forecasts of run strength. At projected runs of less than 2 million, the inriver escapement goal for the system is 0.60-0.85 million; at projected runs of 2-4 million, the inriver escapement goal is 0.75-0.95 million; and at projected runs of greater than 4 million, the inriver escapement goal is 0.85-1.10 million. Preseason forecasts for Kenai River sockeye salmon have generally been based upon either sibling relationships or the estimated abundance of juvenile sockeye salmon rearing in Kenai and Skilak Lakes in the fall. Errors in sibling model forecasts likely result from variable age at maturity, while errors in fall-fry model forecasts likely result from variable over-winter survival.

Variable over-winter survival of juvenile sockeye salmon in this system is likely caused by the relatively small size and poor condition of juveniles rearing in Skilak Lake. Since 1985, the Alaska Department of Fish and Game (ADF&G) has annually estimated the abundance and size of juvenile sockeye salmon rearing in Kenai and Skilak lakes (Decino et al. 2004). These studies have determined that the majority of sockeye salmon in the watershed rear in Skilak Lake, and that their growth is density dependent (Edmundson et al. 2003). Measurements of fall lipid content of juvenile sockeye salmon in Skilak Lake indicated that energy reserves of some individuals was likely not sufficient for their survival until spring (Edmundson et al. 2003). The ADF&G has been developing a bioenergetics model to predict over-winter mortality of juvenile sockeye salmon rearing in this system. A smolt-monitoring program is needed to validate bioenergetics model predictions of over-winter mortality.

Production of sockeye salmon in this system is also affected by a brood interaction in which large escapements into the system reduce returns from current and subsequent spawner populations (Edmundson et al. 2003). Brood interaction likely results from starvation and subsequent mortality of emergent fry. Large fry populations from the previous brood year cause reduced copepod density the following spring limiting food resources available for emergent fry from the subsequent brood (Edmundson et al. 2003).

The brood interaction observed in this system may result in part because most of the sockeye salmon in the watershed (~75%, K. Tarbox, pers. comm.) spawn in a 6-km length of the Kenai River immediately below the outlet of Skilak Lake. Fry emerging from redds below Skilak Lake must migrate upstream to their rearing habitat in the lake. McCart (1967) found that fry emerging from outlet spawning areas form very high-density aggregations along stream margins and rear in these areas several weeks before migrating upstream to rearing lakes. McCart (1967) concluded that mortality must be high at this time, due to predation and competition for food in limited near shore habitats. Upstream migration also involves an energy expenditure that progeny from lakeshore or tributary spawners do not require (McCart 1967). This additional energy expenditure causes emergent fry from outlet spawners to be more dependent on food resources in the early spring. This could explain the observed relationships between spring copepod biomass and both fall fry size and abundance in Skilak Lake (Edmundson et al. 2003), but it may also mean that emergent fry in this system are more dependent on nutrients and carbon provided by salmon carcasses in outlet spawning areas.

Freshwater food webs in the northern Gulf of Alaska region are dependent to some extent on inputs of marine derived nutrients (MDN) and carbon. Edmundson and Carlson (1998) concluded that phosphorus concentration did not generally limit primary production (chlorophyll *a*) in glacial lakes, because production was light limited due to the high turbidity in these systems. But, high turbidity may not limit primary production in shallow outlet spawning areas, particularly in the spring when turbidities are lower. In this habitat, MDN may stimulate production of biofilm and macroinvertebrates (Wipfli et al. 1998), and juvenile fishes may feed directly on salmon carcasses (Bilby et al. 1998). Mazumder et al. (see GEM proposal: Marine-derived nutrients in the Kenai and adjacent watersheds: methods for detecting change) will investigate the role of MDN in the Kenai River watershed.

This project will provide critical salmon smolt abundance data needed to understand the complex interplay between the positive ecological effects of MDN and the compensatory effects of large juvenile salmon populations. Smolt population estimates will be used to (1) validate an over-winter bioenergetics model for sockeye salmon, and (2) manage the resource through improved preseason forecasts of sockeye salmon runs to this system. Finally, the project will provide samples of sockeye salmon smolt, juvenile salmonids, and resident fishes to other investigators studying the role of MDN in the watershed.

B. Relevance to GEM Program Goals and Scientific Priorities

This project will contribute to GEM program goals by enabling detection of changes in marine survival separate from changes in freshwater survival for an important sockeye salmon stock rearing in the northern Gulf of Alaska. This salmon stock migrates through Cook Inlet during June and July. Trends in marine survival will be related to oceanographic conditions in the inlet, which will be monitored by another GEM project (G-040670) 'Monitoring dynamics of the Alaska coastal current and development of applications for management of Cook Inlet salmon'.
The proposed project will also contribute to the GEM program goal to develop a better understanding of the role of MDN in the productivity of watersheds along the margin of the northern Gulf of Alaska. This project will provide samples of sockeye salmon smolt, juvenile salmonids and resident fishes to other investigator studying the role of MDN in the Kenai River watershed (see GEM proposal: Mazumder et al., Marine-Derived Nutrients in the Kenai and Adjacent watersheds: methods for detecting change).

II. PROJECT DESIGN

This project will use two independent methods to estimate the population size of sockeye salmon smolt emigrating from the Kenai River watershed. GEM funding is requested to support estimation of smolt population size using mark-recapture methods. ADF&G funding will support estimation of smolt population size using side-looking sonar. During the first two years of the project, we will evaluate the accuracy and precision of our estimates and identify the methodology that provides the best estimate at the lowest cost. In the third year, we will implement this new method to estimate smolt population size.

A. Objectives

1. Estimate the population size of sockeye salmon smolt emigrating from the Kenai River watershed using mark-recapture methods.
2. Estimate the population size of sockeye salmon smolt emigrating from the Kenai River watershed using side-looking sonar.
3. Estimate the size and age composition of sockeye salmon smolts, and provide samples needed to estimate the proportion of marine derived elements (C, N, S) in smolts, other juvenile salmonids, and resident fishes.

B. Procedural and Scientific Methods

Objective 1.

We will use a simple stratified mark-recapture design to estimate the abundance of sockeye salmon smolts emigrating from Skilak Lake (Carlson et al. 1998). A two-capture site method will be employed with different gear types used to capture the initial and recapture samples. Use of two different gears will likely provide a less biased population estimate (Seber 1982).

Earlier projects designed to estimate sockeye salmon smolt abundance in the Kenai River produced estimates that were not consistent with fall fry abundance estimates and subsequent adult returns (King et al. 1994). These studies employed a single-capture site method using the same gear to obtain the initial and recapture samples (Carlson et al. 1998). Errors in the estimates appeared to be due to size-dependent capture probabilities, i.e. larger smolts were not captured in proportion to their abundance. This was evident from the very low catches (<3,500) in 1992 and 1993 when smolts were larger than in previous years (King et al. 1994). The low total catch in these years also precluded accurate estimates of capture probability and thus total population size. Size-dependent capture probability is a function of trap design and current velocity (Todd 1994). In a subsequent study, King and Breakfield (2002) captured much larger numbers of sockeye salmon smolt (228,000) using inclined-plane and rotary-screw traps deployed below the Soldotna Bridge on the Kenai River.

We propose to initially conduct a pilot study to determine the appropriate study site and trap design that will minimize the problem of size-dependent capture probability. We will survey the upper portion of the Kenai River below Skilak Lake to locate a site where the channel configuration and current speed are optimal for operation of smolt traps. We expect that the upper Kenai River may provide better sites for operation of smolt traps, because this portion of the river exhibits lower and less variable stream discharge. Sites where an island or large rock constricts the channel will likely provide the highest capture probabilities, because smolts are concentrated below such obstacles (Gary Todd, personal communication).

Preliminary smolt population estimates will be derived from mark-recapture experiments conducted each week (May 10-June 30). Two types of smolt trap will be used to recapture marked fish: an inclined-plane trap (Todd 1994) and a rotary-screw trap with a 2-m diameter opening. Todd's (1994) traps captured fish over a broad range of sizes (60-85 mm), exhibited fairly high capture probabilities (6-12%), and produced reasonable smolt population estimates that have provided more precise forecasts of adult sockeye salmon returns to the Kasilof River than other methods. The traps will be fished each night from 2100-0900 hrs the following day. Size-dependent capture probabilities will be estimated for each type of smolt trap.

Representative samples (n=2000) of sockeye salmon smolts will be captured and marked with a dye solution each week. The smolts will be captured with small-mesh beach seines (50 x 3 m) or fyke nets (2 x 2 m) fished at night at the outlet of Skilak Lake, an area with relatively shallow-sloping gravel beaches. A known number of smolts will be placed in an aerated container containing dye solution (6 g of Bismarck Brown Y dye in 180 L water) and held for 30 min. Dyed smolts will be placed in a live box and held for 3 hrs prior to release to estimate handling mortality.

We will examine trap avoidance in relation to current velocity using a DIDSON sonar and acoustic doppler current profiler mounted in a side-looking configuration near the front of the smolt trap. Mounting the two transducers side-by-side will allow for comparison of fish behavior in relation to current velocity. The results from this study will be used to optimize smolt-trap design and minimize trap avoidance.

A conductivity-temperature-depth recorder will be deployed throughout the sampling period to monitor environmental parameters. A transect across the river will also be sampled periodically with the acoustic doppler current profiler to estimate stream discharge near the study site as a function of changes in water level. These data will be used to examine changes in capture probability relative to stream discharge and as inputs to sonar calculations.

Objective 2.

Paired side-looking and up-looking sonars will be used to derive independent estimates of sockeye salmon smolt abundance during two weekly periods near the peak of the smolt emigration. Sonar studies will be conducted at a site near the smolt traps used to estimate population size by mark-recapture. The side-looking system will estimate smolt density using echo integration (MacLennan and Simmonds 1992), and the up-looking system will estimate the vertical distribution of smolt and an alternate scaler for echo integration. An estimate of the vertical distribution of smolt will be needed, because standard echo integration techniques assume that targets are uniformly distributed within the acoustic beam. This assumption is violated in a side-looking deployment, because the smolt depth distribution is non-uniform with most fish close to the surface.

A Biosonics model DT6000 200 kHz sonar system with a 6.6^{o} split-beam transducer will be deployed in a fixed side-looking position nearshore with the beam directed across the river channel. Acoustic digital data will be collected and stored on a laptop computer hard-drive. Fish will be acoustically sampled at 2-4 pings sec^{-1}, 0.2 msec pulse width, and a –65dB target strength threshold. Twelve-volt batteries will power the acoustic system and the laptop computer. The acoustic data will be analyzed using *EchoView* software. Acoustic data will first be edited to remove bottom echoes and other unwanted reverberation. After bottom editing is complete, individual target information will be processed and saved for estimation of *in-situ* target strength and sigma (σ), the backscattering coefficient.

A DIDSON sonar system, positioned in an up-looking configuration, will be used to measure the depth distribution of smolt in a region overlapping the side-looking sonar beam and scale the echo integration results from the side-looking system. The depth distribution of smolt will be used to calculate an equivalent beam angle (ψ') using a modified acoustic beam pattern equation (Clay and Medwin 1977; Kieser, personal communication) to adjust for non-uniform target distribution. To test how sensitive this methodology is to errors in depth distribution, we will also model two extreme depth distributions: (1) uniform 0-1.2 m layer and (2) skewed toward surface within the 0-0.4 m layer. The uniform 0-1.2 m layer assumption is based upon data obtained from up-looking video cameras positioned in stereo on the Kvichak River. In this study, no smolt were observed migrating deeper than 1.2 m below the surface, and their distribution was skewed towards the surface. Estimates based on measured depth distributions (DIDSON sonar) should fall between these two extreme values.

Objective 3.

The size and age composition of sockeye salmon smolts will be estimated from samples collected each week at the outlet of Skilak Lake (initial capture site). Prior to marking, a random sample (n=500) of smolts will be collected and anesthetized in MS-222. These fish will be measured (fork length), weighed (nearest 0.01 g), and a scale will be collected to determine age.

We will also collect samples of sockeye salmon smolts, other juvenile salmonids and resident fishes for analysis of the proportion of marine derived elements (C, N, S). These samples will be frozen and provided to other investigators studying MDN in the Kenai River watershed (see GEM proposal from Mazumder et al.: Marine-Derived Nutrients in the Kenai and Adjacent watersheds: methods for detecting change).

C. Data Analysis and Statistical Methods

Objective 1.

A modified Peterson estimator will be used to estimate smolt population size in each weekly stratum (N_h)

$$N_h = \frac{(n_h + 1)(M_h + 1)}{(m_h + 1)} - 1 \qquad (1)$$

where M_h is the number of fish marked in the initial sample during week h, m_h is the number of marks recaptured during week h, and n_h is the number of fish scanned for tags in the second sample during week h (Chapman 1951). This estimator is approximately unbiased if $(M_h + n_h) < N_h$ if m_h is at least 7 (Robson and Reiger 1964). An approximately unbiased estimate of the variance of N_h is

$$v(\hat{N}_h) = \frac{(n_h+1)(M_h+1)(M_h-m_h)(n_h-m_h)}{(m_h+1)^2(m_h+2)} \quad . \qquad (2)$$

The total smolt population estimate is

$$\hat{N} = \sum_{h=1}^{L} \hat{N}_h \quad , \qquad (3)$$

and the variance estimate is

$$v(\hat{N}) = \sum_{h=1}^{L} v(\hat{N}_h) \, . \qquad (4)$$

Carlson et al. (1998). The null hypothesis of constant capture probability over all sampling periods can be tested using a chi-square test of homogeneity. If the test is non-significant, some strata can be pooled (Carlson et al. 1998).

Similarly, we will test the null hypothesis of constant capture probability over all length strata pooling data over all temporal strata. Separate analyses will be conducted for each trap type. The estimated number of fish within each length strata (1-cm intervals) marked in the initial sample $\hat{M}_l$ is

$$\hat{M}_l = \sum_{h=1}^{L} \hat{p}_{lh} \cdot M_h \qquad (5)$$

where $\hat{p}_{lh}$ is the estimated proportion of the initial marked sample in length stratum l and in temporal stratum h. If the test is significant, we will investigate whether some length strata can be pooled and if not whether separate population estimates can be derived for each length strata.

Objective 2.

Standard echo integration uses the equivalent beam angle (Clay and Medwin 1977, MacLennan and Simmonds 1992) in the density calculation. The equivalent beam angle (ψ), is given by

$$\Psi = \iint D^4_{(\theta,\phi)} \sin\theta \; d\theta \; d\phi \; . \qquad (6)$$

where D is the transducer directivity (Clay and Medwin 1977), D^4 is also referred to as the 2-way beam pattern, and

θ,ϕ are the spherical coordinates of a given point; θ is the angle of the point from the acoustic axis, ϕ is the angle of the point projected onto the plane of the transducer face.

Integration for ϕ is from 0 to 2π and for θ from 0 to π. The transducer directivity *D* is calculated using (Clay and Medwin 1977):

$$D = \frac{\sin[(ka\sin\alpha)/2]}{(ka\sin\alpha)/2} \times \frac{\sin[(ka\sin\beta)/2]}{(ka\sin\beta)/2} \quad . \tag{7}$$

We will calculate an adjusted equivalent beam angle (ψ') to compensate for the bias related to the non-uniform depth distribution using methods developed by Kieser (personal communication).

The volume backscattering coefficient *sv* is dependent on ψ through

$$sv = \frac{\int V^2 dt}{Sl \times Rs \times \frac{c\tau}{2} \times \psi} \tag{8}$$

where V is the output voltage from the echo sounder; integration is over the time interval that covers the range of interest,
Sl is the source level of the echo sounder,
Rs is the receive sensitivity of the echo sounder,
c is the speed of sound,
τ is the pulse duration,
ψ is the equivalent beam angle.

Equation 8 is based on the assumption that the echosounder will use 20 log R TVG and will compensate for absorption loss. We will use the ratio between ψ and ψ′ to correct the sv:

$$sv' = sv \times \frac{\psi}{\psi'} \tag{9}$$

where sv' is the linear *sv* value adjusted for a given distribution of targets.

A single acoustic scaler $\bar{\sigma}_{bs}$, averaged from data obtained across the field season will be used to convert the *sv'* in each range and time cell to density values by

$$D_{aR} = \frac{sv'_R}{\bar{\sigma}_{bs}} \tag{10}$$

where D_{aR} is the mean smolt density in the beam in range bin *R*.

A conversion factor is required to convert smolt density to smolt passage rates (density to flux). The conversion factor (C_R) changes with range as a function of the beam radius and smolt velocity:

$$C_R = Vol_R \times \frac{s_R}{2r_R} \times 3600 \tag{11}$$

where Vol_R is the volume of the bounding polyhedron within the range stratum,

s_R is smolt velocity (m sec^{-1}) in range stratum, and

r_R is the radius of the circular slice of beam at the midpoint of the range stratum.

Hourly fish passage rate F across the sampled range bins (R) is then given by

$$F = \sum_{R} (D_{a_R} \times C_R) \quad . \tag{12}$$

Maxwell et al. (in prep.) provides further detail regarding methods used to estimate smolt abundance using this methodology.

D. Description of Study Area

This project will be conducted on the Kenai Peninsula near the outlet of Skilak Lake and near the communities of Sterling and Soldotna.

E. Coordination and Collaboration with Other Efforts

This project will be part of ongoing ADF&G investigations into the ecological system supporting production of sockeye salmon in the Kenai River watershed. The ADF&G is annually measuring light penetration, temperature, nutrient concentration, chlorophyll *a*, and zooplankton species composition and biomass in Skilak Lake. The ADF&G annually estimates sockeye salmon spawner abundance and distribution in the watershed using sonar, weirs, and statewide harvest and creel surveys, and total sockeye salmon production in the watershed using an age-composition catch allocation model. The ADF&G also annually estimates the abundance, size and age composition, and whole-body energy content of juvenile sockeye salmon rearing in Kenai and Skilak lakes each fall. These data are being used to develop a bioenergetics model for over-wintering juvenile sockeye salmon in the system. The proposed project will provide smolt population estimates needed to validate this bioenergetics model.

This project will collect samples of sockeye salmon smolts, age-0 sockeye salmon, and other juvenile salmonids and resident fishes for analysis of their proportion of marine derived elements (C, N, S). These samples will be frozen and provided to other investigators studying MDN in the Kenai River watershed (see GEM proposal from Mazumder et al.: Marine-Derived Nutrients in the Kenai and Adjacent watersheds: methods for detecting change).

III. SCHEDULE

A. Project Milestones

Objective 1: Estimate the population size of sockeye salmon smolt emigrating from the Kenai River watershed using mark-recapture. To be met annually by March 31.

Objective 2: Estimate the population size of sockeye salmon smolt emigrating from the Kenai River watershed using side-looking sonar. To be met annually by March 31.

Objective 3: Estimate the size and age composition of sockeye salmon smolts, and provide samples needed to estimate the proportion of marine derived elements (C, N, S) in smolts, other juvenile salmonids, and resident species. To be met annually by October 31.

B. Measurable Project Tasks

FY 05, 1st quarter (October 1, 2004-December 31, 2004)
October: Project funding approved by Trustee Council
December: Purchase equipment for smolt traps

FY 05, 2nd quarter (January 1, 2005-March 31, 2005)
January 12-16 (tentative): Annual GEM Workshop

FY 05, 3rd quarter (April 1, 2005-June 30, 2005)
April 1: Purchase sampling supplies and recruit technicians
May 10 – Jun 30: Conduct field sampling

FY 05, 4th quarter (July 1, 2005-September 30, 2005)
Sept. 1: Submit project FY05 annual report to Trustee Council
Sept. 1 - 30: Data entry, error checking, and database management
Sept 30: Provide samples for MDN analyses to other investigators

FY 06, 1st quarter (October 1, 2005-December 31, 2005)
October: Estimate size and age composition of smolt population

FY 06, 2nd quarter (January 1, 2006-March 31, 2006)
January: Annual GEM Workshop
March: Estimate sockeye salmon smolt population size in 2005

FY 06, 3rd quarter (April 1, 2006-June 30, 2006
April 1: Purchase sampling supplies and recruit technicians
May 10 – Jun 30: Conduct field sampling

FY 06, 4th quarter (July 1, 2006-September 30, 2006)
Sept. 1: Submit project FY06 annual report to Trustee Council
Sept. 1 - 30: Data entry, error checking, and database management
Sept 30: Provide samples for MDN analyses to other investigators

FY 07, 1st quarter (October 1, 2006-December 31, 2006)
October: Estimate size and age composition of smolt population

FY 07, 2nd quarter (January 1, 2007-March 31, 2007)

January:	Annual GEM Workshop
March:	Estimate sockeye salmon smolt population size in 2006

FY 07, 3rd quarter (April 1, 2007-June 30, 2007

April 1:	Purchase sampling supplies and recruit technicians
May 10 – Jun 30:	Conduct field sampling

FY 07, 4th quarter (July 1, 2007-September 30, 2007)

Sept. 1:	Submit project FY07 annual report to Trustee Council
Sept. 1 - 30:	Data entry, error checking, and database management
Sept. 30:	Provide samples for MDN analyses to other investigators

March 30, 2008:	Submit final report. This will consist of a draft manuscript for publication to the Trustee Council office.

IV. RESPONSIVENESS TO KEY TRUSTEE COUNCIL STRATEGIES

A. Community Involvement and Traditional Ecological Knowledge (TEK)

Local communities will be informed of the results of this project at Alaska Board of Fisheries and advisory committee meetings. Use of project results in developing annual sockeye salmon forecasts for the Kenai River will be described in any press releases or public communications regarding UCI salmon forecasts. A local hire preference will be implemented during recruitment for all positions funded through this project.

This project will be closely linked to other studies investigating the role of MDN in the Kenai River watershed. The proposed GEM project Mazumder et al. (Marine-Derived Nutrients in the Kenai and Adjacent watersheds: methods for detecting change) included extensive involvement of local communities on the Kenai Peninsula in development of their research plan and local involvement in this project will continue in the implementation phase.

B. Resource Management Applications

This project will develop and implement a smolt-monitoring program for Kenai River sockeye salmon as a tool for managing one of the largest and most accessible salmon stocks in UCI. Sockeye salmon smolt population estimates will be used to develop preseason forecasts of run size for this stock. The Alaska Board of Fisheries has specified that the Kenai River sockeye salmon run will be managed based upon preseason and inseason forecasts of run strength, and inriver escapement goals for this system vary as a function of these forecasts. This management structure causes relative uses of the resource by recreational, personal use, and commercial fishers to be strongly dependent on the accuracy of forecasts.

V. PUBLICATIONS AND REPORTS

A manuscript entitled 'Development of technologies for estimation of sockeye salmon smolt abundance in a glacially turbid system' will be submitted to the North American Journal of Fisheries Management in March 2008.

VI. PROFESSIONAL CONFERENCES

A manuscript entitled 'Development of technologies for estimation of sockeye salmon smolt abundance in a glacially turbid system' will be presented at the annual meeting of the American Fisheries Society, Alaska Chapter in 2008. The location of the meeting is not known at this time.

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CURRICULUM VITAE

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Educational Background:

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Master of Science, Fisheries Oceanography, 1985, University of Alaska Fairbanks.

Appointments:

Research Project Leader, AK Dept. Fish & Game, Soldotna, AK	2000-present
Research Project Leader, AK Dept. Fish & Game, Cordova, AK	1999-2000
Research Biologist, AK Dept. Fish & Game, Cordova, AK	1991-2000
Assistant Research Professor, University of Alaska, Fairbanks, AK	1990-1991
Instructor of Fisheries, University of Alaska, Fairbanks, AK	1986-1990
Graduate Research Assistant, University of Alaska, Fairbanks, AK	1983-1986

Current Duties:

Design and implement research projects to assess the abundance, size and age composition of salmon returning to Upper Cook Inlet and develop preseason and inseason forecasts of abundance. These projects include sonar enumeration of sockeye salmon in the Kenai, Kasilof, Crescent, and Yentna rivers, sampling of commercial catches and escapements to estimate size and age composition, preseason forecasts of abundance from assessment of juvenile salmon populations in rearing lakes, inseason forecasts of abundance from test fishery statistics, and evaluation of biological escapement goals.

Selected Publications:

Willette, T.M., R. DeCino, N. Gove. 2003. Mark-recapture population estimates of coho, pink, and chum salmon runs to upper Cook Inlet in 2002. Alaska Dept. of Fish and Game, Regional Information Report no. 2A03-20, 65 p.

Tobias, T., and T.M. Willette. 2003. An estimate of the return of sockeye salmon to upper Cook Inlet, Alaska 1976-2002. Alaska Dept. of Fish and Game, Regional Information Report no. 2A03-11, 425 p.

Willette, T.M., R.T. Cooney, V. Patrick, D.M. Mason, G.L. Thomas, and D. Scheel. 2001. Ecological processes influencing mortality of juvenile pink salmon (*Oncorhynchus gorbuscha*) in Prince William Sound, Alaska. *Fish. Oceanogr*. **10** (suppl. 1): 14-41.

Willette, T.M. 2001. Foraging behavior of juvenile pink salmon (*Oncorhynchus gorbuscha*) and size-dependent predation risk. *Fish. Oceanogr*. **10** (suppl. 1): 110-131.

Willette, T.M., R.T. Cooney, K. Hyer. 1999. Predator foraging mode shifts affecting mortality of juvenile fishes during the subarctic spring bloom. *Can. J. Fish. Aquat. Sci*. **56**: 364-376.

Willette, T.M., R.T. Cooney, K. Hyer. 1999. Some processes affecting mortality of juvenile fishes during the spring bloom in Prince William Sound, Alaska. In *Proceedings of the International Symposium on Ecosystem Considerations in Fisheries Management*, Alaska Sea Grant Program, Report **99-01**, pp137-142.

Willette, T.M., M. Sturdevant, and S. Jewett. 1997. Prey resource partitioning among several species of forage fishes in PWS, Alaska. In *Proceedings of the International Symposium on the Role of Forage Fishes in Marine Ecosystems*, Alaska Sea Grant Program, Report **97-01**, pp 11-30.

Willette, T.M. 1996. Impacts of the Exxon Valdez Oil Spill on the migration, growth, and survival of juvenile pink salmon in PWS. In *Proceedings of the Exxon Valdez Oil Spill Symposium*, American Fisheries Society Symposium **18**: 533-550.

R.T. Cooney, T.M. Willette, S. Sharr, D. Sharp, J. Olsen. 1995. The effect of climate on Pacific salmon production in the northern Gulf of Alaska: examining the details of a natural experiment. In *Proceedings of the International Symposium on Climate Change and Northern Fish Populations, Can. Spec. Publ. Fish. Aquat. Sci.* **121**: 475-482.

Willette, T.M. and R.T. Cooney. 1991. An empirical orthogonal functions analysis of sea surface temperature anomalies in the North Pacific Ocean and cross-correlations with pink salmon (*Oncorhynchus gorbuscha*) returns to southern Alaska. In *Proceedings of the 1991 Pink and Chum Salmon Workshop*, Parksville, British Columbia.

Jim A. Edmundson

Address:

Alaska Department of Fish and Game
Commercial Fisheries Division,
333 Raspberry Road, Anchorage, AK 907-267-2123
jim_edmundson@fishgame.state.ak.us

Education:

2000-present

University of Victoria Victoria, British Columbia Canada
Ph.D. Candidate (Biology)
Thesis in progress: Trophodynamics of sockeye salmon in relation to stock and recruitment

1995-1997

University of Alaska Fairbanks Fairbanks, Alaska USA
M.Sc. (Fisheries)
Thesis: Growth patterns of juvenile sockeye salmon in different thermal environments of Alaskan lakes

1973-1977

University of Vermont Burlington, Vermont USA B.Sc. (Biology)
Program emphasis: Invertebrate zoology

Professional Experience:

2004-present
Fishery Research Biologist IV (Regional Research Supervisor); Central Region, Commercial Fisheries Division, Alaska Department of Fish and Game

- Coordinate region-wide salmon, herring, shellfish and groundfish research.

2000-2003t
Fishery Research Biologist III (Program Leader); Central Region Limnology, Commercial Fisheries Division, Alaska Department of Fish and Game

- Ecosystem-based research (sockeye salmon)

1988-1999
Limnologist (Laboratory Manager); Statewide Limnology, Commercial Fisheries Division/Commercial Fisheries Management and Development Division, Alaska Department of Fish and Game

- Sockeye salmon rehabilitation, restoration and enhancement (lake fertilization, fry stocking)

1984-1987
Fishery Research Biologist II (Project Leader); Fisheries Rehabilitation, Enhancement and Development Division, Alaska Department of Fish and Game

- Coordinate and implement field and laboratory research projects (limnological studies)

1982-1983
Fishery Biologist I (Project Biologist); Fisheries Rehabilitation, Enhancement and Development Division, Alaska Department of Fish and Game

- Conduct limnological and fisheries surveys

Relevant Publications:

Edmundson, J. A. and S. R. Carlson. 1998. Lake typology influences on the phosphorus-chlorophyll relationship in subarctic, Alaskan lakes. *Lake and Reservoir Management* 14:440-450.

Edmundson, J. A., G. B. Kyle, S. R. Carlson, and P. A. Shields. 1997. Trophic-level responses to nutrient treatment of meromictic and glacially-influenced Coghill Lake. Alaska Fisheries Research Bulletin *4:136-153.*

Edmundson, J. A., T. M. Willette, J. M. Edmundson, D. C. Schmidt, S. R. Carlson, B. G. Bue, and K. E. Tarbox. 2003. Sockeye salmon overescapement, *Exxon Valdez* Oil Spill Restoration Project Final Report (Restoration Project 96258A-1), Ak. Dept. Fish and Game, Division of Commercial Fisheries, Anchorage, Alaska:58p.

Johannes, M.R.S., A. Mazumder, J. A. Edmundson and W. H. Hauser. 2002. Detecting and understanding marine-terrestrial linkages in a developing watershed: nutrient cycling in the Kenai River watershed *Exxon Valdez* Oil Spill Restoration Project Final Report (Restoration Project 02612), University of Victoria, Victoria, BC; Alaska Department of Fish and Game, Commercial Fisheries Division, Anchorage, Alaska.

Mazumder, A. and J. A. Edmundson. 2002. Impact of fertilization and stocking on trophic interactions and growth of juvenile sockeye salmon (Oncorhynchus nerka). Canadian Journal of Fisheries and Aquatic Sciences *59:1610-1627.*

Collaborations:

Dr. Mark Johannes
Northwest Ecosystems Institute
University of Victoria, Department of Biology

Dr. Asit Mazumder
University of Victoria, Department of Biology

Dr. Daniel Schindler
University of Washington, Department of Zoology

Mark Willette
Alaska Department of Fish and Game, Commercial Fisheries Division

Project: Management Applications: Improving Preseason Forecasts of Kenai River Sockeye Salmon Runs through Salmon Smolt Monitoring – Technology Development

EXXON VALDEZ OIL SPILL TRUSTEE COUNCIL
DETAILED BUDGET FORM FY 05 - FY 07

Budget Category:	Proposed FY 05	Proposed FY 06	Proposed FY 07	TOTAL PROPOSED
Personnel	$39.5	$39.5	$39.5	$118.5
Travel	$0.0	$0.0	$1.0	$1.0
Contractual	$0.0	$0.0	$1.0	$1.0
Commodities	$3.6	$5.0	$4.0	$12.6
Equipment	$4.0	$0.0	$0.0	$4.0
Subtotal	$47.1	$44.5	$45.5	$137.1
General Administration (9% of Subtotal)	$4.2	$4.0	$4.1	$12.3
Project Total	$51.3	$48.5	$49.6	$149.4

Cost-share Funds:

Description	Source	Amount
FY05		
Personnel (annual data analysis & reporting)	ADF&G	$26.6
Sampling gear (nets, traps, etc)	ADF&G	$1.8
Equipment (boats, sonars, adcp, ctd)	ADF&G	$177.0
FY06		
Personnel (annual data analysis & reporting)	ADF&G	$26.6
Sampling gear (nets, traps, etc)	ADF&G	$1.8
Equipment (boats, sonars, adcp, ctd)	ADF&G	$177.0
FY07		
Personnel (annual data analysis & reporting)	ADF&G	$26.6
Sampling gear (nets, traps, etc)	ADF&G	$1.8
Equipment (boats, sonars, adcp, ctd)	ADF&G	$177.0
Annual Total		$205.4

FY 05-07

Date Prepared: 13-Jun-04

Project Number: 050765
Project Title: Management applications: improving preseason forecasts of Kenai River sockeye salmon runs through salmon smolt monitoring
Agency: ADF&G

FORM 3A
TRUSTEE
AGENCY
SUMMARY

EXXON VALDEZ OIL SPILL TRUSTEE COUNCIL
DETAILED BUDGET FORM FY 05 - FY 07

Personnel Costs:		GS/Range/	Months	Monthly		Personnel
Name	Description	Step	Budgeted	Costs	Overtime	Sum
William Glick	Fish & Wildlife Tech III	14G	2.0	5.2	1.3	11.7
Jennifer Brannen-Nelson	Fish & Wildlife Tech III	11F	2.0	4.2	1.0	9.4
Stanley Walker	Fish & Wildlife Tech III	11G	2.0	4.2	1.0	9.4
Richard Dederick	Fish & Wildlife Tech II	9J	2.0	4.0	1.0	9.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
	Subtotal		8.0	17.6	4.3	
					Personnel Total	$39.5

Travel Costs:	Ticket	Round	Total	Daily	Travel
Description	Price	Trips	Days	Per Diem	Sum
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
				Travel Total	$0.0

FY 05

Project Number: 050765
Project Title: Management applications: improving preseason forecasts of Kenai River sockeye salmon runs through salmon smolt monitoring
Agency: ADF&G

FORM 3B
Personnel
& Travel
DETAIL

EXXON VALDEZ OIL SPILL TRUSTEE COUNCIL
DETAILED BUDGET FORM FY 05 - FY 07

Contractual Costs:	Contract Sum
Description	
If a component of the project will be performed under contract, the 4A and 4B forms are required. **Contractual Total**	$0.0

Commodities Costs:	Commodity Sum
Description	
Fyke nets	1.6
Misc. sampling supplies	1.0
Misc. sonar supplies	1.0
Commodities Total	$3.6

FY 05

Project Number: 050765
Project Title: Management applications: improving preseason forecasts of Kenai River sockeye salmon runs through salmon smolt monitoring
Agency: ADF&G

FORM 3B
Contractual & Commodities
DETAIL

EXXON VALDEZ OIL SPILL TRUSTEE COUNCIL
DETAILED BUDGET FORM FY 05 - FY 07

New Equipment Purchases: Description	Number of Units	Unit Price	Equipment Sum
			0.0
			0.0
Inclined-plane smolt trap	1	4.0	4.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
		New Equipment Total	$4.0

Existing Equipment Usage: Description	Number of Units	Inventory Agency
18' boston whaler w/ outboard motor	1	ADF&G
16' riverboat w/ outboard motor	1	ADF&G
Rotary Screw Trap	1	ADF&G
200 kHz DT 6000 echosounder with split-beam transducer	1	ADF&G
300 kHz portable acoustic doppler current profiler	1	ADF&G
Conductivity-temperature-depth (CTD) profiler	1	ADF&G
DIDSON Sonar	1	ADF&G
Smolt trap materials	1	ADF&G
Beach seine (50 x 6 m)	1	ADF&G

FY 05

Project Number: 050765
Project Title: Management applications: improving preseason forecasts of Kenai River sockeye salmon runs through salmon smolt monitoring
Agency: ADF&G

FORM 3B
Equipment
DETAIL

EXXON VALDEZ OIL SPILL TRUSTEE COUNCIL
DETAILED BUDGET FORM FY 05 - FY 07

Personnel Costs:		GS/Range/	Months	Monthly		Personnel
Name	Description	Step	Budgeted	Costs	Overtime	Sum
						0.0
William Glick	Fish & Wildlife Tech III	14G	2.0	5.2	1.3	11.7
Jennifer Brannen-Nelson	Fish & Wildlife Tech III	11F	2.0	4.2	1.0	9.4
Stanley Walker	Fish & Wildlife Tech III	11G	2.0	4.2	1.0	9.4
Richard Dederick	Fish & Wildlife Tech II	9J	2.0	4.0	1.0	9.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
	Subtotal		8.0	17.6	4.3	
					Personnel Total	$39.5

Travel Costs:	Ticket	Round	Total	Daily	Travel
Description	Price	Trips	Days	Per Diem	Sum
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
				Travel Total	$0.0

FY 06

Project Number: 050765
Project Title: Management applications: improving preseason forecasts of Kenai River sockeye salmon runs through salmon smolt monitoring
Agency: ADF&G

FORM 3B
Personnel
& Travel
DETAIL

EXXON VALDEZ OIL SPILL TRUSTEE COUNCIL
DETAILED BUDGET FORM FY 05 - FY 07

Contractual Costs:	Contract
Description	Sum
If a component of the project will be performed under contract, the 4A and 4B forms are required. **Contractual Total**	$0.0

Commodities Costs:	Commodity
Description	Sum
Smolt trap and net repair supplies	2.0
Misc. sampling supplies	1.5
Misc. sonar supplies	1.5
Commodities Total	$5.0

FY 06

Project Number: 050765
Project Title: Management applications: improving preseason forecasts of Kenai River sockeye salmon runs through salmon smolt monitoring
Agency: ADF&G

FORM 3B
Contractual &
Commodities
DETAIL

EXXON VALDEZ OIL SPILL TRUSTEE COUNCIL
DETAILED BUDGET FORM FY 05 - FY 07

New Equipment Purchases: Description	Number of Units	Unit Price	Equipment Sum
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
		New Equipment Total	$0.0

Existing Equipment Usage: Description	Number of Units	Inventory Agency
18' boston whaler w/ outboard motor	1	ADF&G
16' riverboat w/ outboard motor	1	ADF&G
Rotary Screw Trap	1	ADF&G
200 kHz DT 6000 echosounder with split-beam transducer	1	ADF&G
300 kHz portable acoustic doppler current profiler	1	ADF&G
Conductivity-temperature-depth (CTD) profiler	1	ADF&G
DIDSON Sonar	1	ADF&G
Smolt trap materials	1	ADF&G
Beach seine (50 x 6 m)	1	ADF&G

FY 06

Project Number: 050765
Project Title: Management applications: improving preseason forecasts of Kenai River sockeye salmon runs through salmon smolt monitoring
Agency: ADF&G

FORM 3B
Equipment
DETAIL

EXXON VALDEZ OIL SPILL TRUSTEE COUNCIL
DETAILED BUDGET FORM FY 05 - FY 07

Personnel Costs: Name	Description	GS/Range/ Step	Months Budgeted	Monthly Costs	Overtime	Personnel Sum
						0.0
William Glick	Fish & Wildlife Tech III	14G	2.0	5.2	1.3	11.7
Jennifer Brannen-Nelson	Fish & Wildlife Tech III	11F	2.0	4.2	1.0	9.4
Stanley Walker	Fish & Wildlife Tech III	11G	2.0	4.2	1.0	9.4
Richard Dederick	Fish & Wildlife Tech II	9J	2.0	4.0	1.0	9.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
	Subtotal		8.0	17.6	4.3	
					Personnel Total	$39.5

Travel Costs: Description	Ticket Price	Round Trips	Total Days	Daily Per Diem	Travel Sum
					0.0
Attend annual EVOS workshop	0.1	2	8	0.1	1.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
				Travel Total	$1.0

FY 07

Project Number: 050765
Project Title: Management applications: improving preseason forecasts of Kenai River sockeye salmon runs through salmon smolt monitoring
Agency: ADF&G

FORM 3B
Personnel
& Travel
DETAIL

EXXON VALDEZ OIL SPILL TRUSTEE COUNCIL
DETAILED BUDGET FORM FY 05 - FY 07

Contractual Costs:	
Description	Contract Sum
Publication costs	1.0
Contractual Total	$1.0

Commodities Costs:	
Description	Commodity Sum
Smolt trap and net repair supplies	2.0
Misc. sampling supplies	1.0
Misc. sonar supplies	1.0
Commodities Total	$4.0

FY 07

Project Number: 050765
Project Title: Management applications: improving preseason forecasts of Kenai River sockeye salmon runs through salmon smolt monitoring
Agency: ADF&G

FORM 3B
Contractual & Commodities
DETAIL

***EXXON VALDEZ* OIL SPILL TRUSTEE COUNCIL**
DETAILED BUDGET FORM FY 05 - FY 07

New Equipment Purchases: Description	Number of Units	Unit Price	Equipment Sum
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
		New Equipment Total	$0.0

Existing Equipment Usage: Description	Number of Units	Inventory Agency
18' boston whaler w/ outboard motor	1	ADF&G
16' riverboat w/ outboard motor	1	ADF&G
Rotary Screw Trap	1	ADF&G
200 kHz DT 6000 echosounder with split-beam transducer	1	ADF&G
300 kHz portable acoustic doppler current profiler	1	ADF&G
Conductivity-temperature-depth (CTD) profiler	1	ADF&G
DIDSON Sonar	1	ADF&G
Smolt trap materials	1	ADF&G
Beach seine (50 x 6 m)	1	ADF&G

FY 07

Project Number: 050765
Project Title: Management applications: improving preseason forecasts of Kenai River sockeye salmon runs through salmon smolt monitoring
Agency: ADF&G

FORM 3B
Equipment
DETAIL

BUDGET JUSTIFICATION: *Fiscal Year 05*

Personnel:
Funds are requested to support four Fish and Wildlife Technician positions with overtime for 2 months. These staff will operate smolt traps and capture smolt for marking (*Objective 1).*
Total: $39.5

ADF&G will provide an in-kind contribution of 1.5 man months for a Fisheries Biologist (cost $7.3K) to supervise the technicians (*Objectives 1*). ADF&G will provide in-kind contributions of 2.5 man months for two Fisheries Biologists (cost $15.5K) and 1.0 man month for a technician (cost $3.8K) to collect and analyze acoustic data and project reports (*Objective 2).*
Total: $26.6

Travel:
No funds are requested.

Contractual:
No funds are requested.

Commodities:
Funds are requested to purchase two fyke nets and misc. field sampling supplies (fuel, anchors, nets, buoys, etc) (*Objective 1).* Funds are also requested to purchase misc. supplies (batteries, fuel, DVDs, etc.) needed for sonar operations (*Objective 2*).
Total: $3.6

ADF&G will provide an in-kind contribution of a misc. smolt trap supplies and beach seines
Total: $1.8

Equipment:
Funds are requested to purchase an inclined-plane smolt trap (*Objective 1).*
Total: 4.0

ADF&G will provide the following equipment as an in-kind contribution (*Objectives 1 & 2)*:

Description	Cost
Rotary screw trap	$3.0
18' Boston whaler w/ outboard	$6.0
16' riverboat w/ outboard	$5.0
200 kHz DT 6000 echosounder w/ split-beam transducer	$50.0
300 kHz acoustic doppler current profiler	$25.0
Conductivity-temperature-depth profiler	$8.0
DIDSON sonar system	$80.0
Total	$177.0

BUDGET JUSTIFICATION: *Fiscal Year 06*

Personnel:
Funds are requested to support four Fish and Wildlife Technician positions with overtime for 2 months. These staff will operate smolt traps and capture smolt for marking (*Objective 1).*
Total: $39.5

ADF&G will provide an in-kind contribution of 1.5 man months for a Fisheries Biologist (cost $7.3K) to supervise the technicians (*Objectives 1*). ADF&G will provide in-kind contributions of 2.5 man months for two Fisheries Biologists (cost $15.5K) and 1.0 man month for a technician (cost $3.8K) to collect and analyze acoustic data and project reports (*Objective 2).*
Total: $26.6

Travel:
No funds are requested.

Contractual:
No funds are requested.

Commodities:
Funds are requested to smolt trap and net repairs and misc. field sampling supplies (fuel, anchors, nets, buoys, etc) (*Objective 1).* Funds are also requested to purchase misc. supplies (batteries, fuel, DVDs, etc.) needed for sonar operations (*Objective 2*).
Total: $5.0

ADF&G will provide an in-kind contribution of a misc. smolt trap supplies and beach seines
Total: $1.8

Equipment:
No funds are requested.

ADF&G will provide the following equipment as an in-kind contribution (*Objectives 1 & 2)*:

Description	Cost
Rotary screw trap	$3.0
18’ Boston whaler w/ outboard	$6.0
16’ riverboat w/ outboard	$5.0
200 kHz DT 6000 echosounder w/ split-beam transducer	$50.0
300 kHz acoustic doppler current profiler	$25.0
Conductivity-temperature-depth profiler	$8.0
DIDSON sonar system	$80.0
Total	$177.0

BUDGET JUSTIFICATION: *Fiscal Year 07*

Personnel:
Funds are requested to support four Fish and Wildlife Technician positions with overtime for 2 months. These staff will operate smolt traps and capture smolt for marking (*Objective 1).*
Total: $39.5

ADF&G will provide an in-kind contribution of 1.5 man months for a Fisheries Biologist (cost $7.3K) to supervise the technicians (*Objectives 1*). ADF&G will provide in-kind contributions of 2.5 man months for two Fisheries Biologists (cost $15.5K) and 1.0 man month for a technician (cost $3.8K) to collect and analyze acoustic data and project reports (*Objective 2).*
Total: $26.6

Travel:
Funds are requested for project Principal Investigator to travel to annual EVOS workshop.
Total: $1.0

Contractual:
Funds are requested for publication of a manuscript describing the project results and conclusions.
Total: $1.0

Commodities:
Funds are requested to smolt trap and net repairs and misc. field sampling supplies (fuel, anchors, nets, buoys, etc) (*Objective 1).* Funds are also requested to purchase misc. supplies (batteries, fuel, DVDs, etc.) needed for sonar operations (*Objective 2*).
Total: $4.0

ADF&G will provide an in-kind contribution of a misc. smolt trap supplies and beach seines
Total: $1.8

Equipment:
No funds are requested.

ADF&G will provide the following equipment as an in-kind contribution (*Objectives 1 & 2)*:

Description	Cost
Rotary screw trap	$3.0
18' Boston whaler w/ outboard	$6.0
16' riverboat w/ outboard	$5.0
200 kHz DT 6000 echosounder w/ split-beam transducer	$50.0
300 kHz acoustic doppler current profiler	$25.0
Conductivity-temperature-depth profiler	$8.0
DIDSON sonar system	$80.0
Total	$177.0